

 Amplify Desmos Math **CALIFORNIA**

Grade 8

**Intervention, Extension, and
Investigation Resources**

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Mini-Lessons

Unit 1

Mini-Lessons

Determining Coordinates After a Rotation

ML 1.06



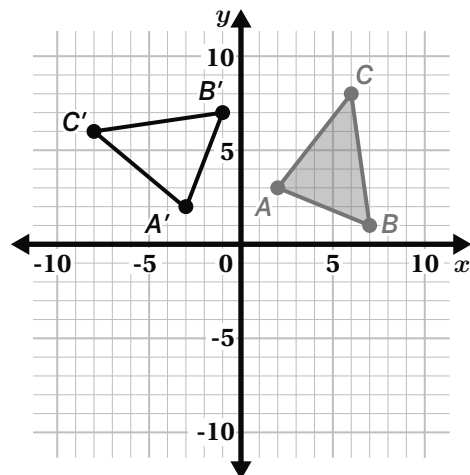
Modeled Review



Name: Priya

Triangle ABC is rotated 90° counterclockwise about the origin. Determine the coordinates of the rotated image.

Pre-image coordinates	Image coordinates
$A(2, 3)$	$A'(-3, 2)$
$B(7, 1)$	$B'(-1, 7)$
$C(6, 8)$	$C'(-8, 6)$

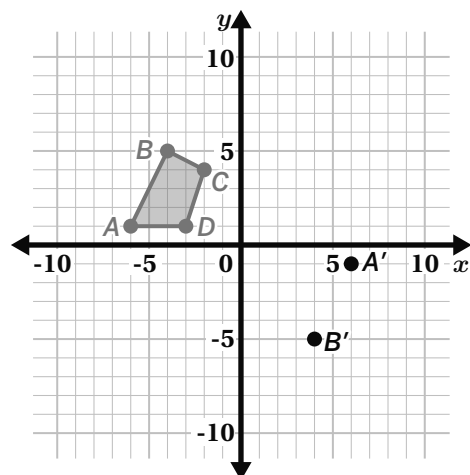


Guided Practice



- Figure $ABCD$ is rotated 180° clockwise about the origin. Determine the coordinates of the rotated image, complete the table, and draw the rotated image.

Pre-image coordinates	Image coordinates
$A(-6, 1)$	$A'(-6, 1)$
$B(-4, 5)$	$B'(4, \underline{\quad})$
$C(-2, 4)$	$C'(2, \underline{\quad})$
$D(-3, 1)$	$D'(\underline{\quad}, \underline{\quad})$



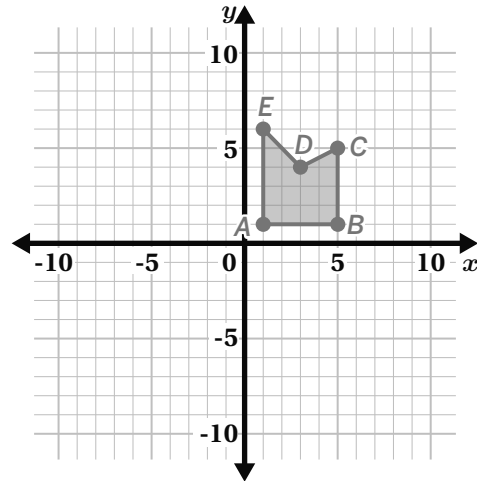


Guided Practice



2. Figure $ABCDE$ is rotated 90° counterclockwise about the origin. Determine the coordinates of the rotated image, complete the table, and draw the rotated image.

Pre-image coordinates	Image coordinates
$A (1, 1)$	$A' (-1, 1)$
$B (5, 1)$	
$C (5, 5)$	
$D (3, 4)$	
$E (1, 6)$	

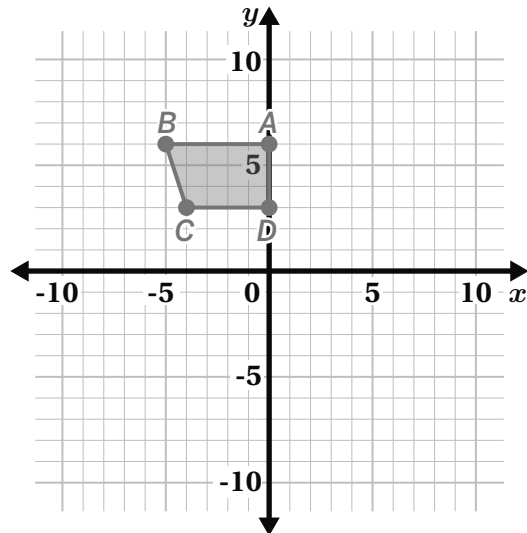


Check



- Trapezoid $ABCD$ is rotated 90° clockwise about the origin. Determine the coordinates of the rotated image, complete the table, and draw the rotated image.

Pre-image coordinates	Image coordinates
$A (0, 6)$	
$B (-5, 6)$	
$C (-4, 3)$	
$D (0, 3)$	



Justifying Congruent Figures

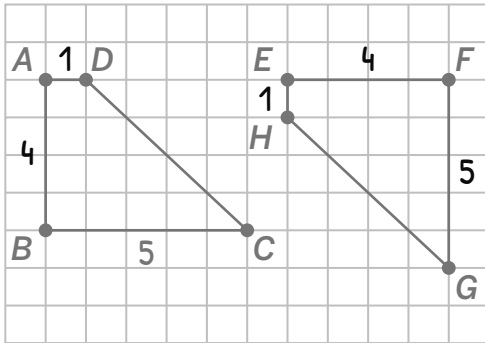
ML 1.09



Modeled Review



Name: Lola



Determine whether Figure $ABCD$ is congruent to figure $EFGH$. Explain your thinking.

Yes, $ABCD$ is congruent to $EFGH$. It can be translated 5 units right and 1 unit down, then reflected across GH . The corresponding side lengths and angle measures are equal.



Guided Practice



For each pair of figures, determine whether they are congruent. Explain your thinking.

1.

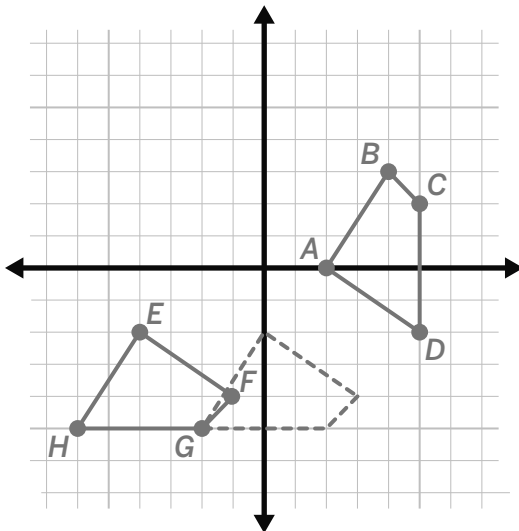


Figure $ABCD$ is _____ and _____ onto Figure $EFGH$. The corresponding side lengths and angle measures are _____.

2.

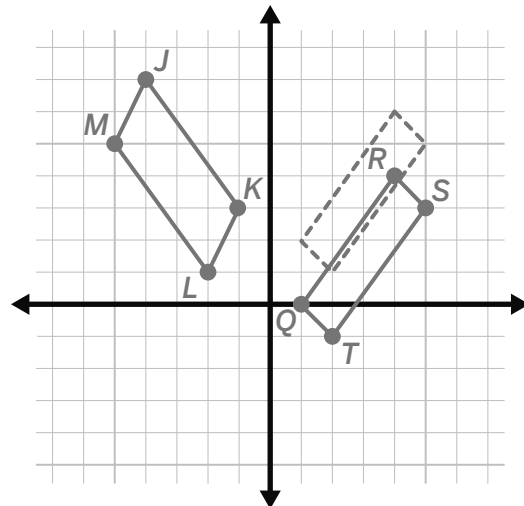


Figure $JKLM$ _____

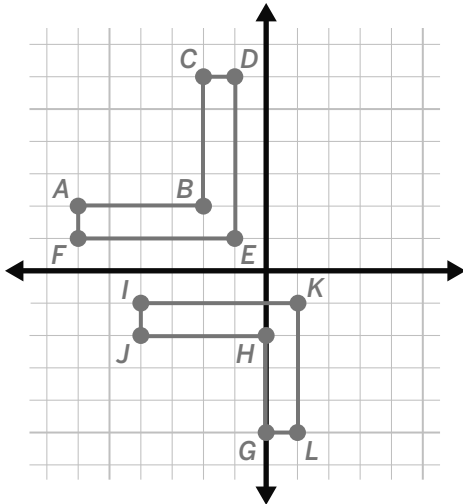


Guided Practice

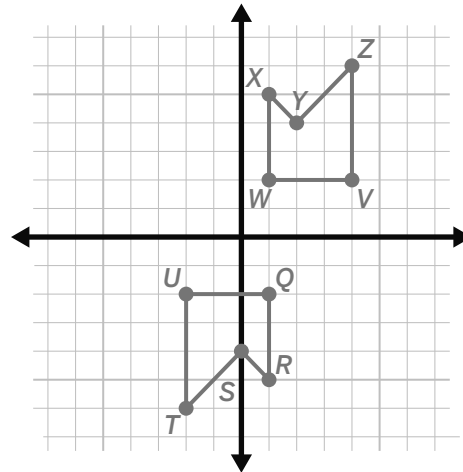


For each pair of figures, determine whether they are congruent. Explain your thinking.

3.



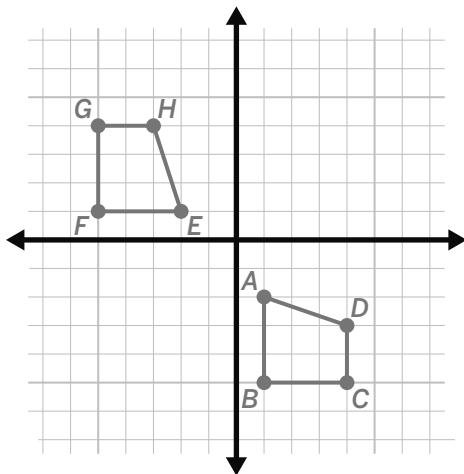
4.



Check



Determine whether Figure $ABCD$ is congruent to Figure $EFGH$. Explain your thinking.



