Lesson Summary

Here are two different strategies for writing the equation of a line using two given points.

Strategy Using a Table

First, calculate the slope using a table. Next, substitute the coordinates of one of the points into the equation $y = mx + b$ to determine the y-intercept. Then write the equation in the form $y = mx + b$.

	x	y	
+2	1	8	−6
	3	2	

slope: $\frac{-6}{2} = -3$

$y = -3x + b$

Substitute (1, 8) in for x and y.

$8 = -3(1) + b$

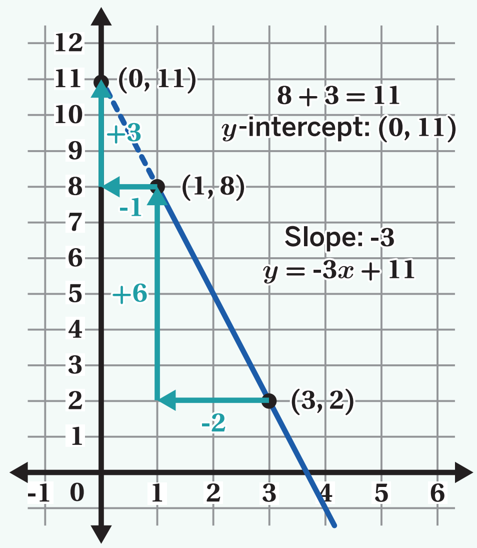
$8 = -3 + b$

$11 = b$

$y = -3x + 11$

Strategy Using Slope Triangles

Draw a line and use similar triangles to determine the slope and y-intercept of the line. Then write the equation in the form $y = mx + b$.



Things to Remember:

Lesson Practice
8.3.11

Name: ______ Date: ______ Period: ______

1. Bao and Maia are each writing an equation of the line that passes through the points $(2, 9)$ and $(12, 14)$. They both calculate the slope as $\frac{1}{2}$.

- Bao substitutes the point $(2, 9)$ to determine the y-intercept.
- Maia substitutes the point $(12, 14)$ to determine the y-intercept.

Here is each student's work and their solutions for the y-intercept. Determine any mistakes in each student's work and explain how you would fix them.

Bao

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

$9 = \frac{1}{2}(2) + b$

$9 = 1 + b$

$b = 8$

Maia

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

$12 = \frac{1}{2}(14) + b$

$12 = 7 + b$

$b = 5$

***Responses vary.* Bao's work is accurate. Maia substituted the x- and y-values from the point $(12, 14)$ incorrectly. She reversed the x- and y-coordinates.**

Her calculations should be:

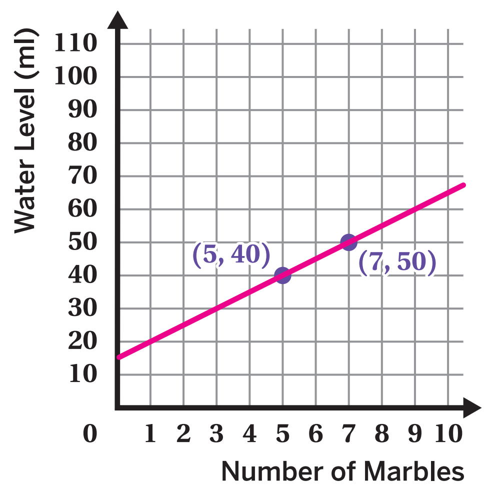
$y = \frac{1}{2}x + b$

$14 = \frac{1}{2}(12) + b$

$14 = 6 + b$

$8 = b$

2. Chloe added marbles to a container of water. When she added 5 marbles, the water level was 40 millimeters. When she added 7 marbles, the water level was 50 millimeters. Write an equation for the water level, y, after x marbles are added. Show or explain your thinking.



$y = 5x + 15$. *Explanations vary.*

Slope: 5

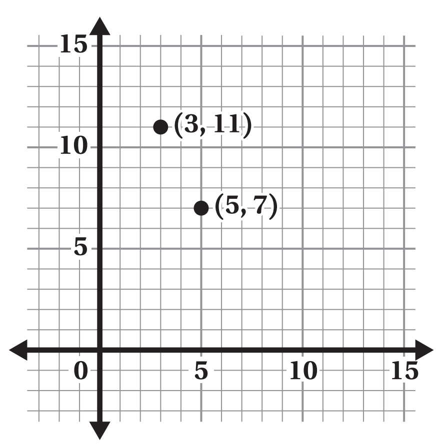
$40 = 5(5) + b$

$40 = 25 + b$

$b = 15$

$y = 5x + 15$

3. Here is a graph showing the points $(3, 11)$ and $(5, 7)$. What is the y-intercept of the line that passes through these points?



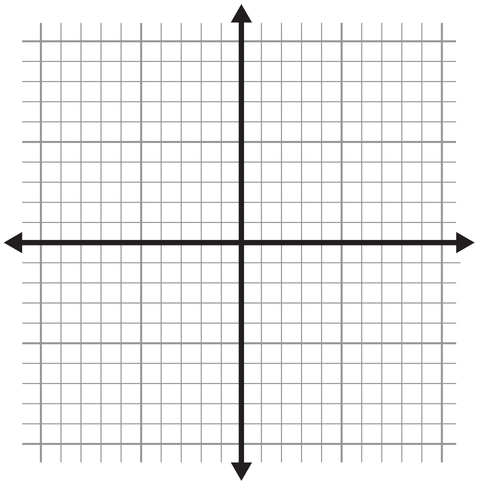
$(0, 17)$

Lesson Practice
8.3.11

Name: ________________ Date: ________ Period: ________

Problems 4–5: Write the equation of the line that passes through each pair of points. Show your work, and use the coordinate plane if it helps with your thinking. ***Work varies.***

4. $(2, 14)$ and $(6, 26)$ $y = 3x + 8$



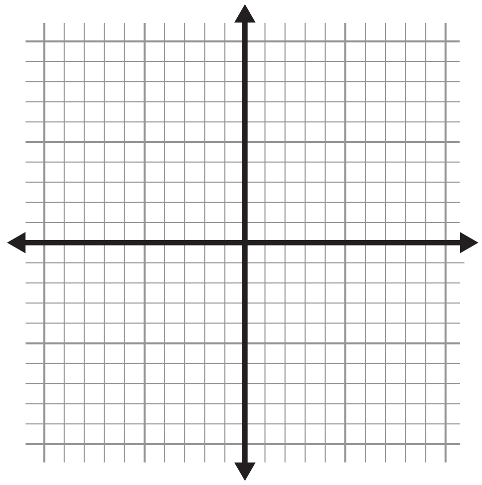
Slope:

	x	y	
$+4$	2	14	$+12$
	6	26	

$\frac{12}{4} = 3$

y-intercept:
$14 = 3(2) + b$
$14 = 6 + b$
$b = 8$

5. $(-5, 7)$ and $(1, 1)$ $y = -x + 2$



Slope:

	x	y	
$+6$	-5	7	-6
	1	1	

$\frac{-6}{6} = -1$

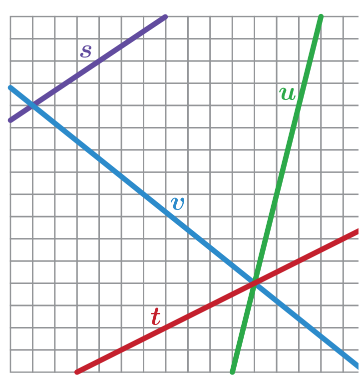
y-intercept:
$1 = -1(1) + b$
$1 = -1 + b$
$b = 2$

6. A line has a slope of 2 and passes through the point $(-6, 1)$. Which is the equation of that line?

A. $y = 2x + 4$
B. $y = 2x + 13$
C. $y = 2x + 8$
D. $y = 2x - 11$

Spiral Review

Problems 7–10: Determine if the slope of each line is positive or negative.



7. Line s
Positive

8. Line t
Positive

9. Line u
Positive

10. Line v
Negative

Reflection

1. Put a question mark next to a problem you're feeling unsure of.

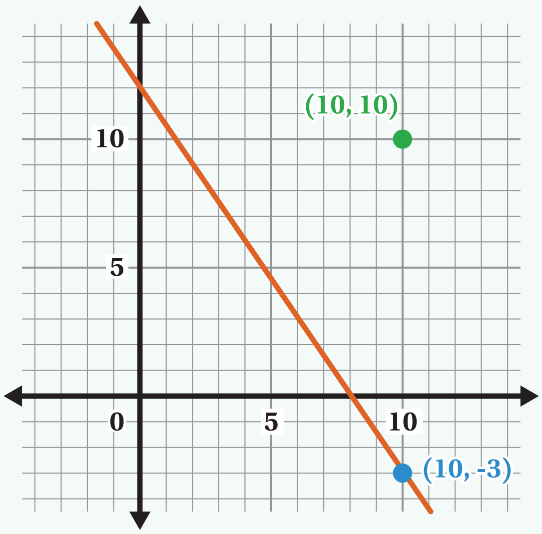
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

A **solution** to an equation with two variables is a set of values that makes the equation true. Solutions are often written as an ordered pair, (x, y).

Every point that lies on a line is a solution to that equation. Points that do not lie on the line are *not* solutions to the equation.

Here is a graph of the linear equation $3x + 2y = 24$.



- $(10, -3)$ is a solution to the equation $3x + 2y = 24$ because the point is on the graph of the line, and because $3(10) + 2(-3) = 24$.
- $(10, 10)$ is *not* a solution because the point is not on the line, and because $3(10) + 2(10) = 50$, not 24.
- Although we can't see it on the graph, $(-10, 27)$ is also a solution because $3(-10) + 2(27) = 24$.

Things to Remember:

Lesson Practice
8.3.12

Name: ________ Date: ________ Period: ________

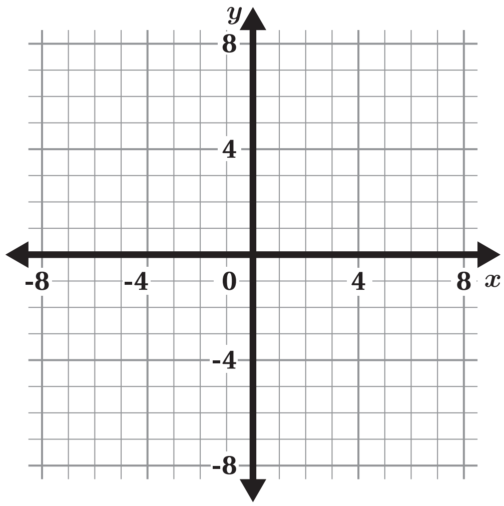
1. Select all of the ordered pairs (x, y) that are solutions to the linear equation $2x + 3y = 6$.

- [x] **A.** $(0, 2)$
- [ ] **B.** $(0, 6)$
- [ ] **C.** $(2, 3)$
- [ ] **D.** $(3, \text{-}2)$
- [x] **E.** $(3, 0)$
- [x] **F.** $(6, \text{-}2)$

2. The graph of a linear equation passes through the points $(\text{-}4, 1)$ and $(4, 6)$.

Select *all* the points that are also solutions to this equation. Use the graph if it helps with your thinking.

- [x] **A.** $(0, 3.5)$
- [ ] **B.** $(8, 5)$
- [x] **C.** $(12, 11)$
- [ ] **D.** $(\text{-}6, 0)$
- [ ] **E.** $(5, 6)$



3. Match each equation with its solutions.

Equation	Solutions
a. $2x + 3y = 7$	c $(\text{-}3, \text{-}7), (0, \text{-}4), (\text{-}1, \text{-}5)$
b. $3x = \frac{y}{2}$	a $\left(3\frac{1}{2}, 0\right), (\text{-}1, 3), \left(0, 2\frac{1}{3}\right)$
c. $x - y = 4$	e $(14, 21), (2, 3), (8, 12)$
d. $y = \text{-}x + 1$	b $(0.5, 3), (1, 6), (1.2, 7.2)$
e. $y = 1.5x$	d $\left(\frac{1}{2}, \frac{1}{2}\right), \left(\frac{1}{4}, \frac{3}{4}\right), \left(\frac{1}{8}, \frac{7}{8}\right)$

4. Determine whether the following statement is *true* or *false*. Explain your thinking.

The ordered pairs $(6, 13)$, $(21, 33)$, and $(99, 137)$ all lie on the line whose equation is $y = \frac{4}{3}x + 5$.

True. ***Explanations vary.*** **All three ordered pairs make the equation true.**

$13 = \frac{4}{3}(6) + 5$ $\quad 33 = \frac{4}{3}(21) + 5$ $\quad 137 = \frac{4}{3}(99) + 5$

$13 = 13$ $\quad 33 = 33$ $\quad 137 = 137$

Name: ________ Date: ________ Period: ________

5. Here is a linear equation: $y = \frac{1}{4}x + \frac{5}{4}$.

Are $(1, 1.5)$ and $(12, 4)$ both solutions to this equation? Explain your thinking.

No. *Explanations vary.* $(1, 1.5)$ is a solution because the x-value and y-value make the equation true. $(12, 4)$ is not a solution because when $x = 12$, y would be 4.25, not 4.

Problems 6–7: Complete each table.

6. $y = \frac{2}{3}x$

x	y
-3	**-2**
3	2

7. $y + x = 5$

x	y
-3	**8**
3	2

Spiral Review

8. This table represents a linear relationship.

Write an equation in the form $y = mx + b$ that represents this relationship.

$y = -\frac{5}{2}x + 25$ (or equivalent)

x	y
2	20
4	15
8	5

9. Deja adds $20 to her bus card. Every time she rides the bus, $2 is subtracted from the amount available on her card. After x rides, there are y dollars left on the card. Write a linear equation that represents this relationship.

$y = -2x + 20$ (or equivalent)

Reflection

1. Circle the problem you think will help you most on the End-of-Unit Assessment.

2. Use this space to ask a question or share something you're proud of.

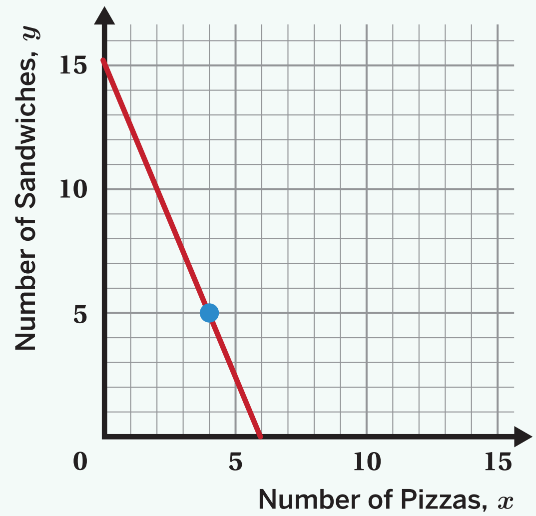
Lesson Practice 8.3.13

Science Mom Lesson 65

Lesson Summary

The four representations of a linear relationship — table, graph, equation, and verbal description — are all useful when solving real-world problems.

Let's say a coach has a $\$120$ budget to buy dinner for their team. Pizzas cost $\$20$ and sandwiches cost $\$8$. x represents the number of pizzas bought and y represents the number of sandwiches bought.



This situation can be modeled by the linear relationship $20x + 8y = 120$.

Here are two ways to show that 4 pizzas and 5 sandwiches is one solution to the equation:

- The values $x = 4$ and $y = 5$ make the equation true.

$$20(4) + 8(5) = 120$$
$$80 + 40 = 120$$
$$120 = 120$$

- The point $(4, 5)$ is on the graph of the linear relationship.

Things to Remember:

Name: ______ Date: ______ Period: ______

Problems 1–5: The owner of a new restaurant is ordering tables and chairs. She wants to have only tables for 2 and tables for 4. The total number of people that can be seated in the restaurant is 120.

1. Complete the table to show some possible combinations of 2-seat tables and 4-seat tables that will seat 120 customers.

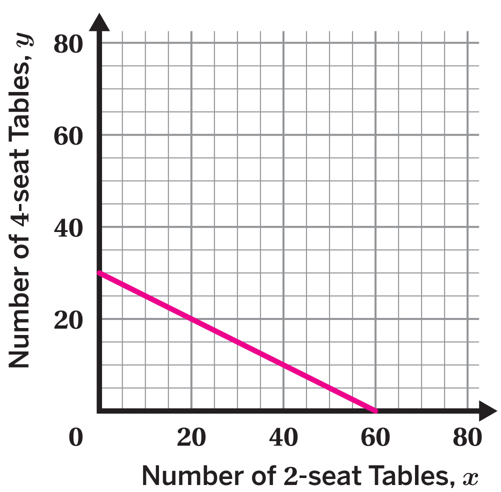
Responses vary.

Number of 2-Seat Tables	Number of 4-Seat Tables
0	**30**
10	**25**
40	**10**

2. Write an equation that represents the number of 2-seat tables, x, and the number of 4-seat tables, y, that the owner can order.

$2x + 4y = 120$ (or equivalent)

3. Graph all the possible combinations of 2-seat and 4-seat tables that will seat 120 customers.



4. What is the slope of the line? What does it tell you about the situation?

$-\frac{1}{2}$ (or equivalent). *Responses vary.* For every 4-seat table taken away, two 2-seat tables can be added.

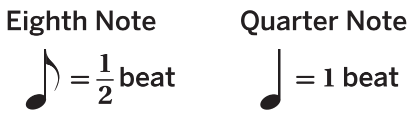
5. What are the x- and y-intercepts of the line? What do they represent in the situation?

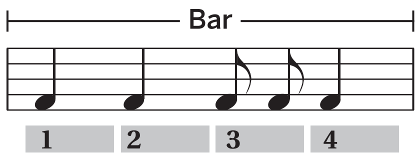
The x-intercept is $(60, 0)$ and the y-intercept is $(0, 30)$. *Responses vary.* The x-intercept means that 60 tables are needed if only 2-seat tables are used. The y-intercept means that 30 tables are needed if only 4-seat tables are used.

Lesson Practice
8.3.13

Name: ________ Date: ________ Period: ________

Problems 6–7: A bar is a section of music made up of notes. A quarter note is 1 beat long. An eighth note is $\frac{1}{2}$ a beat long. A music composer wants to create a bar that's 4 beats long.





6. What are two possible combinations of eighth notes ($\frac{1}{2}$ a beat long) and quarter notes (1 beat long) that they could use to make a bar that's 4 beats long? Use a graph if it helps with your thinking.

Responses vary.

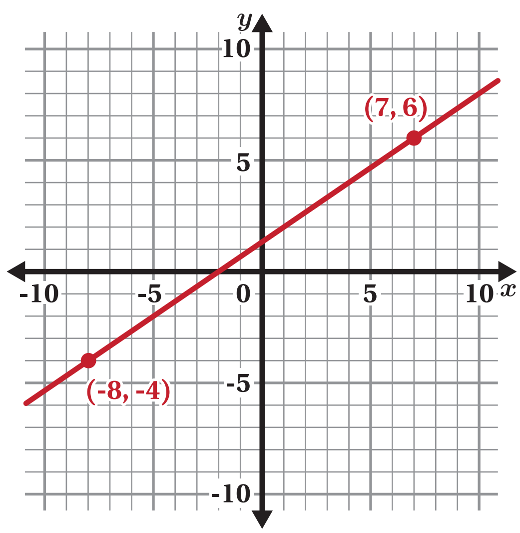
- **8 eighth notes and 0 quarter notes**
- **4 eighth notes and 2 quarter notes**

7. Write an equation to represent the number of eighth notes, x, and number of quarter notes, y, in a bar that has a total of 4 beats.

$0.5x + 1y = 4$ (or equivalent)

Spiral Review

Problems 8–10: Here is the graph of a linear relationship.



8. What is the y-intercept of the line?

A. $\frac{4}{3}$ B. $\frac{3}{4}$

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

9. What is the slope of the line?

A. $\frac{4}{3}$ B. $\frac{3}{4}$

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

10. Write an equation that represents the line.

$y = \frac{2}{3}x + \frac{4}{3}$ (or equivalent)

Reflection

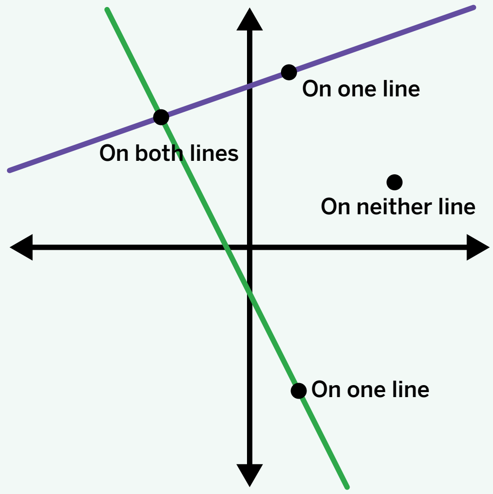
1. Put a star next to your favorite problem.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

Linear relationships can represent many situations. Lines graphed on the same coordinate plane can simultaneously represent multiple conditions or relationships involving the same variables.

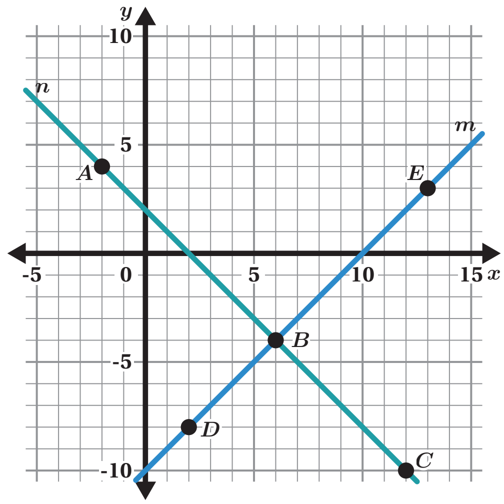
- The coordinates of a point that is on both lines make both relationships true.
- The coordinates of a point on only one line make only one relationship true.
- The coordinates of a point on neither line make neither relationship true.



Things to Remember:

Name: ________ Date: ________ Period: ________

Problems 1–5: Here is a coordinate plane.



1. Determine which line represents this condition: The coordinates of each point have a sum of 2.

Line n

2. Determine which line represents this condition: The y-coordinate of each point is 10 less than the x-coordinate.

Line m

3. Select *all* the points whose coordinates have a sum of 2.

- ☑ **A.** Point A
- ☑ **B.** Point B
- ☑ **C.** Point C
- ☐ **D.** Point D
- ☐ **E.** Point E

4. Select *all* the points whose y-coordinate is 10 less than the x-coordinate.

- ☐ **A.** Point A
- ☑ **B.** Point B
- ☐ **C.** Point C
- ☑ **D.** Point D
- ☑ **E.** Point E

5. Select *all* the points whose coordinates have a sum of 2 and the y-coordinate is 10 less than the x-coordinate.

- ☐ **A.** Point A
- ☑ **B.** Point B
- ☐ **C.** Point C
- ☐ **D.** Point D
- ☐ **E.** Point E

Name: ______________ Date: ______ Period: ______

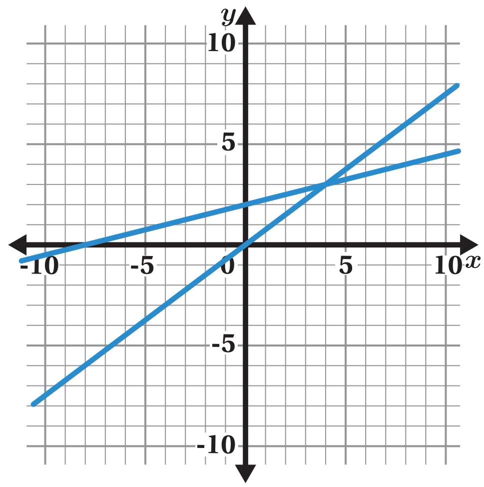
6. These two lines represent a system of equations. What is the y-coordinate of the point that makes both equations true?

A. 0

B. $\frac{1}{5}$

C. 3

D. 4



Spiral Review

Problems 7–9: Consider the equation $4x - 4 = 4x +$ ______. What value or expression could you write in the blank so that the equation is true for:

7. No values of x?

Responses vary. 7

8. All values of x?

-4

9. One value of x?

Responses vary. $2x$

Reflection

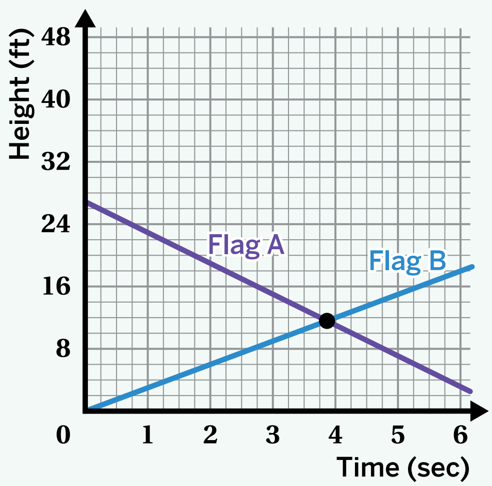
1. Circle the problem you enjoyed doing the most.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

If there are two equations that share the same variables, you can find the solution that makes both equations true by locating the **point of intersection**, where the two lines meet on a graph.

For example, consider this graph.



Although you can't see the exact values of the point of intersection, you can tell that the flags are the same height, at about 11.5 feet, just before 4 seconds.

Things to Remember:

Lesson Practice
8.4.10

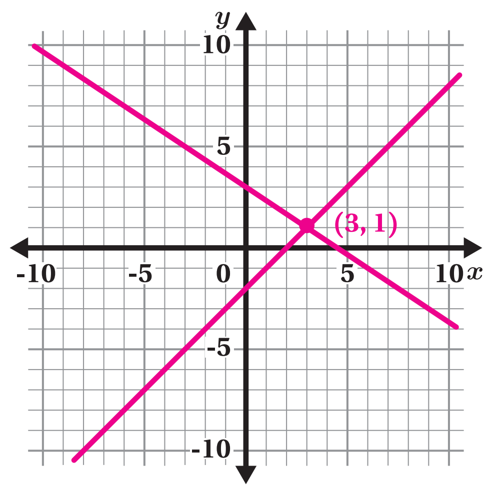
Name: ______ Date: ______ Period: ______

1. Jayden has $11 and begins saving $5 each week to buy a new phone. At the same time that Jayden begins saving, Aditi has $60 and begins spending $2 per week on supplies for her art class. Is there a week when they will have the same amount of money? Explain your thinking.

Yes. *Explanations vary*. They will both have $46 after 7 weeks.

2. Draw a graph to determine x- and y-values that make both of the equations $y = -\frac{2}{3}x + 3$ and $y = x - 2$ true.

(3, 1)



Problems 3–4: Prisha and Mia agree to go to the movies after they have earned the same amount of money for the same number of hours worked.

Mia earns $7 per hour mowing her neighbors' lawns. She also earned $14 one time for hauling away bags of recyclables.

Prisha babysits her neighbor's children. The table shows the amount of money, m, she earns in h hours.

h	m
1	$8.40
2	$16.80
3	$25.20

3. How many hours do they each have to work before they go to the movies?

10 hours

4. How much will each of them have earned?

$84

Name: .... Date: .... Period: ....

5. The point where the graphs of two equations intersect has a y-coordinate of 2. One equation is $y = -3x + 5$.

Determine the other equation if its graph has a slope of 1.

$y = x + 1$ (or equivalent)

6. The graph of the equations $y = \square - x$ and $y = \square\, x - 3$ intersect at the point $(2, 1)$. Determine the missing values in the equations. Show or explain your thinking.

$y = 3 - x$ and $y = 2x - 3$. *Explanations vary.*

I substituted the coordinates of the point $(2, 1)$ into the first equation to determine the missing value, 3.

I substituted the coordinates of the point $(2, 1)$ into the second equation to determine the missing value, 2.

Spiral Review

Problems 7–9: Determine whether each equation is true for *one value*, *all values*, or *no values* of x.

7. $10 + 3x = -4.2x + 9$

One value

8. $5(4x + 1) - x = 19x + 5$

All values

9. $-2(3x - 7) = -6x + 12$

No values

Problems 10–11: Determine whether $x = -1$ is a solution to each equation.

10. $1.5x + 2 = 8.5x - 4$

No

11. $\frac{1}{2} + 2x = \frac{1}{2}x - 1$

Yes

Reflection

1. Put a heart next to the problem you feel most confident about.

2. Use this space to ask a question or share something you're proud of.

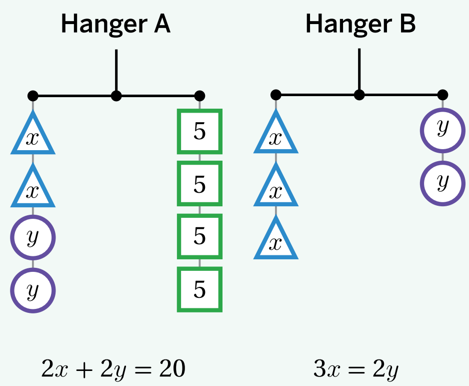
Lesson Summary

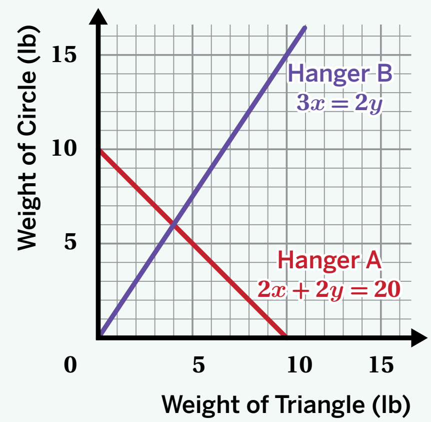
A **system of equations** is a set of two or more equations with the same variables that are meant to be solved together. It is sometimes shown with a single bracket around the equations.

A **solution to a system** of equations is a set of values that makes all equations in that system true.

For example, here is a system of equations:

$$\begin{cases} 2x + 2y = 20 \\ 3x = 2y \end{cases}$$



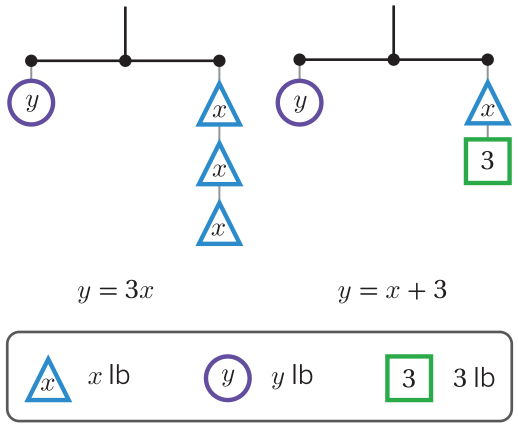


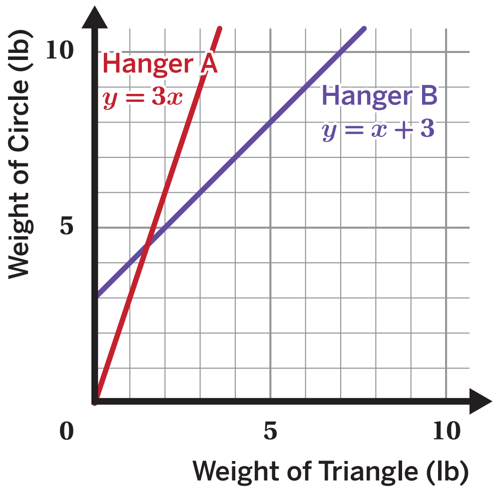
The ordered pair $(4, 6)$ is the point of intersection, which means that it will make both equations true. Both hangers will balance when the triangles weigh 4 pounds and the circles weigh 6 pounds.

Things to Remember:

Name: .... Date: .... Period: ....

Problems 1–2: The hangers and the graph represent the same system of equations.

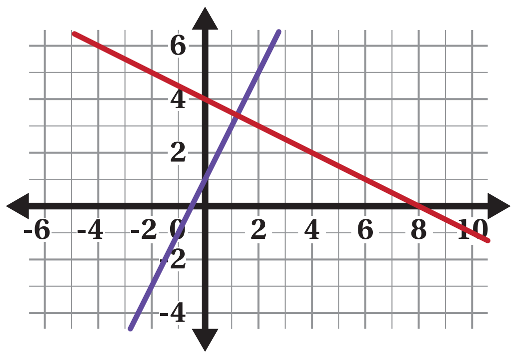




1. Determine the solution to the system of equations.
(1.5, 4.5)

2. What does the solution tell you about the weight of a triangle and the weight of a circle that will balance the hanger?
***Responses vary.* The triangle weighs 1.5 pounds and the circle weighs 4.5 pounds.**

Problems 3–4: Here is a graph.



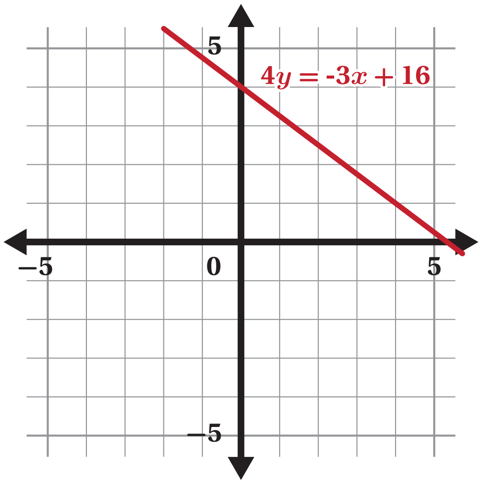
3. Write an equation that can represent each line.
$y = -\frac{1}{2}x + 4$ (or equivalent) and $y = 2x + 1$ (or equivalent)

4. Estimate the solution to the system.
***Responses vary*. (1.2, 3.4)**

Lesson Practice
8.4.11

Name: ________ Date: ________ Period: ________

Problems 5–7: Here is a graph that represents one equation in a system of equations.



5. Write a second equation for the system so that it has infinitely many solutions.
$y = -\frac{3}{4}x + 4$ (or equivalent)

6. Write a second equation whose graph goes through $(0, 1)$ so that the system has no solution.
$y = -\frac{3}{4}x + 1$ (or equivalent)

7. Write a second equation whose graph goes through $(0, 2)$ so that the system has one solution: $(4, 1)$.
$y = -\frac{1}{4}x + 2$ (or equivalent)

Spiral Review

8. Select *all* the equations that have no solution.

- ☐ **A.** $2 + 4(4x + 5) = 8x + 2x - 11$
- ☑ **B.** $-x + 3x - 7 = 2(x - 7)$
- ☑ **C.** $7 - 5x(-3) = 5(3x - 2)$
- ☐ **D.** $6x + 3(2x - 1) = 5x - 4 + 7x + 1$

Problems 9–10: Solve each equation. Show or explain your thinking.

9. $\frac{15(x-3)}{5} = 3(2x - 3)$

$x = 0$. *Explanations vary.*

$\frac{15(x-3)}{5} = 3(2x - 3)$

$3(x - 3) = 3(2x - 3)$

$x - 3 = 2x - 3$

$-3 = x - 3$

$x = 0$

10. $0.4(x + 7) = 0.2(x + 40) - 5.2 + 0.2x$

Infinitely many solutions. *Explanations vary.*

$0.4(x + 7) = 0.2(x + 40) - 5.2 + 0.2x$

$0.4x + 2.8 = 0.2x + 8 - 5.2 + 0.2x$

$0.4x + 2.8 = 0.4x + 2.8$

There are infinitely many solutions because the coefficients and constants are the same on each side of the equal sign.

Reflection

1. Put a star next to a problem you're still wondering about.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

For a point to be a solution to a system of equations, the x- and y-coordinates must make both of the equations true. This ordered pair is the *point of intersection* when the system is graphed.

For example, here is a system of equations:

$$\begin{cases} y = 4x - 5 \\ y = \text{-}2x + 7 \end{cases}$$

To determine the solution to the system, you can write a single equation by taking the two expressions that are equal to y and setting them equal to each other.

$4x - 5 = \text{-}2x + 7$
$6x - 5 = 7$
$6x = 12$
$x = 2$

You can then substitute the solution for x into either of the original equations to determine the value of y.

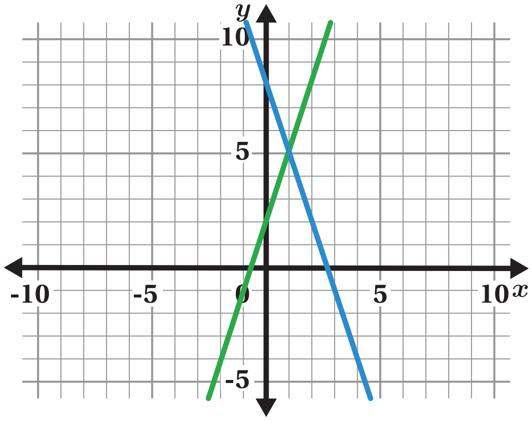
$y = 4x - 5$
$y = 4(2) - 5$
$y = 8 - 5$
$y = 3$

The solution to this system of equations is the point $(2, 3)$.

Things to Remember:

Name: .... Date: .... Period: ....

Problems 1–2: Here is the graph of this system of equations: $\begin{cases} y = \text{-}3x + 8 \\ y = 3x + 2 \end{cases}$



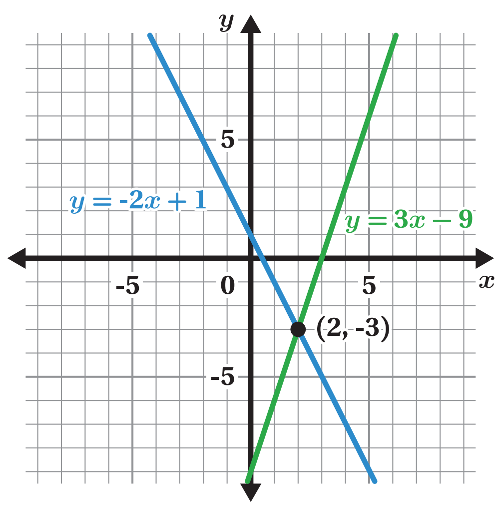
1. How can you determine the solution to this system of equations by looking at the graph?

Responses vary. **The solution to the system is the point where both lines intersect.**

2. What is the solution to the system of equations?

$(1, 5)$

Problems 3–5: Use the lines on the graph to decide whether each statement is true or false.



3. The solution to the equation $\text{-}2x + 1 = 3x - 9$ is $x = 2$.

True

4. The point $(2, \text{-}3)$ is a solution to this system of equations: $\begin{cases} y = \text{-}2x + 1 \\ x = 2 \end{cases}$

True

5. The point $(0, 1)$ is a solution to the equation $y = \text{-}2x + 1$.

True

Name: .... Date: .... Period: ....

Problems 6–7: Solve each system of equations. Show or explain your thinking.

6. $\begin{cases} y = 4x + 8 \\ y = 2x + 16 \end{cases}$

(4, 24). ***Explanations vary.***

$4x + 8 = 2x + 16$
$4x - 2x = 16 - 8$
$2x = 8$
$x = 4$

Substitute the x-value into the first equation and solve for y:
$y = 4(4) + 8$
$y = 24$

7. $\begin{cases} y = -4x + 2 \\ y = 3x - 5 \end{cases}$

(1, -2). ***Explanations vary.***

$-4x + 2 = 3x - 5$
$2 + 5 = 3x + 4x$
$7 = 7x$
$1 = x$

Substitute the x-value into the second equation and solve for y:
$y = 3(1) - 5$
$y = -2$

8. Here is how Haru tried to solve this system of equations. Did Haru solve the system of equations correctly? Explain your thinking.

Haru

$\begin{cases} y = -3x + 1 \\ x = 4 \end{cases}$

$-3x + 1 = 4$
$-3x = 3$
$x = -1$

$y = -3(-1) + 1$
$y = 4$

Solution: (-1, 4)

Haru is incorrect. ***Explanations vary.*** **The x-value is provided in the second equation, $x = 4$. Haru should have used this to determine the y-value by writing and solving the equation $y = -3(4) + 1$, which would result in $y = -11$. The x-value is 4 and the y-value is -11, so the solution should be (4, -11).**

Spiral Review

9. The temperature in degrees Fahrenheit, F, is related to the temperature in degrees Celsius, C, which is represented by the equation $F = \frac{9}{5}C + 32$. There is one temperature where the degrees Fahrenheit and degrees Celsius are the same, so that $C = F$. What is that temperature? Show or explain your thinking.

-40 degrees. ***Explanations vary.***

$C = \frac{9}{5}C + 32$
$-\frac{4}{5}C = 32$
$C = -40$

At -40 °C, the temperature is also -40 °F.

Reflection

1. Circle a problem you're still curious about.

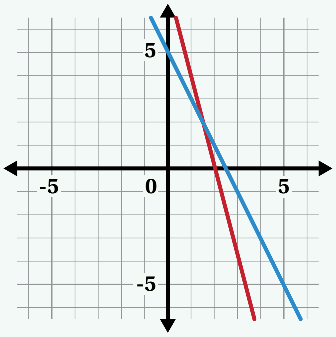
2. Use this space to ask a question or share something you're proud of.

