Using Spreadsheets and Graphs to Display Data

FOCUS

- Display data on graphs using spreadsheets.

You can use a graph to display your data in a way that is clear and easy to understand.

Spreadsheet software can be used to record and graph data.

These data come from the *Census at School* website:

Which method do you use most often to communicate with friends?

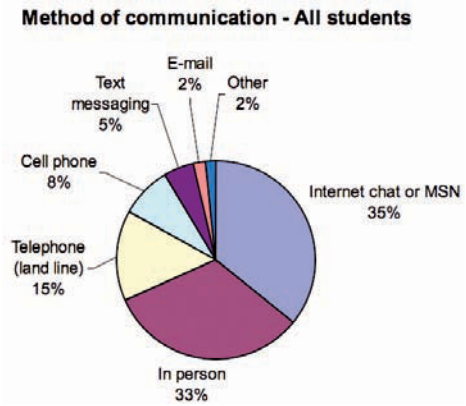
Method of communication	Girls	Boys	All students
		%	
Internet chat or MSN	36.11	35.26	35.7
In person	30.02	35.51	32.65
Telephone (land line)	15.61	13.5	14.6
Cell phone	8.91	7.66	8.31
Text messaging	6.59	3.77	5.23
E-mail	1.73	2.20	1.96
Other	1.03	2.11	1.55

Notes: Secondary students only.
Methods of communication appear in order of frequency for all students.

Source: Statistics Canada, Census at School, 2006/2007.

1. Enter the *Method of communication* and the percent of *All students* into columns and rows.
2. Highlight the data including the column heads. Click the graph/chart icon. Select the circle graph, which is sometimes called a pie chart. Label the graph and all sectors of the circle.
   Your graph might look like this:

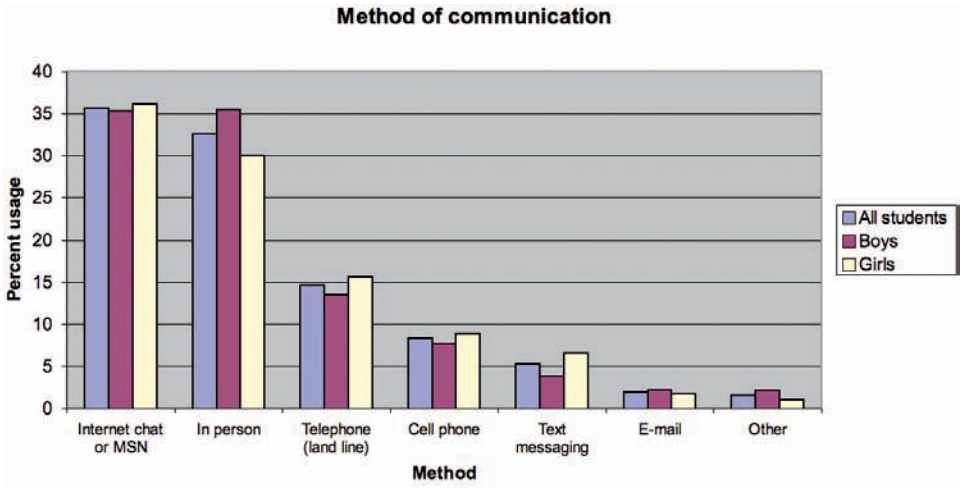
Method of communication	All students
Internet chat or MSN	35.7
In person	32.65
Telephone (land line)	14.6
Cell phone	8.31
Text messaging	5.23
E-mail	1.96
Other	1.55



3. You can also display the data using a bar graph. Create a *Vertical bar graph,* sometimes called a *Column graph* for the data. Label the graph and axes. Experiment with the scale of each axis to most clearly display the data.

4. To display the data for *Boys*, *Girls*, and *All students*, you can make a multiple bar graph.
Enter the data for *Boys* and *Girls* into the next two columns of the spreadsheet. Now highlight all the data and create a bar graph.
Your finished graph might look like this:

Method of communication	All students	Boys	Girls
Internet chat or MSN	35.7	35.26	36.11
In person	32.65	35.51	30.02
Telephone (land line)	14.6	13.5	15.61
Cell phone	8.31	7.66	8.91
Text messaging	5.23	3.77	6.59
E-mail	1.96	2.2	1.73
Other	1.55	2.11	1.03



Check

1. List one advantage and one disadvantage of displaying data using each type of graph above.

2. These data are from *Census at School*:

How long does it usually take you to travel to school?

Minutes	Elementary	Secondary
	%	
Less than 10	38.36	18.96
10 to 19	31.83	31.92
20 to 29	12.55	17.96
30 to 44	10.65	16.83
45 to 59	4.16	7.71
60 or more	2.44	6.61

Source: Statistics Canada, Census at School, 2006/2007.

Use an appropriate graph to display the results for all students. Justify your choice of graph.

Start Where You Are

How Can I Assess My Work?

I can design a **rubric**. A rubric helps me to see how well I understood the task and how good I am at communicating what I know. It lists the content and quality needed for a task; these are called the *criteria* of the task.

My first step to create a rubric is to determine the criteria of the task. Suppose I have to write an article for my school newspaper.

The criteria I would look for in the article are:

- Accurate information
- Well organized
- An eye-catching title
- Correct spelling and grammar

I then assess each criterion using one of 4 *levels of achievement*:

- Not yet adequate
- Adequate
- Proficient
- Excellent

I create a grid:

	Not yet adequate	Adequate	Proficient	Excellent
Accurate information				
Correct spelling and grammar				
Well organized				
Eye-catching title				

I then include what I think needs to be done to achieve each level.

	Not yet adequate	Adequate	Proficient	Excellent
Accurate information	uses few facts that are not enough to explain the topic (1-2 facts)	uses some facts to explain the topic (3-4 facts)	uses most of the available facts to explain the topic (5-7 facts)	uses all the available facts to explain the topic (8 facts)
Correct spelling and grammar		has some spelling and grammatical errors (4-6 errors)	has few spelling and grammatical errors (1-3 errors)	has no spelling or grammatical errors (0 errors)
Well organized	ideas are not in an order that makes sense	ideas are partly in an order that makes sense		all ideas are in an order that makes sense
Eye-catching title	attempts to write a title, but it is not clear and will not attract readers	writes a title that is clear, but may not attract many readers	writes a title that is clear and effective at attracting many readers	writes a title that is very clear and is outstanding at attracting all readers

Check

1. What descriptions might go in the grey areas?

Apply

2. a) Create a rubric to evaluate your day at school. Use the criteria below.

	Not yet adequate	Adequate	Proficient	Excellent
Homework was done				
On time for classes				
Paid attention				
Helped others				

b) Trade rubrics with a classmate. Suggest how to improve your classmate's rubric.

9.5 Designing a Project Plan

FOCUS

- Develop a project plan for data collection.

Have you been stopped in the shopping mall by a person with a clipboard and been asked to answer questions for a survey?
Have you ever answered the telephone at home in the evening and been asked if you would take part in a survey?
Or, have you completed an online survey?
If so, what types of questions were you asked?

Investigate

Suppose your school board would like to know if there is a relation between the number of hours a student works at a part-time job and her or his academic success. Design a plan that the school board could follow to collect the data.

Reflect & Share

Share your plan with that of another group.
How are your plans similar? How are your plans different?
Do your plans avoid potential problems? Explain.
If not, make adjustments to your plan.

Connect

Here are 5 possible steps to consider when you design a plan for data collection:

1. **Prepare a question.** The wording should avoid biases, and be culturally sensitive. If the survey question is personal, the participants should be anonymous.
2. **Identify the population, and possibly choose a sample.** If you select a sample, ensure it represents the population. Consider the time and cost involved in collecting data from your population or sample.
3. **Collect the data.** Consider the timing of your data collection: does it avoid potential problems?
4. **Analyze and display the data.** Choose an appropriate display for the data, such as a table, circle graph, bar graph, or line graph.
5. **Design a rubric.** This should help you evaluate the important components of your project.

Example Designing a Project Plan

Suppose a frozen yogurt company considers adding a new flavour to its menu.
Decide how to conduct a survey to determine whether the new flavour should be added to the menu.

A Solution

Follow the steps:

1. The survey question might be:

   Rate the taste of this new flavour of frozen yogurt on a scale of 1 to 5.

1	*2*	*3*	*4*	*5*
Strongly Dislike	*Dislike*	*No Opinion*	*Like*	*Strongly Like*

2. The population is all people who eat frozen yogurt and may purchase it from this company. A sample of the population might be every 10th customer who comes into a store one day from when it opens to when it closes.
3. To collect the data, the company must have a server who offers every 10th customer a free sample, poses the survey question, and records the responses.
4. To analyze the data, determine the number of people who chose each rating. This can be displayed on a circle graph. Then calculate the mean rating.
5. Evaluate the process you followed to determine if the data are valid and that you have accounted for all possible biases.

Discuss the ideas

1. Why is it important to plan before you collect data?
2. How can a rubric help you reflect on your plan?

Practice

In this lesson, you will prepare a project plan for your data collection. In the Unit Problem, you will carry out the data collection, analyze and display your results, then draw conclusions.

Developing a Project Plan

3. **a)** Choose a topic that interests you. Prepare a question you want to answer about that topic.

b) Explain how the wording of your question avoids bias.

c) Is your topic a sensitive one for different cultures? If so, how will you deal with this?

d) Test your question on a classmate. Make any necessary changes.

4. a) Describe the population for your data collection.

b) Will you collect data from the population or a sample? If you work with a sample, how will you select the sample to ensure it represents the population?

c) Explain how your choice of population or sample takes into account the time and cost of the project.

5. Explain how you will collect the data.
As part of your answer, discuss:

- how the timing of your data collection will not cause a problem
- any privacy considerations

6. How might you display your data? Justify your choice.

Creating a Rubric for Your Project

7. Create a rubric for your project. In the Unit Problem, you will collect the data and present your findings. Your rubric must assess the following criteria:

- the survey question
- the choice of sample or population
- how the data were collected
- the display of your data
- the conclusions you made
- your presentation

Your rubric should have 4 levels of achievement.

Assessing Your Plan

8. a) Trade project plans with a classmate. Look for potential problems in your classmate's plan. Suggest ways of improving the plan.

b) Incorporate your classmate's comments into your plan.

Reflecting on Your Plan

9. People often make predictions about the results of their data collection. Sometimes these predictions are based on data from the past or personal experience. Make a prediction about your results. Explain why you think it might be true.

10. Why is this topic of interest to you? Who else might be interested in the results?

Reflect

Which step in developing your plan did you find most challenging? Explain.

Math Link

Your World

Every five years, Statistics Canada completes a census by collecting data from every household in Canada. Statistics Canada also requires one in five households to provide more detailed information about themselves. These data are used to help us better understand our country, including its natural resources, educational needs, and the economic situations of people living in various regions. Since the same or similar questions are asked every 5 years, the data can show what changes have taken place in our population over time.

Study Guide

Probability

- Probability is the likelihood an event will occur. For example, a weather forecast says that the probability of rain is 60%. This assumes that the predicted weather conditions do not change. If they do change, then the likelihood of rain may also change.
- Decisions based on probabilities may be a combination of theoretical probability, experimental probability, and subjective judgment. People may make different decisions based on one probability. For example, one person may consider a 60% probability of rain as being too high, and cancel a planned outdoor event. Another person may say that a 40% probability it will not rain is good enough to proceed with the event.

Collecting data

- Problems may arise if a person does not consider:
  - bias
  - use of language
  - ethics
  - cost and time
  - timing
  - privacy
  - cultural sensitivity
- The population is the group from which you are getting information.
- When a census is conducted, data are collected from the entire population.
- When data are collected from only part of the population, a *sample* is used. This sample must be representative of the population.
- Valid conclusions are obtained when the sample results represent those of the population.

Review

9.1

1. Two weeks before a municipal election, a survey produced these data about voters' preferences for a new mayor.

Preference for Mayor	Number of Votes
Vivian Rogers	19
Fred Yao	11
Mustafa Abaz	34
Undecided	6

a) Based on these data, predict which candidate will win.

b) What assumptions are you making? For each assumption, explain what would happen if the assumption changes.

2. A volleyball team has won all 5 games it played this season.
Darrell thinks that the team will lose its next game because he believes their winning streak cannot last.
The players on the team believe that the team has a 100% chance of winning the next game.
Explain how probability and subjective judgment may be influencing these opinions.

3. A local hospital is raising money by selling lottery tickets. The chances of winning are advertised as 1 in 3. Explain how someone can use this probability to support:

a) purchasing a ticket

b) not purchasing a ticket

4. Find an example where statistics are used in an advertisement to try to convince consumers that one product is better than another. Suppose the statistic is true. What assumptions are you making about how the data were collected?

9.2

5. **a)** In each case, identify any problems.

i) To determine people's reactions to a possible increase in minimum wage, a student asked: "Don't you agree that minimum wage should increase?"

ii) For a class project, a student needed to determine if college students were maintaining healthy weights. After the student completed the project, she gave a weight loss company the addresses of any overweight participants.

iii) To test the safety of its deluxe car model, a company subjects many cars to different crash tests.

iv) To determine if residents would support the construction of a community outdoor pool, you survey residents by going door-to-door in November.

b) Describe the effect each problem might have on the results of the data collection.

6. Adila wants to know which digital camera is the best buy.

a) What do you think "best buy" means? Design a question that will give Adila the information she wants.

b) Explain how your question avoids bias.

7. For a school project, Raheem wants to find out if there is an increase in teen pregnancy in Canada. Describe the effect of problems Raheem might encounter related to:

a) privacy

b) cultural sensitivity

c) use of language

8. **a)** Provide an example of a question that could lead to problems because participants are only allowed to choose from 3 possible answers.

b) Reword the question to avoid the potential problems.

9. Provide an example of data you might want to collect, but where the cost and time involved might be problematic.

9.3 **10.** As an operator of a skydiving school, would you suggest a census or a sample when inspecting parachutes for excess wear? Explain.

11. Leah wants to test the lifespan of different brands of batteries.

a) List reasons why Leah would use a sample for her data collection.

b) Suggest how she might choose her sample to ensure it represents the population.

12. a) Explain why a sample might be used in each survey.

i) You wish to find out the most popular sport for teens your age.

ii) You wish to find out the most popular Internet provider in your area.

b) Provide an example when a census would be more appropriate for collecting data than a sample.

9.4 **13.** A TV show surveys viewers to determine the popularity of its singers. At the end of each show, viewers cast votes for their favourite singers by calling in at $0.75 per call. Do you think the opinions of the sample will reflect those of the population? Explain.

14. Discuss whether each sampling method should lead to valid conclusions.

a) A car company subjects every 200th vehicle it manufactures to crash tests.

b) Six students from each grade are selected randomly to complete a survey about which extracurricular activities the school should offer.

c) A juice company sets up a booth in a local mall and allows anyone who wishes to participate in a taste test.

15. Describe an appropriate sampling method for each case. Justify your choice.

a) to predict which political party will win the next election

b) to determine which brand of tennis racket is preferred

9.5 **16.** Adam wants to find out what brand of chewing gum is recommended by most dentists.

a) Write an appropriate survey question Adam could use.

b) Choose an appropriate sample. Explain your choice.

c) Explain how Adam could collect the data and display the results.

d) Explain how Adam could express his results as a probability.

Practice Test

1. A coin is tossed 5 times and each time it lands heads up. The coin is to be tossed again. Shawnie says the coin will land heads up. Owen says the coin will land tails up. Jovana says the coin is equally likely to land heads up as tails up. How might these students have made their predictions?

2. Hannah's hockey team won its last 7 out of 8 games. Hannah calculates that the team's probability of winning the next game is $\frac{7}{8} = 0.875$.

a) What assumptions is Hannah making?

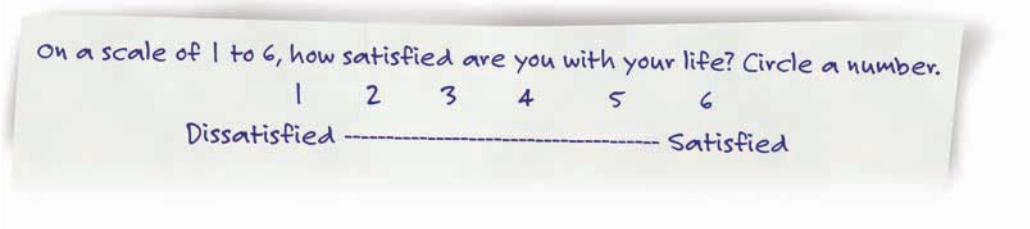
b) For each assumption, explain how the predicted outcome might be affected if the assumption changes.

3. Manroop wants to survey Canadians to determine how happy or depressed they are.

a) Describe how the timing of Manroop's survey may influence her results.

b) Explain how privacy may be a factor in this survey. What should Manroop do to ensure the privacy of the participants?

c) Manroop designs the following question:



What problems might Manroop encounter with this question? What effects would those problems have on her data?

4. Provide an example of a situation where:

a) collecting data from a sample is more appropriate than a census

b) a sample may not result in the same conclusions as a census

Justify each example.

5. For each case, explain how you would select a sample.

a) to test the water quality in your school

b) to determine the most popular brand of toothpaste used by students at your school

c) to measure the average mass of backpacks of students at your school

6. Emile starts a petition to ask the municipal government to allow all stores to open at 9 A.M. on Sunday morning. What problems might he encounter as he solicits signatures? Describe the effect each problem would have on his results.

Unit Problem

What Can You Discover about the World around You?

You will collect data for the project plan you designed in Lesson 9.5. You will then present your findings and assess your work.

Part 1 Collect and Analyze the Data

- Collect the data from your chosen population or sample.
- Organize the data. Consider using a spreadsheet.
- Make an appropriate graph to display your data.
- Analyze your results. What conclusions can you make?

Part 2 Assess Your Data

Use the rubric you made to assess your data collection and make any necessary changes.

Part 3 Present Your Findings

In your presentation, make sure you answer these questions:

- Why did you choose your topic?
- What considerations did you make when writing your question?
- What considerations did you make when selecting the population or sample? If you chose a sample, how did you try to ensure the conclusions would be valid?
- Why did you choose to display the data in the way you did?
- What conclusions can be made from the data?
- Are you surprised by the results? Explain.
- Who might be interested in your data and why?
- If you were to repeat the project, what steps would you take to improve it? Explain.

Part 4 Assess Your Presentation

Use the rubric to assess your presentation.

Your work should include:

- a project plan from Lesson 9.5
- the display of your data and your conclusions
- answers to the presentation questions
- a rubric used for self-assessment

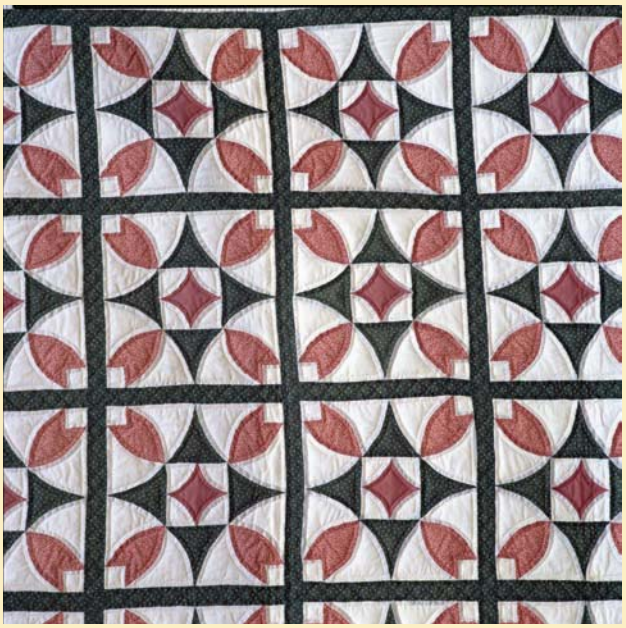
Reflect on Your Learning

What are the most important considerations when collecting data? Why? What are the most important questions to ask about probabilities published in the media? Explain.

Project

Constructing a Math Quilt

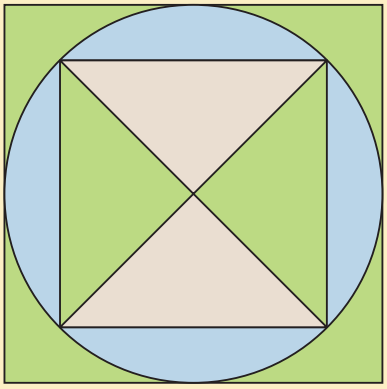
A quilt consists of small blocks that tessellate.



Materials

- ruler
- compass
- pencil crayons or markers
- construction paper
- tape
- dynamic geometry software *(optional)*

Part 1



The larger shape in this quilt block is a square with side length 15 cm.
Within the square there is a circle and within this circle there is a smaller square.

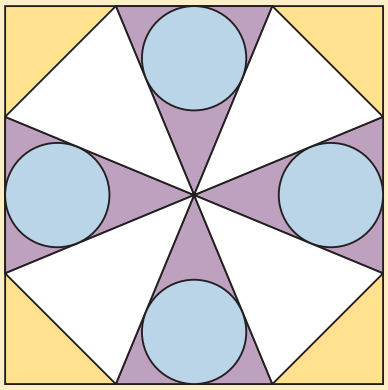
➤ What is the side length of the smaller square?

➤ Describe the triangles in the block.

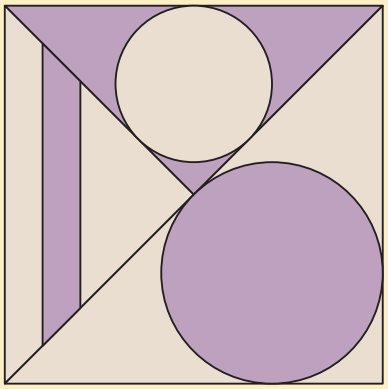
Part 2

Look at these quilt blocks. What shapes do you see?

Block A



Block B



Part 3

Design a square block with side length 15 cm that will be repeated 3 times to form a square with side length 30 cm. Use circles as part of your design. With your four 15-cm blocks, create as many different 30-cm blocks as you can. Describe the symmetries in each 30-cm block.

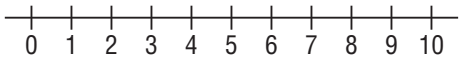
Take It Further

Choose a shape other than a square.
Create a block that will tessellate to form a quilt.

Cumulative Review — Units 1–9

1

1. Sketch this number line.

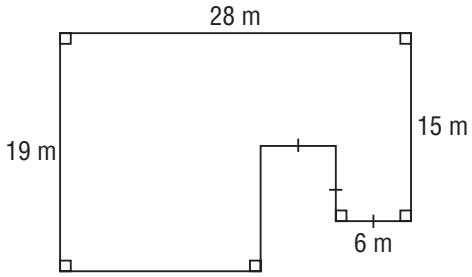


Do *not* use a calculator. Determine or estimate each square root. Where necessary, write the square root to the nearest tenth. Place each square root on the number line.

a) $\sqrt{0.64}$ **b)** $\sqrt{\frac{36}{25}}$ **c)** $\sqrt{79.7}$ **d)** $\sqrt{4.41}$

e) $\sqrt{\frac{100}{9}}$ **f)** $\sqrt{\frac{89}{90}}$ **g)** $\sqrt{30.25}$ **h)** $\sqrt{\frac{17}{4}}$

2. Here is a floor plan for a building that is 5 m tall. It has a flat roof. What is the surface area of the building, including its roof, but excluding its floor?



2

3. A student answered the following skill-testing question to try to win a prize:

$(-4)^3 - (-2)^4 \div 2^2 + 5^2 \times 7^0$

The student's answer was 5. Did the student win the prize? Show your work.

4. Express as a single power, then evaluate.

$\left(\frac{6^7 \times 6^3}{6^5 \times 6^2}\right)^2$

3

5. During the month of July, Bruce earned $225 cutting lawns and $89.25 weeding flower beds. He spent $223.94 on an MP3 player and purchased 3 DVDs at $22.39 each.

a) Write each amount as a rational number. Justify your choice of sign for each number.

b) Write an addition statement for Bruce's balance at the end of July.

c) What is Bruce's balance?

6. Use a calculator. Evaluate to the nearest hundredth.

$$\frac{-17.8 - (-9.6) \div 1.2 + 31.4}{7.6 \times (-4.1) - 2.9}$$

4

7. Marcie is rowing at an average speed of 3 m/s. She travels a distance d metres in t seconds.

a) Create a table of values for this relation.

b) Graph the data. Will you join the points on the graph? Explain.

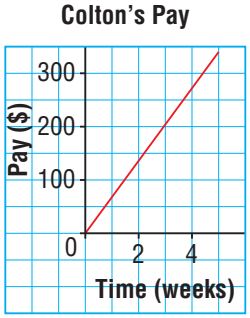
c) Is the relation linear? How do you know?

d) Write an equation that relates d to t.

e) How far does Marcie row in 15 s?

f) How long does it take Marcie to travel 1 km?

8. Colton works for 8 h each week at a sporting goods store. This graph shows how his pay in dollars relates to the number of weeks he works.



a) Estimate how much Colton earns after 2 weeks.

b) Estimate how long it will take Colton to earn $1000. What assumptions do you make?

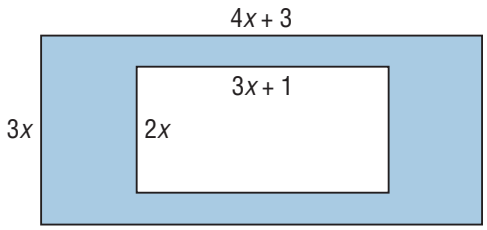
c) What conditions could change that would make this graph no longer valid?

5 **9.** The difference of two polynomials is $4n^2 - 2n + 5$. One polynomial is $-6n^2 - 7n + 8$.

a) What is the other polynomial? Show your work.

b) Why are there two possible answers to part a?

10. This diagram shows one rectangle inside another.



a) Determine the area of the shaded region. Justify your answer.

b) Determine the area of the shaded region when $x = 1.5$ cm.

6 **11.** Mountain bikes can be rented from two stores near the entrance to Stanley Park. Store A charges $6.00 per hour, plus $3.50 for a helmet and lock. Store B charges $6.70 per hour and provides a helmet and lock free. Determine the time in hours for which the rental charges in both stores are equal.

a) Write an equation to solve this problem.

b) Solve the equation.

c) Verify the solution.

12. Jerry hires a pedicab to tour a city. He is charged $2.75 plus $0.60 per minute of travel. He has $12.00. How long can he ride in the pedicab?

a) Choose a variable and write an inequality to solve this problem.

b) Solve the inequality. Explain the solution in words.

c) Verify the solution.

d) Graph the solution.

7 **13.** This photo is to be enlarged. Determine the dimensions of an enlargement with each scale factor.

a) 2 **b)** $\frac{7}{4}$ **c)** 3.5

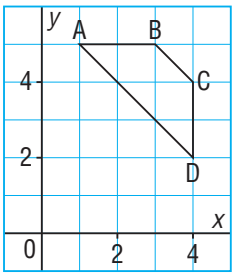
14. A hockey rink measures 60 m by 26 m. A model of a hockey rink measures 1.5 m by 0.65 m.

a) What is the scale factor for this reduction?

b) A hockey goal is 1.8 m high and 1.2 m high. What are the dimensions of a goal on the model hockey rink?

15. Bobbi wants to determine the height of a building. When Bobbi's shadow is 2.5 m long, the shadow of the building is 12 m long. Bobbi is 1.7 m tall. What is the height of the building, to the nearest tenth of a metre? Show your work.

16. Trapezoid ABCD is part of a larger shape.



After each reflection below:

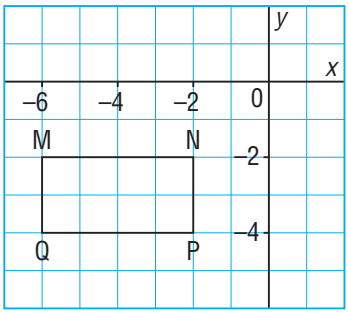
- Draw the image of ABCD.
- Describe any symmetry in the shape and its image.

a) a reflection in the horizontal line through 5 on the y-axis

b) a reflection in the vertical line through 4 on the x-axis

c) a reflection in the oblique line through (0, 6) and (6, 0)

17. a) Does rectangle MNPQ below have rotational symmetry about its centre? If it does, state the order and the angle of rotation symmetry.



b) Rectangle MNPQ is part of a larger shape. It is to be completed in three different ways, by each rotation below:

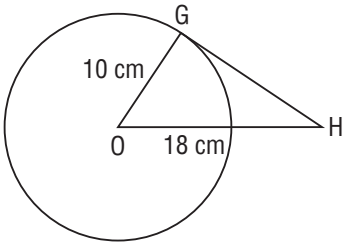
- 90° clockwise about the point (−2, −3)
- 180° about vertex Q
- 270° clockwise about the point (−4, −4)

i) Draw each rotation image.

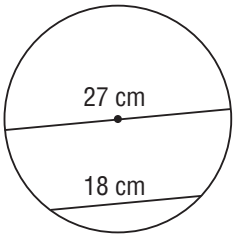
ii) List the coordinates of the larger shape formed by the rectangle and its image each time. Describe any rotational symmetry in this shape.

8

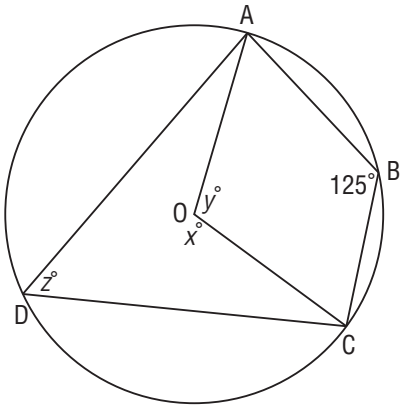
18. Point G is a point of tangency and O is the centre of the circle. Determine the length of GH to the nearest tenth of a centimetre.



19. A circle has diameter 27 cm. How far from the centre of this circle is a chord 18 cm long? Give your answer to the nearest tenth of a centimetre.

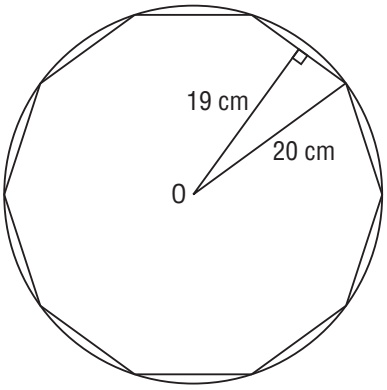


20. Point O is the centre of a circle. Determine the values of $x°$, $y°$, and $z°$.

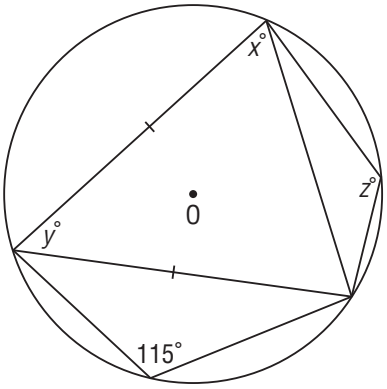


21. A rectangle is inscribed in a circle with radius 14 cm. The length of the rectangle is 21 cm. Determine the width of the rectangle to the nearest tenth of a centimetre.

22. A regular decagon is inscribed in a circle with radius 20 cm and centre O. The distance from O to each side of the decagon is about 19 cm. What is the perimeter of the decagon to the nearest centimetre?



23. Point O is the centre of a circle. Determine the values of $x°$, $y°$, and $z°$.



9 **24.** A baseball team won 58 of its first 100 games of the season. Bao concludes that there is a 58% probability of the team winning its next game.

a) What assumptions is Bao making?

b) For each assumption, explain how the probability might change if the assumption is not true.

25. Zahara is planning a telephone survey to discover how much weekly allowance parents give their children.

a) Identify potential problems she may encounter related to 3 of these factors: bias, timing, privacy, cultural sensitivity, ethics, time

b) For each potential problem in part a, explain how Zahara could avoid the problem.

26. An on-line fashion magazine for teens concludes that high school students spend on average $200 per month on clothes.

a) How do you think the magazine may have conducted the survey?

b) Do you think the conclusion is valid? Explain.

27. For each situation, explain why data are collected from a sample and not a census.

a) to determine the mean cost of hockey equipment for teenagers in Canada

b) to determine the number of Canadian families with at least one cell phone

28. Should a census or sample be used to collect data about each topic? Explain your choice.

a) to determine the popularity of a new television show

b) to determine the condition of an airplane's seatbelts

29. Discuss whether each sampling method would lead to valid conclusions.

a) To determine if the prices of items in a grocery store are appropriate, you survey every 12th customer leaving the store on a given day.

b) To determine the favourite video game of students in a school, you survey 20 randomly selected students from each grade in the school.

Answers

Unit 1 Square Roots and Surface Area, page 4

1.1 Square Roots of Perfect Squares, page 11

3. **a)** 0.5 **b)** $\frac{3}{4}$ or 0.75

c) $\frac{4}{5}$ or 0.8

4. **a)** 1, 4, 9, 16, 25, 36, 49, 64, 81, 100

b) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

5. **a)** 0.6 **b)** 0.7

c) 0.9 **d)** 0.4

e) $\frac{1}{6}$ **f)** $\frac{5}{3}$

g) $\frac{8}{10} = \frac{4}{5}$ **h)** $\frac{6}{4} = \frac{3}{2}$

6. **a)** 121, 144, 169, 196, 225, 256, 289, 324, 361, 400

b) 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

7. **a)** $\frac{13}{4}$ **b)** $\frac{20}{14} = \frac{10}{7}$

c) $\frac{16}{19}$ **d)** $\frac{15}{17}$

e) 12 **f)** 0.15

g) 0.11 **h)** 1.8

i) 0.18 **j)** 0.13

8. **a)** $0.12 = \frac{12}{100}$ is not a perfect square because 12 is not a perfect square.

b) $\sqrt{0.81} = 0.9$, so 0.81 is a perfect square.

c) $\sqrt{0.25} = 0.5$, so 0.25 is a perfect square.

d) $\sqrt{1.69} = 1.3$, so 1.69 is a perfect square.

e) $\frac{9}{12}$ is not a perfect square because 12 is not a perfect square.

f) $\frac{36}{81}$ is a perfect square because both 36 and 81 are perfect squares.

g) $\frac{81}{49}$ is a perfect square because both 81 and 49 are perfect squares.

h) $\frac{75}{27} = \frac{25}{9}$ is a perfect square, because both 25 and 9 are perfect squares.

i) $0.081 = \frac{81}{1000}$ is not a perfect square because 1000 is not a perfect square.

j) $\frac{25}{10}$ is not a perfect square because 10 is not a perfect square.

k) $2.5 = \frac{25}{10}$ so it is not a perfect square.

l) $\frac{8}{50} = \frac{4}{25}$ is a perfect square because both 4 and 25 are perfect squares.

9. **a)** 0.09 **b)** 0.0144

c) 3.61 **d)** 9.61

e) $\frac{4}{9}$ **f)** $\frac{25}{36}$

g) $\frac{1}{49}$ **h)** $\frac{4}{25}$

10. **a)** 3.5 **b)** 5.5

c) 4.5 **d)** 7.5

11. **a)** **i)** $36.0 = \frac{36}{1}$ is a perfect square.

ii) $3.6 = \frac{36}{10} = \frac{18}{5}$ is not a perfect square.

iii) $0.36 = \frac{36}{100} = \frac{9}{25}$ is a perfect square.

iv) $0.036 = \frac{36}{1000} = \frac{9}{250}$ is not a perfect square.

v) $0.0036 = \frac{36}{10\ 000} = \frac{9}{2500}$ is a perfect square.

vi) $0.000\ 36 = \frac{36}{100\ 000} = \frac{9}{25000}$ is not a perfect square.

b) **i)** $\sqrt{36.0} = 6$

ii) $\sqrt{3.6} \doteq 1.9$

iii) $\sqrt{0.36} = 0.6$

iv) $\sqrt{0.036} \doteq 0.19$

v) $\sqrt{0.0036} = 0.06$

vi) $\sqrt{0.000\ 36} \doteq 0.019$

12. **a)** **i)** 300 **ii)** 30

iii) 0.3 **iv)** 0.03

b) **i)** 0.05 **ii)** 0.5

iii) 50 **iv)** 500

13. **a)** **i)** C **ii)** A

iii) E **iv)** B

v) F **vi)** D

14. **a)** 2.4 cm **b)** 9.6 cm

15. **a)** 2.5 km **b)** 3.2 km

c) 7.84 km^2

16. No. $\sqrt{0.04} = 0.2$

17. **b)** For example: (3, 4, 5), (9, 12, 15), (12, 16, 20), (5, 12, 13), (8, 15, 17)

18. Yes, the squares of all numbers between 0.8 and 0.9 are between 0.64 and 0.81.

19. **a)** 3.6 cm **b)** 1 cut

1.2 Square Roots of Non-Perfect Squares, page 18

4. **a)** 1 and 4; $\sqrt{1} = 1$ and $\sqrt{4} = 2$

b) 9 and 16; $\sqrt{9} = 3$ and $\sqrt{16} = 4$

c) 49 and 64; $\sqrt{49} = 7$ and $\sqrt{64} = 8$

d) 64 and 81; $\sqrt{64} = 8$ and $\sqrt{81} = 9$

e) 81 and 100; $\sqrt{81} = 9$ and $\sqrt{100} = 10$

f) 100 and 121; $\sqrt{100} = 10$ and $\sqrt{121} = 11$

5. **a)** $\frac{49}{100}$ and $\frac{64}{100}$; $\sqrt{0.49} = 0.7$ and $\sqrt{0.64} = 0.8$

b) 4 and 9; $\sqrt{4} = 2$ and $\sqrt{9} = 3$

c) 9 and 16; $\sqrt{9} = 3$ and $\sqrt{16} = 4$

d) 49 and 64; $\sqrt{49} = 7$ and $\sqrt{64} = 8$

e) 64 and 81; $\sqrt{64} = 8$ and $\sqrt{81} = 9$

f) 100 and 121; $\sqrt{100} = 10$ and $\sqrt{121} = 11$

6. Estimates will vary, for example:

a) $\sqrt{\frac{8}{10}} \doteq 0.9$ **b)** $\sqrt{\frac{17}{5}} \doteq \frac{9}{5}$

c) $\sqrt{\frac{7}{13}} \doteq 0.7$ **d)** $\sqrt{\frac{29}{6}} \doteq 2.2$

7. Approximations will vary, for example:

a) $\sqrt{4.5} \doteq 2.1$ **b)** $\sqrt{14.5} \doteq 3.8$

c) $\sqrt{84.5} \doteq 9.2$ **d)** $\sqrt{145.5} \doteq 12.1$

e) $\sqrt{284.5} \doteq 16.9$ **f)** $\sqrt{304.5} \doteq 17.4$

8. **a)** $\sqrt{29.5} \doteq 5.4$ **b)** $\sqrt{\frac{5}{2}} \doteq 1.6$

9. **a)** The estimate is incorrect. $\sqrt{4.4} \doteq 2.1$

b) The estimate is incorrect. $\sqrt{0.6} \doteq 0.8$

c) The estimate is correct to the nearest tenth.

d) The estimate is incorrect. $\sqrt{0.4} \doteq 0.6$

10. **a)** Any number between 9 and 16; for example 10.24 and 12.25

b) Any number between 49 and 64; for example 50.41 and 59.29

c) Any number between 144 and 169; for example 158.36 and 166.41

d) Any number between 2.25 and 6.25; for example 3.0 and 3.5

e) Any number between 20.25 and 30.25; for example 22.09 and 29.16

11. **a)** About 2.1 **b)** About 2.9

c) About 0.4 **d)** About 0.5

e) About 0.8 **f)** About 0.4

g) About 0.2 **h)** About 2.2

12. **a)** 0.6 **b)** 0.6

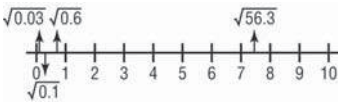
c) 1.8 **d)** 2.9

13. **a)** 1.3 cm **b)** About 2.7 cm

c) About 4.85 cm **d)** 0.7 cm

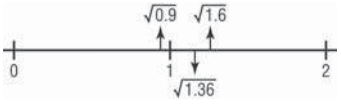
14. There is no limit to the number of decimals and fractions; for example 0.3025 and $\frac{61}{200}$

15.