Determining Unknown Interior and Exterior Angle Measures

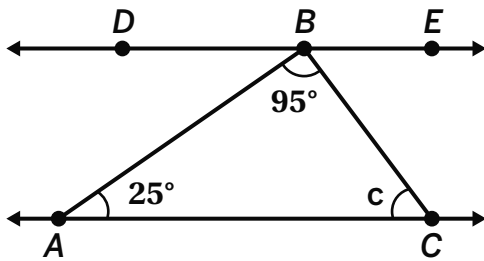
ML 1.12



Modeled Review



Name: Shawn



Line AC is parallel to line DE .
Determine the measure of angle CBE .
Explain your thinking.

The missing angle measure is 60° . Angles ABC , BAC , and ACB form a triangle. Angle ACB is $180^\circ - (95^\circ + 25^\circ) = 60^\circ$. Angle ACB is congruent to angle CBE because they are alternate interior angles.

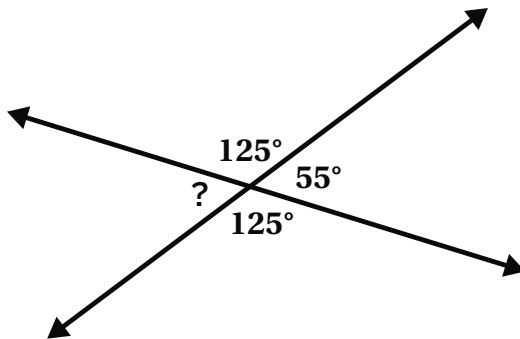


Guided Practice

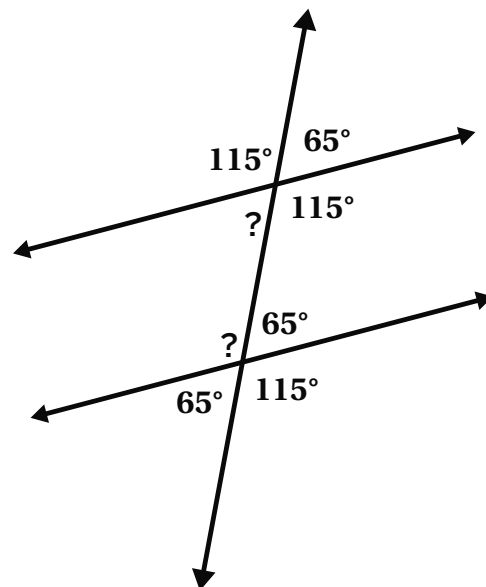


Determine the measure of each missing angle.

1.



2.

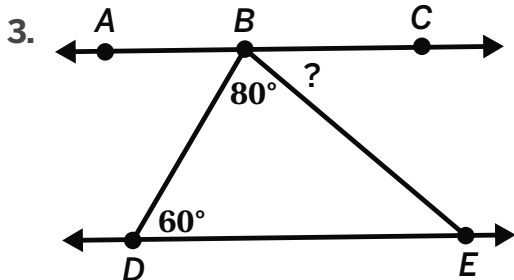




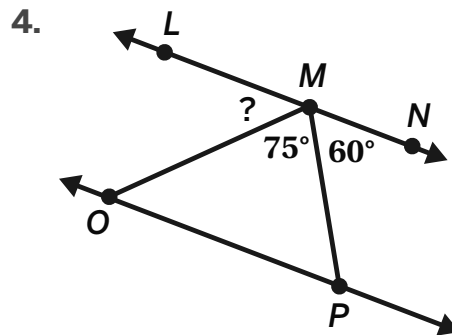
Guided Practice



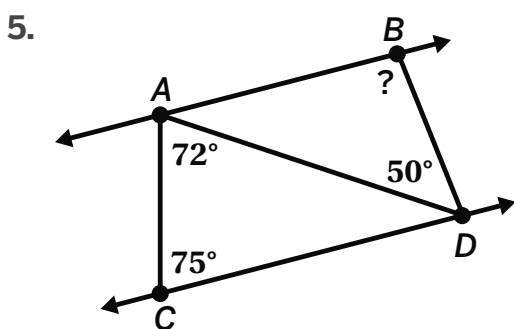
Each diagram includes a pair of parallel lines. Use the given angles to determine the measure of the missing angles marked with question marks. Show your thinking.



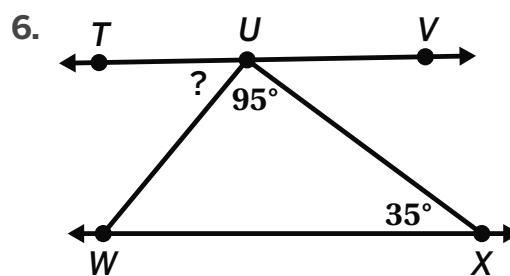
The missing angle measure is _____.



The missing angle measure is _____.



The missing angle measure is _____.



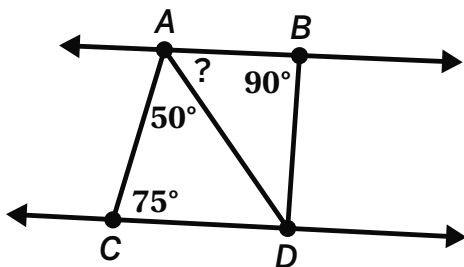
The missing angle measure is _____.



Check



Line AB is parallel to line CD . What is the measure of angle DAB ? Show your thinking.



Unit 2

Mini-Lessons

Dilating Figures on a Square Grid

ML 2.04



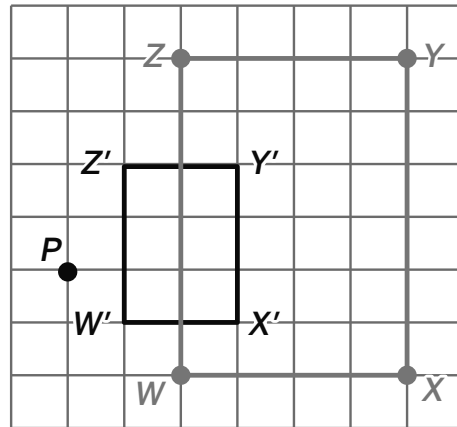
Modeled Review



Name: Maya

Dilate each vertex of rectangle $WXYZ$ using point P as the center of dilation with a scale factor of $\frac{1}{2}$. Draw the image and label the vertices of the image $W'X'Y'Z'$.

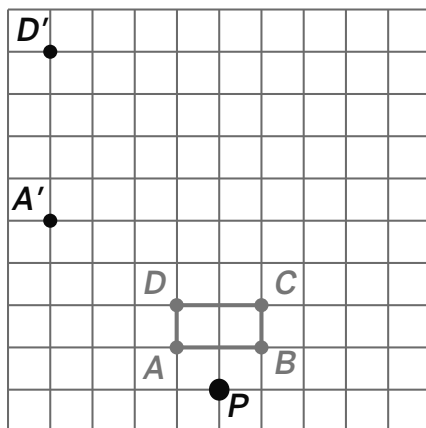
I counted up 4 and right 2 from point P to Z . Then multiplied the distances by $\frac{1}{2}$ to create Z' . I did the same steps to create the image $W'X'Y'Z'$.



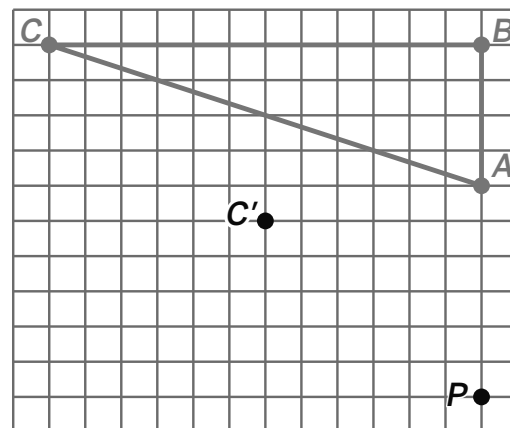
Guided Practice



1. Dilate each vertex of rectangle $ABCD$ using point P as the center of dilation and a scale factor of 4. Draw the image and label the missing vertices $B'C'$.



2. Dilate each vertex of triangle ABC using point P as the center of dilation and a scale factor of $\frac{1}{2}$. Draw the image and label the missing vertices $A'B'$.

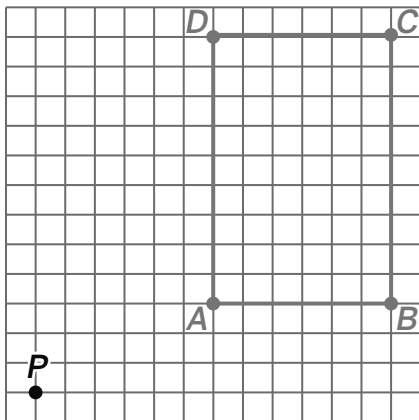




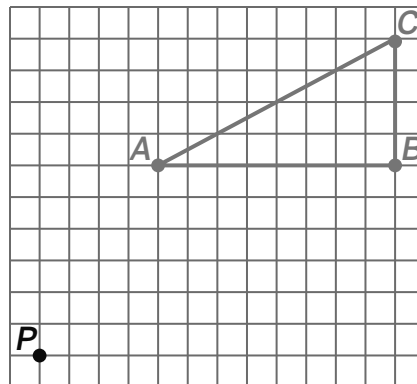
Guided Practice



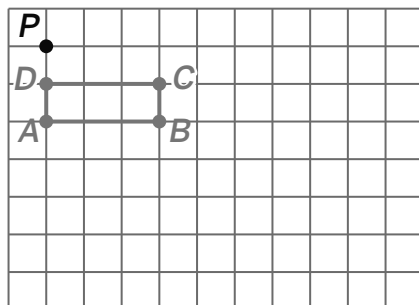
3. Dilate each vertex of rectangle $ABCD$ using point P as the center of dilation and a scale factor of $\frac{1}{3}$. Draw the image and label the vertices $A'B'C'D'$.



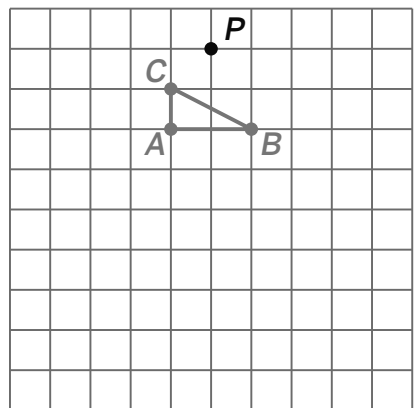
4. Dilate each vertex of triangle ABC using point P as the center of dilation and a scale factor of $\frac{1}{2}$. Draw the image and label the vertices $A'B'C'$.



5. Dilate each vertex of rectangle $ABCD$ using point P as the center of dilation and a scale factor of 3. Draw the image and label the vertices $A'B'C'D'$.