Science Mom Lesson 70

Lesson Summary

Systems of two linear equations can have one solution, no solution, or infinitely many solutions. You can determine the number of solutions to a system of equations by graphing, comparing the slopes and y-intercepts, or solving the system algebraically.

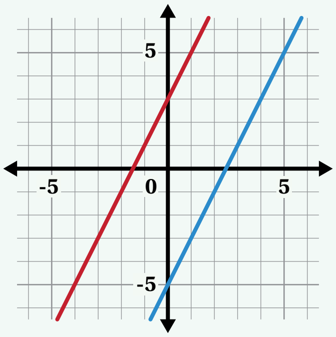
One solution:



$$\begin{cases} y = -4x + 8 \\ y = -2x + 5 \end{cases}$$

- Different slopes

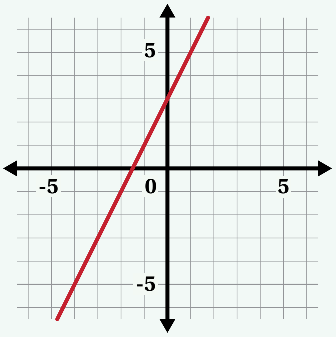
No solution:



$$\begin{cases} y = 2x + 3 \\ y = 2x - 5 \end{cases}$$

- Same slopes
- Different y-intercepts

Infinitely many solutions:



$$\begin{cases} y = 2x + 3 \\ y = 2x + 3 \end{cases}$$

- Same slopes
- Same y-intercepts

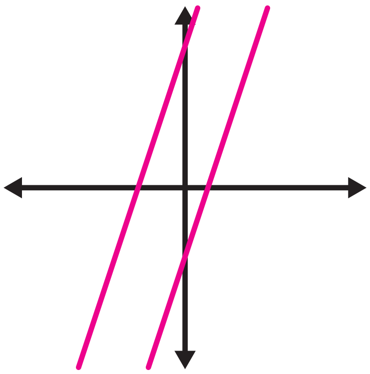
Things to Remember:

Lesson Practice
8.4.13

Name: .... Date: .... Period: ....

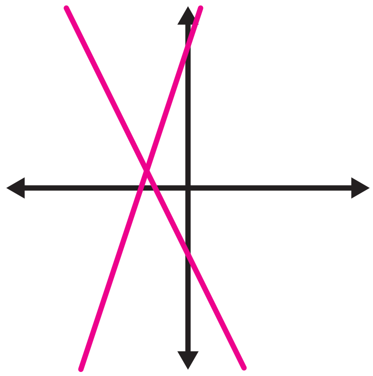
Problems 1–3: Sketch two lines that match each description. Then describe the number of solutions for each system of equations. ***Responses vary.***

1. Two lines with the same slope and different y-intercepts.



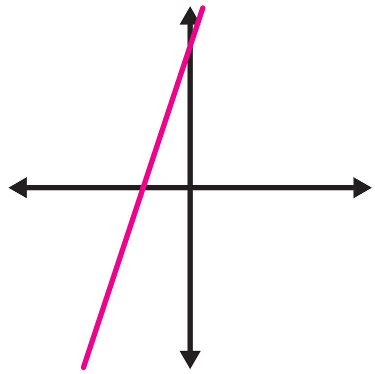
No solution

2. Two lines with different slopes.



One solution

3. Two lines with the same slope and same y-intercept.



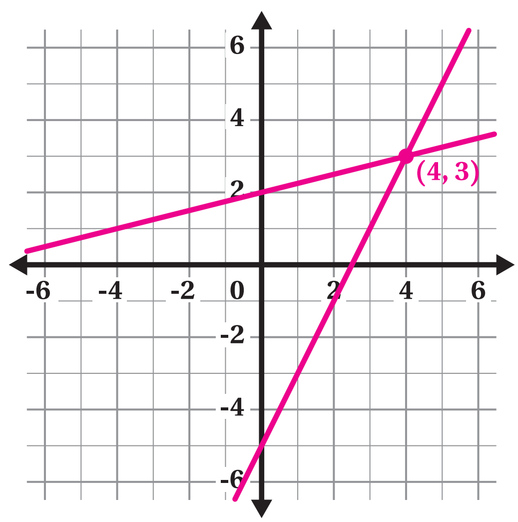
Infinitely many solutions

4. How many solutions does this system have?

$y = \frac{1}{4}x + 2$
$y = 2x - 5$

Show or explain your thinking.

One solution. *Explanations vary.* $(4, 3)$ is the point of intersection.



Problems 5–6: Consider this system of equations: $\begin{cases} x - 6y = 4 \\ 3x - 18y = 4 \end{cases}$

5. Change one number to make a new system with one solution.

Responses vary. $\begin{cases} \mathbf{2x - 6y = 4} \\ \mathbf{3x - 18y = 4} \end{cases}$

6. Change one number to make a new system with an infinite number of solutions.

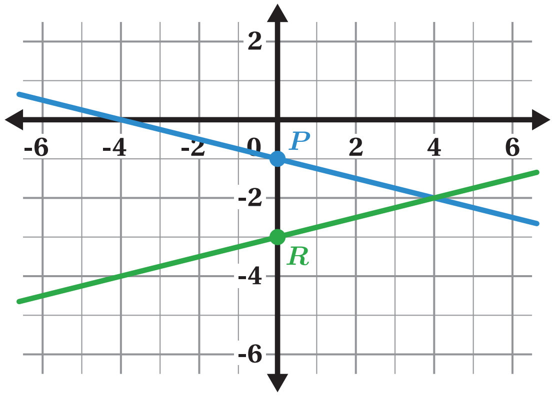
Responses vary. $\begin{cases} \mathbf{x - 6y = 4} \\ \mathbf{3x - 18y = 12} \end{cases}$

Name: .... Date: .... Period: ....

Problems 7–8: Ali and Sid graphed this system:

$$\begin{cases} y = -\frac{1}{4}x - 1 \\ y = \frac{1}{4}x - 3 \end{cases}$$

They marked its solutions with points P and R.



7. Which statement describes Ali and Sid's solutions?

A. Their solutions are correct.

B. They marked the y-intercepts instead of the intersection point of the two lines.

C. They marked the y-intercepts instead of the x-intercepts.

D. They marked only the y-intercepts instead of the x- and y-intercepts.

8. What is the solution to the system of equations?

(4, -2)

Spiral Review

Problems 9–10: Solve each equation.

9. $\frac{3y-6}{9} = \frac{4-2y}{-3}$

$y = 2$. Work varies.

$\frac{3y-6}{9} \cdot 9 = \frac{4-2y}{-3} \cdot 9$

$3y - 6 = -3(4 - 2y)$

$3y - 6 = -12 + 6y$

$6 = 3y$

$2 = y$

10. $0.3(x - 10) - 1.8 = 2.7x$

$x = -2$. Work varies.

$0.3x - 3 - 1.8 = 2.7x$

$3x - 30 - 18 = 27x$

$3x - 48 = 27x$

$-48 = 24x$

$-2 = x$

Reflection

1. Put a question mark next to a response you'd like to compare with a classmate's.
2. Use this space to ask a question or share something you're proud of.

Lesson Practice 8.4.14

Science Mom Lesson 71

Lesson Summary

An ordered pair (x, y) is a solution to a system of equations if it makes both equations true. If you know the value of one variable in one of the equations, you can substitute it into the other equation to solve for the second variable.

Here is a system of equations:

$$\begin{cases} y = 5x \\ 2x - y = 9 \end{cases}$$

Since $y = 5x$, you can substitute $5x$ for y in $2x - y = 9$, and then solve for x.

$$\begin{aligned} 2x - (5x) &= 9 \\ -3x &= 9 \\ x &= -3 \end{aligned}$$

You can then substitute the solution for x into either of the original equations to determine the value of y.

$$\begin{aligned} y &= 5x \\ y &= 5(-3) \\ y &= -15 \end{aligned}$$

The ordered pair (-3, -15) is the solution to the system of equations.

Things to Remember:

Lesson Practice
8.4.14

Name: ________ Date: ________ Period: ________

Problems 1–2: Solve each system of equations.

1. $\begin{cases} y = 6x \\ 4x + y = 7 \end{cases}$

$\left(\frac{7}{10}, \frac{21}{5}\right)$ (or equivalent)

2. $\begin{cases} y = 3x \\ x = \text{-}2y + 70 \end{cases}$

$(10, 30)$

Problems 3–6: Solve each system of equations. Show or explain your thinking. ***Explanations vary.***

3. $\begin{cases} y = 3x - 2 \\ y = \text{-}2x + 8 \end{cases}$

$(2, 4)$

$$\begin{aligned} 3x - 2 &= \text{-}2x + 8 \\ 3x + 2x &= 8 + 2 \\ 5x &= 10 \\ x &= 2 \end{aligned}$$

Substitute the x-value into the first equation and solve for y:

$y = 3(2) - 2$
$y = 4$

4. $\begin{cases} y = \text{-}3x - 5 \\ y = 4x + 30 \end{cases}$

$(\text{-}5, 10)$

$$\begin{aligned} \text{-}3x - 5 &= 4x + 30 \\ \text{-}3x - 4x &= 30 + 5 \\ \text{-}7x &= 35 \\ x &= \text{-}5 \end{aligned}$$

Substitute the x-value into the second equation and solve for y:

$y = 4(\text{-}5) + 30$
$y = 10$

5. $\begin{cases} y = 2x - 9 \\ y = 4 + 2x \end{cases}$

No solution

$$\begin{aligned} 2x - 9 &= 4 + 2x \\ 2x - 2x &= 4 + 9 \\ 0 &= 13 \end{aligned}$$

6. $\begin{cases} x = 2 \\ y = 3x - 1 \end{cases}$

$(2, 5)$

$y = 3(2) - 1$
$y = 5$

The x-value is provided in the first equation: $x = 2$.

Lesson Practice
8.4.14

Name: .... Date: .... Period: ....

7. Here is a system of equations: $\begin{cases} x = 14 \\ 2x - 5y = 13 \end{cases}$

In the solution (x, y), what is the value of y?

$y = 3$

8. Here is an incomplete system of equations. Create a second equation so that the system has no solution.

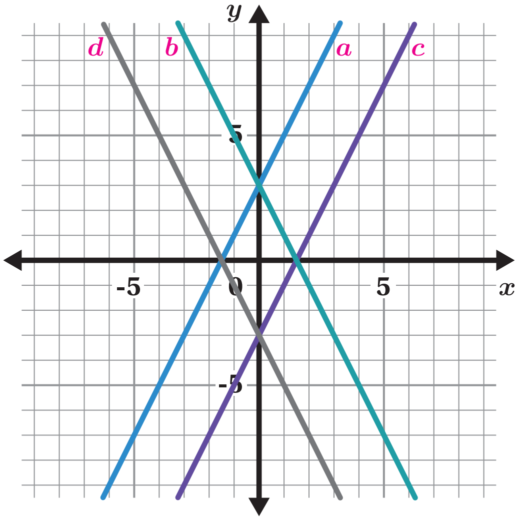
$$\begin{cases} y = \frac{3}{4}x - 4 \\ \boxed{\ ?\ } \end{cases}$$

***Responses vary.* Any equation with a slope of $\frac{3}{4}$ and a y-intercept not equal to -4.**

Spiral Review

9. Label each line on the graph with its corresponding equation.

- Line a: $y = 2x + 3$
- Line b: $y = -2x + 3$
- Line c: $y = 2x - 3$
- Line d: $y = -2x - 3$



Reflection

1. Put a heart next to the problem you're most proud of.

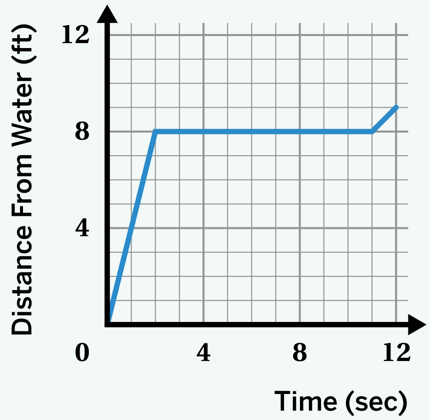
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

You can use a graph to represent a situation. Analyzing a point on a graph or pieces of a graph can help you interpret part of the situation.

For example, this graph represents a turtle's journey across sand. A turtle walks for 2 seconds until it is 8 feet from the water. It stops for 9 seconds and then continues walking away from the water.

The point $(6, 8)$ represents the turtle's distance of 8 feet from the water after 6 seconds.

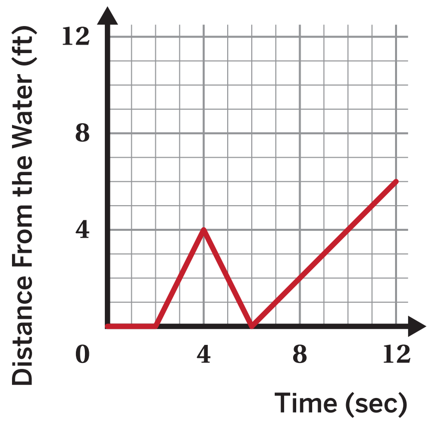


Things to Remember:

Lesson Practice
8.5.01

Name: .... Date: .... Period: ....

Problems 1–3: This graph represents a turtle walking across the sand.

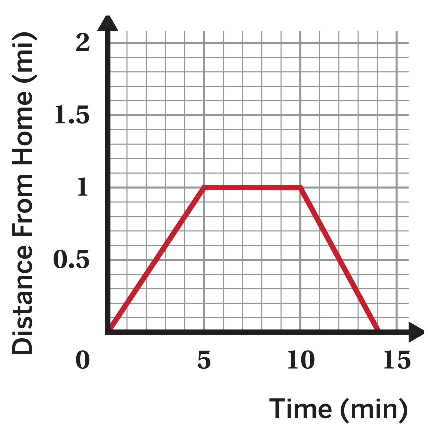


1. What story does the graph tell about the turtle's journey?

2. How far was the turtle from the water after 8 seconds?

3. After how many seconds is the turtle's distance 2 feet from the water?

Problems 4–6: This graph shows Maki's distance from home as time passes. Determine whether each statement is true or false.



4. Maki was 1 mile from home at 5 minutes.

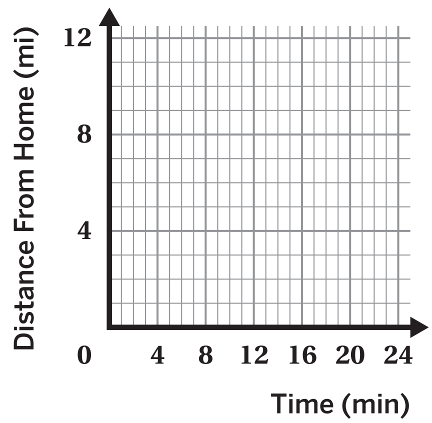
5. Maki was 10 miles from home at 1 minute.

6. Maki's distance from home didn't change from 5 to 10 minutes.

Name: .... Date: .... Period: ....

7. Markayla's family went on vacation. First, they drove away from their house. After several minutes, they stopped to get gas. When Markayla's family left the gas station, they realized they forgot something and drove back to their house. After a few minutes, they drove away from their house again.

   Sketch a graph that could represent Markayla's family's distance from home vs. time.



Spiral Review

8. Solve this system of linear equations. Show or explain your thinking.

$$\begin{cases} y = x - 4 \\ y = 6x - 10 \end{cases}$$

Reflection

1. Circle the problem you're most interested in knowing more about.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

A function is a rule that assigns exactly one output for each possible input. Another way to say this is that the output is a function of the input.

Function

Input	Output
15	7
10	7
20	8
5	9

In this function table, each input appears with exactly one output. Even if an input is repeated in the table, the input should give the same output as previously seen within the table.

Not a function

Input	Output
10	6
10	7
20	8
5	9

Notice in this table, the input of 10 appears twice with two different outputs.

Things to Remember:

Lesson Practice
8.5.02

Name: ______ Date: ______ Period: ______

Problems 1–2: Complete each table based on its rule.

1. Rule: Divide by 4 and then add 2.

Input	Output
0	
2	
4	
6	
8	

2. Rule: If odd, write 1. If even, write 0.

Input	Output
1	
2	
3	
7	
12	

Problems 3–4: Determine whether each table could represent a function. Explain your thinking.

3.

Input	Output
4	-2
1	-1
0	0
1	1
4	2

4.

Input	Output
-2	4
-1	1
0	0
1	1
2	4

5. Which of the following tables could represent a function?

A.

Input	Output
1	0
2	5
3	2.5
4	5
5	8

B.

Input	Output
0	1
5	2
2.5	3
5	4
8	5

C.

Input	Output
3	-8
3	-2
3	-1
3	6
3	12

D.

Input	Output
-1	0
-2	8
2	2
-1	-1
-2	9

Name: .... Date: .... Period: ....

6. Complete the table so that it could represent a function.

Input	Output
-2	0
0	
	10
4	

7. Many people consider mathematician Ada Lovelace to be the world's first computer programmer. Lovelace used functions to write programs for an early computing machine. Certain inputs (such as pressing a certain key on a keyboard) caused certain outputs.

Here's a table that shows how pressing different keys causes different movements in a video game character. Could this table represent a function? Explain your thinking.

Key Pressed	Movement
Right arrow	Walk right
Left arrow	Walk left
Up arrow	Walk right
Down arrow	Jump

Spiral Review

Problems 8–10: Determine whether each ordered pair is a solution for the equation $2x + 4y = 16$.

8. $(1, 3)$

9. $(6, 1)$

10. $(0, 4)$

Reflection

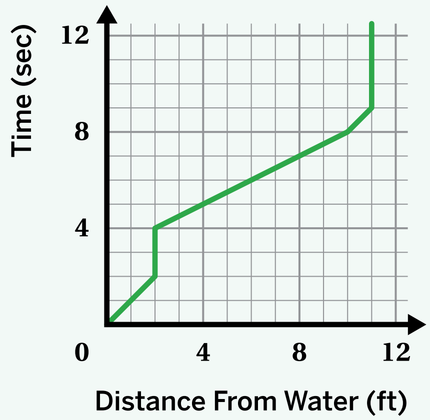
1. Put a star next to the problem you understood best.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

A graph represents a function when each x-value, or input, only has one corresponding y-value, or output. If a graph has multiple y-values for the same x-value, it does not represent a function.

Here are two graphs of the same turtle's journey.

This graph represents a function because for every second, x, the turtle is at only one corresponding distance, y.



This graph does not represent a function because at both 2 feet and 11 feet, the turtle has multiple corresponding times.

Things to Remember:

Lesson Practice
8.5.03

Name: ________________ Date: ________ Period: ________

Problems 1–3: A group of students are timed while sprinting 100 meters.

Time (seconds)	Speed (meters per second)
13.8	7.246
15.9	6.289
16.3	6.135
17.1	5.848
18.2	5.495

1. Is speed a function of time? Explain your thinking.

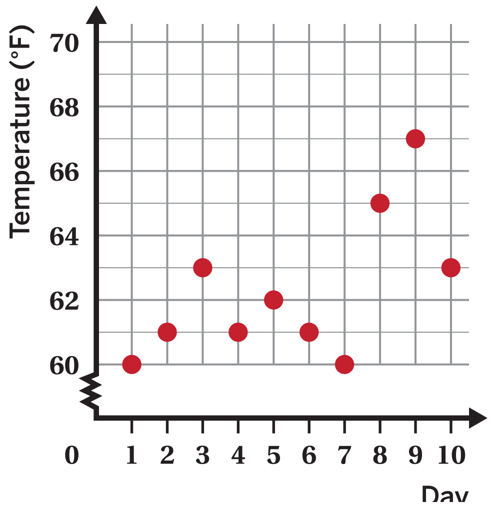
2. Is distance a function of time? Explain your thinking.

Time (seconds)	Distance (meters)
13.8	100
15.9	100
16.3	100
17.1	100
18.2	100

3. Is time a function of distance? Explain your thinking.

Distance (meters)	Time (seconds)
100	13.8
100	15.9
100	16.3
100	17.1
100	18.2

4. This graph represents a city's high temperatures over a 10-day period. Determine whether this statement is true or false: *The high temperature is a function of the day*. Explain your thinking.



Lesson Practice
8.5.03

Name: ____________ Date: ________ Period: ________

Problems 5–6: Determine whether each table could represent a function. Explain your thinking.

5.

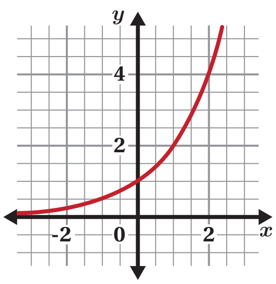
Input	Output
1	0
2	0
3	0
4	0
5	0

6.

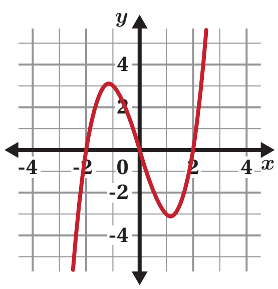
Input	Output
0	1
0	2
0	3
0	4
0	5

7. Which graph does *not* represent y as a function of x?

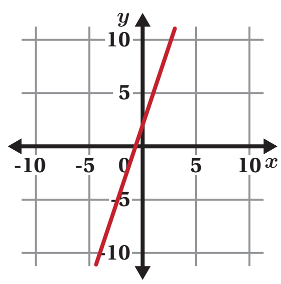
A.



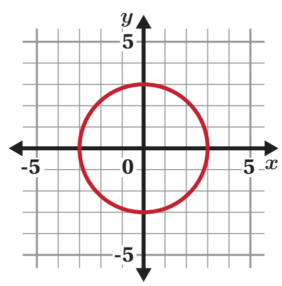
B.



C.



D.



Spiral Review

Problems 8–10: Determine whether each system of equations has one solution, no solution, or infinitely many solutions.

8. $\begin{cases} y = x + 4 \\ y = x + 4 \end{cases}$

9. $\begin{cases} y = -\frac{4}{5}x + 7 \\ y = \frac{4}{5}x - 2 \end{cases}$

10. $\begin{cases} y = 2x + \frac{1}{5} \\ y = 2x + 42 \end{cases}$

Reflection

1. Put a question mark next to a problem you're feeling unsure of.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

In a situation represented by a function, the input is often called the **independent variable** and the output is called the **dependent variable**. The independent variable and dependent variable can switch depending on the problem you are trying to solve.

The independent variable is an input. The dependent variable, or output, depends on the input.

For example, in this situation, m represents the total number of miles walked and d represents the number of days of walking for someone who walks 2 miles a day.

Question	Independent and Dependent Variable	Equation	Explanation
How many miles have I walked, m, after d days?	Independent: Days, d Dependent: Miles, m	$m = 2d$	The number of miles walked depends on the number of days of walking.
How many days, d, will it take me to walk m miles?	Independent: Miles, m Dependent: Days, d	$d = \frac{m}{2}$	The number of days depends on the number of miles.

Things to Remember:

Lesson Practice
8.5.04

Name: .... Date: .... Period: ....

Problems 1–2: Write an equation that expresses the output as a function of the input. Then determine the independent and dependent variables.

1. The perimeter, p, of a square with side length s:

Equation: ....

Independent variable: ....

Dependent variable: ....

2. The total cost, c, after a sales tax of 7% is applied to the cost of a purchase, p.

Equation: ....

Independent variable: ....

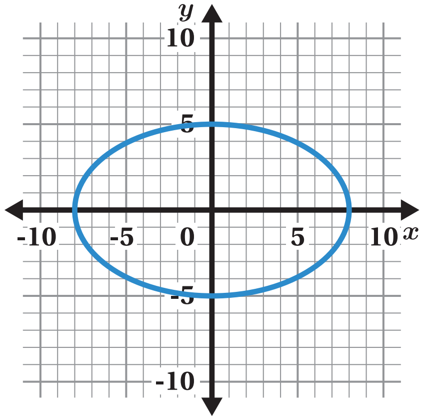
Dependent variable: ....

3. Which of these could represent a function? Select *all* that apply.

☐ **A.** $y = \frac{2}{3}x - 5$

☐ **B.** $x = 4$

☐ **C.**



☐ **D.**

x	y
-1	7
-3	7
-2	7
-1	7

Name: .... Date: .... Period: ....

Problems 4–7: Rafael earns $\$10.50$ per hour helping his neighbor with chores.

4. Is the amount he earns a function of the number of hours he works? Explain your thinking.

5. Is the number of hours he works a function of the amount he earns? Explain your thinking.

6. Write an equation that describes the situation. Use x to represent the independent variable and y to represent the dependent variable.

7. How much will Rafael earn if he works 3 hours each weekday next week? Show or explain your thinking.

Spiral Review

Problems 8–9: Solve each system of equations. Show your thinking.

8. $\begin{cases} y = 7x + 10 \\ y = \text{-}4x - 23 \end{cases}$

9. $\begin{cases} y = 3x - 6 \\ y = \text{-}2x - 1 \end{cases}$

Reflection

1. Put a heart next to the problem you feel most confident about.

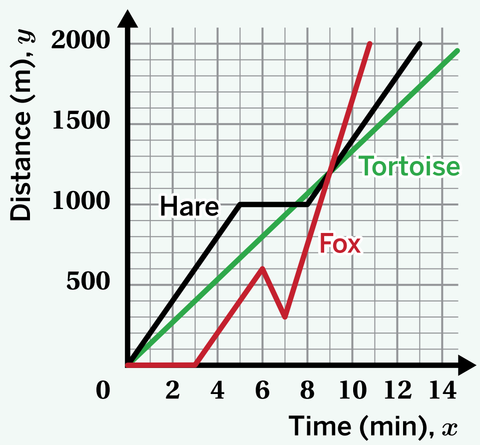
2. Use this space to ask a question or share something you're proud of.

Science Mom Lesson 76

Lesson Summary

A graph can be helpful when comparing multiple functions in a situation, such as by comparing the initial value, slope, and points of intersection.

For example, this graph represents a race between a hare, a tortoise, and a fox. From 0 to 5 minutes, the hare is moving at a steady pace of 200 meters per minute and is in first place. At 9 minutes, the race is tied. The fox does not begin the race until three minutes have passed, but it speeds up at 7 minutes to a pace of 450 meters per minute. The fox wins the race at about 11 minutes.



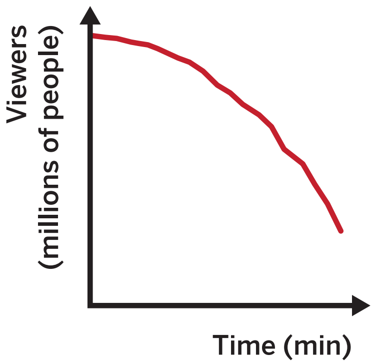
Things to Remember:

Lesson Practice
8.5.05

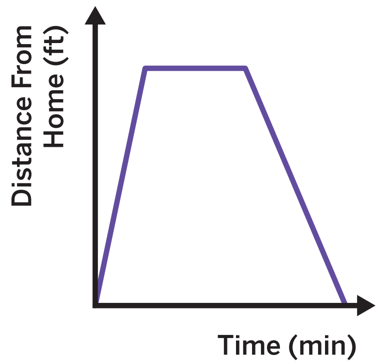
Name: .... Date: .... Period: ....

Problems 1–2: For each graph, write a story that the graph tells about each situation.

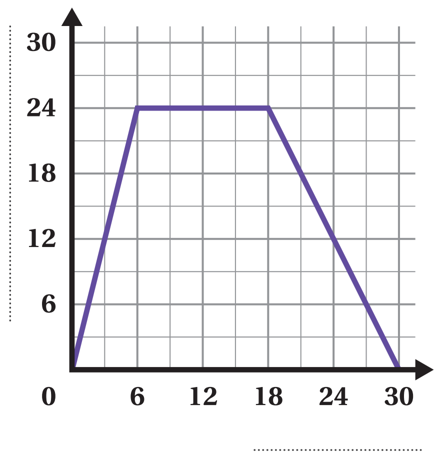
1. The relationship between number of viewers of a short video and time.



2. The distance of a cat from its home as a function of time.



Problems 3–8: Charlie filled up the tub and gave the family dog a bath. Then Charlie let the water in the tub drain. The graph shows the amount of water in the tub, in gallons, as a function of time, in minutes.



3. Label the axes.

4. When did Charlie turn off the water faucet?

5. How much water was in the tub when Charlie bathed the dog?

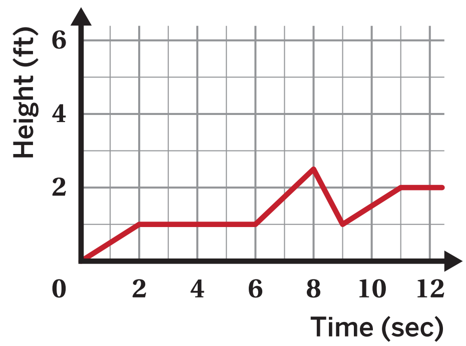
6. How long did it take the tub to drain completely?

7. At what rate did the faucet fill the tub?

8. At what rate did the water drain from the tub?

Name: .... Date: .... Period: ....

9. This graph shows the height, in feet, that a butterfly is flying above the ground over time. At what interval is the butterfly's rate of change 0 feet per second? Select *all* that apply.



- ☐ **A.** Between 0 and 2 seconds
- ☐ **B.** Between 2 and 6 seconds
- ☐ **C.** Between 6 and 8 seconds
- ☐ **D.** Between 9 and 11 seconds
- ☐ **E.** Between 11 and 12 seconds

Spiral Review

10. A car is traveling at a speed of either 55 miles per hour or 35 miles per hour, depending on the speed limits, until it reaches its destination 200 miles away. Let x represent the amount of time, in hours, that the car is traveling at 55 miles per hour. Let y represent the amount of time, in hours, that the car is traveling at 35 miles per hour. The equation $55x + 35y = 200$ represents this situation.

If the car spends 2.5 hours traveling at 35 miles per hour on the trip, how long does it spend traveling at 55 miles per hour? Show or explain your thinking.

Reflection

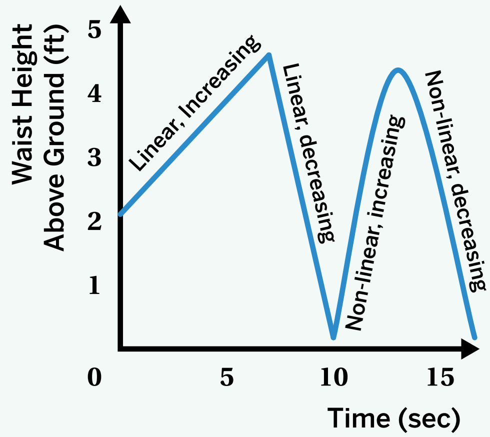
1. Circle a problem you want to talk to a classmate about.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

We can use graphs to represent a story. When drawing a graph, it can be helpful to identify the variables involved so that you can label the axes. Depending on the independent and dependent variables, different graphs can represent distinct details of the same story. It may also be helpful to identify key points in the story according to these chosen variables to help you sketch these features.

The function is:

- **Increasing** when part of the graph is going up from left to right.
- **Decreasing** when part of the graph is going down from left to right.
- *Linear* when part of the graph is a straight line. (Note: A vertical line is not a function.)
- **Non-linear** when part of the graph is not a straight line.



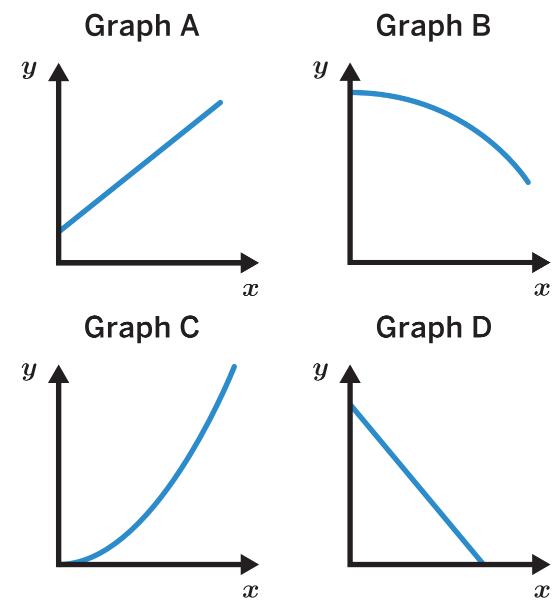
Things to Remember:

Lesson Practice
8.5.06

Name: .... Date: .... Period: ....

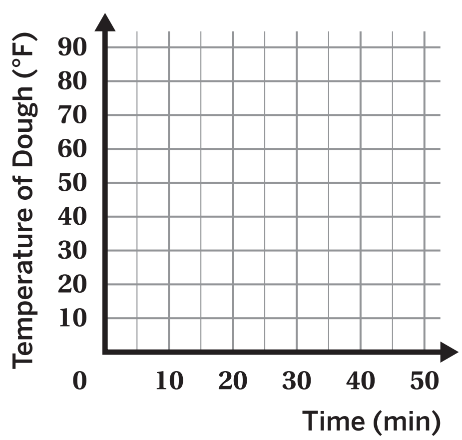
1. Determine which graph best represents the description.

Description	Graph
a Linear and decreasing	....
b Non-linear and increasing	....
c Linear and increasing	....
d Non-linear and decreasing	....

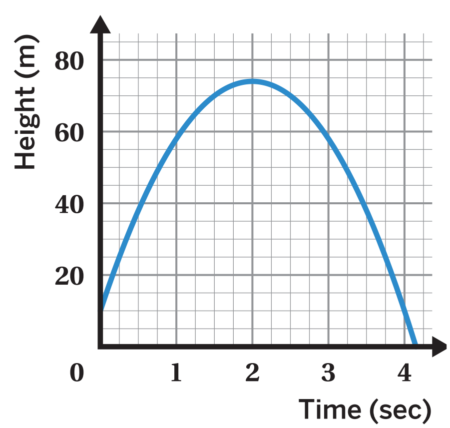


2. Avi places a batch of homemade pretzels in the refrigerator. The dough takes 15 minutes to cool from 70°F to 40°F. Once it is cool, the dough stays in the refrigerator for another 30 minutes. Avi then places the pretzels in the oven to bake. After 5 minutes in the oven, the temperature of the pretzel dough is 80°F.

Sketch a graph that represents this situation.



Problems 3–6: This graph represents the height of an object that is launched upwards from a tower and then falls to the ground.



3. How tall is the tower from which the object was launched?

4. Plot the point that represents the greatest height of the object and the time it took the object to reach that height.

5. Determine one time interval when the height of the object was increasing.

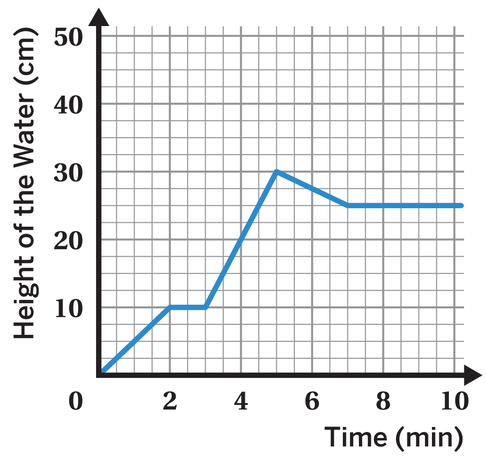
6. Determine one time interval when the height of the object was decreasing.

Lesson Practice
8.5.06

Name: ____________ Date: ________ Period: ________

7. Kimaya fills an aquarium with water. This graph shows the height of the water in the aquarium vs. time.

Tell a story about how Kimaya fills the aquarium based on what you see. Include specific heights and times.



Spiral Review

Problems 8–9: Solve each equation. Show your thinking.

8. $-(-2x+1)=9-14x$

9. $3x+\frac{3}{5}=\frac{1}{3}(5x+5)$

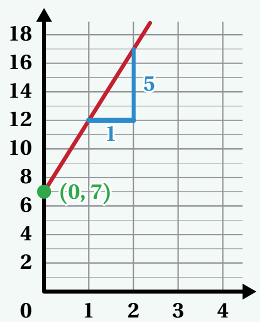
Reflection

1. Put a star next to a problem that looked more difficult than it really was.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

Linear relationships that have exactly one output for every possible input are called **linear functions**. All linear functions can be represented with a graph, a table, and an equation in the form $y = mx + b$, where m is the rate of change and b is the initial value.

Graph



Table

x	y
0	7
1	12
2	17

Equation

$y = 5x + 7$

The slope, or rate of change, is a ratio between the difference of the y-values and the difference of the x-values. In a graph, you can use slope triangles to find the rate of change. In the equation $y = mx + b$, it is the coefficient of the independent variable. In this example, the slope is $\frac{5}{1} = 5$.

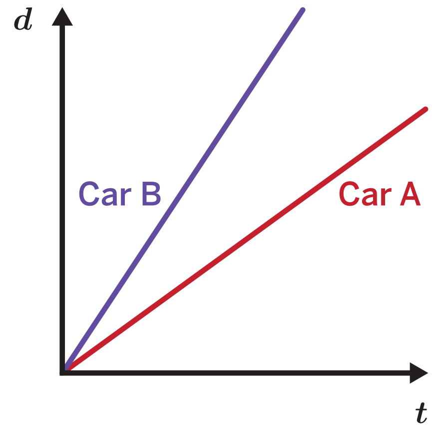
The initial value, or y-intercept, is the dependent value when the independent value is 0. In the equation $y = mx + b$, the y-intercept is the constant, b. In this example, the y-intercept is 7.

Things to Remember:

Lesson Practice
8.5.07

Name: ________ Date: ________ Period: ________

1. Two cars are traveling on the same highway in the same direction. The graphs show the distance, d, of each car from the starting point as a function of time, t. Which car is traveling faster? Explain your thinking.



Problems 2–4: Kiri and Remy race each other home from school. They run at the same speed, but Kiri's house is slightly closer to the school than Remy's house. Suppose there is a graph that shows their distances from home, in meters, as a function of the time, in seconds, from when they began the race.

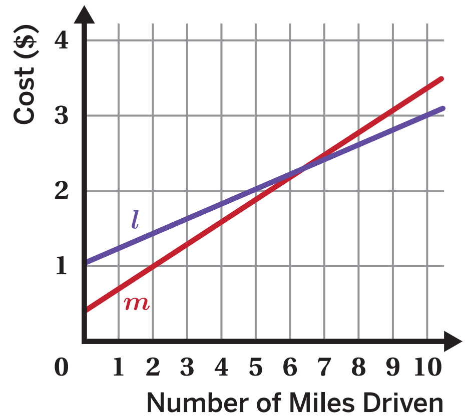
2. If you were to read the graphs from left to right, would you expect the lines to increase or decrease? Explain your thinking.

3. How would you expect the lines representing Kiri's run and Remy's run to be different? Explain your thinking.

4. How would you expect the lines representing Kiri's run and Remy's run to be alike? Explain your thinking.

Name: .... Date: .... Period: ....

Problems 5–6: Two car services offer to pick up a customer and take them to their destination. Service A charges a flat fee of $\$0.40$ plus $\$0.30$ for each mile of the trip. Service B charges a flat fee of $\$1.10$ plus c dollars for each mile of their trip.



5. Match the services with the lines l and m.

6. For Service B, is the additional charge per mile greater than or less than $\$0.30$ for each mile of the trip? Explain your thinking.

Spiral Review

7. Write an equation for each line shown on the graph.

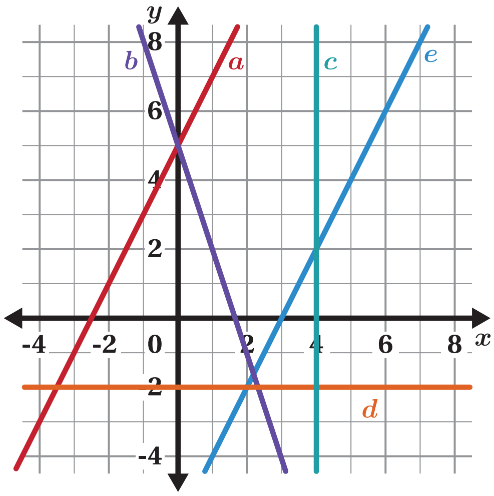
Line a: ....

Line b: ....

Line c: ....

Line d: ....

Line e: ....



Reflection

1. Put a question mark next to a problem you were feeling stuck on.

2. Use this space to ask a question or share something you're proud of.

Lesson Practice 8.5.09

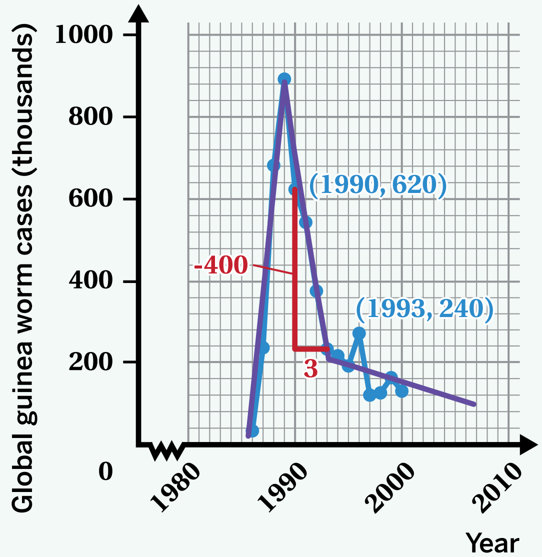
Science Mom Lesson 79

Lesson Summary

You can use one or more linear segments to represent a data set. Using multiple linear segments can help you precisely represent a data set.

