LESSON 1: EXPLORING RELATIONSHIPS

EXERCISES

EXERCISES

1. Write what you already know about ratios.

   Share your work with a classmate.
   Did your classmate understand what you wrote?

2. Write what you know about relationships involving rate and graphing.

3. What does the word *proportional* mean to you?

   Share your thoughts with a classmate.
   Compare your understandings of the word *proportional*.

4. Write a goal stating what you plan to accomplish in this unit.

5. In the exercises for Lesson 1 of Unit 1: Working With Rational Numbers, you were asked to respond to this prompt:

   > *Based on your previous work in math, write three things that you will do during this unit to increase your success.*
   >
   > *For example, consider ways you will participate in classroom discussions, your study habits, how you will organize your time, what you will do when you have a question, and so on.*

   Think about the three things you planned to do. If you can't recall, look back at what you wrote.

   a. Did you do the things you planned? Why or why not?
   b. Which of the three things most helped you to be successful in the previous unit?
   c. Write one thing you will do differently or something you will do more of during this unit to increase your success.

LESSON 2: PROPORTIONAL RELATIONSHIPS EXERCISES

EXERCISES

1. Lucy walks 7 mi in 2 hr. How many miles can she walk in 1 hr?

   A. 5 mi

   B. 3.5 mi

   C. 3 mi

   D. 2 mi

2. This table represents a proportional relationship.

Recycled Glass (lb)	2	3	4	5	10	100
Value ($)	16.4	24.6	32.8	41	82	820

   Express the proportional relationship between the two variables as a ratio.

   _____ : _____

3. Which table shows a proportional relationship?

   A.

x	0	5	4	16
y	0	2.5	2	8

   B.

x	1	2	4	16
y	0	1	2	8

   C.

x	0	5	4	17
y	0.5	20	16	68

   D.

x	0	1	2	3
y	1	3	5	7

LESSON 2: PROPORTIONAL RELATIONSHIPS

EXERCISES

4. Which table shows a proportional relationship?

A

x	0	1	2	3
y	1	2	3	4

B

x	0	20	4	16
y	0	11	2	8

C

x	0	1	2	3
y	4	8	12	16

D

x	0	1	8	20
y	0	25	200	500

5. Jack wants to buy strawberries to make smoothies. He plans to use 5 big strawberries to make 2 smoothies. Use this information to complete the table for Jack.

Smoothies	1	2			10	50
Strawberries		5	7.5	12.5		

6. This table represents a proportional relationship. Fill in the missing numbers.

x	0	1	2		5	
y	0		6	8		18

LESSON 2: PROPORTIONAL RELATIONSHIPS EXERCISES

7. This dollhouse belongs to Maya's twin sisters.

For the twins' birthday, Maya made chairs for the dollhouse. She made the model chairs to match the real chairs the twins have at their study table. The height of the model chairs is 4 in.

If the height of the real chairs is 3 ft, what is the scale Maya used for the model chairs? Show your work.

Challenge Problem

8. A square has a side length of s cm and a perimeter of p cm.
   a. Make a table showing the perimeter in relationship to the side lengths.
   b. Is this relationship a proportional relationship? Explain why or why not.

LESSON 3: CONSTANT OF PROPORTIONALITY EXERCISES

EXERCISES

1. What is the constant of proportionality for $y = 2.3x$?
   The constant of proportionality is _____.

2. Find the constant of proportionality for this table.

x	2	3	4	5
y	4.8	7.2	9.6	12

   k = _____

3. Sophie bought 6 ears of corn for $1.50. She wants to know how much she will have to pay for 32 ears of corn at the same rate.

   What is the constant of proportionality?

   k = $_____

4. These are the two formulas for a proportional relationship.

   $y = kx$ $\qquad$ $x = \frac{1}{k}y$

   Which pair lists the constant of proportionality for the first formula and the constant of proportionality for the second formula?

   A. y and x
   B. x and y
   C. k and $\frac{1}{k}$
   D. k and k

5. Use the constant of proportionality $k = 5.2$ to complete this table.

x	0	2	4			
y				26	41.6	52

LESSON 3: CONSTANT OF PROPORTIONALITY EXERCISES

6. What are the two constants of proportionality for $\frac{x}{y} = \frac{16}{3}$? Show how you know.

7. Karen is building a scale model of the Taj Mahal for an integrated art and social studies project. The height of the Taj Mahal is 73 m. The height of the scale model is 0.73 m.

   a. Karen uses a ratio table to help her convert from the actual measurements of the Taj Mahal to the measurements of the scale model. Complete this ratio table.

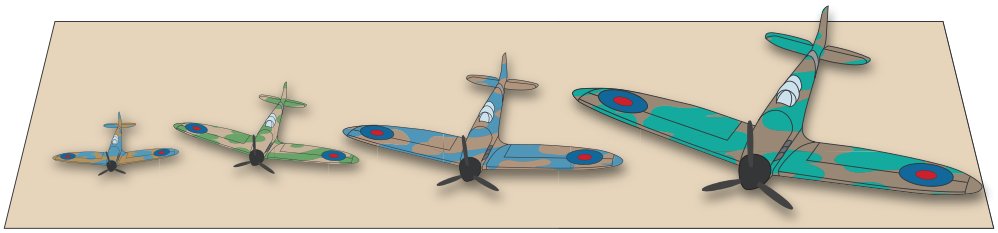
Actual (m)	5		50	73
Scale Model (m)		0.25		0.73

   b. What constant of proportionality describes the relationship?

   c. Write a formula to represent the proportional relationship between the dimensions of the actual Taj Mahal and those of the scale model.

Challenge Problem

8. These model Spitfire planes were built according to different scales.



The scales are (in random order) 1 : 48, 1 : 108, 1 : 32, and 1 : 72.

   a. Which plane is built to each scale? How do you know?

   b. Explain how scale is related to the constant of proportionality.

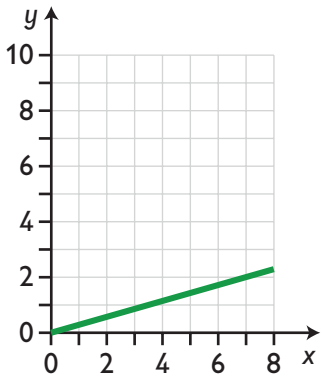
LESSON 4: GRAPHS

EXERCISES

EXERCISES

1. Which graph shows a proportional relationship?

A



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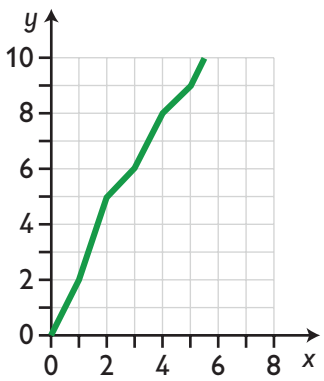

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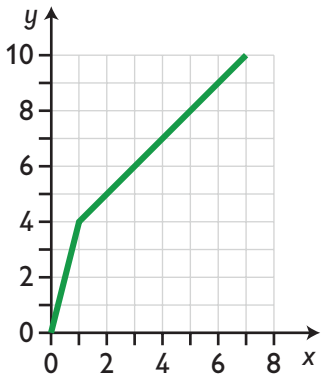

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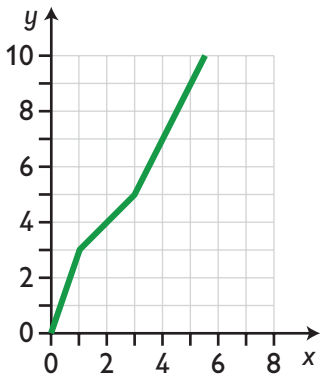


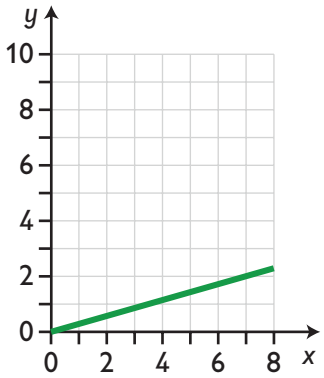
LESSON 4: GRAPHS

EXERCISES

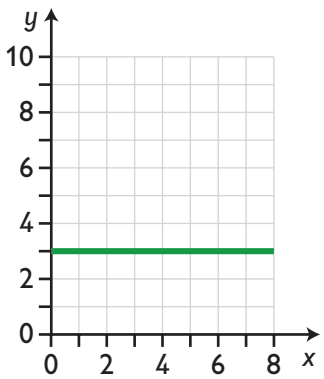
2. Which graph represents this proportional relationship?

x	y
0	0
1	3
2	6

A



B



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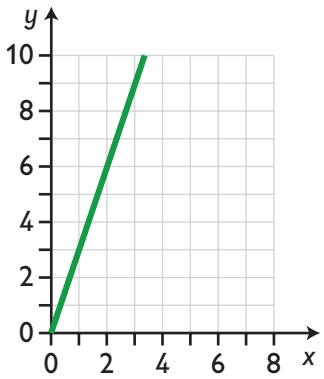

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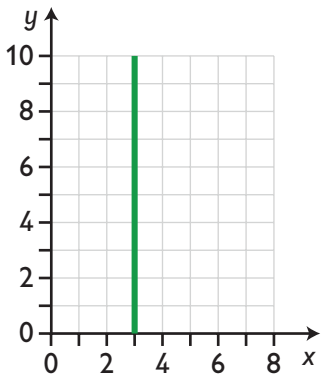


LESSON 4: GRAPHS

EXERCISES

3. Marcus went on a road trip. Every 30 min, he checked to see how far he had traveled. This table shows his observations.

Time (hr)	**Distance** (mi)
0.5	28
1.0	61
1.5	91
2.0	118
2.5	152
3.0	180

Draw a graph of Marcus's road trip data with time (hr) as the independent variable and distance (mi) as the dependent variable.

4. Consider the table of Marcus's road trip (from the previous exercise), which shows the total distance traveled each 30 min. Recall the graph you created from the table data.

Time (hr)	**Distance** (mi)
0.5	28
1.0	61
1.5	91
2.0	118
2.5	152
3.0	180

On Marcus's road trip, distance _____ proportional to time.

A. is

B. is not

LESSON 4: GRAPHS

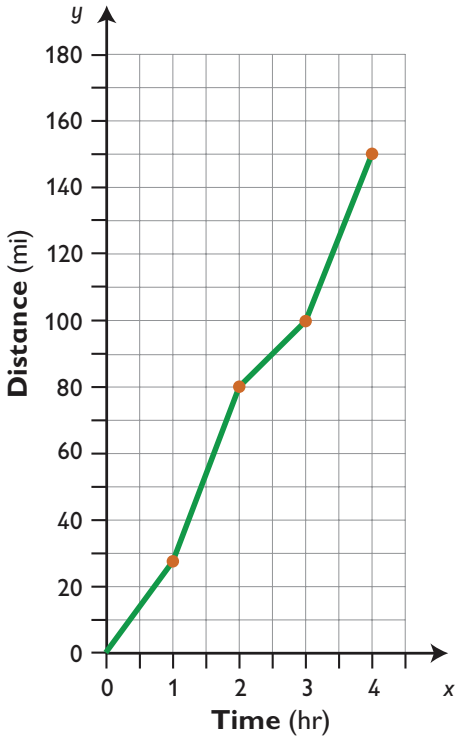
EXERCISES

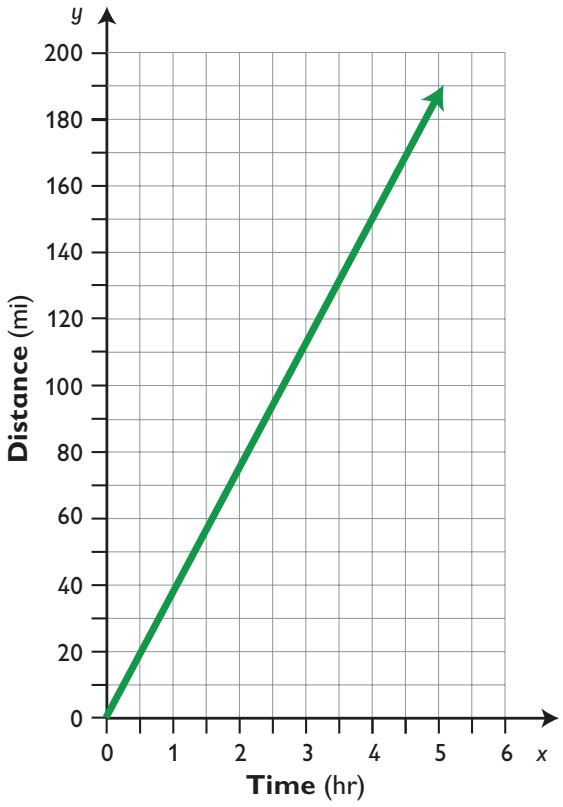
5. Here is the table of Marcus's road trip, showing the total distance traveled each 30 min.