16. **a)** $\sqrt{0.25}$, $\sqrt{0.5}$, $\sqrt{1.44}$, and $\sqrt{3.6}$ are correctly placed.

b)



17. **a)** $\sqrt{52.9} \doteq 7.2732$ **b)** $\sqrt{5.29} = 2.3$

c) $\sqrt{2.25} = 1.5$ **d)** $\sqrt{22.5} \doteq 4.7434$

18. **a)** The numbers are greater than 1.

b) The number must be 0 or 1.

c) The numbers are less than 1.

19. For example:

a) 0.64 **b)** 3

c) $\frac{2}{5}$ **d)** 15

20. **a)** 1.82 km **b)** 2.36 km

21. **a)** **i)** About 0.0707 **ii)** About 0.7071

iii) About 7.0711 **iv)** About 70.7107

v) About 707.1068

b) $\sqrt{0.000\,05} \doteq 0.007\,071$

$\sqrt{0.000\,0005} \doteq 0.000\,7071$

$\sqrt{50\,000\,000} \doteq 7071.0678$

$\sqrt{5\,000\,000\,000} \doteq 70\,710.678$

22. Yes. All numbers between 0.775 and 0.781 have squares between 0.6 and 0.61.

23. For example: (1.1, 0.2), (0.6, 0.2) and (0.6, 0.7)

24. **a)** About 7.8 cm

b) Doubling the side length would increase the area by a factor of 4.

Unit 1: Mid-Unit Review, page 21

1. **a)** $\sqrt{\frac{25}{36}} = \frac{5}{6}$ **b)** $\sqrt{0.36} = 0.6$

2. **a)** 1.96 **b)** $\frac{9}{64}$

c) $\frac{49}{16}$ **d)** 0.25

3. **a)** 0.2 **b)** $\frac{1}{4}$

c) 1.4 **d)** $\frac{2}{9}$

e) 1.3 **f)** $\frac{11}{7}$

g) 0.3 **h)** $\frac{17}{10}$

4. a) 1.8 **b)** 9.5

c) 1.6

5. a) 12.2 cm **b)** 48.8 cm

6. No, the student is incorrect. $\sqrt{0.16} = 0.4$

7. a) $\frac{9}{64}$ is a perfect square, since both 9 and 64 are perfect squares.

b) $3.6 = \frac{36}{10}$ is not a perfect square, since 10 is not a perfect square.

c) $\frac{6}{9}$ is not a perfect square, since 6 is not a perfect square.

d) $5.76 = \frac{576}{100}$ is a perfect square, since both 576 and 100 are perfect squares.

8. Estimates will vary, for example:

a) About 2.4 **b)** About 0.95

c) About 6.5 **d)** About 5.97

e) About 0.24 **f)** 0.3

9. a) About 3.0 cm

b) 4 cm

10. a) Correct **b)** About 1.3

c) Correct **d)** Correct

11. For example:

a) 20.25, 33.64 **b)** 0.5625, 0.64

c) 1.69, 1.7 **d)** 0.09, 0.1024

e) 22.09, 28.09 **f)** 0.0036, 0.0049

Unit 1: Start Where You Are, page 22

1. About 1385 cm^2

2. About 1546 cm^2

1.3 Surface Areas of Objects Made from Right Rectangular Prisms, page 30

4. a) 14 square units **b)** 18 square units

c) 22 square units **d)** 20 square units

e) 22 square units **f)** 26 square units

5. a) i) 18 cm^2 **ii)** 18 cm^2

iii) 18 cm^2

6. a) i) 20 cm^2 **ii)** 20 cm^2

iii) 22 cm^2

8. a) 68 cm^2 **b)** 144 cm^2

c) 255.5 cm^2

10. a) 165.03 m^2 **b)** $1609.20

11. 1346 m^2

12. a) 54 square units

b) 9 ways

c) i) 6 cubes **ii)** 12 cubes

iii) 8 cubes **iv)** 1 cube

v) 0 cubes

14. c) 22 cm^2, 24 cm^2, 26 cm^2

16. 110 m^2

17. a) The piece made from 3 cubes has surface area 14 cm^2; pieces made from 4 cubes have surface area 18 cm^2.

c) 68 faces will not be painted.

1.4 Surface Areas of Other Composite Objects, page 40

3. a) 121 cm^2 **b)** 117 cm^2

c) 283 cm^2 **d)** 360 cm^2

e) 256 cm^2

4. a) 58.1 cm^2 **b)** 62.1 m^2

5. a) About 21.9 m^2 **b)** About 58.3 cm^2

6. Including the bottom of base: About 707 cm^2

7. a) 35 m^2

8. a) 5.42 m^2

b) 2 cans of 1-L wood stain

9. a)

b) About 2081.3 cm^2

10. a) 2832.3 cm^2 **b)** 3652.1 cm^2

11. 1155 cm^2

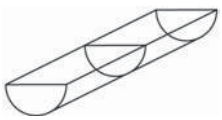
12. a) 61.1 m^2

13. a) 3456 cm^2 **b)** 4509 cm^2

14. About 10 700 cm^2

15. a) About 3336 cm^2

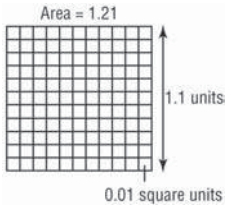
b) i)



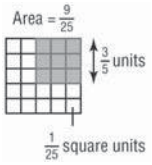
ii) About 4882 cm^2

Unit 1: Review, page 45

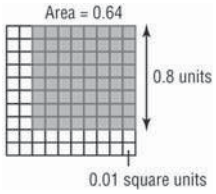
1. **a)** 1.1



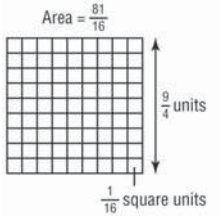
b) $\frac{3}{5}$



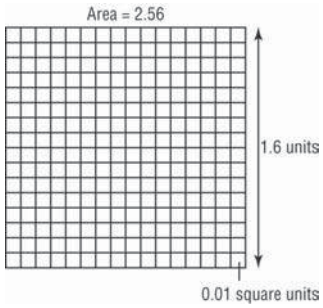
c) 0.8



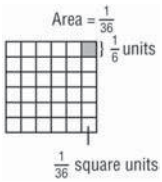
d) $\frac{9}{4}$



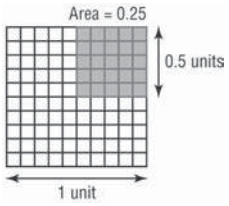
e) 1.6



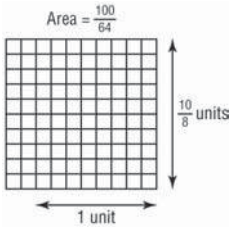
f) $\frac{1}{6}$



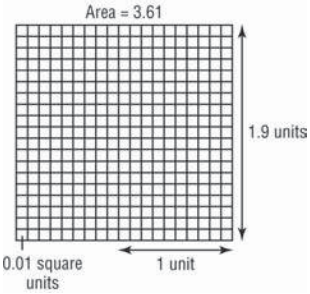
g) 0.5



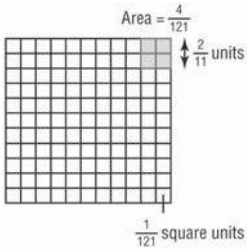
h) $\frac{10}{8} = \frac{5}{4}$



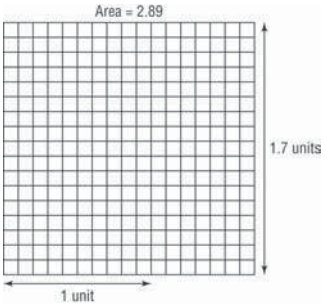
i) 1.9



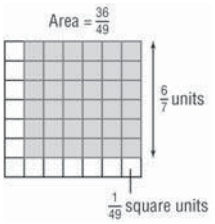
j) $\frac{2}{11}$



k) 1.7



l) $\frac{6}{7}$



2. **a)** $\frac{12}{5}$ **b)** $\frac{15}{8}$

c) $\frac{14}{9}$ **d)** $\frac{18}{11}$

e) 0.14 **f)** 0.17

g) 1.3 **h)** 2.1

3. **a)** $\frac{48}{120}$ is not a perfect square since neither 48 nor 120 are perfect squares.

b) 1.6 is not a perfect square since $1.6 = \frac{16}{10}$ and 10 is not a perfect square.

c) $\frac{49}{100} = \left(\frac{7}{10}\right)^2$ is a perfect square.

d) $0.04 = 0.2^2$ is a perfect square.

e) $\frac{144}{24} = 6$ is not a perfect square.

f) $2.5 = \frac{25}{10}$ is not a perfect square since 10 is not.

g) $\frac{50}{225}$ is not a perfect square since 50 is not.

h) $1.96 = 1.4^2$ is a perfect square.

i) $\frac{63}{28}$ simplifies to $\frac{9}{4}$, which is a perfect square.

4. **a)** $\frac{9}{25}$ **b)** 2.56

c) $\frac{81}{49}$ **d)** 0.64

5. **a)** 0.9 m **b)** 0.1 m

c) 2.2 cm **d)** 2.5 cm

e) 0.4 km **f)** 1.2 km

6. Estimates will vary, for example:

a) $\sqrt{3.8} \doteq 1.9$, using $\sqrt{1} = 1$ and $\sqrt{4} = 2$

b) $\sqrt{33.8} \doteq 5.8$, using $\sqrt{25} = 5$ and $\sqrt{36} = 6$

c) $\sqrt{133.8} \doteq 11.6$, using $\sqrt{121} = 11$ and $\sqrt{144} = 12$

d) $\sqrt{233.8} \doteq 15.3$, using $\sqrt{225} = 15$ and $\sqrt{256} = 16$

7. Estimates will vary, for example:

a) $\sqrt{\frac{77}{10}} \doteq \frac{14}{5}$, using $\sqrt{\frac{784}{100}} = \frac{14}{5}$

b) $\sqrt{\frac{18}{11}} \doteq \frac{14}{11}$, using $\sqrt{\frac{196}{121}} = \frac{14}{11}$

c) $\sqrt{\frac{15}{39}} \doteq \frac{15}{24}$, using $\sqrt{\frac{225}{576}} = \frac{15}{24}$

d) $\sqrt{\frac{83}{19}} \doteq \frac{9}{5}$, using $\sqrt{\frac{81}{25}} = \frac{9}{5}$

e) $\sqrt{\frac{28}{103}} \doteq \frac{5}{10}$, using $\sqrt{\frac{25}{100}} = \frac{5}{10}$

f) $\sqrt{\frac{50}{63}} \doteq \frac{7}{8}$, using $\sqrt{\frac{49}{64}} = \frac{7}{8}$

8. Estimates will vary, for example:

a) About 2.4 **b)** About 0.6

c) About 0.8 **d)** About 0.6

e) About 4.8 **f)** About 3

9. **a)** Correct **b)** Incorrect; $\sqrt{1.6} \doteq 1.3$

c) Incorrect; $\sqrt{156.8} \doteq 12.5$

d) Correct **e)** Correct

f) Incorrect; $\sqrt{0.7} \doteq 0.8$

10. $\sqrt{27.4}$, $\sqrt{60.8}$

11. **a)** $\sqrt{3.2}$, $\sqrt{2.3}$, $\sqrt{2.8}$, $\sqrt{1.2}$

b) $\sqrt{125.4}$, $\sqrt{134.5}$, $\sqrt{129.9}$

c) $\sqrt{12.9}$, $\sqrt{15.2}$

d) $\sqrt{5.7}$, $\sqrt{4.8}$, $\sqrt{3.2}$, $\sqrt{2.3}$, $\sqrt{2.8}$

e) $\sqrt{21.2}$, $\sqrt{23.1}$, $\sqrt{29.1}$

f) $\sqrt{237.1}$, $\sqrt{222.1}$, $\sqrt{213.1}$

12. **a)** About 3.9 cm **b)** About 3.5 cm

c) 8.5 cm

13. For example:

a) $\frac{1}{2}$ **b)** 0.0625

c) 1.97 **d)** $\frac{1}{25}$

14. **a)** **i)** About 0.0387 **ii)** About 0.3873

iii) About 3.8730 **iv)** About 38.7298

v) About 387.2983

15. **a)** 18 cm^2 **b)** 22 cm^2

c) 26 cm^2

16. **a)** 51.7 cm^2 **b)** 515.48 m^2

c) 253.28 m^2

17. **a)**

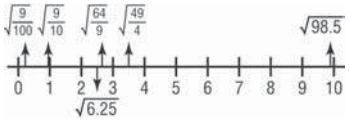
b) 14 824 cm^2

19. **a)** 940.2 cm^2 **b)** 1192.8 cm^2

20. **a)** 30.2 m^2 **b)** 2 containers; $39.90

Unit 1: Practice Test, page 48

1. **a)**



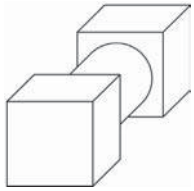
2. **a)** **i)** About 0.65 **ii)** 7.25
iii) 4.8 **iv)** 14.6
v) About 11.64
b) ii, iii, and iv are exact, i and v are approximate

3. For example
a) 0.25 **b)** 0.04

4. 8.67 km

5. **a)** 68.2 m^2 **b)** $49.84

6. **a)**



b) 229.7 cm^2

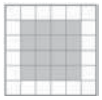
Unit 2 Powers and Exponent Laws, page 50

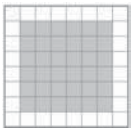
2.1 What is a Power?, page 55

4. **a)** 2^2 **b)** 3^2
c) 5^2

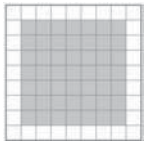
5. **a)** 3^3 **b)** 2^3
c) 5^3

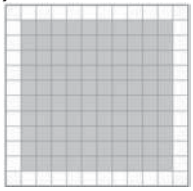
6. **a)** 4^2 **b)** 6×6



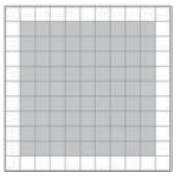


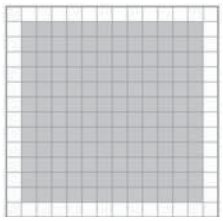
c) 49 **d)** 10^2





e) 81 **f)** 12×12





7. **a)** 2 **b)** 4
c) 8 **d)** –10
e) –6 **f)** 8

8. **a)** 5 **b)** 4
c) 1 **d)** 2
e) 9 **f)** 3

9. **a)** 3×3 **b)** $10 \times 10 \times 10 \times 10$
c) $8 \times 8 \times 8 \times 8 \times 8$ **d)** $(-6)(-6)(-6)(-6)(-6)$
e) $-6 \times 6 \times 6 \times 6 \times 6$ **f)** -4×4

10. **a)** 3^2 can be modelled by 9 unit square tiles arranged in a 3 by 3 square. 2^3 can be modelled by 8 unit cubes arranged in a 2 by 2 by 2 cube.
b) 3^2 represents the area of a square and 2^3 represents the volume of a cube.

11. $6^4 = 6 \times 6 \times 6 \times 6 = 1296$
$4^6 = 4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4096$

12. **a)** 4^4 **b)** 2^3
c) 5^6 **d)** 10^3
e) $(-79)^2$ **f)** $-(-2)^8$

13. **a)** $5^2 = 25$ **b)** $3^4 = 81$
c) $10^5 = 100\,000$ **d)** $-9^3 = -729$
e) $(-2)^3 = -8$ **f)** $-(-4)^3 = 64$
g) $(-5)^4 = 625$ **h)** $-5^4 = -625$
i) $-(-5)^4 = -625$

14. **a)** 8 **b)** 1 000 000
c) 3 **d)** –343
e) –343 **f)** 256
g) –256 **h)** –1296
i) 1296 **j)** –1296
k) –125 **l)** –256

15. **a)** **i)** $3^2 = 9$ **ii)** $13.95
b) **i)** $4^2 = 16$ **ii)** $8.32

16. **a)** 531 441 **b)** –823 543
c) 48 828 125 **d)** –1 048 576
e) 43 046 721 **f)** 8 388 608

17. **a)** **i)** $4 \times 4 \times 4 = 64$ **ii)** $-4 \times 4 \times 4 = -64$
iii) $-(-4 \times 4 \times 4) = 64$
iv) $(-4 \times 4 \times 4) = -64$
b) i and iii are positive. ii and iv are negative.
c) **i)** $4 \times 4 = 16$ **ii)** $-4 \times 4 = -16$
iii) $-(-4 \times 4) = 16$ **iv)** $(-4 \times 4) = -16$
d) i and iii are positive. ii and iv are negative.

18. a) All three expressions are the same.
For $(-3)^5$, the negative sign is part of the base, –3.
For (-3^5), the brackets serve no purpose.
b) -4^6 and (-4^6) are the same.
For -4^6, the negative sign is not part of the base.
For $(-4)^6$, the negative sign is part of the base, –4.

19. a) When the exponent is an odd number, for example: $(-3)^5$, $(-6)^3$, $(-2)^{17}$
b) When the exponent is an even number, for example: $(-3)^6$, $(-6)^2$, $(-2)^{10}$

20. a) 2^2 **b)** 2^4
c) 2^6 **d)** 2^8
e) 2^5 **f)** 2^7

21. a) **i)** $2^4, 4^2, 16^1$ **ii)** $3^4, 9^2, 81^1$
iii) $2^8, 4^4, 16^2, 256^1$

22. a) Same: same numbers
Different: base and exponent interchanged
b) **i)** 3^2 **ii)** 2^5
iii) 3^4 **iv)** 4^5

23. $3^5, 6^3, 3^4, 5^2$

24. a) $64 = 8^2$ **b)** $49 = 7^2$
c) $36 = 6^2$ **d)** $25 = 5^2$
e) $16 = 4^2$ **f)** $9 = 3^2$
g) $4 = 2^2$ **h)** $1 = 1^2$
Each number of squares is a square number that decreases as the size of the squares increases.

2.2 Powers of Ten and the Zero Exponent, page 61

4. a) 1 **b)** 1
c) 1 **d)** 1

5. a) 1 **b)** –1
c) –1 **d)** 1

6. a) 10^3 **b)** 10^5
c) 10^9 **d)** 10^4
e) 10^{11}

7. For example: 10^0, 1^4, $(-6)^0$

8. a) 10 000 000 **b)** 100
c) 1 **d)** 10 000 000 000
e) 10 **f)** 1 000 000

9. a) 6×10^9 **b)** 2×10^2
c) $(5 \times 10^4) + (1 \times 10^3) + (4 \times 10^2) + (1 \times 10^1) + (5 \times 10^0)$
d) $(6 \times 10^7) + (7 \times 10^5) + (2 \times 10^3) + (8 \times 10^0)$
e) $(3 \times 10^5) + (2 \times 10^3) + (4 \times 10^2) + (1 \times 10^1) + (1 \times 10^0)$
f) $(2 \times 10^6) + (8 \times 10^0)$

10. a) 70 000 000 **b)** 39 057
c) 800 500 200 **d)** 98 000 000 001
e) 1 000 000 000 000 000 **f)** 904 031

11. 5×10^8; 4×10^4; 3×10^6; $(1 \times 10^4) + (7 \times 10^3)$; $(1 \times 10^5) + (3 \times 10^4)$; 6×10^2

12. Negative bases may vary.

Exponent	Power	Standard Form
5	$(-3)^5$	–243
4	$(-3)^4$	81
3	$(-3)^3$	–27
2	$(-3)^2$	9
1	$(-3)^1$	–3
0	$(-3)^0$	1

13. a) 4667 > 4327 **b)** 24 240 > 2432
c) 70 007 000 > 777 777

14. a) 1 billion = 10^9; 100 000 = 10^5; 1000 = 10^3; 1 = 10^0; 100 = 10^2; 10 million = 10^7
b) $10^0, 10^2, 10^3, 10^5, 10^7, 10^9$
c) You only need to order or compare the exponents.

15. One trillion is 10^{12}, one quadrillion is 10^{15}, and one quintillion is 10^{18}.

2.3 Order of Operations with Powers, page 66

3. a) 10 **b)** 8
c) 16 **d)** 4
e) 8 **f)** 0
g) 36 **h)** 4
i) –14 **j)** –12

4. a) 40 **b)** 50
c) 1000 **d)** 100
e) –200 **f)** –10
g) –8 **h)** 1

5. a) 0 **b)** –1
c) 35 **d)** 125
e) –8 **f)** 1
g) –64 **h)** 8

6. a) **i)** $4^2 + 4^3 = 80$ **ii)** $5^3 + 5^6 = 15\,750$
b) **i)** $6^3 - 6^2 = 180$ **ii)** $6^3 - 6^5 = -7560$

7. Correction:
$= 9 + 4 \times 16 + 36$ $(-6)^2$ should be 36, not –36.
$= 9 + 64 + 36$ Calculate 4×16 first, not
$= 109$ $9 + 4$.

8. a) Multiply: (7)(4); 3 **b)** Subtract: (2 – 5); 54
c) Evaluate: $(-3)^2$; 37 **d)** Evaluate: 4^0; –8
e) Divide: [10 ÷ (–2)]; 4
f) Divide: [18 ÷ (–6)]; –54

10. a) –392 **b)** –216
c) –8 **d)** 9
e) 16 **f)** 1

11. The order of operations matches the order in which the multiplication and division are written.
$-4^3 \times 10 - 6 \div 2 = -64 \times 10 - 3 = -640 - 3 = -643$

12. $1035

13. 5 different answers:
$2^3 + (3 \times 4)^2 - 6 = 8 + 144 - 6 = 146$;
$(2^3 + 3) \times 4^2 - 6 = 170$; $2^3 + 3 \times (4^2 - 6) = 38$;
$(2^3 + 3 \times 4^2) - 6 = 50$; $(2^3 + 3 \times 4)^2 - 6 = 394$;
$2^3 + (3 \times 4^2 - 6) = 50$

14. **a)** 43, 43 **b)** 13, 25
c) 191, 191 **d)** 72, 7776
e) 119, 20

15. The student multiplied 3 by 4 instead of squaring 4 first. This does not affect the answer because any nonzero number with exponent 0 equals 1.
A more efficient solution:
$-(24 - 3 \times 4^2)^0 \div (-2)^3 = -(1) \div (-8) = \frac{1}{8}$

16. **a)** –197 568 **b)** –92 000
c) –4 **d)** 40.5
e) 169 744 **f)** –1 185 191

17. $(30 + 9 \times 11 \div 3)^0$

18. **a)** Marcia
b) Robbie forgot that the square of –4 is positive.
Nick forgot that the square of –6 is positive.

19. $84.81

20. **a)** $(10 + 2) \times 3^2 - 2 = 106$
b) $10 + 2 \times (3^2 - 2) = 24$
c) $(10 + 2) \times (3^2 - 2) = 84$
d) $(10 + 2 \times 3)^2 - 2 = 254$

21. **a)** $20 \div (2 + 2) \times 2^2 + 6 = 26$
b) $20 \div 2 + 2 \times (2^2 + 6) = 30$
c) $20 \div (2 + 2 \times 2^2) + 6 = 8$
d) $(20 \div 2 + 2) \times (2^2 + 6) = 120$

22. No, Blake did not win the prize.
$5 \times 4^2 - (2^3 + 3^3) \div 5$
$= 5 \times 16 - (8 + 27) \div 5$
$= 80 - 35 \div 5$
$= 80 - 7$
$= 73$

24. **a)** $1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 = 21^2$
$1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 = 28^2$
b) $3^2 - 1^2 = 2^3$; $6^2 - 3^2 = 3^3$; $10^2 - 6^2 = 4^3$;
$15^2 - 10^2 = 5^3$; $21^2 - 15^2 = 6^3$; $28^2 - 21^2 = 7^3$;
$36^2 - 28^2 = 8^3$

25. For example, use –2 and 3.
a) $(-2)^2 + 3^2 = 4 + 9 = 13$ **b)** $(-2 + 3)^2 = 1^2 = 1$
c) The answers are different.
d) I do not agree. The two expressions are not equal because the operations are performed in different orders.

26. Answers may vary. For example:
$4 \div 4 + 4 - 4 = 1$; $4 \div 4 + 4 \div 4 = 2$;
$4 - 4 + 4 - 4^0 = 3$; $4^0 + 4^0 + 4^0 + 4^0 = 4$;
$4 - 4 + 4 + 4^0 = 5$; $4 + 4 - 4^0 - 4^0 = 6$;
$4 + 4^0 + 4^0 + 4^0 = 7$; $(4 + 4) \times 4 \div 4 = 8$;
$4 \div 4 + 4 + 4 = 9$

27. **a)** **i)** $2^4 = 16$ **ii)** $2^2 = 4$
iii) $2^5 = 32$ **iv)** $2^3 = 8$
b) **i)** $28 = 2^4 + 2^3 + 2^2$
ii) $12 = 2^3 + 2^2$ **iii)** $25 = 2^4 + 2^3 + 2^0$
iv) $31 = 2^4 + 2^3 + 2^2 + 2^1 + 2^0$
v) $50 = 2^5 + 2^4 + 2^1$ **vi)** $75 = 2^6 + 2^3 + 2^1 + 2^0$
c) For example:
i) $28 = 3^3 + 3^0$ **ii)** $12 = 3^2 + 3^1$
iii) $25 = 3^2 + 3^2 + 3^1 + 3^1 + 3^0$
iv) $31 = 3^3 + 3^1 + 3^0$
v) $50 = 3^3 + 3^2 + 3^2 + 3^1 + 3^0 + 3^0$
vi) $75 = 3^3 + 3^3 + 3^2 + 3^2 + 3^1$

Unit 2: Mid-Unit Review, page 69

1. **a)** 196 **b)** 5
c) –512 **d)** –256
e) –216 **f)** 256

2.

	Power	Base	Exponent	Repeated Multiplication	Standard Form
a)	4^3	4	3	4 × 4 × 4	64
b)	2^5	2	5	2 × 2 × 2 × 2 × 2	32
c)	8^6	8	6	8 × 8 × 8 × 8 × 8 × 8	262 144
d)	7^2	7	2	7 × 7	49
e)	3^4	3	4	3 × 3 × 3 × 3	81

3. **a)**

Power of 7	Standard Form
7^1	7
7^2	49
7^3	343
7^4	2401
7^5	16 807
7^6	117 649
7^7	823 543
7^8	5 764 801

b) The pattern in the ones digits is 7, 9, 3, 1, 7, 9, 3, 1, …

c)

Power of 7	Standard Form
7^9	40 353 607
7^{10}	282 475 249
7^{11}	1 977 326 743

d) **i)** 1 **ii)** 9
iii) 7 **iv)** 9

4. **a)** 1 000 000 **b)** 1
c) 100 000 000 **d)** 10 000

5. **a)** 10^9 **b)** 10^0
c) 10^2 **d)** 10^5

6. **a)** 1 **b)** 1

c) -1 **d)** 1

7. 10^4 m^2

8. **a)** Subtract: $(-21 - 6)$; 743

b) Multiply: (2×3); 33

c) Subtract: $[5 - (-4)]$; 648

d) Evaluate the power with exponent 0; 1

e) Subtract: $(3 - 5)$; 8

f) Subtract: $(7 - 4)$; -57

9. Sophia is correct. Victor might have included the negative sign in the power -2^4 and evaluated it as 16.

10. $(-3)^3 = -27$, not 27; $(-9)^0 = 1$, not -1

Correction:

$(-2)^4 - (-3)^3 \div (-9)^0 \times 2^3$

$= 16 - (-27) \div 1 \times 8$

$= 16 - (-27) \times 8$

$= 16 - (-216)$

$= 232$

Unit 2: Start Where You Are, page 70

1. **a)** 64.8 **b)** 162

c) 15 **d)** -9

e) 2

2. **a)** 1 **b)** 1.0125

c) 1

2.4 Exponent Laws I, page 76

4. **a)** 5^9 **b)** 10^{13}

c) $(-3)^6$ **d)** 21^{10}

e) $(-4)^4$ **f)** 6^{15}

g) 2^4 **h)** $(-7)^3$

5. **a)** 4^2 **b)** 8^3

c) 15^{10} **d)** $(-6)^5$

e) 2^2 **f)** $(-10)^6$

g) 6^4 **h)** $(-1)^1$

6. **a)** **i)** 1 **ii)** 1

iii) 1 **iv)** 1

7. **a)** **i)** $3^{13} = 1\,594\,323$ **ii)** $3^{13} = 1\,594\,323$

8. **a)** 3^2 **b)** $(-4)^{11}$

c) 6^1 **d)** 4^0

e) $(-3)^4$

9. **a)** **i)** $(-6)^1 = -6$ **ii)** $(-6)^1 = -6$

10. **a)** $10^4 + 10^4 = 20\,000$ **b)** $10^6 - 10^3 = 999\,000$

c) $10^{11} - 10^9 = 99\,000\,000\,000$

d) $10^1 + 10^7 = 10\,000\,010$

e) $10^6 = 1\,000\,000$ **f)** $10^0 = 1$

g) $10^6 = 1\,000\,000$ **h)** $10^5 = 100\,000$

i) $10^5 = 100\,000$ **j)** $10^2 + 10^2 = 200$

11. **a)** 32 **b)** 248

12. **a)** 10^4 m $\times$ 10^3 m $= 10^7$ m^2, or 10 000 000 m^2

b) $2(10^4 \text{ m} + 10^3 \text{ m}) = 22\,000$ m

c) **i)** 10^7 m $\times$ 10^0 m; 10^6 m $\times$ 10^1 m; 10^5 m $\times$ 10^2 m; 10^4 m $\times$ 10^3 m

ii) $2(10^7 \text{ m} + 10^0 \text{ m}) = 20\,000\,002$ m

$2(10^6 \text{ m} + 10^1 \text{ m}) = 2\,000\,020$ m

$2(10^5 \text{ m} + 10^2 \text{ m}) = 200\,200$ m

$2(10^4 \text{ m} + 10^3 \text{ m}) = 22\,000$ m

13. **a)** -32 **b)** 91

c) 21 **d)** -12

e) 80 **f)** -272

g) -10

15. **a)** The student multiplied the exponents instead of adding them. Correction: $4^3 \times 4^4 = 4^7$

b) The student divided the exponents instead of subtracting them.

Correction: $\dfrac{(-7^6)}{(-7^3)} = \dfrac{-7^6}{-7^3} = \dfrac{7^6}{7^3} = 7^3$

c) The student used the exponent laws but the bases are different. Correction: $3^2 \times 2^3 = 9 \times 8 = 72$

d) The student multiplied the exponents in the divisor instead of adding them.

Correction: $\dfrac{5^8}{5^4 \times 5^2} = \dfrac{5^8}{5^6} = 25$

e) The student added all the exponents even though only 2 of them were parts of products of powers. Correction: $1^2 + 1^3 \times 1^2 = 1^2 + 1^5 = 1 + 1 = 2$

16. **a)** $10^2 \times 10^1 = 10^3$ **b)** 1000 times as large

17. **a)** **i)** 150 **ii)** 3125

b) Part ii is a product of two powers that can be simplified using an exponent law.

18. **a)** **i)** 48 **ii)** 4

b) Part ii is a quotient of two powers that can be simplified using an exponent law.

19. Since the base is negative, the power is negative when the exponent is an odd number.

a) $(-2)^5$ **b)** $(-2)^5$

c) $(-2)^2 = 4$ **d)** $(-2)^0 = 1$

e) $(-2)^2 = 4$ **f)** $(-2)^1$

20. For example: $4^2 \times 2^2$

21. **a)** 1 km $= 10^3$ m $= 10^3 \times 10^2$ cm $= 10^5$ cm

b) 1 km $= 10^5$ cm $= 10^5 \times 10^1$ mm $= 10^6$ mm

c) 10^5 m $= (10^5 \div 10^3)$ km $= 10^2$ km

d) 10^9 mm $= (10^9 \div 10^3)$ m $= 10^6$ m

22. **a)** 10^2 km^2 $= (10^3 \times 10^3) \times 10^2$ m^2 $= 10^8$ m^2

b) 10^6 cm^2 $= 10^6 \div (10^2 \times 10^2)$ m^2 $= 10^2$ m^2

c) 10^6 cm^2 $= (10^1 \times 10^1) \times 10^6$ mm^2 $= 10^8$ mm^2

d) 1 km^2 $= (10^3 \times 10^3) \times (10^2 \times 10^2)$ cm^2 $= 10^{10}$ cm^2

2.5 Exponent Laws II, page 84

4. **a)** $6^3 \times 4^3$ **b)** $2^4 \times 5^4$

c) $(-2)^5 \times 3^5$ **d)** $25^2 \times 4^2$

e) $11^1 \times 3^1$ **f)** $(-3)^3 \times (-2)^3$

5. a) $8^3 \div 5^3$ **b)** $21^4 \div 5^4$

c) $(-12)^5 \div (-7)^5$ **d)** $\frac{10^3}{3^3}$

e) $\frac{1^2}{3^2}$ **f)** $\frac{27^4}{100^4}$

6. a) 3^8 **b)** 6^9 **c)** 5^3

d) 7^0 **e)** -8^4 **f)** $(-3)^8$

7. $(2^4)^2 = 2^8$; $(2^2)^4 = 2^8$; The results are the same because each expression is the product of 8 factors of 2.

8. a) $3^3 \times (-5)^3$ **b)** $-2^5 \times 4^5$

c) $\frac{2^4}{3^4}$ **d)** $\frac{(-7)^2}{(-2)^2}$

e) $-(-10)^3 \times 3^3$ **f)** $16^2 \div 9^2$

9. Since $-5^2 = -25$, the base is negative. The power $(-5^2)^3$ is negative when the exponent is an odd number.

10. a) I multiplied first because it was easier than using the power of a product law: $(3 \times 2)^3 = 6^3 = 216$

b) I multiplied first because it was easier than using the power of a product law:
$[(-2) \times 4]^2 = (-8)^2 = 64$

c) I divided first because it was easier than using the power of a quotient law: $\left(\frac{9}{-3}\right)^3 = (-3)^3 = -27$

d) I divided first because it was easier than using the power of a quotient law: $\left(\frac{8}{2}\right)^2 = 4^2 = 16$

e) I used the zero exponent law: $(12^8)^0 = 1$

f) I used the power of a power law:
$[(-4)^2]^2 = (-4)^4 = 256$

11. $[(-2)^3]^4 = (-2)^{12}$; $(-2)^{12}$ is positive because its exponent is even. $[(-2)^3]^5 = (-2)^{15}$; $(-2)^{15}$ is negative because its exponent is odd.

12. $-(4^2)^3 = -4096$; $(-4^2)^3 = -4096$; $[(-4)^2]^3 = 4096$

13. a) i) $(4 \times 3)^3 = 12^3 = 1728$
$(4 \times 3)^3 = 4^3 \times 3^3 = 64 \times 27 = 1728$

b) i) $[(-2) \times (-5)]^2 = 10^2 = 100$
$[(-2) \times (-5)]^2 = (-2)^2 \times (-5)^2 = 4 \times 25 = 100$

c) i) $\left(\frac{6}{2}\right)^4 = 3^4 = 81$

$\left(\frac{6}{2}\right)^4 = \frac{6^4}{2^4} = \frac{1296}{16} = 81$

d) i) $\left(\frac{14}{2}\right)^0 = 7^0 = 1$

$\left(\frac{14}{2}\right)^0 = \frac{14^0}{2^0} = 1$

e) i) $[(-5)^2]^2 = 25^2 = 625$
$[(-5)^2]^2 = (-5)^4 = 625$

f) i) $(2^5)^3 = 32^3 = 32\,768$
$(2^5)^3 = 2^{15} = 32\,768$

14. a) 729 **b)** 256

c) 64 **d)** 1 000 000

e) 1 000 000 000 000 **f)** 144

g) 1 **h)** –512

15. a) The student multiplied the bases and multiplied the powers.
$(3^2 \times 2^2)^3 = 3^6 \times 2^6 = 729 \times 64 = 46\,656$

b) The student added the exponents instead of multiplying them. $[(-3)^2]^3 = (-3)^6 = 729$

c) The student might have thought that 6^1 is 1.
$\left(\frac{6^2}{6^1}\right)^2 = (6^1)^2 = 6^2 = 36$

d) The student did not simplify the powers in the brackets correctly.
$(2^6 \times 2^2 \div 2^4)^3 = (2^{6+2-4})^3 = (2^4)^3 = 2^{12} = 4096$

e) The student multiplied the powers in the brackets instead of adding them.
$(10^2 + 10^3)^2 = (100 + 1000)^2 = 1100^2 = 1\,210\,000$

16. a) 1 047 951 **b)** 28

c) 4100 **d)** 46 720

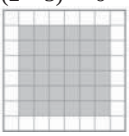
e) –255 **f)** 1 006 561

17. a) 1015 **b)** –59 045

c) 1033 **d)** 59 053

e) –5 **f)** 60 073

18. a) i) $(2 \times 3)^2 = 6^2$

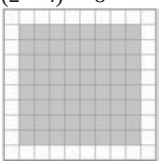


ii) $(2 \times 3)^2 = 2^2 \times 3^2$

iii)

iv) Both rectangles have an area of 36 but they have different dimensions.

b) i) $(2 \times 4)^2 = 8^2$

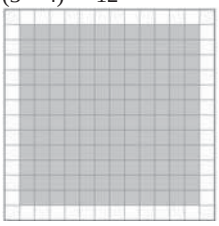


ii) $(2 \times 4)^2 = 2^2 \times 4^2$

iii)

iv) Both rectangles have an area of 64 but they have different dimensions.

c) **i)** $(3 \times 4)^2 = 12^2$

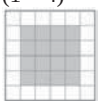


ii) $(3 \times 4)^2 = 3^2 \times 4^2$

iii)

iv) Both rectangles have an area of 144 but they have different dimensions.

d) **i)** $(1 \times 4)^2 = 4^2$



ii) $(1 \times 4)^2 = 1^2 \times 4^2$

iii)

iv) Both rectangles have an area of 16 but they have different dimensions.