For example, you can use multiple linear segments to model this data about cases of the Guinea Worm disease over time.

You can use this model to estimate that between 1990 and 1993, cases of Guinea Worm disease were changing at a rate of approximately $-\frac{400}{3}$ cases per year, or dropping by about 133.33 million cases per year.

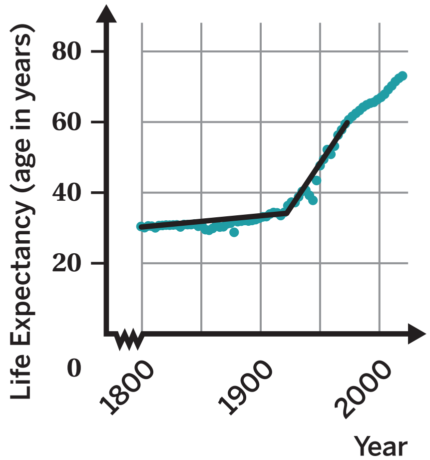


Things to Remember:

Lesson Practice
8.5.09

Name: .... Date: .... Period: ....

1. This graph shows global life expectancy over time. A student started to model the data with two linear functions. Sketch one more linear segment to complete the student's work.



Problems 2–3: On the first day after the new moon, 2% of the Moon's surface is illuminated. On the second day, 6% of the Moon's surface is illuminated.

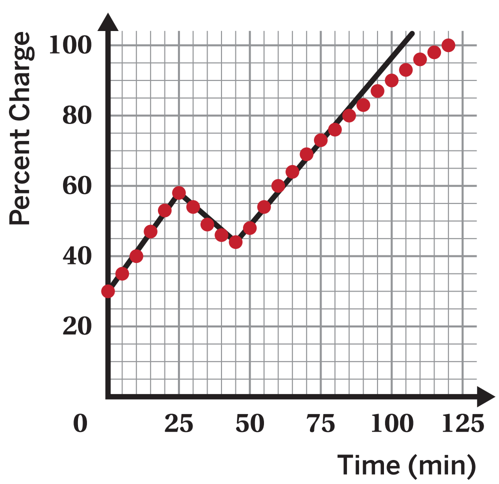
2. Assuming this data can be modeled with a linear function, complete the table. Round to the nearest day if necessary.

3. The Moon's surface is actually 100% illuminated on day 14. How appropriate is it to use a linear function for this data?

Day Number	Illumination
1	2%
2	6%
...	...
	50%
	100%

Problems 4–5: Elena is charging her laptop. After 25 minutes, she unplugs her laptop to complete her homework. After she completes her homework, she plugs in her laptop again until it is fully charged. This graph shows the percent charge of Elena's laptop over time.

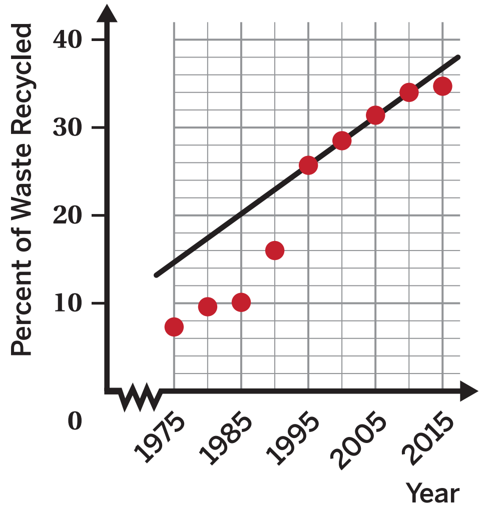
4. Describe the function used to model the data.



5. Which time interval is not modeled appropriately? Explain your thinking.

Name: .... Date: .... Period: ....

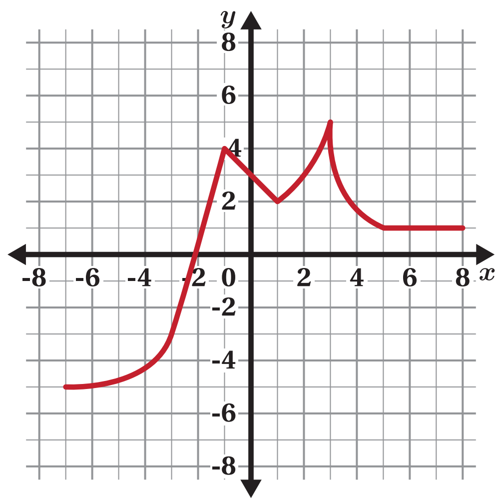
6. This graph shows the percentage of waste produced in the United States that gets recycled over time. A student draws a linear function that models the change from 1975 to 2015. For what years does the model make accurate predictions? For which years is it not as accurate?



Spiral Review

7. The graph shows y as a function of x. For which intervals is the function increasing? Select *all* that apply.

- ☐ **A.** From -7 to -3
- ☐ **B.** From -3 to -1
- ☐ **C.** From -1 to 1
- ☐ **D.** From 1 to 3
- ☐ **E.** From 3 to 5
- ☐ **F.** From 5 to 7



8. Which linear function has a greater rate of change? Explain your thinking.

Function A

$$y = \frac{1}{6}x + \frac{2}{5}$$

Function B

x	y
-9	3
1	5
21	9

Reflection

1. Circle one problem, word, or concept that you want to know more about.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

You can organize and display data that includes numbers in different ways, including in a table and in a scatter plot. A **scatter plot** is a set of disconnected data points plotted on a coordinate plane.

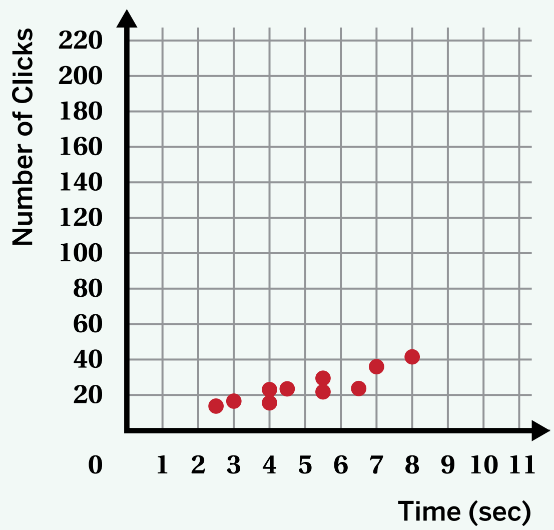
A table and a scatter plot both display the same data, but can be helpful in different ways. For example, you can use a scatter plot to investigate connections between two variables, while a table is helpful for looking for the exact values of specific data points.

Here is data showing the amount of time in seconds and the number of clicks of the button.

Table

Time (sec)	Number of Clicks
2.5	14
3	17
4	16
4	23
4.5	24
5.5	22
5.5	30
6.5	24
7	36
8	42

Scatter Plot



Things to Remember:

Lesson Practice
8.6.01

Name: .... Date: .... Period: ....

Problems 1–3: Here is data on the number of cases of whooping cough from 1944 to 1955.

Year	Number of Cases
1944	109,873
1945	133,792
1946	109,860
1947	156,517
1948	74,715
1949	64,479
1950	120,718
1951	68,687
1952	45,030
1953	37,129
1954	60,866
1955	62,786

1. Describe another way to sort this table. What is a question that can be answered when the table is sorted this way?

***Responses vary*. By the number of cases – in which year were there the fewest number of cases?**

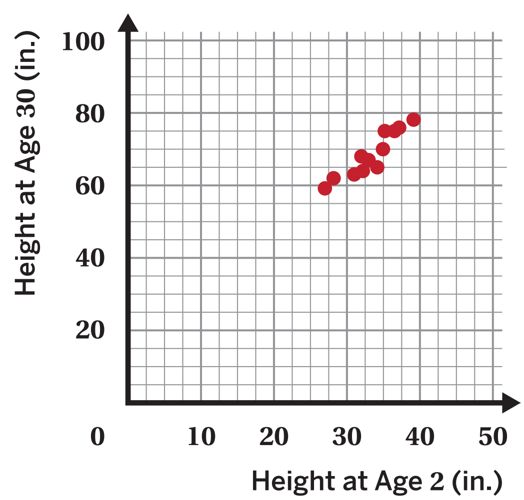
2. Which years in this period of time had more than 100,000 cases of whooping cough?

The years 1944, 1945, 1946, 1947, and 1950 had more than 100,000 cases of whooping cough.

3. Based on this data, would you expect 1956 to have closer to 50,000 cases or 100,000 cases? Explain your thinking.

This data seems to show the number of cases decreasing over time, so I would expect 1956 to have closer to 50,000 cases than 100,000.

Problems 4–5: A research study measured the heights of twelve people on their birthday at age 2 and at age 30.



4. What patterns do you notice in the data?

Responses vary.

- **I notice that the points have a general trend, as if arranged around a line that goes up and to the right.**
- **I notice that for many people, their height at age 30 was about double their height at age two.**

5. A two-year-old has a height of 38 inches. Based on this data, predict their height at age 30.

***Responses vary*. Answers between 70 and 85 are considered correct.**

6. Here is data a teacher collected after asking her students how many hours of sleep they had the night before a test.

How might you organize or display this data? Explain your thinking.

Responses vary.

- **Sort the table by hours of sleep or test score because it is easier to see patterns.**
- **Create a scatter plot because it is easier to see the relationship between both variables.**

	Hours of Sleep	Test Score
Ayaan	7	74
Emika	6	76
Inola	8	88
Kwasi	5	63
Zoe	7	90

Spiral Review

7. A cylinder has a height of 6 feet and a diameter of 2 feet. Which measurement is closest to the volume of the cylinder in cubic feet?

A. 226.2 cubic feet

B. 75.4 cubic feet

C. 18.8 cubic feet

D. 113.1 cubic feet

Problems 8–10: This cylinder has a radius of 4 centimeters and a height of 5 centimeters.

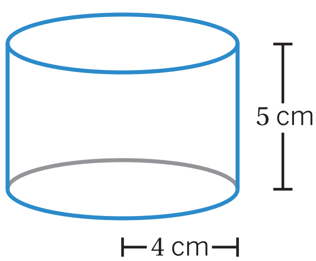


Figure may not be drawn to scale.

8. What is the volume of the cylinder?

80π cubic centimeters (or equivalent)

9. What is the volume of the cylinder when its radius is tripled?

720π cubic centimeters (or equivalent)

10. What is the volume of the cylinder when its radius is halved?

20π cubic centimeters (or equivalent)

Reflection

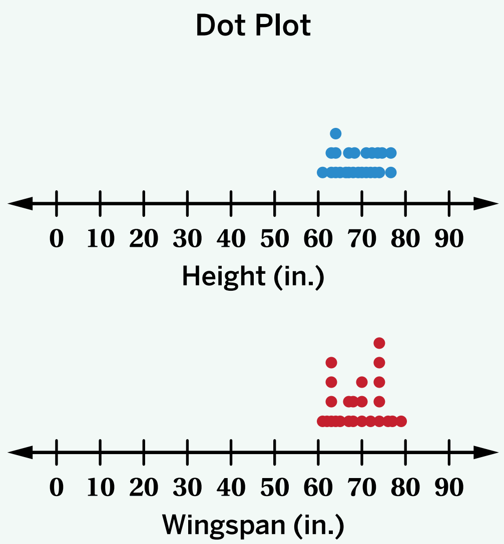
1. Star the problem you spent the most time on.

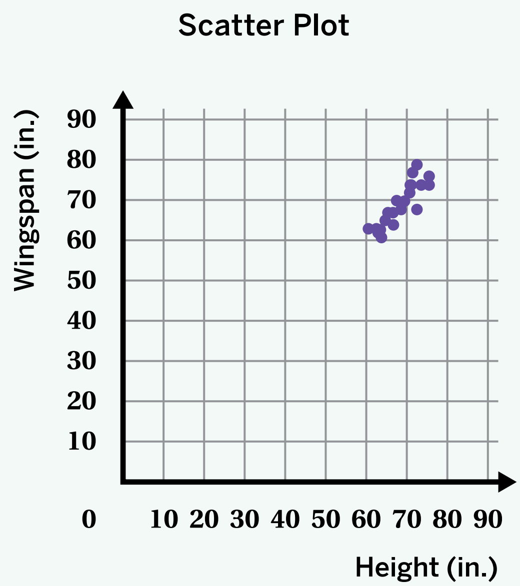
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

Data presented as numbers, quantities, or measurements that can be compared in a meaningful way is called *numerical data*, or *quantitative data*. You can investigate *univariate data*, which involves one variable, and *bivariate data*, which involves two variables.

There are different ways to represent numerical data. A *dot plot* shows data for one variable and a scatter plot shows data for two variables at the same time. Seeing two numerical variables at the same time allows us to notice trends and connections.



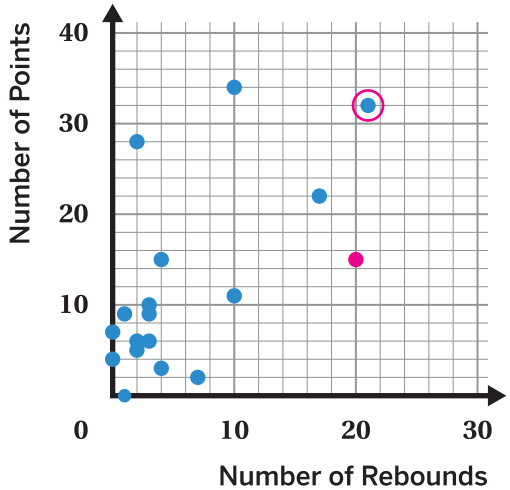


Things to Remember:

Lesson Practice
8.6.02

Name: .... Date: .... Period: ....

Problems 1–5: This scatter plot shows the number of rebounds and points for each player in a recent professional basketball game.



1. Circle the point on the graph that represents the player with the most rebounds. How many rebounds did that player have?

Response shown on graph. 21 rebounds

2. How many players had 0 rebounds?

2 players

3. What is another question you *can* answer based on this scatter plot?

***Responses vary.* Is there a relationship between rebounds and points?**

4. What is a question you *cannot* answer based on this scatter plot?

***Responses vary.* How many three-point and two-point shots did each player make?**

5. The table shows the data for another basketball player. Plot the point for the player on the graph. **Response shown on graph.**

Number of Rebounds	Number of Points
20	15

6. Which representation(s) are appropriate for comparing the heights of students on a volleyball team to the heights of students on a soccer team?

A. Scatter plot

B. Dot plots

C. Both

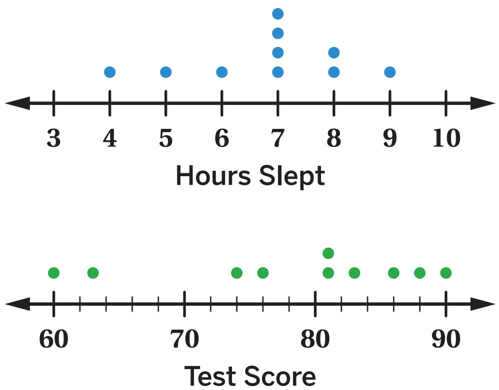
Explain your thinking.

***Explanations vary.* Dot plots are appropriate because I am comparing two separate data sets to each other. A scatter plot would make sense if we were looking at two attributes for one set of humans, like heights and weights for players on the soccer team.**

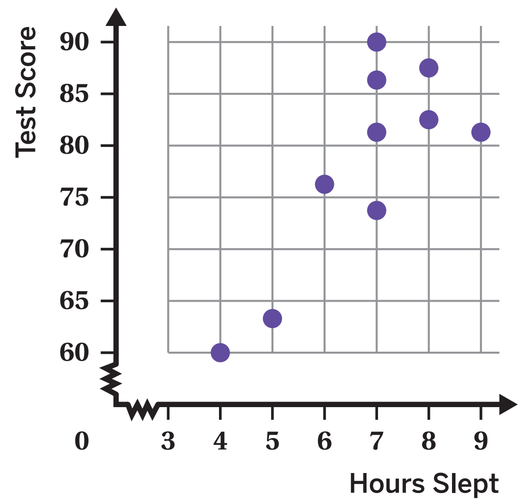
Name: .... Date: .... Period: ....

7. A teacher collected data about her students' test scores and how many hours they slept the night before a test. She represented the data with dot plots and a scatter plot.

Dot Plots



Scatter Plot

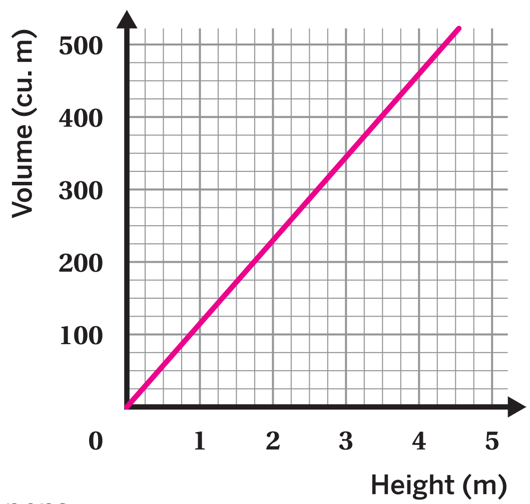


What is different about the two ways of representing the data?

***Responses vary.* Dot plots separate each variable and scatter plots show both variables at once.**

Spiral Review

Problems 8–10: There are many cylinders with a radius of 6 meters. Let h represent the height in meters and V represent the volume in cubic meters.



8. Write an equation that represents the volume, V, as a function of the height, h.

$V = 36\pi h$ (or equivalent)

9. Sketch the graph of the equation, using 3.14 as an approximation for π.

Response shown on graph.

10. If you double the height of a cylinder, what happens to the volume? Use the equation to help you explain your thinking.

***Responses vary.* If you double the height, the volume doubles. Replacing h with $2h$ in the equation gives $V = 36\pi \cdot 2h = 2(36\pi h)$, which is double the original volume.**

Reflection

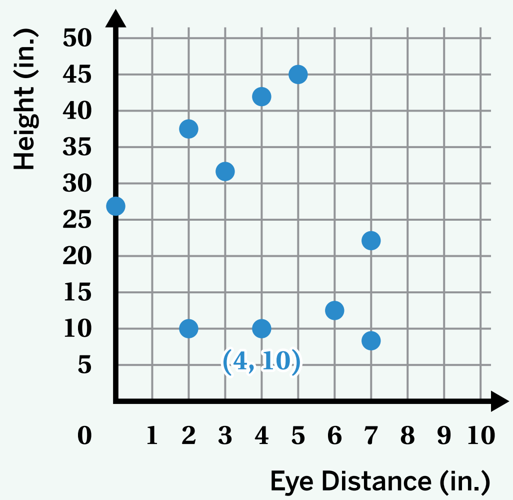
1. Put a question mark next to a response you'd like to compare with a classmate's.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

A point on a scatter plot represents two pieces of information. The axis labels tell you how to interpret the coordinates of each point.

In this example, the point $(4, 10)$ represents a robot with an eye distance of 4 inches and a height of 10 inches.

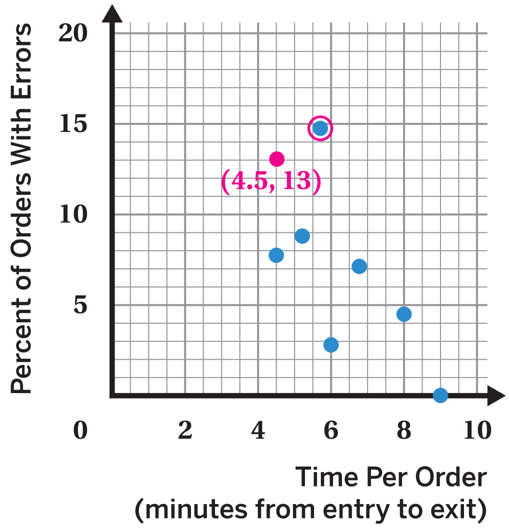


Things to Remember:

Name: ________________ Date: ________ Period: ________

Problems 1–3: A study gathered data about different drive-thru restaurants. The table and scatter plot show the average time per order and the percent of orders with errors for each restaurant.

Restaurant	Time Per Order (min)	Percent of Orders With Errors
CraveBite	8	4.5
Taco Tango	6	2.8
Bite Master	9	0
Noodle Nest	4.5	7.7
Burger Whiz	5.2	8.8
Pajaro	6.8	7.1
NachoLoco	5.7	14.7



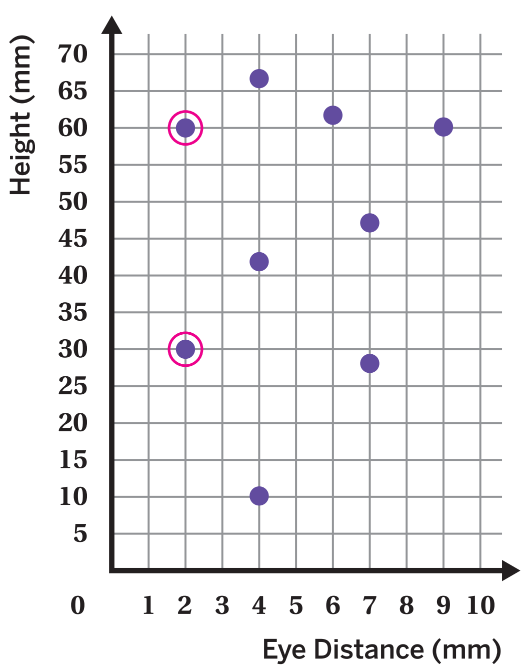
1. Circle the point on the scatter plot that represents the data for NachoLoco.
Response shown on graph.

2. What does the point $(6, 2.8)$ represent?
***Responses vary.* It represents the time per order and the percent of orders with errors for Taco Tango.**

3. In the same study, the data showed that Dumpling Delight takes 4.5 minutes per order and 13% of their orders had errors. Add a point to the scatter plot to represent Dumpling Delight.
Response shown on graph.

4. This scatter plot shows the height and eye distance of robots.

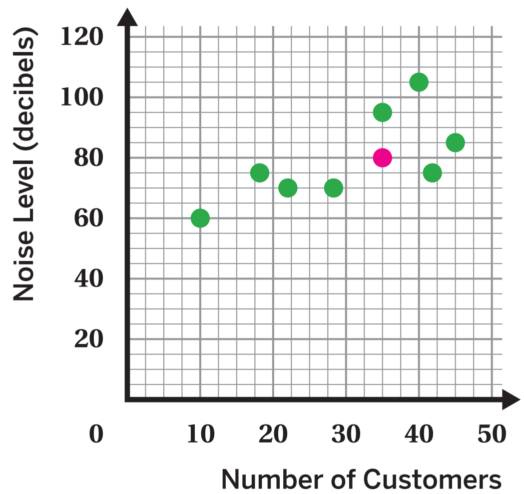
Circle the point(s) for the robot(s) with the smallest eye distance. Write the height and eye distance of each point you circled.
***Responses vary.* The eye distances are both 2 millimeters, and their heights are 30 millimeters and 60 millimeters.**



Lesson Practice
8.6.03

Name: ______________ Date: ________ Period: ________

Problems 5–7: This scatter plot shows the noise level and the number of customers for eight restaurants.



5. What is the noise level at the loudest restaurant?
105 decibels

6. What is the noise level at the restaurant with the most customers?
85 decibels

7. The noise level at a restaurant with 35 customers is 80 decibels. Plot a point on the graph that represents this restaurant.
Response shown on graph.

8. Select *all* the representations that are appropriate for comparing exam score to hours of sleep the night before an exam.

- ☐ **A.** Histogram
- ☑ **B.** Scatter plot
- ☐ **C.** Dot plot
- ☑ **D.** Table
- ☐ **E.** Box plot

Spiral Review

Problems 9–12: Evaluate each expression.

9. $-2 \cdot (-4)$ **= 8** **10.** $-7 \cdot 2$ **= -14** **11.** $9 \cdot (-10)$ **= -90** **12.** $-2 \cdot (-6) \cdot (5)$ **= 60**

Reflection

1. Put a star next to the problem you understood best.

2. Use this space to ask a question or share something you're proud of.

Lesson Practice 8.6.04

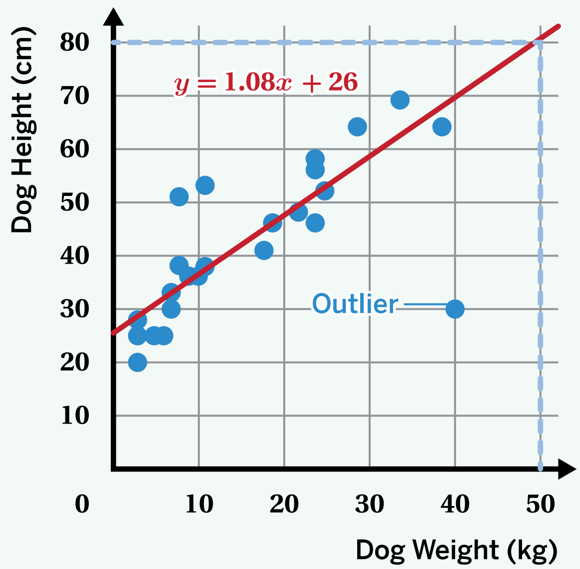
Science Mom Lesson 83

Lesson Summary

A **linear model** is a line on a scatter plot that helps identify trends in data more clearly. You can also use a linear model to make a prediction.

For example, there are two ways you can use this linear model to predict a dog's height when it weighs 50 kilograms.

- Use the graph to locate 50 on the x-axis and follow it up to meet the linear model, which shows a y-value of 80. This means when the dog's weight is 50 kilograms, its height is 80 centimeters.
- Use the equation for the linear model, $y = 1.08x + 26$, by replacing x with 50 and evaluating for y, which is approximately 80 centimeters.

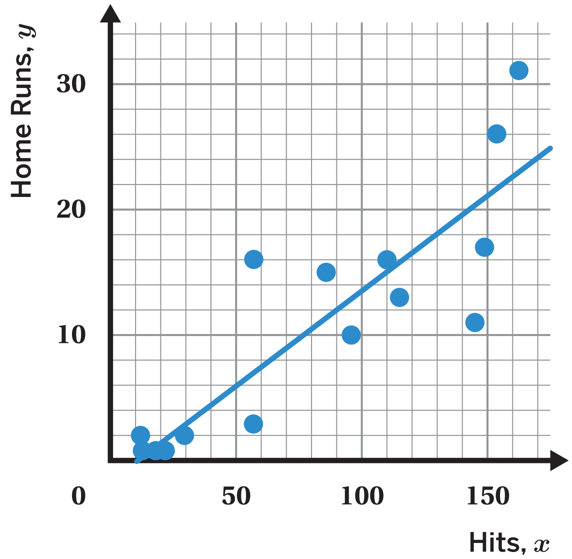


You can identify an **outlier** by looking for points that are far away from the other points and from the predicted values. The point (40, 30) is an outlier on the graph of dog weights and heights.

Things to Remember:

Name: ________ Date: ________ Period: ________

Problems 1–3: This scatter plot shows the number of hits and home runs for 15 baseball players last season and the linear model $y = 0.15x - 1.5$.



1. How many home runs did the player with 154 hits have?

26 home runs

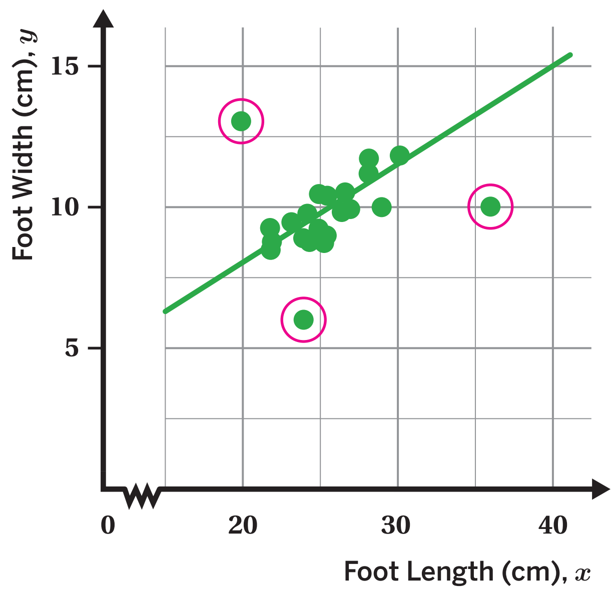
2. If a player has 20 home runs, how many hits does the linear model predict they will have?

Responses between 141 and 145 are considered correct.

3. How many home runs does the linear model predict a player with 250 hits will have?

36 home runs

Problems 4–5: This scatter plot shows several foot lengths and widths, along with a linear model represented by the equation $y = 0.35x + 1$.



4. Use the linear model's equation to predict the width of a foot that is 50 centimeters long.

18.5 centimeters

5. Does the scatter plot appear to have any outliers? If so, circle them and describe what they represent about foot length and foot width.

$(20, 13)$, $(24, 6)$, and $(36, 10)$ are outliers. The point $(20, 13)$ shows a foot with a width much greater than predicted. The points $(24, 6)$ and $(36, 10)$ show feet with widths much smaller than predicted.

6. In your own words, what does an outlier represent?

***Responses vary.* An outlier represents a value that does not follow the data trend. It usually represents a measure that is much greater than or less than the rest of the data.**

Name: ______ Date: ______ Period: ______

7. This scatter plot shows the weight and age for many dogs of a certain breed.

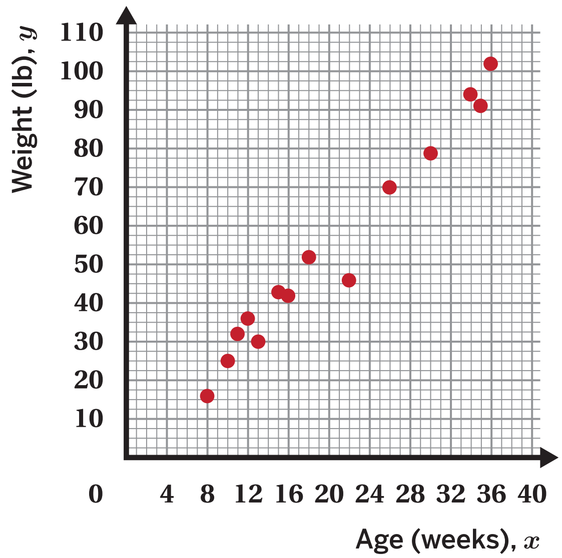
Which is the best prediction for the weight of a dog that is 24 weeks old?

A. 10 pounds

B. 45 pounds

C. 60 pounds

D. 90 pounds



Spiral Review

Problems 8–9: Solve each system of equations. Write the solution as an ordered pair. Show your thinking.

1. $\begin{cases} y = -3x + 13 \\ y = -2x + 1 \end{cases}$

(12, -23). ***Work varies.***

$-3x + 13 = -2x + 1$ $\quad$ $y = -2(12) + 1$

$13 = 1x + 1$ $\quad$ $y = -24 + 1$

$12 = x$ $\quad$ $y = -23$

2. $\begin{cases} y = x + 1 \\ y = -x + 5 \end{cases}$

(2, 3). ***Work varies.***

$x + 1 = -x + 5$ $\quad$ $y = 2 + 1$

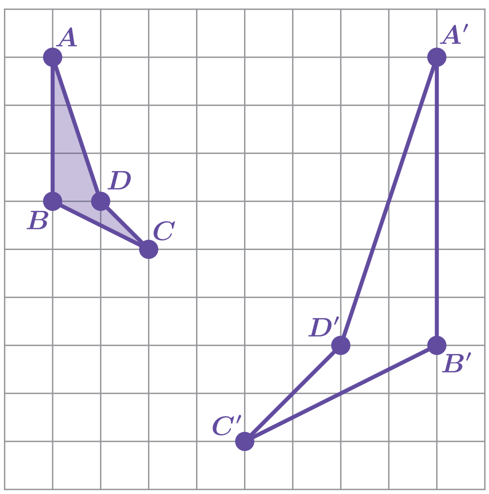
$2x + 1 = 5$ $\quad$ $y = 3$

$2x = 4$

$x = 2$

10. Describe a sequence of transformations that maps polygon $ABCD$ onto polygon $A'B'C'D'$.

Responses vary. **Reflect polygon $ABCD$ across a vertical line that passes through point C, then translate polygon $ABCD$ to the right 2 units and down 4 units. Then dilate the result using point C' as the center of dilation and a scale factor of 2.**



Reflection

1. Put a smiley face next to a problem you were stuck on and then figured out.

2. Use this space to ask a question or share something you're proud of.

Science Mom Lesson 84

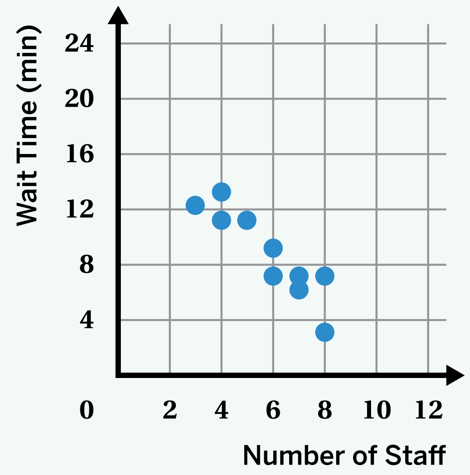
Lesson Summary

You can use a scatter plot to help identify patterns in data points and relationships between two variables.

For example, this scatter plot shows data about how long customers waited at a drive-thru restaurant and the number of staff working at that time.

The scatter plot shows both specific information and general trends, including:

- When 3 staff were working, the wait time was about 12 minutes.
- The more staff there are, the shorter the wait time seems to be.



Things to Remember:

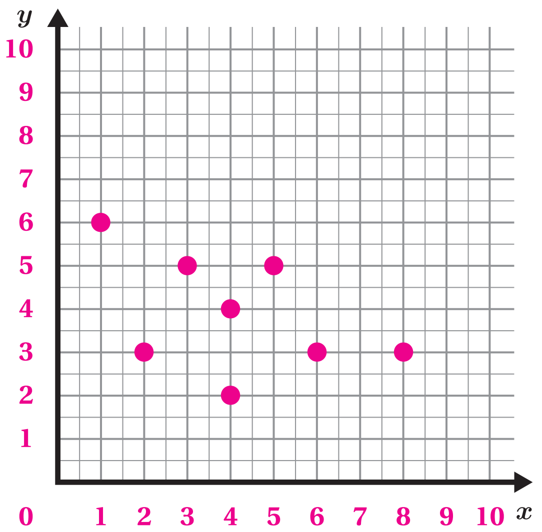
Lesson Practice
8.6.05

Name: ______________________ Date: __________ Period: __________

Problems 1–2: Use the table.

x	y
2	3
5	5
4	2
8	3
6	3
3	5
1	6
4	4

1. Create a scale for the graph so it fits all the data. Then create a scatter plot of the data.

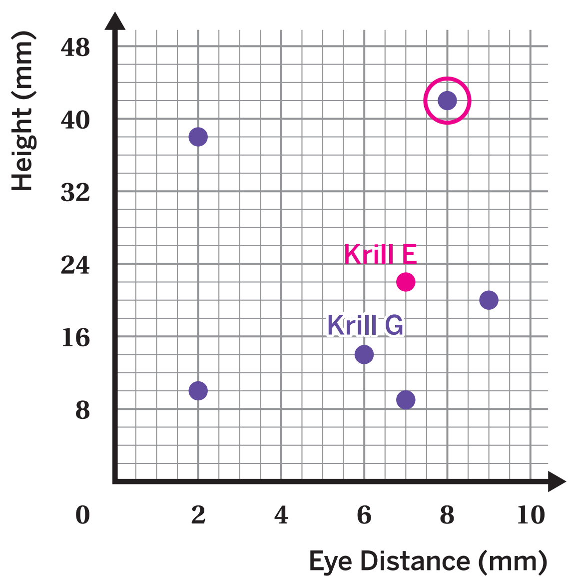


2. When do you think it is better to use a table to represent data? When do you think it is better to use a scatter plot?

***Responses vary.* It is better to use a table when looking for precise values and details of the data. It is better to use a scatter plot when looking for an overall pattern (or the lack of an overall pattern).**

Problems 3–5: The table and scatter plot show the heights and eye distances of seven different krill (small shrimp-like crustaceans).

Krill	Eye Distance (mm)	Height (mm)
A	7	9
B	2	38
C	2	10
D	8	42
E	7	22
F	9	20
G	**6**	**14**



3. On the scatter plot, circle the point that represents the tallest krill.
Response shown on graph.

Name: ____________ Date: ________ Period: ________

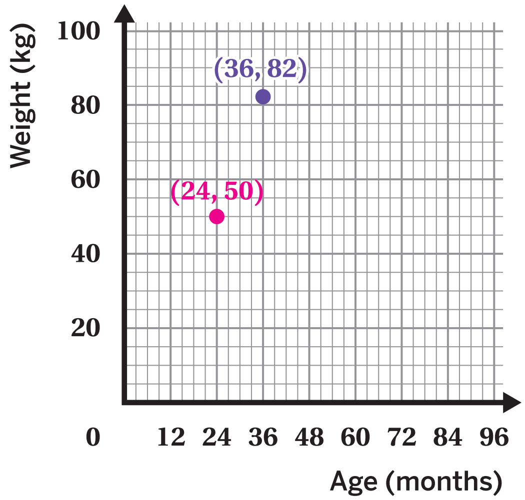
4. On the scatter plot, plot a point that represents Krill E.
Response shown on graph.

5. Complete the table with the values that represent Krill G.
Response shown in table.

Problems 6–7: The graph shows the age and weight of a giant panda.

6. What does the point tell you about the panda?
Responses vary. The panda is 36 months old and weighs 82 kilograms.

7. Plot a point to represent a different giant panda that is 24 months old and weighs 50 kilograms.
Response shown on graph.



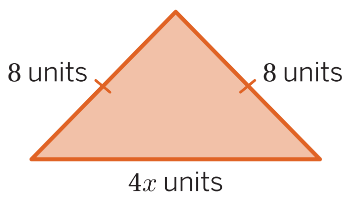
Spiral Review

Problems 8–9: Solve each equation. Show your thinking.

8. $2(3 - 2c) = 30$
$c = -6$. *Work varies.*
$2(3 - 2c) \div 2 = 30 \div 2$
$3 - 2c = 15$
$3 - 2c - 3 = 15 - 3$
$-2c = 12$
$c = -6$

9. $3x - 2 = 7 - 6x$
$x = 1$. *Work varies.*
$3x - 2 + 6x = 7 - 6x + 6x$
$9x - 2 = 7$
$9x - 2 + 2 = 7 + 2$
$9x = 9$
$x = 1$

10. The perimeter of the triangle is $10x$ units. Which equation represents the perimeter of the triangle?



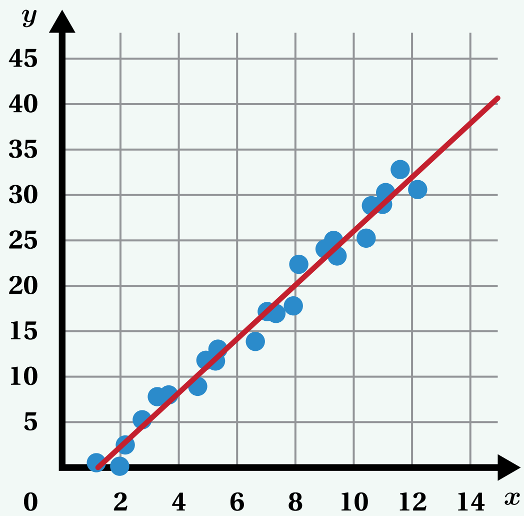
A. $10x = 8 + 12x$
B. $10x = 4 + 16x$
C. $10x = 12 + 8x$
D. $10x = 16 + 4x$

Reflection

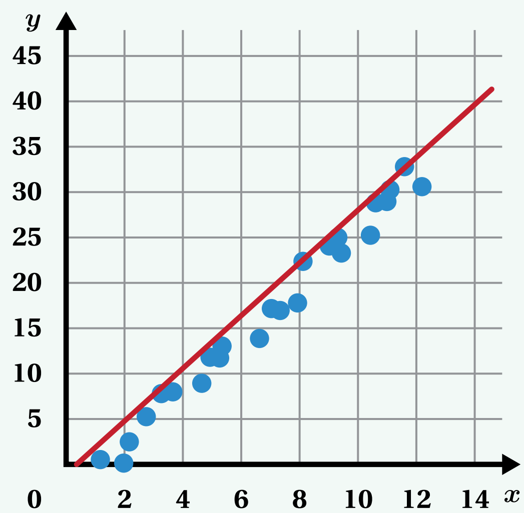
1. Put a smiley face next to the problem that you learned from most.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

When creating a line of fit for a scatter plot, it's important to determine how well the line fits the data. A good line of fit follows the trend of the data, is as close to the plotted points as possible, and has about the same number of points above and below the line. The line may pass through some, all, or none of the points.