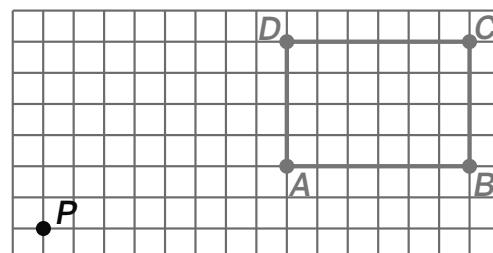
6. Dilate each vertex of triangle ABC using point P as the center of dilation and a scale factor of 4. Draw the image and label the vertices $A'B'C'$.



Check



Dilate each vertex of rectangle $ABCD$ using point P as the center of dilation and a scale factor of $\frac{1}{2}$. Draw the image and label the vertices $A'B'C'D'$.



Determining Missing Side Lengths in Similar Triangles

ML 2.08

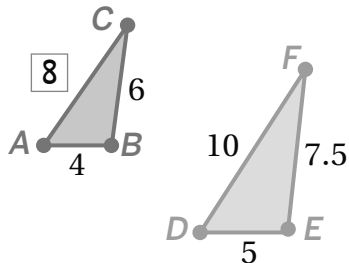


Modeled Review



Name: Santiago

Triangle ABC is similar to triangle DEF . Determine the missing values. Show your thinking. The figures may not be drawn to scale.



$$\frac{AB}{DE} = \frac{AC}{DF}$$

$$\frac{4}{5} = \frac{x}{10}$$

$$x = 8$$

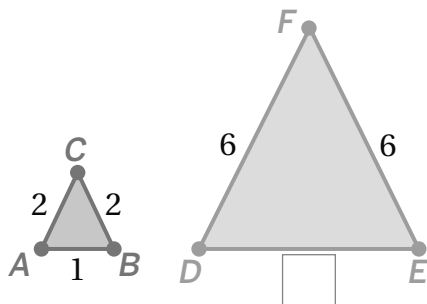


Guided Practice

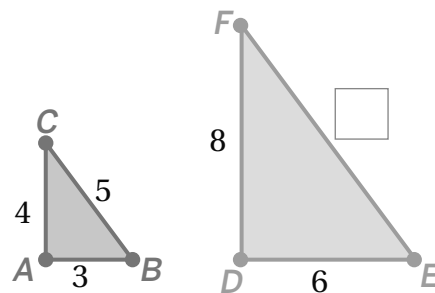


Triangle ABC is similar to triangle DEF . Determine the missing values. Show your thinking. The figures may not be drawn to scale.

1.



2.



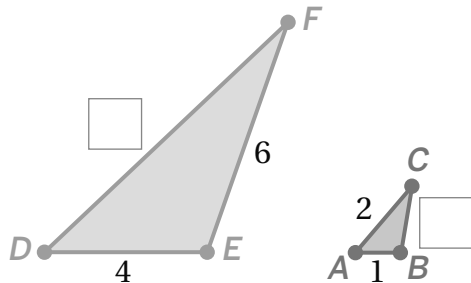


Guided Practice

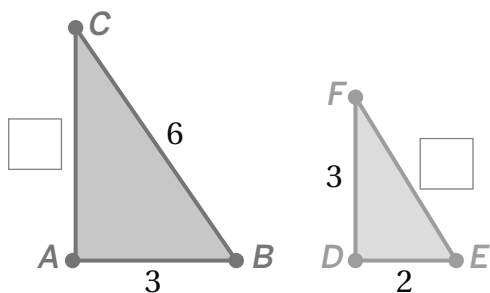


Triangle ABC is similar to triangle DEF . Determine the missing values. Show your thinking. The figures may not be drawn to scale.

3.



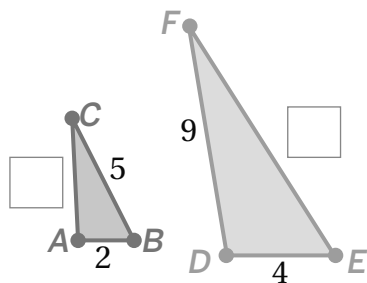
4.



Check



Triangle ABC is similar to triangle DEF . Determine the missing values. Show your thinking. The figures may not be drawn to scale.



Calculating Slope By Drawing Triangles on a Coordinate Plane

ML 2.10



Modeled Review

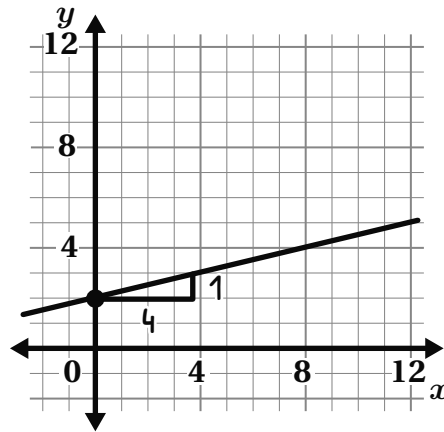


Name: Priya

Determine the slope of the line. Show your thinking.

The slope of the line is the ratio between the height of the triangle to its base.

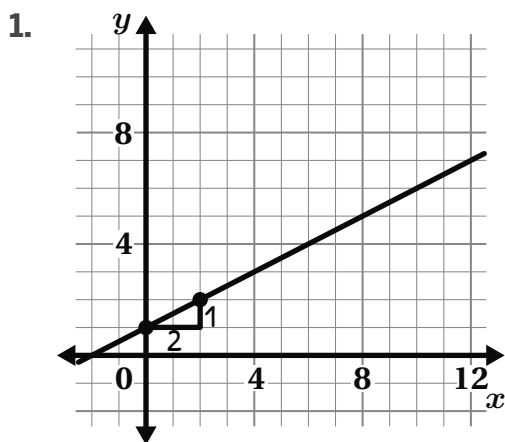
Slope is $\frac{1}{4}$.



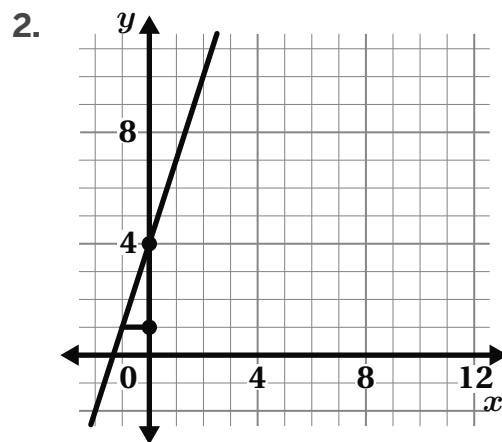
Guided Practice



Determine the slope of the line using a slope triangle.



$$\text{slope} = \frac{\text{height of slope triangle}}{\text{base of slope triangle}} = \frac{\square}{\square}$$



$$\text{slope} = \frac{\text{height of slope triangle}}{\text{base of slope triangle}} = \frac{\square}{\square} = \square$$

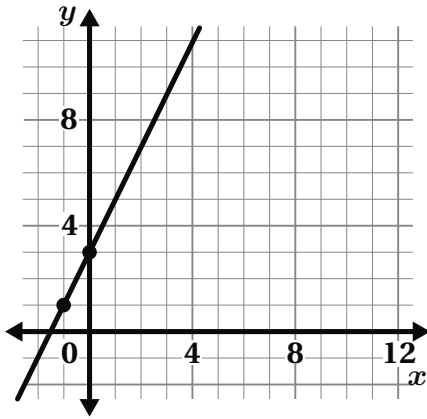


Guided Practice

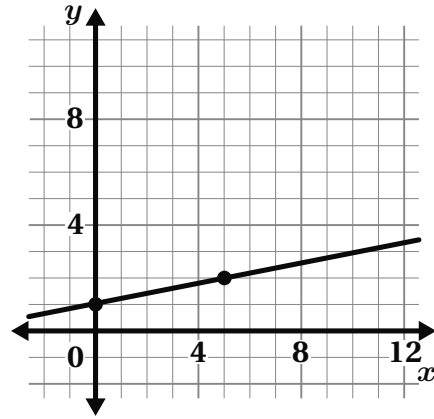


Determine the slope of the line. Show your thinking.

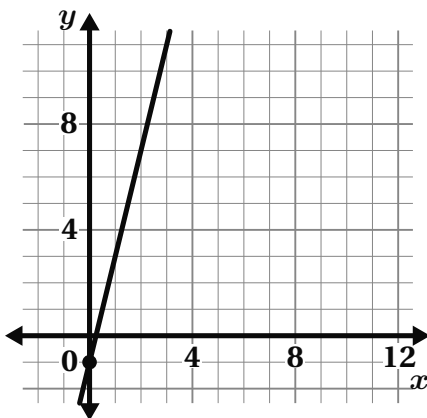
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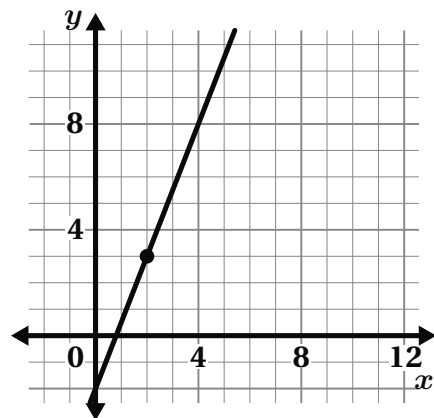
4.



5.



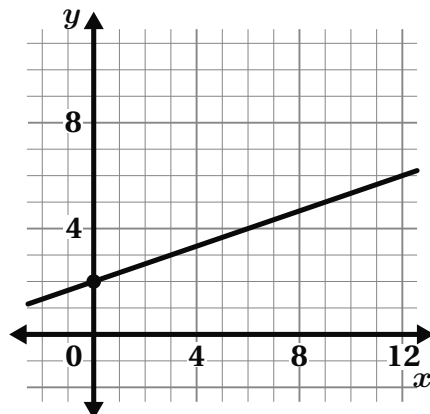
6.



Check



Determine the slope of the line. Show your thinking.



Unit 3

Mini-Lessons

Writing Equations to Represent Proportional Relationships

ML 3.02



Modeled Review

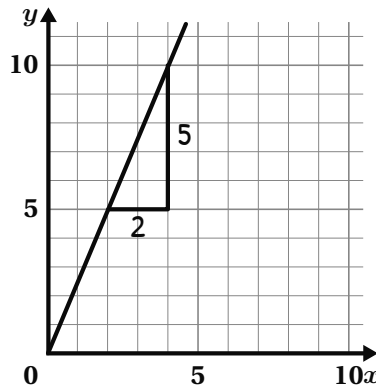


Name: Clare

Write an equation to represent the proportional relationship.

$$\text{slope} = \frac{5}{2}$$

$$y = \frac{5}{2}x$$



Slope is the height of the slope triangle divided by the base of the slope triangle.