Time (hr)	**Distance** (mi)
0.5	28
1.0	61
1.5	91
2.0	118
2.5	152
3.0	180

During which half hour did Marcus travel the fastest?

6. Compare these two graphs.





a. Which point(s) do the two graphs have in common?

b. Which point(s) are different?

LESSON 4: GRAPHS

EXERCISES

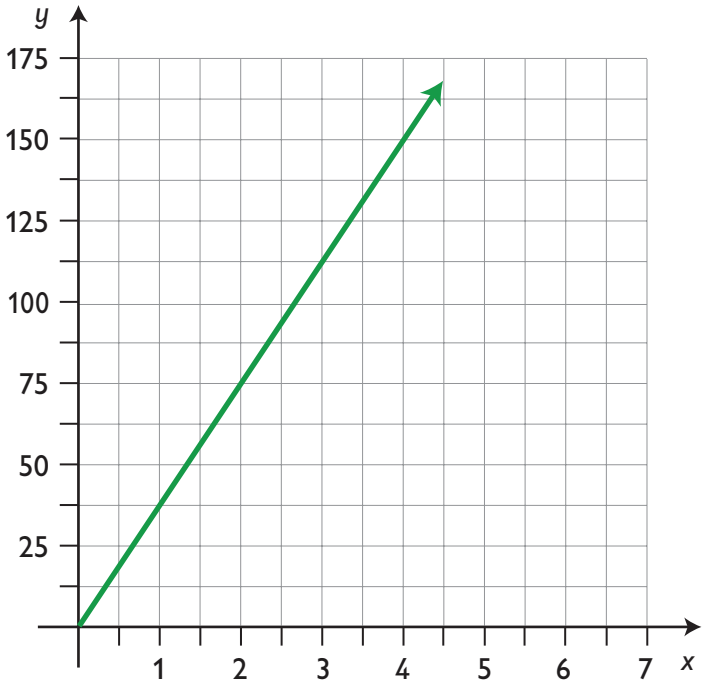
7. Lucy is getting ready for the science fair. In her project, she is studying mold growth under various conditions. This table shows the data she recorded for one of her test food items.

Time (hr)	**Surface Area Covered in Mold** (cm^2)
0	0
4	10
6	30

   a. Draw a graph of Lucy's data with time (hr) as the independent variable and surface area covered by mold (cm^2) as the dependent variable.

   b. Is the growth of mold proportional over time? Explain why or why not.

8. Consider this graph.



Explain why the constant of proportionality for the graph is 37.5.

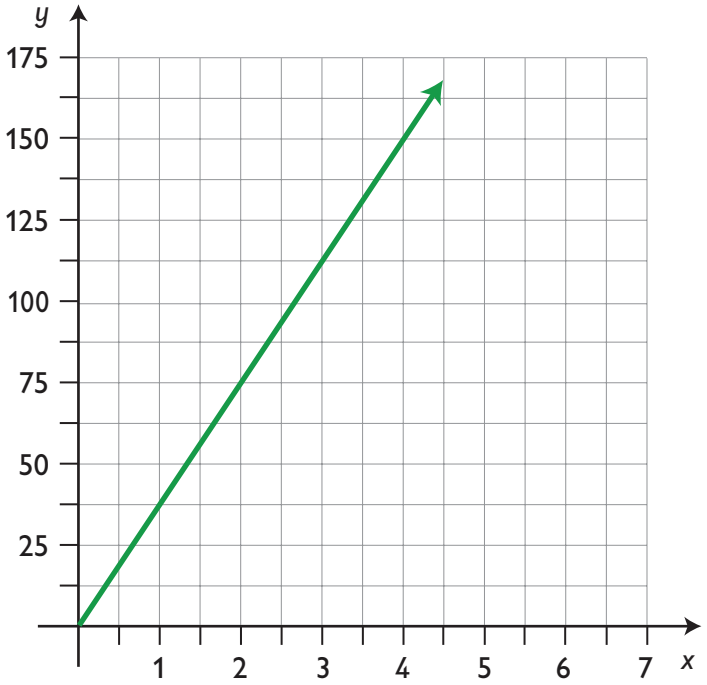
LESSON 4: GRAPHS

EXERCISES

Challenge Problem

9. Consider this graph, which graphs this equation.

$y = 37.5x$



a. Draw the graph again, but with distance (mi) as the independent variable and time (hr) as the dependent variable.

b. What is the constant of proportionality for this new graph? How does it compare to the original graph? Explain.

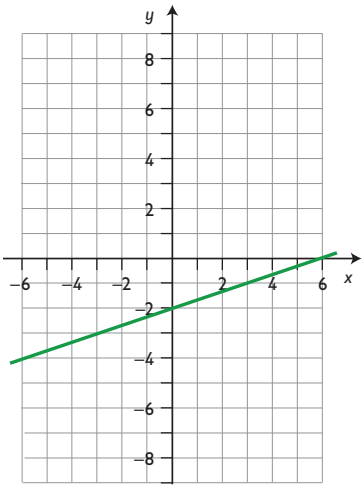
LESSON 5: A STRAIGHT LINE GRAPH

EXERCISES

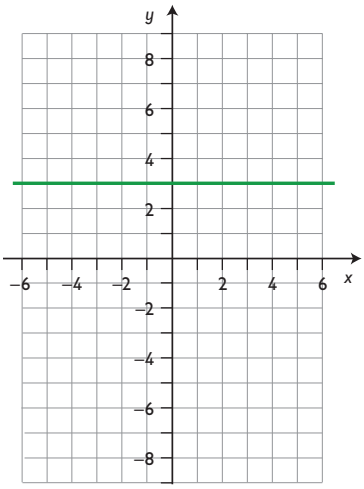
EXERCISES

1. Which graph shows a proportional relationship?

A



B



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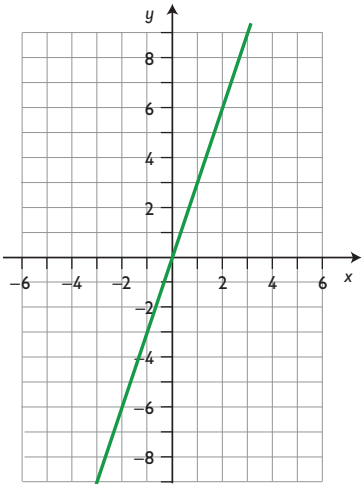

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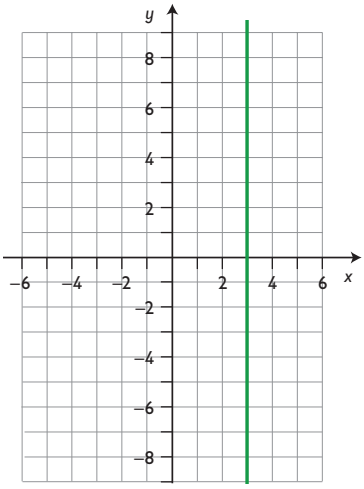


LESSON 5: A STRAIGHT LINE GRAPH

EXERCISES

2. Which of these statements is true about proportional relationships? There may be more than one true statement.

   A. A proportional relationship can be expressed by the formula $x = ky$.

   B. A proportional relationship always includes the point (0, 0).

   C. If a graph is a straight line that passes through the origin, then the graph does not represent a proportional relationship.

   D. If the ratios between the varying quantities are not constant, then the relationship between the quantities is proportional.

   E. The graph of a proportional relationship will always be a straight line that passes through the origin.

3. Consider this equation.

   $$y = \frac{1}{2}x$$

   a. Draw a graph of the equation.

   b. Does this graph represent a proportional relationship? Explain why or why not.

4. The table represents a proportional relationship.

   a. Complete the table.

x			4	
y	4	7	12	20

   b. Then draw a graph of the data in the table.

5. This table represents a proportional relationship with a constant of proportionality of 3.

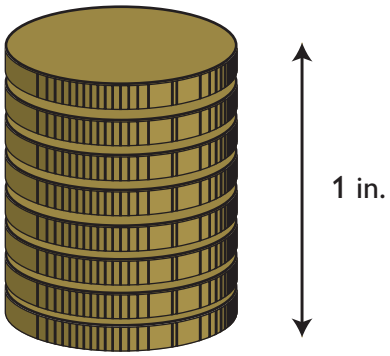
x	$1\frac{1}{3}$	$2\frac{1}{3}$	4	$6\frac{2}{3}$
y	4	7	12	20

   Explain why the constant of proportionality is always equal to the value of the dependent variable when the independent variable is equal to 1.

LESSON 5: A STRAIGHT LINE GRAPH

EXERCISES

6. Suppose that a stack of 8 identical coins has a height of 1 in.

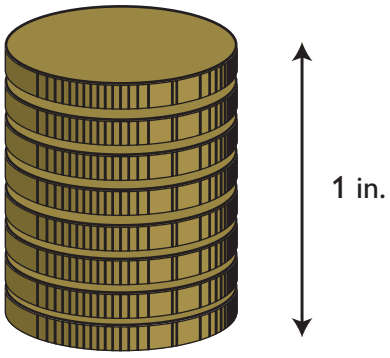


The graph showing the relationship between the number of coins to the height of the stack _____ a straight line that passes through the origin.

A. is

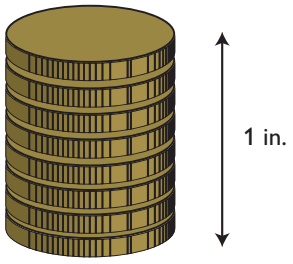
B. is not

7. This stack of 8 identical coins has a height of 1 in.

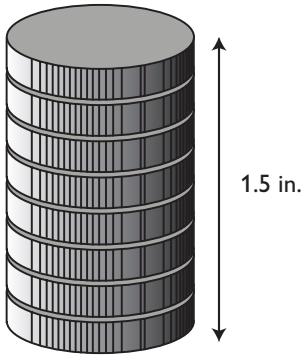


Write a formula for the number of coins in terms of the height of the stack.

8. Consider these two stacks of coins. For one type of coin, a stack of 8 coins has a height of 1 in. For a different type of coin, a stack of 8 coins has a height of 1.5 in.



