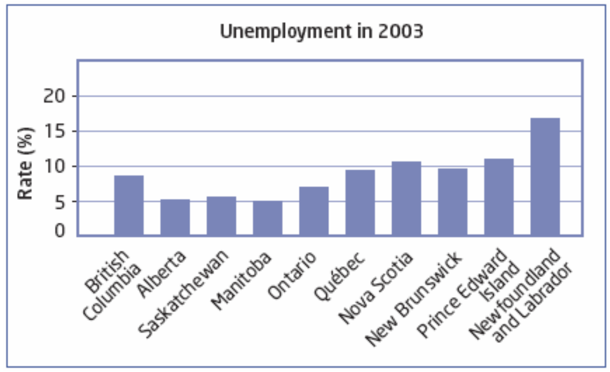
Chapter 2 Relations

Chapter 2 Get Ready

Chapter 2 Get Ready Question 1 Page 40

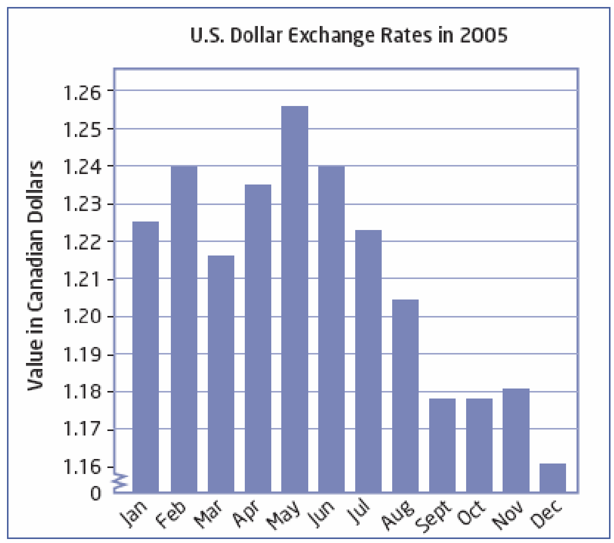


a) The heights of the bars represent the unemployment rate, in percent, for each province in 2003.

b) Newfoundland and Labrador has the greatest unemployment rate.

c) The prairie provinces had the lowest unemployment rate. People had the best chance of finding work in 2003 in the prairie provinces.

Chapter 2 Get Ready Question 2 Page 40

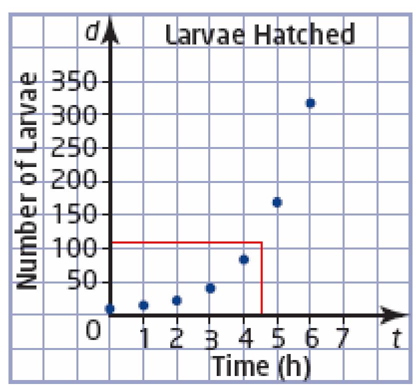


a) The lowest value of the U.S. dollar shown on the graph is $1.16 CDN, in December of 2005.

b) The value of the U.S. dollar compared to the Canadian dollar was the greatest in May of 2005.

c) The graph shows an overall downward trend in the value of the U.S. dollar compared to the Canadian dollar.

Chapter 2 Get Ready Question 3 Page 41

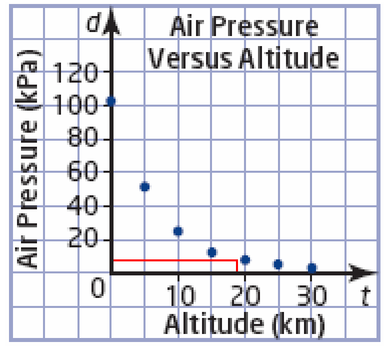


a) The scatter plot is shown.

b) After 4.5 h, about 110 larvae have hatched.

Chapter 2 Get Ready Question 4 Page 41

a) The scatter plot is shown.



b) The air pressure at an altitude of 18 km is about 7.5 kPa.

Chapter 2 Get Ready Question 5 Page 41

a) The unit rate is $\dfrac{42 \text{ pages}}{6 \text{ min}} = 7 \dfrac{\text{pages}}{\text{min}}$.

b) The unit rate is $\dfrac{\$15}{5 \text{ kg}} = \$3/\text{kg}$.

c) The unit rate is $\dfrac{880 \text{ km}}{11 \text{ h}} = 80 \text{ km/h}$.

Chapter 2 Get Ready Question 6 Page 41

a) The unit rate is $\dfrac{\$4.19}{750 \text{ g}} \doteq \$0.0056/\text{g}$.

b) The unit rate is $\dfrac{500 \text{ mL}}{24 \text{ muffin}} \doteq 20.8 \dfrac{\text{mL}}{\text{muffin}}$.

c) The unit rate is $\dfrac{5000 \text{ m}}{38.6 \text{ min}} \doteq 130 \text{ m/min}$.

Chapter 2 Section 1: Hypotheses and Sources of Data

Chapter 2 Section 1 Question 1 Page 45

a) Most people's favourite number is not 7.

b) Adults do not spend more time listening to classical music than rap. (Alternative: Adults spend either less time or as much time listening to classical music as they spend listening to rap.)

c) In Ontario, the number of teenagers who join hockey teams is greater than or equal to the number who join soccer teams.

d) Chocolate is the most popular flavour of ice cream.

Chapter 2 Section 1 Question 2 Page 45

Answers will vary. Sample answers are shown.

a) Hypothesis: Time spent doing homework increases as a student's age increases.

Opposite: Time spent doing homework does not increase as a student's age increases.

b) Hypothesis: Children tend to grow to the same height as their mothers.

Opposite: Children do not tend to grow to the same height as their mothers.

c) Hypothesis: As temperature increases, the crime rate also increases.

Opposite: As temperature increases, the crime rate decreases or remains constant.

d) Hypothesis: As the cost of gasoline increases, the number of people using public transit increases.

Opposite: As the cost of gasoline increases, the number of people using public transit decreases or stays the same.

Chapter 2 Section 1 Question 3 Page 45

a) The data are primary; the office manager gathers the data.

b) The data are secondary; the student uses data gathered by Statistics Canada.

c) The data are primary; the researcher gathers the data.

d) The data are secondary; the researcher uses data gathered by the transit authority.

Chapter 2 Section 1 Question 4 Page 45

Answers about advantages will vary. Sample answers are shown.

a) The data are primary. Advantage: the data are up-to-date.

b) The data are secondary. Advantage: Internet search is fast and easy.

c) The data are primary. Advantage: the survey is getting opinions directly from customers.

d) The data are primary. Advantage: the data are up-to-date.

Chapter 2 Section 1 Question 5 Page 45

Answers will vary. Sample answers are shown.

a) Most students in the class prefer dogs as pets.

b) Survey the class. Primary data are best since the population is small and secondary data may not be available.

Chapter 2 Section 1 Question 6 Page 46

a) The data are primary. Steve gathered the data himself.

b) Answers will vary. Sample answers are shown.

Brown-eyed students are shorter.

Blue is the least common eye colour.

c) The hypotheses can be tested by surveying a larger sample of students.

Name	Eye Colour	Height (cm)
Josanth	brown	167
Fred	green	181
Graham	green	185
Cho	brown	171
Seth	blue	154
Jamal	green	183
Juan	brown	160
Cameron	blue	173

Chapter 2 Section 1 Question 7 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: Females make more phone calls than males.

b) You can survey 50 females and 50 males to test your hypothesis with primary data.

c) You can look for data on the Internet or in publications to test your hypothesis with secondary data.

d) Secondary sources that survey larger samples are more likely to be accurate.

Chapter 2 Section 1 Question 8 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: Taller people perform better at the high jump.

b) Heights of the athletes and how high the athletes can jump are the data needed to test the hypothesis. Primary data for the school team would be easy to collect. Secondary sources could survey a larger sample and yield more accurate results.

Chapter 2 Section 1 Question 9 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: The faster the computer, the more it will cost.

b) Most popular computer vendors have Web sites. A search shows that faster computers do cost more.

c) This is primary data if you collect prices from Web sites for individual suppliers. This is secondary data if you find price surveys with data gathered by someone else.

d) You can also visit a computer store to research speeds and prices.

Chapter 2 Section 1 Question 10 Page 46

Answers will vary. Sample answers are shown.

a) A cow produces 20-25 L of milk in a day.

b) A cow eats 12-15 kg of hay in a day.

c) If the information comes from visiting a dairy farm, it is primary data. If the data comes from a book or the Internet, it is secondary data.

Chapter 2 Section 1 Question 11 Page 47

Solutions for Achievement Checks are shown in the Teacher's Resource.

Chapter 2 Section 1 Question 12 Page 47

Answers will vary. Sample answers are shown.

a) Hypothesis: The greater the latitude of a city, the lower the mean of its daily maximum temperatures in January.

b) Available data shows that the hypothesis is generally true, if other factors such as ocean currents are not relevant.

Chapter 2 Section 1 Question 13 Page 47

Answers will vary.

Chapter 2 Section 1 Question 14 Page 47

If the mean is 6, then the sum of the numbers is 6*n*. If 17 is added, the mean becomes 7, with *n* + 1 numbers in the list. You are looking for a number *n* such that

$$\frac{6n+17}{n+1}=7$$

Use the "guess and check" method to determine that *n* must equal 10.

Chapter 2 Section 2 Sampling Principles

Chapter 2 Section 2 Question 1 Page 52

a) The population is all children.

b) The population is all those who wrote the test.

c) The population is all cars.

d) The population is all food stores.

Chapter 2 Section 2 Question 2 Page 52

a) The data required are the ages when girls and boys learn to walk. Use a sample, the population is very large.

b) The data required are the test marks. Use a census, the population is small.

c) The data required are the salaries of Canadian employees. Use a sample, the population is very large.

d) The data required are people's heights and ages. Use a sample, the population is very large.

e) The data required are the makes of the cars in the school parking lot. Use a census, the population is small.

f) The data required are colours of cars driving by the school. Use a sample, the population is very large.

Chapter 2 Section 2 Question 3 Page 52

Answers will vary. Sample answers are shown.

a) Survey every fourth customer who comes into the cafe.

b) Randomly select 1% of the teenagers in every high school across Ontario.

c) Use a random number generator to select telephone numbers within Canada, and then survey the people who identify themselves as bilingual.

d) Select households to survey by any random method, and then ask the people surveyed where they were born.

Chapter 2 Section 2 Question 4 Page 53

a) This is a non-random sample. It could be biased since University of Waterloo students may not be representative of all university graduates.

b) This is a simple random sample. It could be biased, since the sample excludes anyone who does not have a telephone listing.

c) This is a non-random sample. It is biased because it includes only people who have chosen to spend some of their free time going to a movie.

d) This is a systematic random sampling.

Chapter 2 Section 2 Question 5 Page 53

Answers may vary. Sample answers are shown.

You can group the students by age, by grade level, or by gender.

Chapter 2 Section 2 Question 6 Page 53

a) The population is all farmers in Ontario.

b) Answers will vary. A sample answer is shown.

Use a random number generator to randomly select 10% of the farmers in each county.

Chapter 2 Section 2 Question 7 Page 53

a) The population is all employees of the company.

b) Answers may vary. A sample answer is shown.

Use a random number generator to randomly select a starting point on an alphabetical list of the employees. Then, select every sixth person until you have a total of 50.

Chapter 2 Section 2 Question 8 Page 53

a) The population includes all members of the school teams.

b) Answers will vary. A sample answer is shown.

Write each team member's name on a slip of paper. Then, randomly draw 15% of the slips out of a box.

Chapter 2 Section 2 Question 9 Page 53

The population of the school is 1216 students.

$$\begin{aligned}\text{Number of Grade 9 Students} &= \frac{330}{1216}\times 150\\ &\doteq 41\end{aligned}$$

Grade	Number of Students
9	330
10	308
11	295
12	283

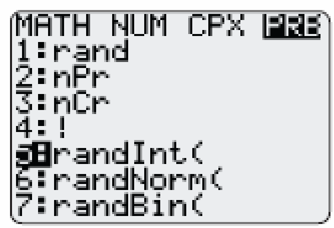
$$\begin{aligned}\text{Number of Grade 10 Students} &= \frac{308}{1216}\times 150\\ &\doteq 38\end{aligned}$$

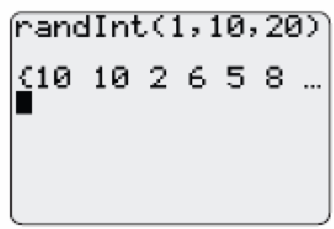
$$\begin{aligned}\text{Number of Grade 11 Students} &= \frac{295}{1216}\times 150\\ &\doteq 36\end{aligned}$$

$$\begin{aligned}\text{Number of Grade 12 Students} &= \frac{283}{1216}\times 150\\ &\doteq 35\end{aligned}$$

Chapter 2 Section 2 Question 10 Page 54

a) Use the command randInt(12,36,25). The first number is the lower limit, the second number is the upper limit, and the third number is the number of random integers desired.





b) Enter randInt(1,500,40). If any numbers are repeated, change the command to generate more random numbers and use the first 40 that are not duplicates.

c) Enter randInt(100,1000,75). Increase 75 to 100 or more if some numbers are repeated.

Chapter 2 Section 2 Question 11 Page 54

a) The sample is not completely random. Students at small schools have a greater chance of being selected than students at large schools.

b) The results are biased. The sample is likely to have a greater proportion of students from small schools than the population does.

Chapter 2 Section 2 Question 12 Page 54

Answers for sampling methods will vary. Sample answers are shown.

a) The population is all students in the school. Obtain a list of students. Use a random number generator to select a starting point. Select every 10th student.

b) The population is all people in the community. Obtain a list of residents. Use a random number generator to select a starting point. Select every 50th resident.

c) The population is all people aged 18 to 30. Use a random number generator to generate telephone numbers across the country. Survey those who identify themselves as between the ages of 18 and 30.

d) The population is all senior citizens in Ontario. Use a random number generator to generate telephone numbers across Ontario. Survey those who identify themselves as senior citizens.

e) The population is all computer printers for sale in Canada. Search retailers on the Internet to assemble a list of all printers sold in Canada. Purchase one of each kind for testing.

f) The population is gasoline prices at all vendors in the community. Use a telephone book to find addresses for all gasoline retailers in the community. Call or visit each one to generate a list of prices.

Chapter 2 Section 2 Question 13 Page 54

The sample is representative only of people who browse the site and are willing to fill out the form. The sample excludes anyone who does not have Internet access or the inclination to complete the survey.

Chapter 2 Section 2 Question 14 Page 54

a) In the 1920s, many people did not have telephones. Since these people were not included in the surveys, the samples were not representative of the whole population.

b) Answers will vary. Sample answers are shown.

People with more than one telephone number have a greater chance of being selected.

People refusing to answer telephone surveys may make the sample unrepresentative of certain groups.

Deaf people will be left out of the sample.

Chapter 2 Section 2 Question 15 Page 55

Answers will vary.

Chapter 2 Section 2 Question 16 Page 55

Answers will vary.

Chapter 2 Section 2 Question 17 Page 55

Answers will vary. Sample answers are shown.

Poorly designed questions can influence the answers that respondents will give.

People may give false answers to questions they feel uncomfortable with.

Chapter 2 Section 2 Question 18 Page 55

Answers will vary. Sample answers are shown.

a) Assign each tree a number and use a random number generator to choose 10% of the trees.

b) Divide the park into sections with similar numbers of trees, and randomly select 10% from each section.

c) Assign each tree a number. Randomly select a starting point, and then select every tenth number before and after the starting number.

d) Sample the 10% of the trees closest to roads.

Any of the random samples will test trees throughout the park. However, the forester could choose a non-random sample with a larger proportion of the hardwood trees that the beetle attacks most often.

Chapter 2 Section 2 Question 19 Page 55

a) Answers will vary. Sample answers are shown.

You can interview sports fans at a sports venue such as an arena or ball park.

You can interview classmates.

b) Convenience samples are not truly random because every member of the population does not have an equal chance of being selected. Interviewing sports fans at a sports venue excludes members of the population who are not interested in sports or do not attend live events. Interviewing classmates excludes members of the population who are not in the class.

Chapter 2 Section 2 Question 20 Page 55

Since the required number is odd, the last digit must be a 1, 3, 5, or 7. For each of the 4 choices of last digit, there are 6 choices for the middle digit and 5 choices for the first digit. The number of odd three-digit numbers possible is $4 \times 6 \times 5 = 120$.

Chapter 2 Section 3 Use Scatter Plots to Analyse Data

Chapter 2 Section 3 Question 1 Page 64

a) independent variable: physical fitness
dependent variable: blood pressure

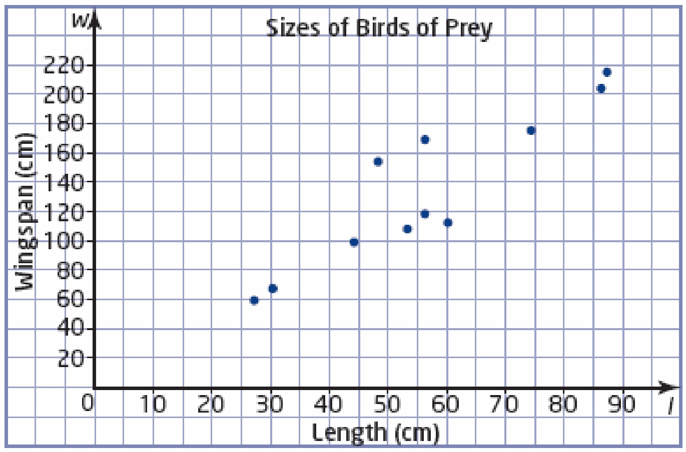
b) independent variable: level of education
dependent variable: income

c) independent variable: load in an airplane
dependent variable: length of runway needed for take off

Chapter 2 Section 3 Question 2 Page 64

a) To show wingspan as the independent variable, move it to the horizontal axis.

b) As the length increases, the wingspan increases.



Chapter 2 Section 3 Question 3 Page 64

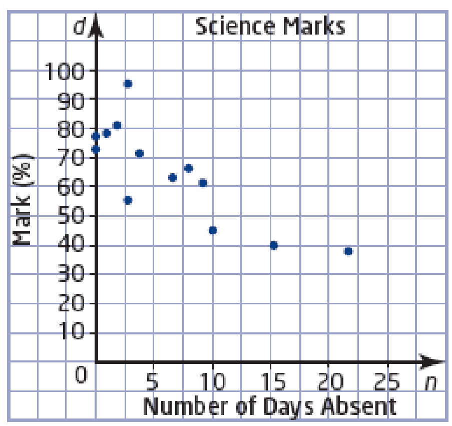
a) independent variable: number of days absent
dependent variable: science mark.

Marks depend on attendance, rather than attendance depending on marks.

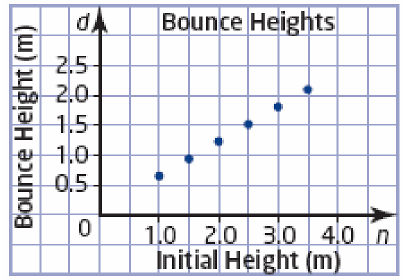
b) The scatter plot is shown.

c) As the number of days absent increases, the marks generally decrease.

d) The point (3, 95) lies somewhat apart from the rest of the data. It can be considered as an outlier.



Chapter 2 Section 3 Question 4 Page 65



a) independent variable: initial height
dependent variable: bounce height

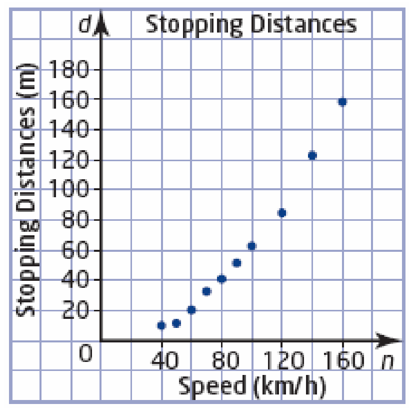
The bounce height depends on the initial height, rather than the initial height depending on the bounce height.

b) The scatter plot is shown.

c) As the initial height increases, so does the bounce height.

d) The point (4.00, 1.62) is an outlier. It should be discarded only for a valid reason, such as a measurement error. Repeat the measurement several times to determine whether this is a measurement error.

Chapter 2 Section 3 Question 5 Page 65



a) The scatter plot is shown.

b) As the speed of a car increases, the stopping distance increases. The pattern is non-linear.

c) A car travelling at 85 km/h needs 46 m to stop. The point is not an outlier since it follows the pattern of the other data

Chapter 2 Section 3 Question 6 Page 65

Answers will vary. Sample answers are shown.

a) Hypothesis: As a person's height increases, so does the shoulder width.

b) Select a sample of persons of varying heights. Measure height and shoulder width.

c) Display your results in a scatter plot, and draw your conclusion.

d) To improve the accuracy of measurements; use a larger sample.

Chapter 2 Section 3 **Question 7** **Page 66**

Answers will vary. Sample answers are shown.

a) Select a sample of athletes. Measure each athlete's height and the maximum height he or she can jump.

b) The independent variable is the height.

The dependent variable is the jump height.

c) If the hypothesis is true, then the points on the scatter plot will follow a line or curve that rises to the right.

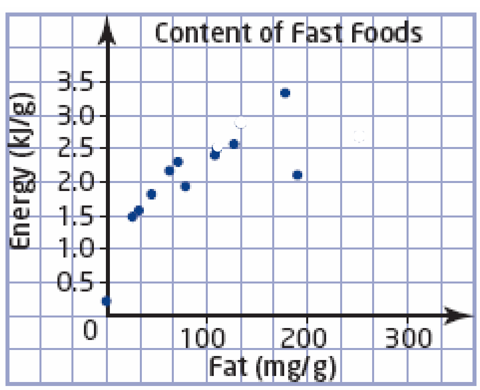
Chapter 2 Section 3 **Question 8** **Page 66**

a) Divide the amount of fat in milligrams by the serving size in grams to obtain the amount of fat per gram.

Divide the energy in kJ by the serving size in grams to obtain the energy per gram.

Item	Fat (mg/g)	Energy (kJ/g)
Harvey's Original Hamburger	127	2.6
Harvey's Veggie Burger	63	2.2
Mr. Submarine Small Assorted Sub	34	1.6
Mr. Submarine Small Vegetarian Sub	26	1.5
Pizza Pizza Pepperoni Slice (walk-in)	69	2.3
Pizza Pizza Vegetarian Slice (walk-in)	43	1.8
KFC Chicken Breast	118	2.4
KFC Popcorn Chicken	184	3.3
Swiss Chalet Quarter Chicken Breast	75	1.9
Swiss Chalet Garden Salad, undressed	0	0.2
Swiss Chalet Caesar Salad	188	2.1

b) The scatter plot is shown.

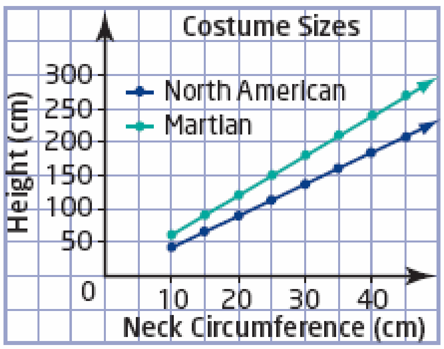


c) The point for Caesar Salad is an outlier due to its high fat content. Nonetheless, this point represents valid data that should not be discarded.

d) Answers will vary. A sample answer is shown.

The scatter plot shows that some fast foods can have a high energy content without a high fat content.

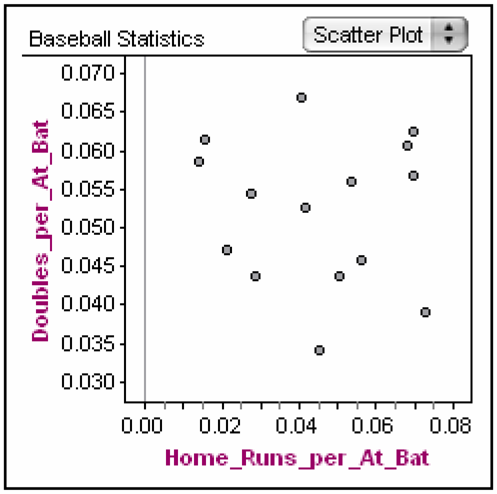
Chapter 2 Section 3 Question 9 Page 67



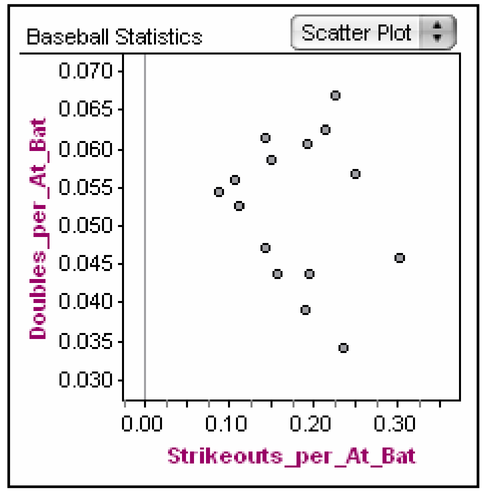
Chapter 2 Section 3 Question 10 Page 67

Divide each statistic by the number of times at bat to obtain the rates. Click here to load the Fathom® file.

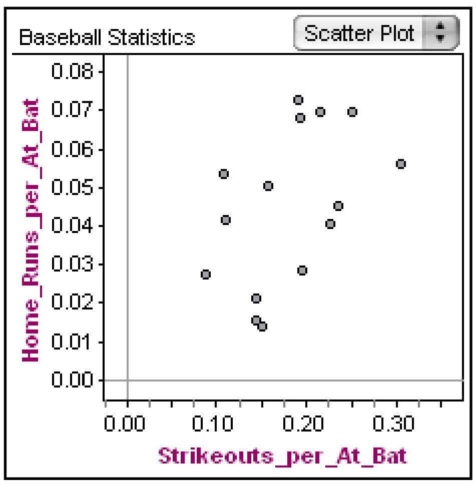
a)



b)



c)



d) Home runs per at bat seem to increase somewhat as the number of strikeouts per at bat increases. The other two scatter plots do not show any relationship between the variables.

Chapter 2 Section 3 Question 11 Page 67

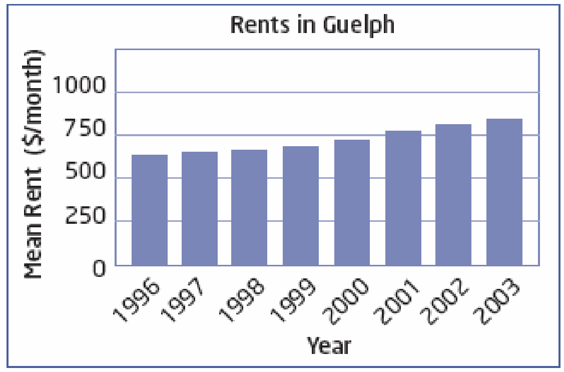
To keep the value of the expression as small as possible, use the smallest numbers for the numerators, and the largest numbers for the denominators. Use "guess and check" to determine which arrangement yields the smallest value for the expression.

$$
\begin{aligned}
\frac{1}{4}+\frac{2}{5}+\frac{3}{6} &= \frac{15}{60}+\frac{24}{60}+\frac{30}{60} \\
&= \frac{69}{60} \\
&= 1\frac{3}{20}
\end{aligned}
$$

Chapter 2 Section 4 Trends, Interpolation, and Extrapolation

Chapter 2 Section 4 Question 1 Page 73

a) The bar graph is shown.

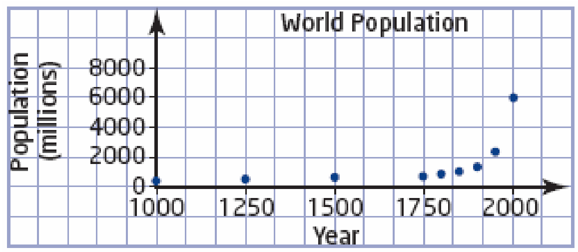


b) The bar graph shows a rising trend in rents.

c) Over 7 years, the mean rent increased by $165. A reasonable estimate for the mean rent in another 7 years is 823 + 165 = $988.

Chapter 2 Section 4 Question 2 Page 73

a) The scatter plot is shown.

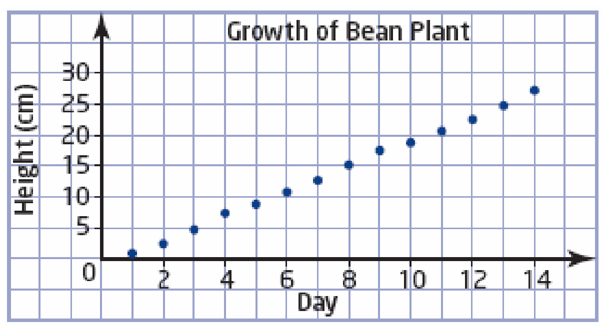


b) The world population is growing much more quickly now than in the past.

c) The graph shows an increasing rate of growth. It does not predict that the world population will stabilize at about 10 billion people around the year 2200.

Chapter 2 Section 4 Question 3 Page 73

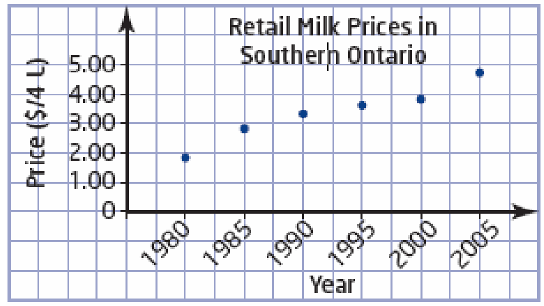
a) The scatter plot is shown.



b) The height is increasing at a nearly constant rate.

c) In future weeks, the height will increase at a slower rate as the plant matures, and reach a maximum height.

Chapter 2 Section 4 Question 4 Page 73



a) The scatter plot is shown.

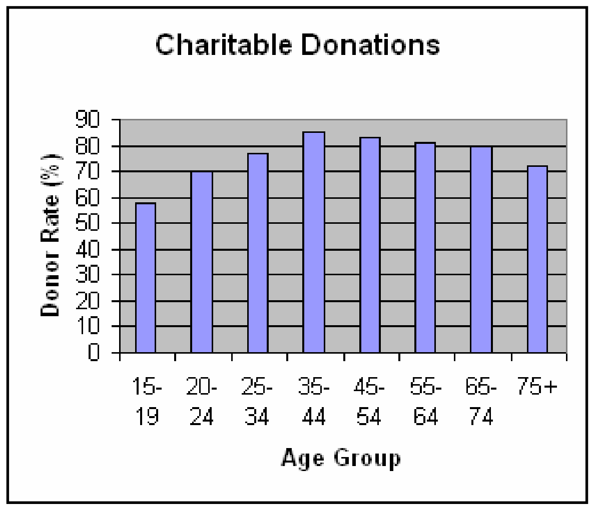
b) Milk prices increased over each 5-year period, but not at a constant rate.

c) The price in 1995 was about $3.60, and the price in 2000 was about $3.80. A reasonable estimate for the price in 1998 is about $3.69.

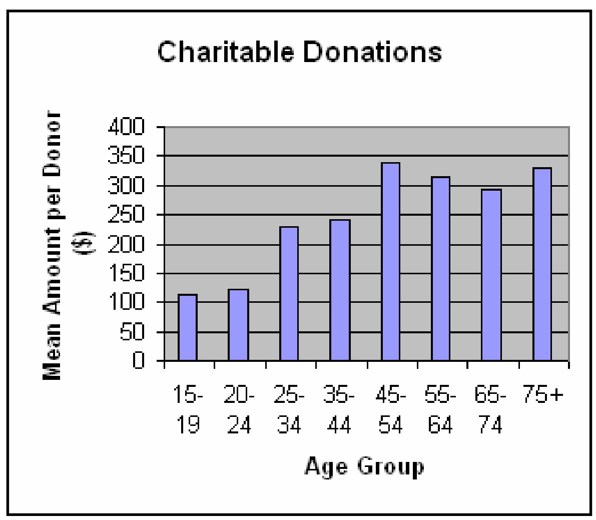
d) From 1980 to 2000, the price of milk went from about $2.00 to about $4.00. A reasonable estimate for a price of $6.00 is another 20 years, or about 2020, assuming prices increase at the same overall rate.

Chapter 2 Section 4 Question 5 Page 74

a) The bar graph is shown. The donation rate increases up to the 35 – 44 age group, and then decreases.

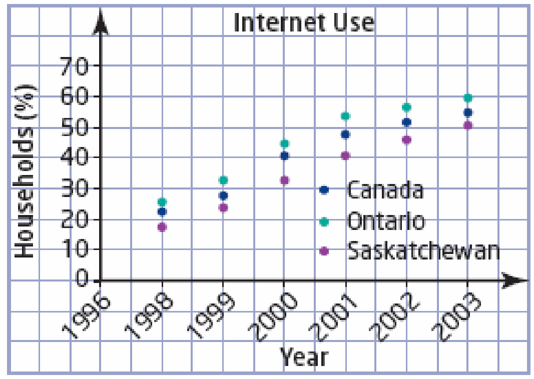


b) The bar graph is shown. Donation amounts increase with age up to the 45 – 54 interval, then decrease, and then increase again for the 75+ interval. Donation amounts are greater for people over 44 than for younger people.



c) Both graphs rise to a maximum for middle-aged people, then decease somewhat. However, the donation amount rises again in the 75+ interval while the donor rate continues to decrease.

Chapter 2 Section 4 Question 6 Page 74



a) The graph is shown. Internet use increased each year, with the national rate being about halfway between the rate in Ontario and the rate in Saskatchewan.

b) From 1998 to 2003, Internet use in Canada increased from about 23% to 55%, or about 6% per year. A reasonable estimate for the usage in 2005 is 55% + 12%, or 67%, assuming that the same rate of growth continues.

Chapter 2 Section 4 Question 7 Page 75

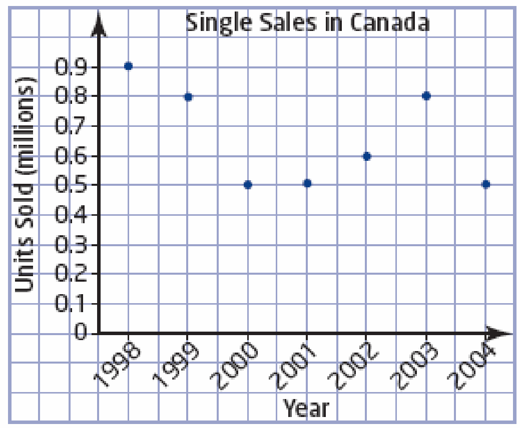
a) The graphs are shown. Overall, sales of singles show a downward trend. Sales of cassettes show a clear downward trend, while sales of CDs show a moderate downward trend.

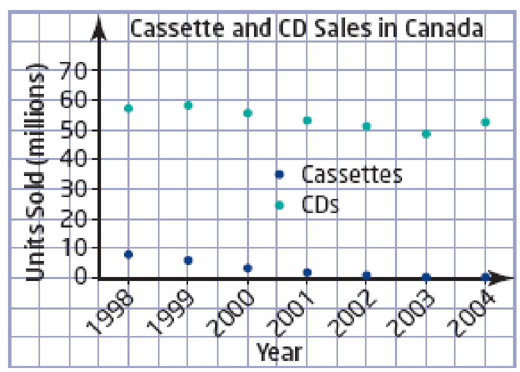
b) Answers will vary. Sample answers are shown.

Singles will sell 0.5 million in 2005.

Cassettes will sell 0.05 million in 2005.

CDs will sell 55 million in 2005.





Chapter 2 Section 4 Question 8 Page 75

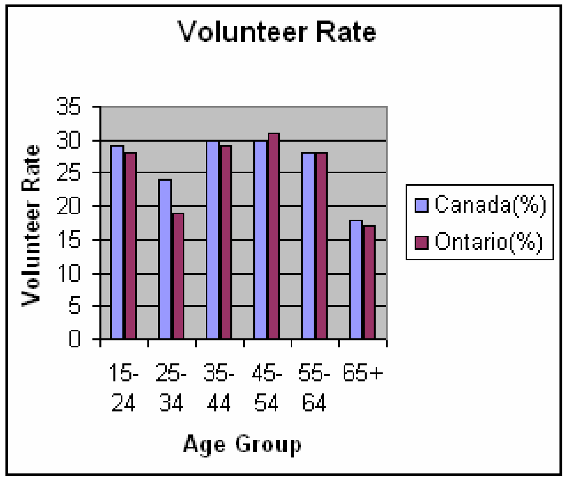
Solutions for Achievement Checks are shown in the Teacher's Resource.

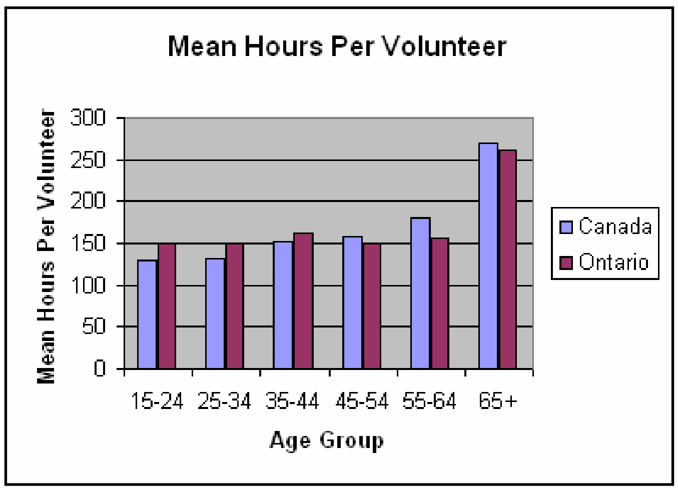
Chapter 2 Section 4 Question 9 Page 76

a) Graphs are shown. The volunteer rate in Ontario is about the same as for all Canadians except in the age group 25-34, when 5% fewer Ontarians volunteer.

b) The age group 45-54 has the greatest volunteer rate. People in this age range may have more free time.

c) As age increases, the hours per volunteer across Canada also increase, especially beyond the age of 65. Most people over 65 are retired and could have more time to volunteer.





Chapter 2 Section 4 Question 10 Page 76

Answers will vary.

Chapter 2 Section 4 Question 11 Page 76

Try each answer. Answer B works.

At noon there are 40 girls in the room. If 15 leave, there are 25 left. Therefore, there are 50 boys in the room. If 45 boys leave, there are 5 boys left. The ratio of girls to boys is 25:5 or 5:1, as required.

Chapter 2 Section 4 Question 12 Page 76

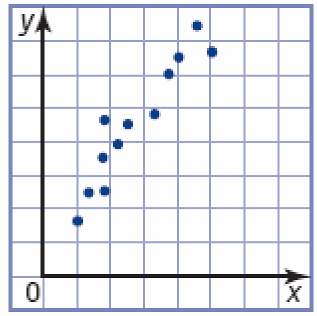
Let the first day be a Saturday. Saturdays will occur on the following days:

1, 8, 15, 22, 29, 36, 43, 50, 57, 64, 71, 78, 85, 92, and 99. There are 15 Saturdays.

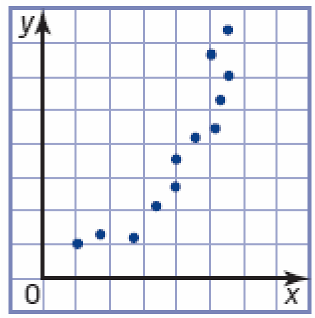
Chapter 2 Section 5 Linear and Non-Linear Relations

Chapter 2 Section 5 Question 1 Page 83

a) This graph appears to be linear. The points lie along a straight line.

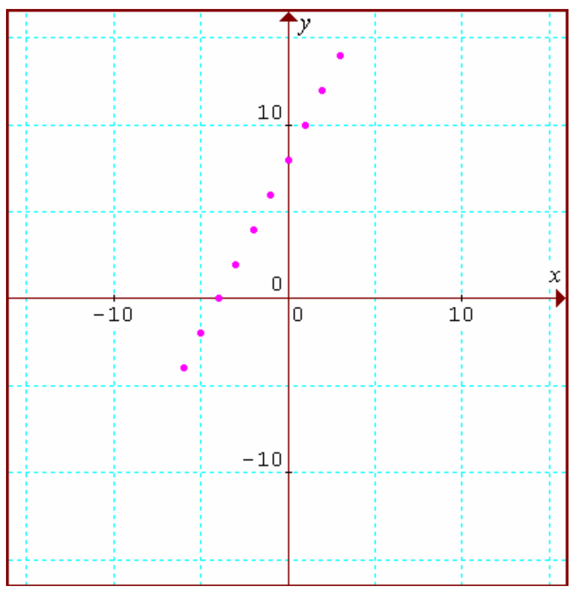


b) This graph does not appear to be linear. The points curve upwards.

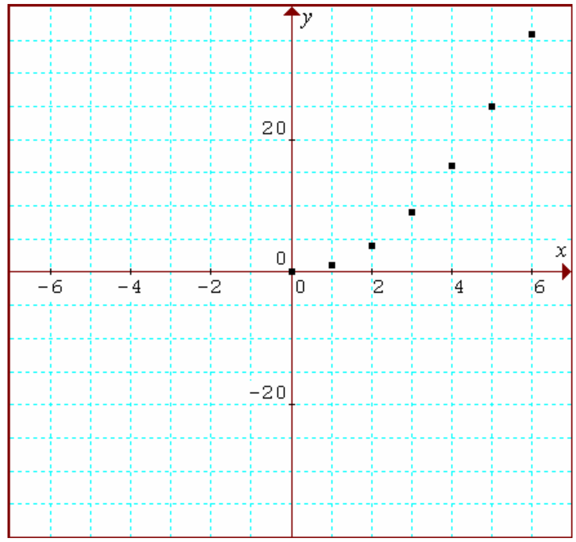


Chapter 2 Section 5 Question 2 Page 83

a) The relationship is linear. The points lie along a straight line.

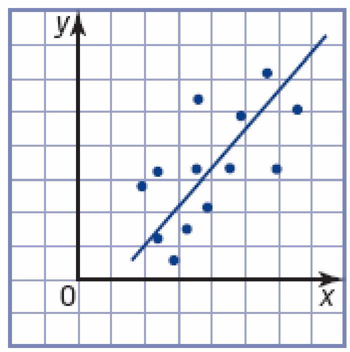


b) The relationship is non-linear. The points do not lie along a straight line.

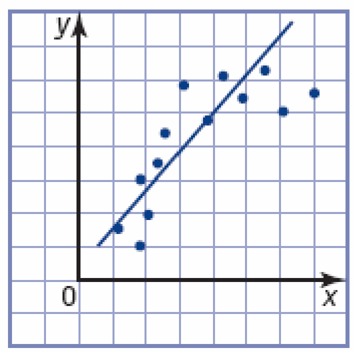


Chapter 2 Section 5 **Question 3** **Page 84**

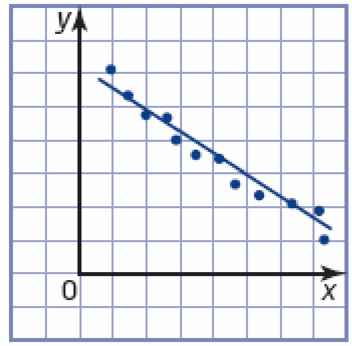
a) The line of best fit is a good model for the data. The points lie reasonably close to a straight line.



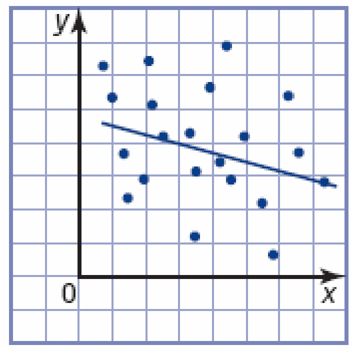
b) The line of best fit is not a good model for the data. The points seem to follow a curve to the right.



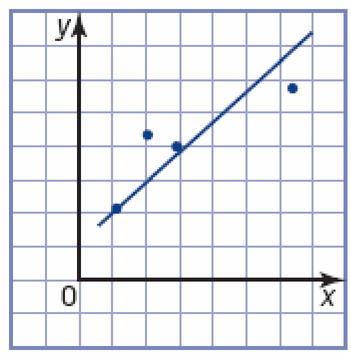
c) The line of best fit is a good model for the data. The points lie close to a straight line.



d) The line of best fit is not a good model for the data. The points do not seem to follow a pattern at all.

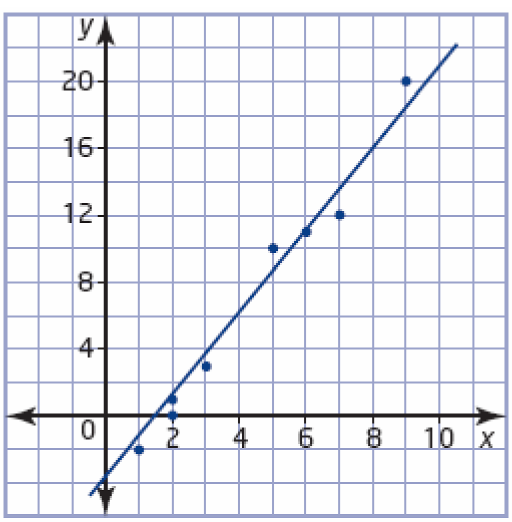


e) The line of best fit is not a good model for the data. There are too few points to determine a definite pattern.

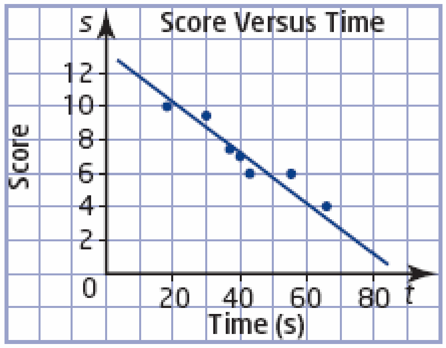


Chapter 2 Section 5 Question 4 Page 84

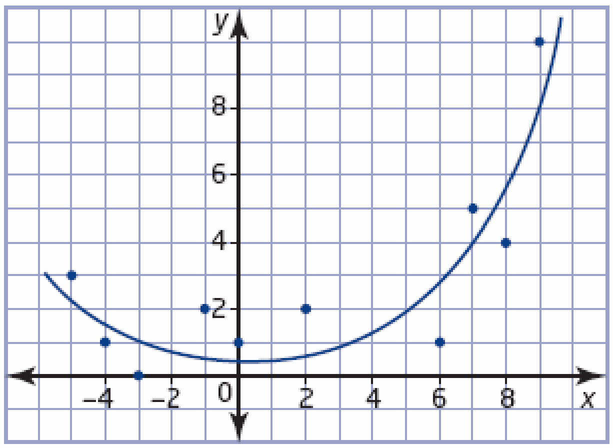
a)



b)



c)



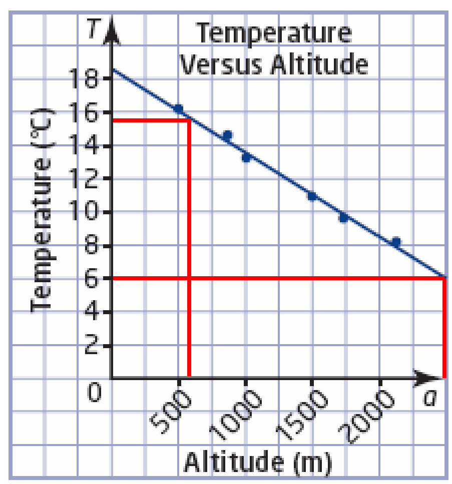
Chapter 2 Section 5 Question 5 Page 85

a) The scatter plot is shown.

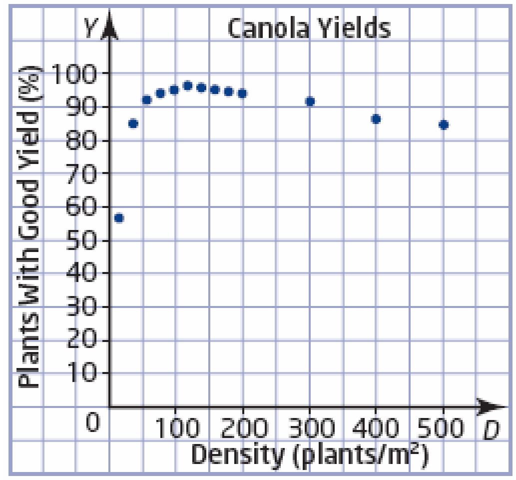
b) The relation is linear. The line of best fit is shown.

c) The temperature at an altitude of 600 m is about 15.5ºC.

d) The temperature at an altitude of 2500 m is about 6.0ºC.



Chapter 2 Section 5 Question 6 Page 85



a) The scatter plot is shown.

b) The yield rises steeply at first, levels off to a maximum around 120 plants/m^2, and then decreases slowly. The relation is non-linear.

c) A line of best fit is not a good model for the data. The points do not lie along a straight line. They follow a curve.

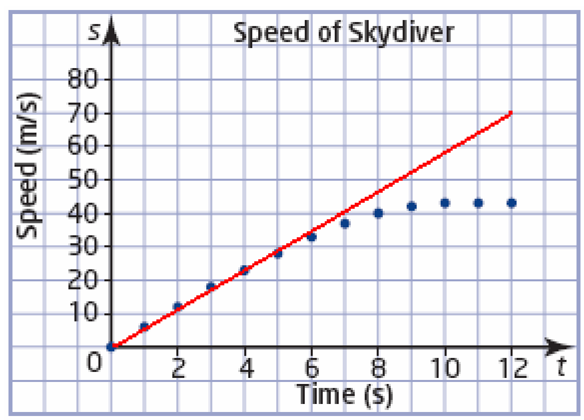
d) Answers will vary. Sample answers are shown.

As plant density increases, weeds are crowded out.

If plant density increases too much, water and nutrients in the soil are shared by too many plants.

As plant density increases, cross-pollination becomes more likely.

Chapter 2 Section 5 Question 7 Page 85



a) The graph is shown.

b) The extrapolation is shown. If the trend continues, the speed after 12 s of free fall is about 70 m/s.

c) See the graph in part **a)**.

d) Air resistance increases with speed. The speed increases only until the air resistance offsets the acceleration due to gravity.

e) Extrapolations can be inaccurate because the relationship between the variables may change beyond the range of the data.

Chapter 2 Section 5 Question 8 Page 86

Answers will vary. Sample answers are shown.

a) The purpose could be to investigate how a person's heart rate changes immediately after exercise.

b) It is reasonable to expect that a person's heart rate will decrease steadily in the time immediately after vigorous exercise.

c) Answers will vary.

d) Answers will vary.

e) Answers will vary.

f) Answers will vary.

Chapter 2 Section 5 Question 9 Page 86

Answers will vary. Use a cylinder not much wider than a penny to maximize the effect of dropping the penny into the water. You may have to use multiple numbers of pennies on each drop in order to see a reasonable change in the height. The relationship should be linear.

Chapter 2 Section 5 Question 10 Page 86

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 2 Section 5 Question 11 Page 87

a) Note that the t values increase at a constant rate. Check the corresponding d values. They also increase at a constant rate of 5. The relation is linear.

b) Note that the t values increase at a constant rate. Check the corresponding h values. They do not change at a constant rate. The relation is non-linear.

Chapter 2 Section 5 Question 12 Page 87

There is a non-linear relation between the gauge reading and the volume of fuel in the tank. The eighths at the low end of the gauge correspond to less fuel than than the eighths at the “full” end of the gauge. The gauge measures the "depth" of the fuel in the tank. Since most fuel tanks curve at the bottom, there is less fuel at the bottom of the tank than at the top.

Chapter 2 Section 5 Question 13 Page 87

Inspect expression D. The denominator is always one larger than the numerator. The value of the fraction will always be less than 1, regardless of the value of n.

Chapter 2 Section 5 Question 14 Page 87

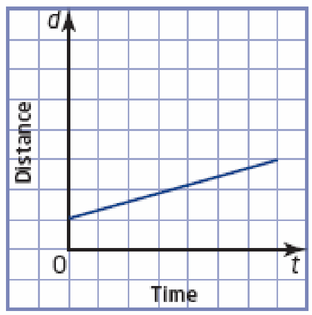
Since the required number is even, the last digit must be a 2, 4, or 6. For each of the 3 choices of last digit, there are 5 choices for the middle digit and 4 choices for the first digit. The number of even three-digit numbers possible is $3 \times 5 \times 4 = 60$.

Chapter 2 Section 6 Distance-Time Graphs

Chapter 2 Section 6 Question 1 Page 91

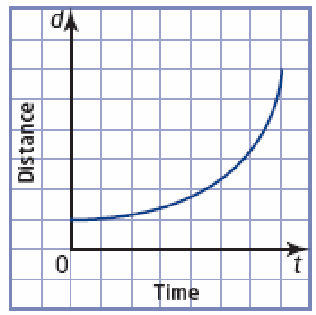
Answers may vary. Sample answers are shown.

a)



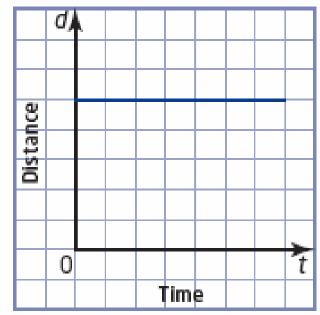
A car is moving away at a constant speed.

b)



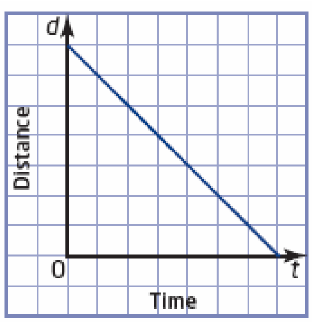
A car is moving away at increasing speed.

c)



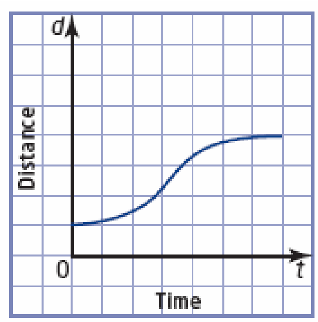
A car is parked, not moving.

d)



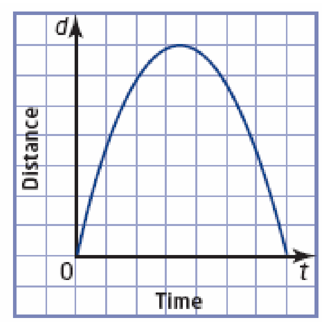
A car is moving closer at a constant speed.

e)



A car is moving away at increasing speed, then slowing down and stopping.

f)

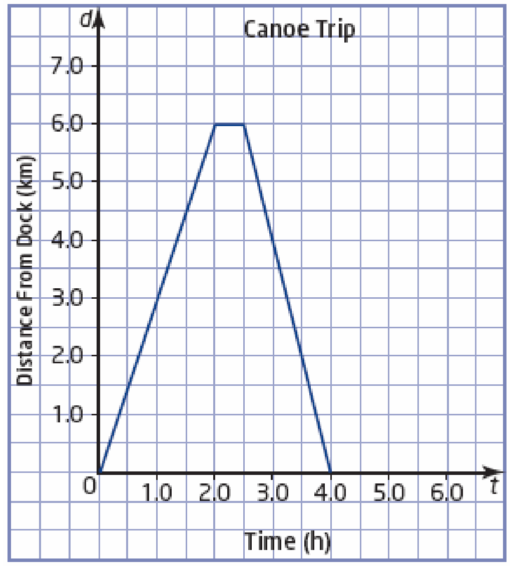


A car is moving away at decreasing speed, stopping for a moment, then coming back with increasing speed.

Chapter 2 Section 6 Question 2 Page 91

Graphs **a)**, **c)**, and **d)** from question 1 show linear relations. The graphs are straight lines.

Chapter 2 Section 6 Question 3 Page 92



a) The trip took 4.0 h.

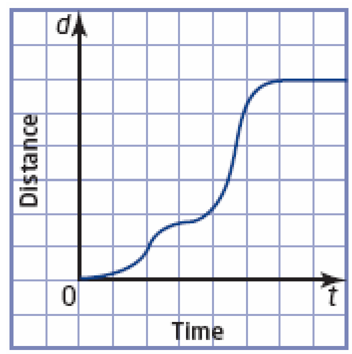
b) The distance to the end of the lake is 6.0 km.

c) The flat portion of the graph represents time that the canoeist rested at the end of the lake.

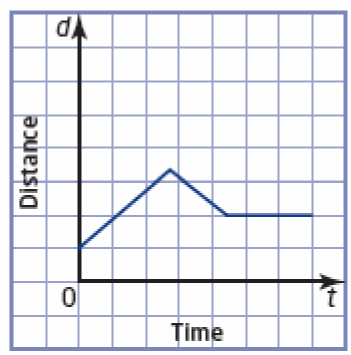
d) It took 2.0 h to reach the end of the lake, but only 1.5 h to come back. The canoeist was travelling faster on the way back.

Chapter 2 Section 6 Question 4 Page 92

After starting out, the cyclist increases her speed, then slows down. Then she travels a bit faster than before, then slows down and stops.



Chapter 2 Section 6 Question 5 Page 92



a) Move away from the wall at a constant speed, then reverse direction and walk back toward the wall at the same speed, but stop before you reach your starting position.

b) If you walked fast, the sloped line segments would be steeper.

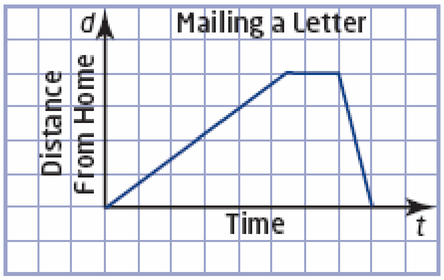
c) If you walked slower, the sloped line segments would be less steep.

d) If you stopped sooner, the middle segment would be shorter and the horizontal segment would be higher.

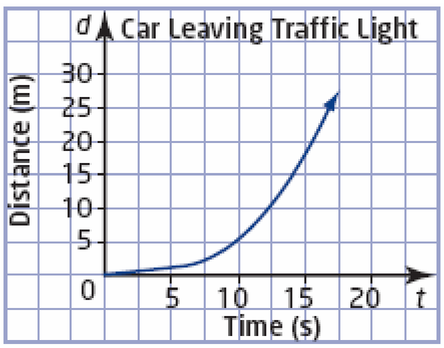
Chapter 2 Section 6 Question 6 Page 93

Answers will vary.

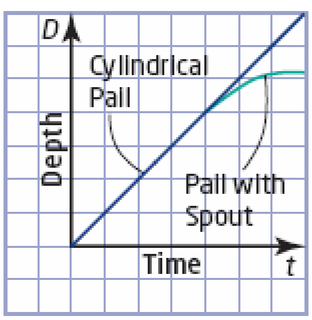
Chapter 2 Section 6 Question 7 Page 93



Chapter 2 Section 6 Question 8 Page 93



Chapter 2 Section 6 Question 9 Page 93



Chapter 2 Section 6 Question 10 Page 93

Answers will vary.

Chapter 2 Section 6　　　　Question 11　Page 93

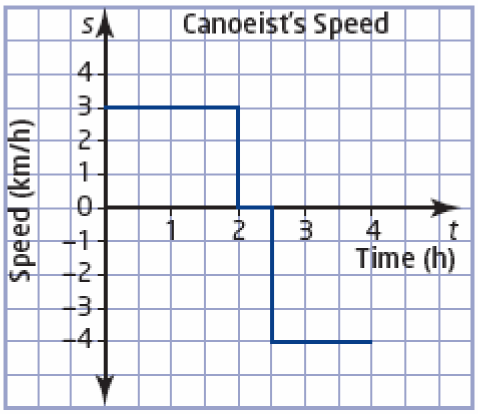
a)

$$\text{First segment } v = \frac{6.0 \text{ km}}{2.0 \text{ h}} = 3 \text{ km/h}$$

$$\text{Second segment } v = \frac{0.0 \text{ km}}{2.0 \text{ h}} = 0 \text{ km/h}$$

$$\text{Third segment } v = \frac{6.0 \text{ km}}{1.5 \text{ h}} = 4 \text{ km/h}$$

b)



c) The steeper the graph, the faster the canoeist is paddling.

d) Negative speed indicates the rate at which the canoeist is returning to the dock.

Chapter 2 Section 6　　　　Question 12　Page 94

d) The horizontal axis represents time. The vertical axis represents the distance from the CBR™ to the ball.

e) The relation between distance and time is not linear. The points do not lie on a straight line.

l) The relation between time and bounce height is linear. The points lie along a straight line.

Chapter 2 Section 6 **Question 13** **Page 94**

Answers will vary.

Chapter 2 Section 6 **Question 14** **Page 94**

Use a table to help you with the "guess and check" method. A calculator or spreadsheet can also be used. Click here to load the spreadsheet file.

Shaheen was born in 1979, and was 26 on her birthday in 2005.

Year	Age	Sum of Digits
2005	0	7
2004	1	6
2003	2	5
2002	3	4
2001	4	3
2000	5	2
1999	6	28
1998	7	27
1997	8	26
1996	9	25
1995	10	24
1994	11	23
1993	12	22
1992	13	21
1991	14	20
1990	15	19
1989	16	27
1988	17	26
1987	18	25
1986	19	24
1985	20	23
1984	21	22
1983	22	21
1982	23	20
1981	24	19
1980	25	18
1979	26	26
1978	27	25
1977	28	24
1976	29	23
1975	30	22
1974	31	21

Chapter 2 Review

Chapter 2 Review   Question 1   Page 95

Answers will vary. Sample answers are shown.

a) Hypothesis: As the temperature in a town during the summer increases, so does the volume of water used by the town's residents.

Opposite: As the temperature in a town during the summer increases, the volume of water used by the town's residents does not increase.

b) Hypothesis: Taller people have higher marks in mathematics.

Opposite: Taller people do not have higher marks in mathematics.

Chapter 2 Review   Question 2   Page 95

a) This is primary data. This is a good choice, since a survey of students at the school could give more accurate results than secondary data would.

b) This is secondary data. This is a good choice, since primary data could take a lot of time to collect, and would not likely be significantly more accurate.

c) This is secondary data. This may not be a good choice, since the encyclopedia might not give information on bears in a specific province.

d) This is secondary data. This is not a good choice. The source of data is convenient, but may not reflect the tastes of students at the school.

Chapter 2 Review   Question 3   Page 95

a) The population is all students at the school.

b) Answers will vary. A sample answer is shown.

Use a random number generator to randomly select 25% of the students from the class lists for each grade.

Chapter 2 Review   Question 4   Page 95

a) The population is all passengers that fly on the airline.

b) Answers will vary. A sample answer is shown.

Obtain a list of all passengers who have flown on the airline. Randomly select one name on the list of the airline's passengers, and then select every hundredth person before and after that name.

Chapter 2 Review Question 5 Page 95

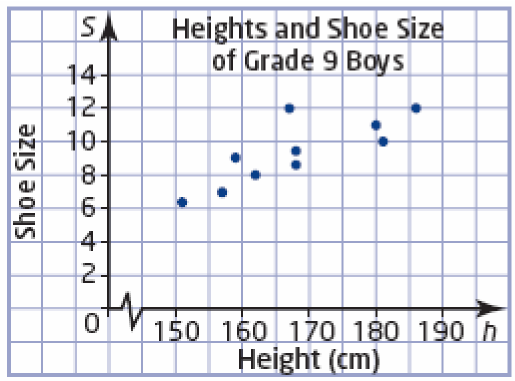
Answers for sampling techniques will vary. Sample answers are shown.

a) The population is all customers of the department store. The store can pick a customer at random, and then every 10th customer entering the store, to survey.

b) The population is all campers at provincial parks. Park rangers at each park can survey every 10th camper who registers.

c) The population is all students at the school. The librarian can use a random number generator to generate 50 random numbers between 1 and the population of the school. Then, he can use the numbers to select students from a school listing to survey.

Chapter 2 Review Question 6 Page 95

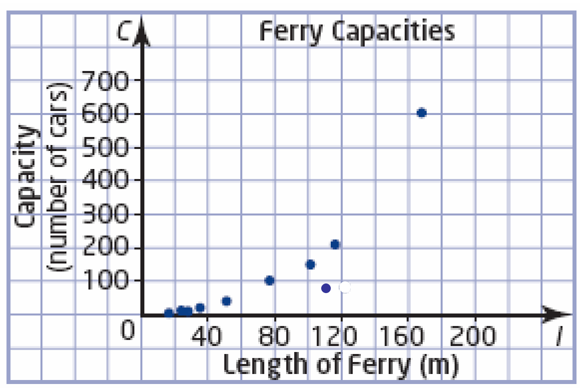


a) The scatter plot is shown.

b) As the students' heights increase, so do their shoe sizes.

c) (167, 12) is an outlier, but should not be discarded since it is a valid measurement, unless there is some reason to believe that the measurement was made in error.

Chapter 2 Review Question 7 Page 96



a) The scatter plot is shown.

b) As the length of the ferry increases, the capacity also increases. The points follow a curve, so the relationship is non-linear.

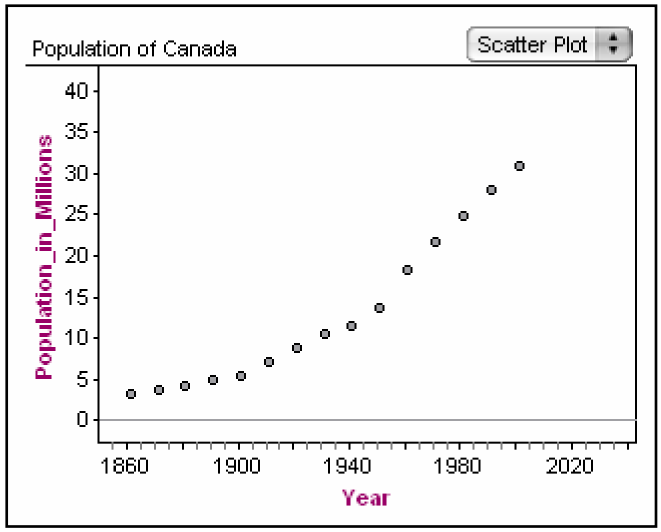
c) The point (110.8, 80) is an outlier.

Answers about causes may vary. Sample answers are shown.

The ferry might carry cargo as well as cars.
The ferry might carry fewer cars so that it can travel faster.
Some ferries derive most of their business from passengers, and may have few spaces for cars.

Chapter 2 Review **Question 8** **Page 96**

a) The scatter plot is shown.



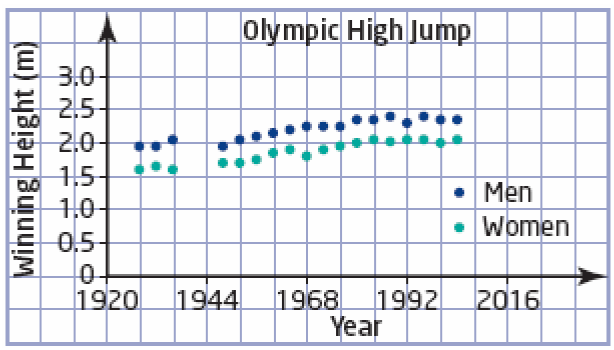
b) The population of Canada has grown at an increasing rate since 1861.

c) The population in 1967 was about 20 million.

d) The population in 2021 will be about 34 million.

Chapter 2 Review **Question 9** **Page 96**

a)



b) Both the men's and women's winning heights are increasing, but the rate of increase has been slower since about 1980.

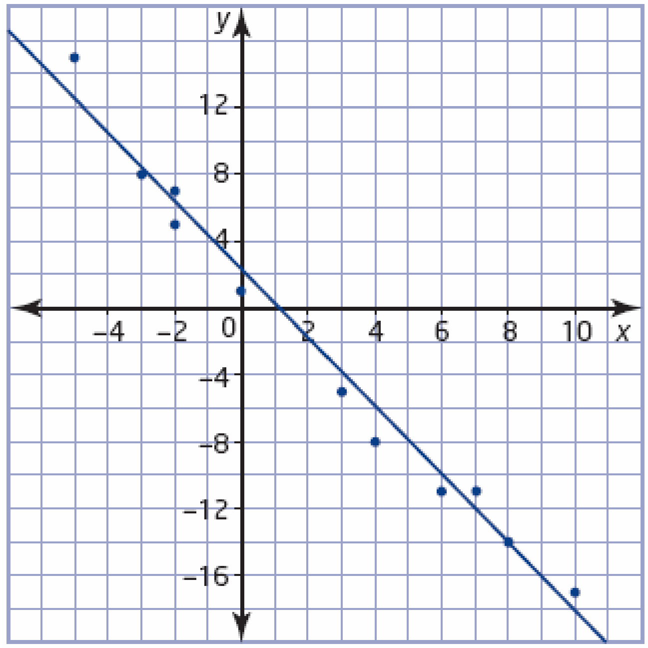
c) There are no apparent outliers.

d) Answers will vary. Sample answers are shown.

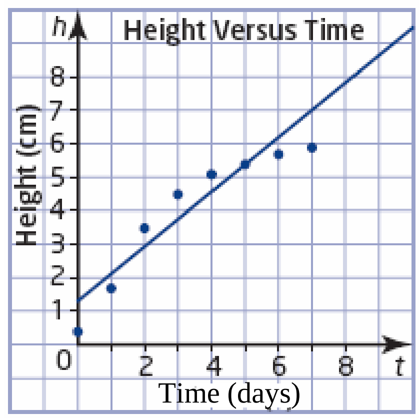
Men's winning height in 2012 will be about 2.48 m. Women's winning height will be about 2.15 m

Chapter 2 Review **Question 10** **Page 97**

a) The scatter plot and line of best fit are shown. The line is a good fit. All of the points are close to the line.

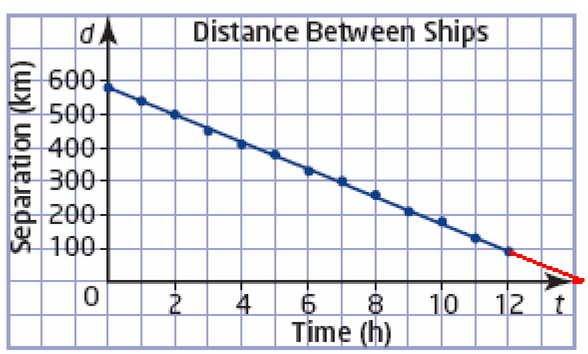


b) The scatter plot and line of best fit are shown. The line is not a good fit. The points appear to follow a curve.



Chapter 2 Review **Question 11** **Page 97**

a) The scatter plot is shown.



b) As time increases, the distance between the two ships decreases. The relationship is linear.

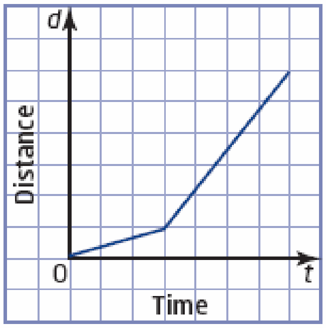
c) There are no apparent outliers.

d) The ships will be closest to each other after 14.3 h.

Chapter 2 Review Question 12 Page 97

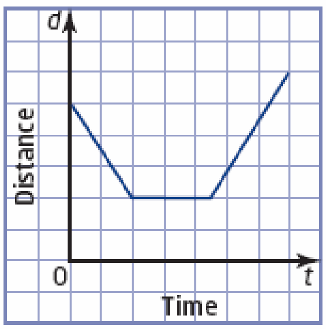
Answers may vary. Sample answers are shown.

a)



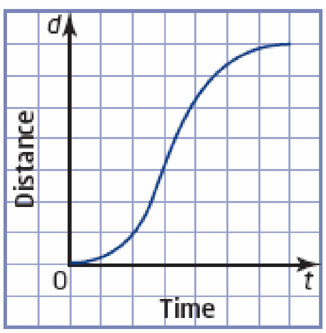
Marni walks away from her home for 2 min at a constant speed, and then runs in the same direction at a constant speed for 2 min.

b)



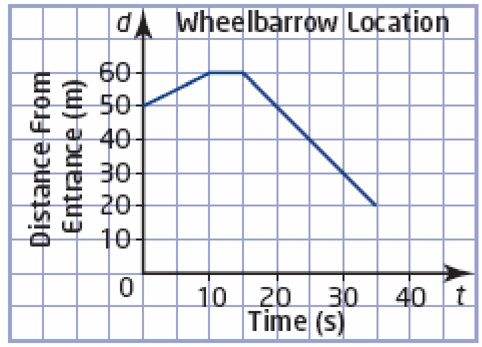
John bikes from school to a store, buys something, and then bikes back past the school to home.

c)

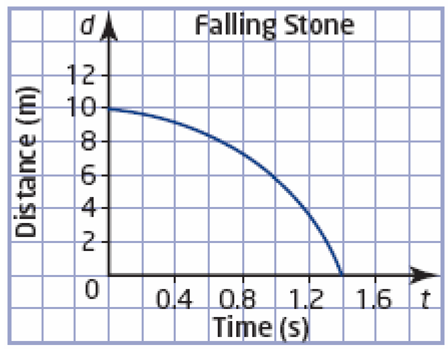


A car speeds up as it leaves a traffic light, and then slows down and stops at another light.

a) The distance-time graph is shown.



b) The distance-time graph is shown.



Chapter 2 Chapter Test

Chapter 2 Chapter Test Question 1 Page 98

Answer B is a primary source of data, since you are collecting it yourself. All of the others are secondary sources.

Chapter 2 Chapter Test Question 2 Page 98

Answer C is not a random sample. You are only surveying people on a particular street corner.

Chapter 2 Chapter Test Question 3 Page 98

Estimating value beyond the known data for a relation is extrapolation. Answer A.

Chapter 2 Chapter Test Question 4 Page 98

The final step in an experiment is the evaluation. Answer C.

Chapter 2 Chapter Test Question 5 Page 98

a) Caffeine cannot affect your sleep.

b) If you study more, your results on tests either improve or stay the same.

c) At least half of the students in your school do not have a part-time job.

d) Cell phone use has not more than doubled in the past 2 years.

Chapter 2 Chapter Test Question 6 Page 98

a) The population is all teachers working for the school board.

Answers will vary. Sample answers are shown.

b) Randomly select 20% of the teachers in each school.

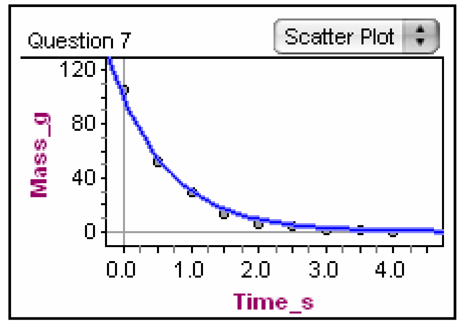
c) Select a name at random from a list of all of the teachers, and then select every fifth name before and after the first name selected.

d) Survey all the teachers in the nearest school.

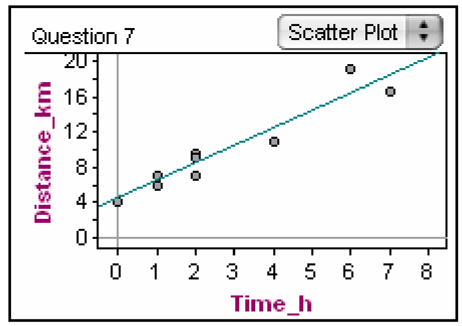
e) Teachers at the same school have the same students and working conditions. These teachers may not have the same concerns and opinions as teachers at other schools

Chapter 2 Chapter Test Question 7 Page 98

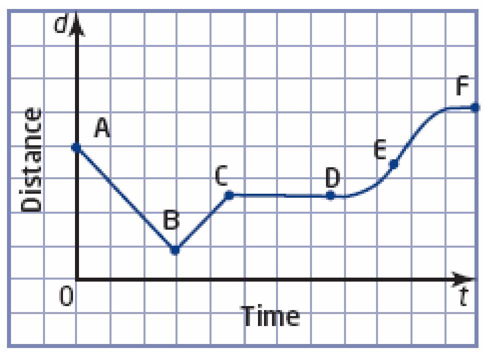
a) The scatter plot and curve of best fit are shown. The relation is non-linear.



b) The scatter plot and line of best fit are shown. The relation appears to be linear.



Chapter 2 Chapter Test Question 8 Page 99



AB: The distance is decreasing at a steady rate.

BC: The distance is increasing at a steady rate.

CD: There is no motion.

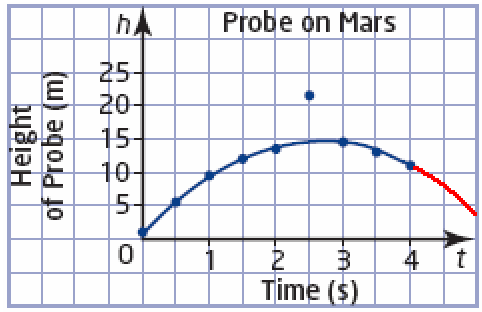
DE: The distance is increasing at an increasing rate.

EF: The distance is increasing at a decreasing rate.

Chapter 2 Chapter Test Question 9 Page 99

Answers will vary.

Chapter 2 Chapter Test **Question 10** **Page 99**



a) The scatter plot is shown.

b) The relation is non-linear. As time increases, the height first increases, then decreases.

c) The point (2.5, 21.4) is an outlier. Possible causes could be an inaccurate reading, or a data transmission error.

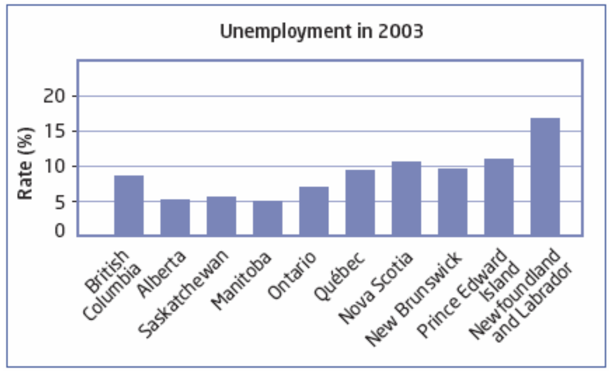
d) See the graph in part **a)** for the curve of best fit.

e) The extrapolation is shown on the graph. The height after 5 s is about 4.7 m.

Chapter 2 **Relations**

Chapter 2 Get Ready

Chapter 2 Get Ready **Question 1** **Page 40**

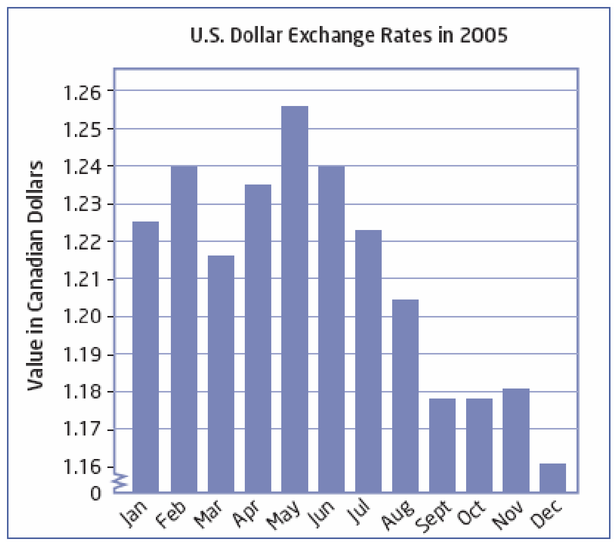


a) The heights of the bars represent the unemployment rate, in percent, for each province in 2003.

b) Newfoundland and Labrador has the greatest unemployment rate.

c) The prairie provinces had the lowest unemployment rate. People had the best chance of finding work in 2003 in the prairie provinces.

Chapter 2 Get Ready **Question 2** **Page 40**



a) The lowest value of the U.S. dollar shown on the graph is $1.16 CDN, in December of 2005.

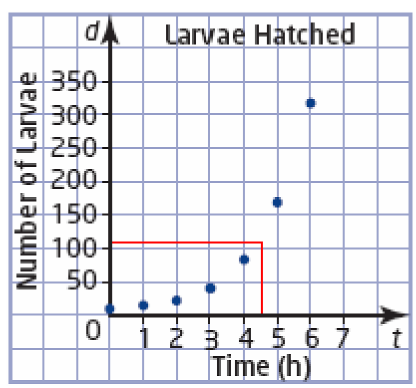
b) The value of the U.S. dollar compared to the Canadian dollar was the greatest in May of 2005.

c) The graph shows an overall downward trend in the value of the U.S. dollar compared to the Canadian dollar.

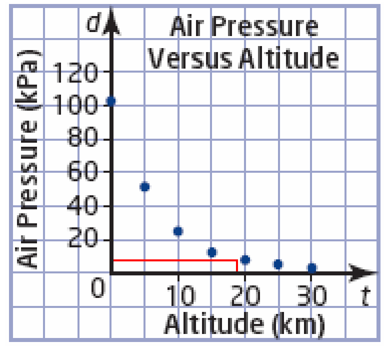
Chapter 2 Get Ready **Question 3** **Page 41**

a) The scatter plot is shown.

b) After 4.5 h, about 110 larvae have hatched.



Chapter 2 Get Ready **Question 4** **Page 41**



a) The scatter plot is shown.

b) The air pressure at an altitude of 18 km is about 7.5 kPa.

Chapter 2 Get Ready **Question 5** **Page 41**

a) The unit rate is $\dfrac{42 \text{ pages}}{6 \text{ min}} = 7 \dfrac{\text{pages}}{\text{min}}$.

b) The unit rate is $\dfrac{\$15}{5 \text{ kg}} = \$3/\text{kg}$.

c) The unit rate is $\dfrac{880 \text{ km}}{11 \text{ h}} = 80 \text{ km/h}$.

Chapter 2 Get Ready **Question 6** **Page 41**

a) The unit rate is $\dfrac{\$4.19}{750 \text{ g}} \doteq \$0.0056/\text{g}$.

b) The unit rate is $\dfrac{500 \text{ mL}}{24 \text{ muffin}} \doteq 20.8 \dfrac{\text{mL}}{\text{muffin}}$.

c) The unit rate is $\dfrac{5000 \text{ m}}{38.6 \text{ min}} \doteq 130 \text{ m/min}$.

Chapter 2 Section 1: Hypotheses and Sources of Data

Chapter 2 Section 1 Question 1 Page 45

a) Most people's favourite number is not 7.

b) Adults do not spend more time listening to classical music than rap. (Alternative: Adults spend either less time or as much time listening to classical music as they spend listening to rap.)

c) In Ontario, the number of teenagers who join hockey teams is greater than or equal to the number who join soccer teams.

d) Chocolate is the most popular flavour of ice cream.

Chapter 2 Section 1 Question 2 Page 45

Answers will vary. Sample answers are shown.

a) Hypothesis: Time spent doing homework increases as a student's age increases.

Opposite: Time spent doing homework does not increase as a student's age increases.

b) Hypothesis: Children tend to grow to the same height as their mothers.

Opposite: Children do not tend to grow to the same height as their mothers.

c) Hypothesis: As temperature increases, the crime rate also increases.

Opposite: As temperature increases, the crime rate decreases or remains constant.

d) Hypothesis: As the cost of gasoline increases, the number of people using public transit increases.

Opposite: As the cost of gasoline increases, the number of people using public transit decreases or stays the same.

Chapter 2 Section 1 Question 3 Page 45

a) The data are primary; the office manager gathers the data.

b) The data are secondary; the student uses data gathered by Statistics Canada.

c) The data are primary; the researcher gathers the data.

d) The data are secondary; the researcher uses data gathered by the transit authority.

Chapter 2 Section 1 Question 4 Page 45

Answers about advantages will vary. Sample answers are shown.

a) The data are primary. Advantage: the data are up-to-date.

b) The data are secondary. Advantage: Internet search is fast and easy.

c) The data are primary. Advantage: the survey is getting opinions directly from customers.

d) The data are primary. Advantage: the data are up-to-date.

Chapter 2 Section 1 Question 5 Page 45

Answers will vary. Sample answers are shown.

a) Most students in the class prefer dogs as pets.

b) Survey the class. Primary data are best since the population is small and secondary data may not be available.

Chapter 2 Section 1 Question 6 Page 46

a) The data are primary. Steve gathered the data himself.

b) Answers will vary. Sample answers are shown.

Brown-eyed students are shorter.

Blue is the least common eye colour.

c) The hypotheses can be tested by surveying a larger sample of students.

Name	Eye Colour	Height (cm)
Josanth	brown	167
Fred	green	181
Graham	green	185
Cho	brown	171
Seth	blue	154
Jamal	green	183
Juan	brown	160
Cameron	blue	173

Chapter 2 Section 1 Question 7 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: Females make more phone calls than males.

b) You can survey 50 females and 50 males to test your hypothesis with primary data.

c) You can look for data on the Internet or in publications to test your hypothesis with secondary data.

d) Secondary sources that survey larger samples are more likely to be accurate.

Chapter 2 Section 1 Question 8 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: Taller people perform better at the high jump.

b) Heights of the athletes and how high the athletes can jump are the data needed to test the hypothesis. Primary data for the school team would be easy to collect. Secondary sources could survey a larger sample and yield more accurate results.

Chapter 2 Section 1 Question 9 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: The faster the computer, the more it will cost.

b) Most popular computer vendors have Web sites. A search shows that faster computers do cost more.

c) This is primary data if you collect prices from Web sites for individual suppliers. This is secondary data if you find price surveys with data gathered by someone else.

d) You can also visit a computer store to research speeds and prices.

Chapter 2 Section 1 Question 10 Page 46

Answers will vary. Sample answers are shown.

a) A cow produces 20-25 L of milk in a day.

b) A cow eats 12-15 kg of hay in a day.

c) If the information comes from visiting a dairy farm, it is primary data. If the data comes from a book or the Internet, it is secondary data.

Chapter 2 Section 1 Question 11 Page 47

Solutions for Achievement Checks are shown in the Teacher's Resource.

Chapter 2 Section 1 Question 12 Page 47

Answers will vary. Sample answers are shown.

a) Hypothesis: The greater the latitude of a city, the lower the mean of its daily maximum temperatures in January.

b) Available data shows that the hypothesis is generally true, if other factors such as ocean currents are not relevant.

Chapter 2 Section 1 Question 13 Page 47

Answers will vary.

Chapter 2 Section 1 Question 14 Page 47

If the mean is 6, then the sum of the numbers is $6n$. If 17 is added, the mean becomes 7, with $n + 1$ numbers in the list. You are looking for a number n such that

$$\frac{6n+17}{n+1}=7$$

Use the "guess and check" method to determine that n must equal 10.

Chapter 2 Section 2 Sampling Principles

Chapter 2 Section 2 Question 1 Page 52

a) The population is all children.

b) The population is all those who wrote the test.

c) The population is all cars.

d) The population is all food stores.

Chapter 2 Section 2 Question 2 Page 52

a) The data required are the ages when girls and boys learn to walk. Use a sample, the population is very large.

b) The data required are the test marks. Use a census, the population is small.

c) The data required are the salaries of Canadian employees. Use a sample, the population is very large.

d) The data required are people's heights and ages. Use a sample, the population is very large.

e) The data required are the makes of the cars in the school parking lot. Use a census, the population is small.

f) The data required are colours of cars driving by the school. Use a sample, the population is very large.

Chapter 2 Section 2 Question 3 Page 52

Answers will vary. Sample answers are shown.

a) Survey every fourth customer who comes into the cafe.

b) Randomly select 1% of the teenagers in every high school across Ontario.

c) Use a random number generator to select telephone numbers within Canada, and then survey the people who identify themselves as bilingual.

d) Select households to survey by any random method, and then ask the people surveyed where they were born.

Chapter 2 Section 2 Question 4 Page 53

a) This is a non-random sample. It could be biased since University of Waterloo students may not be representative of all university graduates.

b) This is a simple random sample. It could be biased, since the sample excludes anyone who does not have a telephone listing.

c) This is a non-random sample. It is biased because it includes only people who have chosen to spend some of their free time going to a movie.

d) This is a systematic random sampling.

Chapter 2 Section 2 Question 5 Page 53

Answers may vary. Sample answers are shown.

You can group the students by age, by grade level, or by gender.

Chapter 2 Section 2 Question 6 Page 53

a) The population is all farmers in Ontario.

b) Answers will vary. A sample answer is shown.

Use a random number generator to randomly select 10% of the farmers in each county.

Chapter 2 Section 2 Question 7 Page 53

a) The population is all employees of the company.

b) Answers may vary. A sample answer is shown.

Use a random number generator to randomly select a starting point on an alphabetical list of the employees. Then, select every sixth person until you have a total of 50.

Chapter 2 Section 2 Question 8 Page 53

a) The population includes all members of the school teams.

b) Answers will vary. A sample answer is shown.

Write each team member’s name on a slip of paper. Then, randomly draw 15% of the slips out of a box.

Chapter 2 Section 2 Question 9 Page 53

The population of the school is 1216 students.

$$\begin{aligned}\text{Number of Grade 9 Students} &= \frac{330}{1216} \times 150 \\ &\doteq 41\end{aligned}$$

$$\begin{aligned}\text{Number of Grade 10 Students} &= \frac{308}{1216} \times 150 \\ &\doteq 38\end{aligned}$$

$$\begin{aligned}\text{Number of Grade 11 Students} &= \frac{295}{1216} \times 150 \\ &\doteq 36\end{aligned}$$

$$\begin{aligned}\text{Number of Grade 12 Students} &= \frac{283}{1216} \times 150 \\ &\doteq 35\end{aligned}$$

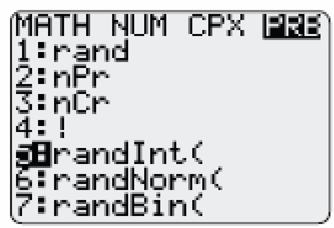
Grade	Number of Students
9	330
10	308
11	295
12	283

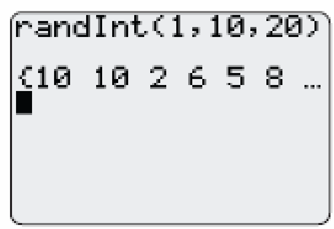
Chapter 2 Section 2 Question 10 Page 54

a) Use the command randInt(12,36,25). The first number is the lower limit, the second number is the upper limit, and the third number is the number of random integers desired.

b) Enter randInt(1,500,40). If any numbers are repeated, change the command to generate more random numbers and use the first 40 that are not duplicates.

c) Enter randInt(100,1000,75). Increase 75 to 100 or more if some numbers are repeated.





Chapter 2 Section 2 Question 11 Page 54

a) The sample is not completely random. Students at small schools have a greater chance of being selected than students at large schools.

b) The results are biased. The sample is likely to have a greater proportion of students from small schools than the population does.

Chapter 2 Section 2 Question 12 Page 54

Answers for sampling methods will vary. Sample answers are shown.

a) The population is all students in the school. Obtain a list of students. Use a random number generator to select a starting point. Select every 10th student.

b) The population is all people in the community. Obtain a list of residents. Use a random number generator to select a starting point. Select every 50th resident.

c) The population is all people aged 18 to 30. Use a random number generator to generate telephone numbers across the country. Survey those who identify themselves as between the ages of 18 and 30.

d) The population is all senior citizens in Ontario. Use a random number generator to generate telephone numbers across Ontario. Survey those who identify themselves as senior citizens.

e) The population is all computer printers for sale in Canada. Search retailers on the Internet to assemble a list of all printers sold in Canada. Purchase one of each kind for testing.

f) The population is gasoline prices at all vendors in the community. Use a telephone book to find addresses for all gasoline retailers in the community. Call or visit each one to generate a list of prices.

Chapter 2 Section 2 Question 13 Page 54

The sample is representative only of people who browse the site and are willing to fill out the form. The sample excludes anyone who does not have Internet access or the inclination to complete the survey.

Chapter 2 Section 2 Question 14 Page 54

a) In the 1920s, many people did not have telephones. Since these people were not included in the surveys, the samples were not representative of the whole population.

b) Answers will vary. Sample answers are shown.

People with more than one telephone number have a greater chance of being selected.

People refusing to answer telephone surveys may make the sample unrepresentative of certain groups.

Deaf people will be left out of the sample.

Chapter 2 Section 2 Question 15 Page 55

Answers will vary.

Chapter 2 Section 2 Question 16 Page 55

Answers will vary.

Chapter 2 Section 2 Question 17 Page 55

Answers will vary. Sample answers are shown.

Poorly designed questions can influence the answers that respondents will give.

People may give false answers to questions they feel uncomfortable with.

Chapter 2 Section 2 Question 18 Page 55

Answers will vary. Sample answers are shown.

a) Assign each tree a number and use a random number generator to choose 10% of the trees.

b) Divide the park into sections with similar numbers of trees, and randomly select 10% from each section.

c) Assign each tree a number. Randomly select a starting point, and then select every tenth number before and after the starting number.

d) Sample the 10% of the trees closest to roads.

Any of the random samples will test trees throughout the park. However, the forester could choose a non-random sample with a larger proportion of the hardwood trees that the beetle attacks most often.

Chapter 2 Section 2 Question 19 Page 55

a) Answers will vary. Sample answers are shown.

You can interview sports fans at a sports venue such as an arena or ball park.

You can interview classmates.

b) Convenience samples are not truly random because every member of the population does not have an equal chance of being selected. Interviewing sports fans at a sports venue excludes members of the population who are not interested in sports or do not attend live events. Interviewing classmates excludes members of the population who are not in the class.

Chapter 2 Section 2 Question 20 Page 55

Since the required number is odd, the last digit must be a 1, 3, 5, or 7. For each of the 4 choices of last digit, there are 6 choices for the middle digit and 5 choices for the first digit. The number of odd three-digit numbers possible is $4 \times 6 \times 5 = 120$.

Chapter 2 Section 3 Use Scatter Plots to Analyse Data

Chapter 2 Section 3 Question 1 Page 64

a) independent variable: physical fitness
dependent variable: blood pressure

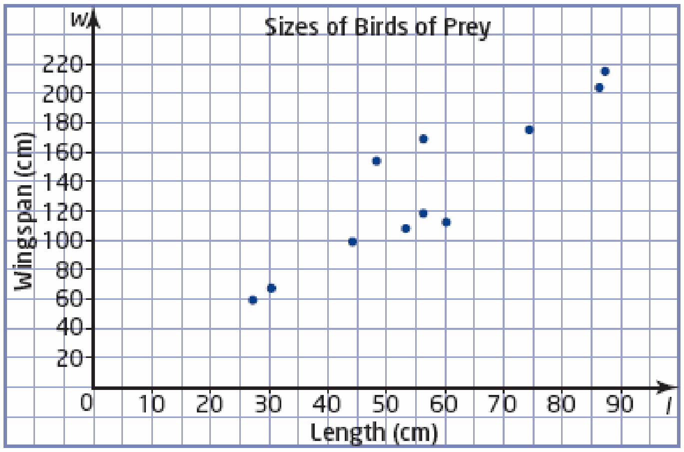
b) independent variable: level of education
dependent variable: income

c) independent variable: load in an airplane
dependent variable: length of runway needed for take off

Chapter 2 Section 3 Question 2 Page 64

a) To show wingspan as the independent variable, move it to the horizontal axis.

b) As the length increases, the wingspan increases.

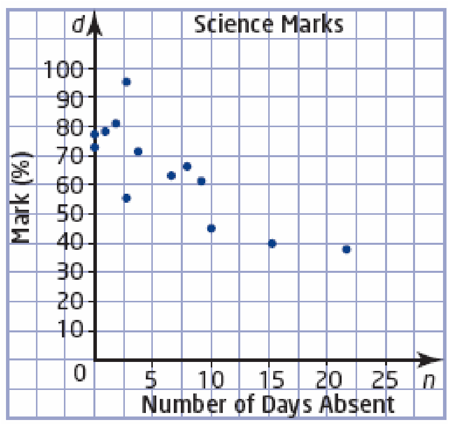


Chapter 2 Section 3 Question 3 Page 64

a) independent variable: number of days absent
dependent variable: science mark.

Marks depend on attendance, rather than attendance depending on marks.

b) The scatter plot is shown.



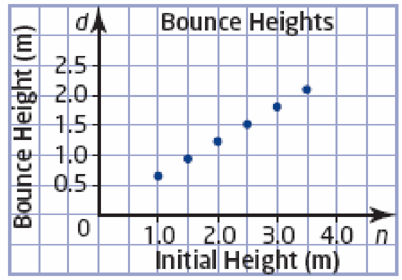
c) As the number of days absent increases, the marks generally decrease.

d) The point (3, 95) lies somewhat apart from the rest of the data. It can be considered as an outlier.

Chapter 2 Section 3 Question 4 Page 65

a) independent variable: initial height
dependent variable: bounce height

The bounce height depends on the initial height, rather than the initial height depending on the bounce height.

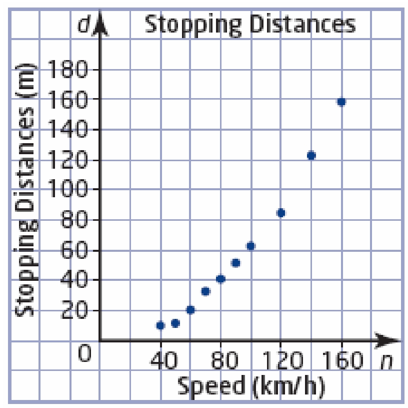


b) The scatter plot is shown.

c) As the initial height increases, so does the bounce height.

d) The point (4.00, 1.62) is an outlier. It should be discarded only for a valid reason, such as a measurement error. Repeat the measurement several times to determine whether this is a measurement error.

Chapter 2 Section 3 Question 5 Page 65



a) The scatter plot is shown.

b) As the speed of a car increases, the stopping distance increases. The pattern is non-linear.

c) A car travelling at 85 km/h needs 46 m to stop. The point is not an outlier since it follows the pattern of the other data

Chapter 2 Section 3 Question 6 Page 65

Answers will vary. Sample answers are shown.

a) Hypothesis: As a person's height increases, so does the shoulder width.

b) Select a sample of persons of varying heights. Measure height and shoulder width.

c) Display your results in a scatter plot, and draw your conclusion.

d) To improve the accuracy of measurements; use a larger sample.

Chapter 2 Section 3 Question 7 Page 66

Answers will vary. Sample answers are shown.

a) Select a sample of athletes. Measure each athlete's height and the maximum height he or she can jump.

b) The independent variable is the height.

The dependent variable is the jump height.

c) If the hypothesis is true, then the points on the scatter plot will follow a line or curve that rises to the right.

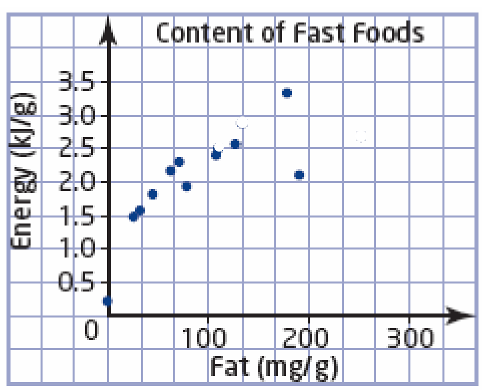
Chapter 2 Section 3 Question 8 Page 66

a) Divide the amount of fat in milligrams by the serving size in grams to obtain the amount of fat per gram.

Divide the energy in kJ by the serving size in grams to obtain the energy per gram.

Item	Fat (mg/g)	Energy (kJ/g)
Harvey's Original Hamburger	127	2.6
Harvey's Veggie Burger	63	2.2
Mr. Submarine Small Assorted Sub	34	1.6
Mr. Submarine Small Vegetarian Sub	26	1.5
Pizza Pizza Pepperoni Slice (walk-in)	69	2.3
Pizza Pizza Vegetarian Slice (walk-in)	43	1.8
KFC Chicken Breast	118	2.4
KFC Popcorn Chicken	184	3.3
Swiss Chalet Quarter Chicken Breast	75	1.9
Swiss Chalet Garden Salad, undressed	0	0.2
Swiss Chalet Caesar Salad	188	2.1

b) The scatter plot is shown.

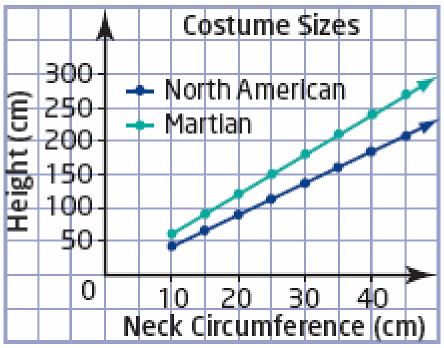


c) The point for Caesar Salad is an outlier due to its high fat content. Nonetheless, this point represents valid data that should not be discarded.

d) Answers will vary. A sample answer is shown.

The scatter plot shows that some fast foods can have a high energy content without a high fat content.

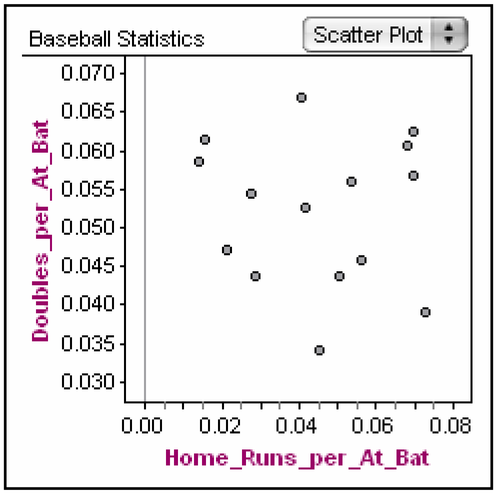
Chapter 2 Section 3 Question 9 Page 67



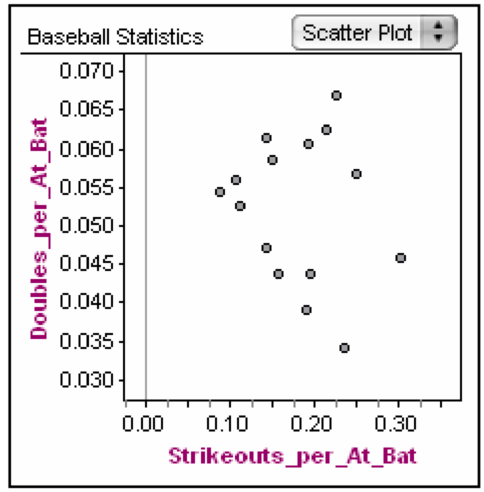
Chapter 2 Section 3 Question 10 Page 67

Divide each statistic by the number of times at bat to obtain the rates. Click here to load the Fathom® file.

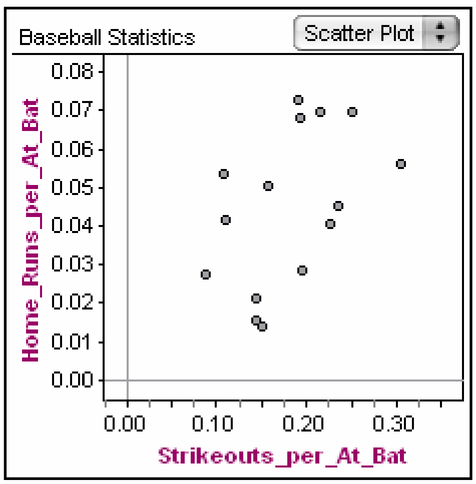
a)



b)



c)



d) Home runs per at bat seem to increase somewhat as the number of strikeouts per at bat increases. The other two scatter plots do not show any relationship between the variables.

Chapter 2 Section 3 Question 11 Page 67

To keep the value of the expression as small as possible, use the smallest numbers for the numerators, and the largest numbers for the denominators. Use "guess and check" to determine which arrangement yields the smallest value for the expression.

$$\begin{aligned}\frac{1}{4}+\frac{2}{5}+\frac{3}{6}&=\frac{15}{60}+\frac{24}{60}+\frac{30}{60}\\&=\frac{69}{60}\\&=1\frac{3}{20}\end{aligned}$$

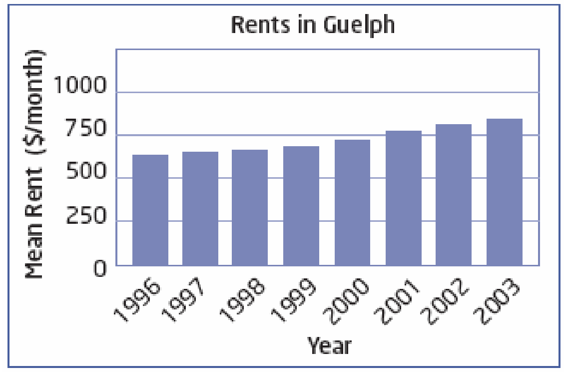
Chapter 2 Section 4 Trends, Interpolation, and Extrapolation

Chapter 2 Section 4 Question 1 Page 73

a) The bar graph is shown.

b) The bar graph shows a rising trend in rents.

c) Over 7 years, the mean rent increased by \$165. A reasonable estimate for the mean rent in another 7 years is 823 + 165 = \$988.

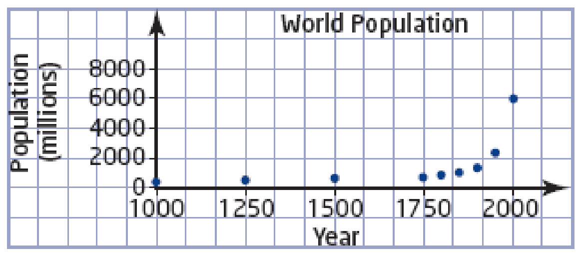


Chapter 2 Section 4 Question 2 Page 73

a) The scatter plot is shown.

b) The world population is growing much more quickly now than in the past.

c) The graph shows an increasing rate of growth. It does not predict that the world population will stabilize at about 10 billion people around the year 2200.

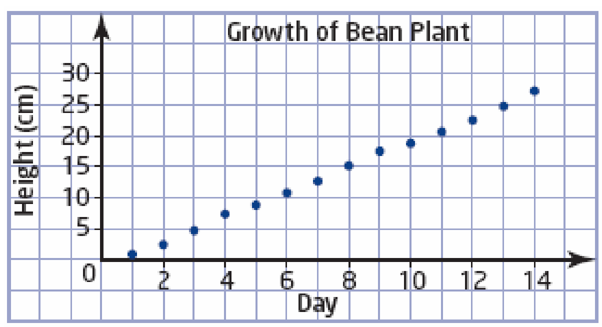


Chapter 2 Section 4 Question 3 Page 73

a) The scatter plot is shown.

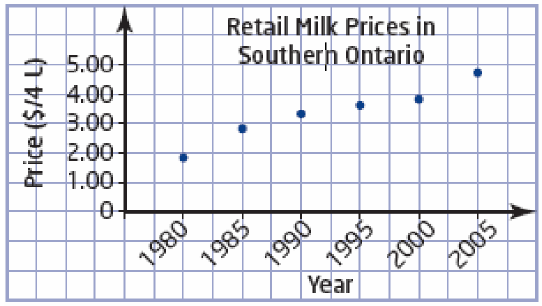
b) The height is increasing at a nearly constant rate.

c) In future weeks, the height will increase at a slower rate as the plant matures, and reach a maximum height.



Chapter 2 Section 4 Question 4 Page 73

a) The scatter plot is shown.



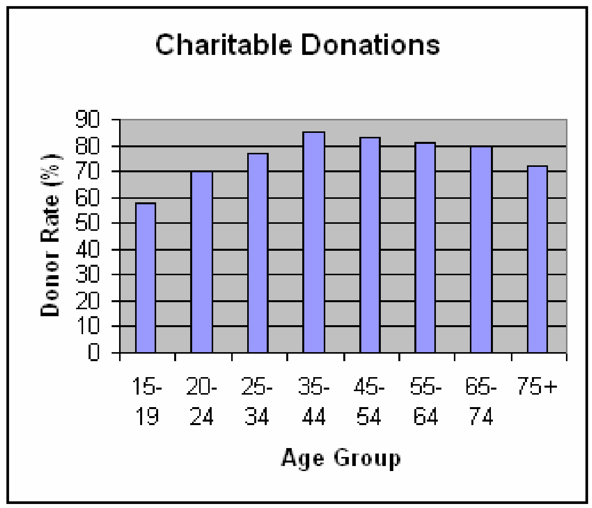
b) Milk prices increased over each 5-year period, but not at a constant rate.

c) The price in 1995 was about $3.60, and the price in 2000 was about $3.80. A reasonable estimate for the price in 1998 is about $3.69.

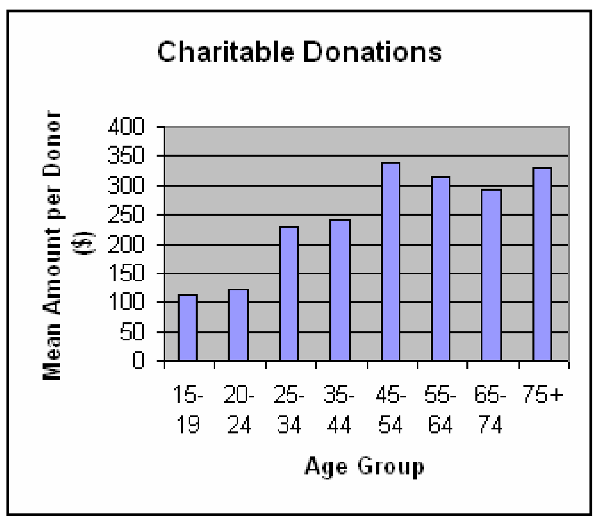
d) From 1980 to 2000, the price of milk went from about $2.00 to about $4.00. A reasonable estimate for a price of $6.00 is another 20 years, or about 2020, assuming prices increase at the same overall rate.

Chapter 2 Section 4 Question 5 Page 74

a) The bar graph is shown. The donation rate increases up to the 35 – 44 age group, and then decreases.



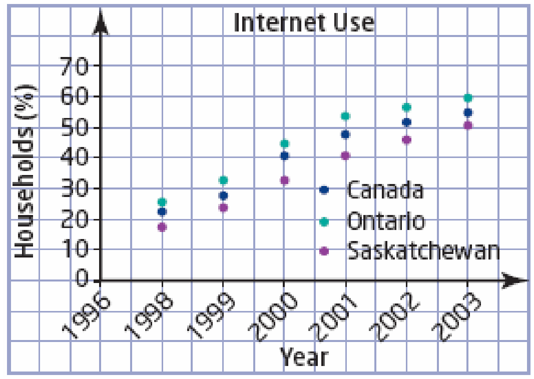
b) The bar graph is shown. Donation amounts increase with age up to the 45 – 54 interval, then decrease, and then increase again for the 75+ interval. Donation amounts are greater for people over 44 than for younger people.



c) Both graphs rise to a maximum for middle-aged people, then decease somewhat. However, the donation amount rises again in the 75+ interval while the donor rate continues to decrease.

Chapter 2 Section 4 **Question 6** **Page 74**

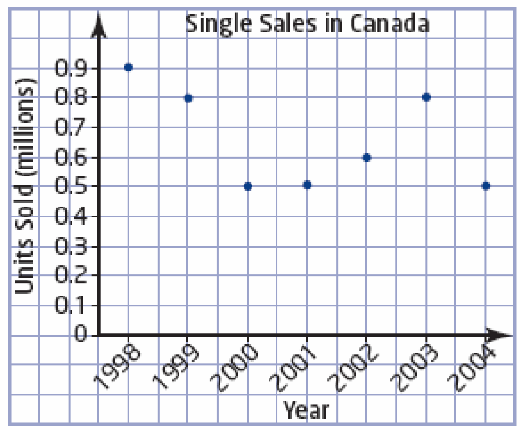
a) The graph is shown. Internet use increased each year, with the national rate being about halfway between the rate in Ontario and the rate in Saskatchewan.

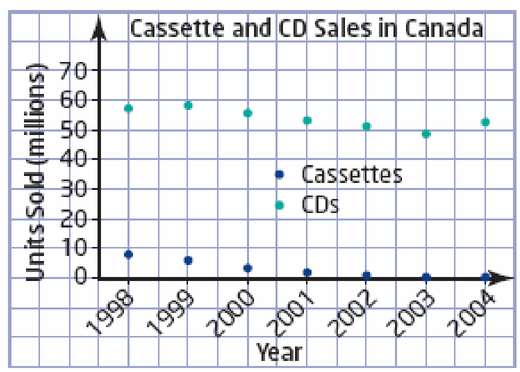


b) From 1998 to 2003, Internet use in Canada increased from about 23% to 55%, or about 6% per year. A reasonable estimate for the usage in 2005 is 55% + 12%, or 67%, assuming that the same rate of growth continues.