This line is a good fit for the data.



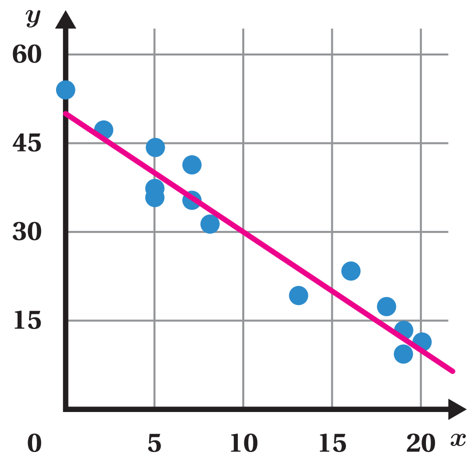
This line is not a good fit for the data.

Things to Remember:

Lesson Practice
8.6.06

Name: ________ Date: ________ Period: ________

Problems 1–2: Use this scatter plot.



1. Sketch a line of fit for the data.

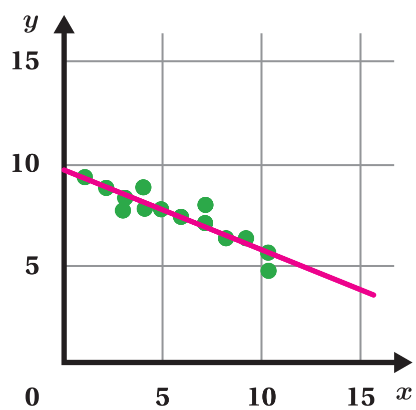
Responses vary. **Sample shown on graph.**

2. If a new data point has an x-value of 10, what does your line of fit predict for the value of y?

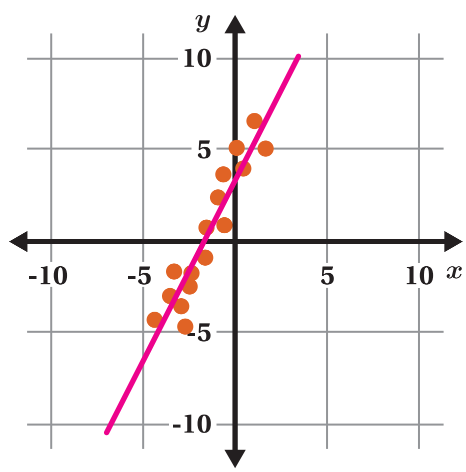
Responses between 25 and 35 are considered correct.

Problems 3–4: Sketch a line that fits the data. ***Responses vary.*** **Samples shown on graphs.**

3.

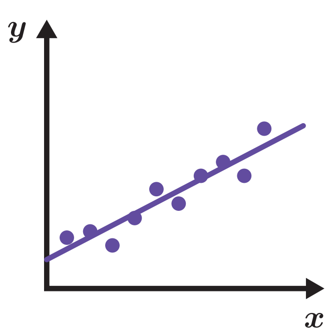


4.

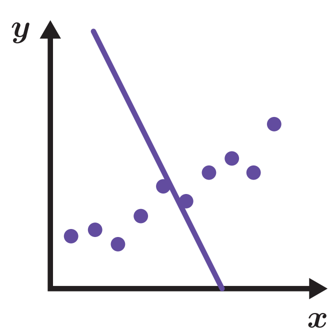


5. Which line best fits the data? Explain your thinking.

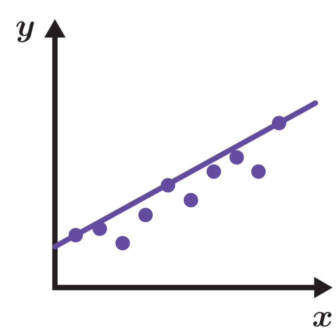
A.



B.

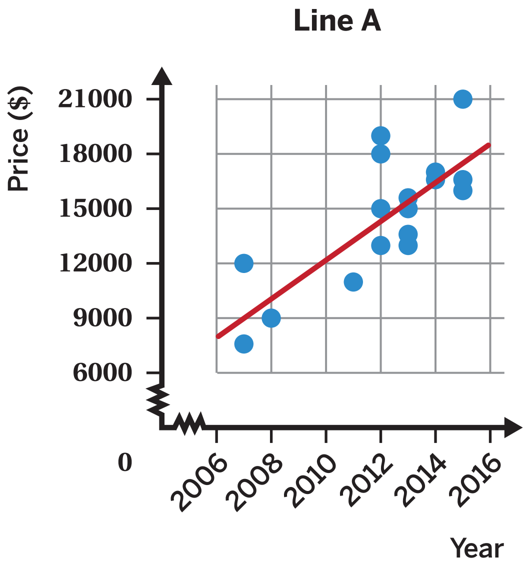


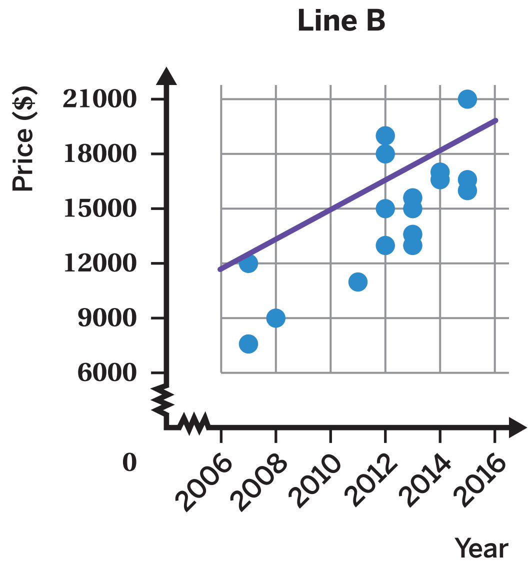
C.



Explanations vary. **The line in graph B balances points on either side of the line but doesn't follow the trend of the data. The line in graph C follows the positive trend of the data but doesn't balance the points on either side of the line. The line in graph A best fits the trend of the data and balances the data points on either side of the line.**

6. Each line of fit applies to the same data.





Which line is a better fit for the data? **Line A**

Explain your thinking. ***Explanations vary.*** **Line A follows the trend of the data and has about half of the points above and below the line.**

Spiral Review

7. Match each equation with the scenario it represents.

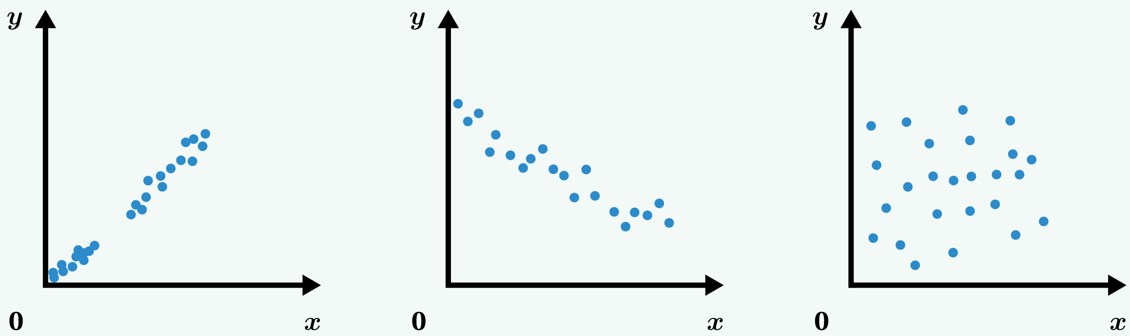
Equation		Scenario
a. $y = 3x$	c	A dump truck is hauling loads of dirt to a construction site. After 20 loads, there are 70 cubic feet of dirt.
b. $\frac{1}{2}x = y$	a	You are making a water and salt mixture that has 2 cups of salt for every 6 cups of water.
c. $y = 3.5x$	d	10 blueberries weigh 4 grams.
d. $y = \frac{2}{5}x$	b	For every 48 cookies I bake, my students receive 24 cookies.

Reflection

1. Put a star next to a problem you could explain to a classmate.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

If two variables on a scatter plot are related, there is an **association**. The slope of a linear model can help determine the type of association. A positive association means that when one variable increases, the other also increases. A negative association means that when one variable increases, the other decreases. If the scatter plot shows no clear trend between the two variables, then the variables have no association.



Positive association **Negative association** **No association**

Things to Remember:

Lesson Practice
8.6.07

Name: .... Date: .... Period: ....

1. Which type of association does the scatter plot show?

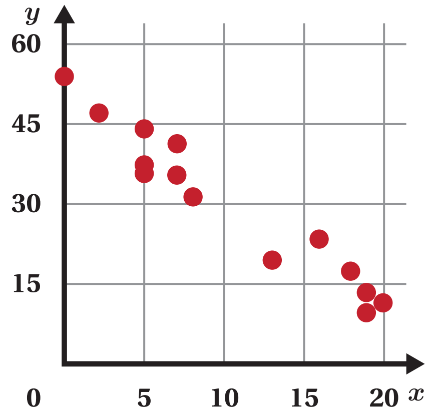
A. Positive association

B. Negative association

C. No association

Explain your thinking.

Explanations vary. **The scatter plot shows a negative association because as x increases, y decreases.**



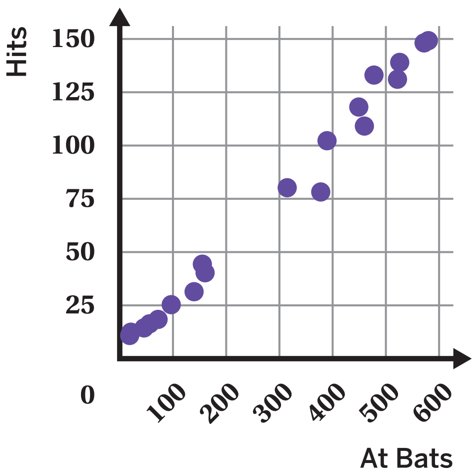
2. The scatter plot shows the number of hits and at bats for players on a baseball team. Which conclusion is best supported by the scatterplot?

A. As the number of at bats increases, the number of hits also increases.

B. As the number of at bats increases, the number of hits decreases.

C. As the number of hits increases, the number of at bats remains the same.

D. There is no relationship between the number of at bats and the number of hits.



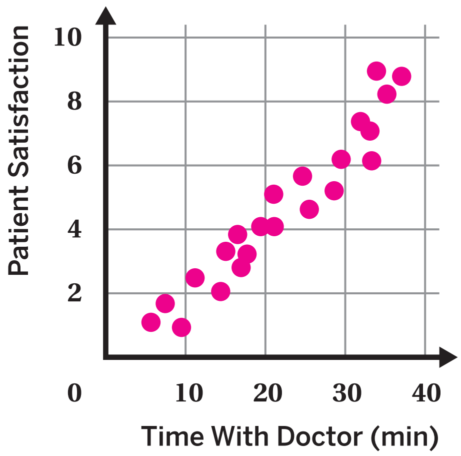
Problems 3–4: The doctors in a medical clinic looked at the relationship between patient satisfaction on a 0–10 scale and the number of minutes spent with a doctor. They found the variables had a positive association.

3. What does this positive association mean about the relationship between patient satisfaction and time with a doctor?

As time with the doctor increases, the patient's satisfaction also increases.

4. Create a scatter plot that represents this situation.

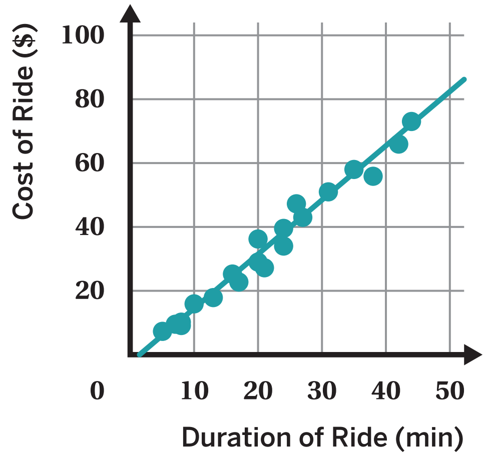
Responses vary. **Sample shown on graph.**



Lesson Practice
8.6.07

Name: .... Date: .... Period: ....

Problems 5–7: The scatter plot shows the data from 20 taxi rides in Austin, Texas, along with a linear model whose equation is $y = 1.7x - 2.5$.



5. What is the slope of the linear model?

1.7

6. What does the slope represent in this situation?

For every minute added to the duration of the taxi ride, the cost of the ride increases by $1.70.

7. What type of association is there between duration and cost of a taxi ride?

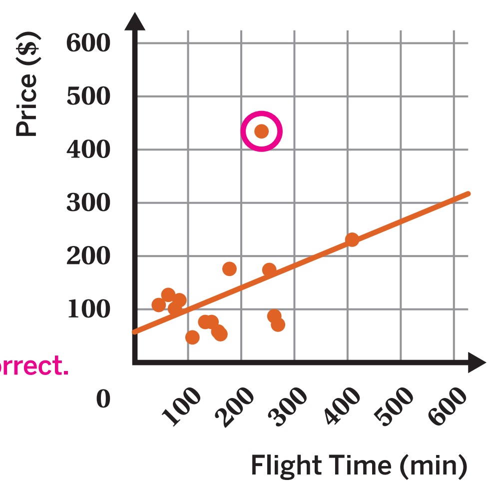
Positive association   Negative association   No association

Explain your thinking.

***Explanations vary.* As the duration of the ride increases, the cost of the ride is expected to increase.**

Spiral Review

Problems 8–9: The scatter plot shows the flight time and price for several different flights from O'Hare Airport in Chicago.



8. Circle any data point(s) that appear to be outliers.

Response shown on graph.

9. Use the linear model to estimate the price of a 10-hour flight from O'Hare Airport.

Responses between $300 and $315 are considered correct.

10. The equation $y = 5280x$ gives the number of feet, y, in x miles. What does the number 5,280 represent in this relationship?

***Responses vary.* There are 5,280 feet in every mile. Each additional mile that someone travels is equivalent to traveling an additional 5,280 feet.**

11. Solve this system of equations. Write your answer as an ordered pair (x, y).

$y = -5x + 2$ **(5, -23)**

$y = -4x - 3$

Reflection

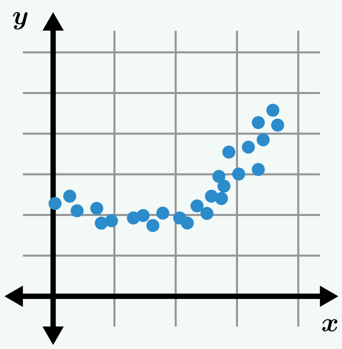
1. Put a heart next to the problem you feel most confident about.

2. Use this space to ask a question or share something you're proud of.

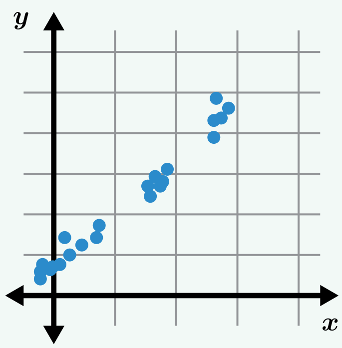
Lesson Summary

When you can model data on a scatter plot with a straight line, we say it has a linear association. Data that can't be modeled by a straight line has a non-linear association. Sometimes groups of data points appear close together, which are called **clusters**.

This scatter plot is an example of a non-linear association, without clusters.



This scatter plot is an example of a linear association, with clusters.



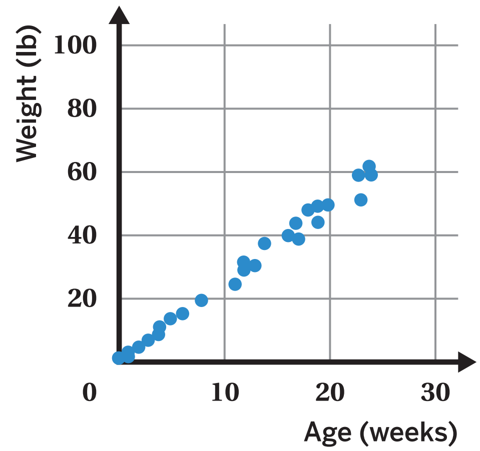
Things to Remember:

Lesson Practice
8.6.08

Name: .... Date: .... Period: ....

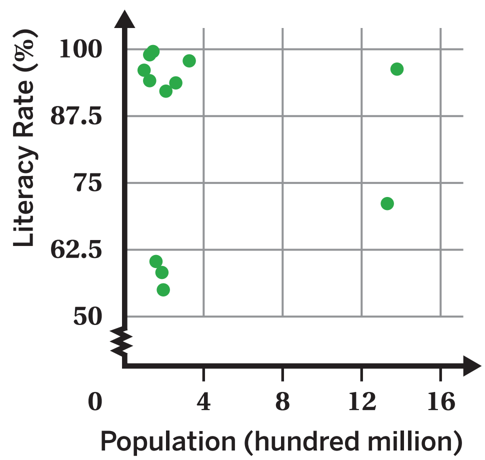
1. The graph shows the age and weight of babies in a nursery. Select *all* the terms that describe the association on the scatter plot.

- ☑ **A.** Linear association
- ☐ **B.** Non-linear association
- ☑ **C.** Positive association
- ☐ **D.** Negative association
- ☐ **E.** No association



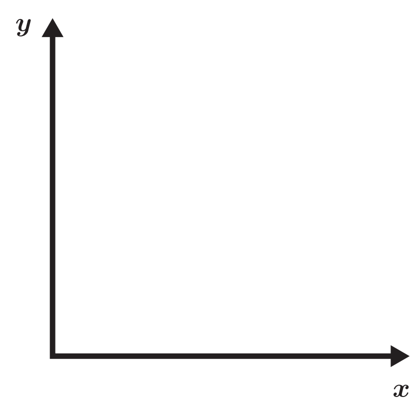
2. The scatter plot shows the literacy rate and population for 12 countries. Decide whether there are clusters in the scatter plot. Explain your thinking.

***Responses vary.* There are clusters of points for countries with populations between 0 and 4 hundred million.**

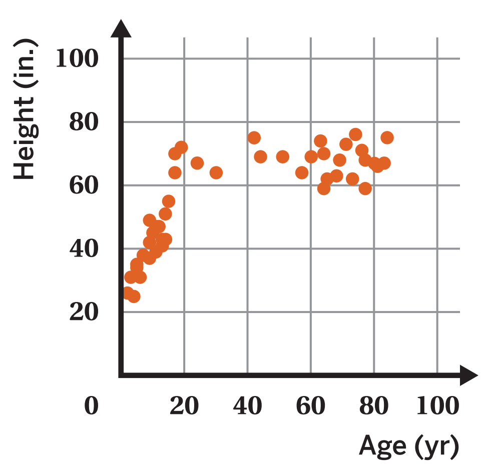


3. Create a scatter plot that has a positive linear association, with clusters.

***Responses vary.* Scatter plots should show points whose y-values generally increase as the x-values increase, and there should be at least one grouping of points.**



Problems 4–5: A doctor in a small town sees patients of all ages. Use the scatter plot of her patient's ages and heights to decide if each statement is true or false.



4. There is a non-linear association between the ages and heights of the doctor's patients.

True

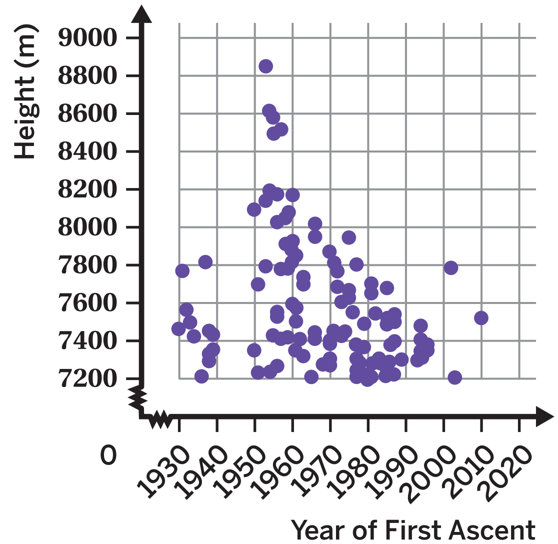
5. As patients' ages increase, their heights tend to decrease.

False

Name: ________ Date: ________ Period: ________

Spiral Review

6. The scatter plot shows data for some of the tallest mountains on Earth. Which of the following terms best describes the association between the heights of the mountains and years of first recorded ascent?



A. Linear association

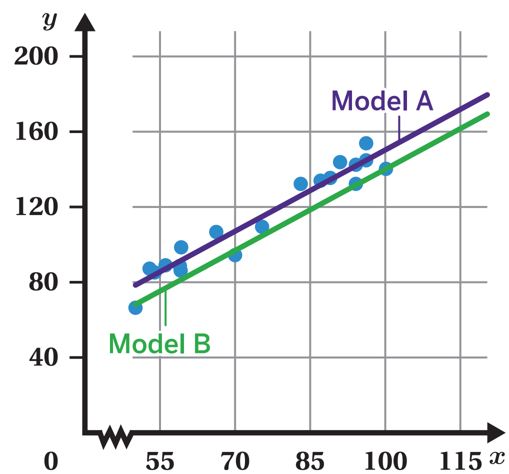
B. Positive association

C. Negative association

D. No association

7. Here are two different linear models for the same data. Which model is a better fit for the data? Explain your thinking.

Model A. *Explanations vary.* In Model B, most of the points are above the line in the graph. In Model A, the points are more evenly arranged around the line.



8. The points $(2, 4)$ and $(6, 7)$ fall on a line. What is the slope of the line?

A. 1 B. 2 C. $\frac{4}{3}$ D. $\frac{3}{4}$

Problems 9–10: A cone has a volume of V cubic units.

9. Another cone has the same height and $\frac{1}{3}$ of the radius of the original cone. Write an expression for its volume.

$\frac{V}{9}$ cubic units (or equivalent)

10. Another cone has the same height and 3 times the radius of the original cone. Write an expression for its volume.

$9V$ cubic units (or equivalent)

Reflection

1. Put a question mark next to a problem you were feeling stuck on.

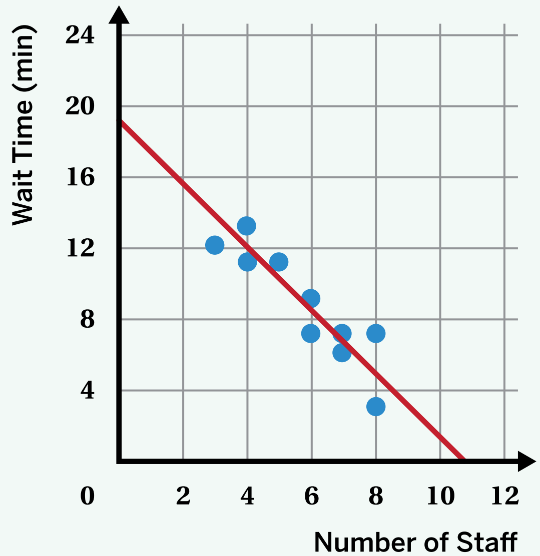
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

By understanding the association between two variables, you can make predictions about unknown values. When there's a linear association, using a linear model can often make predictions more accurate.

For example, this scatter plot shows data about how many minutes customers waited at a drive-through restaurant and the number of staff working at that time. This data can be modeled by the equation $y = -1.75x + 19$.

- The *slope* of the linear model is -1.75, which means that if the number of staff increases by 1 person, the wait time decreases by 1.75 minutes.
- The linear model predicts that if there are 2 staff working, the wait time will be approximately 15.5 minutes.
- But the linear model also predicts that when there are 0 staff working, the wait time will be 19 minutes, which is impossible!



Things to Remember:

Lesson Practice
8.6.09

Name: ______ Date: ______ Period: ______

Problems 1–5: Stores across the country sell a particular book at different prices. The table shows the price of the book and the number of books sold at that price.

Price ($)	Number of Books Sold
10.50	60
12.10	30
8.45	81
9.25	70
9.75	80
7.25	120
12	37
9.99	130
7.99	100

1. Create a scatter plot for this data. Include labels for the horizontal and vertical axes.

2. Are there any outliers? Explain your thinking.

Yes. *Explanations vary.* The point (9.99, 130) is much higher than expected on the scatter plot.

3. What type of association does there appear to be between the price of the book and the number of books sold? Explain your thinking.

Negative linear association. *Explanations vary.* There is a negative linear association between the variables. When the price increases, the number of books sold decreases.

4. Draw a line on the graph that you think is a good fit for the data.

***Responses vary.* Sample shown on graph.**

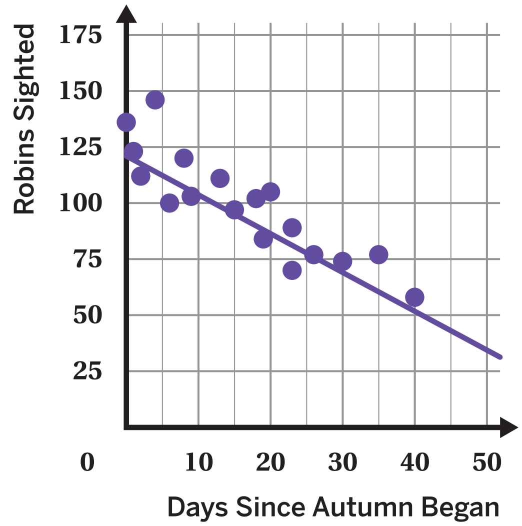
5. A bookstore plans to sell the book for $6. Use your line to predict the number of books the store will sell. Explain your thinking.

Responses between 125 and 145 books are considered correct. *Explanations vary.* The bookstore will sell 130 books. I chose this number because the point (6, 130) is on my line of fit.

Lesson Practice
8.6.09

Name: .... Date: .... Period: ....

Problems 6–7: This scatter plot shows data about the number of robins sighted at a local park and the number of days since autumn began.



6. Approximately how many robins were sighted 15 days since autumn began?

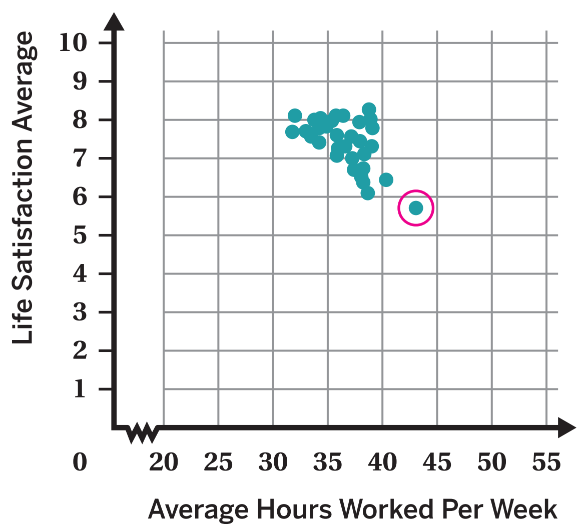
Responses between 90 and 100 robins are considered correct.

7. Use the line of fit to make a prediction for how many robins will be sighted 50 days since autumn began. Explain your thinking.

Responses between 40 and 50 robins are considered correct. *Explanations vary.*
47 robins, because the line of fit looks like it passes through the point (50, 47).

Spiral Review

Problems 8–9: Martina is interested in the quality of life in different countries. Martina created this scatter plot to show the average number of hours people worked in a week and their average life satisfaction (on a 0–10 scale). Each point on the graph represents a different country.



8. Circle the point that represents the country where average life satisfaction is lowest. How many hours are in the average work week in that country?

43 hours per week

9. Select *all* the true statements about the data in the scatter plot.

- ☐ **A.** The variables have a positive association.
- ☑ **B.** The variables have a negative association.
- ☐ **C.** A linear model that fits the data would have a positive slope.
- ☑ **D.** A linear model that fits the data would have a negative slope.
- ☑ **E.** More than half of the countries have an average life satisfaction above 7.

Reflection

1. Circle the question you think will help you most on the End-of-Unit Assessment.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

A **two-way table** lets us compare two variables of *categorical data*, which is data that can be sorted into categories.

This two-way table shows data about whether students meditated on a certain day, and whether they felt calm or agitated that day. Each entry in the table represents the **frequency**, or the number of times, that a category appears in the data set.

	Meditated	Did Not Meditate	Total
Calm	45	8	53
Agitated	23	21	44
Total	68	29	97

For example, 45 students who meditated were calm, and 23 students who meditated were agitated.

You can use these two-way tables to investigate possible connections between variables. In the example, we can see there's a connection between meditating and feeling calm, since a majority of the people who felt calm also meditated.

Things to Remember:

Lesson Practice
8.6.10

Name: .... Date: .... Period: ....

Problems 1–3: The table shows the results of a survey about TV watching habits.

	Watches TV Daily	Does Not Watch TV Daily	Total
Younger Than 18	30	80	110
18 or Older	60	35	95
Total	?	115	205

1. What do you notice?

Responses vary. I notice that out of the people who are 18 years or older, more people watch TV daily than don't.

2. What do you wonder?

Responses vary. I wonder if people younger than 18 who don't watch TV daily use other types of electronic devices on a daily basis, such as laptops, phones, or tablets.

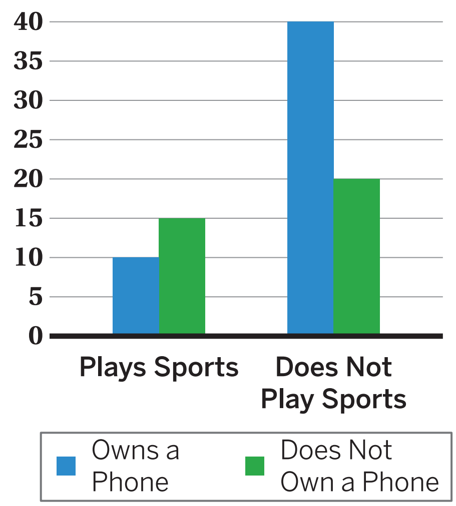
3. In total, how many people responded that they watch TV daily?

90 people

Problems 4–5: The bar graph shows data for a group of 8th grade students.

4. Complete the two-way table based on the information in the bar graph.

	Owns a Phone	Does Not Own a Phone	Total
Plays Sports	10	15	25
Does Not Play Sports	40	20	60
Total	50	35	85



5. Select *all* of the true statements.

- ☑ **A.** More students do not play sports than do.
- ☑ **B.** More students own a phone than don't.
- ☐ **C.** There are only 10 students who own a phone but don't play sports.
- ☐ **D.** There are no students who own a phone and play sports.
- ☐ **E.** There are 35 total students that own a phone.

6. Use the information in the two-way table to write two *true* statements about the data.

	Likes Riding a Bicycle	Does Not Like Riding a Bicycle
Kids	30	10
Adults	40	60

Responses vary.

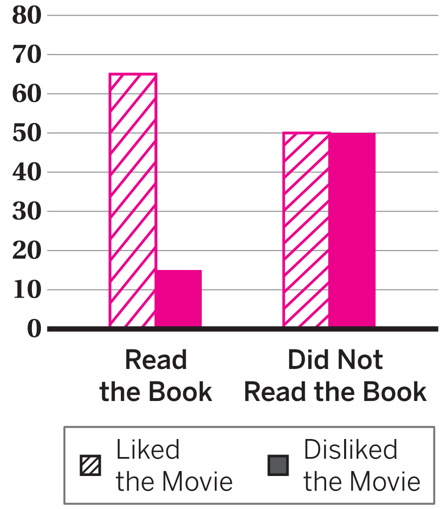
- The table shows that more adults like riding a bicycle than kids.
- More kids like riding a bicycle than don't.

Name: .... Date: .... Period: ....

Problems 7–8: 180 people were surveyed about a movie they watched that was based on a book. Some people had already read the book and some had not.

7. Create a bar graph based on the information in the table.

	Liked the Movie	Disliked the Movie	Total
Read the Book	65	15	80
Did Not Read the Book	50	50	100
Total	115	65	180

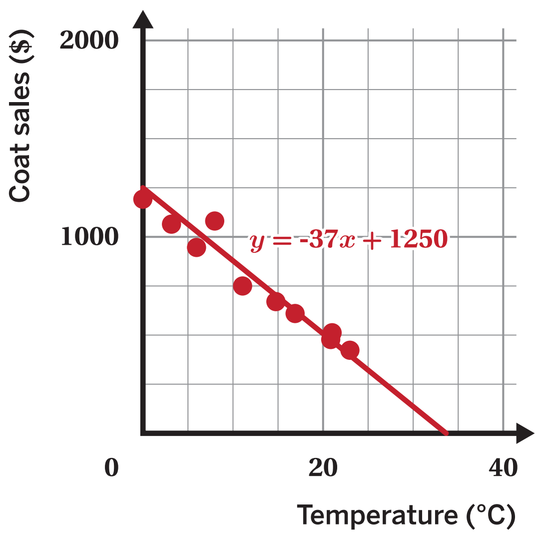


8. What claim might a person make based on this data?

Responses vary. **People who read the book before watching the movie enjoy it more than those who have not read the book.**

Spiral Review

Problems 9–11: The scatter plot shows a store's daily coat sales and the outside temperature that day. The equation for the line of fit is $y = -37x + 1250$.



9. What is the slope and y-intercept of the line of fit?

The slope is -37. The y-intercept is 1250.

10. What does the slope tell you about this situation?

Responses vary. **The slope means that for every temperature increase of 1 degree, coat sales are predicted to decrease by \$37.**

11. What does the y-intercept tell you about this situation?

Responses vary. **The y-intercept means that if the temperature is 0°C, coat sales are predicted to be \$1,250.**

Reflection

1. Circle the problem that was the most challenging for you.

2. Use this space to ask a question or share something you're proud of.

Lesson Practice 8.6.11

Lesson Summary

You can use specific types of two-way tables and bar graphs to show frequencies and percentages within data sets.

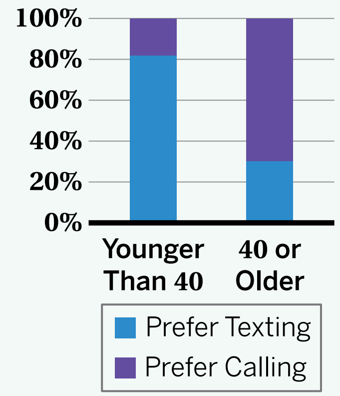
The **relative frequency** of a category is the fraction or percentage of the data set that's in that category. A two-way table of relative frequencies shows the fraction or percentage of each category instead of the number of data points.

Relative Frequencies

	Prefer Texting	Prefer Calling	Total
Younger Than 40	82%	18%	100%
40 or Older	33%	67%	100%

A **segmented bar graph** compares different categories within a data set. Each bar represents all the data within one category, or 100%. The bars are each separated into parts, or segments, that show what percentage each part makes up of the whole category.

Segmented Bar Graph



We can use representations like these to identify associations between two categorical variables. For example, the table and graph show an association between categorical variables, age, and communication preference.

Things to Remember:

Lesson Practice
8.6.11

Name: .... Date: .... Period: ....

Problems 1–4: A farmer brings produce to the farmer's market and records whether people bought lettuce, apples, both, or neither.

	Bought Apples	Did Not Buy Apples	Total
Bought Lettuce	14	58	72
Did Not Buy Lettuce	8	29	37
Total	22	87	109

1. How many people bought lettuce?

72

2. How many people bought lettuce *and* apples?

14

3. Complete the table to show the relative frequencies for each row.

	Bought Apples	Did Not Buy Apples	Total
Bought Lettuce	19%	81%	100%
Did Not Buy Lettuce	22%	78%	100%

4. Based on the data, is there an association between buying lettuce and buying apples? Explain your thinking.

No. *Explanations vary.* The relative frequency for buying apples is roughly the same whether lettuce was bought or not.

Problems 5–7: Researchers want to study news-reading habits among different age groups. They asked whether people primarily read news articles in print or on the internet.

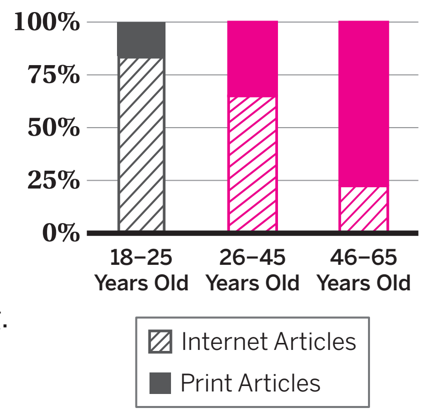
	Internet Articles	Print Articles
18–25 Years Old	151	28
26–45 Years Old	132	72
46–65 Years Old	48	165

5. Calculate the relative frequencies for each age group.

	Internet Articles	Print Articles	Total
18–25 Years Old	84%	16%	100%
26–45 Years Old	65%	35%	100%
46–65 Years Old	23%	77%	100%

6. Complete the segmented bar graph by drawing the missing bars. Create one segmented bar for each row of the table.

Response shown on graph.



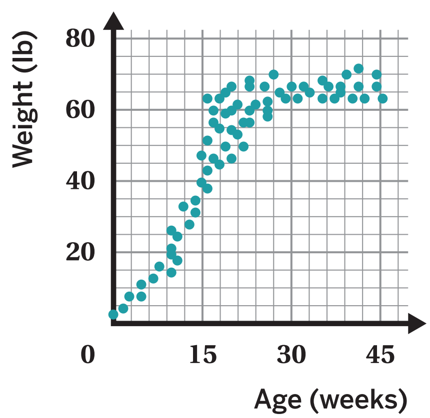
7. Is there an association between age groups and the method they use to read articles? Explain your thinking.

Yes. *Explanations vary.* Younger age groups are more likely to read internet articles than print articles, while the opposite is true for the oldest age group.

Spiral Review

8. Select *all* the phrases that describe the association on this scatter plot showing the age and weight of a group of male huskies.

- ☐ **A.** Linear association
- ☐ **B.** Negative association
- ☑ **C.** Non-linear association
- ☐ **D.** No association
- ☑ **E.** Positive association



9. In a class of 25 students, some students play a sport, some play a musical instrument, some do both, and some do neither. Complete the table.

	Plays an Instrument	Does Not Play an Instrument	Total
Plays a Sport	**1**	11	**12**
Does Not Play a Sport	9	**4**	13
Total	10	**15**	25

Reflection

1. Circle a problem you're still curious about.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

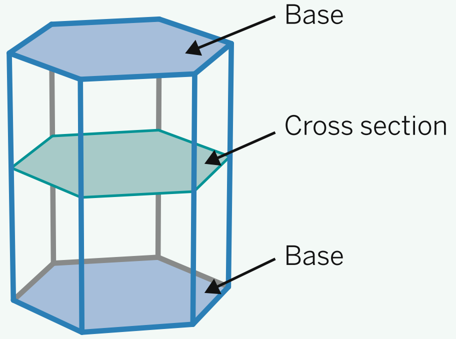
A **cross section** is the shape you see when you cut through a three-dimensional figure.

For example, if you cut a hexagonal *prism* parallel to the *base*, the cross section is a hexagon that is the same size as the base. If you make a vertical cut instead, the cross section is a rectangle that is as tall as the prism.

If you cut a hexagonal *pyramid* parallel to the base, the cross section is a hexagon that is smaller than the base. If you make a vertical cut instead, the cross section is a triangle that is taller than it is wide.

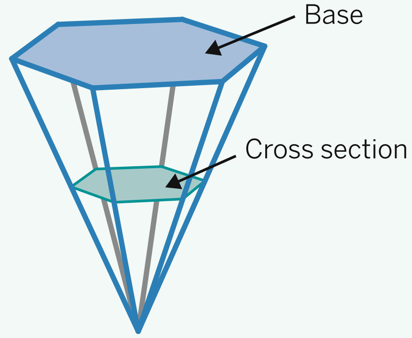
Prism

Hexagonal Prism



Pyramid

Hexagonal Pyramid



Things to Remember:

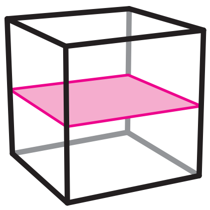
Lesson Practice
7.7.09

Name: ______ Date: ______ Period: ______

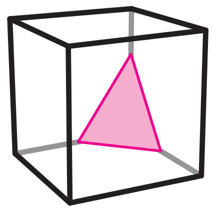
Problems 1–3: Show how to cut a cube to make each cross section.

Sample shown on figures.

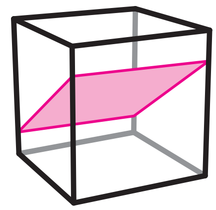
1. Square



2. Triangle

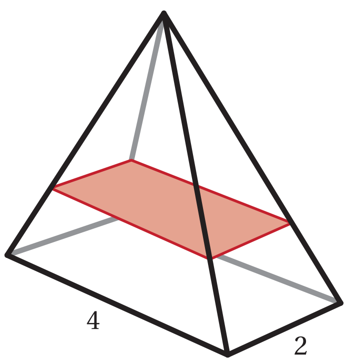


3. Rectangle



Problems 4–5: Determine how each cross section will change.