Stack A



Stack B

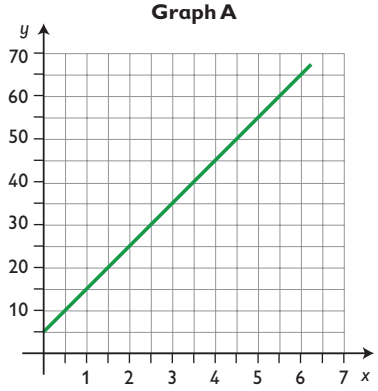
How would a formula for Stack B—for the number of coins in terms of the height of the stack—differ from the formula for Stack A? Explain.

LESSON 5: A STRAIGHT LINE GRAPH

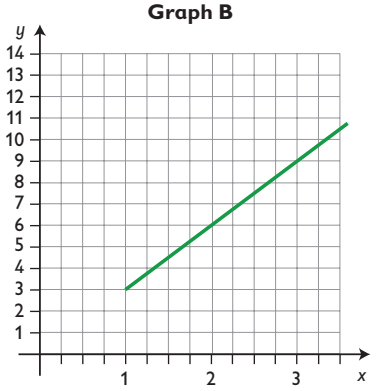
EXERCISES

9. Which of these graph(s) represents a proportional relationship? (There may be more than one graph.) Explain how you know.

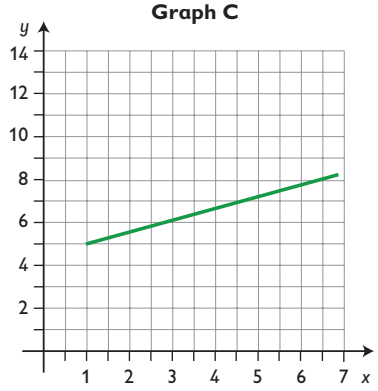
Graph A



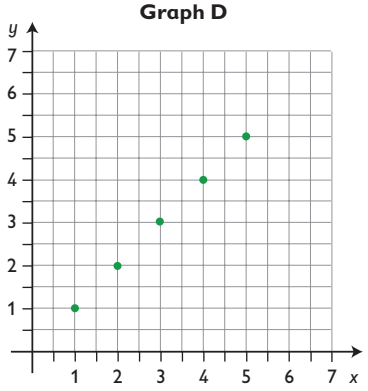
Graph B



Graph C



Graph D



Challenge Problem

10. When one variable in a proportional relationship is equal to zero, the other variable must also equal zero. Explain why.

LESSON 6: RATES AND PROPORTIONS

EXERCISES

EXERCISES

1. Karen bought 1 can of peaches for $2.

   How many cans of peaches could she buy for $10?

   Karen could buy _____ cans of peaches for $10.

2. Jack read 40 pages of a book in 50 min.

   How many pages could he read in 75 min at the same rate?

   Jack could read _____ pages in 75 min.

3. Maya worked for 9 months and earned 12 days of vacation time.

   How many vacation days will she have earned after working exactly 2 years?

   Maya will have earned _____ days of vacation after working exactly 2 years.

4. Lucy used 3 gal of paint to cover 900 ft^2. She needs to cover a total of 1,100 ft^2.

   How many more gallons of paint does she need? Show your work.

5. Marcus has 8 shirts for every 5 pairs of jeans in his closet.

   How many pairs of jeans does he have if he has 40 shirts? Show your work.

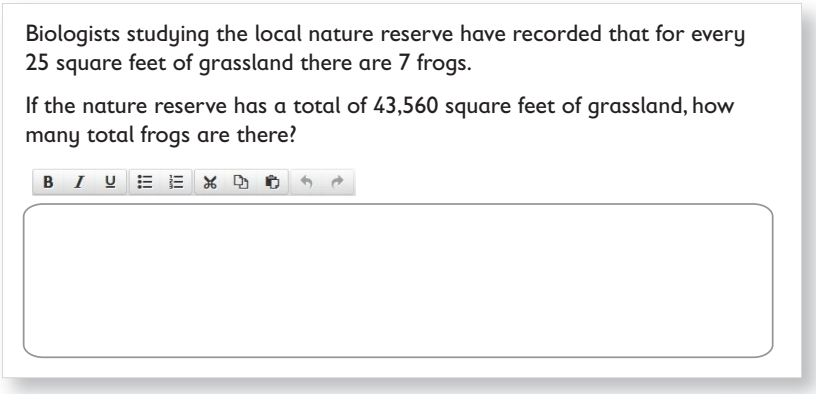
6. The scale on a map is given by 1 in. = 5 mi.

   What is the distance between two towns that are 8.5 in. apart on the map? Show your work.

LESSON 6: RATES AND PROPORTIONS

EXERCISES

7. This problem appeared on the unit assessment in Sophie's class.



If Sophie decides to solve the problem by setting up a proportion and solving for the missing value, which of these equations could she use?

A. $\frac{25}{7} = \frac{x}{43,560}$

B. $\frac{7 \text{ frogs}}{25 \text{ ft}^2} = \frac{x}{43,560 \text{ ft}^2}$

C. $\text{number of frogs} = \frac{25}{7} \cdot 43,560$

D. $\frac{25}{43,560} = 7x$

8. Suppose there are 8 large art tables for every 30 students in Ms. Muñoz's after-school art class.

   a. What is the constant of proportionality for the relationship of art tables to students? Write your answer as a fraction in simplest form.

   b. What is the unit rate of students per art table? Express your rate as a decimal rounded to two decimal places.

   _____ : _____

   c. What is the unit rate of art tables per student? Express your rate as a decimal rounded to three decimal places.

   _____ : _____

Challenge Problem

9. Maya built a robot that can evaluate math equations. Her robot takes 6.5 min to evaluate 572 equations. How many equations can the robot evaluate in 1 hr?

   a. Find the number of equations the robot can evaluate in 1 hr using two different methods. Show your work for each method.

   b. What is similar and what is different between the two methods you selected?

LESSON 7: UNIT RATES

EXERCISES

EXERCISES

1. Sophie can swim 6 laps in 5 min. What is the unit rate of laps per minute?

   _____ laps per minute

2. Karen noticed while pumping gas that it took 1.5 min to pump 3.4 gal of gas.

   What is the unit rate in gallons per minute?

3. Jack spends \$16.31 on $2\frac{1}{3}$ lb of carrot raisin salad. What is the price per pound of carrot raisin salad?

   The price of carrot raisin salad is \$_____ per pound.

4. Marcus drank $\frac{1}{8}$ gal of juice in $2\frac{1}{2}$ min. Suppose he drank at a constant rate.

   How much juice did he drink in 1 min?

5. Lucy and Jack participated in a fundraising walk-a-thon held on the track at school.

   Each lap of the track is $\frac{1}{4}$ of a mile.

   During the event, they raised \$20 for each lap they completed.

   Which of these formulas could be used to represent the relationship between money raised and laps completed? There are two correct formulas.

   A. $y = 20x$

   B. $20y = 5x$

   C. $x = \frac{1}{20}y$

   D. $y = \frac{1}{4}x$

   E. $y = \frac{1}{200}x$

6. It takes Maya 20 min to walk to school. Her school is $\frac{3}{4}$ mi from her house.

   What is Maya's walking speed in miles per hour?

7. If it takes Maya 20 min to walk to school, which is $\frac{3}{4}$ mi from her house, how far could Maya walk in $2\frac{1}{2}$ hr?

LESSON 7: UNIT RATES

EXERCISES

8. Maya's school is $\frac{3}{4}$ mi from her house. It takes her 20 min to walk to school. Write a formula to describe the distance, y, Maya can walk in any amount of time, x.

9. Maya's school is $\frac{3}{4}$ mi from her house. It takes her 20 min to walk to school. Sketch a graph of the relationship.

10. Maya's school is $\frac{3}{4}$ mi from her house. It takes her 20 min to walk to school. What is the constant of proportionality of this relationship?

11. The owners of Nifty Mart advertised that they would not change their unit price of gas for one week. Karen wanted to make sure that they kept their promise, so each day she recorded one gas purchase.

Day	**Volume of Gas** (gal)	**Price** ($)
Monday	58.00	127.60
Tuesday	7.00	15.40
Wednesday	11.40	
Thursday		41.80
Friday		33.00

Unfortunately, Karen lost some of her data. Fill in the missing values in the table, assuming the price of gas is constant.

12. The owners of Nifty Mart advertised that they would not change their unit price of gas for one week. Karen wanted to make sure that they kept their promise, so each day she recorded one gas purchase.

Day	**Volume of Gas** (gal)	**Price** ($)
Monday	58.00	127.60
Tuesday	7.00	15.40
Wednesday	11.40	
Thursday		41.80
Friday		33.00

Write a formula describing the price, y, in terms of the number of gallons, x.

LESSON 7: UNIT RATES

EXERCISES

Challenge Problem

13. At the farmer's market, the price for tomatoes is $1.50 for 2 lb.
    a. Write a formula that shows the proportional relationship between cost and weight for tomatoes at the farmer's market.
    b. Use the formula to determine the cost of 10 lb of tomatoes.
    c. Set up an equation as a proportion using 10 lb of tomatoes to determine the cost.
    d. Which method do you prefer? Explain.

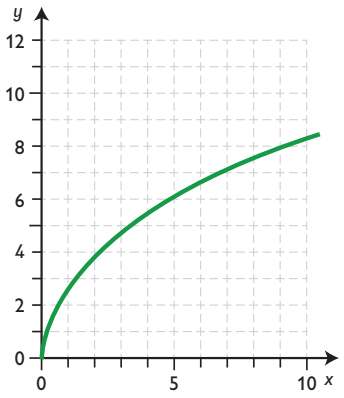
LESSON 8: NON-PROPORTIONAL RELATIONSHIPS EXERCISES

EXERCISES

1. Which of these relationships shows a proportional relationship? There may be more than one proportional relationship.

   A A wind turbine functioning at a consistent rate will generate 500 kilowatts of power each hour.

   B

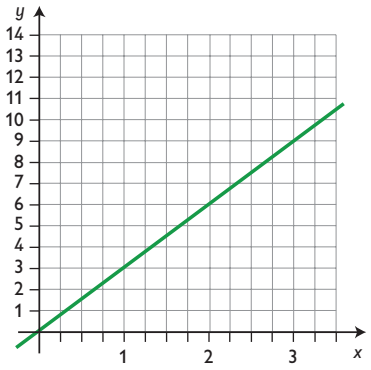


   C

Time	1	3	6	8	12
Earnings	$14.75	$44.25	$88.50	$118.00	$177.00

   D $y - 4 = 2x$

   E



2. A muffin recipe calls for 1 c of mashed bananas per $1\frac{3}{4}$ c of oats.

   In this recipe, the amount of bananas used _____ proportional to the amount of oats.

   A is

   B is not

LESSON 8: NON-PROPORTIONAL RELATIONSHIPS EXERCISES

3. Consider this equation.

   $y = 2.4x - 3$

   The equation describes a _____ relationship.

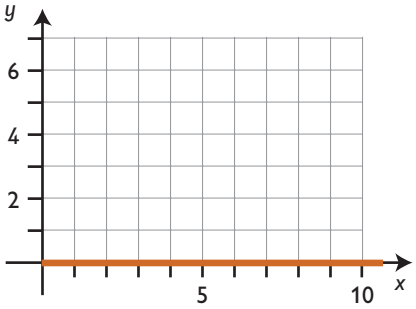
   A proportional

   B non-proportional

4. Decide whether this scenario describes a proportional or non-proportional relationship. Explain why.

   A 14 in. candle burns at a constant rate of $\frac{3}{4}$ in. per hour. Is the height of the candle proportional to the number of hours the candle burns?