Chapter 2 Section 4 **Question 7** **Page 75**

a) The graphs are shown. Overall, sales of singles show a downward trend. Sales of cassettes show a clear downward trend, while sales of CDs show a moderate downward trend.





b) Answers will vary. Sample answers are shown.

Singles will sell 0.5 million in 2005.

Cassettes will sell 0.05 million in 2005.

CDs will sell 55 million in 2005.

Chapter 2 Section 4 Question 8 Page 75

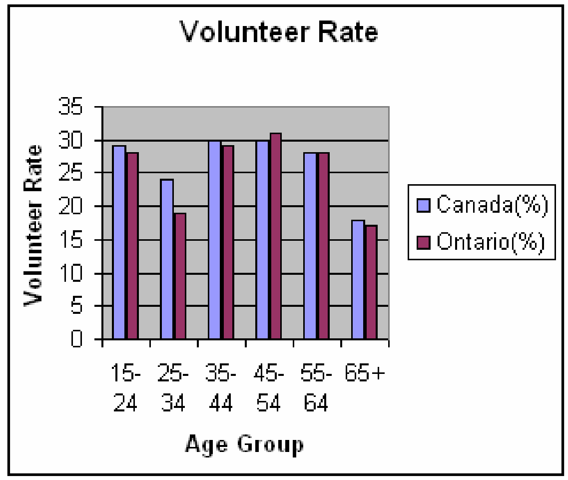
Solutions for Achievement Checks are shown in the Teacher's Resource.

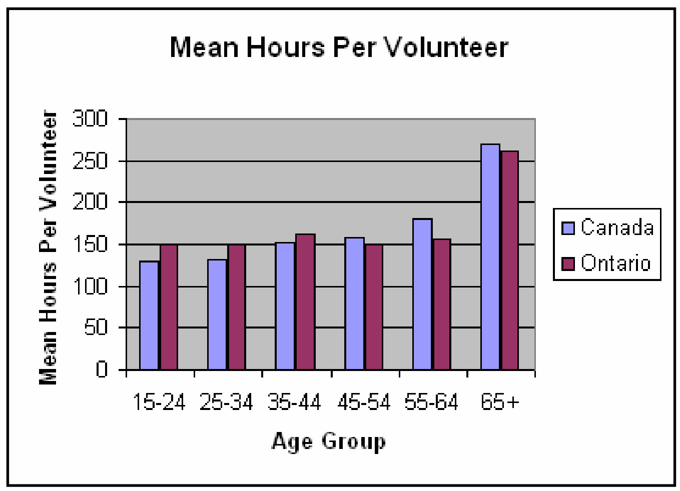
Chapter 2 Section 4 Question 9 Page 76

a) Graphs are shown. The volunteer rate in Ontario is about the same as for all Canadians except in the age group 25-34, when 5% fewer Ontarians volunteer.

b) The age group 45-54 has the greatest volunteer rate. People in this age range may have more free time.

c) As age increases, the hours per volunteer across Canada also increase, especially beyond the age of 65. Most people over 65 are retired and could have more time to volunteer.





Chapter 2 Section 4 Question 10 Page 76

Answers will vary.

Chapter 2 Section 4 Question 11 Page 76

Try each answer. Answer B works.

At noon there are 40 girls in the room. If 15 leave, there are 25 left. Therefore, there are 50 boys in the room. If 45 boys leave, there are 5 boys left. The ratio of girls to boys is 25:5 or 5:1, as required.

Chapter 2 Section 4 Question 12 Page 76

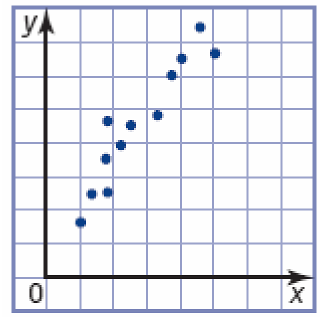
Let the first day be a Saturday. Saturdays will occur on the following days:

1, 8, 15, 22, 29, 36, 43, 50, 57, 64, 71, 78, 85, 92, and 99. There are 15 Saturdays.

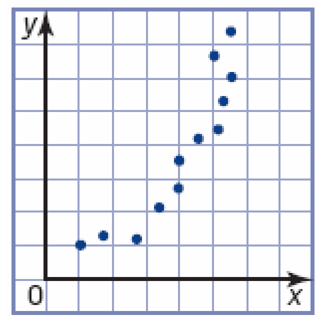
Chapter 2 Section 5   Linear and Non-Linear Relations

Chapter 2 Section 5   Question 1   Page 83

a) This graph appears to be linear. The points lie along a straight line.

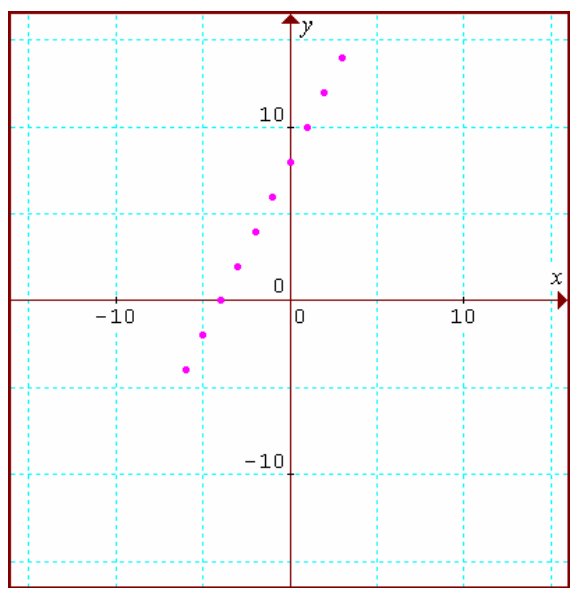


b) This graph does not appear to be linear. The points curve upwards.

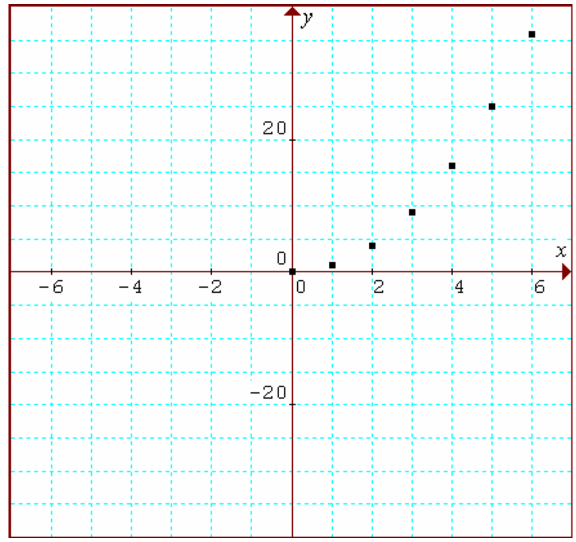


Chapter 2 Section 5   Question 2   Page 83

a) The relationship is linear. The points lie along a straight line.

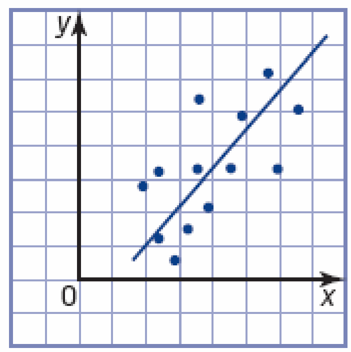


b) The relationship is non-linear. The points do not lie along a straight line.

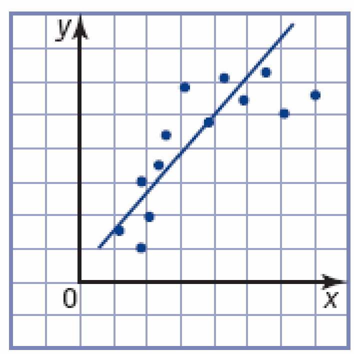


Chapter 2 Section 5 **Question 3** **Page 84**

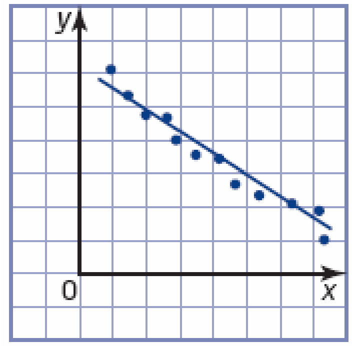
a) The line of best fit is a good model for the data. The points lie reasonably close to a straight line.



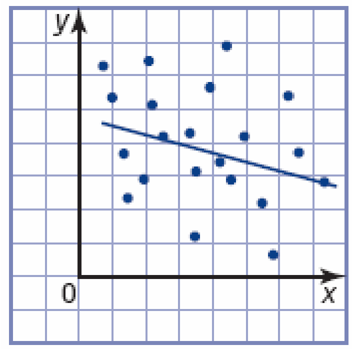
b) The line of best fit is not a good model for the data. The points seem to follow a curve to the right.



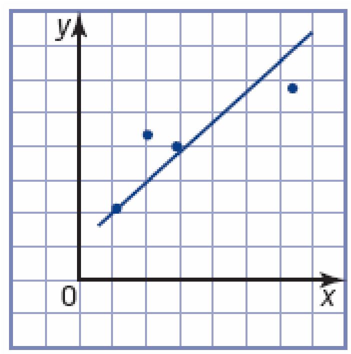
c) The line of best fit is a good model for the data. The points lie close to a straight line.



d) The line of best fit is not a good model for the data. The points do not seem to follow a pattern at all.

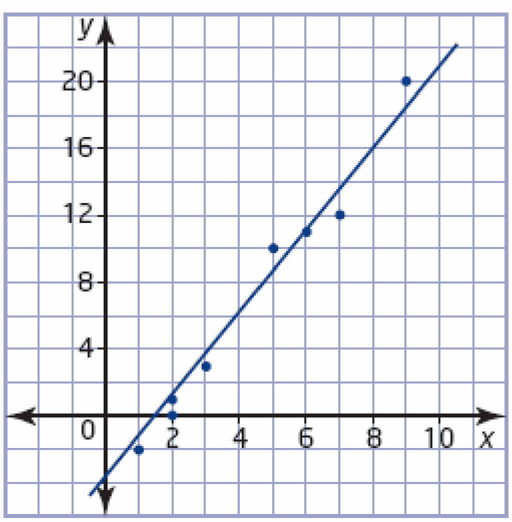


e) The line of best fit is not a good model for the data. There are too few points to determine a definite pattern.

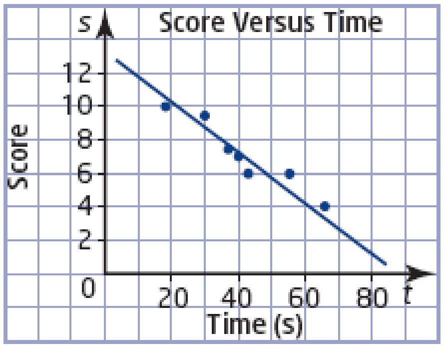


Chapter 2 Section 5 **Question 4** **Page 84**

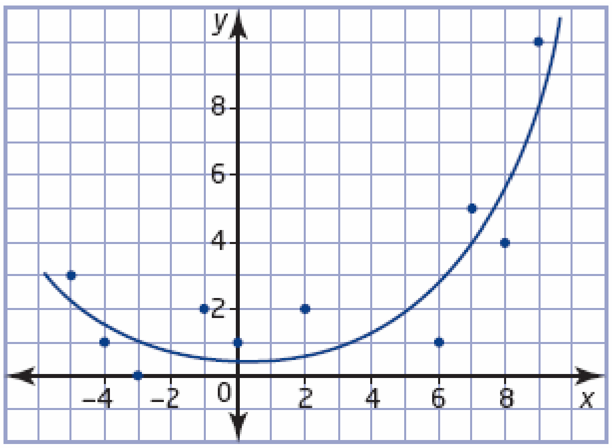
a)



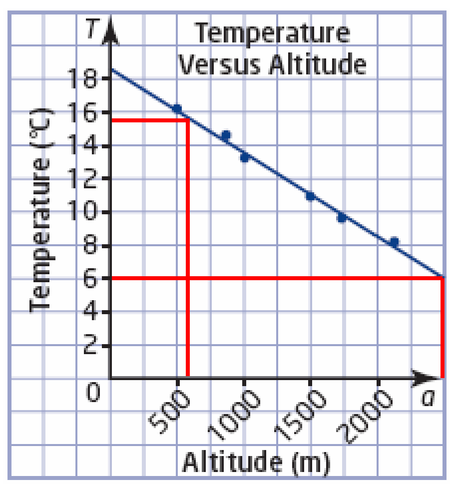
b)



c)



Chapter 2 Section 5 **Question 5** **Page 85**



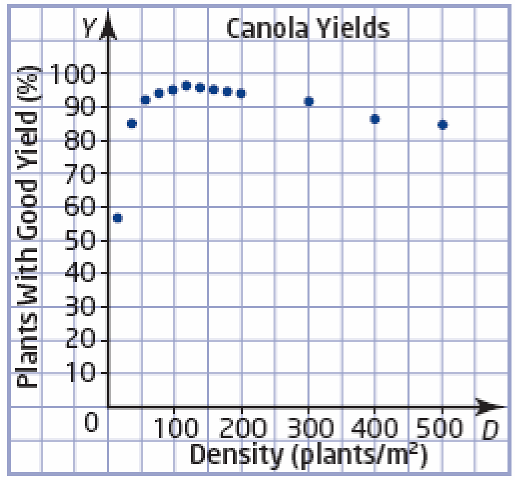
a) The scatter plot is shown.

b) The relation is linear. The line of best fit is shown.

c) The temperature at an altitude of 600 m is about 15.5ºC.

d) The temperature at an altitude of 2500 m is about 6.0ºC.

Chapter 2 Section 5 **Question 6** **Page 85**



a) The scatter plot is shown.

b) The yield rises steeply at first, levels off to a maximum around 120 plants/m^2, and then decreases slowly. The relation is non-linear.

c) A line of best fit is not a good model for the data. The points do not lie along a straight line. They follow a curve.

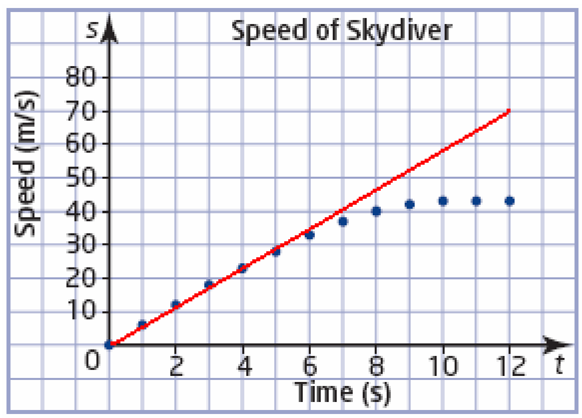
d) Answers will vary. Sample answers are shown.

As plant density increases, weeds are crowded out.

If plant density increases too much, water and nutrients in the soil are shared by too many plants.

As plant density increases, cross-pollination becomes more likely.

Chapter 2 Section 5 **Question 7** **Page 85**



a) The graph is shown.

b) The extrapolation is shown. If the trend continues, the speed after 12 s of free fall is about 70 m/s.

c) See the graph in part **a)**.

d) Air resistance increases with speed. The speed increases only until the air resistance offsets the acceleration due to gravity.

e) Extrapolations can be inaccurate because the relationship between the variables may change beyond the range of the data.

Chapter 2 Section 5　　　　Question 8　Page 86

Answers will vary. Sample answers are shown.

a) The purpose could be to investigate how a person's heart rate changes immediately after exercise.

b) It is reasonable to expect that a person's heart rate will decrease steadily in the time immediately after vigorous exercise.

c) Answers will vary.

d) Answers will vary.

e) Answers will vary.

f) Answers will vary.

Chapter 2 Section 5　　　　Question 9　Page 86

Answers will vary. Use a cylinder not much wider than a penny to maximize the effect of dropping the penny into the water. You may have to use multiple numbers of pennies on each drop in order to see a reasonable change in the height. The relationship should be linear.

Chapter 2 Section 5　　　　Question 10　Page 86

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 2 Section 5　　　　Question 11　Page 87

a) Note that the t values increase at a constant rate. Check the corresponding d values. They also increase at a constant rate of 5. The relation is linear.

b) Note that the t values increase at a constant rate. Check the corresponding h values. They do not change at a constant rate. The relation is non-linear.

Chapter 2 Section 5　　　　Question 12　Page 87

There is a non-linear relation between the gauge reading and the volume of fuel in the tank. The eighths at the low end of the gauge correspond to less fuel than than the eighths at the “full” end of the gauge. The gauge measures the "depth" of the fuel in the tank. Since most fuel tanks curve at the bottom, there is less fuel at the bottom of the tank than at the top.

Chapter 2 Section 5　　　　Question 13　Page 87

Inspect expression D. The denominator is always one larger than the numerator. The value of the fraction will always be less than 1, regardless of the value of n.

Chapter 2 Section 5 Question 14 Page 87

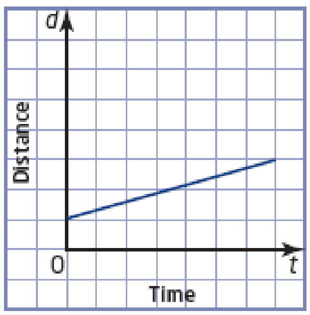
Since the required number is even, the last digit must be a 2, 4, or 6. For each of the 3 choices of last digit, there are 5 choices for the middle digit and 4 choices for the first digit. The number of even three-digit numbers possible is $3 \times 5 \times 4 = 60$.

Chapter 2 Section 6 Distance-Time Graphs

Chapter 2 Section 6 Question 1 Page 91

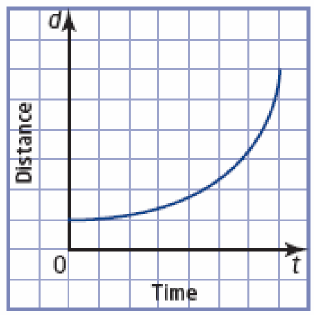
Answers may vary. Sample answers are shown.

a)



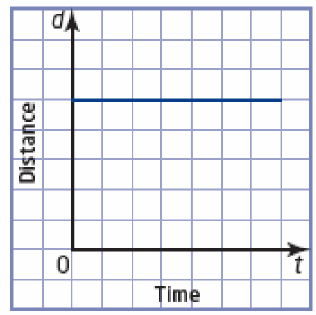
A car is moving away at a constant speed.

b)



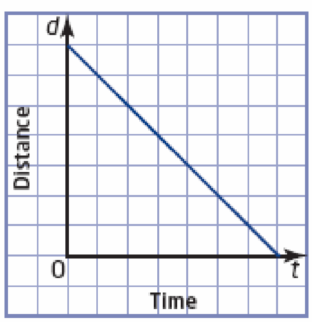
A car is moving away at increasing speed.

c)



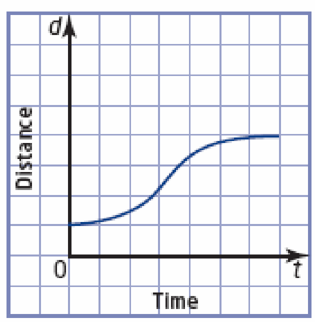
A car is parked, not moving.

d)



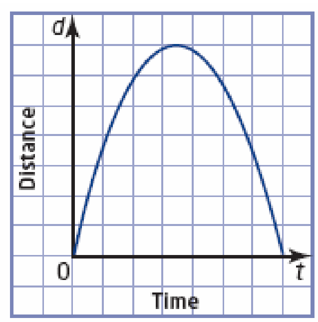
A car is moving closer at a constant speed.

e)



A car is moving away at increasing speed, then slowing down and stopping.

f)

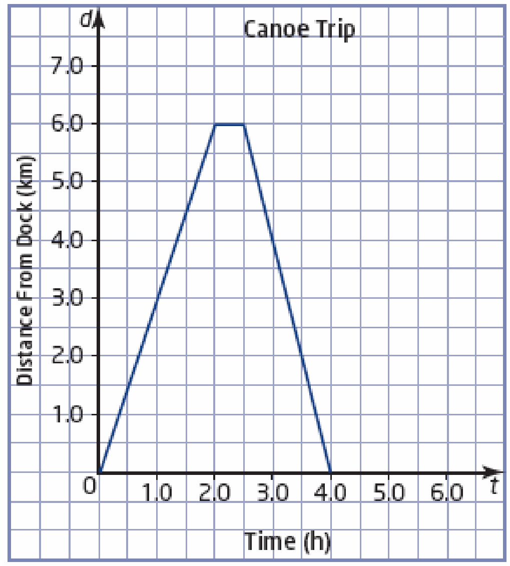


A car is moving away at decreasing speed, stopping for a moment, then coming back with increasing speed.

Chapter 2 Section 6 Question 2 Page 91

Graphs **a)**, **c)**, and **d)** from question 1 show linear relations. The graphs are straight lines.

Chapter 2 Section 6 Question 3 Page 92



a) The trip took 4.0 h.

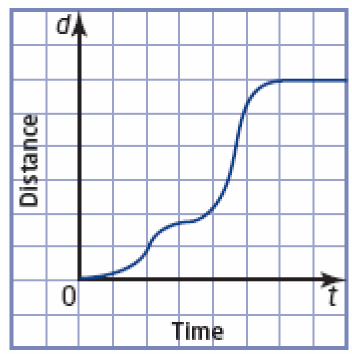
b) The distance to the end of the lake is 6.0 km.

c) The flat portion of the graph represents time that the canoeist rested at the end of the lake.

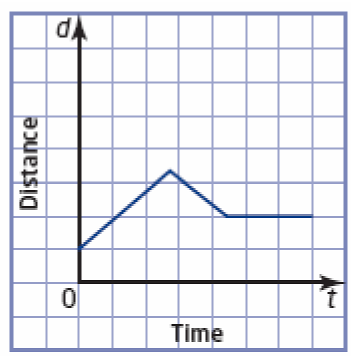
d) It took 2.0 h to reach the end of the lake, but only 1.5 h to come back. The canoeist was travelling faster on the way back.

Chapter 2 Section 6 Question 4 Page 92

After starting out, the cyclist increases her speed, then slows down. Then she travels a bit faster than before, then slows down and stops.



Chapter 2 Section 6 Question 5 Page 92



a) Move away from the wall at a constant speed, then reverse direction and walk back toward the wall at the same speed, but stop before you reach your starting position.

b) If you walked fast, the sloped line segments would be steeper.

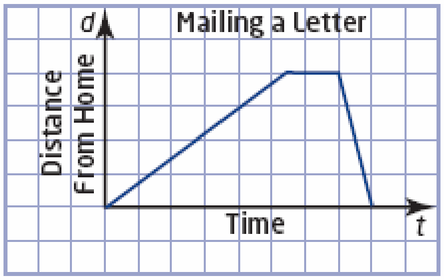
c) If you walked slower, the sloped line segments would be less steep.

d) If you stopped sooner, the middle segment would be shorter and the horizontal segment would be higher.

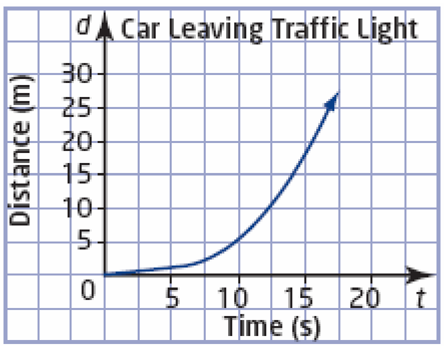
Chapter 2 Section 6 Question 6 Page 93

Answers will vary.

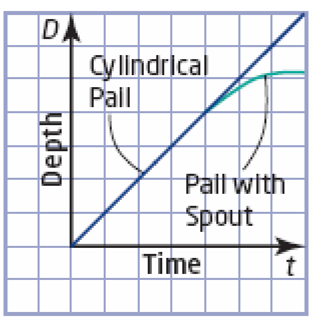
Chapter 2 Section 6 Question 7 Page 93



Chapter 2 Section 6 Question 8 Page 93



Chapter 2 Section 6 Question 9 Page 93



Chapter 2 Section 6 Question 10 Page 93

Answers will vary.

Chapter 2 Section 6 Question 11 Page 93

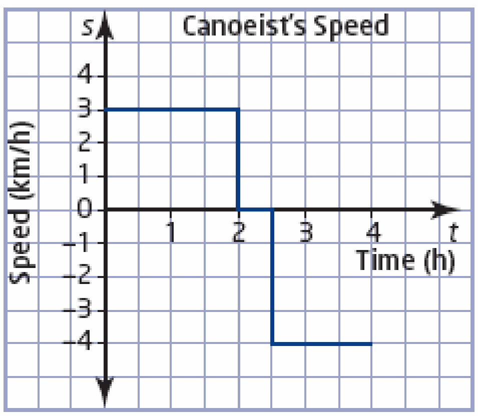
a)

$$\text{First segment } v = \frac{6.0 \text{ km}}{2.0 \text{ h}}$$
$$= 3 \text{ km/h}$$

$$\text{Second segment } v = \frac{0.0 \text{ km}}{2.0 \text{ h}}$$
$$= 0 \text{ km/h}$$

$$\text{Third segment } v = \frac{6.0 \text{ km}}{1.5 \text{ h}}$$
$$= 4 \text{ km/h}$$

b)



c) The steeper the graph, the faster the canoeist is paddling.

d) Negative speed indicates the rate at which the canoeist is returning to the dock.

Chapter 2 Section 6 Question 12 Page 94

d) The horizontal axis represents time. The vertical axis represents the distance from the CBR™ to the ball.

e) The relation between distance and time is not linear. The points do not lie on a straight line.

l) The relation between time and bounce height is linear. The points lie along a straight line.

Chapter 2 Section 6 Question 13 Page 94

Answers will vary.

Chapter 2 Section 6 Question 14 Page 94

Use a table to help you with the "guess and check" method. A calculator or spreadsheet can also be used. Click here to load the spreadsheet file.

Shaheen was born in 1979, and was 26 on her birthday in 2005.

Year	Age	Sum of Digits
2005	0	7
2004	1	6
2003	2	5
2002	3	4
2001	4	3
2000	5	2
1999	6	28
1998	7	27
1997	8	26
1996	9	25
1995	10	24
1994	11	23
1993	12	22
1992	13	21
1991	14	20
1990	15	19
1989	16	27
1988	17	26
1987	18	25
1986	19	24
1985	20	23
1984	21	22
1983	22	21
1982	23	20
1981	24	19
1980	25	18
1979	26	26
1978	27	25
1977	28	24
1976	29	23
1975	30	22
1974	31	21

Chapter 2 Review

Chapter 2 Review Question 1 Page 95

Answers will vary. Sample answers are shown.

a) Hypothesis: As the temperature in a town during the summer increases, so does the volume of water used by the town's residents.

Opposite: As the temperature in a town during the summer increases, the volume of water used by the town's residents does not increase.

b) Hypothesis: Taller people have higher marks in mathematics.

Opposite: Taller people do not have higher marks in mathematics.

Chapter 2 Review Question 2 Page 95

a) This is primary data. This is a good choice, since a survey of students at the school could give more accurate results than secondary data would.

b) This is secondary data. This is a good choice, since primary data could take a lot of time to collect, and would not likely be significantly more accurate.

c) This is secondary data. This may not be a good choice, since the encyclopedia might not give information on bears in a specific province.

d) This is secondary data. This is not a good choice. The source of data is convenient, but may not reflect the tastes of students at the school.

Chapter 2 Review Question 3 Page 95

a) The population is all students at the school.

b) Answers will vary. A sample answer is shown.

Use a random number generator to randomly select 25% of the students from the class lists for each grade.

Chapter 2 Review Question 4 Page 95

a) The population is all passengers that fly on the airline.

b) Answers will vary. A sample answer is shown.

Obtain a list of all passengers who have flown on the airline. Randomly select one name on the list of the airline's passengers, and then select every hundredth person before and after that name.

Chapter 2 Review Question 5 Page 95

Answers for sampling techniques will vary. Sample answers are shown.

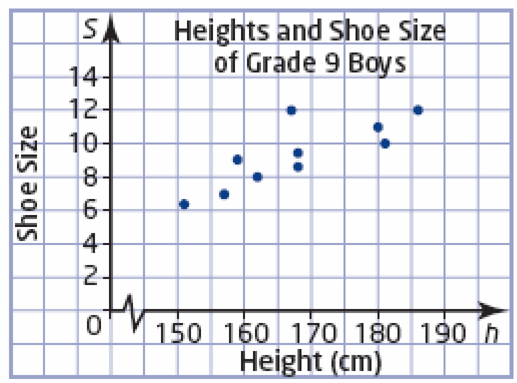
a) The population is all customers of the department store. The store can pick a customer at random, and then every 10th customer entering the store, to survey.

b) The population is all campers at provincial parks. Park rangers at each park can survey every 10th camper who registers.

c) The population is all students at the school. The librarian can use a random number generator to generate 50 random numbers between 1 and the population of the school. Then, he can use the numbers to select students from a school listing to survey.

Chapter 2 Review Question 6 Page 95

a) The scatter plot is shown.

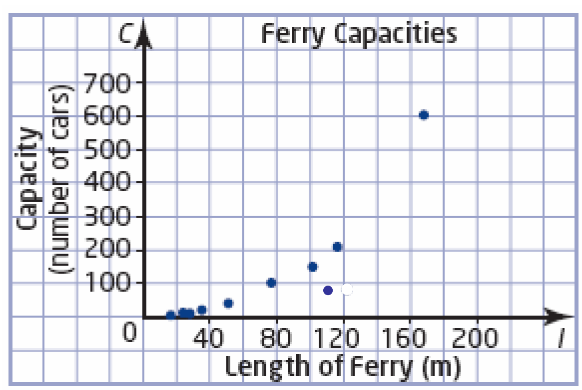


b) As the students' heights increase, so do their shoe sizes.

c) (167, 12) is an outlier, but should not be discarded since it is a valid measurement, unless there is some reason to believe that the measurement was made in error.

Chapter 2 Review Question 7 Page 96

a) The scatter plot is shown.



b) As the length of the ferry increases, the capacity also increases. The points follow a curve, so the relationship is non-linear.

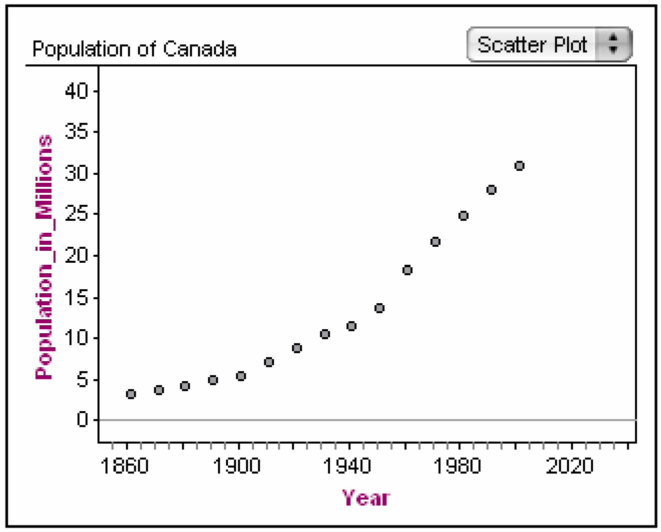
c) The point (110.8, 80) is an outlier.

Answers about causes may vary. Sample answers are shown.

The ferry might carry cargo as well as cars.
The ferry might carry fewer cars so that it can travel faster.
Some ferries derive most of their business from passengers, and may have few spaces for cars.

Chapter 2 Review **Question 8** **Page 96**

a) The scatter plot is shown.



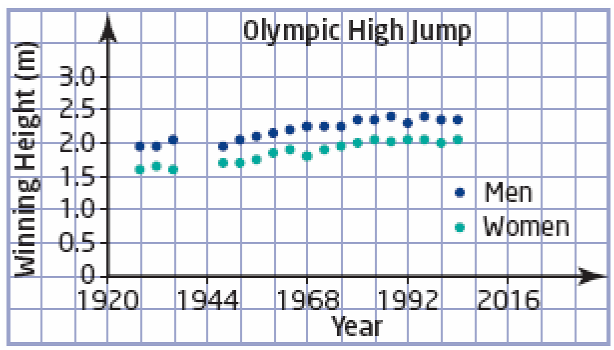
b) The population of Canada has grown at an increasing rate since 1861.

c) The population in 1967 was about 20 million.

d) The population in 2021 will be about 34 million.

Chapter 2 Review **Question 9** **Page 96**

a)



b) Both the men's and women's winning heights are increasing, but the rate of increase has been slower since about 1980.

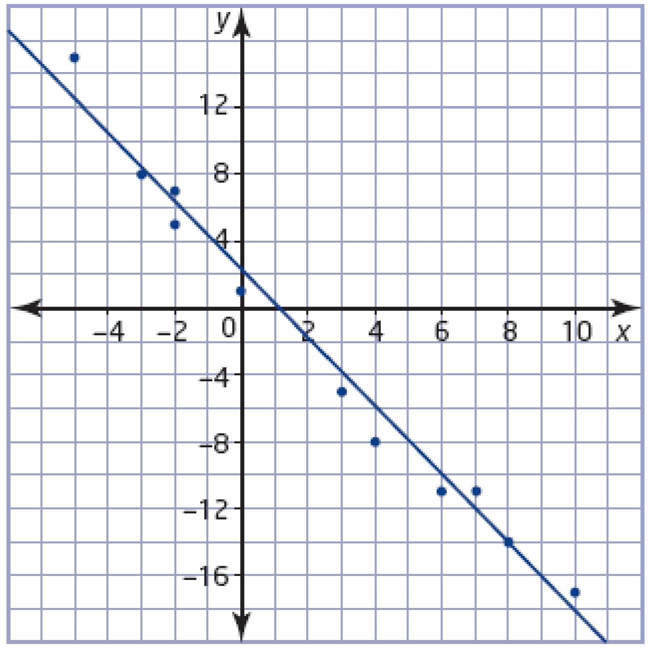
c) There are no apparent outliers.

d) Answers will vary. Sample answers are shown.

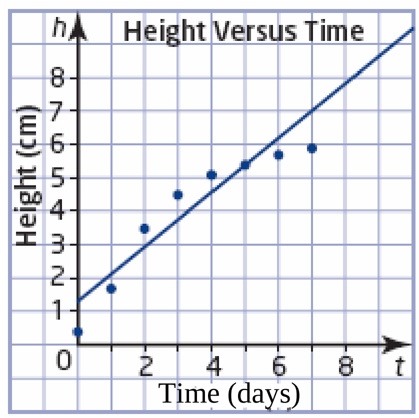
Men's winning height in 2012 will be about 2.48 m. Women's winning height will be about 2.15 m

Chapter 2 Review **Question 10** **Page 97**

a) The scatter plot and line of best fit are shown. The line is a good fit. All of the points are close to the line.

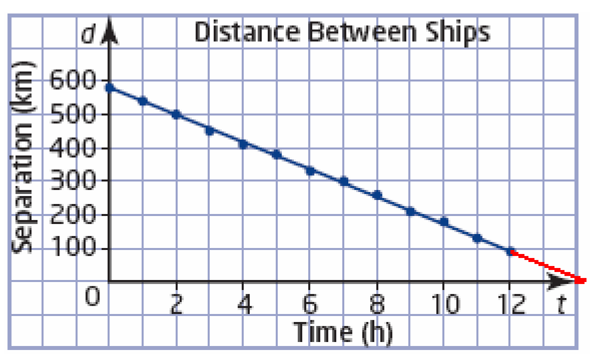


b) The scatter plot and line of best fit are shown. The line is not a good fit. The points appear to follow a curve.



Chapter 2 Review **Question 11** **Page 97**

a) The scatter plot is shown.



b) As time increases, the distance between the two ships decreases. The relationship is linear.

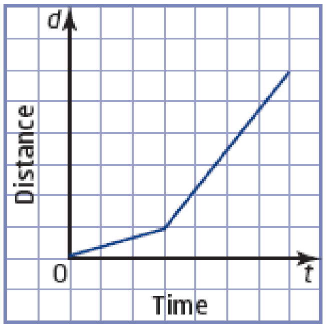
c) There are no apparent outliers.

d) The ships will be closest to each other after 14.3 h.

Chapter 2 Review **Question 12** **Page 97**

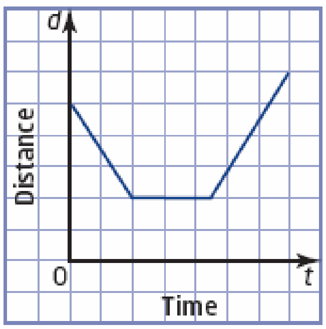
Answers may vary. Sample answers are shown.

a)



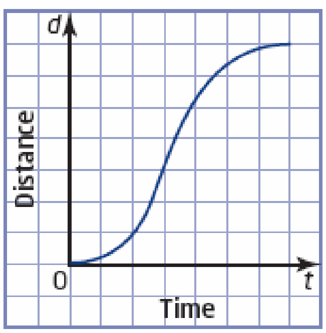
Marni walks away from her home for 2 min at a constant speed, and then runs in the same direction at a constant speed for 2 min.

b)



John bikes from school to a store, buys something, and then bikes back past the school to home.

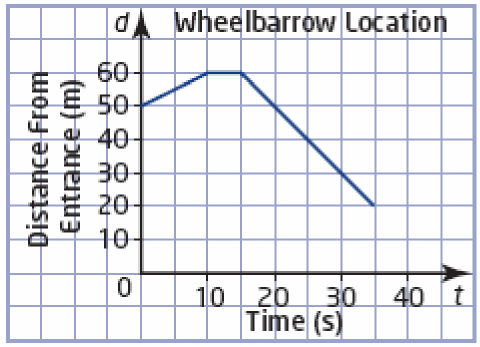
c)



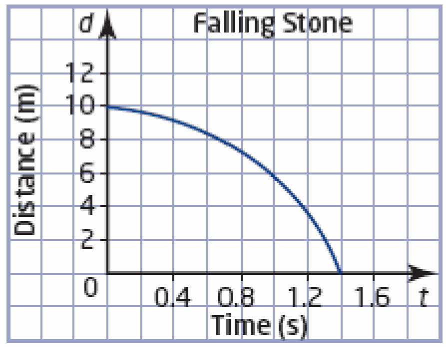
A car speeds up as it leaves a traffic light, and then slows down and stops at another light.

Chapter 2 Review		**Question 13**	**Page 97**

a) The distance-time graph is shown.



b) The distance-time graph is shown.



Chapter 2 Chapter Test

Chapter 2 Chapter Test   Question 1   Page 98

Answer B is a primary source of data, since you are collecting it yourself. All of the others are secondary sources.

Chapter 2 Chapter Test   Question 2   Page 98

Answer C is not a random sample. You are only surveying people on a particular street corner.

Chapter 2 Chapter Test   Question 3   Page 98

Estimating value beyond the known data for a relation is extrapolation. Answer A.

Chapter 2 Chapter Test   Question 4   Page 98

The final step in an experiment is the evaluation. Answer C.

Chapter 2 Chapter Test   Question 5   Page 98

a) Caffeine cannot affect your sleep.

b) If you study more, your results on tests either improve or stay the same.

c) At least half of the students in your school do not have a part-time job.

d) Cell phone use has not more than doubled in the past 2 years.

Chapter 2 Chapter Test   Question 6   Page 98

a) The population is all teachers working for the school board.

Answers will vary. Sample answers are shown.

b) Randomly select 20% of the teachers in each school.

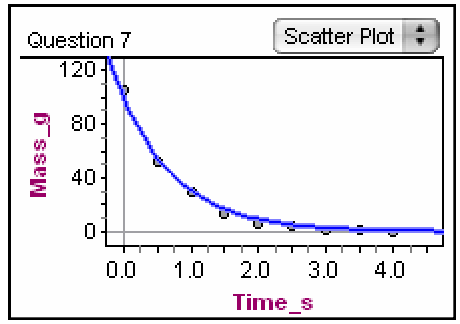
c) Select a name at random from a list of all of the teachers, and then select every fifth name before and after the first name selected.

d) Survey all the teachers in the nearest school.

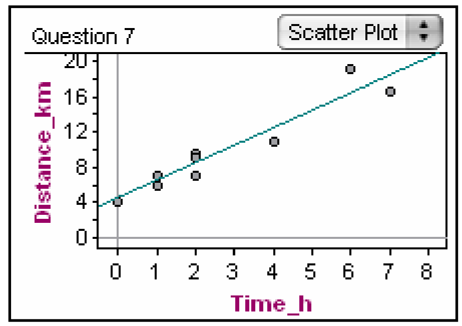
e) Teachers at the same school have the same students and working conditions. These teachers may not have the same concerns and opinions as teachers at other schools

Chapter 2 Chapter Test Question 7 Page 98

a) The scatter plot and curve of best fit are shown. The relation is non-linear.



b) The scatter plot and line of best fit are shown. The relation appears to be linear.



Chapter 2 Chapter Test Question 8 Page 99

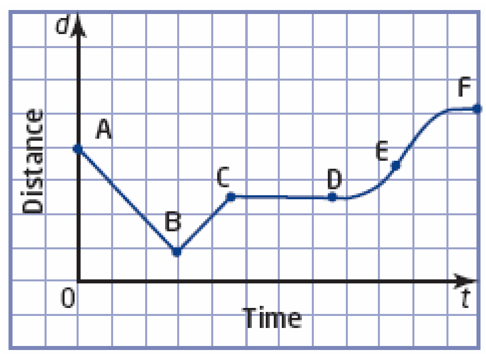
AB: The distance is decreasing at a steady rate.

BC: The distance is increasing at a steady rate.

CD: There is no motion.

DE: The distance is increasing at an increasing rate.

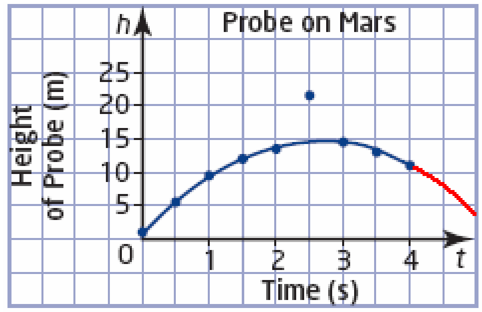
EF: The distance is increasing at a decreasing rate.



Chapter 2 Chapter Test Question 9 Page 99

Answers will vary.

Chapter 2 Chapter Test Question 10 Page 99



a) The scatter plot is shown.

b) The relation is non-linear. As time increases, the height first increases, then decreases.

c) The point (2.5, 21.4) is an outlier. Possible causes could be an inaccurate reading, or a data transmission error.

d) See the graph in part **a)** for the curve of best fit.

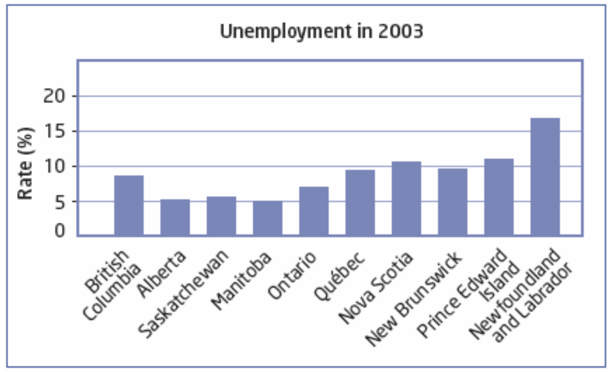
e) The extrapolation is shown on the graph. The height after 5 s is about 4.7 m.

Chapter 2 **Relations**

Chapter 2 Get Ready

Chapter 2 Get Ready **Question 1** **Page 40**

a) The heights of the bars represent the unemployment rate, in percent, for each province in 2003.

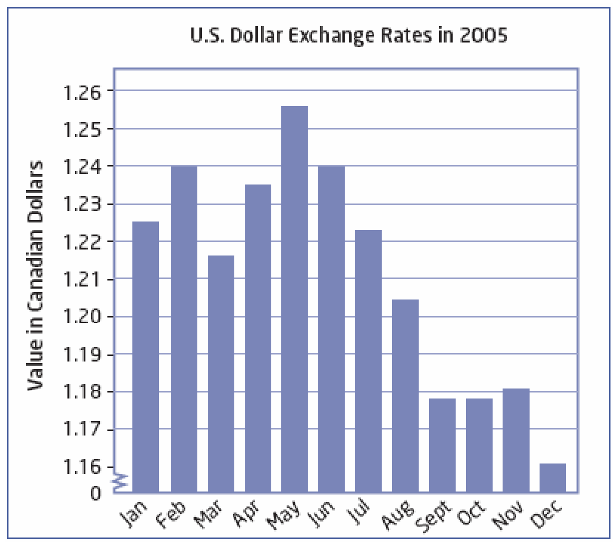


b) Newfoundland and Labrador has the greatest unemployment rate.

c) The prairie provinces had the lowest unemployment rate. People had the best chance of finding work in 2003 in the prairie provinces.

Chapter 2 Get Ready **Question 2** **Page 40**

a) The lowest value of the U.S. dollar shown on the graph is $1.16 CDN, in December of 2005.

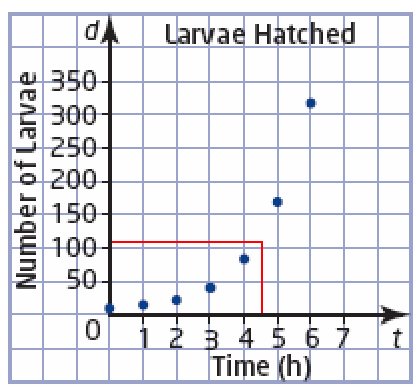


b) The value of the U.S. dollar compared to the Canadian dollar was the greatest in May of 2005.

c) The graph shows an overall downward trend in the value of the U.S. dollar compared to the Canadian dollar.

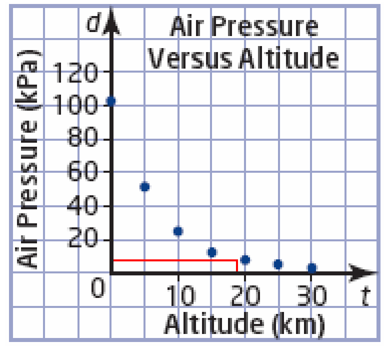
Chapter 2 Get Ready **Question 3** **Page 41**

a) The scatter plot is shown.



b) After 4.5 h, about 110 larvae have hatched.

Chapter 2 Get Ready Question 4 Page 41



a) The scatter plot is shown.

b) The air pressure at an altitude of 18 km is about 7.5 kPa.

Chapter 2 Get Ready Question 5 Page 41

a) The unit rate is $\dfrac{42 \text{ pages}}{6 \text{ min}} = 7 \dfrac{\text{pages}}{\text{min}}$.

b) The unit rate is $\dfrac{\$15}{5 \text{ kg}} = \$3/\text{kg}$.

c) The unit rate is $\dfrac{880 \text{ km}}{11 \text{ h}} = 80 \text{ km/h}$.

Chapter 2 Get Ready Question 6 Page 41

a) The unit rate is $\dfrac{\$4.19}{750 \text{ g}} \doteq \$0.0056/\text{g}$.

b) The unit rate is $\dfrac{500 \text{ mL}}{24 \text{ muffin}} \doteq 20.8 \dfrac{\text{mL}}{\text{muffin}}$.

c) The unit rate is $\dfrac{5000 \text{ m}}{38.6 \text{ min}} \doteq 130 \text{ m/min}$.

Chapter 2 Section 1: Hypotheses and Sources of Data

Chapter 2 Section 1 Question 1 Page 45

a) Most people's favourite number is not 7.

b) Adults do not spend more time listening to classical music than rap. (Alternative: Adults spend either less time or as much time listening to classical music as they spend listening to rap.)

c) In Ontario, the number of teenagers who join hockey teams is greater than or equal to the number who join soccer teams.

d) Chocolate is the most popular flavour of ice cream.

Chapter 2 Section 1 Question 2 Page 45

Answers will vary. Sample answers are shown.

a) Hypothesis: Time spent doing homework increases as a student's age increases.

Opposite: Time spent doing homework does not increase as a student's age increases.

b) Hypothesis: Children tend to grow to the same height as their mothers.

Opposite: Children do not tend to grow to the same height as their mothers.

c) Hypothesis: As temperature increases, the crime rate also increases.

Opposite: As temperature increases, the crime rate decreases or remains constant.

d) Hypothesis: As the cost of gasoline increases, the number of people using public transit increases.

Opposite: As the cost of gasoline increases, the number of people using public transit decreases or stays the same.

Chapter 2 Section 1 Question 3 Page 45

a) The data are primary; the office manager gathers the data.

b) The data are secondary; the student uses data gathered by Statistics Canada.

c) The data are primary; the researcher gathers the data.

d) The data are secondary; the researcher uses data gathered by the transit authority.

Chapter 2 Section 1 Question 4 Page 45

Answers about advantages will vary. Sample answers are shown.

a) The data are primary. Advantage: the data are up-to-date.

b) The data are secondary. Advantage: Internet search is fast and easy.

c) The data are primary. Advantage: the survey is getting opinions directly from customers.

d) The data are primary. Advantage: the data are up-to-date.

Chapter 2 Section 1 Question 5 Page 45

Answers will vary. Sample answers are shown.

a) Most students in the class prefer dogs as pets.

b) Survey the class. Primary data are best since the population is small and secondary data may not be available.

Chapter 2 Section 1 Question 6 Page 46

a) The data are primary. Steve gathered the data himself.

b) Answers will vary. Sample answers are shown.

Brown-eyed students are shorter.

Blue is the least common eye colour.

c) The hypotheses can be tested by surveying a larger sample of students.

Name	Eye Colour	Height (cm)
Josanth	brown	167
Fred	green	181
Graham	green	185
Cho	brown	171
Seth	blue	154
Jamal	green	183
Juan	brown	160
Cameron	blue	173

Chapter 2 Section 1 Question 7 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: Females make more phone calls than males.

b) You can survey 50 females and 50 males to test your hypothesis with primary data.

c) You can look for data on the Internet or in publications to test your hypothesis with secondary data.

d) Secondary sources that survey larger samples are more likely to be accurate.

Chapter 2 Section 1 Question 8 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: Taller people perform better at the high jump.

b) Heights of the athletes and how high the athletes can jump are the data needed to test the hypothesis. Primary data for the school team would be easy to collect. Secondary sources could survey a larger sample and yield more accurate results.

Chapter 2 Section 1 Question 9 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: The faster the computer, the more it will cost.

b) Most popular computer vendors have Web sites. A search shows that faster computers do cost more.

c) This is primary data if you collect prices from Web sites for individual suppliers. This is secondary data if you find price surveys with data gathered by someone else.

d) You can also visit a computer store to research speeds and prices.

Chapter 2 Section 1 Question 10 Page 46

Answers will vary. Sample answers are shown.

a) A cow produces 20-25 L of milk in a day.

b) A cow eats 12-15 kg of hay in a day.

c) If the information comes from visiting a dairy farm, it is primary data. If the data comes from a book or the Internet, it is secondary data.

Chapter 2 Section 1 Question 11 Page 47

Solutions for Achievement Checks are shown in the Teacher's Resource.

Chapter 2 Section 1 Question 12 Page 47

Answers will vary. Sample answers are shown.

a) Hypothesis: The greater the latitude of a city, the lower the mean of its daily maximum temperatures in January.

b) Available data shows that the hypothesis is generally true, if other factors such as ocean currents are not relevant.

Chapter 2 Section 1 Question 13 Page 47

Answers will vary.

Chapter 2 Section 1 Question 14 Page 47

If the mean is 6, then the sum of the numbers is 6*n*. If 17 is added, the mean becomes 7, with *n* + 1 numbers in the list. You are looking for a number *n* such that

$$\frac{6n+17}{n+1}=7$$

Use the "guess and check" method to determine that *n* must equal 10.

Chapter 2 Section 2 Sampling Principles

Chapter 2 Section 2 Question 1 Page 52

a) The population is all children.

b) The population is all those who wrote the test.

c) The population is all cars.

d) The population is all food stores.

Chapter 2 Section 2 Question 2 Page 52

a) The data required are the ages when girls and boys learn to walk. Use a sample, the population is very large.

b) The data required are the test marks. Use a census, the population is small.

c) The data required are the salaries of Canadian employees. Use a sample, the population is very large.

d) The data required are people's heights and ages. Use a sample, the population is very large.

e) The data required are the makes of the cars in the school parking lot. Use a census, the population is small.

f) The data required are colours of cars driving by the school. Use a sample, the population is very large.

Chapter 2 Section 2 Question 3 Page 52

Answers will vary. Sample answers are shown.

a) Survey every fourth customer who comes into the cafe.

b) Randomly select 1% of the teenagers in every high school across Ontario.

c) Use a random number generator to select telephone numbers within Canada, and then survey the people who identify themselves as bilingual.

d) Select households to survey by any random method, and then ask the people surveyed where they were born.

Chapter 2 Section 2 Question 4 Page 53

a) This is a non-random sample. It could be biased since University of Waterloo students may not be representative of all university graduates.

b) This is a simple random sample. It could be biased, since the sample excludes anyone who does not have a telephone listing.

c) This is a non-random sample. It is biased because it includes only people who have chosen to spend some of their free time going to a movie.

d) This is a systematic random sampling.

Chapter 2 Section 2 Question 5 Page 53

Answers may vary. Sample answers are shown.

You can group the students by age, by grade level, or by gender.

Chapter 2 Section 2 Question 6 Page 53

a) The population is all farmers in Ontario.

b) Answers will vary. A sample answer is shown.

Use a random number generator to randomly select 10% of the farmers in each county.

Chapter 2 Section 2 Question 7 Page 53

a) The population is all employees of the company.

b) Answers may vary. A sample answer is shown.

Use a random number generator to randomly select a starting point on an alphabetical list of the employees. Then, select every sixth person until you have a total of 50.

Chapter 2 Section 2 Question 8 Page 53

a) The population includes all members of the school teams.

b) Answers will vary. A sample answer is shown.

Write each team member’s name on a slip of paper. Then, randomly draw 15% of the slips out of a box.

Chapter 2 Section 2 **Question 9** **Page 53**

The population of the school is 1216 students.

$$\text{Number of Grade 9 Students} = \frac{330}{1216} \times 150 \doteq 41$$

Grade	Number of Students
9	330
10	308
11	295
12	283

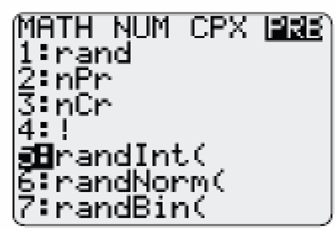
$$\text{Number of Grade 10 Students} = \frac{308}{1216} \times 150 \doteq 38$$

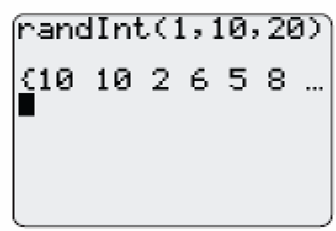
$$\text{Number of Grade 11 Students} = \frac{295}{1216} \times 150 \doteq 36$$

$$\text{Number of Grade 12 Students} = \frac{283}{1216} \times 150 \doteq 35$$

Chapter 2 Section 2 **Question 10** **Page 54**

a) Use the command randInt(12,36,25). The first number is the lower limit, the second number is the upper limit, and the third number is the number of random integers desired.





b) Enter randInt(1,500,40). If any numbers are repeated, change the command to generate more random numbers and use the first 40 that are not duplicates.

c) Enter randInt(100,1000,75). Increase 75 to 100 or more if some numbers are repeated.

Chapter 2 Section 2 **Question 11** **Page 54**

a) The sample is not completely random. Students at small schools have a greater chance of being selected than students at large schools.

b) The results are biased. The sample is likely to have a greater proportion of students from small schools than the population does.

Chapter 2 Section 2 Question 12 Page 54

Answers for sampling methods will vary. Sample answers are shown.

a) The population is all students in the school. Obtain a list of students. Use a random number generator to select a starting point. Select every 10th student.

b) The population is all people in the community. Obtain a list of residents. Use a random number generator to select a starting point. Select every 50th resident.

c) The population is all people aged 18 to 30. Use a random number generator to generate telephone numbers across the country. Survey those who identify themselves as between the ages of 18 and 30.

d) The population is all senior citizens in Ontario. Use a random number generator to generate telephone numbers across Ontario. Survey those who identify themselves as senior citizens.

e) The population is all computer printers for sale in Canada. Search retailers on the Internet to assemble a list of all printers sold in Canada. Purchase one of each kind for testing.

f) The population is gasoline prices at all vendors in the community. Use a telephone book to find addresses for all gasoline retailers in the community. Call or visit each one to generate a list of prices.

Chapter 2 Section 2 Question 13 Page 54

The sample is representative only of people who browse the site and are willing to fill out the form. The sample excludes anyone who does not have Internet access or the inclination to complete the survey.

Chapter 2 Section 2 Question 14 Page 54

a) In the 1920s, many people did not have telephones. Since these people were not included in the surveys, the samples were not representative of the whole population.

b) Answers will vary. Sample answers are shown.

People with more than one telephone number have a greater chance of being selected.

People refusing to answer telephone surveys may make the sample unrepresentative of certain groups.

Deaf people will be left out of the sample.

Chapter 2 Section 2 Question 15 Page 55

Answers will vary.

Chapter 2 Section 2 Question 16 Page 55

Answers will vary.

Chapter 2 Section 2 Question 17 Page 55

Answers will vary. Sample answers are shown.

Poorly designed questions can influence the answers that respondents will give.

People may give false answers to questions they feel uncomfortable with.

Chapter 2 Section 2 Question 18 Page 55

Answers will vary. Sample answers are shown.

a) Assign each tree a number and use a random number generator to choose 10% of the trees.

b) Divide the park into sections with similar numbers of trees, and randomly select 10% from each section.

c) Assign each tree a number. Randomly select a starting point, and then select every tenth number before and after the starting number.

d) Sample the 10% of the trees closest to roads.

Any of the random samples will test trees throughout the park. However, the forester could choose a non-random sample with a larger proportion of the hardwood trees that the beetle attacks most often.

Chapter 2 Section 2 Question 19 Page 55

a) Answers will vary. Sample answers are shown.

You can interview sports fans at a sports venue such as an arena or ball park.

You can interview classmates.

b) Convenience samples are not truly random because every member of the population does not have an equal chance of being selected. Interviewing sports fans at a sports venue excludes members of the population who are not interested in sports or do not attend live events. Interviewing classmates excludes members of the population who are not in the class.

Chapter 2 Section 2 Question 20 Page 55

Since the required number is odd, the last digit must be a 1, 3, 5, or 7. For each of the 4 choices of last digit, there are 6 choices for the middle digit and 5 choices for the first digit. The number of odd three-digit numbers possible is $4 \times 6 \times 5 = 120$.

Chapter 2 Section 3 Use Scatter Plots to Analyse Data

Chapter 2 Section 3 Question 1 Page 64

a) independent variable: physical fitness
dependent variable: blood pressure

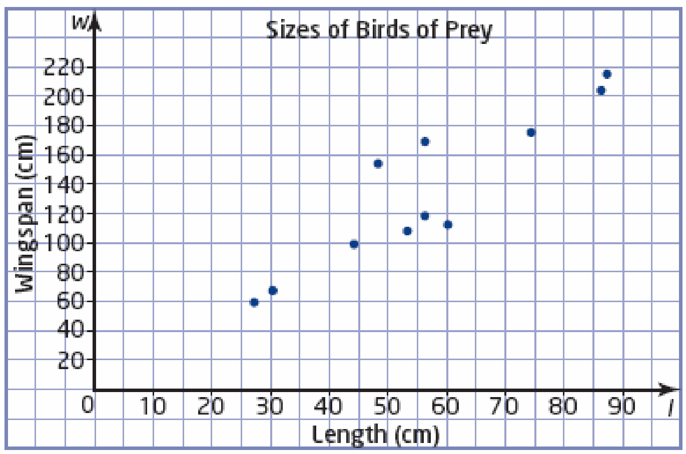
b) independent variable: level of education
dependent variable: income

c) independent variable: load in an airplane
dependent variable: length of runway needed for take off

Chapter 2 Section 3 Question 2 Page 64

a) To show wingspan as the independent variable, move it to the horizontal axis.

b) As the length increases, the wingspan increases.

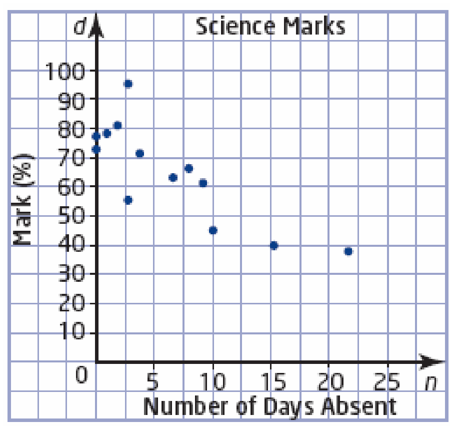


Chapter 2 Section 3 Question 3 Page 64

a) independent variable: number of days absent
dependent variable: science mark.

Marks depend on attendance, rather than attendance depending on marks.

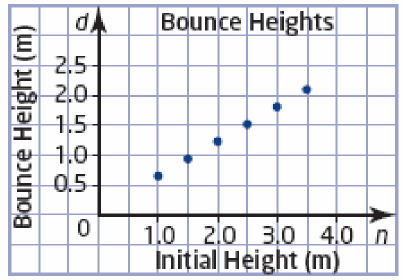
b) The scatter plot is shown.



c) As the number of days absent increases, the marks generally decrease.

d) The point (3, 95) lies somewhat apart from the rest of the data. It can be considered as an outlier.

Chapter 2 Section 3 Question 4 Page 65



a) independent variable: initial height
dependent variable: bounce height

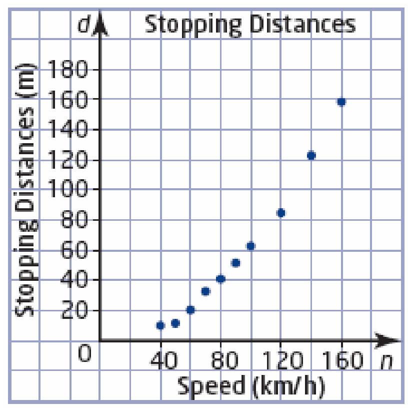
The bounce height depends on the initial height, rather than the initial height depending on the bounce height.

b) The scatter plot is shown.

c) As the initial height increases, so does the bounce height.

d) The point (4.00, 1.62) is an outlier. It should be discarded only for a valid reason, such as a measurement error. Repeat the measurement several times to determine whether this is a measurement error.

Chapter 2 Section 3 Question 5 Page 65



a) The scatter plot is shown.

b) As the speed of a car increases, the stopping distance increases. The pattern is non-linear.

c) A car travelling at 85 km/h needs 46 m to stop. The point is not an outlier since it follows the pattern of the other data

Chapter 2 Section 3 Question 6 Page 65

Answers will vary. Sample answers are shown.

a) Hypothesis: As a person's height increases, so does the shoulder width.

b) Select a sample of persons of varying heights. Measure height and shoulder width.

c) Display your results in a scatter plot, and draw your conclusion.

d) To improve the accuracy of measurements; use a larger sample.

Chapter 2 Section 3 Question 7 Page 66

Answers will vary. Sample answers are shown.

a) Select a sample of athletes. Measure each athlete's height and the maximum height he or she can jump.

b) The independent variable is the height.

The dependent variable is the jump height.

c) If the hypothesis is true, then the points on the scatter plot will follow a line or curve that rises to the right.

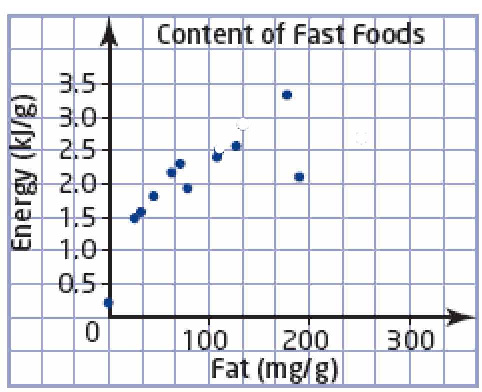
Chapter 2 Section 3 Question 8 Page 66

a) Divide the amount of fat in milligrams by the serving size in grams to obtain the amount of fat per gram.

Divide the energy in kJ by the serving size in grams to obtain the energy per gram.

Item	Fat (mg/g)	Energy (kJ/g)
Harvey's Original Hamburger	127	2.6
Harvey's Veggie Burger	63	2.2
Mr. Submarine Small Assorted Sub	34	1.6
Mr. Submarine Small Vegetarian Sub	26	1.5
Pizza Pizza Pepperoni Slice (walk-in)	69	2.3
Pizza Pizza Vegetarian Slice (walk-in)	43	1.8
KFC Chicken Breast	118	2.4
KFC Popcorn Chicken	184	3.3
Swiss Chalet Quarter Chicken Breast	75	1.9
Swiss Chalet Garden Salad, undressed	0	0.2
Swiss Chalet Caesar Salad	188	2.1

b) The scatter plot is shown.

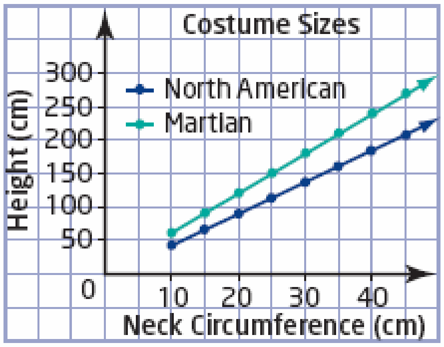


c) The point for Caesar Salad is an outlier due to its high fat content. Nonetheless, this point represents valid data that should not be discarded.

d) Answers will vary. A sample answer is shown.

The scatter plot shows that some fast foods can have a high energy content without a high fat content.

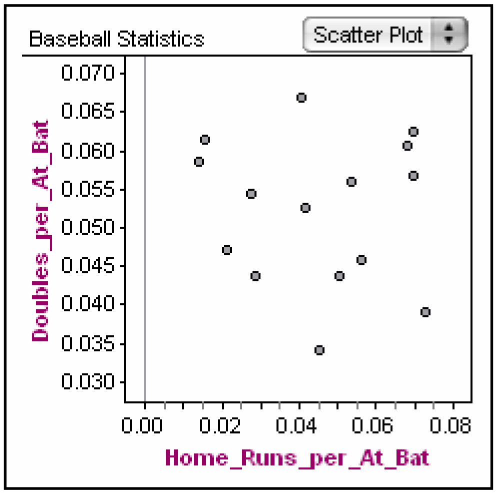
Chapter 2 Section 3 Question 9 Page 67



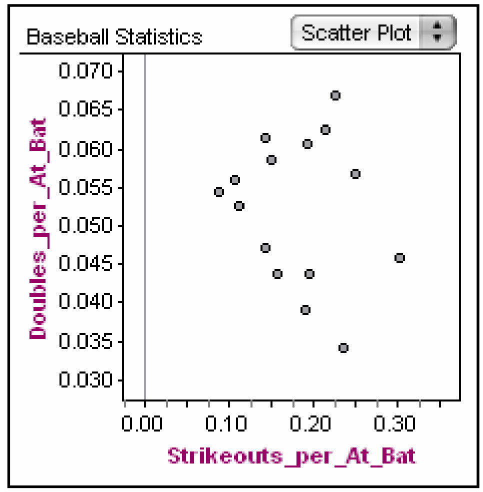
Chapter 2 Section 3 Question 10 Page 67

Divide each statistic by the number of times at bat to obtain the rates. Click here to load the Fathom® file.

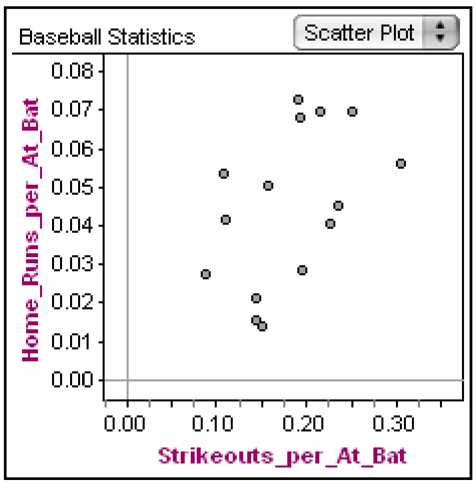
a)



b)



c)



d) Home runs per at bat seem to increase somewhat as the number of strikeouts per at bat increases. The other two scatter plots do not show any relationship between the variables.

Chapter 2 Section 3 Question 11 Page 67

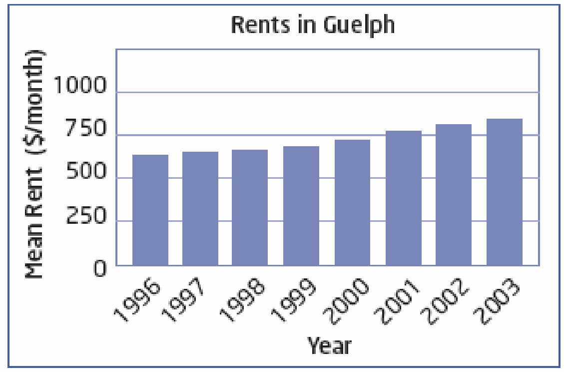
To keep the value of the expression as small as possible, use the smallest numbers for the numerators, and the largest numbers for the denominators. Use "guess and check" to determine which arrangement yields the smallest value for the expression.

$$\begin{aligned}\frac{1}{4}+\frac{2}{5}+\frac{3}{6} &= \frac{15}{60}+\frac{24}{60}+\frac{30}{60}\\ &= \frac{69}{60}\\ &= 1\frac{3}{20}\end{aligned}$$

Chapter 2 Section 4 Trends, Interpolation, and Extrapolation

Chapter 2 Section 4 Question 1 Page 73

a) The bar graph is shown.

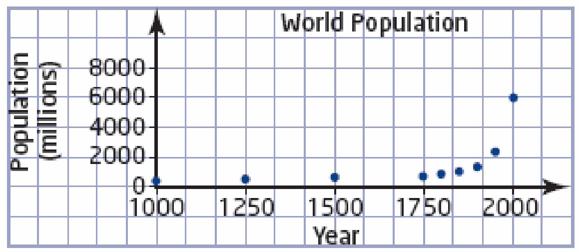


b) The bar graph shows a rising trend in rents.

c) Over 7 years, the mean rent increased by \$165. A reasonable estimate for the mean rent in another 7 years is 823 + 165 = \$988.

Chapter 2 Section 4 Question 2 Page 73

a) The scatter plot is shown.

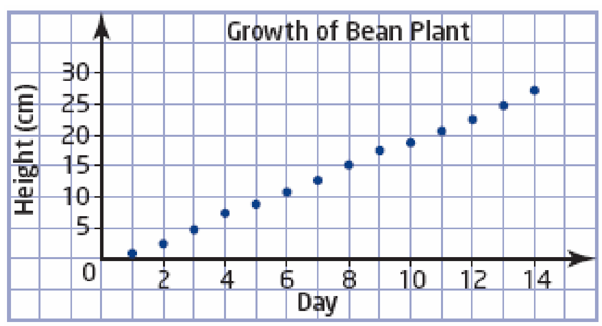


b) The world population is growing much more quickly now than in the past.

c) The graph shows an increasing rate of growth. It does not predict that the world population will stabilize at about 10 billion people around the year 2200.

Chapter 2 Section 4 Question 3 Page 73

a) The scatter plot is shown.

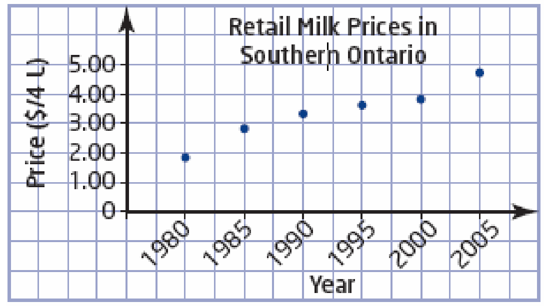


b) The height is increasing at a nearly constant rate.

c) In future weeks, the height will increase at a slower rate as the plant matures, and reach a maximum height.

Chapter 2 Section 4 **Question 4** **Page 73**

a) The scatter plot is shown.



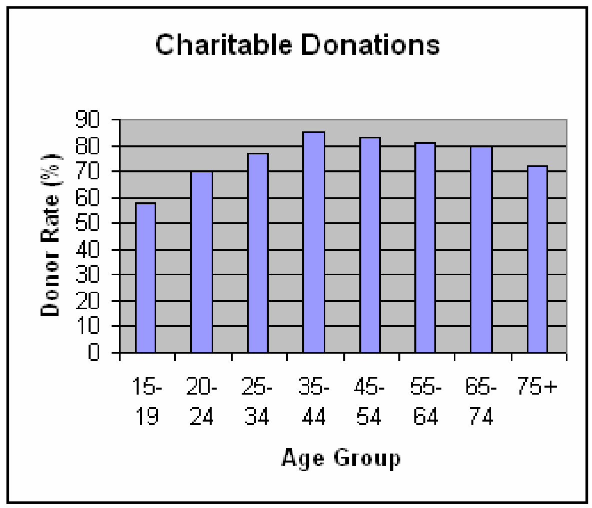
b) Milk prices increased over each 5-year period, but not at a constant rate.

c) The price in 1995 was about $3.60, and the price in 2000 was about $3.80. A reasonable estimate for the price in 1998 is about $3.69.

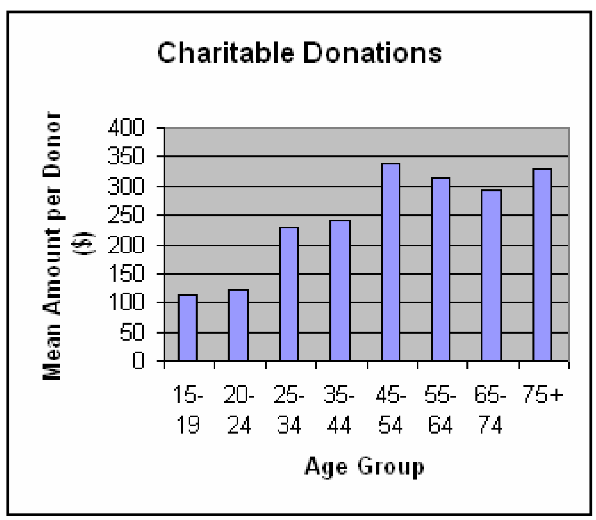
d) From 1980 to 2000, the price of milk went from about $2.00 to about $4.00. A reasonable estimate for a price of $6.00 is another 20 years, or about 2020, assuming prices increase at the same overall rate.

Chapter 2 Section 4 **Question 5** **Page 74**

a) The bar graph is shown. The donation rate increases up to the 35 – 44 age group, and then decreases.



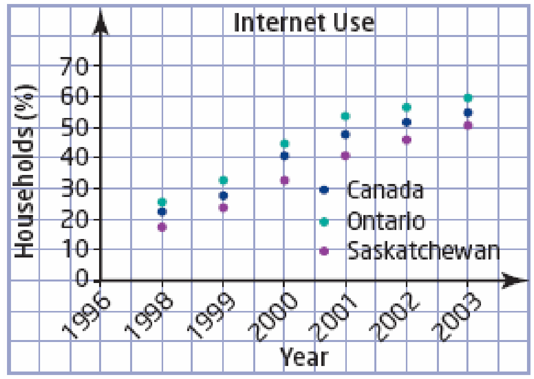
b) The bar graph is shown. Donation amounts increase with age up to the 45 – 54 interval, then decrease, and then increase again for the 75+ interval. Donation amounts are greater for people over 44 than for younger people.



c) Both graphs rise to a maximum for middle-aged people, then decease somewhat. However, the donation amount rises again in the 75+ interval while the donor rate continues to decrease.

Chapter 2 Section 4 Question 6 Page 74

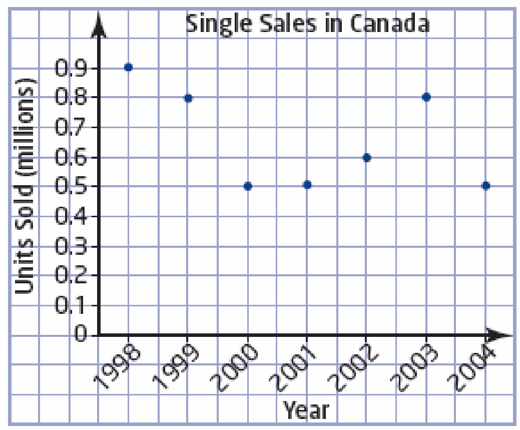
a) The graph is shown. Internet use increased each year, with the national rate being about halfway between the rate in Ontario and the rate in Saskatchewan.

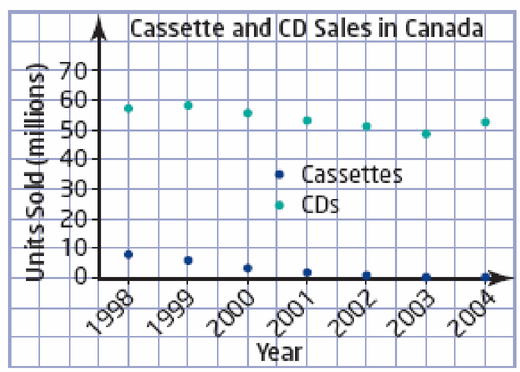


b) From 1998 to 2003, Internet use in Canada increased from about 23% to 55%, or about 6% per year. A reasonable estimate for the usage in 2005 is 55% + 12%, or 67%, assuming that the same rate of growth continues.

Chapter 2 Section 4 Question 7 Page 75

a) The graphs are shown. Overall, sales of singles show a downward trend. Sales of cassettes show a clear downward trend, while sales of CDs show a moderate downward trend.





b) Answers will vary. Sample answers are shown.

Singles will sell 0.5 million in 2005.

Cassettes will sell 0.05 million in 2005.

CDs will sell 55 million in 2005.

Chapter 2 Section 4 Question 8 Page 75

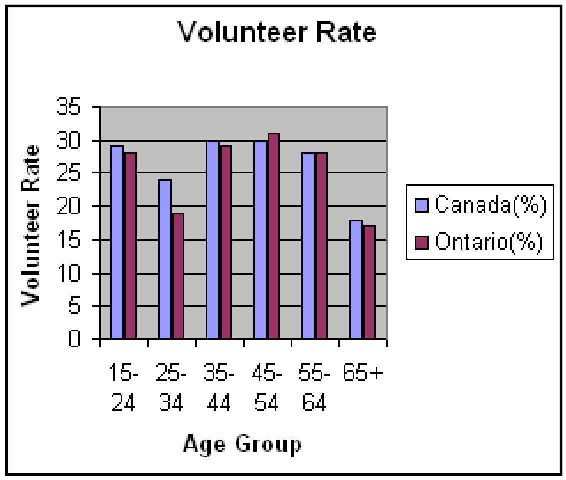
Solutions for Achievement Checks are shown in the Teacher's Resource.

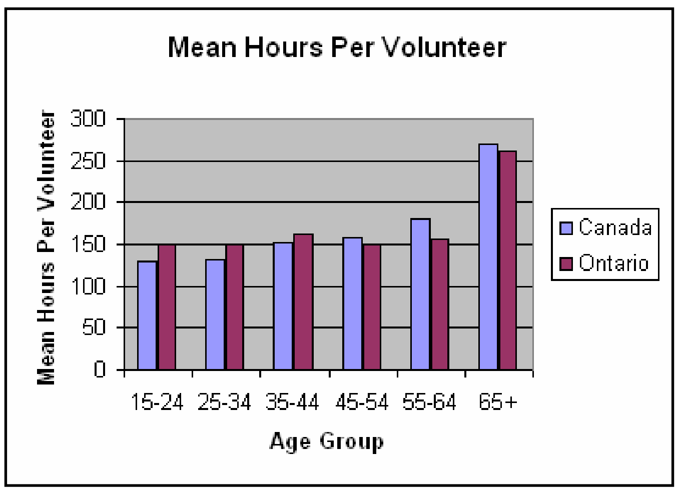
Chapter 2 Section 4 Question 9 Page 76

a) Graphs are shown. The volunteer rate in Ontario is about the same as for all Canadians except in the age group 25-34, when 5% fewer Ontarians volunteer.

b) The age group 45-54 has the greatest volunteer rate. People in this age range may have more free time.

c) As age increases, the hours per volunteer across Canada also increase, especially beyond the age of 65. Most people over 65 are retired and could have more time to volunteer.





Chapter 2 Section 4 Question 10 Page 76

Answers will vary.

Chapter 2 Section 4 Question 11 Page 76

Try each answer. Answer B works.

At noon there are 40 girls in the room. If 15 leave, there are 25 left. Therefore, there are 50 boys in the room. If 45 boys leave, there are 5 boys left. The ratio of girls to boys is 25:5 or 5:1, as required.

Chapter 2 Section 4 Question 12 Page 76

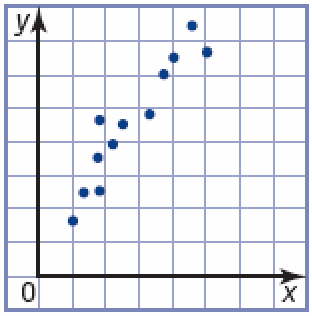
Let the first day be a Saturday. Saturdays will occur on the following days:

1, 8, 15, 22, 29, 36, 43, 50, 57, 64, 71, 78, 85, 92, and 99. There are 15 Saturdays.

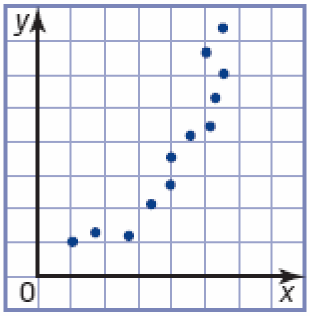
Chapter 2 Section 5 Linear and Non-Linear Relations

Chapter 2 Section 5 Question 1 Page 83

a) This graph appears to be linear. The points lie along a straight line.

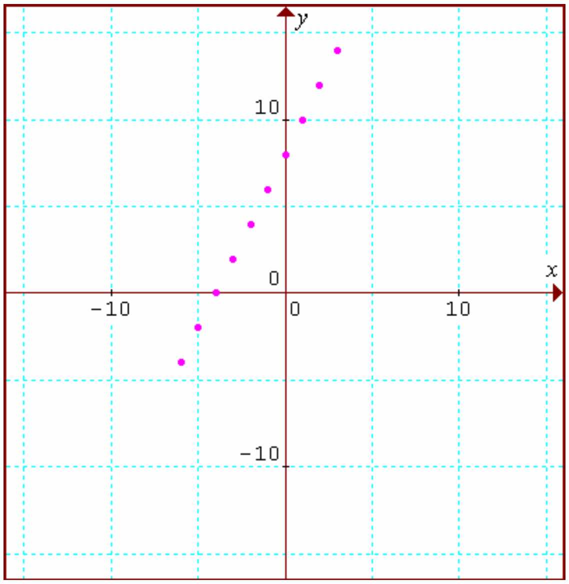


b) This graph does not appear to be linear. The points curve upwards.

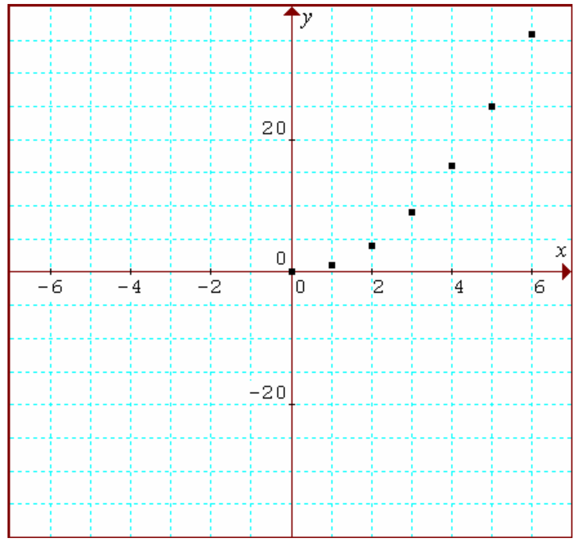


Chapter 2 Section 5 Question 2 Page 83

a) The relationship is linear. The points lie along a straight line.

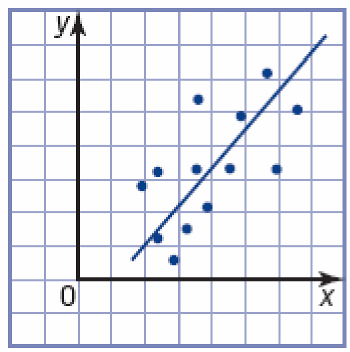


b) The relationship is non-linear. The points do not lie along a straight line.

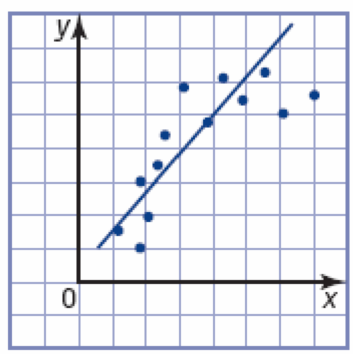


Chapter 2 Section 5 Question 3 Page 84

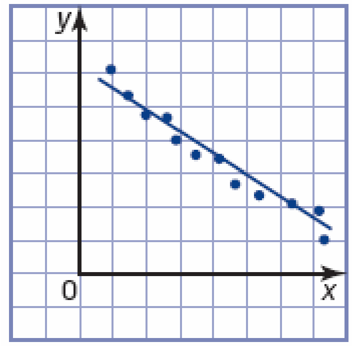
a) The line of best fit is a good model for the data. The points lie reasonably close to a straight line.



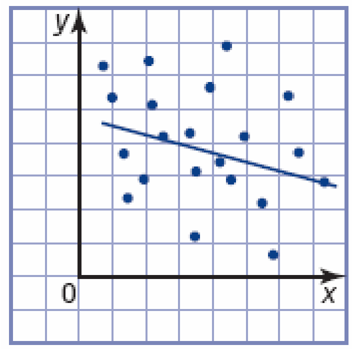
b) The line of best fit is not a good model for the data. The points seem to follow a curve to the right.



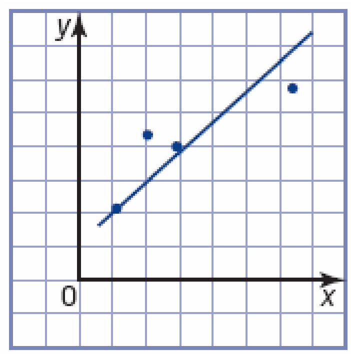
c) The line of best fit is a good model for the data. The points lie close to a straight line.



d) The line of best fit is not a good model for the data. The points do not seem to follow a pattern at all.

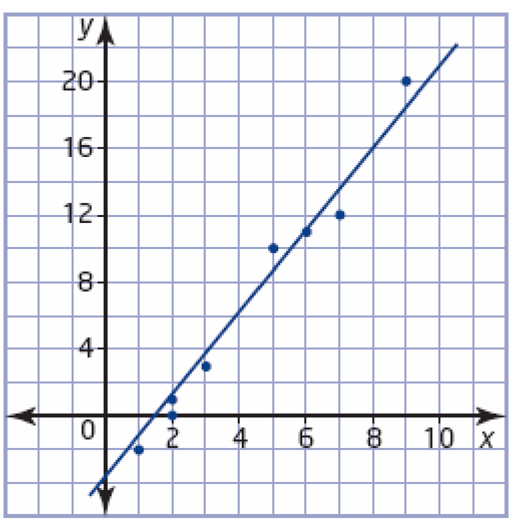


e) The line of best fit is not a good model for the data. There are too few points to determine a definite pattern.

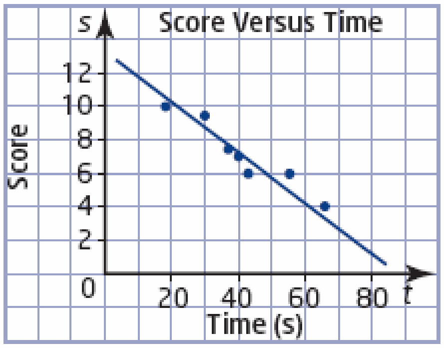


Chapter 2 Section 5 Question 4 Page 84

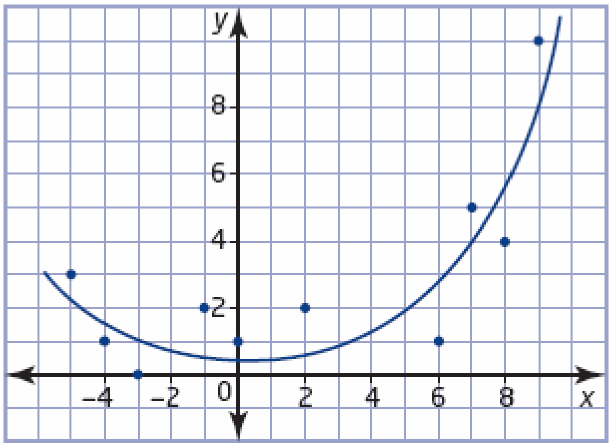
a)



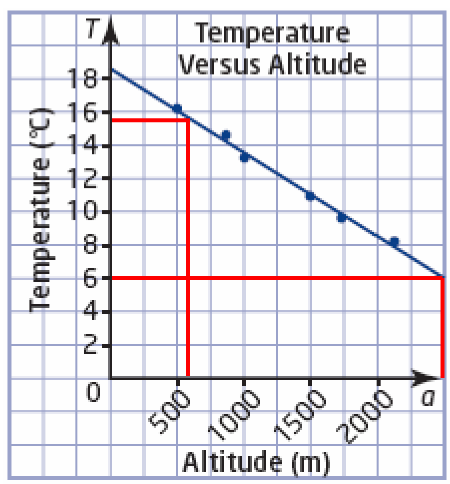
b)



c)



Chapter 2 Section 5 **Question 5** **Page 85**



a) The scatter plot is shown.

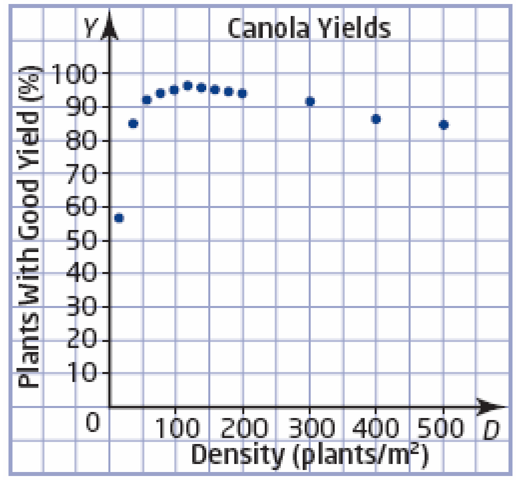
b) The relation is linear. The line of best fit is shown.

c) The temperature at an altitude of 600 m is about 15.5ºC.

d) The temperature at an altitude of 2500 m is about 6.0ºC.

Chapter 2 Section 5 Question 6 Page 85

a) The scatter plot is shown.



b) The yield rises steeply at first, levels off to a maximum around 120 plants/m^2, and then decreases slowly. The relation is non-linear.

c) A line of best fit is not a good model for the data. The points do not lie along a straight line. They follow a curve.

d) Answers will vary. Sample answers are shown.

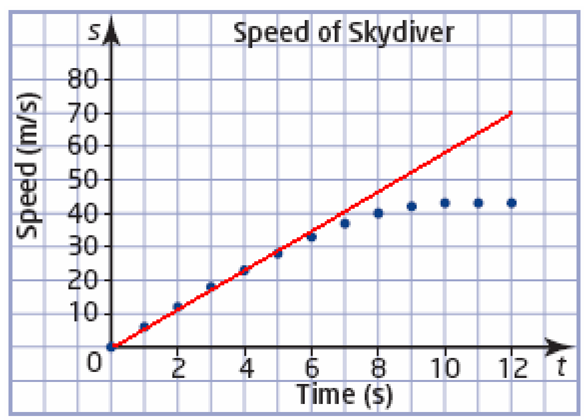
As plant density increases, weeds are crowded out.

If plant density increases too much, water and nutrients in the soil are shared by too many plants.

As plant density increases, cross-pollination becomes more likely.

Chapter 2 Section 5 Question 7 Page 85

a) The graph is shown.



b) The extrapolation is shown. If the trend continues, the speed after 12 s of free fall is about 70 m/s.

c) See the graph in part **a)**.

d) Air resistance increases with speed. The speed increases only until the air resistance offsets the acceleration due to gravity.

e) Extrapolations can be inaccurate because the relationship between the variables may change beyond the range of the data.

Chapter 2 Section 5 Question 8 Page 86

Answers will vary. Sample answers are shown.

a) The purpose could be to investigate how a person's heart rate changes immediately after exercise.

b) It is reasonable to expect that a person's heart rate will decrease steadily in the time immediately after vigorous exercise.

c) Answers will vary.

d) Answers will vary.

e) Answers will vary.

f) Answers will vary.

Chapter 2 Section 5 Question 9 Page 86

Answers will vary. Use a cylinder not much wider than a penny to maximize the effect of dropping the penny into the water. You may have to use multiple numbers of pennies on each drop in order to see a reasonable change in the height. The relationship should be linear.

Chapter 2 Section 5 Question 10 Page 86

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 2 Section 5 Question 11 Page 87

a) Note that the t values increase at a constant rate. Check the corresponding d values. They also increase at a constant rate of 5. The relation is linear.

b) Note that the t values increase at a constant rate. Check the corresponding h values. They do not change at a constant rate. The relation is non-linear.

Chapter 2 Section 5 Question 12 Page 87

There is a non-linear relation between the gauge reading and the volume of fuel in the tank. The eighths at the low end of the gauge correspond to less fuel than than the eighths at the “full” end of the gauge. The gauge measures the "depth" of the fuel in the tank. Since most fuel tanks curve at the bottom, there is less fuel at the bottom of the tank than at the top.

Chapter 2 Section 5 Question 13 Page 87

Inspect expression D. The denominator is always one larger than the numerator. The value of the fraction will always be less than 1, regardless of the value of n.

Chapter 2 Section 5 Question 14 Page 87

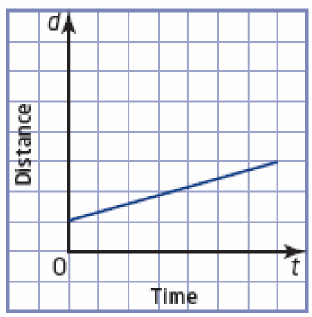
Since the required number is even, the last digit must be a 2, 4, or 6. For each of the 3 choices of last digit, there are 5 choices for the middle digit and 4 choices for the first digit. The number of even three-digit numbers possible is $3 \times 5 \times 4 = 60$.

Chapter 2 Section 6 Distance-Time Graphs

Chapter 2 Section 6 Question 1 Page 91

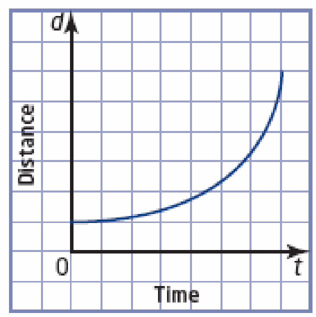
Answers may vary. Sample answers are shown.

a)



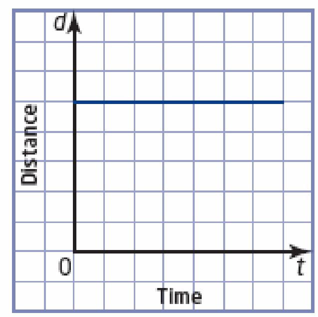
A car is moving away at a constant speed.

b)



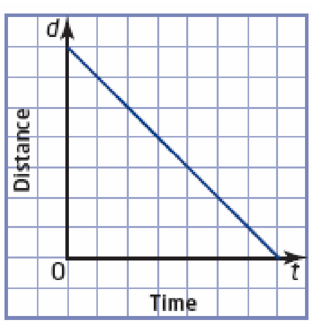
A car is moving away at increasing speed.

c)



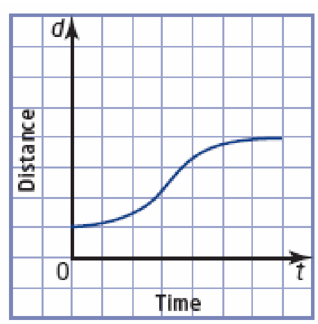
A car is parked, not moving.

d)



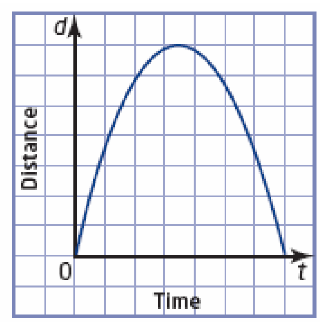
A car is moving closer at a constant speed.

e)



A car is moving away at increasing speed, then slowing down and stopping.

f)



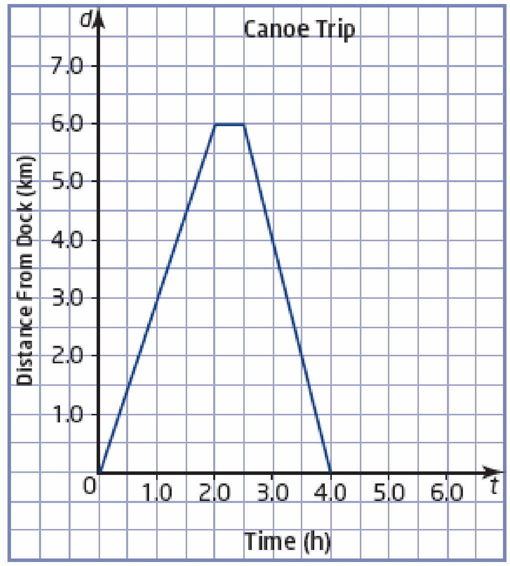
A car is moving away at decreasing speed, stopping for a moment, then coming back with increasing speed.

Chapter 2 Section 6 Question 2 Page 91

Graphs **a)**, **c)**, and **d)** from question 1 show linear relations. The graphs are straight lines.

Chapter 2 Section 6 Question 3 Page 92

a) The trip took 4.0 h.



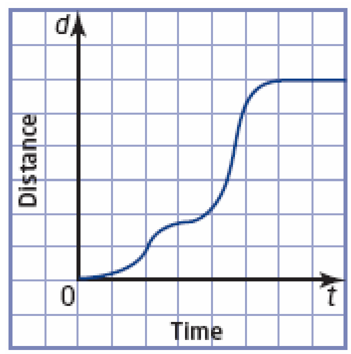
b) The distance to the end of the lake is 6.0 km.

c) The flat portion of the graph represents time that the canoeist rested at the end of the lake.

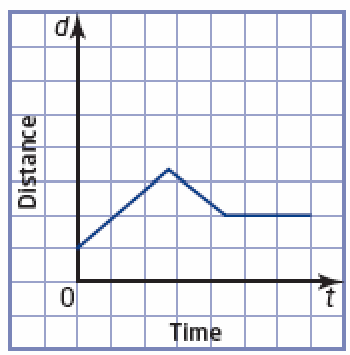
d) It took 2.0 h to reach the end of the lake, but only 1.5 h to come back. The canoeist was travelling faster on the way back.

Chapter 2 Section 6 Question 4 Page 92

After starting out, the cyclist increases her speed, then slows down. Then she travels a bit faster than before, then slows down and stops.



Chapter 2 Section 6 Question 5 Page 92



a) Move away from the wall at a constant speed, then reverse direction and walk back toward the wall at the same speed, but stop before you reach your starting position.

b) If you walked fast, the sloped line segments would be steeper.

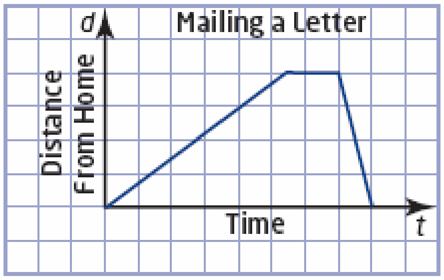
c) If you walked slower, the sloped line segments would be less steep.

d) If you stopped sooner, the middle segment would be shorter and the horizontal segment would be higher.

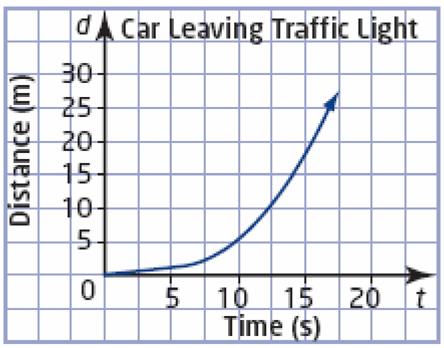
Chapter 2 Section 6 Question 6 Page 93

Answers will vary.

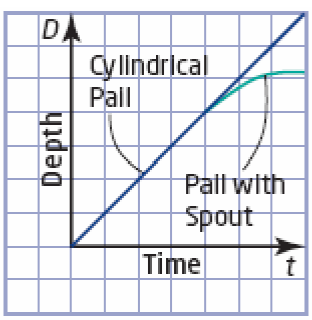
Chapter 2 Section 6 Question 7 Page 93



Chapter 2 Section 6 Question 8 Page 93



Chapter 2 Section 6 Question 9 Page 93



Chapter 2 Section 6 Question 10 Page 93

Answers will vary.

Chapter 2 Section 6 Question 11 Page 93

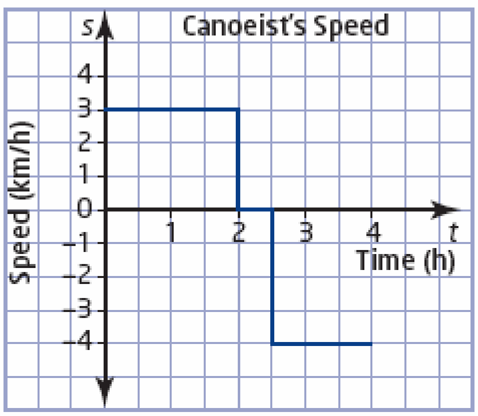
a)

$$\text{First segment } v = \frac{6.0 \text{ km}}{2.0 \text{ h}}$$
$$= 3 \text{ km/h}$$

$$\text{Second segment } v = \frac{0.0 \text{ km}}{2.0 \text{ h}}$$
$$= 0 \text{ km/h}$$

$$\text{Third segment } v = \frac{6.0 \text{ km}}{1.5 \text{ h}}$$
$$= 4 \text{ km/h}$$

b)



c) The steeper the graph, the faster the canoeist is paddling.

d) Negative speed indicates the rate at which the canoeist is returning to the dock.

Chapter 2 Section 6 Question 12 Page 94

d) The horizontal axis represents time. The vertical axis represents the distance from the CBR™ to the ball.

e) The relation between distance and time is not linear. The points do not lie on a straight line.

l) The relation between time and bounce height is linear. The points lie along a straight line.

Chapter 2 Section 6 Question 13 Page 94

Answers will vary.

Chapter 2 Section 6 Question 14 Page 94

Use a table to help you with the "guess and check" method. A calculator or spreadsheet can also be used. Click here to load the spreadsheet file.

Shaheen was born in 1979, and was 26 on her birthday in 2005.

Year	Age	Sum of Digits
2005	0	7
2004	1	6
2003	2	5
2002	3	4
2001	4	3
2000	5	2
1999	6	28
1998	7	27
1997	8	26
1996	9	25
1995	10	24
1994	11	23
1993	12	22
1992	13	21
1991	14	20
1990	15	19
1989	16	27
1988	17	26
1987	18	25
1986	19	24
1985	20	23
1984	21	22
1983	22	21
1982	23	20
1981	24	19
1980	25	18
1979	26	26
1978	27	25
1977	28	24
1976	29	23
1975	30	22
1974	31	21

Chapter 2 Review

Chapter 2 Review Question 1 Page 95

Answers will vary. Sample answers are shown.

a) Hypothesis: As the temperature in a town during the summer increases, so does the volume of water used by the town's residents.

Opposite: As the temperature in a town during the summer increases, the volume of water used by the town's residents does not increase.

b) Hypothesis: Taller people have higher marks in mathematics.

Opposite: Taller people do not have higher marks in mathematics.

Chapter 2 Review Question 2 Page 95

a) This is primary data. This is a good choice, since a survey of students at the school could give more accurate results than secondary data would.

b) This is secondary data. This is a good choice, since primary data could take a lot of time to collect, and would not likely be significantly more accurate.

c) This is secondary data. This may not be a good choice, since the encyclopedia might not give information on bears in a specific province.

d) This is secondary data. This is not a good choice. The source of data is convenient, but may not reflect the tastes of students at the school.

Chapter 2 Review Question 3 Page 95

a) The population is all students at the school.

b) Answers will vary. A sample answer is shown.

Use a random number generator to randomly select 25% of the students from the class lists for each grade.

Chapter 2 Review Question 4 Page 95

a) The population is all passengers that fly on the airline.

b) Answers will vary. A sample answer is shown.

Obtain a list of all passengers who have flown on the airline. Randomly select one name on the list of the airline's passengers, and then select every hundredth person before and after that name.

Chapter 2 Review Question 5 Page 95

Answers for sampling techniques will vary. Sample answers are shown.

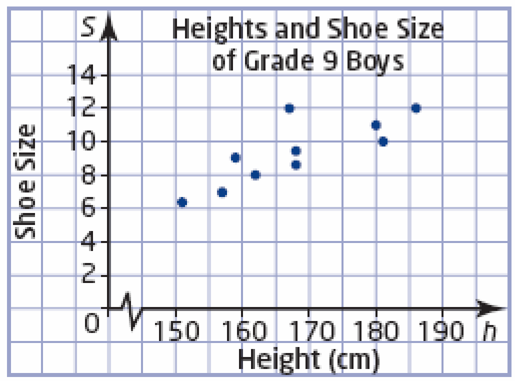
a) The population is all customers of the department store. The store can pick a customer at random, and then every 10th customer entering the store, to survey.

b) The population is all campers at provincial parks. Park rangers at each park can survey every 10th camper who registers.

c) The population is all students at the school. The librarian can use a random number generator to generate 50 random numbers between 1 and the population of the school. Then, he can use the numbers to select students from a school listing to survey.

Chapter 2 Review Question 6 Page 95

a) The scatter plot is shown.

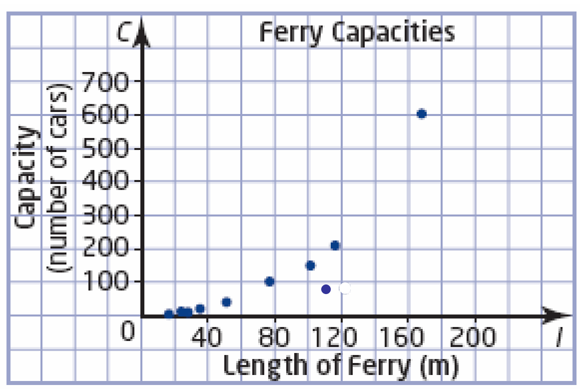


b) As the students' heights increase, so do their shoe sizes.

c) (167, 12) is an outlier, but should not be discarded since it is a valid measurement, unless there is some reason to believe that the measurement was made in error.

Chapter 2 Review Question 7 Page 96

a) The scatter plot is shown.



b) As the length of the ferry increases, the capacity also increases. The points follow a curve, so the relationship is non-linear.

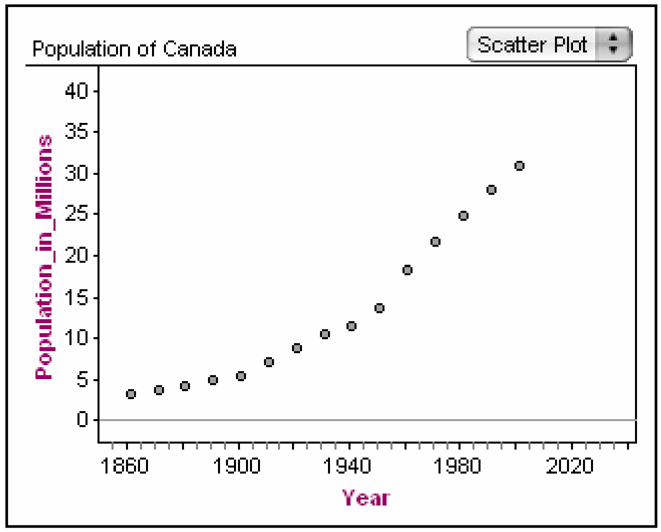
c) The point (110.8, 80) is an outlier.

Answers about causes may vary. Sample answers are shown.

The ferry might carry cargo as well as cars.
The ferry might carry fewer cars so that it can travel faster.
Some ferries derive most of their business from passengers, and may have few spaces for cars.

Chapter 2 Review **Question 8** **Page 96**

a) The scatter plot is shown.



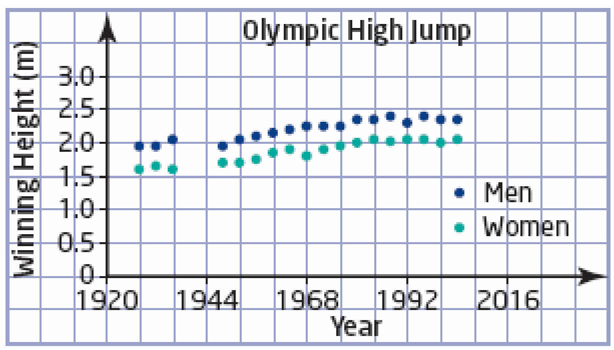
b) The population of Canada has grown at an increasing rate since 1861.

c) The population in 1967 was about 20 million.

d) The population in 2021 will be about 34 million.

Chapter 2 Review **Question 9** **Page 96**

a)



b) Both the men's and women's winning heights are increasing, but the rate of increase has been slower since about 1980.

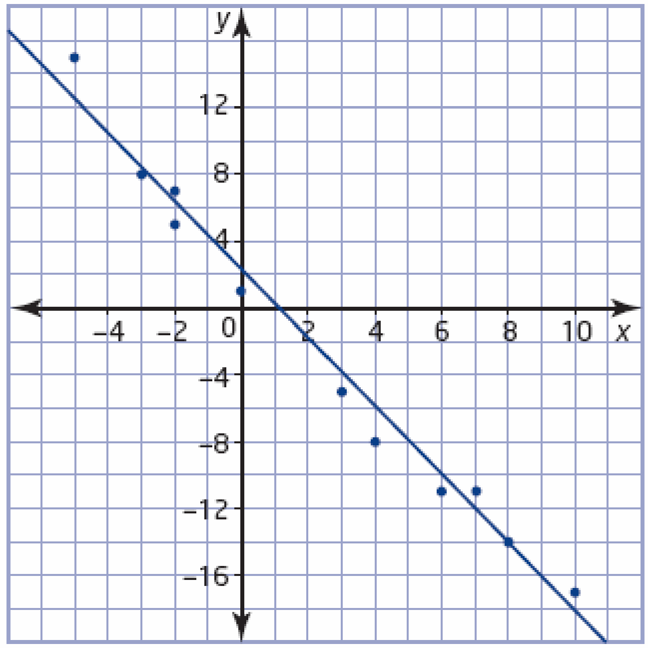
c) There are no apparent outliers.

d) Answers will vary. Sample answers are shown.

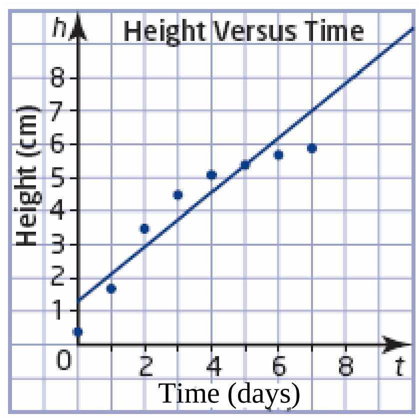
Men's winning height in 2012 will be about 2.48 m. Women's winning height will be about 2.15 m

Chapter 2 Review **Question 10** **Page 97**

a) The scatter plot and line of best fit are shown. The line is a good fit. All of the points are close to the line.