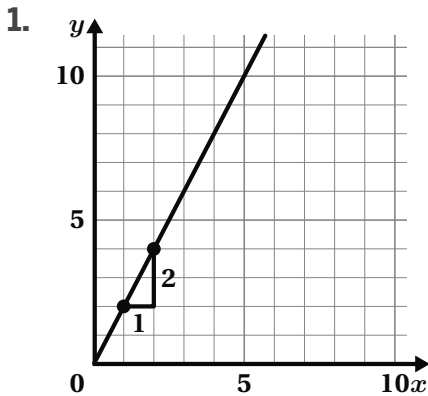


Guided Practice



Write an equation for the proportional relationship using the formula

$$y = mx, \text{ where } m = \frac{\text{height of the slope triangle}}{\text{base of the slope triangle}}$$

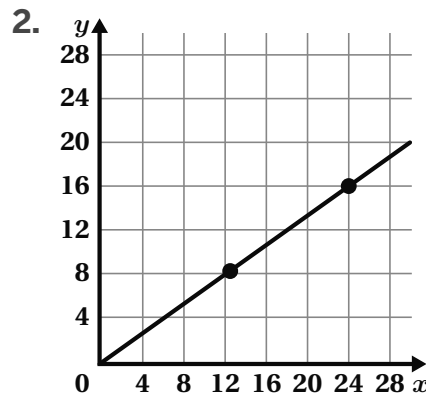


height of the slope triangle = _____

base of the slope triangle = _____

slope = _____

equation: _____



slope = _____

equation: _____

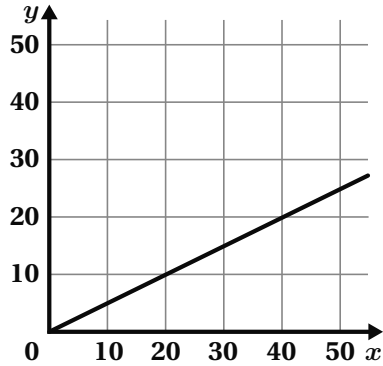


Guided Practice

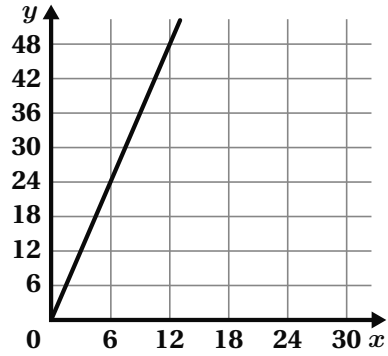


Write an equation to represent each proportional relationship.

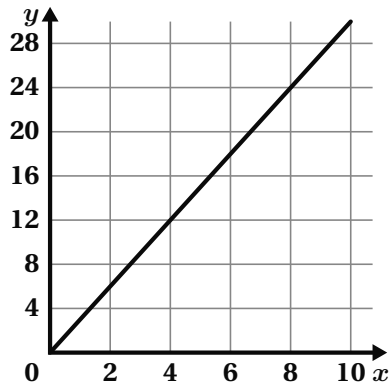
3.



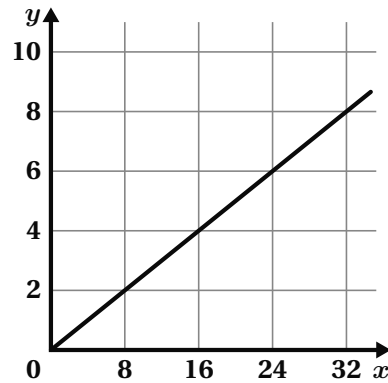
4.



5.



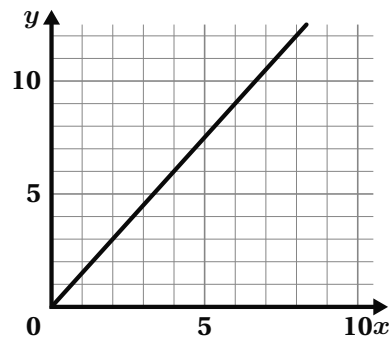
6.



Check



Write an equation to represent the proportional relationship.



Interpreting Slope and Intercepts of Linear Relationships

ML 3.05



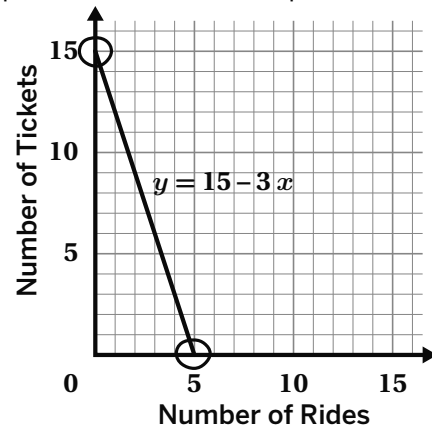
Modeled Review



Name: Jack

The line $y = 15 - 3x$ represents Marc purchasing tickets at a carnival to go on rides.

- Write the vertical intercept as a coordinate pair. What does it represent in this situation?
 (0, 15); Marc started with 15 tickets.
- Write the horizontal intercept as a coordinate pair. What does it represent in this situation?
 (5, 0); Marc went on 5 rides and then ran out of tickets.
- What is the slope and what does it represent?
 -3; Marc uses 3 tickets for each ride.

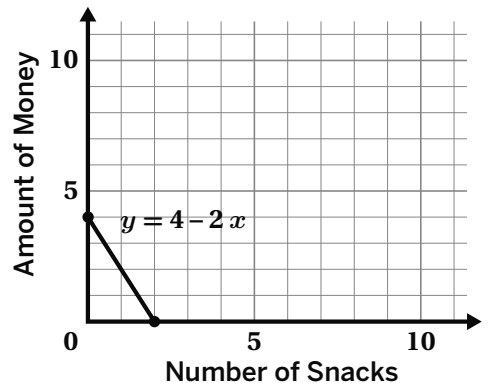


Guided Practice



The line $y = 4 - 2x$ represents Mia purchasing snacks at the theater.

- Write the vertical intercept as a coordinate pair. What does it represent in this situation?
 (0,);
- Write the horizontal intercept as a coordinate pair. What does it represent in this situation?
 (, 0);
- What is the slope, and what does it represent?
 ; This means that Mia's
 at a constant rate of



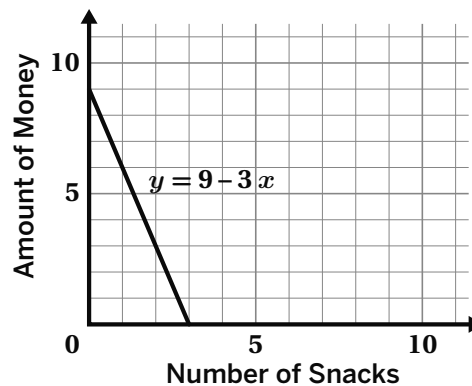


Guided Practice



The line $y = 9 - 3x$ represents Kai purchasing snacks at a soccer game.

- Write the vertical intercept as a coordinate pair. What does it represent in this situation?
- Write the horizontal intercept as a coordinate pair. What does it represent in this situation?
- What is the slope, and what does it represent?

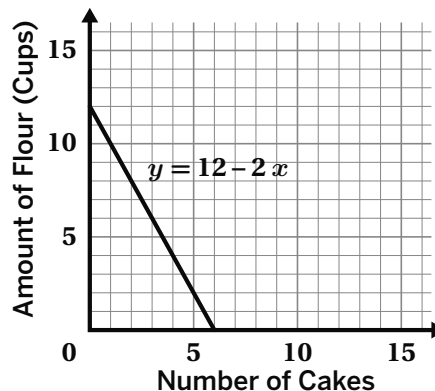


Check



The line $y = 12 - 2x$ represents Amy using flour to make cakes.

- Write the vertical intercept as a coordinate pair. What does it represent in this situation?
- Write the horizontal intercept as a coordinate pair. What does it represent in this situation?
- What is the slope, and what does it represent?



Calculating Slope Given Two Points

ML 3.09



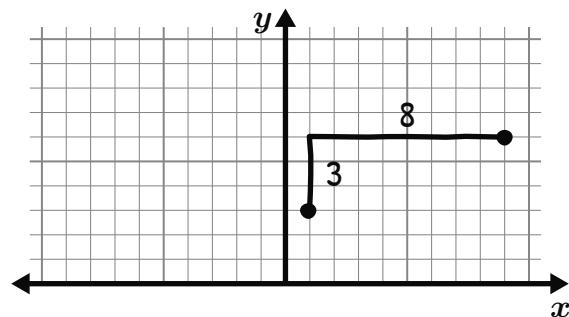
Modeled Review



Name: Han

Calculate the slope of the line that passes through (1, 3) and (9, 6). Use the graph if it is helpful.

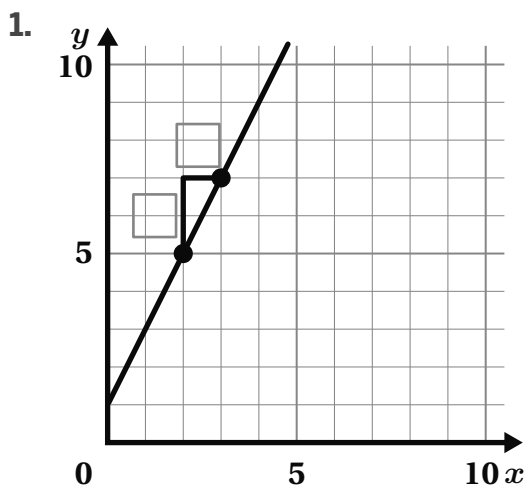
$$\text{slope} = \frac{3}{8}$$



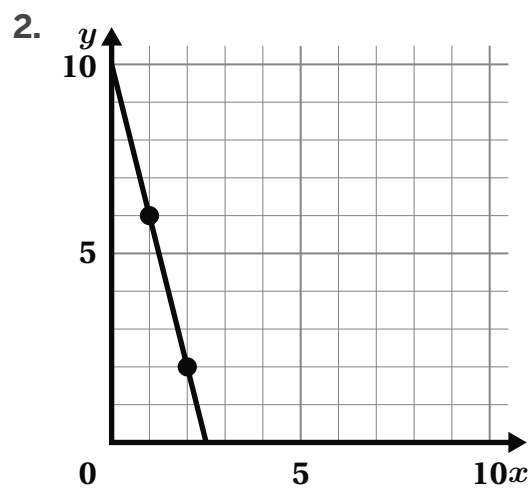
Guided Practice



Calculate the slope of the line that passes through the given points.



slope: _____



slope: _____



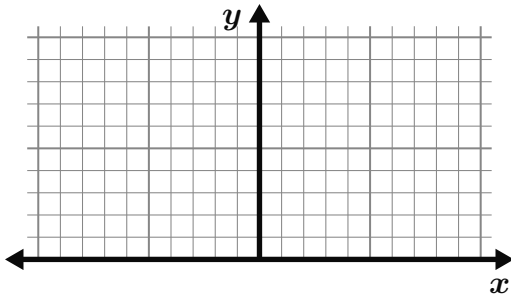
Guided Practice



Calculate the slope of the line that passes through the given points. Use the graph if it is helpful.