5. Decide whether this graph represents a proportional or non-proportional relationship. Explain why.



6. An amusement park offers a $30 summer pass that allows customers to enter the park as many times as they like between the months of June and August for just $8 per visit.

   Is the amount a customer spends on admission fees proportional to the number of times he or she visits the park?

7. Consider the relationships shown in each equation. Determine if each equation is showing a proportional or non-proportional relationship.

   $y = \frac{1}{x}$

   $\frac{1}{4}p = l$

   $C = 2\pi r$

   $p - 3 = 2x$

   $y = x - 1$

LESSON 8: NON-PROPORTIONAL RELATIONSHIPS EXERCISES

8. Consider this non-proportional scenario.

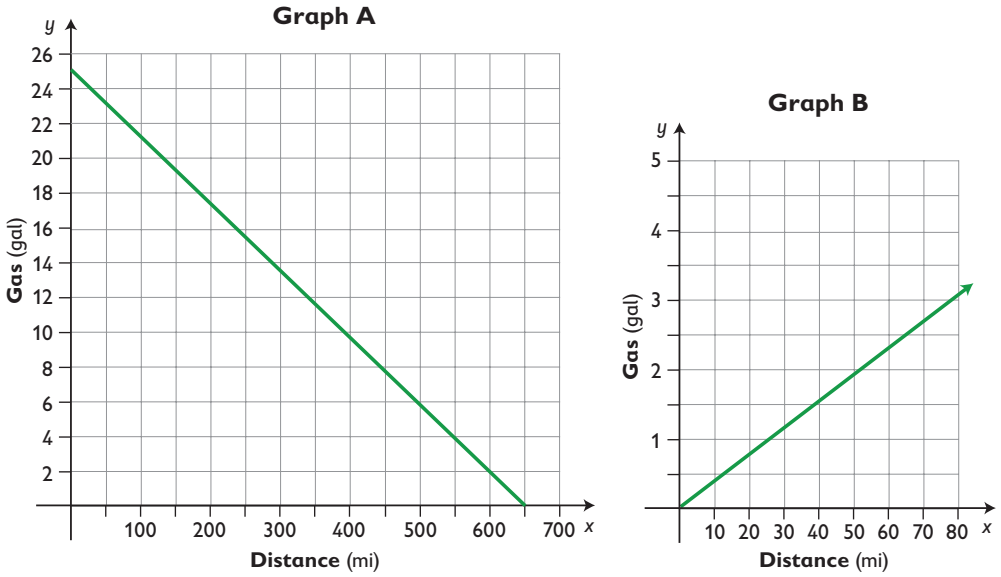
   Jack went to the local arcade. He paid the student admission fee of $5. Then he played 25 arcade games, paying $0.50 per game. He spent a total of $17.50.

   Explain how the scenario could be changed so that it represents a proportional relationship between the cost and the number of games played.

Challenge Problem

9. Maya and her mom went to visit her grandmother, who lives in another part of the state. To get there, Maya's mom drove her van.

   Compare these two graphs, which both represent information about the trip Maya and her mom took.



   a. Graph A shows the relationship between the volume of gas remaining in the tank of the van and the number of miles Maya and her mom traveled. Describe the relationship that Graph B shows.

   b. Do these graphs show proportional or non-proportional relationships?

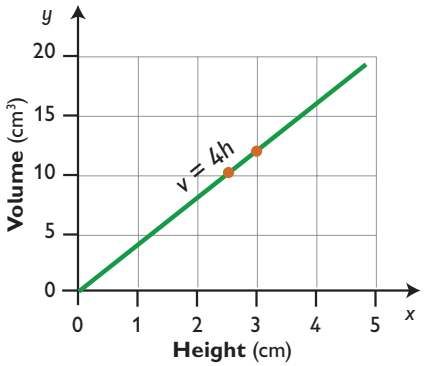
   c. Why do these graphs look so different?

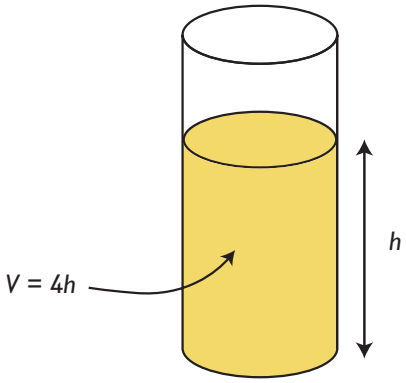
LESSON 9: USING PROPORTIONS

EXERCISES

EXERCISES

1. This graph represents the relationship between the volume of sand in a cylindrical container and the height of the sand.





Which of these statements correctly describes whether the points (2, 7) and (4, 16) lie on the graph?

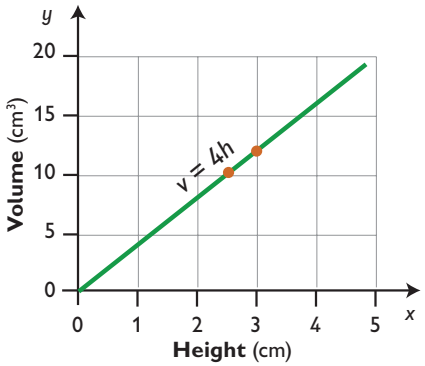
A. Both the point (2, 7) and the point (4, 16) lie on the graph.

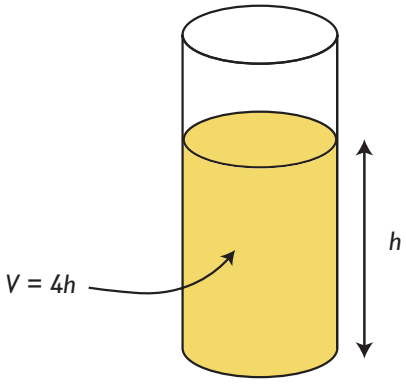
B. Neither the point (2, 7) nor the point (4, 16) lies on the graph.

C. The point (2, 7) does lie on the graph. The point (4, 16) does **not** lie on the graph.

D. The point (2, 7) does **not** lie on the graph. The point (4, 16) does lie on the graph.

2. This graph represents the relationship between the volume of sand in a cylindrical container and the height of the sand.



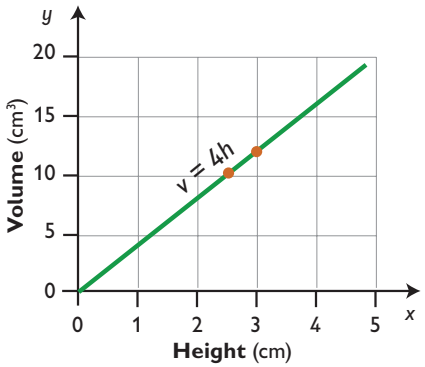


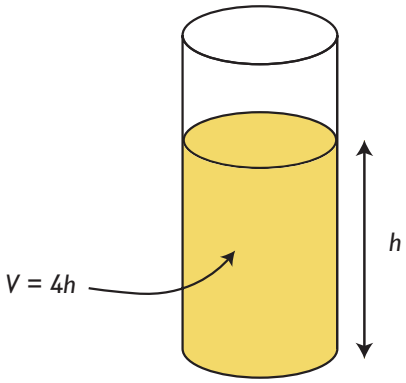
Explain what the plotted points (2.5, 10) and (3, 12) on the graph represent.

LESSON 9: USING PROPORTIONS

EXERCISES

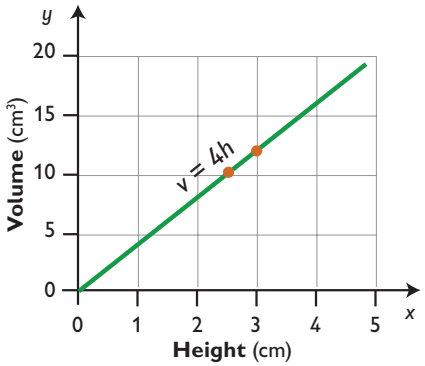
3. This graph represents the relationship between the volume of sand in a cylindrical container and the height of the sand.

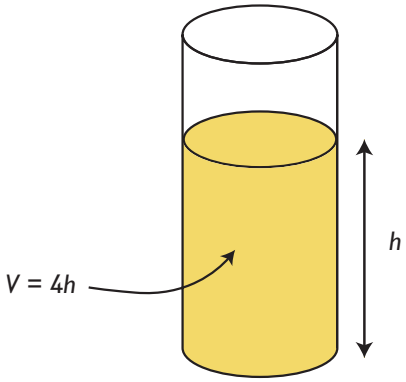




Explain why the volume of sand is proportional to the height of the sand.

4. This graph represents the relationship between the volume of sand in a cylindrical container and the height of the sand.





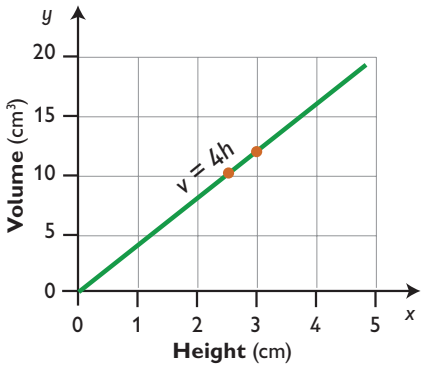
What is the constant of proportionality, also known as the unit rate?

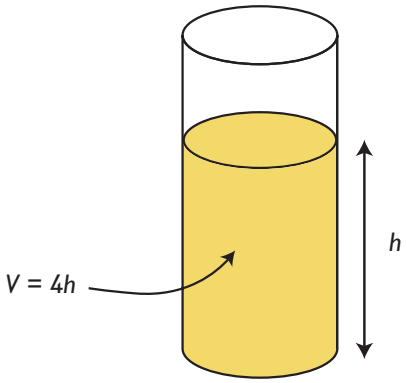
The constant of proportionality, or unit rate, is _____.

LESSON 9: USING PROPORTIONS

EXERCISES

5. This graph represents the relationship between the volume of sand in a cylindrical container and the height of the sand.

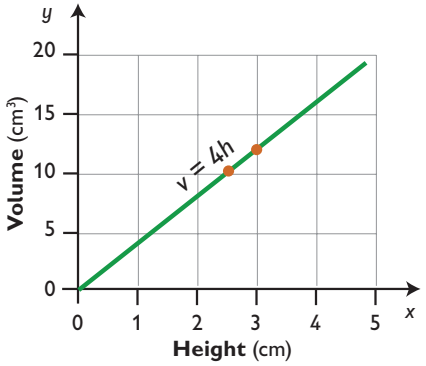


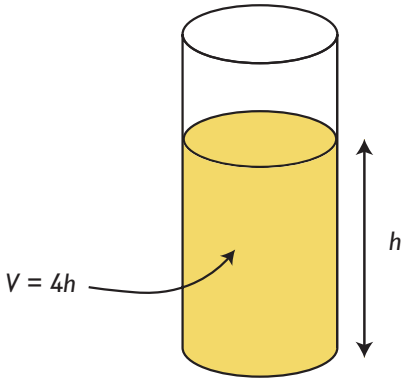


Suppose the total volume of the container is 100 cm^3. What is the value of h?

h = _____ cm

6. This graph represents the relationship between the volume of sand in a cylindrical container and the height of the sand.