19. **a)** 255 583 **b)** 254 819 593
c) 2 097 152 **d)** 1631
e) 6560 **f)** 54 899

20. **a)** **i)** 9^2 **ii)** $(3 \times 3)^2$ **iii)** 3^4
b) **i)** 8^2 **ii)** $(2 \times 4)^2$ **iii)** 2^6

21. **a)** 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096

b) **i)** $2^5 \times 2^6 = 2048$ **ii)** $2^4 \times 2^3 \times 2^5 = 4096$

iii) $2^{10} \div 2^7 = 8$ **iv)** $\frac{2^4 \times 2^8}{2^{10}} = 4$

v) $(2^3 \times 2^2)^3 = 32\,768$

vi) $\left(\frac{2^8}{2^6}\right)^4 = 256$

Unit 2: Review, page 87

1. **a)** $4 \times 4 \times 4 = 64$ **b)** $7 \times 7 = 49$
c) $-(-2)(-2)(-2)(-2)(-2) = 32$
d) $-3 \times 3 \times 3 \times 3 = -81$
e) $-1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 = -1$
f) $(-1)(-1)(-1)(-1)(-1)(-1)(-1)(-1) = 1$

2. 2^2 can be modelled as the area of a square with side length 2 units. 2^3 can be modelled as the volume of a cube with edge length 2 units.

3. **a)** $3^6 = 729$ **b)** $(-8)^3 = -512$
c) $-2^7 = -128$ **d)** $12^2 = 144$
e) $4^5 = 1024$ **f)** $(-5)^4 = 625$

4. 5^8 means $5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 = 390\,625$
8^5 means $8 \times 8 \times 8 \times 8 \times 8 = 32\,768$

5. 16 min

6. **a)** $-4^2 = -16$; $(-4)^2 = 16$
The values are different. The brackets indicate that the negative sign is included in the base.

b) $-2^3 = -8$; $(-2)^3 = -8$
The values are the same. The brackets indicate that the negative sign is included in the base.

7. **a)** **i)** –9 **ii)** –9
iii) –9 **iv)** 9

b) **ii)** The brackets indicate that the negative sign is not part of the base.
iii) The brackets indicate that the first negative sign is not part of the base and the second negative sign is part of the base.
iv) The brackets indicate that the negative sign is part of the base.

8. **a)** 10^8 **b)** 10^4
c) 10^0 **d)** 10^9
e) 10^3

9. **a)** 7×10^8
b) $(3 \times 10^2) + (4 \times 10^1) + (5 \times 10^0)$
c) $(8 \times 10^4) + (2 \times 10^1) + (7 \times 10^0)$

10. **a)**

Power	Repeated Multiplication	Standard Form
3^5	$3 \times 3 \times 3 \times 3 \times 3$	243
3^4	$3 \times 3 \times 3 \times 3$	81
3^3	$3 \times 3 \times 3$	27
3^2	3×3	9
3^1	3	3

b) The exponents are decreasing by 1; the number of factors is decreasing by 1; each number in standard form is divided by 3 to get the number below it.

c) $3^0 = 1$

11. **a)** $10^4 \div 10^2 = 10^2$, or 100 times as high
b) $10^{12} \div 10^7 = 10^5$, or 100 000 times as great

12. **a)** 4729 **b)** 300 208

13. **a)** 90 **b)** –48
c) 900 **d)** 600

14. **a)** 89 **b)** 175
c) 0 **d)** 26

e) 73 **f)** 40 000

15. a) i) 1000 **ii)** 2000
iii) 4000 **iv)** 8000

b) i) $1000 \times 2^4 = 16\,000$ **ii)** $1000 \times 2^6 = 64\,000$
iii) $1000 \times 2^9 = 512\,000$
iv) $1000 \times 2^{12} = 4\,096\,000$

16. 6 different answers:
$4^3 - (2 \times 3)^4 + 11 = -1221$; $(4^3 - 2) \times 3^4 + 11 = 5033$;
$(4^3 - 2 \times 3)^4 + 11 = 11\,316\,507$
$4^3 - (2 \times 3^4 + 11) = -109$; $4^3 - 2 \times (3^4 + 11) = -120$;
$4^3 - (2 \times 3)^4 + 11 = -87$

17. The student incorrectly applied the exponent law when the bases, (–2) and 2, are not the same. Also, $-9 \div (-3)$ is 3, not –3. Correction:
$(-2)^2 \times 2^3 - 3^2 \div (-3) + (-4)^2$
$= 4 \times 8 - 9 \div (-3) + 16$
$= 32 - (-3) + 16$
$= 35 + 16$
$= 51$

18. a) $5^7 = 78\,125$ **b)** $(-2)^5 = -32$
c) $3^6 = 729$ **d)** $-10^4 = -10\,000$

19. $10^{22} = 10\,000\,000\,000\,000\,000\,000\,000$

20. a) $7^2 = 49$ **b)** $(-10)^6 = 1\,000\,000$
c) $8^2 = 64$ **d)** $-6^3 = -216$

21. a) No, the laws of exponents cannot be used because the powers have different bases.
One can only use the exponent laws to simplify power expressions with the same base.

b) Yes, even though these powers have different bases, both bases are powers of 3:
$27^2 \div 9^2 = 3^6 \div 3^4$

22. a) The student divided the exponents instead of subtracting them. $(-3)^6 \div (-3)^2 = (-3)^4 = 81$

b) The student misread the addition sign as a multiplication sign.
$(-4)^2 + (-4)^2 = 16 + 16 = 32$

c) After the first step, the student divided the exponents instead of subtracting them.
$$\frac{(-5)^2 \times (-5)^4}{(-5)^3 \times (-5)^0} = \frac{(-5)^6}{(-5)^3} = (-5)^3 = -125$$

23. a) $3^3 \times 5^3 = 3375$ **b)** $12^5 \div 3^5 = 1024$
c) $(-4)^4 \times 2^4 = 4096$ **d)** $63^0 \times 44^0 = 1$
e) $\frac{3^5}{2^5} = \frac{243}{32}$, or 7.593 75
f) $\frac{15^2}{2^2} = \frac{225}{4}$, or 56.25

24. a) 3^6 **b)** 4^0
c) $(-2)^9$ **d)** 5^{10}

25. a) i) $(5 \times 3)^3 = 15^3 = 3375$
ii) $(5 \times 3)^3 = 5^3 \times 3^3 = 3375$

b) i) $(3 \times 3)^4 = 9^4 = 6561$
ii) $(3 \times 3)^4 = 3^4 \times 3^4 = 6561$

c) i) $(8 \div 2)^5 = 4^5 = 1024$
ii) $(8 \div 2)^5 = 8^5 \div 2^5 = 1024$

d) i) $\left(\frac{9}{3}\right)^2 = 3^2 = 9$ **ii)** $\left(\frac{9}{3}\right)^2 = \frac{9^2}{3^2} = 9$

e) i) $(2^3)^4 = 8^4 = 4096$ **ii)** $(2^3)^4 = 2^{12} = 4096$

f) i) $(6^2)^0 = 36^0 = 1$ **ii)** $(6^2)^0 = 6^0 = 1$

26. a) $6^7 = 279\,936$ **b)** $(-11)^2 = 121$
c) $3^6 = 729$ **d)** $5^0 = 1$
e) $(-4)^3 = -64$ **f)** $10^1 = 10$

27. a) 33 **b)** $\frac{8}{3}$
c) 186 623 **d)** 199 065.6

Unit 2: Practice Test, page 90

1. a) $3^3 \times 4^3$ **b)** $(-5)^4 \times 2^4$
c) $\frac{1^4}{4^4}$ **d)** $-\frac{9^3}{3^3}$

2. a) -2^9 **b)** 6^0
c) $(-5)^6$ **d)** $-(-3)^8$

3. a) 1296 **b)** $\frac{1}{32} = 0.031\,25$
c) 1 **d)** 729

4. The value of a power with a negative base is positive when the exponent is an even number, and is negative when the exponent is an odd number.
For example: $(-3)^2 = (-3) \times (-3) = 9$
$(-3)^3 = (-3) \times (-3) \times (-3) = -27$

5. The area of the diamond is: 27 m × 27 m = 729 m^2, which is less than 1000 m^2.

6. The brackets are not necessary because the order of operations ensures that the multiplication and division are performed before the subtraction.
$(-3^5 \times 10) - (9 \div 3) = (-243 \times 10) - (9 \div 3) =$
$-2430 - 3 = -2433$

7. a) $(2^3 + 4)^2$ was calculated as $(2^3 + 4) \times 2$.
b) The answer –1440 is correct.
c) $(-10)^3$ was evaluated as 1000.
d) The brackets of $(5 + 5)^2$ were ignored, so $(-10)^3$ was divided by 5 and then 5^2 was added.

8. a) 625; The simplified expression $(-5)^{3+2-1} = (-5)^4$ has an even exponent, so the value will be positive.
b) 1; A power with an exponent of 0 gives a value of 1, so the answer will be positive.
c) The simplified expression $(-1)^{2+4-3-2} = (-1)^1$ has an odd exponent, so the answer will be negative.

d) 4352; Each power in the simplified expression $(-4)^6 + (-4)^4$ has an even exponent, so the value will be positive.

Unit 3 Rational Numbers, page 92

3.1 What Is a Rational Number?, page 101

5. $\frac{-3}{2} = -\frac{3}{2} = \frac{3}{-2}$; $\frac{-2}{3} = -\frac{2}{3} = \frac{2}{-3}$

6. **a)** $-\frac{7}{9}, \frac{-7}{9}$ **b)** $-\frac{5}{3}, \frac{5}{-3}$

c) $\frac{-6}{11}, \frac{6}{-11}$

7. **a)** 1.2 **b)** –1.2

c) 2.25 **d)** $-1.8\overline{3}$

8. **a)** A: –7.9, B: –7.2 **b)** C: –4.4, D: –3.2

c) J: –0.7, K: –0.2

d) G: –15.37, H: –15.32

9. **a)** B: –7.2 **b)** D: –3.2

c) K: –0.2 **d)** H: –15.32

10. **a)** E: $-\frac{45}{4}$, F: $-\frac{43}{4}$ **b)** L: $-\frac{41}{8}$, M: $-\frac{23}{4}$

c) N: $-\frac{25}{6}$, P: $-\frac{11}{3}$ **d)** Q: $-\frac{9}{16}$, R: $-\frac{3}{16}$

11. **a)** E: $-\frac{45}{4}$ **b)** M: $-\frac{23}{4}$

c) N: $-\frac{25}{6}$ **d)** Q: $-\frac{9}{16}$

12. Answers will vary. For example:

a) 3.8, 3.9, 4.1 **b)** –1.2, –1.1, –0.6

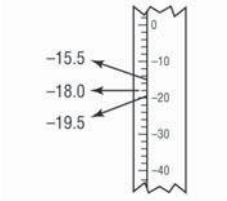
c) –4.4, –4.3, –4.1 **d)** –5.4, –5.1, –4.8

e) –3.2, –0.1, 4.7 **f)** 4.3, 2.1, –2.9

g) –5.63, –5.66, –5.68

h) –2.982, –2.987, –2.989

13. **a)** *See diagram below.*



b) No, the temperature in the freezer may be above –18°C.

14. Answers will vary. For example:

a) $\frac{7}{8}, \frac{9}{8}, \frac{11}{8}$ **b)** $\frac{11}{10}, \frac{3}{10}, -\frac{13}{10}$

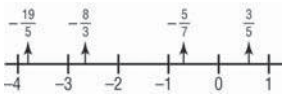
c) $-\frac{179}{48}, -\frac{89}{24}, -\frac{177}{48}$

d) $-\frac{3}{8}, -\frac{1}{4}, -\frac{3}{16}$ **e)** 0.25, $\frac{1}{3}, \frac{5}{12}$

f) –0.27, $\frac{7}{24}$, –0.29 **g)** $-\frac{71}{25}, -\frac{72}{25}, -\frac{74}{25}$

h) $5\frac{16}{25}, 5\frac{17}{25}, 5\frac{19}{25}$

15.



16. **a)** 2.34 **b)** –2.3

c) 1.4 **d)** 3.96

e) –5.6 **f)** $2.8\overline{6}$

17. **a)** $\frac{3}{5}$ **b)** $-1\frac{7}{8}$

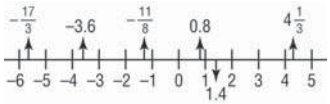
c) $-\frac{13}{5}$ **d)** $-\frac{11}{3}$

18. **a)** $\frac{6}{7}$ **b)** $-\frac{3}{4}$

c) $-\frac{6}{7}$ **d)** $\frac{5}{9}$

19. The statement is true when both numbers are positive.

20. **a)**



b) $-\frac{17}{3}$, –3.6, $-\frac{11}{8}$ **c)** $-\frac{11}{8}$, 0.8, 1.4, $4\frac{1}{3}$

d) Answers will vary. For example:

–4.5, $-2\frac{1}{3}$, –0.3, 1.1, $3\frac{5}{8}$

21. **a)** $-\frac{5}{7} < -\frac{4}{7}$ **b)** $-\frac{5}{6} < -\frac{5}{7}$

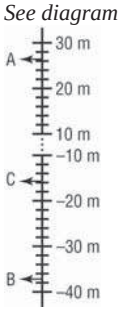
c) $-2.2 = -\frac{11}{5}$ **d)** $-4.46\overline{6} < -4.46$

22. **a)** Hiker A: 26.4 or $\frac{132}{5}$ m

Hiker B: –37.2 or $-\frac{186}{5}$ m

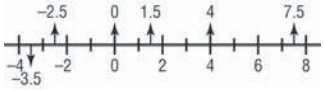
Hiker C: –15.7 or $-\frac{157}{10}$ m

b) *See diagram below.*

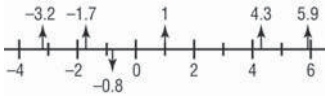


c) Hiker C **d)** Hiker B

23. **a)** $-3.5, -2.5, 0, 1.5, 4, 7.5$

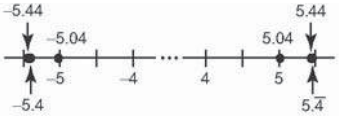


b) $-3.2, -1.7, -0.8, 1, 4.3, 5.9$

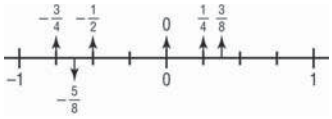


c) $-2.01, -1.22, -1.2, 1.2, 1.\overline{2}, 2.1$

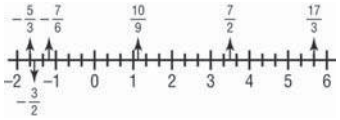
d) $-5.44, -5.4, -5.04, 5.04, 5.44, 5.\overline{4}$



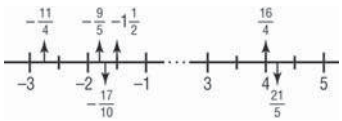
24. **a)** $\frac{3}{8}, \frac{1}{4}, 0, -\frac{1}{2}, -\frac{5}{8}, -\frac{3}{4}$



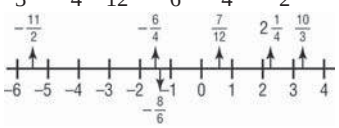
b) $\frac{17}{3}, \frac{7}{2}, \frac{10}{9}, -\frac{7}{6}, -\frac{3}{2}, -\frac{5}{3}$



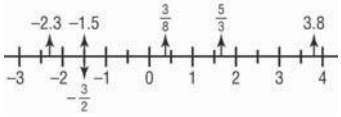
c) $\frac{21}{5}, \frac{16}{4}, -1\frac{1}{2}, -\frac{17}{10}, -\frac{9}{5}, -\frac{11}{4}$



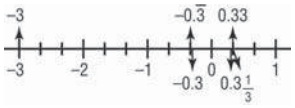
d) $\frac{10}{3}, 2\frac{1}{4}, \frac{7}{12}, -\frac{8}{6}, -\frac{6}{4}, -\frac{11}{2}$



25. **a)** $-2.3, -1.5 = -\frac{3}{2}, \frac{3}{8}, \frac{5}{3}, 3.8$



b) $-3, -0.\overline{3}, -0.3, 0.3, 0.33, \frac{1}{3}$



26. **a)** $3 = \frac{3}{1}$ **b)** $-2 = \frac{-2}{1}$ **c)** $-0.5 = \frac{-1}{2}$ **d)** $-7.45 = \frac{-149}{20}$

27. **a)** Rational number **b)** Irrational number
c) Rational number **d)** Rational number

Unit 3: Start Where You Are, page 105

1. **a)** $3\frac{1}{6}$ **b)** $2\frac{7}{8}$
c) $1\frac{1}{2}$ **d)** $5\frac{5}{12}$
e) $2\frac{7}{10}$ **f)** $\frac{1}{2}$
g) $1\frac{17}{20}$ **h)** $2\frac{5}{6}$

2. **a)** 4 **b)** −4
c) −10 **d)** 4
e) −1 **f)** −3
g) 18 **h)** −18

3.2 Adding Rational Numbers, page 111

3. **a)** $0.8 + 1.5 = 2.3$ **b)** $1.5 + (-0.8) = 0.7$
c) $(-0.8) + (-1.5) = -2.3$
d) $(-1.5) + 0.8 = -0.7$

4. **a)** $\frac{1}{2} + \frac{5}{4} = \frac{7}{4}$ **b)** $\left(-\frac{5}{4}\right) + \frac{1}{2} = -\frac{3}{4}$
c) $\frac{5}{4} + \left(-\frac{1}{2}\right) = \frac{3}{4}$ **d)** $\left(-\frac{1}{2}\right) + \left(-\frac{5}{4}\right) = -\frac{7}{4}$

5. **a)** **i)** 5 **ii)** 6.2
b) **i)** −5 **ii)** −6.2
c) **i)** −1 **ii)** −1.4
d) **i)** 1 **ii)** 1.4

6. Parts c and d

7. **a)** **i)** 12 **ii)** 6
b) **i)** −12 **ii)** −6
c) **i)** −6 **ii)** −3
d) **i)** 6 **ii)** 3

8. Part c

9. **a)** −2.4 **b)** 3.44
c) −32.825 **d)** −96.05
e) 182.281 **f)** −17.938

10. Yes, the sum of two negative rational numbers is less than both numbers.

11. **a)** $-\frac{1}{6}$ **b)** $\frac{7}{15}$
c) $-3\frac{19}{20}$ **d)** $7\frac{1}{10}$
e) $-4\frac{1}{12}$ **f)** $-1\frac{1}{30}$
g) $\frac{7}{8}$ **h)** $-3\frac{5}{6}$

i) $-5\frac{5}{12}$ **j)** $\frac{29}{40}$

12. **a)** The sum is positive. **b)** The sum is negative.
c) The sum has the same sign as the rational number farther away from 0.

13. **a)** –36.25 and –25.35
b) **i)** –36.25 + (–25.35) = –61.60
ii) $61.60
c) **i)** –61.60 + (14.75) = –46.85
ii) $46.85

14. **a)** –0.38 **b)** 0.38
c) $\frac{16}{15}$ **d)** $\frac{11}{20}$

15. **a)** –7.7°C **b)** –17.1°C
c) *See diagram below.*

16. **a)** The sum in part ii is greater since the positive number is farther away from 0.
i) –5.77 **ii)** 5.77
b) The sum in part ii is greater since the sum in part i is a sum of two negative numbers.
i) $-1\frac{5}{12}$ **ii)** $\frac{1}{12}$

17. **a)** 45.50, 22.25, –15.77, –33.10
b) 45.50 + 22.25 + (–15.77) + (–33.10) = 18.88
c) $18.88

18. No, Lucille's business lost $266.04 in the first 6 months.
–545.50 + (–978.44) + 2115.70 + (–888) + 2570.4 + (–2540.2) = –266.04

19. **a)** Any number less than or equal to 3.5
b) Any number greater than or equal to –11.6
c) Any number greater than or equal to 14.4
d) Any number less than or equal to 14.4

20. **a)** $1\frac{5}{8}$ **b)** $-1\frac{7}{15}$
c) $5\frac{5}{8}$ **d)** $-3\frac{7}{12}$

21. Any number less than or equal to 3.3

22. The greatest possible sum less than 0 is $-\frac{1}{12}$.
For example: $-\frac{1}{3}+\frac{1}{4}=-\frac{1}{12}$

3.3 Subtracting Rational Numbers, page 119

3. **a)** **i)** 2 **ii)** 1.8
b) **i)** –8 **ii)** –8.4
c) **i)** 2 **ii)** 1.8
d) **i)** –2 **ii)** –1.8

4. Part d

5. **a)** **i)** 9 **ii)** $\frac{9}{5}$
b) **i)** –13 **ii)** $-\frac{13}{5}$
c) **i)** 13 **ii)** $\frac{13}{5}$
d) **i)** 13 **ii)** $\frac{13}{5}$

6. Part c

7. **a)** 7.3 **b)** –85.77
c) 64.73 **d)** –31.57
e) –38.03 **f)** 151.84

8. **a)** 4.6°C or –4.6°C
b) There are two possible answers depending on which temperature is subtracted from the other temperature.

9. **a)** $-3\frac{5}{6}$ **b)** $-4\frac{14}{15}$
c) $-4\frac{11}{12}$ **d)** $-4\frac{1}{24}$
e) $3\frac{1}{3}$ **f)** $2\frac{5}{24}$

10. Yes, it is possible when you subtract a negative number from a positive number. For example:
1.3 – (–3.5) = 5.8; $\frac{3}{2}-\left(-\frac{5}{2}\right)=4$

11. **a)** –417.5, 8844.43
b) 8844.43 – (–417.5) = 9261.93
The points are 9261.93 m apart.

12. **a)** Negative; –44.98 **b)** Positive; 7.11
c) Positive; $2\frac{1}{4}$ **d)** Negative; $-6\frac{4}{15}$

13. **a)** $1\frac{23}{30}$ **b)** 0.55
c) $4\frac{43}{60}$ **d)** 7.69

14. **a)** Any number greater than or equal to –4.9
For example: –4.8
b) Any number less than or equal to –4.6
For example: –5.2
c) Any number greater than or equal to 8.2
For example: 9.3

d) Any number less than or equal to –3.7
For example: –3.8

15. a) 65.7 **b)** $\frac{3}{10}$

c) –2.03 **d)** $4\frac{1}{6}$

e) –5 **f)** $-8\frac{3}{4}$

16. a) Any 2 numbers with a difference of –3.5
For example: –1.1 and 2.4; 7.2 and 10.7

b) Any 2 numbers with a sum of –13.9
For example: –5.7 and –8.2; –15.7 and 1.8

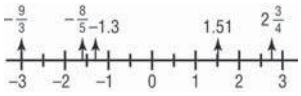
c) Any 2 numbers with a sum of –6.2
For example: –9.3 and 3.1; 1.3 and –7.5

17. a) Any number greater than or equal to –17.5

b) Any number less than or equal to –3.1

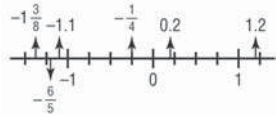
Unit 3: Mid-Unit Review, page 121

1. a)



b) $-\frac{9}{3}$, and $-\frac{8}{5}$; they are on the left of –1.5 on the number line.

2. $-1\frac{3}{8}, -\frac{6}{5}, -1.1, -\frac{1}{4}, 0.2, 1.2$



3. a) > **b)** <

c) < **d)** >

4. Answers will vary. For example:

a) 1.3 **b)** 0

c) $\frac{7}{20}$ **d)** –1

5. a) The sum of two positive numbers is positive.
The sum of two negative numbers is negative.
The sum of a negative number and a positive number has the same sign as the number farther away from 0.

b) i) Positive; 5.82 **ii)** Negative; –6.03

iii) Negative; $-1\frac{19}{24}$ **iv)** Positive; 1.31

v) Negative; $-2\frac{43}{45}$ **vi)** Negative; –0.04

6. a) 8.95 **b)** –57.82

c) –124.7 **d)** $\frac{37}{72}$

e) $-3\frac{1}{20}$ **f)** $-4\frac{20}{21}$

7. a) i) 1.4°C **ii)** An increase

b) 10.9°C

8. a) –22.85 **b)** –97.4

c) $-\frac{1}{2}$ **d)** $-8\frac{5}{18}$

e) –6.1 **f)** $6\frac{3}{8}$

9. 6193.7 – (–86) = 6279.7
The distance between the two points is 6279.7 m.

10. b) i) Positive; 8.7 **ii)** Negative; –2.52

iii) Negative; $-\frac{49}{60}$ **iv)** Positive; $13\frac{1}{6}$

3.4 Multiplying Rational Numbers, page 127

3. Part d

a) –15.6 **b)** –10.4

c) –6.5 **d)** 6.39

4. Parts a, c, and d

a) –2 **b)** $1\frac{1}{4}$

c) $-1\frac{3}{5}$ **d)** $-\frac{7}{16}$

5. a) –0.128 **b)** 2.855

c) 3.304 **d)** 5.95

6. Parts a, b, c, e

7. a) $-\frac{2}{15}$ **b)** $-\frac{3}{20}$

c) $\frac{2}{5}$ **d)** $\frac{5}{9}$

8. a) 12.75

b) The product is less than 10.

c) 11

d) The product is less than 10.

e) 12.5

f) The product is less than 10.

9. a) –$96 **b)** –$105

c) $14.95

10. (–10.4)(3.6) = –37.44
The diver's depth is 37.44 m after 3.6 min.

11. a) –3.444 **b)** 28.44

c) 231.04 **d)** 104.52

12. a) –4 **b)** $\frac{5}{9}$

c) $-14\frac{29}{36}$ **d)** $7\frac{1}{3}$

13. a) 104

b) i) 1.04 **ii)** –0.104

iii) –10.4 **iv)** 0.104

c) I only need to determine the sign and estimate the decimal point.

d) Answers will vary. For example: (260)(0.04) = 10.4; (0.026)(4000) = 104; (−2.6)(−4) = 10.4

14. a) (−3457.25)(25) = −86 431.25

b) −$40 863.38

15. a) Positive; 3.1 **b)** Negative; $-\frac{5}{7}$

16. a) −4.7 **b)** $\frac{7}{2}$

c) −0.4 **d)** $1\frac{2}{5}$

17. Yes, it is possible when both numbers are between 1 and −1. For example: (−0.6)(0.4) = −0.24

18. b) $-\frac{2759}{7826}$

3.5 Dividing Rational Numbers, page 134

3. a) −0.5 **b)** −1.4

c) 2.1 **d)** −0.2

e) 2.4 **f)** −0.9

4. a) $-\frac{2}{3}$ **b)** $-\frac{4}{3}$

c) $\frac{7}{16}$ **d)** $\frac{3}{44}$

e) $-\frac{15}{4}$ **f)** $\frac{36}{55}$

5. Parts c, d, e, and f

6. −1.6 m/h

7. a) 0.8 **b)** −1.4625

c) $-0.41\overline{6}$ **d)** 5.1

e) $-12.5\overline{3}$ **f)** 3.5

8. 5 h

9. a) −11.52 **b)** $-23.28\overline{3}$

c) 36.7 **d)** 4.8

e) $-10.217\overline{3}$ **f)** $-0.240\overline{2}$

10. a) 41

b) The quotient will be less than −10.

c) The quotient will be less than −10.

d) −1.2

11. a) 48 weeks

12. a) $-\frac{15}{14}$ **b)** $\frac{1}{8}$

c) $\frac{2}{3}$ **d)** $-6\frac{2}{15}$

e) $-1\frac{17}{27}$ **f)** $\frac{31}{57}$

13. 35 times

14. −2.8°C/h

15. −$0.32

16. Part c; $\left(\frac{5}{6}\right) \div \left(-\frac{2}{3}\right) = -\frac{5}{4} = -1\frac{1}{4}$

17. a) −4.5 **b)** $-\frac{21}{32}$

c) 2.35 **d)** $-\frac{17}{3}$

18. a) −2.6 **b)** −6.9

c) −6.3 **d)** −3.586

19. a) Ellice: 1300 m ÷ 7.8 min ≐ 166.67 m/min

Alex: −630 m ÷ 4.2 min = −150 m/min

1300 m represents distance in the positive direction and −630 m represents distance in the opposite direction.

b) Ellice runs at the greater average speed.

20. Answers will vary. For example: $-\frac{5}{6} \div \frac{5}{2} = -\frac{1}{3}$

21. Part d

3.6 Order of Operations with Rational Numbers, page 140

3. a) 3.58 **b)** −16.42

c) 73 **d)** −0.192

4. a) $\frac{1}{4}$ **b)** $-\frac{5}{4}$

c) $\frac{15}{8}$ **d)** $\frac{263}{60}$

5. a) −9.1

6. a) −52.64 **b)** 98.784

c) −206.99 **d)** −561.834

7. a) $-2\frac{7}{12}$ **b)** $\frac{8}{9}$

c) $-\frac{8}{27}$ **d)** −8

8. a) Correction:

$(-3.7) \times (-2.8 + 1.5) - 4.8 \div (-1.2)$

$= (-3.7) \times (-1.3) - (-4)$

$= 4.81 + 4$

$= 8.81$

b) Correction:

$$-\frac{3}{8} - \frac{4}{5} \times \frac{3}{10} \div \left(-\frac{4}{5}\right)$$

$$= -\frac{3}{8} - \frac{6}{25} \div \left(-\frac{4}{5}\right)$$

$$= -\frac{3}{8} - \left(-\frac{3}{10}\right)$$

$$= -\frac{3}{40}$$

9. $192.74

10. **a)** 330 cm^2

11. **a)** **i)** About –18°C **ii)** –40°C **iii)** About –47°C

b) **i)** 10°C **ii)** –25°C **iii)** 0°C

12. **a)** Multiplication, addition; $-6\frac{1}{3}$

b) Multiplication, addition; $6\frac{8}{15}$

c) Division, multiplication, addition; $3\frac{1}{8}$

d) Addition, multiplication, subtraction $1\frac{1}{16}$

13. **a)** 54.6 **b)** –5.62

c) About 12.82 **d)** About –14.24

14. **a)** [–8.1 + (–16.7)] ÷ 2 = –12.4; –12.4°C

b) I used brackets to add the two temperatures first before I divided the sum by 2.

15. **a)** Answers will vary. For example:

$$\frac{-3}{2}+\left(\frac{4}{-5}-\frac{-8}{6}\right)\div\frac{10}{-12}=\frac{-107}{50}$$

b) Answers will vary. For example:

$$\left(\frac{6}{-5}-\frac{-12}{10}\right)\left(\frac{2}{-3}-\frac{4}{-8}\right)=0$$

16. **a)** Below 0°C **b)** About –1.01°C

17. Correction:

$(-8.2)^2 \div (-0.3) - 2.9 \times (-5.7)$

$= 67.24 \div (-0.3) - (-16.53)$

$= -224.1\overline{3} - (-16.53)$

$= -224.1\overline{3} + 16.53$

$= -207.60\overline{3}$

18. **a)** 1.63

b) The student likely calculated $6.8 \div (-3) \times (-6.7) + 3.5$ instead of calculating the numerator and the denominator and then finding the result of the division.

19. $\frac{5}{9}$ is equivalent to $\frac{1}{1.8}$, or dividing by 1.8.

20. –14.1°C

21. –3.8 + 9.1 × (–2.5 – 0.5) = –31.1

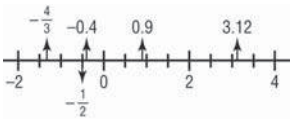
Yes, it is possible to find a positive solution.

For example: –(3.8 + 9.1) × (–2.5) – 0.5 = 31.75

Unit 3: Review, page 144

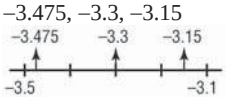
1. Parts a and c

2. $-\frac{4}{3}$, $-\frac{1}{2}$, –0.4, 0.9, 3.12

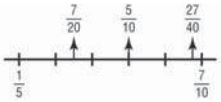


3. Answers will vary. For example:

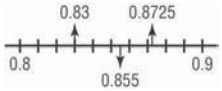
a) –3.475, –3.3, –3.15



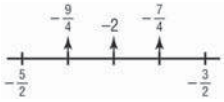
b) $\frac{7}{20}$, $\frac{5}{10}$, $\frac{27}{40}$



c) 0.83, 0.855, 0.8725



d) $-\frac{9}{4}$, –2, $-\frac{7}{4}$



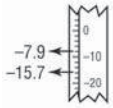
4. –2.00; –0.51; –0.09; 0.54; 0.95

5. **a)** –1.5 **b)** 78.44

c) –28.17 **d)** 48.053

6. **a)** –7.9°C

b) *See diagram below.*



7. **a)** $\frac{13}{8}$ **b)** $1\frac{5}{6}$

c) $-6\frac{1}{4}$ **d)** $-\frac{29}{18}$

8. **a)** 1.4 **b)** –83.14

c) –9.64 **d)** –16.82

9. $22.35

10. **a)** $-\frac{1}{2}$ **b)** $\frac{31}{40}$

c) $10\frac{43}{70}$ **d)** $-13\frac{5}{12}$

11. Parts c and d

a) 1.12 **b)** –1.28

c) $-\frac{4}{5}$ **d)** $\frac{5}{9}$

12. –7.1°C

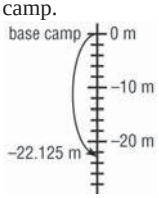
13. Answers will vary. For example:

$$\left(-\frac{7}{9}\right)\left(\frac{4}{5}\right) = \left(-\frac{4}{9}\right)\left(\frac{7}{5}\right)$$

14. **a)** –1.05 **b)** –9.43

c) $\frac{8}{21}$ **d)** –4

15. The climber will be 22.125 m lower than the base camp.



16. Parts c and d

a) −5.5 **b)** About −1.15

c) $-\frac{3}{5}$ **d)** $\frac{1}{3}$

17. Answers will vary. For example:

$\left(-\frac{3}{8}\right)\div\left(\frac{5}{11}\right) = \left(\frac{3}{8}\right)\div\left(-\frac{5}{11}\right)$

18. **a)** −3.75 **b)** −8.3

c) 1.56

19. **a)** −7 **b)** $22.\overline{8}$

c) $-\frac{45}{77}$ **d)** $-\frac{10}{21}$

20. **a)** **i)** −4.74 **ii)** −0.54

b) The orders of operations are different.

21. **a)** $-\frac{17}{20}$ **b)** $\frac{1}{5}$

c) $-\frac{1}{5}$

22. **a)** 1554.82 cm^2

23. **a)** −4.9 **b)** $1\frac{13}{36}$

c) $-1\frac{211}{365}$ **d)** $2\frac{4}{5}$

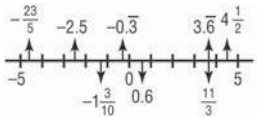
e) $-3\frac{6}{7}$ **f)** −5.8

g) −13.51

Unit 3: Practice Test, page 146

1. **a)** Answers will vary. For example: −0.55

2. **a)**



b) $4\frac{1}{2}, \frac{11}{3} = 3.\overline{6}, 0.6, -0.\overline{3}, -1\frac{3}{10}, -2.5, -\frac{23}{5}$

3. **a)** −1.3 **b)** $\frac{1}{2}$

c) 1.6 **d)** $-\frac{9}{4}$

4. **a)** It means that she owes $2.34.

b) −$67.44 **c)** 19 withdrawals

5. **a)** 823.6 **b)** $7\frac{2}{3}$

c) $2\frac{17}{30}$ **d)** About −3.75

6. **a)** $3\frac{1}{2}$

b) The student added $\frac{1}{2}+\left(-\frac{3}{4}\right)$ instead of doing the division first.

7. **a)** −13.75 **b)** 3.54

Cumulative Review Units 1-3, page 148

1. **a)** $\frac{1}{5}$ **b)** $\frac{15}{13}$

c) $\frac{3}{11}$ **d)** 1.2

e) 0.4 **f)** 1.8

2. **a)** 8 cm **b)** 1.1 m

c) 8.5 mm

3. **a)** 0.49 **b)** 2.56

c) 0.000 036 **d)** $\frac{144}{289}$

e) $\frac{1}{9}$ **f)** $\frac{4}{169}$

4. **a)** $\frac{7}{63}=\frac{1}{9}=\left(\frac{1}{3}\right)^2$, so $\frac{7}{63}$ is a perfect square.

b) $\frac{12}{27}=\frac{4}{9}=\left(\frac{2}{3}\right)^2$, so $\frac{12}{27}$ is a perfect square.

c) $\frac{4}{18}=\frac{2}{9}$, and 2 is not a perfect square, so $\frac{4}{18}$ is not a perfect square.

d) $0.016 = \frac{16}{1000}$, and 1000 is not a perfect square, so 0.016 is not a perfect square.

e) $4.9 = \frac{49}{10}$, and 10 is not a perfect square, so 4.9 is not a perfect square.

f) $0.121 = \frac{121}{1000}$, and 1000 is not a perfect square, so 0.121 is not a perfect square.