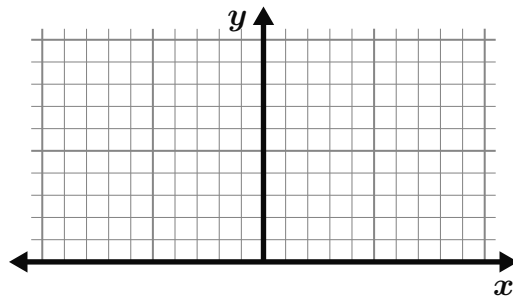
3. $(2, 4)$ and $(3, 1)$

slope: _____



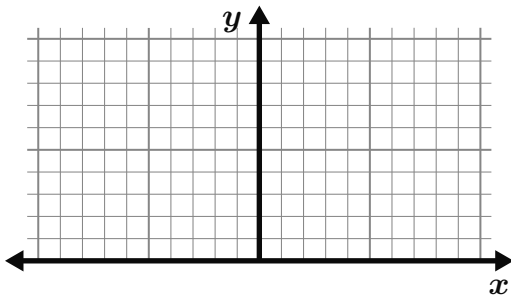
4. $(-1, 2)$ and $(4, 4)$

slope: _____



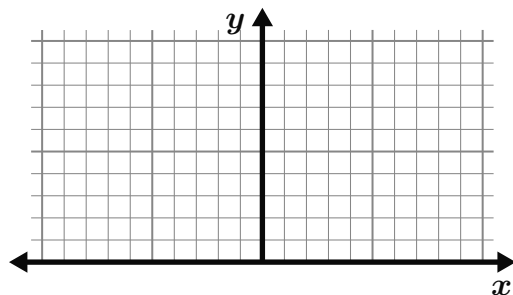
5. $(4, 2)$ and $(8, 5)$

slope: _____



6. $(6, 3)$ and $(9, 1)$

slope: _____

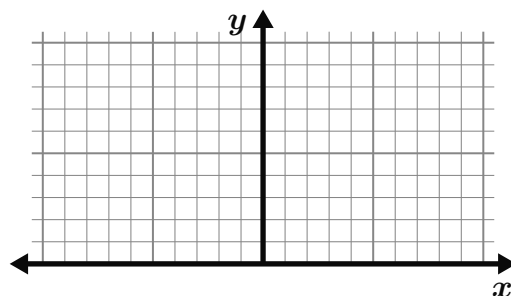


Check



Calculate the slope of the line that goes through $(2, 1)$ and $(4, 6)$. Use the graph if it is helpful.

slope: _____



Unit 4

Mini-Lessons

Solving Linear Equations With Parentheses

ML 4.04



Modeled Review

Name: Kayla

Solve the equation.

$$-3(2x - 4) = 18$$

$$\begin{array}{l} \swarrow \quad \searrow \\ -3(2x - 4) = 18 \\ -6x + 12 = 18 \end{array}$$

$$-6x + 12 = 18$$

$$-12 \quad -12$$

$$-6x = 6$$

$$x = -1$$

Name: Isaiah

Solve the equation.

$$-3(2x - 4) = 18$$

$$\underline{-3(2x - 4) = 18}$$

$$-3 \quad -3$$

$$2x - 4 = -6$$

$$+ 4 = + 4$$

$$2x = -2$$

$$x = -1$$



Guided Practice



Solve each equation. Complete the missing steps.

1. $4x + 9 = 5x + 7$

$$\begin{array}{l} -4x \quad -4x \\ 9 = \underline{\quad} + 7 \\ -7 \quad -7 \\ \underline{\quad} = x \end{array}$$

solution: $x = \underline{\quad}$

2. $x - 8 = 10 - 5x$

$$\begin{array}{l} + \underline{\quad} + \underline{\quad} \\ 6x - 8 = 10 \\ + \underline{\quad} + \underline{\quad} \\ 6x = 18 \\ x = \underline{\quad} \end{array}$$

solution: $x = \underline{\quad}$ Solve the equation $\frac{1}{2}(4x - 2) = 11$ using two different methods.

3. $\frac{1}{2}(4x - 2) = 11$

$$\begin{array}{l} \times 2 \quad \times 2 \\ 4x - 2 = \underline{\quad} \\ \underline{\quad} \quad \underline{\quad} \\ 4x = 24 \\ x = \underline{\quad} \end{array}$$

solution: $x = \underline{\quad}$

4. $\frac{1}{2}(4x - 2) = 11$

$$\begin{array}{l} 2x - \underline{\quad} = 11 \\ + 1 + \underline{\quad} \\ 2x = \underline{\quad} \\ x = \underline{\quad} \end{array}$$

solution: $x = \underline{\quad}$



Guided Practice



Solve each equation.

5. $4(3x + 5) = -2(-8x + 6)$
 $\underline{\hspace{1cm}}x + 20 = \underline{\hspace{1cm}}x - \underline{\hspace{1cm}}$

$\underline{\hspace{1cm}} \quad \underline{\hspace{1cm}}$
 $20 = \underline{\hspace{1cm}}x - 12$

$\underline{\hspace{1cm}} \quad \underline{\hspace{1cm}}$
 $32 = \underline{\hspace{1cm}}x$

$\underline{\hspace{1cm}} = x$

solution: $x = \underline{\hspace{1cm}}$

6. $-2(2x + 3) = 3(x + 5)$

solution: $x = \underline{\hspace{1cm}}$

7. $\frac{1}{3}(x - 5) = 2(x - 1)$

8. $0.5(x - 4) = -3(2x + 5)$

solution: $x = \underline{\hspace{1cm}}$

solution: $x = \underline{\hspace{1cm}}$



Check



Solve the equation.

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

solution: $x = \underline{\hspace{1cm}}$

Solving Systems of Linear Equations by Graphing

ML 4.11



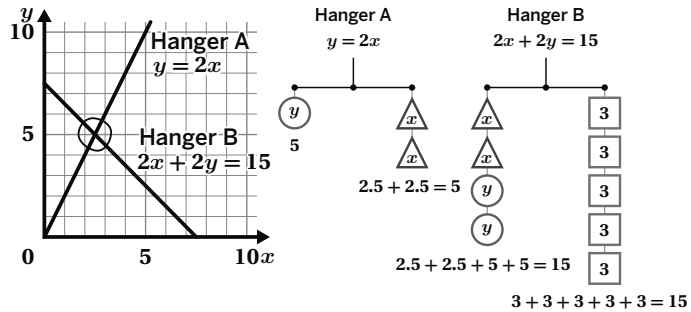
Modeled Review



Name: Clare

Use these hanger diagrams and the related graph to complete the problems.

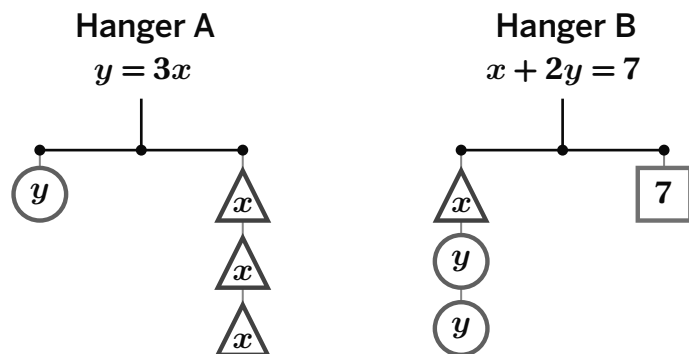
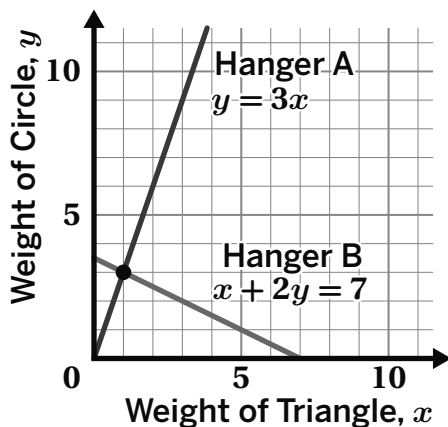
- Determine the solution to the system of equations. **(2.5, 5)**
- What does the solution tell you about the weight of the circle and the triangle to balance both hangers?
Each triangle weighs 2.5 and each circle weighs 5.



Guided Practice



Use these hanger diagrams and the related graph to complete the problems.



- Determine the solution to the system of equations.

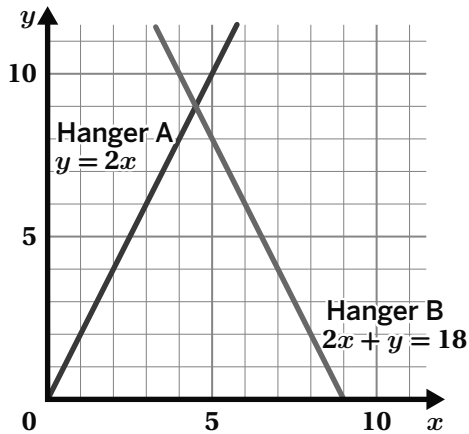
- What does the solution tell you about the weight of the circle and the triangle to balance both hangers?
Each triangle weighs 1 and each circle weighs ____.



Guided Practice

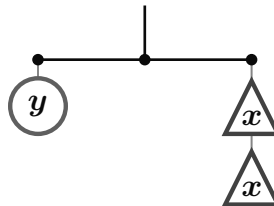


Use these hanger diagrams and the related graph to complete the problems.