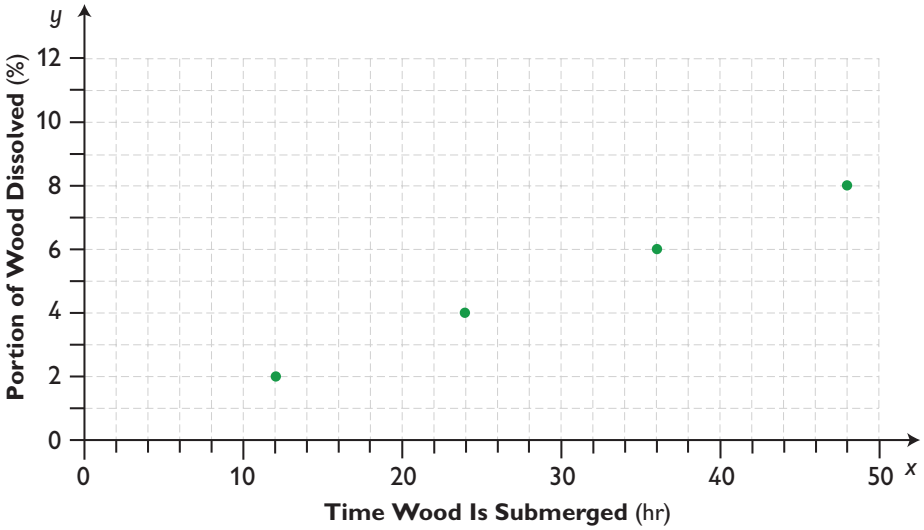


Can you think of a different container in which the volume of the sand is not proportional to the height of the sand? Explain.

LESSON 9: USING PROPORTIONS

EXERCISES

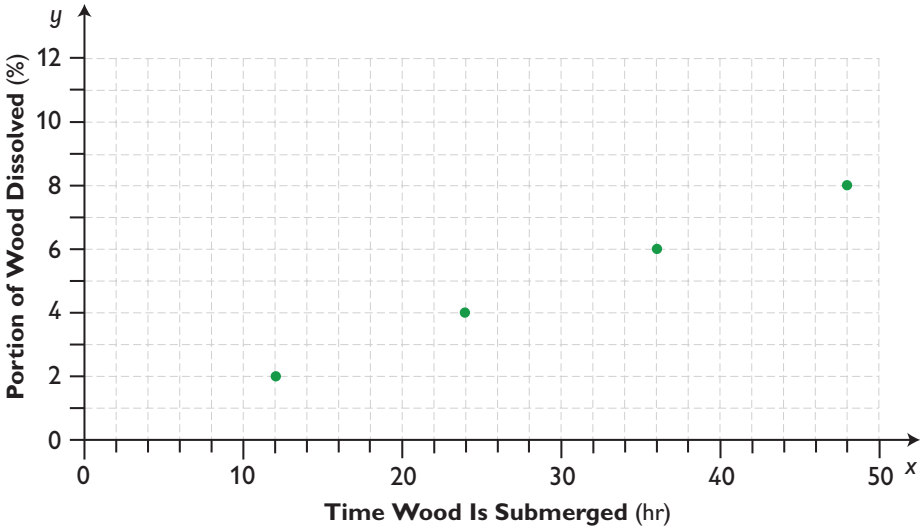
7. A team of graduate students collected data to show the relationship between the number of hours a piece of wood is submerged (completely covered) in a certain chemical and the portion of the wood that is dissolved by the chemical. The results are shown in this graph.



Maya claims that this graph represents a proportional relationship between how long the wood is submerged and the percent of the wood dissolved.

Is Maya correct?

8. This graph represents the relationship between the number of hours a piece of wood is submerged (completely covered) in a certain chemical and the percentage of the wood that is dissolved by the chemical.



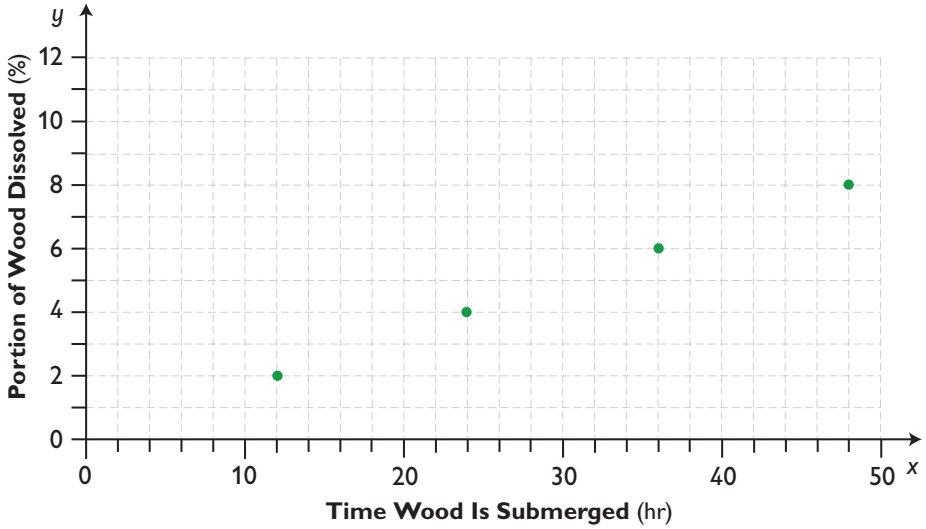
What is the constant of proportionality expressed as percent per hour?

k = _____

LESSON 9: USING PROPORTIONS

EXERCISES

9. This graph represents the relationship between the number of hours a piece of wood is submerged (completely covered) in a certain chemical and the percentage of the wood that is dissolved by the chemical.



Write an equation to express the relationship. Use p for portion of wood dissolved in percent and t for time in hours.

Challenge Problem

10. a. A relationship can have two variables and not be proportional. Explain why.

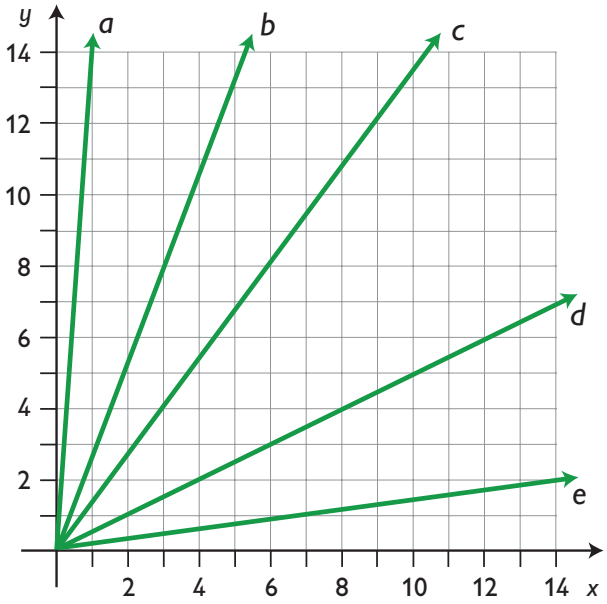
    b. Write a definition of a proportional relationship in your own words.

LESSON 10: ANALYZING GRAPHS

EXERCISES

EXERCISES

1. This coordinate grid shows the graphs of five proportional relationships.



Which of these statements is true? There may be more than one true statement.

A. The constant of proportionality for line *c* is less than the constant of proportionality for line *d*.

B. The constant of proportionality for line *d* is greater than the constant of proportionality for line *c*.

C. The constant of proportionality for line *b* is greater than the constant of proportionality for line *c*.

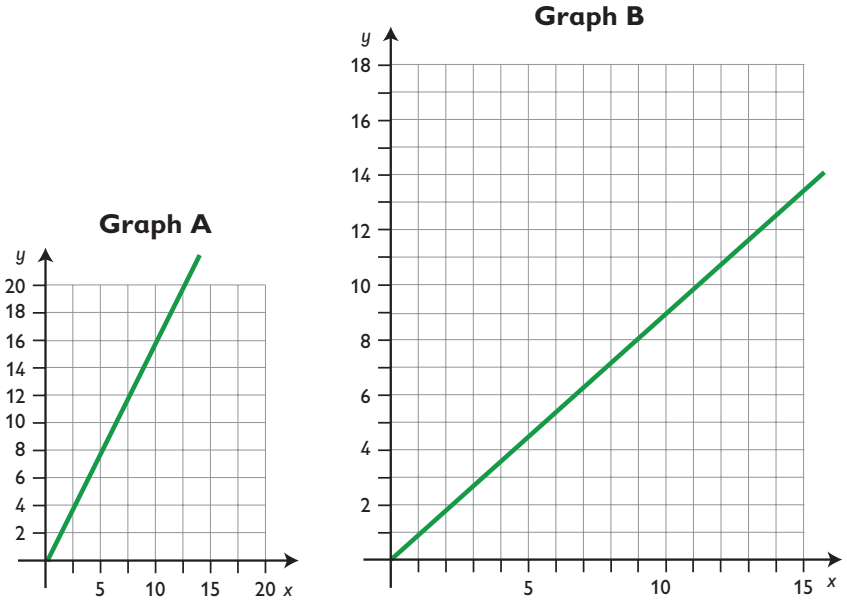
D. The constant of proportionality for line *e* is less than the constant of proportionality for line *d*.

E. The constant of proportionality for line *a* is less than the constant of proportionality for line *b*.

LESSON 10: ANALYZING GRAPHS

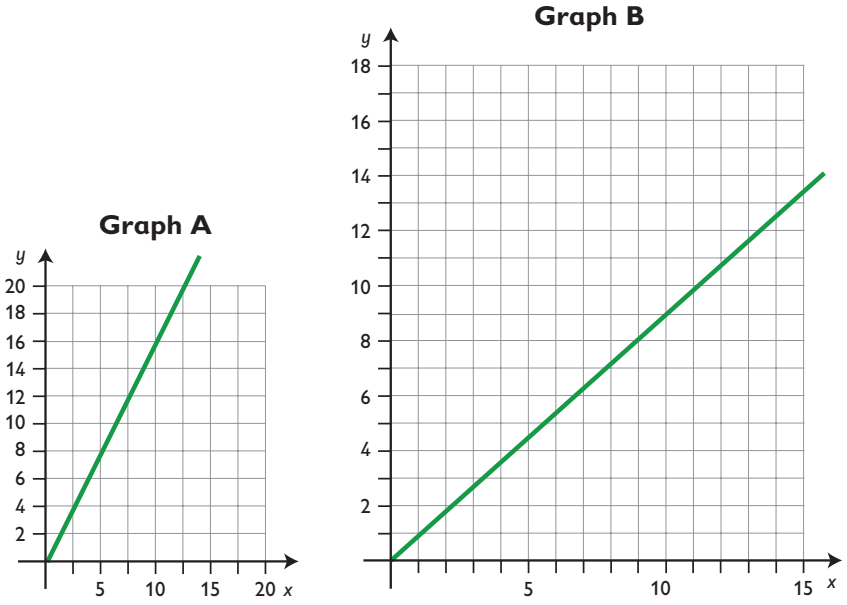
EXERCISES

2. Compare these graphs, both of which represent proportional relationships.



Which graph shows a relationship with a greater constant of proportionality?

3. Consider these graphs of proportional relationships.



Approximate, as closely as possible, the constant of proportionality for each graph.