5. **a)** 2.6 m **b)** 7.8 m

6. 144.5, 168.9

7. **a)** About $\frac{1}{6}$ **b)** About 4

c) About 0.9 **d)** About $\frac{1}{3}$

8. **a)** 17.4 cm **b)** 6.3 m

9. 24 cm^2

10. **a)** 72 cm^2 **b)** About 265 cm^2

11. **a)** $4^3 = 64$ **b)** $6^4 = 1296$
c) $(-3)^7 = -2187$ **d)** $-(-2)^7 = 128$
e) $-10^5 = -100\,000$ **f)** $-1^{12} = -1$

12. **a)** Negative; –81 **b)** Positive; 15 625
c) Negative; –64 **d)** Positive; 49
e) Negative; –1 **f)** Positive; 1

13. **a)** 8×10^2 **b)** $5 \times 10^4 + 2 \times 10^3$
c) $1 \times 10^3 + 7 \times 10^2 + 6 \times 10^1$
d) $7 \times 10^6 + 4 \times 10^0$

14. **a)** 784 **b)** –5
c) –10 **d)** 139
e) 4 **f)** 1

15. **a)** 6^8 **b)** $(-3)^8$
c) $(-5)^3$ **d)** 2^{14}

16. **a)** –6 **b)** 12
c) –3250 **d)** 512

17. **a)** 10^4 m = 10 000 m **b)** 40 000 m

18. **a)** $6^8 = 1\,679\,616$ **b)** $7^6 + 3^9 = 137\,332$
c) $(-2)^3 - 1 = -9$ **d)** $6^8 + 3^{10} = 1\,738\,665$
e) $(-4)^6 - (-2)^{12} - (-3)^8 = -6561$
f) $3^6 = 729$

19. **a)** $-3.\overline{3}$, –3.3, –2.8, –1.9, 1.2, 4.8
b) $-\frac{13}{4}, -2\frac{1}{2}, -\frac{13}{10}, -\frac{2}{5}, \frac{3}{4}, \frac{19}{5}$
c) $-1.01, -\frac{1}{3}, -0.11, 1.1, \frac{4}{3}, 1\frac{3}{8}$
d) $-0.2, -\frac{1}{6}, -0.\overline{1}, \frac{1}{8}, \frac{2}{9}, 0.25$

20. **a)** 1.44 **b)** –10.307
c) 9.17 **d)** –6.43
e) $-\frac{1}{12}$ **f)** $-4\frac{17}{24}$
g) $-7\frac{11}{12}$ **h)** $6\frac{1}{2}$

21. $85.648

22. **a)** –36.5 **b)** 163.84
c) 3.2 **d)** –5.6
e) $11\frac{2}{5}$ **f)** $-18\frac{2}{3}$
g) $\frac{1}{20}$ **h)** $-1\frac{1}{5}$

23. **a)** $-\frac{11}{24}$ **b)** –40.55
c) $-6\frac{1}{20}$ **d)** $5\frac{1}{8}$

Unit 4 Linear Relations, page 150

Unit 4: Start Where You Are, page 153

1. $3n - 2$
2. $3n + 1$

4.1 Writing Equations to Describe Patterns, page 159

4. **a)** 2 **b)** 3
c) 4 **d)** 5

5. **a)** 7 **b)** 8
c) 9 **d)** 10

6. Parts a and c

7. $f + 5$

8. $n = 4s + 1$ **9.** $s = 2f + 3$

10. **a)** The red number 1 represents the red toothpick that is the same in each picture. The number of black toothpicks added is 4 times the number of houses in the picture.
b) $1 + 4n$ **c)** $t = 1 + 4n$

11. **a)** **i)** As the term number increases by 1, the term value increases by 11.
ii) $11t$ **iii)** $v = 11t$
b) **i)** As the term number increases by 1, the term value increases by 3.
ii) $3t + 2$ **iii)** $v = 3t + 2$
c) **i)** As the term number increases by 1, the term value decreases by 1.
ii) $8 - t$ **iii)** $v = 8 - t$

12. **a)**

Figure Number, *n*	Number of Toothpicks, *t*
1	3
2	5
3	7
4	9

b) $2n + 1$ **c)** 91
d) $t = 2n + 1$ **e)** Figure 8

13. **a)**

Number of Tables, *n*	Number of People, *p*
1	6
2	10
3	14
4	18

b) As the number of tables increases by 1, the number of people who can be seated increases by 4.
d) $p = 4n + 2$ **e)** 10 tables

14. **a)** $C = 250 + 1.25n$ **b)** $3375
c) 300 brochures

15. **a)**

Number of Toppings, *n*	Cost of Pizza, *C* ($)
1	9.75
2	10.50
3	11.25
4	12.00
5	12.75

b) $C = 9 + 0.75n$ **c)** 8 toppings

16. a) Variables may differ. $C = 12 + 1.5n$

b) 11 windows

17. The garden size is 73.

18. b) $t = 5 + 4(n - 1)$

19. a)

Figure Number, n	Perimeter, P	Area, A
1	10	4
2	16	7
3	22	10

b) Variables may differ. $P = 4 + 6n$

c) $A = 1 + 3n$

d) Perimeter: 304 cm; area: 151 cm^2

e) Figure 16 **f)** Figure 33

20. a) $v = 84 - 4t$

21. a)

Number of Cuts	1	2	3	4	5	6	7	8	9	10
Number of Pieces	2	4	8	16	32	64	128	256	512	1024

b) The number of pieces doubled each time. They are powers of 2.

c) 32 768 pieces **d)** $P = 2^n$

e) 16 cuts

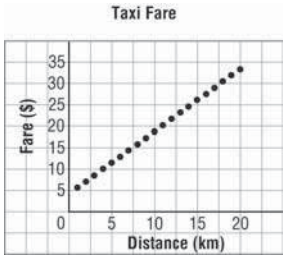
Unit 4 Technology: Tables of Values and Graphing, page 163

1. a) $F = 4.20 + 1.46d$

b)

Distance, d (km)	Fare, F ($)
1	5.66
2	7.12
3	8.58
4	10.04
5	11.50
6	12.96
7	14.42
8	15.88
9	17.34
10	18.80
11	20.26
12	21.72
13	23.18
14	24.64
15	26.10
16	27.56
17	29.02
18	30.48
19	31.94
20	33.40

c)



4.2 Linear Relations, page 170

4. Parts a, b, and c

5. a) i) Yes

ii) When x increases by 1, y increases by 9.

b) i) Yes

ii) When x decreases by 1, y increases by 3.

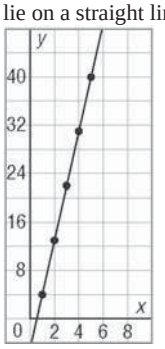
c) i) No

iii) When x increases by 1, y does not increase or decrease by a constant value.

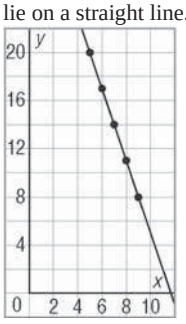
d) i) Yes

ii) When x decreases by 3, y increases by 2.

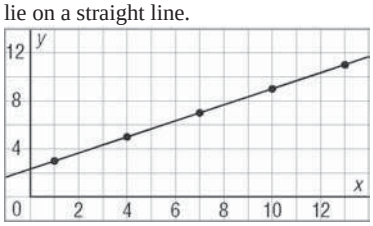
6. a) The relation is linear since the points on the graph lie on a straight line.



b) The relation is linear since the points on the graph lie on a straight line.



d) The relation is linear since the points on the graph lie on a straight line.



7. **a)** $y = 2x$

x	y
1	2
2	4
3	6
4	8

b) $y = x + 2$

x	y
1	3
2	4
3	5
4	6

c) $y = -2x$

x	y
2	–4
4	–8
6	–12
8	–16

d) $y = x - 2$

x	y
4	2
5	3
6	4
7	5

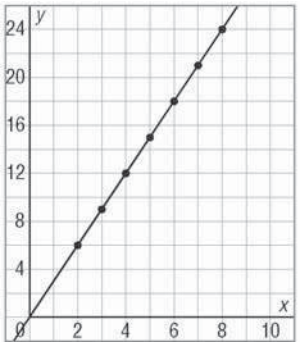
8. **a)**

x	2	3	4	5	6	7	8
y	6	9	12	15	18	21	24

b) When x increases by 1, y increases by 3.

c) $y = 3x$

d)



e) $y = -3$

9. **a)**

x	y
2	11
3	14
4	17
5	20
6	23

b)

x	y
1	7
3	8
5	9
7	10
9	11

c)

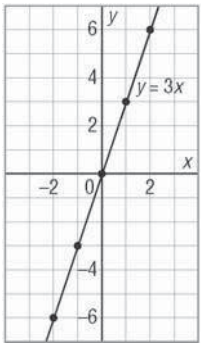
x	y
–4	11
–2	7
0	3
2	–1
4	–5

d)

x	y
4	–10
6	–7
8	–4
10	–1
12	2

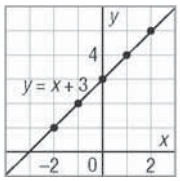
10. **a)** $y = 3x$

x	y
–2	–6
–1	–3
0	0
1	3
2	6



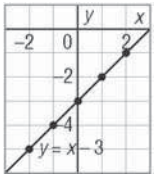
b) $y = x + 3$

x	y
–2	1
–1	2
0	3
1	4
2	5



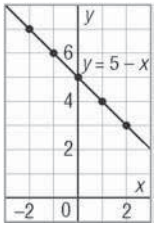
c) $y = x - 3$

x	y
–2	–5
–1	–4
0	–3
1	–2
2	–1



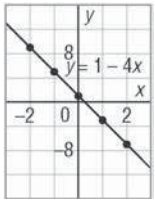
d) $y = 5 - x$

x	y
–2	7
–1	6
0	5
1	4
2	3



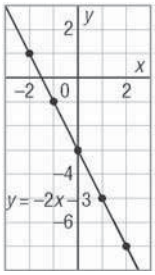
e) $y = 1 - 4x$

x	y
–2	9
–1	5
0	1
1	–3
2	–7



f) $y = -2x - 3$

x	y
–2	1
–1	–1
0	–3
1	–5
2	–7

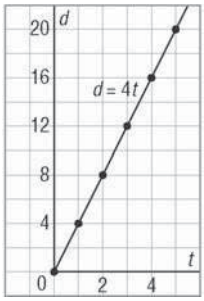


11. a) $d = 4t$

b)

t	d
0	0
1	4
2	8
3	12
4	16
5	20

c) I should join the points since measures of distance and time are not discrete data.



d) The relation is linear.

i) When the time increases by 1, the distance increases by 4.

ii) Points on the graph lie on a straight line.

e) 50.4 km

f) About 1.2 h, or 1 h 11 min

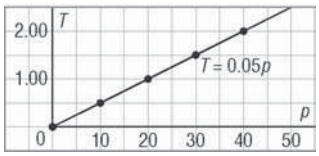
12. a) $T = 0.05p$

b)

p	T
0	0
10	0.50
20	1.00
30	1.50
40	2.00

c) As the purchase price, p, increases by 10, the tax, T, increases by 0.50.

d)

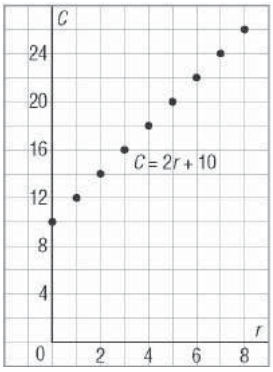


e) I should connect the points with a line because all the values between the points are permitted.

f) To move from one point to the next on the graph, move 10 units right and 0.5 units up.

13. a) Variables may differ: $C = 10 + 2r$

b)

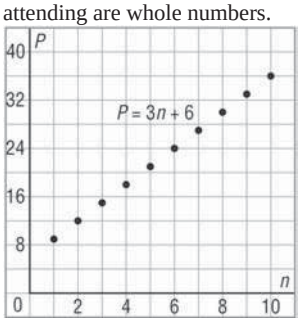


c) $24 **d)** 14 rides

14. b)

n	P
2	12
4	18
6	24
8	30
10	36

c) I would not join the points because the number of pieces of pizza ordered and the number of people attending are whole numbers.



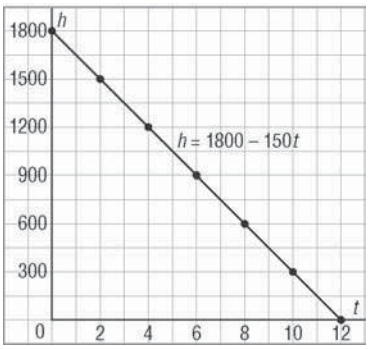
d) The relation is linear.

i) When the number of people increases by 2, the number of pieces increases by 6.

ii) Points on the graph lie on a straight line.

15. a) Variables may differ: $h = 1800 - 150t$

b)

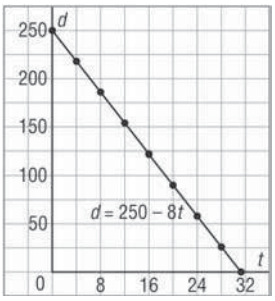


c) 900 m

d) 11 min 20 s after beginning to descend

16. a) $d = 250 - 8t$

b)



c) 154 km **d)** 31.25 h or 31 h 15 min

18.

x	–3	–1	2	5	9	14	20
y	29	26.6	23	19.4	14.6	8.6	1.4

4.3 Another Form of the Equation for a Linear Relation, page 178

4. a) $x = -2$ **b)** $y = -2$

5. a) A horizontal line that intersects the y-axis at 7

b) An oblique line

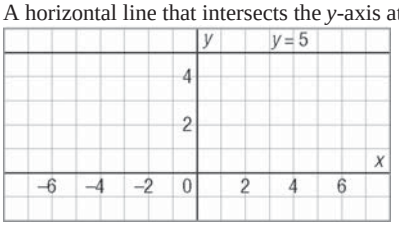
c) A vertical line that intersects the x-axis at –5

d) A vertical line that intersects the x-axis at –9

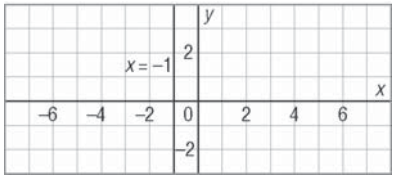
e) A horizontal line that intersects the y-axis at 2.5

f) An oblique line

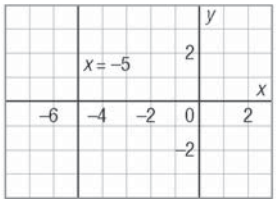
6. a) A horizontal line that intersects the y-axis at 5



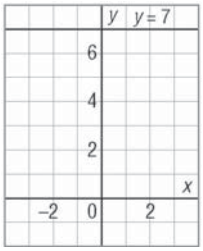
b) A vertical line that intersects the x-axis at -1



c) A vertical line that intersects the x-axis at -5



d) A horizontal line that intersects the y-axis at 7



7. **a)** $y = 2$ **b)** $x = 1$

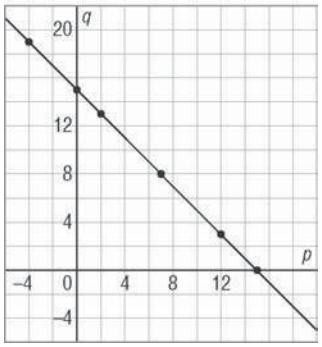
c) $x = -5$

8. $2x + 1 = 0$

9. **a)**

p	q
–4	19
0	15
2	13
7	8
12	3
15	0

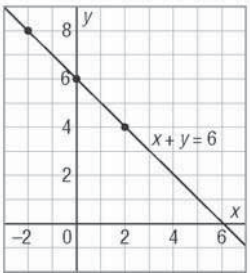
b)



c) $p + q = 15$

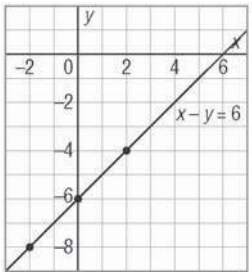
10. **a)** **i)** $x + y = 6$

x	y
–2	8
0	6
2	4



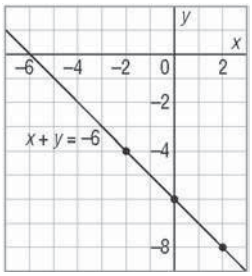
ii) $x - y = 6$

x	y
–2	–8
0	–6
2	–4



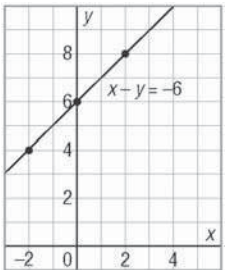
iii) $x + y = -6$

x	y
–2	–4
0	–6
2	–8



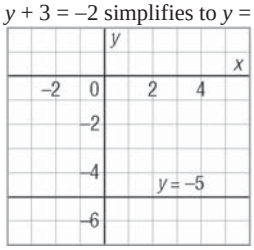
iv) $x - y = -6$

x	y
–2	4
0	6
2	8

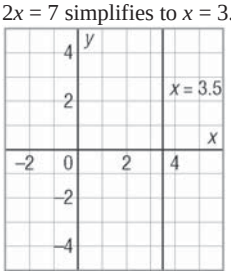


b) The graphs in part a intersect the x-axis and the y-axis at 6 or –6.

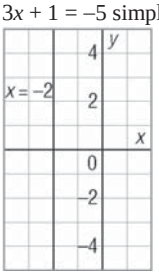
11. a) $y + 3 = -2$ simplifies to $y = -5$.



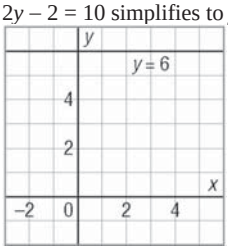
b) $2x = 7$ simplifies to $x = 3.5$.



c) $3x + 1 = -5$ simplifies to $x = -2$.

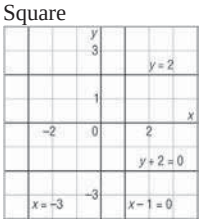


d) $2y - 2 = 10$ simplifies to $y = 6$.



12. $x = -1$, $x = 4$, $y = -4$, $y = 3$

13. a) Square



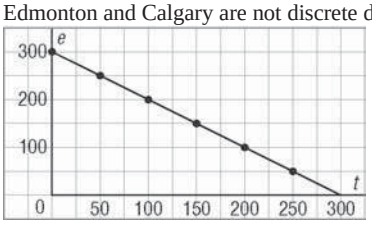
c) Answers may vary. For example:
$x = 0$, $y = 0$, $x = 4$, and $y = -4$

14. a)

Distance Travelled, t (km)	Distance to Edmonton, e (km)
0	300
50	250
100	200
150	150
200	100
250	50

b) 300

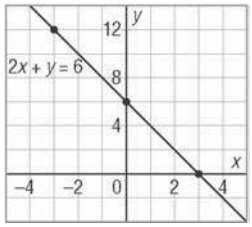
c) I would join the points because distances between Edmonton and Calgary are not discrete data.



d) $e + t = 300$

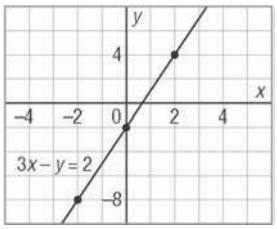
15. a) $2x + y = 6$

x	y
–3	12
0	6
3	0



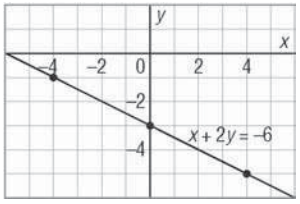
b) $3x - y = 2$

x	y
–2	–8
0	–2
2	4



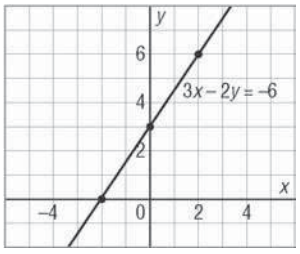
c) $x + 2y = -6$

x	y
–4	–1
0	–3
4	–5

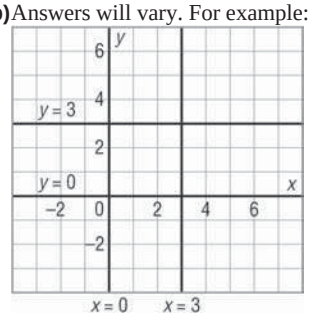


d) $3x - 2y = -6$

x	y
–2	0
0	3
2	6



16. a, b) Answers will vary. For example:

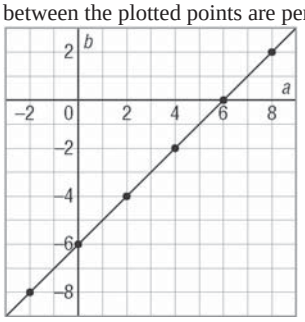


c) The other possible sets of equations are:
$x = 0, y = 0, x = 3, y = -3$; $x = 0, y = 0, x = -3, y = 3$; $x = 0, y = 0, x = -3, y = -3$

17. a)

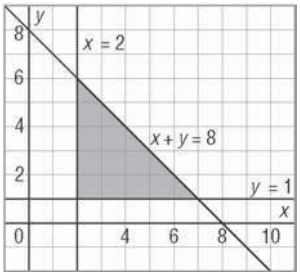
a	b
–2	–8
0	–6
2	–4
4	–2
6	0
8	2

b) I would join the points because all values between the plotted points are permitted.



c) $a - b = 6$

18. a)

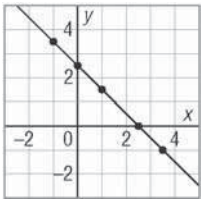


b) Right triangle; the lines $x = 2$ and $y = 1$ are perpendicular.

19. a) Let x and y represent 2 rational numbers with a sum of $2\frac{1}{2}$.

x	y
$3\frac{1}{2}$	–1
$2\frac{1}{2}$	0
$1\frac{1}{2}$	1
0	$2\frac{1}{2}$
–1	$3\frac{1}{2}$

b) The graph is an oblique line that intersects both axes at 2.5.

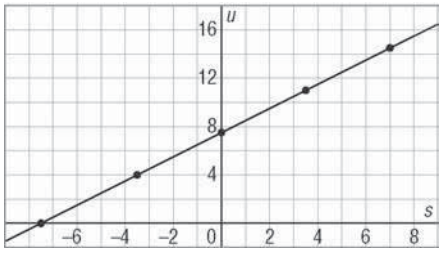


c) $x + y = 2\frac{1}{2}$

20. a) Variables may differ.

s	u
7	14.5
3.5	11
0	7.5
–3.5	4
–7.5	0

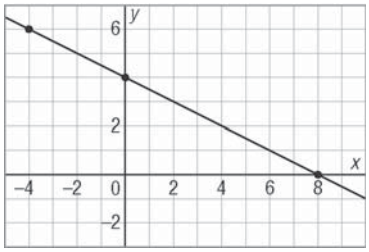
b) The graph is an oblique line that intersects the s-axis at –7.5 and the u-axis at 7.5.



c) $s - u = -7.5$

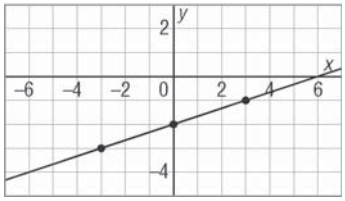
21. a) $\frac{1}{2}x + y = 4$

x	y
–4	6
0	4
8	0



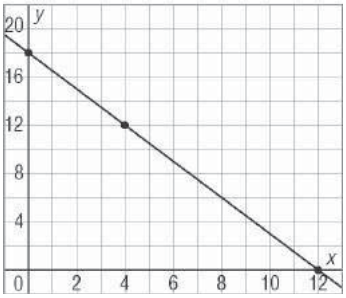
b) $\frac{1}{3}x - y = 2$

x	y
–3	–3
0	–2
3	–1



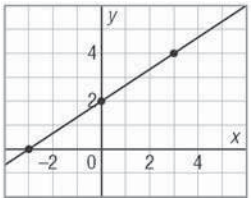
c) $\frac{1}{2}x + \frac{1}{3}y = 6$

x	y
0	18
4	12
12	0



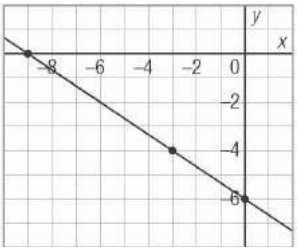
d) $\frac{1}{3}x - \frac{1}{2}y = -1$

x	y
–3	0
0	2
3	4



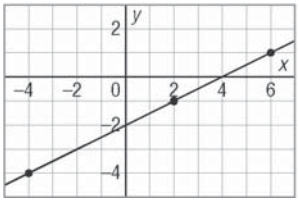
e) $\frac{1}{3}x + \frac{1}{2}y = -3$

x	y
–9	0
–3	–4
0	–6



f) $\frac{1}{4}x - \frac{1}{2}y = 1$

x	y
–4	–4
2	–1
6	1



Unit 4: Mid-Unit Review, page 181

1. a)

Figure Number, n	Perimeter, P
1	4
2	10
3	16
4	22

b) $6n - 2$ **c)** 238 units

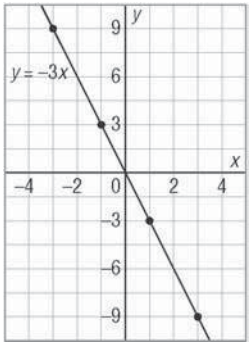
d) $P = 6n - 2$ **e)** Figure 23

2. a) $C = 10 + 0.25t$ **b)** \$23.75

c) 50 min

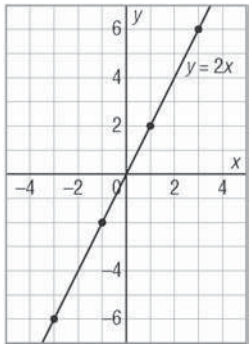
3. a) $y = -3x$

x	y
–3	9
–1	3
1	–3
3	–9



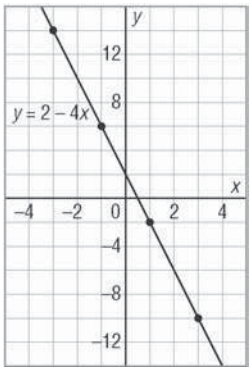
b) $y = 2x$

x	y
–3	–6
–1	–2
1	2
3	6



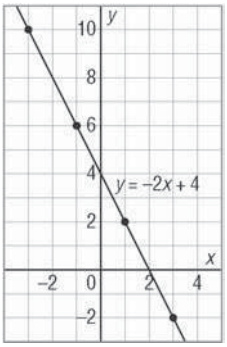
c) $y = 2 - 4x$

x	y
–3	14
–1	6
1	–2
3	–10



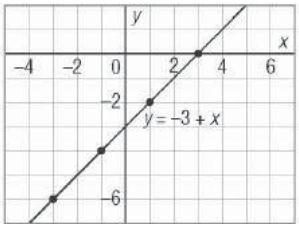
d) $y = -2x + 4$

x	y
–3	10
–1	6
1	2
3	–2



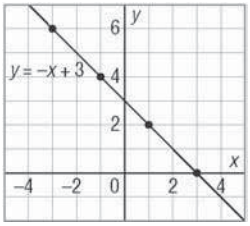
e) $y = -3 + x$

x	y
–3	–6
–1	–4
1	–2
3	0



f) $y = -x + 3$

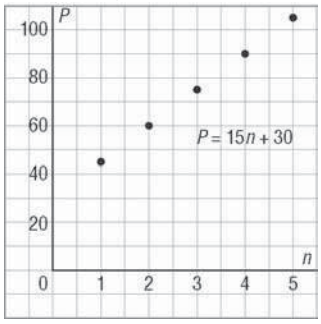
x	y
–3	6
–1	4
1	2
3	0



4. a)

Number of Weeks, n	Total Paid, P ($)
1	45
2	60
3	75
4	90
5	105

b) I should not join the points because Alicia pays once a week, so the data are discrete.



c) In the table, P increases by $15 each week. On the graph, to get from one point to the next, move 1 unit right and 15 units up.

5. a)

x	y
1	10
2	14
3	18
4	22
5	26

b)

x	y
1	−6
3	−10
5	−14
7	−18
9	−22

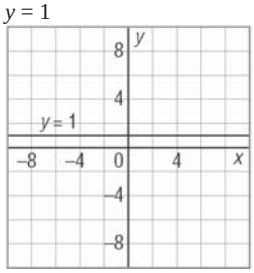
c)

x	y
−2	−15
−1	−9
0	−3
1	3
2	9

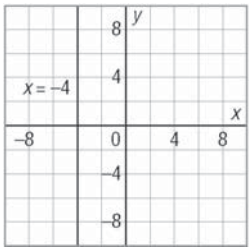
d)

x	y
2	1
4	−2
6	−5
8	−8
10	−11

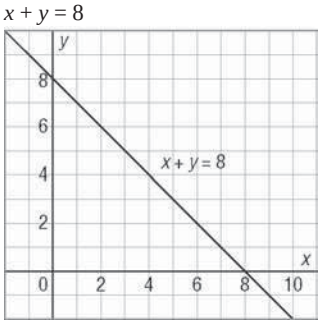
6. a) i) $y = 1$



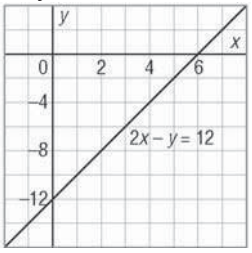
ii) $x = -4$



iii) $x + y = 8$



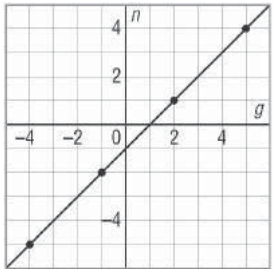
iv) $2x - y = 12$



7. a)

g	n
5	4
2	1
−1	−2
−4	−5

b) I would join the points because all values between the plotted points are permitted.



c) $g - n = 1$

4.4 Matching Equations and Graphs, page 188

3. **a)** iii **b)** i
c) ii

4. **a)** C **b)** B
c) A

5. **a)** ii **b)** iii
c) i

6. **a)** i **b)** iii
c) ii

7. **a)** B **b)** A
c) C

8. Graph B

9. **a)** $y = -x + 2$ **b)** $3x - y = -3$

11. **c)** **i)** C **ii)** A
iii) D **iv)** B

12. **a)** $2y - x = 6$ **b)** $y = 1$
c) $2x + y = 8$

13. **a)** $x - 2y = -8$ **b)** $y = -2x - 8$
c) $y = -2x + 5$ **d)** $y = \frac{1}{2}x - \frac{1}{2}$

4.5 Using Graphs to Estimate Values, page 196

4. **a)** **i)** 6 **ii)** 0
iii) –1
b) **i)** –5 **ii)** 1
iii) 4

5. **a)** **i)** –3 **ii)** 1
iii) 7
b) **i)** 3 **ii)** 0
iii) $-1\frac{1}{2}$

6. **a)** **i)** –10 **ii)** 10
iii) 18
b) **i)** 4 **ii)** –2
iii) $-3\frac{1}{2}$

7. **a)** **i)** 2.5 **ii)** –2.5
iii) –4
b) **i)** –9 **ii)** 7
iii) 11

8. **a)** About \$550 **b)** 10 months
c) About \$480

9. **a)** About 300 Calories **b)** About 24 min
c) About 100 Calories

10. **a)** About 0.5 **b)** About 1.25
c) About 1.5

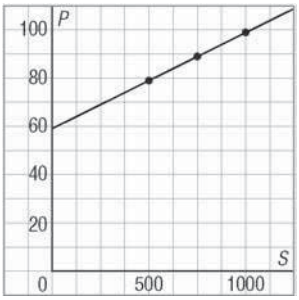
11. **a)** **i)** About 20 m/s **ii)** About 30 m/s
b) **i)** About 220 km/h **ii)** About 30 km/h
c) **i)** I used interpolation for part a, i and ii and part b, ii.
ii) I used extrapolation for part b, i.

12. **i)** About –2.5 **ii)** About 0.5
iii) About 3.5

13. **a)** About \$300
b) About 11 weeks, assuming her rate of pay stays the same.
c) If the rate of pay changed, the graph would no longer be valid.

14. **a)** **i)** About $-\frac{17}{3}$ **ii)** About $-\frac{25}{3}$
iii) About $\frac{35}{3}$
b) **i)** About –2.5 **ii)** About 7.25
iii) About 8.75

15. **a)**



b) About \$1.15 **c)** About 150 mL

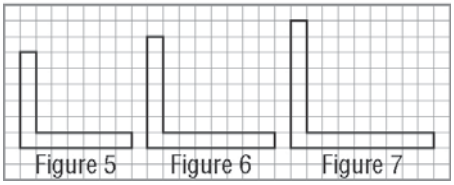
Unit 4 Technology: Interpolating and Extrapolating, page 199

1. **a)** **i)** \$8.50 **ii)** About \$42.50
b) **i)** About 76 L **ii)** About 14 L

Unit 4: Review, page 201

1. **a)** Figure 1: 10 units Figure 2: 14 units
Figure 3: 18 units Figure 4: 22 units

b)



c)

Figure Number, n	Perimeter, P
1	10
2	14
3	18
4	22
5	26
6	30
7	34

d) $6 + 4n$ **e)** $P = 6 + 4n$

f) 126 units **g)** Figure 21

2. a) As n increases by 1, v increases by 3.

b) $3n - 8$ **c)** $v = 3n - 8$

e) 55 **f)** 38

3. a)

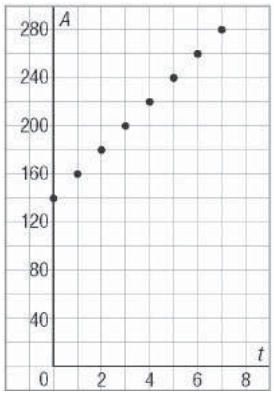
Term Number, n	Term Value, v
1	75
2	71
3	67
4	63
5	59
6	55
7	51

b) $79 - 4n$

4. a)

Time, t (months)	Account Balance, A ($)
0	140
1	160
2	180
3	200
4	220
5	240
6	260
7	280

b) I will not join the points because Norman deposits money once a month, making the data discrete.



c) The relation is linear because the points lie on a straight line.

d) In the table, as t increases by 1, A increases by $20. On the graph, to get from one point to the next, move 1 unit right and 20 units up.

e) $A = 140 + 20t$

5. a) $y = 4x$

x	y
1	4
2	8
3	12

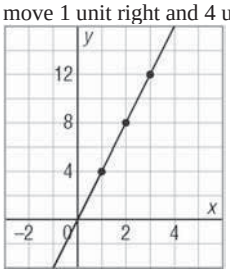
b) $y = 10 - 2x$

x	y
0	10
1	8
2	6

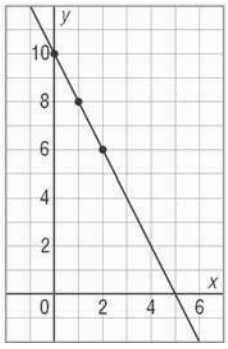
c) $y = 3x + 4$

x	y
–3	–5
–2	–2
–1	1

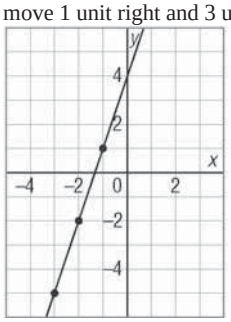
6. a) In the table, as x increases by 1, y increases by 4. On the graph, to get from one point to the next, move 1 unit right and 4 units up.



b) In the table, as x increases by 1, y decreases by 2. On the graph, to get from one point to the next, move 1 unit right and 2 units down.



c) In the table, as x increases by 1, y increases by 3. On the graph, to get from one point to the next, move 1 unit right and 3 units up.

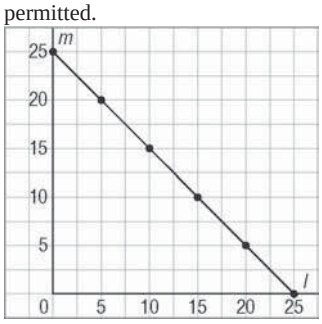


7. a) Let l and m represent the two lengths of string.

l	m
20	5
15	10
10	15
5	20

b) i) The relation is linear because the points lie on a straight line.

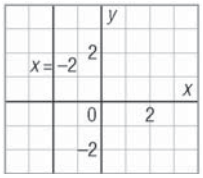
ii) I should join the points because the string can be cut anywhere, so values between points are permitted.



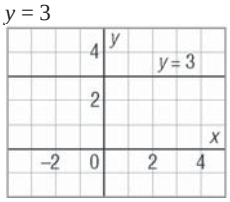
c) i) Variables may differ: $l + m = 25$

8. I do not need to make a table of values since the graphs are vertical lines and horizontal lines.

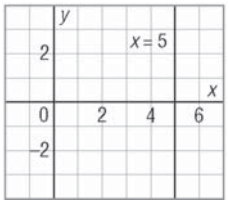
a) $x = -2$



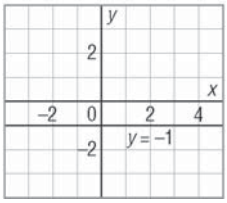
b) $y = 3$



c) $x = 5$

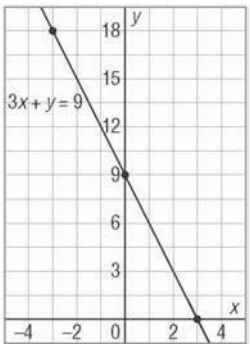


d) $y = -1$



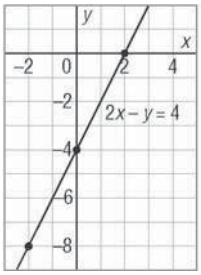
9. a) $3x + y = 9$

x	y
–3	18
0	9
3	0



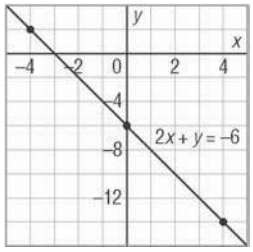
b) $2x - y = 4$

x	y
–2	–8
0	–4
2	0



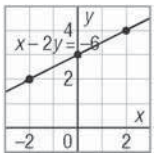
c) $2x + y = -6$

x	y
–4	2
0	–6
4	–14



d) $x - 2y = -6$

x	y
–2	2
0	3
2	4



10. **a)** Vertical **b)** Oblique
c) Horizontal **d)** Vertical

11. $y = -3x - 2$

12. Graph B

13. **a)** iii **b)** i
c) iv **d)** ii

14. **a)** About 2.6 m^3
b) About 1950 kg

15. **a)** About 1035 km
b) About 590 km

16. **a)** About 130 L **b)** About 400 km

17. **a)** **i)** $9\frac{1}{3}$ **ii)** $1\frac{1}{3}$
iii) $-2\frac{2}{3}$
b) **i)** $-2\frac{1}{4}$ **ii)** $1\frac{1}{2}$
iii) $5\frac{1}{4}$

Unit 4: Practice Test, page 204

1. **a)**

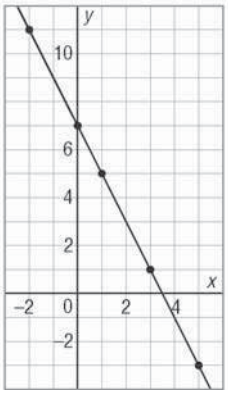
Figure Number, f	Number of Square Tiles, s
1	5
2	10
3	15
4	20

b) $5f$ **c)** $s = 5f$
e) Figure 45

2. **a)** Tables may vary. For example:

x	y
–2	11
0	7
1	5
3	1
5	–3

b)



c) In the table, as the x increases by 2, y decreases by 4. On the graph, to go from one point to the next, move 2 units right and 4 units down.