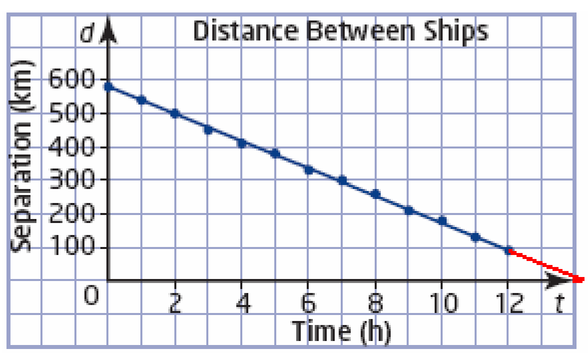


b) The scatter plot and line of best fit are shown. The line is not a good fit. The points appear to follow a curve.



Chapter 2 Review **Question 11** **Page 97**

a) The scatter plot is shown.



b) As time increases, the distance between the two ships decreases. The relationship is linear.

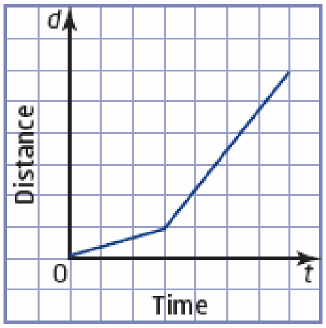
c) There are no apparent outliers.

d) The ships will be closest to each other after 14.3 h.

Chapter 2 Review **Question 12** **Page 97**

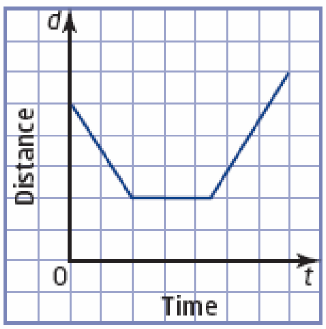
Answers may vary. Sample answers are shown.

a)



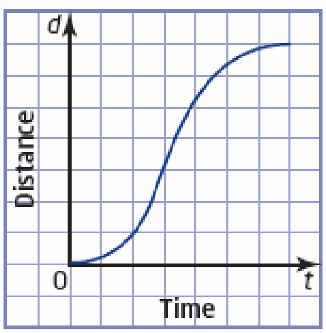
Marni walks away from her home for 2 min at a constant speed, and then runs in the same direction at a constant speed for 2 min.

b)



John bikes from school to a store, buys something, and then bikes back past the school to home.

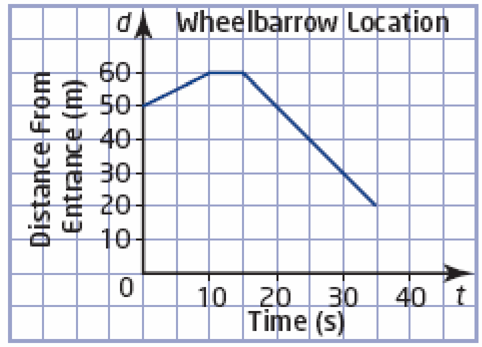
c)



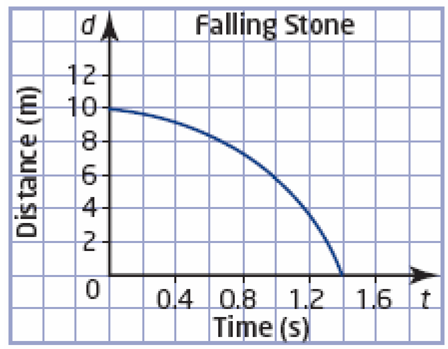
A car speeds up as it leaves a traffic light, and then slows down and stops at another light.

Chapter 2 Review **Question 13** **Page 97**

a) The distance-time graph is shown.



b) The distance-time graph is shown.



Chapter 2 Chapter Test

Chapter 2 Chapter Test Question 1 Page 98

Answer B is a primary source of data, since you are collecting it yourself. All of the others are secondary sources.

Chapter 2 Chapter Test Question 2 Page 98

Answer C is not a random sample. You are only surveying people on a particular street corner.

Chapter 2 Chapter Test Question 3 Page 98

Estimating value beyond the known data for a relation is extrapolation. Answer A.

Chapter 2 Chapter Test Question 4 Page 98

The final step in an experiment is the evaluation. Answer C.

Chapter 2 Chapter Test Question 5 Page 98

a) Caffeine cannot affect your sleep.

b) If you study more, your results on tests either improve or stay the same.

c) At least half of the students in your school do not have a part-time job.

d) Cell phone use has not more than doubled in the past 2 years.

Chapter 2 Chapter Test Question 6 Page 98

a) The population is all teachers working for the school board.

Answers will vary. Sample answers are shown.

b) Randomly select 20% of the teachers in each school.

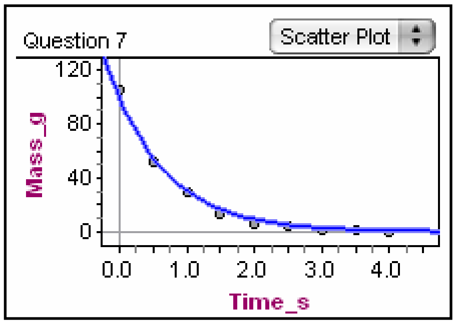
c) Select a name at random from a list of all of the teachers, and then select every fifth name before and after the first name selected.

d) Survey all the teachers in the nearest school.

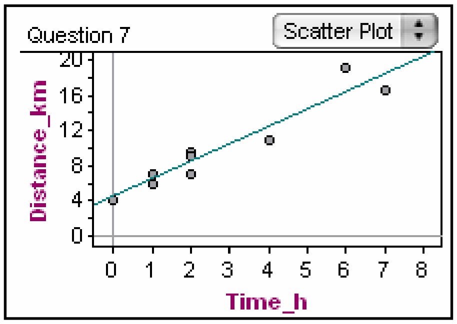
e) Teachers at the same school have the same students and working conditions. These teachers may not have the same concerns and opinions as teachers at other schools

Chapter 2 Chapter Test Question 7 Page 98

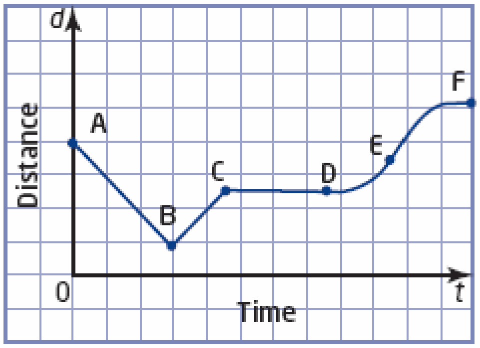
a) The scatter plot and curve of best fit are shown. The relation is non-linear.



b) The scatter plot and line of best fit are shown. The relation appears to be linear.



Chapter 2 Chapter Test Question 8 Page 99



AB: The distance is decreasing at a steady rate.

BC: The distance is increasing at a steady rate.

CD: There is no motion.

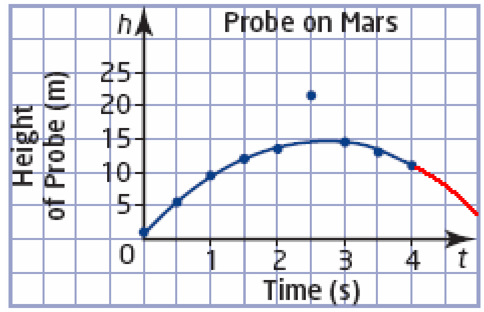
DE: The distance is increasing at an increasing rate.

EF: The distance is increasing at a decreasing rate.

Chapter 2 Chapter Test Question 9 Page 99

Answers will vary.

Chapter 2 Chapter Test Question 10 Page 99



a) The scatter plot is shown.

b) The relation is non-linear. As time increases, the height first increases, then decreases.

c) The point (2.5, 21.4) is an outlier. Possible causes could be an inaccurate reading, or a data transmission error.

d) See the graph in part **a)** for the curve of best fit.

e) The extrapolation is shown on the graph. The height after 5 s is about 4.7 m.

Chapter 2 **Relations**

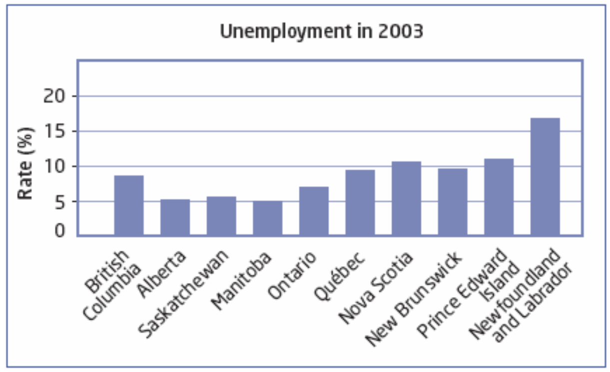
Chapter 2 Get Ready

Chapter 2 Get Ready **Question 1** **Page 40**

a) The heights of the bars represent the unemployment rate, in percent, for each province in 2003.

b) Newfoundland and Labrador has the greatest unemployment rate.

c) The prairie provinces had the lowest unemployment rate. People had the best chance of finding work in 2003 in the prairie provinces.

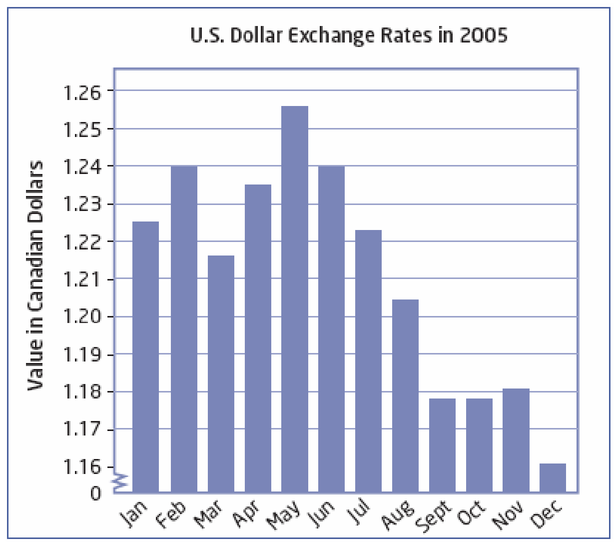


Chapter 2 Get Ready **Question 2** **Page 40**

a) The lowest value of the U.S. dollar shown on the graph is \$1.16 CDN, in December of 2005.

b) The value of the U.S. dollar compared to the Canadian dollar was the greatest in May of 2005.

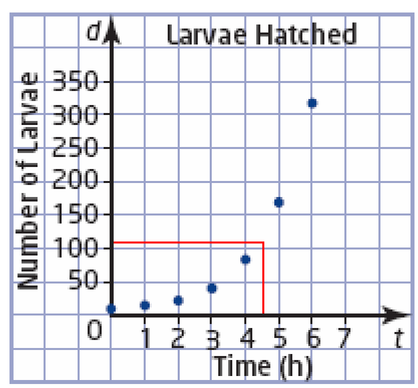
c) The graph shows an overall downward trend in the value of the U.S. dollar compared to the Canadian dollar.



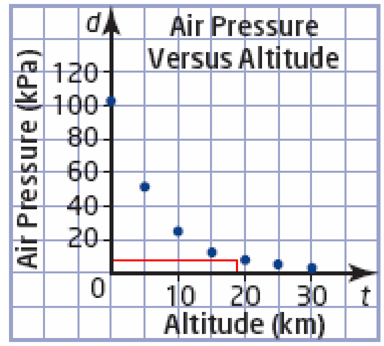
Chapter 2 Get Ready **Question 3** **Page 41**

a) The scatter plot is shown.

b) After 4.5 h, about 110 larvae have hatched.



Chapter 2 Get Ready Question 4 Page 41



a) The scatter plot is shown.

b) The air pressure at an altitude of 18 km is about 7.5 kPa.

Chapter 2 Get Ready Question 5 Page 41

a) The unit rate is $\frac{42 \text{ pages}}{6 \text{ min}} = 7 \frac{\text{pages}}{\text{min}}$.

b) The unit rate is $\frac{\$15}{5 \text{ kg}} = \$3/\text{kg}$.

c) The unit rate is $\frac{880 \text{ km}}{11 \text{ h}} = 80 \text{ km/h}$.

Chapter 2 Get Ready Question 6 Page 41

a) The unit rate is $\frac{\$4.19}{750 \text{ g}} \doteq \$0.0056/\text{g}$.

b) The unit rate is $\frac{500 \text{ mL}}{24 \text{ muffin}} \doteq 20.8 \frac{\text{mL}}{\text{muffin}}$.

c) The unit rate is $\frac{5000 \text{ m}}{38.6 \text{ min}} \doteq 130 \text{ m/min}$.

Chapter 2 Section 1: Hypotheses and Sources of Data

Chapter 2 Section 1 Question 1 Page 45

a) Most people's favourite number is not 7.

b) Adults do not spend more time listening to classical music than rap. (Alternative: Adults spend either less time or as much time listening to classical music as they spend listening to rap.)

c) In Ontario, the number of teenagers who join hockey teams is greater than or equal to the number who join soccer teams.

d) Chocolate is the most popular flavour of ice cream.

Chapter 2 Section 1 Question 2 Page 45

Answers will vary. Sample answers are shown.

a) Hypothesis: Time spent doing homework increases as a student's age increases.

Opposite: Time spent doing homework does not increase as a student's age increases.

b) Hypothesis: Children tend to grow to the same height as their mothers.

Opposite: Children do not tend to grow to the same height as their mothers.

c) Hypothesis: As temperature increases, the crime rate also increases.

Opposite: As temperature increases, the crime rate decreases or remains constant.

d) Hypothesis: As the cost of gasoline increases, the number of people using public transit increases.

Opposite: As the cost of gasoline increases, the number of people using public transit decreases or stays the same.

Chapter 2 Section 1 Question 3 Page 45

a) The data are primary; the office manager gathers the data.

b) The data are secondary; the student uses data gathered by Statistics Canada.

c) The data are primary; the researcher gathers the data.

d) The data are secondary; the researcher uses data gathered by the transit authority.

Chapter 2 Section 1　　Question 4　Page 45

Answers about advantages will vary. Sample answers are shown.

a) The data are primary. Advantage: the data are up-to-date.

b) The data are secondary. Advantage: Internet search is fast and easy.

c) The data are primary. Advantage: the survey is getting opinions directly from customers.

d) The data are primary. Advantage: the data are up-to-date.

Chapter 2 Section 1　　Question 5　Page 45

Answers will vary. Sample answers are shown.

a) Most students in the class prefer dogs as pets.

b) Survey the class. Primary data are best since the population is small and secondary data may not be available.

Chapter 2 Section 1　　Question 6　Page 46

a) The data are primary. Steve gathered the data himself.

b) Answers will vary. Sample answers are shown.

Brown-eyed students are shorter.

Blue is the least common eye colour.

c) The hypotheses can be tested by surveying a larger sample of students.

Name	Eye Colour	Height (cm)
Josanth	brown	167
Fred	green	181
Graham	green	185
Cho	brown	171
Seth	blue	154
Jamal	green	183
Juan	brown	160
Cameron	blue	173

Chapter 2 Section 1　　Question 7　Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: Females make more phone calls than males.

b) You can survey 50 females and 50 males to test your hypothesis with primary data.

c) You can look for data on the Internet or in publications to test your hypothesis with secondary data.

d) Secondary sources that survey larger samples are more likely to be accurate.

Chapter 2 Section 1 Question 8 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: Taller people perform better at the high jump.

b) Heights of the athletes and how high the athletes can jump are the data needed to test the hypothesis. Primary data for the school team would be easy to collect. Secondary sources could survey a larger sample and yield more accurate results.

Chapter 2 Section 1 Question 9 Page 46

Answers will vary. Sample answers are shown.

a) Hypothesis: The faster the computer, the more it will cost.

b) Most popular computer vendors have Web sites. A search shows that faster computers do cost more.

c) This is primary data if you collect prices from Web sites for individual suppliers. This is secondary data if you find price surveys with data gathered by someone else.

d) You can also visit a computer store to research speeds and prices.

Chapter 2 Section 1 Question 10 Page 46

Answers will vary. Sample answers are shown.

a) A cow produces 20-25 L of milk in a day.

b) A cow eats 12-15 kg of hay in a day.

c) If the information comes from visiting a dairy farm, it is primary data. If the data comes from a book or the Internet, it is secondary data.

Chapter 2 Section 1 Question 11 Page 47

Solutions for Achievement Checks are shown in the Teacher's Resource.

Chapter 2 Section 1 Question 12 Page 47

Answers will vary. Sample answers are shown.

a) Hypothesis: The greater the latitude of a city, the lower the mean of its daily maximum temperatures in January.

b) Available data shows that the hypothesis is generally true, if other factors such as ocean currents are not relevant.

Chapter 2 Section 1 Question 13 Page 47

Answers will vary.

Chapter 2 Section 1 Question 14 Page 47

If the mean is 6, then the sum of the numbers is 6*n*. If 17 is added, the mean becomes 7, with *n* + 1 numbers in the list. You are looking for a number *n* such that

$$\frac{6n+17}{n+1}=7$$

Use the "guess and check" method to determine that *n* must equal 10.

Chapter 2 Section 2 Sampling Principles

Chapter 2 Section 2 Question 1 Page 52

a) The population is all children.

b) The population is all those who wrote the test.

c) The population is all cars.

d) The population is all food stores.

Chapter 2 Section 2 Question 2 Page 52

a) The data required are the ages when girls and boys learn to walk. Use a sample, the population is very large.

b) The data required are the test marks. Use a census, the population is small.

c) The data required are the salaries of Canadian employees. Use a sample, the population is very large.

d) The data required are people's heights and ages. Use a sample, the population is very large.

e) The data required are the makes of the cars in the school parking lot. Use a census, the population is small.

f) The data required are colours of cars driving by the school. Use a sample, the population is very large.

Chapter 2 Section 2 Question 3 Page 52

Answers will vary. Sample answers are shown.

a) Survey every fourth customer who comes into the cafe.

b) Randomly select 1% of the teenagers in every high school across Ontario.

c) Use a random number generator to select telephone numbers within Canada, and then survey the people who identify themselves as bilingual.

d) Select households to survey by any random method, and then ask the people surveyed where they were born.

Chapter 2 Section 2 Question 4 Page 53

a) This is a non-random sample. It could be biased since University of Waterloo students may not be representative of all university graduates.

b) This is a simple random sample. It could be biased, since the sample excludes anyone who does not have a telephone listing.

c) This is a non-random sample. It is biased because it includes only people who have chosen to spend some of their free time going to a movie.

d) This is a systematic random sampling.

Chapter 2 Section 2 Question 5 Page 53

Answers may vary. Sample answers are shown.

You can group the students by age, by grade level, or by gender.

Chapter 2 Section 2 Question 6 Page 53

a) The population is all farmers in Ontario.

b) Answers will vary. A sample answer is shown.

Use a random number generator to randomly select 10% of the farmers in each county.

Chapter 2 Section 2 Question 7 Page 53

a) The population is all employees of the company.

b) Answers may vary. A sample answer is shown.

Use a random number generator to randomly select a starting point on an alphabetical list of the employees. Then, select every sixth person until you have a total of 50.

Chapter 2 Section 2 Question 8 Page 53

a) The population includes all members of the school teams.

b) Answers will vary. A sample answer is shown.

Write each team member’s name on a slip of paper. Then, randomly draw 15% of the slips out of a box.

Chapter 2 Section 2 Question 9 Page 53

The population of the school is 1216 students.

$$\text{Number of Grade 9 Students} = \frac{330}{1216} \times 150 \doteq 41$$

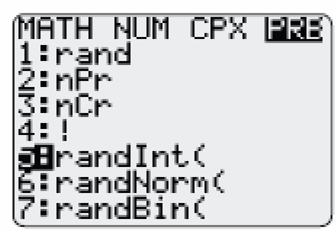
Grade	Number of Students
9	330
10	308
11	295
12	283

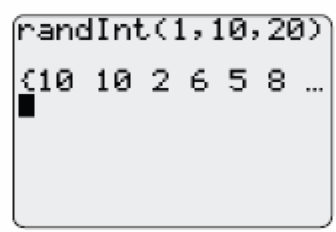
$$\text{Number of Grade 10 Students} = \frac{308}{1216} \times 150 \doteq 38$$

$$\text{Number of Grade 11 Students} = \frac{295}{1216} \times 150 \doteq 36$$

$$\text{Number of Grade 12 Students} = \frac{283}{1216} \times 150 \doteq 35$$

Chapter 2 Section 2 Question 10 Page 54





a) Use the command randInt(12,36,25). The first number is the lower limit, the second number is the upper limit, and the third number is the number of random integers desired.

b) Enter randInt(1,500,40). If any numbers are repeated, change the command to generate more random numbers and use the first 40 that are not duplicates.

c) Enter randInt(100,1000,75). Increase 75 to 100 or more if some numbers are repeated.

Chapter 2 Section 2 Question 11 Page 54

a) The sample is not completely random. Students at small schools have a greater chance of being selected than students at large schools.

b) The results are biased. The sample is likely to have a greater proportion of students from small schools than the population does.

Chapter 2 Section 2 Question 12 Page 54

Answers for sampling methods will vary. Sample answers are shown.

a) The population is all students in the school. Obtain a list of students. Use a random number generator to select a starting point. Select every 10th student.

b) The population is all people in the community. Obtain a list of residents. Use a random number generator to select a starting point. Select every 50th resident.

c) The population is all people aged 18 to 30. Use a random number generator to generate telephone numbers across the country. Survey those who identify themselves as between the ages of 18 and 30.

d) The population is all senior citizens in Ontario. Use a random number generator to generate telephone numbers across Ontario. Survey those who identify themselves as senior citizens.

e) The population is all computer printers for sale in Canada. Search retailers on the Internet to assemble a list of all printers sold in Canada. Purchase one of each kind for testing.

f) The population is gasoline prices at all vendors in the community. Use a telephone book to find addresses for all gasoline retailers in the community. Call or visit each one to generate a list of prices.

Chapter 2 Section 2 Question 13 Page 54

The sample is representative only of people who browse the site and are willing to fill out the form. The sample excludes anyone who does not have Internet access or the inclination to complete the survey.

Chapter 2 Section 2 Question 14 Page 54

a) In the 1920s, many people did not have telephones. Since these people were not included in the surveys, the samples were not representative of the whole population.

b) Answers will vary. Sample answers are shown.

People with more than one telephone number have a greater chance of being selected.

People refusing to answer telephone surveys may make the sample unrepresentative of certain groups.

Deaf people will be left out of the sample.

Chapter 2 Section 2 Question 15 Page 55

Answers will vary.

Chapter 2 Section 2 Question 16 Page 55

Answers will vary.

Chapter 2 Section 2 Question 17 Page 55

Answers will vary. Sample answers are shown.

Poorly designed questions can influence the answers that respondents will give.

People may give false answers to questions they feel uncomfortable with.

Chapter 2 Section 2 Question 18 Page 55

Answers will vary. Sample answers are shown.

a) Assign each tree a number and use a random number generator to choose 10% of the trees.

b) Divide the park into sections with similar numbers of trees, and randomly select 10% from each section.

c) Assign each tree a number. Randomly select a starting point, and then select every tenth number before and after the starting number.

d) Sample the 10% of the trees closest to roads.

Any of the random samples will test trees throughout the park. However, the forester could choose a non-random sample with a larger proportion of the hardwood trees that the beetle attacks most often.

Chapter 2 Section 2 Question 19 Page 55

a) Answers will vary. Sample answers are shown.

You can interview sports fans at a sports venue such as an arena or ball park.

You can interview classmates.

b) Convenience samples are not truly random because every member of the population does not have an equal chance of being selected. Interviewing sports fans at a sports venue excludes members of the population who are not interested in sports or do not attend live events. Interviewing classmates excludes members of the population who are not in the class.

Chapter 2 Section 2 Question 20 Page 55

Since the required number is odd, the last digit must be a 1, 3, 5, or 7. For each of the 4 choices of last digit, there are 6 choices for the middle digit and 5 choices for the first digit. The number of odd three-digit numbers possible is $4 \times 6 \times 5 = 120$.

Chapter 2 Section 3 Use Scatter Plots to Analyse Data

Chapter 2 Section 3 Question 1 Page 64

a) independent variable: physical fitness
dependent variable: blood pressure

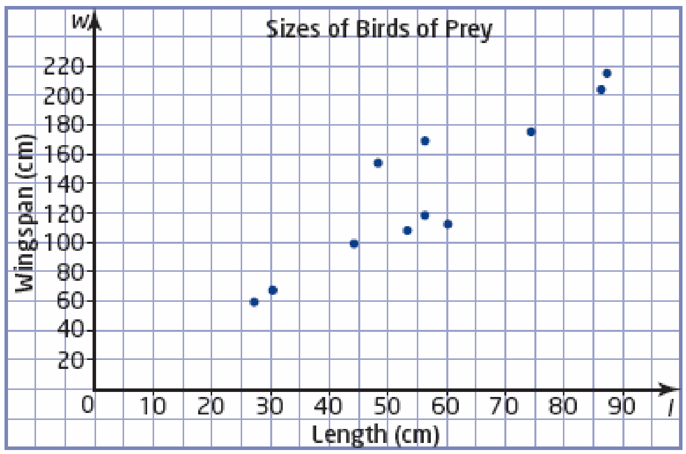
b) independent variable: level of education
dependent variable: income

c) independent variable: load in an airplane
dependent variable: length of runway needed for take off

Chapter 2 Section 3 Question 2 Page 64

a) To show wingspan as the independent variable, move it to the horizontal axis.

b) As the length increases, the wingspan increases.

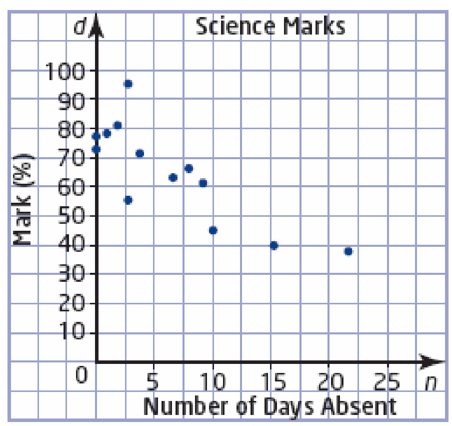


Chapter 2 Section 3 Question 3 Page 64

a) independent variable: number of days absent
dependent variable: science mark.

Marks depend on attendance, rather than attendance depending on marks.

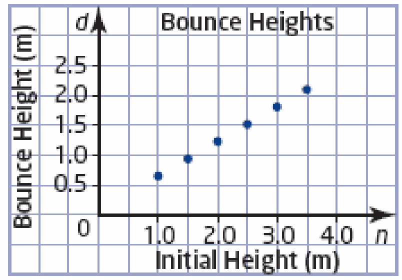
b) The scatter plot is shown.



c) As the number of days absent increases, the marks generally decrease.

d) The point (3, 95) lies somewhat apart from the rest of the data. It can be considered as an outlier.

Chapter 2 Section 3 Question 4 Page 65



a) independent variable: initial height
dependent variable: bounce height

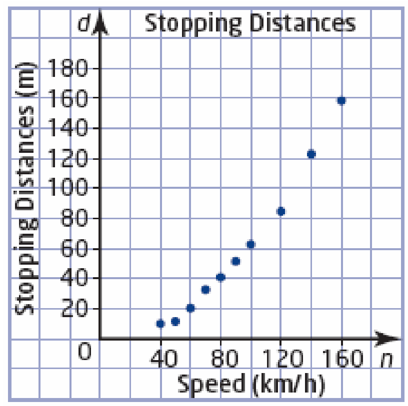
The bounce height depends on the initial height, rather than the initial height depending on the bounce height.

b) The scatter plot is shown.

c) As the initial height increases, so does the bounce height.

d) The point (4.00, 1.62) is an outlier. It should be discarded only for a valid reason, such as a measurement error. Repeat the measurement several times to determine whether this is a measurement error.

Chapter 2 Section 3 Question 5 Page 65



a) The scatter plot is shown.

b) As the speed of a car increases, the stopping distance increases. The pattern is non-linear.

c) A car travelling at 85 km/h needs 46 m to stop. The point is not an outlier since it follows the pattern of the other data

Chapter 2 Section 3 Question 6 Page 65

Answers will vary. Sample answers are shown.

a) Hypothesis: As a person’s height increases, so does the shoulder width.

b) Select a sample of persons of varying heights. Measure height and shoulder width.

c) Display your results in a scatter plot, and draw your conclusion.

d) To improve the accuracy of measurements; use a larger sample.

Chapter 2 Section 3 Question 7 Page 66

Answers will vary. Sample answers are shown.

a) Select a sample of athletes. Measure each athlete's height and the maximum height he or she can jump.

b) The independent variable is the height.

The dependent variable is the jump height.

c) If the hypothesis is true, then the points on the scatter plot will follow a line or curve that rises to the right.

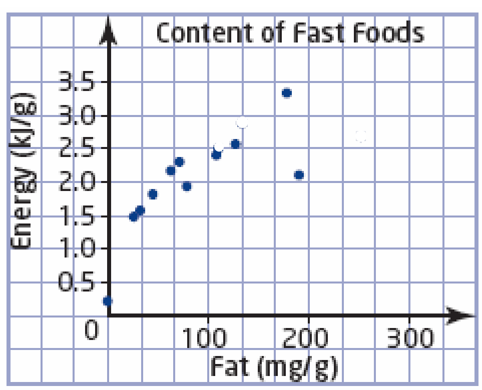
Chapter 2 Section 3 Question 8 Page 66

a) Divide the amount of fat in milligrams by the serving size in grams to obtain the amount of fat per gram.

Divide the energy in kJ by the serving size in grams to obtain the energy per gram.

Item	Fat (mg/g)	Energy (kJ/g)
Harvey's Original Hamburger	127	2.6
Harvey's Veggie Burger	63	2.2
Mr. Submarine Small Assorted Sub	34	1.6
Mr. Submarine Small Vegetarian Sub	26	1.5
Pizza Pizza Pepperoni Slice (walk-in)	69	2.3
Pizza Pizza Vegetarian Slice (walk-in)	43	1.8
KFC Chicken Breast	118	2.4
KFC Popcorn Chicken	184	3.3
Swiss Chalet Quarter Chicken Breast	75	1.9
Swiss Chalet Garden Salad, undressed	0	0.2
Swiss Chalet Caesar Salad	188	2.1

b) The scatter plot is shown.

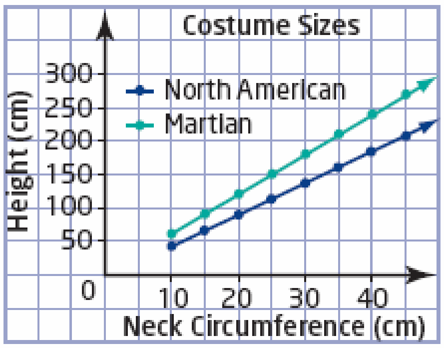


c) The point for Caesar Salad is an outlier due to its high fat content. Nonetheless, this point represents valid data that should not be discarded.

d) Answers will vary. A sample answer is shown.

The scatter plot shows that some fast foods can have a high energy content without a high fat content.

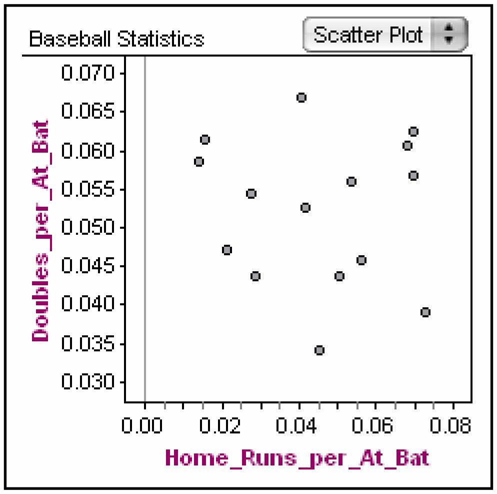
Chapter 2 Section 3 Question 9 Page 67



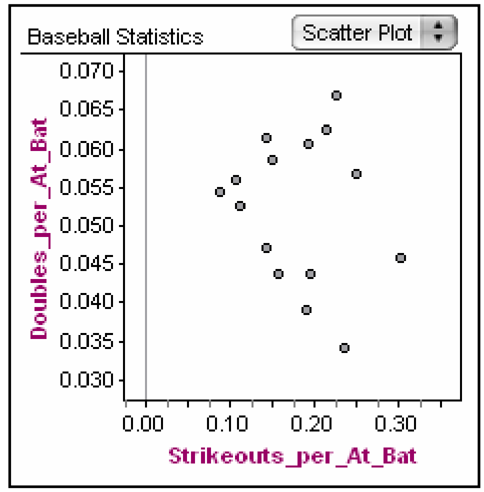
Chapter 2 Section 3 Question 10 Page 67

Divide each statistic by the number of times at bat to obtain the rates. Click here to load the Fathom® file.

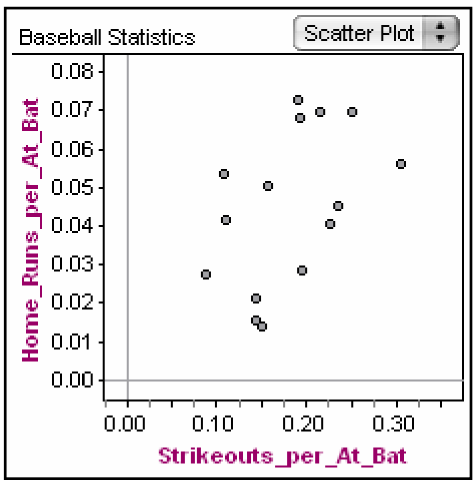
a)



b)



c)



d) Home runs per at bat seem to increase somewhat as the number of strikeouts per at bat increases. The other two scatter plots do not show any relationship between the variables.

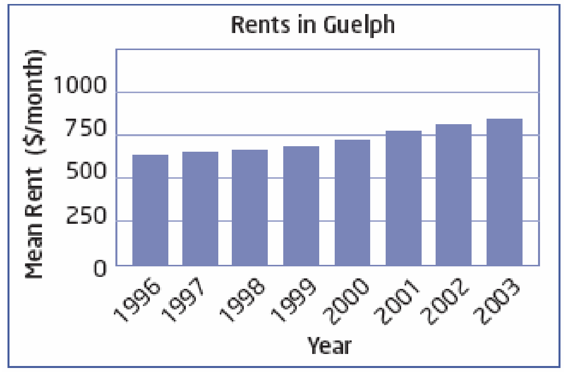
Chapter 2 Section 3 Question 11 Page 67

To keep the value of the expression as small as possible, use the smallest numbers for the numerators, and the largest numbers for the denominators. Use "guess and check" to determine which arrangement yields the smallest value for the expression.

$$\begin{aligned}\frac{1}{4}+\frac{2}{5}+\frac{3}{6} &= \frac{15}{60}+\frac{24}{60}+\frac{30}{60} \\ &= \frac{69}{60} \\ &= 1\frac{3}{20}\end{aligned}$$

Chapter 2 Section 4 Trends, Interpolation, and Extrapolation

Chapter 2 Section 4 Question 1 Page 73

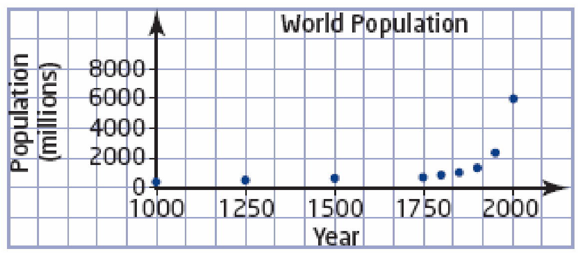


a) The bar graph is shown.

b) The bar graph shows a rising trend in rents.

c) Over 7 years, the mean rent increased by $165. A reasonable estimate for the mean rent in another 7 years is 823 + 165 = $988.

Chapter 2 Section 4 Question 2 Page 73

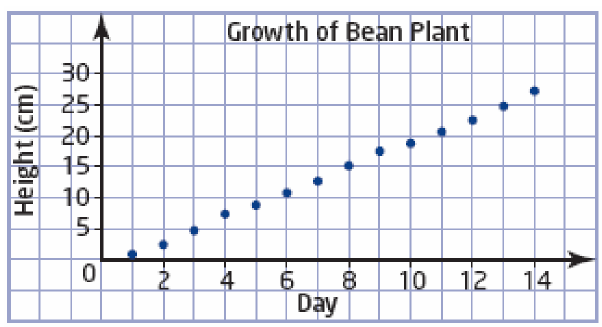


a) The scatter plot is shown.

b) The world population is growing much more quickly now than in the past.

c) The graph shows an increasing rate of growth. It does not predict that the world population will stabilize at about 10 billion people around the year 2200.

Chapter 2 Section 4 Question 3 Page 73



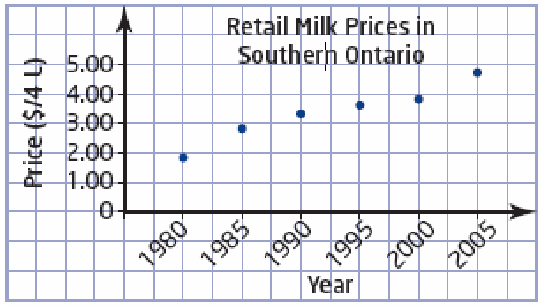
a) The scatter plot is shown.

b) The height is increasing at a nearly constant rate.

c) In future weeks, the height will increase at a slower rate as the plant matures, and reach a maximum height.

Chapter 2 Section 4 **Question 4** **Page 73**

a) The scatter plot is shown.



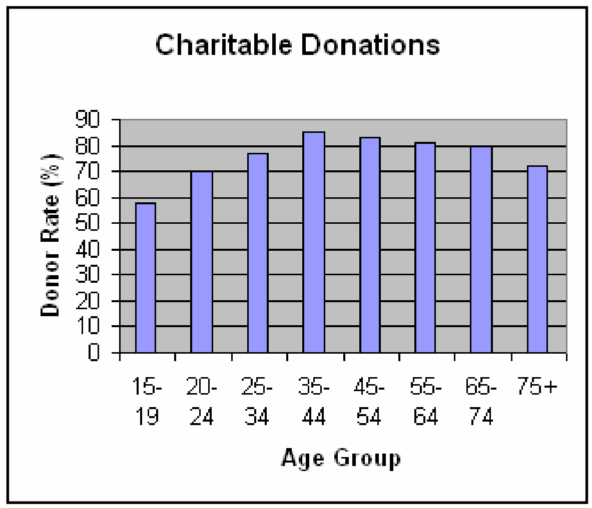
b) Milk prices increased over each 5-year period, but not at a constant rate.

c) The price in 1995 was about $3.60, and the price in 2000 was about $3.80. A reasonable estimate for the price in 1998 is about $3.69.

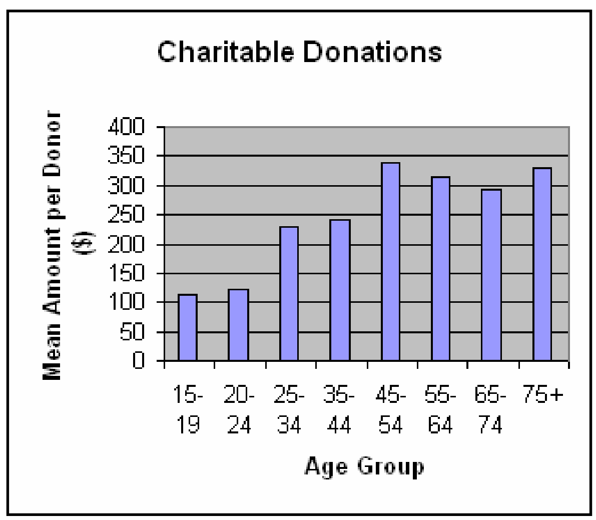
d) From 1980 to 2000, the price of milk went from about $2.00 to about $4.00. A reasonable estimate for a price of $6.00 is another 20 years, or about 2020, assuming prices increase at the same overall rate.

Chapter 2 Section 4 **Question 5** **Page 74**

a) The bar graph is shown. The donation rate increases up to the 35 – 44 age group, and then decreases.



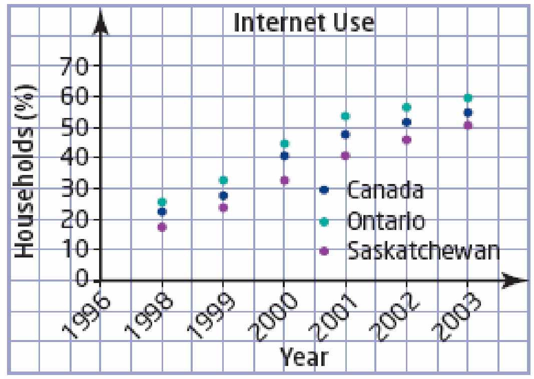
b) The bar graph is shown. Donation amounts increase with age up to the 45 – 54 interval, then decrease, and then increase again for the 75+ interval. Donation amounts are greater for people over 44 than for younger people.



c) Both graphs rise to a maximum for middle-aged people, then decease somewhat. However, the donation amount rises again in the 75+ interval while the donor rate continues to decrease.

Chapter 2 Section 4 Question 6 Page 74

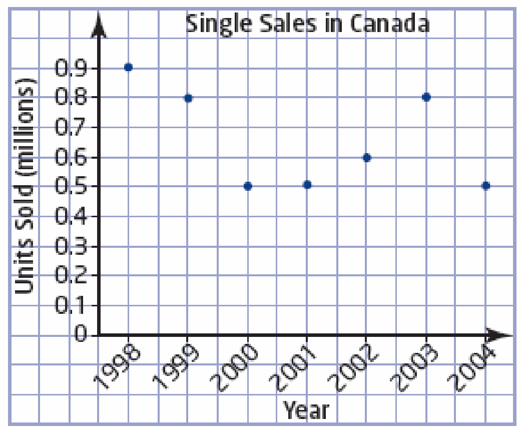
a) The graph is shown. Internet use increased each year, with the national rate being about halfway between the rate in Ontario and the rate in Saskatchewan.

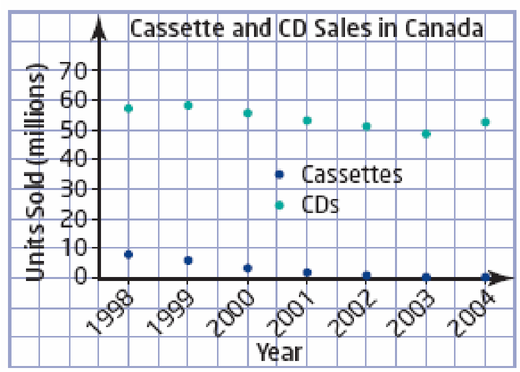


b) From 1998 to 2003, Internet use in Canada increased from about 23% to 55%, or about 6% per year. A reasonable estimate for the usage in 2005 is 55% + 12%, or 67%, assuming that the same rate of growth continues.

Chapter 2 Section 4 Question 7 Page 75

a) The graphs are shown. Overall, sales of singles show a downward trend. Sales of cassettes show a clear downward trend, while sales of CDs show a moderate downward trend.





b) Answers will vary. Sample answers are shown.

Singles will sell 0.5 million in 2005.

Cassettes will sell 0.05 million in 2005.

CDs will sell 55 million in 2005.

Chapter 2 Section 4 Question 8 Page 75

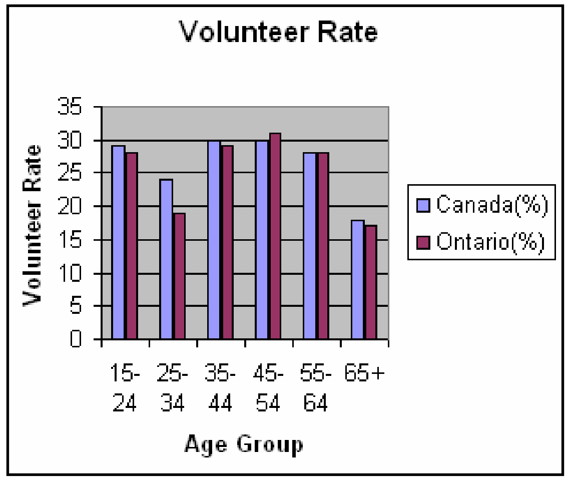
Solutions for Achievement Checks are shown in the Teacher's Resource.

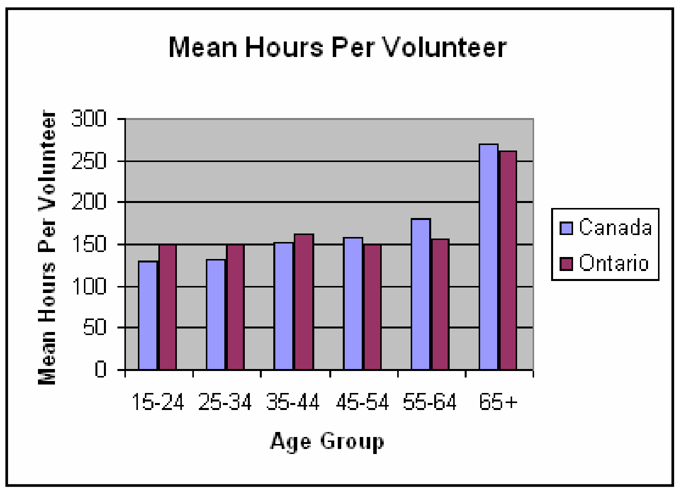
Chapter 2 Section 4 Question 9 Page 76

a) Graphs are shown. The volunteer rate in Ontario is about the same as for all Canadians except in the age group 25-34, when 5% fewer Ontarians volunteer.

b) The age group 45-54 has the greatest volunteer rate. People in this age range may have more free time.

c) As age increases, the hours per volunteer across Canada also increase, especially beyond the age of 65. Most people over 65 are retired and could have more time to volunteer.





Chapter 2 Section 4 Question 10 Page 76

Answers will vary.

Chapter 2 Section 4 Question 11 Page 76

Try each answer. Answer B works.

At noon there are 40 girls in the room. If 15 leave, there are 25 left. Therefore, there are 50 boys in the room. If 45 boys leave, there are 5 boys left. The ratio of girls to boys is 25:5 or 5:1, as required.

Chapter 2 Section 4 Question 12 Page 76

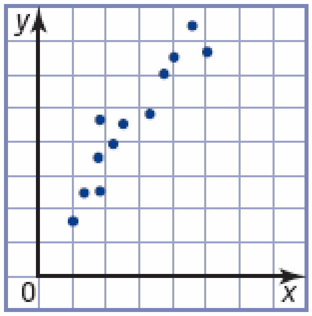
Let the first day be a Saturday. Saturdays will occur on the following days:

1, 8, 15, 22, 29, 36, 43, 50, 57, 64, 71, 78, 85, 92, and 99. There are 15 Saturdays.

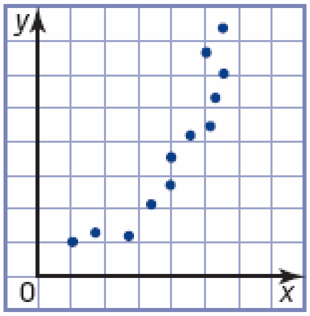
Chapter 2 Section 5 Linear and Non-Linear Relations

Chapter 2 Section 5 Question 1 Page 83

a) This graph appears to be linear. The points lie along a straight line.

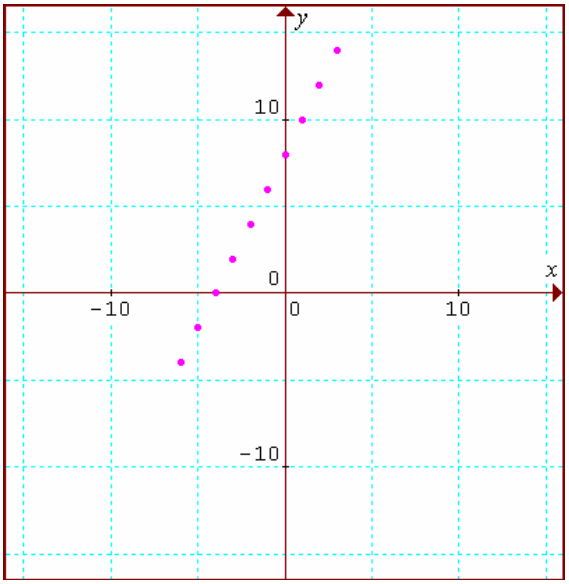


b) This graph does not appear to be linear. The points curve upwards.

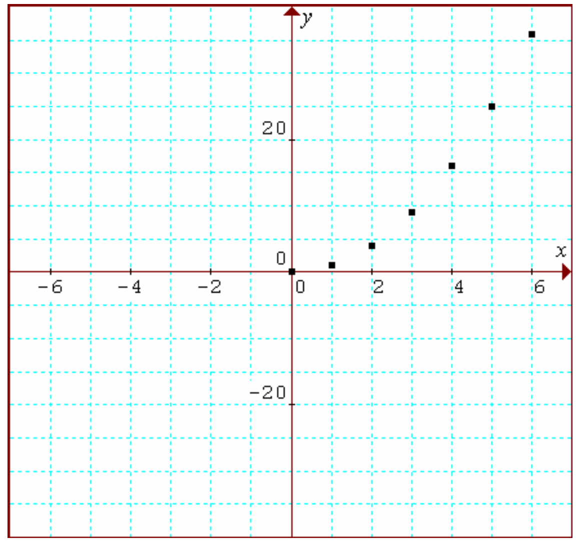


Chapter 2 Section 5 Question 2 Page 83

a) The relationship is linear. The points lie along a straight line.

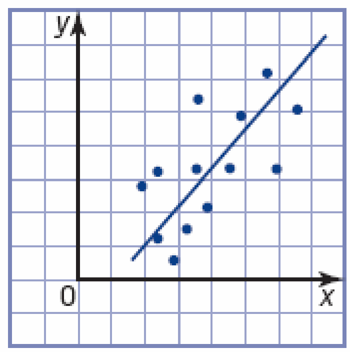


b) The relationship is non-linear. The points do not lie along a straight line.

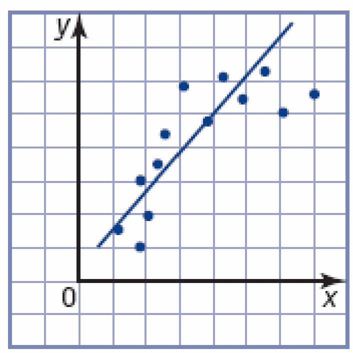


Chapter 2 Section 5 **Question 3** **Page 84**

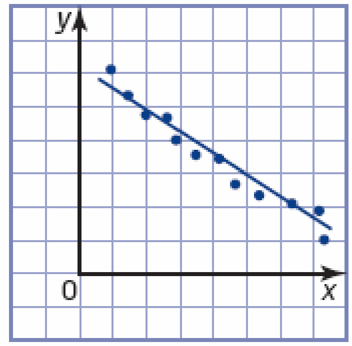
a) The line of best fit is a good model for the data. The points lie reasonably close to a straight line.



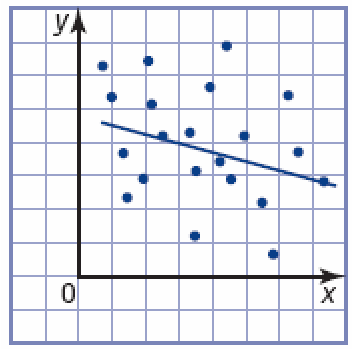
b) The line of best fit is not a good model for the data. The points seem to follow a curve to the right.



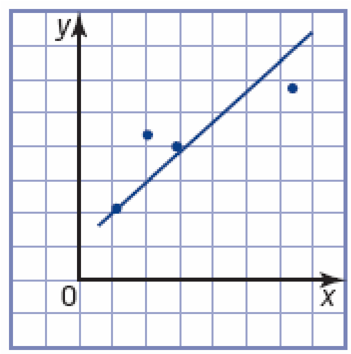
c) The line of best fit is a good model for the data. The points lie close to a straight line.



d) The line of best fit is not a good model for the data. The points do not seem to follow a pattern at all.

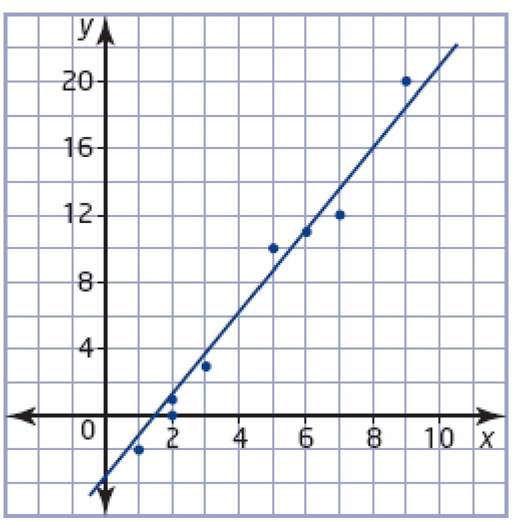


e) The line of best fit is not a good model for the data. There are too few points to determine a definite pattern.

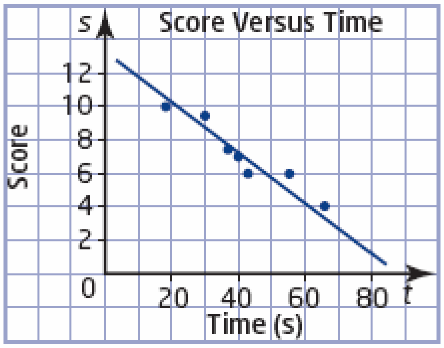


Chapter 2 Section 5 Question 4 Page 84

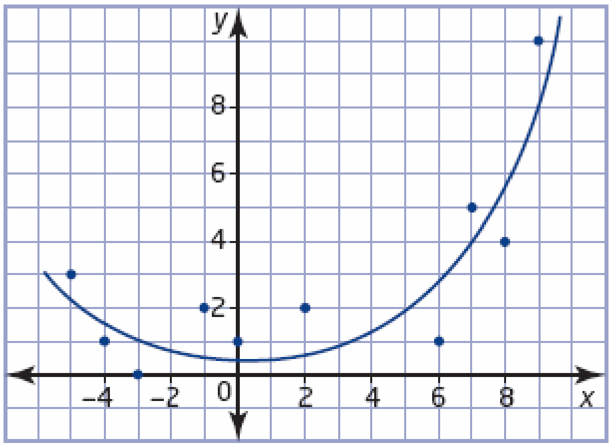
a)



b)

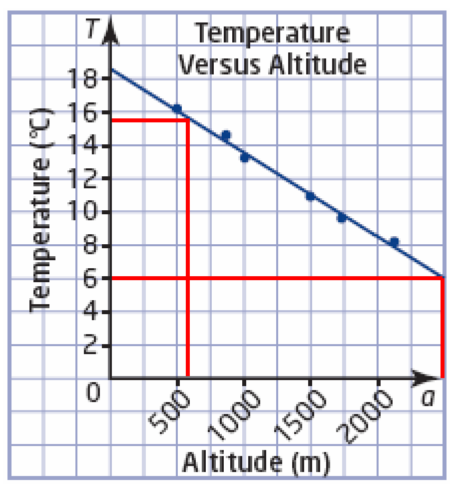


c)



Chapter 2 Section 5 **Question 5** **Page 85**

a) The scatter plot is shown.

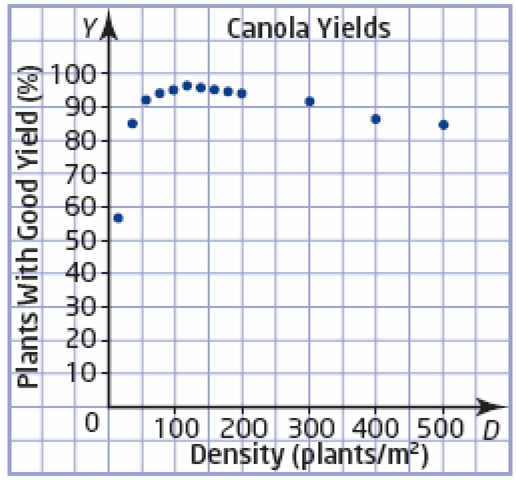


b) The relation is linear. The line of best fit is shown.

c) The temperature at an altitude of 600 m is about 15.5ºC.

d) The temperature at an altitude of 2500 m is about 6.0ºC.

Chapter 2 Section 5 Question 6 Page 85



a) The scatter plot is shown.

b) The yield rises steeply at first, levels off to a maximum around 120 plants/m^2, and then decreases slowly. The relation is non-linear.

c) A line of best fit is not a good model for the data. The points do not lie along a straight line. They follow a curve.

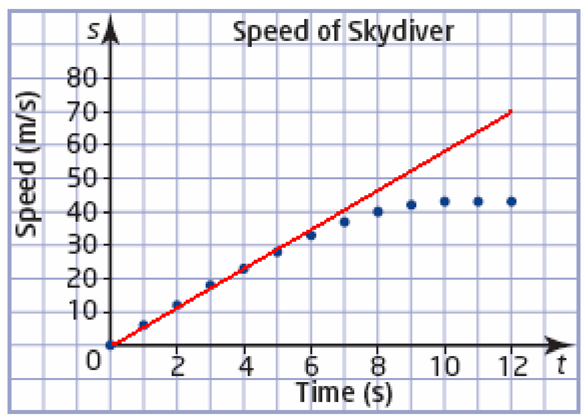
d) Answers will vary. Sample answers are shown.

As plant density increases, weeds are crowded out.

If plant density increases too much, water and nutrients in the soil are shared by too many plants.

As plant density increases, cross-pollination becomes more likely.

Chapter 2 Section 5 Question 7 Page 85



a) The graph is shown.

b) The extrapolation is shown. If the trend continues, the speed after 12 s of free fall is about 70 m/s.

c) See the graph in part **a)**.

d) Air resistance increases with speed. The speed increases only until the air resistance offsets the acceleration due to gravity.

e) Extrapolations can be inaccurate because the relationship between the variables may change beyond the range of the data.

Chapter 2 Section 5 Question 8 Page 86

Answers will vary. Sample answers are shown.

a) The purpose could be to investigate how a person's heart rate changes immediately after exercise.

b) It is reasonable to expect that a person's heart rate will decrease steadily in the time immediately after vigorous exercise.

c) Answers will vary.

d) Answers will vary.

e) Answers will vary.

f) Answers will vary.

Chapter 2 Section 5 Question 9 Page 86

Answers will vary. Use a cylinder not much wider than a penny to maximize the effect of dropping the penny into the water. You may have to use multiple numbers of pennies on each drop in order to see a reasonable change in the height. The relationship should be linear.

Chapter 2 Section 5 Question 10 Page 86

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 2 Section 5 Question 11 Page 87

a) Note that the t values increase at a constant rate. Check the corresponding d values. They also increase at a constant rate of 5. The relation is linear.

b) Note that the t values increase at a constant rate. Check the corresponding h values. They do not change at a constant rate. The relation is non-linear.

Chapter 2 Section 5 Question 12 Page 87

There is a non-linear relation between the gauge reading and the volume of fuel in the tank. The eighths at the low end of the gauge correspond to less fuel than than the eighths at the “full” end of the gauge. The gauge measures the "depth" of the fuel in the tank. Since most fuel tanks curve at the bottom, there is less fuel at the bottom of the tank than at the top.

Chapter 2 Section 5 Question 13 Page 87

Inspect expression D. The denominator is always one larger than the numerator. The value of the fraction will always be less than 1, regardless of the value of n.

Chapter 2 Section 5 Question 14 Page 87

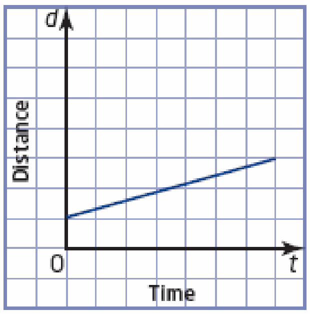
Since the required number is even, the last digit must be a 2, 4, or 6. For each of the 3 choices of last digit, there are 5 choices for the middle digit and 4 choices for the first digit. The number of even three-digit numbers possible is $3 \times 5 \times 4 = 60$.

Chapter 2 Section 6 Distance-Time Graphs

Chapter 2 Section 6 Question 1 Page 91

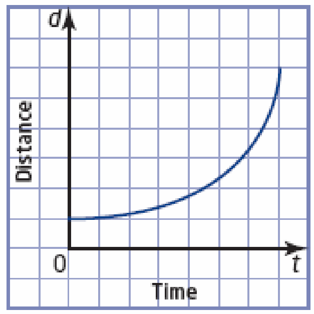
Answers may vary. Sample answers are shown.

a)



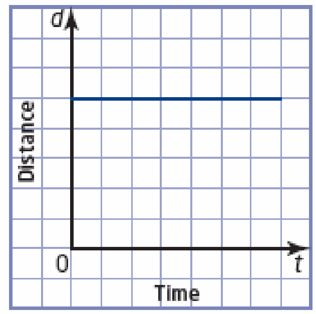
A car is moving away at a constant speed.

b)



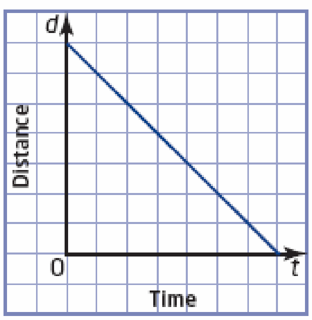
A car is moving away at increasing speed.

c)



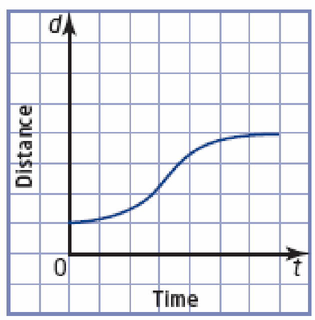
A car is parked, not moving.

d)



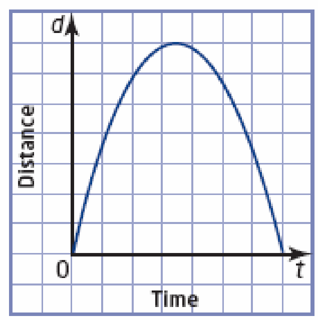
A car is moving closer at a constant speed.

e)



A car is moving away at increasing speed, then slowing down and stopping.

f)

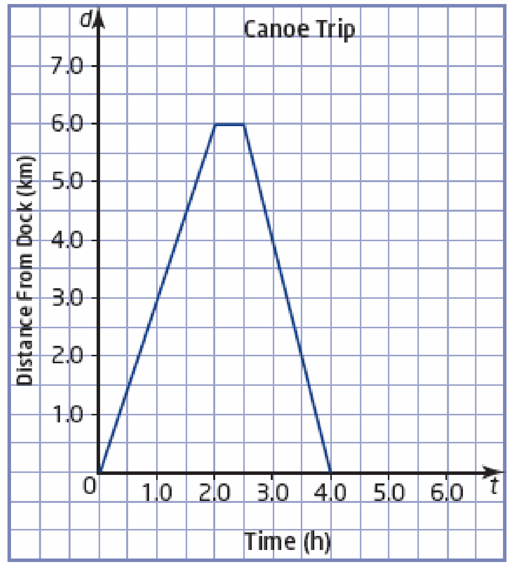


A car is moving away at decreasing speed, stopping for a moment, then coming back with increasing speed.

Chapter 2 Section 6 Question 2 Page 91

Graphs **a)**, **c)**, and **d)** from question 1 show linear relations. The graphs are straight lines.

Chapter 2 Section 6 Question 3 Page 92



a) The trip took 4.0 h.

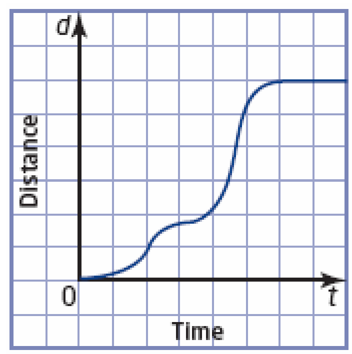
b) The distance to the end of the lake is 6.0 km.

c) The flat portion of the graph represents time that the canoeist rested at the end of the lake.

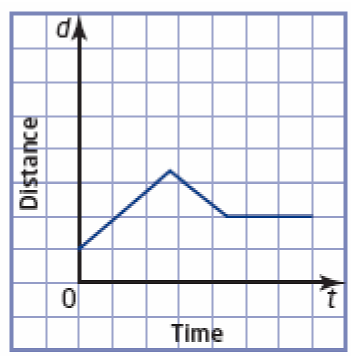
d) It took 2.0 h to reach the end of the lake, but only 1.5 h to come back. The canoeist was travelling faster on the way back.

Chapter 2 Section 6 Question 4 Page 92

After starting out, the cyclist increases her speed, then slows down. Then she travels a bit faster than before, then slows down and stops.



Chapter 2 Section 6 Question 5 Page 92



a) Move away from the wall at a constant speed, then reverse direction and walk back toward the wall at the same speed, but stop before you reach your starting position.

b) If you walked fast, the sloped line segments would be steeper.

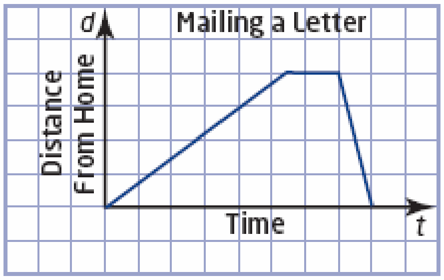
c) If you walked slower, the sloped line segments would be less steep.

d) If you stopped sooner, the middle segment would be shorter and the horizontal segment would be higher.

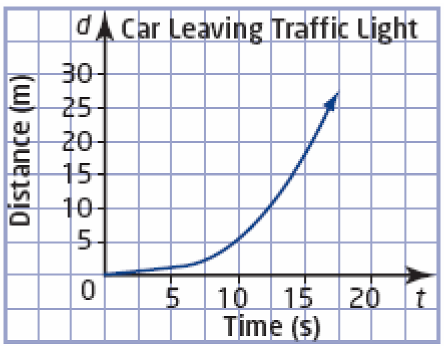
Chapter 2 Section 6 Question 6 Page 93

Answers will vary.

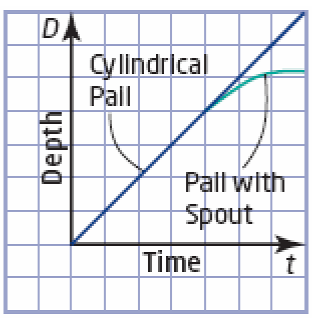
Chapter 2 Section 6 Question 7 Page 93



Chapter 2 Section 6 Question 8 Page 93



Chapter 2 Section 6 Question 9 Page 93



Chapter 2 Section 6 Question 10 Page 93

Answers will vary.

Chapter 2 Section 6 **Question 11** **Page 93**

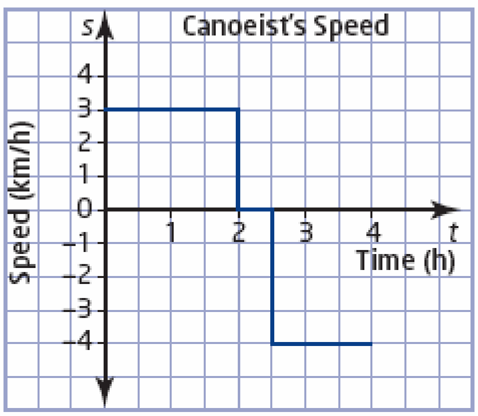
a)

$$\text{First segment } v = \frac{6.0 \text{ km}}{2.0 \text{ h}}$$
$$= 3 \text{ km/h}$$

$$\text{Second segment } v = \frac{0.0 \text{ km}}{2.0 \text{ h}}$$
$$= 0 \text{ km/h}$$

$$\text{Third segment } v = \frac{6.0 \text{ km}}{1.5 \text{ h}}$$
$$= 4 \text{ km/h}$$

b)



c) The steeper the graph, the faster the canoeist is paddling.

d) Negative speed indicates the rate at which the canoeist is returning to the dock.

Chapter 2 Section 6 **Question 12** **Page 94**

d) The horizontal axis represents time. The vertical axis represents the distance from the CBR™ to the ball.

e) The relation between distance and time is not linear. The points do not lie on a straight line.

l) The relation between time and bounce height is linear. The points lie along a straight line.

Chapter 2 Section 6 Question 13 Page 94

Answers will vary.

Chapter 2 Section 6 Question 14 Page 94

Use a table to help you with the "guess and check" method. A calculator or spreadsheet can also be used. Click here to load the spreadsheet file.

Year	Age	Sum of Digits
2005	0	7
2004	1	6
2003	2	5
2002	3	4
2001	4	3
2000	5	2
1999	6	28
1998	7	27
1997	8	26
1996	9	25
1995	10	24
1994	11	23
1993	12	22
1992	13	21
1991	14	20
1990	15	19
1989	16	27
1988	17	26
1987	18	25
1986	19	24
1985	20	23
1984	21	22
1983	22	21
1982	23	20
1981	24	19
1980	25	18
1979	26	26
1978	27	25
1977	28	24
1976	29	23
1975	30	22
1974	31	21

Shaheen was born in 1979, and was 26 on her birthday in 2005.

Chapter 2 Review

Chapter 2 Review Question 1 Page 95

Answers will vary. Sample answers are shown.

a) Hypothesis: As the temperature in a town during the summer increases, so does the volume of water used by the town's residents.

Opposite: As the temperature in a town during the summer increases, the volume of water used by the town's residents does not increase.

b) Hypothesis: Taller people have higher marks in mathematics.

Opposite: Taller people do not have higher marks in mathematics.

Chapter 2 Review Question 2 Page 95

a) This is primary data. This is a good choice, since a survey of students at the school could give more accurate results than secondary data would.

b) This is secondary data. This is a good choice, since primary data could take a lot of time to collect, and would not likely be significantly more accurate.

c) This is secondary data. This may not be a good choice, since the encyclopedia might not give information on bears in a specific province.

d) This is secondary data. This is not a good choice. The source of data is convenient, but may not reflect the tastes of students at the school.

Chapter 2 Review Question 3 Page 95

a) The population is all students at the school.

b) Answers will vary. A sample answer is shown.

Use a random number generator to randomly select 25% of the students from the class lists for each grade.

Chapter 2 Review Question 4 Page 95

a) The population is all passengers that fly on the airline.

b) Answers will vary. A sample answer is shown.

Obtain a list of all passengers who have flown on the airline. Randomly select one name on the list of the airline's passengers, and then select every hundredth person before and after that name.

Chapter 2 Review Question 5 Page 95

Answers for sampling techniques will vary. Sample answers are shown.

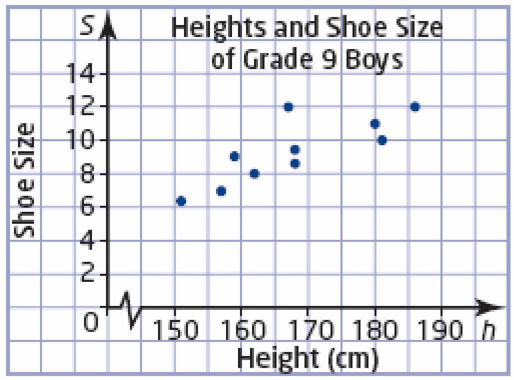
a) The population is all customers of the department store. The store can pick a customer at random, and then every 10th customer entering the store, to survey.

b) The population is all campers at provincial parks. Park rangers at each park can survey every 10th camper who registers.

c) The population is all students at the school. The librarian can use a random number generator to generate 50 random numbers between 1 and the population of the school. Then, he can use the numbers to select students from a school listing to survey.

Chapter 2 Review Question 6 Page 95

a) The scatter plot is shown.

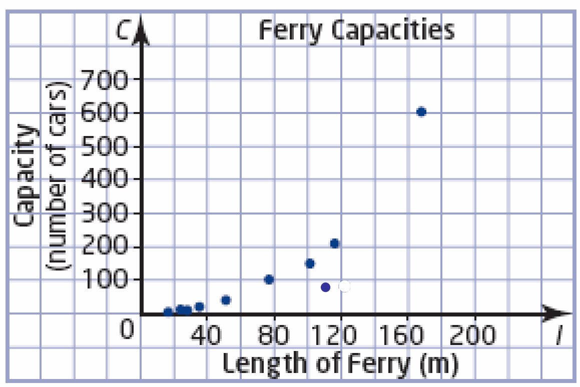


b) As the students' heights increase, so do their shoe sizes.

c) (167, 12) is an outlier, but should not be discarded since it is a valid measurement, unless there is some reason to believe that the measurement was made in error.

Chapter 2 Review Question 7 Page 96

a) The scatter plot is shown.



b) As the length of the ferry increases, the capacity also increases. The points follow a curve, so the relationship is non-linear.

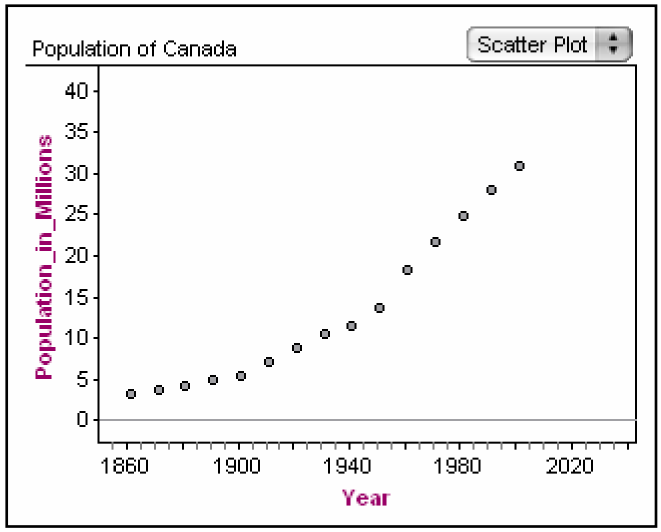
c) The point (110.8, 80) is an outlier.

Answers about causes may vary. Sample answers are shown.

The ferry might carry cargo as well as cars.
The ferry might carry fewer cars so that it can travel faster.
Some ferries derive most of their business from passengers, and may have few spaces for cars.

Chapter 2 Review **Question 8** **Page 96**

a) The scatter plot is shown.



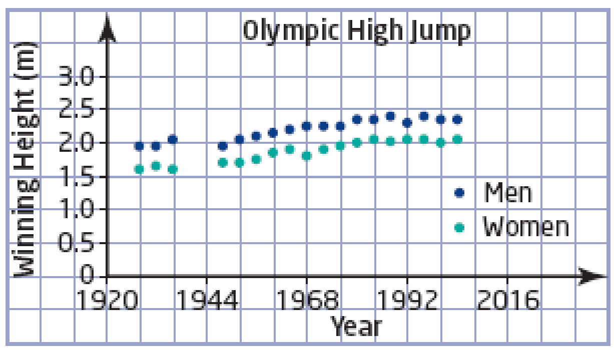
b) The population of Canada has grown at an increasing rate since 1861.

c) The population in 1967 was about 20 million.

d) The population in 2021 will be about 34 million.

Chapter 2 Review **Question 9** **Page 96**

a)



b) Both the men's and women's winning heights are increasing, but the rate of increase has been slower since about 1980.

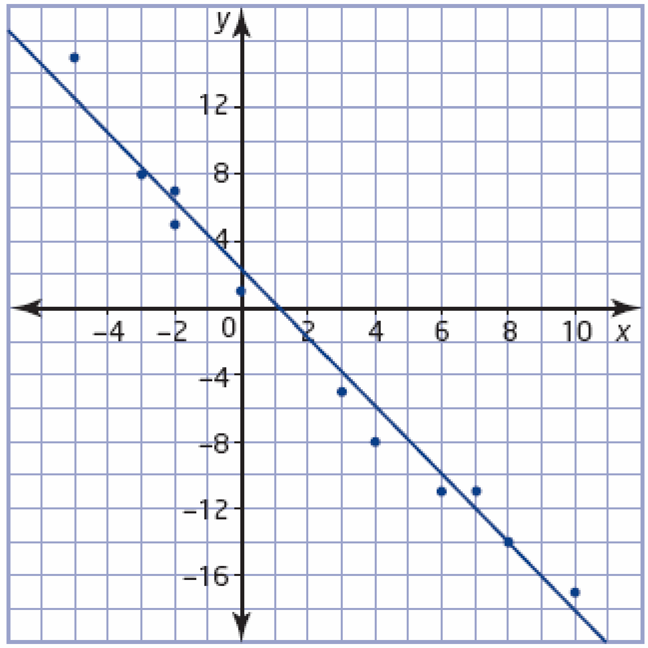
c) There are no apparent outliers.

d) Answers will vary. Sample answers are shown.

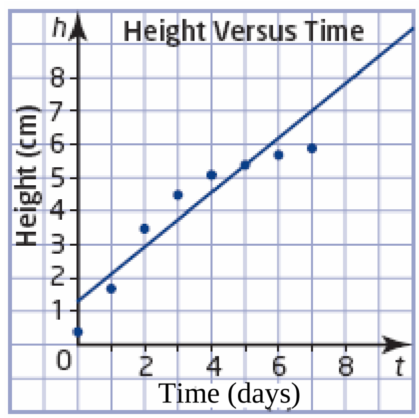
Men's winning height in 2012 will be about 2.48 m. Women's winning height will be about 2.15 m

Chapter 2 Review **Question 10** **Page 97**

a) The scatter plot and line of best fit are shown. The line is a good fit. All of the points are close to the line.



b) The scatter plot and line of best fit are shown. The line is not a good fit. The points appear to follow a curve.



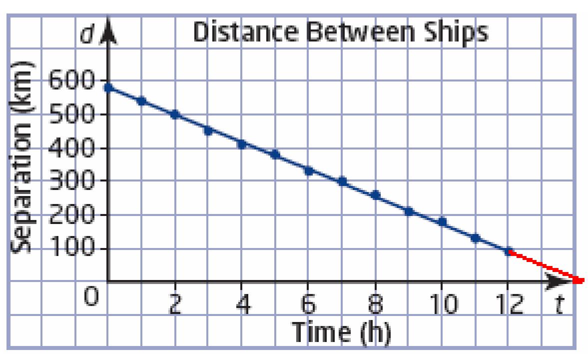
Chapter 2 Review **Question 11** **Page 97**

a) The scatter plot is shown.

b) As time increases, the distance between the two ships decreases. The relationship is linear.

c) There are no apparent outliers.

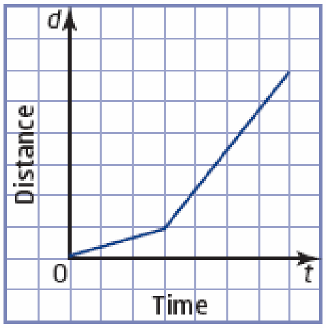
d) The ships will be closest to each other after 14.3 h.



Chapter 2 Review **Question 12** **Page 97**

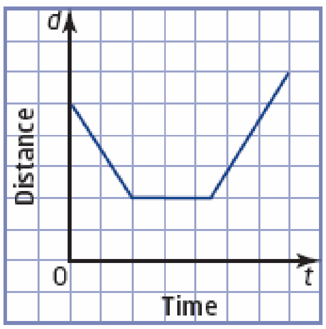
Answers may vary. Sample answers are shown.

a)



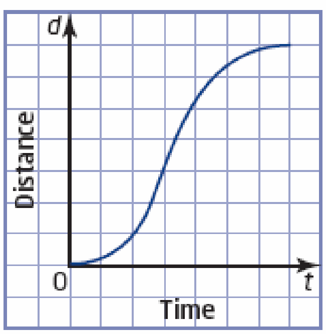
Marni walks away from her home for 2 min at a constant speed, and then runs in the same direction at a constant speed for 2 min.

b)



John bikes from school to a store, buys something, and then bikes back past the school to home.

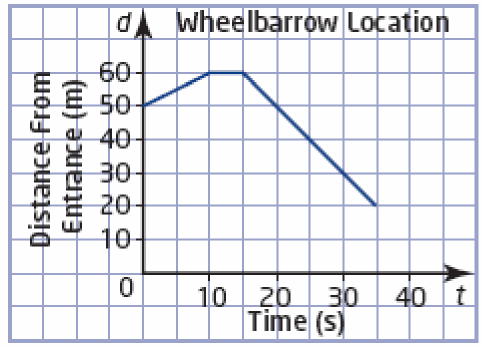
c)



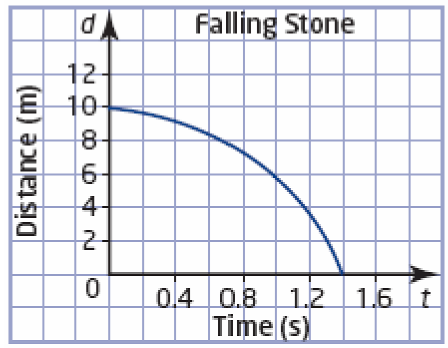
A car speeds up as it leaves a traffic light, and then slows down and stops at another light.

Chapter 2 Review **Question 13** **Page 97**

a) The distance-time graph is shown.



b) The distance-time graph is shown.



Chapter 2 Chapter Test

Chapter 2 Chapter Test Question 1 Page 98

Answer B is a primary source of data, since you are collecting it yourself. All of the others are secondary sources.

Chapter 2 Chapter Test Question 2 Page 98

Answer C is not a random sample. You are only surveying people on a particular street corner.

Chapter 2 Chapter Test Question 3 Page 98

Estimating value beyond the known data for a relation is extrapolation. Answer A.

Chapter 2 Chapter Test Question 4 Page 98

The final step in an experiment is the evaluation. Answer C.

Chapter 2 Chapter Test Question 5 Page 98

a) Caffeine cannot affect your sleep.

b) If you study more, your results on tests either improve or stay the same.

c) At least half of the students in your school do not have a part-time job.

d) Cell phone use has not more than doubled in the past 2 years.

Chapter 2 Chapter Test Question 6 Page 98

a) The population is all teachers working for the school board.

Answers will vary. Sample answers are shown.

b) Randomly select 20% of the teachers in each school.

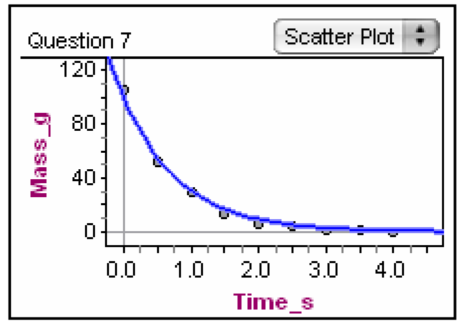
c) Select a name at random from a list of all of the teachers, and then select every fifth name before and after the first name selected.

d) Survey all the teachers in the nearest school.

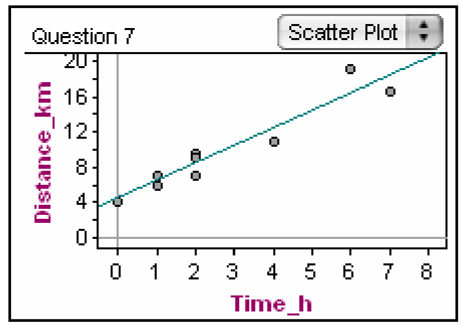
e) Teachers at the same school have the same students and working conditions. These teachers may not have the same concerns and opinions as teachers at other schools

Chapter 2 Chapter Test Question 7 Page 98

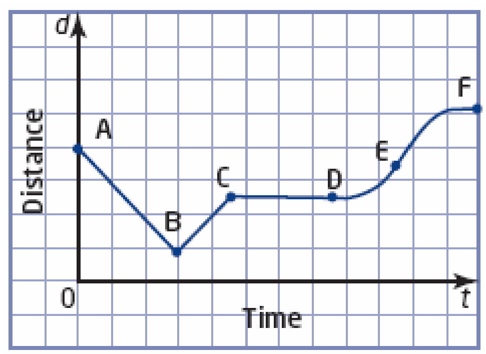
a) The scatter plot and curve of best fit are shown. The relation is non-linear.



b) The scatter plot and line of best fit are shown. The relation appears to be linear.



Chapter 2 Chapter Test Question 8 Page 99



AB: The distance is decreasing at a steady rate.

BC: The distance is increasing at a steady rate.

CD: There is no motion.

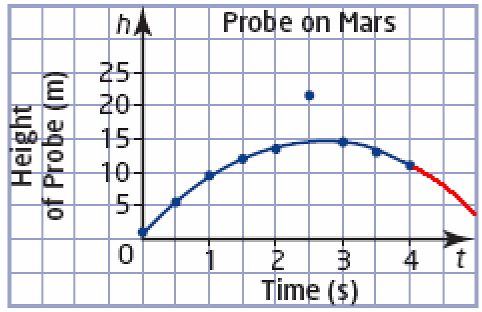
DE: The distance is increasing at an increasing rate.

EF: The distance is increasing at a decreasing rate.

Chapter 2 Chapter Test Question 9 Page 99

Answers will vary.

Chapter 2 Chapter Test **Question 10** **Page 99**



a) The scatter plot is shown.

b) The relation is non-linear. As time increases, the height first increases, then decreases.

c) The point (2.5, 21.4) is an outlier. Possible causes could be an inaccurate reading, or a data transmission error.

d) See the graph in part **a)** for the curve of best fit.

e) The extrapolation is shown on the graph. The height after 5 s is about 4.7 m.

Chapter 6 Analyse Linear Relations

Chapter 6 Get Ready

Chapter 6 Get Ready Question 1 Page 294

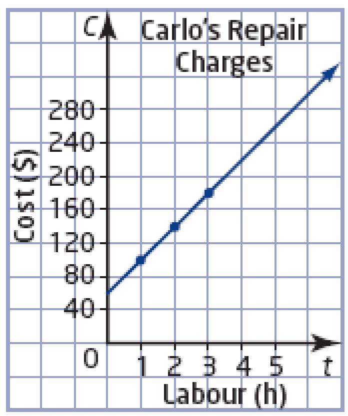
a)

Time Worked (h)	Earnings ($)
3	30
5	50
6	60
9	90

b) The graph crosses the vertical axis at the point (0, 0). This point shows the earnings, $0, after zero hours.

Chapter 6 Get Ready Question 2 Page 294

Labour (h)	Repair Cost ($)
1	100
2	140
3	180

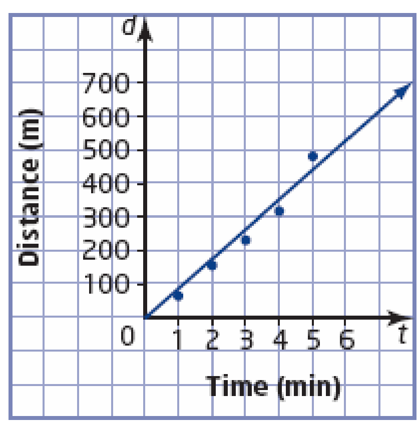


a) The graph is shown.

b) From the graph, the repair cost for a 5-h job is $260.

c) The graph crosses the vertical axis at the point (0, 60). This point shows the repair cost, $60, for 0 h. It is Carlo's basic charge to make a house call.

Chapter 6 Get Ready Question 3 Page 295



Answers will vary slightly. Sample answers are shown.

a) The distance travelled after 2.5 min is about 220 m.

b) The distance travelled after 6 min is about 540 m.

Chapter 6 Get Ready Question 4 Page 295

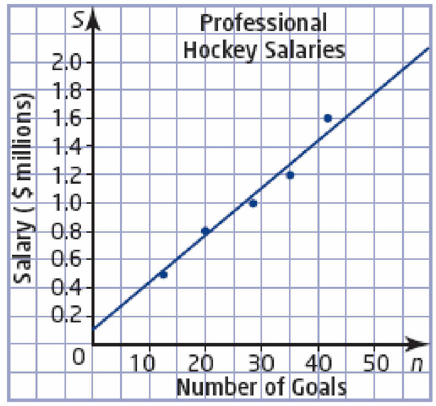
Answers will vary slightly. Sample answers are shown.

a) It took about 2 h 15 min to travel 200 m.

b) It took about 7 h to travel 600 m.

Chapter 6 Get Ready Question 5 Page 295

Number of Goals	Salary ($millions)
35	1.2
27	1.0
20	0.8
42	1.6
12	0.5



a) The graph and line of best fit are shown.

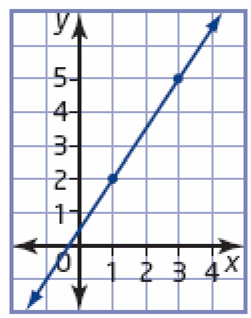
b) A player who scores 30 goals should be paid \$1.1 million. A player who scores 50 goals should be paid \$1.8 million.

c) A player who is paid \$1.4 million should score 38 goals. A player who is paid \$2 million should score 56 goals.

Chapter 6 Get Ready Question 6 Page 295

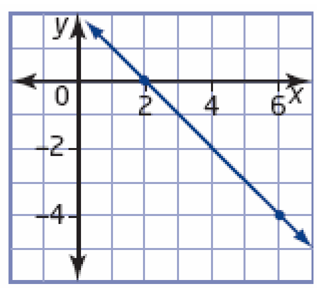
a)
$$m = \frac{\text{rise}}{\text{run}} = \frac{3}{2}$$

The slope is $\frac{3}{2}$.



b)
$$m = \frac{\text{rise}}{\text{run}} = \frac{-4}{4} = -1$$

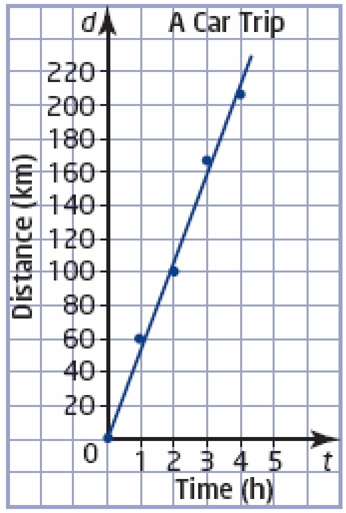
The slope is –1.



Chapter 6 Get Ready **Question 7** **Page 295**

Time (h)	Distance (km)
0	0
1	60
2	100
3	165
4	205

a) The graph and line of best fit are shown.



b) Answers will vary slightly. Sample answers are (2, 106), and (4, 209).

c) Use $(x_1, y_1) = (2, 106)$ and $(x_2, y_2) = (4, 209)$.

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{209 - 106}{4 - 2} \\ &= \frac{103}{2} \\ &= 51.5 \end{aligned}$$

The slope is 51.5. This means that the average speed of the car is 51.5 km/h.

Chapter 6 Section 1: The Equation of a Line in Slope *y*-Intercept Form: $y = mx + b$

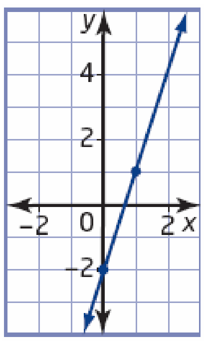
Chapter 6 Section 1 Question 1 Page 304

	Equation	Slope	y-intercept
a)	$y = 4x + 1$	4	1
b)	$y = \frac{2}{3}x + 3$	$\frac{2}{3}$	3
c)	$y = x - 2$	1	–2
d)	$y = -\frac{2}{3}x$	$-\frac{2}{3}$	0
e)	$y = 3$	0	3
f)	$y = -x - \frac{1}{2}$	–1	$-\frac{1}{2}$

Chapter 6 Section 1 Question 2 Page 304

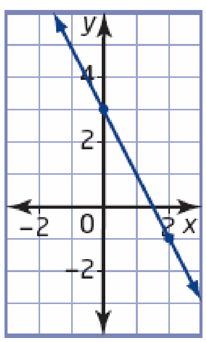
a)
$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{1-(-2)}{1-0} \\ &= \frac{3}{1} \\ &= 3 \end{aligned}$$

The slope is 3, and the *y*-intercept is –2.



b)
$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-1-3}{2-0} \\ &= \frac{-4}{2} \\ &= -2 \end{aligned}$$

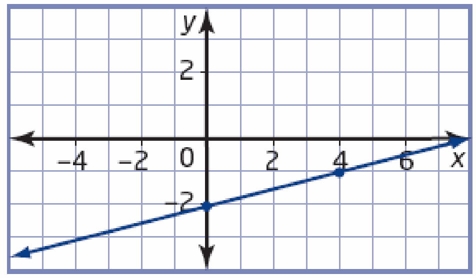
The slope is –2, and the *y*-intercept is 3.



c) $m = \frac{y_2 - y_1}{x_2 - x_1}$

$= \frac{-1-(-2)}{4-0}$

$= \frac{1}{4}$

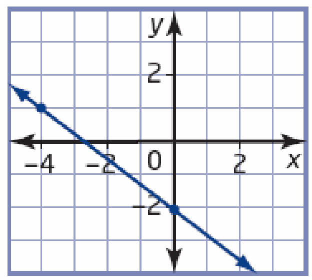


The slope is $\frac{1}{4}$, and the *y*-intercept is –2.

d) $m = \frac{y_2 - y_1}{x_2 - x_1}$

$= \frac{-2-1}{0-(-4)}$

$= -\frac{3}{4}$



The slope is $-\frac{3}{4}$, and the *y*-intercept is –2.

Chapter 6 Section 1 Question 3 Page 304

a) $y = 3x - 2$

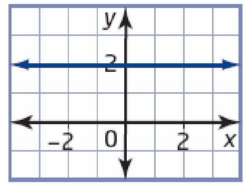
b) $y = -2x + 3$

c) $y = \frac{1}{4}x - 2$

d) $y = -\frac{3}{4}x - 2$

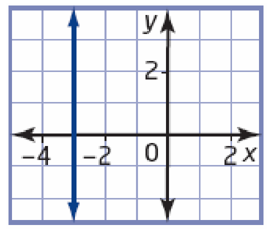
Chapter 6 Section 1 **Question 4** **Page 304**

a) $y = 2$



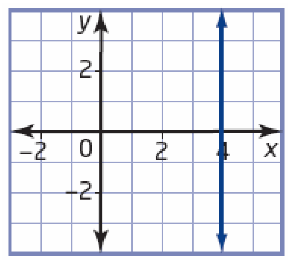
The slope is 0, and the y-intercept is 2.

b) $x = -3$



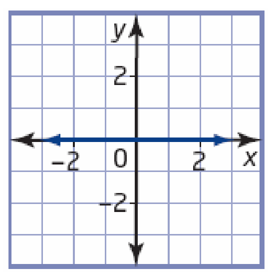
The slope is undefined, and there is no y-intercept.

c) $x = 4$



The slope is undefined, and there is no y-intercept.

d) $y = 0$



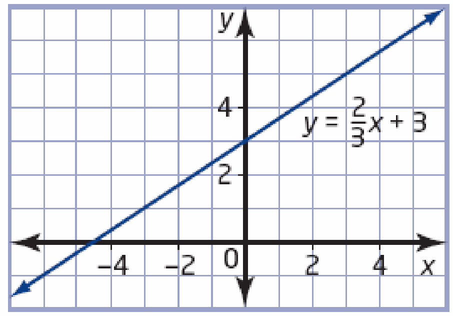
The slope is 0, and the y-intercept is 0.

Chapter 6 Section 1 **Question 5** **Page 304**

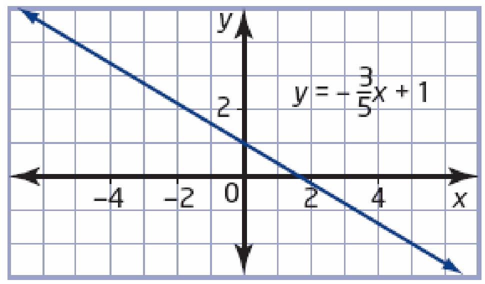
The line in question 4, part d), is the x-axis.

Chapter 6 Section 1 **Question 6** **Page 305**

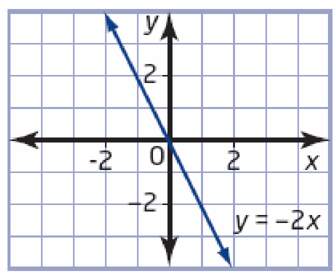
a) $y = \frac{2}{3}x + 3$



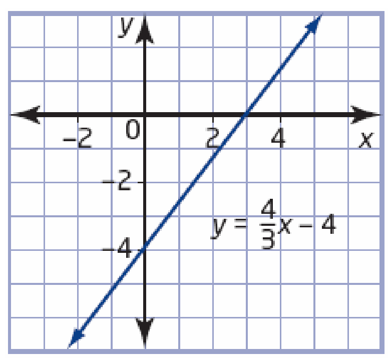
b) $y = -\frac{3}{5}x + 1$



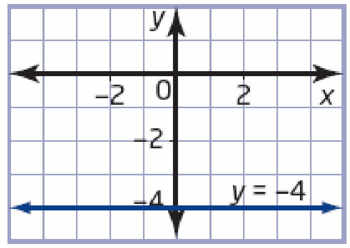
c) $y = -2x$



d) $y = \frac{4}{3}x - 4$



e) $y = -4$



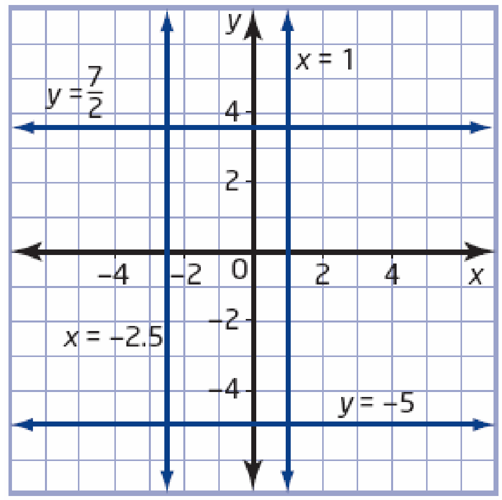
Chapter 6 Section 1 Question 7 Page 305

a) The slope is 0, and the *y*-intercept is –5.

b) The slope is undefined, and there is no *y*-intercept.

c) The slope is 0, and the *y*-intercept is $\frac{7}{2}$.

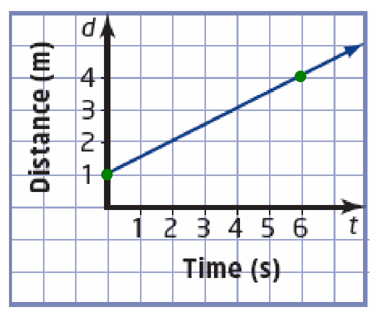
d) The slope is undefined, and there is no *y*-intercept.



Chapter 6 Section 1 Question 8 Page 305

a) The person was at an initial distance of 1 m from the sensor.

b)
$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{4-1}{6-0} \\ &= \frac{3}{6} \\ &= 0.5 \end{aligned}$$

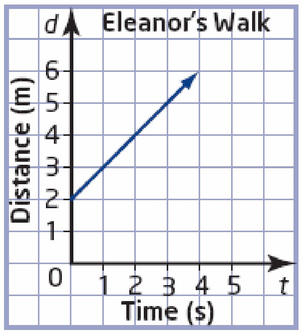


The person was walking at a speed of 0.5 m/s.

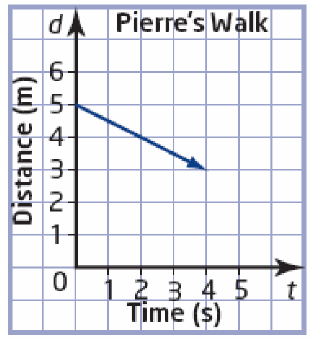
c) The person was walking away from the sensor. This is because on the graph, the person's distance from the sensor increases as time goes by.

Chapter 6 Section 1 Question 9 Page 305

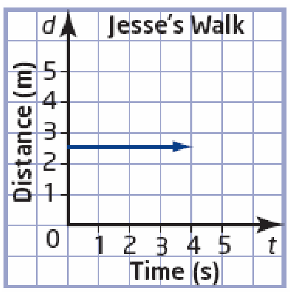
a)



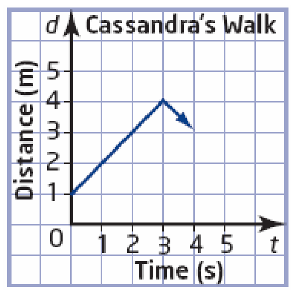
b)



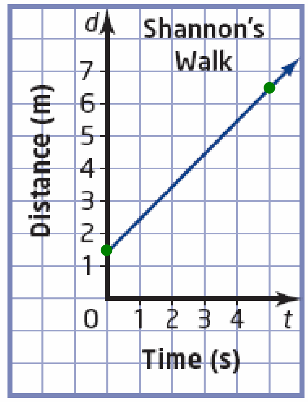
c)



d)



Chapter 6 Section 1 Question 10 Page 306



a) $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$= \dfrac{6.5 - 1.5}{5 - 0}$

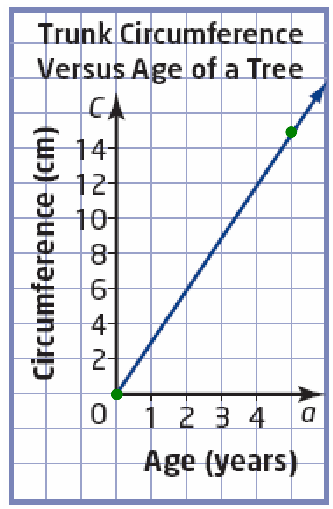
$= \dfrac{5}{5}$

$= 1$

The slope is 1, and the *y*-intercept is 1.5.

The slope represents Shannon's walking speed of 1 m/s away from the sensor. The *t*-intercept represents Shannon's initial distance of 1.5 m away from the sensor.

The equation is $d = t + 1.5$.



b) $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$= \dfrac{15 - 0}{5 - 0}$

$= \dfrac{15}{5}$

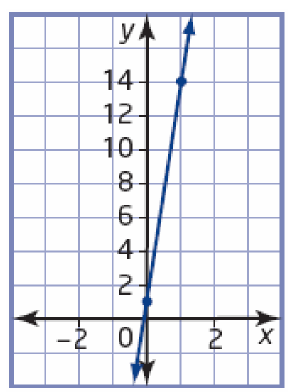
$= 3$

The slope is 3, and the *y*-intercept is 0.

The slope shows that the circumference of the trunk is three times its age. The *a*-intercept shows that when the tree began to grow from a seed, it had circumference zero.

The equation is $C = 3a$.

Chapter 6 Section 1 Question 11 Page 306



$m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$= \dfrac{14 - 1}{1 - 0}$

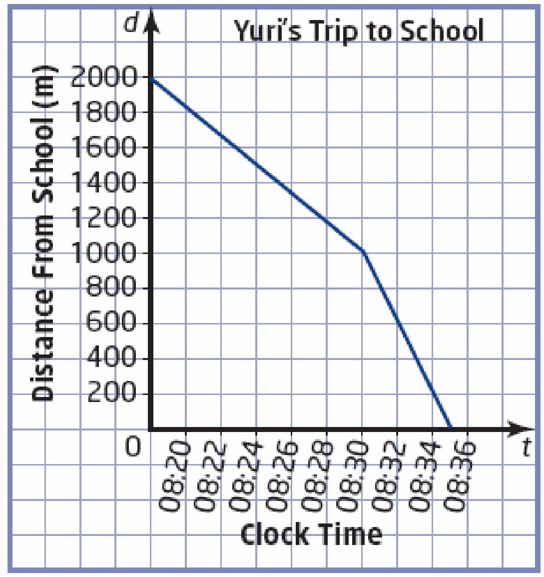
$= \dfrac{13}{1}$

$= 13$

The slope is 13, and the *y*-intercept is 1. The letters are m and a.

Chapter 6 Section 1 Question 12 Page 306

Answers will vary. Sample answers are shown.



Yuri left home at 08:18 on his rollerblades. He travelled the first kilometre to school in 12 minutes, or 0.2 h, at a speed of $\frac{1}{0.2}$, or 5 km/h. Concerned that he might be late, he increased his speed, travelling the second kilometre in 5 minutes, or $\frac{1}{12}$ h, at a speed of $\frac{1}{\frac{1}{12}}$, or 12 km/h. Yuri arrived at school at 08:35, five minutes late.

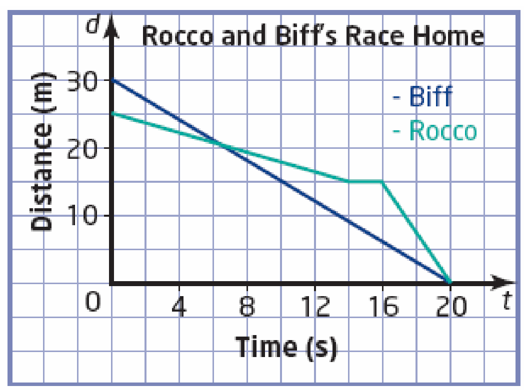
Chapter 6 Section 1 Question 13 Page 307

Answers will vary. A sample answer is shown.

If Yuri left 10 min earlier at 08:08, the graph would shift to the left by 10 min. He would have arrived at school at 08:25, five minutes early.

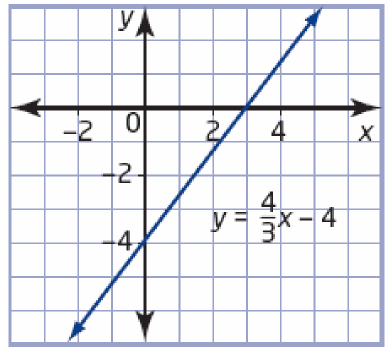
Chapter 6 Section 1 Question 14 Page 307

Answers will vary. Sample answers are shown.



Biff moves at a constant speed, reaching home in 20 s, at a speed of $\frac{30}{20}$, or 1.5 m/s. Rocco started 25 m from home, and moved at a constant speed up to 15 m in 14 s, at a speed of $\frac{15}{14}$, or about 1.07 m/s. He stopped for 2 s, and then ran the remaining 15 m in 4 s, at a speed of $\frac{15}{4}$, or 3.75 m/s. Both bears reached home at the same time, after 20 s.

Chapter 6 Section 1 **Question 15** **Page 307**



a) The value of the *y*-coordinate for any *x*-intercept is 0. In the graph shown, the *x*-intercept is (3, 0).

b)

$$\begin{aligned} y &= 3x - 6 \\ 0 &= 3x - 6 \\ 0 + 6 &= 3x - 6 + 6 \\ 6 &= 3x \\ \frac{6}{3} &= \frac{3x}{3} \\ 2 &= x \end{aligned}$$

The *x*-intercept is 2.

$$\begin{aligned} y &= \frac{2}{3}x + 5 \\ 0 &= \frac{2}{3}x + 5 \\ 0 - 5 &= \frac{2}{3}x + 5 - 5 \\ -5 &= \frac{2}{3}x \\ 3(-5) &= 3 \times \frac{2}{3}x \\ -15 &= 2x \\ \frac{-15}{2} &= \frac{2x}{2} \\ -\frac{15}{2} &= x \end{aligned}$$

The *x*-intercept is $-\frac{15}{2}$.

Chapter 6 Section 1   Question 16 Page 307

a) Use the "guess and check" method. The first positive integer that works is 11.

b) Continue using the "guess and check" method. Other numbers that work are 23, 35, 47, 59, and 71.

c) The pattern is add 12 to get the next term. You can find other numbers that work by multiplying a whole number by 12, and adding 11.

Chapter 6 Section 2 The Equation of a Line in Standard Form: *Ax* + *By* + *C* = 0

Chapter 6 Section 2 Question 1 Page 312

a)
$$\begin{aligned} x+y-3&=0\\ x+y-3-x+3&=0-x+3\\ y&=-x+3 \end{aligned}$$

b)
$$\begin{aligned} 2x+3y+6&=0\\ 2x+3y+6-2x-6&=0-2x-6\\ 3y&=-2x-6\\ \frac{3y}{3}&=\frac{-2x-6}{3}\\ y&=\frac{-2x}{3}-\frac{6}{3}\\ y&=-\frac{2}{3}x-2 \end{aligned}$$

c)
$$\begin{aligned} x-4y+12&=0\\ x-4y+12-x-12&=0-x-12\\ -4y&=-x-12\\ \frac{-4y}{-4}&=\frac{-x-12}{-4}\\ y&=\frac{-1x}{-4}+\frac{-12}{-4}\\ y&=\frac{1}{4}x+3 \end{aligned}$$

d)
$$\begin{aligned} 3x+2y-5&=0\\ 3x+2y-5-3x+5&=0-3x+5\\ 2y&=-3x+5\\ \frac{2y}{2}&=\frac{-3x+5}{2}\\ y&=\frac{-3x}{2}+\frac{5}{2}\\ y&=-\frac{3}{2}x+\frac{5}{2} \end{aligned}$$

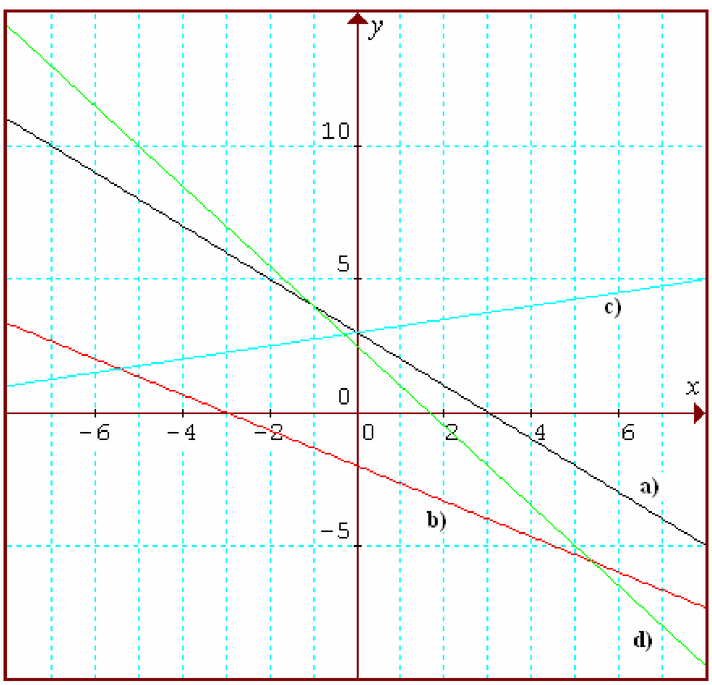
Chapter 6 Section 2 Question 2 Page 312

a) The slope is –1, and the *y*-intercept is 3.

b) The slope is $-\frac{2}{3}$, and the *y*-intercept is –2.

c) The slope is $\frac{1}{4}$, and the *y*-intercept is 3.

d) The slope is $-\frac{3}{2}$, and the *y*-intercept is $\frac{5}{2}$.



Chapter 6 Section 2 **Question 3 Page 312**

a)

$$
\begin{aligned}
x+3y-3&=0\\
x+3y-3-x+3&=0-x+3\\
3y&=-x+3\\
\frac{3y}{3}&=\frac{-x+3}{3}\\
y&=\frac{-1x}{3}+\frac{3}{3}\\
y&=-\frac{1}{3}x+1
\end{aligned}
$$

The slope is $-\frac{1}{3}$, and the *y*-intercept is 1.

b)

$$
\begin{aligned}
2x-5y+8&=0\\
2x-5y+8-2x-8&=0-2x-8\\
-5y&=-2x-8\\
\frac{-5y}{-5}&=\frac{-2x-8}{-5}\\
y&=\frac{-2x}{-5}+\frac{-8}{-5}\\
y&=\frac{2}{5}x+\frac{8}{5}
\end{aligned}
$$

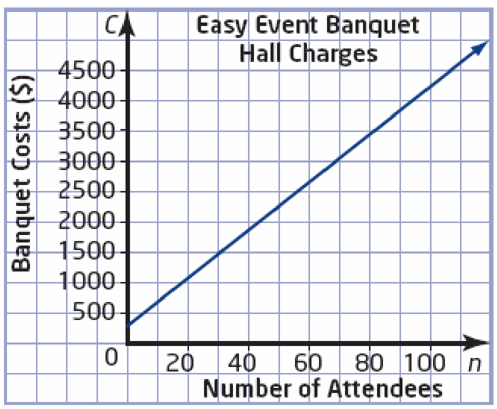
The slope is $\frac{2}{5}$, and the *y*-intercept is $\frac{8}{5}$.

Chapter 6 Section 2 **Question 4** **Page 312**

a)
$$
\begin{aligned}
40n - C + 250 &= 0 \\
40n - C + 250 - 40n - 250 &= 0 - 40n - 250 \\
-C &= -40n - 250 \\
\frac{-C}{-1} &= \frac{-40n - 250}{-1} \\
C &= \frac{-40n}{-1} + \frac{-250}{-1} \\
C &= 40n + 250
\end{aligned}
$$

b) The fixed cost is \$250. The variable cost is \$40 per person.

c)



d)
$$
\begin{aligned}
C &= 40(100) + 250 \\
&= 4000 + 250 \\
&= 4250
\end{aligned}
$$

The cost for 100 people is \$4250.

e) This is not a better deal than Celebrations. Celebrations charges \$3750 for 100 people, whereas Easy Event charges \$4250.