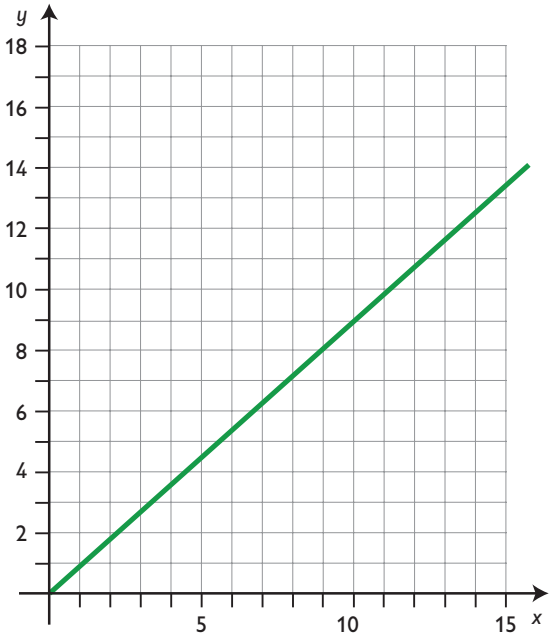
a. Graph A: k = _____

b. Graph B: k = _____

LESSON 10: ANALYZING GRAPHS

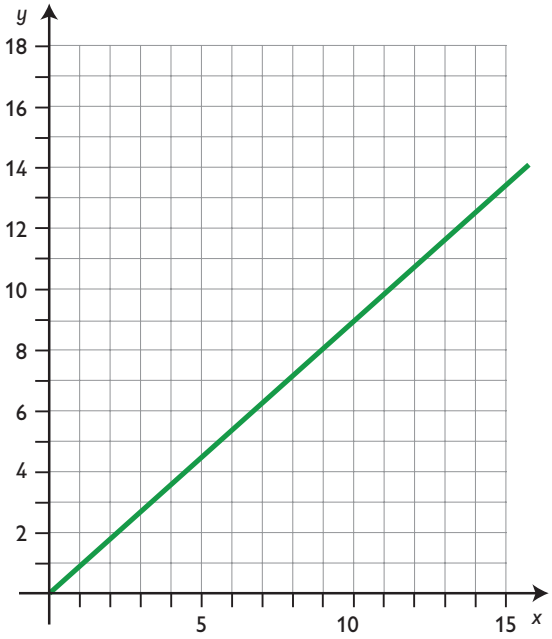
EXERCISES

4. Consider this graph.



Make a table that lists at least three pairs of values that define the points on the graph.

5. Consider this graph.



Write a formula for the line shown in the graph.

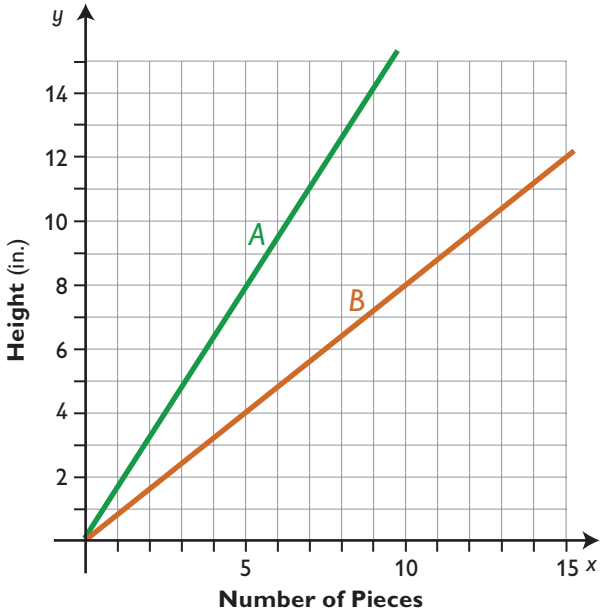
LESSON 10: ANALYZING GRAPHS

EXERCISES

6. Mr. Valdez bought lumber to remodel his restaurant. He made a stack of 5 pieces of plywood. Sophie measured the height of the stack and found that it was 4 in.

   Mr. Valdez also made a stack of 5 two-by-fours. Sophie measured the height of this stack as well and found that it was 8 in.

   In both cases, there is a proportional relationship between the height of the stack and the amount of lumber. Here is a graph of these two proportional relationships.



   Which line represents the plywood?

   _____ represents the plywood.

7. Sophie measured the height of the stacks of plywood and two-by-fours Mr. Valdez bought to remodel his restaurant. Here are her results.

   Plywood: 5 pieces are 4 in. high

   Two-by-fours: 5 pieces are 8 in. high

   Find the constant of proportionality for the plywood. Write an appropriate formula for the height, h, in terms of the number of pieces, n.

LESSON 10: ANALYZING GRAPHS

EXERCISES

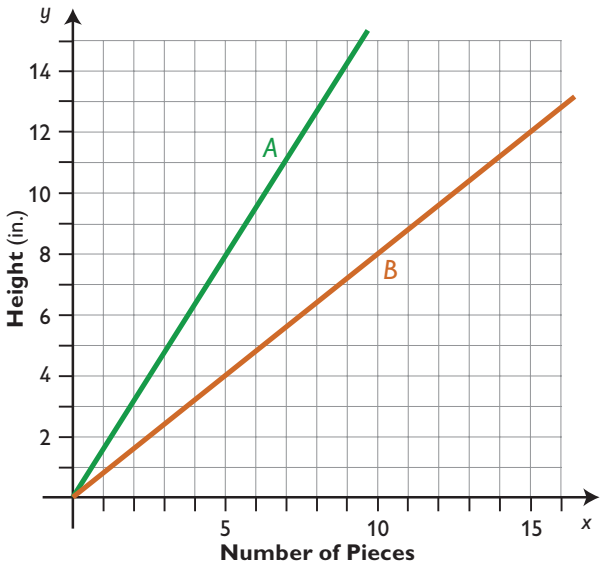
8. Sophie measured the height of the stacks of plywood and two-by-fours Mr. Valdez bought to remodel his restaurant. Here are her results.

   Plywood: 5 pieces are 4 in. high

   Two-by-fours: 5 pieces are 8 in. high

   Find the constant of proportionality for the two-by-fours. Write an appropriate formula for the height, h, in terms of the number of pieces, n.

9. Here is a graph of the measurements Sophie took of the materials Mr. Valdez bought to remodel his restaurant. Sophie found the height of a stack of 5 sheets of plywood to be 4 in. and a stack of 5 two-by-fours to be 8 in.



   Mr. Valdez also bought 5 sheets of drywall. Sophie measured the height of this stack and found that it was 2.5 in.

   Which of these statements describes where a graph of the proportional relationship of the drywall would be located in the coordinate grid?

   A. The drywall graph would be between line A and line B.

   B. The drywall graph would be steeper than line A; it would be between line A and the y-axis.

   C. The drywall graph would not be as steep as line B; it would be between line B and the x-axis.

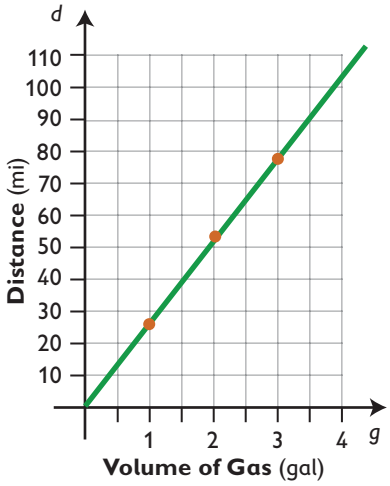
   D. The drywall graph would have the same steepness as line B; it would be in exactly the same location as line B.

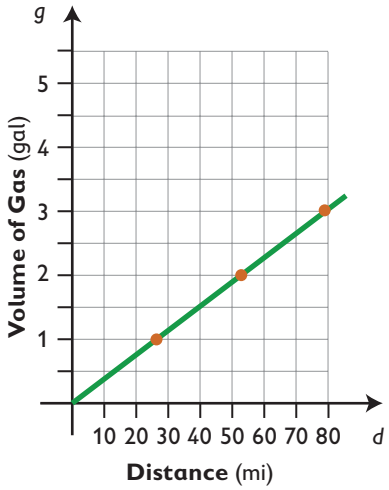
LESSON 10: ANALYZING GRAPHS

EXERCISES

Challenge Problem

10. Both of these graphs represent the relationship between gallons of gas and miles traveled.





a. Do these graphs represent the same data? Explain how you know.

b. Compute the constant of proportionality in each case. What do you notice?

LESSON 11: PUTTING IT TOGETHER 1

EXERCISES

EXERCISES

1. Look back at the notes you took during this unit, and think about the strategies you have developed for working on problems involving proportional and non-proportional relationships.

   Write three things you have learned about proportional relationships.

2. Consider the differences between proportional and non-proportional relationships.

   Create a graphic organizer to show these differences and explain how to identify whether a relationship is proportional or not. Organize your visual in a way that will allow you to use it as a reference throughout the rest of the school year.

   Use a chart similar to the one shown. Start by thinking of two real-world situations, one that represents a proportional relationship and one that represents a non-proportional relationship. In the Word Problem row, describe the situations. Then complete the rest of your graphic organizer based on the two situations.

	Proportional Relationship	**Non-Proportional Relationship**
Word Problem		
Table		
Graph		
Equation		

3. Read your work on the Self Check.

   What would you do differently if you were starting the Self Check task now?

4. During this unit so far, you have examined different methods for solving problems involving proportional relationships.

   For example, you have solved proportional relationship problems by:

   - Setting up a proportion and solving for the missing value
   - Finding the unit rate and multiplying
   - Writing and solving a formula using the constant of proportionality

   Has the method you now prefer to use changed from the method you preferred earlier in the unit? If so, why has your preferred method changed? If not, why do you still prefer your initial method?

5. Complete any exercises from earlier lessons that you have not finished.

LESSON 15: CONNECTION TO PERCENT EXERCISES

EXERCISES

1. Maya is doing some back-to-school shopping. She purchased a backpack for $35. The sales tax is 7%.

   What is the total amount Maya paid for the backpack, including the sales tax?

   $_____

2. Another item Maya purchased while back-to-school shopping is a pair of shoes. The price of the shoes was $49. The sales tax is 7%.

   What is the total amount Maya paid for the pair of shoes, including the sales tax?

   $_____

3. Jack is also doing some back-to-school shopping. He purchased a box of pencils. The price was $3 and the sales tax is 7%.

   Write and evaluate an equation to find the total amount Jack paid for the pencils.

4. While doing some back-to-school shopping, Jack wanted to figure out whether he could afford a calculator. The price was $15. The sales tax is 7%.

   Write and evaluate an equation to find the total amount Jack would pay for the calculator.

5. What is 60% of 50?

   A. 10
   B. 15
   C. 30
   D. 60

6. Write a formula to determine 60% of any amount.

7. Consider the formula to determine 60% of any amount, x. Make a graph that shows this relationship for amounts from 0–50.

LESSON 15: CONNECTION TO PERCENT

EXERCISES

8. What is 20% of $16.09 to the nearest cent?

   A. $0.31

   B. $3.21

   C. $3.22

   D. $12.87

9. Consider a situation in which sales tax is 20%. Write a formula to determine the total cost of any amount with 20% sales tax.

10. Consider the formula to determine the total cost of any price, x, and a constant sales tax of 20%. Make a graph that shows this relationship for dollar amounts from $10 to $20.

Challenge Problem

11. You wrote and evaluated equations to determine the total amount Jack paid for some back-to-school items.

    Box of pencils: price is $3; sales tax is 7%

    Calculator: price is $15; sales tax is 7%

    Explain how you could use the distributive property to help simplify the total cost formulas you wrote about this situation.

LESSON 16: MORE ABOUT SALES TAX

EXERCISES

EXERCISES

1. Sophie bought a present for her friend's birthday. The price of the present was $15. The sales tax in her city is 8.75%.

   Which of these formulas could be used to determine the total cost, t, of the present? There may be more than one correct formula.