3. **a)** Vertical **b)** Horizontal
c) Vertical

4. **a)** i **b)** ii
c) iv **d)** iii

5. **a)** About 8 days **b)** About 450 L
c) About 350 L
d) The rate of water usage remains constant and no water was added to the cistern.

Unit 5 Polynomials, page 208

5.1 Modelling Polynomials, page 214

4. Parts a, c, d, and f; the terms in the polynomial are of degree 1, 2, or a constant.

5. **a)** Trinomial; it has three terms of different degrees.
b) Binomial; it has two terms of different degrees.
c) Monomial: it has only one term of degree 1.
d) Monomial: it has only one term of degree 0.

6. **a)** Coefficient: –7; variable: x; degree: 1

b) Coefficient: 14; variable: a; degree: 2

c) Coefficient: 1; variable: m; degree: 1

d) No coefficient; no variable; degree: 0

7. **a)** 2 **b)** 1

c) 2 **d)** 0

8. Parts a and d can be modelled by the same set of algebra tiles. Parts b and f can be modelled by the same set of algebra tiles.

9. **a)** Coefficients: 5, –6; variable: x; degree: 2; constant term: 2

b) Coefficient: 7; variable: b; degree: 1; constant term: –8

c) Coefficient: 12; variable: c; degree: 2; constant term: 2

d) Coefficient: 12; variable: m; degree: 1

e) No coefficients; no variable; degree: 0; constant term: 18

f) Coefficients: 5, –8; variable: x; degree: 2; constant term: 3

10. Both students are correct. A monomial is a polynomial with one term.

11. **a)**

b)

c)

d)

e)

f)

12. **a)** B **b)** D

c) E **d)** A

e) C

13. **a)** –16; monomial **b)** $x - 8$; binomial

c) $4x$; monomial **d)** $2x^2 - 8x + 3$; trinomial

e) $-5t + 5$; binomial **f)** $5x^2$; monomial

g) $-2x^2 + 2x - 3$; trinomial

h) $-3x^2 + 8$; binomial

14. Answers will vary. For example:

a) $3x - 2$ **b)** 5

c) $-2x^2$

d) $x^2 + 3x + 5$

15. Parts a and f; b, d, and h; c and e; g and i are equivalent.

16. Parts b and e are equivalent because they can be represented by the same algebra tiles. Parts c and d are equivalent because they can be represented by the same algebra tiles.

17. Answers will vary. For example: 4^x

18. **a)** **i)** Variable: x; degree: 2; number of terms: 3; coefficients: –3, –2

ii) Variable: m; degree: 2; number of terms: 2; coefficients: 1, 1

b) Answers will vary. For example: $c^2 - 5$

c) $-5 + c^2$; they can be represented by the same algebra tiles.

19. **a)** $-8d^2 - 4 - 3d$; $-3d - 8d^2 - 4$; $-3d - 4 - 8d^2$; $-4 - 3d - 8d^2$; $-4 - 8d^2 - 3d$

b) $-8d^2 - 3d - 4$; for 3 terms, the maximum number of arrangements is 6.

20. **a)** **i)** 22.5 m

ii) 70 m

iii) 240 m

b) No, doubling the speed more than doubles the stopping distance.

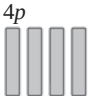
5.2 Like Terms and Unlike Terms, page 222

4. **a)** $3d$

$-5d$

b) $3d$ and $-5d$ are like terms because both can be modelled by algebra tiles of the same shape and size. They have the same variable raised to the same exponent.

5. **a)** $4p$



$2p^2$

b) $4p$ and $2p^2$ are unlike terms because they cannot be modelled by algebra tiles of the same shape and size. They have the same variable, but raised to different exponents.

6. $-3x$, $3x$, $7x$; they have the same variable raised to the same exponent.

7. $-n^2$, $2n^2$, $5n^2$; they have the same variable raised to the same exponent.

8. **a)** $x + 4$ **b)** $x - 2$
c) $2x^2 + x + 1$ **d)** $5x^2 - 3x + 1$
e) $-2x + 4$ **f)** $-x^2 - 2x - 1$

9. Parts a and e are equivalent; both simplify to $2x^2 + 1$. Parts b and f are equivalent; both simplify to $-x - 3$. Parts c and d are equivalent; both simplify to $-x^2 + 2x$.

10. $2x + 3x = 5x$; $4 + 3x$ cannot be simplified.

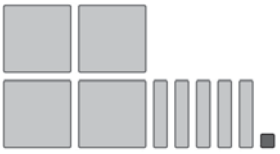
11. **a)** $5c + 4$

b) $2x^2 - 2x$

c) $-3f^2 + 1$

d) $7b^2 + 3b + 1$

e) $4t^2 + 5t - 1$



f) $a^2 + 7a - 4$

12. **a)** $-m - 4$ **b)** $x + 2$
c) $g + 3$ **d)** $-3h - 4$
e) $-11n - 11$ **f)** $-s - 11$

13. **a)** $x^2 - 4x + 15$ **b)** $-3m^2 + 10m$
c) $8x - 7$ **d)** $4p^2 - 2p + 7$
e) 0 **f)** $-9x^2 + 5x + 4$

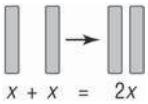
14. **a)** $x^2 + 4y - 1$ **b)** $-p^2 + 3p - 4pq - 1$
c) $4x^2 - 7x + 7xy - 2y$ **d)** $4r^2 - 3rs + s$
e) $-2g^2 + 6g + gh - 4$ **f)** $-6s^2 + 5s - 11st$

15. Parts a and f are equivalent; both simplify to $5x + 1$. Parts b and e are equivalent; part b simplifies to $2x^2 - 3x + 5$. Parts c and d are equivalent; part c simplifies to $-3x^2 - 5x + 4$.

16. Answers will vary. For example:
$5a^2 - 7a^2 + 6a - 2a - 8$

17. Answers will vary. For example:
$x^2 + 3 + 2x - 2x + 7$

18. **a)** $x + x = 2x$



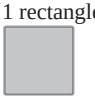
b) **i)** $2r + 1$ **ii)** $6t^2 - 9t$
iii) $4c^2 + 6c + 3$ **iv)** $6x^2 - 2xy - 3y$

c) Answers will vary. For example: $-8d^2 - 3d - 4$

19. **a)** $5x + x + 5x + x = 12x$
b) $2x + 2 + 2x + 2 = 4x + 4$
c) $3x + 2x + 3x + 2x = 10x$
d) $4x + 3 + 4x + 3 = 8x + 6$

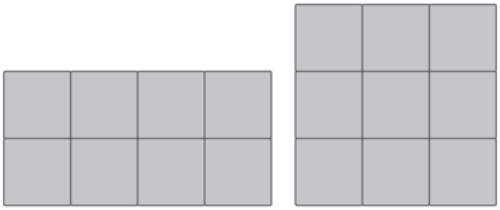
20. **a)** 5 rectangles; for example:

b) 1 rectangle

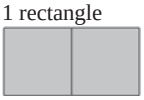


c) 4 rectangles; for example:

d) 3 rectangles; for example:

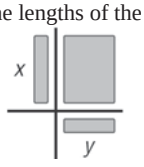


e) 1 rectangle



f) 8 rectangles; for example:

21. An xy tile would be a rectangle with dimensions equal to the lengths of the x-tile and the y-tile.



22. $x + y + 2x + 2y + 3x + 3y = 6x + 6y$

5.3 Adding Polynomials, page 228

3. **a)** $(3x + 5) + (-2x + 2)$

b) $(-2x^2 + 4x - 2) + (2x^2 + 4x + 8)$

c) $(3x^2 - 6x + 4) + (-x^2 - 4x + 2)$

4. $4x^2 + 1$

5. **a)** $7g + 7$ **b)** -1

c) $6p - 5$ **d)** $-m + 11$

6. **a)** $5x - 1$ **b)** $x^2 - 3x$

c) $-5x^2 + 2x + 12$

8. **a)** $9x + 7$ **b)** $7b + 5$

c) $-5y + 3$ **d)** $2n + 5$

e) $-7s + 1$ **f)** $-14h$

g) $11m - 5$ **h)** $-11m + 5$

9. **a)** $6m^2 + 2m - 4$ **b)** $-6k + 4$

c) $p^2 - 7p + 2$ **d)** $3t^2 + 9$

e) $5x^2 - 2x + 7$ **f)** $-3x^2 - x + 13$

g) $-5x^2 - x + 16$ **h)** $-2r^2 + r + 6$

10. **a)** **i)** $(2n + 1) + (n + 5) + (2n + 5) = 5n + 11$

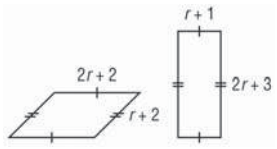
ii) $(7r + 2) + (7r + 2) + (7r + 2) + (7r + 2) = 28r + 8$

iii) $(6t + 5) + (2t + 1) + (6t + 5) + (2t + 1) = 16t + 12$

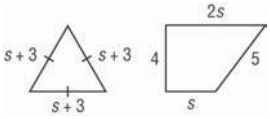
iv) $(f + 2) + (3f + 1) + (f + 2) + (3f + 1) = 8f + 6$

11. Answers will vary. For example:

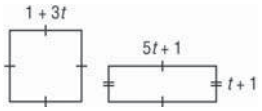
a)



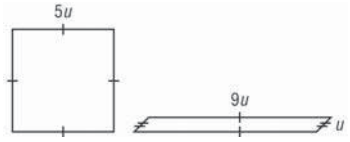
b)



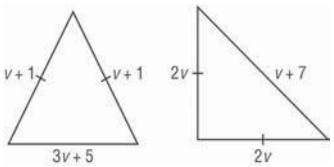
c)



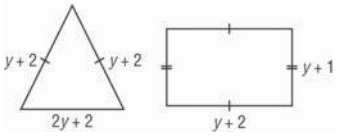
d)



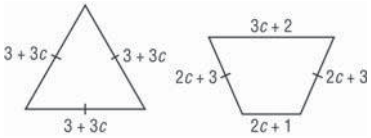
e)



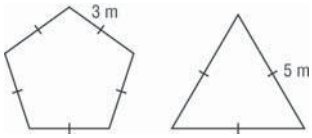
f)



g)



h)



12. No, the student made errors in simplifying.
$-7x - 5x = -12x$, not $-2x$, and $3 + 9 = 12$, not 1.
The correct answer is: $3x^2 - 12x + 12$

13. **a)** Answers will vary. For example:
$-2x^2 + 2x + 1 = (-x^2 + x + 1) + (-x^2 - x)$

b) There are many possibilities.

14. $8m^2 + 8m - 4$

15. **a)** $2x^2 + 3x - 1$ **b)** $-x^2 - 2x + 6$

c) $x^2 - 4x - 2$ **d)** $-4x^2 - 6x - 3$

e) $-3x^2 - 5x + 1$ **f)** $-3x^2 - 7x + 2$

16. **a)** $-5x^2 - 3x + 1$

b) The coefficients of the like terms are opposites.

17. **a)** $-4y^2 - xy$ **b)** $p^2 - 5q^2 + 7p - q + pq$

c) $m^2 + 4n^2 + 5m - 8n + 3mn + 10$

d) $-f^2 + 2g^2 - 11f + 9g - 2$

18. **a)** $3x + 2y + 2$

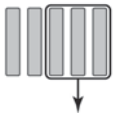
19. There are many possibilities.
For example: $(x + y + 1)$, $(x + y + 1)$, $(x + 3y + 5)$

5.4 Subtracting Polynomials, page 234

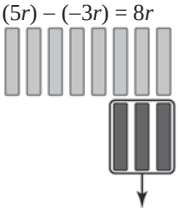
4. **a)** $(-2x^2 + 4x - 2) - (-x^2 + 3x - 1) = -x^2 + x - 1$

b) $(x^2 - 5x - 4) - (x^2 - 4x - 2) = -x - 2$

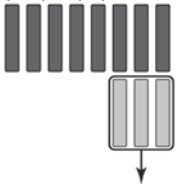
5. **a)** $(5r) - (3r) = 2r$



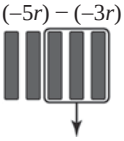
b) $(5r) - (-3r) = 8r$



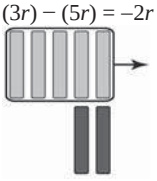
c) $(-5r) - (3r) = -8r$



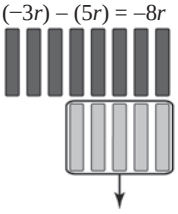
d) $(-5r) - (-3r) = -2r$



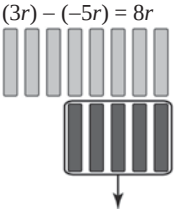
e) $(3r) - (5r) = -2r$



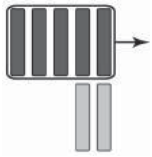
f) $(-3r) - (5r) = -8r$



g) $(3r) - (-5r) = 8r$



h) $(-3r) - (-5r) = 2r$



6. **a)** $2x + 1$ **b)** $2x + 5$
c) $8x + 1$ **d)** $8x + 5$

7. **a)** $s^2 + s + 3$ **b)** $s^2 - s + 3$
c) $5s^2 - 3s - 3$ **d)** $-5s^2 + 3s - 3$

8. **a)** $5x + 9$ **b)** $4b^2 - 3b$
c) $-7x + 2$ **d)** $2p + 1$
e) $2x^2 + 4x + 8$ **f)** $4m^2 - 7m + 10$
g) $-5x^2 + x + 4$ **h)** $4r^2 - 7r - 4$

9. **a)** $(4n + 2500) - (2n + 2100)$
b) \$6400 more

10. **a)** Answers may vary. For example:
Substitute $x = 4$.

$[2(4)^2 + 5(4) + 10] - [(4)^2 - 3]$
$= 2(16) + 20 + 10 - (16 - 3)$
$= 32 + 20 + 10 - 13$
$= 49$
$(4)^2 + 8(4) + 10$
$= (16) + 32 + 10$
$= 58$
$49 \neq 58$, so the answer is incorrect.

b) Correction:
$(2x^2 + 5x + 10) - (x^2 - 3)$
$= 2x^2 + 5x + 10 - x^2 + 3$
$= 2x^2 - x^2 + 5x + 10 + 3$
$= x^2 + 5x + 13$

12. **a)** The student did not change the signs of $+5y$ and -2 inside the second pair of brackets.

b) Correction:
$(2y^2 - 3y + 5) - (y^2 + 5y - 2)$
$= 2y^2 - 3y + 5 - y^2 - 5y + 2$
$= y^2 - 8y + 7$

13. **a)** $w + 4$ **b)** $s + 3$
c) $4p + 1$

14. **c)** The sum of the two polynomials is 0.
The coefficients of the like terms in each polynomial are opposites.

15. **a)** $3r^2 + 10s^2$ **b)** $-8m^2 - 3mn - 3n^2$
c) $12c^2 - 10d^2 - cd$ **d)** $-e^2 + 15e + 6f + 5f^2$
e) $-2j^2 - 10j + 5jk - 2k + k^2$

16. **a)** $-5x^2 + 9x - 11$ or $-11x^2 + x + 3$
b) $(-5x^2 + 9x - 11) - (-8x^2 + 5x - 4) = 3x^2 + 4x - 7$
$(-8x^2 + 5x - 4) - (-11x^2 + x + 3) = 3x^2 + 4x - 7$

17. $6x - 8$

18. There are many possibilities.
For example: $(-4x^2 - 2x) - (-4x + 5) = -4x^2 + 2x - 5$

Unit 5: Mid-Unit Review, page 237

1. **a)** Variable: m; number of terms: 2; coefficient: 3; constant term: -5; degree: 1

b) Variable: r; number of terms: 1; coefficient: 4; constant term: none; degree: 1

c) Variable: x; number of terms: 3; coefficients: 1, 4; constant term: 1; degree: 2

2. Answers will vary, for example: $3m^2 - 4m - 5$

3. **a)** $-x^2 + 12$; binomial
b) $-2x^2 - 4x + 8$; trinomial **c)** $-4x$; monomial

4. **a)**

b)

c)

5. **a)** $2x$ and $-5x$ are like terms because they have the same variable raised to the same exponent.

b) 3 and $4g$ are unlike terms because one is a constant and the other has a variable.

c) 10 and 2 are like terms because they are both constants.

d) $2q^2$ and $-7q^2$ are like terms because they have the same variable raised to the same exponent.

e) $8x^2$ and $3x$ are unlike terms because they have variables raised to different exponents.

f) $-5x^2$ and $-5x$ are unlike terms because they have variables raised to different exponents.

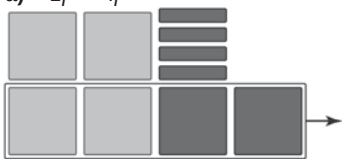
6. $-2x^2 - 3x + 1$

7. No, both answers are correct. The polynomials have their terms ordered differently.

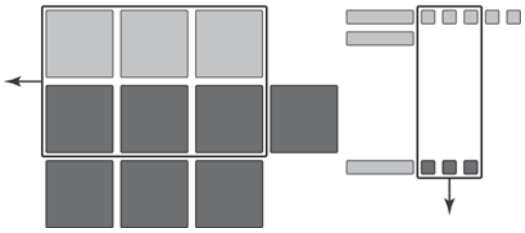
8. No, Cooper is incorrect. $5x$ and -2 are unlike terms that cannot be simplified.

9. Parts a and h, b and e, d and f are equivalent.

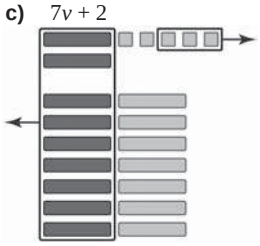
10. **a)** $2f^2 - 4f$



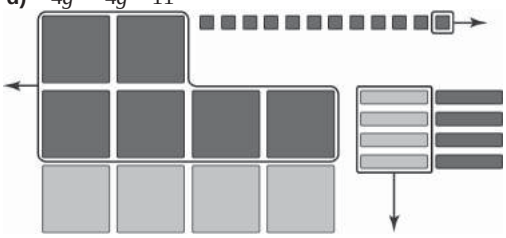
b) $-4r^2 + 3r + 2$



c) $7v + 2$



d) $4g^2 - 4g - 11$



11. **a)** $15w^2 + 14w$ **b)** $6m^2$

c) $6h - 6$ **d)** $-a^2 + 6a + 9$

e) $y^2 + 13y - 6$ **f)** $10p^2 + 7p - 24$

12. **a)** $2x^2 + 2x + 3$ **b)** $-2x^2 - 2x - 3$

5.5 Multiplying and Dividing a Polynomial by a Constant, page 246

3. **a)** $(4)(5) = 20$ **b)** $(3)(x) = 3x$

c) $2(x + 2) = 2x + 4$ **d)** $3(3x + 2) = 9x + 6$

4. **a)** $20 \div 4 = 5$ **b)** $3x \div 3 = x$

c) $(2x + 4) \div 2 = x + 2$ **d)** $(9x + 6) \div 3 = 3x + 2$

5. **a)** ii

6. Part c

7. **a)** **i)** $15r$ **ii)** $-15r$

iii) $15r$ **iv)** $-15r$

v) $15r$ **vi)** $-15r$

b) The product of two negative numbers or two positive numbers is positive. The product of a negative number and a positive number is negative.

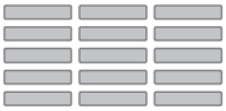
c) **i)**

ii)

iii)

iv)

v)



vi)

8. a) **i)** $3k$ **ii)** $-3k$
iii) $-3k$ **iv)** $3k$

b) Dividing two numbers with the same sign gives a positive quotient. Dividing two numbers with opposite signs gives a negative quotient.

c) **i)**

ii)

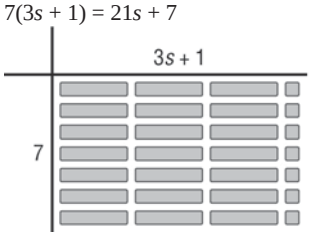
9. a) $(2)(3v^2 + 2v + 4) = 6v^2 + 4v + 8$

b) $5(m^2 + 3) = 5m^2 + 15$

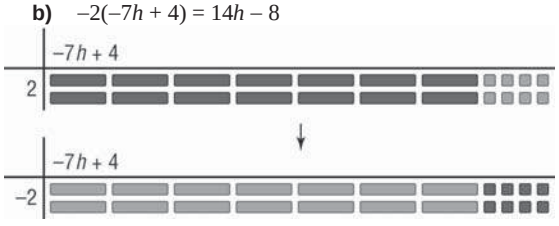
10. a) $\dfrac{6v^2 + 4v + 8}{2} = 3v^2 + 2v + 4$

b) $\dfrac{5m^2 + 15}{5} = m^2 + 3$

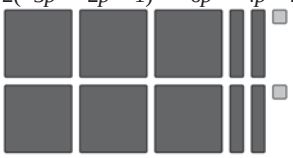
11. a) $7(3s + 1) = 21s + 7$



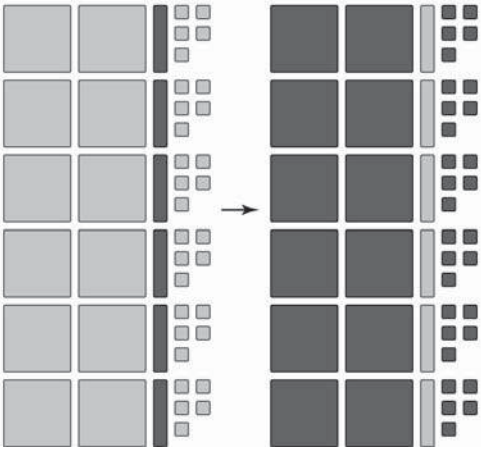
b) $-2(-7h + 4) = 14h - 8$



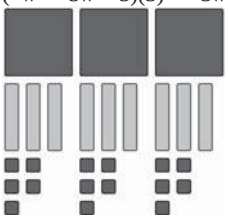
c) $2(-3p^2 - 2p + 1) = -6p^2 - 4p + 2$



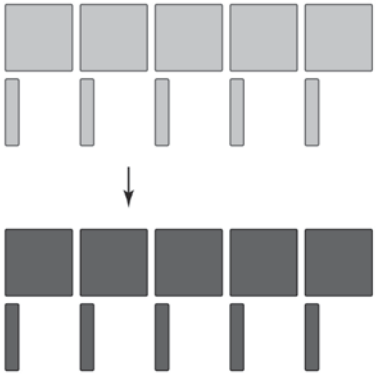
d) $-6(2v^2 - v + 5) = -12v^2 + 6v - 30$



e) $(-w^2 + 3w - 5)(3) = -3w^2 + 9w - 15$



f) $(x^2 + x)(-5) = -5x^2 - 5x$



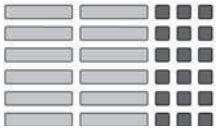
12. The errors are: $-2(-r) = 2r$, not $-2r$, and $-2(7) = -14$, not -16.
Correction:

$-2(4r^2 - r + 7)$

$= (-2)(4r^2) + (-2)(-r) + (-2)(7)$

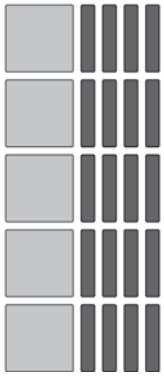
$= -8r^2 + 2r - 14$

13. **a)** $\frac{12p-18}{6} = 2p-3$

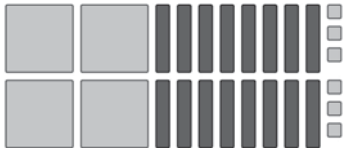


b) $\frac{-6q^2-10}{2} = -3q^2-5$

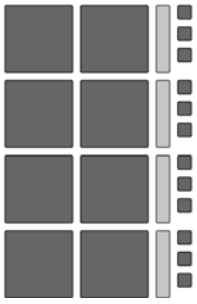
c) $\frac{5h^2-20h}{5} = h^2-4h$



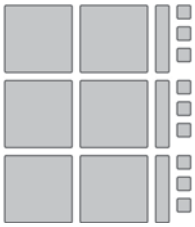
d) $\frac{4r^2-16r+6}{2} = 2r^2-8r+3$



e) $\frac{-8a^2+4a-12}{4} = -2a^2+a-3$



f) $\frac{6x^2+3x+9}{3} = 2x^2+x+3$



14. Errors are: The negative sign should apply to all the denominators. $\frac{-7}{7}$ simplifies to −1, not 0.

$2m^2 - 4m$ cannot be simplified to $-2m$.

Correction:

$(-14m^2 - 28m + 7) \div (-7)$

$= \frac{-14m^2}{-7} + \frac{-28m}{-7} + \frac{7}{-7}$

$= 2m^2 + 4m - 1$

15. **a)** $12u^2 - 48u - 24$ **b)** $24m^2 - 36m$

c) $-20t^2 - 8t$ **d)** $30s^2 + 25s + 35$

e) $-28y^2 + 12y - 36$ **f)** $80n^2 - 10n - 60$

16. **a)** $2d^2 - 1$ **b)** $2x + 1$

c) $5 - 2m^2$ **d)** $-5 + n$

e) $-2k^2 + 4k - 7$ **f)** $6d^2 - 3d - 5$

g) $2c^2 - 3c + 1$

17. Parts c and f; the expressions in each pair are equivalent because of the distributive property.

18. **a)** **i)** $12p$ **ii)** $-7x$

iii) $-12m^2 + 28$ **iv)** $-f^2 + 7f - 4$

v) $-y^2 + 6y$ **vi)** $-24n + 6 - 9n^2$

b) The products and quotients in parts i, ii, iii, iv, and vi can be modelled with algebra tiles.

19. **a)** **i)** $4x + 2$; $6x + 3$; $8x + 4$; $10x + 5$

ii) $2 - 4x$; $3 - 6x$; $4 - 8x$; $5 - 10x$

b) **i)** Each time, the coefficient of the x-term increases by 2 while the constant term increases by 1.

ii) Each time, the coefficient of the x-term decreases by 2 while the constant term increases by 1.

c) **i)** $12x + 6$; $14x + 7$; $16x + 8$

ii) $6 - 12x$; $7 - 14x$; $8 - 16x$

d) **i)** $2x + 1$; 0; $-2x - 1$

ii) $1 - 2x$; 0; $-1 + 2x$

20. **a)** $5a^2 + 7a + 2$ **b)** 110 cm

21. **a)** Perimeter of square A: $4(4s + 1) = 16s + 4$

Perimeter of square B: $3(16s + 4) = 48s + 12$

b) $32s + 8$

22. **a)** $4x^2 - 6xy + 14y^2$ **b)** $-4pq - 12p^2 - 12q^2$

c) $-6gh + 18h^2 - 9g^2 - 27g$

d) $-5r^2 + 40rs - 15s^2 - 25s + 20r$

e) $-8t^2 + 6v^2 - 38tv + 12v + 2t$

23. **a)** $n^2 - 4mn + 2m^2$ **b)** $3rs + 8r + 2s$

c) $2gh - 6g^2 - 3h$ **d)** $-2t^2 + 4ut + 8t$

24. $\pi(3x)^2 - \pi x^2 = 8\pi x^2$

5.6 Multiplying and Dividing a Polynomial by a Monomial, page 255

4. **a)** $(3c)(3c) = 9c^2$ **b)** $m(m + 3) = m^2 + 3m$

c) $2r(r + 2) = 2r^2 + 4r$

5. **a)** $\frac{9c^2}{3c} = 3c$

b) For example: $\frac{m^2 + 3m}{m} = m + 3$

c) For example: $\frac{2r^2 + 4r}{2r} = r + 2$

6. Part c

7. **a)** $3x(2x + 1) = 6x^2 + 3x$

b) $4x(2x + 7) = 8x^2 + 28x$

8. **a)** For example: $\frac{6x^2 + 3x}{3x} = 2x + 1$

b) For example: $\frac{8x^2 + 28x}{4x} = 2x + 7$

9. **a)** **i)** $12m^2$ **ii)** $-12m^2$

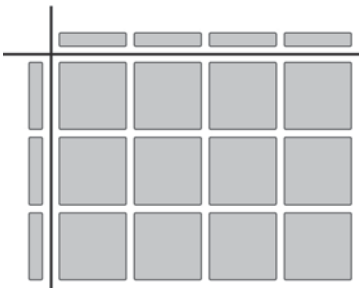
iii) $-12m^2$ **iv)** $12m^2$

v) $12m^2$ **vi)** $-12m^2$

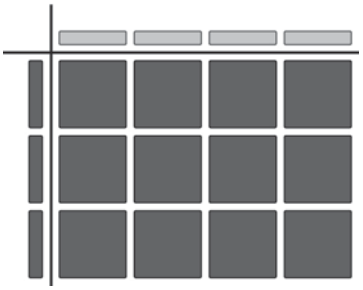
b) The products have the same two factors, $3m$ and $4m$, that only differ by the sign of the coefficient.

c) Each of the problems can be modelled by algebra tiles.

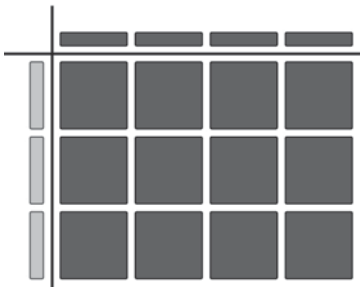
i)



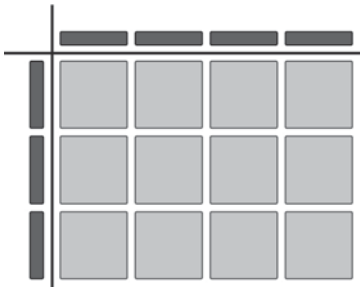
ii)



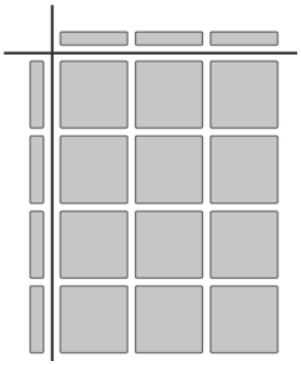
iii)



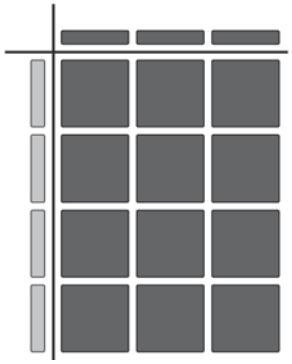
iv)



v)



vi)



10. **a)** **i)** 6 **ii)** -6

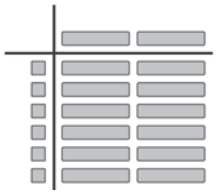
iii) -6 **iv)** 6

v) $6x$ **vi)** 6

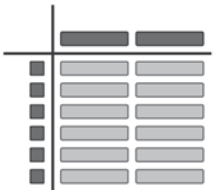
vii) -6 **viii)** -6

b) Some quotients are the same because they have the same numerators and denominators that only differ by the signs of the coefficients.

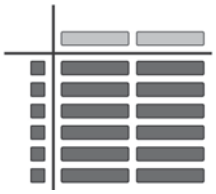
c) **i)**



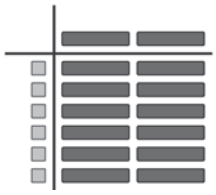
ii)



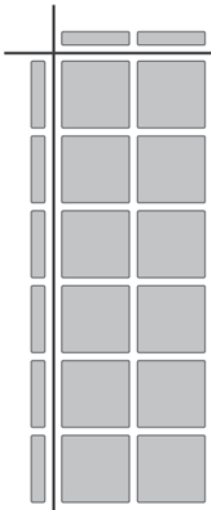
iii)



iv)



v)



11. **a)** $-12r^2$ **b)** $2n$
c) $-35g^2$ **d)** -4
e) $27h^2$ **f)** $4p$
g) -6 **h)** 3

12. **a)** $2x^2 + 12x$ **b)** $15t^2 + 6t$
c) $-6w^2 + 10w$ **d)** $-2x - 8x^2$
e) $-15g - 3g^2$ **f)** $8y + 6y^2$
g) $7sy + y$ **h)** $-6r + 12r^2$

13. $2x(x + 1) = 2x(x) + 2x(1) = 2x^2 + 2x$

14. The student calculated $(-2d)(-3d)$ as $-6d^2$ instead of $6d^2$ and wrote $-(9)(-3d)$ instead of $+(9)(-3d)$ in the second line.
Correction:

$$(-2d+9)(-3d)$$
$$=(-2d)(-3d)+(9)(-3d)$$
$$=6d^2-27d$$

15. Think multiplication: $3r(r - 4) = 3r^2 - 12r$

$$\frac{3r^2-12r}{3r}=r-4$$

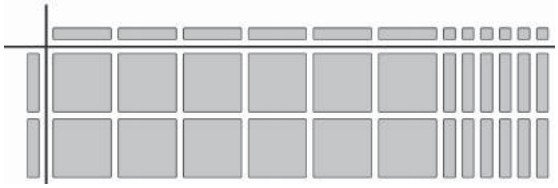
Or, write the quotient expression as the sum of two fractions:

$$\frac{3r^2-12r}{3r}$$
$$=\frac{3r^2}{3r}+\frac{-12r}{3r}$$
$$=r-4$$

16. **a)** $5x + 2$ **b)** $6x + 4$
c) $2 + y$ **d)** $5x - 2$
e) $3 - 2g$ **f)** $-4 - 8k$
g) $-6h - 9$ **h)** $4m - 9$

17. **a)** **i)** $3n + 1$ **ii)** $-12r + 21r^2$
iii) $8s - 2$ **iv)** $4t^2 - 36t$

18. **a)** $6x + 6$



19. **a)** Larger rectangle: $(2s)(3s + 2) = 6s^2 + 4s$
Smaller rectangle: $(2s)(s + 1) = 2s^2 + 2s$
b) $(6s^2 + 4s) - (2s^2 + 2s) = 4s^2 + 2s$
c) $30\ \text{cm}^2$

20. **a)** $6mn + 12m$ **b)** $10g - 6fg$
c) $-42mp + 49m^2$ **d)** $-32hk - 12k^2$
e) $-8t^2 + 12rt$ **f)** $-8gh + 5g^2$

21. **a)** $4x + 2y$ **b)** $6h + 3$
c) $-3p + 4q$ **d)** $-8s + 7$
e) $-2n - 6p$

22. Divide the shape into two rectangles.
$(7x)(5x) + (4x)(7x) = 63x^2$

23. **a)** $\frac{54s^2}{6} = 9s^2$ **b)** $3s$

24. **a)** $2\pi r(r+h) = 2\pi r^2 + 2\pi rh$

b) $2\pi(5)(5+3) = 251 \text{ cm}^2$

$2\pi(5)^2 + 2\pi(5)(3) = 251 \text{ cm}^2$

25. $\frac{13}{2}x - 6 - \frac{9}{4}y + \frac{5}{4x}$

Unit 5: Review, page 259

1. **a)**

b)

2. **a)** Variable: w; coefficient: 4; constant: -3

b) Variable: v; coefficient: 5; constant: 3

c) Variable: y; coefficients: -1, 5; constant: -6

3. **a)** **i)** Binomial **ii)** 1st degree

b) **i)** Monomial **ii)** 2nd degree

c) **i)** Trinomial **ii)** 2nd degree

4. **a)** $-y^2 - 3y + 4$

b) $-3x + 4$

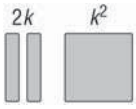
5. Parts a and h; b and g; d and e are equivalent.

6. **a)** $4x + 3$; 1st degree

b) $2x^2 - 2x + 6$; 2nd degree

c) $-x^2 - 9$; 2nd degree

7. $2k = k + k$; $k^2 = k \times k$



8. **a)** $-2h - 1$ **b)** $2j^2 + 3j - 4$

c) $p^2 - 5p$

9. **a)** $5x^2$ and $-2x^2$ are like terms.

b) $-8x$, $5x$, and $-x$; 8, -2, and 11 are like terms.

10. **a)** B **b)** C

c) E **d)** A

e) D

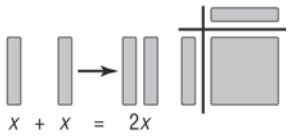
11. Answers will vary. For example:

$-x^2 + 3x - 2x + 3 + 5$

12. **a)** $4x - 7$ **b)** $-7y^2 + y$

c) $3a + 3$ **d)** $2a$

13.



14. **a)** $(-2x^2 + 3x - 4) + (-4x^2 + x - 3) = -6x^2 + 4x - 7$

b) $(3x^2 - 6x + 7) - (2x^2 - 2x + 3) = x^2 - 4x + 4$

15. **a)** $4p^2 + 4p + 6$ **b)** $q^2 + 2q + 5$

c) $4r^2 - 7r - 3$ **d)** $-3s^2 + 8s + 8$

e) $-2t^2 + 2t + 10$ **f)** $-6u^2 + 4$

g) $-4a^2 - 5ab - 4b^2$

h) $4x^2 + 2x + 9xy - 5y - 3y^2$

16. $12c + 13$

17. A − Q; B − S; C − P; D − R; E − T

18. $-5d^2 - 12d + 5$ or $-11d^2 + 2d - 3$

19. **a)** $10a + 10$; 40 cm **b)** $15a + 21$; 66 cm

20. **a)** $(4)(-x) = -4x$ **b)** $2(2x + 3) = 4x + 6$

21. **a)** For example: $\frac{-4x}{4} = -x$

b) For example: $\frac{4x+6}{2} = 2x + 3$

22. **a)** $5k$ **b)** $-20x^2$

c) $-6m + 8$ **d)** $-2n^2$

e) $-12s + 3$ **f)** $3 - 4m$

g) $-35 + 10x$ **h)** $-2 + 4n - 6n^2$

i) $2x + 6x^2$ **j)** $3p^2 + 3p - 2$

k) $-5 + 7q - 2q^2$ **l)** $-12 - 30n + 42n^2$

23. **a)** $2x^2 - 2xy - 2y^2$ **b)** $-6m^2 + 3n - 4m$

c) $-6pq + p^2 - 3q$ **d)** $8r^2 - 12r + 16s - 20s^2$

24. **a)** $(3x)(2x + 3) = 6x^2 + 9x$

b) $(5a)(8a + 3) = 40a^2 + 15a$

25. **a)** For example: $\frac{6x^2+9x}{3x} = 2x + 3$

b) For example: $\frac{40a^2+15a}{5a} = 8a + 3$

26. **a)** $14s^2$ **b)** $15g^2$

c) $3m^2 + 2m$ **d)** $-5t^2 + 15t$

e) $-28z^2 - 7z$ **f)** $6f^2 + 10f$

g) $-15k + 5k^2$ **h)** $y - y^2$

27. **a)** Inside rectangle: $8x^2$; outside rectangle: $18x^2$

b) $18x^2 - 8x^2 = 10x^2$

28. **a)** -4 **b)** 8

c) $4x$ **d)** $-2a - 3$

e) $-2 + c$ **f)** $-2y + 3$

29. **a)** $(2d + 5)$ metres

b) The deck is 16 m by 13 m with an area of 208 m^2.