Chapter 6 Section 2 Question 5 Page 312

$$\begin{aligned} C &= 40(50) + 250 \\ &= 2000 + 250 \\ &= 2250 \end{aligned}$$

The cost for 50 people at Easy Event is $2250.

$$\begin{aligned} C &= 25(50) + 1250 \\ &= 1250 + 1250 \\ &= 2500 \end{aligned}$$

If only 50 people attend, then the cost at Celebrations is $2500 and the cost at Easy Event is $2250. In this case, Easy Event is a better deal. This is because the lower fixed cost at Easy Event offsets the higher variable cost when there are fewer people at a banquet.

Chapter 6 Section 2 Question 6 Page 313

$$\begin{aligned} n - E + 15 &= 0 \\ n - E + 15 - n - 15 &= 0 - n - 15 \\ -E &= -n - 15 \\ \frac{-E}{-1} &= -\frac{n}{-1} - \frac{15}{-1} \\ E &= n + 15 \end{aligned}$$

$$\begin{aligned} E &= 0 + 15 \\ &= 15 \end{aligned}$$

$$\begin{aligned} E &= 5 + 15 \\ &= 20 \end{aligned}$$

A beginning factory worker earns $15/h, while a factory worker with 5 years of experience earns $20/h.

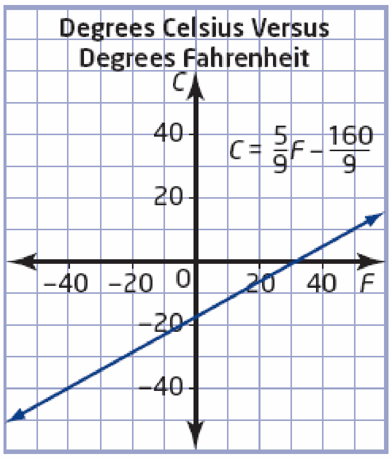
The letters are o and t.

Chapter 6 Section 2 **Question 7** **Page 313**

a)

$$\begin{aligned}
9C - 5F + 160 &= 0 \\
9C - 5F + 160 + 5F - 160 &= 0 + 5F - 160 \\
9C &= 5F - 160 \\
\frac{9C}{9} &= \frac{5F - 160}{9} \\
C &= \frac{5F}{9} - \frac{160}{9} \\
C &= \frac{5}{9}F - \frac{160}{9}
\end{aligned}$$

b)



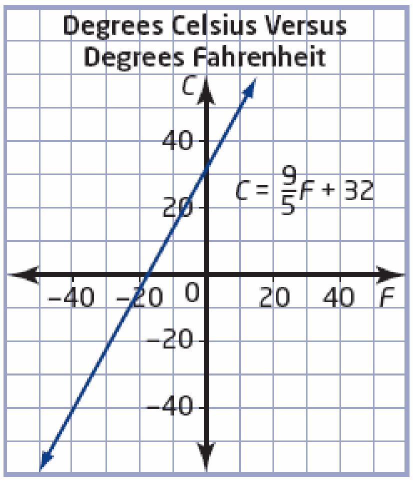
c) The slope is $\frac{5}{9}$ and the C-intercept is $-\frac{160}{9}$. The slope is a multiplication coefficient and the C-intercept is a constant. To change a Fahrenheit temperature to a Celsius temperature, multiply the Fahrenheit temperature by the slope and add the C-intercept.

Chapter 6 Section 2 Question 8 Page 313

a)

$$
\begin{aligned}
9C - 5F + 160 &= 0 \\
9C - 5F + 160 - 9C - 160 &= 0 - 9C - 160 \\
-5F &= -9C - 160 \\
\frac{-5F}{-5} &= \frac{-9C - 160}{-5} \\
F &= \frac{-9C}{-5} + \frac{-160}{-5} \\
F &= \frac{9}{5}C + 32
\end{aligned}
$$

b)



c) The slope is $\frac{9}{5}$ and the F-intercept is 32. The slope is a coefficient and the F-intercept is a constant. To change a Celsius temperature to a Fahrenheit temperature, multiply the Celsius temperature by the slope and add the F-intercept.

Chapter 6 Section 2 Question 9 Page 313

a) The two graphs are similar in that they both have positive slope. They are different in that one has a positive vertical intercept while the other has a negative vertical intercept.

b) The slopes of the two graphs are reciprocals because $\frac{9}{5} \times \frac{5}{9} = 1$.

Chapter 6 Section 2 Question 10 Page 313

Solutions for Achievement Checks are shown in the Teacher's Resource.

Chapter 6 Section 2 Question 11 Page 314

a)

$$\begin{aligned} y &= -2x+7 \\ y+2x-7 &= -2x+7+2x-7 \\ 2x+y-7 &= 0 \end{aligned}$$

$A=2, B=1, C=-7$

b)

$$\begin{aligned} y &= x-3 \\ y-x+3 &= x-3-x+3 \\ -x+y+3 &= 0 \\ \frac{-x+y+3}{-1} &= \frac{0}{-1} \\ \frac{-1x}{-1}+\frac{y}{-1}+\frac{3}{-1} &= 0 \\ x-y-3 &= 0 \end{aligned}$$

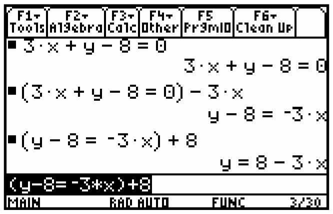
$A=1, B=-1, C=-3$

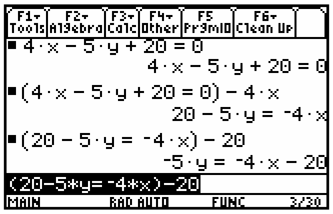
c)

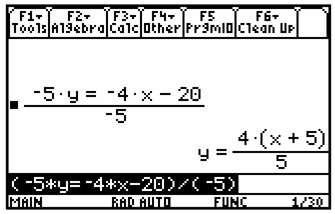
$$\begin{aligned} y &= \frac{3}{4}x-2 \\ 4\times y &= 4\times\left(\frac{3}{4}x-2\right) \\ 4y &= 4\times\frac{3}{4}x-4\times 2 \\ 4y &= 3x-8 \\ 4y-3x+8 &= 3x-8-3x+8 \\ -3x+4y+8 &= 0 \\ \frac{-3x+4y+8}{-1} &= \frac{0}{-1} \\ \frac{-3x}{-1}+\frac{4y}{-1}+\frac{8}{-1} &= 0 \\ 3x-4y-8 &= 0 \end{aligned}$$

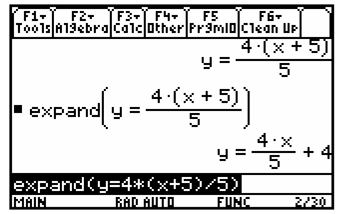
$A=3, B=-4, C=-8$

f)


F1 Tools F2 Algebra F3 Calc F4 Other F5 PrgmIO F6 Clean Up
■ 3·x + y − 8 = 0
3·x + y − 8 = 0
■ (3·x + y − 8 = 0) − 3·x
y − 8 = −3·x
■ (y − 8 = −3·x) + 8
y = 8 − 3·x
(y-8=-3*x)+8
MAIN RAD AUTO FUNC 3/30


F1 Tools F2 Algebra F3 Calc F4 Other F5 PrgmIO F6 Clean Up
■ 4·x − 5·y + 20 = 0
4·x − 5·y + 20 = 0
■ (4·x − 5·y + 20 = 0) − 4·x
20 − 5·y = −4·x
■ (20 − 5·y = −4·x) − 20
−5·y = −4·x − 20
(20-5*y=-4*x)-20
MAIN RAD AUTO FUNC 3/30

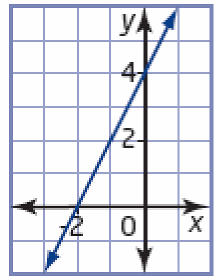

F1 Tools F2 Algebra F3 Calc F4 Other F5 PrgmIO F6 Clean Up
■ (−5·y = −4·x − 20) / −5
y = 4·(x + 5) / 5
(-5*y=-4*x-20)/(-5)
MAIN RAD AUTO FUNC 1/30


F1 Tools F2 Algebra F3 Calc F4 Other F5 PrgmIO F6 Clean Up
y = 4·(x + 5) / 5
■ expand(y = 4·(x + 5) / 5)
y = 4·x / 5 + 4
expand(y=4*(x+5)/5)
MAIN RAD AUTO FUNC 2/30

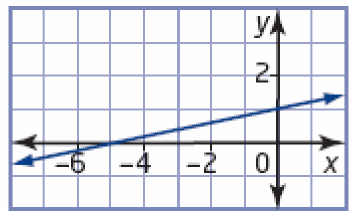
Chapter 6 Section 3   Graph a Line Using Intercepts

Chapter 6 Section 3   Question 1   Page 319

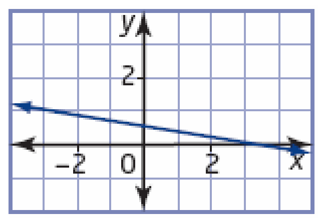
a) The *x*-intercept is –2. The *y*-intercept is 4.



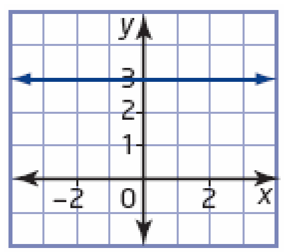
b) The *x*-intercept is –5. The *y*-intercept is 1.



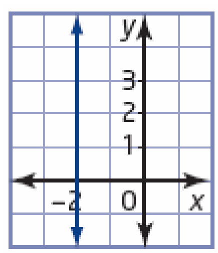
c) The *x*-intercept is 3. The *y*-intercept is 0.5.



d) The *x*-intercept does not exist. The *y*-intercept is 3.

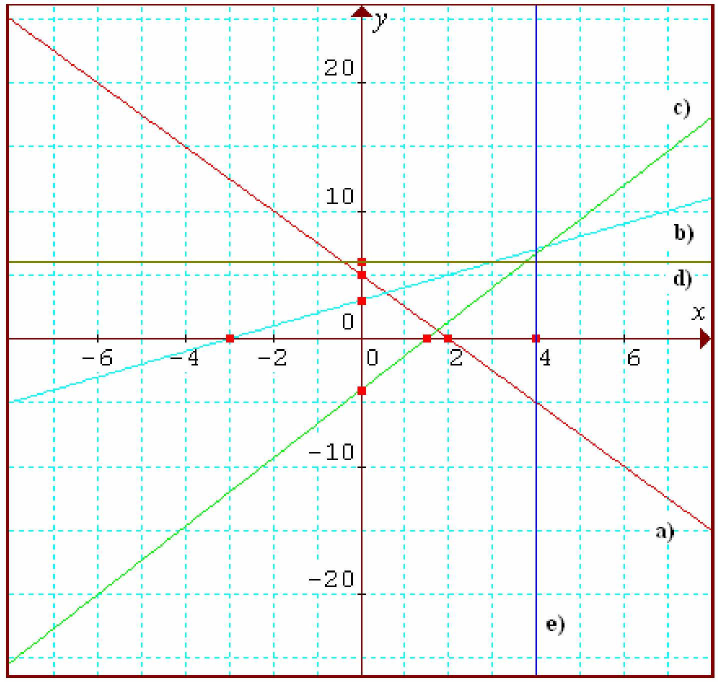


e) The *x*-intercept is –2. The *y*-intercept is does not exist.



Chapter 6 Section 3 **Question 2** **Page 319**

x-intercept	*y*-intercept
2	5
−3	3
1.5	−4
none	6
4	none

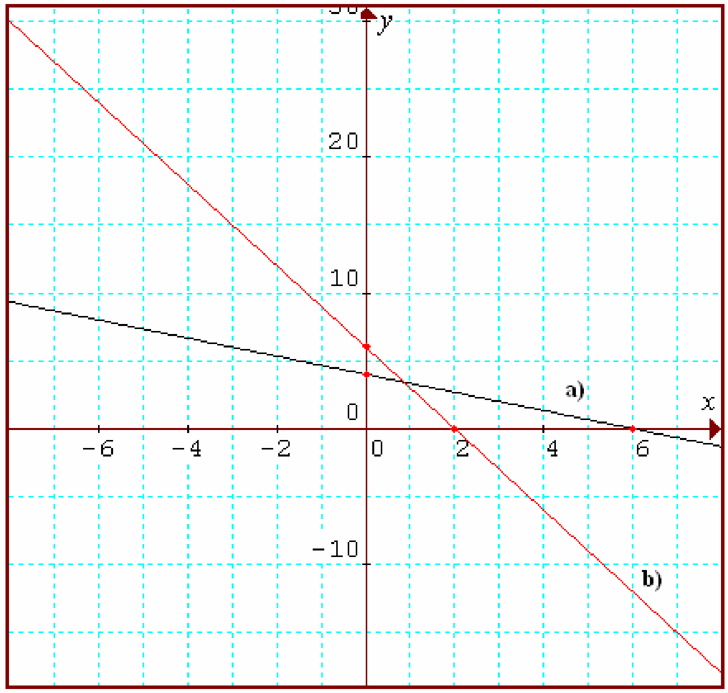


Chapter 6 Section 3 **Question 3** **Page 320**

a)

$$\begin{aligned} 2x+3y &= 12 \\ 2x+3(0) &= 12 \\ 2x &= 12 \\ \frac{2x}{2} &= \frac{12}{2} \\ x &= 6 \\ 2(0)+3y &= 12 \\ 3y &= 12 \\ \frac{3y}{3} &= \frac{12}{3} \\ y &= 4 \end{aligned}$$

The x-intercept is 6 and the y-intercept is 4.



b)

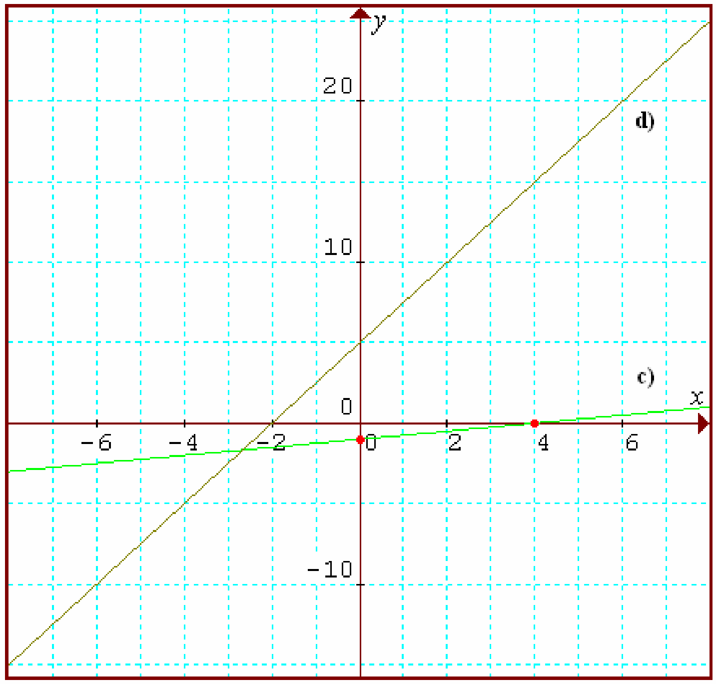
$$\begin{aligned} 3x+y &= 6 \\ 3x+(0) &= 6 \\ 3x &= 6 \\ \frac{3x}{3} &= \frac{6}{3} \\ x &= 2 \\ 3(0)+y &= 6 \\ y &= 6 \end{aligned}$$

The x-intercept is 2 and the y-intercept is 6.

c)

$$x - 4y = 4$$
$$x - 4(0) = 4$$
$$x = 4$$
$$(0) - 4y = 4$$
$$-4y = 4$$
$$\frac{-4y}{-4} = \frac{4}{-4}$$
$$y = -1$$

The x-intercept is 4 and the y-intercept is –1.



d)

$$-5x + 2y = 10$$
$$-5x + 2(0) = 10$$
$$-5x = 10$$
$$\frac{-5x}{-5} = \frac{10}{-5}$$
$$x = -2$$
$$-5(0) + 2y = 10$$
$$2y = 10$$
$$\frac{2y}{2} = \frac{10}{2}$$
$$y = 5$$

The x-intercept is –2 and the y-intercept is 5.

e)

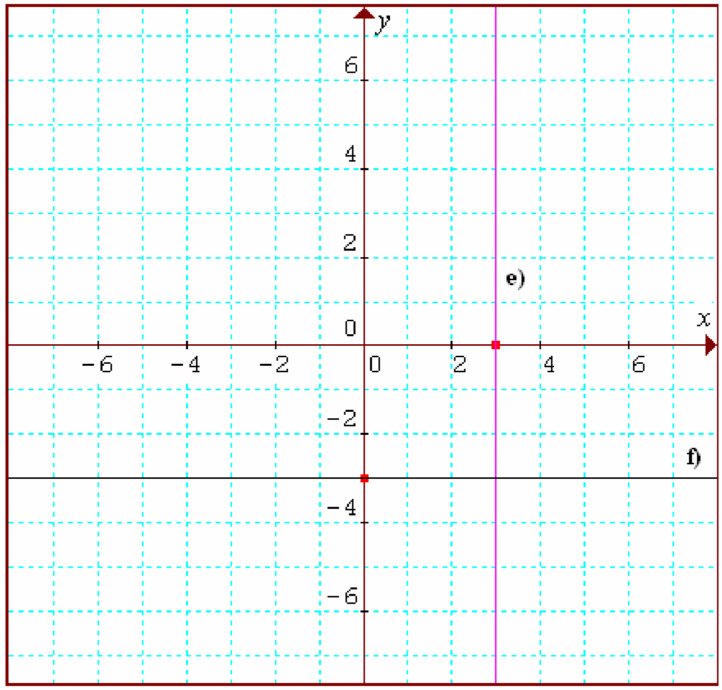
$$4x = 12$$
$$\frac{4x}{4} = \frac{12}{4}$$
$$x = 3$$

The *x*-intercept is 3 and the *y*-intercept does not exist.

f)

$$3y = -9$$
$$\frac{3y}{3} = \frac{-9}{3}$$
$$y = -3$$

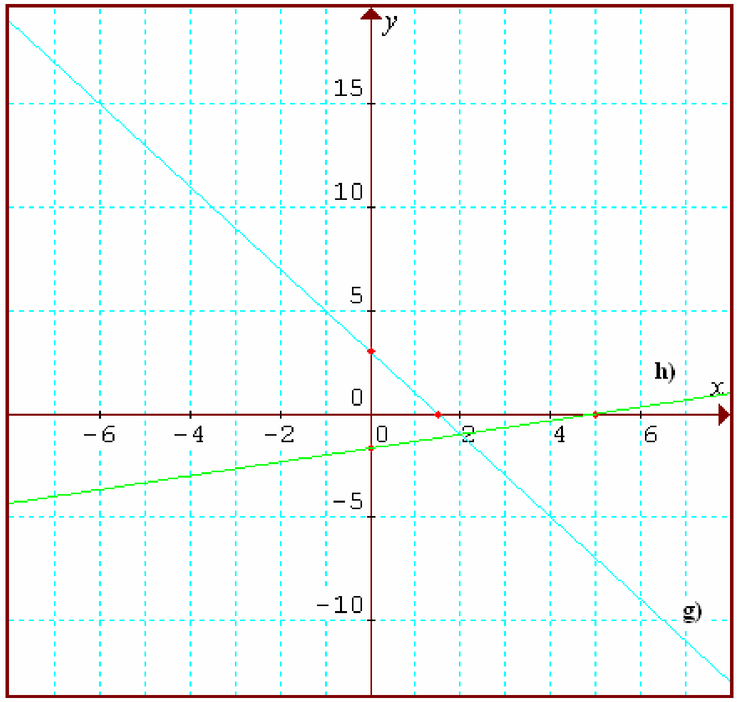
The *x*-intercept does not exist and the *y*-intercept is –3.



g)

$$4x + 2y = 6$$
$$4x + 2(0) = 6$$
$$4x = 6$$
$$\frac{4x}{4} = \frac{6}{4}$$
$$x = \frac{3}{2}$$
$$4(0) + 2y = 6$$
$$2y = 6$$
$$\frac{2y}{2} = \frac{6}{2}$$
$$y = 3$$

The x-intercept is $\frac{3}{2}$ and the y-intercept is 3.



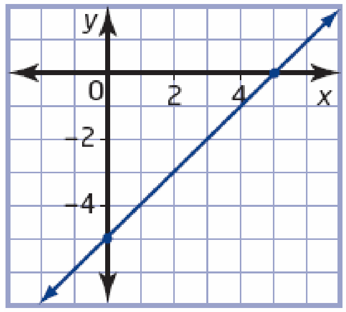
h)

$$x - 3y = 5$$
$$x - 3(0) = 5$$
$$x = 5$$
$$(0) - 3y = 5$$
$$-3y = 5$$
$$\frac{-3y}{-3} = \frac{5}{-3}$$
$$y = -\frac{5}{3}$$

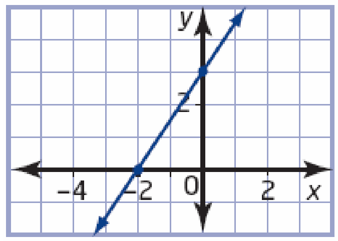
The x-intercept is 5 and the y-intercept is $-\frac{5}{3}$.

Chapter 6 Section 3 **Question 4** **Page 320**

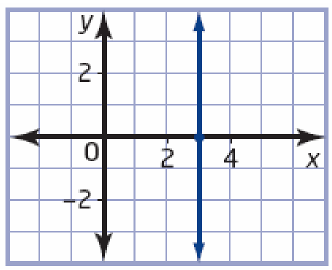
a)
$$
\begin{aligned}
m &= \frac{\text{rise}}{\text{run}} \\
&= \frac{5}{5} \\
&= 1
\end{aligned}
$$



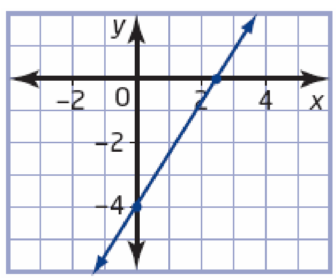
b)
$$
\begin{aligned}
m &= \frac{\text{rise}}{\text{run}} \\
&= \frac{3}{2}
\end{aligned}
$$



c) The slope is undefined.



d)
$$
\begin{aligned}
m &= \frac{\text{rise}}{\text{run}} \\
&= \frac{4}{2.5} \\
&= \frac{40}{25} \\
&= \frac{8}{5} \text{ or } 1.6
\end{aligned}
$$



Chapter 6 Section 3 Question 5 Page 320

a) Use the points (6, 0) and (0, 5).

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{5-0}{0-6}$$
$$= -\frac{5}{6}$$

b) Use the points (3, 0) and (0, –4).

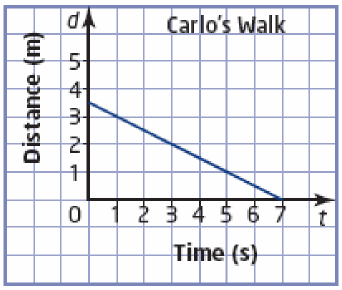
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{-4-0}{0-3}$$
$$= \frac{-4}{-3}$$
$$= \frac{4}{3}$$

c) Use the points (–6, 0) and (0, 3).

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{3-0}{0-(-6)}$$
$$= \frac{3}{6}$$
$$= \frac{1}{2}$$

d) Since there is no x-intercept, the line is horizontal. The slope is 0.

Chapter 6 Section 3 Question 6 Page 320



a) The d-intercept, 3.5, represents Carlo's initial distance from the motion sensor because the t-value at the d-intercept is 0.

b) The t-intercept, 7, represents the time at which Carlo's distance from the motion sensor is 0 because the d-value at the t-intercept is 0.

c) Answers will vary. A sample answer is shown.

Start 3.5 m away from the motion sensor and walk towards it at a speed of 0.5 m/s.

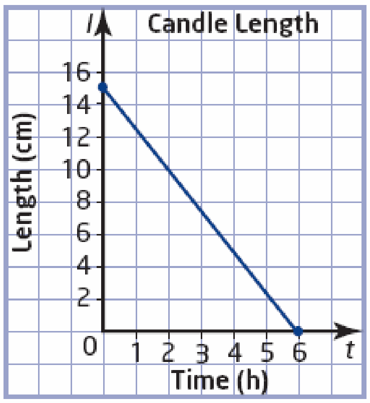
Chapter 6 Section 3 Question 7 Page 321

Answers will vary. A sample answer is shown.

The coefficient of x is 1. This makes it easy to determine the x-intercept.

Chapter 6 Section 3 Question 8 Page 321

a)



b) The slope should be negative because the candle's length decreases with time.

c) Refer to the graph in part a).

d) After 3 h, the candle will have burned 3 × 2.5 = 7.5 cm. The length left is 15 – 7.5, or 7.5 cm.

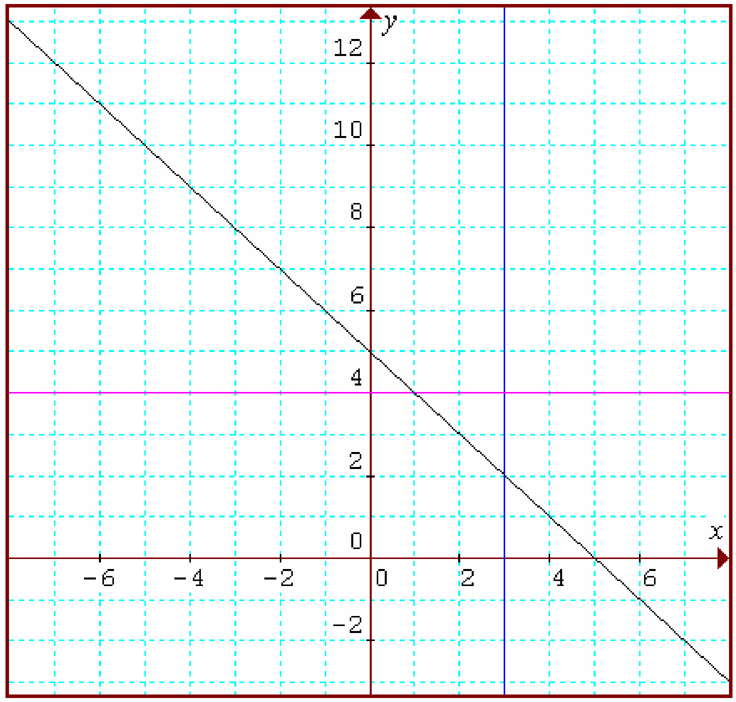
After 4.5 h, the will have burned 4.5 × 2.5 = 11.25 cm. The length left is 15 – 11.25, or 3.75 cm.

e) The t-intercept, 6, represents the time it takes for the candle to burn out completely.

f) The graph has no meaning below the t-axis because a candle cannot have negative length.

Chapter 6 Section 3 **Question 9** **Page 321**

a) A line can have no x-intercept. A horizontal line having a y-intercept not equal to 0 has no x-intercept.



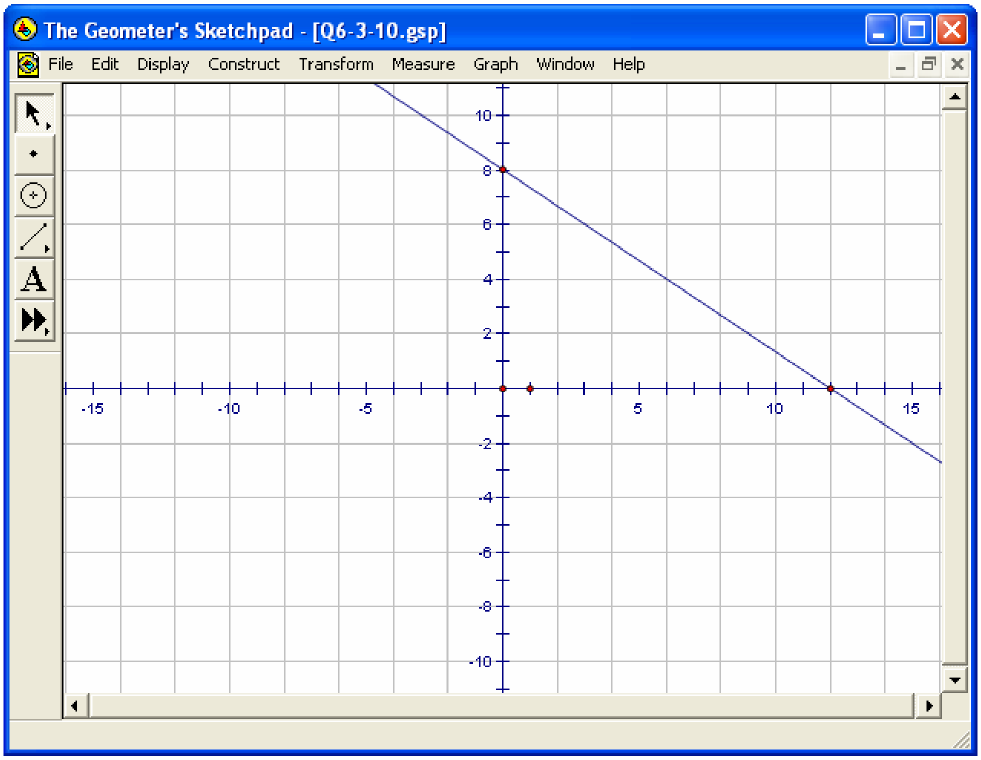
b) It is not possible for a line to have more than one x-intercept. Two distinct lines intersect at one point at most. Considering the x-axis as a line, no other line will cross the axis twice.

c) It is not possible for a line to have neither an x-intercept nor a y-intercept. A line can have no x-intercept or no y-intercept, but not both. A line that has no x-intercept is parallel to the x-axis and a line that has no y-intercept is parallel to the y-axis. No line can be parallel to both the x-axis and the y-axis at the same time.

Chapter 6 Section 3 Question 10 Page 321

Answers will vary. Sample answers are shown. Click here to load the sketch.

a)

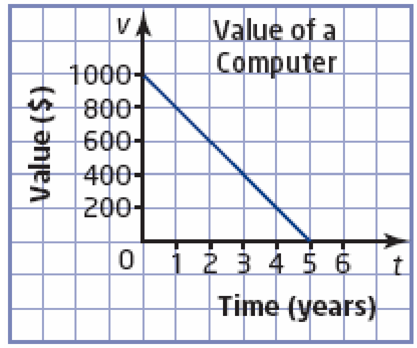


b) If the x-intercept is increased, the steepness of the slope decreases.
If the x-intercept is decreased, the steepness of the slope increases.
If the y-intercept is increased, the steepness of the slope increases.
If the y-intercept is decreased, the steepness of the slope decreases.

c) The increase in the price of comic books means that Joanne will be able to buy fewer comic books. This means that the linear model will have a lower horizontal intercept. Joanne's buying power will be less.

d) The decrease in the price of novels means that Joanne will be able to buy more novels. This means that the linear model will have a higher vertical intercept. Joanne's buying power will be greater.

Chapter 6 Section 3 Question 11 Page 321



a) The computer originally cost $1000.

b) The computer no longer has any value after 5 years.

c)
$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{0 - 1000}{5 - 0} \\ &= \frac{-1000}{5} \\ &= -200 \end{aligned}$$

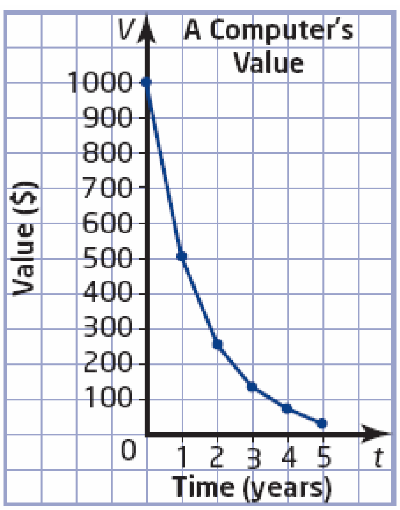
The slope is –200. The value of the computer decreases by $200 per year.

Chapter 6 Section 3 Question 12 Page 322

a)

Time (years)	Computer's Value
0	$1000.00
1	$500.00
2	$250.00
3	$125.00
4	$62.50
5	$31.25

b)



The relation is non-linear. The points form a curve.

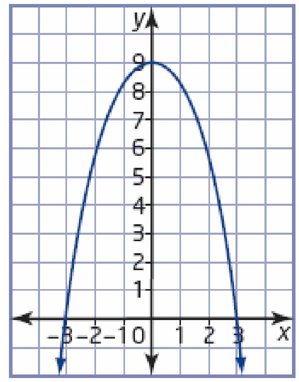
Answers will vary for the remaining parts of the question. Sample answers are shown.

c) The computer will be worth less than 10% of its value after 3.5 years. It will never be worth $0 because half of a positive number is always another positive number.

d) The *t*-intercept does not exist. It does not exist because the computer's value will never reach 0.

e) The computer's value depreciates faster in the system where its value is halved each year. This is because half of $1000 is more than $200, which is the amount subtracted each year in the other model.

Chapter 6 Section 3 Question 13 Page 322



a) This graph has two *x*-intercepts, at 3 and –3.

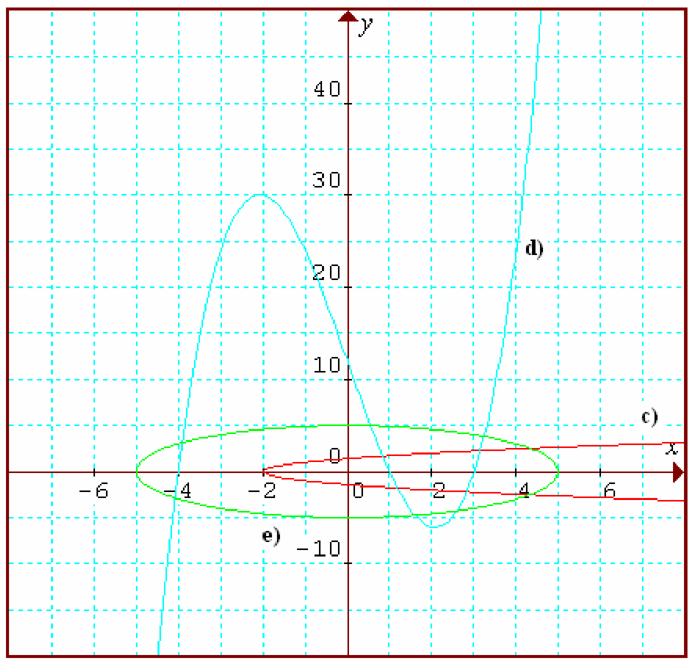
b) This graph has one *y*-intercept, at 9.

Answers will vary for the remaining parts of this question. Sample answers are shown.

c) A relation that has two *y*-intercepts is shown.

d) A relation that has three *x*-intercepts is shown.

e) A relation that has two *x*-intercepts and two *y*-intercepts is shown.



Chapter 6 Section 3 Question 14 Page 322

Answers will vary. A sample answer is shown.

Locate B by moving 5 units right, 3 units down, and 1 unit out of the page. Locate C by moving 2 units left, 0 units down, and 4 units out of the page. The resulting figure is a triangle.

Chapter 6 Section 3 Question 15 Page 322

$$\begin{aligned}
6x-2y-18&=0\\
6x-2y-18-6x+18&=0-6x+18\\
-2y&=-6x+18\\
\frac{-2y}{-2}&=\frac{-6x+18}{-2}\\
y&=\frac{-6x}{-2}+\frac{18}{-2}\\
y&=3x-9\\
y&=3(x-3)
\end{aligned}$$

The value of *a*, in this case 3, is the *x*-intercept.

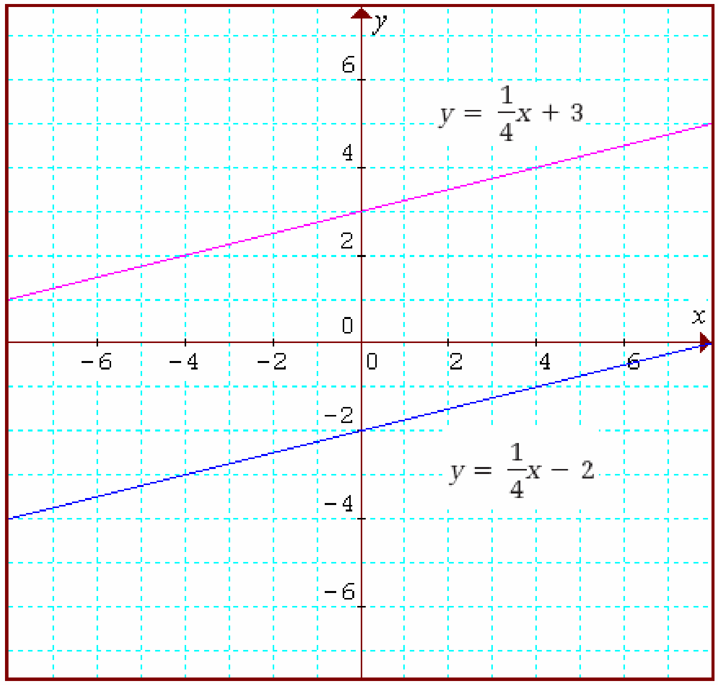
For an equation in the form $y = m(x - a)$, the value of *a* is the *x*-intercept of the graph of the line.

Chapter 6 Section 4   Parallel and Perpendicular Lines

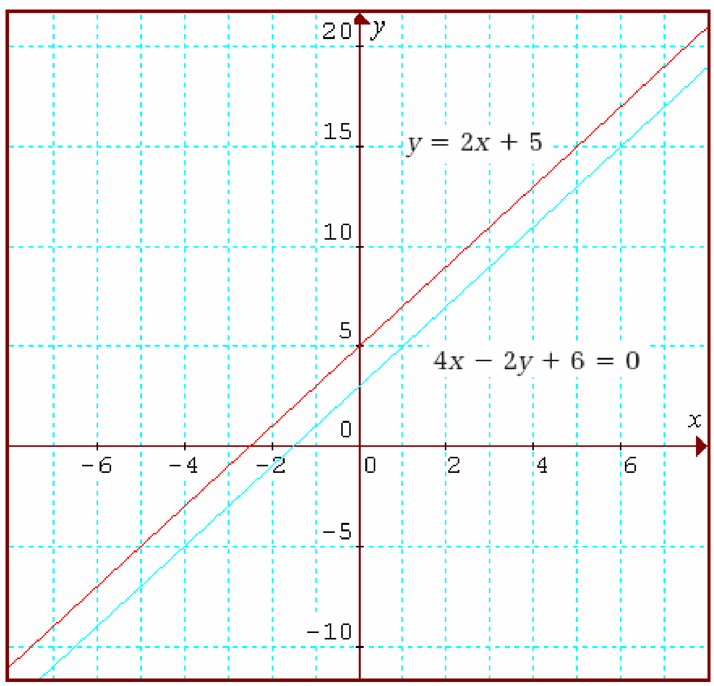
Chapter 6 Section 4   Question 1   Page 328

a) Each line has a slope of $\frac{1}{4}$.

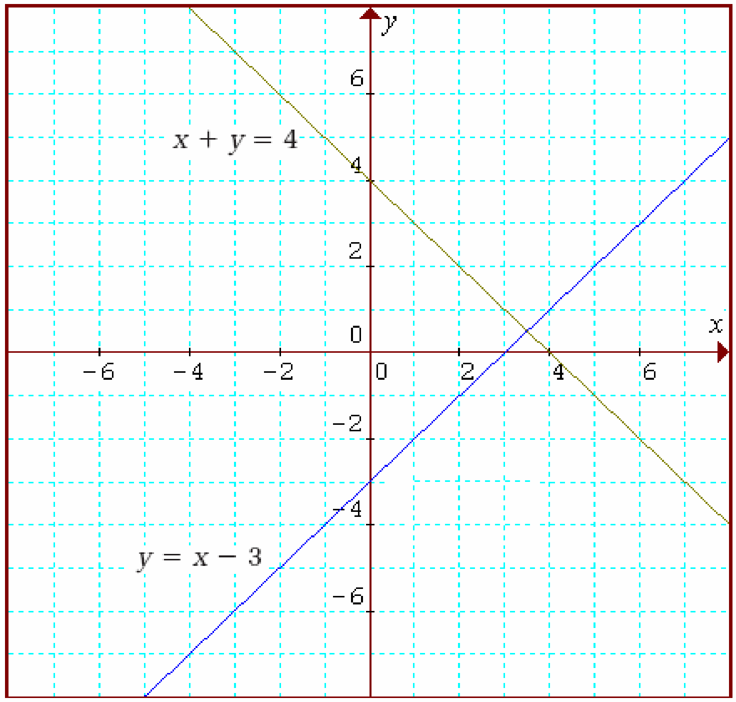
The lines are parallel.



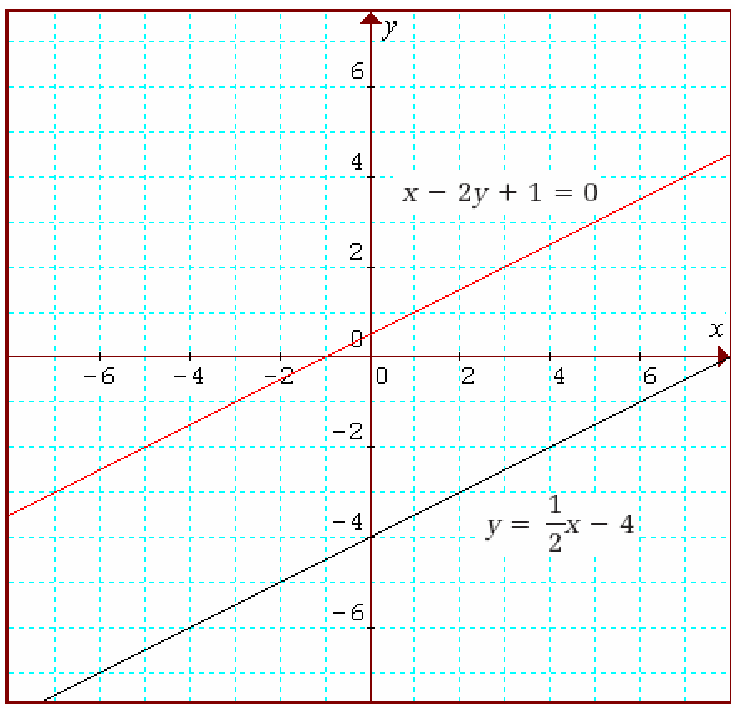
b) Each line has a slope of 2.
The lines are parallel.



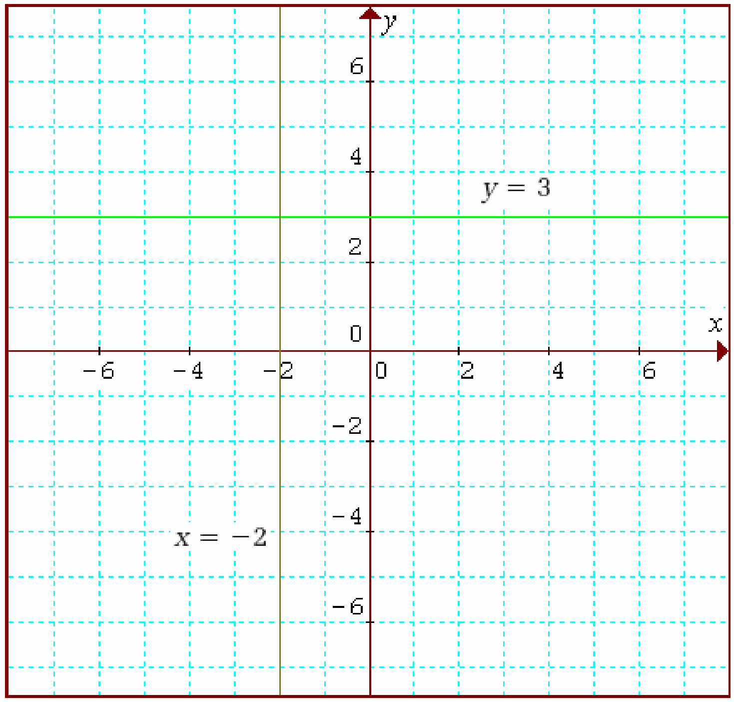
c) The slope of the first graph is –1, while the slope of the second is 1. The lines are perpendicular.



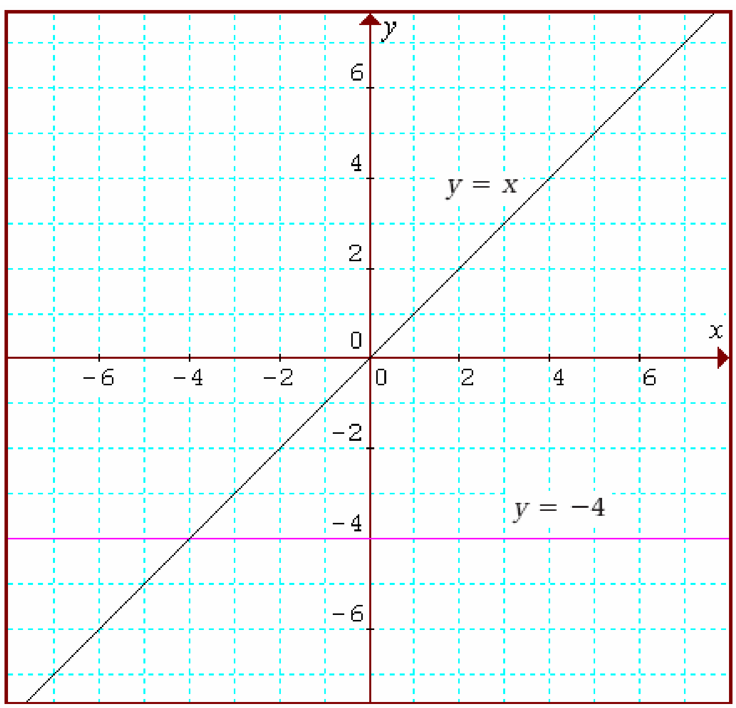
d) The slope of each line is $\frac{1}{2}$. The lines are parallel.



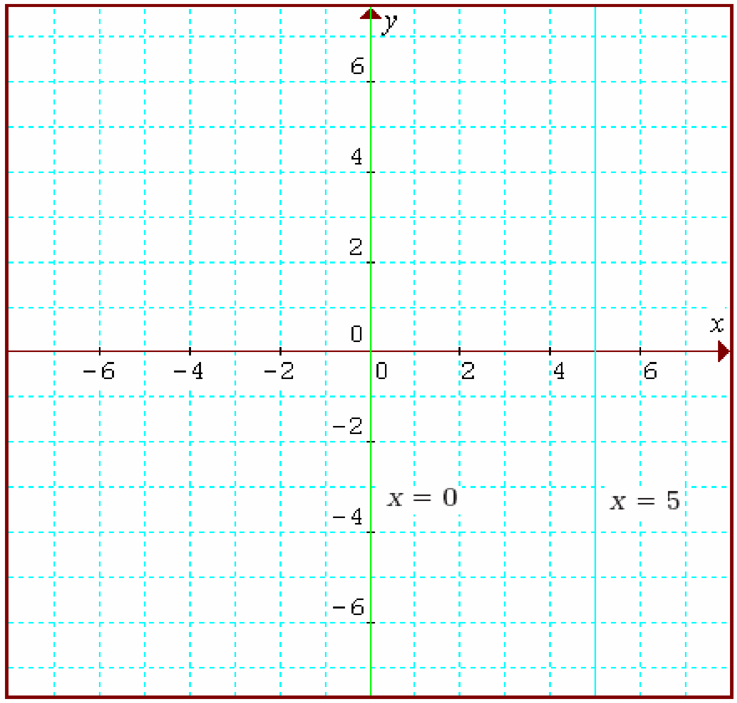
a) The slope of the horizontal line is 0. The slope of the vertical line is undefined. The lines are perpendicular.



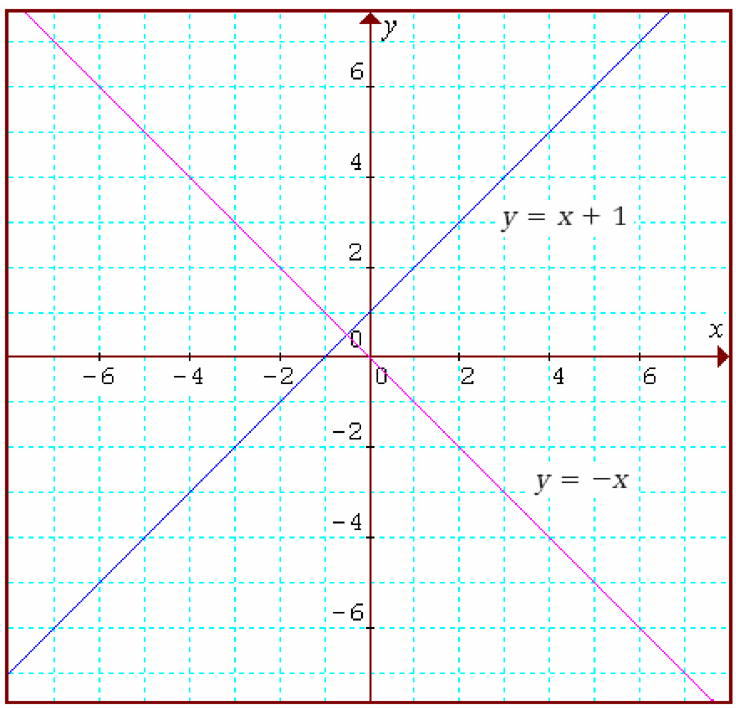
b) The slope of the horizontal line is 0. The slope of the angled line is 1. The lines are neither parallel nor perpendicular.



c) The two lines are vertical. Their slopes are undefined. The lines are parallel.



d) The slope of the ascending line is 1. The slope of the descending line is –1. The lines are perpendicular.



Chapter 6 Section 4 Question 3 Page 328

a) The lines are parallel. Their slopes, $\frac{2}{3}$ and $\frac{4}{6}$, are equivalent.

b) The lines are perpendicular. Their slopes, $\frac{3}{4}$ and $-\frac{4}{3}$, are negative reciprocals.

c) The lines are neither parallel nor perpendicular. Their slopes, 2 and –2, are not equal, and are not negative reciprocals.

d) The lines are perpendicular. Their slopes, 1 and –1, are negative reciprocals.

e) The lines are parallel. Their slopes, $\frac{1}{5}$ and 0.2, are equivalent.

f) The lines are perpendicular. Their slopes, $\frac{9}{4}$ and $-\frac{4}{9}$, are negative reciprocals.

Chapter 6 Section 4 Question 4 Page 328

a) The slope of the line is $\frac{3}{5}$. The slope of a line that is parallel to this line is $\frac{3}{5}$.

b) The slope of the line is –1. The slope of a line that is parallel to this line is –1.

c)
$$\begin{aligned} 2x - y + 3 &= 0 \\ 2x - y + 3 + y &= 0 + y \\ 2x + 3 &= y \end{aligned}$$

The slope of the line is 2. The slope of a line that is parallel to this line is 2.

d)
$$\begin{aligned} 4x + 3y &= 12 \\ 4x + 3y - 4x &= 12 - 4x \\ 3y &= -4x + 12 \\ \frac{3y}{3} &= \frac{-4x + 12}{3} \\ y &= \frac{-4x}{3} + \frac{12}{3} \\ y &= -\frac{4}{3}x + 4 \end{aligned}$$

The slope of the line is $-\frac{4}{3}$. The slope of a line that is parallel to this line is $-\frac{4}{3}$.

e) This line is horizontal. The slope of the line is 0. The slope of a line that is parallel to this line is 0.

f) This line is vertical. The slope of the line is undefined. The slope of a line that is parallel to this line is undefined.

Chapter 6 Section 4 Question 5 Page 328

a) The slope of a line that is perpendicular to the given line is $-\frac{5}{3}$.

b) The slope of a line that is perpendicular to the given line is 1.

c) The slope of a line that is perpendicular to the given line is $-\frac{1}{2}$.

d) The slope of a line that is perpendicular to the given line is $\frac{3}{4}$.

e) The slope of a line that is perpendicular to the given line is undefined.

f) The slope of a line that is perpendicular to the given line is 0.

Chapter 6 Section 4 Question 6 Page 328

$$\begin{aligned}
3x-6y-5&=0\\
3x-6y-5-3x+5&=0-3x+5\\
-6y&=-3x+5\\
\frac{-6y}{-6}&=\frac{-3x+5}{-6}\\
y&=\frac{-3x}{-6}+\frac{5}{-6}\\
y&=\frac{1}{2}x-\frac{5}{6}
\end{aligned}$$

Answers will vary. Sample answers are shown.

$y=\frac{1}{2}x+1$

$y=\frac{1}{2}x-1$

Chapter 6 Section 4 Question 7 Page 328

$$\begin{aligned} 4x + y - 2 &= 0 \\ 4x + y - 2 - 4x + 2 &= 0 - 4x + 2 \\ y &= -4x + 2 \end{aligned}$$

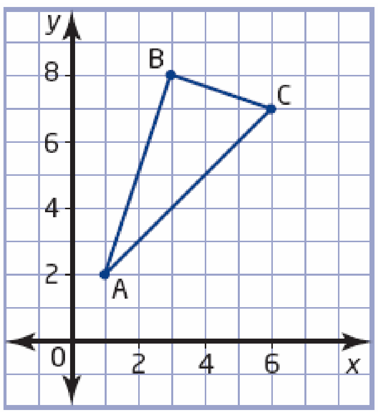
Answers will vary. Sample answers are shown.

$y = \frac{1}{4}x + 1$

$y = \frac{1}{4}x - 1$

Chapter 6 Section 4 Question 8 Page 328

a)



b) The triangle appears to be a right triangle with the right angle at B.

c) The slope of AB is 3. The slope of AC is 1. The slope of BC is $-\frac{1}{3}$.

d) The slopes of AB and BC are negative reciprocals. This means that AB and BC are perpendicular. Perpendicular lines meet at right angles, so this is a right triangle.

Chapter 6 Section 4 **Question 9** **Page 329**

a)

$$\begin{aligned} m_{AB} &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{5-1}{-2-1} \\ &= \frac{4}{-3} \\ &= -\frac{4}{3} \end{aligned}$$

$$\begin{aligned} m_{BC} &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-2-5}{3-(-2)} \\ &= \frac{-7}{5} \\ &= -\frac{7}{5} \end{aligned}$$

$$\begin{aligned} m_{AC} &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-2-1}{3-1} \\ &= \frac{-3}{2} \\ &= -\frac{3}{2} \end{aligned}$$

No pair of slopes are negative reciprocals. ΔABC is not a right triangle.

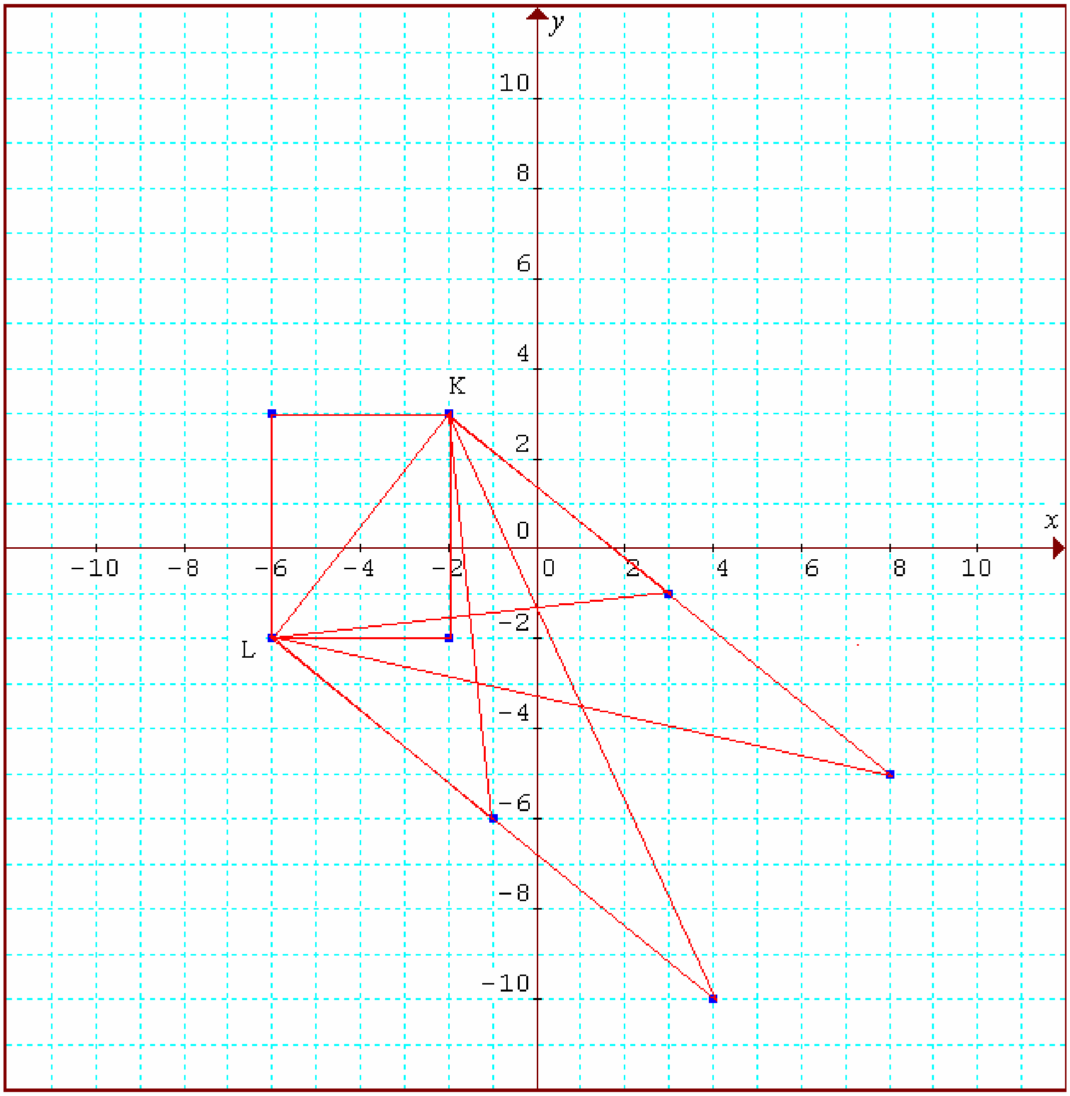
b)

$$\begin{aligned} m_{PQ} &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{2-4}{-2-2} \\ &= \frac{-2}{-4} \\ &= \frac{1}{2} \end{aligned}$$

$$\begin{aligned} m_{QR} &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-2-2}{5-(-2)} \\ &= \frac{-4}{7} \\ &= -\frac{4}{7} \end{aligned}$$

$$\begin{aligned} m_{PR} &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-2-4}{5-2} \\ &= \frac{-6}{3} \\ &= -2 \end{aligned}$$

The slope of PQ is $\frac{1}{2}$. The slope of PR is –2. These are negative reciprocals. ΔPQR is a right triangle.



a) Some possible answers are (–2, –2), (–6, 3), (3, –1), (8, –5), (–1, –6), and (4, –10).

b) There are many other possible answers. All you need is one right angle.

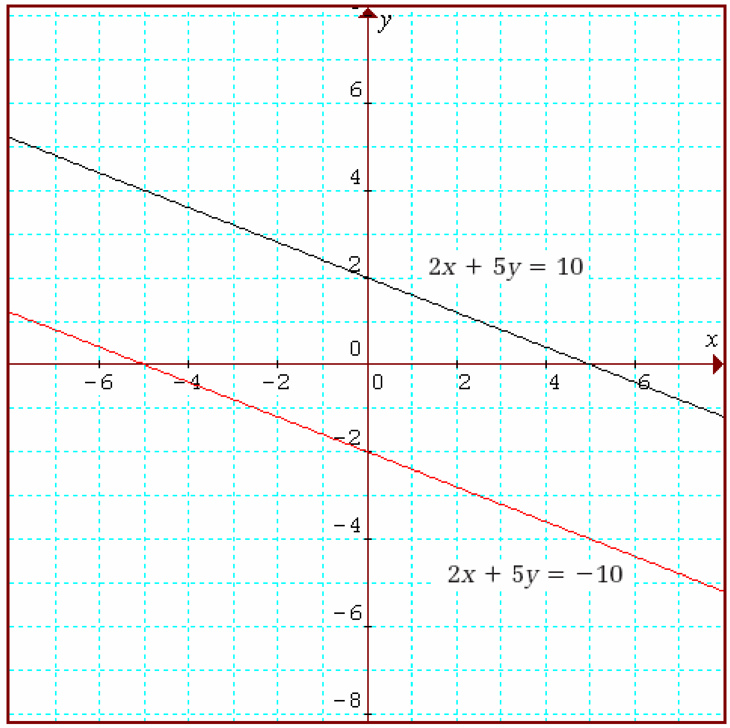
Chapter 6 Section 4 Question 11 Page 329

Solutions for Achievement Checks are shown in the Teacher's Resource.

Chapter 6 Section 4 Question 12 Page 329

a) For the line $2x+5y=10$, the x-intercept is 5, and the y-intercept is 2.

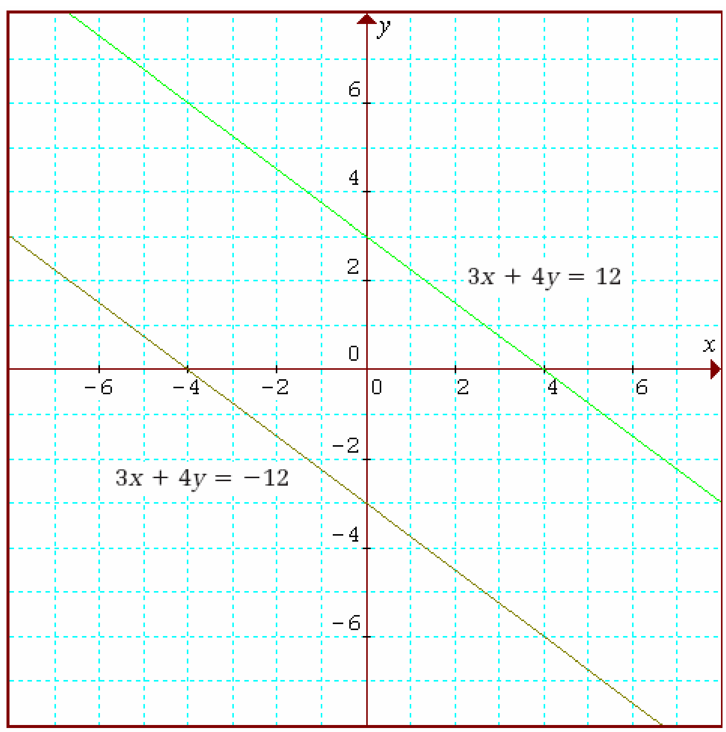
For the line $2x+5y=-10$, the x-intercept is –5, and the y-intercept is –2.



b) For the line $3x+4y=12$, the x-intercept is 4, and the y-intercept is 3.

For the line $3x+4y=-12$, the x-intercept is –4, and the y-intercept is –3.

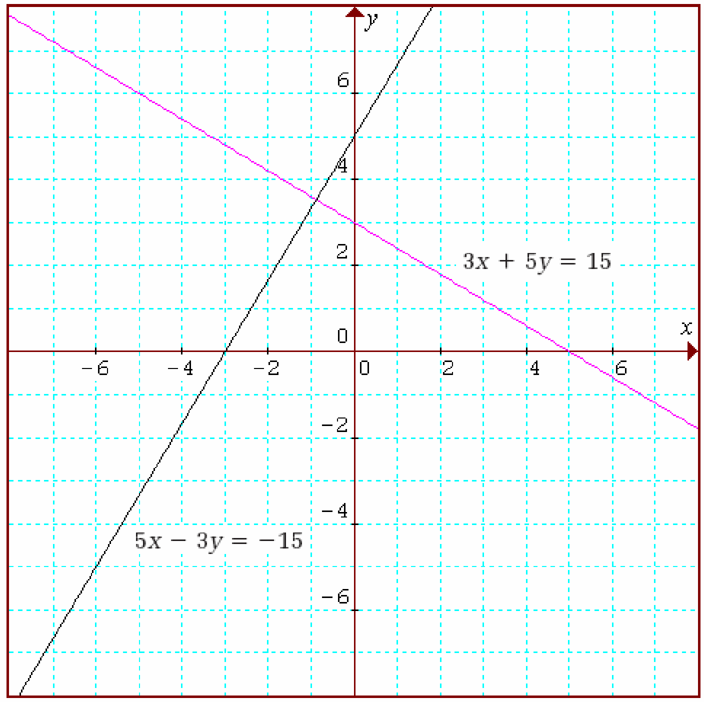
c) Answers will vary.



Chapter 6 Section 4 **Question 13** **Page 329**

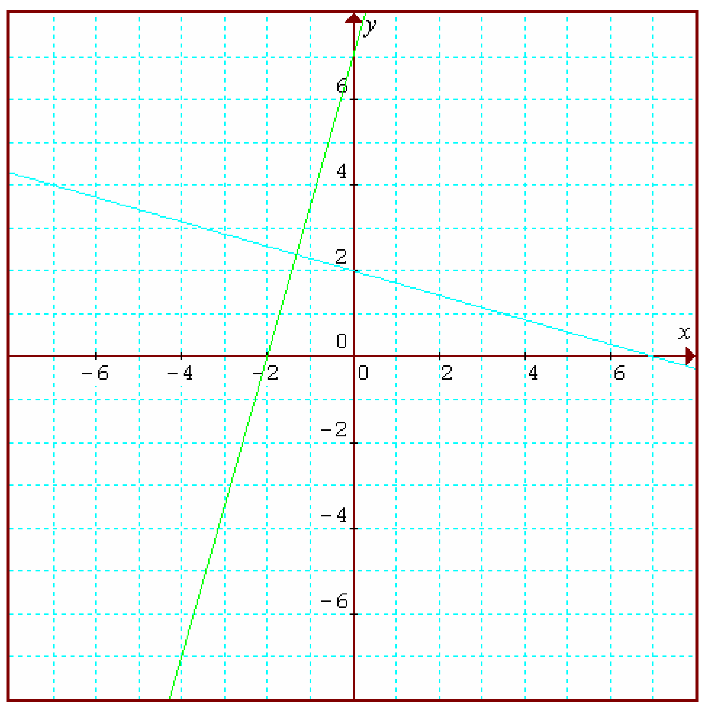
a) For the line $3x+5y=15$, the x-intercept is 5, and the y-intercept is 3.

For the line $5x-3y=-15$, the x-intercept is –3, and the y-intercept is 5.



b) For the line $2x+7y=14$, the x-intercept is 7, and the y-intercept is 2.

For the line $7x-2y=-14$, the x-intercept is –2, and the y-intercept is 7.



c) Answers will vary.

Chapter 6 Section 4 Question 14 Page 329

a)

$$\begin{aligned}
Ax - 3y + 15 &= 0 \\
Ax - 3y + 15 - Ax - 15 &= 0 - Ax - 15 \\
-3y &= -Ax - 15 \\
\frac{-3y}{-3} &= \frac{-Ax - 15}{-3} \\
y &= \frac{-Ax}{-3} + \frac{-15}{-3} \\
y &= \frac{A}{3}x + 5
\end{aligned}$$

Since *A* and *k* are one-digit numbers, *A* can be –9, –6, –3, 0, 3, 6, or 9. This gives corresponding values for *k* of –3, –2, –1, 0, 1, 2, and 3. There are 7 pairs of values for *A* and *k* for which the two lines are parallel.

b) If the lines are to be perpendicular, $k = -\frac{3}{A}$. *A* can be –3, –1, 1, or 3. This gives corresponding value of *k* of 1, 3, –3, and –1. There are 4 pairs of values for *A* and *k* for which the two lines are perpendicular.

c) The first line has a *y*-intercept of 5. The second line has a *y*-intercept of 7. Since the values of *A* and *k* affect only the slopes of the lines, there is no pair of values that make the lines coincident.

Chapter 6 Section 5 Find an Equation for a Line Given the Slope and a Point

Chapter 6 Section 5 Question 1 Page 335

a)

$$\begin{aligned} y &= mx + b \\ 5 &= 1(3) + b \\ 5 &= 3 + b \\ 5 - 3 &= 3 + b - 3 \\ 2 &= b \\ y &= x + 2 \end{aligned}$$

b) The y-intercept is given as –4.

$y = -3x - 4$

c)

$$\begin{aligned} y &= mx + b \\ 6 &= \frac{2}{3}(-2) + b \\ 6 &= -\frac{4}{3} + b \\ 6 + \frac{4}{3} &= -\frac{4}{3} + b + \frac{4}{3} \\ \frac{18}{3} + \frac{4}{3} &= b \\ \frac{22}{3} &= b \\ y &= \frac{2}{3}x + \frac{22}{3} \end{aligned}$$

d)

$$\begin{aligned} y &= mx + b \\ -2 &= -\frac{1}{2}(5) + b \\ -2 &= -\frac{5}{2} + b \\ -2 + \frac{5}{2} &= -\frac{5}{2} + b + \frac{5}{2} \\ \frac{-4}{2} + \frac{5}{2} &= b \\ \frac{1}{2} &= b \\ y &= -\frac{1}{2}x + \frac{1}{2} \end{aligned}$$

e) The *y*-intercept is given as 0.

$$y = -\frac{4}{5}x$$

f)

$$\begin{aligned}
y &= mx + b \\
\frac{3}{4} &= 2\left(\frac{1}{2}\right) + b \\
\frac{3}{4} &= 1 + b \\
\frac{3}{4} - 1 &= 1 + b - 1 \\
\frac{3}{4} - \frac{4}{4} &= b \\
-\frac{1}{4} &= b \\
y &= 2x - \frac{1}{4}
\end{aligned}$$

Chapter 6 Section 5 **Question 2** **Page 336**

a) The *y*-intercept is given as 0.
$y = -3x$

b)

$$\begin{aligned} y &= mx + b \\ -5 &= \frac{2}{3}(4) + b \\ -5 &= \frac{8}{3} + b \\ -5 - \frac{8}{3} &= \frac{8}{3} + b - \frac{8}{3} \\ \frac{-15}{3} - \frac{8}{3} &= b \\ -\frac{23}{3} &= b \\ y &= \frac{2}{3}x - \frac{23}{3} \end{aligned}$$

c) The slope of the line is 0. The equation is $y = -6$.

d) The *y*-intercept is given as 0.
$y = \frac{5}{2}x$

e) The given line is vertical. The required line is horizontal, with a slope of 0. The equation is $y = -3$.

f)

$$\begin{aligned} y &= mx + b \\ 7 &= -\frac{1}{4}(-2) + b \\ 7 &= \frac{1}{2} + b \\ 7 - \frac{1}{2} &= \frac{1}{2} + b - \frac{1}{2} \\ \frac{14}{2} - \frac{1}{2} &= b \\ \frac{13}{2} &= b \\ y &= -\frac{1}{4}x + \frac{13}{2} \end{aligned}$$

a)

$$
\begin{aligned}
C &= md + b \\
40 &= 10(2.5) + b \\
40 &= 25 + b \\
40 - 25 &= 25 + b - 25 \\
15 &= b
\end{aligned}
$$

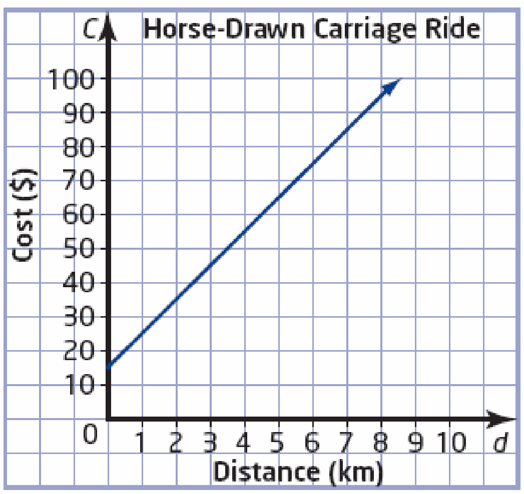
$$C = 10d + 15$$

b) $C = 10d + 15$

$$
\begin{aligned}
C &= 10(6.5) + 15 \\
&= 65 + 15 \\
&= 80
\end{aligned}
$$

A 6.5 km ride costs $80.

c)



d) From the graph, the cost of a 6.5 km ride is $80.

Chapter 6 Section 5 **Question 4** **Page 336**

a)

Distance (km)	Cost ($)	First Differences
2.5	40	
3.5	50	10
4.5	60	10
5.5	70	10
6.5	80	10

This method uses a table of values to determine the cost of a 6.5 km ride.

b)

$$\begin{aligned} C &= 10d + 15 \\ 100 &= 10d + 15 \\ 100 - 15 &= 10d + 15 - 15 \\ 85 &= 10d \\ \frac{85}{10} &= \frac{10d}{10} \\ 8.5 &= d \end{aligned}$$

Distance (km)	Cost ($)	First Differences
2.5	40	
3.5	50	10
4.5	60	10
5.5	70	10
6.5	80	10
7.5	90	10
8.5	100	10

From the equation, $100 will get you 8.5 km.

From the graph, $100 will get you 8.5 km.

Continue the table for two more rows. The table shows that $100 will get you 8.5 km.

c)

$$\begin{aligned} C &= 10d + 15 \\ C &= 10(5.8) + 15 \\ &= 58 + 15 \\ &= 73 \end{aligned}$$

From the equation, a 5.8 km ride costs $73.

From the graph, a 5.8 km ride costs about $73.

From the table, you can estimate that a 5.8 km ride costs about $73.

d) Answers will vary. Sample answers are shown.

The equation method gives accurate answers, but requires solving. The graph method is easy, but gives less exact answers. The table method is easy, but gives less exact answers.

Chapter 6 Section 5 Question 5 Page 336

$$
\begin{aligned}
2x-3y+6&=0\\
2x-3y+6-2x-6&=0-2x-6\\
-3y&=-2x-6\\
\frac{-3y}{-3}&=\frac{-2x-6}{-3}\\
y&=\frac{-2x}{-3}+\frac{-6}{-3}\\
y&=\frac{2}{3}x+2
\end{aligned}
$$

The desired slope is $\frac{2}{3}$. The desired *y*-intercept is –1. The equation is $y=\frac{2}{3}x-1$.

Chapter 6 Section 5 Question 6 Page 336

$$
\begin{aligned}
4x-5y&=20\\
4x-5y-4x&=20-4x\\
-5y&=-4x+20\\
\frac{-5y}{-5}&=\frac{-4x+20}{-5}\\
y&=\frac{-4x}{-5}+\frac{20}{-5}\\
y&=\frac{4}{5}x-4
\end{aligned}
$$

The desired slope is $-\frac{5}{4}$. The equation is $y=-\frac{5}{4}x-4$.

Chapter 6 Section 5 **Question 7 Page 337**

The desired slope is $-\frac{8}{9}$.

$$
\begin{aligned}
y &= mx + b \\
-8 &= -\frac{8}{9}(18) + b \\
-8 &= -16 + b \\
-8 + 16 &= -16 + 16 + b \\
8 &= b
\end{aligned}
$$

$$y = -\frac{8}{9}x + 8$$

$$
\begin{aligned}
0 &= -\frac{8}{9}x + 8 \\
0 - 8 &= -\frac{8}{9}x + 8 - 8 \\
-8 &= -\frac{8}{9}x \\
9 \times (-8) &= 9 \times \left(-\frac{8}{9}x\right) \\
-72 &= -8x \\
\frac{-72}{-8} &= \frac{-8x}{-8} \\
9 &= x
\end{aligned}
$$

The *x*-intercept is 9 and the *y*-intercept is 8. The letters are h and i.

Chapter 6 Section 5 **Question 8** **Page 337**

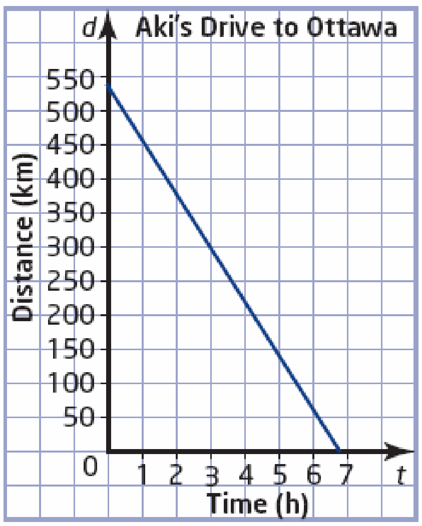
a) The ordered pair (3, 300) means that Aki has 300 km left to drive after 3 h.

b) The slope m = –80 means that the distance remaining between Aki and Ottawa is decreasing at a rate of 80 km/h.

c)
$$\begin{aligned} d &= mt + b \\ 300 &= -80(3) + b \\ 300 &= -240 + b \\ 300 + 240 &= -240 + b + 240 \\ 540 &= b \end{aligned}$$

d) $d = -80t + 540$

e)



The d-intercept represents Aki's distance from Ottawa just as he started this trip.

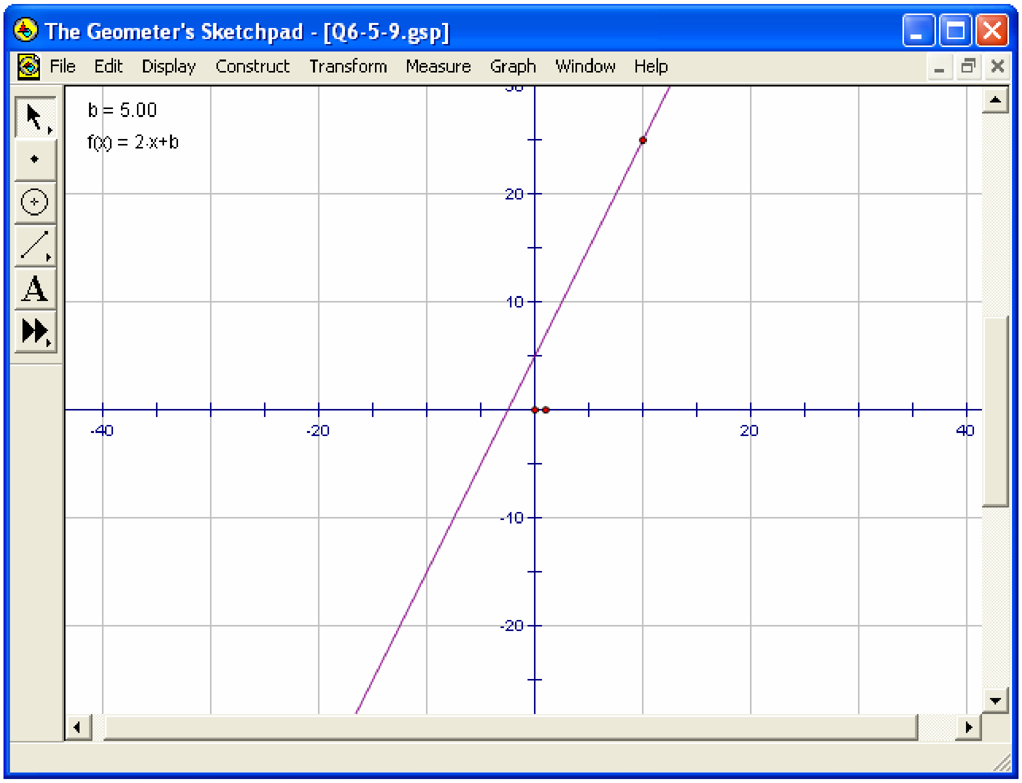
f)
$$\begin{aligned} 0 &= -80t + 540 \\ 0 - 540 &= -80t + 540 - 540 \\ -540 &= -80t \\ \frac{-540}{-80} &= \frac{-80t}{-80} \\ 6.75 &= t \end{aligned}$$

The trip to Ottawa will take 6.75 h.

g) No. Aki has driven for 3 h at 80 km/h. So, he has driven 240 km. He still has 300 km to drive. At 80 km/h, this will take him another $3\frac{3}{4}$ h.

Chapter 6 Section 5 Question 9 Page 337

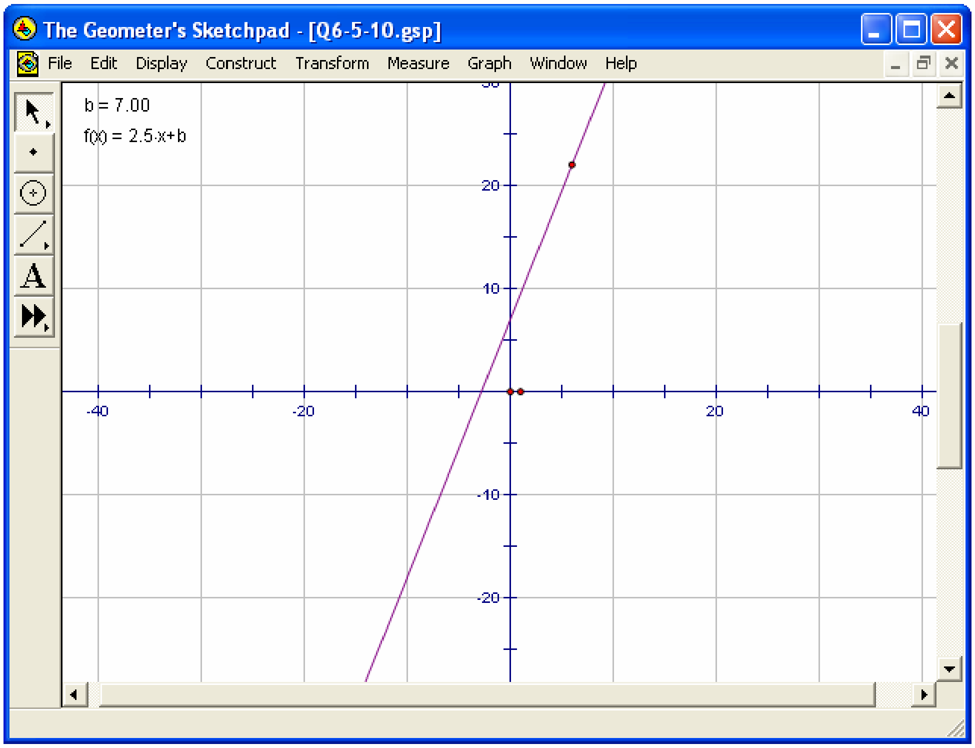
a) Click here to load the sketch.



b) Answers will vary.

Chapter 6 Section 5 Question 10 Page 337

a) Click here to load the sketch.

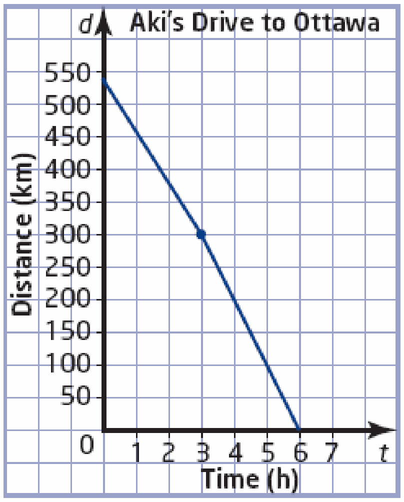


The fixed cost is $7.00.

b) $C = 2.5d + 7.00$

c)
$$\begin{aligned}
C &= md + b \\
22 &= 2.5(6) + b \\
22 &= 15 + b \\
22 - 15 &= 15 + b - 15 \\
7 &= b \\
C &= 2.5d + 7
\end{aligned}$$

a)



b) Answers will vary. The answer to part f) would change. Aki has 300 km left to go to Ottawa. At 100 km/h, the rest of the trip will take $\frac{300}{100} = 3$ h. The trip will take 3 + 3 = 6 h. The answer to part g) will change. Aki has reached the halfway point of his trip at 3 h.

c) Explanations and methods used will vary.

Chapter 6 Section 6 Find an Equation for a Line Given Two Points

Chapter 6 Section 6 Question 1 Page 342

a)

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{6-3}{5-2} \\ &= \frac{3}{3} \\ &= 1 \end{aligned}$$

$$\begin{aligned} y &= mx + b \\ 3 &= 1(2) + b \\ 3 &= 2 + b \\ 3 - 2 &= 2 + b - 2 \\ 1 &= b \end{aligned}$$

The equation is $y = x + 1$.

b)

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{5-(-1)}{0-4} \\ &= \frac{6}{-4} \\ &= -\frac{3}{2} \end{aligned}$$

$$\begin{aligned} y &= mx + b \\ -1 &= -\frac{3}{\cancel{2}_{1}}\left(\cancel{4}^{2}\right) + b \\ -1 &= -6 + b \\ -1 + 6 &= -6 + b + 6 \\ 5 &= b \end{aligned}$$

The equation is $y = -\frac{3}{2}x + 5$.

c)

$$\begin{aligned}
m &= \frac{y_2 - y_1}{x_2 - x_1} \\
&= \frac{-6-4}{-2-(-3)} \\
&= \frac{-10}{1} \\
&= -10
\end{aligned}$$

$$\begin{aligned}
y &= mx + b \\
4 &= -10(-3) + b \\
4 &= 30 + b \\
4 - 30 &= 30 + b - 30 \\
-26 &= b
\end{aligned}$$

The equation is $y = -10x - 26$.

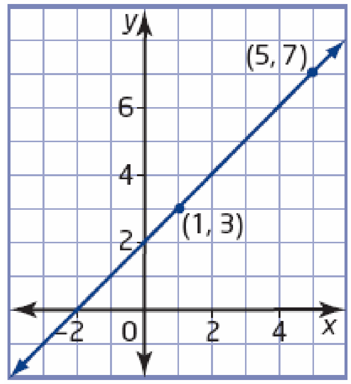
d)

$$\begin{aligned}
m &= \frac{y_2 - y_1}{x_2 - x_1} \\
&= \frac{-5-0}{\frac{7}{2}-\frac{1}{2}} \\
&= \frac{-5}{\frac{6}{2}} \\
&= -\frac{5}{3}
\end{aligned}$$

$$\begin{aligned}
y &= mx + b \\
0 &= -\frac{5}{3}\left(\frac{1}{2}\right) + b \\
0 &= -\frac{5}{6} + b \\
0 + \frac{5}{6} &= -\frac{5}{6} + b + \frac{5}{6} \\
\frac{5}{6} &= b
\end{aligned}$$

The equation is $y = -\frac{5}{3}x + \frac{5}{6}$.

a)

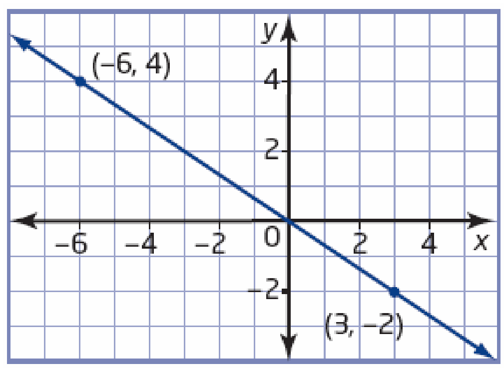


$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{7-3}{5-1} \\ &= \frac{4}{4} \\ &= 1 \end{aligned}$$

$$\begin{aligned} y &= mx + b \\ 3 &= 1(1) + b \\ 3 &= 1 + b \\ 3 - 1 &= 1 + b - 1 \\ 2 &= b \end{aligned}$$

The equation is $y = x + 2$.

b)



$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-2-4}{3-(-6)} \\ &= \frac{-6}{9} \\ &= -\frac{2}{3} \end{aligned}$$

$$\begin{aligned} y &= mx + b \\ 4 &= -\frac{2}{\cancel{3}_{1}}\left(\cancel{-6}^{2}\right) + b \\ 4 &= 4 + b \\ 4 - 4 &= 4 + b - 4 \\ 0 &= b \end{aligned}$$

The equation is $y = -\frac{2}{3}x$.

Chapter 6 Section 6 Question 3 Page 342

a)

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{0 - (-2)}{4 - 0}$$
$$= \frac{2}{4}$$
$$= \frac{1}{2}$$

$$y = mx + b$$
$$-2 = \frac{1}{2}(0) + b$$
$$-2 = b$$

The equation is $y = \frac{1}{2}x - 2$.

b)

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{-5 - 0}{0 - (-5)}$$
$$= \frac{-5}{5}$$
$$= -1$$

$$y = mx + b$$
$$-5 = -1(0) + b$$
$$-5 = b$$

The equation is $y = -x - 5$.

Chapter 6 Section 6 **Question 4** **Page 342**

a)

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{3-3}{5-0} \\ &= \frac{0}{5} \\ &= 0 \end{aligned}$$

Since the slope is 0, the line is horizontal. The *y*-intercept is given as 3.
The equation is $y = 3$.

b)

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-4-6}{-2-(-2)} \\ &= \frac{-10}{0} \end{aligned}$$

The slope is undefined.

The line is vertical.

The equation is $x = -2$.

Chapter 6 Section 6 **Question 5** **Page 342**

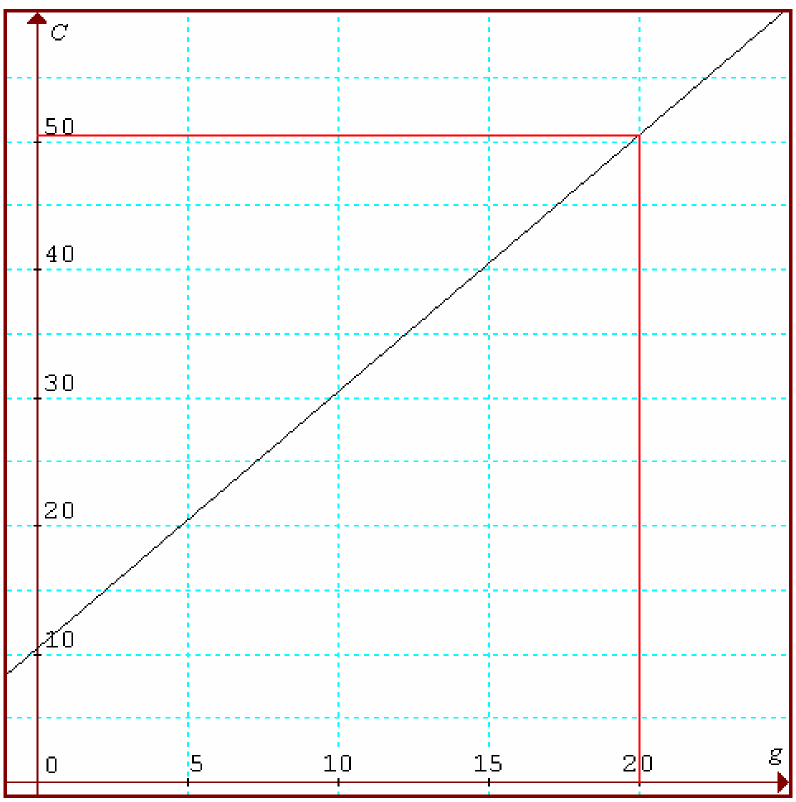
a)
$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{28.50 - 20.50}{9 - 5} \\ &= \frac{8.00}{4} \\ &= 2.00 \end{aligned}$$

The variable cost is \$2.00 per game.

$$\begin{aligned} C &= mg + b \\ 20.50 &= 2.00(5) + b \\ 20.50 &= 10 + b \\ 20.50 - 10 &= 10 + b - 10 \\ 10.50 &= b \end{aligned}$$

The equation is $C = 2.00g + 10.50$.

c)



d) The *C*-intercept is 10.50. This represents the fixed base cost of \$10.50.

e) Answers will vary slightly. From the graph, the cost of 20 games is about $50.50.

f)
$$\begin{aligned} C &= 2.00(20) + 10.50 \\ &= 40.00 + 10.50 \\ &= 50.50 \end{aligned}$$

From the equation, the cost of 20 games is $50.50.

g) Answers will vary. Sample answers are shown.

The graph is easy to use, but lacks accuracy. The equation takes longer to use, but gives an exact answer.

Chapter 6 Section 6 Question 6 Page 342

a) Fiona is moving away from the sensor because she is farther away from it after 4 s than she was after 2 s.

b)
$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{4.5 - 1.5}{4 - 2} \\ &= \frac{3.0}{2} \\ &= 1.5 \end{aligned}$$

Fiona is walking at 1.5 m/s.

c)
$$\begin{aligned} d &= mt + b \\ 1.5 &= 1.5(2) + b \\ 1.5 &= 3 + b \\ 1.5 - 3 &= 3 + b - 3 \\ -1.5 &= b \end{aligned}$$

The equation is $d = 1.5t - 1.5$.

d) The *d*-intercept is –1.5 m. Fiona started at 1.5 m behind the motion sensor. Then, she walked towards the sensor, and passed it.

Chapter 6 Section 6 **Question 7** **Page 343**

a) The point (5, 17.25) represents Colette's wage of \$17.25/h with 5 years of experience and the point (1, 14.25) represents Lee's wage of \$14.25/h with 1 year of experience.

b)

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{17.25 - 14.25}{5 - 1} \\ &= \frac{3.00}{4} \\ &= 0.75 \end{aligned}$$

$$\begin{aligned} w &= mn + b \\ 14.25 &= 0.75(1) + b \\ 14.25 &= 0.75 + b \\ 14.25 - 0.75 &= 0.75 + b - 0.75 \\ 13.50 &= b \end{aligned}$$

The slope is 0.75, and the *w*-intercept is 13.50. The slope represents the yearly hourly wage increase, and the *w*-intercept represents the starting hourly wage.

c) The equation is $w = 0.75n + 13.50$.

d)

$$\begin{aligned} w &= 0.75(7) + 13.50 \\ &= 5.25 + 13.50 \\ &= 18.75 \end{aligned}$$

Maria's wage is \$18.75 per hour.

e)

$$\begin{aligned} w &= 0.75(25) + 13.50 \\ &= 18.75 + 13.50 \\ &= 32.25 \end{aligned}$$

A worker who has been with the lab for 25 years should earn \$32.25 per hour. This may be somewhat high. The store might put a cap on the maximum salary after a number of years. Answers will vary.

Chapter 6 Section 6 **Question 8** **Page 343**

a)
$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{40 - 240}{2.5 - 0} \\ &= \frac{-200}{2.5} \\ &= -80 \end{aligned}$$

Anil's family is travelling at 80 km/h.

b)
$$\begin{aligned} d &= mt + b \\ 240 &= -80(0) + b \\ 240 &= b \end{aligned}$$

The equation is $d = -80t + 240$.

c)
$$\begin{aligned} 0 &= -80t + 240 \\ 0 + 80t &= -80t + 240 + 80t \\ 80t &= 240 \\ \frac{80t}{80} &= \frac{240}{80} \\ t &= 3 \end{aligned}$$

The entire trip takes 3 h. Anil's family will arrive home in another 0.5 h, at 7:30P.M.. They will arrive 15 minutes before the game starts, assuming that their speed remains at 80 km/h.

Chapter 6 Section 6 Question 9 Page 343

a)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1-6}{10-0} = \frac{-5}{10} = -\frac{1}{2}$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6-2}{8-0} = \frac{4}{8} = \frac{1}{2}$$

$$d = mt + b$$
$$6 = -\frac{1}{2}(0) + b$$
$$6 = b$$

$$d = mt + b$$
$$2 = \frac{1}{2}(0) + b$$
$$2 = b$$

The equation for Lucas is $d = -\frac{1}{2}t + 6$.

The equation for Myrna is $d = \frac{1}{2}t + 2$.

b)
$$-\frac{1}{2}t + 6 = \frac{1}{2}t + 2$$
$$-\frac{1}{2}t + 6 + \frac{1}{2}t - 2 = \frac{1}{2}t + 2 + \frac{1}{2}t - 2$$
$$4 = t$$

Lucas and Myrna were the same distance from their sensors after 4 s.

c)
$$d = -\frac{1}{2}(4) + 6 = -2 + 6 = 4$$

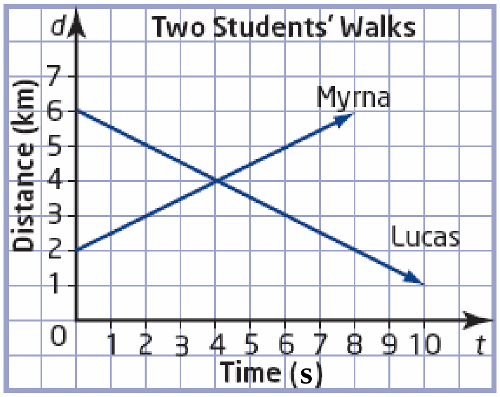
This occurred at a distance of 4 m.

d) Answers will vary. A sample answer is shown.

Lucas's distance has to equal Myrna's distance, so set the right sides of the equations equal. Then, solve for *t*.

Chapter 6 Section 6 **Question 10** **Page 343**

a)



b) The two lines cross at (4, 4).

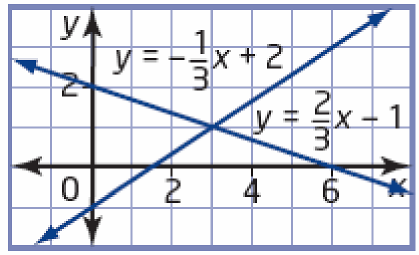
c) Answers will vary. A sample answer is shown.

The point of intersection shows that Lucas and Myrna were both 4 m away from the sensor after 4 s. This means that they must have crossed paths at this time and distance from the sensor.

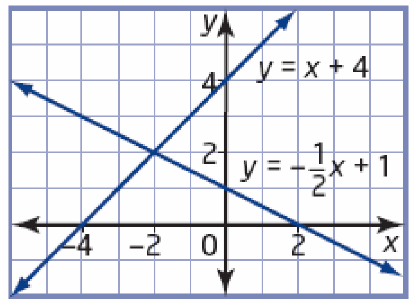
Chapter 6 Section 7 Linear Systems

Chapter 6 Section 7 Question 1 Page 348

a) The point of intersection is (3, 1).



b) The point of intersection is (–2, 2).

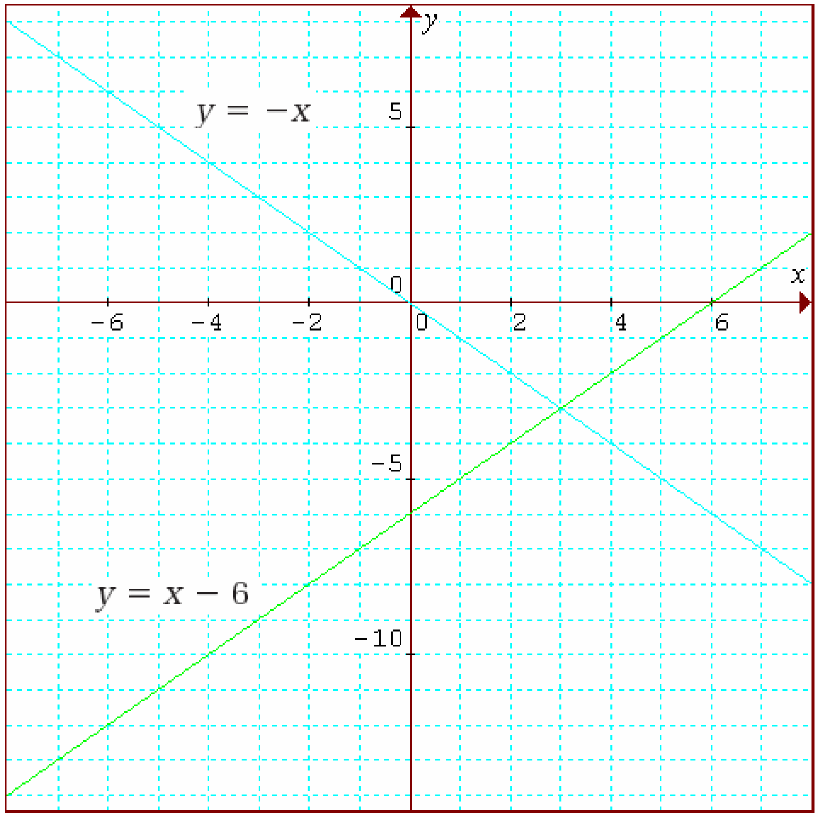


Chapter 6 Section 7 **Question 2** **Page 349**

a) For the equation $y = -x$, the slope is –1 and the y-intercept is 0.

For the equation $y = x - 6$, the slope is 1 and the y-intercept is –6.

The solution is (3, –3).



$$\begin{aligned} \text{L.S.} &= y & \text{R.S.} &= -x \\ &= -3 & &= -(3) \end{aligned}$$

L.S. = R.S.

The point $(3, -3)$ satisfies the equation $y = -x$.

$$\begin{aligned} \text{L.S.} &= y & \text{R.S.} &= x - 6 \\ &= -3 & &= 3 - 6 \\ & & &= -3 \end{aligned}$$

L.S. = R.S.

The point $(3, -3)$ satisfies the equation $y = x - 6$.

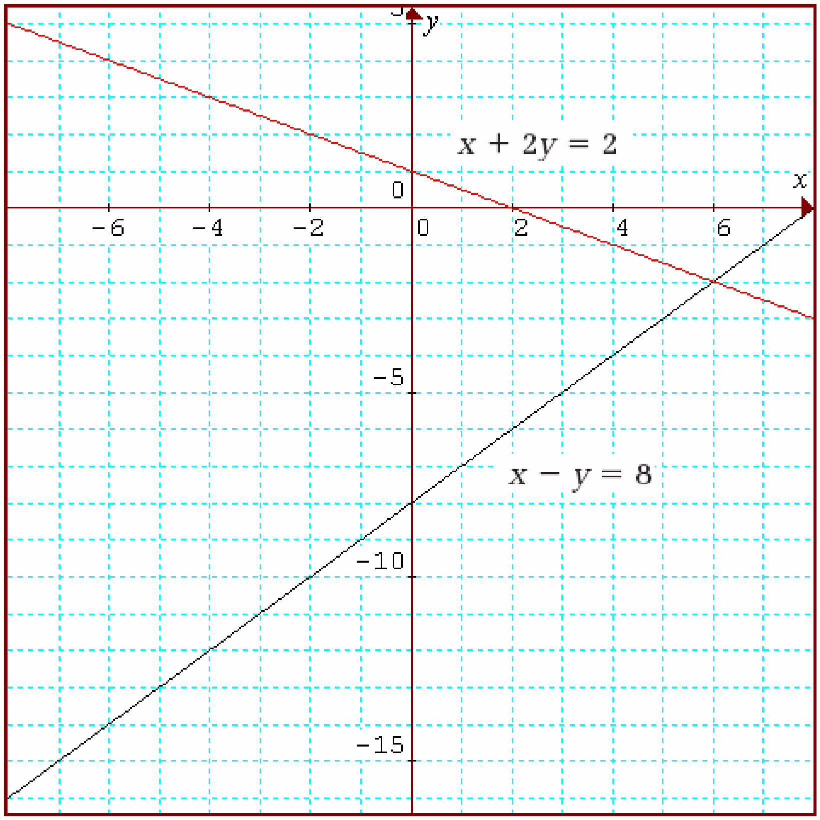
b)

$$x - y = 8$$
$$x - y + y - 8 = 8 + y - 8$$
$$x - 8 = y$$

The slope is 1, and the y-intercept is –8.

$$x + 2y = 2$$
$$x + 2y - x = 2 - x$$
$$2y = -x + 2$$
$$\frac{2y}{2} = \frac{-x+2}{2}$$
$$y = \frac{-1x}{2} + \frac{2}{2}$$
$$y = -\frac{1}{2}x + 1$$

The slope is $-\frac{1}{2}$ and the y-intercept is 1.



The solution is (6, –2).

L.S. $= x - y$ R.S. $= 8$

$= 6 - (-2)$

$= 8$

L.S. = R.S.

The point $(6, -2)$ satisfies the equation $x - y = 8$.

L.S. $= x + 2y$ R.S. $= 2$

$= 6 + 2(-2)$

$= 6 - 4$

$= 2$

L.S. = R.S.

The point $(6, -2)$ satisfies the equation $x + 2y = 2$.

c)

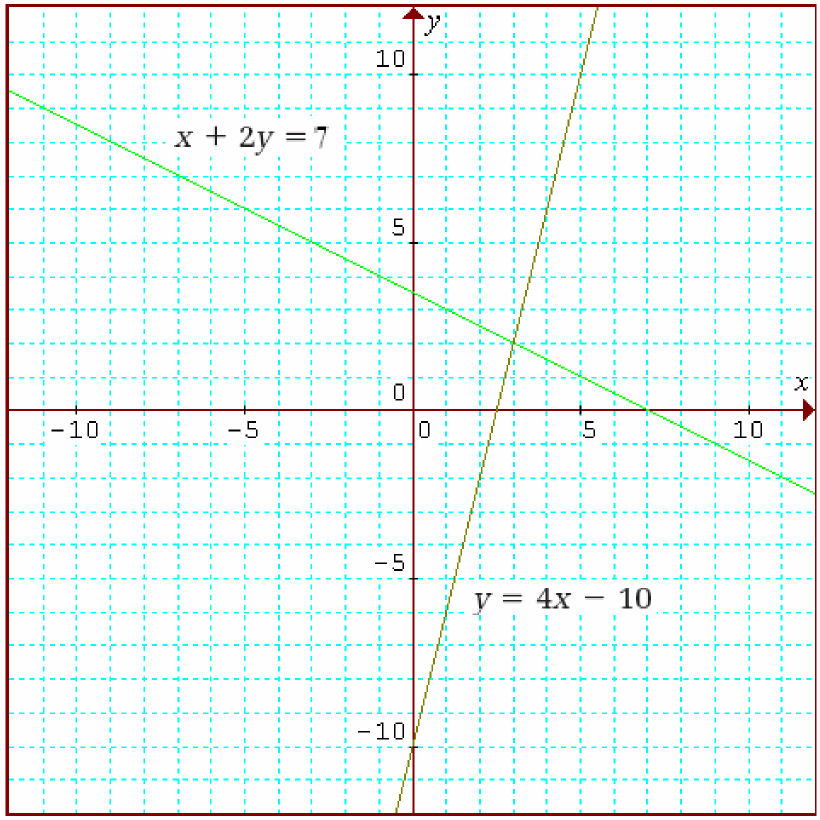
$$x + 2y = 7$$
$$x + 2y - x = 7 - x$$
$$2y = -x + 7$$
$$\frac{2y}{2} = \frac{-x+7}{2}$$
$$y = \frac{-1x}{2} + \frac{7}{2}$$
$$y = -\frac{1}{2}x + \frac{7}{2}$$

The slope is $-\frac{1}{2}$, and the y-intercept is $\frac{7}{2}$.

$$y = 4x - 10$$

The slope is 4 and the y-intercept is –10.

The solution is (3, 2).



L.S. $= x + 2y$ R.S. = 7

$$= 3 + 2(2)$$
$$= 3 + 4$$
$$= 7$$

L.S. = R.S.

The point $(3, 2)$ satisfies the equation $x + 2y = 7$.

L.S. $= y$ R.S. $= 4x - 10$

$$= 2 \qquad = 4(3) - 10$$
$$= 12 - 10$$
$$= 2$$

L.S. = R.S.

The point $(3, 2)$ satisfies the equation $y = 4x - 10$.

d)

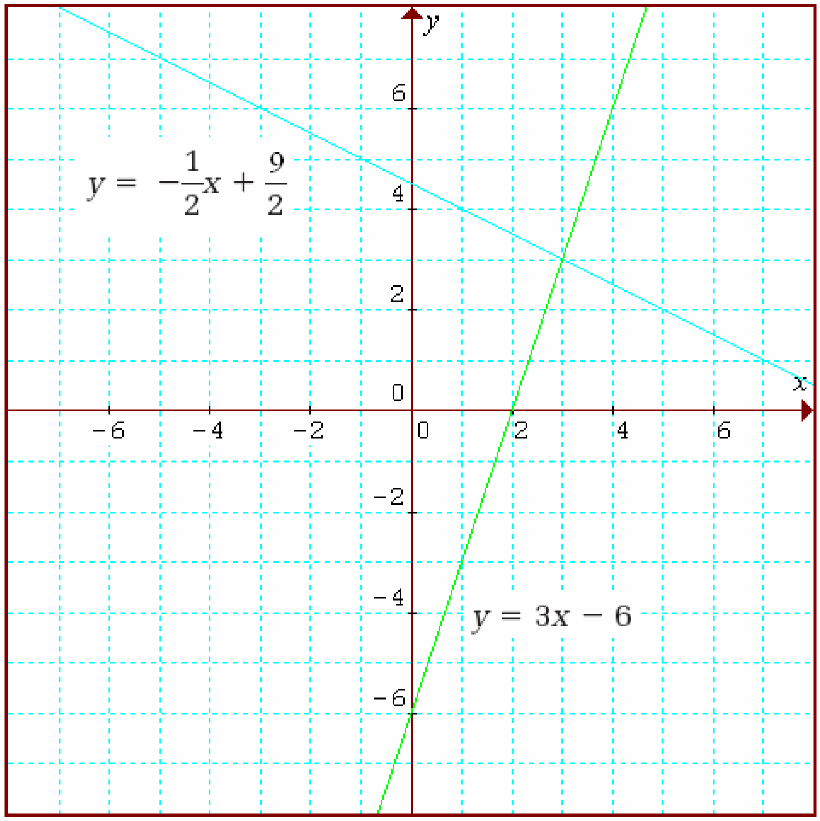
$$y = -\frac{1}{2}x + \frac{9}{2}$$

The slope is $-\frac{1}{2}$, and the y-intercept is $\frac{9}{2}$.

$$y = 3x - 6$$

The slope is 3 and the y-intercept is –6.

The solution is (3, 3).



L.S. $= y$ R.S. $= -\frac{1}{2}x + \frac{9}{2}$

$$= 3 \qquad = -\frac{1}{2}(3) + \frac{9}{2}$$

$$= -\frac{3}{2} + \frac{9}{2}$$

$$= \frac{6}{2}$$

$$= 3$$

L.S. = R.S.

The point $(3,3)$ satisfies the equation $y = -\frac{1}{2}x + \frac{9}{2}$.

L.S. $= y$ R.S. $= 3x - 6$

$$= 3 \qquad = 3(3) - 6$$

$$= 9 - 6$$

$$= 3$$

L.S. = R.S.

The point $(3,3)$ satisfies the equation $y = 3x - 6$.

Chapter 6 Section 7 **Question 3** **Page 349**

a) $$\begin{aligned} C &= 50d \\ &= 50(6) \\ &= 300 \end{aligned}$$

$$\begin{aligned} C &= 40d + 100 \\ &= 40(6) + 100 \\ &= 240 + 100 \\ &= 340 \end{aligned}$$

Six days of skiing will cost Mike $300 under the Standard Rate option, and $340 under the Frequent Extremist option.

b) Mike should choose the Standard Rate option. It is $40 cheaper.

Chapter 6 Section 7 **Question 4** **Page 349**

a) $$\begin{aligned} C &= 50d \\ &= 50(20) \\ &= 1000 \end{aligned}$$

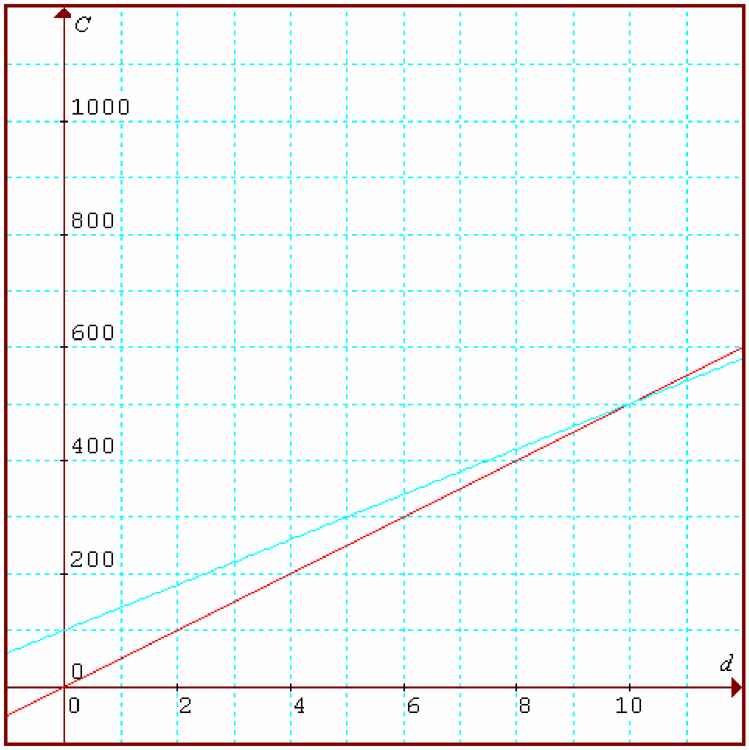
$$\begin{aligned} C &= 40d + 100 \\ &= 40(20) + 100 \\ &= 800 + 100 \\ &= 900 \end{aligned}$$

Twenty days of skiing will cost Mike $1000 under the Standard Rate option, and $900 under the Frequent Extremist option.

b) Mike should choose the Frequent Extremist option. It is $100 cheaper.