4. Here is a pyramid that has been cut parallel to its base. What will happen to the area of the cross section as the cut moves closer to the base?

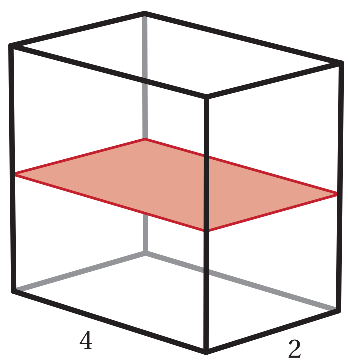


A. Increase

B. Decrease

C. Stay the same

5. Here is a rectangular prism that has been cut parallel to its base. What will happen to the area of the cross section as the cut moves closer to the base?



A. Increase

B. Decrease

C. Stay the same

6. Cuts are made through a cube and a right square pyramid. One cut is vertical and one cut is horizontal. Select *all* the statements that are true about the two-dimensional cross sections that could result from one of these cuts.

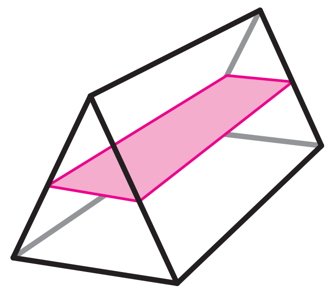
- ☐ **A.** A triangle could result from one of these slices through the cube.
- ☑ **B.** A square could result from one of these slices through the cube.
- ☐ **C.** A rectangle, but not a square, could result from one of these slices through the cube.
- ☑ **D.** A triangle could result from one of these slices through the pyramid.
- ☑ **E.** A square could result from one of these slices through the pyramid.

Lesson Practice
7.7.09

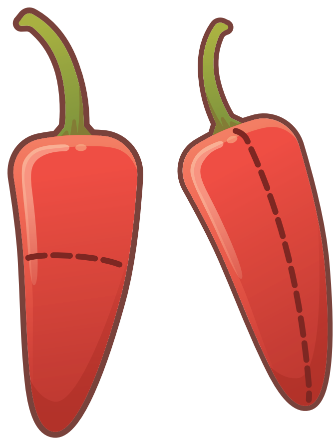
Name: ______________ Date: ______ Period: ______

7. Kris says: *No matter which way you cut this triangular prism, the cross section will be a triangle*. Sid says: *I'm not so sure*. Describe or show a cut that Sid might be thinking of.

***Responses vary*. Sample shown on figure. Sid might be thinking of cutting the prism parallel to one of the rectangular faces.**



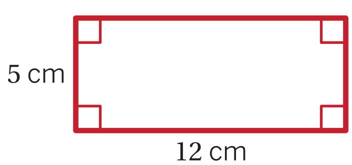
8. Here are two peppers. One is cut horizontally, and the other is cut vertically, producing different cross sections. Sketch the two cross sections.



Spiral Review

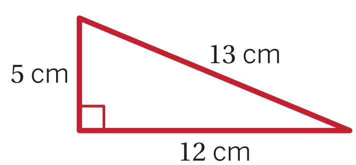
Problems 9–11: Determine the area of each shape.

9.



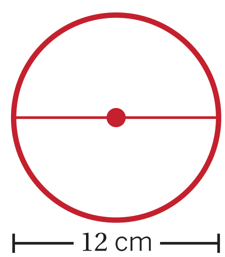
60 square centimeters

10.



30 square centimeters

11.



36π square centimeters (or equivalent)

12. Select *all* the expressions that are equivalent to $3x - 4 + 2x - 6$.

- ☐ **A.** $x - 2$
- ☐ **B.** $5x - 2$
- ☑ **C.** $5(x - 2)$
- ☐ **D.** $5x + 10$
- ☑ **E.** $5x - 10$

Reflection

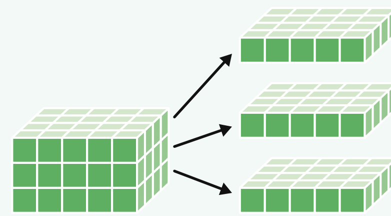
1. Star a problem you are still feeling confused about.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

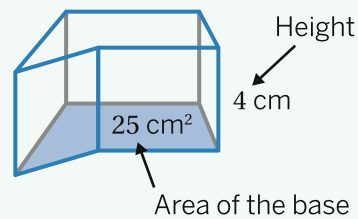
Any cross section of a prism that is parallel to the base will be identical to the base. This means you can slice a prism into layers to help you calculate its *volume*.

For example, if you have a rectangular prism that is 3 units tall and has a base that is 4 units by 5 units, you can imagine the prism as 3 layers of $4 \cdot 5$ cubic units.



That means the volume of this rectangular prism is $(4 \cdot 5) \cdot 3$ cubic units.

In general, you can calculate the volume of any prism by multiplying the area of its base by its height.



In other words, the volume of a prism is $V = B \cdot h$, where h is its height and B is the area of its base.

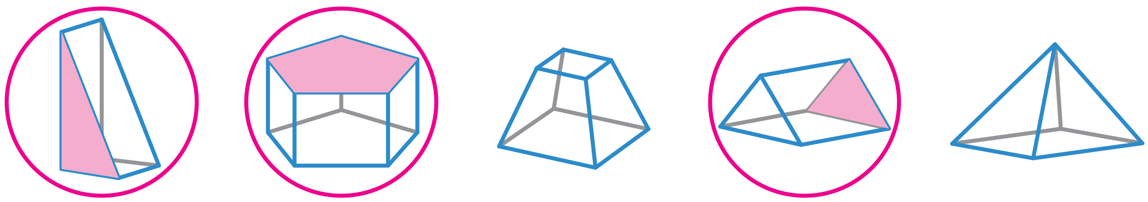
For example, this prism has a volume of 100 cubic centimeters because $25 \cdot 4 = 100$.

Things to Remember:

Lesson Practice
7.7.10

Name: ______________ Date: ______ Period: ______

Problems 1–2: Here is a set of 3-D objects.



Object A Object B Object C Object D Object E

1. Circle all of the prisms.

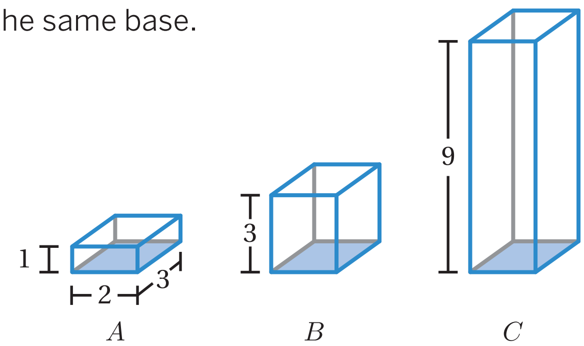
2. For each prism, shade one of the bases.
   Sample shown on figures.

Problems 3–5: Here are three prisms with the same base.

3. Determine the volume of prism A.
   6 cubic units

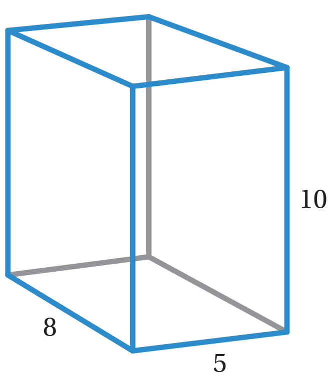
4. Determine the volume of prism B.
   18 cubic units

5. Determine the volume of prism C.
   54 cubic units



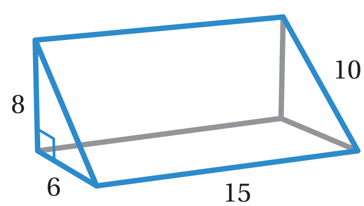
Problems 6–7: Determine the volume of each prism. Show or explain your thinking.

6.



400 cubic units. ***Explanations vary.*** **This shape is a prism, so the volume is the area of the base multiplied by the height. $40 \cdot 10 = 400$ cubic units.**

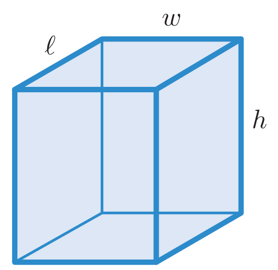
7.



360 cubic units. ***Explanations vary.*** **This shape is a prism, so the volume is the area of the base multiplied by the height. $24 \cdot 15 = 360$ cubic units.**

8. Fill in the table using the numbers 1 to 9 only once to create two prisms with the same volume. ***Responses vary.***

	Prism 1 (units)	Prism 2 (units)
Length, ℓ	1	3
Width, w	8	4
Height, h	9	6



Spiral Review

9. Select *all* the expressions that are equivalent to $3(x - 2) + 5$.

- [ ] **A.** $3x + 3$
- [ ] **B.** $3(x - 1)$
- [x] **C.** $3x - 1$
- [x] **D.** $-1 + 3x$
- [ ] **E.** $1 - 3x$

10. Mayra buys a \$25 hat. The sales tax is 6.25%. How much will Mayra spend in total, including the tax?

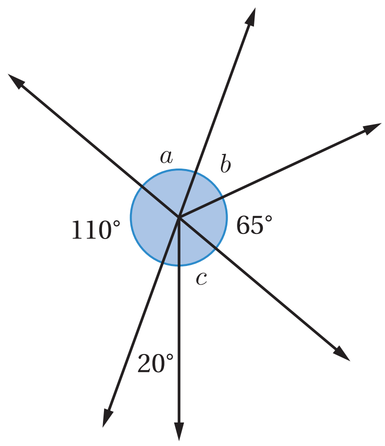
\$26.56

11. Here is a diagram. Determine the values of a, b, and c.

$a = 70°$

$b = 45°$

$c = 50°$



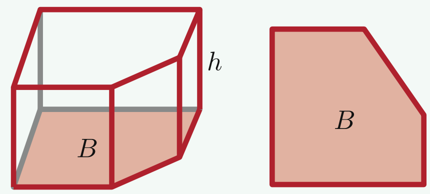
Reflection

1. Circle the problem you're most interested in knowing more about.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

To calculate the volume of a prism, you can multiply the area of the base, B, by the height, h.

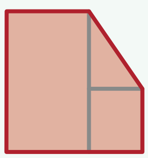


Sometimes the shape of a prism's base is a more complex *polygon*.

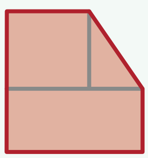
There are many strategies for calculating the area of a complex shape, including breaking it into rectangles and triangles, or surrounding the shape in a rectangle and subtracting the missing piece.

Here are three first steps you might take in calculating the area of this prism's base:

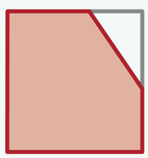
Example 1



Example 2



Example 3

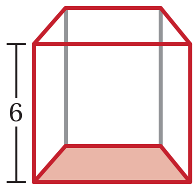


Things to Remember:

Name: .... Date: .... Period: ....

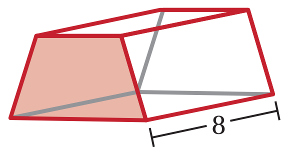
Problems 1–2: The volume of each prism is 24 cubic units. What is the area of each prism's base?

1.



Area of the base: 4 square units

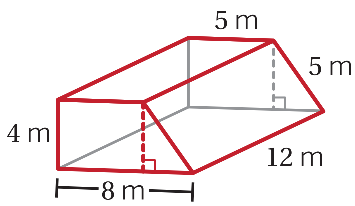
2.



Area of the base: 3 square units

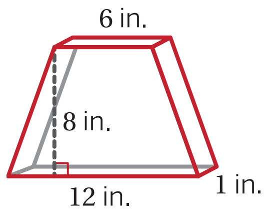
Problems 3–5: Determine the volume of each prism. Show or explain your thinking.

3.



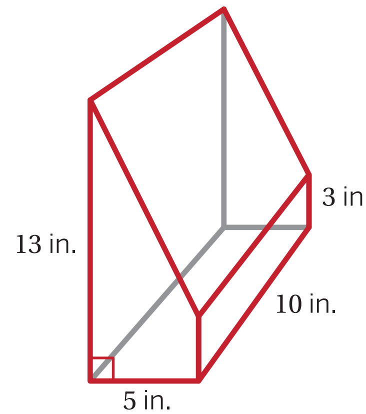
312 cubic meters. ***Explanations vary.*** **The base of the pyramid is a trapezoid. The area of the base can be split into a rectangle and a triangle. The area of the rectangle is 20 square meters. The area of the triangle is 6 square meters. $26 \cdot 12 = 312$**

4.



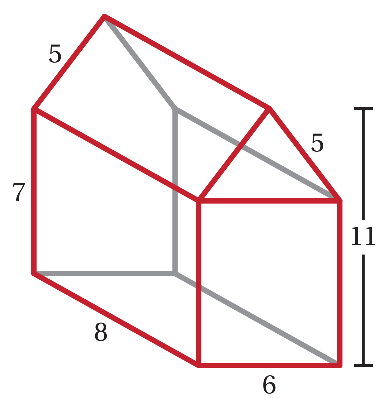
72 cubic inches. ***Explanations vary.*** **The base of this prism is a trapezoid. The area of the base can be found by rearranging the trapezoid into an 8-by-9 inch rectangle. $72 \cdot 1 = 72$**

5.



400 cubic inches. ***Explanations vary.*** **The area of the base can be split into a rectangle and a triangle. The area of the rectangle is 15 square inches and the area of the triangle is 25 square inches. $40 \cdot 10 = 400$**

6. We can create a house-shaped prism by attaching a triangular prism on top of a rectangular prism. Select *all* the true statements about the house-shaped prism.



☐ **A.** The shape of the base is a triangle.

☑ **B.** The shape of the base is a pentagon.

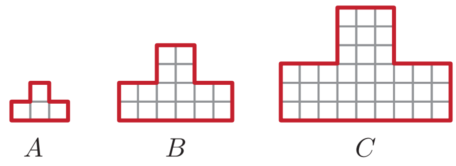
☑ **C.** The area of the base is 54 square units.

☐ **D.** The area of the base is 42 square units.

☑ **E.** The volume of the prism is 432 cubic units.

Name: ______ Date: ______ Period: ______

7. Here are the bases of three different prisms. They all have the same volume. How tall could each prism be? Explain your thinking.



***Responses vary.* The area of base A is 4 square units, base B is 16 square units, and base C is 36 square units. If A were 36 units high, its volume would be $36 \cdot 4 = 144$ cubic units. Then B could be $\frac{144}{16} = 9$ units high and C could be $\frac{144}{36} = 4$ units high.**

Spiral Review

Problems 8–11: Write each fraction as a decimal.

8. $\frac{1}{2} = \mathbf{0.5}$

9. $\frac{1}{4} = \mathbf{0.25}$

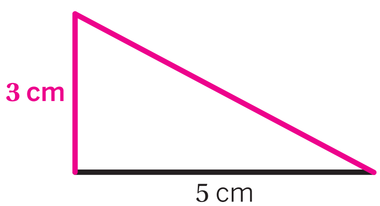
10. $\frac{3}{4} = \mathbf{0.75}$

11. $\frac{1}{5} = \mathbf{0.2}$

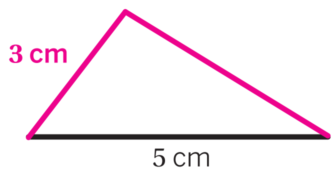
Problems 12–13: Two different triangles each have one side that is 5 centimeters long and one side that is 3 centimeters long.

12. Sketch two non-identical triangles with these measurements.

Triangle A



Triangle B



13. Explain how you can tell that your two triangles are not identical.

***Explanations vary.* For one of the triangles, the 5-centimeter side is the longest side. For the other triangle, it is the second-longest side.**

Reflection

1. Star the problem you spent the most time on.

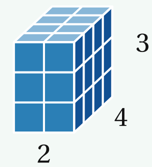
2. Use this space to ask a question or share something you're proud of.

Lesson Practice 7.7.12

Lesson Summary

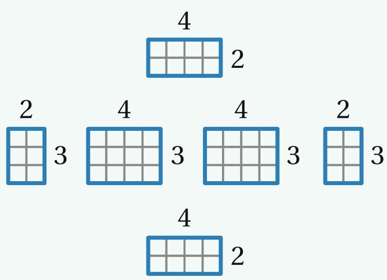
The *surface area* of a three-dimensional shape is the number of square units that cover all the faces of the polyhedron, without any gaps or overlaps.

Here are two strategies for calculating the surface area of a rectangular prism.



Strategy 1

Calculate the area of each face separately and then add all of the areas.

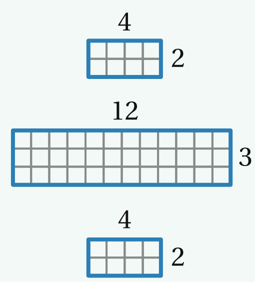


$$8 + 6 + 12 + 12 + 6 + 8 = 52$$

Surface area: 52 square units

Strategy 2

Break the prism into its two identical bases and unfold the sides into one long rectangle. Add the three areas.



$$8 + 36 + 8 = 52$$

Surface area: 52 square units

Using either strategy to calculate the surface area or using equivalent calculations will result in the same total surface area.

Things to Remember:

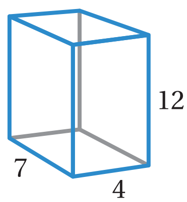
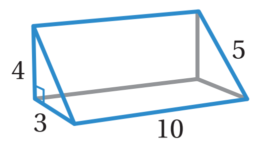
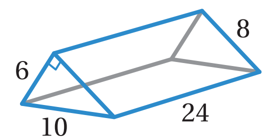
Lesson Practice
7.7.12

Name: ______ Date: ______ Period: ______

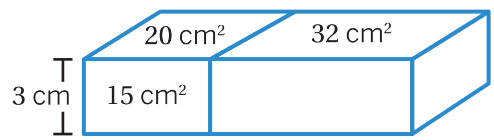
1. Select *all* the situations where knowing the surface area of an object would be useful.

- ☑ **A.** The amount of paint needed to paint a room.
- ☐ **B.** The amount of water needed to fill an aquarium.
- ☑ **C.** How much wrapping paper a gift will need.
- ☐ **D.** How many watermelons fit in a box for shipping.
- ☐ **E.** The amount of gasoline left in the tank of a vehicle.

Problems 2–4: Determine the volume and surface area of each prism.

	2. 	**3.** 	**4.** 
Volume (cubic units)	336	60	576
Surface Area (square units)	320	132	624

5. Determine the surface area and volume of this shape.



Show or explain your thinking.

Surface area: **206 square centimeters. *Explanations vary*. The prism is made of two smaller prisms. The first of the smaller prisms has five faces showing with a total surface area of 82 square centimeters. The second of the smaller prisms has five faces showing with a total surface area of 124 square centimeters. Combined, the two smaller prisms' surface areas are 206 square centimeters.**

Volume: **156 cubic centimeters. *Explanations vary*. The first of the smaller prisms has a volume of $3 \cdot 5 \cdot 4 = 60$, or 60 cubic centimeters. The second of the smaller prisms has a volume of $3 \cdot 8 \cdot 4 = 96$, or 96 cubic centimeters. Combined, the two smaller prisms' volumes are 156 cubic centimeters, which is the total volume of the larger prism.**

Lesson Practice
7.7.12

Name: .... Date: .... Period: ....

Spiral Review

Problems 6–9: Write each fraction as a percentage.

6. $\frac{1}{4}$ **= 25%**

7. $\frac{1}{5}$ **= 20%**

8. $\frac{3}{5}$ **= 60%**

9. $\frac{3}{10}$ **= 30%**

Problems 10–11: In a 4-by-6 foot Colorado state flag, the gold-colored circle has a 1-foot radius.

Public Domain

10. How much gold fabric is needed to create the flag?

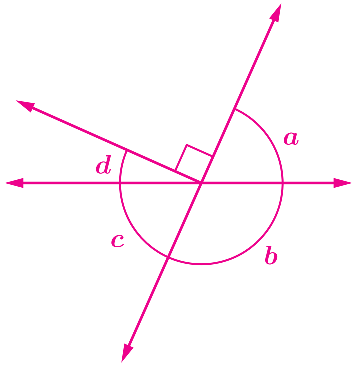
π square feet (or equivalent)

11. What percent of the flag is gold?

About 13%

12. Draw one or more diagrams that show complementary and supplementary angles.

***Responses vary.* In this diagram, the angles marked c and d are complementary and the angles marked a and b are supplementary.**



Reflection

1. Put a heart next to the problem you're most proud of.

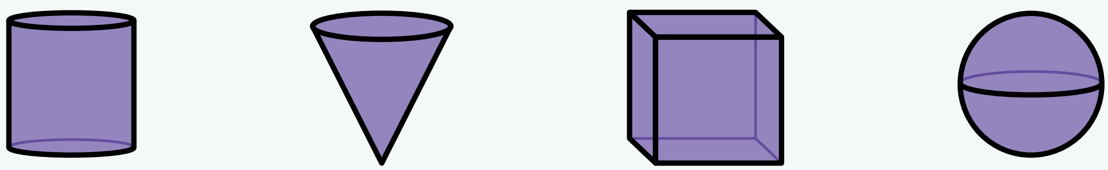
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

The *volume* of an object is the number of cubic units that fill its three-dimensional region without any gaps or overlaps.

You can often determine relationships between the volumes of different figures with similar measurements. For example, if the base of a **cone** and a **cylinder** have the same *diameter* and height, then the cylinder will have a volume that is three times greater than the cone.

There are also relationships between the volumes of the same figure with different measurements. For example, if the diameter of a **sphere** is doubled, or if the side length of a cube is doubled, the original volume of these figures will be multiplied by 8.

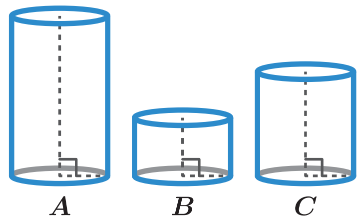


Things to Remember:

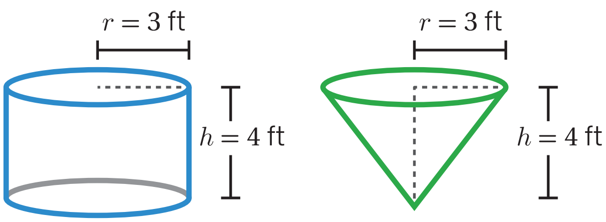
Lesson Practice
8.5.10

Name: .... Date: .... Period: ....

1. Cylinders A, B, and C have the same radius but different heights. Order the cylinders from *least* volume to *greatest* volume.



2. Here is a cylinder and a cone with the same base and height. How much more water would you need to fill the cylinder than the cone?



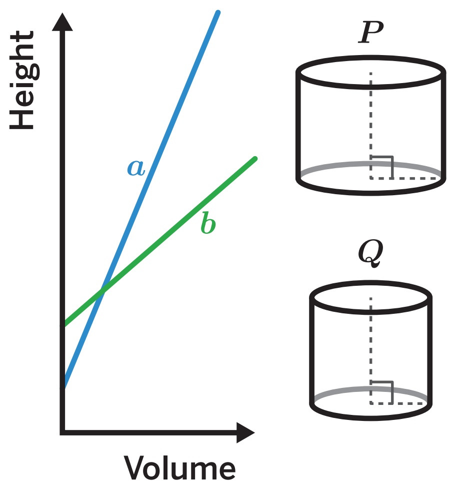
   A. 3 times as much

   B. 2 times as much

   C. 5 times as much

   D. 4 times as much

Problems 3–4: Cylinders P and Q have the same height. Each starts off filled with different amounts of water. The graph shows the height of the water in each cylinder as the volume of water increases.



3. Match lines a and b to cylinders P and Q.

Cylinder	Line
P	
Q	

4. Describe what the slopes of lines a and b represent in this situation.

Lesson Practice
8.5.10

Name: ____________ Date: ________ Period: ________

Spiral Review

5. The area of a circle is approximately 201.06 square inches. What is its radius in inches?

6. Match each circle with its area.

- Circle A has a radius of 4 units.
- Circle B has a radius of 10 units.
- Circle C has a radius of 8 units.

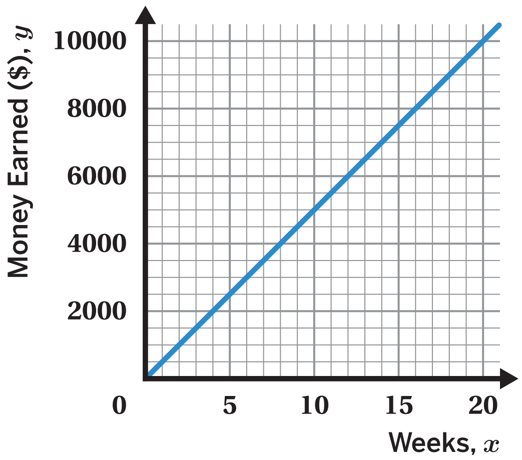
Area of the Circle	Circle
About 314 square units	
64π square units	
16π square units	

7. Here are two expressions that represent the volume of liquid in two different containers after t seconds:

- $1250 - 25t$ represents the volume of liquid in Container A.
- $50t + 250$ represents the volume of liquid in Container B.

What does the equation $1250 - 25t = 50t + 250$ represent in this situation?

8. Mai earns $\$1{,}710$ every 3 weeks by working as a freelance photographer. Jayla is also a freelance photographer whose earnings are represented by the graph. Who earns more per week, and how much more? Show or explain your thinking.



Reflection

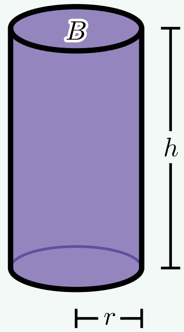
1. Put a star next to a problem you want to understand better.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

A prism has two congruent bases connected by perpendicular lines. Its volume can be determined by multiplying the area of its base by its height. A cylinder has two congruent circles for its base and the sides are perpendicular to the bases. This means you can also determine the volume of a cylinder by using the area of its base multiplied by its height.

If you know the radius and height of a cylinder, then you can determine the volume of the cylinder. The base area is determined using the expression $\pi \bullet r^2$. The volume, in cubic units, can be determined by multiplying the base area by the height, h. The formula for the volume of a cylinder is $V = \pi r^2 \bullet h$.



$V = \pi r^2 \bullet h$

Things to Remember:

Lesson Practice
8.5.11

Name: ______ Date: ______ Period: ______

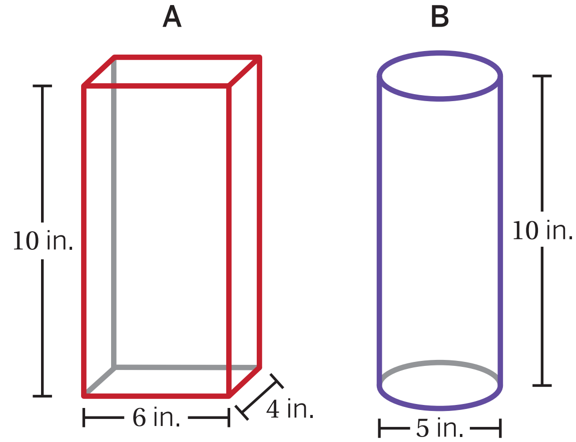
Problems 1–3: Draw a cylinder.

1. Label the radius 3 units and the height 10 units.

2. Determine the area of the base. Write your response in terms of π.

3. Determine the volume of the cylinder. Write your response in terms of π.

Problems 4–6: Containers A and B hold oatmeal. Container A is a rectangular prism and Container B is a cylinder.

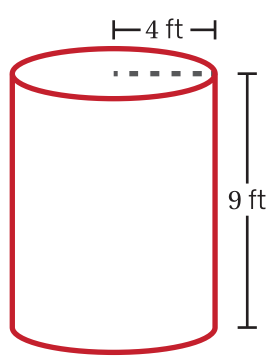


4. The diameter of Container B is 5 inches. What is its radius?

5. Which container's base has a larger area? Explain your thinking.

6. Which has a larger volume: Container A or B? Explain your thinking.

7. Here is a cylinder with a radius of 4 feet and a height of 9 feet. What is the volume of the cylinder in cubic feet? Round your answer to the nearest hundredth.

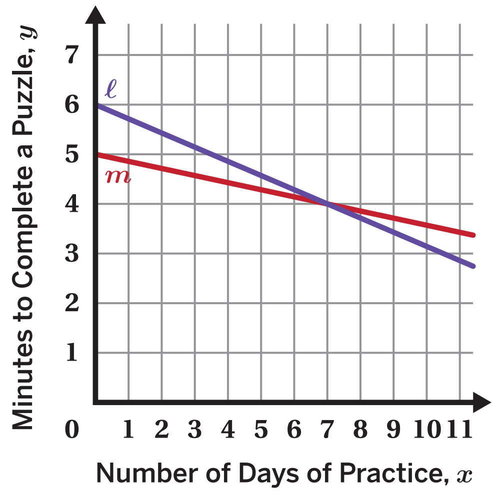


Lesson Practice
8.5.11

Name: .... Date: .... Period: ....

Spiral Review

Problems 8–9: Two students join a puzzle-solving club, and they each improve their completion time as they practice. Student A improves their completion time at a faster rate than Student B.



8. Match each student with the line that represents their time.

9. Which student completed puzzles faster before practicing? Explain your thinking.

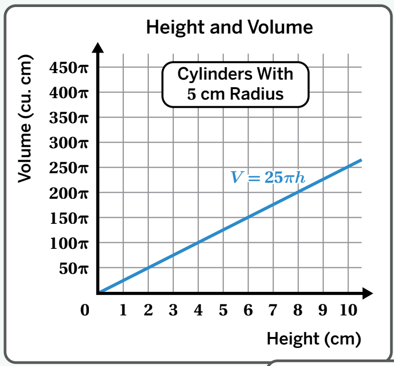
Reflection

1. Put a heart next to the problem you found most interesting.

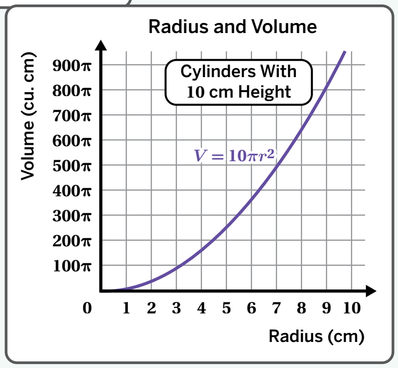
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

The volume of a cylinder depends on the cylinder's radius and height. The formula for the volume of a cylinder is $V = \pi r^2 h$, where r represents the radius and h represents the height.



When a cylinder's height, h, increases at a constant rate, the cylinder's volume, V, also increases at a constant rate. This means there is a proportional linear relationship between the height and volume. That's why we can represent the relationship between volume and height with a straight line.



On the other hand, we *cannot* represent the relationship between a cylinder's radius and volume with a line because the ratio of the volume to the radius changes as the radius increases. That's why the graph of the relationship between radius and volume is curved and non-linear.

Things to Remember:

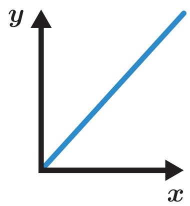
Lesson Practice
8.5.12

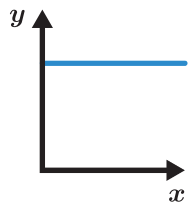
Name: ______ Date: ______ Period: ______

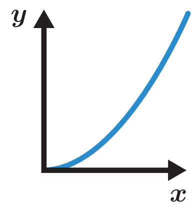
1. Each row of this table lists information about a specific cylinder. Complete the table.

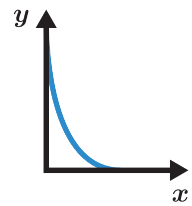
Diameter (units)	Area of Base (sq. units)	Height (units)	Volume (cu. units)
4		10	
6			63π
	25π	6	

2. Which graph could represent the volume of water in a cylinder as a function of its height if the radius is held constant? Explain your thinking.

A. 

B. 

C. 

D. 

Problems 3–6: Imagine several cylinders that all have a height of 18 meters. Let r represent the radiuses of the cylinders, in meters, and V represent the volume of the cylinders, in cubic meters.

3. Write an equation that represents the relationship between the volume, V, and the radius, r, for all cylinders with a height of 18 meters.

4. Complete this table:

r (m)	1	2	3
V (cu. m)			

5. If the radius of a cylinder is doubled, does the volume double? Explain your thinking.

6. Is the graph representing the relationship between a cylinder's volume and its radius linear? Explain your thinking.

7. A cylinder has a volume of 48π cubic centimeters and a height represented by h.

Complete this table with the volumes of other cylinders that have the same radius but different heights.

Height (cm)	Volume (cu. cm)
h	48π
$2h$	
$5h$	
$\frac{h}{2}$	
$\frac{h}{5}$	

8. Which change do you think would increase the volume of a cylinder the most — doubling the radius or doubling the height? Explain your thinking.

Spiral Review

Problems 9–10: A gas company's delivery truck has a cylindrical tank with a diameter of 14 feet and a height of 40 feet.

9. Draw the tank, then label its radius and height.

10. How much gas can fit in the tank? Show or explain your thinking.

Reflection

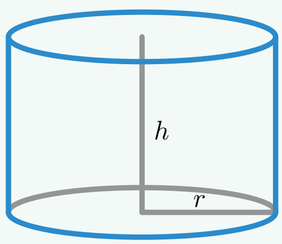
1. Circle the problem you feel least confident about.

2. Use this space to ask a question or share something you're proud of.

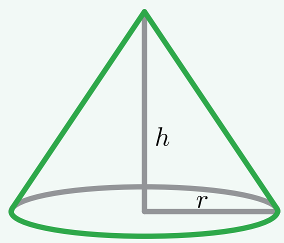
Lesson Summary

We learned that we can find the volume of a cylinder by calculating $V = \pi r^2 \cdot h$. If a cone and a cylinder have the same base and the same height, then the volume of the cone is one-third the volume of the cylinder.

If the radius and the height are known, we can determine the volume by using this formula for a cone: $V = \frac{1}{3}\pi r^2 \cdot h$.



Volume of a cylinder:
$V = \pi r^2 h$



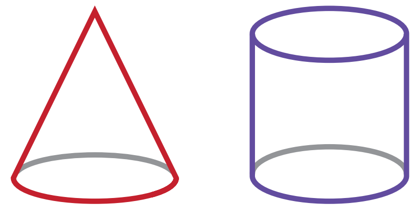
Volume of a cone:
$V = \frac{1}{3}\pi r^2 h$

Things to Remember:

Lesson Practice
8.5.13

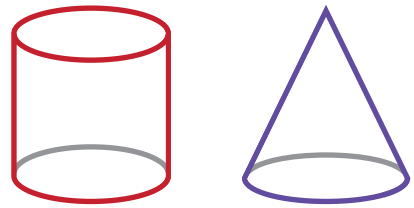
Name: ______ Date: ______ Period: ______

1. The volume of a cone is 36π cubic units. What is the volume of a cylinder with the same radius and the same height?



$V = 36\pi$ $\quad$ $V = ?$

2. The volume of a cylinder is 175π cubic units. What is the volume of a cone with the same radius and the same height?



$V = 175\pi$ $\quad$ $V = ?$

3. A cylinder and a cone have the same height and radius. The height of each is 5 centimeters, and the radius is 2 centimeters. Calculate the volume of the cylinder and the cone (rounded to the nearest tenth). Use 3.14 as an approximation for π.

Cylinder: ______

Cone: ______

Problems 4–6: This table shows the radiuses of four cones with a height of 18 meters.

4. Complete the table with the volume of each cone.

Radius (m)	Volume (cu. m)
1	
2	
3	
4	

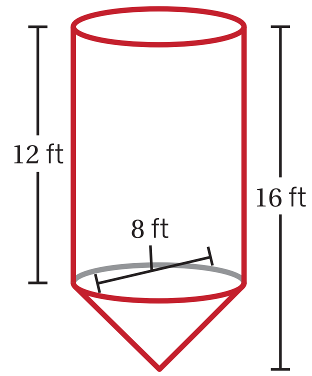
5. Based on your table, if the radius of a cone doubles, does the volume also double? Explain your thinking.

6. Based on your table, is the relationship between the radius of a cone and its volume linear? Explain your thinking.

Name: .... Date: .... Period: ....

7. A silo is a large cylindrical container used on farms to hold grain. On Estaban's farm, a silo has a cone-shaped spout on the bottom to regulate the flow of grain going out. The diameter of the silo is 8 feet. The cylindrical part of the silo has a height of 12 feet, and the height of the entire silo is 16 feet.

Approximately how many cubic feet of grain can the entire silo hold? Explain your thinking.



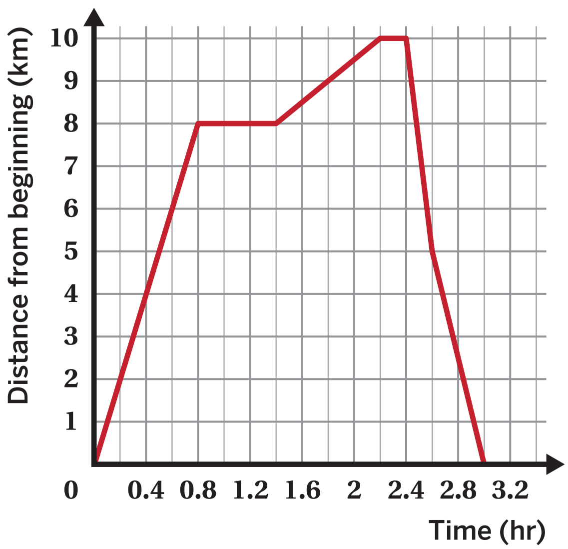
Spiral Review

Problems 8–10: This graph shows a trip on a bike trail.

8. When was the bike rider going the fastest?

9. During what times did the rider stop?

10. During what times was the rider going back toward the beginning of the trail?



Reflection

1. Put a star next to a problem you could explain to a classmate.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

Knowing when to calculate volume and surface area can be helpful in answering questions about situations in context.

Questions related to volume:

- How much water can a container hold?
- How much material did it take to build a solid object?

Questions related to surface area:

- How much fabric is needed to cover a surface?
- How much of an object needs to be painted?

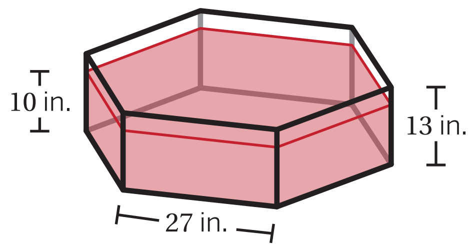
One way to decide if a question is asking about volume or surface area is to think about the units of measure. Volume is measured in cubic units and surface area is measured in square units.

Things to Remember:

Lesson Practice
7.7.13

Name: ______________________ Date: __________ Period: __________

Problems 1–3: Here is a new sandbox Polina is designing for her local playground.



1. Polina knows she needs 18,940 cubic inches of sand to fill the sandbox up 10 inches. What is the area of the sandbox's base?

1,894 square inches

2. If Polina wanted to fill the sandbox up 3 more inches to the top, how much more sand would she need?

5,682 cubic inches

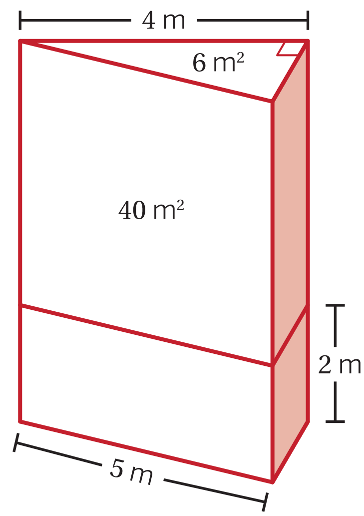
3. Polina wants to paint the entire outside of the sandbox (not including the bottom). How many square inches will she need to cover with paint? Explain your thinking.

2,106 square inches. *Explanations vary.* She will need $13 \cdot 27 = 351$ square inches of paint for each side, and $351 \cdot 6 = 2106$ square inches in total.

4. There are two boxes of cereal in the shape of rectangular prisms. The first box has a height of 10 inches, a length of 8 inches, and a width of 3.5 inches. The second box has a height of 10 inches, a length of 7.5 inches, and a width of 2.5 inches. What is the difference in volume, in cubic inches, between the two boxes of cereal?

A. 467.5 **B.** 92.5 **C.** 280 **D.** 375

Problems 5–6: Here is a pair of stacked triangular prisms with bases of the same size.



5. Determine the surface area of this shape.

132 square meters

6. Determine the volume of this shape.

60 cubic meters

Lesson Practice
7.7.13

Name: .... Date: .... Period: ....

Spiral Review

Problems 7–10: Write each decimal or percentage as a fraction.