Unit 5: Practice Test, page 262

1. **a)** $2t^2 - 6t + 4$

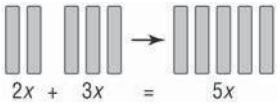
b) Degree: 2; number of terms: 3

c) Constant: 4; coefficient of t^2: 2

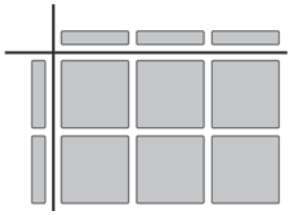
2. **a)** $d + 2 + (d + 3) + 6 + (d + d + 3) + 4 = 4d + 18$

b) 38 m

3. **a)**

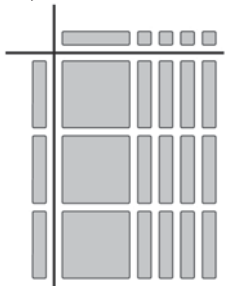


b)



4. The student's answer is incorrect.

$3r(r + 4) = 3r^2 + 12r$



5. **a)** $-18d + 18$ **b)** $3h^2 + 9h - 6$

c) $-5y^2 + 7y - 12$ **d)** $8y^2 - 2y$

6. **a)** $75m^2 - 50m$ **b)** $-15v^2 + 10v + 5$

c) $4x - 2$ **d)** $2 - g^2 + 5g$

7. Answers will vary. For example:

a) $(x^2 + x + 1) + (2x^2 - 5x - 3) = 3x^2 - 4x - 2$

b) $(5x^2 + 2x + 2) - (2x^2 + 6x + 4) = 3x^2 - 4x - 2$

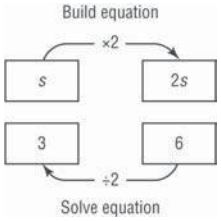
8. **a)**

b) $15s^2 + 40s$ **c)** $16s + 16$

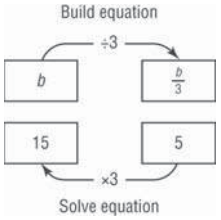
Unit 6 Linear Equations and Inequalities, page 264

6.1 Solving Equations by Using Inverse Operations, page 271

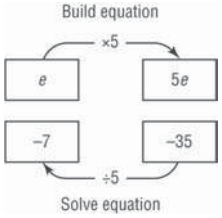
5. **a)** $s = 3$



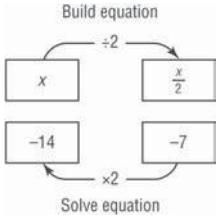
b) $b = 15$



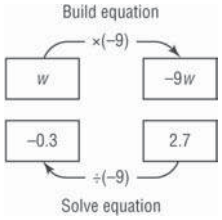
c) $e = -7$



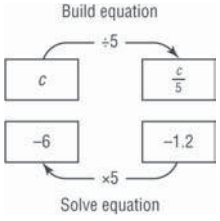
d) $x = -14$



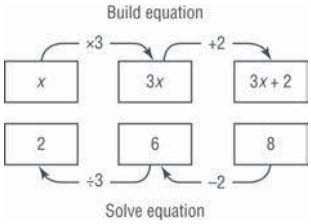
e) $w = -0.3$



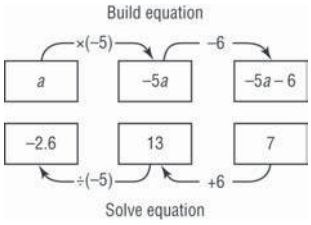
f) $c = -6$



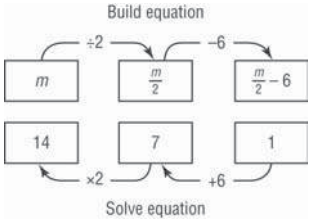
6. a) $x = 2$



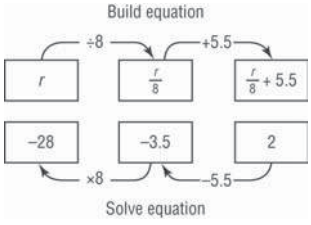
b) $a = -2.6$



c) $m = 14$



d) $r = -28$



7. The student should divide each side by –5 instead of adding 5 to undo multiplying m by –5.

Correction:

$$-5m = 15$$
$$m = \frac{15}{-5}$$
$$m = -3$$

8. a) $x = 2.4$ **b)** $b = 7.5$
c) $x = 40$ **d)** $x = 4.3$
e) $n = 120$ **f)** $c = -4$

9. a) $2x = -10$; $x = -5$
b) $3x + 6.4 = 13.9$; $x = 2.5$
c) $4x = -8.8$; $x = -2.2$ **d)** $2x + 3.6 = 10$; $x = 3.2$

10. a) $c = 45$ **b)** $m = -33$
c) $n = -6$ **d)** $q = -20$
e) $c = 3$ **f)** $a = -5.85$

11. a) $\frac{x}{4} = -7$; $x = -28$ **b)** $3 + \frac{x}{5} = 6$; $x = 15$
c) $\frac{x}{2} = 2.5$; $x = 5$ **d)** $\frac{x}{3} - 4 = 2$; $x = 18$

12. No, Jenna's partner should undo the operations in the reverse order: subtract 4 then divide by –2.

13. a) $\frac{b}{3} - 13.5 = 2.8$ **b)** $b = 48.9$

14. a) $2(1.2 + l) = 6.6$ **b)** $l = 2.1$

15. a) $0.12x = 39.48$; $x = 329$
b) $0.12(329) = 39.48$

16. a) \$3500

17. a) Let s represent Steve's sales, in dollars.
$1925 + 0.1s = 2725$
b) \$8000

18. a) $x = 4$ **b)** $m = 1.5$
c) $t = 2.1$ **d)** $y = 0.8$
e) $a = -3.8$

19. a) Let w represent the volume of 1 bottle of water, in litres. $4w + 6(0.5) = 4.42$
b) 0.355 L

20. a) The student should not multiply 4.2 by 3 in line 2.

Correction:

$$3(x - 2.4) = 4.2$$
$$3x - 3(2.4) = 4.2$$
$$3x - 7.2 = 4.2$$
$$3x = 4.2 + 7.2$$
$$3x = 11.4$$
$$x = \frac{11.4}{3}$$
$$x = 3.8$$

b) The student forgot the negative sign for $\frac{1}{2}x$ in line 3, and should multiply –2 by –2 instead of dividing it by 2 in line 4.

Correction:

$$5 - \frac{1}{2}x = 3$$
$$5 - \frac{1}{2}x - 5 = 3 - 5$$
$$-\frac{1}{2}x = -2$$
$$x = 4$$

21. a) Let t represent the number of extra toppings.
$16.50 = 7.50 + 1.50t$

b) The customer ordered 6 toppings.

22. a) Let c dollars represent the original price.

$0.09c = 4.95$

b) The item cost $55.00.

$$0.09c = 4.95$$
$$c = \frac{4.95}{0.09}$$
$$c = 55$$

23. a) $180(n - 2) = 1080$

b) Kyler's solution:

$$180(n-2) = 1080$$
$$180n - 360 = 1080$$
$$180n - 360 + 360 = 1080 + 360$$
$$180n = 1440$$
$$n = \frac{1440}{180}$$
$$n = 8$$

c) Esta's solution:

$$180(n-2) = 1080$$
$$n - 2 = \frac{1080}{180}$$
$$n - 2 = 6$$
$$n = 6 + 2$$
$$n = 8$$

d) Answers may vary. Esta's method of undoing the operations is simpler.

24. a) $x = -6.1$ **b)** $m = 3.25$

c) $p = -2\frac{1}{12}$ **d)** $g = 0.965$

6.2 Solving Equations by Using Balance Strategies, page 280

4. a) $3t + 2 = t + 8$; $t = 3$ **b)** $5s + 3 = 2s + 9$; $s = 2$

5. a) Step 1: Subtract f from each side.

Step 2: Add 2 to each side.

Step 3: Divide each side by 2.

b) Algebraic solution:

$$3f - 2 = f + 4$$
$$3f - 2 - f = f + 4 - f$$
$$2f - 2 = 4$$
$$2f - 2 + 2 = 4 + 2$$
$$2f = 6$$
$$\frac{2f}{2} = \frac{6}{2}$$
$$f = 3$$

6. a) $g = 1$ **b)** $k = -2$

c) $a = -2$ **d)** $h = 2$

7. a) **i)** $h = 3$ **ii)** $h = -3$

iii) $h = -3$ **iv)** $h = -3$

v) $h = 3$ **vi)** $h = 3$

b) There are only 2 solutions because the equations only differ by their signs.

8. a) $s = 2$ **b)** $t = -3$

c) $w = 0.2$

9. $\frac{10}{x} = -3$; $x = -3\frac{1}{3}$

10. a) $a = 5$ **b)** $y = -3.2$

c) $z = 5.4$ **d)** $u = 6.3$

e) $b = 4.1$ **f)** $p = -2.5$

11. a) $n = -1$ **b)** $q = 9$

c) $a = 3.6$ **d)** $v = -2.8$

e) $x = 2.5$ **f)** $b = -3.5$

12. a) Let n represent the number of people.

$50n = 2000 + 40n$

b) The two halls will cost the same with 200 people.

13. $5 - 3n = 3.5n - 8$; $n = 2$

14. a) $1500 + 0.04s$ **b)** $1700 + 0.02s$

c) $1500 + 0.04s = 1700 + 0.02s$

d) $s = 10\,000$; $10 000 of sales would result in the same total earnings from both plans.

15. a) Student A forgot to write the negative sign for -5 in the last line.

Correction:

$$2.2x = 7.6x + 27$$
$$2.2x - 7.6x = 7.6x - 7.6x + 27$$
$$-5.4x = 27$$
$$x = -5$$

b) Student B should subtract $2.2x$ instead of adding $2.2x$ on each side in line 2.

Correction:

$$-2.3x - 2.7 = 2.2x + 11.7$$
$$-2.3x - 2.2x - 2.7 = 2.2x - 2.2x + 11.7$$
$$-4.5x - 2.7 = 11.7$$
$$-4.5x - 2.7 + 2.7 = 11.7 + 2.7$$
$$-4.5x = 14.4$$
$$x = \frac{14.4}{-4.5}$$
$$x = -3.2$$

16. a) **i)** $x = 81$; $x = 9$ **ii)** $a = 432$; $a = 3$

b) An additional step of multiplying each side by the variable is required to solve a variable in the denominator. After this step, solving for the variable is the same as solving for a variable in the numerator.

17. a) $g = 35$ **b)** $j = -17.5$

c) $h = 2.54$ **d)** $s = 10$

18. a) Let k represent the number of kilometres driven.

$199 + 0.2k = 149 + 0.25k$

b) Hendrik must drive a distance of 1000 km for the two rental costs to be the same.

19. **a)** $m = 8$ **b)** $t = \frac{20}{11}$

c) $r = -\frac{1}{39}$ **d)** $x = \frac{67}{90}$

20. **a)** Dembe's method:

$$\frac{x}{3} + \frac{x}{4} = x - \frac{1}{6}$$
$$12\left(\frac{x}{3} + \frac{x}{4}\right) = 12\left(x - \frac{1}{6}\right)$$
$$4x + 3x = 12x - 2$$
$$7x = 12x - 2$$
$$7x - 12x = 12x - 12x - 2$$
$$-5x = -2$$
$$\frac{-5x}{-5} = \frac{-2}{-5}$$
$$x = \frac{2}{5}$$

Bianca's method:

$$\frac{x}{3} + \frac{x}{4} = x - \frac{1}{6}$$
$$24\left(\frac{x}{3} + \frac{x}{4}\right) = 24\left(x - \frac{1}{6}\right)$$
$$8x + 6x = 24x - 4$$
$$14x = 24x - 4$$
$$14x - 24x = 24x - 24x - 4$$
$$-10x = -4$$
$$\frac{-10x}{-10} = \frac{-4}{-10}$$
$$x = \frac{4}{10}$$
$$x = \frac{2}{5}$$

b) Using the least common denominator saves the step of simplifying the final answer.

21. **a)** $x = -3\frac{2}{3}$ **b)** $x = 20$

c) $x = 4$ **d)** $x = 5$

22. Marlene made 10 assisted blocks.

23. **a)** Let m represent the number of minutes.
$28 + 0.45(m - 30) = 40 + 0.25m$

b) The monthly costs for both plans are the same at 127.5 min.

Unit 6: Start Where You Are, page 285

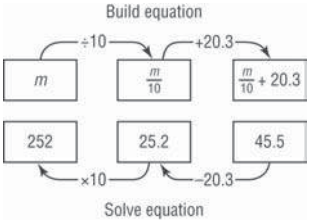
1. The price before the increase was $1.28/L.

Unit 6 Mid-Unit Review, page 286

1. **a)** Divide by −3. **b)** Add 2.

c) Divide by 2. **d)** Subtract 9.

2. **a)**



b)

$$\frac{m}{10} + 20.3 = 45.5$$
$$\frac{m}{10} + 20.3 - 20.3 = 45.5 - 20.3$$
$$\frac{m}{10} = 25.2$$
$$\frac{m}{10} \times 10 = 25.2 \times 10$$
$$m = 252$$

3. **a)** $2.5 + 1.2k = 27.7$; $k = 21$
Sheila travelled 21 km.

4. **a)** Let s represent the length of the third side in centimetres: $2(2.7) + s = 7.3$, or $5.4 + s = 7.3$

b) $s = 1.9$

5. **a)** $k = -4.5$ **b)** $b = 7\frac{2}{3}$

c) $x = 10.1$ **d)** $b = 7$

e) $n = 2.4$ **f)** $h = -23.2$

6. $6k + 1 = 2k + 9$; $k = 2$

7. **a)** $a = -16$ **b)** $w = 6.4$

c) $z = 8.4$ **d)** $x = 6$

e) $r = 7$ **f)** $y = -3$

g) $m = -1$

8. **a)** Let t represent the time in hours. $15 + 3t = 12 + 4t$

b) $t = 3$

6.3 Introduction to Linear Inequalities, page 292

3. **a)** True **b)** False

c) False **d)** False

e) True **f)** True

g) True **h)** False

4. **a)** $x < -2$ **b)** $p \geq 6$

c) $y < 0$ **d)** $m > 0$

5. **a)** No, $0 > -2$ **b)** Yes, $-6.9 < -2$

c) Yes, $-2.001 < -2$ **d)** Yes, $-3 < -2$

e) No, $-2 = -2$ **f)** No, $-\frac{1}{2} > -2$

6. Answers will vary. For example:

a) 5.01, 8, 10, 35 **b)** 6.9, 6, 0, −7

c) −1.5, 0, 2, 2.01 **d)** −20, −15, −13, −12.25

7. **a)** No **b)** Yes

c) No **d)** Yes

8. **a)** Let c represent the number of cups of water a coffee maker can hold. $c \leq 12$

b) Let a years represent the age to obtain a learner's permit to drive in Nunavut. $a \geq 15$

c) Let m represent the maximum seating capacity of a school bus. $m \leq 48$

d) Let n represent the number of people participating in the charity bike-a-thon each year. $n > 2500$

e) Let s represent the size of shoes in a shoe store. $s \leq 13$

9. **a)** Graph v **b)** Graph iii

c) Graph iv **d)** Graph ii

e) Graph i **f)** Graph v

g) Graph iv **h)** Graph i

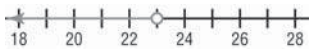
10. Both are correct. They wrote the same inequality using a different variable.

11. **a)** **i)** Let k represent the mass in kilograms of a child who must ride in a car seat in Canada. $k < 23$

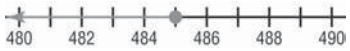
ii) Let t represent the temperature in degrees Celsius that a silicone oven mitt can resist. $t \leq 485$

iii) Let w dollars represent the minimum hourly wage in dollars in Alberta. $w \geq 8.40$

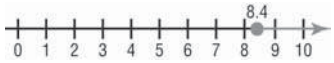
b) **i)**



ii)



iii)

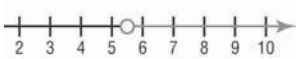


12. **a)** $x > 1$; neither 1 nor -3 is part of the solution.

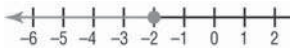
b) $x \leq 2$; both 1 and -3 are part of the solution.

c) $x < -10$; neither 1 nor -3 is part of the solution.

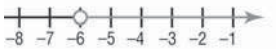
13. **a)**



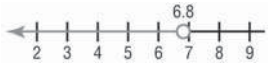
b)



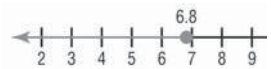
c)



d)

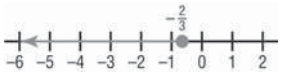


e)

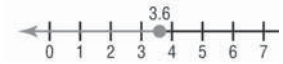


f)

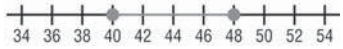
g)



h)



14. Let t represent the possible show time in minutes. $t \leq 48$ and $t \geq 40$



15. **a)** Over is >; under is <; maximum is $\leq$; minimum is $\geq$; at least is $\geq$; no more than is $\leq$.

16. $y \geq 0$

6.4 Solving Inequality by Using Addition and Subtraction, page 298

4. **a)** Subtract 4. **b)** Add $\frac{2}{3}$.

c) Add 4. **d)** Add 4.5.

e) Subtract $\frac{3}{10}$.

f) Subtract 4.9.

5. **a)** Add 2. **b)** Subtract 4.2.

c) Add $\frac{1}{2}$.

6. Answers will vary. For example:

a) 5, 6.5, $\frac{15}{2}$ **b)** 10, 9.5, $\frac{3}{2}$

c) $-5, -7.1, -8\frac{1}{4}$ **d)** 11, 11.2, $\frac{23}{2}$

7. **a)** $c > 4$ corresponds to graph iii; 3 is not a solution.

b) $w \leq 13$ corresponds to graph ii; 3 is a possible solution.

c) $r < -7$ corresponds to graph i; 3 is not a solution.

d) $m \leq -9$ corresponds to graph iv; 3 is not a solution.

8. **a)** $x > -3$ **b)** $y \leq -6$

c) $a \leq 4$ **d)** $x < -5$

e) $k < -21$ **f)** $q < 6.4$

9. **a)** $t < 43$ **b)** $x < -11$

c) $x < 11$ **d)** $a \leq -7$

e) $p \geq -10.4$ **f)** $y \geq -37.4$

10. No, –9 is only one of the possible solutions. The solution of $-7 \geq b + 2$ is $-9 \geq b$.

11. **a)** $p = -10.2$ **b)** $p \geq -10.2$

c) The processes are the same.

d) The solution of an inequality is a range of numbers, whereas the solution of the related equation is one number.

12. a) Let v dollars represent the money that Joel can deposit in his account. $212.35 + v \geq 750$

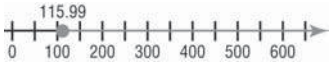
b) $v \geq$ 537.65; Joel can deposit $537.65 or more in his account to avoid paying a monthly fee.

c)

13. a) Let b dollars represent the money that Teagan should have in her savings before adding $20. $b + 20 \geq 135.99$

b) $b \geq$ 115.99; Teagan should have $115.99 or more in her savings before adding $20.

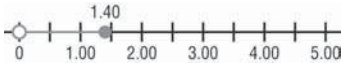
c)



14. a) Let m dollars represent the money that Marie can spend on a muffin. $3.45 + m \leq 4.85$

b) $m \leq$ 1.40; Marie cannot spend more than $1.40 on a muffin.

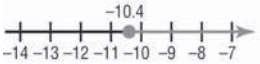
c)



d) Since $1.40 is less than $1.45, Marie cannot afford to buy the deluxe muffin.

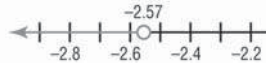
15. a) i) $a \leq -7$

ii) $p \geq -10.4$

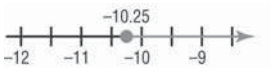


c) The graphs and solutions of part a are the same as those of questions 9d and 9e.

16. a) i) The value of x is less than −2.57.



ii) The value of b is greater than or equal to −10.25.



iii) The value of p is less than or equal to 1.005.

b) It is more difficult to accurately place the values of the solutions in these graphs.

c) Using an inequality is more accurate.

6.5 Solving Inequality by Using Multiplication and Division, page 305

3. a) No, the sign will not change.

$$-9 < -2$$
$$(4)(-9) < (4)(-2)$$
$$-36 < -8$$

b) Yes, the sign will change.

$$14.5 > 11.5$$
$$(14.5)(-3) < (11.5)(-3)$$
$$-43.5 < -34.5$$

c) Yes, the sign will change.

$$6 > -12$$
$$6 \div (-4) < (-12) \div (-4)$$
$$-1.5 < 3$$

d) No, the sign will not change.

$$-4 < 10$$
$$(-4) \div 4 < 10 \div 4$$
$$-1 < 2.5$$

4. a) −2, 0 **b)** −5

5. a) i) I would reverse the inequality symbol; $y \geq 6$

ii) I would not reverse the inequality symbol; $c > -4$

iii) I would reverse the inequality symbol; $x > -5$

iv) I would reverse the inequality symbol; $m > -6$

b) Answers will vary. For example:

i) $6, \frac{13}{2}, 6.1$ **ii)** $-2, -\frac{1}{4}, -3.5$

iii) $-4, -\frac{14}{3}, -4.5$ **iv)** $-5, \frac{3}{2}, -3.5$

6. No, the student is incorrect. The inequality symbol will change when multiplying each side of an inequality by −3.

7. a) $t > -\frac{3}{2}$ **b)** $x < -\frac{22}{5}$

c) $m \leq -5$ **d)** $x < -3$

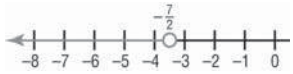
8. Let c represent the number of cars washed.

$$5c \geq 300$$
$$5c \div 5 \geq 300 \div 5$$
$$c \geq 60$$

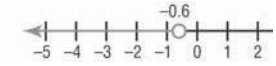
At least 60 cars would have to be washed.

9. a) $k \geq -\frac{3}{2}$

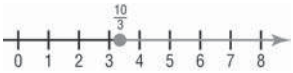
b) $g < -\frac{7}{2}$



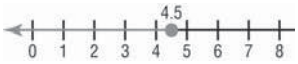
c) $a < -0.6$



d) $b \geq \frac{10}{3}$



e) $s \leq 4.5$

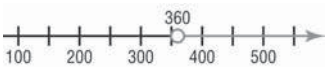


f) $v \geq -2.4$

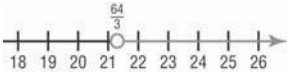
10. a) $7.5s - 1200 > 1500$, where s is the whole number representing the number of tickets sold.

b) $s > 360$; more than 360 tickets need to be sold.

c)

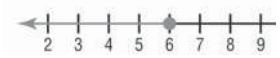


11. a) $x > \frac{64}{3}$

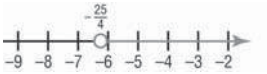


b) $c \geq 16$

c) $d \leq 6$



d) $f > -\frac{25}{4}$



12. a) $a \geq 2\frac{1}{3}$ **b)** $t \geq 2$

c) $z \geq 2$ **d)** $b \geq -9$

13. a) Let k represent the number of kilometres driven.
$2.5 + 1.2k \leq 12$

b) $k \leq 7.91\overline{6}$ or $k \leq 7\frac{11}{12}$

Jake can travel up to $7.91\overline{6}$ km for \$12.

d)

14. a) $w = \frac{2}{5}$ **b)** $w \leq \frac{2}{5}$

c) The processes are the same, except when multiplying each side by a negative fraction. The equality symbol stays the same but the inequality symbol reverses.

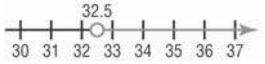
d) Both solutions involve the same fraction. The solution of an inequality is a range of numbers, whereas the solution of the related equation is one number.

15. a) Let h represent the number of hours.
$0.55 + 0.004\,20h > 5 + 0.001\,05h$

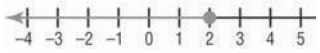
b), c) $h > 1412.7$; Since the minimum cost of electricity, \$0.01, is for about 2 h use of the regular light bulb or for about 10 h use of the energy saver light bulb, we need to check the time of use near 1413 h for a more accurate solution. For 1413 h, electricity cost of regular light bulb: \$0.55 + \$0.004 20(1413) = \$6.48
For 1413 h, electricity cost of energy saver light bulb: \$5.00 + \$0.001 05(1413) = \$6.48
For 1414 h, electricity cost of regular light bulb: \$0.55 + \$0.004 20(1414) = \$6.49
For 1414 h, electricity cost of energy saver light bulb: \$5.00 + \$0.001 05(1414) = \$6.48
So, for 1414 h or more, it is cheaper to use an energy saver light bulb.

d)

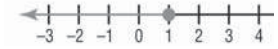
16. a) $h > 32.5$



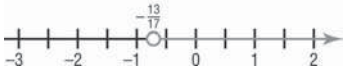
b) $n \leq 2$



c) $v \leq 1$

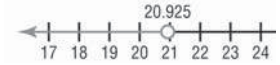


d) $z > -\frac{13}{17}$



17. a) $a > \frac{3}{2}$

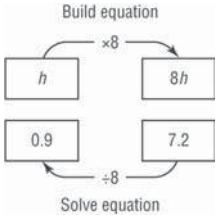
b) $m < 20.925$



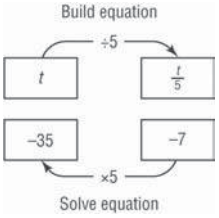
18. **a)** 5000 brochures **b)** 0 to 4999 brochures
c) More than 5000 brochures

Unit 6: Review, page 308

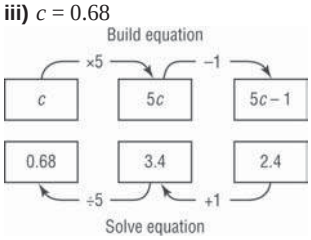
1. **a)** **i)** $h = 0.9$



ii) $t = -35$



iii) $c = 0.68$



b) **i)**

$$8h = 7.2$$
$$\frac{8h}{8} = \frac{7.2}{8}$$
$$h = 0.9$$

ii)

$$\frac{t}{5} = -7$$
$$5\left(\frac{t}{5}\right) = 5(-7)$$
$$t = -35$$

iii)

$$5c - 1 = 2.4$$
$$5c - 1 + 1 = 2.4 + 1$$
$$5c = 3.4$$
$$\frac{5c}{5} = \frac{3.4}{5}$$
$$c = 0.68$$

2. **a)** Milan's steps:

$$4(3.2s + 5.7) = -6$$
$$\frac{4(3.2s + 5.7)}{4} = \frac{-6}{4}$$
$$3.2s + 5.7 = -1.5$$
$$3.2s + 5.7 - 5.7 = -1.5 - 5.7$$
$$3.2s = -7.2$$
$$\frac{3.2s}{3.2} = \frac{-7.2}{3.2}$$
$$s = -2.25$$

b) Daria's steps:

$$4(3.2s + 5.7) = -6$$
$$4(3.2s) + 4(5.7) = -6$$
$$12.8s + 22.8 = -6$$
$$12.8s + 22.8 - 22.8 = -6 - 22.8$$
$$12.8s = -28.8$$
$$\frac{12.8s}{12.8} = \frac{-28.8}{12.8}$$
$$s = -2.25$$

3. **a)** $b = -12.4$ **b)** $t = -10.2$
c) $w = 29.6$ **d)** $x = -2.5$

4. **a)** Let l represent the length of the shorter side in centimetres. $2(3.1 + l) = 8.4$
b) $l = 1.1$; the length of the shorter side is 1.1 cm.

5. Algebraic solution:

$$3r + 3 = r + 7$$
$$3r + 3 - r = r + 7 - r$$
$$2r + 3 = 7$$
$$2r + 3 - 3 = 7 - 3$$
$$2r = 4$$
$$\frac{2r}{2} = \frac{4}{2}$$
$$r = 2$$

6. Algebraic solution:

$$2x - 3 = 6 - x$$
$$2x - 3 + x = 6 - x + x$$
$$3x - 3 = 6$$
$$3x - 3 + 3 = 6 + 3$$
$$3x = 9$$
$$\frac{3x}{3} = \frac{9}{3}$$
$$x = 3$$

7. **a)** $a = 16$ **b)** $m = \frac{1}{15}$
c) $x = \frac{880}{63}$ **d)** $g = -5.5$
e) $x = \frac{4}{3}$ **f)** $p = 3.4$

8. **a)** Let k represent the distance driven in kilometres.
$200 = 25 + 0.35k$

b) $k = 500$; for a distance of 500 km, the cost will be the same for the two companies.

9. The student forgot to multiply 5.4 by 3.5 and multiply 1.2 by 2.5 in line 2. The result of $7v - 7.5v$ should be $-0.5v$ instead of $0.5v$ in line 4.
Correction:

$$3.5(2v - 5.4) = 2.5(3v - 1.2)$$
$$7v - 18.9 = 7.5v - 3$$
$$7v - 7v - 18.9 = 7.5v - 7v - 3$$
$$-18.9 + 3 = 0.5v - 3 + 3$$
$$0.5v = -15.8$$
$$\frac{0.5v}{0.5} = \frac{-15.8}{0.5}$$
$$v = -31.8$$

10. **a)** Let a years represent the age of a person being admitted. $a \geq 18$

b) Let h represent the height of a person in centimetres admitted to the ride. $h \geq 90$

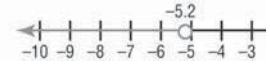
c) Let c represent the amount that Horton can spend in dollars. $c \leq 50$

d) Let y years represent the age of a player for the game. $y \geq 5$

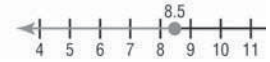
11. **a)** $x \leq -5$ **b)** $x < 1$

c) $x > 3.5$ **d)** $x \geq 1\frac{2}{3}$

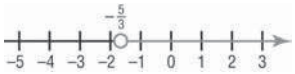
12. **a)** **i)**



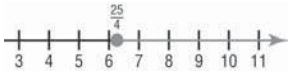
ii)



iii)



iv)



b) **i)** Neither −3 nor 5 are possible solutions.
ii) Both 5 and −3 are possible solutions.
iii) 5 is a possible solution.
iv) Neither 5 nor −3 are possible solutions.

13. Answers will vary. For example:

a) $h < -3$; -10, $-\frac{9}{2}$, -7.5

b) $k > -3$; 0, $\frac{12}{5}$, -1.5 **c)** $y < 5$; 4, $\frac{1}{2}$, 3.5

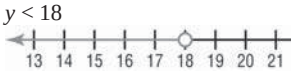
14. **a)** No **b)** No

c) No **d)** Yes

15. **a)** Let p represent the number of students that can attend the prom. $400 + 30p \leq 10\,000$

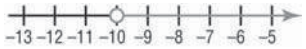
b) $p \leq 320$

16. **a)** $y < 18$

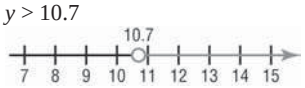


b) $y > -2$

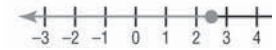
c) $x > -10$



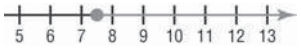
d) $y > 10.7$



e) $y \leq 2.5$



f) $a \geq 7.5$



Unit 6: Practice Test, page 310

1. Algebraic solution:

$$15 + 2d = 5d + 6$$
$$15 + 2d - 2d = 5d + 6 - 2d$$
$$15 = 3d + 6$$
$$15 - 6 = 3d + 6 - 6$$
$$3d = 9$$
$$\frac{3d}{3} = \frac{9}{3}$$
$$d = 3$$

2. **a)** $x = 2.1$ **b)** $x = \frac{52}{7}$ or $7\frac{3}{7}$

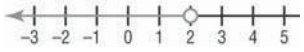
c) $r = -25.8$ **d)** $w = 18.6$

e) $c = -17$ **f)** $m = -1.2$

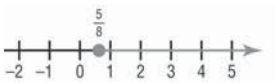
3. **a)** Let n represent the number of meals.
$100 + 15n = 25 + 20n$

b) $n = 15$

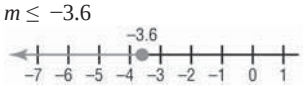
4. **a)** $t < 2$



b) $t \geq \frac{5}{8}$

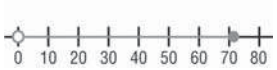


c) $m \leq -3.6$



5. **a)** Let k represent the distance the business person can travel, in kilometres. $24.95 + 0.35k \leq 50$

b) $k \leq 71.57$



6. **a)** The student forgot to multiply 2 by 4 in line 2.
Correction:

$$\frac{1}{4}c - 2 = 3$$
$$\frac{1}{4}c - 2 + 2 = 3 + 2$$
$$\frac{1}{4}c = 5$$
$$4 \times \frac{1}{4}c = 4 \times 5$$
$$c = 20$$

b) The student should not change the inequality symbol when subtracting 4 in line 2. The negative sign for –12 should stay in line 5.
Correction:

$$x + 4 < -8 - 2x$$
$$x + 4 - 4 < -8 - 2x - 4$$
$$x < -2x - 12$$
$$x + 2x < -2x - 12 + 2x$$
$$3x < -12$$
$$3x \div 3 < -12 \div 3$$
$$x < -4$$

Cumulative Review Units 1-6, page 312

1. **a)** About 1.9 **b)** 0.9
c) $\frac{4}{5}$ **d)** 0.02
e) About 5 **f)** 2.1
g) 1.6 **h)** About 0.5

2. **a)** −8
b) 1
c) −33 497
d) −304
e) 18

3. **a)** $-2\frac{13}{24}$ **b)** $-11\frac{3}{20}$
c) −4.42 **d)** $\frac{7}{18}$
e) −34.43 **f)** $-\frac{1}{8}$
g) 3

4. **a)** When the term number increases by 1, the term value increases by 2.
b) $v = 2n + 3$ **d)** 51
e) Term number 115

5. **a)**

x	y
1	1
2	4
3	7
4	10

b) As x increases by 1, y increases by 3.

6. **a)** **i)** Vertical **ii)** Horizontal **iii)** Oblique

7. **a)** Graph B **b)** Graph C
c) Graph A

8. **a)** About 5.5 days **b)** About 1600 km

9. **a)** Coefficient: 3; variable: x; degree: 1; constant: −6
b) Coefficients: 4, −2; variable: n; degree: 2; constant: 5
c) Coefficients: none; variable: none; degree: 0; constant: 19
d) Coefficients: −1, −21; variable: a; degree: 2; constant: 7

10. **a)** $-7a + 1$ **b)** $y^2 + 2y - 4$
c) $2c - 10cd + d + 4$ **d)** $6m^2 - 2n^2 + 2m - 3n$

11. **a)** $10s^2 - 6s + 3$ **b)** $3x^2 - 8x + 6$
c) $-t^2 + 14t + 2$ **d)** $n^2 + n - 6$
e) $x^2 + 4y^2 + 9xy - 7$
f) $-3a^2 - 4b^2 + 5ab - 15b + 8a + 6$

12. **a)** $27s^2 - 63s + 36$ **b)** $7w^2 + 8w - 5$
c) $21m^2 - 63m$ **d)** $2d - 3$

13. **a)** $x = 0.8$ **b)** $a = -10.8$
c) $s = -4.2$ **d)** $c = 24$
e) $n = 5.1$ **f)** $c = -\frac{7}{8}$
g) $d = 6$ **h)** $v = -44.6$
i) $t = 10$ **j)** $r = 6$

14. **b)** **i)** Both **ii)** Both
iii) −4 only **iv)** Neither

15. **a)** $x < -4$ **b)** $x < -2$
c) $b \geq 3.3$ **d)** $n \geq 72$
e) $m \leq -38$ **f)** $t < -7.5$
g) $s \geq 11$

16. **a)** $140 + 15n \leq 210$, n is an integer
b) $n \leq 4.\overline{6}$, n is an integer

Unit 7 Similarity and Transformations, page 314

Unit 7: Start Where You Are, page 317

1. **a)** $\angle ACB = 76°$
b) $\angle GEF = 36°$; $\angle GFE = 108°$
c) $\angle HJK = \angle KHJ = 72°$

7.1 Scale Diagrams and Enlargements, page 323

4. **a)** 4 **b)** 1.5

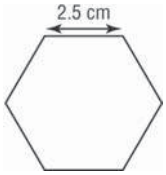
5. **a)** 36 cm **b)** 205 mm
c) 6.51 cm **d)** 171 mm
e) 10 cm

6. **a)** 210 cm by 150 cm **b)** 350 cm by 250 cm
c) 61 cm by 44 cm **d)** 74 cm by 53 cm

7. About 1.6

8. About 7.5

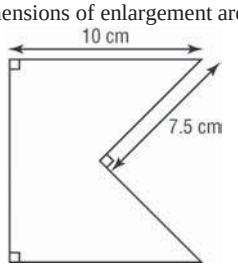
9.



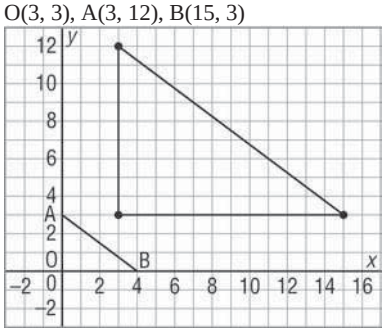
11. **a)** Diagram C
i) The scale factor is 2.
ii) Each side is 2 times the length of the corresponding side on the original diagram.
b) Diagrams C and D
i) The scale factor for both diagrams is 1.5.
ii) Each side is 1.5 times the length of the corresponding side on the original diagram.

12. **a)** 320 **b)** 11.2 m

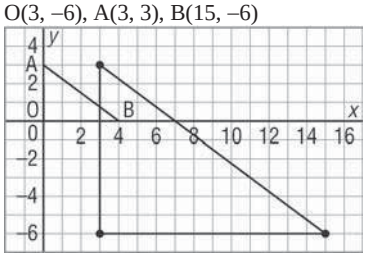
14. Dimensions of enlargement are marked on diagram:



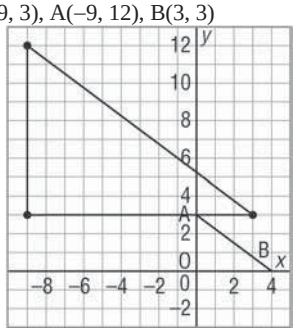
15. There are 3 possible enlargements of ΔABC.
a) O(3, 3), A(3, 12), B(15, 3)



b) O(3, −6), A(3, 3), B(15, −6)



O(−9, 3), A(−9, 12), B(3, 3)



16. **a)** 80 000 microns, or 0.08 m, or 8 cm, or 80 mm
b) 12 500

7.2 Scale Diagrams and Reductions, page 329

4. **a)** 0.025 **b)** 0.04
c) 0.002 **d)** $0.01\overline{6}$

5. **a)** $\frac{1}{5}$ **b)** $\frac{3}{4}$

6. **a)** $\frac{3}{5}$ **b)** $\frac{2}{3}$
c) $\frac{17}{63}$ **d)** $\frac{1}{250}$
e) $\frac{3}{40}$

7. $\frac{1}{2}$; 0.5

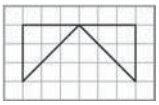
8. Rectangle C; each side of rectangle C is $\frac{1}{4}$ the corresponding length on the larger rectangle.