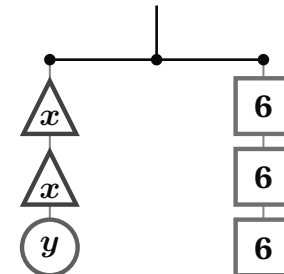
Hanger A

$$y = 2x$$



Hanger B

$$2x + y = 18$$



3. Determine the solution to the system of equations.

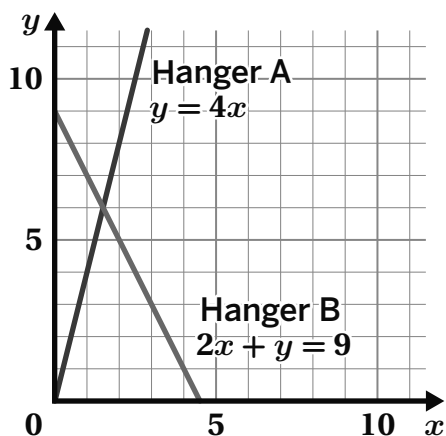
4. What does the solution tell you about the weight of the circle and the triangle to balance both hangers?



Check

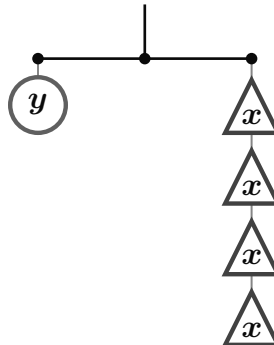


Use these hanger diagrams and the related graph to complete the problems.



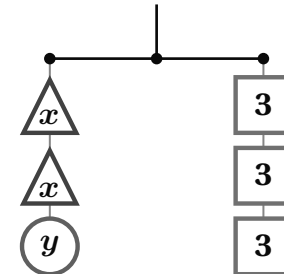
Hanger A

$$y = 4x$$



Hanger B

$$2x + y = 9$$



3. Determine the solution to the system of equations.

4. What does the solution tell you about the weight of the circle and the triangle to balance both hangers?

Unit 5

Mini-Lessons

Justifying Whether a Graph Represents a Function

ML 5.03

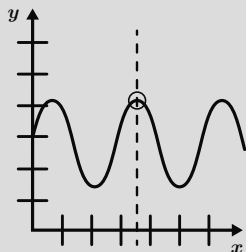


Modeled Review

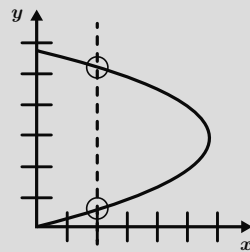


Function: a rule that assigns exactly one output to each possible input.

Function



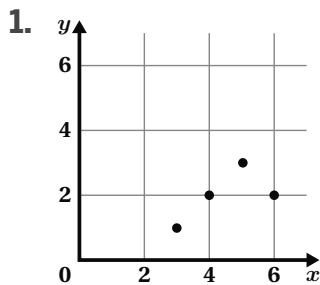
Not a function



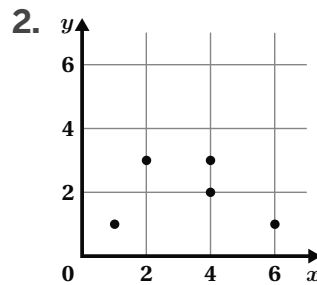
Guided Practice



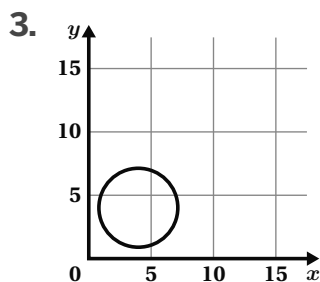
Determine whether the graph is a function. If the graph is not a function, draw a vertical line where the graph shows more than one output for the same input.



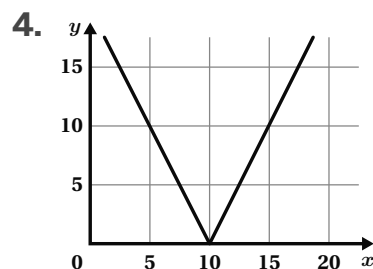
Function Not a function



Function Not a function



Function Not a function



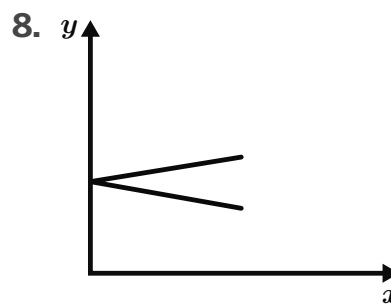
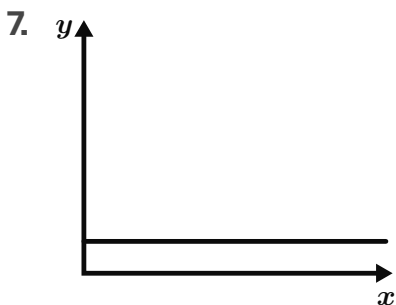
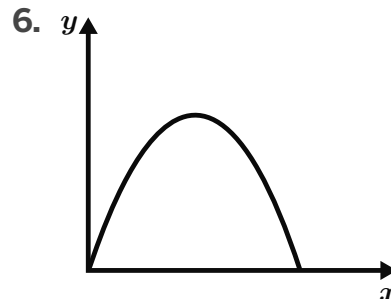
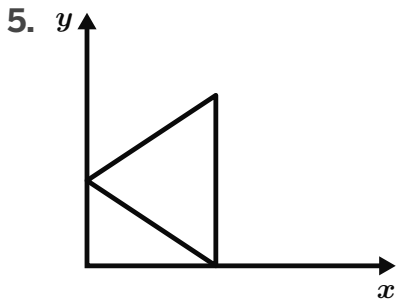
Function Not a function



Guided Practice



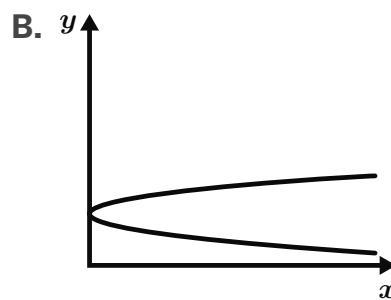
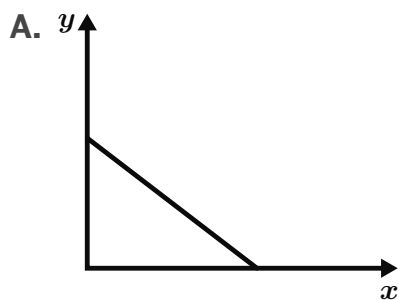
Determine whether y is a function of x and write “function” or “not a function.” If the graph is not a function, draw a vertical line where the graph shows more than one output for the same input.



Check



Select the graph in which y is a function of x . On the graph that is not a function, draw a vertical line where the graph shows more than one output for the same input.



Comparing Properties of Linear Functions

ML 5.07

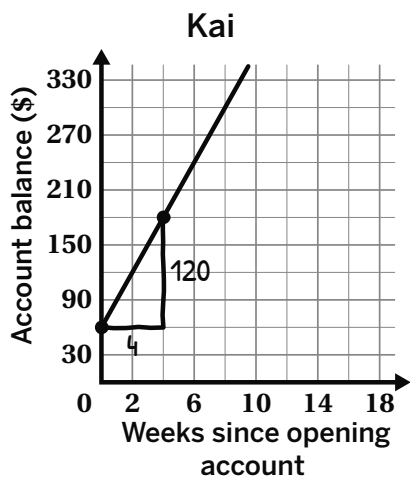


Modeled Review



Name: Maya

The graph and table each show a different savings account with changes occurring at a constant rate.



Slope = $\frac{120}{4} = 30$ y -intercept = 60

Jada

Number of weeks	Account balance (\$)
+1 1	75
2	60
3	45

$y = mx + b$ (1, 75)

$y = -15x + b$

$75 = -15(1) + b$

$75 = -15 + b$

$90 = b$

Slope = $\frac{-15}{1} = -15$

- Whose balance changes at a faster rate? Explain your thinking.
Kai; Kai's account is increasing by \$30 every week, while Jada's account is decreasing by \$15 every week.
- Who started with the larger amount in their account? Explain your thinking.
Jada; At 0 weeks she had \$90 in her account, while Kai at 0 weeks had \$60.



Guided Practice



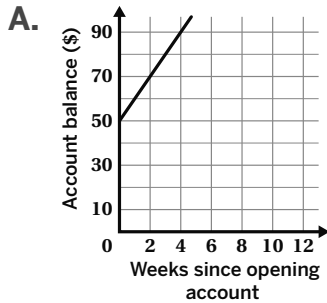
- Which representation has the fastest rate of change?
 - $y = -3x + 1$
 - $y = 2x + 1$
 - $y = -\frac{1}{2}x + 1$
- Which representation has the least y -intercept?
 - The account balance, a , starts at \$30 and increases by \$5 per week.
 - The account balance, a , starts at \$50 and increases by \$8 per week.
 - The account balance, a , starts at \$20 and increases by \$9 per week.



Guided Practice



3. The savings accounts of three customers are being compared. Circle the representation with the fastest rate of change. Explain your reasoning.



B.

Number of weeks	Account balance (\$)
1	90
2	70
3	50

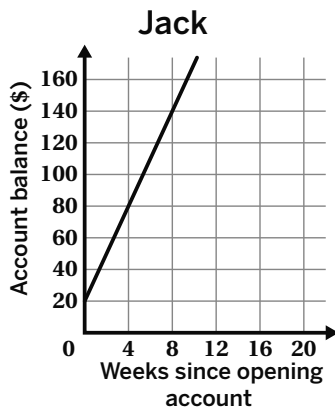
- C. The account balance, a , starts at \$30 and increases \$18 per week.



Check



The graph and table each show a different person's savings account.



Han

Number of weeks	Account balance (\$)
1	100
2	80
3	60

- Whose account balance changes at a faster rate? Explain your thinking.
- Who started with the larger initial amount saved? Explain your thinking.

Calculating Volumes of Cylinders

ML 5.11



Modeled Review



Name: Clare

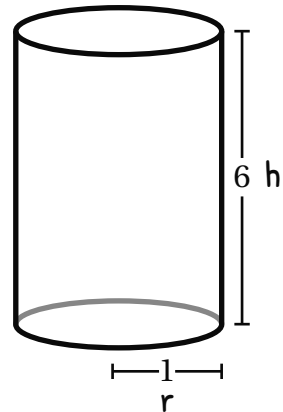
Calculate the volume of the cylinder.