   A. $t = (0.0875 \cdot 15) + 15$

   B. $t = 15(0.0875 + 1)$

   C. $t = 15 + \frac{8.75}{15}$

   D. $t = (100 - 8.75) \cdot 15$

   E. $t = 1.0875 \cdot 15$

2. Jack is figuring out how much it would cost him to purchase a new skateboard. The price of the skateboard is $19.00. The sales tax is 7%.

   Which table correctly represents this situation?

   A.

Starting Amount	Percent Change	Final Amount
$19.00	7% increase	$1.33

   B.

Starting Amount	Percent Change	Final Amount
$19.00	93% decrease	$17.67

   C.

Starting Amount	Percent Change	Final Amount
$19.00	0.7% increase	$13.30

   D.

Starting Amount	Percent Change	Final Amount
$19.00	7% increase	$20.33

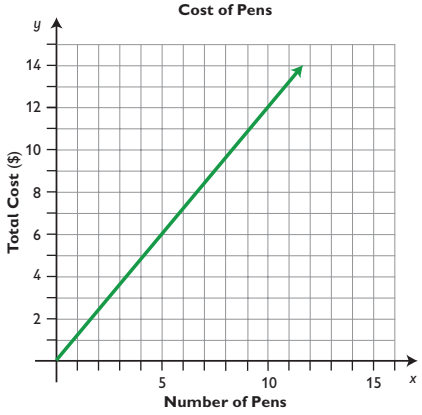
LESSON 16: MORE ABOUT SALES TAX

EXERCISES

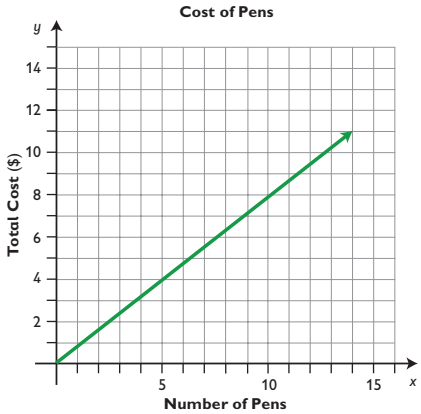
3. Maya would like to purchase some pens. Each pen costs $0.75. The sales tax is 6%.

   Which graph correctly represents the proportional relationship in this situation?

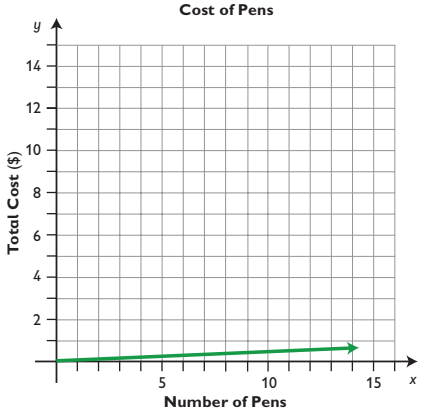
A



B



C



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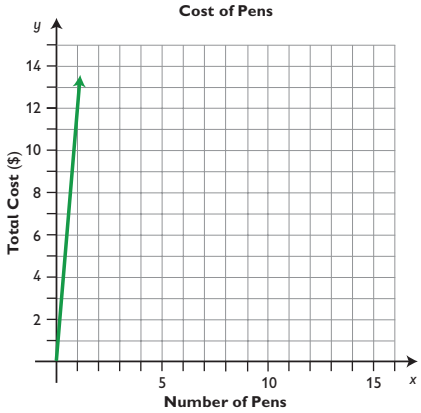


4. Marcus bought a new smart phone for $85.20. The price of the smart phone before sales tax was $80.

   Complete the table to show the percent change in terms of an increase or decrease.

Starting Amount	Percent Change	Final Amount
$80		$85.20

5. What formula would you use to find the sales tax if you know the prices of an item before and after sales tax? Explain.

LESSON 16: MORE ABOUT SALES TAX

EXERCISES

6. Mrs. Luna is a driving instructor. On average, 75% of her students pass their driving test on the first try.

   How many students should pass on the first try if Mrs. Luna has 32 students? Complete the table.

Starting Amount	Percent Change	Final Amount

7. On average, 75% of the students in Mrs. Luna's driving instruction course pass their driving test on the first try.

   What formula would you use to find the number of students in a particular class who pass the driving test on their first try? Be sure to define each variable in your formula.

8. In Mrs. Luna's driving instruction course, an average of 75% of her students pass their driving test on the first try.

   Make a graph that shows the formula for class sizes of 0–40 students. Click in the coordinate grid to add a point.

9. Lucy's step-brother owns a coffee shop. He estimates that 65% of his customers order regular coffee and the rest order decaffeinated coffee.

   What formula could Lucy use to determine the number of customers who will order decaffeinated coffee on any given morning? Explain.

10. An estimated 65% of the customers at Lucy's step-brother's coffee shop order regular coffee. The rest of the customers order decaffeinated coffee.

    Make a graph that shows the formula for the relationship of the number of customers ordering decaffeinated coffee to the total number of customers. Show the formula for 0 to 200 total customers. Click in the coordinate grid to add a point.

Challenge Problem

11. Consider Lucy's step-brother's coffee shop. An estimated 65% of the customers order regular coffee and the rest order decaffeinated coffee.

    a. Explain how you would use a formula to determine the total number of customers Lucy's step-brother has if he sells 54 cups of decaffeinated coffee.

    b. Describe how you would use a graph to determine the total number of customers Lucy's step-brother has if he sells 54 cups of decaffeinated coffee.

LESSON 17: PERCENT INCREASE

EXERCISES

EXERCISES

1. Find 55 increased by 30%.

2. A number increased by 12% is 28. What is the original number?

   The original number is _____.

3. The average length of a business phone call changed from 30 sec to 45 sec.

   What percent increase is this? Write your response as a complete sentence.

4. The price of a pair of socks changed from $7.50 to $10.20.

   What percent increase is this? Write your response as a complete sentence.

5. Mrs. Abir's school raised $2,580 during last year's annual fundraising campaign. This year's target amount is 15% higher than the amount raised last year.

   What is this year's target amount? Write your response as a complete sentence and show your work.

6. Karen ordered lemon chicken from her favorite Chinese restaurant. She paid $9.00 for a bill of $7.77.

   What percent tip did Karen pay? Round the percent to the nearest tenth.

   Karen paid about a _____% tip.

7. After lunch at her favorite Chinese restaurant, Karen wants to tip her server 20% for his service.

   What should Karen multiply her bill by to determine the tip she wants to leave?

   A. 20.0

   B. 1.20

   C. 1.02

   D. 0.20

LESSON 17: PERCENT INCREASE

EXERCISES

8. After lunch at her favorite Chinese restaurant, Karen wants to tip her server 20% for his service.

   What should Karen multiply her bill by to determine the total amount, including the tip?

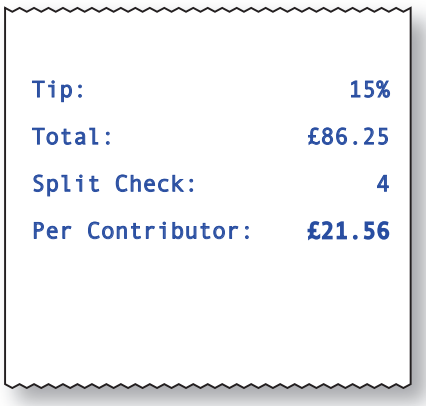
   A. 20.0
   B. 1.20
   C. 1.02
   D. 0.20

9. The minimum wage in San Francisco was increased to $10.55 per hour in 2013. This amount is 31.875% greater than the minimum wage in the state of California.

   What is the minimum wage in California? Write your response as a complete sentence.

Challenge Problem

10. This is a check for a meal shared by you and three other people. You owe £21.56 (British pounds).



Tip:	15%
Total:	£86.25
Split Check:	4
Per Contributor:	£21.56

How much of this amount pays for the tip? Explain.

LESSON 18: PERCENT DECREASE

EXERCISES

EXERCISES

1. Sophie joined a running group to prepare for a 5 mi race. After two months, her time had dropped from 40 min to 38 min. What is the percent decrease?

   A. The decrease is about 9.5%.

   B. The decrease is about 0.05%.

   C. The decrease is about 0.95%.

   D. The decrease is about 5%.

2. Find 75 decreased by 25%.

3. A number decreased by 14% is 43. What is the original number?

   The original number is _____.

4. Maya bought two boxes of cereal, each marked 20% off. Therefore, she saved _____% altogether.

   A. 10% B. 20% C. 40%

5. A fitness club manager reduces the prices by 50% during a spring sale. The manager raises the prices by 100% after the sale. Therefore, after the sale the prices are _____ the prices before the sale.

   A. the same as B. higher than C. lower than

6. Karen answered 20% of the questions on her first quiz correctly and 30% of the questions on her second quiz correctly. Both quizzes had the same number of questions, so for both quizzes she answered _____ of all the quiz questions correctly.

   A. less than 50% B. 50% C. more than 50%

7. Jack starts a new job making sandwiches at a bakery. Soon the amount of time it takes for him to make a sandwich changes from 50 sec to 15 sec.

   What is the percent decrease? Write your response as a complete sentence.

8. Maya fills a bucket with 51 kg of sand. The weight of the sand changes to 37.5 kg after she uses some to build a sand castle.

   What percent decrease is this? Write your response as a complete sentence.

LESSON 18: PERCENT DECREASE

EXERCISES

9. A recycling truck makes two separate runs on its daily collection route. It collects 16 tons of recyclable materials on its first run, which is 15% more than the amount it collects on the second run.

   How much recycling does the truck collect on its second run? Write your answer as a decimal to one place.

   The truck collects _____ tons of recyclable materials on its second run.

10. A dress that normally costs $86.00 is on sale for 25% off the original price.

    What is the sale price? Write your response as a complete sentence.

11. The length of a 4 min video is decreased by 30% when it is edited. What is the length of the edited video? Express your answer in minutes and seconds.

    The edited version is _____ min and _____ sec.

12. Sophie bought a pair of skates for $403 during a summer sale.

    What is the original price of the skates if they were on sale for 35% off? Write your response as a complete sentence.

13. Marcus earned 59 out of 80 possible points on his biology exam. His teacher tells him that his score is 8% below the class average.

    What is the class average?

Challenge Problem

14. Each spring a clothing store has a sale: 20% off all winter items. Any winter items that remain after one month are marked an additional 40% off the first sale price.
    a. A coat originally sold for $200. What is the price of the coat if it remains after one month?
    b. Write an expression to find the price of any item after both discounts.
    c. For any item after both discounts have been applied, what is the percent off the **original** price?

LESSON 19: MISTAKES WITH PERCENTS

EXERCISES

EXERCISES

1. The students in Ms. Siboyani's class are studying nutrition labels on food. They are discussing the calories and calories from fat in 1 serving of a snack they all like. They have highlighted this information in pink on the label.

Nutritional Facts

Serving Size 1 cup (228g)
Serving per Container 2

Amount per Serving

Calories 260	Calories from Fat 120
	% Daily Value*
Total Fat 13 g	**20%**
Saturated Fat 5g	**25%**
Trans Fat 2g	
Cholesterol 30mg	**10%**
Sodium 660mg	**28%**
Total Carbohydrate 31g	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	

Vitamin A 4%	Vitamin C 2%
Calcium 15%	Iron 4%

*Percent Daily Values and based ona 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.

Which of these students have reasoned correctly? There may be more than one student who is correct.

A. Lucy says, "If you eat 1 serving, you are eating 260 calories. Of those calories, 120 calories are from fat. So, the percent of calories from fat is 120 ÷ 260, or about 46%."