9. Triangle B is a reduction of triangle A; the scale factor for the reduction is $\frac{1}{3}$.

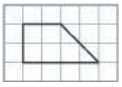
10. Polygon C is a reduction of polygon B; the scale factor for the reduction is $\frac{2}{3}$.

11. **a)** 25 cm **b)** 3.6 cm
c) 10 cm **d)** 0.16 m, or 16 cm
e) 48 cm

12. **a)**



b)



13. **a)** 4.55 mm **b)** 16 m

14. Length: $\frac{1}{200} \times 18$ m = 0.09 m, or 9 cm

Width: $\frac{1}{200} \times 9$ m = 0.045 m, or 4.5 cm

15. Length: 0.002 × 99 m = 0.198 m, or 19.8 cm
Width: 0.002 × 54 m = 0.108 m, or 10.8 cm

19. **a)** 1:50, or $\frac{1}{50}$, or 0.02

b) **i)** Length: 2.75 m; width: 1.5 m
ii) Length: 2.5 m; width: 1.25 m

c) 1.5 m

d) \$4.99/m × 27 m = \$134.73

20. **a)** 0.004 **b)** 60 m
c) 19 m

7.3 Similar Polygons, page 341

4. **a)** AB = 12 **b)** BC = 20
c) CD = 9 **d)** DE = 5.6

5. **a)** $x = 12.5$ **b)** $y = 32.1$
c) $z = 8.\overline{3}$ **d)** $a = 0.0525$

6. Square IJKL ~ square QRST:

$\frac{IJ}{QR} = \frac{JK}{RS} = \frac{KL}{ST} = \frac{LI}{TQ} = 2$; $\angle I = \angle Q$, $\angle J = \angle R$,

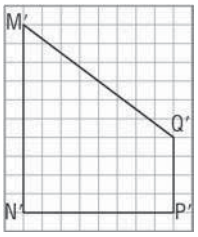
$\angle K = \angle S$, $\angle L = \angle T$

Quadrilateral ABCD ~ quadrilateral QPMN:

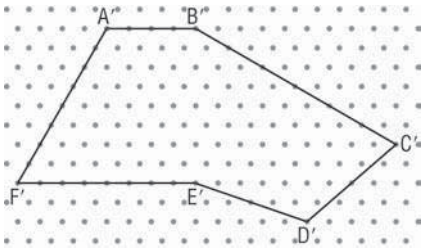
$\frac{AB}{QP} = \frac{BC}{PM} = \frac{CD}{MN} = \frac{DA}{NQ} = \frac{1}{2}$; $\angle A = \angle Q$, $\angle B = \angle P$,

$\angle C = \angle M$, $\angle D = \angle N$

7.



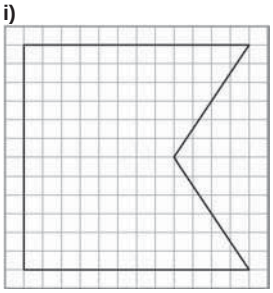
8.



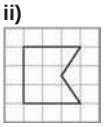
9. Rectangle EFGH ~ rectangle IJKM since the corresponding sides are proportional.

$\frac{EF}{IJ} = \frac{FG}{JK} = 1.5625$

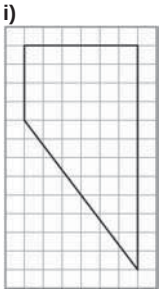
10. **a)** **i)**



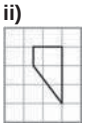
ii)



b) **i)**

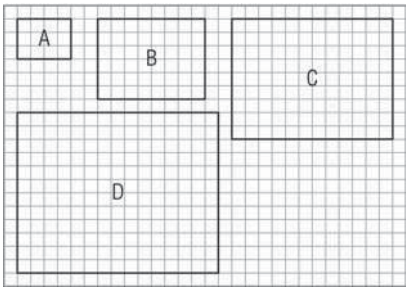


ii)



11. **a)** No; some corresponding angles are not equal.
b) Yes; the corresponding sides are proportional and the corresponding angles are equal.

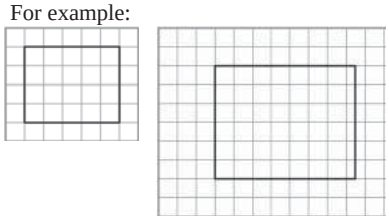
12.



a) **i)** Rectangles A, B, and C are similar, the corresponding sides are proportional and all the angles are right angles.
Rectangle D is not similar to any other rectangle since the corresponding sides are not proportional:

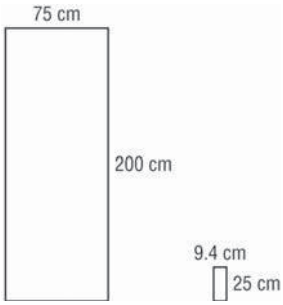
$$\frac{\text{Length of D}}{\text{Length of C}} \neq \frac{\text{Width of D}}{\text{Width of C}}$$

ii) For example:



b) The diagonal of rectangle B is 10 units and the diagonal of rectangle C is 15 units.

13. **a)**

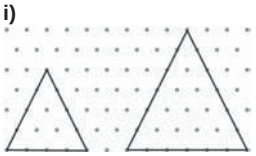


b) The width of the doll's house door is about 9.4 cm.

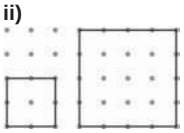
14. No; the corresponding angles are not equal.

15. **a)** For example:

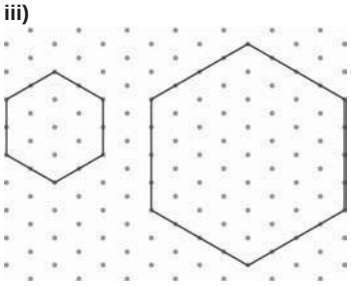
i)



ii)



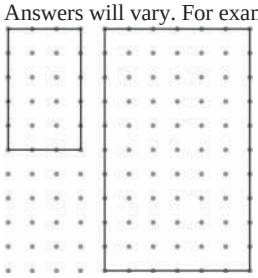
iii)



b) Yes; all regular polygons of the same type are similar. Their corresponding sides are proportional and their corresponding angles are equal.

16. Yes, all circles are similar since they have the same shape.

17. **a)** Answers will vary. For example:



The ratio of the corresponding sides is 2:1.

b) The ratio of the areas is 4:1.

c) The ratio of the areas is the square of the ratio of the corresponding sides.

d) Yes; this relationship is true for all similar shapes.

7.4 Similar Triangles, page 349

4. **a)** Yes; the corresponding angles are equal:
$\angle P = \angle N$, $\angle Q = \angle M$, $\angle R = \angle H$

b) Yes; $\frac{ST}{JH} = \frac{TU}{HG} = \frac{US}{GJ} = \frac{1}{2}$

c) Yes; the corresponding angles are equal:
$\angle C = \angle R$, $\angle E = \angle Q$, $\angle D = \angle P = 50°$

d) No; $\frac{DE}{TS} = \frac{FD}{VT} = \frac{1}{2}$ but $\frac{EF}{SV} = \frac{5}{9}$

5. **a)** $\Delta HGF \sim \Delta HJK$; the corresponding angles are equal: $\angle H = \angle H$, $\angle G = \angle J$, $\angle F = \angle K$

b) $\Delta CED \sim \Delta CAB$; the corresponding sides are proportional: $\frac{CE}{CA} = \frac{ED}{AB} = \frac{DC}{BC} = \frac{1}{2}$.

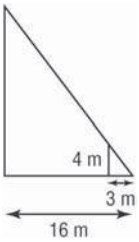
c) $\Delta QMN \sim \Delta QRP$; corresponding angles are equal:
$\angle Q = \angle Q$, $\angle M = \angle R$, $\angle N = \angle P$

6. **a)** 6 **b)** 16
c) 8.0

7. The flagpole is 12.8 m tall.

9. **a)** 7.65 m **b)** 27.2 m

10. **a)**



b) The building is about 21.3 m tall.

11. Using similar triangles, the length of the lake is 105 m.

12. The distance across the river is 82.5 m.

13. Equate the ratios of the corresponding sides.
The height of the tree is 5.3 m.

14. Equate the ratios of the corresponding sides for similar triangles. The ladder reaches 7 m up the wall.

15. $x \doteq 4.3$ m; $y = 9.6$ m

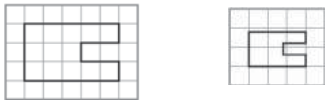
Unit 7: Mid-Unit Review, page 352

1. 21 cm by 14 cm

2. **a)** The diagram is an enlargement with a scale factor of 3.

b) The scale diagram is a 12-cm by 6.4-cm rectangle.

3. **a)** **b)**

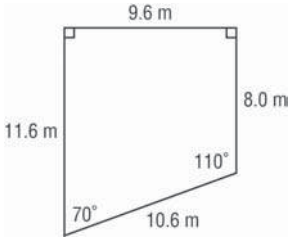


4. $\frac{1}{2000}$

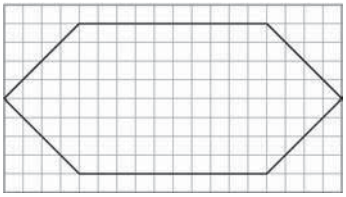
5. **a)** Quadrilateral ABCD ~ quadrilateral MKJN; the corresponding sides are proportional:

$$\frac{AB}{MK} = \frac{BC}{KJ} = \frac{CD}{JN} = \frac{DA}{NM} = \frac{2}{3}$$

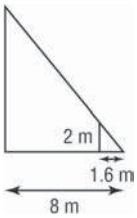
b) Answers will vary. For example:
This quadrilateral is similar to quadrilateral EFGH.



6. The length of each side of this hexagon is 2 times the length of the corresponding side in the original hexagon and the corresponding angles are all equal.



7. **a)**



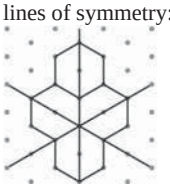
b) The height of the tree is 10 m.

7.5 Reflections and Line Symmetry, page 357

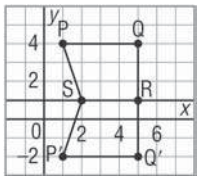
3. **a)** 1 **b)** 0
c) 1 **d)** 1
e) 3 **f)** 0

4. **a)** The 3 lines through the centre of the diagram are lines of symmetry.

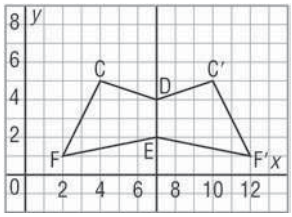
b) The 3 lines through the centre of the diagram are lines of symmetry:



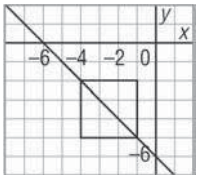
5. **a)**



b)



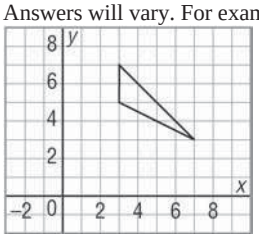
c)



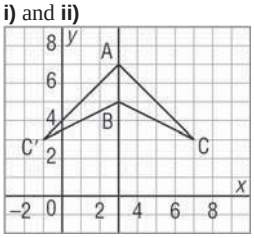
6. a) The vertical line through the centre of the tessellation is a line of symmetry.

b) The vertical line through the centre of the blanket is a line of symmetry.

7. a) Answers will vary. For example:



b) **i)** and **ii)**

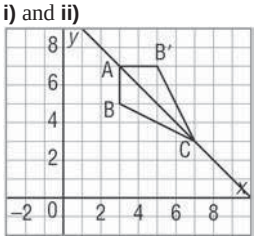


iii) A(3, 7), B(3, 5), C(7, 3), C′(–1, 3)

iv) The line of symmetry is the vertical line through 3 on the *x*-axis.

c) For one side:

i) and **ii)**

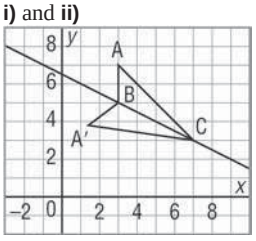


iii) B'(5, 7)

iv) The line of symmetry is the line through AC.

For the other side:

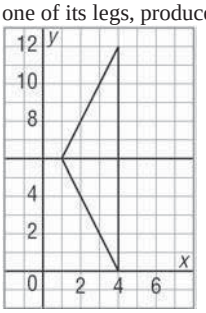
i) and **ii)**



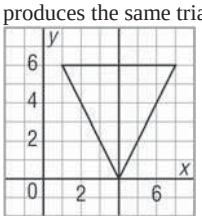
iii) A'(1.4, 3.8)

iv) The line of symmetry is the line through BC.

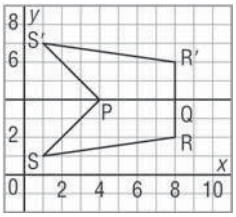
d), e) A scalene triangle always produces a shape that is a quadrilateral with line symmetry. Right triangles or isosceles triangles may reflect to produce another triangle instead of a quadrilateral. A right triangle, when reflected in one of its legs, produces another triangle.



An isosceles triangle, when reflected in its height, produces the same triangle.



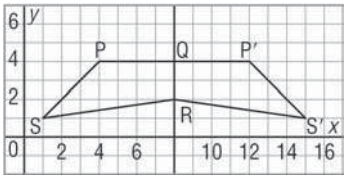
8. a)



The larger shape has coordinates: R(8, 2), S(1, 1), P(4, 4), S'(1, 7), R'(8, 6).

It is a pentagon with a line of symmetry through PQ.

b)

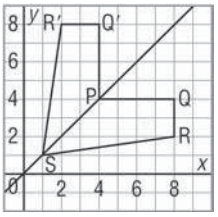


The larger shape has coordinates: R(8, 2), S(1, 1), P(4, 4), P'(12, 4), S'(15, 1)

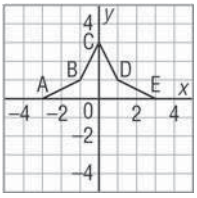
It is a pentagon with a line of symmetry through QR.

c) The larger shape has coordinates: P(4, 4), Q(8, 4), R(8, 2), S(1, 1), R′(2, 8), Q′(4, 8)

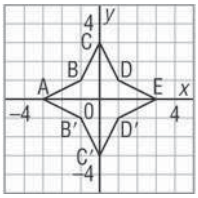
It is a hexagon with a line of symmetry through PS.



9. **a)**



b)

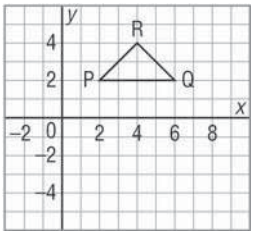


c) A(−3, 0), B(−1, 1), C(0, 3), D(1, 1), E(3, 0), D'(1, −1), C′(0, −3), B′(−1, −1)

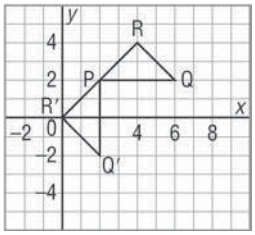
d) The shape has 4 lines of symmetry: *x*-axis, *y*-axis, the line through points B′ and D, the line through points B and D′

10. Pentagon A is the reflection image in the horizontal line through 7 on the *y*-axis.
The line of symmetry is the horizontal line through 7 on the *y*-axis.
Pentagon C is the reflection image in the vertical line through 5 on the *x*-axis.
The line of symmetry is the vertical line through 5 on the *x*-axis.
Pentagon D is the reflection image in the horizontal line through 3 on the *y*-axis.
The line of symmetry is the horizontal line through 3 on the *y*-axis.

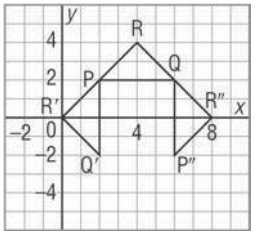
11. **a)**



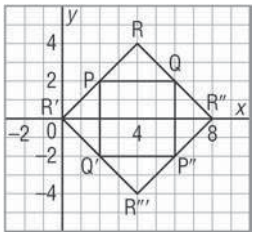
b)



c)



d)



e) The final shape has 4 lines of symmetry: *x*-axis, the vertical line through 4 on the *x*-axis, the line through the points (2, 2) and (6, −2) and the line through the points (6, 2) and (2, −2).

7.6 Rotations and Rotational Symmetry, page 365

4. **a)** 120° **b)** 72° **c)** 40° **d)** 30°

5. **a)** 6 **b)** 18 **c)** 8 **d)** 10

6. **a)** 3; 120° **b)** 5; 72° **c)** 4; 90° **d)** 8; 45°

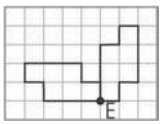
7. **a)** Yes; the snowflake has rotational symmetry of order 6 and the angle of rotation symmetry is 60°.

b) No; the picture does not have rotational symmetry.

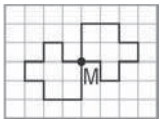
8. **a)** Yes; the shape has rotational symmetry of order 4 and the angle of rotation symmetry is 90°.

b) Yes; the shape has rotational symmetry of order 6 and the angle of rotation symmetry is 60°.

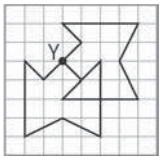
9. **a)**



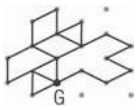
b)



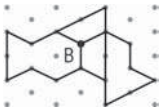
c)



10. **a)**



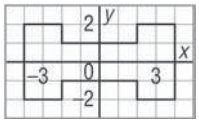
b)



11. **a)** The tessellation has rotational symmetry of order 4 about a point where the heads of 4 lizards meet.

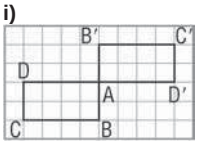
b) Rotational symmetry of order 15 about the centre

12. **a)**

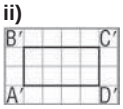


b) The shape formed is a dodecagon that has rotational symmetry of order 2.

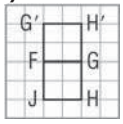
13. **a)** **i)**



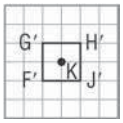
ii)



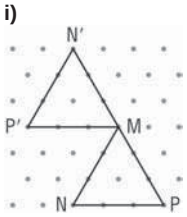
b) **i)**



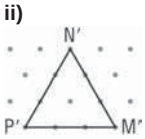
ii)



c) **i)**

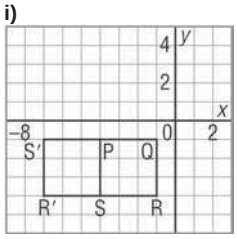


ii)

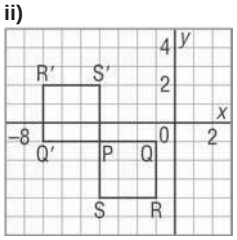


d) In parts a, b, and c, the image is the same in part ii. It is because each shape is rotated about the centre of the shape through the angle of rotation symmetry.

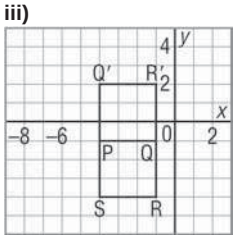
14. **a)** **i)**



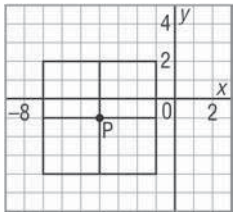
ii)



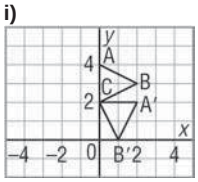
iii)



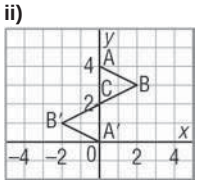
b) The shape formed has rotational symmetry of order 2 about P.



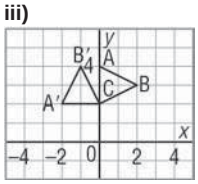
15. a) i)



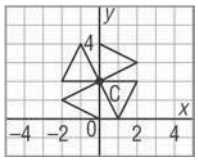
ii)



iii)



b) The shape formed has rotational symmetry of order 4 about C.



7.7 Identifying Types of Symmetry on the Cartesian Plane, page 373

3. a) Rotational symmetry of order 2

b) Rotational symmetry of order 2

c) Line symmetry: the horizontal line through the centre is a line of reflection.

d) Line symmetry: the horizontal line through the centre is a line of reflection.

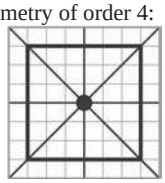
4. a) 8 lines of symmetry through the centre; rotational symmetry of order 8 about the centre

b) 5 lines of symmetry through the centre; rotational symmetry of order 5 about the centre

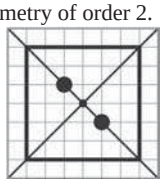
c) No line symmetry; no rotational symmetry

d) No lines of symmetry; rotational symmetry of order 5 about the centre

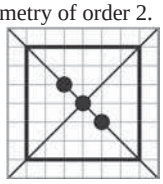
5. This face has 4 lines of symmetry and rotational symmetry of order 4:



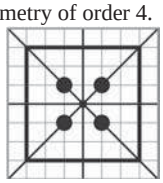
This face has 2 lines of symmetry and rotational symmetry of order 2.



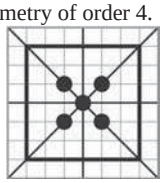
This face has 2 lines of symmetry and rotational symmetry of order 2.



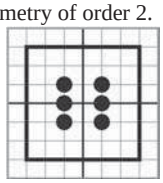
This face has 4 lines of symmetry and rotational symmetry of order 4.



This face has 4 lines of symmetry and rotational symmetry of order 4.



This face has 2 lines of symmetry and rotational symmetry of order 2.



6. a) Square D is a rotation of 180°; Square A is a rotation of 90° counterclockwise.

b) Square B is a reflection in the vertical line through 5 on the *x*-axis; Square C is a reflection in the *x*-axis.

7. a) By reflection in the *y*-axis

b) By reflection in the line through (1, −1) and (−1, 1) and by a 180° rotation about the origin

c) By reflection in the *x*-axis

d) By reflection in the line through (−1, −1) and (1, 1) and by a 180° rotation about the origin

8. a) By reflection in the *x*-axis, and by a 180° rotation about the point (−2.5, 0)

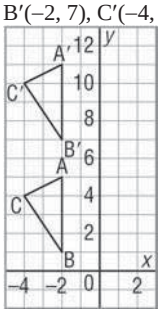
b) By 90° clockwise rotation about the point (2, 3)

9. The diagram formed by ΔFGH and ΔF′G′H′ has rotational symmetry of order 2.

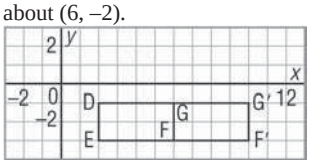
10. a) The diagram has 1 line of symmetry, which is the vertical line through the centre of the diagram.

b) The diagram has rotational symmetry of order 2 about the centre of the diagram.

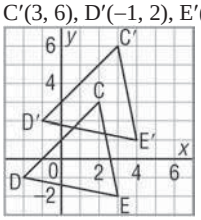
11. a) A(–2, 5), B(–2, 1), C(–4, 4), A′(–2, 11), B′(–2, 7), C′(–4, 10). There is no symmetry.



b) Vertices are: D(2, –1), E(2, –3), F(6, –3) = E′, G (6, –1) = D′, G′(10, –1), F′(10, –3)
The diagram has line symmetry and rotational symmetry. The line of symmetry is the vertical line through 6 on the *x*-axis and the 2 rectangles are related by rotational symmetry of order 2 about (6, –2).

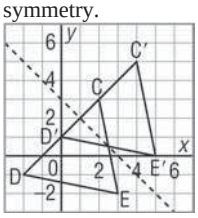


12. a)-c) Vertices are: C(2, 3), D(–2, –1), E(3, –2), C′(3, 6), D′(–1, 2), E′(4, 1)

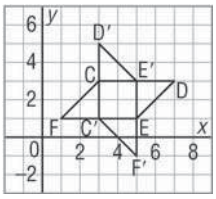


d) The translation does not result in any symmetry because there is no axis of symmetry and there is no line of symmetry.

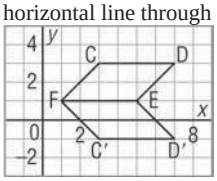
e) The translation R2, U2 results in a line of symmetry.



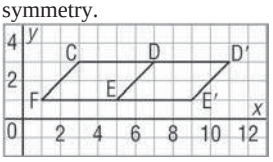
13. a), b) i) The diagram has rotational symmetry of order 4 about (4, 2).



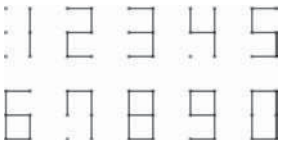
ii) The diagram has a line of symmetry, which is the horizontal line through 1 on the *y*-axis.



iii) The diagram does not have line or rotational symmetry.

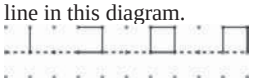


14. a)

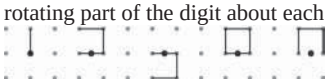


Digits 1 and 3 have a horizontal line of symmetry.
Digits 1, 2, and 5 have rotational symmetry of order 2.
Digits 4, 6, 7, and 9 have no line or rotational symmetry.
Digits 8 and 0 have both horizontal and vertical lines of symmetry and rotational symmetry of order 2.

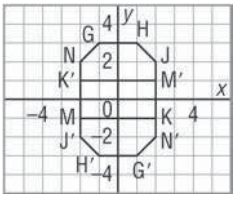
b) Digits 1, 3, 8, and 0 can be completed by reflecting these halves of the digits in the dotted line in this diagram.



c) Digits 1, 2, 5, 8, and 0 can be completed by rotating part of the digit about each dot shown.



15. a)



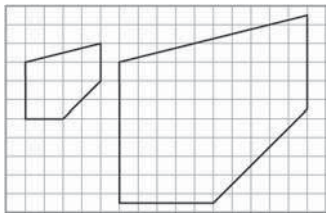
b) G(–1, 3), H(1, 3), J(2, 2), N′(2, –2), G′(1, –3), H′(–1, –3), J′(–2, –2), N(–2, 2)

c) The larger shape has line symmetry about the x-axis and the y-axis, and rotational symmetry of order 2 about the origin.

Unit 7: Review, page 377

1. **a)** 9 cm by 15 cm **b)** 7.5 cm by 12.5 cm
c) 4.5 cm by 7.5 cm **d)** 12.6 cm by 21 cm

2.



3. **a)** $\frac{2}{3}$ **b)** 96 cm

4. About 10.4 m

5. About 2.4 m and about 3.1 m

6. Pentagon Z is similar to the red pentagon. The ratios of the corresponding sides are all equal to $\frac{10}{9}$.

7. **a)** 6 m **b)** 4 m
c) About 5.3 m

8. **a)** 2 cm **b)** 2.8 cm

9. 46.4 m

10. About 35.6 m

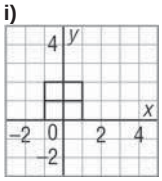
11. In similar triangles, the ratios of the corresponding sides are proportional.

$$\frac{25}{25+12.5} = \frac{x}{22.5}$$

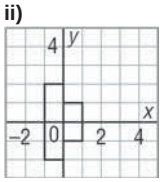
$x = 15$ m

12. **a)** 1 **b)** 0
c) 2 **d)** 3

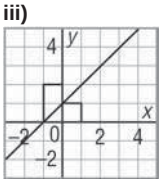
13. **a)** **i)**



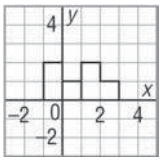
ii)



iii)



b)

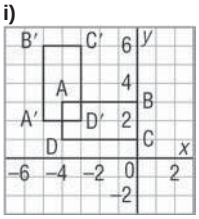


c) **i)** A(−1, 2), B(0, 2), C(0, 1), D(1, 1), E(1, 0), F(−1, 0), A′(1, 2), D′(−1, 1)
ii) A(−1, 2), B(0, 2), C(0, 1), D(1, 1), E(1, 0), F(−1, 0), A′(−1, −2), B′(0, −2), C′(0, −1), D′(1, −1)
iii) A(−1, 2), B(0, 2), C(0, 1), D(1, 1), E(1, 0), F(−1, 0)

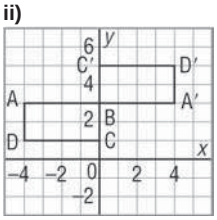
d) **i)** 4 lines of symmetry
ii) 1 line of symmetry
iii) 1 line of symmetry
b) 0 lines of symmetry

14. **a)** 3 **b)** 2
c) 6 **d)** 8

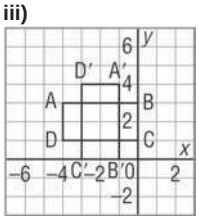
15. **a)** **i)**



ii)



iii)



b) **i)** The diagram has no rotational symmetry.
ii) The diagram has rotational symmetry of order 2 about B(0, 3).

iii) The diagram has rotational symmetry of order 4 about (–2, 2).

16. i) 1 line of symmetry: the line through the points (–6, 0) and (0, 6)

ii) No line symmetry

iii) 4 lines of symmetry: the vertical line through –2 on the *x*-axis, the horizontal line through 2 on the *y*-axis, the line through the points (–3, 1) and (–1, 3), the line through the points (–3, 3) and (–1, 1)

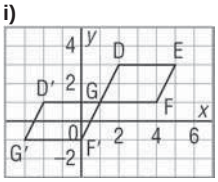
17. a) 1 line of symmetry: the line through the points (–2, 2) and (2, –2); rotational symmetry of order 2 about the origin

b) 1 line of symmetry: the vertical line through 0.5 on the *x*-axis

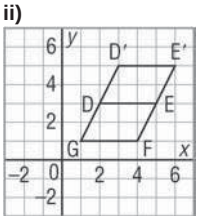
18. a) Rotational symmetry of order 3 about the centre; 3 lines of symmetry

b) 1 line of symmetry: the vertical line through the centre

19. a) i)



ii)



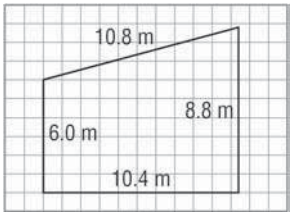
b) i) Yes; rotational symmetry of order 2 about G(1, 1).

ii) Yes; rotational symmetry of order 2 about (3.5, 3).

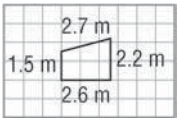
Unit 7: Practice Test, page 380

1. a) 8.1 m **b)** 5.2 m

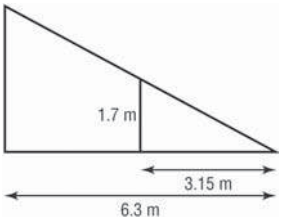
c)



d)



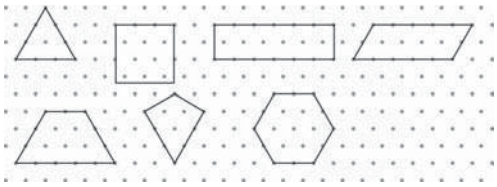
2. a)



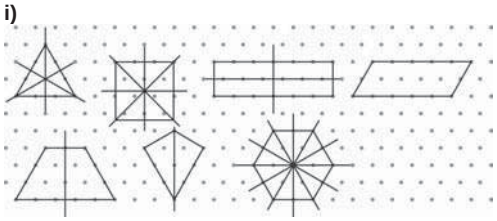
b) The corresponding angles in the triangles are equal.

c) The height of the tree is 3.4 m.

3. a)



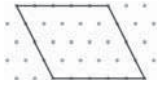
b) i)



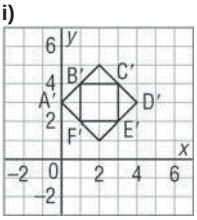
ii) Equilateral triangle: rotational symmetry of order 3; angle of rotation symmetry 120°
Square: rotational symmetry of order 4; angle of rotation symmetry 90°
Rectangle: rotational symmetry of order 2; angle of rotation symmetry 180°
Parallelogram: rotational symmetry of order 2; angle of rotation symmetry 180°
Regular hexagon: rotational symmetry of order 6; angle of rotation symmetry 60°

c) Answers will vary. For example:

d) Answers will vary. For example:



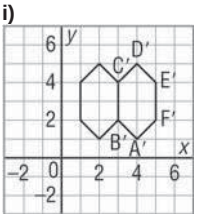
4. **a)** **i)**



ii) A′(0, 3), B′(1, 4), C′(3, 4), D′(4, 3), E′(3, 2), F′(1, 2)

iii) 4 lines of symmetry: the vertical line through 2 on the *x*-axis, the horizontal line through 3 on the *y*-axis, the line through the points (0, 1) and (4, 5), the line through the points (0, 5) and (5, 0); and rotational symmetry of order 4 about (2, 3)

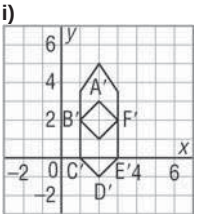
b) **i)**



ii) A′(4, 1), B′(3, 2), C′(3, 4), D′(4, 5), E′(5, 4), F′(5, 2)

iii) 2 lines of symmetry: the vertical line through 3 on the *x*-axis, the horizontal line through 3 on the *y*-axis; and rotational symmetry of order 2 about (3, 3)

c) **i)**



ii) A′(2, 3), B′(1, 2), C′(1, 0), D′(2, –1), E′(3, 0), F′(3, 2)

iii) 2 lines of symmetry: the vertical line through 2 on the *x*-axis, the horizontal line through 2 on the *y*-axis; and rotational symmetry of order 2 about (2, 2)

Unit 8 Circle Geometry, page 382

8.1 Properties of Tangents to a Circle, page 388

3. **a)** QR **b)** CE

4. **a)** 90° **b)** 90°

5. **a)** 90° **b)** 67°

c) 43°

6. **a)** 5 **b)** 12

c) 20

7. **a)** $d° = 62°$, $e° = 55°$ **b)** $d° = 57°$, $e° = 21°$

8. **a)** $a \doteq 8.5$ **b)** $a \doteq 7.9$

9. $a \doteq 11.5$, $b \doteq 5.3$

11. Answers may vary. For example: Both the line perpendicular to AB at P and the line perpendicular to CD at Q pass through the centre of the circle. The intersection of these two lines is the centre of the circle.

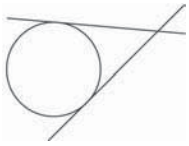
12. About 139 km

13. About 196 km

14. $x \doteq 10.8$; $y \doteq 10.4$; $z° = 60°$

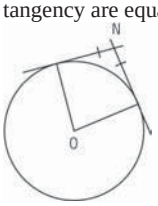
15. **a)** Two tangents

b) All other lines from this point would intersect the circle twice or not at all.



c) Each of the lines intersects the circle at exactly one point.

16. **a)** The distances from N to the two points of tangency are equal.



b) The lengths of the two tangents are equal.

c) $x = y \doteq 19.4$

17. 5 cm

18. 2835 km

19. About 61.7 cm

20. About 8.5 cm

21. 50 cm

22. **a)** About 6 m

b) The actual strap should be slightly longer to be able to join the ends of the strap.

8.2 Properties of Chords in a Circle, page 397

3. **a)** $d° = 90°$ **b)** $e = 5$

c) $f = 7$

4. **a)** $x° = 50°$, $y° = 90°$ **b)** $x° = 22°$, $y° = 136°$

c) $x° = y° = 35°$

5. **a)** $a = b \doteq 9.5$ **b)** $a \doteq 5.7$, $b \doteq 11.5$

6. $b \doteq 7.5$

7. **a)** $r \doteq 2.2$ **b)** $r = 6$

8. The distances between the centre and all chords of the same length are equal.

9. Draw two chords and their perpendicular bisectors. The intersection point of the perpendicular bisectors is the centre of the circle.

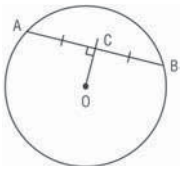
10. **a)** $s \doteq 3.8$ **b)** $s \doteq 7.3$

11. 9.6 cm

12. **a)** Parts i, ii, and iii

b) **i)** About 6.5 cm **ii)** About 5.4 cm **iii)** 0 cm

13.



14. About 15.3 cm

15. **a)** About 5.1 cm

b) The congruent chords are equidistant from the centre of the circle.

17. About 39.0 km

18. About 3.0 m

19. **a)** About 21.3 cm; about 4.7 cm

b) Two answers; the water level could be below or above the centre of the bowl

Unit 8: Mid-Unit Review, page 403

1. **a)** $x° = 22°, y° = 90°$ **b)** $x° = 46°, y = 33°$

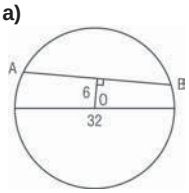
2. About 10.4

3. About 35.4 cm

4. $m° = 19°$

5. **a)** About 19.6 **b)** About 6.2

6. **a)** **b)** About 29.7 cm



7. About 26.2 cm

8.3 Properties of Angles in a Circle, page 410

3. **a)** Inscribed angle: ∠DFE; central angle: ∠DOE

b) Inscribed angle: ∠PRQ; central angle: ∠POQ

c) Inscribed angles: ∠NJM and ∠NKM; central angle: ∠NOM

4. **a)** $x° = 65°$ **b)** $x° = 90°$

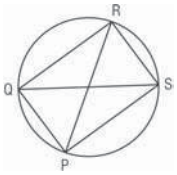
c) $x° = 40°$ **d)** $x° = 58°$

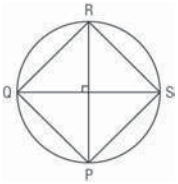
5. **a)** $y° = 140°, z° = 70°$ **b)** $y° = 25°, z° = 130°$

c) $y° = 27°, z° = 42°$

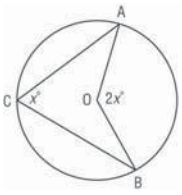
6. **a)** $x° = 80°, y° = 50°$ **b)** $x° = 25°, y° = 65°$

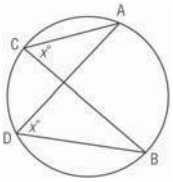
7. **a)** A rectangle **b)** A square



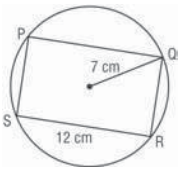


8. **a)** **b)**





9. **a)**



b) About 7.2 cm

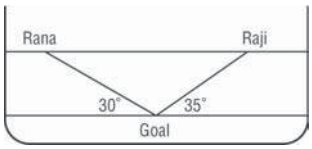
11. **a)** $x° = 40°, y = 40°$

b) $x° = 45°, y° = 40°$

c) $x° = 58°, y° = 116°$

12. Yes

13. **a)**

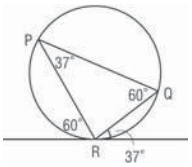


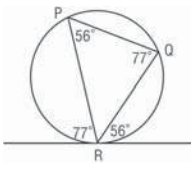
b) Raji

14. 45°

15. **a)** ∠QRS = ∠QPR and ∠PRT = ∠PQR

b) For example:





Unit 8: Review, page 418

1. **a)** $x° = 90°$, $y = 65°$
b) $a \doteq 9.7$, $y° = 36°$
c) $a = b \doteq 17.9$

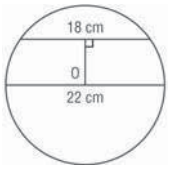
2. Since $7^2 + 13^2 \neq 16^2$, $\angle HPO \neq 90°$. So, the wire HP is not a tangent.