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

$$V = \pi(1)^2(6)$$

$$V = 6\pi$$

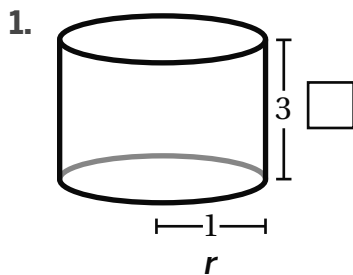
6π cubic units



Guided Practice

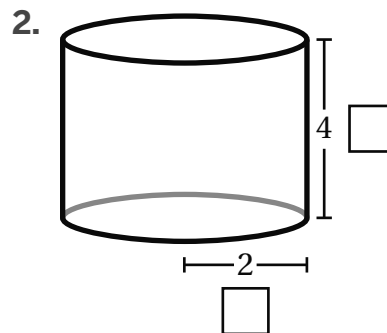


Write an equation to find the volume, V , of each cylinder.



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

$$V = \pi(1)^2(\underline{\quad})$$



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

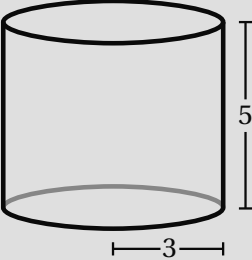
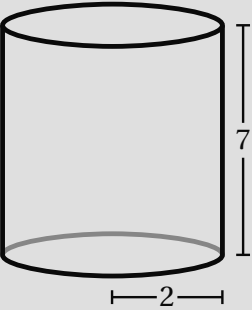
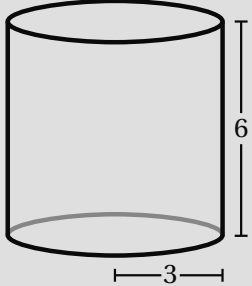
$$V = \underline{\hspace{2cm}}$$



Guided Practice



3. Calculate the volume, V , of each cylinder using the formula.

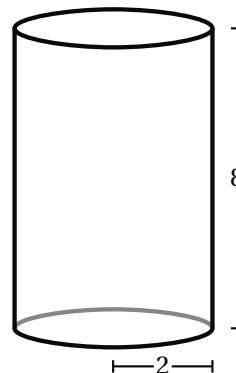
Cylinder	Formula $V = \pi r^2 h$	Volume
		
		
		



Check



Calculate the volume of the cylinder.



Unit 6

Mini-Lessons

Interpreting Points on a Scatter Plot

ML 6.03



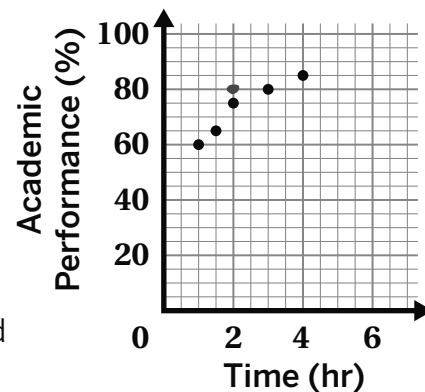
Modeled Review



Name: Diego

This scatter plot shows the academic performance and the number of hours students studied for a math test.

1. What is the highest academic performance a student received?
85%
2. What is the academic performance of the student who studied the least?
60%
3. Another student studied 2 hours and earned an academic performance of 80%. Plot a point on the graph that represents this student.



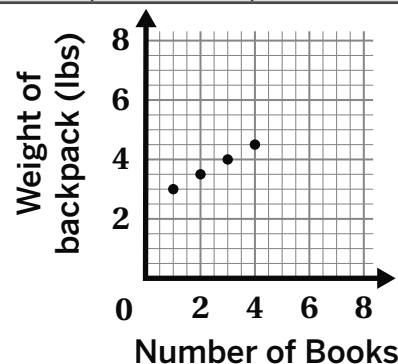
Guided Practice



The table and scatter plot show the number of books each student carried in their backpack and the corresponding weight of each backpack.

1. Circle the point on the scatter plot that represents the data for Mia.
2. What does the point (3, 4) represent?
3. In the same study, the data showed that Arjun had a backpack weighing 5 pounds with 6 books. Add a point to the scatter plot to represent Arjun.

Student	Number of books	Backpack weight (lbs)
Isaiah	1	3
Kayla	3	4
Mia	2	3.5
Felipe	4	4.5



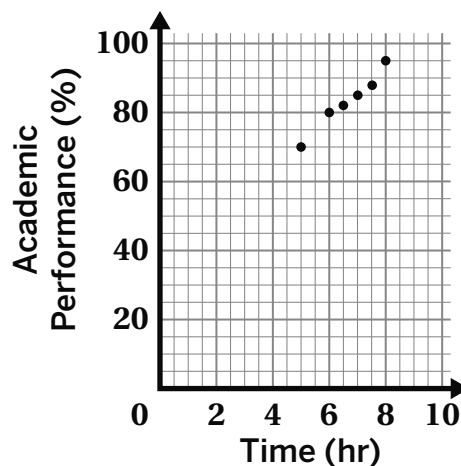


Guided Practice



This scatter plot illustrates the connection between the amount of sleep students get each night and their academic performance.

- What is the highest academic performance a student received?
- How many hours did the student who received the highest academic performance sleep?
- The academic performance for a student who slept 5 hours is 50%. Plot a point on the graph that represents this student.

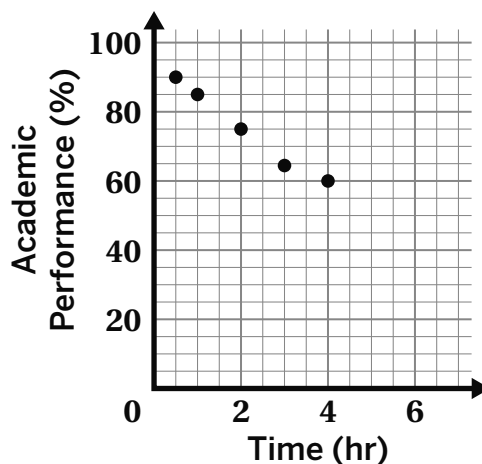


Check



This scatter plot shows the academic performance and the number of hours of screen time students have.

- What is the highest academic performance observed in a student?
- What is the lowest academic performance observed in a student?
- The academic performance for a student who had 4 hours of screen time is 75%. Plot a point on the graph that represents this student.



Using Lines of Fit to Make Predictions

ML 6.09



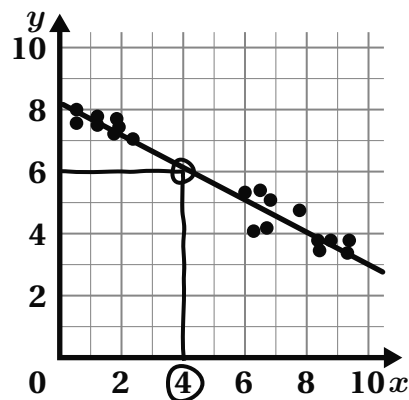
Modeled Review



Name: Tristan

Use the line of fit to predict the y -value of a new data point whose x -value is 4.

6

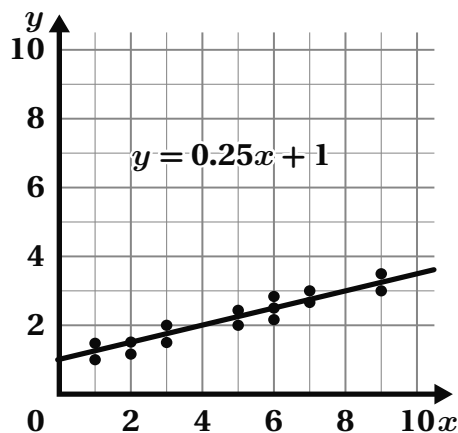


Guided Practice



1. Use the line of fit to make predictions and complete the table.

x	y
4	
8	

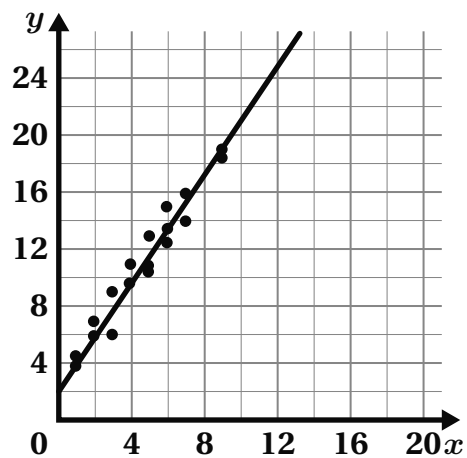




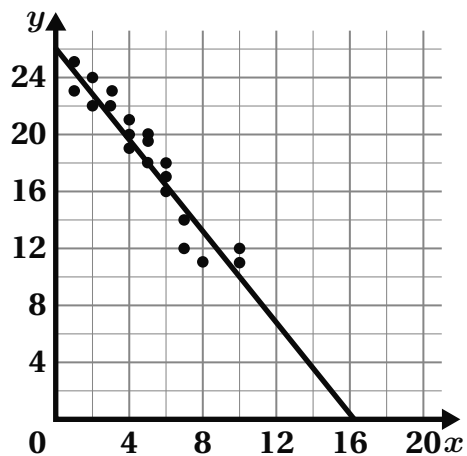
Guided Practice



2. Use the line of fit to predict the y -value of a new data point whose x -value is 8.



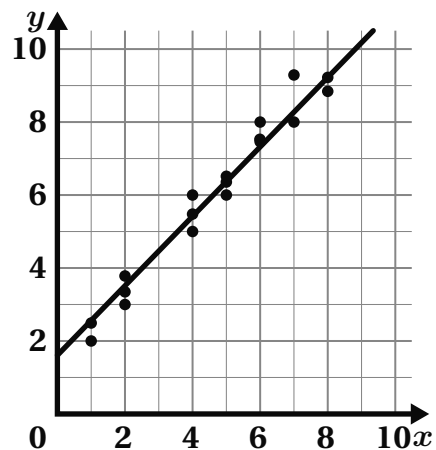
3. Use the line of fit to predict the y -value of a new data point whose x -value is 12.



Check



- Use the line of fit to predict the y -value of a new data point whose x -value is 3.



Calculating Missing Values in Two-Way Tables

ML 6.10



Modeled Review

Name: Avery

A group of people were asked whether or not they liked their food and if they were satisfied with the service at a restaurant. Some of the responses are recorded in the two-way table. Calculate the missing values.

$$81 - 72 = 9$$

$$29 - 21 = 8$$

$$72 + 8 = 80$$

$$81 + 29 = 110$$

	Satisfied	Dissatisfied	Total
Liked food	72	8	80
Did not like food	9	21	30
Total	81	29	110



Guided Practice



For Problems 1–2, use the number bank to fill in the missing values in each two-way table.

60	33	10	12	5	46
----	----	----	----	---	----

- Customers were surveyed about their preference for outdoor or indoor seating and whether they found the restaurant's ambiance satisfactory. Some of the responses are recorded in the two-way table.