Chapter 6 Section 7 Question 5 Page 349

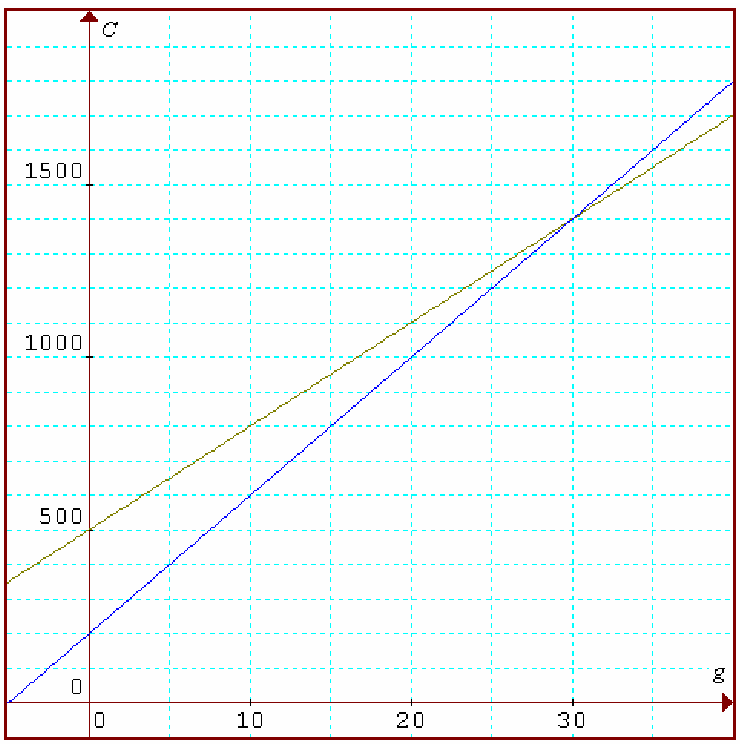
Refer to the graph. The point of intersection is (10, 500). If Mike went skiing 10 times, then the Standard Rate option would cost \$500, and the Frequent Extremist option would also cost \$500. In this case, it does not matter which option Mike chooses.



Chapter 6 Section 7 Question 6 Page 349

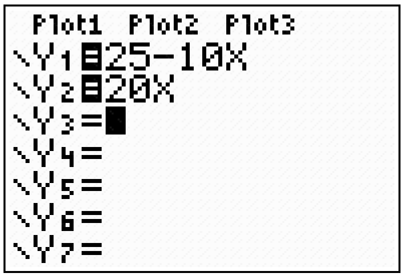
Answers will vary. A sample answer is shown.

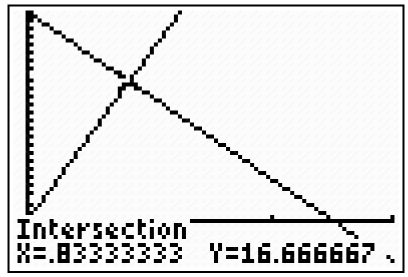
This special may affect the couple's decision because the point of intersection is now (30, 1400). This means that the cost for 30 guests at each hotel is the same. For fewer than 30 guests, the Waverly Inn is cheaper. For more than 30 guests, the Hotel Niagara is cheaper.



Chapter 6 Section 7 Question 7 Page 349

Debbie's equation is $d = 25 - 10t$. Ken's equation is $d = 20t$. Use a graphing calculator to plot the equations, and to find the point of intersection.



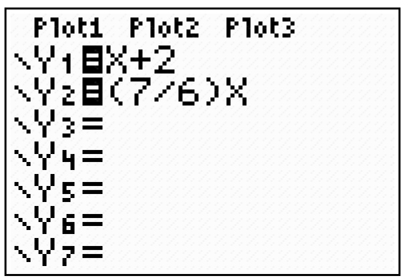


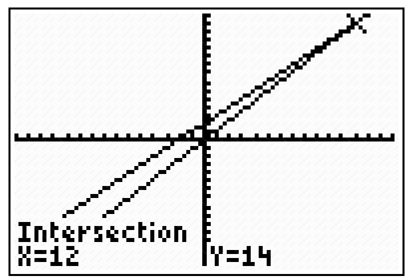
They will meet 16.7 km from Fort Erie. This will happen 0.83 h after they start, or about 2:50.

Chapter 6 Section 7 Question 8 Page 349

$$\begin{aligned} x - y + 2 &= 0 \\ x - y + 2 + y &= 0 + y \\ x + 2 &= y \end{aligned}$$

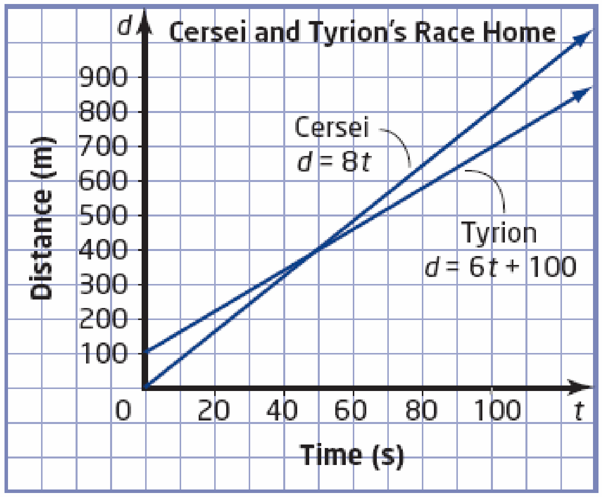
$$\begin{aligned} 7x - 6y &= 0 \\ 7x - 6y - 7x &= 0 - 7x \\ -6y &= -7x \\ \frac{-6y}{-6} &= \frac{-7x}{-6} \\ y &= \frac{7}{6}x \end{aligned}$$





Use a graphing calculator to plot the equations, and to find the point of intersection. The point of intersection is (12, 14). The letters are l and n.

Chapter 6 Section 7 Question 9 Page 350



a) Tyrion had a head start of 100 m.

b) Cersei runs at 8 m/s.

c) Tyrion runs at 6 m/s.

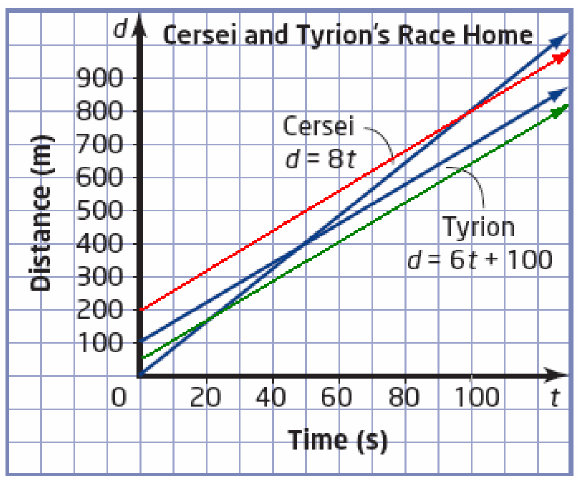
d) Cersei will win if the race is longer than 400 m while Tyrion will win if the race is shorter than 400 m. If the race is 400 m, then they will tie.

e) Answers will vary. A sample answer is shown.

The solution of this linear system is the point (50, 400). This means that if Cersei gives Tyrion a head start of 100 m, she will catch up with him after she has run 400 m and he has run 300 m. This will occur 50 s after they both start running.

Chapter 6 Section 7 Question 10 Page 350

Answers will vary. Sample answers are shown.



a) If Tyrion's head start is doubled, then his distance-time equation will be $d = 6t + 200$ and the new intersection point will be (100, 800). This means that if the race is less than 800 m, Tyrion will win, and if the race is more than 800 m, Cersei will win. If the race is 800 m exactly, they will tie.

b) If Tyrion's head start is halved, then his distance-time equation will be $d = 6t + 50$ and the new intersection point will be (25, 200). This means that if the race is less than 200 m, Tyrion will win, and if the race is more than 200 m, Cersei will win. If the race is 200 m exactly, they will tie.

Chapter 6 Section 7 Question 11 Page 350

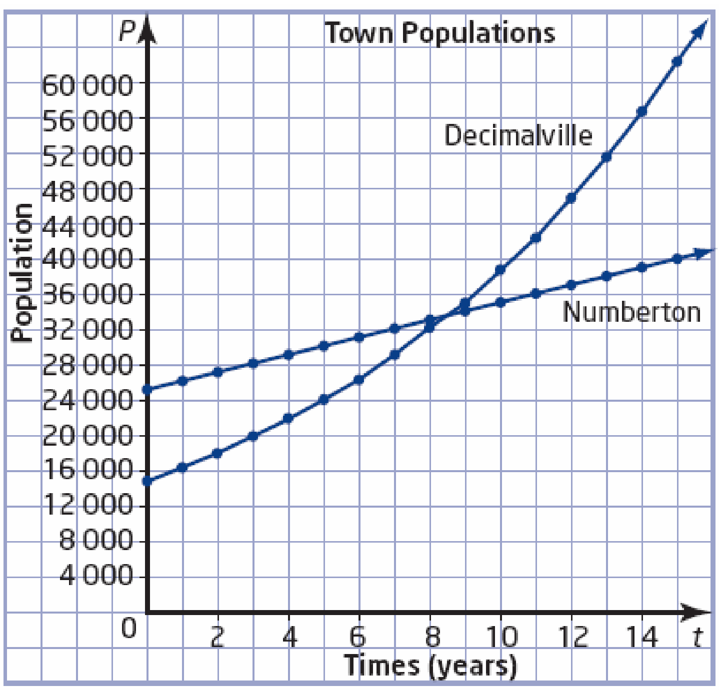
Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 6 Section 7 Question 12 Page 351

a)

Year	Numberton's Population	Decimalville's Population
0	25 000	15 000
1	26 000	16 500
2	27 000	18 150
3	28 000	19 965
4	29 000	21 962
5	30 000	24 158
6	31 000	26 573
7	32 000	29 231
8	33 000	32 154
9	34 000	35 369
10	35 000	38 906
11	36 000	42 797
12	37 000	47 076
13	38 000	51 784
14	39 000	56 962
15	40 000	62 659

b)

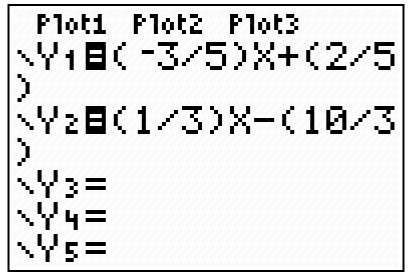


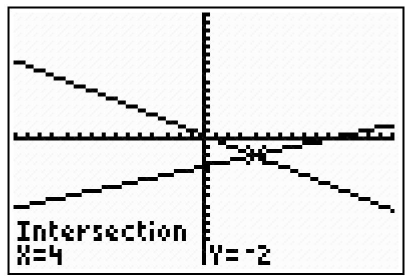
c) Numberton's population growth is linear. Decimalville's population growth is non-linear.

d) The solution to this system occurs some time in the eighth year when both populations number between 33 000 and 34 000. Up to this time, Numberton's population was greater, but after this time, Decimalville's population will be greater.

Chapter 6 Section 7 Question 13 Page 351

$$\begin{aligned} 3x+5y &= 2 \\ 3x+5y-3x &= 2-3x \\ 5y &= -3x+2 \\ \frac{5y}{5} &= \frac{-3x+2}{5} \\ y &= \frac{-3x}{5}+\frac{2}{5} \\ y &= -\frac{3}{5}x+\frac{2}{5} \end{aligned}$$

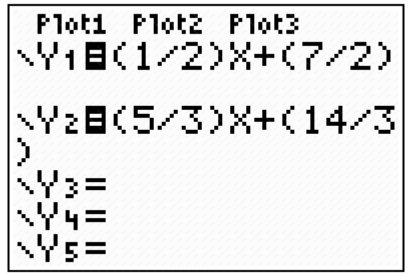


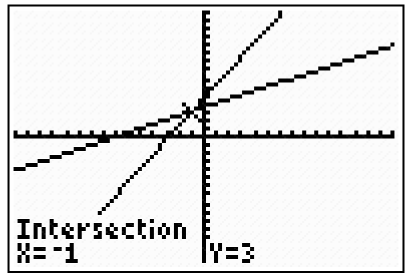


$$\begin{aligned} x-3y &= 10 \\ x-3y-x &= 10-x \\ -3y &= -x+10 \\ \frac{-3y}{-3} &= \frac{-x+10}{-3} \\ y &= \frac{-1x}{-3}+\frac{10}{-3} \\ y &= \frac{1}{3}x-\frac{10}{3} \end{aligned}$$

The point of intersection is (4, –2). Answer B.

Chapter 6 Section 7 Question 14 Page 351





$$\begin{aligned}
-2x+4y&=14\\
-2x+4y+2x&=14+2x\\
4y&=2x+14\\
\frac{4y}{4}&=\frac{2x+14}{4}\\
y&=\frac{2x}{4}+\frac{14}{4}\\
y&=\frac{1}{2}x+\frac{7}{2}
\end{aligned}$$

$$\begin{aligned}
5x-3y&=-14\\
5x-3y-5x&=-14-5x\\
-3y&=-5x-14\\
\frac{-3y}{-3}&=\frac{-5x-14}{-3}\\
y&=\frac{-5x}{-3}+\frac{-14}{-3}\\
y&=\frac{5}{3}x+\frac{14}{3}
\end{aligned}$$

$$\begin{aligned}
4x-6y+12&=0\\
4x-6y+12-4x-12&=0-4x-12\\
-6y&=-4x-12\\
\frac{-6y}{-6}&=\frac{-4x-12}{-6}\\
y&=\frac{-4x}{-6}+\frac{-12}{-6}\\
y&=\frac{2}{3}x+2
\end{aligned}$$

The point of intersection is (–1, 3). The desired slope is $-\frac{3}{2}$.

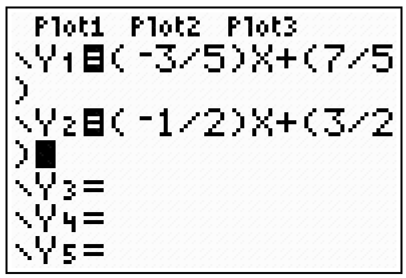
$$
\begin{aligned}
y &= mx + b \\
3 &= -\frac{3}{2}(-1) + b \\
3 &= \frac{3}{2} + b \\
3 - \frac{3}{2} &= \frac{3}{2} + b - \frac{3}{2} \\
\frac{6}{2} - \frac{3}{2} &= b \\
\frac{3}{2} &= b
\end{aligned}
$$

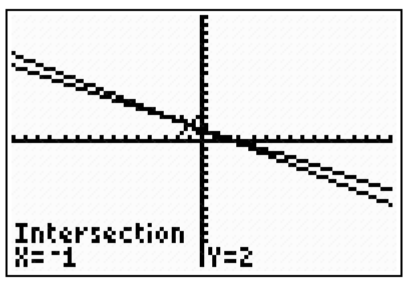
The equation is $y = -\frac{3}{2}x + \frac{3}{2}$.

Chapter 6 Section 7 **Question 15** **Page 351**

a)

$$
\begin{aligned}
3x + 5y &= 7 \\
3x + 5y - 3x &= 7 - 3x \\
5y &= -3x + 7 \\
\frac{5y}{5} &= \frac{-3x + 7}{5} \\
y &= \frac{-3x}{5} + \frac{7}{5} \\
y &= -\frac{3}{5}x + \frac{7}{5}
\end{aligned}
$$





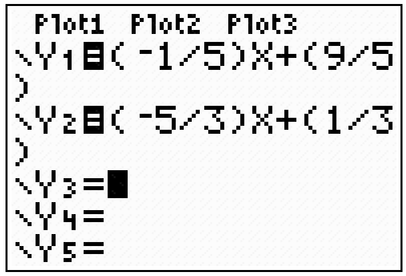
$$
\begin{aligned}
2x + 4y &= 6 \\
2x + 4y - 2x &= 6 - 2x \\
4y &= -2x + 6 \\
\frac{4y}{4} &= \frac{-2x + 6}{4} \\
y &= \frac{-2x}{4} + \frac{6}{4} \\
y &= -\frac{1}{2}x + \frac{3}{2}
\end{aligned}
$$

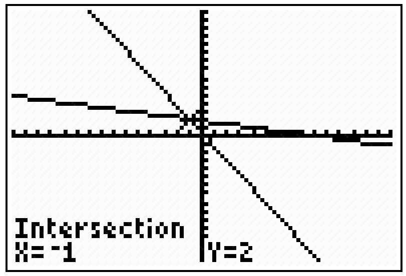
The point of intersection is (–1, 2).

b)

$$\begin{aligned} x+5y &= 9 \\ x+5y-x &= 9-x \\ 5y &= -x+9 \\ \frac{5y}{5} &= \frac{-x+9}{5} \\ y &= \frac{-1x}{5}+\frac{9}{5} \\ y &= -\frac{1}{5}x+\frac{9}{5} \end{aligned}$$

$$\begin{aligned} 5x+3y &= 1 \\ 5x+3y-5x &= 1-5x \\ 3y &= -5x+1 \\ \frac{3y}{3} &= \frac{-5x+1}{3} \\ y &= \frac{-5x}{3}+\frac{1}{3} \\ y &= -\frac{5}{3}x+\frac{1}{3} \end{aligned}$$



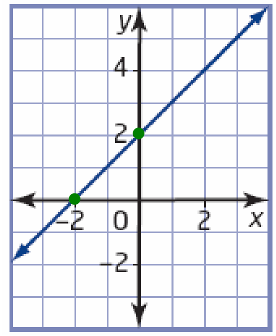


The point of intersection is (–1, 2).

c) Answers will vary. A sample answer is shown. The point of intersection of several lines whose constants, in standard form, are arithmetic sequences is always (–1, 2).

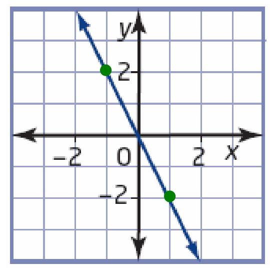
Chapter 6 Review

Chapter 6 Review **Question 1** **Page 352**



a)
$$
\begin{aligned}
m &= \frac{y_2 - y_1}{x_2 - x_1} \\
&= \frac{2 - 0}{0 - (-2)} \\
&= \frac{2}{2} \\
&= 1
\end{aligned}
$$

The slope is 1. The *y*-intercept is 2.



b)
$$
\begin{aligned}
m &= \frac{y_2 - y_1}{x_2 - x_1} \\
&= \frac{-2 - 2}{1 - (-1)} \\
&= \frac{-4}{2} \\
&= -2
\end{aligned}
$$

The slope is –2. The *y*-intercept is 0.

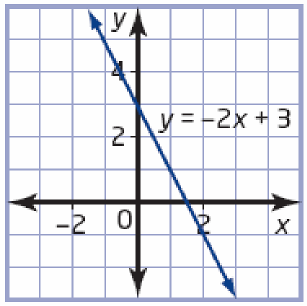
Chapter 6 Review **Question 2** **Page 352**

a) The slope is –3. The *y*-intercept is 2.

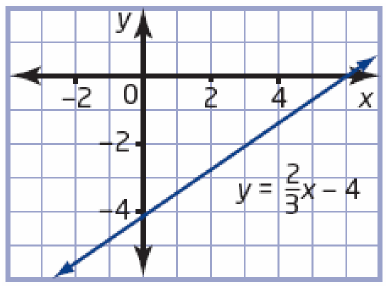
b) The slope is $\frac{3}{5}$. The *y*-intercept is –1.

Chapter 6 Review **Question 3** **Page 352**

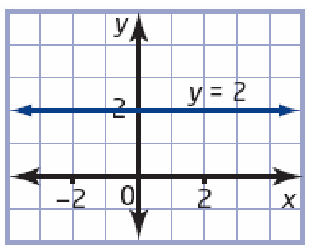
a) $y = -2x + 3$



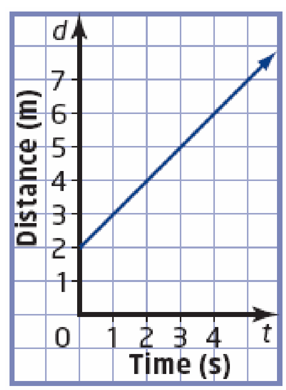
b) $y = \frac{2}{3}x - 4$



c) $y = 2$



Chapter 6 Review **Question 4** **Page 352**



a) The slope is 1. The *d*-intercept is 2. The slope shows that the person is moving away from the motion sensor at a speed of 1 m/s. The *d*-intercept shows that the person started 2 m away from the sensor.

b) $d = t + 2$

Chapter 6 Review **Question 5** **Page 352**

a)

$$\begin{aligned} 2x + y - 6 &= 0 \\ 2x + y - 6 - 2x + 6 &= 0 - 2x + 6 \\ y &= -2x + 6 \end{aligned}$$

b)

$$\begin{aligned} 3x + 5y + 15 &= 0 \\ 3x + 5y + 15 - 3x - 15 &= 0 - 3x - 15 \\ 5y &= -3x - 15 \\ \frac{5y}{5} &= \frac{-3x - 15}{5} \\ y &= \frac{-3x}{5} - \frac{15}{5} \\ y &= -\frac{3}{5}x - 3 \end{aligned}$$

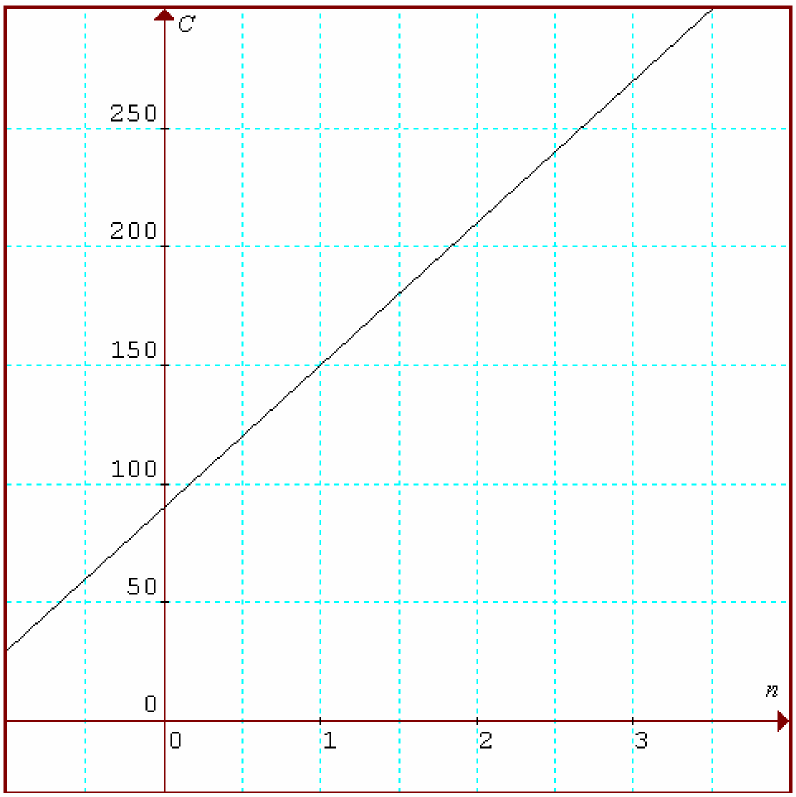
Chapter 6 Review **Question 6** **Page 352**

a)

$$
\begin{aligned}
60n - C + 90 &= 0 \\
60n - C + 90 + C &= 0 + C \\
60n + 90 &= C \\
C &= 60n + 90
\end{aligned}
$$

b) The slope is 60 and the C-intercept is 90. The slope represents the dollar amount per hour that the plumber charges. The C-intercept shows that the plumber also charges a base cost of $90.

c)



d)

$$
\begin{aligned}
C &= 60(3) + 90 \\
&= 180 + 90 \\
&= 270
\end{aligned}
$$

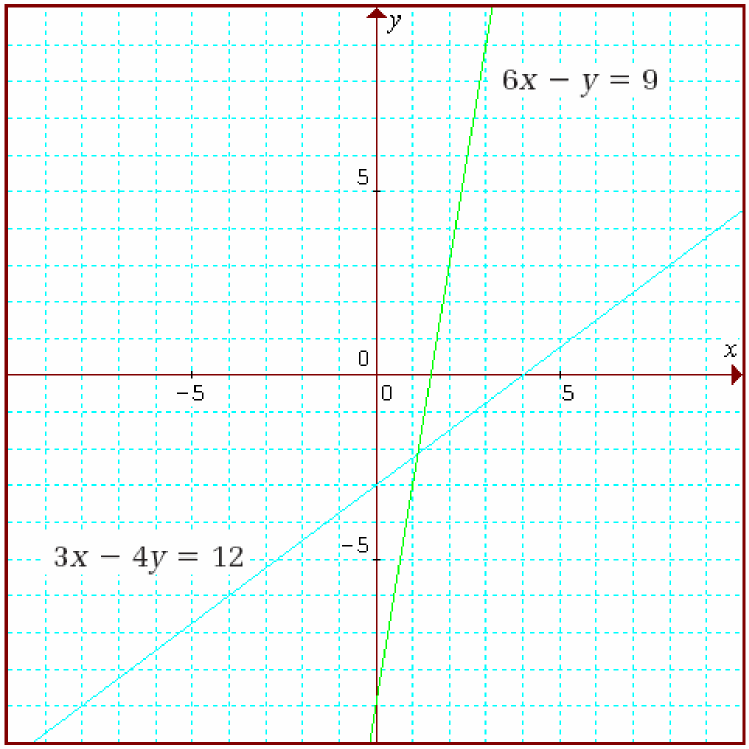
A 3-h house call costs $270.

a)

$$3x - 4y = 12$$
$$3x - 4(0) = 12$$
$$3x = 12$$
$$\frac{3x}{3} = \frac{12}{3}$$
$$x = 4$$

$$3(0) - 4y = 12$$
$$-4y = 12$$
$$\frac{-4y}{-4} = \frac{12}{-4}$$
$$y = -3$$

The x-intercept is 4, and the y-intercept is –3.



b)

$$6x - y = 9$$
$$6x - (0) = 9$$
$$6x = 9$$
$$\frac{6x}{6} = \frac{9}{6}$$
$$x = \frac{3}{2}$$

$$6(0) - y = 9$$
$$-y = 9$$
$$\frac{-y}{-1} = \frac{9}{-1}$$
$$y = -9$$

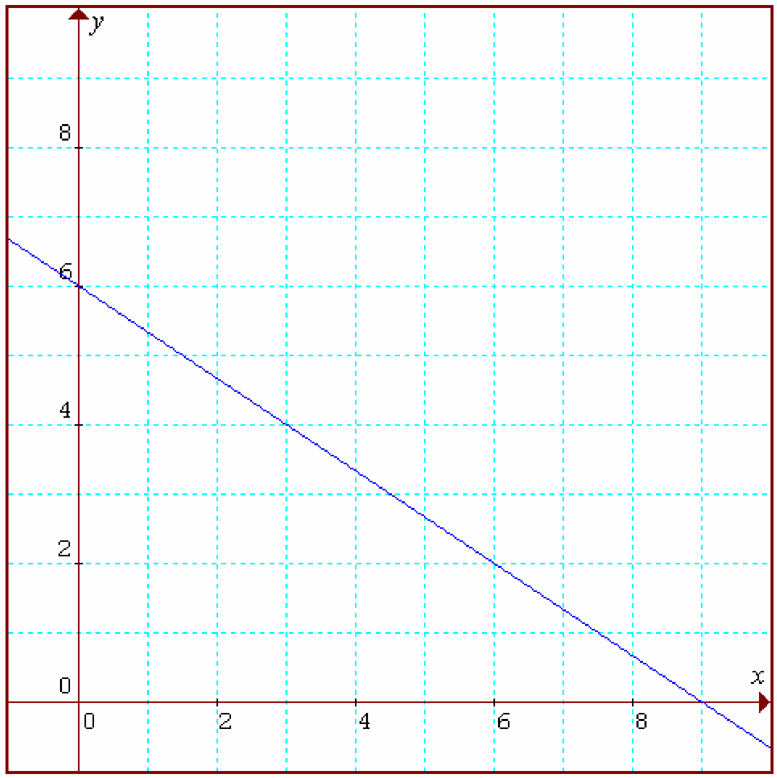
The x-intercept is $\frac{3}{2}$, and the y-intercept is –9.

Chapter 6 Review **Question 8** **Page 352**

a) Cindy can buy $\frac{18}{3}$, or 6 hamburgers.

b) Cindy can buy $\frac{18}{2}$, or 9 pops.

c) Cindy can buy 2 hamburgers and 6 pops; or 4 hamburgers and 3 pops.



Chapter 6 Review **Question 9** **Page 353**

The slopes of parallel lines are identical. For example, $y = 3x + 1$ and $y = 3x - 5$ are parallel lines with a slope 3.

Chapter 6 Review **Question 10** **Page 353**

The slopes of perpendicular lines are negative reciprocals. For example, $y = 3x + 1$ and $y = -\frac{1}{3}x$ are perpendicular lines.

Chapter 6 Review **Question 11** **Page 353**

$$
\begin{aligned}
y &= mx + b \\
-4 &= \frac{2}{3}(1) + b \\
-4 &= \frac{2}{3} + b \\
-4 - \frac{2}{3} &= \frac{2}{3} + b - \frac{2}{3} \\
-\frac{12}{3} - \frac{2}{3} &= b \\
-\frac{14}{3} &= b \\
y &= \frac{2}{3}x - \frac{14}{3}
\end{aligned}
$$

Chapter 6 Review **Question 12** **Page 353**

$$
\begin{aligned}
3x - 4y &= 12 \\
3x - 4y - 3x &= 12 - 3x \\
-4y &= -3x + 12 \\
\frac{-4y}{-4} &= \frac{-3x + 12}{-4} \\
y &= \frac{-3x}{-4} + \frac{12}{-4} \\
y &= \frac{3}{4}x - 3
\end{aligned}
$$

The desired slope is $\frac{3}{4}$.

$$
\begin{aligned}
y &= mx + b \\
0 &= \frac{3}{\cancel{4}_{2}}\left(\cancel{6}^{3}\right) + b \\
0 &= \frac{9}{2} + b \\
0 - \frac{9}{2} &= \frac{9}{2} + b - \frac{9}{2} \\
-\frac{9}{2} &= b \\
y &= \frac{3}{4}x - \frac{9}{2}
\end{aligned}
$$

Chapter 6 Review **Question 13** **Page 353**

The desired slope is $-\frac{1}{2}$. The y-intercept is 0.

The equation is $y = -\frac{1}{2}x$.

Chapter 6 Review **Question 14** **Page 353**

a)

$$\begin{aligned} f &= mt + b \\ 88 &= 32(2) + b \\ 88 &= 64 + b \\ 88 - 64 &= 64 + b - 64 \\ 24 &= b \end{aligned}$$

Set must carry a minimum of 24 L of fuel in his plane at all times.

b) $f = 32t + 24$

c)

$$\begin{aligned} 160 &= 32t + 24 \\ 160 - 24 &= 32t + 24 - 24 \\ 136 &= 32t \\ \frac{136}{32} &= \frac{32t}{32} \\ 4.25 &= t \end{aligned}$$

Seth has enough fuel to fly 4 h and 15 min before having to refuel.

d)

$$\begin{aligned} f &= 24t + 24 \\ 160 &= 24t + 24 \\ 160 - 24 &= 24t + 24 - 24 \\ 136 &= 24t \\ \frac{136}{24} &= \frac{24t}{24} \\ 5\frac{2}{3} &= t \end{aligned}$$

Seth has enough fuel to fly 5 h and 40 min at the new fuel burn rate.

Chapter 6 Review **Question 15** **Page 353**

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-5-5}{3-(-2)} \\ &= \frac{-10}{5} \\ &= -2 \end{aligned}$$

$$\begin{aligned} y &= mx + b \\ 5 &= -2(-2) + b \\ 5 &= 4 + b \\ 5 - 4 &= 4 + b - 4 \\ 1 &= b \\ y &= -2x + 1 \end{aligned}$$

Chapter 6 Review **Question 16** **Page** 353

a)

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{4.0-2.5}{3-1} \\ &= \frac{1.5}{2} \\ &= 0.75 \end{aligned}$$

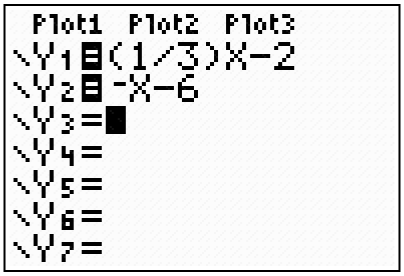
$$\begin{aligned} d &= mt + b \\ 2.5 &= 0.75(1) + b \\ 2.5 &= 0.75 + b \\ 2.5 - 0.75 &= 0.75 + b - 0.75 \\ 1.75 &= b \\ d &= 0.75t + 1.75 \end{aligned}$$

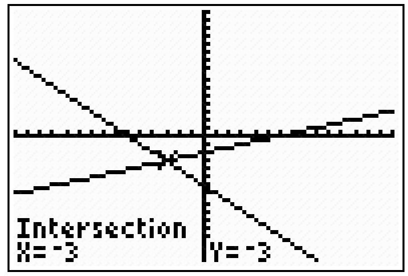
b) The slope, 0.75, shows that Claudia is walking at a speed of 0.75 m/s away from the motion sensor. The *d*-intercept, 1.75, shows that she started 1.75 m away from the sensor.

c) $$\begin{aligned} d &= 0.75(5) + 1.75 \\ &= 3.75 + 1.75 \\ &= 5.5 \end{aligned}$$

Claudia will be 5.5 m from the sensor 5 s after she begins walking.

Chapter 6 Review **Question 17** **Page 353**





The solution is (–3, –3).

$\text{L.S.} = -3 \qquad \text{R.S.} = \frac{1}{3}(-3)$

$\qquad\qquad\qquad\quad = -1$

L.S. = R.S.

The solution satisfies the equation $y = \frac{1}{3}x - 2$.

$\text{L.S.} = -3 \qquad \text{R.S.} = -(-3) - 6$

$\qquad\qquad\qquad\quad = 3 - 6$

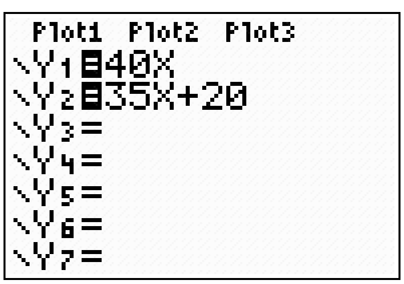
$\qquad\qquad\qquad\quad = -3$

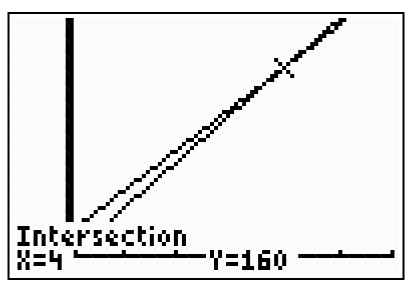
L.S. = R.S.

The solution satisfies the equation $y = -x - 6$.

Chapter 6 Review **Question 18** **Page 353**

a)





The solution is (4, 160). This means that both tutors charge $160 for 4 h of tutoring.

b) If a student wants to spend as little money as possible, then for less than 4 h the student should hire Mr. Wellington. The student should hire Ms. Tenshu for more than 4 h of tutoring. The assumption is that both tutors are equally helpful.

Chapter 6 Chapter Test

Chapter 6 Chapter Test Question 1 Page 354

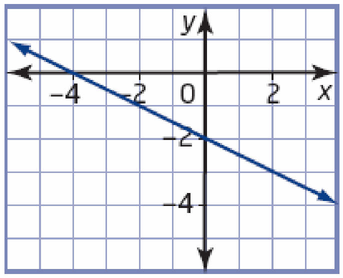
The slope is –3 and the *y*-intercept is –1. Answer C.

Chapter 6 Chapter Test Question 2 Page 354

The *x*-intercept is –4.

The *y*-intercept is –2.

Answer D.



Chapter 6 Chapter Test Question 3 Page 354

A line parallel to the given line must have a slope of $\frac{1}{5}$. Answer B.

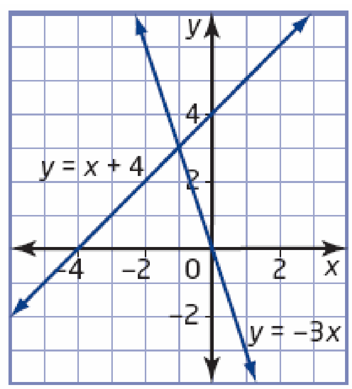
Chapter 6 Chapter Test Question 4 Page 354

A line perpendicular to the given line must have a slope of $-\frac{2}{3}$. Answer B.

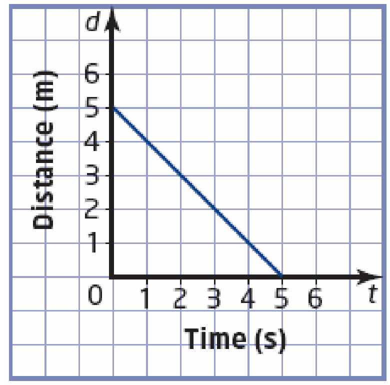
Chapter 6 Chapter Test Question 5 Page 354

From the graph, the point of intersection is (–1, 3).

Answer A.



Chapter 6 Chapter Test   Question 6   Page 354



a) The person was 5 m from the motion sensor when she began walking.

b) The distance is decreasing. She was walking towards, the sensor.

c)
$$
\begin{aligned}
m &= \frac{y_2 - y_1}{x_2 - x_1} \\
&= \frac{0-5}{5-0} \\
&= \frac{-5}{5} \\
&= -1
\end{aligned}
$$

She was walking at 1 m/s.

d) The *d*-intercept is 5.

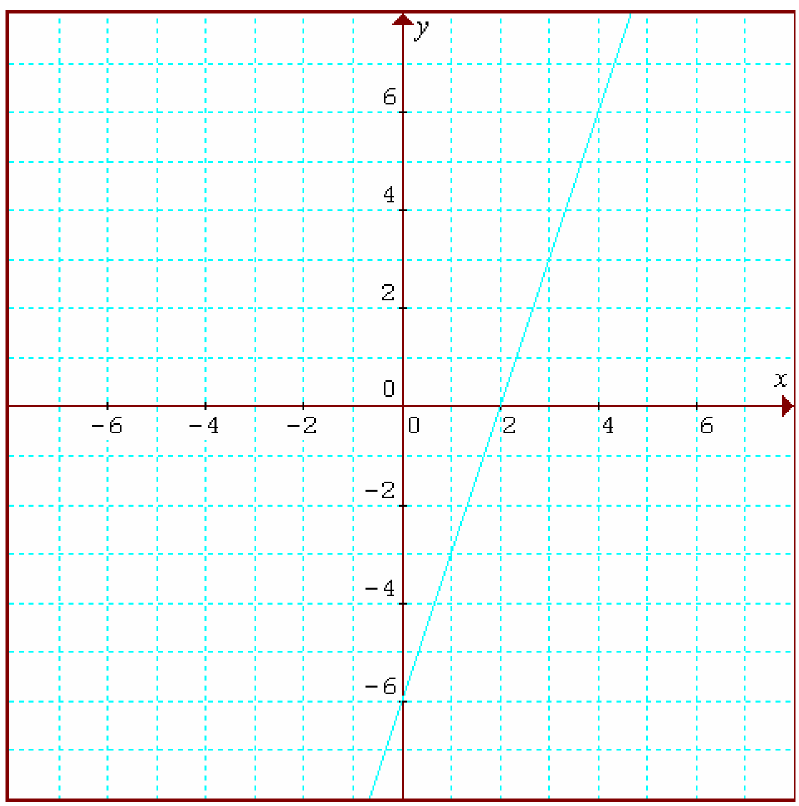
$d = -t + 5$

Chapter 6 Chapter Test   Question 7   Page 354

$$
\begin{aligned}
3x - y &= 6 \\
3(0) - y &= 6 \\
-y &= 6 \\
y &= -6
\end{aligned}
$$

$$
\begin{aligned}
3x - (0) &= 6 \\
3x &= 6 \\
\frac{3x}{3} &= \frac{6}{3} \\
x &= 2
\end{aligned}
$$

The *x*-intercept is 2, and the *y*-intercept is –6.



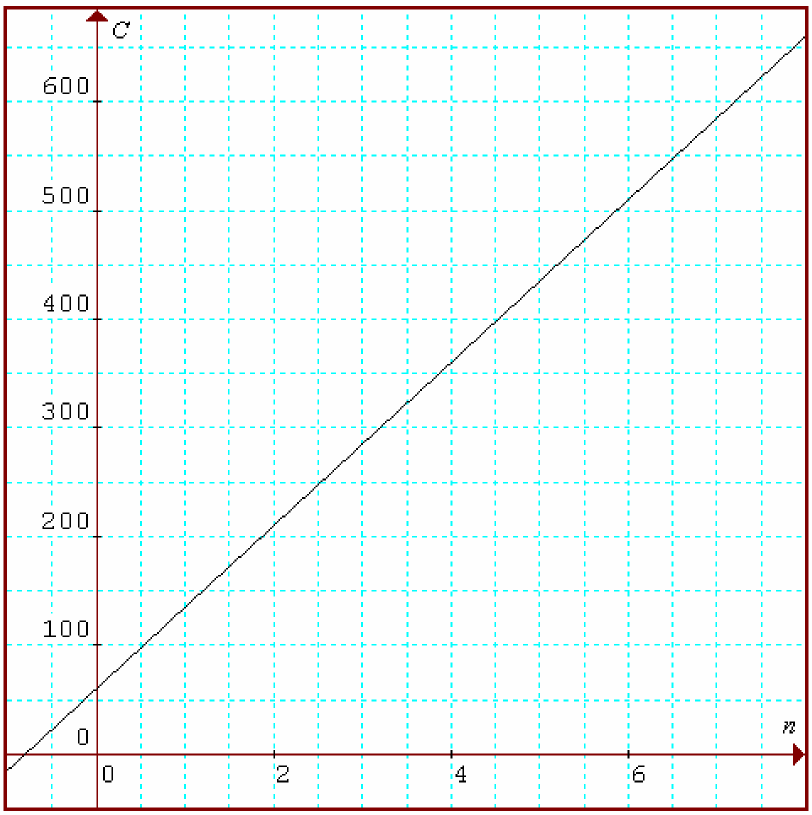
Chapter 6 Chapter Test **Question 8** **Page 354**

a)

$$
\begin{aligned}
75n - C + 60 &= 0 \\
75n - C + 60 + C &= 0 + C \\
75n + 60 &= C \\
C &= 75n + 60
\end{aligned}
$$

b) The slope is 75 and the *C*-intercept is 60. The slope represents the dollar amount per hour that the electrician charges. The *C*-intercept shows that the electrician also charges a base cost of $60.

c)



d)

$$
\begin{aligned}
C &= 75(2) + 60 \\
&= 150 + 60 \\
&= 210
\end{aligned}
$$

The cost of a 2-h house call is $210.

Chapter 6 Chapter Test Question 9 Page 355

$$
\begin{aligned}
y &= mx + b \\
-1 &= \frac{2}{3}(4) + b \\
-1 &= \frac{8}{3} + b \\
-1 - \frac{8}{3} &= \frac{8}{3} + b - \frac{8}{3} \\
-\frac{3}{3} - \frac{8}{3} &= b \\
-\frac{11}{3} &= b
\end{aligned}
$$

The equation is $y = \frac{2}{3}x - \frac{11}{3}$.

Chapter 6 Chapter Test Question 10 Page 355

$$
\begin{aligned}
m &= \frac{y_2 - y_1}{x_2 - x_1} \\
&= \frac{8 - (-4)}{6 - (-3)} \\
&= \frac{12}{9} \\
&= \frac{4}{3}
\end{aligned}
$$

$$
\begin{aligned}
y &= mx + b \\
-4 &= \frac{4}{3}(-3) + b \\
-4 &= -4 + b \\
-4 + 4 &= -4 + b + 4 \\
0 &= b \\
y &= \frac{4}{3}x
\end{aligned}
$$

Chapter 6 Chapter Test Question 11 Page 355

a)

$$\begin{aligned} L &= 3.8G \\ &= 3.8(0.5) \\ &= 1.9 \text{ L} \end{aligned} \qquad \begin{aligned} L &= 3.8G \\ &= 3.8(0.125) \\ &= 0.475 \text{ L} \end{aligned}$$

b)

$$\begin{aligned} L &= 3.8G \\ \frac{L}{3.8} &= \frac{3.8G}{3.8} \\ G &= \frac{L}{3.8} \end{aligned}$$

c)

$$\begin{aligned} G &= \frac{L}{3.8} \\ &= \frac{4}{3.8} \\ &\doteq 1.053 \text{ gallons} \end{aligned} \qquad \begin{aligned} G &= \frac{L}{3.8} \\ &= \frac{0.25}{3.8} \\ &\doteq 0.066 \text{ gallons} \end{aligned}$$

Chapter 6 Chapter Test Question 12 Page 355

$$\begin{aligned} 2x - 3y + 6 &= 0 \\ 2x - 3y + 6 - 2x - 6 &= 0 - 2x - 6 \\ -3y &= -2x - 6 \\ \frac{-3y}{-3} &= \frac{-2x-6}{-3} \\ y &= \frac{-2x}{-3} + \frac{-6}{-3} \\ y &= \frac{2}{3}x + 2 \end{aligned}$$

The desired slope is $-\frac{3}{2}$.

$$\begin{aligned} 3x + 7y + 9 &= 0 \\ 3x + 7(0) + 9 &= 0 \\ 3x + 9 &= 0 \\ 3x + 9 - 9 &= 0 - 9 \\ 3x &= -9 \\ \frac{3x}{3} &= \frac{-9}{3} \\ x &= -3 \end{aligned}$$

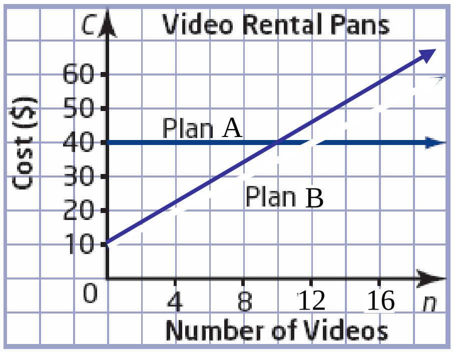
The desired line passes through (–3, 0).

$$\begin{aligned} y &= mx + b \\ 0 &= -\frac{3}{2}(-3) + b \\ 0 &= \frac{9}{2} + b \\ 0 - \frac{9}{2} &= \frac{9}{2} + b - \frac{9}{2} \\ -\frac{9}{2} &= b \end{aligned}$$

The equation is $y = -\frac{3}{2}x - \frac{9}{2}$.

Chapter 6 Chapter Test Question 13 Page 355

a)



b) If you rent fewer than 10 videos in a month, Plan B is cheaper. If you rent more than 10 videos, Plan A is cheaper. For 10 videos both plans cost the same, $40.

Chapter 6 Chapter Test Question 14 Page 355

a) Use $(x_1, y_1) = (0, 0)$ and $(x_2, y_2) = (0.25, 40)$.

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{40 - 0}{0.25 - 0} \\ &= \frac{40}{0.25} \\ &= 160 \end{aligned}$$

Tess's airplane is flying at 160 km/h.

b) $d = 160t$

c)
$$\begin{aligned} 360 &= 160t \\ \frac{360}{160} &= \frac{160t}{160} \\ 2.25 &= t \end{aligned}$$

Tess will take another 2 h and 15 min to arrive at her cottage, for an arrival time of 2:30.

Chapters 4 to 6 Review

Chapters 4 to 6 Review Question 1 Page 356

a) $x-2=-5$ The solution is $x = –3$.

$$x-2+2=-5+2$$
$$x=-3$$

b) $\frac{y}{6}=-7$ The solution is $y = –42$.

$$6\times\frac{y}{6}=6(-7)$$
$$y=-42$$

c) $9+w=13$ The solution is $w = 4$.

$$9+w-9=13-9$$
$$w=4$$

d) $8s=32$ The solution is $s = 4$.

$$\frac{8s}{8}=\frac{32}{8}$$
$$s=4$$

e) $4n+9=25$ The solution is $n = 4$.

$$4n+9-9=25-9$$
$$4n=16$$
$$\frac{4n}{4}=\frac{16}{4}$$
$$n=4$$

f) $16-5r=-14$ The solution is $r = 6$.

$$16-5r-16=-14-16$$
$$-5r=-30$$
$$\frac{-5r}{-5}=\frac{-30}{-5}$$
$$r=6$$

a)

$$\begin{aligned}5x-8&=2x+7\\5x-8+8-2x&=2x+7+8-2x\\3x&=15\\\frac{3x}{3}&=\frac{15}{3}\\x&=5\end{aligned}$$

$$\begin{aligned}\text{L.S.}&=5x-8 & \text{R.S.}&=2x+7\\&=5(5)-8 & &=2(5)+7\\&=25-8 & &=10+7\\&=17 & &=17\end{aligned}$$

L.S. = R.S.

The solution is $x = 5$.

b)

$$\begin{aligned}-2y-7&=4y+11\\-2y-7+7-4y&=4y+11+7-4y\\-6y&=18\\\frac{-6y}{-6}&=\frac{18}{-6}\\y&=-3\end{aligned}$$

$$\begin{aligned}\text{L.S.}&=-2y-7 & \text{R.S.}&=4y+11\\&=-2(-3)-7 & &=4(-3)+11\\&=6-7 & &=-12+11\\&=-1 & &=-1\end{aligned}$$

L.S. = R.S.

The solution is $y = -3$.

c)

$$\begin{aligned}4(3w+2)&=w-14\\12w+8&=w-14\\12w+8-8-w&=w-14-8-w\\11w&=-22\\\frac{11w}{11}&=\frac{-22}{11}\\w&=-2\end{aligned}$$

$$\begin{aligned}\text{L.S.}&=4(3w+2) & \text{R.S.}&=w-14\\&=4(3(-2)+2) & &=-2-14\\&=4(-6+2) & &=-16\\&=4(-4)\\&=-16\end{aligned}$$

L.S. = R.S.

The solution is $w = -2$.

d)

$$\begin{aligned}3-2(s-1)&=13+6s\\3-2s+2&=13+6s\\5-2s&=13+6s\\5-2s-5-6s&=13+6s-5-6s\\-8s&=8\\\frac{-8s}{-8}&=\frac{8}{-8}\\s&=-1\end{aligned}$$

$$\begin{aligned}\text{L.S.}&=3-2(s-1) & \text{R.S.}&=13+6s\\&=3-2(-1-1) & &=13+6(-1)\\&=3-2(-2) & &=13-6\\&=3+4 & &=7\\&=7\end{aligned}$$

L.S. = R.S.

The solution is s = –1.

e)

$$\begin{aligned}2(n+9)&=-6(2n-5)+8\\2n+18&=-12n+30+8\\2n+18&=-12n+38\\2n+18-18+12n&=-12n+38-18+12n\\14n&=20\\\frac{14n}{14}&=\frac{20}{14}\\n&=\frac{20}{14}\\n&=\frac{10}{7}\end{aligned}$$

$$\begin{aligned}\text{L.S.}&=2(n+9)\\&=2\left(\frac{10}{7}+9\right)\\&=2\left(\frac{10}{7}+\frac{63}{7}\right)\\&=2\left(\frac{73}{7}\right)\\&=\frac{146}{7}\end{aligned}$$

$$\begin{aligned}\text{R.S.}&=-6(2n-5)+8\\&=-6\left(2\left(\frac{10}{7}\right)-5\right)+8\\&=-6\left(\frac{20}{7}-\frac{35}{7}\right)+8\\&=-6\left(\frac{-15}{7}\right)+8\\&=\frac{90}{7}+\frac{56}{7}\\&=\frac{146}{7}\end{aligned}$$

L.S. = R.S.

The solution is $n=\frac{10}{7}$.

f)

$$\begin{aligned}5(4k-3)-5k&=10+2(3k+1)\\20k-15-5k&=10+6k+2\\15k-15&=12+6k\\15k-15+15-6k&=12+6k+15-6k\\9k&=27\\\frac{9k}{9}&=\frac{27}{9}\\k&=3\end{aligned}$$

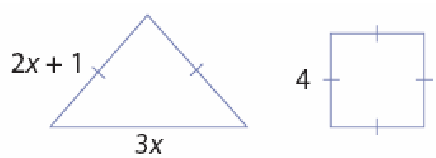
$$\begin{aligned}\text{L.S.}&=5(4k-3)-5(k)\\&=5(4(3)-3)-5(3)\\&=5(12-3)-15\\&=5(9)-15\\&=45-15\\&=30\end{aligned}$$

$$\begin{aligned}\text{R.S.}&=10+2(3k+1)\\&=10+2(3(3)+1)\\&=10+2(9+1)\\&=10+2(10)\\&=30\end{aligned}$$

L.S. = R.S.

The solution is $k=3$.

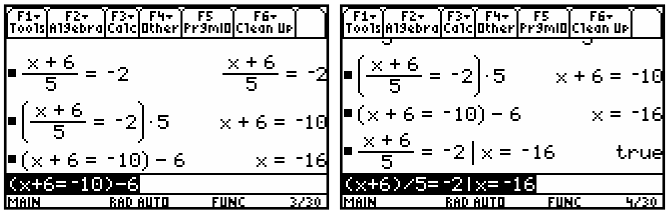
Chapters 4 to 6 Review Question 3 Page 356



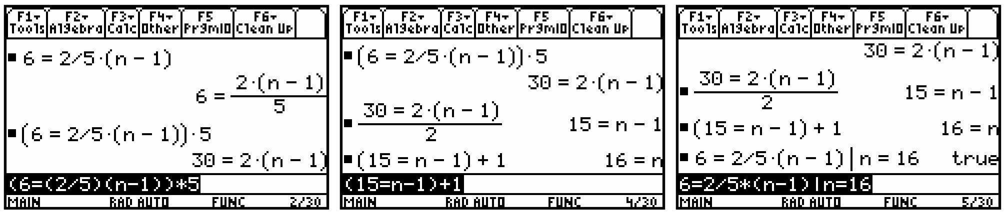
$$\begin{aligned}2x+1+2x+1+3x&=4(4)\\7x+2&=16\\7x+2-2&=16-2\\7x&=14\\\frac{7x}{7}&=\frac{14}{7}\\x&=2\end{aligned}$$

The side lengths of the triangle are $2(2)+1$, or 5 units and $3(2)$, or 6 units.

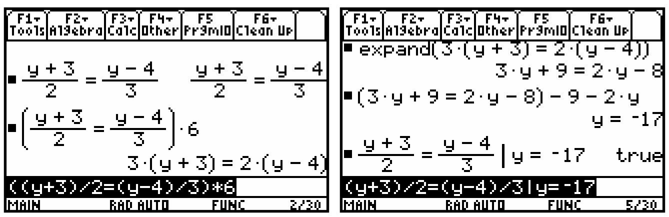
a)


(x+6)/5 = -2
((x+6)/5 = -2)·5   x + 6 = -10
(x + 6 = -10) - 6   x = -16
(x+6=-10)-6
(x+6)/5 = -2 | x = -16   true
(x+6)/5=-2|x=-16
MAIN RAD AUTO FUNC 3/30
MAIN RAD AUTO FUNC 4/30

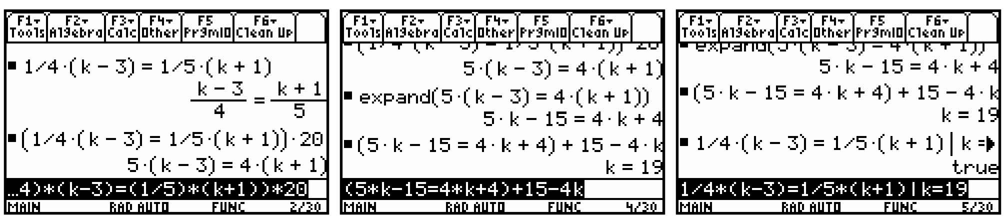
b)


6 = 2/5·(n - 1)
6 = 2·(n - 1)/5
(6 = 2/5·(n - 1))·5
30 = 2·(n - 1)
(6=(2/5)(n-1))*5
30 = 2·(n - 1)/2   15 = n - 1
(15 = n - 1) + 1   16 = n
(15=n-1)+1
6 = 2/5·(n - 1) | n = 16   true
6=2/5*(n-1)|n=16
MAIN RAD AUTO FUNC 2/30
MAIN RAD AUTO FUNC 4/30
MAIN RAD AUTO FUNC 5/30

c)


(y+3)/2 = (y-4)/3
((y+3)/2 = (y-4)/3)·6
3·(y + 3) = 2·(y - 4)
((y+3)/2=(y-4)/3)*6
expand(3·(y + 3) = 2·(y - 4))
3·y + 9 = 2·y - 8
(3·y + 9 = 2·y - 8) - 9 - 2·y
y = -17
(y+3)/2 = (y-4)/3 | y = -17   true
(y+3)/2=(y-4)/3|y=-17
MAIN RAD AUTO FUNC 2/30
MAIN RAD AUTO FUNC 5/30

d)


1/4·(k - 3) = 1/5·(k + 1)
(k-3)/4 = (k+1)/5
(1/4·(k - 3) = 1/5·(k + 1))·20
5·(k - 3) = 4·(k + 1)
...4)*(k-3)=(1/5)*(k+1))*20
expand(5·(k - 3) = 4·(k + 1))
5·k - 15 = 4·k + 4
(5·k - 15 = 4·k + 4) + 15 - 4·k
k = 19
(5*k-15=4*k+4)+15-4k
1/4·(k - 3) = 1/5·(k + 1) | k =
true
1/4*(k-3)=1/5*(k+1)|k=19
MAIN RAD AUTO FUNC 2/30
MAIN RAD AUTO FUNC 4/30
MAIN RAD AUTO FUNC 5/30

Chapters 4 to 6 Review **Question 5** **Page 356**

a)

$$
\begin{aligned}
A &= P + I \\
A - I &= P + I - I \\
P &= A - I
\end{aligned}
$$

b)

$$
\begin{aligned}
d &= 2r \\
\frac{d}{2} &= \frac{2r}{2} \\
r &= \frac{d}{2}
\end{aligned}
$$

c)

$$
\begin{aligned}
v &= u + at \\
v - u &= u + at - u \\
v - u &= at \\
\frac{v-u}{t} &= \frac{at}{t} \\
a &= \frac{v-u}{t}
\end{aligned}
$$

d)

$$
\begin{aligned}
P &= 2(l + w) \\
P &= 2l + 2w \\
P - 2w &= 2l + 2w - 2w \\
P - 2w &= 2l \\
\frac{P-2w}{2} &= \frac{2l}{2} \\
l &= \frac{P-2w}{2} \\
l &= \frac{P}{2} - w
\end{aligned}
$$

Chapters 4 to 6 Review Question 6 Page 356

a) Let *w* represent the width. The length is $2w-2$.

$$\begin{aligned} 2w-2+2w-2+w+w &= 86 \\ 6w-4 &= 86 \\ 6w-4+4 &= 86+4 \\ 6w &= 90 \\ \frac{6w}{6} &= \frac{90}{6} \\ w &= 15 \end{aligned}$$

The width is 15 m, and the length is $2(15)-2$, or 28 m.

b) Answers will vary. A sample answer is shown.

Make a table of possible lengths and widths. Calculate the perimeter for each pair. Continue until you have a perimeter of 86 m. Click here to load the spreadsheet.

Width	Length	Perimeter
1	0	2
2	2	8
3	4	14
4	6	20
5	8	26
6	10	32
7	12	38
8	14	44
9	16	50
10	18	56
11	20	62
12	22	68
13	24	74
14	26	80
15	28	86

c) Answers will vary. A sample answer is shown.

The equation gives an exact answer, but requires skill to solve. The table is easy to use, but may not give an exact answer if it is not an integer.

Chapters 4 to 6 Review Question 7 Page 356

a) Natalie is paid $9 for each hour that she works.

b) $P = 9t$, where *t* represents the time, in hours, that Natalie works and *P* represents the total amount she is paid for this time. The constant of variation represents the dollar amount that Natalie is paid per hour.

c)
$$\begin{aligned} P &= 9(9) \\ &= 81 \end{aligned}$$

Natalie will earn $81 for 9 h worked.

Chapters 4 to 6 Review Question 8 Page 356

Distance, *d* (km)	Cost, *C* ($)
0	50
100	65
200	80
300	95
400	110

a) The fixed cost is $50.

b) Use $(x_1, y_1) = (0, 50)$ and $(x_2, y_2) = (400, 110)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{110 - 50}{400 - 0} = \frac{60}{400} = 0.15$$

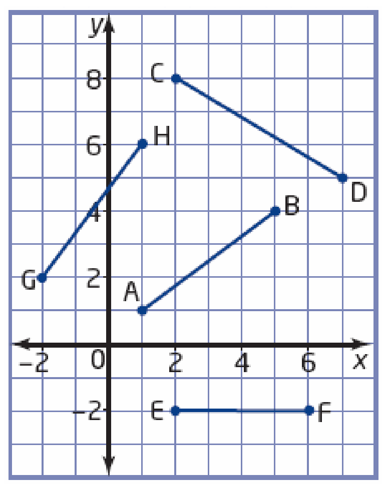
The variable cost is $0.15 times the number of kilometres. This is found by calculating the slope, or rate of change, from the data in the table.

c) $C = 0.15d + 50$

d)
$$C = 0.15(750) + 50 = 112.50 + 50 = 162.50$$

The cost of renting a car for a day and driving 750 km is $162.50.

Chapters 4 to 6 Review Question 9 Page 357



a) $$m_{AB} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 1}{5 - 1} = \frac{3}{4}$$

b) $$m_{CD} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 8}{7 - 2} = -\frac{3}{5}$$

c) $$m_{EF} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - (-2)}{6 - 2} = 0$$

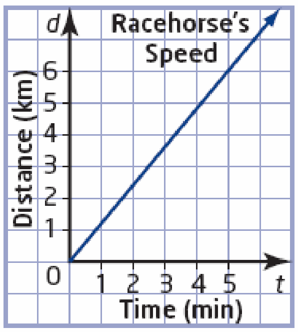
d) $$m_{GH} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6 - 2}{1 - (-2)} = \frac{4}{3}$$

Chapters 4 to 6 Review Question 10 Page 357

a)
$$\text{rate of change} = \frac{\text{change in distance}}{\text{change in time}}$$
$$= \frac{6}{5}$$
$$= 1.2$$

The rate of change of the horse's distance is 1.2 km/min.

b)



c) The rate of change of the horse's distance is the slope of the line. It shows how quickly the horse's distance changes. It represents the average speed: in this case 1.2 km/min or 72 km/h.

Chapters 4 to 6 Review Question 11 Page 357

a)

x	*y*	First Difference
0	5	
1	7	2
2	9	2
3	11	2
4	13	2

The first differences are constant. The relation is linear.

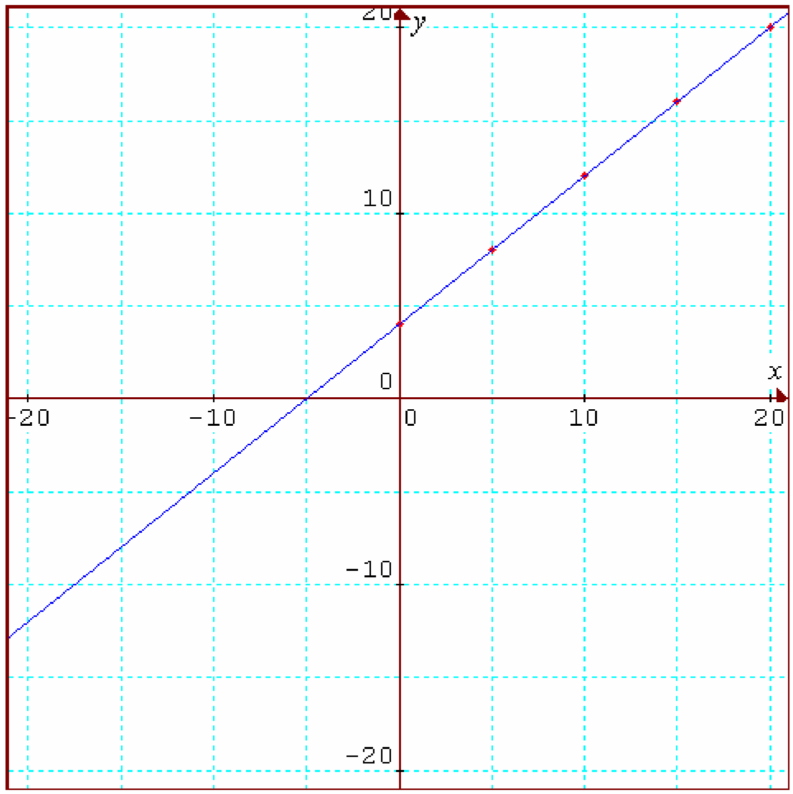
b)

x	*y*	First Difference
0	−4	
2	−2	2
4	2	4
6	8	6
8	16	8

The first differences are not constant. The relation is non-linear.

a)

x	y
0	4
5	8
10	12
15	16
20	20



b) Answers will vary. A sample answer is shown.

Multiply any value of x by $\frac{4}{5}$ and add 4 to obtain the corresponding y-value.

c) Use $(x_1, y_1) = (0, 4)$ and $(x_2, y_2) = (20, 20)$.

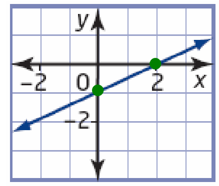
$$
\begin{aligned}
m &= \frac{y_2 - y_1}{x_2 - x_1} \\
&= \frac{20 - 4}{20 - 0} \\
&= \frac{16}{20} \\
&= \frac{4}{5}
\end{aligned}
$$

$$
\begin{aligned}
y &= mx + b \\
4 &= \frac{4}{5}(0) + b \\
4 &= b
\end{aligned}
$$

$$y = \frac{4}{5}x + 4$$

Chapters 4 to 6 Review **Question 13 Page 357**

a)

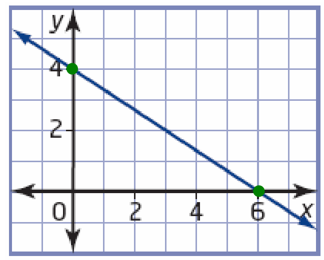


$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{1}{2}$$

The slope is $\frac{1}{2}$, and the y-intercept is –1.

The equation is $y = \frac{1}{2}x - 1$.

b)



$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{-4}{6}$$
$$= -\frac{2}{3}$$

The slope is $-\frac{2}{3}$, and the y-intercept is 4.

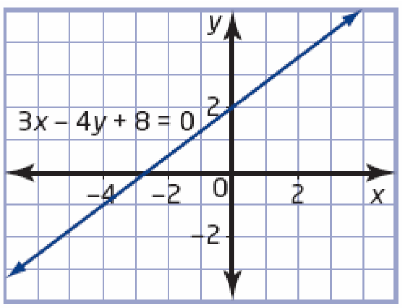
The equation is $y = -\frac{2}{3} + 4$.

Chapters 4 to 6 Review **Question 14** **Page 357**

a)
$$
\begin{aligned}
3x-4y+8&=0\\
3x-4y+8-3x-8&=0-3x-8\\
-4y&=-3x-8\\
\frac{-4y}{-4}&=\frac{-3x-8}{-4}\\
y&=\frac{-3x}{-4}+\frac{-8}{-4}\\
y&=\frac{3}{4}x+2
\end{aligned}
$$

b) The slope is $\frac{3}{4}$, and the y-intercept is 2.

c)

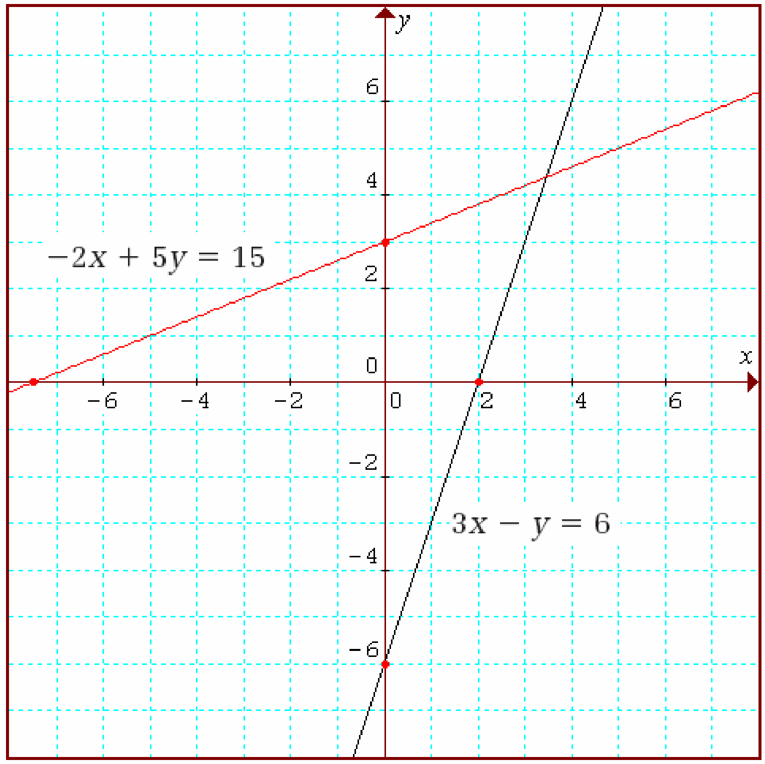


a)

$$\begin{aligned} 3x - y &= 6 \\ 3x - 0 &= 6 \\ 3x &= 6 \\ \frac{3x}{3} &= \frac{6}{3} \\ x &= 2 \end{aligned}$$

$$\begin{aligned} 3(0) - y &= 6 \\ -y &= 6 \\ y &= -6 \end{aligned}$$

The x-intercept is 2, and the y-intercept is –6.



b)

$$\begin{aligned} -2x + 5y &= 15 \\ -2x + 5(0) &= 15 \\ -2x &= 15 \\ \frac{-2x}{-2} &= \frac{15}{-2} \\ x &= -\frac{15}{2} \end{aligned}$$

$$\begin{aligned} -2(0) + 5y &= 15 \\ 5y &= 15 \\ \frac{5y}{5} &= \frac{15}{5} \\ y &= 3 \end{aligned}$$

The x-intercept is $-\frac{15}{2}$, and the y-intercept is 3.

Chapters 4 to 6 Review Question 16 Page 357

a) The slopes are negative reciprocals. The lines are perpendicular.

b) The slopes are equal. The lines are parallel.

c) The slopes are neither equal nor negative reciprocals. The lines are neither.

d) The first line is horizontal, while the second is vertical. The lines are perpendicular.

Chapters 4 to 6 Review Question 17 Page 357

a)

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{3-2}{6-3} \\ &= \frac{1}{3} \end{aligned}$$

$$\begin{aligned} y &= mx + b \\ 2 &= \frac{1}{3}(3) + b \\ 2 &= 1 + b \\ 2 - 1 &= 1 + b - 1 \\ 1 &= b \end{aligned}$$

$$y = \frac{1}{3}x + 1$$

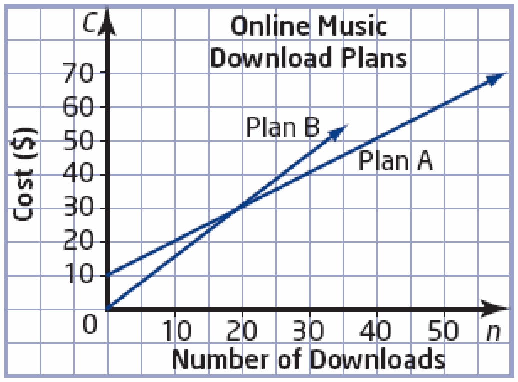
b)

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-3-3}{1-(-2)} \\ &= \frac{-6}{3} \\ &= -2 \end{aligned}$$

$$\begin{aligned} y &= mx + b \\ 3 &= -2(-2) + b \\ 3 &= 4 + b \\ 3 - 4 &= 4 + b - 4 \\ -1 &= b \end{aligned}$$

$$y = -2x - 1$$

a)



The solution is (20, 30).

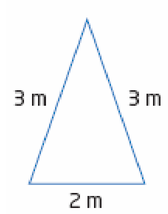
b) If you make fewer than 20 downloads per month, then Plan B is cheaper. If you make more than 20 downloads a month, then Plan A is cheaper.

Chapter 7 Geometric Relationships

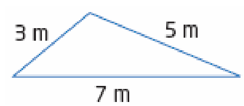
Chapter 7 Get Ready

Chapter 7 Get Ready Question 1 Page 362

a) Two sides are equal. The triangle is isosceles.

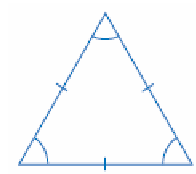


b) No two sides are equal. The triangle is scalene.

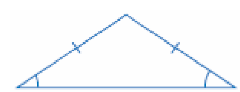


Chapter 7 Get Ready Question 2 Page 362

a) All three angles are equal and acute. The triangle is equilateral and acute.

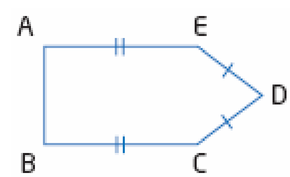


b) Two angles are equal, and one angle is obtuse. The triangle is isosceles and obtuse.

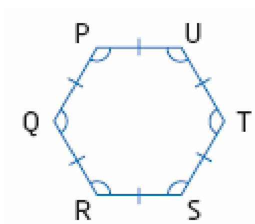


Chapter 7 Get Ready Question 3 Page 363

a) Polygon ABCDE is an irregular pentagon.

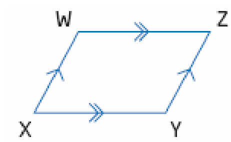


b) Polygon PQRSTU is a regular hexagon.

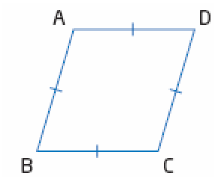


Chapter 7 Get Ready Question 4 Page 363

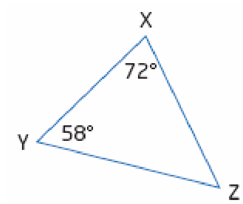
a) Opposite pairs of sides are parallel. WXYZ is a parallelogram.



b) All four sides are equal, but no angles are right angles. ABCD is a rhombus.



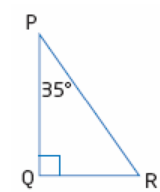
Chapter 7 Get Ready Question 5 Page 363



a) $\angle Z + 72° + 58° = 180°$

$\angle Z = 180° - 72° - 58°$

$\angle Z = 50°$

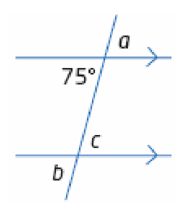


b) $\angle R + 90° + 35° = 180°$

$\angle R = 180° - 90° - 35°$

$\angle R = 55°$

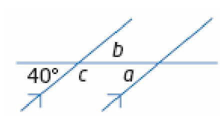
Chapter 7 Get Ready Question 6 Page 363



a) a = 75°, opposite angles.

b = 75°, corresponding angles.

c = 75°, alternate angles.



b) a = 40°, corresponding angles.

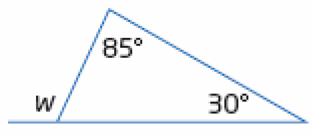
b = 40°, opposite angles.

c = 140°, supplementary angles (also co-interior with a).

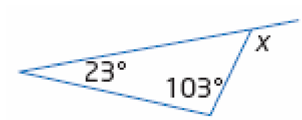
Chapter 7 Section 1: Angle Relationships in Triangles

Chapter 7 Section 1 Question 1 Page 371

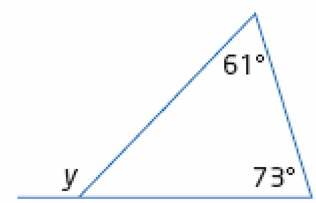
a) $w = 85° + 30°$
$\quad = 115°$



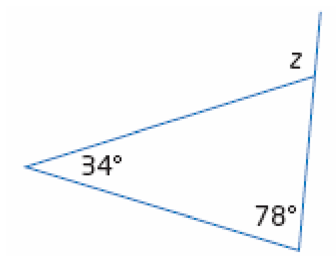
b) $x = 103° + 23°$
$\quad = 126°$



c) $y = 61° + 73°$
$\quad = 134°$

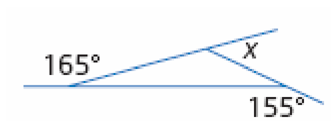


d) $z = 34° + 78°$
$\quad = 112°$

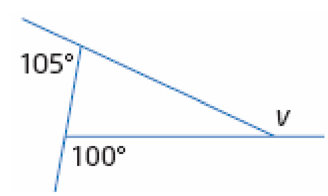


Chapter 7 Section 1 Question 2 Page 371

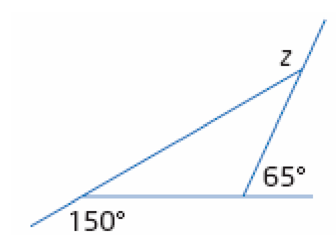
a) $x + 165° + 155° = 360°$
$x = 360° - 165° - 155°$
$x = 40°$



b) $v + 105° + 100° = 360°$
$v = 360° - 105° - 100°$
$v = 155°$



c) $z + 150° + 65° = 360°$
$z = 360° - 150° - 65°$
$z = 145°$



Chapter 7 Section 1 Question 3 Page 371

$$x + 120° + 70° = 360°$$
$$x = 360° - 120° - 70°$$
$$x = 170°$$

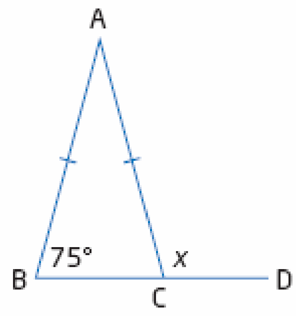
Answer C.

Chapter 7 Section 1 Question 4 Page 372

a) $\angle A + 75° + 75° = 180°$

$$\angle A = 180° - 75° - 75°$$
$$\angle A = 30°$$

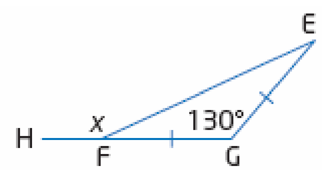
$$x = 75° + 30°$$
$$= 105°$$



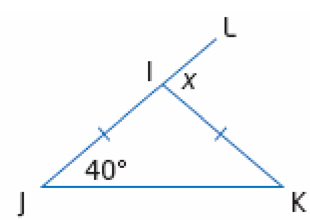
b)

$$2\angle E + 130° = 180°$$
$$2\angle E = 180° - 130°$$
$$2\angle E = 50°$$
$$\frac{2\angle E}{2} = \frac{50°}{2}$$
$$\angle E = 25°$$

$$x = 25° + 130°$$
$$= 155°$$

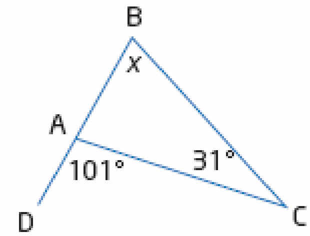


c) $x = 40° + 40°$
$= 80°$



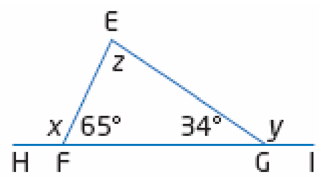
Chapter 7 Section 1 **Question 5** **Page 372**

a)



$$x + 31° = 101°$$
$$x = 101° - 31°$$
$$x = 70°$$

b)

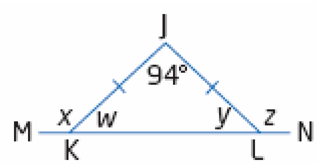


$$z + 65° + 34° = 180°$$
$$z = 180° - 65° - 34°$$
$$z = 81°$$

$$\begin{aligned} x &= 81° + 34° \\ &= 115° \end{aligned}$$

$$\begin{aligned} y &= 81° + 65° \\ &= 146° \end{aligned}$$

c)

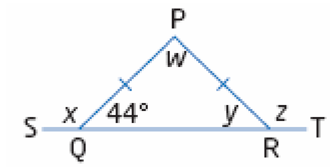


$$w = y$$
$$2w + 94° = 180°$$
$$2w = 180° - 94°$$
$$2w = 86°$$
$$\frac{2w}{2} = \frac{86°}{2}$$
$$w = 43°$$
$$y = 43°$$

$$\begin{aligned} x &= 94° + 43° \\ &= 137° \end{aligned}$$

$$\begin{aligned} z &= 94° + 43° \\ &= 137° \end{aligned}$$

d)



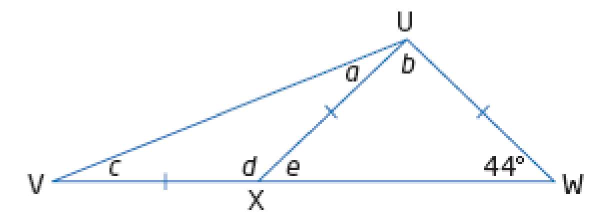
$$y = 44°$$

$$\begin{aligned} w + 44° + 44° &= 180° \\ w + 88° &= 180° \\ w &= 180° - 88° \\ w &= 92° \end{aligned}$$

$$\begin{aligned} x &= 92° + 44° \\ &= 136° \end{aligned}$$

$$\begin{aligned} z &= 92° + 44° \\ &= 136° \end{aligned}$$

e)



$$e = 44°$$

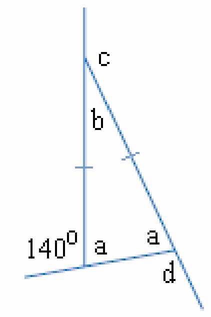
$$\begin{aligned} b + 44° + 44° &= 180° \\ b + 88° &= 180° \\ b &= 180° - 88° \\ b &= 92° \end{aligned}$$

$$\begin{aligned} d &= 92° + 44° \\ &= 136° \end{aligned}$$

$$\begin{aligned} a &= c \\ 2a + 136° &= 180° \\ 2a &= 180° - 136° \\ 2a &= 44° \\ \frac{2a}{2} &= \frac{44°}{2} \\ a &= 22° \\ c &= 22° \end{aligned}$$

Chapter 7 Section 1 **Question 6 Page 372**

Case #1:



$$\begin{aligned} a &= 180° - 140° \\ &= 40° \end{aligned}$$

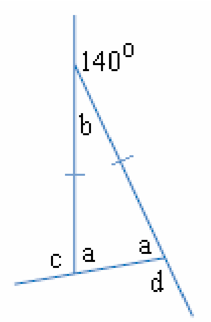
$$\begin{aligned} b + 40° + 40° &= 180° \\ b + 80° &= 180° \\ b &= 180° - 80° \\ b &= 100° \end{aligned}$$

$$\begin{aligned} c &= 40° + 40° \\ &= 80° \end{aligned}$$

$$\begin{aligned} d &= 100° + 40° \\ &= 140° \end{aligned}$$

The other exterior angles measure $80°$ and $140°$.

Case #2:



$$\begin{aligned} b &= 180° - 140° \\ &= 40° \end{aligned}$$

$$\begin{aligned} 2a + 40° &= 180° \\ 2a + &= 180° - 40° \\ 2a &= 140° \\ \frac{2a}{2} &= \frac{140°}{2} \\ a &= 70° \end{aligned}$$

$$\begin{aligned} c &= 40° + 70° \\ &= 110° \end{aligned}$$

$$\begin{aligned} d &= 70° + 40° \\ &= 110° \end{aligned}$$

The other exterior angles measure $110°$ and $110°$.

Chapter 7 Section 1 Question 7 Page 372

$$\begin{aligned} \text{mean} &= \frac{360°}{3} \\ &= 120° \end{aligned}$$

Chapter 7 Section 1 Question 8 Page 372

Isosceles triangles have 2 exterior angles equal. Equilateral triangles have 3 exterior angles equal.

Chapter 7 Section 1 Question 9 Page 372

a) A triangle cannot have two obtuse interior angles. The sum of two obtuse angles is greater than 180º.

b) Any acute triangle will have three obtuse exterior angles.

Chapter 7 Section 1 Question 10 Page 373

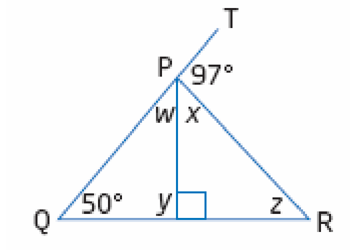
a) $$\begin{aligned} \angle \text{DAC} &= 180° - 5° \\ &= 175° \end{aligned}$$

b) $$\begin{aligned} x + 90° + 5° &= 180° \\ x + 95° &= 180° \\ x &= 180° - 95° \\ x &= 85° \end{aligned}$$

$$\begin{aligned} y &= 90° + 5° \\ &= 95° \end{aligned}$$

The interior angle at the top of the ramp measures 85º, while the exterior angle measures 95º.

Chapter 7 Section 1 **Question 11** **Page 373**



$$\begin{aligned} y &= 180° - 90° \\ &= 90° \end{aligned}$$

$$\begin{aligned} w + 90° + 50° &= 180° \\ w + 140° &= 180° \\ w &= 180° - 140° \\ w &= 40° \end{aligned}$$

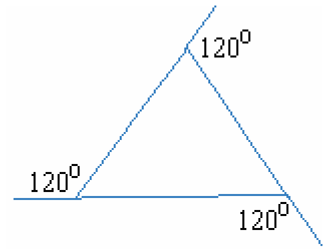
$$\begin{aligned} z + 50° &= 97° \\ z &= 97° - 50° \\ z &= 47° \end{aligned}$$

$$\begin{aligned} x + 47° + 90° &= 180° \\ x + 137° &= 180° \\ x &= 180° - 137° \\ x &= 43° \end{aligned}$$

Chapter 7 Section 1 **Question 12** **Page 373**

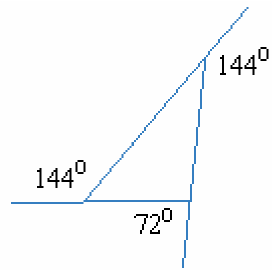
a)

$$\begin{aligned} x + x + x &= 360° \\ 3x &= 360° \\ \frac{3x}{3} &= \frac{360°}{3} \\ x &= 120° \end{aligned}$$



b)

$$\begin{aligned} x + 2x + 2x &= 360° \\ 5x &= 360° \\ \frac{5x}{5} &= \frac{360°}{5} \\ x &= 72° \\ 2x &= 144° \end{aligned}$$



c)

$$\begin{aligned} x + 2x + 3x &= 360° \\ 6x &= 360° \\ \frac{6x}{6} &= \frac{360°}{6} \\ x &= 60° \\ 2x &= 120° \\ 3x &= 180° \end{aligned}$$

This triangle is not possible. An exterior angle cannot equal 180º.

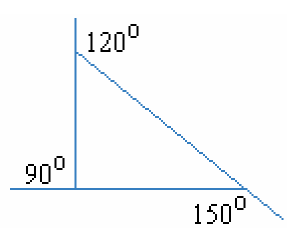
d)

$$\begin{aligned} x + x + 2x &= 360° \\ 4x &= 360° \\ \frac{4x}{4} &= \frac{360°}{4} \\ x &= 90° \\ 2x &= 180° \end{aligned}$$

This triangle is not possible. An exterior angle must be less than 180º.

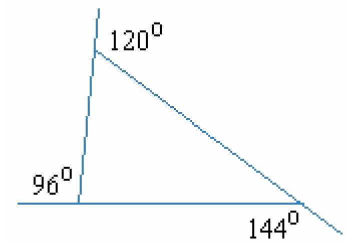
e)

$$\begin{aligned} 3x + 4x + 5x &= 360° \\ 12x &= 360° \\ \frac{12x}{12} &= \frac{360°}{12} \\ x &= 30° \\ 3x &= 90° \\ 4x &= 120° \\ 5x &= 150° \end{aligned}$$



f) $4x + 5x + 6x = 360°$

$$15x = 360°$$
$$\frac{15x}{15} = \frac{360°}{15}$$
$$x = 24°$$
$$4x = 96°$$
$$5x = 120°$$
$$6x = 144°$$



g) $3x + 4x + 8x = 360°$

$$15x = 360°$$
$$\frac{15x}{15} = \frac{360°}{15}$$
$$x = 24°$$
$$3x = 72°$$
$$4x = 96°$$
$$8x = 192°$$

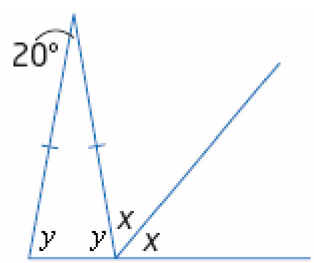
This triangle is not possible. An exterior angle cannot exceed 180º.

Chapter 7 Section 1 Question 13 Page 373

Hexaflexagons are paper hexagons folded from strips of paper which reveal different faces as they are flexed. You can download templates and instructions for making a hexaflexagon.

Chapter 7 Section 1 Question 14 Page 373

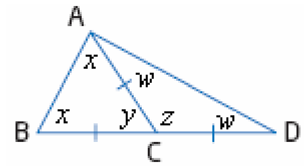
$$2y + 20° = 180°$$
$$2y = 180° - 20°$$
$$2y = 160°$$
$$\frac{2y}{2} = \frac{160°}{2}$$
$$y = 80°$$



$$2x = 20° + 80°$$
$$2x = 100°$$
$$\frac{2x}{2} = \frac{100°}{2}$$
$$x = 50°$$

Answer B.

Chapter 7 Section 1 **Question 15** **Page 373**



$\angle ABC + \angle ADC = x + w$

$$
\begin{aligned}
y + z &= 180° \\
2x + y + z + 2w &= 360° \\
2x + 180° + 2w &= 360° \\
2x + 2w &= 360° - 180° \\
2x + 2w &= 180° \\
\frac{2x + 2w}{2} &= \frac{180°}{2} \\
\frac{2x}{2} + \frac{2w}{2} &= 90° \\
x + w &= 90°
\end{aligned}
$$

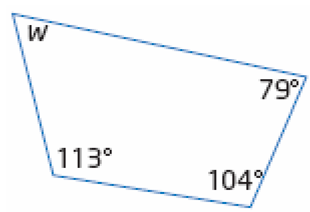
Answer C.

Chapter 7 Section 2 Angle Relationships in Quadrilaterals

Chapter 7 Section 2 Question 1 Page 381

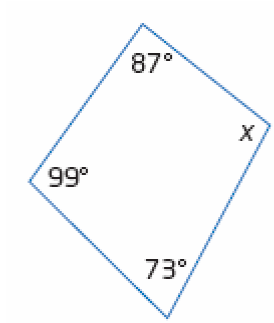
a)

$$\begin{aligned} w + 113° + 104° + 79° &= 360° \\ w + 296° &= 360° \\ w &= 360° - 296° \\ w &= 64° \end{aligned}$$



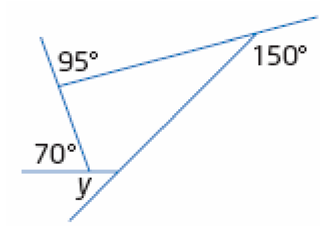
b)

$$\begin{aligned} x + 87° + 99° + 73° &= 360° \\ x + 259° &= 360° \\ x &= 360° - 259° \\ x &= 101° \end{aligned}$$



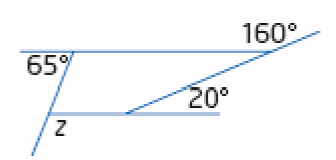
c)

$$\begin{aligned} y + 70° + 95° + 150° &= 360° \\ y + 315° &= 360° \\ y &= 360° - 315° \\ y &= 45° \end{aligned}$$



d)

$$\begin{aligned} z + 65° + 160° + 20° &= 360° \\ z + 245° &= 360° \\ z &= 360° - 245° \\ z &= 115° \end{aligned}$$



Chapter 7 Section 2 Question 2 Page 381

$$\begin{aligned} x + 40° + 90° + 120° &= 360° \\ x + 250° &= 360° \\ x &= 360° - 250° \\ x &= 110° \end{aligned}$$

Answer A.

Chapter 7 Section 2 Question 3 Page 381

$$
\begin{aligned}
x + 80° + 100° + 120° &= 360° \\
x + 300° &= 360° \\
x &= 360° - 300° \\
x &= 60°
\end{aligned}
$$

Answer B.

Chapter 7 Section 2 Question 4 Page 381

a)
$$
\begin{aligned}
\angle\text{D} + 100° + 75° + 50° &= 360° \\
\angle\text{D} + 225° &= 360° \\
\angle\text{D} &= 360° - 225° \\
\angle\text{D} &= 135°
\end{aligned}
$$

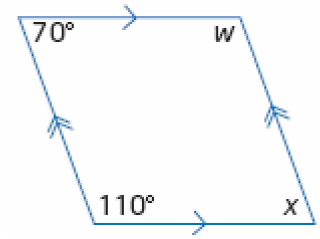
b)
$$
\begin{aligned}
\angle\text{C} + 20° + 35° + 150° &= 360° \\
\angle\text{C} + 205° &= 360° \\
\angle\text{C} &= 360° - 205° \\
\angle\text{C} &= 155°
\end{aligned}
$$

c)
$$
\begin{aligned}
\angle\text{B} + 70° + 70° + 70° &= 360° \\
\angle\text{B} + 210° &= 360° \\
\angle\text{B} &= 360° - 210° \\
\angle\text{B} &= 150°
\end{aligned}
$$

d)
$$
\begin{aligned}
\angle\text{A} + 90° + 90° + 90° &= 360° \\
\angle\text{A} + 270° &= 360° \\
\angle\text{A} &= 360° - 270° \\
\angle\text{A} &= 90°
\end{aligned}
$$

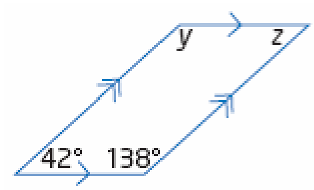
Chapter 7 Section 2 Question 5 Page 381

a) Opposite angles in a parallelogram are equal.



$x = 70°$
$w = 110°$

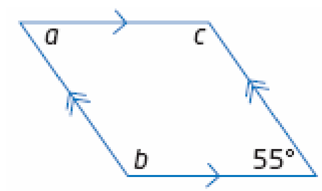
b) Opposite angles in a parallelogram are equal.



$y = 138°$
$z = 42°$

c) Since opposite angles in a parallelogram are equal, $a = 55°$ and $b = c$.

Adjacent angles in a parallelogram are supplementary.



$$b + 55° = 180°$$
$$b = 180° - 55°$$
$$b = 125°$$

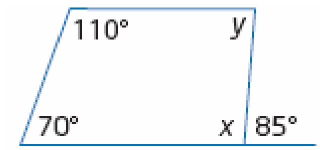
$$c = b$$
$$= 125°$$

Chapter 7 Section 2 Question 6 Page 381

For both triangles and quadrilateral, the sum of the exterior angles is 360º.

Chapter 7 Section 2 **Question 7** **Page 382**

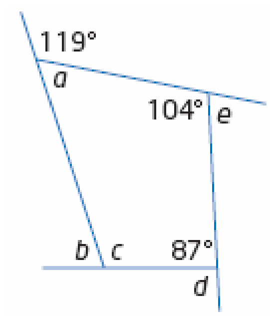
a)



$$\begin{aligned} x &= 180° - 85° \\ &= 95° \end{aligned}$$

$$\begin{aligned} y + 95° + 70° + 110° &= 360° \\ y + 275° &= 360° \\ y &= 360° - 275° \\ y &= 85° \end{aligned}$$

b)



$$\begin{aligned} d &= 180° - 87° \\ &= 93° \end{aligned}$$

$$\begin{aligned} e &= 180° - 104° \\ &= 76° \end{aligned}$$

$$\begin{aligned} a &= 180° - 119° \\ &= 61° \end{aligned}$$

$$\begin{aligned} c + 61° + 87° + 104° &= 360° \\ c + 252° &= 360° \\ c &= 360° - 252° \\ c &= 108° \end{aligned}$$

$$\begin{aligned} b &= 180° - 108° \\ &= 72° \end{aligned}$$

Chapter 7 Section 2 **Question 8** **Page 382**

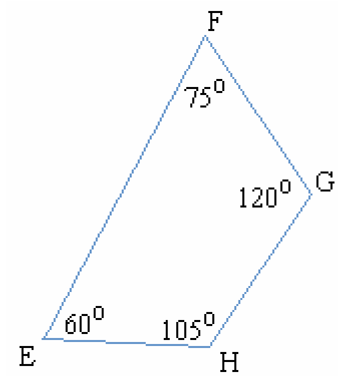
As shown in question 7 b), you need three angles, each at a different vertex; to calculate the measure of all of the interior and exterior angles of a quadrilateral. You can use angle relationships to calculate the others.

Chapter 7 Section 2 **Question 9** **Page 382**

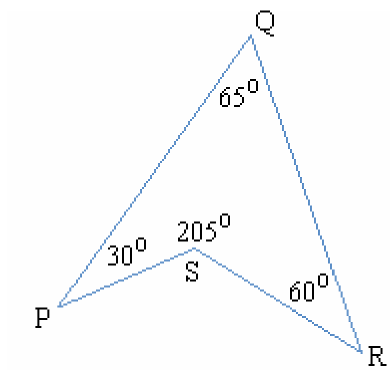
a) $\angle A + \angle B + \angle C = 170° + 65° + 160°$
$= 395°$

The sum of the interior angles of a quadrilateral must be 360º. This quadrilateral is not possible.

b) $\angle H + 60° + 75° + 120° = 360°$
$\angle H + 255° = 360°$
$\angle H = 360° - 255°$
$\angle H = 105°$



c) $\angle S + 30° + 65° + 60° = 360°$
$\angle S + 155° = 360°$
$\angle S = 360° - 155°$
$\angle S = 205°$

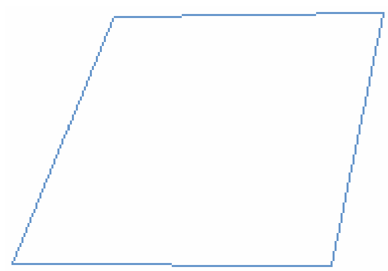


Chapter 7 Section 2 Question 10 Page 382

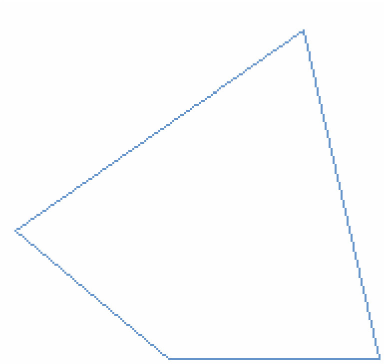
Answers will vary. Sample answers are shown.

a) Four obtuse angles add to more than 360º. This quadrilateral is not possible.

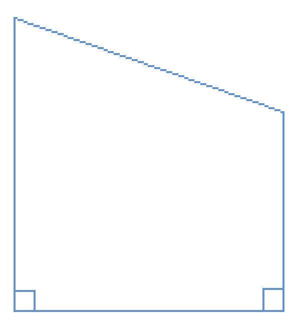
b) Exactly two obtuse angles:



c) One obtuse and three acute angles:



d) One obtuse angle, and two right angles:

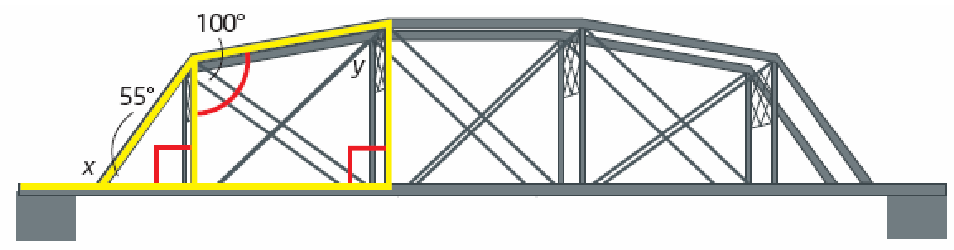


e) If three of the angles are right angles, then the fourth must be a right angle as well. This quadrilateral is not possible.

Chapter 7 Section 2 Question 11 Page 382

$$\begin{aligned} \text{mean} &= \frac{360°}{4} \\ &= 90° \end{aligned}$$

Chapter 7 Section 2 **Question 12 Page 382**



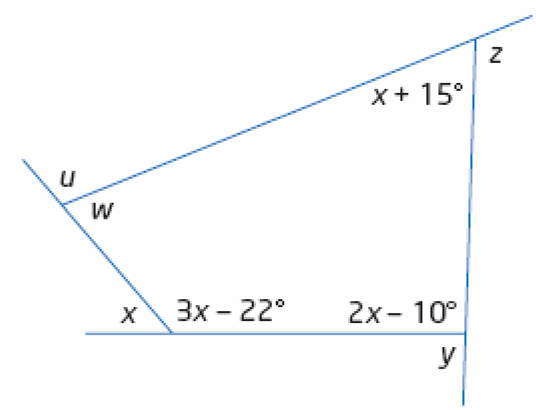
a) $x = 180° - 55°$
$= 125°$

b) $y + 90° + 90° + 100° = 360°$
$y + 280° = 360°$
$y = 360° - 280°$
$y = 80°$

c) Answers will vary. Sample answers are shown.

Triangles and quadrilaterals are easy to construct. Triangles are rigid.

Chapter 7 Section 2 Question 13 Page 383



$$
\begin{aligned}
x + 3x - 22^\circ &= 180^\circ \\
4x - 22^\circ &= 180^\circ \\
4x &= 180^\circ + 22^\circ \\
4x &= 202^\circ \\
\frac{4x}{4} &= \frac{202^\circ}{4} \\
x &= 50.5^\circ
\end{aligned}
$$

$$
\begin{aligned}
3x - 22^\circ &= 3(50.5^\circ) - 22^\circ \\
&= 151.5^\circ - 22^\circ \\
&= 129.5^\circ
\end{aligned}
$$

$$
\begin{aligned}
2x - 10^\circ &= 2(50.5^\circ) - 10^\circ \\
&= 101^\circ - 10^\circ \\
&= 91^\circ
\end{aligned}
$$

$$
\begin{aligned}
y &= 180^\circ - 91^\circ \\
&= 89^\circ
\end{aligned}
$$

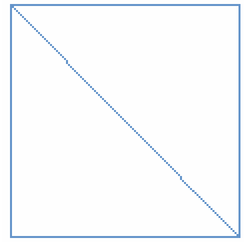
$$
\begin{aligned}
x + 15^\circ &= 50.5^\circ + 15^\circ \\
&= 65.5^\circ
\end{aligned}
$$

$$
\begin{aligned}
z &= 180^\circ - 65.5^\circ \\
&= 114.5^\circ
\end{aligned}
$$

$$
\begin{aligned}
w + 129.5^\circ + 65.5^\circ + 91^\circ &= 360^\circ \\
w + 286^\circ &= 360^\circ \\
w &= 360^\circ - 286^\circ \\
w &= 74^\circ
\end{aligned}
$$

$$
\begin{aligned}
u &= 180^\circ - 74^\circ \\
&= 106^\circ
\end{aligned}
$$

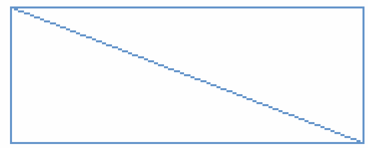
Chapter 7 Section 2 Question 14 Page 383



a) Each diagonal divides the quadrilateral into two congruent triangles.

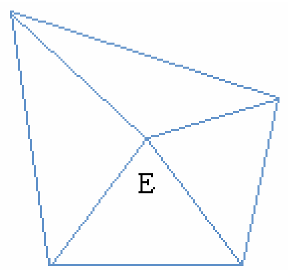
b) The diagonal is a line of symmetry for the square, but not for the rectangle.

c) The diagonal bisects the corner angles in the square. The diagonal does not bisect the corner angles in the rectangle.



Chapter 7 Section 2 Question 15 Page 383

a)



b) The sum of the four angles at point E is 360º.

c) The sum of all of the interior angles of the four triangles inside the quadrilateral is $4 \times 180° = 720°$.

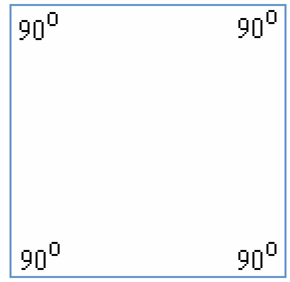
d) The sum of the interior angles of quadrilateral is equal to the sum of the interior angles of the four triangles less the sum of the angles at E: $720° - 360° = 360°$.

Chapter 7 Section 2 **Question 16** **Page 383**

a) $x + x + x + x = 360°$

$$4x = 360°$$
$$\frac{4x}{4} = \frac{360°}{4}$$
$$x = 90°$$

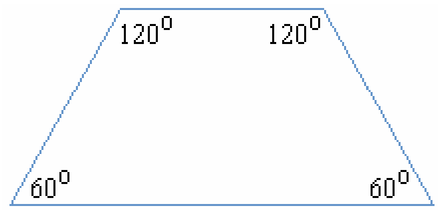
The angles are $90°$, $90°$, $90°$, and $90°$.



b) $x + x + 2x + 2x = 360°$

$$6x = 360°$$
$$\frac{6x}{6} = \frac{360°}{6}$$
$$x = 60°$$

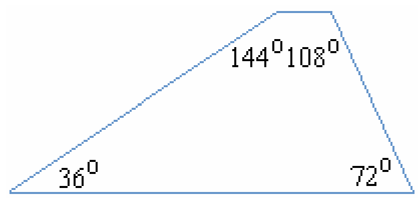
The angles are $60°$, $60°$, $120°$, and $120°$.



c) $x + 2x + 3x + 4x = 360°$

$$10x = 360°$$
$$\frac{10x}{10} = \frac{360°}{10}$$
$$x = 36°$$

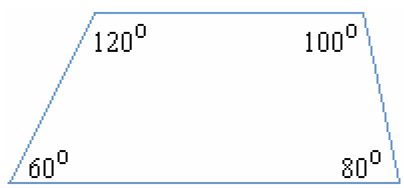
The angles are $36°$, $72°$, $108°$, and $144°$.



d) $3x + 4x + 5x + 6x = 360°$

$$18x = 360°$$
$$\frac{18x}{18} = \frac{360°}{18}$$
$$x = 20°$$

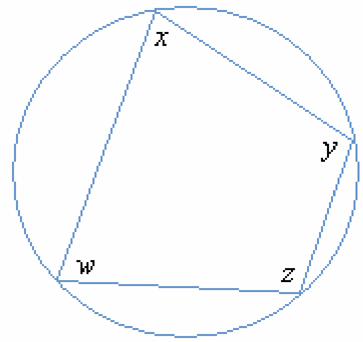
The angles are $60°$, $80°$, $100°$, and $120°$.



Chapter 7 Section 2 **Question 17** **Page 383**

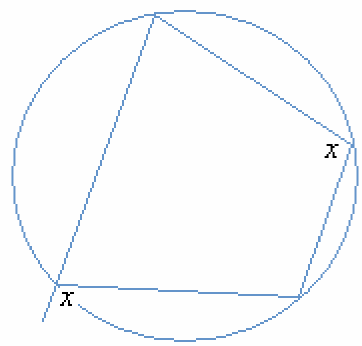
Answers will vary. Sample answers are shown.

In a cyclic quadrilateral, opposite angles are supplementary.

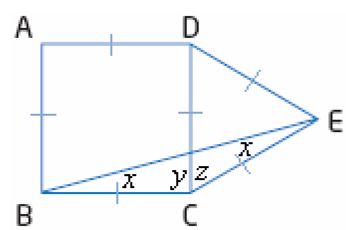


$$x + z = 180°$$
$$w + y = 180°$$

Any external angle is equal to the interior and opposite internal angle.



Chapter 7 Section 2 **Question 18** **Page 383**



$$y = 90°$$
$$z = 60°$$
$$y + z = 150°$$

$$2x + 150° = 180°$$
$$2x = 180° - 150°$$
$$2x = 30°$$
$$\frac{2x}{2} = \frac{30°}{2}$$
$$x = 15°$$
$$\angle\text{CEB} = 15°$$

Answer B.

Chapter 7 Section 2 Question 19 Page 383

Let the sides measure *a*, *b*, *c*, and *d*. You can place them in the following orders:

a, *b*, *c*, and *d*
a, *c*, *b*, and *d*
a, *b*, *d*, and *c*

Any other arrangement will produce a quadrilateral congruent to one of these.

There are 3 non-congruent quadrilaterals you can make with four sides of unequal lengths.

Chapter 7 Section 3 Angle Relationships in Polygons

Note: Let S represent the sum of the interior angles.

Chapter 7 Section 3 Question 1 Page 391

a)
$$\begin{aligned} S &= 180(n-2) \\ &= 180(10-2) \\ &= 180(8) \\ &= 1440 \end{aligned}$$

The sum of the interior angles is $1440°$.

b)
$$\begin{aligned} S &= 180(n-2) \\ &= 180(15-2) \\ &= 180(13) \\ &= 2340 \end{aligned}$$

The sum of the interior angles is $2340°$.

c)
$$\begin{aligned} S &= 180(n-2) \\ &= 180(20-2) \\ &= 180(18) \\ &= 3240 \end{aligned}$$

The sum of the interior angles is $3240°$.

Chapter 7 Section 3 Question 2 Page 391

a)
$$\begin{aligned} S &= 180(n-2) \\ &= 180(7-2) \\ &= 180(5) \\ &= 900 \end{aligned}$$

Each angle measures $\frac{900°}{7}$, or $128.6°$.

b)
$$\begin{aligned} S &= 180(n-2) \\ &= 180(12-2) \\ &= 180(10) \\ &= 1800 \end{aligned}$$

Each angle measures $\frac{1800°}{12}$, or $150°$.

Chapter 7 Section 3 Question 3 Page 391

a)
$$\begin{aligned} 180(n-2) &= 540 \\ 180n-360 &= 540 \\ 180n-360+360 &= 540+360 \\ 180n &= 900 \\ \frac{180n}{180} &= \frac{900}{180} \\ n &= 5 \end{aligned}$$

The polygon has 5 sides.

b)
$$\begin{aligned} 180(n-2) &= 1800 \\ 180n-360 &= 1800 \\ 180n-360+360 &= 1800+360 \\ 180n &= 2160 \\ \frac{180n}{180} &= \frac{2160}{180} \\ n &= 12 \end{aligned}$$

The polygon has 12 sides.

c)
$$\begin{aligned} 180(n-2) &= 3060 \\ 180n-360 &= 3060 \\ 180n-360+360 &= 3060+360 \\ 180n &= 3420 \\ \frac{180n}{180} &= \frac{3420}{180} \\ n &= 19 \end{aligned}$$

The polygon has 19 sides.

Chapter 7 Section 3 Question 4 Page 391

Polygon	Number of Sides	Number of Diagonals From One Vertex	Number of Triangles in the Polygon	Sum of Interior Angles
quadrilateral	4	1	2	360°
pentagon	5	2	3	540°
decagon	10	7	8	1440°
icosagon	20	17	18	3240°

Chapter 7 Section 3 Question 5 Page 391

A regular polygon has equal interior angles, equal exterior angles, and equal sides.

Chapter 7 Section 3 Question 6 Page 391

$$\begin{aligned} S &= 180(n-2) \\ &= 180(4-2) \\ &= 180(2) \\ &= 360 \end{aligned}$$

Each angle in a square measures $\frac{360°}{4}$, or $90°$.