3. Draw a line perpendicular to the radius OP at the point P. This line is a tangent using the Tangent-Radius Property.

4. About 14.1 cm

5. **a)** $x \doteq 6.2$
b) $x \doteq 3.9$

6. **a)**



b) The chord is about 6.3 cm from the centre of the circle.

7. **a)** $x° = 35°$, $y° = 110°$
b) $x° = y° = 45°$

8. About 3.5 cm

9. **a)** $x° = y° = 90°$
b) $x° = y° = 60°$
c) $x° = 15°$, $y° = 75°$

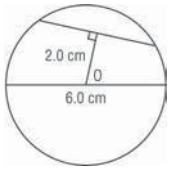
10. About 34.6 cm

Unit 8: Practice Test, page 420

1. $x \doteq 6.6$ cm, $y = 34°$

2. $x° = 61°$, $y° = 90°$, $z° = 30.5°$

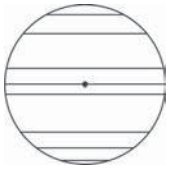
3. **a)**



b) About 4.5 cm
c) CD is shorter than AB.

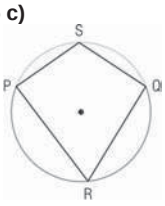
4. The central angle of a semicircle is 180°. The inscribed angle is one-half of the central angle, which is 90°.

5. The longest chord is the diameter. The farther away a chord is from the centre of the circle, the shorter the chord.



6. **a)** Parts i and ii
b) **i)** About 13.9 cm **ii)** About 10.6 cm

7. **a)** to **c)**



d) $\angle PRQ$ and $\angle PSQ$ have a sum of 180°.

Unit 9 Probability and Statistics, page 422

9.1 Probability in Society, page 427

3. **a)** Experimental probability; decision is based on Andrei's past experience.
b) Theoretical probability; the more tickets you buy, the greater your chance of winning.
c) Experimental probability; decision is based on Anita's past experience.
d) Subjective judgment; decision is based on Doug's feelings.

4. **a)** Claudia will continue to perform at the same level and the next math quiz will have the same difficulty.
b) Omar will leave work at the same time and the traffic patterns will be the same every day.

5. If Winona doesn't go canoeing, her decision will be based on probability (it is likely that it will rain). If she does go, her decision will be based on subjective judgment (the feeling that it will not rain).

6. Theoretical probability and subjective judgment

7. **a)** More money should be spent to increase the probability of recovering a stolen vehicle.
b) Because the probability of recovering a stolen vehicle is so low, there are better ways of spending money than on solving this problem.

8. **a)** Vanessa made the assumption that the same types of birds visit her birdfeeder at different times of the day, every day.
b) The percent of birds that are cardinals would change.

9. **a)** Kathryn assumes that the next 10 people she meets are a fair representation of the community.

b) The next 10 people may favour one candidate very strongly over the other, making the number of those who support Choo greater than or less than 7.

10. Since there is such a small chance the blood was not the suspect's, it is very likely the suspect committed the crime. There is a chance the blood belongs to someone else, so the jury should not convict a possibly innocent man.

11. a) The experimental probability may convince the teenager to try the treatment. He may also use subjective judgment about whether to try the treatment, depending on his personal beliefs of the effectiveness of acne treatment.

b) He would be assuming that he will respond to the treatment in a way that is similar to the response of other people who tried the treatment. His response to the treatment may differ from most people's.

14. The student is assuming that it is equally likely for Shaquille to miss as to make the shot, which ignores Shaquille's skill level in free throws. His skill makes it more likely that he will make free throws.

16. The Farmer's Almanac makes the assumption that long range weather patterns can be predicted from previous years' weather patterns.

17. a) This gives the impression that it is much more dangerous to travel by car than by plane. This information could be misleading because there are more people travelling by road than by air.

b) We need to know how many people travelled by plane and by car in 2004.

9.2 Potential Problems with Collecting Data, page 435

3. a) Privacy **b)** Use of language
c) Cultural sensitivity **d)** Time

4. a) **Part a:** Since the survey is not anonymous, the students may hesitate to respond negatively (to the principal) or positively (to avoid seeming to flatter the principal in front of their friends).
Part b: The principal should give students a written survey and ask them to return it anonymously to his/her office. The question should ask: "Are you enjoying school?"

b) **Part a:** The statement presents the most ethical option and no reasons for choosing another option, which may affect the results in favour of turning the wallet in.
Part b: The statement could be made into a question: "If you find a $20-bill, do you keep it or turn it in?"

c) **Part a:** Some people would not be aware of the cultural importance of head covering.
Part b: Brenda should ask if students are aware of the cultural significance of someone covering her or his head, and then ask the question.

d) **Part a:** Carlos will probably run out of time before he asks every student.
Part b: Carlos should choose a representative sample of the students to survey.

5. a) Students will think Parinder's question asks about how much time they spend on the computer at school and at home.

b) "How much time do you spend on the school computers?"

c) The school administration could be interested in the results to plan the school's budget for new computers.

6. a) No; many students who are bullied are afraid to tell people, especially in a non-anonymous environment.

b) An anonymous survey

7. a) On a warm August evening, the fans may not immediately see the point of building an indoor stadium, so many may respond negatively.

b) On a very cold November evening, Trinity may receive many more responses in favour of an indoor stadium.

8. a) **i)** The use of the words "violent criminal"; bias toward using DNA tests
ii) The use of the words "gas guzzling"; negative description of SUVs
iii) The question emphasizes the positive aspect of spell checks.

b) **i)** Do you think that DNA evidence should be allowed in courts?
ii) Are you in favour of banning SUVs?
iii) Do you think students should be allowed to use spell check?

9. a) No

b) Rebecca should have asked if her friends had any problems with their service provider, what service providers they had in the past, and whether they are satisfied with their current service providers.

10. a) Ethics: The survey designers didn't tell Sasha that promotional emails might be sent to the email address he provided. This reflects poorly on the brands advertised on the website.

b) Tell people their email addresses may be used for future correspondence and allow people then to indicate whether they wish to receive such emails.

11. Finding the favourite ice cream flavour of Canadian teens by surveying each teen would be expensive and time-consuming.

13. a) Privacy: People may not want to admit how much or how little they spend on clothes. Timing: Depending on the month in which Bridget interviews people, there may be clothing sales because a new season begins or for a holiday season shopping. Ethics: People may want to know *why* Bridget is asking them.

b) Privacy: Bridget could ask people to write a number on a slip of paper and leave it on her desk later. Timing: Bridget could ask at different months in the year. Ethics: Bridget could tell people why she is doing this survey.

15. Personal interviews: time-consuming, costly, and do not allow for anonymity; phone interviews: seen as invasive, so low response rate; email surveys: often returned by those with strong opinions about the issues

16. a) Some people may not understand the religious significance of the holiday.

9.3 Using Samples and Populations to Collect Data, page 440

3. a) Residents of Comox aged 13 to 25 years

b) All 1-L juice cartons

c) All schools managed by the board

d) All First Nations people in Nunavut

4. a) Census **b)** Sample

5. a) People who ride buses

b) All residents of Canada over the age of 18

c) Parents or guardians

d) People who have had relatives or friends in the emergency room

6. a) James; Courtney only surveyed a small sample.

b) Courtney's friends may not be representative of the grade 9 students.

7. a) It would be very time-consuming to test every AAA battery and there would be none left to sell.

b) It would be difficult to find every single First Nations child in Canada, requiring a lot of time and people.

8. a) Sample **b)** Sample

c) Sample **d)** Census

9. a) Invalid **b)** Invalid

10. a) All students in the high school

b) Sample

c) Ask a sample that is representative of the students in the high school. Include students of different grades, gender, ethnicity, and so on.

11. a) The topping your family wants on a pizza

b) Typical prices for a skateboard

Unit 9: Mid-Unit Review, page 444

1. a) 90% of a person's lies will be detected, not 1 out of 10 people will be able to lie undetected.

b) His reaction to the test will be different from most other people's.

2. 1 in 20 is a fairly small chance, so we probably don't need to worry about the WAIS collapsing. However, 1 in 20 is far from impossible, and considering the gravity of the situation if WAIS were to collapse, we should do everything possible to avoid it.

3. a) i) Do you find listening to music helps you relax while studying?

ii) Do you find listening to music distracting when you're trying to study?

b) Do you support listening to music while studying?

4. a) Privacy: The survey is not anonymous.

b) Many student smokers would lie and claim that they do not smoke, thus skewing the results toward a low number of student smokers.

5. a) i) People may refuse to disclose how much they earn.

ii) Well-educated parents who choose to stay home with children may resent the question.

iii) Change "years of post-secondary education" to levels of education, or number of courses at each level.

iv) Surveying a very large sample would take a lot of time and would be costly.

b) i) People may lie about the amount of money they make.

ii) People may be reluctant to answer or may answer dishonestly.

iii) People's answers may not reflect their true situations if the questions are unclear.

iv) Ahmed may not get as many results as he hopes for.

6. Asking students on a Monday morning if they enjoy going to school

7. a) Students who regularly eat at the cafeteria

b) Students who are enrolled in phys-ed classes

c) Students who drive to school

d) Students who go to or participate in football games

8. **a)** Too time-consuming

b) Too many DVD players to conduct a census; moreover, DVD player prices change often.

c) It is probably impossible to catch all the northern pike in Misaw Lake, and doing so could devastate the local ecosystem.

9. **a)** Census **b)** Sample

9.4 Selecting a Sample, page 448

3. **a)** Not a representative sample: People who do not enjoy shopping are not likely to be in a mall.

b) Not a representative sample: The majority of the cafeteria's customers are likely to be students, not teachers.

c) Not a representative sample: The neighbourhood sampled has a high crime rate, and probably has a different police presence than neighbourhoods with lower crime rates.

d) Not a representative sample: The survey targets those people (not necessarily teenagers) already interested in fitness and willing to take the time to participate.

4. **a)** Not appropriate **b)** Not appropriate

c) Appropriate **d)** Appropriate

e) Not appropriate

5. **a)** **i)** No **ii)** Yes

iii) Yes

b) **i)** The arena should survey residents of the surrounding community who skate or want to learn to skate.

6. **a)** Stratified random sampling: Survey 100 Canadian citizens from each of the income tax brackets.

b) Simple random sampling: Have a computer randomly select 300 student IDs and poll those students.

7. No

8. **a)** Surveying 300 15-year-olds

b) Survey 300 randomly selected members of the population

9. **a)** People who work for companies that make fur coats

b) A group of people from homes where people always recycle

10. **a)** No, the number of people in the sample is probably too small to represent the Canadian population.

b) The survey may have been conducted at a climate change rally.

c) Survey Canadian citizens using simple random sampling.

11. Self-selected sampling and convenience sampling

12. **a)** **i)** Randomly select student ID numbers.

ii) Inspect every 10th phone in the assembly line.

iii) Randomly select a high school and then a grade within that high school and survey every student in that grade.

iv) Divide the orchard into 8 equal plots of land and survey 5 apple trees from each plot.

b) Answers will vary. For example:

i) Course offerings

ii) Making sure there are no defects in the cell phones

iii) The most popular music artist among teenagers

iv) The average number of apples produced per season

Unit 9: Start Where You Are, page 453

1. Left box: has many spelling or grammatical errors; right box: ideas are mostly in an order that makes sense

Unit 9: Review, page 458

1. **a)** Mustafa Abaz

b) Assumptions: The sample surveyed is representative of the voting population. Nothing would happen before the election to change the popularity of the candidates.

2. Experimental probability: The players' past results indicate that they have a very good team with a very high probability of winning. Subjective judgment: Darrell strongly believes that the winning streak cannot last.

3. **a)** The chance of winning (1 in 3) is relatively high for a lottery, so there is a good chance of winning.

b) The chance of winning is still less than 50%, so it's better to not risk money on what will likely be a loss.

5. **a)** **i)** Use of language: The question is biased toward increasing the minimum wage.

ii) Ethics: The student used the results of the survey for something other than what she had claimed.

iii) Bias: It is not clear how the 1000 cars are tested.

iv) Timing: During November, not many people in the northern hemisphere think about outdoor pools.

b) i) More people surveyed will be in favour of increasing the minimum wage.

ii) It may not affect the data collection, but participants may feel frustrated or angry.

iii) There could be a defect later on in the assembly that might not be discovered.

iv) There would be fewer people who are in favour of building a new outdoor pool.

6. a) The best quality camera for its price. "What do you think is the best digital camera for its price?"

b) The question avoids bias by not leading the reader to answer one way or another.

7. a) Pregnant teens may not want to admit that they are pregnant.

b) There could be different cultural opinions regarding teen pregnancy that should be taken into account.

c) Raheem must word the question in a way that does not support or condemn teen pregnancy.

8. a) "What is your favourite fruit: apple, orange, or banana?"

b) "What is your favourite fruit?"

10. Census; if even one parachute is no longer working, a person could die.

11. a) Testing every brand of battery would be very time-consuming and would use up the batteries.

b) A sample of randomly selected brands would most likely represent the population.

12. a) i) Too time-consuming

ii) Time-consuming and difficult if people do not wish to share that information

b) Determining brands of calculators used by students in your math class

13. No; people who do not watch the TV show are excluded and only those who feel strongly about the competition would be likely to pay to vote.

14. a) Yes

b) Depends on the size of the school.

c) No

15. a) Simple random sampling of the entire country's voting population

b) Convenience sampling near several local tennis courts

16. a) Which brand of chewing gum do you recommend most?

b) Get the membership list of the province's dental association and call every 10th dentist.

c) Phone interviews; bar graph

d) The total number of dentists who selected a particular brand, divided by the total number of dentists surveyed

Unit 9: Practice Test, page 460

1. Shawnie: experimental probability; Owen: subjective judgment; Jovana: theoretical probability

2. a) Assumptions: The next team she plays is as skilled as the previous teams; her own team's skill level will not change.

b) If Hannah's team plays a team that is better than previous teams, or if Hannah's team loses a player, the chance of winning will be lower (a probability less than 0.875). If Hannah's team plays a team that is worse than previous teams, or if Hannah's team improves, the chance of winning will be higher (greater than 0.875).

3. a) If Manroop surveys people on a Monday morning at work, she would probably get a larger number of depressed people than if she surveyed people on a Saturday night. Also, time of the year may change responses since many people are depressed in the winter when there is less light.

b) People may not want to give such personal information to a stranger. Manroop should conduct an anonymous survey.

c) Use of language: "Satisfaction with life" does not necessarily mean happiness. The data might not reflect how happy or depressed Canadians are, but how much satisfaction they feel.

4. a) The cost of a new snowboard

b) Asking students in a grade 9 drama class to determine the most popular movie in a high school

5. a) Collect vials of water from 3 water fountains and 3 taps that are randomly selected from around the school. This sample would be representative of the school's entire water supply, assuming that any contamination in the water supply would affect all water fountains and taps.

b) Have the computer randomly select 50 student ID numbers and survey those students.

c) Randomly select 10 students from each grade and weigh their backpacks.

6. Emile could have problems with language if he asks questions in a way that would lead toward a certain answer. He could also have cultural sensitivity problems if he asks groups that have religious objections to shopping on Sundays.

Cumulative Review Units 1-9, page 464

1. **a)** 0.8 **b)** $\frac{6}{5}$

c) 8.9 **d)** 2.1

e) $\frac{10}{3}$ **f)** 1

g) 5.5 **h)** 2.1

2. 978 m^2

3. No; −43

4. $6^6 = 46\,656$

5. **a)** 225, 89.25, −223.94, 3 × (−22.39)

b) 225 + 89.25 + (−223.94) + 3 × (−22.39)

c) $23.14

6. −0.63

7. **a)**

t	0	1	2	3	4
d	0	3	6	9	12

b) Yes, because time and distance are not discrete.

c) The relation is linear; the graph is a straight line.

d) $d = 3t$

e) 45 m

f) About 5.6 min

8. **a)** About $140 **b)** About 15 weeks

c) For example, Colton may change the number of hours he works per week

9. **a)** $-2n^2 - 9n + 13$ or $-10n^2 - 5n + 3$

10. **a)** $6x^2 + 7x$ **b)** 24 cm^2

11. **b)** $t = 5$

12. **b)** Jerry can ride the pedicab for about 15 min.

13. **a)** 9.4 cm by 8 cm

b) 8.225 cm by 7 cm

c) 16.45 cm by 14 cm

14. **a)** $\frac{1}{40}$ **b)** 0.045 m by 0.03 m

15. About 8.2 m

16. **a)** Line symmetry about the horizontal line through 5 on the y-axis

b) Line symmetry about the vertical line through 4 on the x-axis

c) Line symmetry about the line through AD; line symmetry about the line through (0, 1) and (4, 5); rotational symmetry of order 2 about the midpoint of AD

17. **a)** Yes, rotational symmetry of order 2 with an angle of 180°.

b) **ii)** 90° clockwise about (−2, −3): (−1, 1), (−1, −3), (−2, −3), (–2, –4), (−6, –4), (–6, –2), (–3, –2), (–3, 1)
180° about Q: (−2, −2), (–2, –4), (–6, –4), (−6, −6), (−10, −6), (−10, −4), (−6, −2); rotational symmetry of order 2 around Q
270° clockwise about (−4, −4): (–2, –2), (–2, –4), (–4, –4), (–4, −6), (−6, −6), (−6, −2)

18. About 15.0 cm

19. About 10.1 cm

20. $x° = 250°$, $y° = 110°$, $z° = 55°$

21. About 18.5 cm

22. About 125 cm

23. $x° = 65°$, $y° = 50°$, $z° = 130°$

24. **a)** The other team will be the same skill level as the previous teams.

b) If the other team is better than previous teams, Bao's team is more likely to lose; if the other team is worse, Bao's team is more likely to win.

26. **a)** On-line survey

b) Not valid, because readers of a fashion magazine would be more likely to spend money on clothing than the average person.

27. **a)** Too time-consuming

b) Too time-consuming

28. **a)** Sample **b)** Census

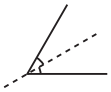
Illustrated Glossary

acute angle: an angle measuring less than 90°

acute triangle: a triangle with three acute angles

algebraic expression: a mathematical expression containing a variable: for example, $6x - 4$ is an algebraic expression

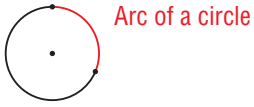
angle bisector: the line that divides an angle into two equal angles



angle of rotation symmetry: the minimum angle required for a shape to rotate and coincide with itself

approximate: a number close to the exact value of an expression; the symbol $\doteq$ means "is approximately equal to"

arc: a segment of the circumference of a circle



area: the number of square units needed to cover a region

average: a single number that represents a set of numbers (see *mean*, *median*, and *mode*)

bar graph: a graph that displays data by using horizontal or vertical bars

bar notation: the use of a horizontal bar over a decimal digit to indicate that it repeats; for example, $1.\overline{3}$ means 1.333 333 …

base: the side of a polygon or the face of an object from which the height is measured

base of a power: see *power*

bias: a prejudice that is in favour of or against a topic

binomial: a polynomial with two terms; for example, $3x - 8$

bisector: a line that divides a line segment or an angle into two equal parts

capacity: the amount a container can hold

Cartesian Plane: another name for a coordinate grid (see *coordinate grid*)

census: a data collection method using each member of the population

central angle: an angle whose arms are radii of a circle

certain event: an event with probability 1, or 100%

chance: probability expressed as a percent

chord: a line segment that joins two points on a circle

circle graph: a diagram that uses sectors of a circle to display data

circumference: the distance around a circle, also the perimeter of the circle

coefficient: the numerical factor of a term; for example, in the terms $3x$ and $3x^2$, the coefficient is 3

common denominator: a number that is a multiple of each of the given denominators; for example, 12 is a common denominator for the fractions $\frac{1}{3}, \frac{5}{4}, \frac{7}{12}$

common factor: a number that is a factor of each of the given numbers; for example, 3 is a common factor of 15, 9, and 21

commutative property: the property of addition and multiplication that states that numbers can be added or multiplied in any order; for example,

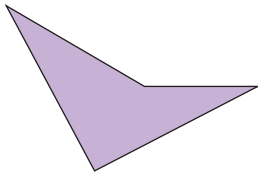
$3 + 5 = 5 + 3$; $3 \times 5 = 5 \times 3$

composite number: a number with three or more factors; for example, 8 is a composite number because its factors are 1, 2, 4, and 8

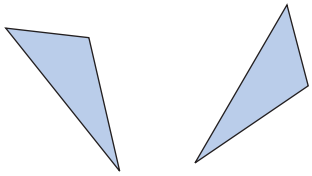
composite object: the result of combining one or more objects to make a new object

composite shape: the result of combining one or more shapes to make a new shape

concave polygon: has at least one angle greater than 180°



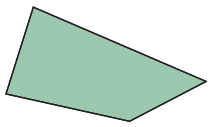
congruent: shapes that match exactly, but do not necessarily have the same orientation



consecutive numbers: integers that come one after the other without any integers missing; for example, 34, 35, 36 are consecutive numbers, so are −2, −1, 0, and 1

constant term: the number in an expression or equation that does not change; for example, in the expression $4x + 3$, 3 is the constant term

convex polygon: has all angles less than 180°



coordinate axes: the horizontal and vertical axes on a grid

coordinate grid: a two-dimensional surface on which a coordinate system has been set up

coordinates: the numbers in an ordered pair that locate a point on a coordinate grid (see *ordered pair*)

corresponding angles: matching angles in similar polygons

corresponding lengths: matching lengths on an original diagram and its scale diagram

corresponding sides: matching sides of similar polygons

cube: an object with six congruent square faces

cube number: a number that can be written as a power with an integer base and exponent 3; for example, $8 = 2^3$

cubic units: units that measure volume

data: facts or information

database: an organized collection of facts or information, often stored on a computer

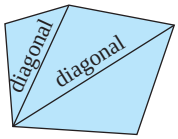
degree of a polynomial: the value of the greatest exponent of a term in a polynomial

degree of a term: the value of the exponent of the term

denominator: the term below the line in a fraction

dependent variable: a variable whose value is determined by the value of another (the independent) variable

diagonal: a line segment that joins two vertices of a shape, but is not a side



diameter: the distance across a circle, measured through its centre; or the line segment that joins two points on the circle and passes through its centre

digit: any of the symbols used to write numerals; for example, 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9

dimensions: measurements, such as length, width, and height

discrete data: data that can be counted

distributive property: the property stating that a product can be written as a sum or difference of two products; for example, $a(b + c) = ab + ac$, $a(b - c) = ab - ac$

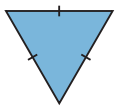
dividend: the number that is divided

divisor: the number that divides into another number

double bar graph: a bar graph that shows two sets of data

equation: a mathematical statement that two expressions are equal

equilateral triangle: a triangle with three equal sides



equivalent: having the same value; for example, $\frac{2}{3}$ and $\frac{6}{9}$; 3:4 and 9:12

estimate: a reasoned guess that is close to the actual value, without calculating it exactly

evaluate: to determine the value of a numerical expression

even number: a number that has 2 as a factor; for example, 2, 4, 6

event: any set of outcomes of an experiment

experimental probability: the probability of an event calculated from experimental results

exponent: see *power*

expression: a mathematical statement made up of numbers and/or variables connected by operations

extrapolate: to estimate a value that lies beyond data points on a graph

factor: to factor means to write as a product; for example, $20 = 2 \times 2 \times 5$

formula: a rule that is expressed as an equation

fraction: an indicated quotient of two quantities

frequency: the number of times a particular number occurs in a set of data

greatest common factor (GCF): the greatest number that divides into each number in a set; for example, 5 is the greatest common factor of 10 and 15

height: the perpendicular distance from the base of a shape to the opposite side or vertex; the perpendicular distance from the base of an object to the opposite face or vertex

hexagon: a six-sided polygon

horizontal axis: the horizontal number line on a coordinate grid

hypotenuse: the side opposite the right angle in a right triangle

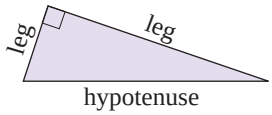


image: the shape that results from a transformation

impossible event: an event that will never occur; an event with probability 0, or 0%

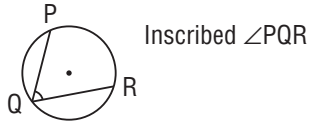
improper fraction: a fraction with the numerator greater than the denominator; for example, both $\frac{6}{5}$ and $\frac{5}{3}$ are improper fractions

independent events: two events in which the result of one event does not depend on the result of the other event

independent variable: a variable whose value is not determined by the value of another variable, and whose value determines the value of another (the dependent) variable

inequality: a statement that one quantity is greater than (or less than) another quantity; or a statement that one quantity is greater than or equal to (or less than or equal to) another quantity

inscribed angle: an angle in a circle with its vertex and the endpoints of its arms on the circle



inscribed polygon: a polygon whose vertices lie on a circle

inspection: solving an equation by finding the value of the variable by using addition, subtraction, multiplication, and division facts

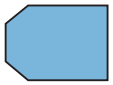
integers: the set of numbers $\ldots -3, -2, -1, 0, +1, +2, +3, \ldots$

interpolate: to estimate a value that lies between 2 data points on a graph

inverse operation: an operation that reverses the result of another operation; for example, subtraction is the inverse of addition, and division is the inverse of multiplication

irrational number: a number that *cannot* be written in the form $\frac{m}{n}$, $n \neq 0$, where m and n are integers

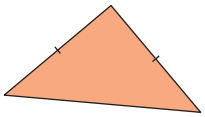
irregular polygon: a polygon that does not have all sides equal or all angles equal



isometric: equal measure; on isometric dot paper, the line segments joining 2 adjacent dots in any direction are equal

isometric drawing: a representation of an object as it would appear in three dimensions

isosceles triangle: a triangle with two equal sides



legend: part of a circle graph that shows what category each sector represents

legs: the sides of a right triangle that form the right angle (see *hypotenuse*)

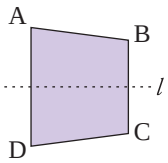
like terms: terms that have the same variables; for example, $4x$ and $-3x$ are like terms

line graph: a graph that displays data by using points joined by line segments

line of best fit: a line that passes as close as possible to a set of plotted points

line segment: the part of a line between two points on the line

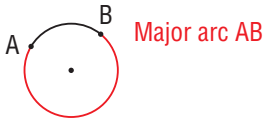
line symmetry: a shape that can be divided into 2 congruent parts, so that the parts coincide when the shape is folded along a line of symmetry



linear relation: a relation that has a straight-line graph

lowest common multiple (LCM): the lowest multiple that is the same for two numbers; for example, the lowest common multiple of 12 and 21 is 84

major arc: the longer of the two arcs between two points on a circle



mass: the amount of matter in an object

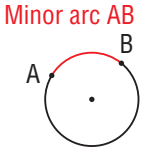
mean: the sum of a set of numbers divided by the number of numbers in the set

measure of central tendency: a single number that represents a set of numbers (see *mean, median,* and *mode*)

median: the middle number when data are arranged in numerical order; if there is an even number of data, the median is the mean of the two middle numbers

midpoint: the point that divides a line segment into two equal parts

minor arc: the shorter of the two arcs between two points on a circle



mixed number: a number consisting of a whole number and a fraction; for example, $1\frac{1}{18}$ is a mixed number

mode: the number that occurs most often in a set of numbers

monomial: a polynomial with one term; for example, 14 and $5x^2$ are monomials

multiple: the product of a given number and a natural number; for example, some multiples of 8 are 8, 16, 24, …

natural numbers: the set of numbers 1, 2, 3, 4, 5, …

negative number: a number less than 0

net: a pattern that can be folded to make an object

non-perfect square: a fraction or a decimal that is not a perfect square

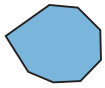
numerator: the term above the line in a fraction

numerical coefficient: the number by which a variable is multiplied; for example, in the expression $4x + 3$, 4 is the numerical coefficient

obtuse angle: an angle whose measure is greater than 90° and less than 180°

obtuse triangle: a triangle with one angle greater than 90°

octagon: an eight-sided polygon



odd number: a number that does not have 2 as a factor; for example, 1, 3, 7

operation: a mathematical process or action such as addition, subtraction, multiplication, division, or raising to a power

opposite numbers: two numbers with a sum of 0; for example, 2.4 and -2.4 are opposite numbers

order of operations: the rules that are followed when simplifying or evaluating an expression

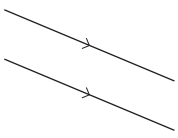
order of rotational symmetry: the number of times a shape coincides with itself during a rotation of 360°

ordered pair: two numbers in order, for example, (2, 4); on a coordinate grid, the first number is the horizontal coordinate of a point, and the second number is the vertical coordinate of the point

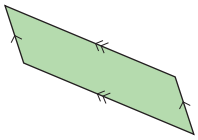
origin: the point where the x-axis and the y-axis intersect

outcome: a possible result of an experiment or a possible answer to a survey question

parallel lines: lines on the same flat surface that do not intersect



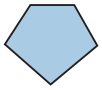
parallelogram: a quadrilateral with both pairs of opposite sides parallel



part-to-part ratio: a ratio that compares a part of the whole to another part of the whole

part-to-whole ratio: a ratio that compares a part of the whole to the whole

pentagon: a five-sided polygon



percent: the number of parts per 100; the numerator of a fraction with denominator 100

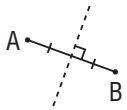
perfect square: a number that is the square of a number; for example, 16 is a perfect square because $16 = 4^2$

perimeter: the distance around a closed shape

perpendicular: lines or line segments that intersect at right angles

perpendicular bisector: the line that is perpendicular to a line segment and divides it into two equal parts

The broken line is the perpendicular bisector of AB.



pi (π): the ratio of the circumference of a circle to its diameter; $\pi = \frac{\text{circumference}}{\text{diameter}}$

plane: a flat surface with the property that a line segment joining any two points lies completely on its surface

point of tangency: the point where a tangent intersects a circle (see *tangent*)

polygon: a closed shape that consists of line segments; for example, triangles and quadrilaterals are polygons

polyhedron (*plural,* polyhedra): an object with faces that are polygons

polynomial: one term or the sum of terms whose variables have whole-number exponents; for example, $x^2 + 3xy - 2y^2 + 5x$

population: the set of all things or people being considered

power: an expression of the form a^n, where a is the base and n is the exponent; it represents a product of equal factors; for example, $4 \times 4 \times 4$ can be written as 4^3

power of a power: a power that is raised to a power; for example, $(3^2)^4$

power of a product: a product that is raised to a power; for example, $(3 \times 4)^5$

power of a quotient: a quotient that is raised to a power; for example, $\left(\frac{5}{6}\right)^3$

prediction: a statement of what you think will happen

prime number: a whole number with exactly two factors, itself and 1; for example, 2, 3, 5, 7, 11, 29, 31, and 43

probability: the likelihood of a particular outcome; the number of times a particular outcome occurs, written as a fraction of the total number of outcomes

product: the result when two or more numbers are multiplied; or the expression of one number multiplied by another

proper fraction: a fraction with the numerator less than the denominator; for example, $\frac{5}{6}$

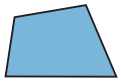
proportion: a statement that two ratios are equal; for example, $r{:}24 = 3{:}4$

Pythagorean Theorem: the rule that states that, for any right triangle, the area of the square on the hypotenuse is equal to the sum of the areas of the squares on the legs

Pythagorean triple: three whole-number side lengths of a right triangle

quadrant: one of four regions into which coordinate axes divide a plane

quadrilateral: a four-sided polygon



quotient: the result when one number is divided by another; or the expression of one number divided by another

radius (*plural,* radii): the distance or line segment from the centre of a circle to any point on the circle

random sample: a sampling in which all members of the population have an equal chance of being selected

range: the difference between the greatest and least numbers in a set of data

rate: a comparison of two quantities measured in different units

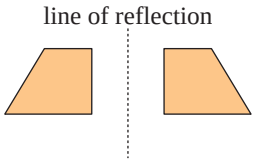
ratio: a comparison of two or more quantities with the same unit

rational number: any number that can be written in the form $\frac{m}{n}$, $n \neq 0$, where m and n are integers

reciprocals: two numbers whose product is 1; for example, $\frac{2}{3}$ and $\frac{3}{2}$

rectangle: a quadrilateral that has four right angles

reflection: a transformation that is illustrated by a shape and its image in a line of reflection



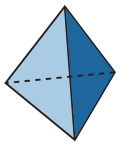
reflex angle: an angle between 180° and 360°

regular polygon: a polygon that has all sides equal and all angles equal

regular prism: a prism with regular polygons as bases; for example, a cube

regular pyramid: a pyramid with a regular polygon as its base; for example, a tetrahedron

regular tetrahedron: an object with four congruent triangular faces; a regular triangular pyramid



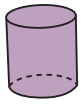
relation: a rule that relates two quantities

repeating decimal: a decimal with a repeating pattern in the digits to the right of the decimal point; it is written with a bar above the repeating digits; for example, $\frac{1}{15} = 0.0\overline{6}$

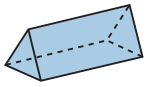
rhombus: a parallelogram with four equal sides

right angle: a 90° angle

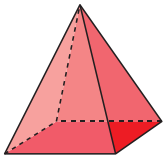
right cylinder: an object with two parallel, congruent, circular bases



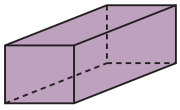
right prism: an object that has two congruent and parallel faces (the *bases*), and other faces that are rectangles



right pyramid: an object that has one face that is a polygon (the *base*), and other faces that are triangles with a common vertex

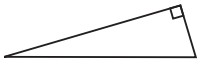


right rectangular prism: a prism that has rectangular faces

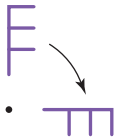


right rectangular pyramid: a pyramid with a rectangular base

right triangle: a triangle that has one right angle



rotation: a transformation in which a shape is turned about a fixed point



rotational symmetry: the property of a shape that it coincides with itself after a rotation of less than 360° about its centre

sample: a portion of the population

scale: the numbers on the axes of a graph

scale diagram: a diagram that is an enlargement or a reduction of another diagram

scale factor: the ratio of corresponding lengths of two similar shapes

scalene triangle: a triangle with all sides different

sector: part of a circle between two radii and the included arc

semicircle: half a circle

similar polygons: polygons with the same shape; one polygon is an enlargement or a reduction of the other polygon

simplest form: a ratio with terms that have no common factors, other than 1; a fraction with numerator and denominator that have no common factors, other than 1

spreadsheet: a computer-generated arrangement of data in rows and columns, where a change in one value results in appropriate calculated changes in the other values

square: a rectangle with four equal sides

square number: a number that can be written as a power with an integer base and exponent 2; for example, $49 = 7^2$

square root: a number which, when multiplied by itself, results in a given number; for example, 5 is a square root of 25

statistics: the branch of mathematics that deals with the collection, organization, and interpretation of data

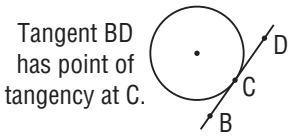
straight angle: an angle measuring 180°

supplementary angles: two angles whose sum is 180°

surface area: the total area of the surface of an object

symmetrical: having symmetry (see *line symmetry*)

tangent: a line that intersects a circle at only one point



term: a number, a variable, or the product of numbers and variables; for example, -5, y, $7a^2$

terminating decimal: a decimal with a certain number of digits after the decimal point; for example, $\frac{1}{8} = 0.125$

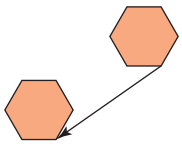
tessellate: to use congruent copies of a shape to cover a plane with no overlaps or gaps

theoretical probability: the number of favourable outcomes written as a fraction of the total number of possible outcomes

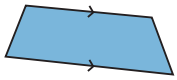
three-dimensional: having length, width, and depth or height

transformation: a translation, rotation, or reflection

translation: a transformation that moves a point or a shape in a straight line to another position on the same flat surface



trapezoid: a quadrilateral that has exactly one pair of parallel sides



triangle: a three-sided polygon

trinomial: a polynomial with three terms; for example, $3x^2 - 5x + 8$

two-dimensional: having length and width, but no thickness, height, or depth

two-term ratio: a comparison of two quantities with the same unit

unit fraction: a fraction that has a numerator of 1

unit price: the price of one item, or the price of a particular mass or volume of an item

unit rate: a quantity associated with a single unit of another quantity; for example, 6 m in 1 s is a unit rate; it is written as 6 m/s

valid conclusions: results of data collection that represent what is typical of the population

variable: a letter or symbol representing a quantity that can vary

vertex (*plural*, vertices): the point where 2 sides of a shape meet, or the point where 3 or more edges of an object meet

vertical axis: the vertical number line on a coordinate grid

volume: the amount of space occupied by an object

whole numbers: the set of numbers 0, 1, 2, 3, …

***x*-axis:** the horizontal number line on a coordinate grid

***y*-axis:** the vertical number line on a coordinate grid

zero pair: two opposite numbers whose sum is equal to zero; for example, -4.1 and 4.1

zero property: the property of addition that states that adding 0 to a number does not change the number; for example, $3 + 0 = 3$; for multiplication, multiplying a number by 0 results in the product 0; for example, $3 \times 0 = 0$

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