7. $0.25 = \frac{1}{4}$ **(or equivalent)**

8. $40\% = \frac{2}{5}$ **(or equivalent)**

9. $1\% = \frac{1}{100}$

10. $0.8 = \frac{4}{5}$ **(or equivalent)**

Problems 11–13: A customer buys a winter jacket at a used clothing store that costs $\$30$. The sales tax is 6% where they live.

11. How much does the customer pay in total?

$31.80

12. Write an equation that represents the total cost (including sales tax), c, of any item bought in this store with price p.

$c = 1.06p$ **(or equivalent)**

13. The customer buys a backpack at a different store. It is on sale for 30% off. The customer pays $\$33.39$ total (including sales tax). What was the original price of the backpack?

$45

Reflection

1. Circle the problem you think will help you most on the End-of-Unit Assessment.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

Expressions with *exponents* are useful for representing repeated multiplication. In the expression 3^5, 5 is the exponent. When the exponent is a positive integer, it says how many times the number or expression is multiplied.

For example, $3^5 = \underbrace{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}_{\text{5 times}}$. Imagine writing 3^{100} using multiplication!

Here are a few more examples:

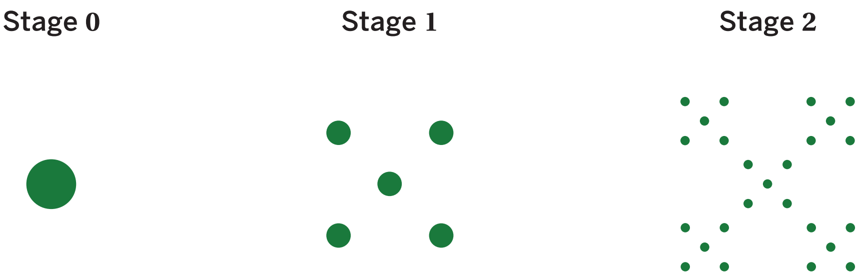
- $7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 = 7^5$
- $5 \cdot 8 \cdot 5 \cdot 8 \cdot 5 \cdot 8 \cdot 5 = 5^4 \cdot 8^3$
- $10 \cdot 10 \cdot 10 + 10 \cdot 10 = 10^3 + 10^2$

Things to Remember:

Lesson Practice
8.7.01

Name: ______________ Date: ________ Period: ________

1. Here are three stages of a pattern of circles.



How many circles will there be in Stage 4?

5^4 (or equivalent)

2. Complete the table.

Expanded Expression	Exponent Expression	Value
$3 \cdot 3 \cdot 3 \cdot 3$	3^4	81
$7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$	7^5	$16{,}807$
$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	2^5	32
$4 \cdot 4 \cdot 4$	4^3	64

Problems 3–4: Write an equivalent expression that uses exponents.

3. $2 \cdot 9 \cdot 2 \cdot 9 \cdot 2 \cdot 2$

$2^4 \cdot 9^2$ (or equivalent)

4. $7 \cdot 7 \cdot 7 + 7 \cdot 7 \cdot 7 \cdot 7$

$7^3 + 7^4$ (or equivalent)

5. Each day, the number of grains of rice you have triples. On Day 1, you have 3 grains of rice. On Day 2, you have 9 grains of rice. On what day will you have 243 grains of rice?

Day 5

Show or explain your thinking.

Explanations vary. **$3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 243$, so you will have 243 grains of rice on Day 5.**

6. Adnan starts with two coins on Day 1. The number of coins doubles every day. How many coins will Adnan have on Day 8? Write your answer as an expression with an exponent.

2^8

Lesson Practice
8.7.01

Name: ______________________ Date: __________ Period: __________

Spiral Review

7. Which expression is equivalent to $10000 + 225$?

A. $10^3 + 9 \cdot 25$ B. $10^4 + 15^2$ C. $100^3 + 9 \cdot 25$ D. $1000^2 + 15^2$

8. The points $(2, 4)$ and $(6, 7)$ lie on a line. What is the slope of the line?

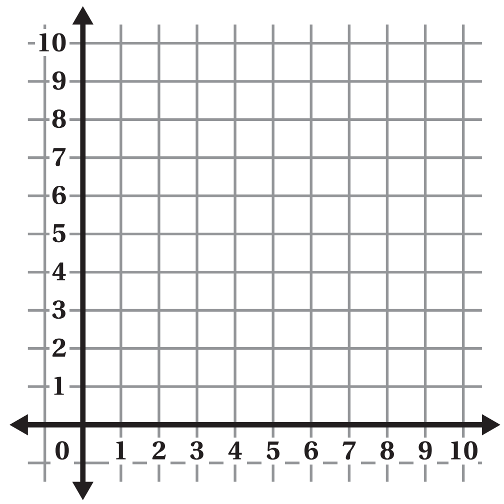
Sketch on the grid if it helps with your thinking.

A. 2

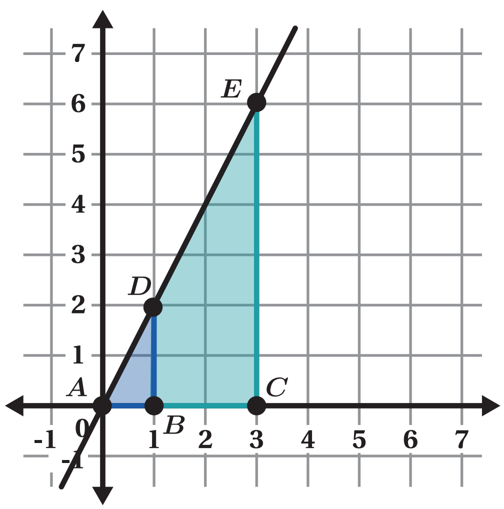
B. 1

C. $\frac{4}{3}$

D. $\frac{3}{4}$



Problems 9–10: Here is a diagram that shows a pair of similar figures.



9. What does the center of dilation need to be to dilate triangle ACE onto triangle ABD?

Point A or $(0, 0)$

10. What does the scale factor need to be to dilate triangle ACE onto triangle ABD?

$\frac{1}{3}$

Reflection

1. Circle the problem you enjoyed doing the most.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

Expanding is one strategy for determining if expressions with exponents are equivalent.

Here are two **powers of ten** that are equivalent to 10^8. Each expression can be expanded to "$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$."

- $10^5 \cdot 10^3 = (10 \cdot 10 \cdot 10 \cdot 10 \cdot 10) \cdot (10 \cdot 10 \cdot 10) = 10^8$
- $(10^2)^4 = (10 \cdot 10) \cdot (10 \cdot 10) \cdot (10 \cdot 10) \cdot (10 \cdot 10) = 10^8$

Things to Remember:

Lesson Practice
8.7.02

Name: ______ Date: ______ Period: ______

Problems 1–2: For each expression, write an equivalent expression with a single power. Two examples are shown.

1.

Expression	Single Power
$6^3 \cdot 6^9$	6^{12}
$2 \cdot 2^4$	2^5
$12^5 \cdot 12^{12}$	12^{17}
$7^6 \cdot 7^6 \cdot 7^6$	7^{18}

2.

Expression	Single Power
$(3^7)^2$	3^{14}
$(2^9)^3$	2^{27}
$(7^6)^3$	7^{18}
$(11^2)^3$	11^6

3. Which expression is equivalent to $6^4 \cdot 2^4$?

A. 8^4 **B.** 8^8 **C.** 12^4 **D.** 12^{16}

Problems 4–6: Here is a large rectangular swimming pool. The pool is filled to the top with water.

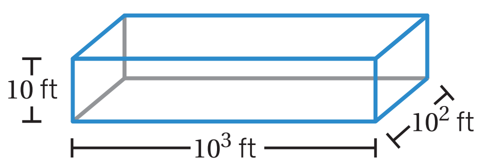


Figure may not be drawn to scale.

4. Write an expression with exponents to represent how much water the pool holds.

$10^3 \cdot 10^2 \cdot 10^1$ cubic feet
(or equivalent)

5. Write an equivalent expression with a single power.

10^6 cubic feet

6. You want to buy a cover to put on top of the pool. Write an expression with exponents to represent the area of the cover you need to buy.

$10^3 \cdot 10^2$ square feet
(or equivalent)

7. Select *all* the expressions that are equivalent to 6^8.

- ☑ **A.** $2^8 \cdot 3^8$
- ☐ **B.** $(6^4)^4$
- ☑ **C.** $(6^2)^4$
- ☐ **D.** $6^4 + 6^4$
- ☐ **E.** $6^4 \cdot 6^2$

Lesson Practice
8.7.02

Name: ________ Date: ________ Period: ________

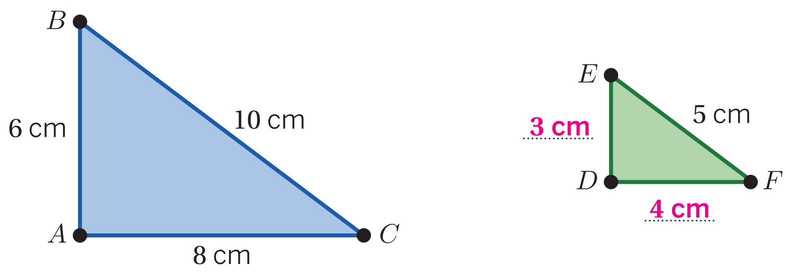
8. Fill in each blank using the whole numbers 1 to 9 only once to make a true statement.

Responses vary. $6^1 \cdot 6^5 = (6^2)^3$

$6^{\square} \cdot 6^{\square} = (6^{\square})^{\square}$

Spiral Review

9. Triangle DEF is similar to triangle ABC. Label the side lengths for DE and DF.



10. Solve this system of equations:

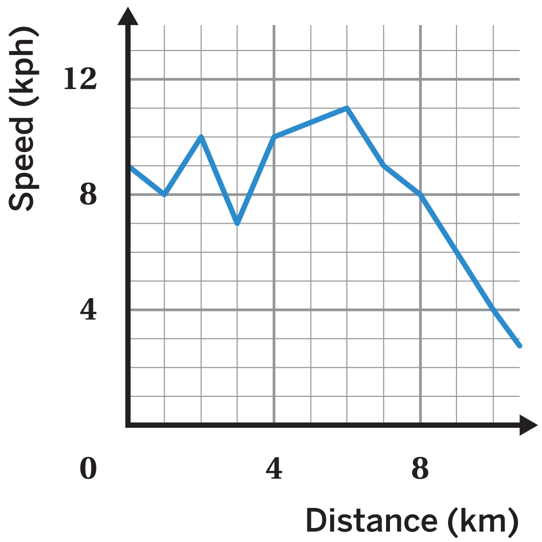
$y = -\frac{3}{2}x + 4$

$y = 2x - 3$

(2, 1)

11. Cielo runs a 10-kilometer race. An app keeps track of Cielo's speed. Is speed a function of distance? Explain your thinking.

Yes. *Explanations vary.* For every value of distance, there is exactly one corresponding speed.



Reflection

1. Star a problem you're still feeling confused about.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

You can rewrite expressions as a single power like 7^3 to help you make sense of more complex expressions, especially ones that involve division. Expanding is one strategy for rewriting expressions with exponents as single powers.

Here are two examples.

$$\begin{aligned}\frac{(3^3)^2}{3^4} &= \frac{(3 \bullet 3 \bullet 3) \bullet (3 \bullet 3 \bullet 3)}{3 \bullet 3 \bullet 3 \bullet 3} \\ &= \frac{3}{3} \bullet \frac{3}{3} \bullet \frac{3}{3} \bullet \frac{3}{3} \bullet 3 \bullet 3 \\ &= 1 \bullet 1 \bullet 1 \bullet 1 \bullet 3 \bullet 3 \\ &= 3^2\end{aligned}$$

$$\begin{aligned}\frac{9^2 \bullet 3^5}{3^3} &= \frac{(9 \bullet 9) \bullet (3 \bullet 3 \bullet 3 \bullet 3 \bullet 3)}{3 \bullet 3 \bullet 3} \\ &= \frac{(3 \bullet 3 \bullet 3 \bullet 3) \bullet (3 \bullet 3 \bullet 3 \bullet 3 \bullet 3)}{3 \bullet 3 \bullet 3} \\ &= \frac{3}{3} \bullet \frac{3}{3} \bullet \frac{3}{3} \bullet 3 \bullet 3 \bullet 3 \bullet 3 \bullet 3 \bullet 3 \\ &= 1 \bullet 1 \bullet 1 \bullet 3 \bullet 3 \bullet 3 \bullet 3 \bullet 3 \bullet 3 \\ &= 3^6\end{aligned}$$

Knowing that $\frac{(3^3)^2}{3^4} = 3^2$ and $\frac{9^2 \bullet 3^5}{3^3} = 3^6$ can help you compare the two: $\frac{9^2 \bullet 3^5}{3^3}$ is greater than $\frac{(3^3)^2}{3^4}$ because 3^6 is greater than 3^2.

Things to Remember:

Name: ______ Date: ______ Period: ______

1. Select *all* the expressions that are equivalent to 10^6.

- ☑ **A.** $5^6 \cdot 2^6$
- ☐ **B.** $10^8 - 10^2$
- ☑ **C.** $10^3 \cdot 10 \cdot 10^2$
- ☑ **D.** $\frac{10^9}{10^3}$
- ☐ **E.** $(10^3)^3$

Problems 2–9: Rewrite each expression as a single power.

2. $4^4 \cdot 5^4$ $= \mathbf{20^4}$

3. $\frac{5^6}{5^3}$ $= \mathbf{5^3}$

4. $(14^3)^6$ $= \mathbf{14^{18}}$

5. $\frac{21^3 \cdot 21^5}{21^2}$ $= \mathbf{21^6}$

6. $8^3 \cdot 8^6$ $= \mathbf{8^9}$

7. $\frac{3^{10}}{3}$ $= \mathbf{3^9}$

8. $(12^2)^7 \cdot 12$ $= \mathbf{12^{15}}$

9. $\frac{16^6}{2^6}$ $= \mathbf{8^6}$

10. Fill in each blank using the whole numbers 1 to 9 only once to make a true statement.

$$(3 \cdot 5)^{\square} \cdot (2 \cdot 3)^{\square} \cdot (2 \cdot 5)^{\square} = 2^{\square} \cdot 3^{\square} \cdot 5^{\square}$$

Responses vary.

$\mathbf{(3 \cdot 5)^2 \cdot (2 \cdot 3)^4 \cdot (2 \cdot 5)^5 = 2^9 \cdot 3^6 \cdot 5^7}$

Name: ________ Date: ________ Period: ________

11. Demari says $3^6 \cdot 15^5 \cdot 5^6$ is equivalent to 15^{11}. Is Demari's claim correct? Show or explain your thinking.

Yes. ***Explanations vary.*** **The factors of $3^6 \cdot 5^6$ can be regrouped to have six pairs of $3 \cdot 5$, which is the same as 15^6. Then the expression can be rewritten as $15^6 \cdot 15^5$, which is equivalent to 15^{11}.**

12. What is the value of n in the equation $7^n = 7^{12} \cdot 7^4$?

16

13. Order the expressions from *least* to *greatest*.

$3^5 \cdot 4^5$	$2^7 \cdot 6^7$	$(12^2)^4$	$12^2 \cdot 12^2$	$12^3 \cdot (12^2)^3$

$12^2 \cdot 12^2$	$3^5 \cdot 4^5$	$2^7 \cdot 6^7$	$(12^2)^4$	$12^3 \cdot (12^2)^3$

Least **Greatest**

Spiral Review

Problems 14–15: Bananas cost $1.50 per pound and guavas cost $3.00 per pound. Demetrius's family spends $12 on fruit for a breakfast they're hosting. They buy b pounds of bananas and g pounds of guavas.

14. Write an equation relating the two variables.

$1.5b + 3g = 12$ (or equivalent)

15. If Demetrius's family buys 4 pounds of bananas, how many pounds of guavas can they buy?

2 pounds

Reflection

1. Put a star next to the problem you understood best.

2. Use this space to ask a question or share something you're proud of.

Science Mom Lesson 104

Lesson Summary

Positive, negative, and zero exponents are all related.

For example, this table shows that each time the exponent decreases by 1, the value is divided by 4. Based on this pattern, we can determine that $4^0 = 1$. Similarly, if we divide both sides of $4^0 = 1$ by 4, we get $4^{-1} = \frac{1}{4}$.

Exponent Form	Expanded Form	Value
4^2	$4 \cdot 4$	16
4^1	4	4
4^0	1	1
4^{-1}	$\frac{1}{4}$	$\frac{1}{4}$
4^{-2}	$\frac{1}{4} \cdot \frac{1}{4}$	$\frac{1}{16}$

We can use these patterns to make generalizations about powers with zero and negative exponents.

- Any power with a 0 exponent is equal to 1. For example, $\left(\frac{1}{5}\right)^0 = 1$ and $(-3)^0 = 1$.
- Powers with negative exponents are equal to 1 divided by the power with a positive exponent. For examples, $5^{-2} = \left(\frac{1}{5}\right)^2 = \frac{1}{5} \cdot \frac{1}{5} = \frac{1}{25}$.

Things to Remember:

Lesson Practice
8.7.05

Name: .... Date: .... Period: ....

Problems 1–2: Prisha says: "I can determine the value of 5^0 by looking at other powers of 5." She organizes her work in a table.

Exponent Form	Value
5^3	125
5^2	25
5^1	5
5^0	

1. What pattern do you notice in Prisha's table?

Responses vary. **When the power of 5 decreases by 1, the value is divided by 5.**

2. If this pattern continues, what would the value of 5^0 be?

1

3. Select *all* the expressions that are equivalent to 4^{-3}.

- ☐ **A.** -12
- ☑ **B.** 2^{-6}
- ☑ **C.** $\frac{1}{4^3}$
- ☑ **D.** $\left(\frac{1}{4}\right) \cdot \left(\frac{1}{4}\right) \cdot \left(\frac{1}{4}\right)$
- ☐ **E.** $(-4) \cdot (-4) \cdot (-4)$

Problems 4–7: Determine if each equation is true or false. Then change one side of each false equation to make it true.

	Equation	True	False	Changed Equation
4.	$\frac{5^3}{5^3} = 5^0$	✔		
5.	$\frac{5^{-3}}{5^3} = 5^0$		✔	*Responses vary.* $\frac{5^{-3}}{5^3} = 5^{-6}$
6.	$5^0 \cdot 5^{-6} \cdot 5^5 = \frac{1}{5}$	✔		
7.	$(5^{-4})^0 = \frac{1}{5^4}$		✔	*Responsess vary.* $(5^{-4})^0 = 1$

Lesson Practice
8.7.05

Name: ____________ Date: ________ Period: ________

Problems 8–10: Rewrite each expression as a single power.

8. $\frac{3^7}{3^{11}}$ 3^{-4} or $\frac{1}{3^4}$

9. $2^{-5} \bullet 3^{-5}$ 6^{-5} or $\frac{1}{6^5}$

10. $7^0 \bullet \frac{8^{-3}}{4^{-3}}$ 2^{-3} or $\frac{1}{2^3}$

11. In the expressions, a and b represent integers. The value of Expression 2 is 100 times greater than the value of Expression 1. What is the value of b?

Expression 1: 10^{a+b} Expression 2: 10^a

A. 2 **B.** 0 **C.** -2 **D.** -4

Spiral Review

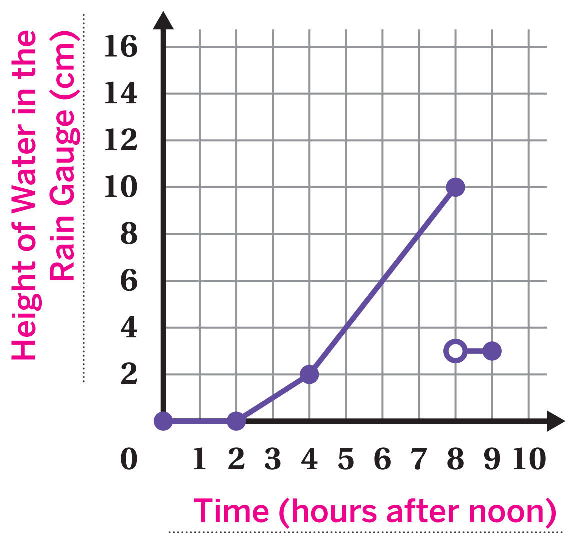
Problems 12–13: Adrian set up a rain gauge to measure rainfall in his backyard. The graph shows the total rainfall (in centimeters) in Adrian's rain gauge from noon to 9:00 PM.

12. Label the axes on the graph, including the units of measurement in parentheses.

Responses vary.

13. Use the graph to write a story that describes the rainfall that day.

Responses vary. At 2 PM, the gauge was empty, but it began to fill as it rained. Two hours later, the gauge had 2 centimeters of water in it. At 8 PM, Adrian found that the gauge had 10 centimeters of water in it. But then he accidentally knocked the gauge over, spilling all but 3 centimeters of water. At 9 PM, there were no further changes in the water level.



Reflection

1. Put a star next to a problem you're still wondering about.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

You can write large numbers as a combination of powers of 10 to make them less awkward to work with and to prevent having to count 0s.

The number 90,700,000 can be written many different ways using powers of 10.

For example:

- $90700000 = 9 \bullet 10^7 + 7 \bullet 10^5$
- $90700000 = 90 \bullet 10^6 + 7 \bullet 10^5$
- $90700000 = 9.07 \bullet 10^7$

Things to Remember:

Lesson Practice
8.7.07

Name: .... Date: .... Period: ....

Problems 1–3: Write each value as a number times 10^3.

1. 42,300

$42.3 \cdot 10^3$

2. 2,000

$2 \cdot 10^3$

3. 301,000

$301 \cdot 10^3$

Problems 4–6: Rewrite each expression as a combination of powers of 10.

Responses vary.

4. 4,200,000

- $4 \cdot 10^6 + 2 \cdot 10^5$
- $4.2 \cdot 10^6$
- $42 \cdot 10^5$

5. 40,700

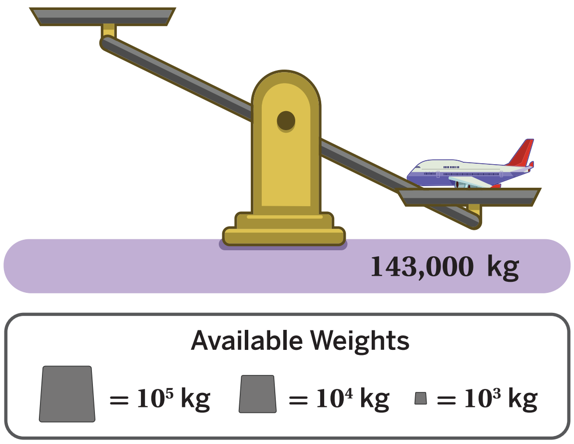
- $4.07 \cdot 10^4$
- $4 \cdot 10^4 + 7 \cdot 10^2$
- $40700 \cdot 10^0$

6. 999

- $9.99 \cdot 10^2$
- $99.9 \cdot 10^1$
- $9 \cdot 10^2 + 9 \cdot 10^1 + 9 \cdot 10^0$

Problems 7–8: Three students tried to balance the scale using weights measuring 10^5 kg, 10^4 kg, and 10^3 kg.

- Lucy wrote the weight of the plane as $14.3 \cdot 10^4$ kilograms.
- Parv wrote the weight of the plane as $143 \cdot 10^2$ kilograms.
- Kiri wrote the weight of the plane as $1 \cdot 10^5 + 4 \cdot 10^4 + 3 \cdot 10^3$ kilograms.



7. Which of these expressions are accurate?

Lucy's and Kiri's expressions

8. Write an expression to represent a different combination of available weights that will balance the scale.

Responses vary. $1.43 \cdot 10^5$ kilograms

Name: .... Date: .... Period: ....

9. Which of the following numbers has the greatest value?

A. $48.34 \cdot 10^3$

B. $4.834 \cdot 10^5$

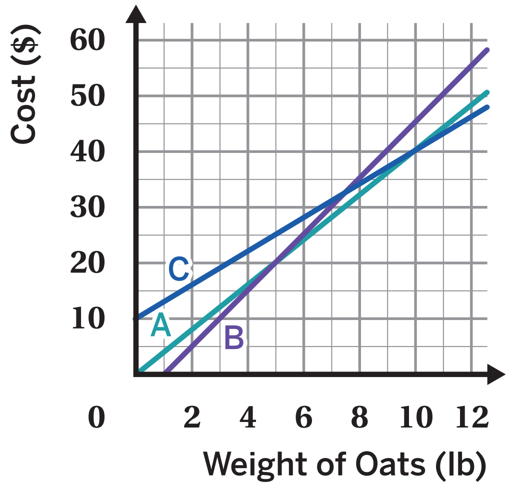
C. $4.834 \cdot 10^4$

D. $4.83 \cdot 10^5$

Spiral Review

Problems 10–12: Three stores are selling oats by the pound.

- Store A sells oats for a dollars per pound.
- Store B sells oats for b dollars per pound, with a coupon for $5 off the total purchase.
- Store C is an online store. They sell oats for c dollars per pound, with a $10 delivery fee.



10. Which store has the lowest price for two pounds of oats?
Store B

11. If a customer wants to buy 6 pounds of oats to make granola, which store has the lowest price?
Store A

12. How many pounds of oats would a customer need to buy to make Store C a good option? Explain your thinking.

Responses vary.

- **10 pounds. If a customer orders 10 pounds of oats, Store C and Store A have the lowest price.**
- **11 pounds, because Store C is the cheapest for *all* oat purchases above 10 pounds.**

13. Select *all* expressions that are equivalent to 10^{-3}.

- [x] A. $(5 \cdot 2)^{-3}$
- [ ] B. $\frac{10^6}{10^3}$
- [x] C. $\frac{1}{10^3}$
- [ ] D. $(10^{-3})^{-1}$
- [x] E. $\frac{1}{1000}$

Reflection

1. Circle the problem you feel most confident about.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

Like large numbers, you can write small numbers using combinations of powers of 10. Numbers less than 1 will use negative powers of 10.

For example:

- $0.000000877 = 8 \bullet 10^{-7} + 7 \bullet 10^{-8} + 7 \bullet 10^{-9}$
- $0.00000000034 = 3 \bullet 10^{-10} + 4 \bullet 10^{-11}$
- $0.00000049 = 4 \bullet 10^{-7} + 9 \bullet 10^{-8}$

You can write large and small values as a number times a single power of 10 to help compare those values and get a sense of their scale.

For example:

- $42000000000 = 4.2 \bullet 10^{10}$
- $2500000000 = 25 \bullet 10^{8}$
- $0.00000000034 = 3.4 \bullet 10^{-10}$
- $0.00000049 = 49 \bullet 10^{-8}$

Things to Remember:

Lesson Practice
8.7.08

Name: ________ Date: ________ Period: ________

1. Select *all* expressions that are equivalent to $\frac{1}{1000}$.

- ☑ **A.** $1 \cdot 10^{-3}$
- ☐ **B.** $-1 \cdot 10^{3}$
- ☐ **C.** $1 \cdot 10^{\frac{1}{3}}$
- ☑ **D.** $10 \cdot 10^{-4}$
- ☐ **E.** $10 \cdot 10^{-3}$

2. Order the expressions from *least* to *greatest*.

$2 \cdot 10^{-3}$	$3 \cdot 10^{-2}$	$-3 \cdot 10^{-2}$	$-2 \cdot 10^{-3}$	$3 \cdot 10^{2}$

$-3 \cdot 10^{-2}$	$-2 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$3 \cdot 10^{-2}$	$3 \cdot 10^{2}$

Least **Greatest**

Problems 3–4: Write each sum as a decimal.

3. $3 \cdot 10^{-4} + 2 \cdot 10^{-5} + 3 \cdot 10^{-6}$

0.000323

4. $2 \cdot 10^{-7} + 3 \cdot 10^{-5} + 5 \cdot 10^{-3}$

0.0050302

Problems 5–6: Write each value as a number times a single power of 10.

5. $\frac{7}{10000}$

$7 \cdot 10^{-4}$ (or equivalent)

6. 0.0013

$1.3 \cdot 10^{-3}$ (or equivalent)

7. Write 0.00573 in three different ways, using a single multiple of 10.

Responses vary.

$573 \cdot 10^{-5}$ $57.3 \cdot 10^{-4}$ $5.73 \cdot 10^{-3}$

8. Fill in each blank using the digits 0 to 9 to make a sum that's as close to 10 as possible.

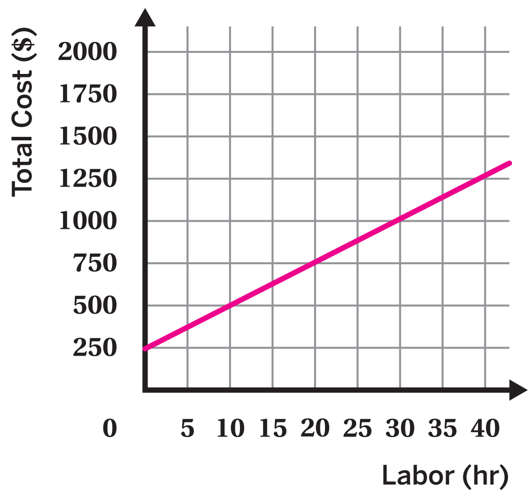
$\square\square \cdot 10^{-\square} + \square\square \cdot 10^{-\square}$

$98 \cdot 10^{-1} + 76 \cdot 10^{-3}$

Spiral Review

Problems 9–11: An electrician charges a flat rate of \$250, plus \$25 for each hour of labor.

9. Graph a line representing the relationship between the number of hours of labor and the total cost.



10. What is the total cost for 20 hours of labor?

\$750

11. What is the slope of this line?

25

Explain its meaning in context.

***Explanations vary.* The slope is the same as the price per hour, in dollars, that the electrician charges for labor.**

Reflection

1. Put a star next to a problem you could explain to a classmate.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

There are many ways to express a number using a power of 10. One specific way is called **scientific notation**, which can be helpful for comparing very large or very small numbers. When a number is written in scientific notation, the first part is a number greater than or equal to 1, but less than 10. The second part is an integer power of 10.

For example:

- 425,000,000 is $4.25 \cdot 10^8$ in scientific notation
- 0.0000000000783 is $7.83 \cdot 10^{-11}$ in scientific notation

Things to Remember:

Lesson Practice
8.7.09

Name: .... Date: .... Period: ....

Problems 1–4: Write each value as a number times a power of 10. ***Responses vary.***

1. 0.04
- $4 \cdot 10^{-2}$
- $0.4 \cdot 10^{-1}$

2. 0.072
- $7.2 \cdot 10^{-2}$
- $72 \cdot 10^{-3}$

3. 0.0000325
- $3.25 \cdot 10^{-5}$
- $325 \cdot 10^{-7}$

4. 0.003
- $3 \cdot 10^{-3}$
- $0.3 \cdot 10^{-2}$

Problems 5–10: Write each value in scientific notation.

5. 0.00083
$8.3 \cdot 10^{-4}$

6. $760{,}000{,}000$
$7.6 \cdot 10^{8}$

7. $147 \cdot 10^{6}$
$1.47 \cdot 10^{8}$

8. 0.038
$3.8 \cdot 10^{-2}$

9. 3.8
$3.8 \cdot 10^{0}$

10. $38 \cdot 10^{-4}$
$3.8 \cdot 10^{-3}$

11. There are a total of $367{,}400$ books in a library. When the number of books is written in scientific notation, what is the power of 10?
5

12. Trinidad wrote 0.0000683 as $0.683 \cdot 10^{-4}$. Is this number written in scientific notation? Explain your thinking.
No. *Explanations vary.* The first part of a number written in scientific notation must be greater than or equal to 1. The first part of Trinidad's number is less than 1.

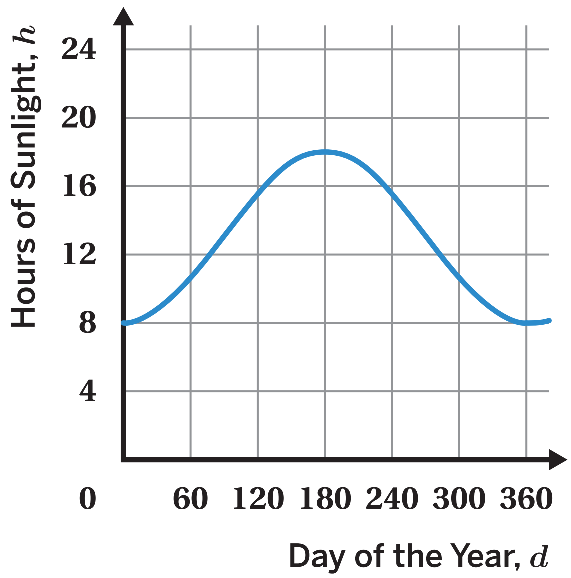
13. TC says: *Any positive number multiplied by* 10^5 *will be greater than any other number multiplied by* 10^3. Is this statement *always*, *sometimes*, or *never* true? Explain your thinking.
Sometimes. *Explanations vary.* For example, if 3.7 is multiplied by 10^5 and 8.1 is multiplied by 10^3, then $3.7 \cdot 10^5$ will be greater than $8.1 \cdot 10^3$, making the statement true. But, if 37 is multiplied by 10^5 and 8,100 is multiplied by 10^3, then $8100 \cdot 10^3$ will be greater than $37 \cdot 10^5$, making the statement not true.

Lesson Practice
8.7.09

Name: .... Date: .... Period: ....

Spiral Review

Problems 14–17: Here is the graph representing the predicted number of hours of sunlight, h, on a given day of the year, d, in Metropolis.



14. Is hours of sunlight a function of days of the year? Explain your thinking.

Yes. *Explanations vary.* For every value of d, there is only one value of h.

15. For what days of the year do the hours of sunlight increase?

***Responses vary.* Around Day 0 to around Day 180**

16. For what days of the year do the hours of sunlight decrease?

***Responses vary.* Around Day 180 to Day 360**

17. Which day of the year has the most hours of sunlight?

Day 180

18. Select *all* the expressions that are equivalent to $4 \cdot 10^{-3}$.

- ☑ **A.** $4 \cdot \left(\frac{1}{10}\right) \cdot \left(\frac{1}{10}\right) \cdot \left(\frac{1}{10}\right)$
- ☐ **B.** $4 \cdot (-10) \cdot (-10) \cdot (-10)$
- ☑ **C.** $4 \cdot 0.001$
- ☐ **D.** $4 \cdot 0.0001$
- ☑ **E.** 0.004
- ☐ **F.** 0.0004

Reflection

1. Put a star next to a problem where you revised your thinking.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

You can use scientific notation when comparing quantities.

Here is one example. How many jelly beans weigh as much as one Egyptian pyramid?

- Jelly bean weight: $1.5 \cdot 10^{-3}$ kilograms
- Egyptian pyramid weight: $5.216 \cdot 10^{9}$ kilograms

It can be helpful to round the first parts of both numbers before calculating.

- $1.5 \cdot 10^{-3}$ is about $2 \cdot 10^{-3}$.
- $5.216 \cdot 10^{9}$ is about $5 \cdot 10^{9}$.

There are many strategies you can use when comparing quantities in scientific notation. Here are two:

Divide the larger number by the smaller number.

$$\frac{5 \cdot 10^{9}}{2 \cdot 10^{-3}} = 2.5 \cdot 10^{12}$$

$2.5 \cdot 10^{12}$ jelly beans weigh about the same as the pyramid.

Multiply the smaller number by the number needed to equal the larger number.

$$2 \cdot 10^{-3} \cdot ? = 5 \cdot 10^{9}$$

$2.5 \cdot 10^{12}$ jelly beans weigh about the same as the pyramid.

Things to Remember:

Lesson Practice
8.7.11

Name: .... Date: .... Period: ....

1. Which number is greater? Circle one.

$17 \cdot 10^8$ $\qquad$ $4 \cdot 10^8$

About how many times greater is it than the other number?

$17 \cdot 10^8$ is about 4 times greater than $4 \cdot 10^8$.

2. Which number is greater? Circle one.

$2 \cdot 10^6$ $\qquad$ $7.839 \cdot 10^6$

About how many times greater is it than the other number?

$7.839 \cdot 10^6$ is about 4 times greater than $2 \cdot 10^6$.

3. Which number is greater? Circle one.

$42 \cdot 10^7$ $\qquad$ $8.5 \cdot 10^8$

About how many times greater is it than the other number?

$8.5 \cdot 10^8$ is about 2 times greater than $42 \cdot 10^7$.

Problems 4–5: Complete each sentence by writing a number in scientific notation.

Responses vary.

4. $10.3 \cdot 10^9$ is about ...$2 \cdot 10^6$... times as large as $5.2 \cdot 10^3$.

5. $12.5 \cdot 10^{11}$ is about $4 \cdot 10^8$ times as large as ...$3.1 \cdot 10^3$....

6. The mass of a penny is $3.1 \cdot 10^{-3}$ kilograms and the mass of an Egyptian pyramid is $5.216 \cdot 10^9$ kilograms. Based on this information, how many pennies weigh about as much as one pyramid? Write your answer in scientific notation.

Responses between $1.667 \cdot 10^{12}$ and $1.7 \cdot 10^{12}$ are considered correct.

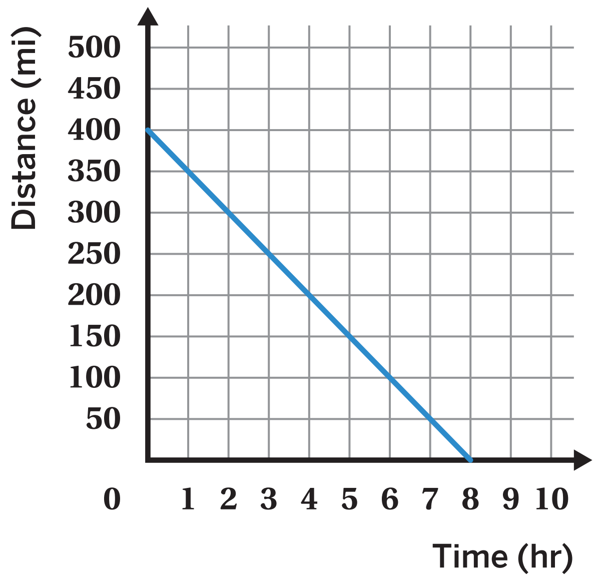
Name: ________ Date: ________ Period: ________

7. A number is $3 \cdot 10^5$ times as large as another number. Determine two numbers that make this relationship true and complete the statement below. ***Responses vary.***

$8.1 \cdot 10^9$ is $3 \cdot 10^5$ times as large as $2.7 \cdot 10^4$.

Spiral Review

Problems 8–11: A family sets out on a road trip to visit their cousins. They travel at a steady rate. The graph shows the distance to their cousins' house each hour of the trip.



8. How far is the trip?

400 miles

9. How long did the trip take?

8 hours

10. How fast are they traveling?

50 miles per hour

Explain your thinking

***Explanations vary.* If they travel 400 miles in 8 hours, I can divide 400 by 8 to get how many miles they travel per hour. This gives me 50 miles per hour.**

11. Is the slope positive or negative? **Negative**

Explain how you know and why that fits the situation.

***Explanations vary.* The slope is negative because the line moves down toward the right. It shows the change in remaining miles for each hour. 50 fewer miles remain after each hour, which means the car is traveling at a steady rate of 50 miles per hour.**

Reflection

1. Circle the problem you're most interested in knowing more about.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

Scientific notation can be useful for adding or subtracting very large or very small numbers. It is important to pay attention to place value when adding and subtracting numbers written in scientific notation.

For example: Let's add $3.4 \cdot 10^5 + 2.1 \cdot 10^6$.

It may appear that you can add the first parts: 3.4 and 2.1. However, these numbers *do not* have the same place value because they are multiplied by different powers of 10.

If you rewrite one number so that both numbers have the same power of 10, then you can add their first parts. In this case, let's rewrite $2.1 \cdot 10^6$ as $21 \cdot 10^5$.

$$\begin{aligned} 3.4 \cdot 10^5 + 2.1 \cdot 10^6 &= 3.4 \cdot 10^5 + 21 \cdot 10^5 \\ &= 24.4 \cdot 10^5 \\ &= 2.44 \cdot 10^6 \end{aligned}$$

Now that the power of 10 is the same, you can add 3.4 and 21. The sum is $24.4 \cdot 10^5$, or $2.44 \cdot 10^6$ when rewritten in scientific notation.

Things to Remember:

Lesson Practice
8.7.13

Name: ________ Date: ________ Period: ________

Problems 1–4: Determine the value of each expression. Write your answers in scientific notation.

1. $5.3 \cdot 10^4 + 4.7 \cdot 10^4$ $= 1 \cdot 10^5$

2. $3.7 \cdot 10^6 - 3.3 \cdot 10^6$ $= 4 \cdot 10^5$

3. $4.8 \cdot 10^{-3} + 6.3 \cdot 10^{-3}$ $= 1.11 \cdot 10^{-2}$

4. $6.6 \cdot 10^{-5} - 6.1 \cdot 10^{-5}$ $= 5 \cdot 10^{-6}$

5. Write the value of $2.3 \cdot 10^4 + 4.1 \cdot 10^5$ in scientific notation.
$4.33 \cdot 10^5$

Problems 6–8: Decide whether each statement is true or false. Show or explain your thinking.