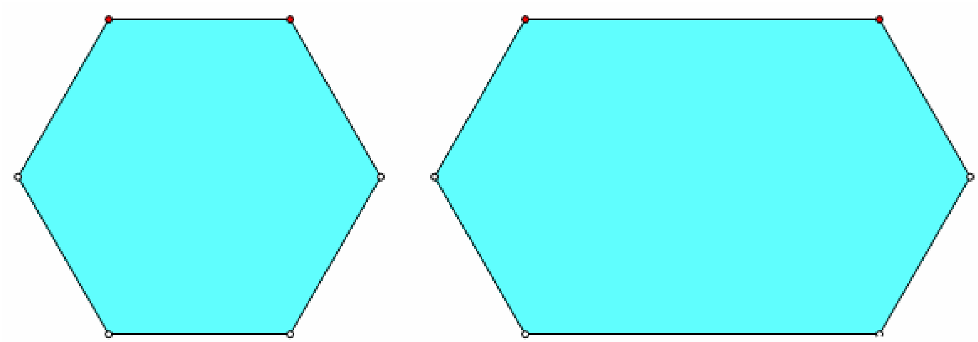
Chapter 7 Section 3 Question 7 Page 391

a)
$$\begin{aligned} S &= 180(n-2) \\ &= 180(6-2) \\ &= 180(4) \\ &= 720 \end{aligned}$$

Each angle in a regular hexagon measures $\frac{720°}{6}$, or $120°$. The adjacent sides of the table will meet at 120º.

b) Answers will vary.

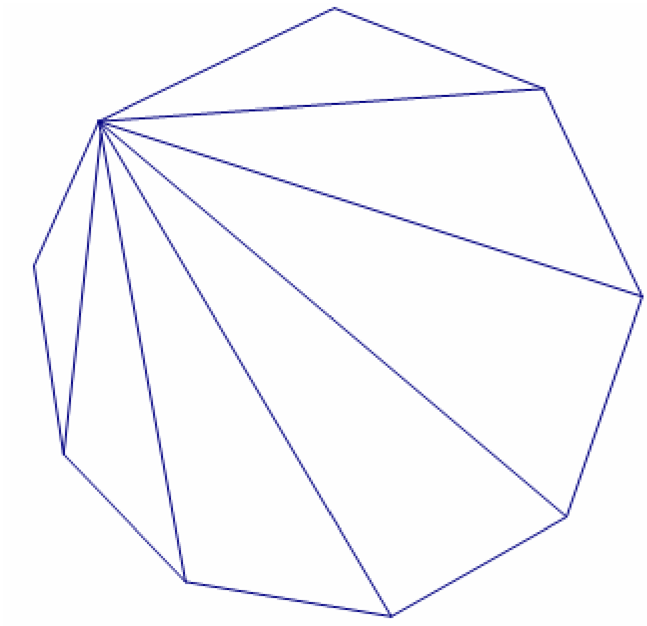
c)



Changing the lengths of one pair of opposite sides by doubling them does not change the measures of the angles.

Chapter 7 Section 3 Question 8 Page 391

a)



b) There are 6 diagonals that can be drawn from any one vertex. Refer to the diagram in part a).

c)
$$\begin{aligned}S&=180(n-2)\\&=180(9-2)\\&=180(7)\\&=1260\end{aligned}$$

The sum of the interior angles of the polygon is 1260º.

Chapter 7 Section 3 **Question 9** **Page 392**

a) $S = 180(n-2)$

$= 180(10-2)$

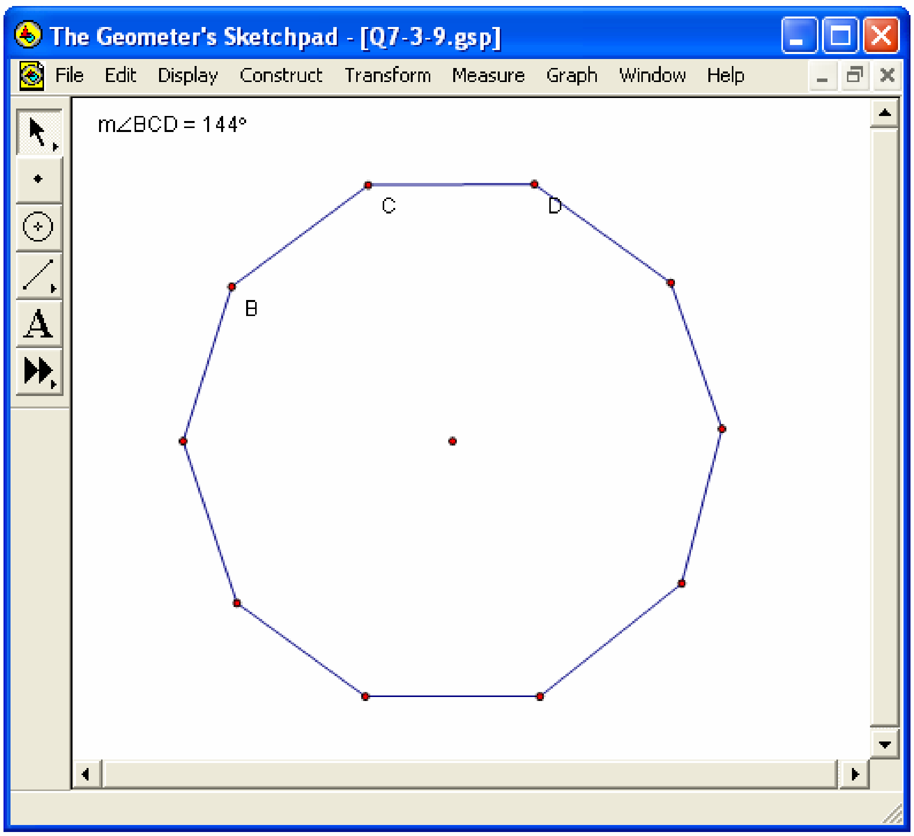
$= 180(8)$

$= 1440$

Each angle in a regular 10-sided polygon measures $\frac{1440°}{10}$, or $144°$.

Second methods may vary. A sample method is shown.

You can use *The Geometer's Sketchpad®* to construct a model of a 10-sided regular polygon, and then measure one of the angles. Click here to load the sketch.



b) $S = 180(n-2)$

$= 180(16-2)$

$= 180(14)$

$= 2520$

Each angle in a regular 16-sided polygon measures $\frac{2520°}{16}$, or $157.5°$.

c) $S = 180(n - 2)$

$= 180(20 - 2)$

$= 180(18)$

$= 3240$

Each angle in a regular 20-sided polygon measures $\frac{3240°}{20}$, or $162°$.

d) The measure of each interior angle of a regular polygon with *n* sides may be calculated from the expression $\frac{180(n-2)}{n}$.

Chapter 7 Section 3 Question 10 Page 392

a) A Canadian dollar coin has 11 sides.

b)
$$\begin{aligned}\frac{180(n-2)}{n} &= \frac{180(11-2)}{11} \\ &= \frac{180(9)}{11} \\ &\doteq 147.3\end{aligned}$$

The angle between adjacent sides of the coin is about 147.3º.

c) Answers will vary. A sample answer is shown.

The Royal Canadian Mint may have chosen this shape to make it easier for blind people and vending machines to recognize, and harder to forge.

Chapter 7 Section 3 Question 11 Page 392

The sum of the exterior angles is 360° for all convex polygons. You cannot determine the number of sides from the sum of the exterior angles.

Chapter 7 Section 3 Question 12 Page 392

Three regular polygons whose interior angles divide evenly into 360º are triangles (60º), rectangles (90º), and hexagons (120º).

Chapter 7 Section 3 **Question 13 Page 392**

a) The gazebo has 12 sides.

b)
$$\begin{aligned}\frac{180(n-2)}{n} &= \frac{180(12-2)}{12}\\ &= \frac{180(10)}{12}\\ &= 150\end{aligned}$$

The angle between adjacent sides is 150º.

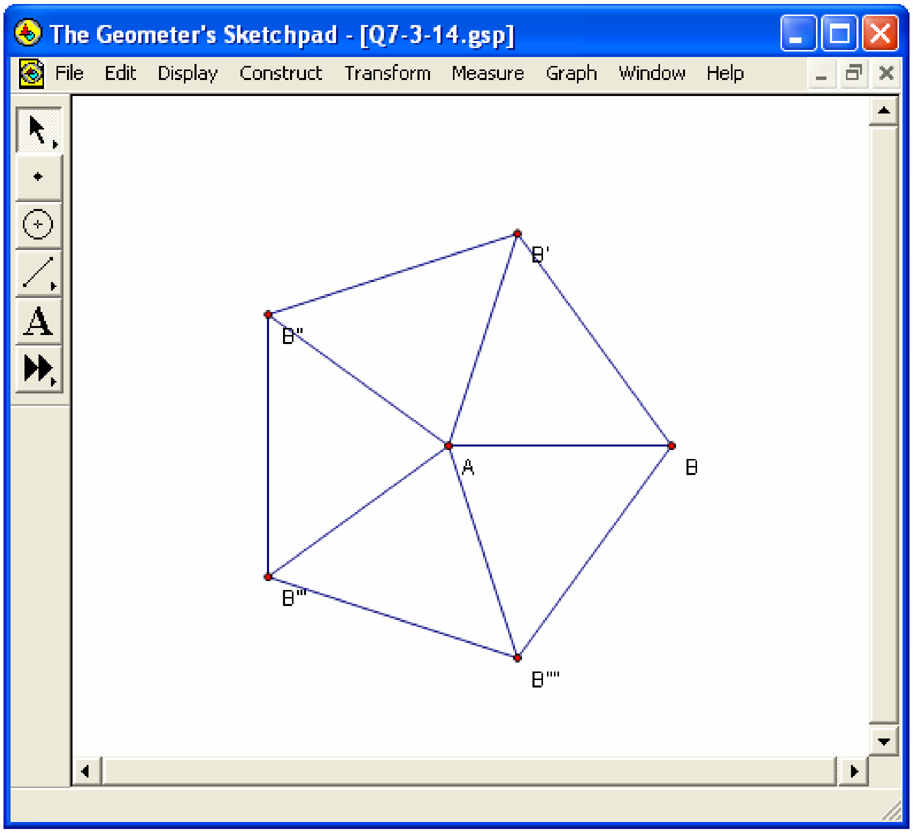
c) The angle between adjacent roof supports is $\frac{360°}{12}$, or $30°$.

d) Answers will vary.

e) The angle between adjacent roof supports in a gazebo with six sides is $\frac{360°}{6}$, or $60°$.

Chapter 7 Section 3 Question 14 Page 392

a) Click here to load the sketch.



The shape formed is a pentagon.

b) To construct a regular octagon using this method, rotate the line segment 7 times through an angle of 45º.

c) Use an angle of $\frac{360°}{20}$, or 18° for a regular 20-sided figure.

d) The angle of rotation is 360° divided by the number of sides.

Chapter 7 Section 3 Question 15 Page 393

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 7 Section 3 Question 16 Page 393

All regular polygons are convex. The angle between adjacent sides must be less than 180º.

Chapter 7 Section 3 Question 17 Page 393

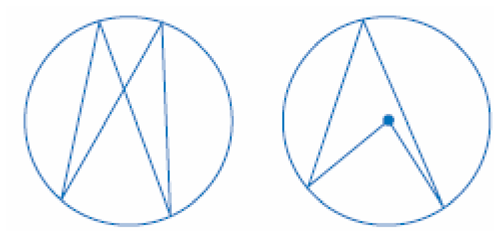
Answers will vary. A sample answer is shown.

The formula for the sum of the interior angles applies to concave polygons. An *n*-sided concave polygon can be divided into $n - 2$ triangles by diagonals from two or more vertices. Alternatively, you can use *The Geometer's Sketchpad*® to measure angle sums in various concave polygons.

Chapter 7 Section 3 Question 18 Page 393

Answers will vary. Sample answers are shown.

In the first diagram, angles on the same chord are equal. In the second diagram, the angle at the centre is double the angle at the circumference.

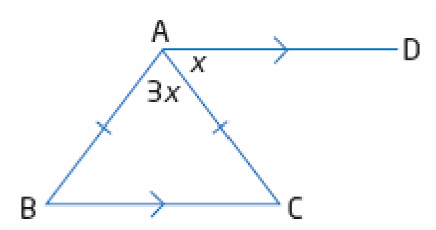


Chapter 7 Section 3 Question 19 Page 393

Answers will vary.

Chapter 7 Section 3 Question 20 Page 393

$\angle ABC$ and $\angle BCA$ both measure the same as angle *x*.



$$\begin{aligned} 3x + x + x &= 180° \\ 5x &= 180° \\ \frac{5x}{5} &= \frac{180°}{5} \\ x &= 36° \end{aligned}$$

$\angle BCA = 36°$

Answer B.

Chapter 7 Section 3 Question 21 Page 393

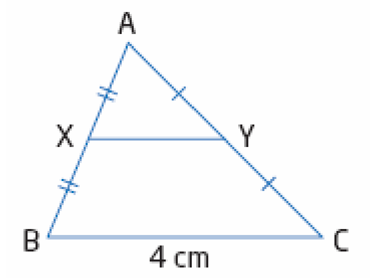
Each diagonal requires one pair of vertices. There are 12×11, or 132 pairs of vertices. However, each one has been counted twice. That leaves $\frac{132}{2}$, or 66. However, this also counts the edges of the polygon. The number of possible diagonals is $66 - 12$, or 54. Answer A.

Chapter 7 Section 4 Midpoints and Medians in Triangles

Chapter 7 Section 4 Question 1 Page 398

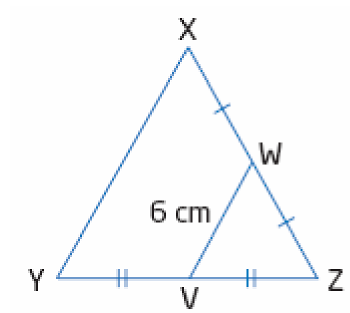
a) $$\begin{aligned} XY &= \frac{1}{2}BC \\ &= \frac{1}{2}(4) \\ &= 2 \end{aligned}$$

The length of XY is 2 cm.



b) $$\begin{aligned} XY &= 2VW \\ &= 2(6) \\ &= 12 \end{aligned}$$

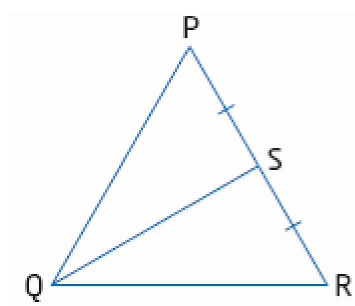
The length of XY is 12 cm.



Chapter 7 Section 4 Question 2 Page 398

a) The area of ΔPQS is half the area of ΔPQR. The area of ΔPQR is 16 cm^2. So, the area of ΔPQS is 8 cm^2.

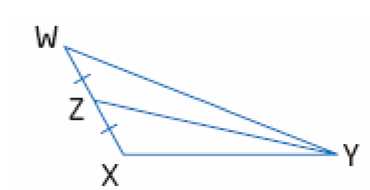
b) The area of ΔQSR is half the area of ΔPQR. The area of ΔPQR is 16 cm^2. So, the area of ΔQSR is 8 cm^2.



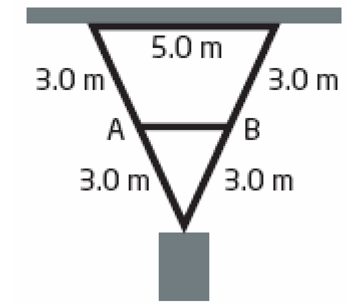
Chapter 7 Section 4 Question 3 Page 398

a) The area of ΔWZY is equal to the area of ΔXYZ. The area of ΔXYZ is 19 cm^2. So, the area of ΔWZY is 19 cm^2.

b) The area of ΔWXY is double the area of ΔXYZ. The area of ΔXYZ is 19 cm^2. So, the area of ΔWXY is 38 cm^2.

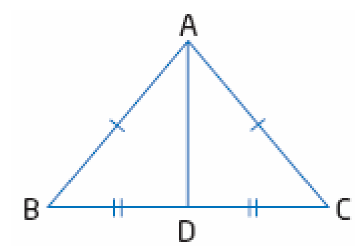


Chapter 7 Section 4 Question 4 Page 398



The length of the cross-brace AB is $\frac{1}{2} \times 5$, or 2.5 m.

Chapter 7 Section 4 Question 5 Page 399

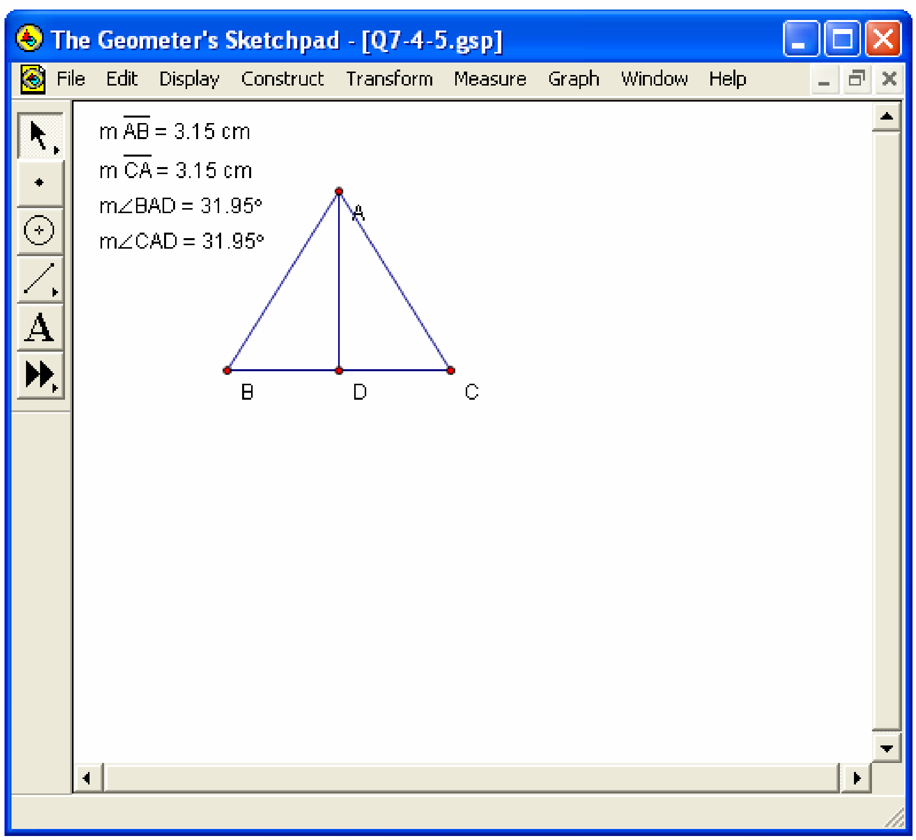


a) Answers will vary.

b) You can fold along the median and see if the equal sides line up.

c) You can construct the isosceles triangle and median, and then measure the angle on either side of the median.

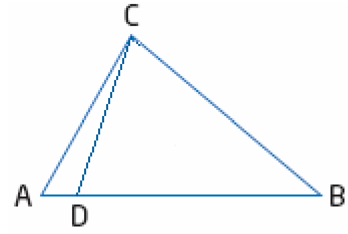
d) Click here to load the sketch.



The median bisects the angle.

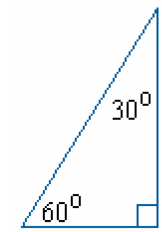
Chapter 7 Section 4 Question 6 Page 399

If point D is moved close to vertex A, $\angle ADC$ is obtuse.



Chapter 7 Section 4 Question 7 Page 399

a) Refer to the diagram. In this case, the 60º angle is opposite the second-longest side.

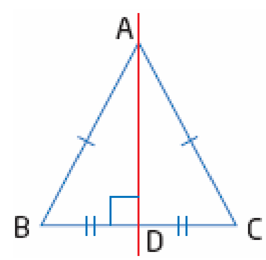


b) Refer to the diagram. In this case, the 60º angle is opposite the second-longest side.

c) Since the angles sum to 180°, one of the angles must be larger than 60° and the third angle must be smaller. The largest angle is opposite the largest side, and the smallest angle is opposite the smallest side. Therefore, the 60° angle is opposite the second-longest side.

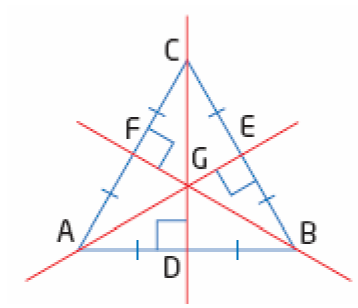
Chapter 7 Section 4 Question 8 Page 399

Since ΔABD and ΔACD are congruent (ASA or SAS), the perpendicular at D must pass through A.



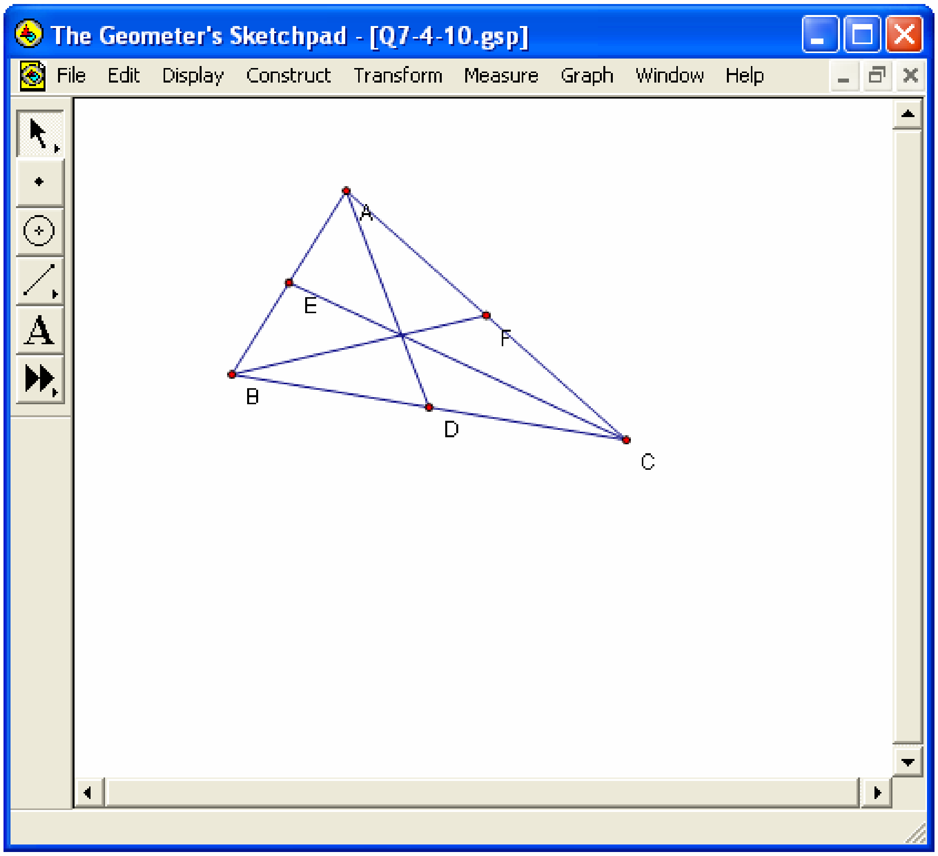
Chapter 7 Section 4 Question 9 Page 399

ΔAGC, ΔCGB, and ΔBGA are not equilateral triangles. The centre angle at G is obtuse for all three triangles.

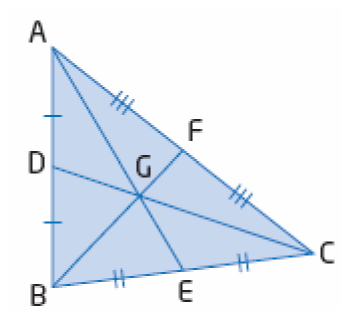


Chapter 7 Section 4 Question 10 Page 399

Medians intersect at a point for all triangles. You can verify this using geometry software. A sample sketch is shown. Click here to load the sketch.



Chapter 7 Section 4 Question 11 Page 400



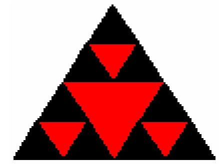
a) ΔBEG and ΔCEG have the same area because GE is a median of ΔBGC.

b) The same logic applies as in part a), since DG and GF are also medians.

c) AE is a median, so ΔABE has the same area as ΔACE. Since the areas of ΔBEG and ΔCEG are equal, the areas of ΔABG and ΔACG are also equal. The areas of the two triangles in ΔABG are equal, as are the areas of the two triangles in ΔACG. Therefore, ΔADG, ΔBDG, ΔAFG, and ΔCFG each have an area equal to half that of ΔABG. Comparing ΔBCF and ΔBAF shows that ΔBEG and ΔCEG also each have an area half that of ΔABG.

Chapter 7 Section 4 Question 12 Page 400

a) Answers will vary. Start with an equilateral triangle, shown in black. Connect the midpoints of the sides. Shade the smaller triangle formed, shown in red. Repeat for each of the three smaller black triangles. Continue the process.



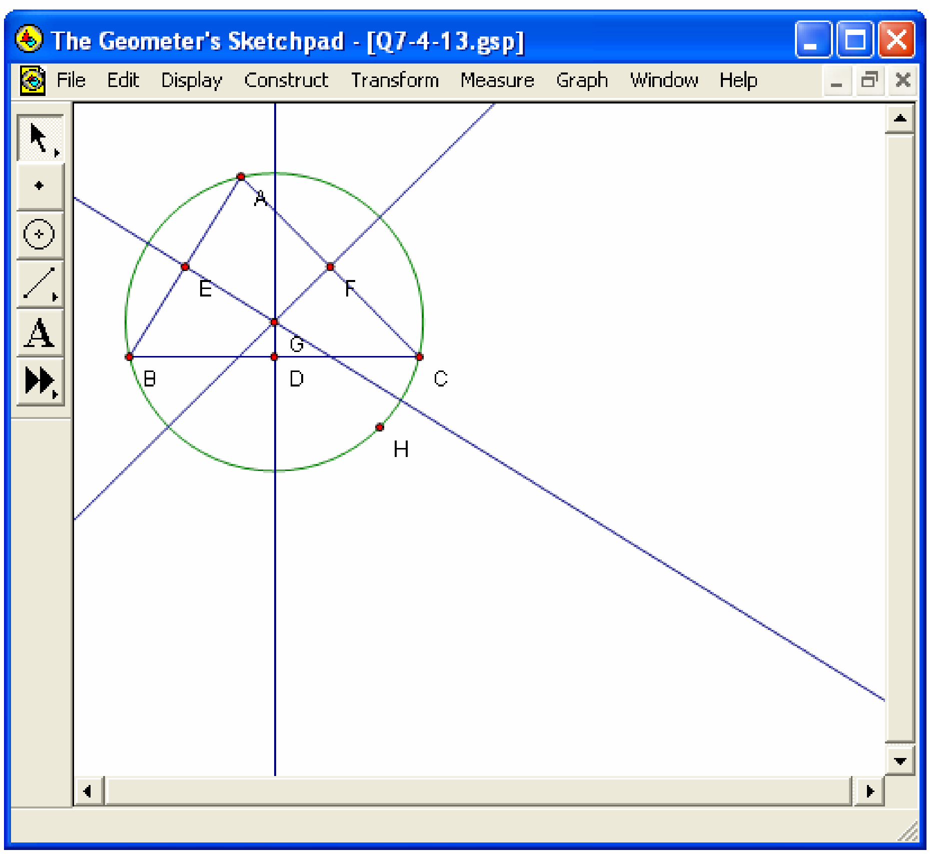
b) After the first step, $\frac{1}{4}$ of the original triangle is shaded. After the second step, $\frac{1}{4}+\frac{1}{4}\left(\frac{3}{4}\right)$ is shaded. After the third step, $\frac{1}{4}+\frac{1}{4}\left(\frac{3}{4}\right)+\frac{1}{4}\left(\frac{3}{4}\right)^2$ is shaded.

c) After the fourth step, $\frac{1}{4}+\frac{1}{4}\left(\frac{3}{4}\right)+\frac{1}{4}\left(\frac{3}{4}\right)^2+\frac{1}{4}\left(\frac{3}{4}\right)^3$, or about 0.6836 (68.36%) is shaded.

Chapter 7 Section 4 Question 13 Page 400

a) The right bisectors of a triangle intersect at a single point. You can verify this using geometry software. A sample sketch is shown. Click here to load the sketch.

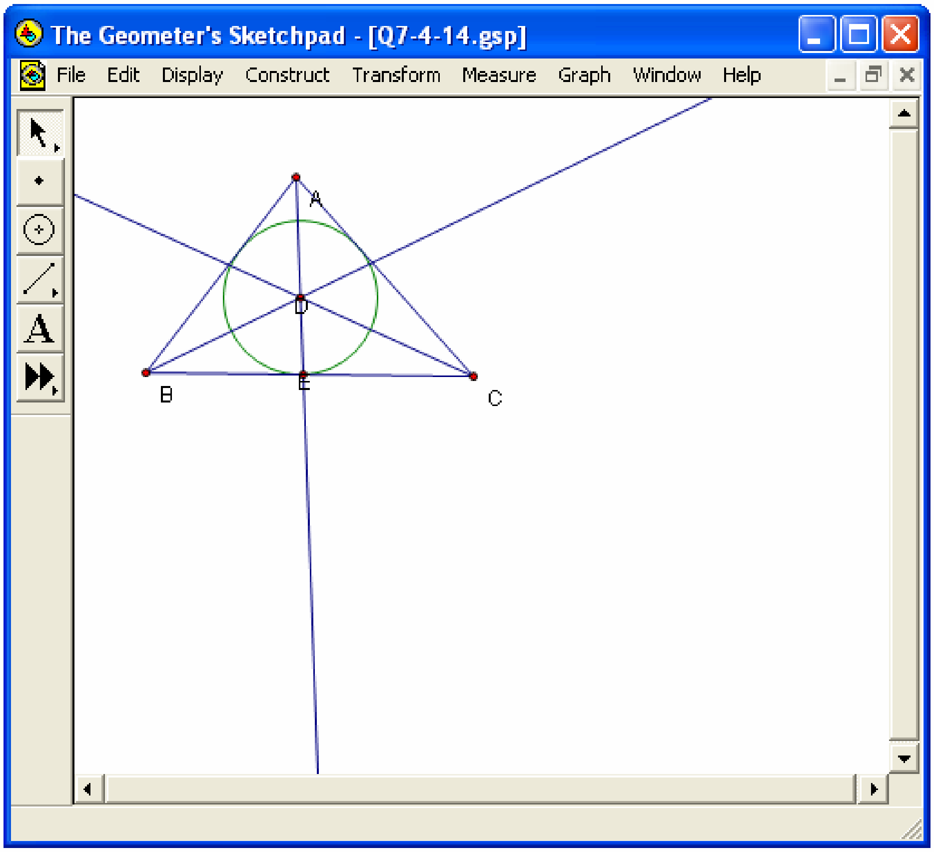
b) You can draw a circle from the point in part a) that passes through all three vertices of the triangle.



Chapter 7 Section 4 **Question 14** **Page 400**

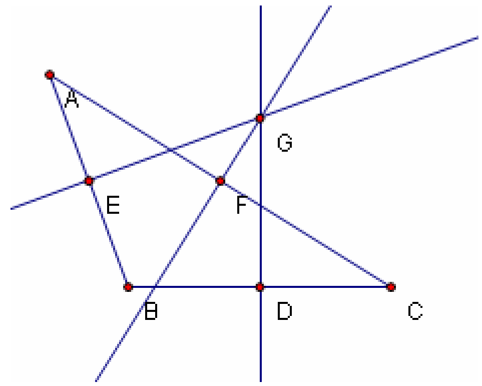
a) The angle bisectors of a triangle always intersect at a point. You can verify this using geometry software. A sample sketch is shown. Click here to load the sketch.

b) You can construct a circle from this point that has a radius equal to the minimum distance from the point to any side of the triangle.



Chapter 7 Section 4 Question 15 Page 400

For an obtuse triangle, the intersection of the right bisectors of the sides is outside the triangle.



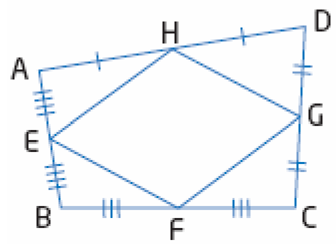
Chapter 7 Section 4 Question 16 Page 400

The longest side cannot be equal to or greater than the sum of the two shortest sides. Cases c), d) and g) are not possible.

Chapter 7 Section 5 Midpoints and Diagonals in Quadrilaterals

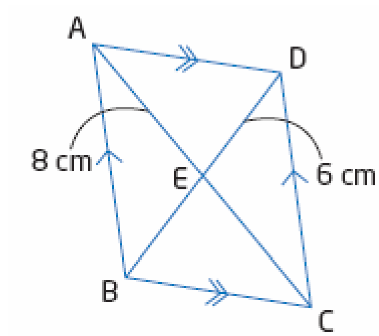
Chapter 7 Section 5 Question 1 Page 405

The midpoints of the sides of quadrilateral ABCD are joined to produce parallelogram EFGH. So, EF is parallel to HG, and EH is parallel to FG.



Chapter 7 Section 5 Question 2 Page 405

The diagonals of parallelogram ABCD bisect each other.
So, BE = DE, or 6 cm, and CE = AE, or 8 cm.
Also, AC = 2AE, or 16 cm, and BD = 2DE, or 12 cm.



Chapter 7 Section 5 Question 3 Page 405

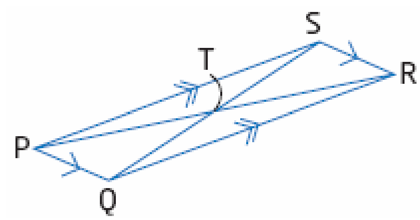
The diagonals of parallelogram PQRS bisect each other.

$$PT = \frac{1}{2}PR$$
$$= \frac{1}{2}(14)$$
$$= 7$$

The length of PT is 7 m.

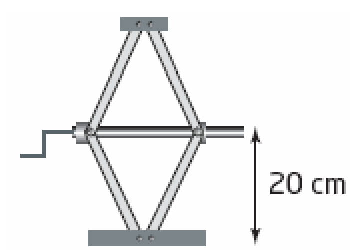
$$ST = \frac{1}{2}QS$$
$$= \frac{1}{2}(10)$$
$$= 5$$

The length of ST is 5 m.

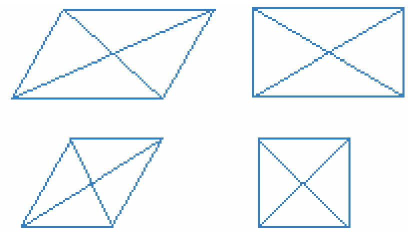


Chapter 7 Section 5 Question 4 Page 405

The shaft and a line from the top of the jack to its base form diagonals of the parallelogram. Since the diagonals of a parallelogram bisect each other, the top of the jack will be 2(20), or 40 cm high when the shaft is 20 cm from the base.



Chapter 7 Section 5 Question 5 Page 405



a) The diagonals bisect each other in all four.

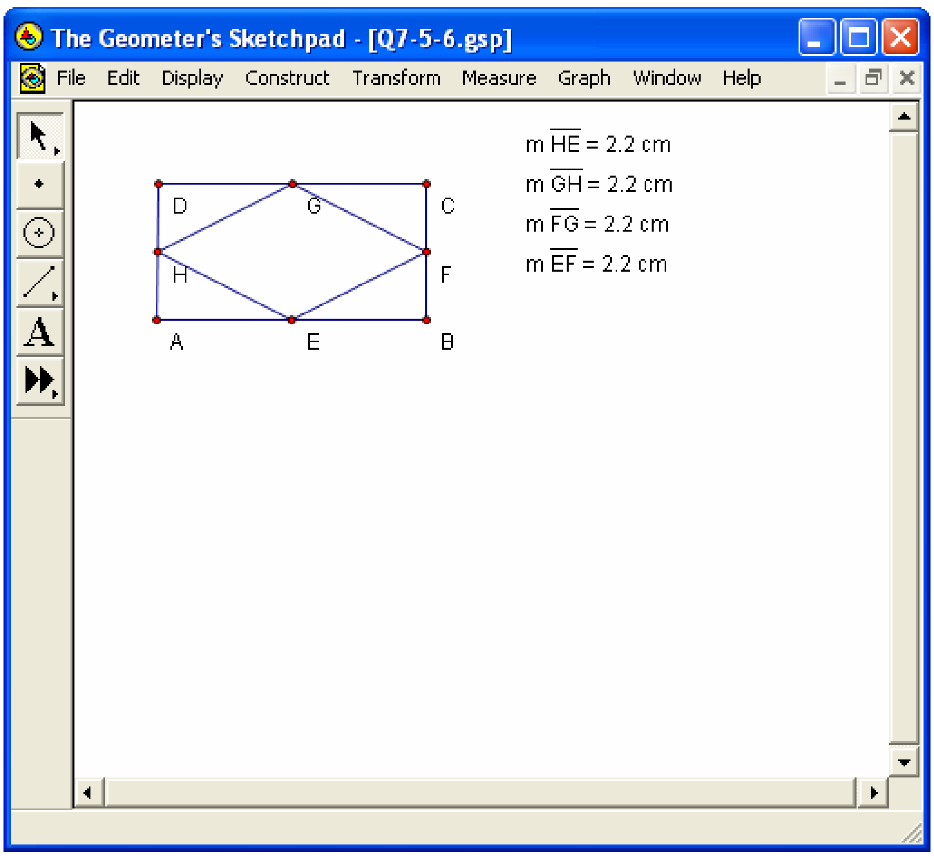
b) The diagonals have the same length in the rectangle and the square.

c) The diagonals intersect at 90º in the rhombus and the square.

d) The diagonals bisect each other at 90º in the rhombus and the square.

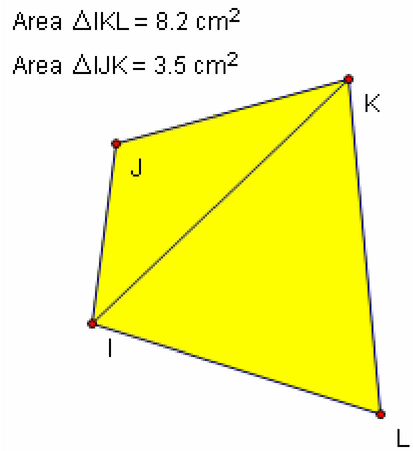
Chapter 7 Section 5 Question 6 Page 405

EFGH is a rhombus when ABCD is a rectangle. You can verify this using geometry software. A sample sketch is shown. Click here to load the sketch.



Chapter 7 Section 5 Question 7 Page 405

a) This is false. Any quadrilateral with four unequal sides is a counter-example. A sample is shown.

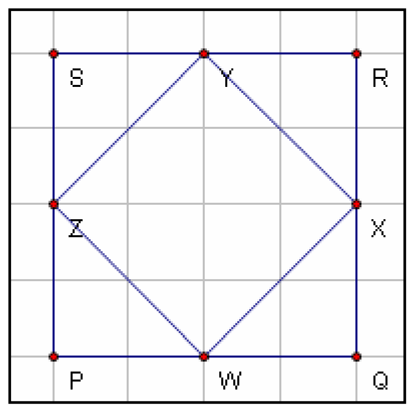


b) This is true. Any line segment joining opposite midpoints creates two parallelograms with equal heights and bases.

Chapter 7 Section 5 Question 8 Page 406

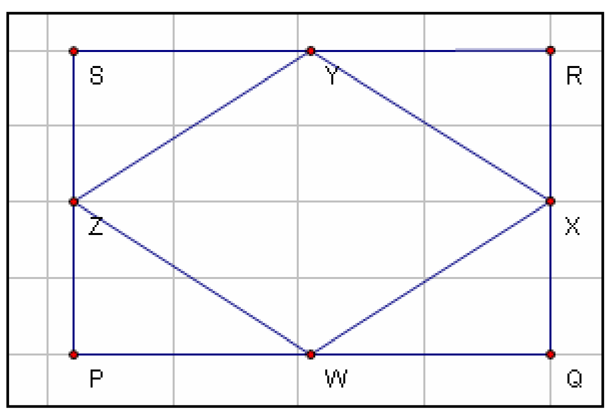
a) WXYZ is a square.

b) The area of WXYZ is half the area of PQRS. The diagonals of WXYZ form four triangles that are congruent to the triangles outside WXYZ.



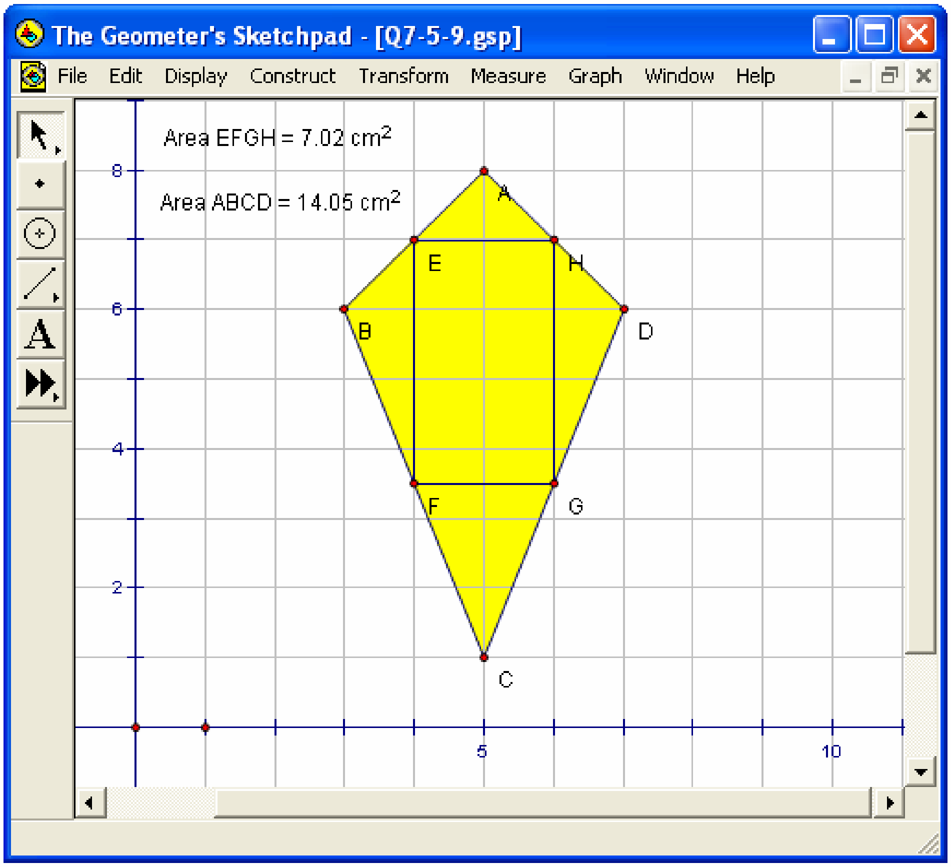
c) If PQRS is stretched into a rectangle, WXYZ becomes a rhombus.

d) The area relationship between WXYZ and PQRS will not change. All the triangles are still congruent.



Chapter 7 Section 5 Question 9 Page 406

a) The diagram is shown.



b) The diagonals intersect at 90º.

c) EFGH is a rectangle.

d) Answers will vary. A sample answer is shown.

The area of ABCD is twice the area of EFGH.

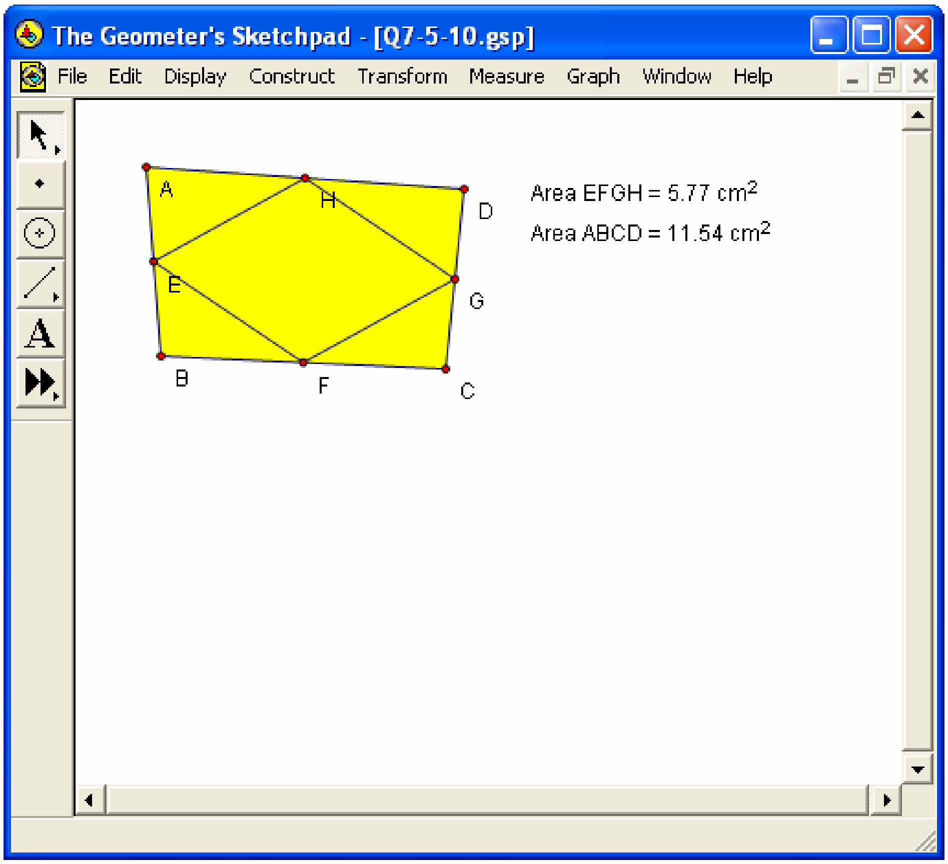
e) You can use geometry software to measure the areas of ABCD and EFGH. A sample sketch is shown. Click here to load the sketch.

Chapter 7 Section 5 **Question 10** **Page 406**

Answers will vary. Sample answers are shown.

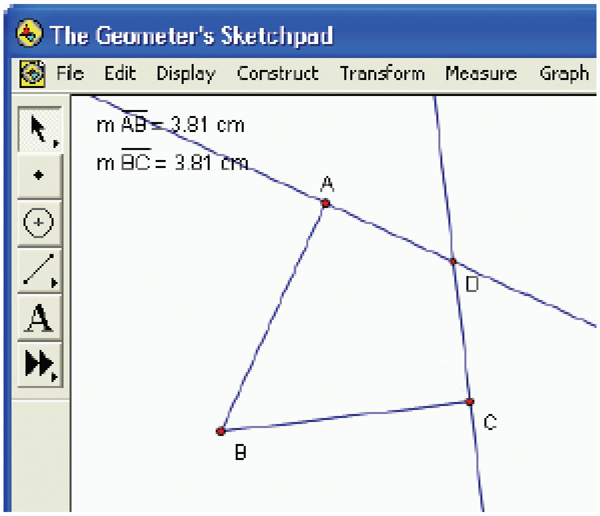
a) The area of EFGH is half the area of ABCD.

b) Use geometry software to compare the areas. A sample sketch is shown. Click here to load the sketch.



Chapter 7 Section 5 Question 11 Page 406

a)



b) By the Pythagorean theorem, $AD^2 + AB^2 = BD^2 = CD^2 + AB^2$. So, AD = CD.

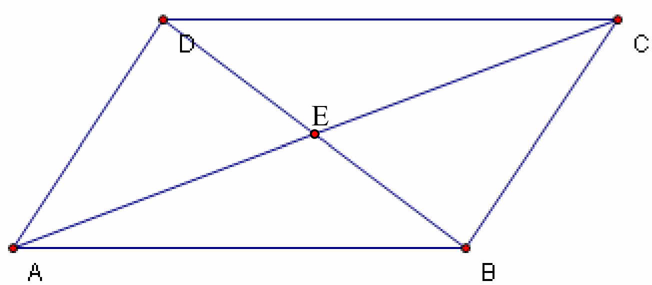
c) ΔABD is congruent to ΔCBD (SSS), so ∠ABD equals ∠CBD.

Chapter 7 Section 5 Question 12 Page 407

Solutions for the Achievements Checks are shown in the Teacher's Resource.

Chapter 7 Section 5 Question 13 Page 407

In any parallelogram ABCD, ΔABC and ΔCDA are congruent (SSS), as are ΔABD and ΔCDB.
Thus, ∠CAB = ∠ACD, ∠CDB = ∠ABD, ∠ACB = ∠CAD, and ∠ADB = ∠CBD. ΔABE and ΔCDE are congruent (ASA), so DE = BE and AE = CE.



Chapter 7 Section 5 **Question 14 Page 407**

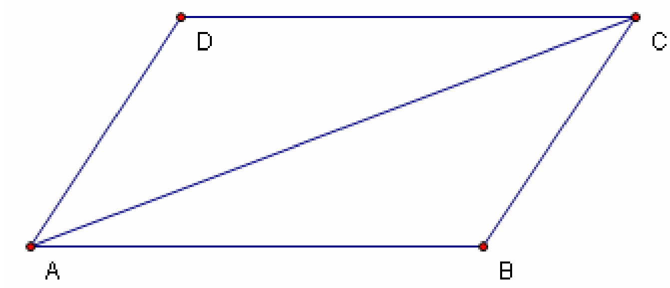
ΔABC and ΔCDA are congruent (SSS). So, $\angle$BCA = $\angle$DAC.

Therefore, AD is parallel to BC.

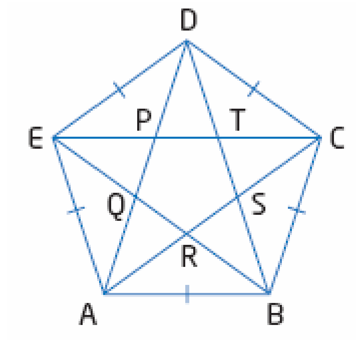
Similarly, $\angle$BAC = $\angle$DCA.

Therefore, AB is parallel to CD.

ABCD is a parallelogram.



Chapter 7 Section 5 **Question 15** **Page 407**



a) The five triangles formed by two adjacent sides of PQRST, ΔABC, ΔBCD, ΔCDE, ΔDEA and ΔEAB, are isosceles and congruent (SAS). So, all the acute angles in these triangles are equal.

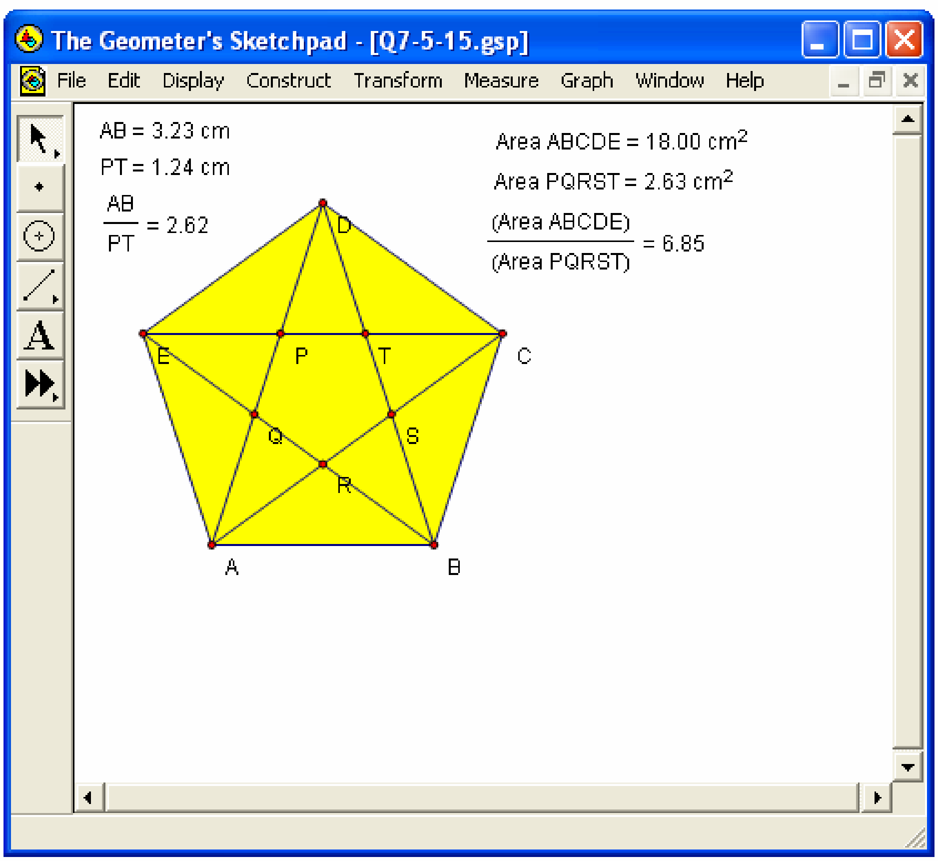
ΔABR, ΔBCS, ΔCDT, ΔDEP, and ΔEAQ are all congruent (ASA). The obtuse angles of these triangles are opposite to the interior angles of PQRST. Thus, these angles are all equal. ΔDTP, ΔEPQ, ΔAQR, ΔBRS, and ΔCST are all congruent (SAS), so the sides of PQRST are all equal. PQRST is a regular pentagon.

b) PQRST is similar to ABCDE. Both are regular pentagons.

c) Using direct measurement from the diagram, the ratio is about $\frac{1.6}{0.6}$, or about 2.7.

d) The ratio of areas is 2.7^2, or about 7.

e) Geometry software produces results similar to the conjectures in parts c) and d). A sample sketch is shown. Click here to load the sketch.



**Chapter 7 Section 5		Question 16	Page 407**

a) There are 10 choices for the first point, and for each of these there are 9 choices for the second point. However, this counts each line segment twice. The number of line segments that can be constructed between 10 points is $\frac{10 \times 9}{2}$, or 45.

b) Using reasoning similar to part a), the number of handshakes is $\frac{12 \times 11}{2}$, or 66.

**Chapter 7 Section 5		Question 17	Page 407**

a) Using reasoning similar to question 10, the number of line segments is $\frac{n(n-1)}{2}$.

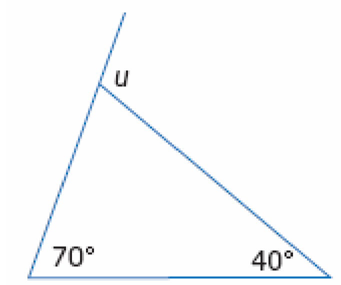
b) To obtain the number of diagonals, use the expression from part a), and subtract the line segments that form the edges of the polygon:

$$\begin{aligned}\frac{n(n-1)}{2} - n &= \frac{n^2 - n}{2} - \frac{2n}{2} \\ &= \frac{n^2 - 3n}{2} \\ &= \frac{n(n-3)}{2}\end{aligned}$$

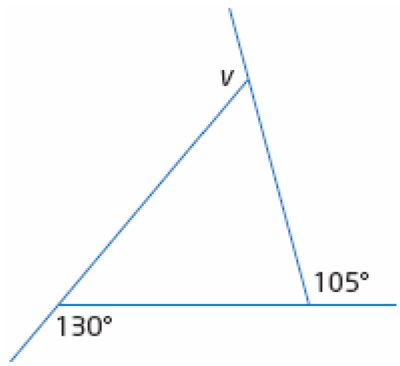
Chapter 7 Review

Chapter 7 Review **Question 1** **Page 408**

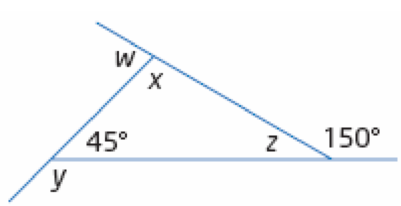
a) $u = 70° + 40°$
$= 110°$



b) $v + 130° + 105° = 360°$
$v + 235° = 360°$
$v = 360° - 235°$
$v = 125°$



c)



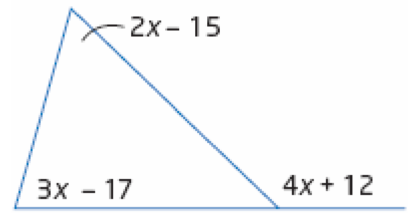
$y = 180° - 45°$
$= 135°$

$z = 180° - 150°$
$= 30°$

$w = 45° + 30°$
$= 75°$

$x = 180° - 75°$
$= 105°$

Chapter 7 Review **Question 2** **Page 408**

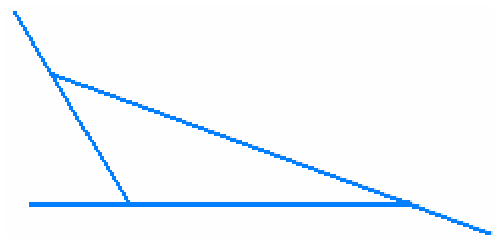


$$
\begin{aligned}
2x-15+3x-17 &= 4x+12 \\
5x-32 &= 4x+12 \\
5x-32+32-4x &= 4x+12+32-4x \\
x &= 44
\end{aligned}
$$

$$
\begin{aligned}
4x+12 &= 4(44)+12 \\
&= 188
\end{aligned}
$$

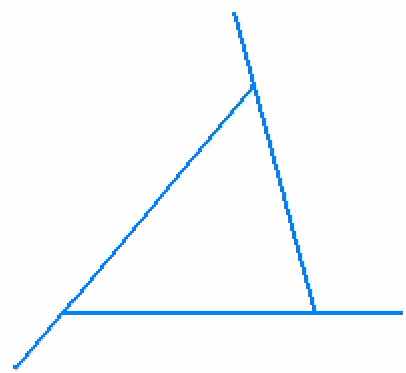
Since the exterior angle must be less than 180º, this angle relationship is not possible.

Chapter 7 Review **Question 3** **Page 408**



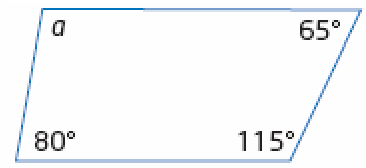
a) A triangle with an acute exterior angle occurs for any obtuse triangle.

b) It is not possible to have two acute exterior angles. In order to sum to 180º; the third exterior angle would have to be greater than 180°.



c) Any acute triangle has three obtuse exterior angles.

d) This is not possible. The sum of the exterior angles would be less than 360°.

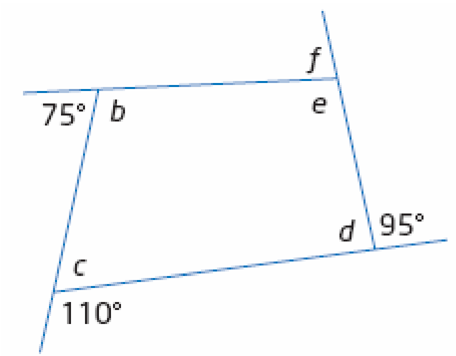


a) $a + 80° + 115° + 65° = 360°$

$a + 260° = 360°$

$a = 360° - 260°$

$a = 100°$



b)

$b = 180° - 75°$
$= 105°$

$c = 180° - 110°$
$= 70°$

$d = 180° - 95°$
$= 85°$

$e + 105° + 70° + 85° = 360°$

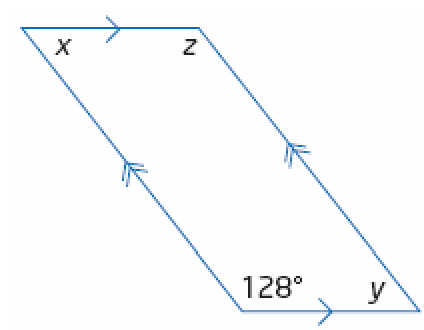
$e + 260° = 360°$

$e = 360° - 260°$

$e = 100°$

$f = 180° - 100°$
$= 80°$

c) Since opposite angles in a parallelogram are equal, $z = 128°$ and $x = y$.



Adjacent angles in a parallelogram are supplementary.

$y + 128° = 180°$

$y = 180° - 128°$

$y = 52°$

$x = y$
$= 52°$

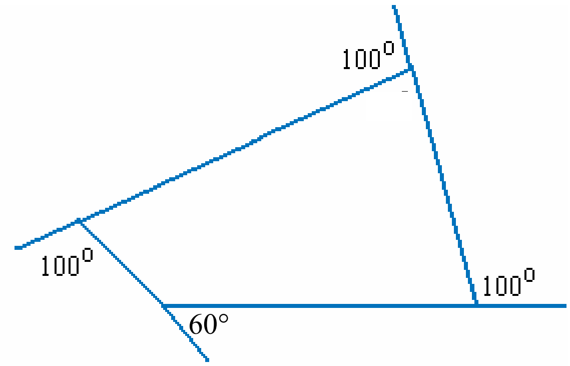
Chapter 7 Review **Question 5** **Page 408**

a) An example of a quadrilateral with three obtuse interior angles is one with three 110° angles and one 30º angle.

b) It is not possible to have a quadrilateral with four obtuse interior angles. The sum of the interior angles would be greater than 360°.

c) An example of a quadrilateral with three obtuse exterior angles is one with three 100° angles and one 60º angle.

d) A quadrilateral with four obtuse exterior angles is not possible. The sum of the exterior angles would be greater than 360°.



Chapter 7 Review **Question 6** **Page 409**

a)
$$\begin{aligned} S &= 180(n-2) \\ &= 180(6-2) \\ &= 180(4) \\ &= 720 \end{aligned}$$
The sum of the interior angles of a hexagon is 720°.

b)
$$\begin{aligned} S &= 180(n-2) \\ &= 180(8-2) \\ &= 180(6) \\ &= 1080 \end{aligned}$$
The sum of the interior angles of an octagon is 1080°.

c)
$$\begin{aligned} S &= 180(n-2) \\ &= 180(12-2) \\ &= 180(10) \\ &= 1800 \end{aligned}$$
The sum of the interior angles of a dodecagon is 1800°.

Chapter 7 Review **Question 7** **Page 409**

a) $$\frac{180(n-2)}{n}=\frac{180(5-2)}{5}$$
$$=\frac{180(3)}{5}$$
$$=108$$

Each interior angle of a pentagon measures 108°.

b) $$\frac{180(n-2)}{n}=\frac{180(9-2)}{9}$$
$$=\frac{180(7)}{9}$$
$$=140$$

Each interior angle of a nonagon measures 140°.

c) $$\frac{180(n-2)}{n}=\frac{180(16-2)}{16}$$
$$=\frac{180(14)}{16}$$
$$=157.5$$

Each interior angle of a hexadecagon measures 157.5°.

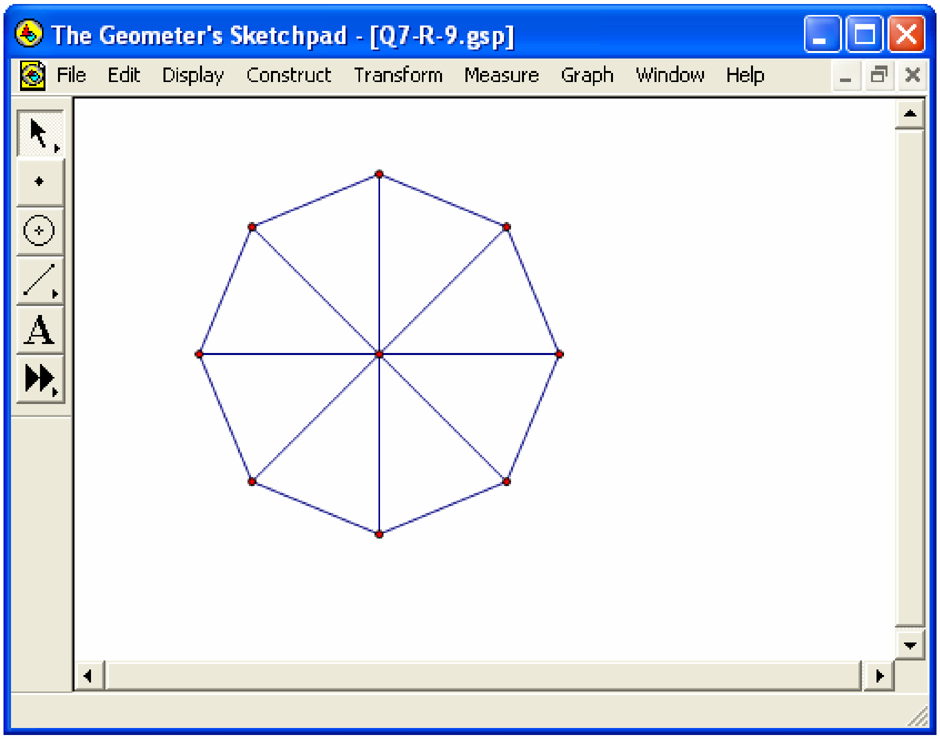
Chapter 7 Review **Question 8** **Page 409**

$$\begin{aligned}180(n-2)&=168n\\180n-360&=168n\\180n-360-168n+360&=168n-168n+360\\12n&=360\\\frac{12n}{12}&=\frac{360}{12}\\n&=30\end{aligned}$$

The polygon has 30 sides.

Chapter 7 Review Question 9 Page 409

a)

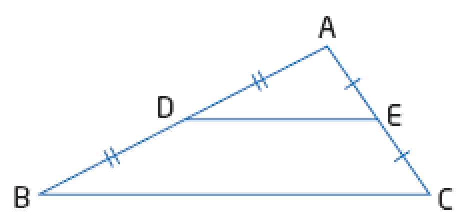


b) Answers will vary. A sample answer is shown.

Use geometry software. Construct a line segment, and rotate it around one end point 7 times at an angle of 45º. Join the ends of the segments. Click here to load the sketch.

Chapter 7 Review Question 10 Page 409

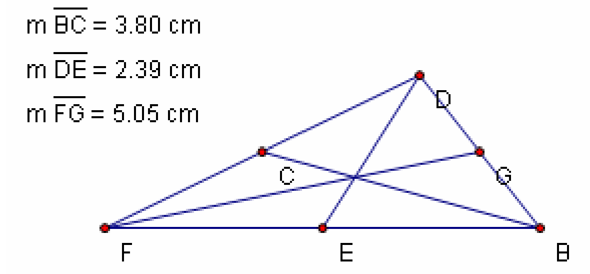
DE connects the midpoints of AB and AC.
Therefore, the base and altitude of ΔADE are half those of ΔABC. The area of ΔADE is $\left(\frac{1}{2}\right)^2$, or $\frac{1}{4}$ the area of ΔABC.



Chapter 7 Review **Question 11** **Page 409**

a) Each median divides the triangle into two triangles. All of these triangles are congruent (SAS). The medians are equal in length since they are sides of the congruent triangles.

b) This is generally false. Any scalene triangle is a counter-example.



Chapter 7 Review **Question 12** **Page 409**

Answers will vary.

Chapter 7 Review **Question 13** **Page 409**

Answers will vary.

Chapter 7 Chapter Test

Chapter 7 Chapter Test Question 1 Page 410

$$
\begin{aligned}
x + 110° + 110° &= 360° \\
x + 220° &= 360° \\
x &= 360° - 220° \\
x &= 140°
\end{aligned}
$$

Answer C.

Chapter 7 Chapter Test Question 2 Page 410

The interior angle at B is $180° - 119°$, or $61°$.

$$
\begin{aligned}
x + 51° + 61° &= 180° \\
x + 112° &= 180° \\
x &= 180° - 112° \\
x &= 68°
\end{aligned}
$$

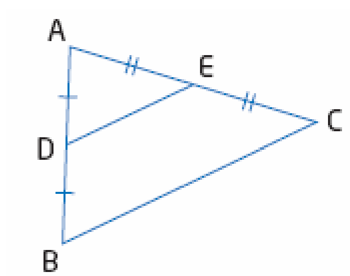
Answer B.

Chapter 7 Chapter Test Question 3 Page 410

The sum of the exterior angles of a convex polygon is always 360º. Answer B.

Chapter 7 Chapter Test Question 4 Page 410

The area of ΔADE is one-quarter of the area of ΔABC, or one-third of the area of trapezoid DBCE. Answer D.

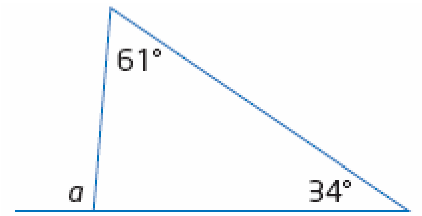


Chapter 7 Chapter Test Question 5 Page 410

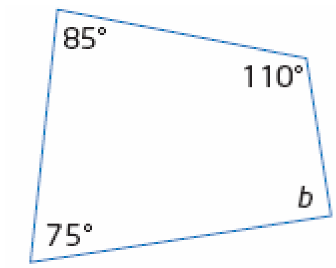
The diagonals of a rectangle bisect each other. Answer B.

Chapter 7 Chapter Test Question 6 Page 410

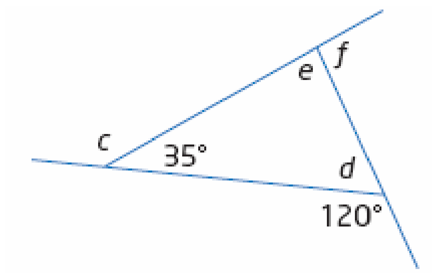
a) $a = 61° + 34°$
$= 95°$



b) $b + 110° + 85° + 75° = 360°$
$b + 270° = 360°$
$b = 360° - 270°$
$b = 90°$



c)



$c = 180° - 35°$
$= 145°$

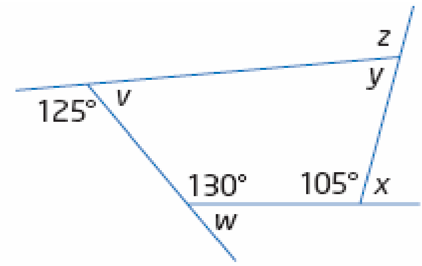
$d = 180° - 120°$
$= 60°$

$e + 60° + 35° = 180°$
$e + 95° = 180°$
$e = 180° - 95°$
$e = 85°$

$f = 35° + 60°$
$= 95°$

d)

$$\begin{aligned} v &= 180° - 125° \\ &= 55° \end{aligned}$$



$$\begin{aligned} w &= 180° - 130° \\ &= 50° \end{aligned}$$

$$\begin{aligned} x &= 180° - 105° \\ &= 75° \end{aligned}$$

$$\begin{aligned} y + 55° + 130° + 105° &= 360° \\ y + 290° &= 360° \\ y &= 360° - 290° \\ y &= 70° \end{aligned}$$

$$\begin{aligned} z &= 180° - 70° \\ &= 110° \end{aligned}$$

Chapter 7 Chapter Test Question 7 Page 410

Answers will vary. Sample answers are shown.

a) For a parallelogram:

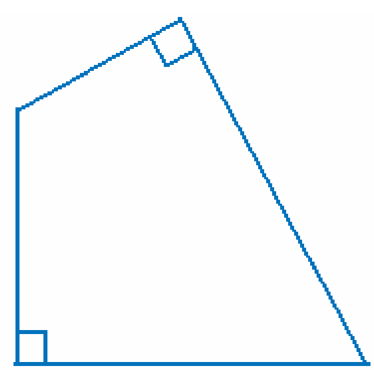
The sum of the interior angles is 360°. Opposite interior angles are equal. Adjacent interior angles are supplementary.

b) For a parallelogram:

The diagonals bisect each other and bisect the area of the parallelogram.

Chapter 7 Chapter Test Question 8 Page 410

A quadrilateral with a pair of equal opposite angles is shown. However, it is not a parallelogram.



Chapter 7 Chapter Test Question 9 Page 410

$$
\begin{aligned}
S &= 180(n-2) \\
&= 180(14-2) \\
&= 180(12) \\
&= 2160
\end{aligned}
$$

The sum of the interior angles of a 14-sided polygon is 2160°.

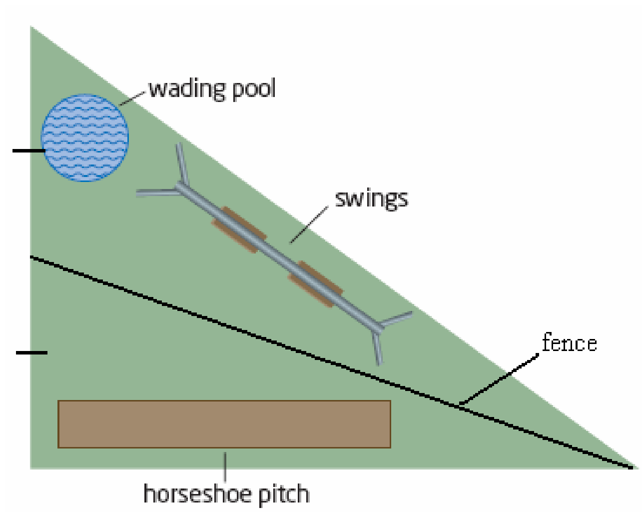
Chapter 7 Chapter Test Question 10 Page 410

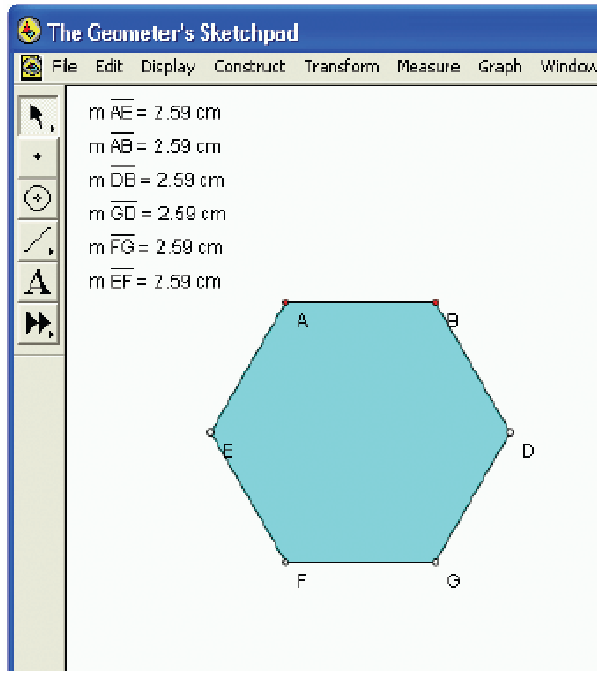
$$
\begin{aligned}
180(n-2) &= 2340 \\
180n - 360 &= 2340 \\
180n - 360 + 360 &= 2340 + 360 \\
180n &= 2700 \\
\frac{180n}{180} &= \frac{2700}{180} \\
n &= 15
\end{aligned}
$$

The polygon has 15 sides.

Chapter 7 Chapter Test Question 11 Page 410

Run the fence along the median from the right vertex of the lot.





a) The shape is a hexagon.

b) The hexagon is regular. The sides are equal, and measuring with a protractor shows that the interior angles are equal.

c)
$$\begin{aligned} S &= 180(n-2) \\ &= 180(6-2) \\ &= 180(4) \\ &= 720 \end{aligned}$$

Each interior angle measures $\frac{720°}{6}$, or 120°.

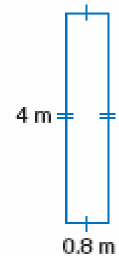
d) For regular polygons, the measure of the interior angles increases as the number of sides increases. Manpreet should increase the measure of each interior angle.

Chapter 8 **Measurement Relationships**

Chapter 8 Get Ready

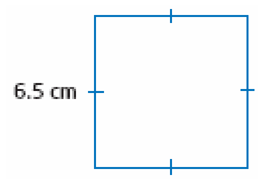
Chapter 8 Get Ready Question 1 Page 414

a) $P = 2(4 + 0.8)$
$= 2(4.8)$
$= 9.6$



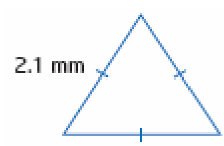
The perimeter is 9.6 m.

b) $P = 4(6.5)$
$= 26$



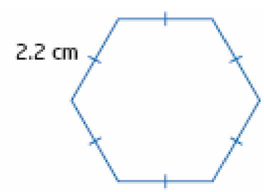
The perimeter is 26 cm.

c) $P = 2.1 + 2.1 + 2.1$
$= 6.3$



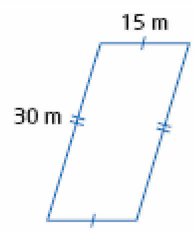
The perimeter is 6.3 mm.

d) $P = 6(2.2)$
$= 13.2$



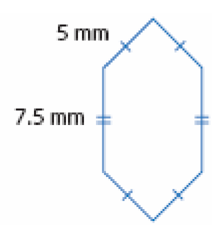
The perimeter is 13.2 cm.

e) $P = 2(15 + 30)$
$= 2(45)$
$= 90$



The perimeter is 90 m.

f) $P = 2(7.5) + 4(5)$
$= 15 + 20$
$= 35$

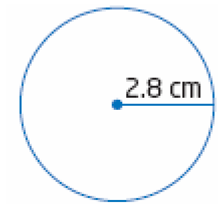


The perimeter is 35 mm.

Chapter 8 Get Ready Question 2 Page 414

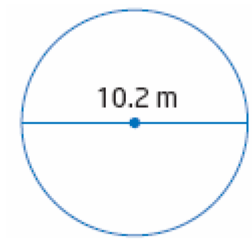
a) $C = 2\pi(2.8)$
$\doteq 17.6$

The circumference is approximately 17.6 cm.



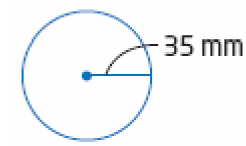
b) $C = \pi(10.2)$
$\doteq 32.0$

The circumference is approximately 32.0 m.



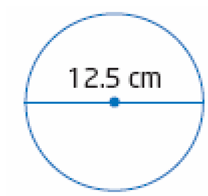
c) $C = 2\pi(35)$
$\doteq 219.9$

The circumference is approximately 219.9 mm.



d) a) $C = \pi(12.5)$
$\doteq 39.3$

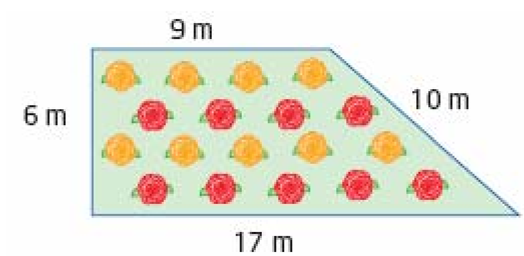
The circumference is approximately 39.3 cm.



Chapter 8 Get Ready Question 3 Page 414

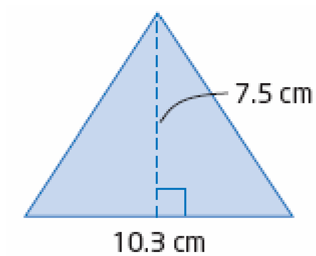
$P = 9 + 10 + 17 + 6$
$= 42$

The perimeter is 42 m.



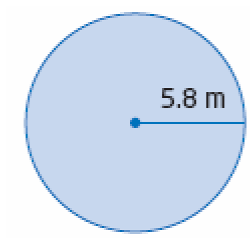
Chapter 8 Get Ready **Question 4** **Page 415**

a) $$A = \frac{1}{2}bh$$
$$= \frac{1}{2}(10.3)(7.5)$$
$$\doteq 38.6$$



The area is approximately 38.6 cm^2.

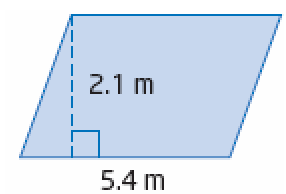
b) $$A = \pi r^2$$
$$= \pi(5.8)^2$$
$$\doteq 105.7$$



The area is approximately 105.7 m^2.

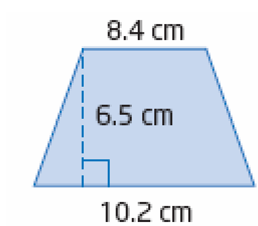
Chapter 8 Get Ready **Question 5** **Page 415**

a) $$A = bh$$
$$= 5.4 \times 2.1$$
$$= 11.34$$



The area is 11.34 m^2.

b) $$A = \frac{1}{2}h(a+b)$$
$$= \frac{1}{2}(6.5)(10.2+8.4)$$
$$= 60.45$$



The area is 60.45 cm^2.

Chapter 8 Get Ready Question 6 Page 416

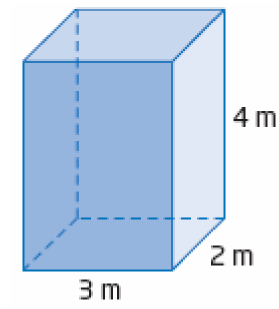
a) $SA = 2lw + 2wh + 2lh$

$= 2(3 \times 2) + 2(2 \times 4) + 2(3 \times 4)$

$= 12 + 16 + 24$

$= 52$

The surface area is 52 m^2.

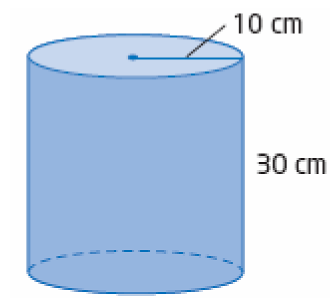


b) $SA = 2\pi r^2 2\pi rh$

$= 2\pi(10)^2 + 2\pi(10)(30)$

$\doteq 2513$

The surface area is approximately 2513 cm^2.



Chapter 8 Get Ready Question 7 Page 416

a) $V = lwh$

$= 3 \times 2 \times 4$

$= 24$

The volume is 24 m^3.

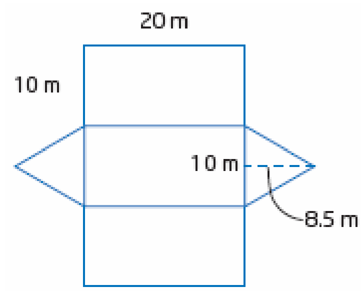
b) $V = \pi r^2 h$

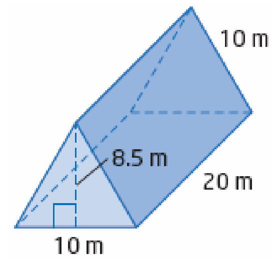
$= \pi(10)^2(30)$

$\doteq 9425$

The volume is approximately 9425 cm^3.

a)





b) $SA = 3A_{\text{face}} + 2A_{\text{base}}$

$$= 3(20 \times 10) + 2\left(\frac{1}{2} \times 10 \times 8.5\right)$$
$$= 600 + 85$$
$$= 685$$

The surface area is 685 m^2.

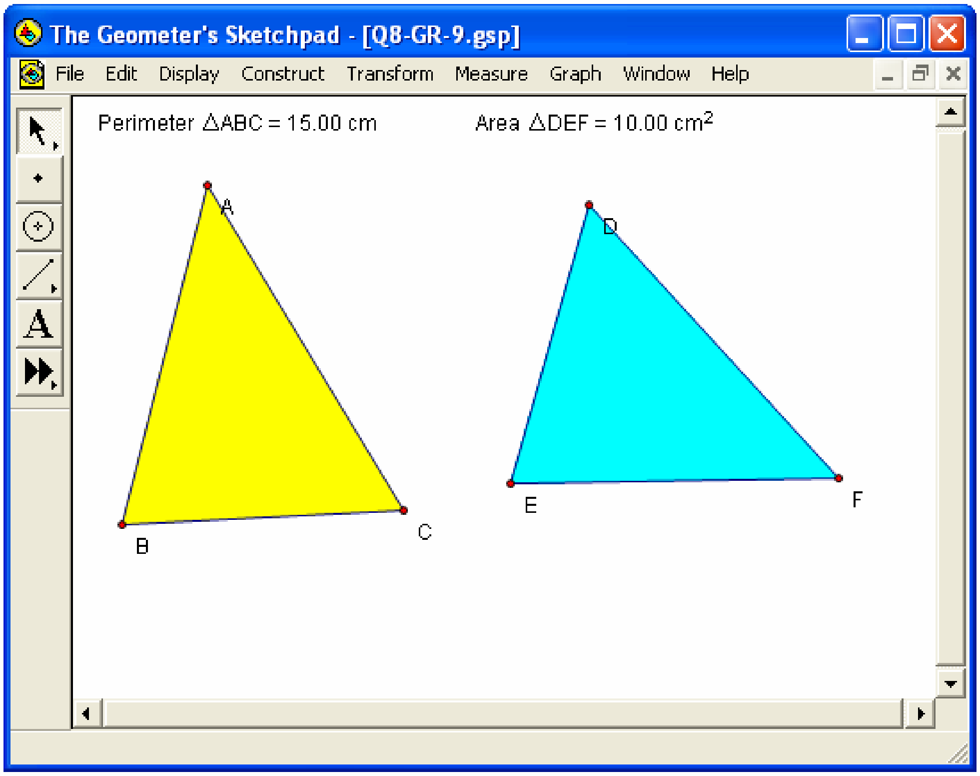
c) $V = A_{\text{base}} \times h$

$$= \frac{1}{2} \times 10 \times 8.5 \times 20$$
$$= 850$$

The volume is 850 m^3.

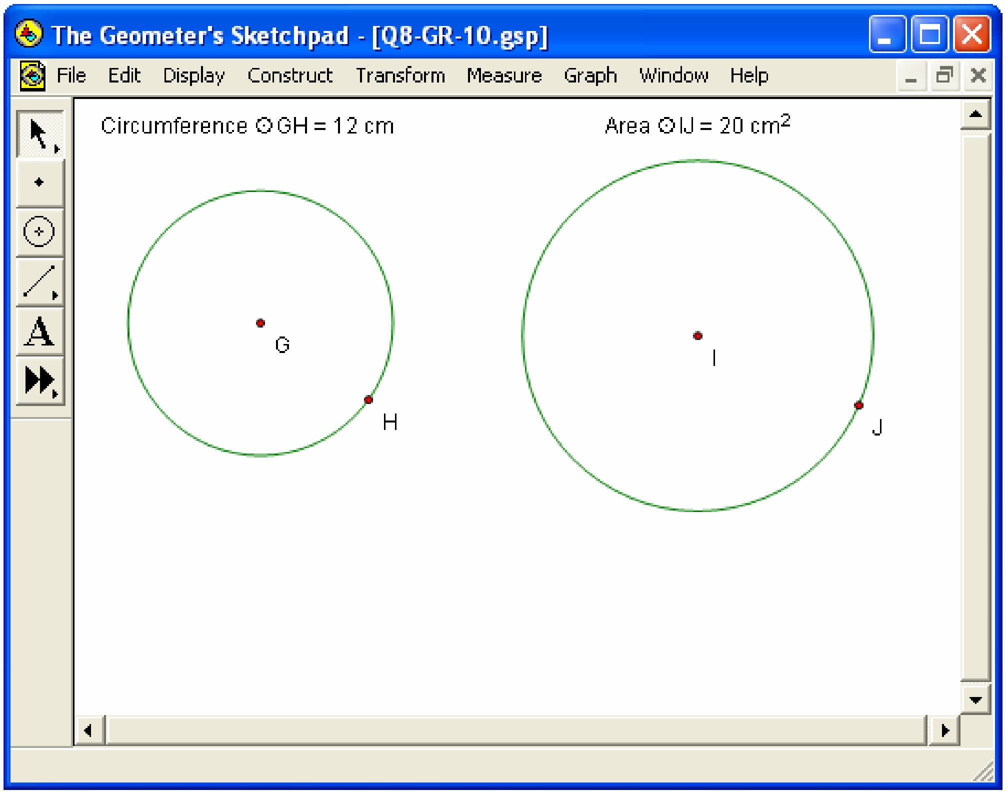
Chapter 8 Get Ready Question 9 Page 417

Answers will vary. A sample sketch is shown. Click here to load the sketch.



Chapter 8 Get Ready Question 10 Page 417

Answers will vary. A sample sketch is shown. Click here to load the sketch.

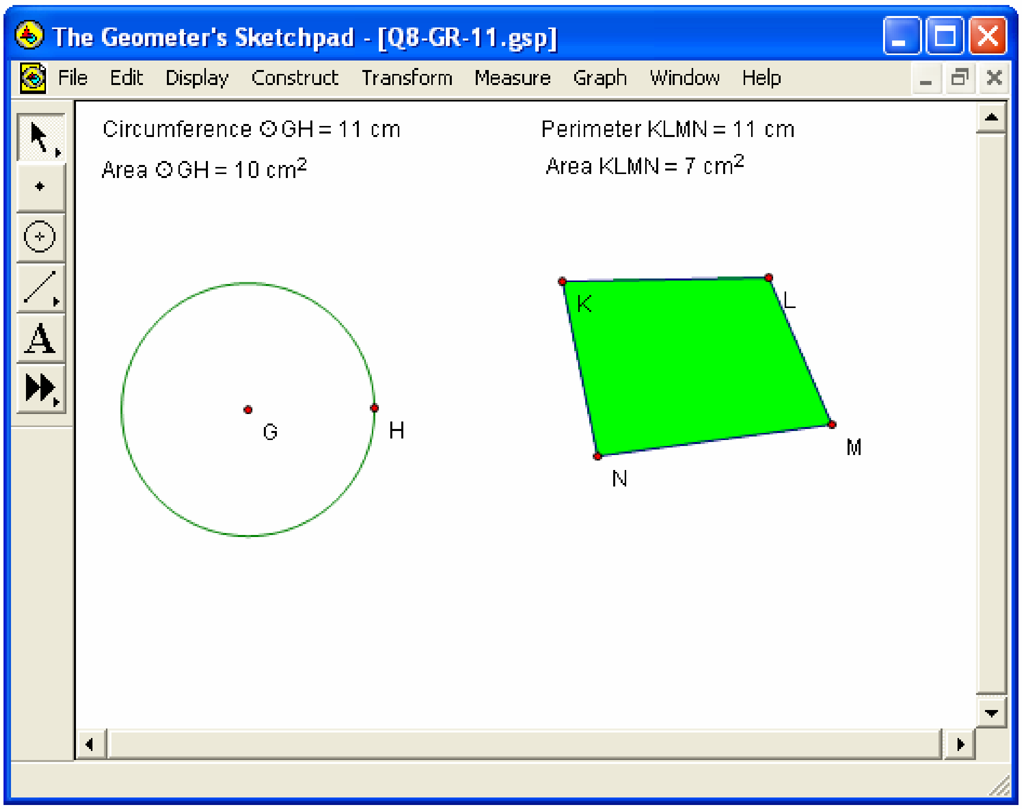


Chapter 8 Get Ready Question 11 Page 417

a) Answers will vary. A sample sketch is shown. Click here to load the sketch.

b) Answers will vary.

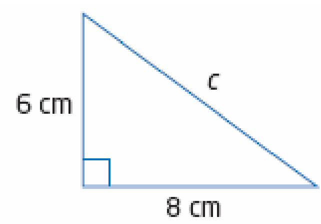
c) The quadrilateral does not have the same area as a circle with the same perimeter.



Chapter 8 Section 1: Apply the Pythagorean Theorem

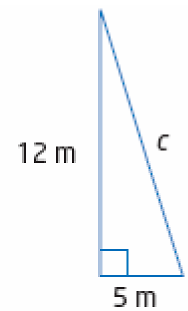
Chapter 8 Section 1 Question 1 Page 423

a)
$$
\begin{aligned}
c^2 &= 6^2 + 8^2 \\
c^2 &= 36 + 64 \\
c^2 &= 100 \\
\sqrt{c^2} &= \sqrt{100} \\
c &= 10
\end{aligned}
$$



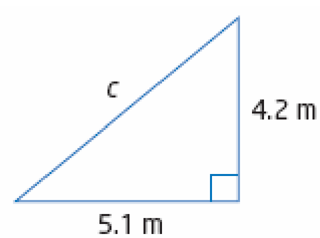
The length of the hypotenuse is 10 cm.

b)
$$
\begin{aligned}
c^2 &= 12^2 + 5^2 \\
c^2 &= 144 + 25 \\
c^2 &= 169 \\
\sqrt{c^2} &= \sqrt{169} \\
c &= 13
\end{aligned}
$$



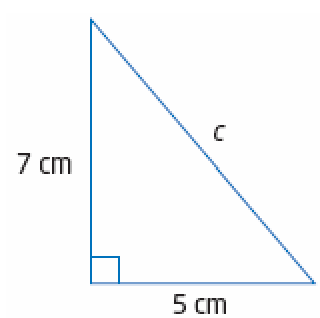
The length of the hypotenuse is 13 m.

c)
$$
\begin{aligned}
c^2 &= 4.2^2 + 5.1^2 \\
c^2 &= 17.64 + 26.01 \\
c^2 &= 43.65 \\
\sqrt{c^2} &= \sqrt{43.65} \\
c &\doteq 6.6
\end{aligned}
$$



The length of the hypotenuse is approximately 6.6 m.

d)
$$
\begin{aligned}
c^2 &= 7^2 + 5^2 \\
c^2 &= 49 + 25 \\
c^2 &= 74 \\
\sqrt{c^2} &= \sqrt{74} \\
c &\doteq 8.6
\end{aligned}
$$

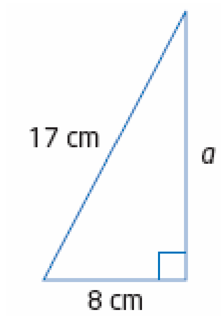


The length of the hypotenuse is approximately 8.6 cm.

Chapter 8 Section 1 Question 2 Page 423

a)

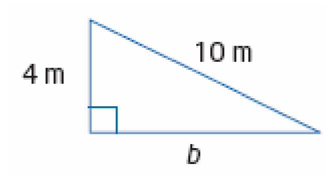
$$
\begin{aligned}
17^2 &= a^2 + 8^2 \\
289 &= a^2 + 64 \\
289 - 64 &= a^2 + 64 - 64 \\
225 &= a^2 \\
\sqrt{225} &= \sqrt{a^2} \\
15 &= a
\end{aligned}
$$



The length of side a is 15 cm.

b)

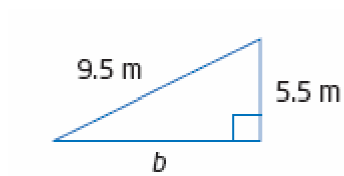
$$
\begin{aligned}
10^2 &= b^2 + 4^2 \\
100 &= b^2 + 16 \\
100 - 16 &= b^2 + 16 - 16 \\
84 &= b^2 \\
\sqrt{84} &= \sqrt{b^2} \\
9.2 &\doteq b
\end{aligned}
$$



The length of side b is approximately 9.2 m.

c)

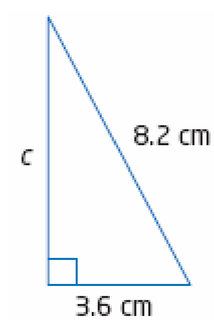
$$
\begin{aligned}
9.5^2 &= b^2 + 5.5^2 \\
90.25 &= b^2 + 30.25 \\
90.25 - 30.25 &= b^2 + 30.25 - 30.25 \\
60 &= b^2 \\
\sqrt{60} &= \sqrt{b^2} \\
7.7 &\doteq b
\end{aligned}
$$



The length of side b is approximately 7.7 m.

d)

$$
\begin{aligned}
8.2^2 &= c^2 + 3.6^2 \\
67.24 &= c^2 + 12.96 \\
67.24 - 12.96 &= c^2 + 12.96 - 12.96 \\
54.28 &= c^2 \\
\sqrt{54.28} &= \sqrt{c^2} \\
7.4 &\doteq c
\end{aligned}
$$

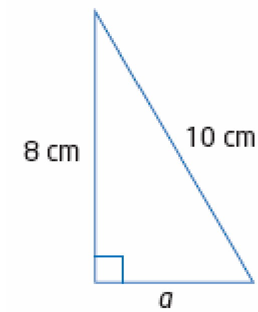


The length of side c is approximately 7.4 cm.

Chapter 8 Section 1 Question 3 Page 423

a)

$$\begin{aligned} 10^2 &= a^2 + 8^2 \\ 100 &= a^2 + 64 \\ 100 - 64 &= a^2 + 64 - 64 \\ 36 &= a^2 \\ \sqrt{36} &= \sqrt{a^2} \\ 6 &= a \end{aligned}$$

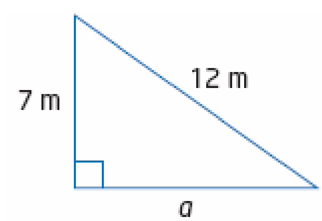


$$\begin{aligned} A &= \frac{1}{2}bh \\ &= \frac{1}{2}(6)(8) \\ &= 24 \end{aligned}$$

The area of the right triangle is 24 cm^2.

b)

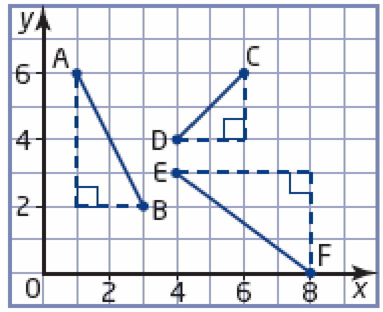
$$\begin{aligned} 12^2 &= a^2 + 7^2 \\ 144 &= a^2 + 49 \\ 144 - 49 &= a^2 + 49 - 49 \\ 95 &= a^2 \\ \sqrt{95} &= \sqrt{a^2} \\ 9.75 &\doteq a \end{aligned}$$



$$\begin{aligned} A &= \frac{1}{2}(9.75)(7) \\ &\doteq 34.1 \end{aligned}$$

The area of the right triangle is approximately 34.1 m^2.

Chapter 8 Section 1 Question 4 Page 424



a)

$$AB^2 = 4^2 + 2^2$$
$$AB^2 = 16 + 4$$
$$AB^2 = 20$$
$$\sqrt{AB^2} = \sqrt{20}$$
$$AB \doteq 4.5$$

The length of line segment AB is approximately 4.5 units.

b)

$$CD^2 = 2^2 + 2^2$$
$$CD^2 = 4 + 4$$
$$CD^2 = 8$$
$$\sqrt{CD^2} = \sqrt{8}$$
$$CD \doteq 2.8$$

The length of line segment CD is approximately 2.8 units.

c)

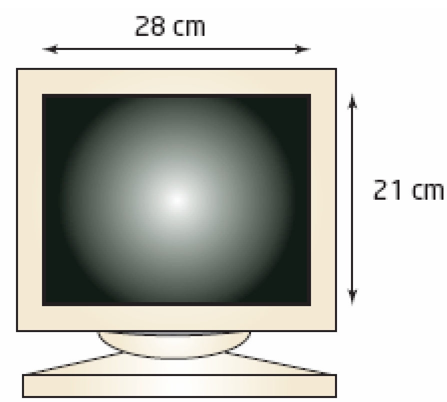
$$EF^2 = 4^2 + 3^2$$
$$EF^2 = 16 + 9$$
$$EF^2 = 25$$
$$\sqrt{EF^2} = \sqrt{25}$$
$$EF = 5$$

The length of line segment EF is 5 units.

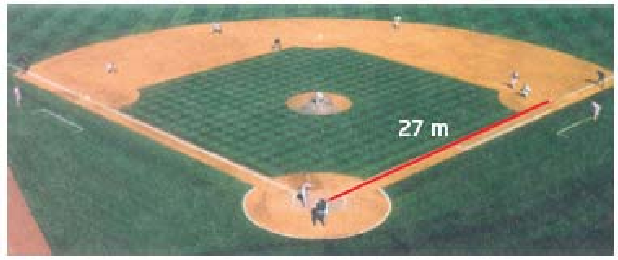
Chapter 8 Section 1 Question 5 Page 424

$$d^2 = 28^2 + 21^2$$
$$d^2 = 784 + 441$$
$$d^2 = 1225$$
$$\sqrt{d^2} = \sqrt{1225}$$
$$d = 35$$

The length of the diagonal is 35 cm.



Chapter 8 Section 1 Question 6 Page 424



$$d^2 = 27^2 + 27^2$$
$$d^2 = 729 + 729$$
$$d^2 = 1458$$
$$\sqrt{d^2} = \sqrt{1225}$$
$$d \doteq 38$$

The second-base player must throw the ball approximately 38 m to reach home plate.

Chapter 8 Section 1 Question 7 Page 424

$$42^2 = s^2 + s^2$$
$$1764 = 2s^2$$
$$\frac{1764}{2} = \frac{2s^2}{2}$$
$$882 = s^2$$
$$\sqrt{882} = \sqrt{s^2}$$
$$29.7 \doteq s$$

$$\begin{aligned} P &= 4s \\ &= 4(29.7) \\ &\doteq 119 \end{aligned}$$

The perimeter of the courtyard is approximately 119 m.

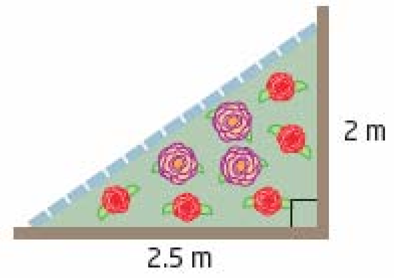
Chapter 8 Section 1 Question 8 Page 424

$$125^2 = h^2 + 50^2$$
$$15\,625 = h^2 + 2500$$
$$15\,625 - 2500 = h^2 + 2500 - 2500$$
$$13\,125 = h^2$$
$$\sqrt{13\,125} = \sqrt{h^2}$$
$$114.56 \doteq h$$

The height of the kite above the tree is 114.56 – 10, or 104.56 m.

Chapter 8 Section 1 **Question 9** **Page 424**

$$
\begin{aligned}
c^2 &= 2^2 + 2.5^2 \\
c^2 &= 4 + 6.25 \\
c^2 &= 10.25 \\
\sqrt{c^2} &= \sqrt{10.25} \\
c &\doteq 3.2
\end{aligned}
$$

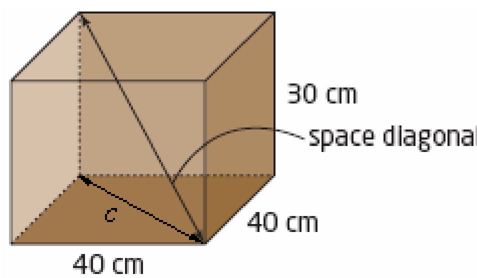


The third side measures approximately 3.2 m.

Emily will need $\frac{3.2}{0.3}$, or about 11 border stones.

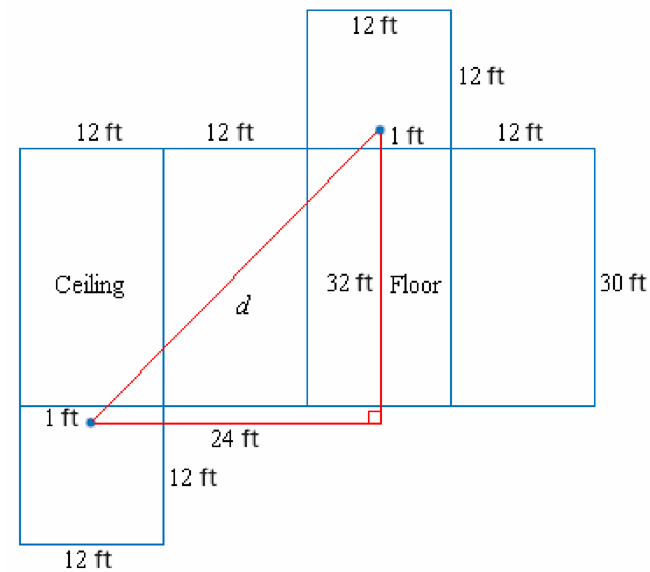
Chapter 8 Section 1 **Question 10** **Page 425**

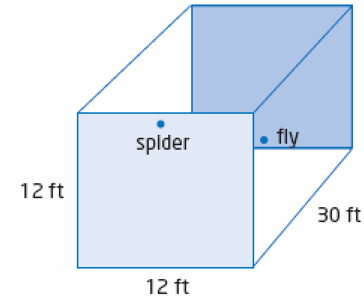
$$
\begin{aligned}
c^2 &= 40^2 + 40^2 \\
c^2 &= 1600 + 1600 \\
c^2 &= 3200 \\
\sqrt{c^2} &= \sqrt{3200} \\
c &\doteq 56.6
\end{aligned}
$$



$$
\begin{aligned}
d^2 &= 56.6^2 + 30^2 \\
d^2 &= 3203.56 + 900 \\
d^2 &= 4103.56 \\
\sqrt{d^2} &= \sqrt{4103.56} \\
d &\doteq 64
\end{aligned}
$$

The length of the space diagonal is approximately 64 cm.





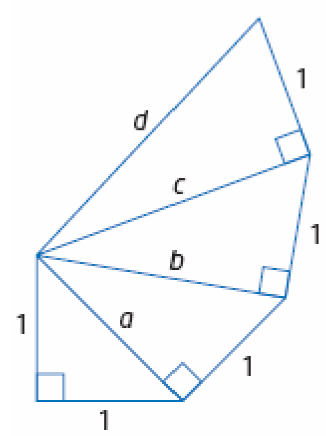
Refer to the net shown.

$$
\begin{aligned}
d^2 &= 24^2 + 32^2 \\
d^2 &= 576 + 1024 \\
d^2 &= 1600 \\
\sqrt{d^2} &= \sqrt{1600} \\
d &= 40
\end{aligned}
$$

The spider must crawl a distance of 40 ft to reach the fly.

Chapter 8 Section 1 **Question 12** **Page 425**

a)



$a^2 = 1^2 + 1^2$
$a^2 = 1 + 1$
$a^2 = 2$
$a = \sqrt{2}$

$b^2 = 1^2 + \left(\sqrt{2}\right)^2$
$b^2 = 1 + 2$
$b^2 = 3$
$b = \sqrt{3}$

$c^2 = 1^2 + \left(\sqrt{3}\right)^2$
$c^2 = 1 + 3$
$c^2 = 4$
$c = \sqrt{4}$

$d^2 = 1^2 + 2^2$
$d^2 = 1 + 5$
$d^2 = 5$
$d = \sqrt{5}$

b) $A = \frac{1}{2} \times 1 \times 1 + \frac{1}{2} \times 1 \times \sqrt{2} + \frac{1}{2} \times 1 \times \sqrt{3} + \frac{1}{2} \times 1 \times \sqrt{4}$

$= \frac{1}{2} + \frac{\sqrt{2}}{2} + \frac{\sqrt{3}}{2} + \frac{\sqrt{4}}{2}$

c) As you add right triangles to the spiral pattern, the area will increase by $\frac{\sqrt{\text{Number of Triangles}}}{2}$.

Chapter 8 Section 1 Question 13 Page 425

a) This name is appropriate because this set of three whole numbers satisfies the Pythagorean theorem.

b) Multiples of a Pythagorean triple are also Pythagorean triples. One example is shown.

$$2(3,4,5)=(6,8.10)$$
$$\begin{aligned}6^2+8^2&=36+64\\&=100\\&=10^2\end{aligned}$$

c) Triples of the form ($m^2 - n^2$, $2mn$, $m^2 + n^2$) are Pythagorean triples, with some restrictions on the values of *m* and *n*. Examples are shown. Click here to load the spreadsheet.

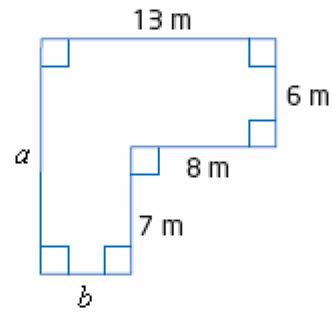
m	n	$m^2 - n^2$	$2mn$	$m^2 + n^2$	$(m^2 - n^2)^2 + (2mn)^2$	$(m^2 + n^2)^2$
2	1	3	4	5	25	25
3	1	8	6	10	100	100
3	2	5	12	13	169	169
4	1	15	8	17	289	289
4	2	12	16	20	400	400
4	3	7	24	25	625	625
5	1	24	10	26	676	676
5	2	21	20	29	841	841
5	3	16	30	34	1156	1156
5	4	9	40	41	1681	1681

d) The restrictions on the values of *m* and *n* are $m > n > 0$.

Chapter 8 Section 2 Perimeter and Area of Composite Figures

Chapter 8 Section 2 Question 1 Page 432

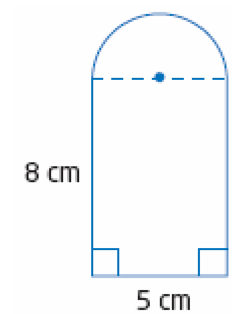
a)



$$\begin{aligned} a &= 6+7 \\ &= 13 \\ b &= 13-8 \\ &= 5 \\ P &= 13+6+8+7+5+13 \\ &= 52 \end{aligned}$$

The perimeter of the figure is 52 m.

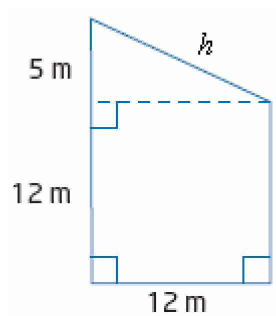
b)



$$\begin{aligned} P_{\text{semicircle}} &= \frac{1}{2}\pi(5) \\ &\doteq 8 \\ P &= 8+8+8+5 \\ &= 29 \end{aligned}$$

The perimeter of the figure is about 29 cm.

c)

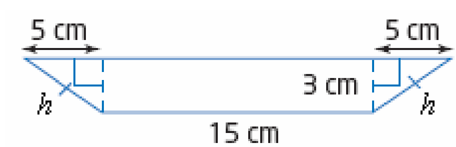


$$\begin{aligned} h^2 &= 5^2+12^2 \\ h^2 &= 25+144 \\ h^2 &= 169 \\ h &= \sqrt{169} \\ h &= 13 \end{aligned}$$

$$\begin{aligned} P &= 12+12+12+5+13 \\ &= 54 \end{aligned}$$

The perimeter of the figure is 54 m.

d)



$$\begin{aligned} h^2 &= 5^2+3^2 \\ h^2 &= 25+9 \\ h^2 &= 34 \\ h &= \sqrt{34} \\ h &\doteq 6 \end{aligned}$$

$$\begin{aligned} P &= 15+6+5+15+5+6 \\ &= 52 \end{aligned}$$

The perimeter of the figure is about 52 cm.

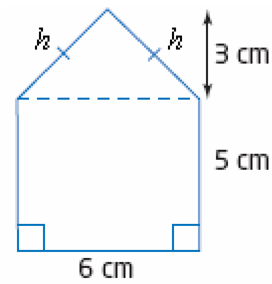
e) $h^2 = 3^2 + 3^2$

$h^2 = 9 + 9$

$h^2 = 18$

$h = \sqrt{18}$

$h \doteq 4$



$P = 6 + 5 + 4 + 4 + 5$

$= 24$

The perimeter of the figure is about 24 cm.

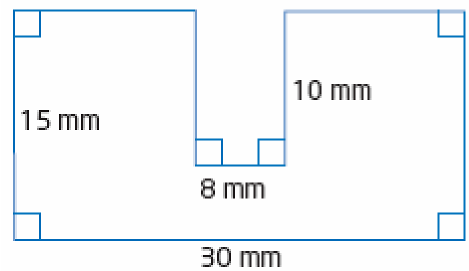
Chapter 8 Section 2 Question 2 Page 432

a) $A = A_{\text{rectangle}} - A_{\text{cutout}}$

$= 30 \times 15 - 8 \times 10$

$= 450 - 80$

$= 370$



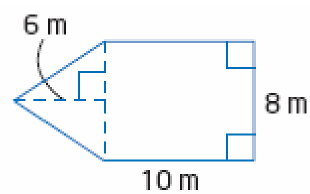
The area of the figure is 370 mm^2.

b) $A = A_{\text{rectangle}} + A_{\text{triangle}}$

$= 10 \times 8 + \frac{1}{2} \times 8 \times 6$

$= 80 + 24$

$= 104$

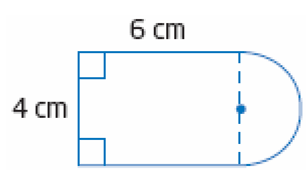


The area of the figure is 104 m^2.

c) $A = A_{\text{rectangle}} + A_{\text{semicircle}}$

$= 4 \times 6 + \frac{1}{2} \times \pi \times 2^2$

$\doteq 30$

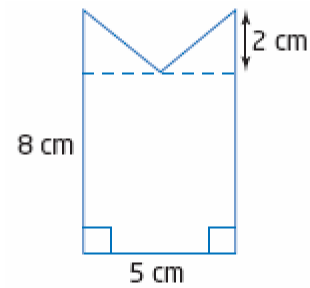


The area of the figure is approximately 30 cm^2.

d) $A = A_{\text{rectangle}} - A_{\text{triangle}}$

$$= 5 \times 10 - \frac{1}{2} \times 5 \times 2$$
$$= 50 - 5$$
$$= 45$$

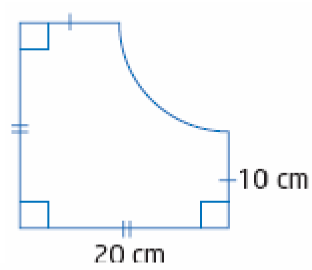
The area of the figure is 45 cm^2.



e) $A = A_{\text{square}} - A_{\text{quartercircle}}$

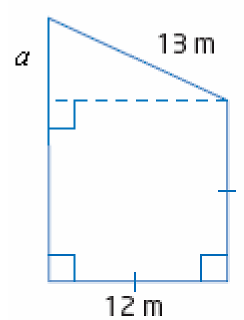
$$= 20 \times 20 - \frac{1}{4} \times \pi \times 10^2$$
$$\doteq 321$$

The area of the figure is approximately 321 cm^2.



f)

$$13^2 = a^2 + 12^2$$
$$169 = a^2 + 144$$
$$169 - 144 = a^2 + 144 - 144$$
$$25 = a^2$$
$$\sqrt{25} = a$$
$$5 = a$$



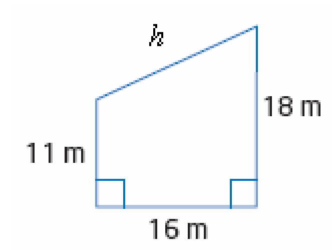
$$A = A_{\text{square}} + A_{\text{triangle}}$$
$$= 12 \times 12 + \frac{1}{2} \times 12 \times 5$$
$$= 144 + 30$$
$$= 174$$

The area of the figure is 174 cm^2.