B. Marcus says, "No matter how many servings you have, the ratio of calories from fat to total calories stays the same: 120 : 260 or 6 : 13."

C. Karen says, "In 1 serving, calories from fat (120) is approximately 46% of the calories (260). So, if you eat $\frac{1}{2}$ of a serving, the percentage of calories from fat would be 50% of 46%, which is 23%."

D. Sophie says, "If you reduce the serving size by 50%, you reduce the calories from fat by 50%."

E. Jack says, "If you eat 1 serving, you are eating 260 calories. The percent of fat that you eat is, $\frac{120}{260} + 120$ or 31.5%."

LESSON 19: MISTAKES WITH PERCENTS

EXERCISES

2. The students in Ms. Siboyani's class are studying nutrition labels on food. They are discussing the total fat in 1 serving of a snack they all like. They have highlighted this information in pink on the label.

Nutritional Facts

Serving Size 1 cup (228g)
Serving per Container 2

Amount per Serving

Calories 260	Calories from Fat 120
	% Daily Value*
Total Fat 13 g	**20%**
Saturated Fat 5g	**25%**
Trans Fat 2g	
Cholesterol 30mg	**10%**
Sodium 660mg	**28%**
Total Carbohydrate 31g	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	

Vitamin A 4%	Vitamin C 2%
Calcium 15%	Iron 4%

*Percent Daily Values and based ona 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.

Which of these students has reasoned correctly?

A. Sophie says, "If you eat 1 serving, you are getting 20% of your daily value of total fat. If you eat 2 servings, you are getting 0.5 • 20% of your daily value of total fat."

B. Jack says, "If you eat $\frac{3}{4}$ of a serving, instead of getting 20% of your daily value of total fat you would get 15% of your daily value, because 15% is 75% of 20%."

C. Lucy says, "If you eat $1\frac{1}{2}$ servings of the snack, you are getting 40% of your daily value of total fat."

D. Maya says, "If you reduce the serving size by 10%, the formula for the percent daily value of total fat would be $y = (0.1) \cdot 20\%$, which is 2%."

LESSON 19: MISTAKES WITH PERCENTS

EXERCISES

3. The students in Ms. Siboyani's class are studying nutrition labels on food. They are discussing the sodium in 1 serving of a snack they all like. They have highlighted this information in pink on the label.

Nutritional Facts

Serving Size 1 cup (228g)
Serving per Container 2

Amount per Serving

Calories 260	Calories from Fat 120
	% Daily Value*
Total Fat 13 g	**20%**
Saturated Fat 5g	**25%**
Trans Fat 2g	
Cholesterol 30mg	**10%**
Sodium 660mg	**28%**
Total Carbohydrate 31g	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	

Vitamin A 4%	Vitamin C 2%
Calcium 15%	Iron 4%

*Percent Daily Values and based ona 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.

Which of these students has reasoned correctly?

A. Maya says, "If you eat 1 serving, you are getting 28% of your daily value of sodium. If you eat $1\frac{1}{2}$ servings, you are still getting 28% of your daily value of sodium."

B. Karen says, "If you eat $\frac{3}{4}$ of a serving, instead of getting 28% of your daily value of sodium you would get 75% of 28%."

C. Marcus says, "If you eat 4 servings of the snack, you would get less than 100% of your daily value of sodium."

D. Jack says, "If you eat 2 servings, the formula for the percent daily value of sodium would be $y = (1.5) \cdot 28\%$, which is 42%."

4. An athletic apparel store is going out of business and needs to sell its entire remaining inventory. Every item in the store is 75% off the usual price.

   Sophie wants to buy a new pair of running shoes that usually cost $100. What is the sale price of the shoes?

   The sale price of the shoes is $_____.

LESSON 19: MISTAKES WITH PERCENTS

EXERCISES

5. Sophie bought a new pair of running shoes that usually cost $100. She paid 75% off the usual price.

   Jack says, "Wow, Sophie, that's a great deal. You only have to pay three-quarters of the original price!"

   Is Jack correct or incorrect? Explain.

6. Sophie is talking with Jack about the new pair of running shoes she purchased at 75% off the usual price of $100.

   Sophie says, "The ratio of the sale price to the original price is 1 : 4."

   Is Sophie correct or incorrect? Explain.

7. Yesterday, 10% of the students watched hockey and 20% watched basketball. A student reporting the school news said that, therefore, 70% of the students did not watch either sport.

   What mistake in reasoning about percents did the student reporter make?

8. Karen answered 20% of the questions on her first math test correctly and 60% of the questions on her second math test correctly. Therefore, Karen says, she answered 80% of the questions correctly.

   What mistake in reasoning about percents did Karen make?

9. On Blowout Sale Friday, the price of every item in a store was reduced by 70%. The next day, prices were increased by 50%. Maya says that the prices are now 20% lower than they were before Blowout Sale Friday.

   What mistake in reasoning about percents did Maya make?

LESSON 19: MISTAKES WITH PERCENTS

EXERCISES

Challenge Problem

10. Lucy wants to set $300 aside in a savings account. She has two options: set the money aside at 3% interest for 2 years, or set the money aside at 2% interest for 3 years.

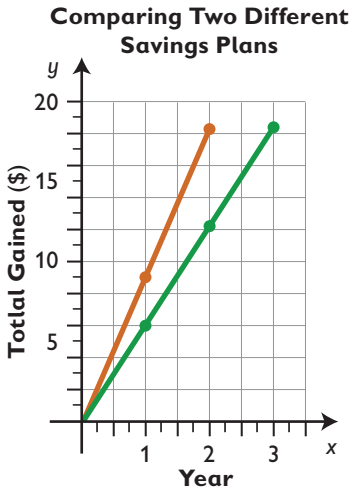
    Lucy created tables to help her compare the options and determine which option will result in the highest payoff. Then she graphed the table data.

Plan 1

Year	Starting Amount	Percent Change	Final Amount	Total Gain
1	$300.00	3% increase	$309.00	$9.00
2	$309.00	3% increase	$318.27	$18.27

Plan 2

Year	Starting Amount	Percent Change	Final Amount	Total Gain
1	$300.00	2% increase	$306.00	$6.00
2	$306.00	2% increase	$312.12	$12.12
3	$312.12	2% increase	$318.36	$18.36



Lucy is confused. She says, "I thought the two plans would give me the same final amount. Since the graph shows these are proportional relationships and since both have a total increase of 6% from the original amount of $300, I must have done something wrong. Maybe I made an error with my calculations."

Explain the mistake(s) in reasoning about percents that Lucy made.

LESSON 20: PUTTING IT TOGETHER—PART 2

EXERCISES

EXERCISES

1. Which of these decimal multipliers is the same as a 64% increase?

   A. 64

   B. 6.4

   C. 1.64

   D. 1.064

2. Which of these fraction multipliers are the same as a $33\frac{1}{3}\%$ decrease? There may be more than one equivalent fraction multiplier.

   A. $\frac{6}{9}$

   B. $\frac{1}{3}$

   C. $\frac{2}{3}$

   D. $\frac{2}{6}$

   E. $\frac{5}{8}$

3. Consider the change from the dollar amount of \$150 to the dollar amount of \$180.

   Which of these percents, fractions, or decimals indicate the correct increase or decrease between the amounts of money? There may be more than one correct value.

   A. 2% increase

   B. 1.2

   C. 20% increase

   D. $\frac{1}{3}$

   E. $\frac{6}{5}$

LESSON 20: PUTTING IT TOGETHER—PART 2

EXERCISES

4. In a bookstore, 12.5% of all the books sold are hardcover.

   The bookstore sold 88 books one week.

   How many of those books were hardcover?

   _____ books

5. In a bookstore, 12.5% of all the books sold are hardcover.

   What would you multiply the amount of hardcover books by to find the total number of books sold?

   A. $\frac{1}{0.125}$
   B. 1 + 0.125
   C. 1 – 0.125
   D. 0.125

6. Maya participated in a 10 km run. She planned to run at a constant speed. She was hoping to run 9.5 min kilometers, which means it takes 9.5 min to run 1 km.

   Here is the table of her actual run times.

Distance (km)	1	2	3	4	5	6	7	8	9	10
Time (min)	9.5	19	28.5	38	48	58	68.5	79	90	101

   a. For how many miles did she run at that constant speed? _____ mi
   b. Write an equation representing the proportional relationship of 9.5 minutes (t) per kilometer (d).

7. Maya participated in a 10 km run. She planned to run at a constant speed. She was hoping to run 9.5 min kilometers, which means it takes 9.5 min to run 1 km.

   Here is the table of her actual run times.

Distance (km)	1	2	3	4	5	6	7	8	9	10
Time (min)	9.5	19	28.5	38	48	58	68.5	79	90	101

   The table indicates an increase of time from 9.5 min/km at the beginning of the run to 10.1 min/km at the end. What is the percent of this increase? Round to a whole percent.

   _____ % increase

LESSON 20: PUTTING IT TOGETHER—PART 2

EXERCISES

8. Maya participated in a 10 km run. She planned to run at a constant speed. She was hoping to run 9.5 min kilometers, which means it takes 9.5 min to run 1 km.

   Here is the table of her actual run times.

Distance (km)	1	2	3	4	5	6	7	8	9	10
Time (min)	9.5	19	28.5	38	48	58	68.5	79	90	101

   What is the meaning of the point (10, 95) in the context of Maya's run?

9. A store manager reduces the price of a tool kit that normally costs $25.00 down to $17.50 during a sale. However, demand for the tool kit increases when the students at the local high school begin a building project, and the manager decides to raise the price back to $25.00.

   Find the percent of price decrease from $25.00 to $17.50. Write your answer as a whole percent.

   _____ % decrease

10. A store manager reduces the price of a tool kit that normally costs $25.00 down to $17.50 during a sale. However, demand for the tool kit increases when the students at the local high school begin a building project, and the manager decides to raise the price back to $25.00.

    Find the percent of price increase from $17.50 to $25.00. Write your answer as a percent to one decimal place.

    _____ % increase

11. A store manager reduces the price of a tool kit that normally costs $25.00 down to $17.50 during a sale. However, demand for the tool kit increases when the students at the local high school begin a building project, and the manager decides to raise the price back to $25.00.

    Why is the percent increase different from the percent decrease? Explain.

Challenge Problem

12. Consider this multiplication equation, where r is the product, n is a number, and p is a percentage.

    $r = p \cdot n$

    When is $r > n$? When is $r < n$? Explain.

LESSON 21: PUTTING IT TOGETHER—PART 3

EXERCISES

EXERCISES

1. Read your Self Check and think about your other work about percents in this unit.

   Write down three things you have learned.

   Share your work with a classmate.
   Does your classmate understand what you wrote?

2. In the second part of this unit, you explored many ways that proportional relationships are used in real-world situations such as percent problems. For example, you looked at how sales tax is calculated from the price of an item.

   Describe a situation from your everyday life in which you used proportional relationships. (If you have never before used proportional relationships in your everyday life, consider some of the examples from the unit. Imagine a real-world situation in which you would need to use proportional relationships; describe that imagined situation.)Write what you have learned.

3. In the unit, you discovered that people often make mistakes with percents.

   Explain a strategy or method you like to use to double-check your work and ensure you have not made a mistake in your reasoning about percents.

4. Review the notes you took during the lessons about proportional relationships, percents, and ratios. Add any additional ideas you have about these topics to your notes.

   If you are still confused about something, be sure to research your questions and add more information to your notes. Ask for help from a classmate, review the related lessons, look at the resources in the Concept Corner, talk with your teacher, and so on, to help you clarify areas of confusion.

5. Complete any exercises from this unit that you have not finished.