6. $3 \cdot 10^2 + 4 \cdot 10^3 = 7 \cdot 10^5$
False. ***Explanations vary.*** **The digits 3 and 4 do not have the same place value because the powers of 10 are not the same.**

7. $8 \cdot 10^2 - 5.1 \cdot 10^3 = 2.9 \cdot 10^2$
False. ***Explanations vary.*** **$5.1 \cdot 10^3$ is greater than $8 \cdot 10^2$, so the difference must be negative.**

8. $7 \cdot 10^{-4} + 9 \cdot 10^{-3} = 9.7 \cdot 10^{-3}$
True. ***Explanations vary.*** **$7 \cdot 10^{-4} = 0.7 \cdot 10^{-3}$, which will result in a sum of $9.7 \cdot 10^{-3}$.**

Name: .... Date: .... Period: ....

9. Fill in each blank to create a true equation. Try to make an expression none of your classmates will.

$\square \cdot 10^{\square} + \square \cdot 10^{\square} = 3.6 \cdot 10^4$

Responses vary. $\mathbf{3 \cdot 10^4 + 6 \cdot 10^3}$

Spiral Review

Problems 10–13: Multiply the numbers in each expression. Write your answers in scientific notation.

10. $4.1 \cdot 10^7 \cdot 2$ $\mathbf{= 8.2 \cdot 10^7}$

11. $3 \cdot (1.5 \cdot 10^{11})$ $\mathbf{= 4.5 \cdot 10^{11}}$

12. $(3 \cdot 10^3)^2$ $\mathbf{= 9 \cdot 10^6}$

13. $(9 \cdot 10^6) \cdot (3 \cdot 10^6)$ $\mathbf{= 2.7 \cdot 10^{13}}$

Problems 14–15: Diego was trying to solve an equation. But when he checked his answer, he saw his solution was incorrect.

Diego

$$-4(7 - 2x) = 3(x + 4)$$
$$-28 - 8x = 3x + 12$$
$$-28 = 11x + 12$$
$$-40 = 11x$$
$$-\frac{40}{11} = x$$

14. What would you recommend Diego change in his work?

***Responses vary.* It looks like Diego multiplied -4 by 7 to get -28. He also tried to multiply -4 by -$2x$, but that would give him +$8x$, not -$8x$.**

15. What is the correct solution to the equation?

$\mathbf{x = 8}$

Reflection

1. Put a question mark next to a problem you were feeling stuck on.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

Scientific notation is a useful tool for adding, subtracting, multiplying, dividing, and comparing very small or very large numbers.

- You can rewrite the number $39{,}000{,}000{,}000{,}000$ as $3.9 \cdot 10^{13}$ and still convey just how large the number is.
- To add or subtract numbers written in scientific notation, it is useful to rewrite the numbers so they have the same power of 10.
- To multiply or divide numbers written in scientific notation, it is useful to multiply or divide the numbers that come before the powers of 10. Then you can use exponent rules to multiply or divide the powers of 10.
- If the product or quotient is not written in scientific notation, you can always rewrite it to be in that form.
- Sometimes it can be helpful to round numbers written in scientific notation when exact values are less important.

Some situations that involve very large or very small numbers include salaries of wealthy people, talking about large groups like the total number of workers at a company, or the sizes of microscopic objects like cells and bacteria.

Things to Remember:

Lesson Practice
8.7.14

Name: ________ Date: ________ Period: ________

Problems 1–3: In 2022, the United States had an approximate population of $3.3 \cdot 10^8$ people. California, Texas, Florida, and New York had the greatest populations out of all the states.

State	Population (people)
California	$3.9 \cdot 10^7$
Texas	$3.0 \cdot 10^7$
Florida	$2.2 \cdot 10^7$
New York	$2.0 \cdot 10^7$

1. What was the total population of all four states? Write your answer in scientific notation.
   About $1.1 \cdot 10^8$ people

2. What was the total population for the other 46 states? Write your answer in scientific notation.
   About $2.2 \cdot 10^8$ people

3. About how many times greater was the population of California than the population of Florida?
   About 2 times greater

Problems 4–7: Here is a table about different life forms on our planet.

Creature	Population	Mass of One Individual (kg)
Humans	$8 \cdot 10^9$	$6.2 \cdot 10^1$
Sheep	$1.38 \cdot 10^9$	$6 \cdot 10^1$
Chickens	$3.44 \cdot 10^{10}$	$2.6 \cdot 10^0$
Antarctic krill	$8 \cdot 10^{14}$	$1 \cdot 10^{-3}$
Bacteria	$5 \cdot 10^{30}$	$1 \cdot 10^{-12}$

4. Which is greater: the total mass of all humans or the total mass of all Antarctic krill?
   The total mass of all Antarctic krill.

   Humans:
   $(8 \cdot 10^9) \cdot (6.2 \cdot 10^1)$
   $\approx 5 \cdot 10^{11}$ **kilograms**

   Antarctic krill:
   $(8 \cdot 10^{14}) \cdot (1 \cdot 10^{-3})$
   $= 8 \cdot 10^{11}$ **kilograms**

5. How can you tell which creature has the greatest total mass?
   ***Responses vary.* Bacteria has the greatest total mass because the population of bacteria times the mass of one bacteria is $5 \cdot 10^{18}$, which is larger than the mass of any of the other creatures.**

6. About how many more chickens are there than sheep? Write your answer in scientific notation. Show or explain your thinking.
   Responses between $3 \cdot 10^{10}$ and $3.302 \cdot 10^{10}$ are considered correct. *Explanations vary.* $3.44 \cdot 10^{10} - 1.38 \cdot 10^9$ can be rewritten as $34.4 \cdot 10^9 - 1.38 \cdot 10^9$, which equals $33.02 \cdot 10^9$ or $3.302 \cdot 10^{10}$ (about 33 billion).

7. Do you think kilograms would be an appropriate unit for measuring the mass of each creature listed in the table? Explain your thinking.
   ***Responses vary.* I think it would be appropriate to use kilograms to measure all the different creatures, because it would make it easier to compare the different masses. But I also think it's usually better to use a smaller unit, such as nanograms, to measure the mass of bacteria.**

Lesson Practice
8.7.14

Name: ______ Date: ______ Period: ______

Problems 8–9: Here is a list of facts about space, the world, and the human body.

- The Milky Way is about 10^5 light years across.
- One light year is about 10^{16} meters long.
- There are about $3.7 \cdot 10^{13}$ cells in a human body.
- The world's population is about $8 \cdot 10^9$.

8. Which is greater: the number of meters across the Milky Way or the total number of cells in all the humans in the world? Show or explain your thinking.

Number of human cells. *Explanations vary.* The Milky Way is about $10^5 \cdot 10^{16}$, or 10^{21}, meters across. The total number of human cells is $(3.7 \cdot 10^{13}) \cdot (8 \cdot 10^9)$, or $2.96 \cdot 10^{23}$, which is greater than the approximate number of meters across the Milky Way.

9. Yona says that there are about 30 times as many cells in all humans as there are meters across the Milky Way. Is Yona correct? Show or explain your thinking.

No. *Explanations vary.* The number of cells is about $\frac{3 \cdot 10^{23}}{1 \cdot 10^{21}} = 3 \cdot 10^2$, or 300, times the number of meters across the Milky Way.

Spiral Review

10. Write a number and power of 10 to show the value of $(6.2 \cdot 10^5) \cdot (3.4 \cdot 10^2)$ in scientific notation.

2.108 $\cdot$ **10^8**

11. Select *all* the expressions that are equivalent to 3^8.

- [x] **A.** $(3^2)^3 \cdot 3^2$
- [ ] **B.** $\frac{1}{3^4 \cdot 3^4}$
- [x] **C.** $\frac{(3^4)^3 \cdot 3^0 \cdot 3^3}{3^2 \cdot 3^5}$
- [ ] **D.** $(3^2 \cdot 3^2)^4$
- [x] **E.** $\frac{3^3 \cdot 3^3 \cdot 3^4}{3^2}$

Reflection

1. Put a heart next to a problem you understand well.

2. Use this space to ask a question or share something you're proud of.

Lesson Practice 8.8.01

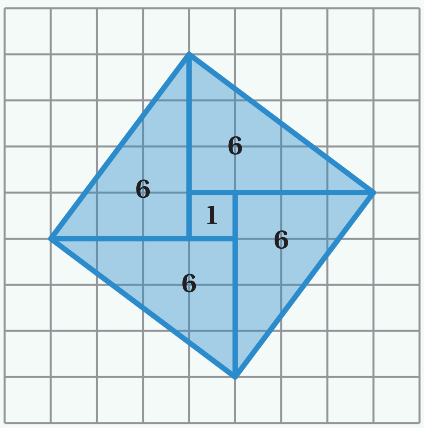
Science Mom Lesson 111

Lesson Summary

There are many strategies for determining the area of a tilted square. Here are two strategies called "decompose and rearrange" and "surround and subtract."

Decompose and Rearrange

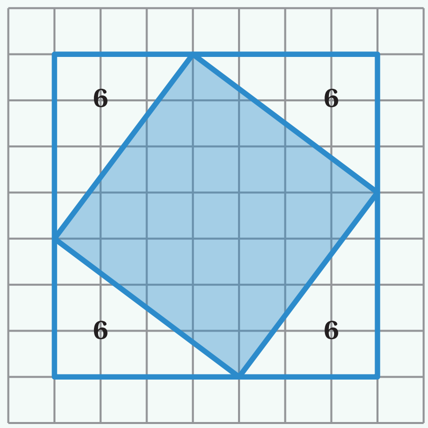
Area is calculated by adding the areas of the four triangles and one center square.



$4 \cdot 6 + 1 = 25$ square units

Surround and Subtract

Area is calculated by finding the area of the large square minus the area of the four triangles.



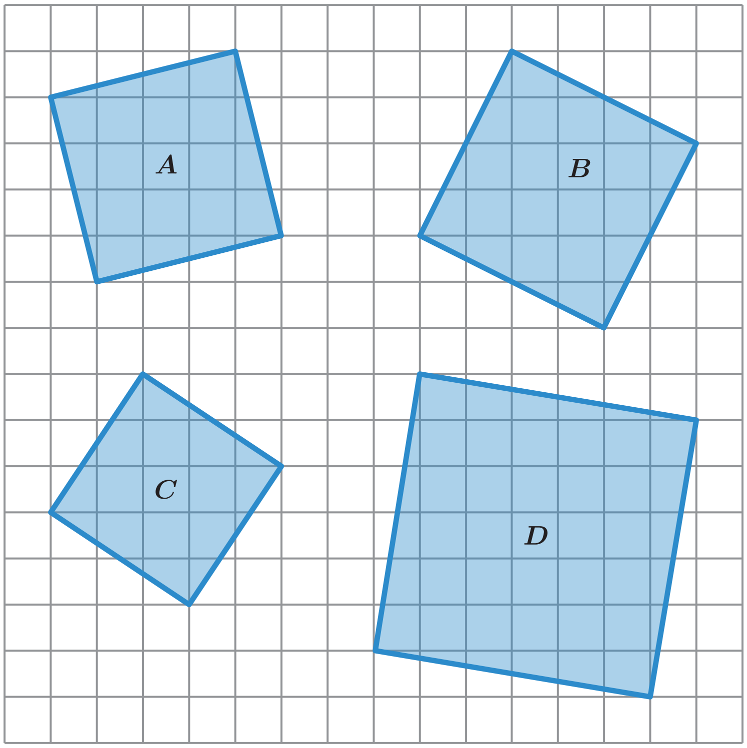
$7 \cdot 7 - 4 \cdot 6 = 25$ square units

Things to Remember:

Lesson Practice
8.8.01

Name: .... Date: .... Period: ....

Problems 1–4: Determine the area of each tilted square. Each square grid represents 1 square unit.



1. Square A
   17 square units

2. Square B
   20 square units

3. Square C
   13 square units

4. Square D
   37 square units

Problems 5–7: Determine the area of each square given its side length.

5. Side length: 3 inches
   9 square inches

6. Side length: 100 centimeters
   10,000 square centimeters

7. Side length: x units
   x^2 square units

Problems 8–10: Here are the areas of three squares. Determine the side length of each square.

8. Area: 81 square inches
   9 inches

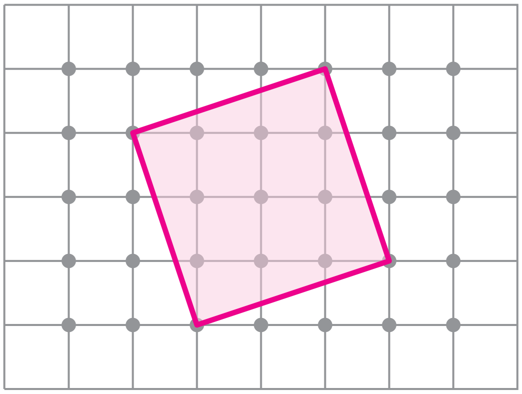
9. Area: $\frac{4}{25}$ square centimeters
   $\frac{2}{5}$ centimeters

10. Area: m^2 units
    m units

Name: ______ Date: ______ Period: ______

11. Determine the area of the largest tilted square that can be created on the dot grid.

10 square units



Spiral Review

12. Select *all* the expressions that are equivalent to 3^8.

- ☐ **A.** $3^6 \cdot 10^2$
- ☐ **B.** 8^3
- ☑ **C.** $\frac{3^6}{3^{-2}}$
- ☑ **D.** $(3^4)^2$
- ☑ **E.** $(3^2)^4$

13. In July 2023, the population of Arlington, Texas was 392,786. What is the value of the exponent when this number is written in scientific notation?

5

14. Which expression is equal to $(3.1 \cdot 10^4) \cdot (2 \cdot 10^6)$?

A. $5.1 \cdot 10^{10}$ **B.** $5.1 \cdot 10^{24}$ **C.** $6.2 \cdot 10^{10}$ **D.** $6.2 \cdot 10^{24}$

15. Here is Oliver's work for solving this problem:

Evaluate $5.4 \cdot 10^5 + 2.3 \cdot 10^4$ and write the answer in scientific notation.

Oliver

$5.4 \cdot 10^5$ can be rewritten as $54 \cdot 10^4$

$54 \cdot 10^4 + 2.3 \cdot 10^4 = 56.3 \cdot 10^4$

Is Oliver's solution correct?

No

Explain your thinking.

***Explanations vary*. Oliver's calculations are correct, but the final answer isn't in scientific notation. To finish the problem, Oliver should rewrite the answer to be $5.63 \cdot 10^5$.**

Reflection

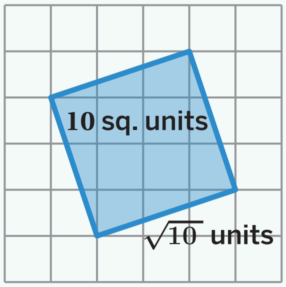
1. Put a smiley face next to a problem you were stuck on and then figured out.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

There is a known relationship between the area of any square and its side length. The exact value of the side length of a square can be written as the **square root** of its area.

For example, $\sqrt{10}$ is the exact value for the side length of a square with an area of 10 square units.



Things to Remember:

Lesson Practice
8.8.02

Name: ______ Date: ______ Period: ______

1. Square A has an area of 81 square feet. Select *all* the expressions that are equal to the side length of this square (in feet).

- ☐ **A.** 3
- ☐ **B.** $\frac{81}{2}$
- ☑ **C.** $\sqrt{81}$
- ☐ **D.** $\sqrt{9}$
- ☑ **E.** 9

Problems 2–5: Here are the areas of different squares. Determine the side length for each square.

2. Area: 37 square units

$\sqrt{37}$ units (or equivalent)

3. Area: $\frac{100}{9}$ square units

$\frac{10}{3}$ units (or equivalent)

4. Area: $\frac{2}{5}$ square units

$\sqrt{\frac{2}{5}}$ units (or equivalent)

5. Area: 0.0001 square units

0.01 units (or equivalent)

Problems 6–8: Here is some information about three squares. Determine which side length matches each square.

- Square A is smaller than square B.
- Square B is smaller than square C.
- The three squares' side lengths are $\sqrt{26}$, 4.2, and $\sqrt{11}$ units.

6. Square A

$\sqrt{11}$ units

7. Square B

4.2 units

8. Square C

$\sqrt{26}$ units

Problems 9–11: Here are the side lengths of different squares. Determine the area of each square.

9. Side length: $\frac{1}{5}$ centimeters

$\frac{1}{25}$ square centimeters (or equivalent)

10. Side length: $\frac{3}{7}$ units

$\frac{9}{49}$ square units (or equivalent)

11. Side length: 0.1 meter

0.01 square meters (or equivalent)

Name: ______ Date: ______ Period: ______

Spiral Review

12. Which expression is equivalent to $(12^3)(12^{-8})$?

A. 12^{-24} **B.** -12^5 **C.** $\frac{1}{12^5}$ **D.** $\frac{1}{12^{-5}}$

Problems 13–14: Here is a table showing the areas of six large countries.

Country	Area (sq. km)
Russia	$1.71 \cdot 10^7$
Canada	$9.98 \cdot 10^6$
China	$9.60 \cdot 10^6$
United States	$9.53 \cdot 10^6$
Brazil	$8.52 \cdot 10^6$
India	$3.29 \cdot 10^6$

13. About how many times greater is the area of Russia than the area of Canada?
About 1.7 times greater

14. The Eastern Hemisphere countries on this list are Russia, China, and India. The Western Hemisphere countries are Canada, the United States, and Brazil. Which has the greater total area?

A. The three Eastern Hemisphere countries

B. The three Western Hemisphere countries

Explain your thinking.
Explanations vary. **The Eastern Hemisphere countries' areas sum to 2.999×10^7 square kilometers whereas the Western Hemisphere countries' areas sum to 2.803×10^7 square kilometers.**

15. Select *all* the expressions that are equivalent to 10^{-6}.

- ☐ **A.** $-\frac{1}{1000000}$
- ☑ **B.** $\left(\frac{1}{10}\right)^6$
- ☐ **C.** $10^8 \cdot 10^{-2}$
- ☑ **D.** $\frac{1}{10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10}$
- ☑ **E.** $\frac{1}{10^6}$

Reflection

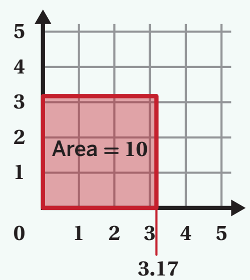
1. Circle a problem you're still curious about.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

You can use several strategies to approximate the values of square roots. One strategy is to use the areas of squares. The side length of a square is equal to the square root of its area. Another strategy is to create a table of values for n and determine n^2. Remember that $(\sqrt{n})^2 = n$. Below is a description of how each strategy can be used to approximate $\sqrt{10}$.

Using Squares

- Create a square that has an area equal to about 10 square units.
- Approximate the side length of the square created.



Using a Table

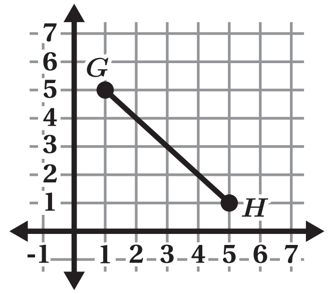
- Create a table of decimal value guesses for n.
- Calculate n^2 for each guess of n.
- The closer n^2 is to 10, the better that value of n is as an approximation for $\sqrt{10}$.

n	n^2
3.1	9.61
3.16	9.9856
3.17	10.0489
3.165	10.017225

Things to Remember:

Name: ____________ Date: ________ Period: ________

Problems 1–2: Here is the line segment GH. Each grid square represents 1 square unit. Use the ruler, circle, or square if they help with your thinking.



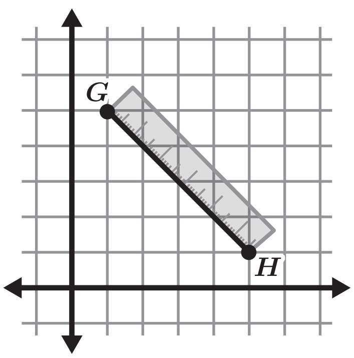
1. Determine the approximate length of GH.

Responses between 5 and 6 are considered correct.

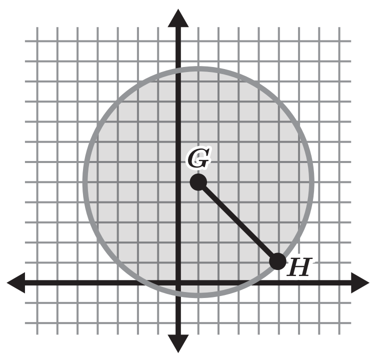
2. Determine the exact length of GH.

$\sqrt{32}$ units

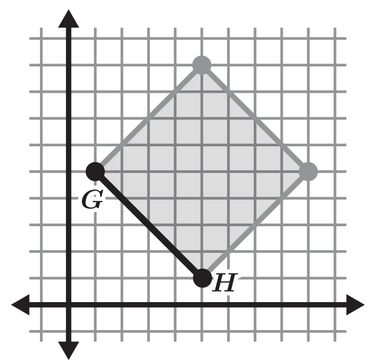
Ruler



Circle



Square



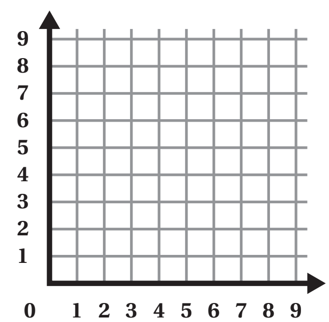
3. Determine the value of $\sqrt{16}$.

4

Problems 4–5: Estimate each square root. Draw a square if it helps with your thinking.

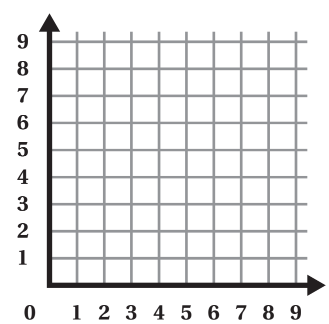
4. $\sqrt{35}$

Responses between 5 and 6 are considered correct.



5. $\sqrt{66}$

Responses between 8 and 9 are considered correct.



Problems 6–7: Determine which two whole numbers each square root is between.

6. $\sqrt{7}$

Between 2 and 3

7. $\sqrt{31}$

Between 5 and 6

8. Here is a list of values ordered from least to greatest. One value is unknown. Which could be the unknown value?

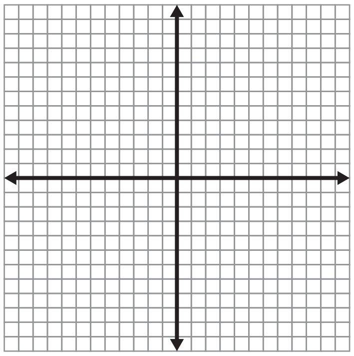
$2.5, \frac{19}{3}, \sqrt{51},$ ....

A. $(3.1)^2$ B. $\frac{15}{4}$ C. 6.89 D. 2.1

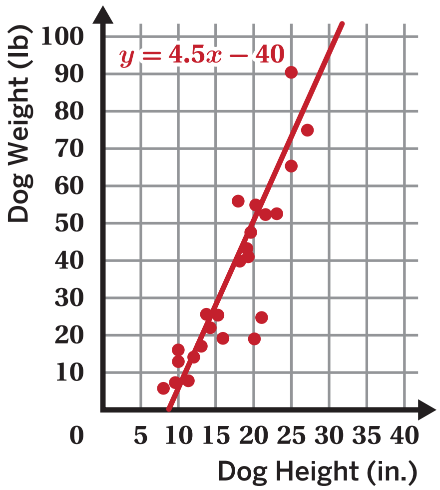
Spiral Review

9. Identify two points on a line that would create a slope of 6. Use the coordinate plane if it helps with your thinking.

Responses vary. **The points (1, 1) and (2, 7).**



Problems 10–12: Here is a scatter plot that shows the heights and weights of 25 dogs, as well as a linear model for the same situation and its equation.



10. What does the slope of the linear model mean in this situation?

For every 1 inch increase in height, the weight is predicted to increase by 4.5 pounds.

11. Based on the model, what will be the weight of a dog that is 25 inches tall?

72.5 pounds

12. Does the data show a positive or negative association?

Positive association

Explain your thinking.

***Explanations vary.* As the dog height increases, the weight also tends to increase.**

Reflection

1. Put a star next to a problem you could explain to a classmate.

2. Use this space to ask a question or share something you're proud of.

Lesson Practice 8.8.04

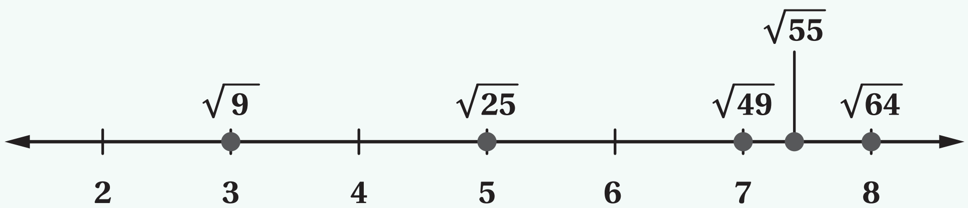
Science Mom Lesson 114

Lesson Summary

You can represent a square root on a number line. We write a solution to an equation, such as $x^2 = 3$, using square root notation. The positive solution to this equation is $x = \sqrt{3}$.

You can approximate a square root on a number line by observing the whole numbers around it.

For example, you can determine that $\sqrt{55}$ is between 7 and 8 because $7^2 = 49$ and $8^2 = 64$, and 55 is between 49 and 64. More precisely, $\sqrt{55}$ should be plotted slightly left of 7.5 since it is closer to 7 than 8.



A **perfect square** is a number that is the square of an integer. For example, 49 is a perfect square because $7 \cdot 7 = 7^2 = 49$, but 55 is not a perfect square because no integer can be squared to equal 55.

Things to Remember:

Lesson Practice
8.8.04

Name: ________ Date: ________ Period: ________

1. The number z is positive. Determine the exact value of z if $z^2 = 60$.

A. 30 B. $\sqrt{7.75}$ C. 7.75 D. $\sqrt{60}$

2. Which statement *best* describes the value of $\sqrt{41}$?

A. The value of $\sqrt{41}$ is between 6 and 6.5.

B. The value of $\sqrt{41}$ is between 6.5 and 7.

C. The value of $\sqrt{41}$ is between 7 and 7.5.

D. The value of $\sqrt{41}$ is between 7.5 and 8.

3. Write two square roots that are between 7 and 8.

***Responses vary.* $\sqrt{50}$ and $\sqrt{61}$**

4. Explain how you know that $\sqrt{30}$ is between 5 and 6.

***Responses vary.* $\sqrt{25} = 5$ and $\sqrt{36} = 6$, and $\sqrt{30}$ is between $\sqrt{25}$ and $\sqrt{36}$.**

5. Explain how you know that $\sqrt{37}$ is a little more than 6.

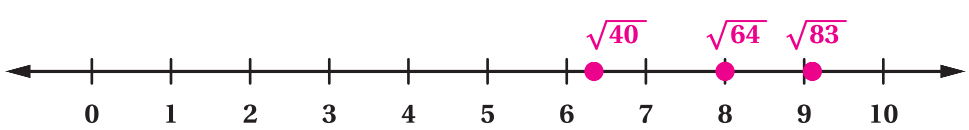
***Responses vary.* $\sqrt{36}$ is exactly 6, and $\sqrt{37}$ is a little more than that.**

6. Explain how you know that $\sqrt{95}$ is a little less than 10.

***Responses vary.* $\sqrt{100}$ is exactly 10, and $\sqrt{95}$ is a little less than that.**

7. Estimate each number and plot it on the number line.

$\sqrt{83}$	$\sqrt{40}$	$\sqrt{64}$



8. Select *all the* numbers that are greater than 10 and less than 11.

☑ **A.** $\sqrt{120}$ ☐ **B.** $\sqrt{122}$ ☐ **C.** $\sqrt{130}$

☐ **D.** $\sqrt{95}$ ☑ **E.** $\sqrt{105}$

9. Fill in each blank using the digits 1 to 9 only once to make the inequality true.

$\square < \sqrt{\square\square} < \square$

Responses vary. $5 < \sqrt{32} < 6$

Spiral Review

Problems 10–11: Evaluate each expression. Write your answer in scientific notation.

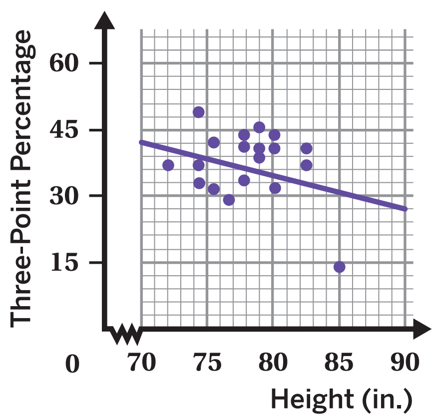
10. $(2 \cdot 10^3)(3.4 \cdot 10^{11})$

$6.8 \cdot 10^{14}$

11. $\dfrac{4.6 \cdot 10^3}{2 \cdot 10^5}$

$2.3 \cdot 10^{-2}$

Problems 12–13: This scatter plot shows the heights (in inches) and the three-point percentages for different basketball players last season.



12. Predict the three-point percentage for a player who is 70 inches tall.

Responses between 42% and 44% are considered correct.

13. Identify a data point that appears to be an outlier.

(85, 14)

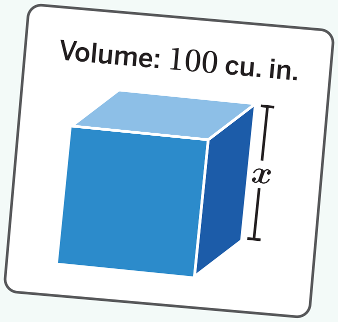
Reflection

1. Circle a problem you want to talk to a classmate about.

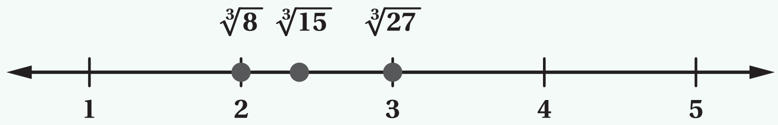
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

A **cube root** describes the edge length of a cube given its volume. For the cube shown with a volume of 100 cubic inches, the equation $x^3 = 100$ can help you find its edge length. Its exact solution would be represented as $x = \sqrt[3]{100}$.



We can approximate a cube root on a number line by observing the whole numbers around it. For example, you can determine that $\sqrt[3]{15}$ is between 2 and 3 because $2^3 = 8$ and $3^3 = 27$, and 15 is between 8 and 27.



8 and 27 are perfect cubes because they are both the cube of an integer: $2 \cdot 2 \cdot 2 = 2^3 = 8$ and $3 \cdot 3 \cdot 3 = 3^3 = 27$.

Things to Remember:

Lesson Practice
8.8.05

Name: ________ Date: ________ Period: ________

1. What is the volume of each cube based on its edge length?

	Edge Length	Volume
Cube A	4 cm	**64 cu. cm**
Cube B	$\sqrt[3]{11}$ ft	**11 cu. ft**
Cube C	s units	**s^3 cu. units**

2. What is the exact edge length of each cube based on its volume?

	Edge Length	Volume
Cube D	**10 cm**	1,000 cu. cm
Cube E	**$\sqrt[3]{23}$ in.**	23 cu. in.
Cube F	**$\sqrt[3]{v}$ units**	v cu. units

Problems 3–6: Write an equivalent expression that doesn't use a cube root symbol.

3. $\sqrt[3]{1}$ $= 1$

4. $\sqrt[3]{216}$ $= 6$

5. $\sqrt[3]{\frac{27}{125}}$ $= \frac{3}{5}$

6. $\sqrt[3]{\frac{1}{64}}$ $= \frac{1}{4}$

Problems 7–10: Write an exact solution to each equation.

7. $t^2 = 64$
$t = 8$ or $t = -8$

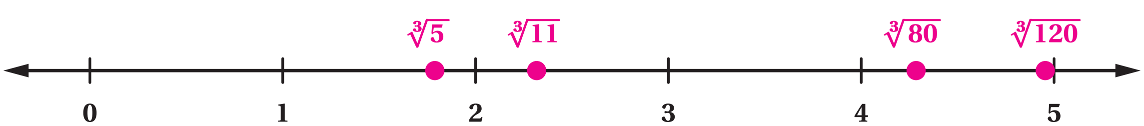
8. $f^3 = 181$
$f = \sqrt[3]{181}$

9. $m^2 = 8$
$m = \sqrt{8}$ or $m = -\sqrt{8}$

10. $c^3 = 343$
$c = 7$

11. Plot each cube root on the number line.

$\sqrt[3]{5}$	$\sqrt[3]{11}$	$\sqrt[3]{80}$	$\sqrt[3]{120}$



Name: .... Date: .... Period: ....

12. Order the following from *least* to *greatest*. Use the number line if it helps with your thinking.

$\sqrt[3]{27}$	$\sqrt[3]{530}$	$\sqrt{48}$	$\sqrt{121}$	π	$\frac{19}{2}$

$\sqrt[3]{27}$	π	$\sqrt{48}$	$\sqrt[3]{530}$	$\frac{19}{2}$	$\sqrt{121}$

Least **Greatest**

13. Cube B has a volume that is double the volume of cube A. What could be the edge lengths of each cube?

***Responses vary*. Cube A has an edge length of 2 and cube B has an edge length of $\sqrt[3]{16}$.**

Spiral Review

14. What two consecutive whole numbers does $\sqrt{40}$ lie between?

A. 4 and 5 **B.** 5 and 6 **C.** 6 and 7 **D.** 7 and 8

15. Which set of ordered pairs represents a function?

A. $\{(-5, 10), (-20, 0), (-20, 25)\}$

B. $\{(-10, 0), (-10, 5), (-10, 25)\}$

C. $\{(-25, 0), (5, -10), (-25, 30)\}$

D. $\{(-20, 0), (5, -10), (30, -25)\}$

Reflection

1. Circle the problem you feel most confident about.

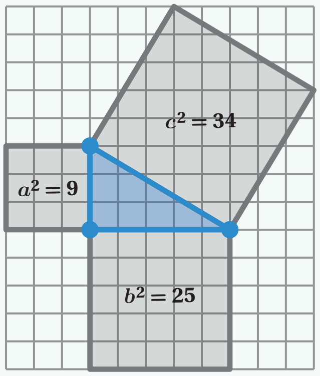
2. Use this space to ask a question or share something you're proud of.

Science Mom Lesson 116

Lesson Summary

The **Pythagorean theorem** says that for right triangles, $a^2 + b^2 = c^2$, where a and b represent the lengths of the two shorter sides and c represents the length of the longest side.

The relationship $a^2 + b^2 = c^2$ is only true for right triangles.



For triangle H:

$(\sqrt{10})^2 + (\sqrt{17})^2 = 27$

$c^2 = (\sqrt{29})^2 = 29$

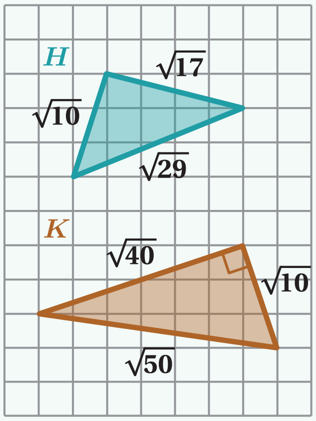
$27 \neq 29$ so $a^2 + b^2 = c^2$ is not true.

For triangle K:

$(\sqrt{10})^2 + (\sqrt{40})^2 = 50$

$c^2 = (\sqrt{50})^2 = 50$

$50 = 50$ so $a^2 + b^2 = c^2$ is true.



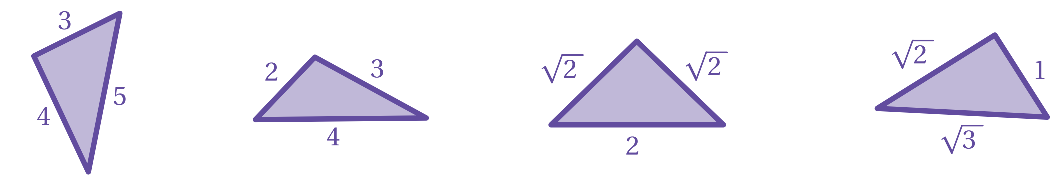
Things to Remember:

Lesson Practice
8.8.06

Name: .... Date: .... Period: ....

1. For which of the following triangles is $a^2 + b^2 = c^2$ true? **Triangles A, C, and D**

Triangle A | Triangle B | Triangle C | Triangle D



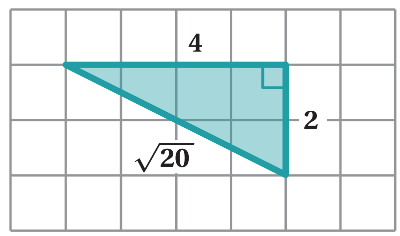
Show or explain your thinking. ***Work varies.***

Triangle A: $3^2 + 4^2 = 25$ and $5^2 = 25$

Triangle C: $(\sqrt{2})^2 + (\sqrt{2})^2 = 4$ and $2^2 = 4$

Triangle D: $1^2 + (\sqrt{2})^2 = 3$ and $(\sqrt{3})^2 = 3$

2. Select *all* the equations that represent the relationship between the side lengths of the triangle.



☐ **A.** $(\sqrt{20})^2 + 4^2 = 2^2$

☑ **B.** $(\sqrt{20})^2 = 4^2 + 2^2$

☑ **C.** $2^2 + 4^2 = (\sqrt{20})^2$

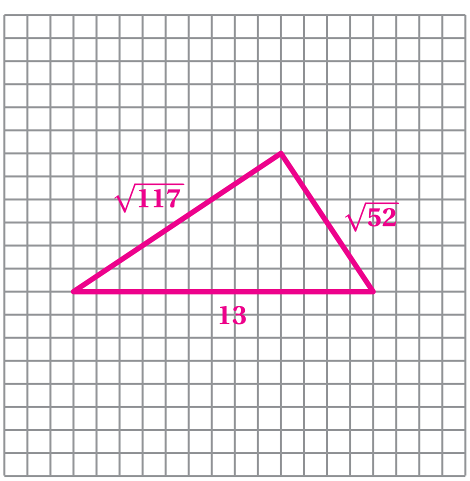
☐ **D.** $2^2 + (\sqrt{20})^2 = 4^2$

☑ **E.** $(\sqrt{20})^2 = 2^2 + 4^2$

3. Draw a triangle where $a^2 + b^2 = c^2$. What are its side lengths?

Responses vary.

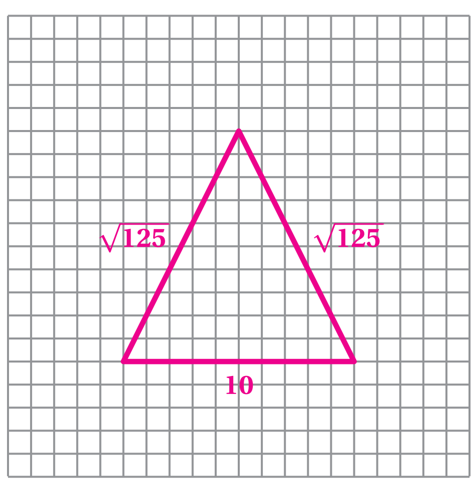
$a =$ $\sqrt{117}$, $b =$ $\sqrt{52}$, $c =$ 13



4. Draw a triangle where $a^2 + b^2 \neq c^2$. What are its side lengths?

Responses vary.

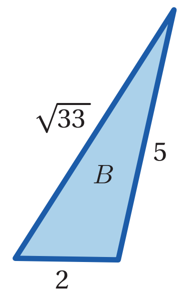
$a =$ $\sqrt{125}$, $b =$ $\sqrt{125}$, $c =$ 10



Name: ______ Date: ______ Period: ______

5. Felipe claims the Pythagorean theorem is true for any triangle. Is his claim correct?

No



Explain your thinking using triangle B as an example.

***Explanations vary.* The Pythagorean theorem only applies to right triangles. Triangle B is an obtuse triangle, so the Pythagorean theorem does not apply.**

Spiral Review

6. Order the following expressions from *least* to *greatest*.

$25 \div 10$	$250000 \div 1000$	$2.5 \div 1000$	$0.025 \div 1$

$2.5 \div 1000$	$0.025 \div 1$	$25 \div 10$	$250000 \div 1000$

Least **Greatest**

Problems 7–9: A teacher tells her students she is just over 1.5 billion seconds old.