Chapter 8 Section 2 Question 3 Page 433

a)

$$h^2 = 7^2 + 16^2$$
$$h^2 = 49 + 256$$
$$h^2 = 305$$
$$h = \sqrt{305}$$
$$h \doteq 17$$



$$P = 17 + 18 + 16 + 11$$
$$= 62$$

The length of fencing needed is about 62 m.

b)

$$A = \frac{1}{2}(16)(11 + 18)$$
$$= 232$$

The area of the yard is 232 m^2.

c) To find the perimeter:

Step 1: Use the Pythagorean theorem to determine the length of the unknown side.

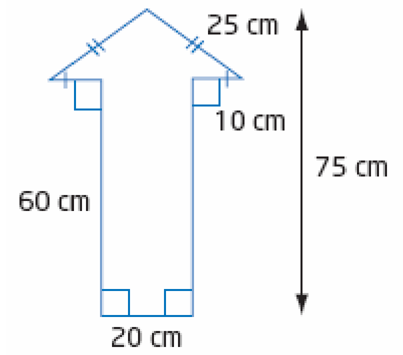
Step 2: Add the dimensions of the outer boundary to determine the perimeter.

To find the area: Use the formula for the area of a trapezoid.

Chapter 8 Section 2 Question 4 Page 433

a) $A = A_{\text{rectangle}} + A_{\text{triangle}}$

$$= 20 \times 60 + \frac{1}{2} \times 40 \times 15$$
$$= 1200 + 300$$
$$= 1500$$



The area of one side of one arrow is 1500 cm^2.

b) There are 12 sides to be painted.

$$12 \times 1500 = 18\,000$$

$$18\,000 \text{ cm}^2 = \frac{18\,000}{100 \times 100} \text{ m}^2$$
$$= 1.8 \text{ m}^2$$

Since one can of paint covers 2 m^2, only one can will need to be purchased.

c) $\text{Cost} = \$3.95 + 0.08 \times \$3.95 + 0.07 \times \$3.95$
$$= \$4.54$$

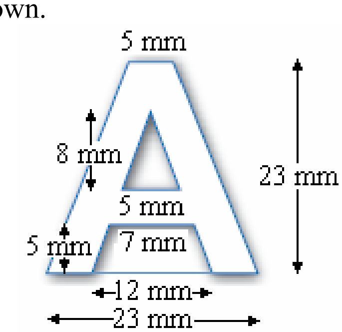
The cost of paint will be $4.54.

Chapter 8 Section 2 Question 5 Page 433

Measurements may vary. Sample measurements are shown.

$A = A_{\text{big trapezoid}} - A_{\text{small trapezoid}} - A_{\text{triangle}}$

$$= \frac{1}{2} \times 23 \times (23 + 5) - \frac{1}{2} \times 5 \times (12 + 7) - \frac{1}{2} \times 5 \times 8$$
$$= 254.5$$



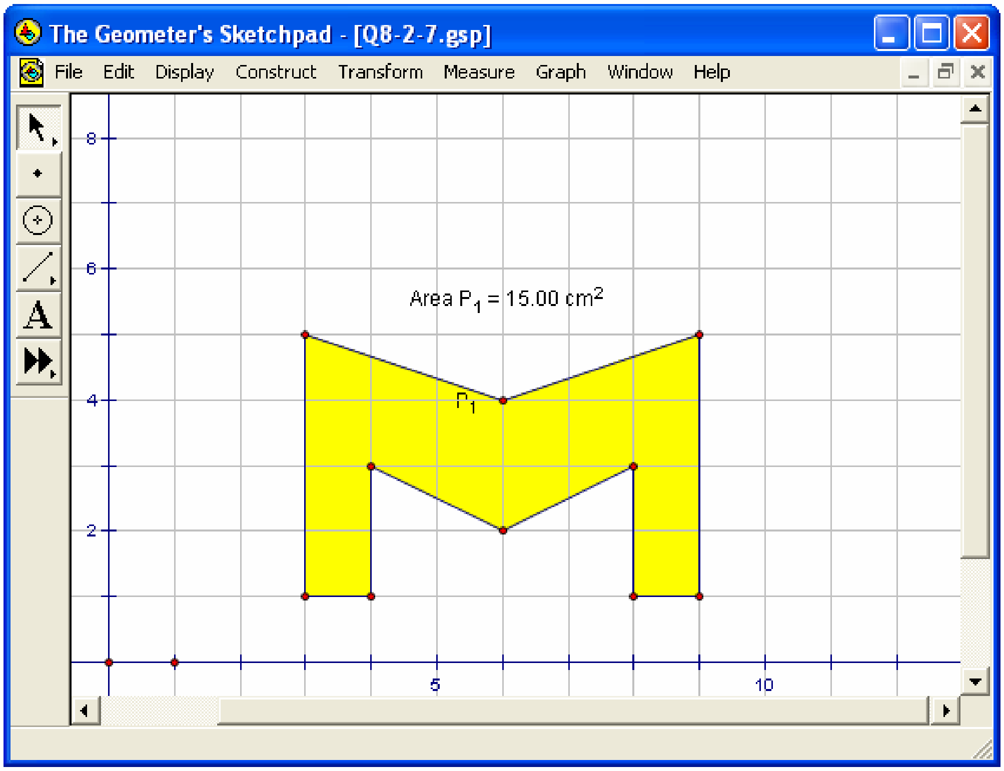
The area is 300 mm^2, to the nearest hundred square millimetres.

Chapter 8 Section 2 Question 6 Page 433

Answers will vary. See the solution for question 7 for a sample logo.

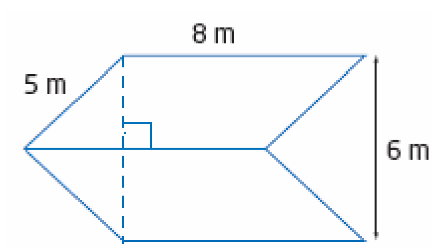
Chapter 8 Section 2 Question 7 Page 433

Answers will vary. A sample sketch is shown. Click here to load the sketch.



Chapter 8 Section 2 Question 8 Page 433

a) $P = 5 + 8 + 5 + 5 + 8 + 5$
$= 36$



The perimeter is 36 m. The plants are ro be placed every 20 cm, or 0.2 m.

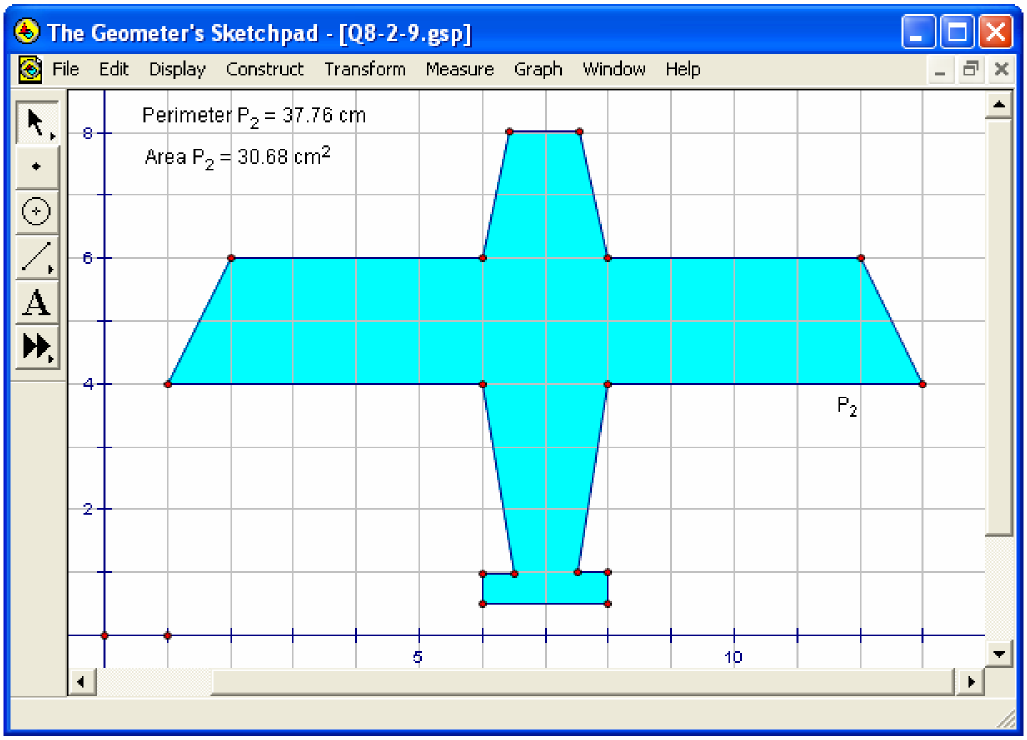
Emily will need $\frac{36}{0.2}$, or 180 plants.

b) $A = 2A_{\text{parallelogram}}$
$= 2(8 \times 3)$
$= 48$

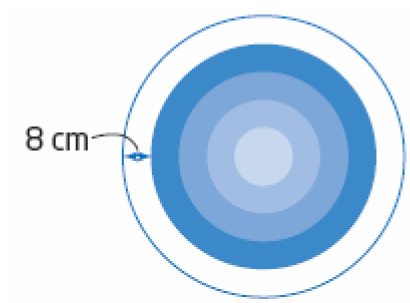
The area of the garden is 48 m^2.

Chapter 8 Section 2 Question 9 Page 433

Answers will vary. A sample sketch is shown. Click here to load the sketch.



Chapter 8 Section 2 Question 10 Page 434



a) $A_{\text{outer ring}} = A_{\text{target}} - A_{\text{up to first inner ring}}$

$$= \pi \times 40^2 - \pi \times 32^2$$

$$\doteq 1810$$

The area of the outer ring is approximately 1810 cm^2.

b) $\dfrac{A_{\text{outer ring}}}{A_{\text{target}}} = \dfrac{1810}{\pi \times 40^2}$

$$\doteq 0.36$$

The area of the outer ring is about 36% of the area of the total area.

Chapter 8 Section 2 Question 11 Page 434

a) $s^2 = 5$

$s = \sqrt{5}$

$s \doteq 2.2$

The length of one side of the patio is approximately 2.2 m.

b) The perimeter of the patio is 4×2.2, or 9 m to the nearest metre.

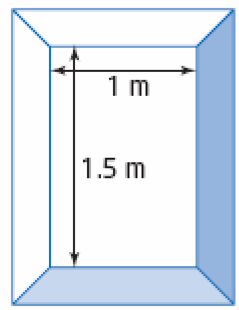
Chapter 8 Section 2 Question 12 Page 434

$A_{\text{frame}} = A_{\text{outside}} - A_{\text{picture}}$

$= 1.7 \times 1.2 - 1.5 \times 1$

$= 0.54$

The area of the frame is 0.54 m^2, or 5400 cm^2.



Chapter 8 Section 2 Question 13 Page 434

Solutions for the Achievement Checks are shown in the Teacher's Resource.

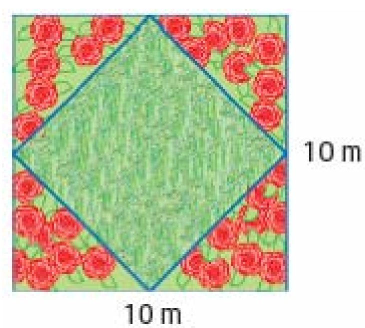
Chapter 8 Section 2 Question 14 Page 435

a) $s^2 = 5^2 + 5^2$

$s^2 = 25 + 25$

$s^2 = 50$

The area of the lawn is 50 m^2.



b) The four flower beds make up the same area as the lawn. The area of the lawn is four times the area of one flower bed.

c) When a square is inscribed within a square, four congruent triangles are always formed. However, the answer to part b) is only true when the vertices of the inscribed square are at the midpoints of the outer square.

Chapter 8 Section 2 Question 15 Page 435

Doubling the radius of a circle results in four times the area.

Consider a circle with a radius *r*, and another with radius 2*r*.

$$A_r = \pi r^2$$

$$\begin{aligned} A_{2r} &= \pi(2r)^2 \\ &= \pi(4r^2) \\ &= 4\pi r^2 \\ &= 4A_r \end{aligned}$$

The area of the second circle is four times the area of the first.

Chapter 8 Section 2 Question 16 Page 435

a) You must add the previous two terms to obtain the next term: 34, 55, 89, and 144.

b) The areas are: 1, 2, 6, 15, 40, 104, ...

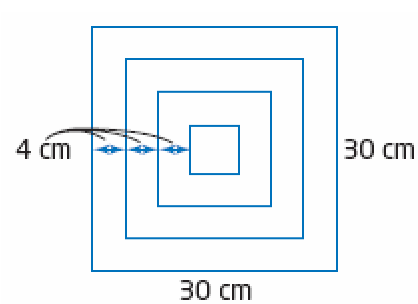
$$\begin{aligned} &1 \times 1 = 1 \\ &1 \times 2 = 2 \\ &2 \times 3 = 6 \\ &3 \times 5 = 15 \\ &5 \times 8 = 40 \\ &8 \times 13 = 104 \end{aligned}$$

c) Answers will vary.

d) Answers will vary.

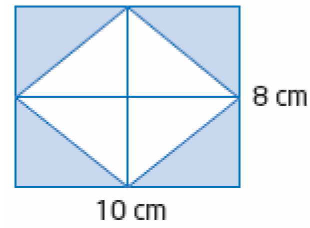
Chapter 8 Section 2 Question 17 Page 435

$$\begin{aligned} \frac{P_{\text{smallest square}}}{P_{\text{largest square}}} &= \frac{4 \times 6}{4 \times 30} \\ &= \frac{1}{5} \end{aligned}$$



The ratio of the perimeter of the smallest square to the perimeter of the largest square is 1:5.

Chapter 8 Section 2 Question 18 Page 435



The figure can be divided into 8 congruent triangles. The area of the shaded region is one-half the area of the rectangle.

$$\begin{aligned} A_{\text{shaded region}} &= \frac{1}{2} \times A_{\text{rectangle}} \\ &= \frac{1}{2} \times 10 \times 8 \\ &= 40 \end{aligned}$$

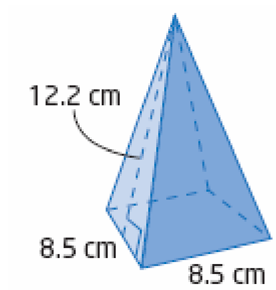
The area of the shaded region is 40 cm^2.

Chapter 8 Section 3 Surface Area and Volume of Prisms and Pyramids

Chapter 8 Section 3 Question 1 Page 441

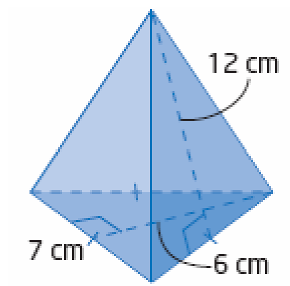
a)
$$
\begin{aligned}
SA &= A_{\text{base}} + 4A_{\text{triangle}} \\
&= 8.5 \times 8.5 + 4\left(\frac{1}{2} \times 8.5 \times 12.2\right) \\
&= 72.25 + 207.4 \\
&= 279.65
\end{aligned}
$$

The surface area is 279.65 cm^2.



b)
$$
\begin{aligned}
SA &= A_{\text{base}} + 3A_{\text{triangle}} \\
&= \frac{1}{2} \times 7 \times 6 + 3\left(\frac{1}{2} \times 7 \times 12\right) \\
&= 21 + 126 \\
&= 147
\end{aligned}
$$

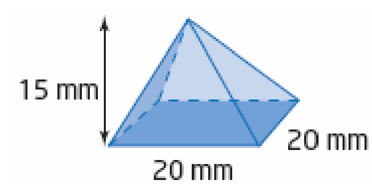
The surface area is 147 cm^2.



Chapter 8 Section 3 Question 2 Page 441

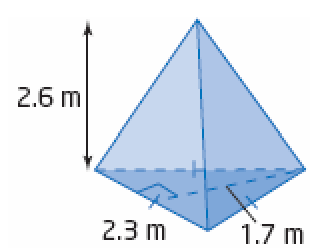
a)
$$
\begin{aligned}
V &= \frac{1}{3}A_{\text{base}} \times h \\
&= \frac{1}{3} \times 20^2 \times 15 \\
&= 2000
\end{aligned}
$$

The volume is 2000 mm^3.

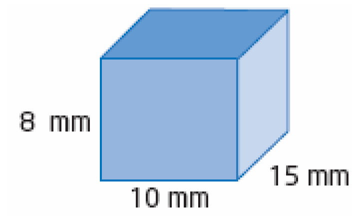


b)
$$
\begin{aligned}
V &= \frac{1}{3}A_{\text{base}} \times h \\
&= \frac{1}{3} \times \left(\frac{1}{2} \times 2.3 \times 1.7\right) \times 2.6 \\
&\doteq 2
\end{aligned}
$$

The volume is approximately 2 m^3.

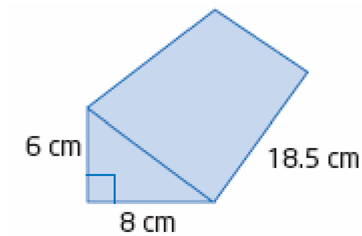


Chapter 8 Section 3 Question 3 Page 441



a) $$\begin{aligned} SA &= 2A_{\text{bottom}} + 2A_{\text{sides}} + 2A_{\text{front}} \\ &= 2(10 \times 15) + 2(8 \times 15) + 2(10 \times 8) \\ &= 300 + 240 + 160 \\ &= 700 \end{aligned}$$

The surface area is 700 mm^2.



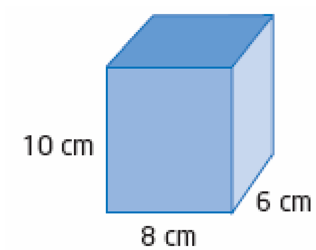
b)

$$\begin{aligned} c^2 &= 6^2 + 8^2 \\ c^2 &= 36 + 64 \\ c^2 &= 100 \\ c &= \sqrt{100} \\ c &= 10 \end{aligned}$$

$$\begin{aligned} SA &= 2A_{\text{base}} + A_{\text{left side}} + A_{\text{bottom}} + A_{\text{right side}} \\ &= 2\left(\frac{1}{2} \times 8 \times 6\right) + 6 \times 18.5 + 8 \times 18.5 + 10 \times 18.5 \\ &= 48 + 111 + 148 + 185 \\ &= 492 \end{aligned}$$

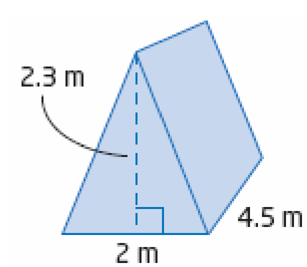
The surface area is 492 cm^2.

Chapter 8 Section 3 Question 4 Page 441



a) $$\begin{aligned} V &= A_{\text{base}} \times h \\ &= (10 \times 8) \times 6 \\ &= 480 \end{aligned}$$

The volume is 480 cm^2.



b) $$\begin{aligned} V &= A_{\text{base}} \times h \\ &= \left(\frac{1}{2} \times 2 \times 2.3\right) \times 4.5 \\ &= 10.35 \end{aligned}$$

The volume is 10.35 m^2.

Chapter 8 Section 3 Question 5 Page 441

a)
$$\begin{aligned} SA &= 2A_{\text{bottom}} + 2A_{\text{sides}} + 2A_{\text{front}} \\ &= 2(3\times 2) + 2(2\times 4) + 2(3\times 4) \\ &= 12 + 16 + 24 \\ &= 52 \end{aligned}$$

The surface area is 52 m^2.

b)
$$\begin{aligned} V &= A_{\text{base}} \times h \\ &= (3\times 2)\times 4 \\ &= 24 \end{aligned}$$

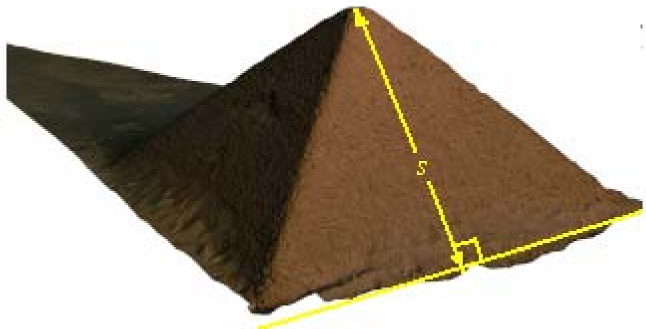
The volume is 24 m^2.

Chapter 8 Section 3 Question 6 Page 441

$$\begin{aligned} SA &= A_{\text{base}} \times h \\ 3000 &= (20\times 5)\times h \\ 3000 &= 100h \\ \frac{3000}{100} &= \frac{100h}{100} \\ 30 &= h \end{aligned}$$

The height of the cereal box is 30 cm.

Chapter 8 Section 3 **Question 7** **Page 442**



a) $V = \frac{1}{3}A_{\text{base}} \times h$

$= \frac{1}{3} \times 220^2 \times 105$

$= 1\,694\,000$

The volume is 1 694 000 m^3.

b)

$s^2 = 110^2 + 105^2$

$s^2 = 12\,100 = 11\,025$

$s^2 = 23\,125$

$s = \sqrt{23\,125}$

$s \doteq 152.1$

$SA = A_{\text{base}} + 4A_{\text{triangle}}$

$= 220 \times 220 + 4\left(\frac{1}{2} \times 220 \times 152.1\right)$

$= 48\,400 + 66\,924$

$= 115\,324$

The surface area is about 115 324 m^2.

Chapter 8 Section 3 Question 8 Page 442

$$\begin{aligned} V &= \frac{1}{3}A_{\text{base}} \times h \\ 2\,211\,096 &= \frac{1}{3} \times 215^2 \times h \\ 2\,211\,096 &= \frac{46\,225h}{3} \\ 3 \times 2\,211\,096 &= 3 \times \frac{46\,225h}{3} \\ 6\,633\,288 &= 46\,225h \\ \frac{6\,633\,288}{46\,225} &= \frac{46\,225h}{46\,225} \\ 143.5 &\doteq h \end{aligned}$$

The height of the pyramid is approximately 143.5 m.

Chapter 8 Section 3 Question 9 Page 442

$$\begin{aligned} V &= A_{\text{base}} \times h \\ &= 40 \times 26 \\ &= 1040 \end{aligned}$$

The volume is 1040 cm^3, or 1.04 L. It will hold 1 L of milk.

Chapter 8 Section 3 Question 10 Page 442

a)

$$\begin{aligned} V &= A_{\text{base}} \times h \\ 3000 &= 100h \\ \frac{3000}{100} &= \frac{100h}{100} \\ 30 &= h \end{aligned}$$

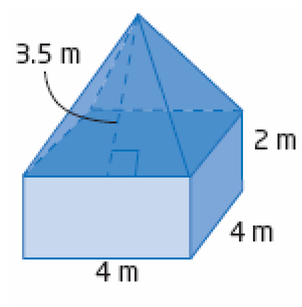
The height of the prism is 30 cm.

b) Assume that there are no irregularities (bumps/dimples) on the surface, the top of the juice container is flat, and the container is completely full.

Chapter 8 Section 3 Question 11 Page 442

a)

$$\begin{aligned}3.5^2 &= 2^2 + h^2\\ 12.25 &= 4 + h^2\\ 8.25 &= h^2\\ \sqrt{8.25} &= h\\ 2.9 &\doteq h\end{aligned}$$



$$\begin{aligned}V &= V_{\text{prism}} + V_{\text{pyramid}}\\ &= 4\times 4\times 2 + \frac{1}{3}\times 4^2 \times 2.9\\ &\doteq 47\end{aligned}$$

The volume of the shed is about 47 m^3.

b) $$\begin{aligned}SA &= 4A_{\text{rectangle}} + 4A_{\text{triangle}}\\ &= 4(2\times 4) + 4\left(\frac{1}{2}\times 4\times 3.5\right)\\ &= 32 + 28\\ &= 60\end{aligned}$$

The surface area is 60 m^2. Adam will need $\frac{60}{4}$, or 15 cans of paint.

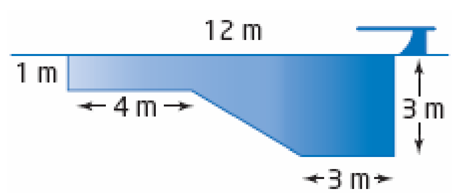
c) $$\begin{aligned}\text{Cost} &= 15\times \$16.95\times 1.15\\ &= \$292.39\end{aligned}$$

The total cost is $292.39.

Chapter 8 Section 3 Question 12 Page 442

a) Answers will vary. A possible estimate is about 80 m^3, or 80 000 L.

b) $$\begin{aligned}V &= \left(A_{\text{rectangle}} - A_{\text{trapezoid}}\right)\times \text{width}\\ &= \left(12\times 3 - \frac{1}{2}\times 2\times (4+9)\right)\times 4\\ &= (36-13)\times 4\\ &= 92\end{aligned}$$



The volume of the pool is 92 m^3, or 92 000 L.

c) At 100 L/min, it will take $\frac{92\ 000}{100}$, or 920 min (15 h 20 min) to fill the pool.

Chapter 8 Section 3 Question 13 Page 443

a) Predictions may vary. A sample prediction is that doubling the height doubles the volume.

b)

$$\begin{aligned} V &= A_{\text{base}} \times h \\ &= \left(\frac{1}{2} \times 6 \times 8\right) \times 10 \\ &= 240 \end{aligned}$$

$$\begin{aligned} V &= A_{\text{base}} \times h \\ &= \left(\frac{1}{2} \times 6 \times 8\right) \times 20 \\ &= 480 \end{aligned}$$

Doubling the height from 10 cm to 20 cm doubles the volume from 240 cm^3 to 480 cm^3.

c) Answers will vary. The sample prediction was accurate.

d) This is true in general. Doubling the height doubles the volume of the prism.

Chapter 8 Section 3 Question 14 Page 443

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 8 Section 3 Question 15 Page 443

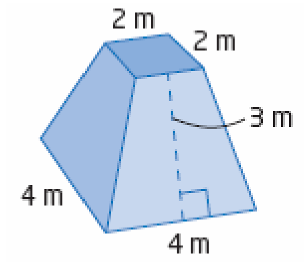
The height of the pyramid is three times the height of the prism.

$$\begin{aligned} V_{\text{pyramid}} &= \frac{1}{3} A_{\text{base}} \times h \\ &= \frac{1}{3} lwh \end{aligned}$$

$$\begin{aligned} V_{\text{prism}} &= A_{\text{base}} \times h \\ &= lwh \end{aligned}$$

If the two volumes are equal, then the height of the pyramid must be three times the height of the prism because *w* and *l* are the same for both.

Chapter 8 Section 3 Question 16 Page 443



a) $SA = A_{\text{bottom}} + A_{\text{top}} + 4 \times A_{\text{trapezoid}}$

$$= 4 \times 4 + 2 \times 2 + 4\left(\frac{1}{2} \times 3(4+2)\right)$$
$$= 16 + 4 + 36$$
$$= 56$$

The surface area of the frustum is 56 m^2.

b) The area to be painted it 56 – 16, or 40 m^2. The cost is 40 × \$49.50, or \$1980.00.

Chapter 8 Section 3 Question 17 Page 443

a) $SA = 2(2l \times 2w + 2w \times 2h + 2l \times 2h)$

$$= 2(4lw + 4wh + 4lh)$$
$$= 2(4(lw + wh + lh))$$
$$= 8(lw + wh + lh)$$

The surface area quadruples if each dimension is doubled.

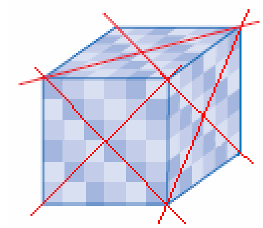
b) $V = 2l \times 2w \times 2h$

$$= 8lwh$$

The volume increases by 8 times if each dimension is doubled.

Chapter 8 Section 3 Question 18 Page 443

All cubes along diagonals will be cut.



Consider the 6 x 6 x 6 cube as made up of a 4 x 4 x 4 cube, and a 6 x 6 x 6 shell around it.

Consider the top face of the 4 x 4 x 4 cube. When this face is cut, all cubes marked x will be cut.

x	o	o	x
o	x	x	o
o	x	x	o
x	o	o	x

When the next cuts are made from the right side, the cubes marked o in the top and bottom rows will be cut. When the final cuts are made from the front side, the cubes marked o on the left and right sides will be cut. Hence, all cubes in the 4 x 4 x 4 cube will be cut.

Now consider the 6 x 6 x 6 shell. When the top face cuts are made, all cubes marked x will be cut.

x	o	o	o	o	x
o	x	o	o	x	o
o	o	x	x	o	o
o	o	x	x	o	o
o	x	o	o	x	o
x	o	o	o	o	x

When the next cuts are made from the right side, the cubes marked o in the top and bottom rows will be cut. When the final cuts are made from the front side, the cubes marked o on the left and right sides will be cut. This leaves 8 cubes uncut, as shown.

x	x	x	x	x	x
x	x	**o**	**o**	x	x
x	**o**	x	x	**o**	x
x	**o**	x	x	**o**	x
x	x	**o**	**o**	x	x
x	x	x	x	x	x

This pattern will occur on all six faces, leaving 6×8, or 48 cubes uncut.

Chapter 8 Section 4 Surface Area of a Cone

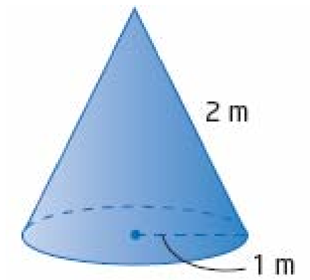
Chapter 8 Section 4 Question 1 Page 447

a) $SA = \pi rs + \pi r^2$

$= \pi \times 1 \times 2 + \pi \times 1^2$

$\doteq 9$

The surface area is approximately 9 m^2.

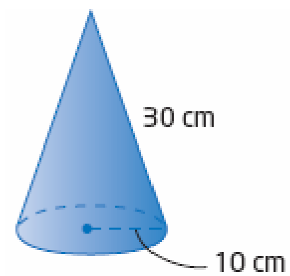


b) $SA = \pi rs + \pi r^2$

$= \pi \times 10 \times 30 + \pi \times 10^2$

$\doteq 1257$

The surface area is approximately 1257 cm^2.

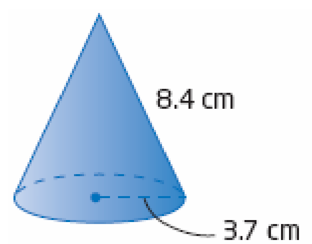


c) $SA = \pi rs + \pi r^2$

$= \pi \times 3.7 \times 8.4 + \pi \times 3.7^2$

$\doteq 141$

The surface area is approximately 141 cm^2.



Chapter 8 Section 4 Question 2 Page 447

a) $s^2 = 12^2 + 5^2$

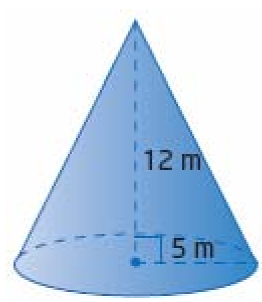
$s^2 = 144 + 25$

$s^2 = 169$

$s = \sqrt{169}$

$s = 13$

The slant height is 13 m.



b) $SA = \pi rs + \pi r^2$

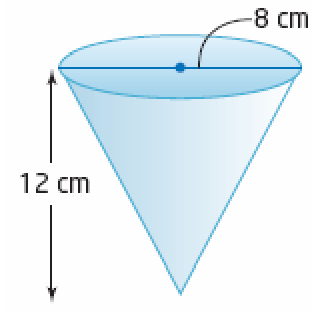
$= \pi \times 5 \times 13 + \pi \times 5^2$

$\doteq 283$

The surface area is approximately 283 m^2.

Chapter 8 Section 4 Question 3 Page 447

a)



$$s^2 = 12^2 + 4^2$$
$$s^2 = 144 + 16$$
$$s^2 = 160$$
$$s = \sqrt{160}$$
$$s \doteq 12.6$$

$$\begin{aligned} SA_{\text{lateral}} &= \pi rs \\ &= \pi \times 4 \times 12.6 \\ &\doteq 158 \end{aligned}$$

The area of paper required is about 158 cm^2.

b) Answers will vary. Assume that there is no paper being overlapped.

Chapter 8 Section 4 Question 4 Page 448

a) The cones have the same slant height. Both form triangles with the same side measurements.

b) The cones do not have the same surface area. The second cone has the greater surface area. The slant height is the same for both, but in the expression $SA = \pi rs + \pi r^2$, the second cone has the greater radius.

c)

$$s^2 = 6^2 + 4^2$$
$$s^2 = 36 + 16$$
$$s^2 = 52$$
$$s = \sqrt{52}$$
$$s \doteq 7.2$$

First cone:

$$\begin{aligned} SA &= \pi rs + \pi r^2 \\ &= \pi \times 4 \times 7.2 + \pi \times 4^2 \\ &\doteq 141 \end{aligned}$$

Second cone:

$$\begin{aligned} SA &= \pi rs + \pi r^2 \\ &= \pi \times 6 \times 7.2 + \pi \times 6^2 \\ &\doteq 249 \end{aligned}$$

The second cone has the greater surface area. The prediction was correct.

Chapter 8 Section 4 Question 5 Page 448

a)
$$
\begin{aligned}
SA_{\text{lateral}} &= \pi rs \\
60 &= \pi \times 4 \times s \\
60 &= 4\pi s \\
\frac{60}{4\pi} &= \frac{4\pi s}{4\pi} \\
5 &\doteq s
\end{aligned}
$$

The slant height is approximately 5 cm.

b)
$$
\begin{aligned}
5^2 &= 4^2 + h^2 \\
25 &= 16 + h^2 \\
9 &= h^2 \\
\sqrt{9} &= h \\
3 &= h
\end{aligned}
$$

The height of the cone is 3 cm.

Chapter 8 Section 4 Question 6 Page 448

Doubling the height of a cone does not double the surface area. Answers will vary. A sample answer is shown.

The formula for the surface area of the cone is $SA = \pi rs + \pi r^2$. When the height is doubled only the term πrs is changed. The term πr^2 remains unaltered. Hence, doubling the height of a cone does not double the surface area.

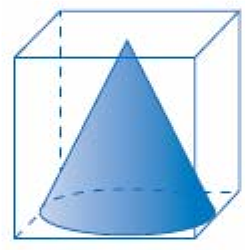
Chapter 8 Section 4 Question 7 Page 448

Doubling the radius of a cone does not double the surface area. Answers will vary. A sample answer is shown.

The formula for the surface area of a cone is $SA = \pi rs + \pi r^2$. When the radius is doubled, the term πr^2 will quadruple and the term πrs will more than double. Hence, the surface area of the new cone will be more than double the original cone.

Chapter 8 Section 4 **Question 8** **Page 448**

a) The radius of the largest cone that will fit into the box is 5 cm, while the height is 10 cm.



b)

$$s^2 = 10^2 + 5^2$$
$$s^2 = 100 + 25$$
$$s^2 = 125$$
$$s = \sqrt{125}$$
$$s \doteq 11.2$$

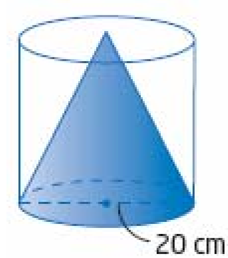
$$\begin{aligned} SA &= \pi rs + \pi r^2 \\ &= \pi \times 5 \times 11.2 + \pi \times 5^2 \\ &\doteq 254 \end{aligned}$$

The surface area is about 254 cm^2.

Chapter 8 Section 4 **Question 9** **Page 448**

First, find the height of the cylinder. Then, find the slant height of the cone and finally its surface area.

$$V = \pi r^2 h$$
$$9425 = \pi \times 10^2 \times h$$
$$9425 = 100\pi h$$
$$\frac{9425}{100\pi} = \frac{100\pi h}{100\pi}$$
$$30.0 \doteq h$$



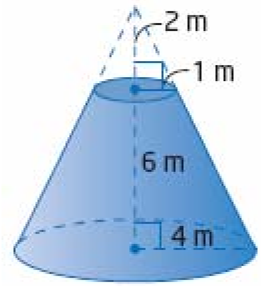
$$s^2 = 10^2 + 30.0^2$$
$$s^2 = 100 + 900$$
$$s^2 = 1000$$
$$s = \sqrt{1000}$$
$$s \doteq 31.6$$

$$\begin{aligned} SA &= \pi rs + \pi r^2 \\ &= \pi \times 10 \times 31.6 + \pi \times 10^2 \\ &\doteq 1307 \end{aligned}$$

The surface area is about 1307 cm^2.

Chapter 8 Section 4 Question 10 Page 448

To find the surface area of the frustum, first find the surface area of the original cone, and then subtract the surface area of the top portion that has been removed.



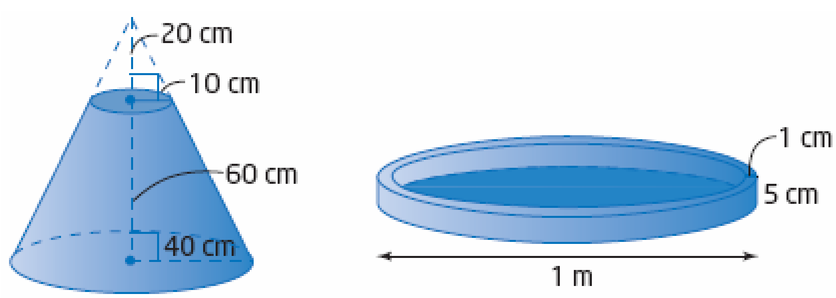
$$s_{\text{cone}}^2 = 4^2 + 8^2$$
$$s_{\text{cone}}^2 = 16 + 64$$
$$s_{\text{cone}}^2 = 80$$
$$s_{\text{cone}} = \sqrt{80}$$
$$s_{\text{cone}} \doteq 8.9$$

$$s_{\text{top}}^2 = 1^2 + 2^2$$
$$s_{\text{top}}^2 = 1 + 4$$
$$s_{\text{top}}^2 = 5$$
$$s_{\text{top}} = \sqrt{5}$$
$$s_{\text{top}} \doteq 2.2$$

$$\begin{aligned} SA_{\text{frustum}} &= \text{lateral } SA_{\text{cone}} - \text{lateral } SA_{\text{top}} + A_{\text{base of cone}} + A_{\text{base of top}} \\ &= \pi \times 4 \times 8.9 - \pi \times 1 \times 2.2 + \pi \times 4^2 + \pi \times 1^2 \\ &\doteq 158 \end{aligned}$$

The surface area of the frustum is about 158 m^2.

Chapter 8 Section 4 Question 11 Page 449



a) The area to be painted includes the base of the frustum, the lateral area of the frustum, the top of the frustum, the outer walls of the cylinder, the inner walls of the cylinder, the thin strip of the cylinder, the outer part of the base of the cylinder, and the inner part of the base of the cylinder.

b) To find the surface area of the frustum, first find the surface area of the original cone, and then subtract the surface area of the top portion that has been removed.

$$s_{\text{cone}}^2 = 40^2 + 80^2$$
$$s_{\text{cone}}^2 = 1600 + 6400$$
$$s_{\text{cone}}^2 = 8000$$
$$s_{\text{cone}} = \sqrt{8000}$$
$$s_{\text{cone}} \doteq 89.4$$

$$s_{\text{top}}^2 = 10^2 + 20^2$$
$$s_{\text{top}}^2 = 100 + 400$$
$$s_{\text{top}}^2 = 500$$
$$s_{\text{top}} = \sqrt{500}$$
$$s_{\text{top}} \doteq 22.4$$

$$\begin{aligned} SA_{\text{frustum}} &= \text{lateral } SA_{\text{cone}} - \text{lateral } SA_{\text{top}} + A_{\text{base of cone}} + A_{\text{base of top}} \\ &= \pi \times 40 \times 89.4 - \pi \times 10 \times 22.4 + \pi \times 40^2 + \pi \times 10^2 \\ &\doteq 15\,871 \end{aligned}$$

The area of the frustum is about 15 871 cm^2.

$$\begin{aligned} A_{\text{outer walls}} &= 2\pi \times 50 \times 5 \\ &\doteq 1571 \\ A_{\text{inner walls}} &= 2\pi \times 49 \times 4 \\ &\doteq 1232 \\ A_{\text{top strip}} &= \pi \times 50^2 - \pi \times 49^2 \\ &\doteq 311 \\ A_{\text{outside bottom}} &= \pi \times 50^2 \\ &\doteq 7854 \\ A_{\text{inside bottom}} &= \pi \times 49^2 \\ &= 7543 \\ SA_{\text{open cylinder}} &= 1571 + 1232 + 311 + 7854 + 7543 \\ &= 18\,511 \end{aligned}$$

The area of the cylinder is about 18 511 cm^2.

The total surface area is 15 871 + 18 511, or 34 382 cm^2 (about 3.4 m^2).

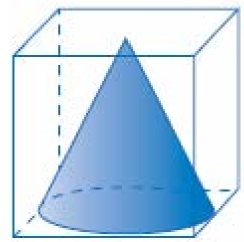
c) Emily will need 4 cans of paint to cover all surfaces.

Chapter 8 Section 4 Question 12 Page 449

Answers will vary.

Chapter 8 Section 4 Question 13 Page 449

a) The radius of the cone is $\frac{1}{2}x$, and the height is *x*.



b)

$$s^2 = x^2 + \left(\frac{1}{2}x\right)^2$$
$$s^2 = x^2 + \frac{1}{4}x^2$$
$$s^2 = \frac{5}{4}x^2$$
$$s = \sqrt{\frac{5}{4}x^2}$$
$$s = \frac{\sqrt{5}}{2}x$$

$$\begin{aligned}SA &= \pi r^2 + \pi rs \\ &= \pi\left(\frac{1}{2}x\right)^2 + \pi\left(\frac{1}{2}x\right)\left(\frac{\sqrt{5}}{2}x\right) \\ &= \frac{1}{4}\pi x^2 + \frac{\sqrt{5}}{4}\pi x^2\end{aligned}$$

Chapter 8 Section 4 Question 14 Page 449

a) $\text{Lateral Area} = \pi rs$

$$\frac{\text{Lateral Area}}{\pi r} = \frac{\pi rs}{\pi r}$$
$$s = \frac{\text{Lateral Area}}{\pi r}$$

b) $$\begin{aligned}s &= \frac{\text{Lateral Area}}{\pi r} \\ &= \frac{100}{4\pi} \\ &\doteq 7.96\end{aligned}$$

The slant height is 7.96 cm.

Chapter 8 Section 4 **Question 15** **Page 449**

Answers will vary. A sample answer is shown.

The radius is about 4500 m.

$$\begin{aligned} s^2 &= 4500^2 + 2351^2 \\ s^2 &= 25\,777\,201 \\ s &= \sqrt{25\,777\,201} \\ s &\doteq 5077 \end{aligned}$$

$$\begin{aligned} SA_{\text{lateral}} &= \pi r s \\ &= \pi \times 4500 \times 5077 \\ &\doteq 71\,774\,397 \end{aligned}$$

The surface area is about 71 774 397 m^2.

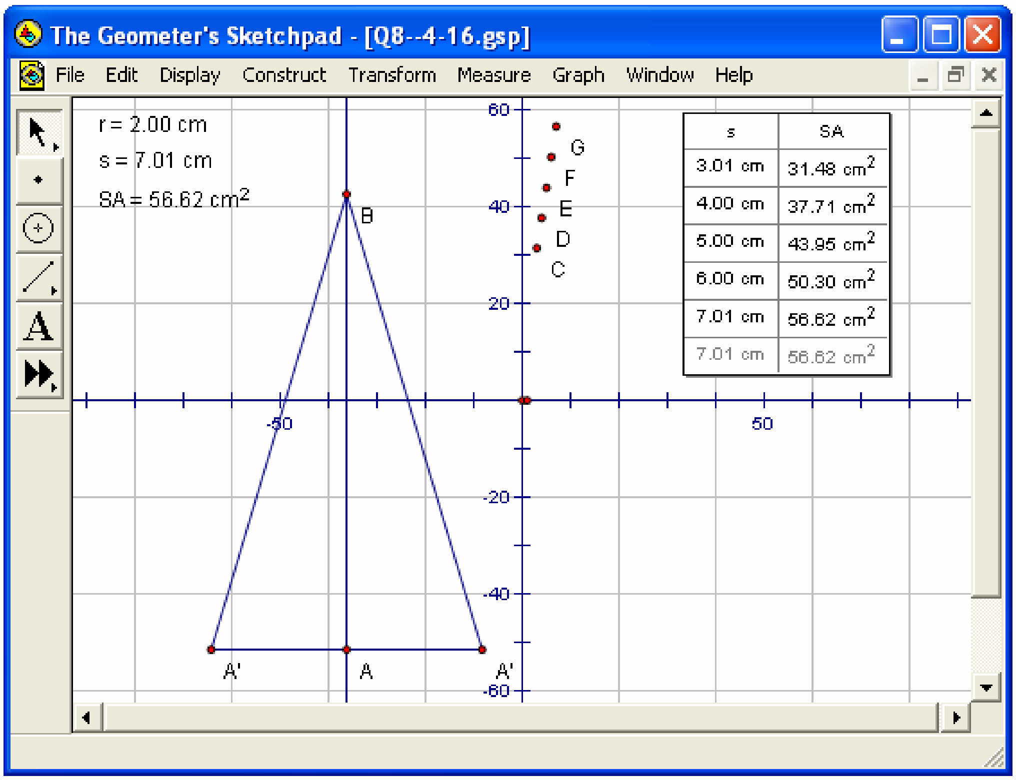
Chapter 8 Section 4 **Question 16** **Page 450**

a) $SA = \pi r^2 + \pi rs$

$= \pi(2)^2 + \pi(2)s$

$= 4\pi + 2\pi s$

b) Answers will vary. A sample sketch is shown. Click here to load the sketch.



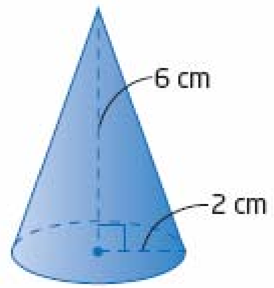
c) Answers will vary. The relation appears to be linear.

Chapter 8 Section 5 Volume of a Cone

Chapter 8 Section 5 Question 1 Page 454

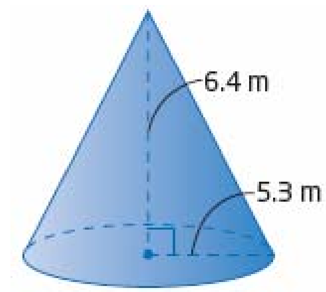
a) $$V = \frac{1}{3}\pi r^2 h$$
$$= \frac{1}{3}\pi \times 2^2 \times 6$$
$$\doteq 25$$

The volume is approximately 25 cm^3.



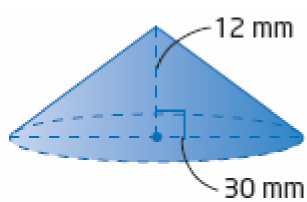
b) $$V = \frac{1}{3}\pi r^2 h$$
$$= \frac{1}{3}\pi \times 5.3^2 \times 6.4$$
$$\doteq 188$$

The volume is approximately 188 m^3.



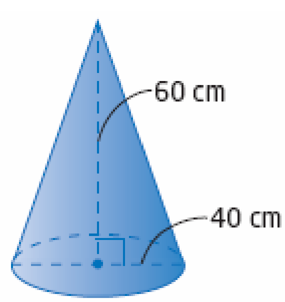
c) $$V = \frac{1}{3}\pi r^2 h$$
$$= \frac{1}{3}\pi \times 15^2 \times 12$$
$$\doteq 2827$$

The volume is approximately 2827 mm^3.



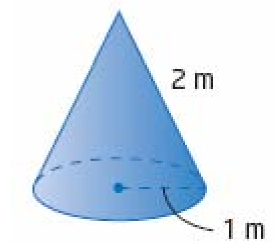
d) $$V = \frac{1}{3}\pi r^2 h$$
$$= \frac{1}{3}\pi \times 20^2 \times 60$$
$$\doteq 25\,133$$

The volume is approximately 25 133 cm^3.



Chapter 8 Section 5 **Question 2** **Page 454**

a)

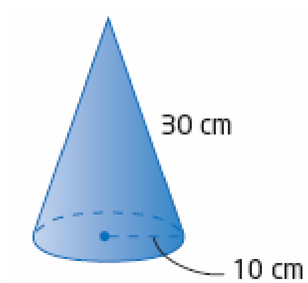


$$2^2 = 1^2 + h^2$$
$$4 = 1 + h^2$$
$$3 = h^2$$
$$\sqrt{3} = h$$
$$1.7 \doteq h$$

$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi \times 1^2 \times 1.7 \\ &\doteq 2 \end{aligned}$$

The volume is about 2 m^3.

b)



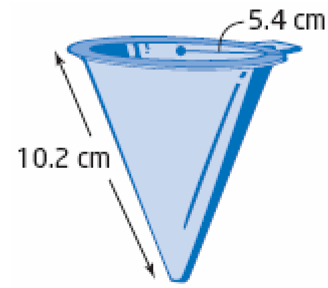
$$30^2 = 10^2 + h^2$$
$$900 = 100 + h^2$$
$$800 = h^2$$
$$\sqrt{800} = h$$
$$28.3 \doteq h$$

$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi \times 10^2 \times 28.3 \\ &\doteq 2964 \end{aligned}$$

The volume is about 2964 cm^3.

Chapter 8 Section 5 Question 3 Page 454

$$\begin{aligned}10.2^2 &= 5.4^2 + h^2\\ 104.04 &= 29.16 + h^2\\ 74.88 &= h^2\\ \sqrt{74.88} &= h\\ 8.65 &\doteq h\end{aligned}$$



$$\begin{aligned}V &= \frac{1}{3}\pi r^2 h\\ &= \frac{1}{3}\pi \times 5.4^2 \times 8.65\\ &\doteq 264.1\end{aligned}$$

The funnel can hold about 264.1 cm^3 of oil.

Chapter 8 Section 5 Question 4 Page 455

$$\begin{aligned}V &= \frac{1}{3}\pi r^2 h\\ 67 &= \frac{1}{3}\pi \times 3^2 \times h\\ 67 &= 3\pi h\\ \frac{67}{3\pi} &= \frac{3\pi h}{3\pi}\\ 7.1 &\doteq h\end{aligned}$$

The height of the paper cup is approximately 7.1 cm^2.

Chapter 8 Section 5 Question 5 Page 455

The volume of the cone is $\frac{1}{3}\times 300$, or 100 cm^3.

Chapter 8 Section 5 Question 6 Page 455

Answers will vary.

Chapter 8 Section 5 Question 7 Page 455

The volume of the cylinder is 3×150, or 450 cm^3.

Chapter 8 Section 5 Question 8 Page 455

a) Answers will vary. A possible estimate is 18 m.

b)

$$V = \frac{1}{3}\pi r^2 h$$

$$4000 = \frac{1}{3}\pi \times 15^2 \times h$$

$$4000 = 75\pi h$$

$$\frac{4000}{75\pi} = \frac{75\pi h}{75\pi}$$

$$16.98 \doteq h$$

The height of the storage unit is approximately 16.98 m.

c) Answers will vary. The estimate in part a) was about 1 m too high.

Chapter 8 Section 5 Question 9 Page 455

a) Answers will vary. A sample answer is shown.

The cone with base radius of 4 cm has the greater volume. The formula for the volume of a cone contains two factors of *r* and only one factor of *h*. Hence, the volume is more dependent on *r* than on *h*.

b)

$$V = \frac{1}{3}\pi r^2 h$$

$$= \frac{1}{3}\pi \times 3^2 \times 4$$

$$\doteq 38$$

$$V = \frac{1}{3}\pi r^2 h$$

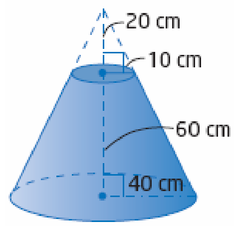
$$= \frac{1}{3}\pi \times 4^2 \times 3$$

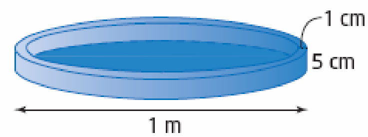
$$\doteq 50$$

The prediction was correct. The cone with a radius of 3 cm has a volume of 38 m^3, while the cone with a radius of 4 cm has a volume of 50 cm^3.

Chapter 8 Section 5 Question 10 Page 455

To find the volume of the frustum, first find the volume of the original cone, and then subtract the volume of the top portion that has been removed.





$$\begin{aligned} V_{\text{frustum}} &= V_{\text{cone}} - V_{\text{top}} \\ &= \frac{1}{3}\pi \times 40^2 \times 80 - \frac{1}{3}\pi \times 10^2 \times 20 \\ &\doteq 131\,947 \end{aligned}$$

The volume of the frustum is approximately 131 947 cm^3.

$$\begin{aligned} V_{\text{cylinder}} &= V_{\text{wall}} + V_{\text{base}} \\ &= \left(\pi \times 50^2 \times 5 - \pi \times 49^2 \times 5\right) + \pi \times 49^2 \times 1 \\ &\doteq 9098 \end{aligned}$$

The volume of the cylinder is approximately 9098 cm^3.

The total volume of concrete required is 131 947 + 9098, or 141 045 cm^3.

Chapter 8 Section 5 Question 11 Page 455

a)
$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ 3 \times V &= 3 \times \frac{1}{3}\pi r^2 h \\ 3V &= \pi r^2 h \\ \frac{3V}{\pi r^2} &= \frac{\pi r^2 h}{\pi r^2} \\ h &= \frac{3V}{\pi r^2} \end{aligned}$$

b) 1 L = 1000 cm^3

$$\begin{aligned} h &= \frac{3V}{\pi r^2} \\ &= \frac{3 \times 1000}{\pi \times 4^2} \\ &\doteq 59.7 \end{aligned}$$

The height of the cone is approximately 59.7 cm.

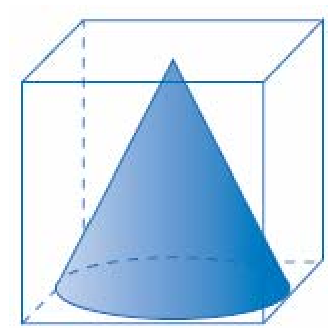
Chapter 8 Section 5 Question 12 Page 455

120 mL = 120 cm^3

$$
\begin{aligned}
V &= \frac{1}{3}\pi r^2 h \\
120 &= \frac{1}{3}\pi r^2 (15) \\
120 &= 5\pi r^2 \\
\frac{120}{5\pi} &= \frac{5\pi r^2}{5\pi} \\
\frac{120}{5\pi} &= r^2 \\
\sqrt{\frac{120}{5\pi}} &= r \\
2.8 &\doteq r
\end{aligned}
$$

The radius of the cone is approximately 2.8 cm.

Chapter 8 Section 5 Question 13 Page 456



a) The radius of the cone is 5 cm, and the height is 10 cm.

b) Estimates will vary. A possible estimate is 1:4.

c)
$$
\begin{aligned}
V &= \frac{1}{3}\pi r^2 h \\
&= \frac{1}{3}\pi \times 5^2 \times 10 \\
&\doteq 262
\end{aligned}
$$

The volume of the cone is approximately 262 cm^3.

d) The ratio of the volume of the cone to the volume of the cube is 262:1000, or about 1:3.82.

e) Answers will vary. The estimate in part b) was close to the correct ratio.

Chapter 8 Section 5 Question 14 Page 456

$$
\begin{aligned}
V &= \frac{1}{3}\pi r^2 h \\
200 &= \frac{1}{3}\pi r^2 (2r) \\
200 &= \frac{2\pi}{3} r^3 \\
\frac{3}{2\pi} \times 200 &= \frac{3}{2\pi} \times \frac{2\pi}{3} r^3 \\
\frac{300}{\pi} &= r^3 \\
4.57 &\doteq r
\end{aligned}
$$

$$
\begin{aligned}
h &= 2 \times 4.57 \\
&\doteq 9.1
\end{aligned}
$$

The height of the cone is about 9.1 m.

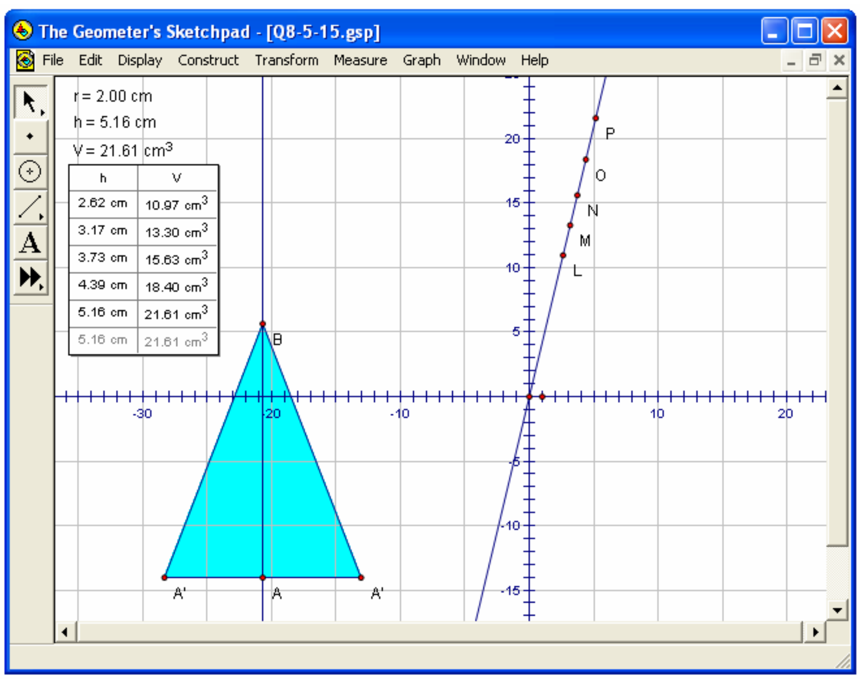
Chapter 8 Section 5 Question 15 Page 456

Answers will vary. A sample answer is shown. Click here to load the sketch.

Use geometry software to construct a model of a cone with a fixed radius. Collect data on volume as the height is changed. Plot the data.

When the radius is constant, a change in height produces a proportional change in volume.

A sample screen shot is shown.



Chapter 8 Section 5 Question 16 Page 456

a) $$\begin{aligned}V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi \times r^2 \times 20 \\ &= \frac{20}{3}\pi r^2\end{aligned}$$

b)

c) Answers will vary. A sample answer is shown.

The relation is increasing for all values of *r* greater than 0 (since the radius cannot be negative). The growth rate is non-linear.

Chapter 8 Section 5 Question 17 Page 456

Cube: $$\begin{aligned}V &= s^3 \\ &= 6^3 \\ &= 216\end{aligned}$$

The volume of the cube is 216 cm^3.

Pyramid: $$\begin{aligned}V &= \frac{1}{3}A_{base} \times h \\ &= \frac{1}{3} \times 6^2 \times 12 \\ &= 144\end{aligned}$$

The volume of the pyramid is 144 cm^3.

Cone: $$\begin{aligned}V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi \times 3^2 \times 12 \\ &\doteq 113\end{aligned}$$

The volume of the cone is approximately 113 cm^3.

Cylinder: $$\begin{aligned}V &= \pi r^2 h \\ &= \pi \times 3^2 \times 6 \\ &\doteq 170\end{aligned}$$

The volume of the cone is approximately 170 cm^3.

From least to greatest, the volumes are cone, pyramid, cylinder and cube. Answer D.

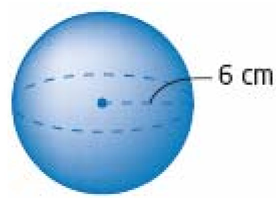
Chapter 8 Section 6   Surface Area of a Sphere

Chapter 8 Section 6   Question 1   Page 459

a) $SA = 4\pi r^2$

$= 4\pi \times 6^2$

$\doteq 452$



The volume is approximately 452 cm^2.

b) $SA = 4\pi r^2$

$= 4\pi \times 30.2^2$

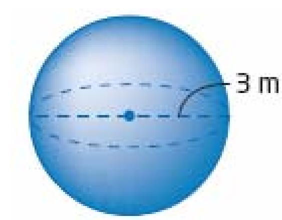
$\doteq 11\,461$

The volume is approximately 11 461 mm^2.

c) $SA = 4\pi r^2$

$= 4\pi \times 1.5^2$

$\doteq 28$

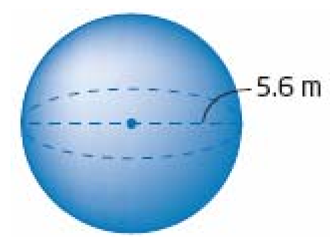


The volume is approximately 28 m^2.

d) $SA = 4\pi r^2$

$= 4\pi \times 2.8^2$

$\doteq 99$



The volume is approximately 99 m^2.

Chapter 8 Section 6   Question 2   Page 459

a) Estimates will vary. A possible estimate is 4800 mm^2.

b) $SA = 4\pi r^2$

$= 4\pi \times 20^2$

$\doteq 5027$

The surface area is approximately 5027 mm^2.
Answers will vary. The estimate in part a) was close.

Chapter 8 Section 6 Question 3 Page 459

$$\begin{aligned}
SA &= 4\pi r^2 \\
42.5 &= 4\pi r^2 \\
\frac{42.5}{4\pi} &= \frac{4\pi r^2}{4\pi} \\
\frac{42.5}{4\pi} &= r^2 \\
\sqrt{\frac{42.5}{4\pi}} &= r \\
1.8 &\doteq r
\end{aligned}$$

The radius of the sphere is approximately 1.8 m.

Chapter 8 Section 6 Question 4 Page 459

a) $$\begin{aligned}
SA &= 4\pi r^2 \\
&= 4\pi \times 12.4^2 \\
&\doteq 1932.2
\end{aligned}$$

The area of leather required is approximately 1932.2 cm^2, or 0.193 22 m^2.

b) It will cost 0.193 22 × \$28, or \$5.41 to cover the ball.

Chapter 8 Section 6 Question 5 Page 459

a) $$\begin{aligned}
SA &= 4\pi r^2 \\
&= 4\pi \times 6400^2 \\
&\doteq 514\,718\,540
\end{aligned}$$

The surface area of the Earth is approximately 514 718 540 km^2.

b) Assume that the Earth is a sphere.

Chapter 8 Section 6 Question 6 Page 460

a) $SA = 4\pi r^2$

$= 4\pi \times 3400^2$

$\doteq 145\,267\,244$

The surface area of Mars is approximately 145 267 244 km^2.

b) The surface area of the Earth is $\frac{514\,718\,540}{145\,267\,244}$, or about 3.5 times greater than the surface area of Mars.

Chapter 8 Section 6 Question 7 Page 460

a) Estimates will vary. A possible estimate is 10 800 cm^2, or 1.08 m^2. This will require 2 jars of crystals.

b) $SA = 4\pi r^2$

$= 4\pi \times 30^2$

$\doteq 11\,310$

The surface area of the ball is approximately 11 310 cm^2, or 1.131 m^2.

c) Answers will vary. A sample answer is shown.

In this case, whether you use the approximate value or the exact value, two jars of reflective crystals are required to cover the gazing ball.

Chapter 8 Section 6 Question 8 Page 460

a) Predictions will vary. A possible prediction is 750 cm^2.

b) Change in $SA = 4\pi \times 17^2 - 4\pi \times 15^2$

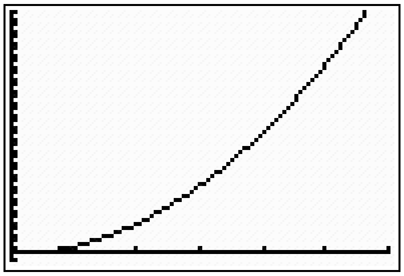
$\doteq 804$

The change in the surface area is about 804 cm^2.

c) Answers will vary. The prediction in part a) was close to the correct answer.

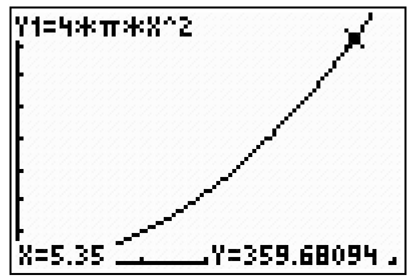
Chapter 8 Section 6 **Question 9 Page 460**

a)

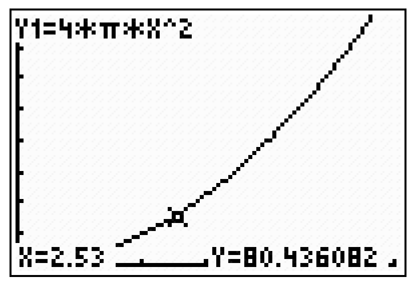


b) The radius must be greater than 0. As the radius increases, the surface area also increases in a non-linear pattern.

c) For a radius of 5.35 cm, the surface area is about 360 cm^2.



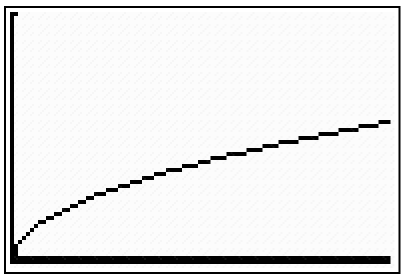
For a surface area of 80 cm^2, the radius is about 2.5 cm.



Chapter 8 Section 6 Question 10 Page 460

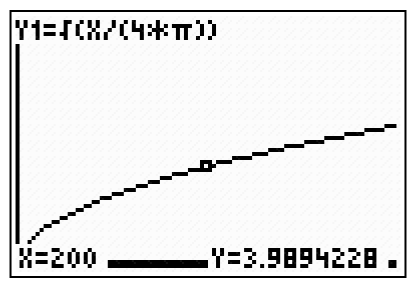
a)
$$SA = 4\pi r^2$$
$$\frac{SA}{4\pi} = \frac{4\pi r^2}{4\pi}$$
$$\frac{SA}{4\pi} = r^2$$
$$r = \sqrt{\frac{SA}{4\pi}}$$

b)



c) The radius and the surface area must be greater than 0. The trend between the two variables is non-linear with the radius increasing as the surface area increases but at a slower rate.

d) When the surface area is 200 cm^2, the radius is about 4 cm.



Chapter 8 Section 6 Question 11 Page 460

The surface area has increased by a factor of nine.

$$\begin{aligned} SA_{\text{old}} &= 4\pi r^2 \\ SA_{\text{new}} &= 4\pi (3r)^2 \\ &= 4\pi \times 9r^2 \\ &= 9\left(4\pi r^2\right) \end{aligned}$$

Chapter 8 Section 6 Question 12 Page 460

A cube with an edge length of 2*r* has a surface area of $6(2r)^2 = 24r^2$. A sphere of radius *r* has a surface area of $4\pi r^2$, or about $12.6r^2$. The cube has the larger surface area.

Chapter 8 Section 6 Question 13 Page 461

a) Answers will vary. A possible estimate is $\frac{1}{2}$.

b)

$$\begin{aligned} SA_{\text{sphere}} &= 4\pi r^2 \\ &= 4\pi \times 5^2 \\ &= 100\pi \\ &= 314 \end{aligned}$$

The surface area of the sphere is 100π, or about 314 cm^2.

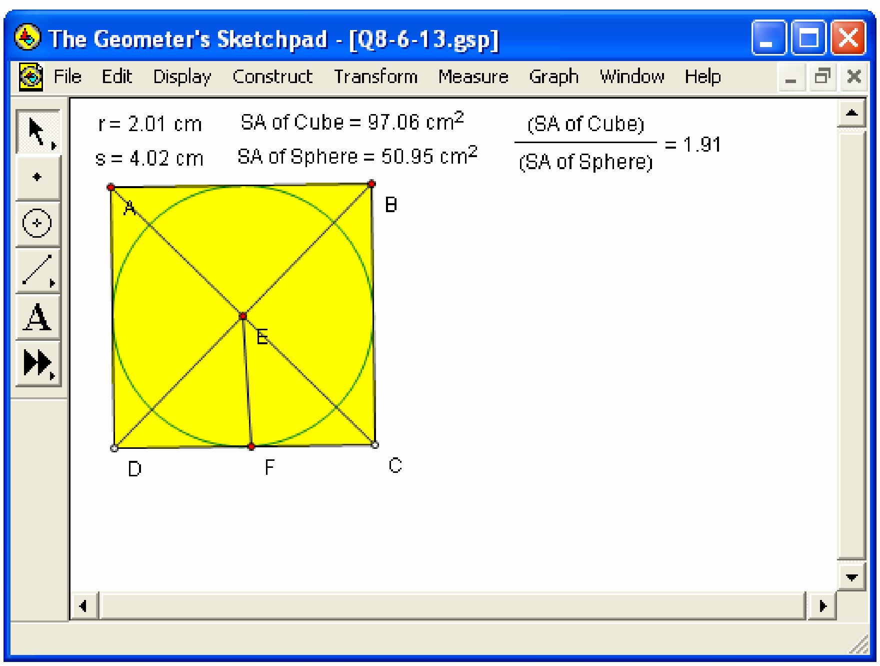
$$\begin{aligned} SA_{\text{cube}} &= 6s^2 \\ &= 6 \times 10^2 \\ &= 600 \end{aligned}$$

The surface area of the cube is 600 cm^2.

The ratio of the surface areas is 100π:600, or π:6. Alternatively, the ratio is 314:600, or about 1:1.91.

c) Answers will vary. The estimate in part a) was close to the correct answer.

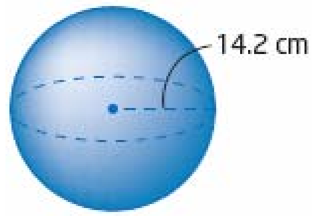
d) Answers will vary. A sample sketch is shown. The ratio of the surface areas of a cube and a sphere inscribed in the cube is constant at about 1.91. Click here to load the sketch.



Chapter 8 Section 7 Volume of a Sphere

Chapter 8 Section 7 Question 1 Page 465

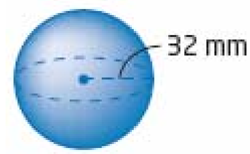
a)



$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 14.2^3 \\ &\doteq 11\,994 \end{aligned}$$

The volume is approximately 11 994 cm^3.

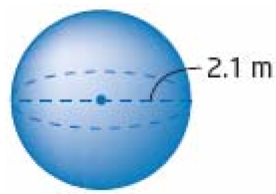
b)



$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 32^3 \\ &\doteq 137\,258 \end{aligned}$$

The volume is approximately 137 258 mm^3.

c)



$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 1.05^3 \\ &\doteq 5 \end{aligned}$$

The volume is approximately 5 m^3.

Chapter 8 Section 7 Question 2 Page 465

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 2.15^3 \\ &\doteq 42 \end{aligned}$$

The volume is approximately 42 cm^3.

Chapter 8 Section 7 Question 3 Page 465

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 4^3 \\ &\doteq 268 \end{aligned}$$

The volume of each hailstone is approximately 268 cm^3.

Chapter 8 Section 7 Question 4 Page 465

a) $$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 20^3 \\ &\doteq 33\,510 \end{aligned}$$

The volume of the ball is approximately 33 510 mm^3.

b) $$\begin{aligned} V &= s^3 \\ &= 40^3 \\ &= 64\,000 \end{aligned}$$

The volume of the cube is 64 000 mm^3.

c) The amount of empty space is 64 000 – 33 510, or 30 490 mm^3.

Chapter 8 Section 7 Question 5 Page 466

a) $V_{\text{small}} = \frac{4}{3}\pi r^3$
$= \frac{4}{3}\pi \times 2^3$
$\doteq 33.5$

$V_{\text{large}} = \frac{4}{3}\pi r^3$
$= \frac{4}{3}\pi \times 70.15^3$
$\doteq 1\,446\,011.1$

The volume of the small lollipop is approximately 33.5 cm^3, and the volume of the large lollipop is approximately 1 446 011.1 cm^3.

The volume of the large lollipop is $\frac{1\,446\,011.1}{33.5}$, or about 43 165 times the volume of the small lollipop. The mass of the large lollipop is $0.05 \times 43\,165$, or about 2158 kg.

b) Answers will vary. A sample answer is shown.

Assume that the largest lollipop had the same mass per cubic centimetre as the small lollipop.

Chapter 8 Section 7 **Question 6 Page 466**

a) $V = \frac{4}{3}\pi r^3$

$= \frac{4}{3}\pi \times 30^3$

$\doteq 113\,097$

The volume of the ball is approximately 113 097 cm^3.

b) $V = \pi r^2 h$

$= \pi \times 30^2 \times 60$

$\doteq 169\,646$

The volume of the cylindrical container is approximately 169 646 cm^3.

c) $\frac{V_{\text{sphere}}}{V_{\text{container}}} = \frac{113\,097}{169\,646}$

$\doteq 0.67 \text{ or } \frac{2}{3}$

The ratio of the volume of the sphere to the volume of the container is about 2:3.

d) This ratio is consistent for any sphere that just fits inside the cylinder, since $h = 2r$.

$$\frac{V_{\text{sphere}}}{V_{\text{container}}} = \frac{\frac{4}{3}\pi r^3}{\pi r^2 h}$$

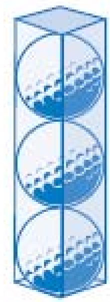
$$= \frac{\frac{4}{3}\pi r^3}{\pi r^2 (2r)}$$

$$= \frac{\frac{4}{3}\pi r^3}{2\pi r^3}$$

$$= \frac{\frac{4}{3}}{2}$$

$$= \frac{2}{3}$$

Chapter 8 Section 7 Question 7 Page 466

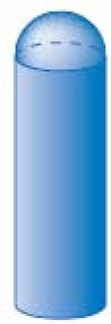


The box will measure 12.9 cm by 4.3 cm by 4.3 cm.

$$\begin{aligned}SA &= 4A_{\text{face}} + 2A_{\text{base}}\\ &= 4(12.9 \times 4.3) + 2(4.3^2)\\ &= 221.88 + 36.98\\ &= 258.86\end{aligned}$$

The amount of material needed to make the box is 258.86 cm^2.

Chapter 8 Section 7 Question 8 Page 466



a) Answers will vary. A possible estimate is 800 m^3.

b)
$$\begin{aligned}V_{\text{silo}} &= V_{\text{cylinder}} + V_{\text{hemisphere}}\\ &= \pi r^2 h + \frac{1}{2}\left(\frac{4}{3}\pi r^3\right)\\ &= \pi \times 3.25^2 \times 20 + \frac{1}{2} \times \frac{4}{3}\pi \times 3.25^3\\ &\doteq 736\end{aligned}$$

The volume of the silo is approximately 736 m^3.

c) The silo can hold 0.80×736, or about 589 m^3 of grain.

d)
$$\begin{aligned}V_{\text{bin}} &= 7 \times 3 \times 2.5\\ &= 52.5\end{aligned}$$

It will take $\frac{589}{52.5}$, or about 11.2 truckloads to fill the silo. So, 12 truckloads are needed.

Chapter 8 Section 7 Question 9 Page 466

The length of the cylinder is 10.2 – 4, or 6.2 m.

$$\begin{aligned}V_{\text{tank}} &= V_{\text{cylinder}} + V_{\text{sphere}}\\ &= \pi r^2 h + \frac{4}{3}\pi r^3\\ &= \pi \times 2^2 \times 6.2 + \frac{4}{3}\pi \times 2^3\\ &\doteq 111\end{aligned}$$

The volume of the tank is approximately 111 m^3.

Chapter 8 Section 7 Question 10 Page 467

Answers will vary. A sample answer is shown.

Assume that the classroom measures 10 m by 5 m by 3 m. Assume that 3 basketballs line up on each metre. The number of balls that will fit into the classroom is about $30 \times 15 \times 9$, or 4050.

Chapter 8 Section 7 Question 11 Page 467

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 8 Section 7 Question 12 Page 467

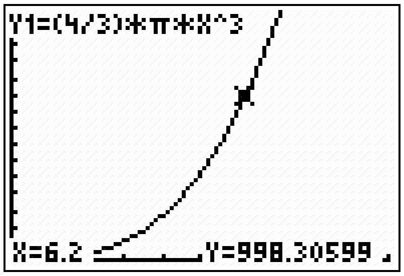
Estimates will vary. A possible estimate is 5 cm.

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ 600 &= \frac{4}{3}\pi r^3 \\ 3 \times 600 &= 3 \times \frac{4}{3}\pi r^3 \\ 1800 &= 4\pi r^3 \\ \frac{1800}{4\pi} &= \frac{4\pi r^3}{4\pi} \\ \frac{1800}{4\pi} &= r^3 \\ 5.23 &\doteq r \end{aligned}$$

The radius of the sphere is approximately 5.23 cm.

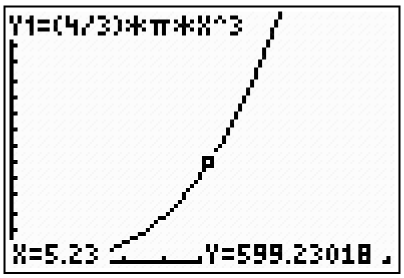
Chapter 8 Section 7 Question 13 Page 467

a)



The volume of a sphere with a radius of 6.2 cm is approximately 998.3 cm^3.

b)



The volume of a sphere with a radius of 5.23 cm is 599.2 cm^3. The answer checks.

Chapter 8 Section 7 Question 14 Page 467

$$\begin{aligned} SA &= 4\pi r^2 \\ 250 &= 4\pi r^2 \\ \frac{250}{4\pi} &= \frac{4\pi r^2}{4\pi} \\ \frac{250}{4\pi} &= r^2 \\ \sqrt{\frac{250}{4\pi}} &= r \\ 4.46 &\doteq r \end{aligned}$$

$$\begin{aligned} SA &= 4\pi r^2 \\ 500 &= 4\pi r^2 \\ \frac{500}{4\pi} &= \frac{4\pi r^2}{4\pi} \\ \frac{500}{4\pi} &= r^2 \\ \sqrt{\frac{500}{4\pi}} &= r \\ 6.31 &\doteq r \end{aligned}$$

$$\begin{aligned} V_{\text{old}} &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 4.46^3 \\ &\doteq 372 \end{aligned}$$

$$\begin{aligned} V_{\text{new}} &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 6.31^3 \\ &\doteq 1052 \end{aligned}$$

The volume increases by a factor of $\frac{1052}{372}$, or about 2.83.

Chapter 8 Section 7 Question 15 Page 467

a) Answers will vary. A possible estimate is 1:2.

b)

$$\begin{aligned} V_{\text{cube}} &= s^3 \\ &= 8^3 \\ &= 512 \end{aligned}$$

$$\begin{aligned} V_{\text{sphere}} &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 4^3 \\ &= \frac{256\pi}{3} \\ &\doteq 268 \end{aligned}$$

The ratio of the volume of the sphere to the volume of the cube is 268:512, or about 1:0.52.
Note: the actual ratio is $\pi{:}6$.

$$\begin{aligned} \frac{\frac{256\pi}{3}}{512} &= \frac{256\pi}{1536} \\ &= \frac{\pi}{6} \end{aligned}$$

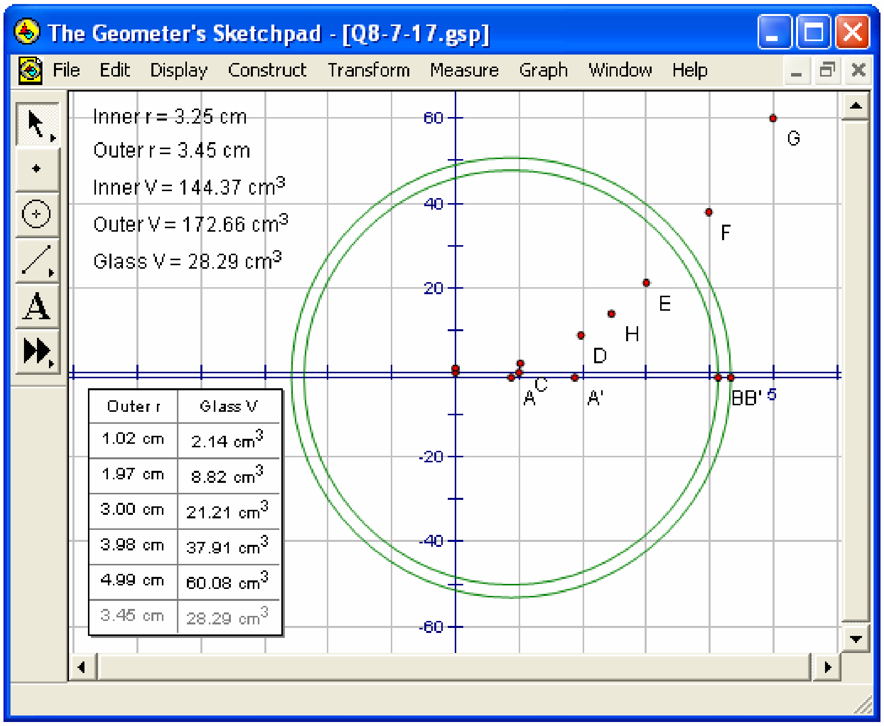
c) Answers will vary. The answer in part b) is close to the estimate in part a).

Chapter 8 Section 7 Question 16 Page 467

A cube with edges of length 2*r* has a larger volume than a sphere with a radius of *r*. The sphere will fit inside the cube.

Chapter 8 Section 7 Question 17 Page 468

Answers will vary. A sample sketch is shown. Click here to load the sketch.



The relationship is non-linear.

Chapter 8 Section 7 Question 18 Page 469

$$\begin{aligned} V_{\text{cylinder}} &= \pi r^2 h \\ &= \pi \times 6^2 \times 6 \\ &\doteq 679 \end{aligned}$$

The volume of the cylinder is approximately 679 cm^3.

$$\begin{aligned} V_{\text{cone}} &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi \times 6^2 \times 6 \\ &\doteq 226 \end{aligned}$$

The volume of the cone is approximately 226 cm^3.

$$\begin{aligned} V_{\text{sphere}} &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 6^3 \\ &\doteq 905 \end{aligned}$$

The volume of the sphere is approximately 905 cm^3.

From least volume to greatest volume the order is cone, cylinder, and sphere. Answer B.

Chapter 8 Section 7　　　　**Question 19**　**Page 469**

$$\begin{aligned} V_{\text{box}} &= lwh \\ &= 4 \times 12 \times 16 \\ &= 768 \end{aligned}$$

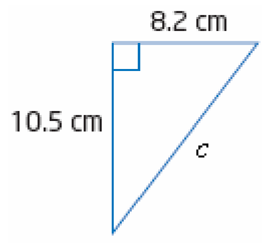
$$\begin{aligned} V_{\text{balls}} &= 12\left(\frac{4}{3}\pi r^3\right) \\ &= 12\left(\frac{4}{3}\pi \times 2^3\right) \\ &\doteq 402.12 \end{aligned}$$

The volume of empty space is 768 – 402.12, or 365.88 cm^3.

Chapter 8 Review

Chapter 8 Review **Question 1** **Page 470**

a)



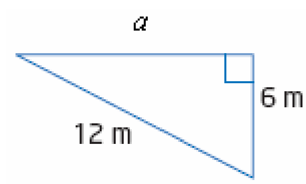
$$c^2 = 8.2^2 + 10.5^2$$
$$c^2 = 67.24 + 110.25$$
$$c^2 = 177.49$$
$$\sqrt{c^2} = \sqrt{177.49}$$
$$c \doteq 13.32$$

$$P = 13.32 + 8.2 + 10.5$$
$$\doteq 32.0$$

$$A = \frac{1}{2}bh$$
$$= \frac{1}{2} \times 8.2 \times 10.5$$
$$\doteq 43.1$$

The perimeter is about 32.0 cm, and the area is about 43.1 cm^2.

b)



$$12^2 = 6^2 + a^2$$
$$144 = 36 + a^2$$
$$144 - 36 = 36 + a^2 - 36$$
$$108 = a^2$$
$$\sqrt{108} = \sqrt{a^2}$$
$$10.39 \doteq a$$

$$P = 10.39 + 12 + 6$$
$$\doteq 28.4$$
$$A = \frac{1}{2} \times 6 \times 10.39$$
$$\doteq 31.2$$

The perimeter is about 28.4 m, and the area is about 31.2 m^2.

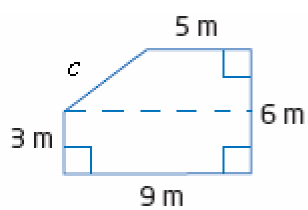
Chapter 8 Review **Question 2** **Page 470**

$$
\begin{aligned}
6^2 &= 2^2 + a^2 \\
36 &= 4 + a^2 \\
36 - 4 &= 4 + a^2 - 4 \\
32 &= a^2 \\
\sqrt{32} &= \sqrt{a^2} \\
5.7 &\doteq a
\end{aligned}
$$

The ladder reaches approximately 5.7 m up the wall.

Chapter 8 Review **Question 3** **Page 470**

a)



$$
\begin{aligned}
c^2 &= 3^2 + 4^2 \\
c^2 &= 9 + 16 \\
c^2 &= 25 \\
c &= \sqrt{25} \\
c &= 5
\end{aligned}
$$

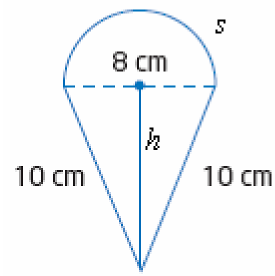
$$
\begin{aligned}
P &= 5 + 5 + 6 + 9 + 3 \\
&= 28
\end{aligned}
$$

$$
\begin{aligned}
A &= A_{\text{trapezoid}} + A_{\text{rectangle}} \\
&= \frac{1}{2} \times 3 \times (5 + 9) + 3 \times 9 \\
&= 21 + 27 \\
&= 48
\end{aligned}
$$

The perimeter is 28 m, and the area is 48 m^2.

b)

$$s = \frac{1}{2}\pi d$$
$$= \frac{1}{2}\pi \times 8$$
$$\doteq 12.57$$



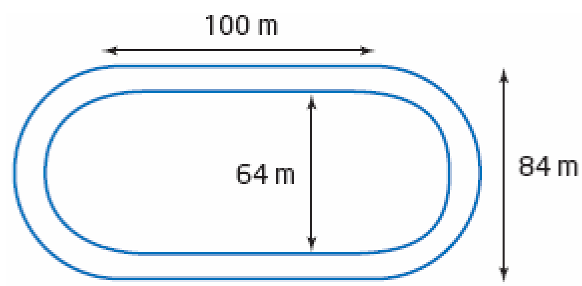
$$P = 12.57 + 10 + 10$$
$$\doteq 32.6$$

$$h^2 + 4^2 = 10^2$$
$$h^2 + 16 = 100$$
$$h^2 = 100 - 16$$
$$h^2 = 84$$
$$h = \sqrt{84}$$
$$h \doteq 9.17$$

$$A = A_{\text{triangle}} + A_{\text{semicircle}}$$
$$= \frac{1}{2} \times 8 \times 9.17 + \frac{1}{2}\pi \times 4^2$$
$$\doteq 61.8$$

The perimeter is about 32.6 cm, and the area is about 61.8 cm^2.

Chapter 8 Review **Question 4** **Page 470**



a) $d = 100 + 100 + \pi \times 64$
$\doteq 401.1$

Tyler runs about 401.1 m.

b) $d = 100 + 100 + \pi \times 84$
$\doteq 463.9$

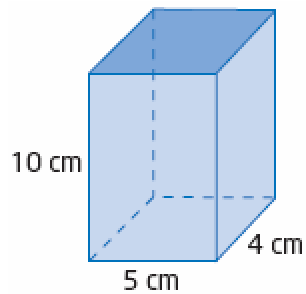
Dylan runs about 463.9 m.

c) Dylan runs 463.9 – 401.1, or 62.8 m farther than Tyler.

Chapter 8 Review **Question 5** **Page 470**

a)

$$\begin{aligned} SA &= 2A_{\text{bottom}} + 2A_{\text{sides}} + 2A_{\text{front}} \\ &= 2(5 \times 4) + 2(10 \times 4) + 2(10 \times 5) \\ &= 40 + 80 + 100 \\ &= 220 \end{aligned}$$



The surface area is 220 cm^2.

b)

$$\begin{aligned} s^2 &= 115^2 + 147^2 \\ s^2 &= 13\,225 + 21\,609 \\ s^2 &= 34\,834 \\ s &= \sqrt{34\,834} \\ s &\doteq 186.6 \end{aligned}$$

$$\begin{aligned} SA &= A_{\text{base}} + 4A_{\text{triangle}} \\ &= 230 \times 230 + 4\left(\frac{1}{2} \times 230 \times 186.6\right) \\ &= 52\,900 + 85\,836 \\ &= 138\,736 \end{aligned}$$

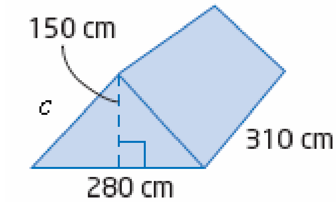
The surface area is about 138 736 m^2.

Chapter 8 Review Question 6 Page 471

a) $V = A_{base} \times h$

$= \left(\frac{1}{2} \times 280 \times 150\right) \times 310$

$= 6\,510\,000$



The volume of the tent is 6 510 000 cm^3.

b)

$c^2 = 140^2 + 150^2$

$c^2 = 19\,600 + 22\,500$

$c^2 = 42\,100$

$c = \sqrt{42\,100}$

$c \doteq 205.2$

$SA = A_{bottom} + 2A_{sides} + 2A_{front}$

$= 280 \times 310 + 2 \times 205.2 \times 310 + 2\left(\frac{1}{2} \times 280 \times 150\right)$

$= 86\,800 + 127\,224 + 42\,000$

$= 256\,024$

The amount of nylon required to make the tent is 256 024 cm^2.

c) Answers will vary. A sample answer is shown.

Assume that the side walls of the tent are flat.

d) Answers will vary. A sample answer is shown.

The answer is fairly reasonable. When erecting a tent, you want the side walls to be as flat and stretched as possible.

Chapter 8 Review Question 7 Page 471

500 mL = 500 cm^3

$V = \pi r^2 h$

$500 = \pi \times 4^2 \times h$

$500 = 16\pi h$

$\frac{500}{16\pi} = \frac{16\pi h}{16\pi}$

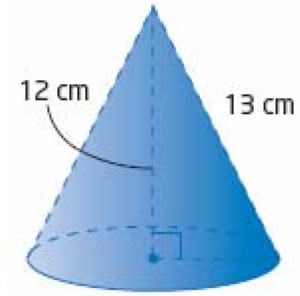
$\frac{500}{16\pi} = h$

$9.9 \doteq h$

The height of the can is 9.9 cm.

Chapter 8 Review **Question 8** **Page 471**

$$13^2 = 12^2 + r^2$$
$$169 = 144 + r^2$$
$$25 = r^2$$
$$\sqrt{25} = r$$
$$5 = r$$

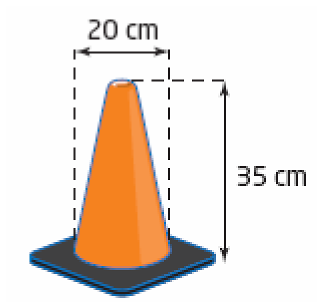


$$\begin{aligned} SA &= \pi rs + \pi r^2 \\ &= \pi \times 5 \times 13 + \pi \times 5^2 \\ &\doteq 283 \end{aligned}$$

The surface area is approximately 283 cm^2.

Chapter 8 Review **Question 9** **Page 471**

$$s^2 = 10^2 + 35^2$$
$$s^2 = 100 + 1225$$
$$s^2 = 1325$$
$$s = \sqrt{1325}$$
$$s \doteq 36.4$$



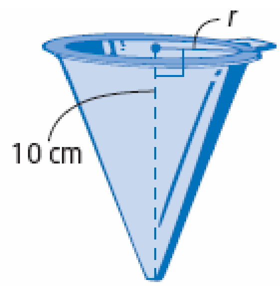
$$\begin{aligned} SA &= \pi rs + \pi r^2 \\ &= \pi \times 10 \times 36.4 + \pi \times 10^2 \\ &\doteq 1458 \end{aligned}$$

The surface area is about 1458 cm^2.

Chapter 8 Review **Question 10** **Page 471**

100 mL = 100 cm^3

$$V = \frac{1}{3}\pi r^2 h$$
$$100 = \frac{1}{3}\pi r^2 (10)$$
$$100 = \frac{10\pi}{3} r^2$$
$$\frac{3}{10\pi} \times 100 = \frac{3}{10\pi} \times \frac{10}{3}\pi r^2$$
$$\frac{300}{10\pi} = r^2$$
$$\sqrt{\frac{300}{10\pi}} = r$$
$$3.1 \doteq r$$



The radius is approximately 3.1 cm.

Chapter 8 Review **Question 11** **Page 471**

$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi \times 8^2 \times 10 \\ &\doteq 670 \end{aligned}$$

The volume of the cone is approximately 670 cm^3. The volume of the cone is $\frac{1}{3}$ of the volume of the cylinder.

Chapter 8 Review **Question 12** **Page 471**

$$\begin{aligned} SA &= 4\pi r^2 \\ &= 4\pi \times 10.9^2 \\ &\doteq 1493.0 \end{aligned}$$

The amount of leather required to cover the volleyball is approximately 1493.0 cm^2.

Chapter 8 Review **Question 13 Page 471**

a) $$\begin{aligned} SA &= \frac{1}{2}\left(4\pi r^2\right) \\ &= \frac{1}{2} \times 4\pi \times 6400^2 \\ &\doteq 257\,359\,270 \end{aligned}$$

The area of the Northern Hemisphere is approximately 257 359 270 km^2.

b) Answers will vary. A sample answer is shown.

Assume that the Earth is a sphere.

c) The fraction of the Northern Hemisphere that Canada covers is $\frac{9\,970\,610}{257\,359\,270}$, or about 0.04. This is about $\frac{1}{25}$ of the Northern Hemisphere.

Chapter 8 Review **Question 14 Page 471**

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 11.15^3 \\ &\doteq 5806.5 \end{aligned}$$

The volume of the soccer ball is approximately 5806.5 cm^3.

Chapter 8 Review **Question 15 Page 471**

a) Answers will vary. A possible estimate is 5200 cm^3.

b)
$$
\begin{aligned}
V_{\text{emptyspace}} &= V_{\text{box}} - V_{\text{ball}} \\
&= 22.3^3 - 5806.5 \\
&= 5283.07
\end{aligned}
$$

c) Answers will vary. The estimate in part a) was close to the correct answer.

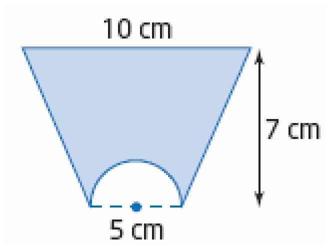
Chapter 8 Chapter Test

Chapter 8 Chapter Test Question 1 Page 472

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \times 3^3 \\ &\doteq 113 \end{aligned}$$

The volume of the sphere is approximately 113 cm^3. Answer C.

Chapter 8 Chapter Test Question 2 Page 472



$$\begin{aligned} A &= A_{\text{trapezoid}} - A_{\text{semicircle}} \\ &= \frac{1}{2} \times 7 \times (10 + 5) - \frac{1}{2}\pi \times 2.5^2 \\ &\doteq 43 \end{aligned}$$

The area of the figure is approximately 43 cm^2. Answer A.

Chapter 8 Chapter Test Question 3 Page 472

$$\begin{aligned} V &= \pi r^2 h \\ &= \pi \times 3.75^2 \times 1.4 \\ &\doteq 61.850 \end{aligned}$$

The volume of the water is approximately 61.850 m^3,
or 61 850 L. Answer A.

Chapter 8 Chapter Test Question 4 Page 472

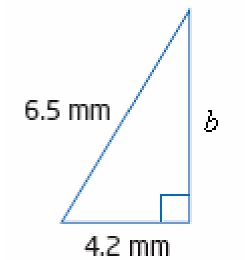
$$\begin{aligned} s^2 &= 15^2 + 15^2 \\ s^2 &= 225 + 225 \\ s^2 &= 450 \\ s &= \sqrt{450} \\ s &\doteq 21.2 \end{aligned}$$

$$\begin{aligned} Lateral\ Area &= \pi rs \\ &= \pi \times 15 \times 21.2 \\ &\doteq 999 \end{aligned}$$

The amount of plastic sheeting required is approximately 999 m^2. Answer D.

Chapter 8 Chapter Test Question 5 Page 472

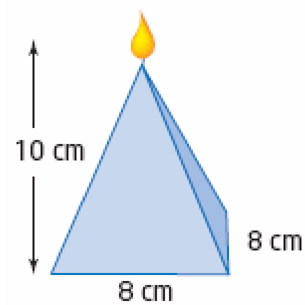
$$\begin{aligned} 6.5^2 &= 4.2^2 + b^2 \\ 42.25 &= 17.64 + b^2 \\ 24.61 &= b^2 \\ \sqrt{24.61} &= b \\ 5.0 &\doteq b \end{aligned}$$



The length of the unknown side is approximately 5.0 mm. Answer B.

Chapter 8 Chapter Test Question 6 Page 472

a) $$\begin{aligned} V &= \frac{1}{3}A_{\text{base}} \times h \\ &= \frac{1}{3} \times 8^2 \times 10 \\ &\doteq 213 \end{aligned}$$



The amount of wax required is approximately 213 cm^3.

b)

$$\begin{aligned} s^2 &= 4^2 + 10^2 \\ s^2 &= 16 + 100 \\ s^2 &= 116 \\ s &= \sqrt{116} \\ s &\doteq 10.77 \end{aligned}$$

$$\begin{aligned} SA &= A_{\text{base}} + 4A_{\text{triangle}} \\ &= 8 \times 8 + 4\left(\frac{1}{2} \times 8 \times 10.77\right) \\ &= 64 + 172.32 \\ &\doteq 236.3 \end{aligned}$$

The area of plastic wrap needed is about 236.3 cm^2, assuming no overlap.

Chapter 8 Chapter Test Question 7 Page 472

Answers will vary. A sample answer is shown.

Assume that the paper towels are stacked in three columns with two rolls in each column. Then, the dimensions of the carton would be 10 cm by 30 cm by 56 cm.

$$
\begin{aligned}
SA &= 2A_{\text{bottom}} + 2A_{\text{sides}} + 2A_{\text{front}} \\
&= 2(10 \times 30) + 2(56 \times 30) + 2(10 \times 56) \\
&= 600 + 3360 + 1120 \\
&= 5080
\end{aligned}
$$

The area of cardboard needed is 5080 cm^2.

Chapter 8 Chapter Test Question 8 Page 472

Doubling the radius of a sphere will increase the volume eight times. Doubling the radius of a cylinder will quadruple the volume.

Sphere:

$$
\begin{aligned}
V &= \frac{4}{3}\pi r^3 \\
&= \frac{4}{3}\pi \times 1^3 \\
&= \frac{4}{3}\pi
\end{aligned}
$$

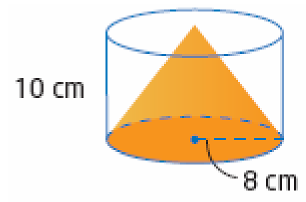
$$
\begin{aligned}
V &= \frac{4}{3}\pi r^3 \\
&= \frac{4}{3}\pi \times 2^3 \\
&= 8 \times \frac{4}{3}\pi
\end{aligned}
$$

Cylinder:

$$
\begin{aligned}
V &= \pi r^2 h \\
&= \pi \times 1^2 \times 1 \\
&= \pi
\end{aligned}
$$

$$
\begin{aligned}
V &= \pi r^2 h \\
&= \pi \times 2^2 \times 1 \\
&= 4\pi
\end{aligned}
$$

Chapter 8 Chapter Test   Question 9   Page 472

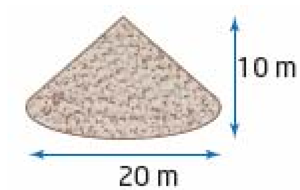


$$s^2 = 8^2 + 10^2$$
$$s^2 = 64 + 100$$
$$s^2 = 164$$
$$s = \sqrt{164}$$
$$s \doteq 12.8$$

$$\begin{aligned} SA &= \pi rs + \pi r^2 \\ &= \pi \times 8 \times 12.8 + \pi \times 8^2 \\ &\doteq 523 \end{aligned}$$

The surface area of the cone is about 523 cm^2.

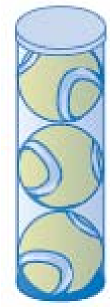
Chapter 8 Chapter Test   Question 10   Page 472



$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi \times 10^2 \times 10 \\ &\doteq 1047 \end{aligned}$$

The volume of the pile is approximately 1047 m^3.

Chapter 8 Chapter Test   Question 11 Page 473



a) $V = \pi r^2 h$

$= \pi \times 4.2^2 \times 25.2$

$\doteq 1396.5$

The volume of the can is approximately 1396.5 cm^3.

b) $SA = 2\pi r^2 + 2\pi rh$

$= 2\pi \times 4.2^2 + 2\pi \times 4.2 \times 25.2$

$\doteq 776$

The amount of aluminum required to make the can is approximately 776 cm^2.

c) $A = \pi r^2$

$= \pi \times 4.2^2$

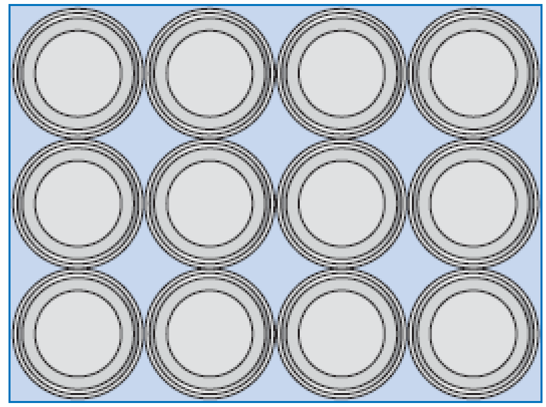
$\doteq 55$

The amount of plastic required for the lid is approximately 55 cm^2.

d) Answers will vary. A sample answer is shown.

Assume that the circular lid covers the top of the cylindrical can with no side parts.

Chapter 8 Chapter Test   Question 12   Page 473



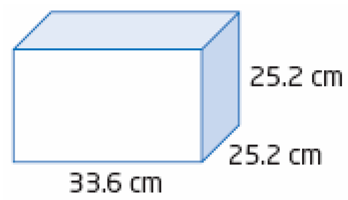
a) $V_{\text{emptyspace}} = V_{\text{can}} - V_{\text{balls}}$

$$= 1396.5 - 3\left(\frac{4}{3}\pi \times 4.2^3\right)$$

$$\doteq 465.5$$

The empty space in each can is approximately 465.5 cm^3.

b)



c) $V_{\text{emptyspace}} = V_{\text{box}} - V_{\text{cans}} + V_{\text{empty space in cans}}$

$$= 25.2 \times 25.2 \times 33.6 - 12(1396.5) + 12(465.5)$$

$$\doteq 10\,165.3$$

The total empty space is about 10 165.3 cm^3.

d) $SA = 4(33.6 \times 25.2) + 2(25.2 \times 25.2)$

$$\doteq 4657$$

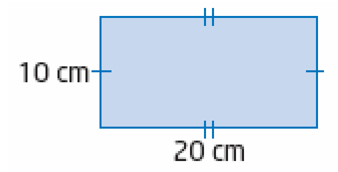
The area of cardboard needed to make the box is about 4657 cm^2.

Chapter 9 Optimizing Measurements

Chapter 9 Get Ready

Chapter 9 Get Ready Question 1 Page 476

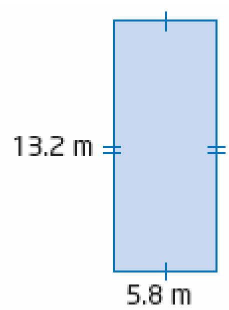
a) $P = 2w + 2l$
$= 2 \times 10 + 2 \times 20$
$= 20 + 40$
$= 60$



$A = lw$
$= 10 \times 20$
$= 200$

The perimeter is 60 cm, and the area is 200 cm^2.

b) $P = 2w + 2l$
$= 2 \times 5.8 + 2 \times 13.2$
$= 11.6 + 26.4$
$= 38$

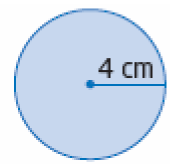


$A = lw$
$= 13.2 \times 5.8$
$= 76.56$

The perimeter is 38 m, and the area is 76.56 m^2.

Chapter 9 Get Ready **Question 2** **Page 476**

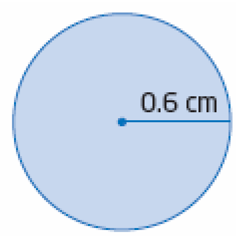
a) $$\begin{aligned} C &= 2\pi r \\ &= 2 \times \pi \times 4 \\ &\doteq 25.1 \end{aligned}$$



$$\begin{aligned} A &= \pi r^2 \\ &= \pi \times 4^2 \\ &\doteq 50.3 \end{aligned}$$

The circumference is approximately 25.1 cm, and the area is approximately 50.3 cm^2.

b) $$\begin{aligned} C &= 2\pi r \\ &= 2 \times \pi \times 0.6 \\ &\doteq 3.8 \end{aligned}$$

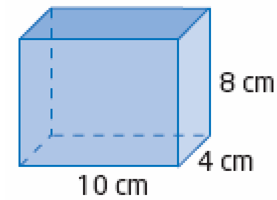


$$\begin{aligned} A &= \pi r^2 \\ &= \pi \times 0.6^2 \\ &\doteq 1.1 \end{aligned}$$

The circumference is approximately 3.8 cm, and the area is approximately 1.1 cm^2.

Chapter 9 Get Ready **Question 3** **Page 476**

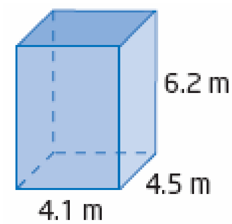
a) $$\begin{aligned} V &= lwh \\ &= 10 \times 4 \times 8 \\ &= 320 \end{aligned}$$



$$\begin{aligned} SA &= 2A_{\text{bottom}} + 2A_{\text{sides}} + 2A_{\text{front}} \\ &= 2(4 \times 10) + 2(4 \times 8) + 2(8 \times 10) \\ &= 80 + 64 + 160 \\ &= 304 \end{aligned}$$

The volume is 320 cm^3, and the surface area is 304 cm^2.

b) $$\begin{aligned} V &= lwh \\ &= 4.1 \times 4.5 \times 6.2 \\ &= 114.39 \end{aligned}$$



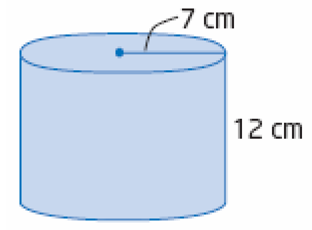
$$\begin{aligned} SA &= 2A_{\text{bottom}} + 2A_{\text{sides}} + 2A_{\text{front}} \\ &= 2(4.1 \times 4.5) + 2(4.5 \times 6.2) + 2(4.1 \times 6.2) \\ &= 36.9 + 55.8 + 50.84 \\ &= 143.54 \end{aligned}$$

The volume is 114.39 m^3, and the surface area is 143.54 m^2.

Chapter 9 Get Ready **Question 4** **Page 476**

a)

$$\begin{aligned} V &= \pi r^2 h \\ &= \pi \times 7^2 \times 12 \\ &\doteq 1847 \end{aligned}$$

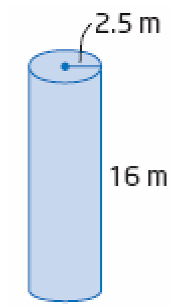


$$\begin{aligned} SA &= 2\pi r^2 + 2\pi r h \\ &= 2\pi \times 7^2 + 2\pi \times 7 \times 12 \\ &\doteq 836 \end{aligned}$$

The volume is approximately 1847 cm^3, and the surface area is approximately 836 cm^2.

b)

$$\begin{aligned} V &= \pi r^2 h \\ &= \pi \times 2.5^2 \times 16 \\ &\doteq 314 \end{aligned}$$

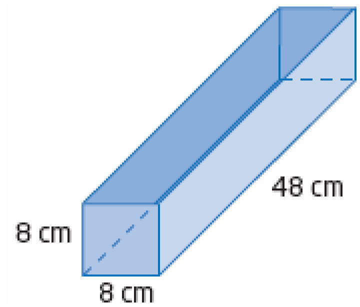


$$\begin{aligned} SA &= 2\pi r^2 + 2\pi r h \\ &= 2\pi \times 2.5^2 + 2\pi \times 2.5 \times 16 \\ &\doteq 291 \end{aligned}$$

The volume is approximately 314 m^3, and the surface area is approximately 291 m^2.

Chapter 9 Get Ready **Question 5** **Page 477**

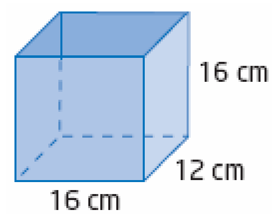
a)
$$\begin{aligned} V &= lwh \\ &= 48 \times 8 \times 8 \\ &= 3072 \end{aligned}$$



$$\begin{aligned} SA &= A_{\text{sides}} + A_{\text{bottom}} \\ &= \big(2(8 \times 48) + 2(8 \times 8)\big) + (8 \times 48) \\ &= 768 + 128 + 384 \\ &= 1280 \end{aligned}$$

The volume is 3072 cm^3, and the surface area is 1280 cm^2.

$$\begin{aligned} V &= 16 \times 12 \times 16 \\ &= 3072 \end{aligned}$$



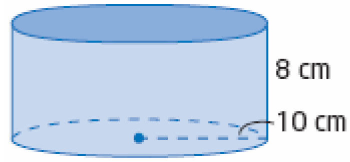
$$\begin{aligned} SA &= A_{\text{sides}} + A_{\text{bottom}} \\ &= \big(2(16 \times 16) + 2(12 \times 16)\big) + (16 \times 12) \\ &= (512 + 384) + 192 \\ &= 1088 \end{aligned}$$

The volume is 3072 cm^3, and the surface area is 1088 cm^2.

b) The volumes of the two boxes are equal.

c) The second container requires less material.

Chapter 9 Get Ready **Question 6** **Page 477**



a) $V = \pi r^2 h$

$= \pi \times 10^2 \times 8$

$\doteq 2513$

$SA = \pi r^2 + 2\pi rh$

$= \pi \times 10^2 + 2\pi \times 10 \times 8$

$\doteq 817$

The volume is approximately 2513 m^3, and the surface area is approximately 817 m^2.