7. Write her age in seconds using scientific notation.

1.5×10^9

8. What is a more reasonable unit of measurement for this situation?

***Responses vary.* Years**

9. Convert the teacher's age to a new unit. Show or explain your thinking.

***Responses vary.* There are 31,536,000 seconds in a year. $1.5 \times 10^9 \div 31536000$ is about 47.6, so she is about 48 years old.**

10. Kwasi is jogging in a 30-kilometer trail race. The equation $y = -6x + 30$ represents this situation, where y is the distance, in kilometers, that Kwasi has left to run after x hours. How much further will Kwasi have to run after 3.5 hours?

A. 6 **B.** 9 **C.** 21 **D.** 30

Reflection

1. Put a star next to a problem where you revised your thinking.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

The Pythagorean theorem states that for any right triangle, $a^2 + b^2 = c^2$. There are many proofs for the Pythagorean theorem.

One proof involves drawing squares on the sides of a right triangle, like in Figure 1. You can cut up pieces of the smaller squares to equal the area of the larger square.

Another involves rearranging triangles. Make a square where each side is $(a + b)$ units long (like Figures 2 and 3).

You can fill each large square with 4 small right triangles, a^2 and b^2 (Figure 2) or the same four small triangles and c^2 (Figure 3). Since the total area and the area of the four small triangles are the same, $a^2 + b^2$ has to equal c^2.

Figure 1

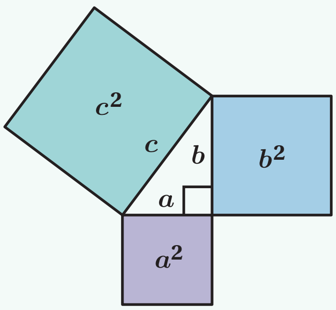


Figure 2

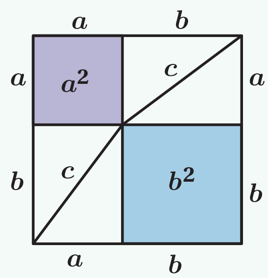
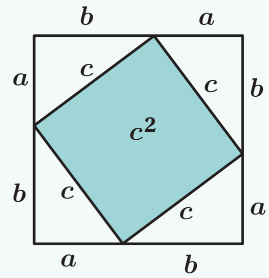


Figure 3



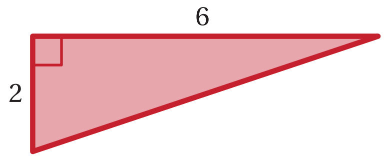
Things to Remember:

Lesson Practice
8.8.07

Name: .... Date: .... Period: ....

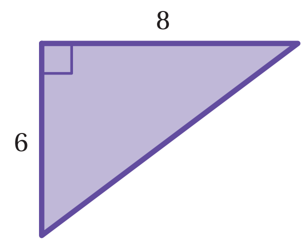
Problems 1–2: Determine the length of each unlabeled side.

1.



$\sqrt{40}$ units (or equivalent)

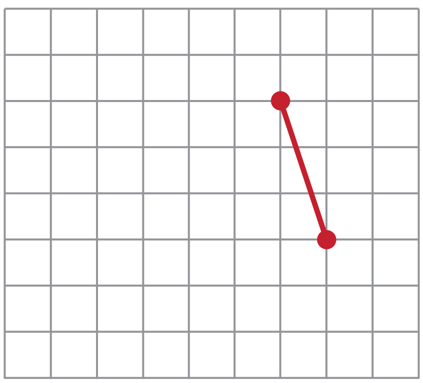
2.



10 units (or equivalent)

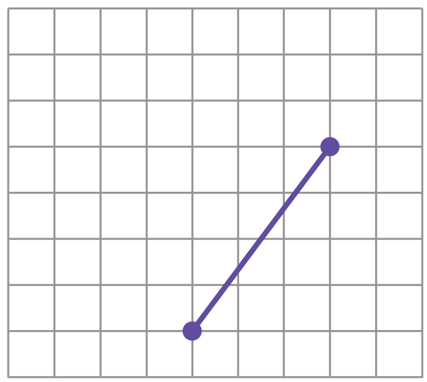
Problems 3–4: Determine the exact length of each segment. Each grid line represents one unit.

3.



$\sqrt{10}$ units

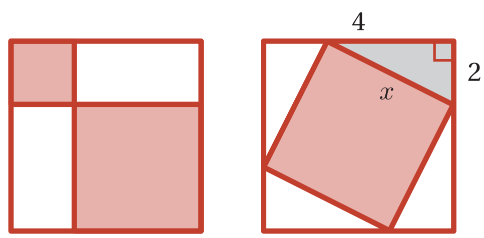
4.



5 units (or equivalent)

5. Determine the exact value of x.

$\sqrt{20}$ units



6. Determine a set of values for a, b, and c that meet the following criteria:

- Make the shaded areas of figure G and figure H equal.
- Make $a^2 + b^2 = c^2$ true.

Responses vary. $a = 5$, $b = 8$, and $c = \sqrt{89}$.

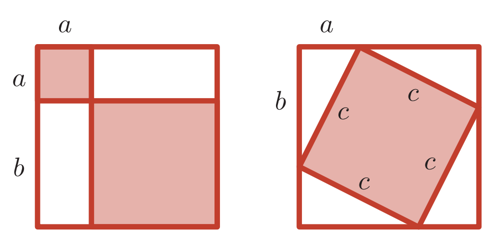


Figure G Figure H

Lesson Practice
8.8.07

Name: ____________ Date: ________ Period: ________

Spiral Review

Problems 7–10: For each square root, write which two consecutive whole numbers the value is between. For example, $\sqrt{2}$ is between 1 and 2.

7. $\sqrt{10}$

3 and 4

8. $\sqrt{54}$

7 and 8

9. $\sqrt{18}$

4 and 5

10. $\sqrt{99}$

9 and 10

Problems 11–13: Rewrite each expression as a single power of 10. For example, $(10^5)^0$ can be rewritten as 10^0.

11. $10^5 \bullet 10^0$

$\mathbf{10^5}$

12. $\dfrac{10^9}{10^0}$

$\mathbf{10^9}$

13. Which expression is equivalent to $3^{-4} \bullet 3^9$?

A. $\dfrac{3^{-4}}{3^{-1}}$

B. $(3^5)^{-1}$

C. $\dfrac{3^4}{3^{-1}}$

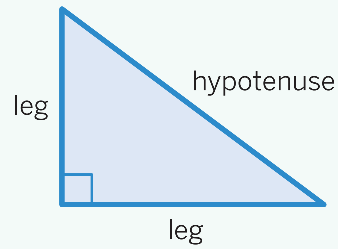
D. $(3^{-1})^5$

Reflection

1. Put a heart next to a problem you understand well.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

The **hypotenuse** is the side of a right triangle that is opposite the right angle, and is the longest side. Only right triangles have a *hypotenuse*. The **legs** of a right triangle are the sides that make the right angle.



The Pythagorean theorem says that in a right triangle, the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse. This can be represented by the equation $a^2 + b^2 = c^2$, where a and b represent the lengths of the legs and c represents the length of the hypotenuse.

When any two side lengths of a right triangle are known, the Pythagorean theorem can be used to calculate the length of the third side, whether it is the hypotenuse or a leg. You can substitute the lengths you know into the equation $\text{leg}^2 + \text{leg}^2 = \text{hypotenuse}^2$ or $a^2 + b^2 = c^2$, and then solve for the unknown value.

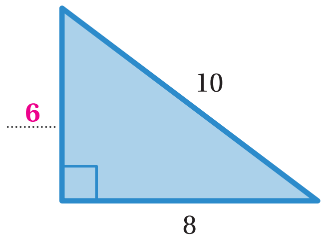
Things to Remember:

Lesson Practice
8.8.08

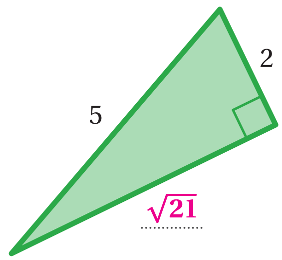
Name: .... Date: .... Period: ....

Problems 1–3: Calculate the exact value of the unknown side length in each right triangle.

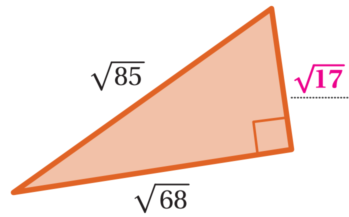
1.



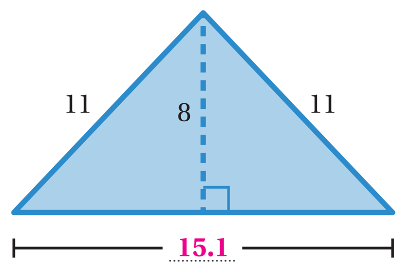
2.



3.



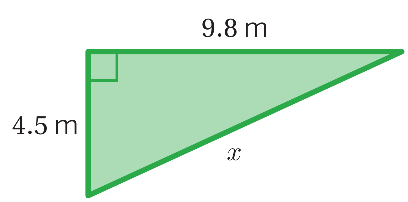
4. Calculate the value of the unknown side length to the nearest tenth.



5. Ivory and Chey are walking home from their friend's house. They start by walking 2 kilometers west and then 3 kilometers south. How many kilometers, to the nearest tenth, do they live from their friend's house?

3.6 kilometers

6. This diagram shows a right triangle.



Which measurement is closest to the value of x, in meters?

A. 3.8 meters

B. 8.7 meters

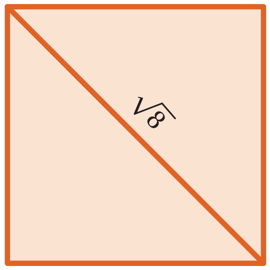
C. 10.8 meters

D. 11.2 meters

Name: .... Date: .... Period: ....

7. What is the area of this square?

4 square units



Spiral Review

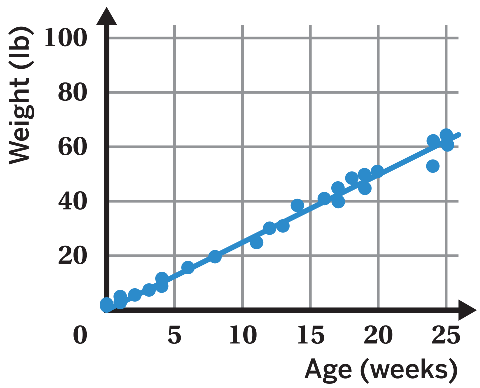
8. In 2015, there were roughly $1 \cdot 10^6$ high school football players and $2 \cdot 10^3$ professional football players in the United States. About how many times more high school football players were there?

There were approximately 500 times more high school football players.

Show or explain your thinking.

Explanations vary. $\frac{1 \cdot 10^6}{2 \cdot 10^3} = 0.5 \cdot 10^3$
$= 5 \cdot 10^2$
$= 500$

Problems 9–10: The scatter plot shows some ages and weights for a large dog breed. The scatter plot shows the model of $y = 2.45x + 1.22$.



9. What does the slope mean in this situation?

***Responses vary.* The slope means that this type of dog can be expected to gain 2.45 pounds per week.**

10. Based on this model, how heavy would you expect a newborn puppy to be?

1.22 pounds

Reflection

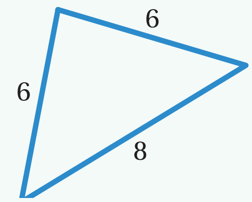
1. Star a problem you're still feeling confused about.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

If a triangle has side lengths a, b, and c, where c is the longest side and $a^2 + b^2 = c^2$, then the converse of the Pythagorean theorem says that you must have a right triangle. We can use this to determine whether any triangle is a right triangle. If the sides of a triangle *do not* make the equation $a^2 + b^2 = c^2$ true, then you know it is *not* a right triangle.

In the triangle shown, let $a = 6$, $b = 6$, and $c = 8$. You can use substitution to determine whether the triangle is a right triangle.



$$\begin{aligned} a^2 + b^2 &= 36 + 36 \\ &= 72 \end{aligned}$$

Because $c^2 = 8^2$, or 64, the triangle cannot be a right triangle because $a^2 + b^2 \neq c^2$.

Things to Remember:

Lesson Practice
8.8.09

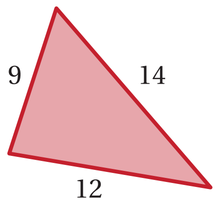
Name: .... Date: .... Period: ....

1. The lengths of two sides of a triangle are 5 and 6. Which side length would make the triangle a right triangle?

A. $\sqrt{8}$ **B.** $\sqrt{11}$ **C.** 9 **D.** 10

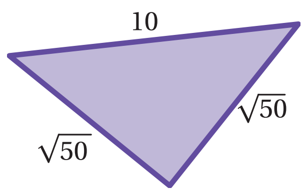
Problems 2–4: Determine whether each triangle is a right triangle.

2.



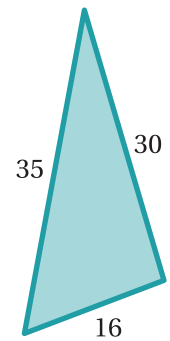
No

3.



Yes

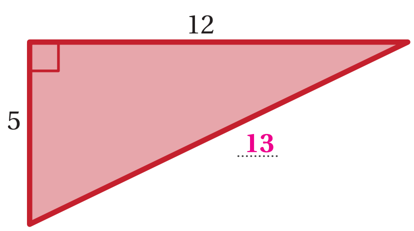
4.



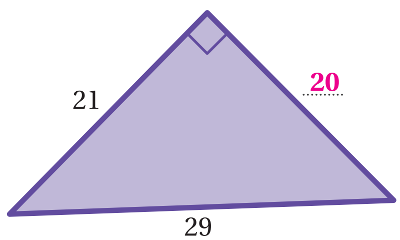
No

Problems 5–6: Calculate the value of the unknown side length so that each triangle is a right triangle.

5.



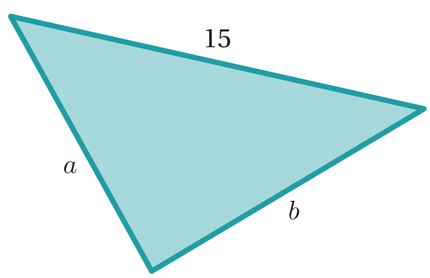
6.



7. The longest side of this triangle has a length of 15 centimeters. What could the lengths of the other two sides be so that this is a right triangle?

Responses vary.

- Side a: $\sqrt{200}$ centimeters
  Side b: 5 centimeters
- Side a: $\sqrt{125}$ centimeters
  Side b: 10 centimeters



Name: ______ Date: ______ Period: ______

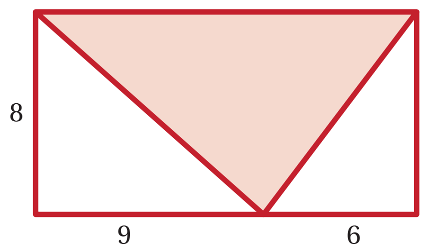
8. The side lengths of a triangle are 5, 7, and 9 units. Does the length of the longest side need to *increase*, *decrease*, or *stay the same* to make the triangle a right triangle? Circle one.

Increase   Decrease   Stay the same

Explain your thinking.

Explanations vary. **$5^2 + 7^2 < 9^2$. The length of the longest side needs to decrease so that the square of its side length is equal to $5^2 + 7^2$, or 74.**

9. Here is a 15-by-8 rectangle divided into triangles. Is the shaded triangle a right triangle? Circle one.



Yes   No

Explain your thinking.

Explanations vary. **I used the Pythagorean theorem to calculate the lengths of the legs of the shaded triangle, which are $\sqrt{145}$ and 10. The length of the longest side of the shaded triangle is 15 (the same as the length of the rectangle). For the triangle to be a right triangle, the side lengths must make the equation $a^2 + b^2 = c^2$ true. Because $145 + 100 = 245$, not 225, I know that the shaded triangle is not a right triangle.**

Spiral Review

10. Determine which two whole numbers $\sqrt{53}$ is between.

Between 7 and 8

11. Write an expression equivalent to $\sqrt[3]{\frac{64}{125}}$ that does not use a cube root symbol.

$\frac{4}{5}$ **(or equivalent)**

Reflection

1. Put a heart next to the problem you're most proud of.

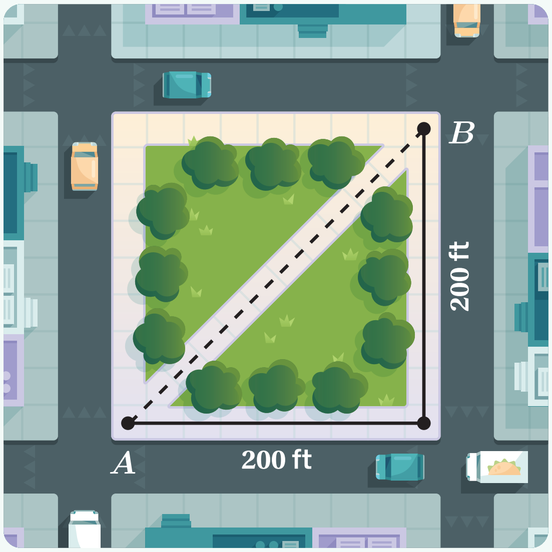
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

The Pythagorean theorem can be used to solve problems that can be modeled with right triangles. The sides of a triangle might represent units such as the length of an object or the distance between two objects.

To apply the Pythagorean theorem, the lengths of two sides must be known so the length of the third side can be determined.

For example, you can use the Pythagorean theorem to calculate the distance to walk through the park from point A to point B.



Let the length of the path through the park equal c.

$$c^2 = (200)^2 + (200)^2$$

$$c^2 = 40000 + 40000$$

$$c^2 = 80000$$

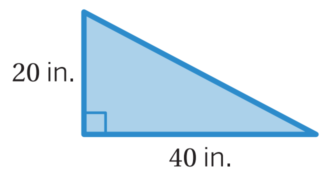
$$c = \sqrt{80000}$$

Things to Remember:

Lesson Practice
8.8.10

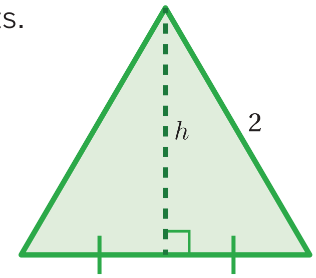
Name: .... Date: .... Period: ....

1. Here is a skateboarding ramp. The length of the base is 40 inches, and the height of the ramp is 20 inches. What is the approximate length of the ramp in inches?



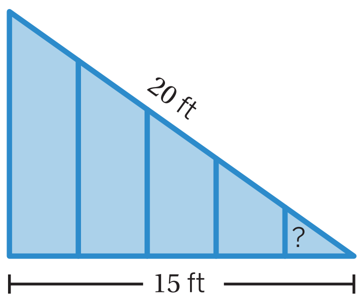
About 44.7 inches

2. Here is an equilateral triangle. The length of each side is 2 units. A height, h, is drawn. Determine the exact height.



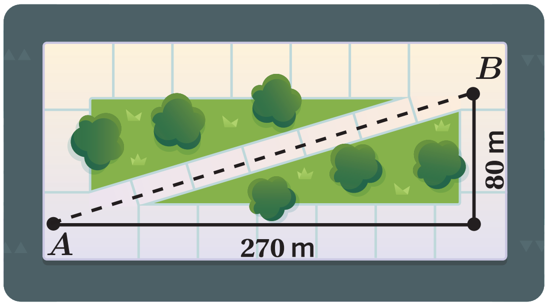
$\sqrt{3}$ units

3. A 20-foot roof needs 5 support beams placed equidistant along the floor. Each support is a different length. Determine the exact length of the shortest support beam.



$\sqrt{7}$ feet

Problems 4–5: A standard city block in Manhattan is a rectangle measuring 80 meters by 270 meters. Sol is thinking about cutting diagonally through the park to get from point A to point B.



4. Determine the distance Sol would walk by cutting through the park.

$\sqrt{79300} \approx 282$ meters

5. If Sol walks an average of 1.42 meters per second, how much time will cutting through the park save? Round your answer to the nearest second.

About 48 seconds

Lesson Practice
8.8.10

Name: .... Date: .... Period: ....

Spiral Review

6. Select *all* the sets of side lengths that form a right triangle.

- ☐ **A.** $7, 8, 13$
- ☑ **B.** $4, 10, \sqrt{84}$
- ☑ **C.** $\sqrt{8}, 11, \sqrt{129}$
- ☑ **D.** $\sqrt{1}, 2, \sqrt{3}$
- ☐ **E.** $\sqrt{2}, 3, \sqrt{13}$

Problems 7–9: Circle the number that is greater.

7. $12 \cdot 10^9$ or $4 \cdot 10^9$

8. $1.5 \cdot 10^{-12}$ or $3 \cdot 10^{-12}$

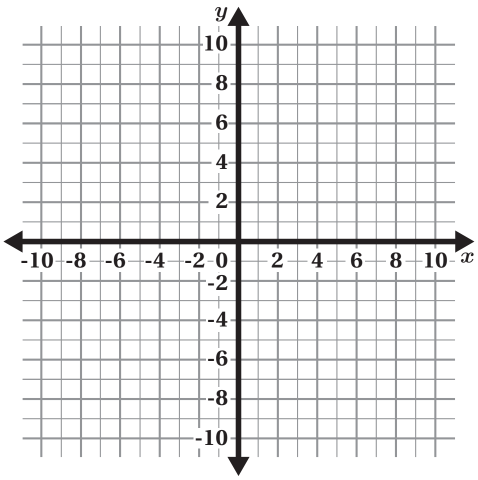
9. $20 \cdot 10^4$ or $6 \cdot 10^5$

10. A line contains the point $(3, 5)$. If the line has a negative slope, which of these points could also be on the line?

Use the graph if it helps with your thinking.

A. $(6, 5)$ **B.** $(4, 7)$

C. $(5, 4)$ **D.** $(2, 0)$



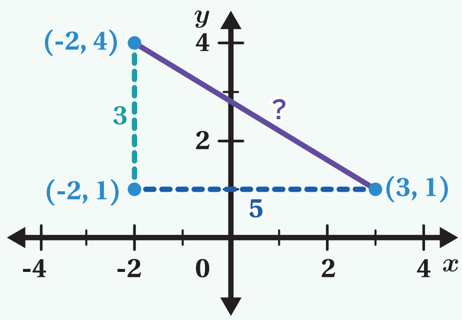
Reflection

1. Put a star next to a problem that looked more difficult than it really was.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

You can use the Pythagorean theorem to calculate the distance between two points on a diagonal line segment. Start by drawing horizontal and vertical legs to form a right triangle. Then use the Pythagorean theorem to calculate the length of the hypotenuse, which will be the distance between the two points.



Calculate the distance between two points on a horizontal line by determining the absolute value of the difference between their x-coordinates. The distance between $(-2, 1)$ and $(3, 1)$ is $|-2 - 3| = 5$ units.

Similarly, you can calculate the distance between two points on a vertical line by determining the absolute value of the distance between their y-coordinates. The distance between points $(-2, 4)$ and $(-2, 1)$ is $|4 - 1| = 3$ units.

$$\text{leg}^2 + \text{leg}^2 = \text{hypotenuse}^2$$

$$3^2 + 5^2 = x^2$$

$$9 + 25 = x^2$$

$$34 = x^2$$

$$\sqrt{34} = x$$

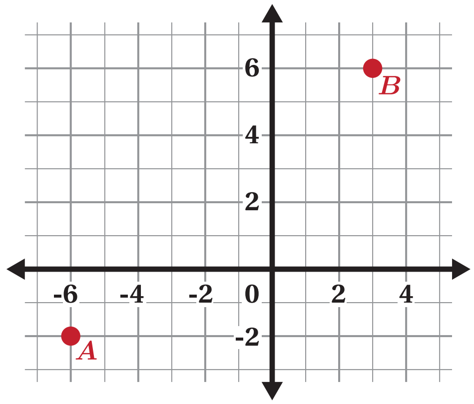
Things to Remember:

Lesson Practice
8.8.11

Name: ______ Date: ______ Period: ______

1. Here is a coordinate plane with labeled points.

What is the distance between point A and point B?



A. $\sqrt{17}$

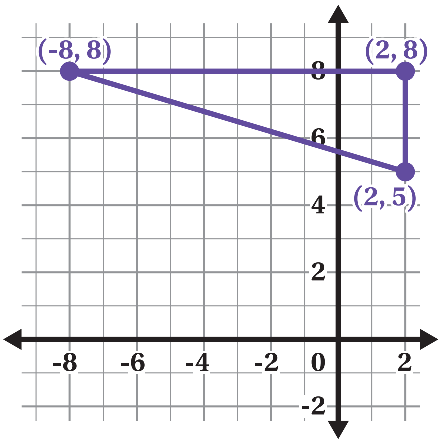
B. $\sqrt{128}$

C. $\sqrt{145}$

D. 17

Problems 2–3: Calculate the length of each side of these right triangles.

2.

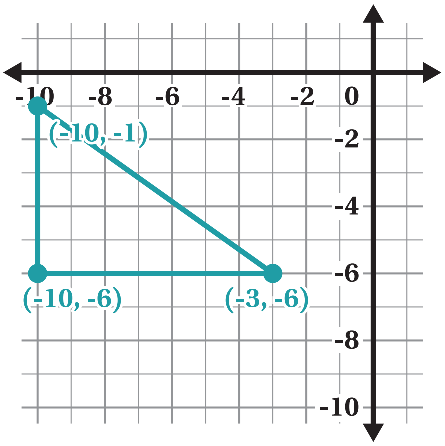


Shorter leg: 3 units

Longer leg: 10 units

Hypotenuse: $\sqrt{109}$ units

3.

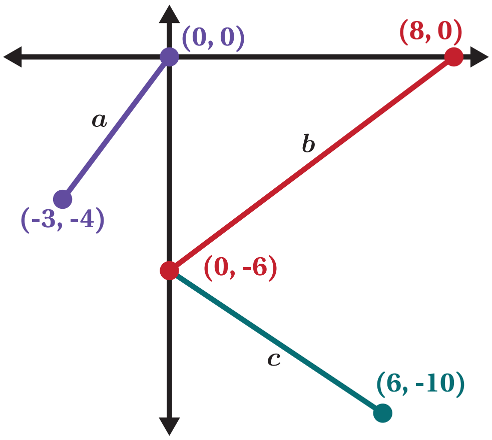


Shorter leg: 5 units

Longer leg: 7 units

Hypotenuse: $\sqrt{74}$ units

Problems 4–6: Calculate the length of each segment.



4. Segment a

5 units

5. Segment b

10 units

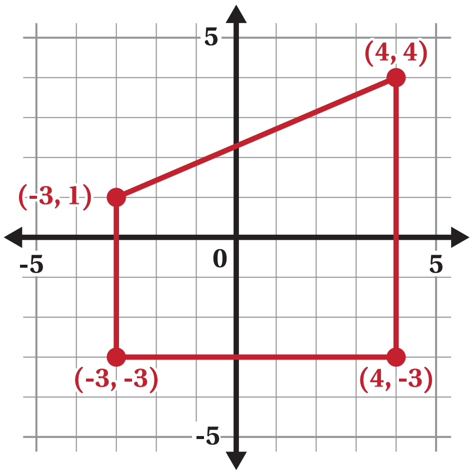
6. Segment c

$\sqrt{52}$ units

Name: ______________ Date: ________ Period: ________

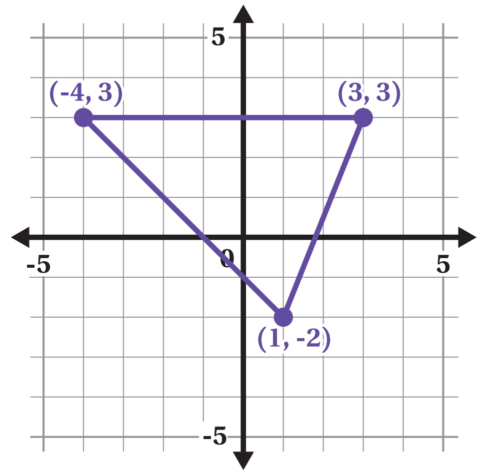
Problems 7–8: Calculate the perimeter of each polygon.

7.



$18 + \sqrt{58}$, or about 25.6 units

8.



$7 + \sqrt{50} + \sqrt{29}$, or about 19.5 units

9. The distance between (0, -8) and another point is 5 units. What are possible coordinates for the second point if the two points do not lie on a horizontal or vertical line?

Responses vary.

- (-4, -5)
- (4, -5)
- (-3, -12)
- (3, -12)

Spiral Review

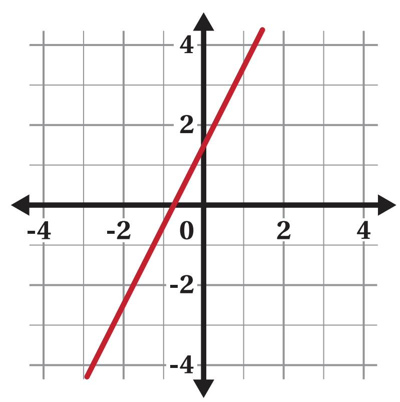
10. Determine the value of the expression. Write your answer in scientific notation.

$(5.6 \cdot 10^8) + (7.3 \cdot 10^8)$

$1.29 \cdot 10^9$

11. Write an equation for the line.

$y = 2x + 1.5$



Reflection

1. Put a star next to the problem you understood best.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

You can write every number as a decimal. Some fractions can be written as terminating decimals, while others can be written as repeating decimals. To write a fraction as a decimal, you can use long division.

For example, here is how you can use long division to rewrite $\frac{1}{15}$ as a decimal.

$$\begin{array}{r} 0.06666\ldots \\ 15\overline{)1.00} \\ -90 \\ \hline 100 \\ -90 \\ \hline 100 \\ -90 \\ \hline 100 \\ -90 \\ \hline 10 \end{array}$$

To avoid writing the repeating part of a decimal over and over, you can use **bar notation**, which shows a line over the part of the decimal that repeats. For example, when writing $\frac{1}{15}$ as a decimal, you would write $0.06666\ldots$ as $0.0\overline{6}$.

Things to Remember:

Lesson Practice
8.8.12

Name: .... Date: .... Period: ....

Problems 1–4: Write each fraction as a decimal.

1. $\frac{99}{100}$

0.99

2. $\frac{7}{9}$

$0.\overline{7}$

3. $\frac{1}{15}$

$0.0\overline{6}$

4. $\frac{3}{7}$

$0.\overline{428571}$

5. Which decimal is equivalent to $\frac{5}{18}$?

A. $0.\overline{27}$
B. 0.27
C. $0.2\overline{7}$
D. $\overline{0.27}$

Problems 6–7: Determine whether the decimal representation of each fraction will repeat or terminate. Explain your thinking.

6. $\frac{1}{16}$

Terminate. *Explanations vary.* $\frac{1}{16} = \frac{1}{2 \cdot 2 \cdot 2 \cdot 2}$. The denominator only includes factors of 2, so the decimal will terminate.

7. $\frac{1}{12}$

Repeat. *Explanations vary.* $\frac{1}{12} = \frac{1}{2 \cdot 2 \cdot 3}$. The denominator includes factors other than 2 or 5, so it will repeat.

Name: .... Date: .... Period: ....

8. Order these numbers from *least* to *greatest*:

1.04	$1.0\overline{47}$	$1.0\overline{4}$	1.047	$1.04\overline{7}$

1.04	$1.0\overline{4}$	1.047	$1.0\overline{47}$	$1.04\overline{7}$

Least **Greatest**

9. What is the smallest whole number n that would make $\frac{n}{36}$ a terminating decimal?

9

Explain your thinking. ***Explanations vary.* Because $\frac{n}{36} = \frac{n}{2 \cdot 2 \cdot 3 \cdot 3}$, I need to eliminate factors other than 2 and 5. $n = 3 \cdot 3 = 9$ would result in the smallest denominator equivalent to a multiple of 2.**

Spiral Review

Problems 10–11: The numbers x and w are positive. Determine the exact value of each variable.

10. $x^2 = 90$

$x = \sqrt{90}$

11. $w^2 = 36$

$w = 6$

Reflection

1. Put a star next to a problem that looked more difficult than it really was.

2. Use this space to ask a question or share something you're proud of.

Lesson Summary

You can express all repeating decimals as fractions. One way to do this is to multiply equations by factors of 10 until the repeating decimals can subtract to 0. Once the repetition is removed, the resulting equation can be solved and left in fraction form.

For example, see these steps to represent $0.\overline{57} = 0.575757575...$ as a fraction.

If a decimal expansion of a number is a repeating or terminating decimal, the number can be written as a fraction. If the digits in the decimal expansion do not repeat (non-repeating) and do not terminate (non-terminating), then the number cannot be written as a fraction.

$$\begin{aligned} x &= 0.\overline{57} \\ 10x &= 5.\overline{75} \\ 100x &= 57.\overline{57} \end{aligned}$$

$$\begin{aligned} 100x &= 57.\overline{57} \\ -(x &= 0.\overline{57}) \\ \hline 99x &= 57 \\ x &= \frac{57}{99} \\ 0.\overline{57} &= \frac{57}{99} \end{aligned}$$

Things to Remember:

Lesson Practice
8.8.13

Name: ________ Date: ________ Period: ________

Problems 1–2: Here are the numbers 0.444 and $0.\overline{4}$.

1. How are the numbers alike?

***Responses vary*. They're both decimals between 0.4 and 0.5, and the first three digits in their decimal expansions are the same.**

2. How are the numbers different?

Responses vary.

- **$0.\overline{4}$ is greater than 0.444 because it has a greater digit in the ten-thousandths place.**
- **0.444 is a terminating decimal, while $0.\overline{4}$ is an infinitely repeating decimal.**

Problems 3–4: Match each fraction with its decimal representation.

3.

Decimal	Fraction
a. $0.\overline{6}$	**a** $\frac{2}{3}$
b. 0.66	**b** $\frac{33}{50}$

4.

Decimal	Fraction
a. $0.4\overline{8}$	**d** $\frac{7}{90}$
b. $0.\overline{48}$	**c** $\frac{7}{100}$
c. 0.07	**b** $\frac{48}{99}$
d. $0.0\overline{7}$	**a** $\frac{44}{90}$

Problems 5–10: Write each decimal as a fraction.

5. $3.\overline{45}$

$\frac{38}{11}$ (or equivalent)

6. 3.45

$\frac{69}{20}$ (or equivalent)

7. $0.\overline{7}$

$\frac{7}{9}$ (or equivalent)

8. $0.1\overline{3}$

$\frac{12}{90}$ (or equivalent)

9. $0.6\overline{38}$

$\frac{632}{990}$ (or equivalent)

10. $0.\overline{03}$

$\frac{3}{99}$ (or equivalent)

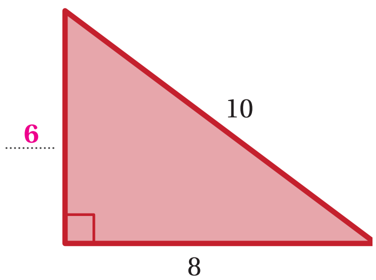
Lesson Practice
8.8.13

Name: .... Date: .... Period: ....

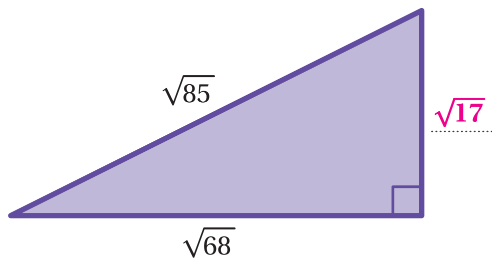
Spiral Review

Problems 11–12: Fill in the blank with the unknown side length of each right triangle.

11.



12.



Problems 13–14: Determine whether each comparison is true or false.

	Comparison	True	False
13.	$2 > \sqrt{2}$	✓	
14.	$\sqrt{15} < 3$		✓

15. Mohamed and Jalen are comparing $\sqrt{38}$ to 6.9. Mohamed says that $\sqrt{38}$ is greater than 6.9 and Jalen says that $\sqrt{38}$ is less than 6.9. Whose claim is correct?

Jalen's is correct.

Explain your thinking.

Explanations vary. **I agree with Jalen's response because $\sqrt{38}$ is closer to $\sqrt{36}$ (which is equal to 6) than to $\sqrt{49}$ (which is equal to 7).**

Reflection

1. Put a heart next to the problem you feel most confident about.
2. Use this space to ask a question or share something you're proud of.

Lesson Summary

A **rational number** is a number that can be written as a fraction of two integers, where the denominator is not zero. An **irrational number** is a number that cannot be written in that way.

Here are some examples of rational and irrational numbers.

Examples of Rational Numbers

- Fractions: $\frac{10}{5}$, $3\frac{11}{20} = \frac{71}{20}$
- Terminating decimals: $1.5 = \frac{3}{2}$, $1.73 = \frac{173}{100}$
- Repeating decimals: $1.\overline{73} = \frac{172}{99}$, $0.1212... = \frac{12}{99}$
- Square roots of perfect squares and cube roots of perfect cubes: $\sqrt[3]{8} = \frac{2}{1}$, $\sqrt{64} = \frac{8}{1}$, $\sqrt{\frac{1}{9}} = \frac{1}{3}$

Examples of Irrational Numbers

- Non-terminating, non-repeating decimals: π, $0.743...$, $2.742050...$
- Square roots of non-perfect squares and cube roots of non-perfect cubes: $\sqrt{2}$, $3 \cdot \sqrt{5}$, $\sqrt[3]{9}$

Things to Remember:

Lesson Practice
8.8.14

Name: .... Date: .... Period: ....

1. Sort the numbers based on whether they are rational or irrational.

0.1234	$-\sqrt{12}$	$-\frac{13}{3}$
$-\sqrt{100}$	$\sqrt{37}$	-77

Rational	Irrational
0.1234	**$-\sqrt{12}$**
$-\frac{13}{3}$	**$\sqrt{37}$**
$-\sqrt{100}$	
-77	

2. Select *all* the rational numbers.

- ☐ **A.** π^2
- ☐ **B.** $\sqrt{14}$
- ☐ **C.** $-\sqrt{99}$
- ☑ **D.** $-\sqrt{100}$
- ☑ **E.** $-\frac{123}{45}$
- ☑ **F.** $\sqrt{64}$

3. Determine whether each number is rational or irrational.

Number	Rational	Irrational
$\frac{1}{\sqrt{16}}$	✓	
$\sqrt{10}$		✓
$-2\frac{1}{3}$	✓	
0.532	✓	

4. A student claims that $\sqrt{\frac{7}{9}}$ is rational. Is their claim correct?

No

Explain your thinking.

Explanations vary. **$\sqrt{\frac{7}{9}} = \frac{\sqrt{7}}{3}$. This is an irrational number because it cannot be written as a fraction where both the numerator and denominator are non-zero integers.**

Lesson Practice
8.8.14

Name: .... Date: .... Period: ....

Spiral Review

Problems 5–6: Rewrite each expression as a single power.

5. $3^{-5} \cdot 4^{-5}$ $= 12^{-5}$ (or equivalent)

6. $(3^{-3})^2 = 3^{-6}$ (or equivalent)

Problems 7–8: Write an equation that expresses the relationship between a right triangle's side lengths if they measure:

7. 10, 6, and 8 units

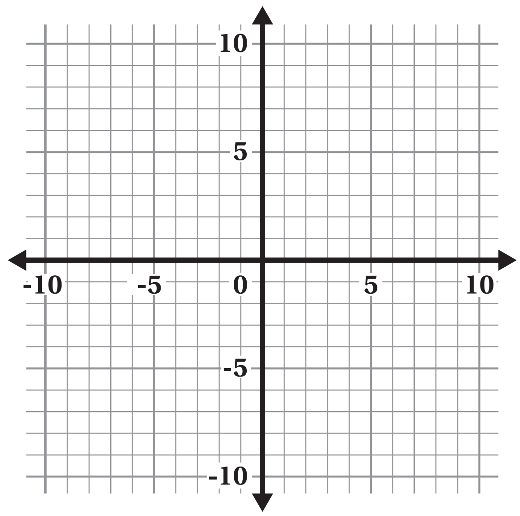
Responses vary. $6^2 + 8^2 = 10^2$

8. $\sqrt{5}$, $\sqrt{3}$, and $\sqrt{8}$ units

Responses vary. $(\sqrt{3})^2 + (\sqrt{5})^2 = (\sqrt{8})^2$

9. A square has vertices $(0, 0)$, $(5, 2)$, $(3, 7)$, and $(-2, 5)$. Which of these statements is true?

Use the graph if it helps with your thinking.



A. The square's side length is 5.

B. The square's side length is between 6 and 7.

C. The square's side length is between 5 and 6.

D. The square's side length is 7.

10. Fill in each blank using the digits 0 to 9 only once to make the equation true.

$$\sqrt{\square\square} + \sqrt{\square\square} = \sqrt{\square\square}$$

Responses vary. $\sqrt{09} + \sqrt{25} = \sqrt{64}$

Reflection

1. Put a question mark next to a problem you're feeling unsure of.

2. Use this space to ask a question or share something you're proud of.