$V = \pi r^2 h$

$= \pi \times 5^2 \times 32$

$\doteq 2513$

$SA = \pi r^2 + 2\pi rh$

$= \pi \times 5^2 + 2\pi \times 5 \times 32$

$\doteq 1084$

The volume is approximately 2513 m^3, and the surface area is approximately 1084 m^2.

b) The volumes of the two containers are equal.

c) The first container requires less material.

Chapter 9 Section 1: Investigate Measurement Concepts

Chapter 9 Section 1 Question 1 Page 482

a) The question asks you to investigate the dimensions of rectangles that you can form with a perimeter of 24 units.

b) Answers will vary. A sample answer is shown.

Begin with one grid square as the width and nine grid squares as the length. Then, increase the width by one square and decrease the length by the same amount to draw a series of rectangles with a perimeter of 24 units.

Rectangle	Width (units)	Length (units)	Perimeter (units)	Area (square units)
1	1	11	24	11
2	2	10	24	20
3	3	9	24	27
4	4	8	24	32
5	5	7	24	35

Chapter 9 Section 1 Question 2 Page 482

a) The question asks you to investigate the dimensions of rectangles that you can form with a perimeter of 20 units.

b) Answers will vary. A sample answer is shown.

Begin with one toothpick as the width and nine toothpicks as the length. Then, increase the width by one toothpick and decrease the length by the same amount to construct a series of rectangles with a perimeter of 20 units.

Rectangle	Width (units)	Length (units)	Perimeter (units)	Area (square units)
1	1	9	20	9
2	2	8	20	16
3	3	7	20	21
4	4	6	20	24
5	5	5	20	25

Chapter 9 Section 1 Question 3 Page 482

a) The question asks you to investigate the dimensions of various rectangles with an area of 12 square units.

b) Answers will vary. A sample answer is shown.

Let the space between two pins on the geoboard be 1 unit and use an elastic band to make different rectangles with an area of 12 square units. Start with a width of 1 unit and a length of 12 units. Then, increase the width by 1 unit and decrease the length to maintain an area of 12 square units.

Rectangle	Width (units)	Length (units)	Area (square units)	Perimeter (units)
1	1	12	12	26
2	2	6	12	16
3	3	4	12	14

Chapter 9 Section 1 Question 4 Page 483

a)

Rectangle	Width (m)	Length (m)	Perimeter (m)	Area (m^2)
1	1	16	34	16
2	2	8	20	16
3	4	4	16	16

b) The greater the perimeter, the higher the cost of the shed, since a greater length of wall is needed.

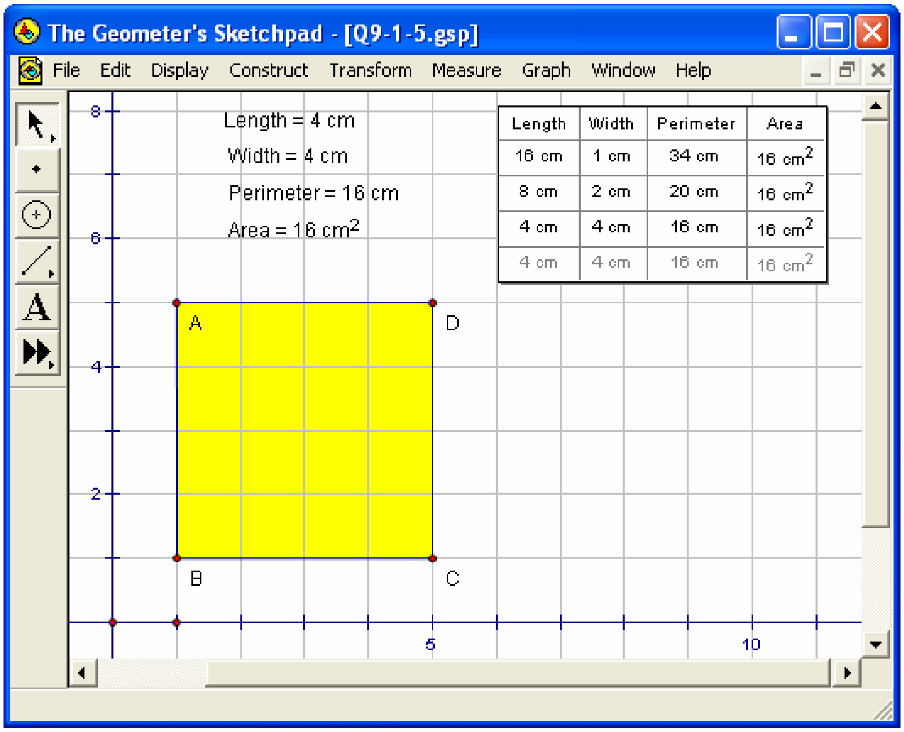
c) Rectangle 3 (a square) with dimensions 4 m by 4 m will be the most economical.

d) Answers will vary. A sample answer is shown.

You must consider the type and quality of the material used to construct the shed, and build it with attention to protecting what will be stored in it.

Chapter 9 Section 1 Question 5 Page 483

A rectangle with dimensions 4 m by 4 m encloses the greatest area for the same amount of fencing. Sketches may vary. A sample sketch is shown. Click here to load the sketch.



Chapter 9 Section 1 Question 6 Page 483

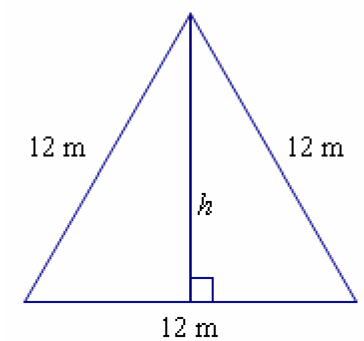
Rectangle	Width (m)	Length (m)	Perimeter (m)	Area (m^2)
1	1	15	32	15
2	2	14	32	28
3	3	13	32	39
4	4	12	32	48
5	5	11	32	55
6	6	10	32	60
7	7	9	32	63
8	8	8	32	64

The maximum area that Colin can enclose is 64 m^2, using a square 8 m by 8 m. Click here to load the spreadsheet.

Chapter 9 Section 1 **Question 7** **Page 483**

a) Regular polygons enclose the greatest area.

b) For a triangle, the greatest area is enclosed using an equilateral triangle with side length 12 m.



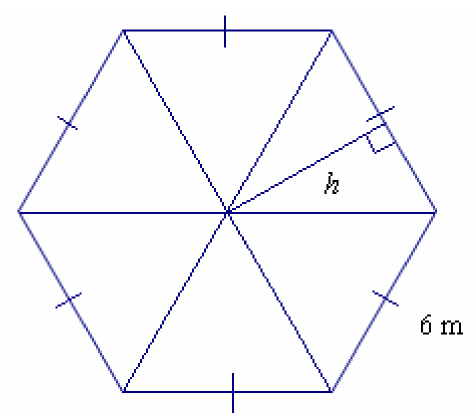
$$\begin{aligned} 12^2 &= 6^2 + h^2 \\ 144 &= 36 + h^2 \\ 108 &= h^2 \\ \sqrt{108} &= h \\ 10.39 &\doteq h \end{aligned}$$

$$\begin{aligned} A &= \frac{1}{2}bh \\ &= \frac{1}{2} \times 12 \times 10.39 \\ &= 62.35 \end{aligned}$$

The area of the triangle is about 62.35 m^2.

For a rectangle, the greatest area is enclosed by a square with side length 9 m. The area is 9×9, or 81 m^2.

For a hexagon, the greatest area is enclosed by a regular side length of 6 m.



$$\begin{aligned} 6^2 &= 3^2 + h^2 \\ 36 &= 9 + h^2 \\ 27 &= h^2 \\ \sqrt{27} &= h \\ 5.20 &\doteq h \end{aligned}$$

$$\begin{aligned} A_{\text{triangle}} &= \frac{1}{2}bh \\ &= \frac{1}{2} \times 6 \times 5.20 \\ &= 15.6 \end{aligned}$$

$$\begin{aligned} A_{\text{hexagon}} &= 6A_{\text{triangle}} \\ &= 6 \times 15.6 \\ &= 93.6 \end{aligned}$$

The area of the hexagon is about 93.6 m^2.

For a circle with a circumference of 36 m, the radius is $\frac{36}{2\pi}$, or approximately 5.73 m.

$$\begin{aligned} A &= \pi r^2 \\ &= \pi \times 5.73^2 \\ &\doteq 103.15 \end{aligned}$$

The area of the circle is about 103.15 m^2.

c) The shape of the enclosure affects its area. Different shapes result in different areas. The greatest area can be achieved by using a circle.

Chapter 9 Section 2 Perimeter and Area Relationships of a Rectangle

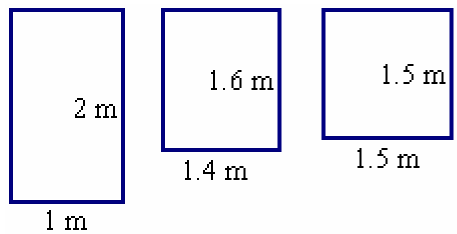
Chapter 9 Section 2 Question 1 Page 487

The maximum area occurs when a square shape is used.

a) 5 m × 5 m **b)** 9 m × 9 m **c)** 12.5 m × 12.5 m **d)** 20.75 m × 20.75 m

Chapter 9 Section 2 Question 2 Page 488

a) Answers will vary. Sample answers are shown.



b) The maximum area occurs when a square shape is used, 1.5 m by 1.5 m.

Chapter 9 Section 2 Question 3 Page 488

a) The maximum area occurs when a square shape is used, 20.5 m by 20.5 m.

b) The same area cannot be enclosed using 2 m long barriers. It is not possible to create a dimension of 20.5 m using 2 m barriers.

c)
$$\begin{aligned} A_{\text{usingrope}} &= 20.5 \times 20.5 \\ &= 420.25 \end{aligned}$$

$$\begin{aligned} A_{\text{usingbarriers}} &= 20 \times 20 \\ &= 400 \end{aligned}$$

If rope is used, you can enclose 420.25 – 400, or 20.25 m^2 more area.

Chapter 9 Section 2 Question 4 Page 488

Answers will vary. A spreadsheet solution is shown. Let the length represent the side formed by the barn. The maximum area occurs with two widths of 4 m and one length of 8 m of fencing. Click here to load the spreadsheet.

Rectangle	Width (m)	Length (m)	Sum of Lengths of Three Sides (m)	Area (m^2)
1	1	14	16	14
2	2	12	16	24
3	3	10	16	30
4	4	8	16	32
5	5	6	16	30
6	6	4	16	24
7	7	2	16	14

Chapter 9 Section 2 Question 5 Page 488

a) Use 5 pieces on a side to form sides that are 2.8 × 5, or 14 m long.

$$\begin{aligned} A &= 14^2 \\ &= 196 \end{aligned}$$

The maximum area that can be enclosed is 196 m^2.

b) Use 10 pieces on a side to form sides that are 2.8 × 10, or 28 m long.

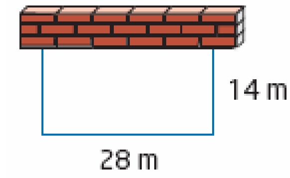
$$\begin{aligned} A &= 28^2 \\ &= 784 \end{aligned}$$

The maximum area that can be enclosed is 784 m^2.

Chapter 9 Section 2 Question 6 Page 488

From question 4, the maximum area occurs when one length is formed by the wall, and the length is twice the width.

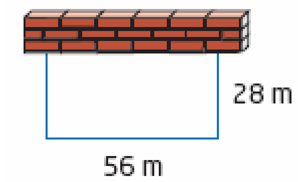
a) Since you need a length that is twice the width, use 10 pieces for the length, and 5 pieces for each width, for dimensions of 28 m by 14 m.



$$\begin{aligned} A &= 14 \times 28 \\ &= 392 \end{aligned}$$

The existing border provides 392 – 196, or 196 m^2 of additional area.

b) Since you need a length that is twice the width, use 20 pieces for the length, and 10 pieces for each width, for dimensions of 56 m by 28 m.



$$\begin{aligned} A &= 28 \times 56 \\ &= 1568 \end{aligned}$$

The existing border provides 1568 – 784, or 784 m^2 of additional area.

Chapter 9 Section 2 Question 7 Page 488

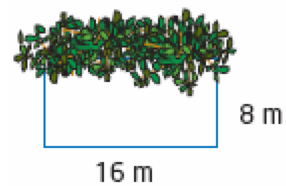
Answers will vary. A spreadsheet investigation is shown. Click here to load the spreadsheet.

Rectangle	Width (m)	Length (m)	Sum of Lengths of Two Sides (m)	Area (m^2)
1	1	39	40	39
2	2	38	40	76
3	3	37	40	111
4	4	36	40	144
5	5	35	40	175
6	6	34	40	204
7	7	33	40	231
8	8	32	40	256
9	9	31	40	279
10	10	30	40	300
11	11	29	40	319
12	12	28	40	336
13	13	27	40	351
14	14	26	40	364
15	15	25	40	375
16	16	24	40	384
17	17	23	40	391
18	18	22	40	396
19	19	21	40	399
20	20	20	40	400

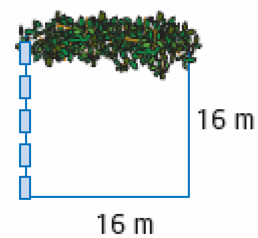
The maximum area of 400 m^2 occurs when a square area 20 m by 20 m is used.

When 4 sides are required, the maximum area occurs when a square of side length 8 m is used, resulting in an area of 8^2, or 64 m^2.

When one side is a hedge, the maximum area occurs when the hedge is used as a length, and the length is twice the width, for dimensions of 16 m by 8 m, and an area of 16 × 8, or 128 m^2.



When a hedge and a fence are used, the maximum area occurs when a square is used, for dimensions of 16 m by 16 m, and an area of 16^2, or 256 m^2. A spreadsheet investigation is shown. Click here to load the spreadsheet.



Rectangle	Width (m)	Length (m)	Sum of Lengths of Two Sides (m)	Area (m^2)
1	1	31	32	31
2	2	30	32	60
3	3	29	32	87
4	4	28	32	112
5	5	27	32	135
6	6	26	32	156
7	7	25	32	175
8	8	24	32	192
9	9	23	32	207
10	10	22	32	220
11	11	21	32	231
12	12	20	32	240
13	13	19	32	247
14	14	18	32	252
15	15	17	32	255
16	16	16	32	256

Chapter 9 Section 2 Question 9 Page 489

a)

Rectangle	Width (m)	Length (m)	Area (m^2)	Fence Used (m)
1	1	72	72	74
2	2	36	72	40
3	3	24	72	30
4	4	18	72	26
5	5	14.4	72	24.4
6	6	12	72	24

b) The minimum length of fence occurs when the building is used as one length, and the length is twice the width, for dimensions of 12 m by 6 m.

c) The minimum length of fence is 24 m.

Chapter 9 Section 2 Question 10 Page 489

Answers will vary.

Chapter 9 Section 2 Question 11 Page 489

Answers will vary. Sample answers are shown.

a) A minimum perimeter for a given area is important to know if cost of materials for enclosing the area is a factor, such as fencing in a pasture for livestock.

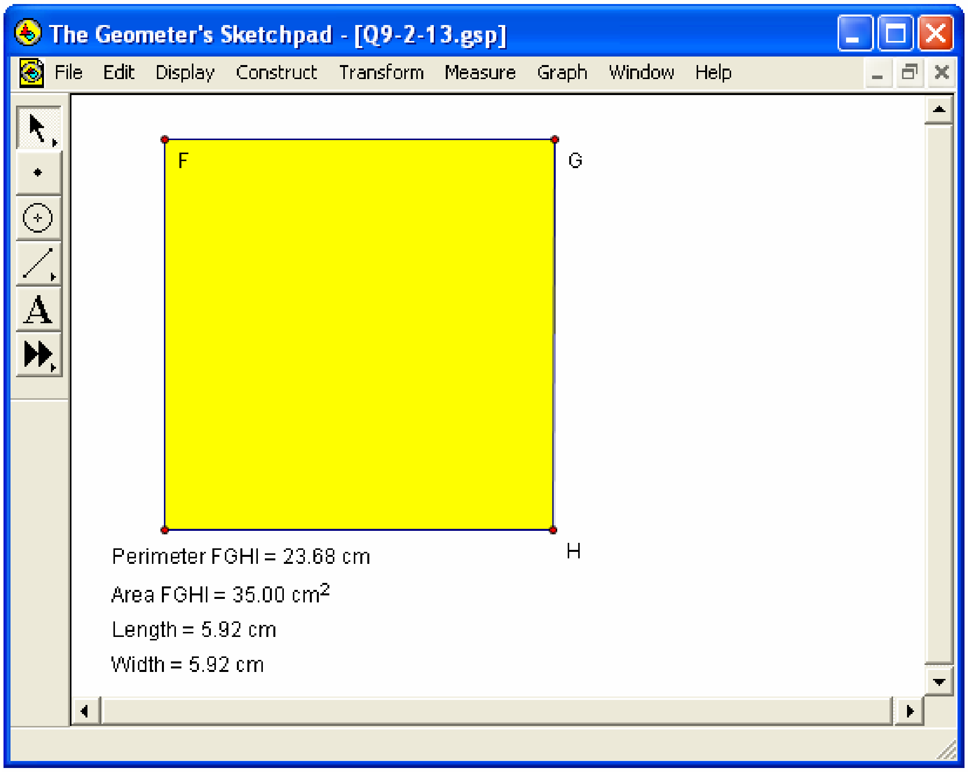
b) The maximum area for a given perimeter is important to know if space available should be maximized, such as a storage shed.

Chapter 9 Section 2 Question 12 Page 490

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 9 Section 2 Question 13 Page 490

The maximum area occurs when a square is used of side length of approximately 5.92 m. Investigations may vary. A solution using dynamic geometry software is shown. Click here to load the sketch.



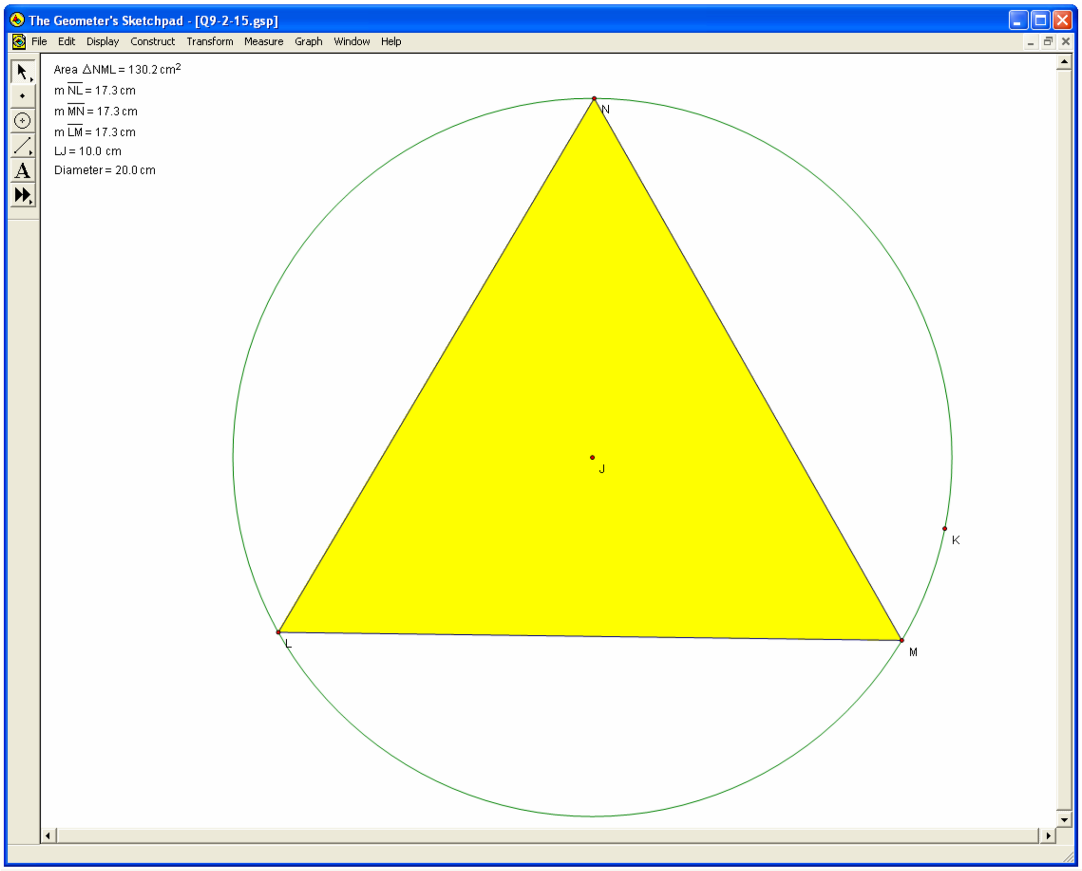
Chapter 9 Section 2 Question 14 Page 490

Answers will vary. A spreadsheet investigation is shown. The minimum perimeter is 20 m using dimensions of 5 m by 10 m. Click here to load the spreadsheet.

Rectangle	Width (m)	Length (m)	Perimeter (m)	Area (m^2)
1	1	50.0	52.0	50
2	2	25.0	29.0	50
3	3	16.7	22.7	50
4	4	12.5	20.5	50
5	5	10.0	20.0	50

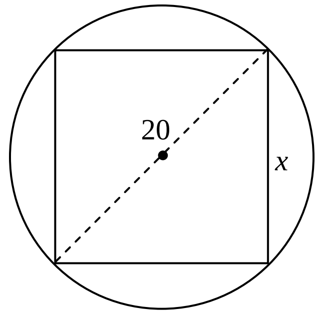
Chapter 9 Section 2 Question 15 Page 490

Answers will vary. An investigation using dynamic geometry software is shown. The maximum area occurs when an equilateral triangle of side length 17.3 cm is used. Click here to load the sketch.



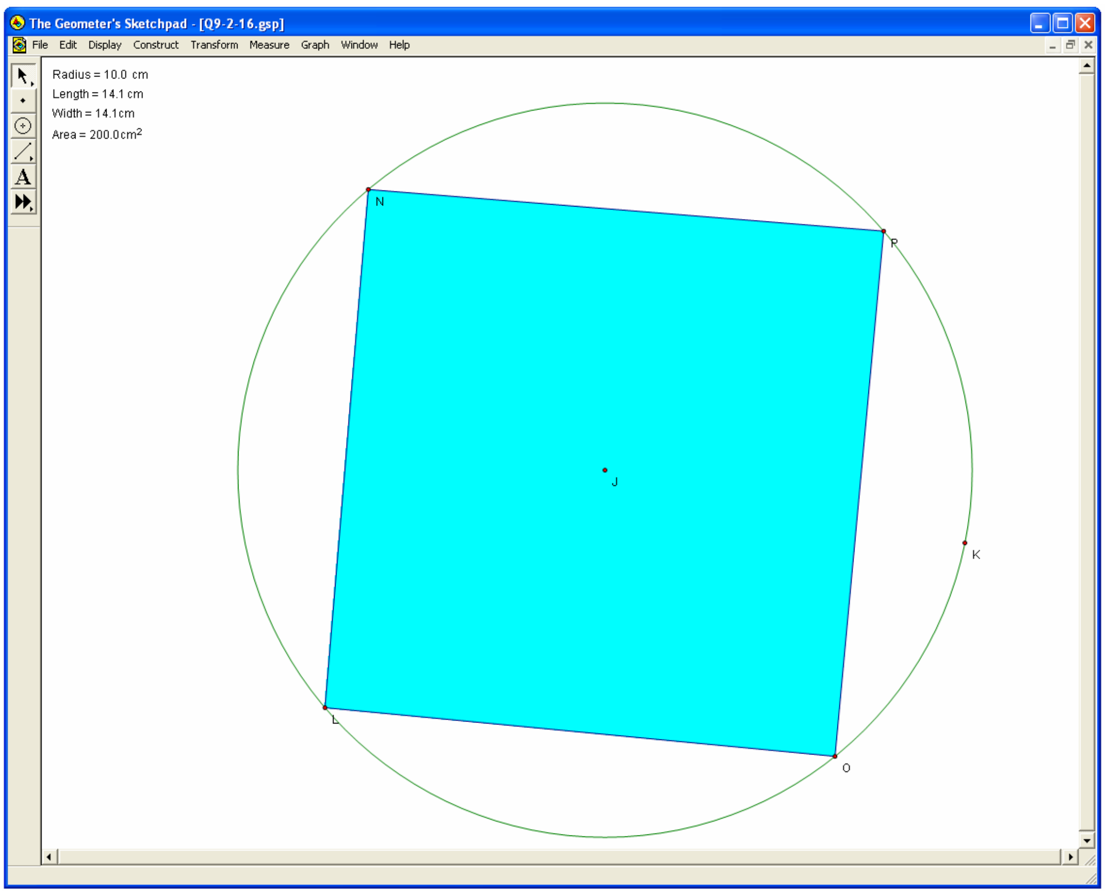
Chapter 9 Section 2 **Question 16** **Page 490**

Methods will vary. The maximum area occurs when a square is used of side length of approximately 14.1 cm.



$$x^2 + x^2 = 20^2$$
$$2x^2 = 400$$
$$\frac{2x^2}{2} = \frac{400}{2}$$
$$x^2 = 200$$
$$x = \sqrt{200}$$
$$x \doteq 14.1$$

Investigation with dynamic geometry software confirms the result. Click here to load the sketch.



Chapter 9 Section 2 Question 17 Page 490

Ranjeet is correct. If the string is used to enclose a circle, the circle will have a greater area than the square.

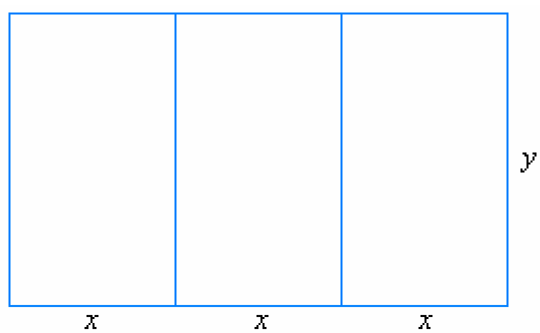
$$C = 2\pi r$$
$$24 = 2\pi r$$
$$\frac{24}{2\pi} = \frac{2\pi r}{2\pi}$$
$$3.82 \doteq r$$

$$A = \pi \times 3.82^2$$
$$\doteq 45.8$$

Chapter 9 Section 2 Question 18 Page 490

Consider the layout of the three adjoining fields shown. The total length of fence is $6x + 4y = 500$. Investigations may vary. A spreadsheet investigation is shown. Click here to load the spreadsheet.

The maximum area occurs when $x = 41.7$ m and $y = 62.45$ m.

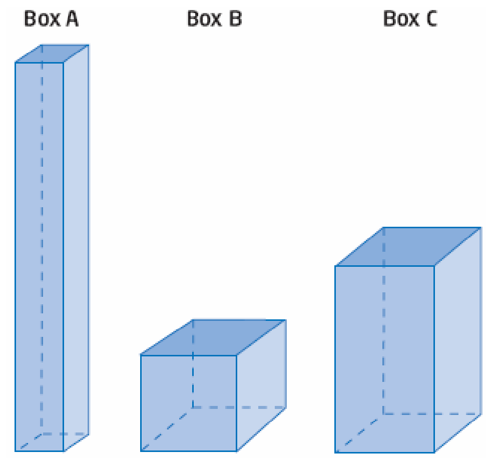


x (m)	y (m)	Fencing (m)	Area (m^2)
40.00	65.00	500.00	2600.00
40.10	64.85	500.00	2600.49
40.20	64.70	500.00	2600.94
40.30	64.55	500.00	2601.37
40.40	64.40	500.00	2601.76
40.50	64.25	500.00	2602.13
40.60	64.10	500.00	2602.46
40.70	63.95	500.00	2602.77
40.80	63.80	500.00	2603.04
40.90	63.65	500.00	2603.29
41.00	63.50	500.00	2603.50
41.10	63.35	500.00	2603.69
41.20	63.20	500.00	2603.84
41.30	63.05	500.00	2603.97
41.40	62.90	500.00	2604.06
41.50	62.75	500.00	2604.13
41.60	62.60	500.00	2604.16
41.70	62.45	500.00	2604.17
41.80	62.30	500.00	2604.14
41.90	62.15	500.00	2604.09
42.00	62.00	500.00	2604.00
42.10	61.85	500.00	2603.89
42.20	61.70	500.00	2603.74
42.30	61.55	500.00	2603.57
42.40	61.40	500.00	2603.36

Chapter 9 Section 3 Minimize the Surface Area of a Square-Based Prism

Chapter 9 Section 3 Question 1 Page 495

From least to greatest surface area the prisms are ranked B, C, and A. The cubic shape has the least surface area. The thinnest shape has the greatest surface area.



Chapter 9 Section 3 Question 2 Page 495

a)

$$\begin{aligned} V &= s^3 \\ 512 &= s^3 \\ \sqrt[3]{512} &= \sqrt[3]{s^3} \\ \sqrt[3]{512} &= s \\ 8 &= s \end{aligned}$$

The square-based prism with the least surface area is a cube with a side length of 8 cm.

b)

$$\begin{aligned} V &= s^3 \\ 1000 &= s^3 \\ \sqrt[3]{1000} &= \sqrt[3]{s^3} \\ \sqrt[3]{1000} &= s \\ 10 &= s \end{aligned}$$

The square-based prism with the least surface area is a cube with a side length of 10 cm.

c)

$$\begin{aligned} V &= s^3 \\ 750 &= s^3 \\ \sqrt[3]{750} &= \sqrt[3]{s^3} \\ \sqrt[3]{750} &= s \\ 9.1 &\doteq s \end{aligned}$$

The square-based prism with the least surface area is a cube with a side length of 9.1 cm.

d)

$$\begin{aligned} V &= s^3 \\ 1200 &= s^3 \\ \sqrt[3]{1200} &= \sqrt[3]{s^3} \\ \sqrt[3]{1200} &= s \\ 10.6 &\doteq s \end{aligned}$$

The square-based prism with the least surface area is a cube with a side length of 10.6 cm.

Chapter 9 Section 3 Question 3 Page 495

a)

$$\begin{aligned} SA &= 6s^2 \\ &= 6 \times 8^2 \\ &= 384 \end{aligned}$$

The surface area of the prism is 384 cm^2.

b)

$$\begin{aligned} SA &= 6s^2 \\ &= 6 \times 10^2 \\ &= 600 \end{aligned}$$

The surface area of the prism is 600 cm^2.

c)

$$\begin{aligned} SA &= 6s^2 \\ &= 6 \times 9.1^2 \\ &\doteq 497 \end{aligned}$$

The surface area of the prism is about 497 cm^2.

d)

$$\begin{aligned} SA &= 6s^2 \\ &= 6 \times 10.6^2 \\ &\doteq 674 \end{aligned}$$

The surface area of the prism is about 674 cm^2.

Chapter 9 Section 3 Question 4 Page 495

$$\begin{aligned} V &= s^3 \\ 3200 &= s^3 \\ \sqrt[3]{3200} &= s \\ 14.7 &\doteq s \end{aligned}$$

The square-based prism with the least surface area is a cube with a side length of about 14.7 cm.

Chapter 9 Section 3 Question 5 Page 496

a)
$$\begin{aligned} V &= s^3 \\ 4000 &= s^3 \\ \sqrt[3]{4000} &= s \\ 15.9 &\doteq s \end{aligned}$$

The box with the least surface area is a cube with a side length of about 15.9 cm.

b) Answers will vary. Sample answers are shown.

A square-based prism is difficult to pick up with one hand to pour the laundry soap. Manufacturers may also want a large front on the box to display the company logo and brand name.

Chapter 9 Section 3 Question 6 Page 496

a)
$$\begin{aligned} V &= s^3 \\ 750 &= s^3 \\ \sqrt[3]{750} &= s \\ 9.09 &\doteq s \end{aligned}$$

The box with the least surface area is a cube with a side length of 9.09 cm.

b)
$$\begin{aligned} SA &= 6s^2 \\ &= 6 \times 9.09^2 \\ &\doteq 495.8 \end{aligned}$$

The minimum area of cardboard required is about 495.8 cm^2.

Chapter 9 Section 3 Question 7 Page 496

2.5 L = 2500 cm^3

$$\begin{aligned} V &= s^3 \\ 2500 &= s^3 \\ \sqrt[3]{2500} &= s \\ 13.6 &\doteq s \end{aligned}$$

$$\begin{aligned} SA &= 6s^2 \\ &= 6 \times 13.6^2 \\ &\doteq 1110 \end{aligned}$$

The minimum area of cardboard required is about 1110 cm^2.

Chapter 9 Section 3 Question 8 Page 496

a) A spreadsheet solution is shown. The prism has a base length of 17.1 cm and a height of 8.5 cm, for a volume of 2500 cm^3, and a minimum surface area. Click here to load the spreadsheet.

Base (cm)	Height (cm)	Volume (cm^3)	Surface Area (cm^2)
16.0	9.8	2500.0	881.0
16.1	9.6	2500.0	880.3
16.2	9.5	2500.0	879.7
16.3	9.4	2500.0	879.2
16.4	9.3	2500.0	878.7
16.5	9.2	2500.0	878.3
16.6	9.1	2500.0	878.0
16.7	9.0	2500.0	877.7
16.8	8.9	2500.0	877.5
16.9	8.8	2500.0	877.3
17.0	8.7	2500.0	877.2
17.1	8.5	2500.0	877.2
17.2	8.5	2500.0	877.2
17.3	8.4	2500.0	877.3
17.4	8.3	2500.0	877.5

b) The dimensions are different from the box in question 7.

c) The lidless box requires less material.

Chapter 9 Section 3 Question 9 Page 496

a) 200mL = 200 cm^3

$$\begin{aligned} V &= s^3 \\ 200 &= s^3 \\ \sqrt[3]{200} &= s \\ 5.8 &\doteq s \end{aligned}$$

The box with a minimum surface area is a cube with a side length of 5.8 cm.

b) Answers will vary. A sample answer is shown.

Cubical boxes are harder to hold, and the cube would be very small.

c) Answers will vary.

Chapter 9 Section 3 Question 10 Page 497

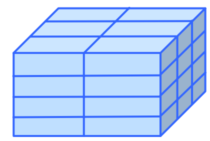
Answers will vary.

Chapter 9 Section 3 Question 11 Page 497

You cannot make a cube with an integral side length using all 100 cubes. Find dimensions that are as close to a cube as possible, such as $5 \times 5 \times 4$.

Chapter 9 Section 3 Question 12 Page 497

a) Pack the boxes as shown.



b) This is the closest that 24 boxes can be stacked to form a cube, which provides the minimum surface area.

c) Answers will vary. A sample answer is shown.

Packing 24 boxes per carton is not the most economical use of cardboard. A cube can be created to package 6 tissue boxes: length 1 box (1 × 24 cm), width 2 boxes (2 × 12 cm), and height 3 boxes (3 × 8 cm).

Chapter 9 Section 3 Question 13 Page 497

A spreadsheet solution is shown. The warehouse should be built with a base length of 12.6 m and a height of 6.3 m for a volume of 1000 m^3 and a surface area of 476.22 m^2. Click here to load the spreadsheet.

Base (m)	Height (m)	Volume (m^3)	Surface Area (m^2)
12.0	6.9	1000.0	477.33
12.1	6.8	1000.0	476.99
12.2	6.7	1000.0	476.71
12.3	6.6	1000.0	476.49
12.4	6.5	1000.0	476.34
12.5	6.4	1000.0	476.25
12.6	6.3	1000.0	476.22
12.7	6.2	1000.0	476.25
12.8	6.1	1000.0	476.34

Chapter 9 Section 3 Question 14 Page 497

$$\begin{aligned} V &= s^3 \\ 216\,000 &= s^3 \\ \sqrt[3]{216\,000} &= s \\ 60 &= s \end{aligned}$$

$$\begin{aligned} SA &= 6s^2 \\ &= 6 \times 60^2 \\ &= 21\,600 \end{aligned}$$

The least amount of cardboard required is 21 600 × 1.10, or 23 760 cm^2.

Chapter 9 Section 3 Question 15 Page 497

$$\begin{aligned} V &= s^3 \\ 2700 &= s^3 \\ \sqrt[3]{2700} &= s \\ 13.92 &\doteq s \end{aligned}$$

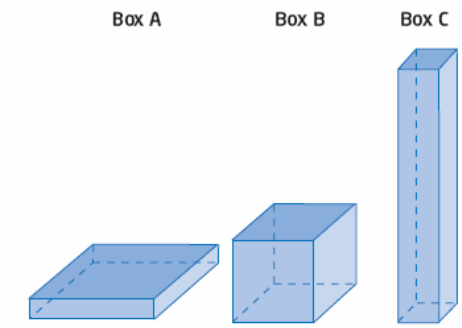
$$\begin{aligned} SA &= 6s^2 \\ &= 6 \times 13.92^2 \\ &\doteq 1162.6 \end{aligned}$$

The length of a side is 13.92 cm. Each flap has a base and a height of $\frac{1}{3} \times 13.92$, or 4.64 cm. The area of flaps needed is $4 \times \frac{1}{2} \times 4.64^2$, or about 43.1 cm^2. The total area of cardboard required for a box is 1162.6 + 43.1, or 1205.7 cm^2.

Chapter 9 Section 4 Maximize the Volume of a Square-Based Prism

Chapter 9 Section 4 Question 1 Page 501

The prisms in order of volume from greatest to least are B, C, and A.



Chapter 9 Section 4 Question 2 Page 502

a)

$$\begin{aligned} SA &= 6s^2 \\ 150 &= 6s^2 \\ \frac{150}{6} &= \frac{6s^2}{6} \\ 25 &= s^2 \\ \sqrt{25} &= s \\ 5 &= s \end{aligned}$$

The square-based prism with the maximum volume is a cube with a side length of 5 cm.

b)

$$\begin{aligned} SA &= 6s^2 \\ 2400 &= 6s^2 \\ \frac{2400}{6} &= \frac{6s^2}{6} \\ 400 &= s^2 \\ \sqrt{400} &= s \\ 20 &= s \end{aligned}$$

The square-based prism with the maximum volume is a cube with a side length of 20 m.

c)

$$\begin{aligned} SA &= 6s^2 \\ 750 &= 6s^2 \\ \frac{750}{6} &= \frac{6s^2}{6} \\ 125 &= s^2 \\ \sqrt{125} &= s \\ 11.2 &\doteq s \end{aligned}$$

The square-based prism with the maximum volume is a cube with a side length of about 11.2 cm.

d)
$$\begin{aligned} SA &= 6s^2 \\ 1200 &= 6s^2 \\ \frac{1200}{6} &= \frac{6s^2}{6} \\ 200 &= s^2 \\ \sqrt{200} &= s \\ 14.1 &\doteq s \end{aligned}$$

The square-based prism with the maximum volume is a cube with a side length of about 14.1 m.

Chapter 9 Section 4 Question 3 Page 502

a)
$$\begin{aligned} V &= s^3 \\ &= 5^3 \\ &= 125 \end{aligned}$$

The volume is 125 cm^3.

b)
$$\begin{aligned} V &= s^3 \\ &= 20^3 \\ &= 8000 \end{aligned}$$

The volume is 8000 m^3.

c)
$$\begin{aligned} V &= s^3 \\ &= 11.2^3 \\ &= 1405 \end{aligned}$$

The volume is about 1405 cm^3.

d)
$$\begin{aligned} V &= s^3 \\ &= 14.1^3 \\ &\doteq 2803 \end{aligned}$$

The volume is about 2803 m^3.

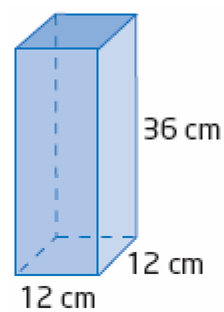
Chapter 9 Section 4 Question 4 Page 502

A spreadsheet solution is shown. The maximum volume occurs with a cube of side length 10.8 cm, for a volume of 1260.1 cm^3. Click here to load the spreadsheet.

Base (cm)	Height (cm)	Volume (cm^3)	Surface Area (cm^2)
10.0	12.5	1250.0	700.0
10.1	12.3	1252.3	700.0
10.2	12.1	1254.4	700.0
10.3	11.8	1256.1	700.0
10.4	11.6	1257.6	700.0
10.5	11.4	1258.7	700.0
10.6	11.2	1259.5	700.0
10.7	11.0	1260.0	700.0
10.8	10.8	1260.1	700.0
10.9	10.6	1260.0	700.0
11.0	10.4	1259.5	700.0

Chapter 9 Section 4 Question 5 Page 502

a)
$$\begin{aligned} SA &= 4A_{\text{side}} + 2A_{\text{bottom}} \\ &= 4(12 \times 36) + 2(12 \times 12) \\ &= 1728 + 288 \\ &= 2016 \end{aligned}$$



$$\begin{aligned} V &= lwh \\ &= 12 \times 12 \times 36 \\ &= 5184 \end{aligned}$$

The surface area is 2016 cm^2, and the volume is 5184 cm^3.

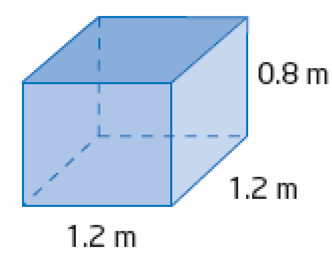
b)
$$\begin{aligned} SA &= 6s^2 \\ 2016 &= 6s^2 \\ \frac{2016}{6} &= \frac{6s^2}{6} \\ 336 &= s^2 \\ \sqrt{336} &= s \\ 18.3 &\doteq s \end{aligned}$$

The box with maximum volume is a cube with a side length of 18.3 cm.

c)
$$\begin{aligned} V &= s^3 \\ &= 18.3^3 \\ &\doteq 6128 \end{aligned}$$

The volume of the box in part b) is about 6128 cm^3, which is greater than the volume of the box in part a).

Chapter 9 Section 4 Question 6 Page 502



a) $SA = 4A_{side} + 2A_{bottom}$

$= 4(1.2 \times 0.8) + 2(1.2 \times 1.2)$

$= 3.84 + 2.88$

$= 6.72$

$V = lwh$

$= 1.2 \times 1.2 \times 0.8$

$= 1.152$

The surface area is 6.72 m^2, and the volume is 1.152 m^3.

b) $SA = 6s^2$

$6.72 = 6s^2$

$\frac{6.72}{6} = \frac{6s^2}{6}$

$1.12 = s^2$

$\sqrt{1.12} = s$

$1.1 \doteq s$

The box with maximum volume is a cube with a side length of 1.1 m.

c) $V = s^3$

$= 1.1^3$

$= 1.331$

The volume of the box in part b) is 1.331 m^3, which is greater than the volume of the box in part a).

Chapter 9 Section 4 Question 7 Page 502

a) $SA = 6s^2$

$12 = 6s^2$

$\frac{12}{6} = \frac{6s^2}{6}$

$2 = s^2$

$\sqrt{2} = s$

$1.4 \doteq s$

The box with maximum volume is a cube with a side length of 1.4 m.

b) $V = s^3$

$= 1.4^3$

$\doteq 3$

The volume of the box is about 3 m^3.

Chapter 9 Section 4 Question 8 Page 503

a)

$$
\begin{aligned}
SA &= 6s^2 \\
2500 &= 6s^2 \\
\frac{2500}{6} &= \frac{6s^2}{6} \\
\frac{1250}{3} &= s^2 \\
\sqrt{\frac{1250}{3}} &= s \\
20.4 &\doteq s
\end{aligned}
$$

The box with maximum volume is a cube with a side length of 20.4 cm.

b) $V = s^3$

$= 20.4^3$

$\doteq 8490$

The volume of the box is about 8490 cm^3.

c) $\text{Empty Space} = V_{\text{box}} - V_{\text{drive}}$

$= 8490 - 14 \times 20 \times 2.5$

$= 7790$

The volume of empty space is 7790 cm^3.

d) Answers will vary. A sample answer is shown.

Assume that there is no empty space in the box. The DVD would fit into the cube with enough room around the edges for the shredded paper. The shredded paper is tightly packed.

Chapter 9 Section 4 Question 9 Page 503

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 9 Section 4 **Question 10** **Page 503**

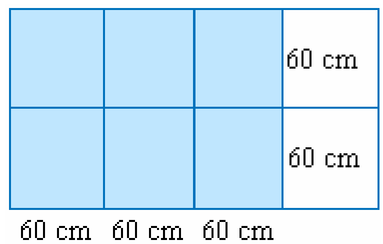
a) Dylan has 120 × 240, or 28 800 cm^2 of plywood available.

$$\begin{aligned}
SA &= 6s^2 \\
28\,800 &= 6s^2 \\
\frac{28\,800}{6} &= \frac{6s^2}{6} \\
4800 &= s^2 \\
\sqrt{4800} &= s \\
69.3 &\doteq s
\end{aligned}$$

Ideally, Dylan needs a cube with a side length 69.3 cm.

b) Diagrams will vary. A sample answer is shown.

Dylan needs 6 pieces of wood measuring 69.3 cm by 69.3 cm. These cannot be cut from a piece of wood measuring 120 cm by 240 cm. Dylan's closest option is to cut 6 pieces measuring 60 cm by 60 cm, as shown.

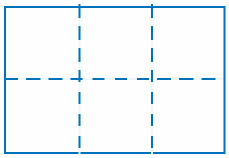


c) Answers will vary. A sample answer is shown.

Assume that Dylan does not want to cut some of the wasted wood, and glue it onto his pieces to make bigger pieces. Assume that the saw cuts are negligible.

Chapter 9 Section 4 **Question 11** **Page 503**

a)



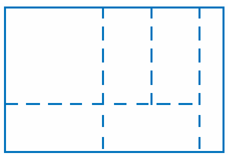
b) $V = s^3$

$= 10^3$

$= 1000$

The volume of the box is 1000 cm^3.

c)



d) Assume that the height is half the base length. From the diagram, the base length will be $\frac{2}{3} \times 20$, or 13.3 cm, and the height will be 6.7 cm.

$$\begin{aligned} V &= lwh \\ &= 13.3 \times 13.3 \times 6.7 \\ &\doteq 1185.2 \end{aligned}$$

The volume of the box is about 1185.2 cm^3.

e) Answers will vary. A sample answer is shown.

Assume that the cuts waste a negligible amount of glass.

Chapter 9 Section 5 Maximize the Volume of a Cylinder

Chapter 9 Section 5 Question 1 Page 508

a)

$$SA = 6\pi r^2$$
$$1200 = 6\pi r^2$$
$$\frac{\overset{200}{\cancel{1200}}}{\underset{1}{\cancel{6}}\pi} = \frac{\overset{1}{\cancel{6\pi}} r^2}{\underset{1}{\cancel{6\pi}}}$$
$$\frac{200}{\pi} = r^2$$
$$\sqrt{\frac{200}{\pi}} = r$$
$$7.98 \doteq r$$

$$h = 2 \times 7.98$$
$$= 15.96$$

The radius of the cylinder is 7.98 cm, and the height is 15.96 cm.

b)

$$SA = 6\pi r^2$$
$$10 = 6\pi r^2$$
$$\frac{\overset{5}{\cancel{10}}}{\underset{3}{\cancel{6}}\pi} = \frac{\overset{1}{\cancel{6\pi}} r^2}{\underset{1}{\cancel{6\pi}}}$$
$$\frac{5}{3\pi} = r^2$$
$$\sqrt{\frac{5}{3\pi}} = r$$
$$0.73 \doteq r$$

$$h = 2 \times 0.73$$
$$= 1.46$$

The radius of the cylinder is 0.73 m, and the height is 1.46 m.

c)

$$\begin{aligned}
SA &= 6\pi r^2 \\
125 &= 6\pi r^2 \\
\frac{125}{6\pi} &= \frac{6\pi r^2}{6\pi} \\
\frac{125}{6\pi} &= r^2 \\
\sqrt{\frac{125}{6\pi}} &= r \\
2.58 &\doteq r
\end{aligned}$$

$$\begin{aligned}
h &= 2 \times 2.58 \\
&= 5.16
\end{aligned}$$

The radius of the cylinder is 2.58 cm, and the height is 5.16 cm.

d)

$$\begin{aligned}
SA &= 6\pi r^2 \\
6400 &= 6\pi r^2 \\
\frac{\overset{3200}{\cancel{6400}}}{\underset{3}{\cancel{6}}\,\pi} &= \frac{\overset{1}{\cancel{6\pi}}\, r^2}{\underset{1}{\cancel{6\pi}}} \\
\frac{3200}{3\pi} &= r^2 \\
\sqrt{\frac{3200}{3\pi}} &= r \\
18.43 &\doteq r
\end{aligned}$$

$$\begin{aligned}
h &= 2 \times 18.43 \\
&= 36.86
\end{aligned}$$

The radius of the cylinder is 18.43 mm, and the height is 36.86 mm.

Chapter 9 Section 5 **Question 2** **Page 508**

a) $V = \pi r^2 h$
$$= \pi \times 7.98^2 \times 15.96$$
$$\doteq 3193$$

The volume of the cylinder is about 3193 cm^3.

b) $V = \pi r^2 h$
$$= \pi \times 0.73^2 \times 1.46$$
$$\doteq 2$$

The volume of the cylinder is about 2 m^3.

c) $V = \pi r^2 h$
$$= \pi \times 2.58^2 \times 5.16$$
$$\doteq 108$$

The volume of the cylinder is about 108 cm^3.

d) $V = \pi r^2 h$
$$= \pi \times 18.43^2 \times 36.86$$
$$\doteq 39\,333$$

The volume of the cylinder is about 39 333 cm^3.

Chapter 9 Section 5 Question 3 Page 508

$$
\begin{aligned}
SA &= 6\pi r^2 \\
8 &= 6\pi r^2 \\
\frac{\overset{4}{\cancel{8}}}{\underset{3}{\cancel{6}}\pi} &= \frac{\overset{1}{\cancel{6\pi}}r^2}{\underset{1}{\cancel{6\pi}}} \\
\frac{4}{3\pi} &= r^2 \\
\sqrt{\frac{4}{3\pi}} &= r \\
0.65 &\doteq r
\end{aligned}
$$

$$
\begin{aligned}
h &= 2 \times 0.65 \\
&= 1.3
\end{aligned}
$$

$$
\begin{aligned}
V &= \pi r^2 h \\
&= \pi \times 0.65^2 \times 1.3 \\
&\doteq 2
\end{aligned}
$$

The volume of fuel that the tank can hold is about 2 m^3.

Chapter 9 Section 5 **Question 4** **Page 508**

a)

$$SA = 6\pi r^2$$
$$72 = 6\pi r^2$$
$$\frac{\cancelto{12}{72}}{\cancelto{1}{6}\pi} = \frac{\cancelto{1}{6\pi} r^2}{\cancelto{1}{6\pi}}$$
$$\frac{12}{\pi} = r^2$$
$$\sqrt{\frac{12}{\pi}} = r$$
$$2.0 \doteq r$$

$$\begin{aligned} h &= 2 \times 2.0 \\ &= 4.0 \end{aligned}$$

The radius of the cylinder is 2.0 m, and the height is 4.0 m.

b) $$\begin{aligned} V &= \pi r^2 h \\ &= \pi \times 2.0^2 \times 4.0 \\ &\doteq 50.265 \end{aligned}$$

The volume is about 50.265 m^3, or 50 265 L.

c) Answers will vary. A sample answer is shown.

Assume that no metal will be wasted in the building process, and that no metal is being overlapped.

Chapter 9 Section 5 **Question 5** **Page 509**

a) The height of the optimal cylinder is 12 cm.

b) The cylinder will hold $\frac{12}{0.2}$, or 60 CDs.

c) Answers will vary. A sample answer is shown.

Assume that only the dimensions of the CDs need to be considered, that no extra space is left for the container's closing mechanism, and that the plastic container has negligible thickness.

Chapter 9 Section 5 **Question 6** **Page 509**

a) Answers will vary. A sample answer is shown.

Adjust the surface area formula for the new cylinder, isolate the height and run a few trials using a spreadsheet to find the maximum volume.

b)

$$SA = \pi r^2 + 2\pi rh$$
$$SA - \pi r^2 = 2\pi rh$$
$$\frac{SA - \pi r^2}{2\pi r} = \frac{2\pi rh}{2\pi r}$$
$$\frac{SA - \pi r^2}{2\pi r} = h$$

The radius and height are both 7.3 cm, for a volume of 1213.9 cm^3. Click here to load the spreadsheet.

Radius (cm)	Height (cm)	Volume (cm^3)	Surface Area (cm^2)
7.0	7.9	1211.2	500.0
7.1	7.7	1212.8	500.0
7.2	7.5	1213.7	500.0
7.3	7.3	1213.9	500.0
7.4	7.1	1213.5	500.0
7.5	6.9	1212.3	500.0
7.6	6.7	1210.5	500.0
7.7	6.5	1207.9	500.0
7.8	6.3	1204.6	500.0
7.9	6.1	1200.5	500.0

Chapter 9 Section 5 Question 7 Page 509

a) Answers will vary. A possible answer is that a cylinder will have the greatest volume.

b)

$$\begin{aligned} SA_{\text{cylinder}} &= 6\pi r^2 \\ 2400 &= 6\pi r^2 \\ \frac{2400}{6\pi} &= \frac{6\pi r^2}{6\pi} \\ \frac{400}{\pi} &= r^2 \\ \sqrt{\frac{400}{\pi}} &= r \\ 11.28 &\doteq r \end{aligned}$$

$$\begin{aligned} SA_{\text{prism}} &= 6s^2 \\ 2400 &= 6s^2 \\ \frac{2400}{6} &= \frac{6s^2}{6} \\ 400 &= s \\ \sqrt{400} &= s \\ 20 &= s \end{aligned}$$

$$\begin{aligned} h &= 2 \times 11.28 \\ &= 22.56 \end{aligned}$$

$$\begin{aligned} V_{\text{prism}} &= s^3 \\ &= 20^3 \\ &= 8000 \end{aligned}$$

$$\begin{aligned} V_{\text{cylinder}} &= \pi r^2 h \\ &= \pi \times 11.28^2 \times 22.56 \\ &\doteq 9018 \end{aligned}$$

The cylinder has a volume of about 9018 cm^2, while the square-based prism has a volume of 8000 cm^2.

Chapter 9 Section 5 Question 8 Page 509

a) Answers will vary. A possible answer is that the sphere will produce the greatest volume.

b)

$$\begin{aligned} SA_{\text{sphere}} &= 4\pi r^2 \\ 2000 &= 4\pi r^2 \\ \frac{2000}{4\pi} &= \frac{4\pi r^2}{4\pi} \\ \frac{500}{\pi} &= r^2 \\ \sqrt{\frac{500}{\pi}} &= r \\ 12.62 &\doteq r \end{aligned}$$

The sphere has a radius of 12.62 cm.

$$\begin{aligned} SA_{\text{cylinder}} &= 6\pi r^2 \\ 2000 &= 6\pi r^2 \\ \frac{2000}{6\pi} &= \frac{6\pi r^2}{6\pi} \\ \frac{1000}{3\pi} &= r^2 \\ \sqrt{\frac{1000}{3\pi}} &= r \\ 10.30 &\doteq r \end{aligned}$$

$$\begin{aligned} h &= 2 \times 10.30 \\ &= 20.60 \end{aligned}$$

The cylinder has a radius of 10.30 cm and a height of 20.60 cm.

$$\begin{aligned} SA_{\text{cube}} &= 6s^2 \\ 2000 &= 6s^2 \\ \frac{2000}{6} &= \frac{6s^2}{6} \\ \frac{1000}{3} &= s^2 \\ \sqrt{\frac{1000}{3}} &= s \\ 18.26 &\doteq s \end{aligned}$$

The square-based prism has a side length of 18.26 cm.

c) $$V_{\text{sphere}} = \frac{4}{3}\pi r^3$$
$$= \frac{4}{3}\pi \times 12.62^3$$
$$\doteq 8419.1$$

The sphere has a volume of about 8419.1 cm^3.

$$V_{\text{cylinder}} = \pi r^2 h$$
$$= \pi \times 10.30^2 \times 20.60$$
$$\doteq 6865.8$$

The cylinder has a volume of about 6865.8 cm^3.

$$V_{\text{cube}} = s^3$$
$$= 18.26^3$$
$$\doteq 6088.4$$

The square-based prism has a volume of about 6088.4 cm^3.

d) The sphere has the greatest volume. This will always be the case.

e) For a given surface area, volume of a sphere > volume of a cylinder > volume of a square-based prism.

Chapter 9 Section 5 Question 9 Page 509

You have 2 m^2 of metal to work with.

a) For a cylinder with a top and a bottom, the maximum volume occurs for a radius of 0.33 cm and a height of 0.63 cm. Click here to load the spreadsheet.

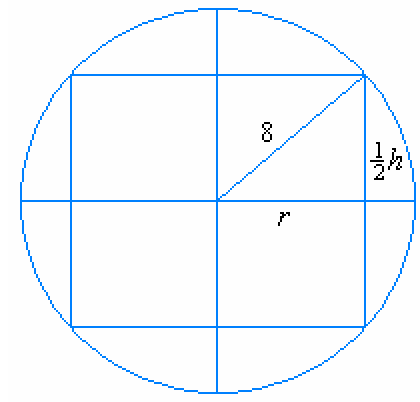
Radius (m)	Height (m)	Volume (m^3)	Surface Area (m^2)
0.30	0.76	0.21518	2
0.31	0.72	0.21641	2
0.32	0.67	0.21706	2
0.33	0.63	0.21710	2
0.34	0.60	0.21652	2
0.35	0.56	0.21530	2
0.36	0.52	0.21343	2
0.37	0.49	0.21087	2
0.38	0.46	0.20761	2
0.39	0.43	0.20364	2

b) For a cylinder with no top, the maximum volume occurs with a radius and height of 0.46 m. Click here to load the spreadsheet.

Radius (m)	Height (m)	Volume (m^3)	Surface Area (m^2)
0.38	0.65	0.2938	2
0.39	0.62	0.2968	2
0.40	0.60	0.2995	2
0.41	0.57	0.3017	2
0.42	0.55	0.3036	2
0.43	0.53	0.3051	2
0.44	0.50	0.3062	2
0.45	0.48	0.3069	2
0.46	0.46	0.3071	2
0.47	0.44	0.3069	2
0.48	0.18	0.1326	2
0.49	0.16	0.1204	2
0.50	0.14	0.1073	2

Chapter 9 Section 5 Question 10 Page 509

Methods may vary. A solution using a spreadsheet, and another using dynamic geometry software are shown. The volume is maximized at 1238.22 cm^3 for a radius of 6.53 cm and a height of 9.24 cm.

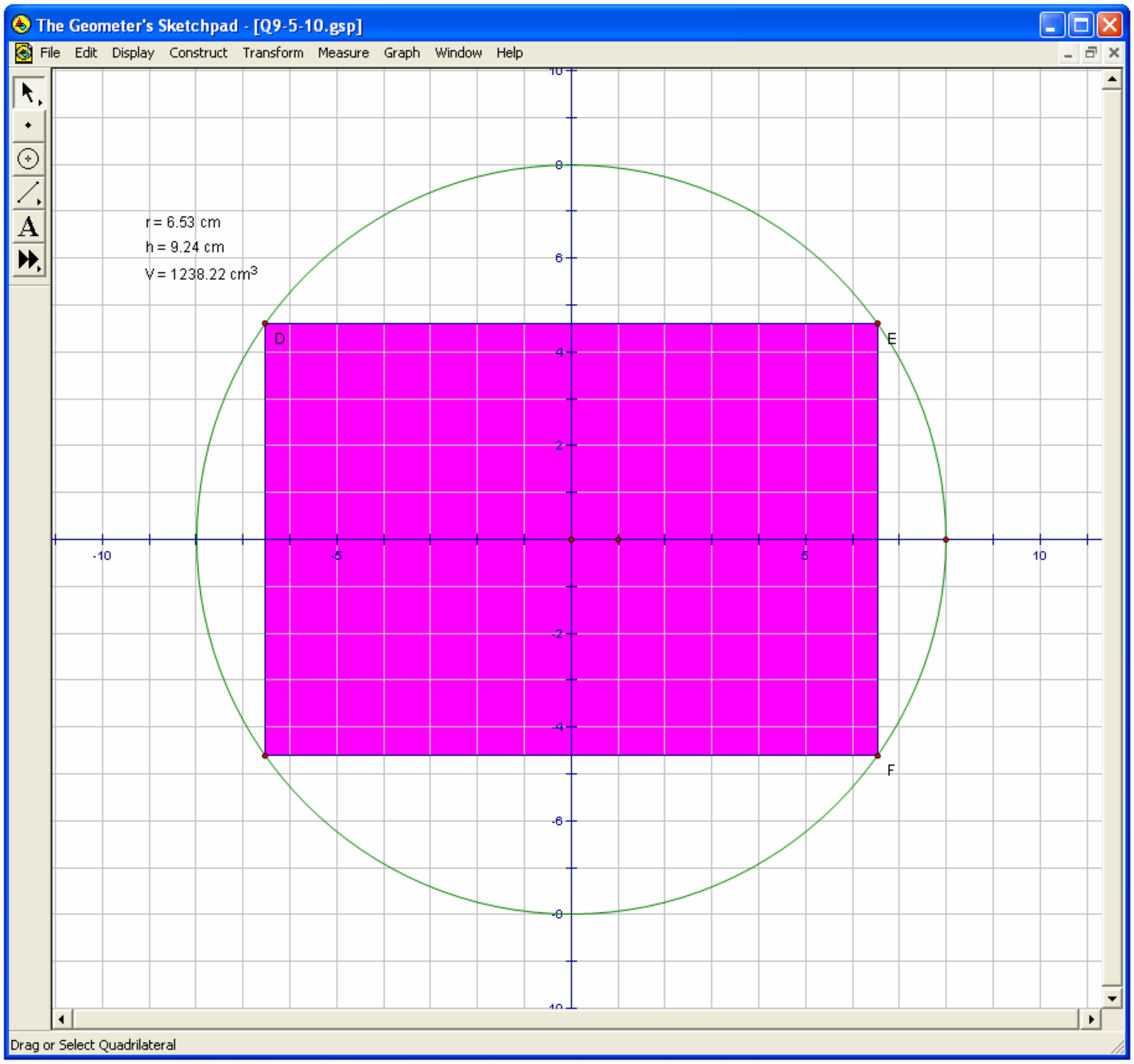


$$
\begin{aligned}
r^2 + \left(\frac{1}{2}h\right)^2 &= 8^2 \\
r^2 + \frac{1}{4}h^2 &= 64 \\
\frac{1}{4}h^2 &= 64 - r^2 \\
4 \times \frac{1}{4}h^2 &= 4 \times \left(64 - r^2\right) \\
h^2 &= 256 - 4r^2 \\
h &= \sqrt{256 - 4r^2}
\end{aligned}
$$

Use this formula for *h*, as well as the formulas for volume and surface area, in a spreadsheet. Click here to load the spreadsheet.

Radius (cm)	Height (cm)	Volume (cm^3)	Surface Area (cm^2)
6.50	9.33	1238.04	646.40
6.51	9.30	1238.14	646.66
6.52	9.27	1238.20	646.92
6.53	9.24	1238.22	647.16
6.54	9.21	1238.21	647.40
6.55	9.19	1238.16	647.63
6.56	9.16	1238.08	647.85
6.57	9.13	1237.97	648.07

Click here to load the sketch.



Chapter 9 Section 6 Minimize the Surface Area of a Cylinder

Chapter 9 Section 6 Question 1 Page 513

a)

$$
\begin{aligned}
V &= 2\pi r^3 \\
1200 &= 2\pi r^3 \\
\frac{\overset{600}{\cancel{1200}}}{\underset{1}{\cancel{2}}\,\pi} &= \frac{\overset{1}{\cancel{2\pi}}\,r^3}{\underset{1}{\cancel{2\pi}}} \\
\frac{600}{\pi} &= r^3 \\
\sqrt[3]{\frac{600}{\pi}} &= r \\
5.8 &\doteq r
\end{aligned}
$$

$$
\begin{aligned}
h &= 2 \times 5.8 \\
&= 11.6
\end{aligned}
$$

The radius of the cylinder with minimum surface area is 5.8 cm, and the height is 11.6 cm.

b)

$$
\begin{aligned}
V &= 2\pi r^3 \\
1 &= 2\pi r^3 \\
\frac{1}{2\pi} &= \frac{2\pi r^3}{2\pi} \\
\frac{1}{2\pi} &= r^3 \\
\sqrt[3]{\frac{1}{2\pi}} &= r \\
0.5 &= r
\end{aligned}
$$

$$
\begin{aligned}
h &= 2 \times 0.5 \\
&= 1.0
\end{aligned}
$$

The radius of the cylinder with minimum surface area is 0.5 m, and the height is 1.0 m.

c)

$$V = 2\pi r^3$$
$$225 = 2\pi r^3$$
$$\frac{225}{2\pi} = \frac{2\pi r^3}{2\pi}$$
$$\frac{225}{2\pi} = r^3$$
$$\sqrt[3]{\frac{225}{2\pi}} = r$$
$$3.3 \doteq r$$

$$\begin{aligned} h &= 2 \times 3.3 \\ &= 6.6 \end{aligned}$$

The radius of the cylinder with minimum surface area is 3.3 cm, and the height is 6.6 cm.

d)

$$V = 2\pi r^3$$
$$4 = 2\pi r^3$$
$$\frac{\cancel{4}^{2}}{\cancel{2}_{1}\pi} = \frac{\cancel{2\pi}^{1} r^3}{\cancel{2\pi}_{1}}$$
$$\frac{2}{\pi} = r^3$$
$$\sqrt[3]{\frac{2}{\pi}} = r$$
$$0.9 \doteq r$$

$$\begin{aligned} h &= 2 \times 0.9 \\ &= 1.8 \end{aligned}$$

The radius of the cylinder with minimum surface area is 0.9 m, and the height is 1.8 m.

Chapter 9 Section 6 Question 2 Page 513

a) $$\begin{aligned} SA &= 2\pi r^2 + 2\pi rh \\ &= 2\pi \times 5.8^2 + 2\pi \times 5.8 \times 11.6 \\ &\doteq 634 \end{aligned}$$

The surface area of the cylinder is about 634 cm^2.

b) $$\begin{aligned} SA &= 2\pi r^2 + 2\pi rh \\ &= 2\pi \times 0.5^2 + 2\pi \times 0.5 \times 1.0 \\ &\doteq 5 \end{aligned}$$

The surface area of the cylinder is about 5 m^2.

c) $$\begin{aligned} SA &= 2\pi r^2 + 2\pi rh \\ &= 2\pi \times 3.3^2 + 2\pi \times 3.3 \times 6.6 \\ &\doteq 205 \end{aligned}$$

The surface area of the cylinder is about 205 cm^2.

d) $$\begin{aligned} SA &= 2\pi r^2 + 2\pi rh \\ &= 2\pi \times 0.9^2 + 2\pi \times 0.9 \times 1.8 \\ &\doteq 15 \end{aligned}$$

The surface area of the cylinder is about 15 m^2.

Chapter 9 Section 6 Question 3 Page 513

$$\begin{aligned} V &= 2\pi r^3 \\ 540 &= 2\pi r^3 \\ \frac{\overset{270}{\cancel{540}}}{\underset{1}{\cancel{2}}\pi} &= \frac{\overset{1}{\cancel{2\pi}} r^3}{\underset{1}{\cancel{2\pi}}} \\ \frac{270}{\pi} &= r^3 \\ \sqrt[3]{\frac{270}{\pi}} &= r \\ 4.4 &\doteq r \end{aligned}$$

$$\begin{aligned} h &= 2 \times 4.4 \\ &= 8.8 \end{aligned}$$

The radius of the cylinder with minimum surface area is 4.4 cm, and the height is 8.8 cm.

Chapter 9 Section 6 Question 4 Page 514

a)

$$\begin{aligned}
V &= 2\pi r^3 \\
5000 &= 2\pi r^3 \\
\frac{\overset{2500}{\cancel{5000}}}{\underset{1}{\cancel{2}}\,\pi} &= \frac{\overset{1}{\cancel{2\pi}}\, r^3}{\underset{1}{\cancel{2\pi}}} \\
\frac{2500}{\pi} &= r^3 \\
\sqrt[3]{\frac{2500}{\pi}} &= r \\
9.3 &\doteq r
\end{aligned}$$

$$\begin{aligned}
h &= 2 \times 9.3 \\
&= 18.6
\end{aligned}$$

The radius of the cylinder with minimum surface area is 9.3 cm, and the height is 18.6 cm.

b) Answers will vary. A sample answer is shown.

Assume that no extra material will be needed to enclose the volume.

Chapter 9 Section 6 Question 5 Page 514

$$\begin{aligned}
V &= 2\pi r^3 \\
12\,000 &= 2\pi r^3 \\
\frac{\overset{6000}{\cancel{12\,000}}}{\underset{1}{\cancel{2}}\,\pi} &= \frac{\overset{1}{\cancel{2\pi}}\, r^3}{\underset{1}{\cancel{2\pi}}} \\
\frac{6000}{\pi} &= r^3 \\
\sqrt[3]{\frac{6000}{\pi}} &= r \\
12.4 &\doteq r
\end{aligned}$$

$$\begin{aligned}
h &= 2 \times 12.4 \\
&= 24.8
\end{aligned}$$

The radius of the cylinder with minimum surface area is 12.4 cm, and the height is 24.8 cm.

Chapter 9 Section 6 Question 6 Page 514

a)

$$V = 2\pi r^3$$
$$375 = 2\pi r^3$$
$$\frac{375}{2\pi} = \frac{2\pi r^3}{2\pi}$$
$$\frac{375}{2\pi} = r^3$$
$$\sqrt[3]{\frac{375}{2\pi}} = r$$
$$3.9 \doteq r$$

$$\begin{aligned} h &= 2 \times 3.9 \\ &= 7.8 \end{aligned}$$

The radius of the cylinder with minimum surface area is 3.9 cm, and the height is 7.8 cm.

b) $$\begin{aligned} SA &= 2\pi r^2 + 2\pi rh \\ &= 2\pi \times 3.9^2 + 2\pi \times 3.9 \times 7.8 \\ &\doteq 287 \end{aligned}$$

The cost of the aluminum required is 12 × 0.001 × 287, or \$3.44.

Chapter 9 Section 6 Question 7 Page 514

Answers will vary. A sample answer is shown.

It is not always practical to use cylinders with the optimum volume. They may be harder to use, to handle, to carry, or to store.

Chapter 9 Section 6 Question 8 Page 514

$$V_{\text{cylinder}} = 2\pi r^3$$
$$500 = 2\pi r^3$$
$$\frac{\overset{250}{\cancel{500}}}{\underset{1}{\cancel{2}}\,\pi} = \frac{\overset{1}{\cancel{2\pi}}\,r^3}{\underset{1}{\cancel{2\pi}}}$$
$$\frac{250}{\pi} = r^3$$
$$\sqrt[3]{\frac{250}{\pi}} = r$$
$$4.30 \doteq r$$

$$V_{\text{cube}} = s^3$$
$$500 = s^3$$
$$\sqrt[3]{500} = s$$
$$7.94 \doteq s$$

$$SA_{\text{cube}} = 6s^2$$
$$= 6 \times 7.94^2$$
$$\doteq 378$$

$$h = 2 \times 4.30$$
$$= 8.60$$

$$SA_{\text{cylinder}} = 2\pi r^2 + 2\pi rh$$
$$= 2\pi \times 4.30^2 + 2\pi \times 4.30 \times 8.60$$
$$\doteq 349$$

A cylinder will have a surface area of about 349 cm^2, and a cube will have a surface area of about 378 cm^2. A cylinder is more cost efficient.

Chapter 9 Section 6 Question 9 Page 514

The cafeteria does not appear to designed to minimize heat loss The cylindrical shape is taller than its diameter. However, there is a large glass area which would encourage solar heating.

Chapter 9 Section 6 Question 10 Page 515

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 9 Section 6 **Question 11** **Page 515**

a)

Radius (cm)	Height (cm)	Volume (cm^3)	Surface Area (cm^2)
7.0	9.7	1500.0	582.5
7.1	9.5	1500.0	580.9
7.2	9.2	1500.0	579.5
7.3	9.0	1500.0	578.4
7.4	8.7	1500.0	577.4
7.5	8.5	1500.0	576.7
7.6	8.3	1500.0	576.2
7.7	8.1	1500.0	575.9
7.8	7.8	1500.0	575.7
7.9	7.7	1500.0	575.8
8.0	7.5	1500.0	576.1

The minimum surface area for the open cylinder occurs with a radius of 7.8 cm and a height of 7.8 cm. Click here to load the spreadsheet.

b) The minimum surface area is about 576 cm^2.

c) Answers will vary. A sample answer is shown.

Assume that the only cardboard needed is used to enclose the required volume so there is no wastage.

Chapter 9 Section 6 **Question 12** **Page 515**

a) Answers will vary. A possible answer is that the sphere will have the minimum surface area for a given volume.

b)
$$\begin{aligned} V_{\text{cube}} &= s^3 \\ 1000 &= s^3 \\ \sqrt[3]{1000} &= s \\ 10 &= s \end{aligned}$$

$$\begin{aligned} SA_{\text{cube}} &= 6s^2 \\ &= 6 \times 10^2 \\ &= 600 \end{aligned}$$

The surface area of a cube with a volume of 1000 cm^3 is 600 cm^2.

$$\begin{aligned} V_{\text{cylinder}} &= 2\pi r^3 \\ 1000 &= 2\pi r^3 \\ \frac{1000}{2\pi} &= \frac{2\pi r^3}{2\pi} \\ \frac{500}{\pi} &= r^3 \\ \sqrt[3]{\frac{500}{\pi}} &= r \\ 5.42 &\doteq r \end{aligned}$$

$$\begin{aligned} h &= 2 \times 5.42 \\ &= 10.84 \end{aligned}$$

$$\begin{aligned} SA_{\text{cylinder}} &= 2\pi r^2 + 2\pi rh \\ &= 2\pi \times 5.42^2 + 2\pi \times 5.42 \times 10.84 \\ &\doteq 553.7 \end{aligned}$$

The minimum surface area of a cylinder with a volume of 1000 cm^3 is about 553.7 cm^2.

$$\begin{aligned}
V_{\text{sphere}} &= \frac{4}{3}\pi r^3 \\
1000 &= \frac{4}{3}\pi r^3 \\
3 \times 1000 &= 3 \times \frac{4}{3}\pi r^3 \\
3000 &= 4\pi r^3 \\
\frac{3000}{4\pi} &= \frac{4\pi r^3}{4\pi} \\
\frac{750}{\pi} &= r^3 \\
\sqrt[3]{\frac{750}{\pi}} &= r \\
6.20 &\doteq r
\end{aligned}$$

$$\begin{aligned}
SA_{\text{sphere}} &= 4\pi r^2 \\
&= 4\pi \times 6.20^2 \\
&\doteq 483.1
\end{aligned}$$

The surface area of a sphere with a volume of 1000 cm^3 is about 483.1 cm^2.

The sphere has the least surface area.

Chapter 9 Section 6 Question 13 Page 515

To enclose a maximum volume, use a sphere.

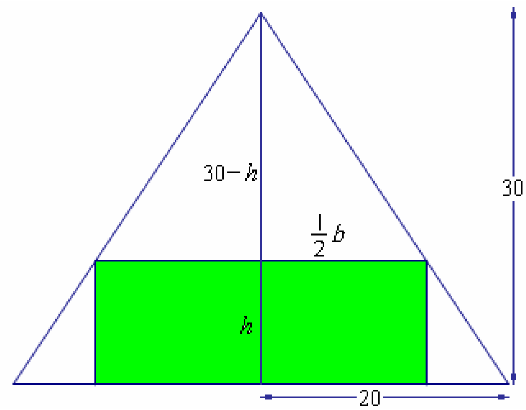
$$\begin{aligned}
SA &= 4\pi r^2 \\
3584 &= 4\pi r^2 \\
\frac{3584}{4\pi} &= \frac{4\pi r^2}{4\pi} \\
\frac{896}{\pi} &= r^2 \\
\sqrt{\frac{896}{\pi}} &= r \\
16.89 &\doteq r
\end{aligned}$$

$$\begin{aligned}
V &= \frac{4}{3}\pi r^3 \\
&= \frac{4}{3}\pi \times 16.89^3 \\
&\doteq 20\,183
\end{aligned}$$

The greatest volume that can be enclosed is about 20 183 cm^3.

Chapter 9 Section 6 Question 14 Page 515

Consider a square-based prism of base length b and height h inscribed in a cone of radius 20 cm and height 30 cm, as shown. Using similar triangles,



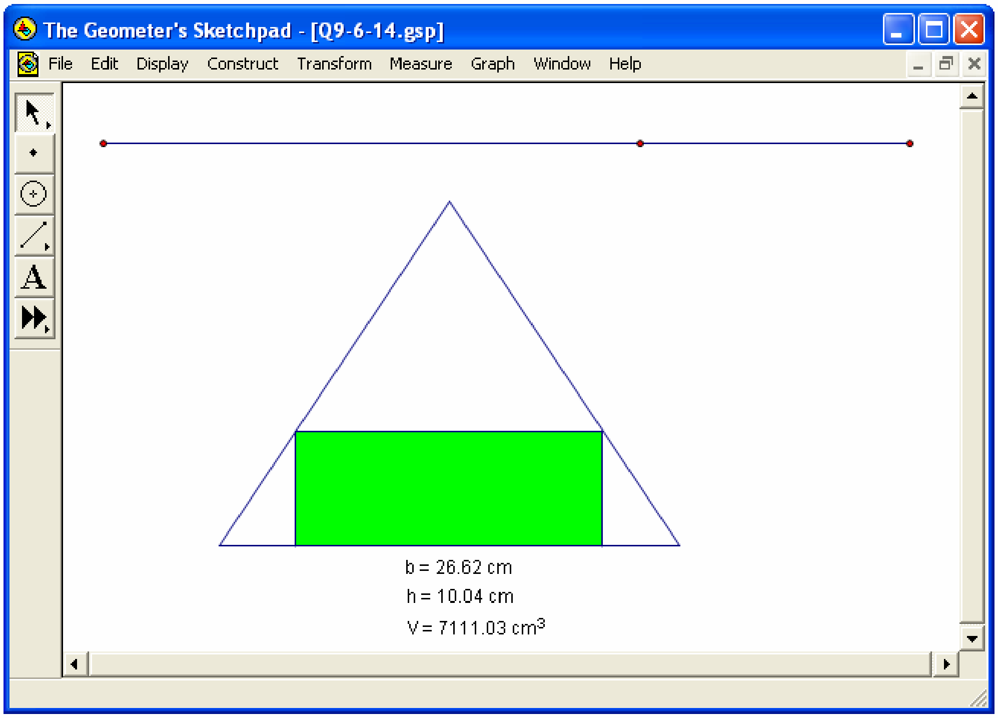
$$\frac{30}{20} = \frac{30-h}{0.5b}$$
$$1.5 = \frac{30-h}{0.5b}$$
$$0.5b \times 1.5 = 0.5b \times \frac{30-h}{0.5b}$$
$$0.75b = 30 - h$$
$$h = 30 - 0.75b$$

Use this relation to investigate the volume of the inscribed square-based prism. A sample spreadsheet is shown. Click here to load the spreadsheet.

The maximum volume of 7111.11 cm^3 occurs with a base length of 26.67 cm and a height of 10 cm.

Base (cm)	Height (cm)	Volume (cm^3)
26.55	10.09	7110.70
26.56	10.08	7110.77
26.57	10.07	7110.83
26.58	10.07	7110.89
26.59	10.06	7110.94
26.60	10.05	7110.98
26.61	10.04	7111.01
26.62	10.04	7111.05
26.63	10.03	7111.07
26.64	10.02	7111.09
26.65	10.01	7111.10
26.66	10.01	7111.11
26.67	10.00	7111.11
26.68	9.99	7111.11
26.69	9.98	7111.09
26.70	9.98	7111.08

Alternatively, you can use dynamic geometry software to investigate the inscribed square-based prism. A sample sketch is shown, resulting in a similar answer. Click here to load the sketch.



Chapter 9 Section 6 Question 15 Page 515

Use a spreadsheet to investigate the surface area with a constant volume. Solve the volume formula for a cone for *h*. Calculate the slant height from the Pythagorean Theorem. The minimum surface area of 225.4 cm^2 occurs with a radius of 4.24 cm and a height of 11.95 cm. Click here to load the spreadsheet.

$$V = \frac{1}{3}\pi r^2 h$$
$$3 \times V = 3 \times \frac{1}{3}\pi r^2 h$$
$$3V = \pi r^2 h$$
$$\frac{3V}{\pi r^2} = \frac{\pi r^2 h}{\pi r^2}$$
$$\frac{3V}{\pi r^2} = h$$

$$s^2 = r^2 + h^2$$
$$s = \sqrt{r^2 + h^2}$$

Radius (cm)	Height (cm)	Volume (cm^3)	Slant Height (cm)	Surface Area (cm^2)
4.20	12.18	225.00	12.88	225.4183
4.21	12.12	225.00	12.83	225.4081
4.22	12.07	225.00	12.78	225.4014
4.23	12.01	225.00	12.73	225.3980
4.24	11.95	225.00	12.68	225.3979
4.25	11.90	225.00	12.63	225.4012
4.26	11.84	225.00	12.58	225.4078
4.27	11.78	225.00	12.53	225.4178
4.28	11.73	225.00	12.49	225.4311

Chapter 9 Section 6 Question 16 Page 515

Use a spreadsheet to investigate the volume with a constant surface area. Solve the formula for the surface area of a cone to determine the formula for the slant height. Use the Pythagorean theorem to calculate the height of the cone. The maximum volume of 977.205 cm^3 occurs with a radius of 6.91 cm and a height of 19.54 cm. Click here to load the spreadsheet.

$$SA = \pi r^2 + \pi rs$$
$$SA - \pi r^2 = \pi rs$$
$$\frac{SA - \pi r^2}{\pi r} = \frac{\pi rs}{\pi r}$$
$$\frac{SA - \pi r^2}{\pi r} = s$$

$$s^2 = r^2 + h^2$$
$$s^2 - r^2 = h^2$$
$$h = \sqrt{s^2 - r^2}$$

Radius (cm)	Slant Height (cm)	Height (cm)	Surface Area (cm^2)	Volume (cm^3)
6.85	21.03	19.88	600.00	977.059
6.86	20.98	19.83	600.00	977.104
6.87	20.93	19.77	600.00	977.140
6.88	20.88	19.71	600.00	977.169
6.89	20.83	19.66	600.00	977.189
6.90	20.78	19.60	600.00	977.201
6.91	20.73	19.54	600.00	977.205
6.92	20.68	19.49	600.00	977.201
6.93	20.63	19.43	600.00	977.188
6.94	20.58	19.37	600.00	977.168

Chapter 9 Review

Chapter 9 Review   Question 1   Page 516

a)

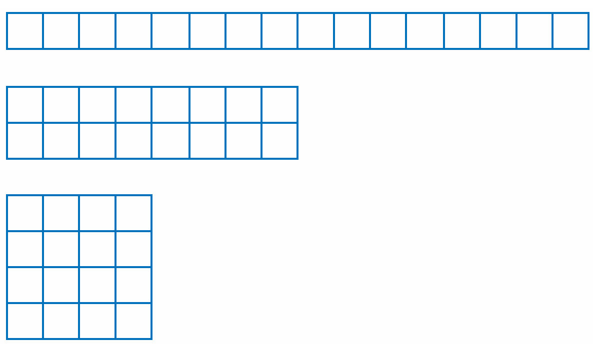
Rectangle	Width (m)	Length (m)	Perimeter (m)	Area (m^2)
1	1	19	40	19
2	2	18	40	36
3	3	17	40	51
4	4	16	40	64
5	5	15	40	75
6	6	14	40	84
7	7	13	40	91
8	8	12	40	96
9	9	11	40	99
10	10	10	40	100

b) There are 10 possible rectangles, assuming that side lengths are integers.

c) Choose a 10 m by 10 m rectangle in order to maximize the play area of the sandbox.

Chapter 9 Review   Question 2   Page 516

a)



b)

Rectangle	Width (m)	Length (m)	Perimeter (m)	Area (m^2)
1	1	16	34	16
2	2	8	20	16
3	4	4	16	16

c) The 4 m by 4 m garden is the most economical. For the same enclosed area, it has the least perimeter. Fewer edging bricks will be required.

Chapter 9 Review Question 3 Page 516

A square shape has the minimum perimeter. Make the whiteboard 1 m by 1 m.

Chapter 9 Review Question 4 Page 516

a) The maximum area occurs with a square of side length 30 cm, for an area of 30×30, or 900 m^2.

b) The maximum area occurs with one length equal to twice the width. Use two widths of 30 m each, and one length of 60 m, for an area of 30×60, or 1800 m^2.

Chapter 9 Review Question 5 Page 516

a) The most economical rink is a square with a side length of $\sqrt{1800}$, or about 42.4 m.

b) Answers will vary. A sample answer is shown.

A square ice rink may not be best as skaters may want longer straight runs to gain speed.

Chapter 9 Review Question 6 Page 516

Side Length of Square Base (cm)	Area of Square Base (cm^2)	Height (cm)	Volume (cm^3)	Surface Area (cm^2)
9.45	89.30	9.80	875	548.9754
9.46	89.49	9.78	875	548.9621
9.47	89.68	9.76	875	548.9500
9.48	89.87	9.74	875	548.9391
9.49	90.06	9.72	875	548.9295
9.50	90.25	9.70	875	548.9211
9.51	90.44	9.67	875	548.9138
9.52	90.63	9.65	875	548.9079
9.53	90.82	9.63	875	548.9031
9.54	91.01	9.61	875	548.8995
9.55	91.20	9.59	875	548.8971
9.56	91.39	9.57	875	548.8960
9.57	91.58	9.55	875	548.8960
9.58	91.78	9.53	875	548.8973
9.59	91.97	9.51	875	548.8997

A cube measuring about 9.6 cm on a side requires the least amount of material. Click here to load the spreadsheet.

Chapter 9 Review **Question 7** **Page 516**

a) 1 L = 1000 cm^3

$$
\begin{aligned}
V &= s^3 \\
1000 &= s^3 \\
\sqrt[3]{1000} &= s \\
10 &= s
\end{aligned}
$$

The box that requires the minimum amount of material is a cube with a side length of 10 cm.

b) Answers will vary. A sample answer is shown.

The surface area of a cylinder that contains the same volume will be less than the surface area of the box. The manufacturer could save on packaging costs.

A cube-shaped box is harder to pick up than a more rectangular box.

Chapter 9 Review **Question 8** **Page 517**

3 L = 3000 cm^3

$$
\begin{aligned}
V &= s^3 \\
3000 &= s^3 \\
\sqrt[3]{3000} &= s \\
14.4 &\doteq s
\end{aligned}
$$

$$
\begin{aligned}
SA &= 6s^2 \\
&= 6 \times 14.4^2 \\
&\doteq 1244
\end{aligned}
$$

An area of about 1244 cm^2 of cardboard is required to make the box.

Chapter 9 Review **Question 9** **Page 517**

Side Length of Square Base (m)	Area of Square Base (m^2)	Surface Area (m^2)	Height (m)	Volume (m^3)
0.50	0.25	2	0.75	0.18750
0.51	0.26	2	0.73	0.18867
0.52	0.27	2	0.70	0.18970
0.53	0.28	2	0.68	0.19056
0.54	0.29	2	0.66	0.19127
0.55	0.30	2	0.63	0.19181
0.56	0.31	2	0.61	0.19219
0.57	0.32	2	0.59	0.19240
0.58	0.34	2	0.57	0.19244
0.59	0.35	2	0.55	0.19231
0.60	0.36	2	0.53	0.19200

The maximum volume occurs when a cube of side length approximately 0.58 m is used. Click here to load the spreadsheet.

Chapter 9 Review **Question 10** **Page 517**

$$SA = 6s^2$$
$$1200 = 6s^2$$
$$\frac{1200}{6} = \frac{6s^2}{6}$$
$$200 = s^2$$
$$\sqrt{200} = s$$
$$14.1 \doteq s$$

The maximum volume occurs when using a cube with a side length of approximately 14.1 cm.

Chapter 9 Review **Question 11** **Page 517**

It is not possible to cut six 14.1 cm by 14.1 cm pieces from a 60 cm by 20 cm piece of cardboard. Only four such pieces fit into these dimensions.

Chapter 9 Review Question 12 Page 517

Radius (cm)	Height (cm)	Volume (cm^3)	Surface Area (cm^2)
6.100	12.686	1482.918	720.000
6.110	12.645	1483.005	720.000
6.120	12.604	1483.081	720.000
6.130	12.564	1483.145	720.000
6.140	12.523	1483.198	720.000
6.150	12.483	1483.239	720.000
6.160	12.443	1483.269	720.000
6.170	12.402	1483.287	720.000
6.180	12.362	1483.293	720.000
6.190	12.322	1483.288	720.000
6.200	12.283	1483.271	720.000
6.210	12.243	1483.242	720.000

The maximum volume of 1483.29 cm^3 occurs with a radius of 6.18 cm and a height of 12.36 cm. Click here to load the spreadsheet.

Chapter 9 Review Question 13 Page 517

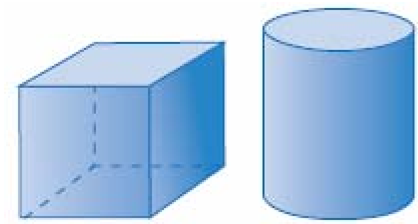
Since there is no lid, you must change the formula for height from

$h = \frac{SA - 2\pi r^2}{2\pi r}$ to $h = \frac{SA - \pi r^2}{2\pi r}$.

Chapter 9 Review Question 14 Page 517

Answers will vary. A sample answer is shown.

A cylinder will have a greater volume using the same amount of cardboard, but the square-based prism may be easier for customers to store.



Chapter 9 Review **Question 15** **Page 517**

a)

Radius (cm)	Base Area (cm^2)	Volume (cm^3)	Height (cm)	Surface Area (cm^2)
3.90	47.78	400	8.37	300.6955
3.91	48.03	400	8.33	300.6615
3.92	48.27	400	8.29	300.6316
3.93	48.52	400	8.24	300.6055
3.94	48.77	400	8.20	300.5833
3.95	49.02	400	8.16	300.5650
3.96	49.27	400	8.12	300.5506
3.97	49.51	400	8.08	300.5400
3.98	49.76	400	8.04	300.5332
3.99	50.01	400	8.00	300.5302
4.00	50.27	400	7.96	300.5310
4.01	50.52	400	7.92	300.5355
4.02	50.77	400	7.88	300.5438

The minimum surface area is 300.53 cm^2 when the radius is 3.99 cm, and the height is 8.00 cm. Click here to load the spreadsheet.

b) Answers will vary. A sample answer is shown.

Assume there is no waste material while making the pop can.

Chapter 9 Review **Question 16** **Page 517**

a) The minimum surface area occurs when the height equals the diameter of 12.2 cm. The number of CDs that the container will hold is $\frac{12.2}{0.2}$, or 61.

b) Answers will vary. A sample answer is shown.

Assume that no extra space is allowed inside the container.

c)
$$\begin{aligned} SA &= 2\pi r^2 + 2\pi rh \\ &= 2\pi \times 6.1^2 + 2\pi \times 6.1 \times 12.2 \\ &\doteq 701.4 \end{aligned}$$

The amount of material required is about 701.4 cm^2.

Chapter 9 Chapter Test

Chapter 9 Chapter Test Question 1 Page 518

The field should be a square with a side length of 100 m. Answer B.

Chapter 9 Chapter Test Question 2 Page 518

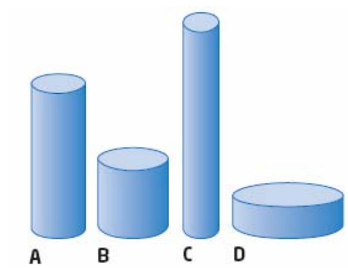
8 L = 8000 cm^3

$$\begin{aligned} V &= s^3 \\ 8000 &= s^3 \\ \sqrt[3]{8000} &= s \\ 20 &= s \end{aligned}$$

The box should be a cube with side length 20 cm. Answer D.

Chapter 9 Chapter Test Question 3 Page 518

The surface area is a minimum when the diameter equals the height. Answer B.



Chapter 9 Chapter Test Question 4 Page 518

$$\begin{aligned} SA &= 6s^2 \\ 600 &= 6s^2 \\ \frac{600}{6} &= \frac{6s^2}{6} \\ 100 &= s^2 \\ \sqrt{100} &= s \\ 10 &= s \end{aligned}$$

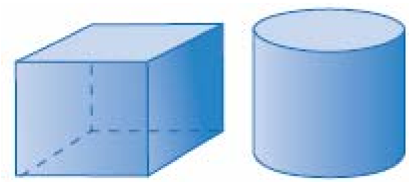
The volume is a maximum when a cube with a side length of 10 cm is used. Answer A.

Chapter 9 Chapter Test Question 5 Page 518

The area is a maximum when a square shape of side length 50 cm is used.

Chapter 9 Chapter Test Question 6 Page 518

Their volumes of the containers are equal, since they have the same base area and the same height. The cylinder requires less material to make.



Chapter 9 Chapter Test Question 7 Page 518

a) 5 L = 5000 cm^3

$$\begin{aligned} V &= s^3 \\ 5000 &= s^3 \\ \sqrt[3]{5000} &= s \\ 17.1 &\doteq s \end{aligned}$$

The minimum surface area occurs when a cube of side length approximately 17.1 cm is used.

b) Answers will vary. A sample answer is shown.

Assume that no material is overlapped, and that no extra material is required for sealing purposes.

Chapter 9 Chapter Test   Question 8   Page 518

a)
$$\begin{aligned} SA &= 6s^2 \\ 8.64 &= 6s^2 \\ \frac{8.64}{6} &= \frac{6s^2}{6} \\ 1.44 &= s^2 \\ \sqrt{1.44} &= s \\ 1.2 &= s \end{aligned}$$

The maximum volume occurs when a cube of side length 1.2 m is used.

b)
$$\begin{aligned} V &= s^3 \\ &= 1.2^3 \\ &= 1.728 \end{aligned}$$

The volume of the box is 1.728 m^3.

c) The material available for each of the smaller boxes is $\frac{8.64}{3}$, or 2.88 m^2.

$$\begin{aligned} SA &= 6s^2 \\ 2.88 &= 6s^2 \\ \frac{2.88}{6} &= \frac{6s^2}{6} \\ 0.48 &= s^2 \\ \sqrt{0.48} &= s \\ 0.69 &\doteq s \end{aligned}$$

Each small box is a cube with a side length of approximately 0.69 cm.

d)
$$\begin{aligned} V_{\text{small}} &= s^3 \\ &= 0.69^3 \\ &\doteq 0.33 \end{aligned}$$

The total volume of the three small bins is 3×0.33, or 0.99 m^3. This is less than the volume of the original large bin.

Chapter 9 Chapter Test Question 9 Page 519

Radius (m)	Height (m)	Volume (m^3)	Surface Area (m^2)
18.50	18.60	20000.00	3237.3722
18.51	18.58	20000.00	3237.3668
18.52	18.56	20000.00	3237.3633
18.53	18.54	20000.00	3237.3617
18.54	18.52	20000.00	3237.3620
18.55	18.50	20000.00	3237.3641
18.56	18.48	20000.00	3237.3681
18.57	18.46	20000.00	3237.3741
18.58	18.44	20000.00	3237.3818

The minimum surface area occurs with a radius of 18.53 m and a height of 18.54 m. Click here to load the spreadsheet.

Chapter 9 Chapter Test Question 10 Page 519

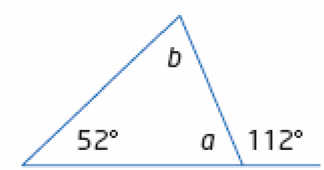
Base (m)	Height (m)	Volume (m^3)	Surface Area (m^2)
0.8	1.1	0.672	4.0
0.9	0.9	0.718	4.0
1.0	0.8	0.750	4.0
1.1	0.6	0.767	4.0
1.2	0.5	0.768	4.0
1.3	0.4	0.751	4.0
1.4	0.4	0.714	4.0
1.5	0.3	0.656	4.0

The maximum volume occurs with a base length of 1.2 m and a height of 0.5 m. Click here to load the spreadsheet.

Chapters 7 to 9 Review **Question 1 Page 520**

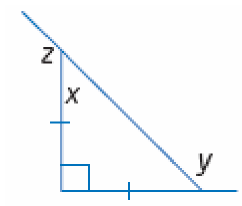
a)

$$\begin{aligned} a &= 180° - 112° \\ &= 68° \end{aligned}$$



$$\begin{aligned} b + 52° &= 112° \\ b &= 112° - 52° \\ b &= 60° \end{aligned}$$

b)



$$\begin{aligned} 2x + 90° &= 180° \\ 2x &= 180° - 90° \\ 2x &= 90° \\ \frac{2x}{2} &= \frac{90°}{2} \\ x &= 45° \end{aligned}$$

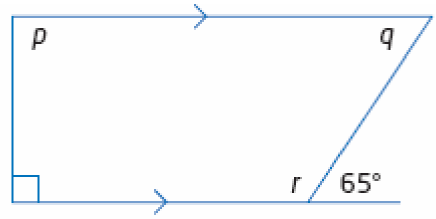
$$\begin{aligned} z &= 90° + 45° \\ &= 135° \end{aligned}$$

$$\begin{aligned} y &= 90° + 45° \\ &= 135° \end{aligned}$$

Chapters 7 to 9 Review **Question 2** **Page 520**

a)

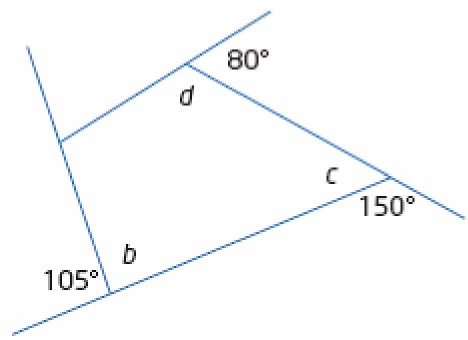
$$r = 180° - 65°$$
$$= 115°$$



$$q + 115° = 180°$$
$$q = 180° - 115°$$
$$q = 65°$$

$$p + 65° + 115° + 90° = 360°$$
$$p + 270° = 360°$$
$$p = 360° - 270°$$
$$p = 90°$$

b) $b = 180° - 105°$
$= 75°$

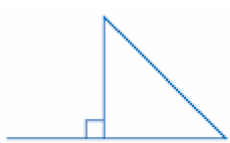


$c = 180° - 150°$
$= 30°$

$d = 180° - 80°$
$= 100°$

Chapters 7 to 9 Review **Question 3** **Page 520**

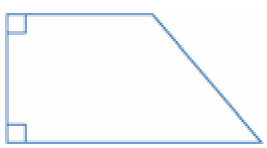
a)



b) Each exterior angle and its adjacent interior angle have a sum of 180°. Thus an exterior right angle has an adjacent interior right angle. This cannot occur in a triangle because two right interior angles have a sum of 180°, leaving no room for the triangle's third angle.

c)

d)



Chapters 7 to 9 Review **Question 4** **Page 520**

a)

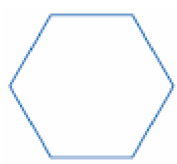
$$
\begin{aligned}
180(n-2) &= 144n \\
180n - 360 &= 144n \\
180n - 360 + 360 - 144n &= 144n + 360 - 144n \\
36n &= 360 \\
\frac{36n}{36} &= \frac{360}{36} \\
n &= 10
\end{aligned}
$$

The polygon has 10 sides.

b) The sum of the exterior angles is 360º for all polygons.

Chapters 7 to 9 Review **Question 5** **Page 520**

a)

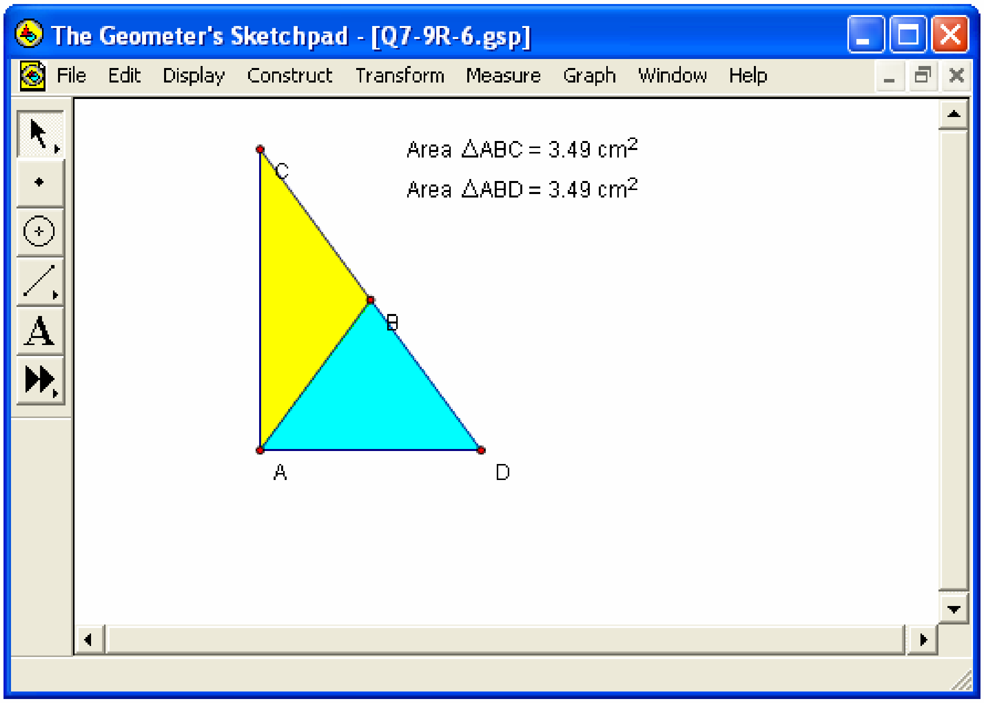


b) Answers will vary. A sample answer is shown.

You can use dynamic geometry software to rotate a line segment about one of its endpoints five times through an angle of 60º. Then, join the endpoints of the line segments formed.

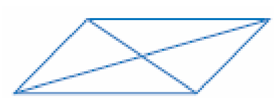
Chapters 7 to 9 Review **Question 6** **Page 520**

Adam is correct. The median from the hypotenuse divides the area of a right triangle into two equal parts. You can verify this conjecture using dynamic geometry software. A sample sketch is shown. Click here to load the sketch.



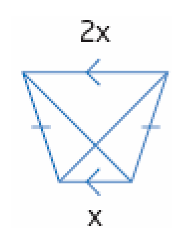
Chapters 7 to 9 Review **Question 7** **Page 520**

a) It is false that the diagonals of a parallelogram are equal in length. A counter-example is shown.



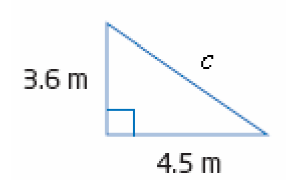
b) It is true that the line segment joining the midpoints of two sides of a triangle is always parallel to the third side. You can use dynamic geometry software to show that interior angles add to 180º, making the line segments parallel.

c) It is false that the diagonals of a trapezoid are never equal in length. A counter-example is shown.



Chapters 7 to 9 Review **Question 8 Page 520**

a)



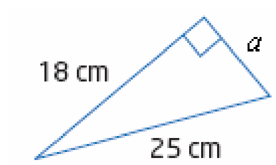
$$c^2 = 3.6^2 + 4.5^2$$
$$c^2 = 12.96 + 20.25$$
$$c^2 = 33.21$$
$$c = \sqrt{33.21}$$
$$c \doteq 5.8$$

$$P = 5.8 + 3.6 + 4.5$$
$$= 13.9$$

$$A = \frac{1}{2} \times 4.5 \times 3.6$$
$$= 8.1$$

The perimeter is 13.9 m, and the area is 8.1 m^2.

b)



$$25^2 = a^2 + 18^2$$
$$625 = a^2 + 324$$
$$625 - 324 = a^2$$
$$301 = a^2$$
$$\sqrt{301} = a$$
$$a \doteq 17.3$$

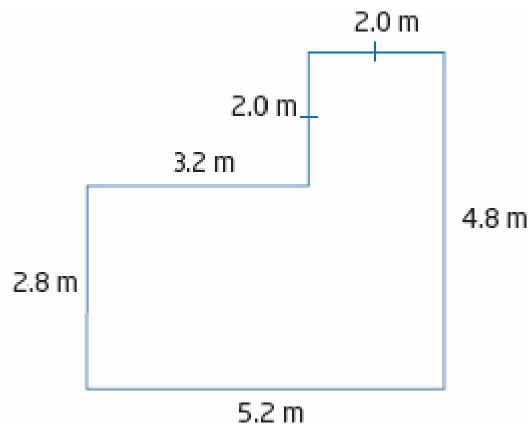
$$P = 17.3 + 18 + 25$$
$$= 60.3$$

$$A = \frac{1}{2} \times 18 \times 17.3$$
$$= 155.7$$

The perimeter is 60.3 cm, and the area is 155.7 cm^2.

Chapters 7 to 9 Review Question 9 Page 520

$$\begin{aligned} P &= 5.2 + 4.8 + 2.0 + 2.0 + 3.2 + 2.8 \\ &= 20.0 \end{aligned}$$



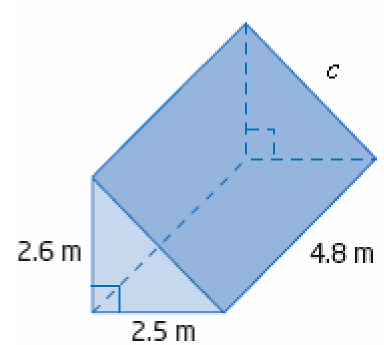
$$\begin{aligned} A &= A_{\text{rectangle}} - A_{\text{cutout}} \\ &= 5.2 \times 4.8 - 3.2 \times 2.0 \\ &= 24.96 - 6.4 \\ &= 18.56 \end{aligned}$$

The perimeter is 20.0 m, and the area is 18.56 m^2.

Chapters 7 to 9 Review Question 10 Page 521

a)

$$\begin{aligned} c^2 &= 2.6^2 + 2.5^2 \\ c^2 &= 6.76 + 6.25 \\ c^2 &= 13.01 \\ c &= \sqrt{13.01} \\ c &\doteq 3.6 \end{aligned}$$



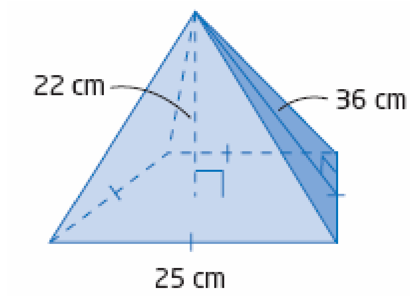
$$\begin{aligned} SA &= 2A_{\text{base}} + A_{\text{left side}} + A_{\text{bottom}} + A_{\text{right side}} \\ &= 2 \times \left(\frac{1}{2} \times 2.5 \times 2.6\right) + 2.6 \times 4.8 + 2.5 \times 4.8 + 3.6 \times 4.8 \\ &= 6.5 + 12.48 + 12 + 17.28 \\ &\doteq 48.3 \end{aligned}$$

$$\begin{aligned} V &= A_{\text{base}} \times h \\ &= \left(\frac{1}{2} \times 2.5 \times 2.6\right) \times 4.8 \\ &= 15.6 \end{aligned}$$

The surface area is approximately 48.3 m^2, and the volume is 15.6 m^3.

b)

$$\begin{aligned} SA &= A_{base} + 4A_{triangle} \\ &= 25 \times 25 + 4\left(\frac{1}{2} \times 25 \times 36\right) \\ &= 625 + 1800 \\ &= 2425 \end{aligned}$$



$$\begin{aligned} V &= \frac{1}{3} A_{base} \times h \\ &= \frac{1}{3} \times 25^2 \times 22 \\ &\doteq 4583.3 \end{aligned}$$

The surface area is 2425 cm^2, and the volume is approximately 4583.3 cm^3.

Chapters 7 to 9 Review **Question 11** **Page 521**

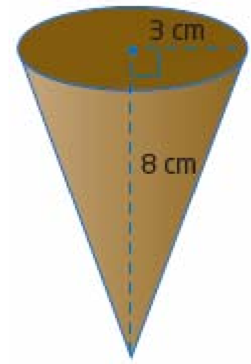
325 mL = 325 cm^3

$$\begin{aligned} V &= \pi r^2 h \\ 325 &= \pi \times 3.6^2 \times h \\ 325 &= 12.96\pi h \\ \frac{325}{12.96\pi} &= \frac{12.96\pi h}{12.96\pi} \\ \frac{325}{12.96\pi} &= h \\ 8.0 &\doteq h \end{aligned}$$

The height of the can is 8.0 cm.

Chapters 7 to 9 Review **Question 12** **Page 521**

a)



$$\begin{aligned}s^2 &= 8^2 + 3^2\\ s^2 &= 64 + 9\\ s^2 &= 73\\ s &= \sqrt{73}\\ s &\doteq 8.5\end{aligned}$$

$$\begin{aligned}SA &= \pi rs + \pi r^2\\ &= \pi \times 3 \times 8.5 + \pi \times 3^2\\ &\doteq 108\end{aligned}$$

The area of paper required is about 108 cm^2.

b) $$\begin{aligned}V &= \frac{1}{3}\pi r^2 h\\ &= \frac{1}{3} \times \pi \times 3^2 \times 8\\ &\doteq 75\end{aligned}$$

The volume of the cone is approximately 75 cm^3.

Chapters 7 to 9 Review **Question 13** **Page 521**

a) $$\begin{aligned}V &= \frac{4}{3}\pi r^3\\ &= \frac{4}{3}\pi \times 20^3\\ &\doteq 33\,510\end{aligned}$$

The volume of the golf ball is approximately 33 510 mm^3.

b) $$\begin{aligned}SA &= 4\pi r^2\\ &= 4\pi \times 20^2\\ &\doteq 5027\end{aligned}$$

The surface area of the golf ball is approximately 5027 mm^2.

c) The entire surface of a golf ball is covered with small indentations (commonly known as dimples). Due to the presence of dimples, the actual surface area of the golf ball is greater and the volume of the golf ball is less than that calculated in parts a) and b).

Chapters 7 to 9 Review **Question 14** **Page 521**

a) Allie should make a square garden, using 13 pieces, or 6.5 m, on a side.

b) The area of the garden is 6.5^2, or 42.25 m^2.

c) The perimeter of the garden is 4×6.5, or 26 m.

Chapters 7 to 9 Review **Question 15** **Page 521**

$$\begin{aligned} V &= s^3 \\ 10\ 000 &= s^3 \\ \sqrt[3]{10\ 000} &= s \\ 21.5 &\doteq s \end{aligned}$$

$$\begin{aligned} SA &= 6s^2 \\ &= 6 \times 21.5^2 \\ &\doteq 2774 \end{aligned}$$

The area of cardboard required is about 2774 cm^2.

Chapters 7 to 9 Review **Question 16** **Page 521**

a)

$$\begin{aligned} SA &= 6s^2 \\ 150 &= 6s^2 \\ \frac{150}{6} &= \frac{6s^2}{6} \\ 25 &= s^2 \\ \sqrt{25} &= s \\ 5 &= s \end{aligned}$$

The maximum volume occurs with a cube of side length 5 cm.

b)

Radius (cm)	Height (cm)	Volume (cm^3)	Surface Area (cm^2)
2.5	7.0	138.4	150.0
2.6	6.6	139.8	150.0
2.7	6.1	140.7	150.0
2.8	5.6	141.0	150.0
2.9	5.3	140.9	150.0
3.0	5.0	140.2	150.0

The maximum volume of 141 cm^2 occurs with a radius of 2.8 cm and a height of 5.6 cm.
Click here to load the spreadsheet.

Radius (cm)	Height (cm)	Volume (cm^3)	Surface Area (cm^2)
3.880	8.140	385.000	293.043
3.890	8.099	385.000	293.021
3.900	8.057	385.000	293.003
3.910	8.016	385.000	292.989
3.920	7.975	385.000	292.979
3.930	7.935	385.000	292.972
3.940	7.894	385.000	292.969
3.950	7.854	385.000	292.970
3.960	7.815	385.000	292.975
3.970	7.776	385.000	292.983

The minimum surface area of about 293 cm^2 occurs with a radius of 3.9 cm and a height of 7.9 cm. Click here to load the spreadsheet.