	Satisfied	Unsatisfactory	Total
Outdoor	20		25
Indoor		35	45
Total	30	40	70

- Participants in a wellness retreat were surveyed on their interest in meditation or yoga and their perception of mental health benefits. Some of the responses are recorded in the two-way table.

	Beneficial	Not beneficial	Total
Meditation		13	25
Yoga	27		
Total	39		85



Guided Practice



3. Visitors to a museum were surveyed on their enjoyment of the interactive exhibits and if they found the staff's assistance helpful. Some of the responses are recorded in the two-way table. Calculate the missing values.

	Helpful	Not helpful	Total
Enjoyed	45	25	
Did not enjoy		15	
Total	65		105

4. Patients in a healthcare facility were surveyed on their comfort with medical staff and satisfaction with care quality. Some of the responses are recorded in the two-way table. Calculate the missing values.

	Satisfied	Not satisfied	Total
Comfortable	33	21	
Not comfortable		27	
Total	52		100

5. Students were polled about their preference for group projects or individual assignments and their satisfaction with the level of challenge in the coursework. Some of the responses are recorded in the two-way table. Calculate the missing values.

	Satisfied	Not satisfied	Total
Individual	56		65
Group	37	13	
Total		22	



Check



Participants in a fitness program were asked about their preference for cardio or strength training and how they rated the effectiveness of the program. Some of the responses are recorded in the two-way table. Calculate the missing values.

	Effective	Not effective	Total
Cardio		20	
Strength	12		20
Total	92	28	

Unit 7

Mini-Lessons

Multiplying Powers

ML 7.03



Modeled Review



Name: Jack

Decide if the expressions in each pair are equivalent. Show your thinking.

Expression 1	Expression 2	Equivalent?
$(5^5)^2$ $(5^5) \cdot (5^5)$ $(5 \cdot 5 \cdot 5 \cdot 5 \cdot 5) \cdot (5 \cdot 5 \cdot 5 \cdot 5 \cdot 5)$	$5^4 \cdot 5^3$ $(5 \cdot 5 \cdot 5 \cdot 5) \cdot (5 \cdot 5 \cdot 5)$	Yes <input checked="" type="radio"/> No <input type="radio"/>
$4^3 \cdot 2^5$ $(4 \cdot 4 \cdot 4) \cdot (2 \cdot 2 \cdot 2 \cdot 2 \cdot 2)$ $(4 \cdot 2)(4 \cdot 2)(4 \cdot 2) \cdot 2 \cdot 2$	8^8 $(8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8)$	Yes <input type="radio"/> No <input checked="" type="radio"/>
$15^3 \cdot 2^3$ $(15 \cdot 15 \cdot 15) \cdot (2 \cdot 2 \cdot 2)$ $(15 \cdot 2)(15 \cdot 2)(15 \cdot 2)$	$(5 \cdot 2)^3 \cdot 3^3$ $(10 \cdot 10 \cdot 10) \cdot (3 \cdot 3 \cdot 3)$ $(10 \cdot 3)(10 \cdot 3)(10 \cdot 3)$	<input checked="" type="radio"/> Yes <input type="radio"/> No



Guided Practice



1. Match each expression to the correct expanded form on the right.

Expression

Expanded Form

$(3^4)^2$

$3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$

3^9

$(3 \cdot 3 \cdot 3) \cdot (3 \cdot 3 \cdot 3)$

$(3^3) \cdot (3^3)$

$(3 \cdot 3 \cdot 3 \cdot 3) \cdot (3 \cdot 3 \cdot 3 \cdot 3)$



Guided Practice



2. Decide if the expressions in each pair are equivalent. Show your thinking.

Expression 1	Expression 2	Equivalent?
$(7^4)^2$	49^4	Yes No
$6^3 \cdot 2^4$	$(2 \cdot 2)^3 \cdot 3^3$	Yes No
$5^3 \cdot 2^3$	10	Yes No
$(6^4)^2$	$6^4 \cdot 6^2$	Yes No
$8^4 \cdot 3^3$	$(3 \cdot 2)^4 \cdot 4^3$	Yes No



Check



Decide if the expressions in each pair are equivalent. Show your thinking.

Expression 1	Expression 2	Equivalent?
$(4^3)^2$	$4^3 \cdot 4^3$	Yes No
$3^2 \cdot 2^3$	6^5	Yes No

Writing Numbers in Scientific Notation

ML 7.09



Modeled Review

Name: Priya

Write each number in scientific notation.

Number	Scientific Notation
48,200	$4.82 \cdot 10^4$
0.00099	$9.9 \cdot 10^{-4}$
$36 \cdot 10^5$	$3.6 \cdot 10^6$



Guided Practice



- Write each number in scientific notation by completing the blanks for the numbers.

Number	Scientific Notation
23,000,000	$2.3 \cdot 10^{\square}$
0.0012	$\underline{\hspace{1cm}} \cdot 10^{\square}$
24,600	$\underline{\hspace{1cm}}$
0.082	$\underline{\hspace{1cm}}$



Guided Practice



2. Write each number in scientific notation.

Number	Scientific Notation
2,250	
0.0065	
$23 \cdot 10^3$	
347	
0.056	
$78 \cdot 10^4$	
505	
0.00073	
$602 \cdot 10^5$	
85,600	



Check



Write each number in scientific notation.

Number	Scientific Notation
794,000	
0.000087	
$486 \cdot 10^6$	

Unit 8

Mini-Lessons

Approximating Square Roots

ML 8.03



Modeled Review



Name: Evan

Approximate $\sqrt{18}$.

$\sqrt{18}$ is between 4.2 and 4.3

I multiplied 4.1, 4.2, and 4.3 by themselves to find their squares.

n	n^2
4.1	16.81
4.2	17.64
4.3	18.49

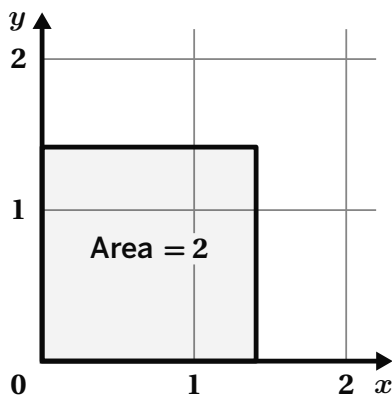


Guided Practice



Approximate the square root using the side lengths of the squares and the tables.

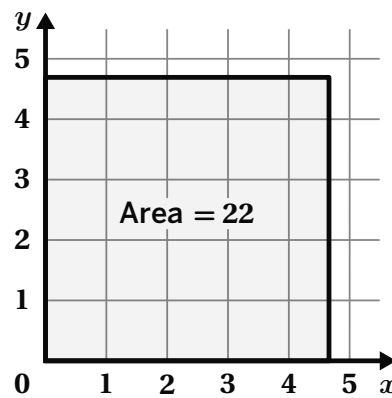
1. $\sqrt{2}$



n	n^2
1.4	1.96
1.5	

$\sqrt{2}$ is between _____ and _____

2. $\sqrt{22}$



n	n^2
4.6	

$\sqrt{22}$ is between _____ and _____



Guided Practice



For Problems 3–6, complete the table to approximate the square root.

3. $\sqrt{6}$ is between _____ and _____

n	n^2
2.3	5.29
2.4	

4. $\sqrt{10}$ is between _____ and _____

n	n^2
3.1	

5. $\sqrt{15}$ is between _____ and _____

n	n^2

6. $\sqrt{40}$ is between _____ and _____

n	n^2



Check



Approximate $\sqrt{28}$.

$\sqrt{28}$ is between _____ and _____

n	n^2

Calculating Unknown Side Lengths

ML 8.08

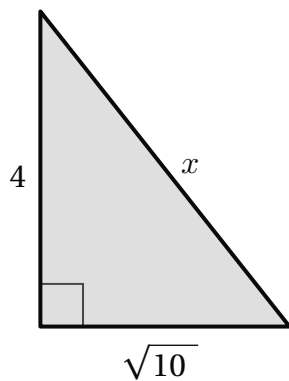


Modeled Review



Name: Anna

Calculate the exact value of the unknown side length, x , in the right triangle.



$$x = \underline{\sqrt{26}}$$

$$a^2 + b^2 = c^2$$

$$4^2 + (\sqrt{10})^2 = c^2$$

$$16 + 10 = c^2$$

$$26 = c^2$$

$$\sqrt{26} = \sqrt{c^2}$$

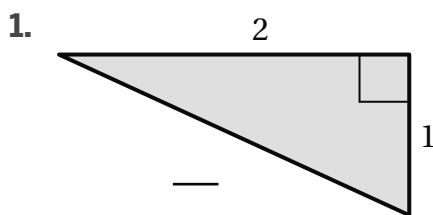
$$\sqrt{26} = c$$



Guided Practice



Calculate the exact value of the unknown side length, x , in each right triangle.



$$a^2 + b^2 = c^2$$

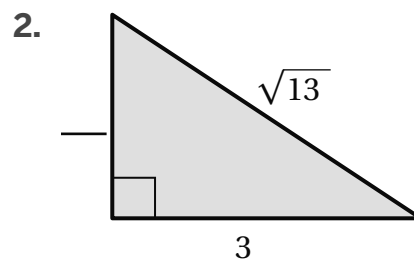
$$1^2 + (\quad)^2 = c^2$$

$$1 + \underline{\hspace{2cm}} = c^2$$

$$\underline{\hspace{2cm}} = c^2$$

$$\underline{\hspace{2cm}} = \sqrt{c^2}$$

$$\underline{\hspace{2cm}} = c$$



$$a^2 + b^2 = c^2$$

$$3^2 + b^2 = (\quad)^2$$

$$\underline{\hspace{2cm}} + b^2 = \underline{\hspace{2cm}}$$

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

$$b^2 = \underline{\hspace{2cm}}$$

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

$$b = \underline{\hspace{2cm}}$$

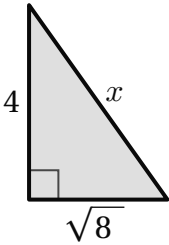
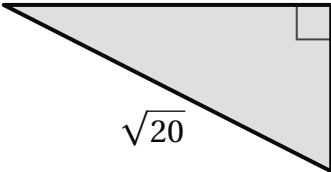
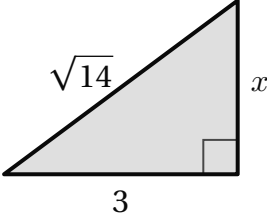


Guided Practice



3. Calculate the exact value of the unknown side length, x , in each right triangle.

$$a^2 + b^2 = c^2$$

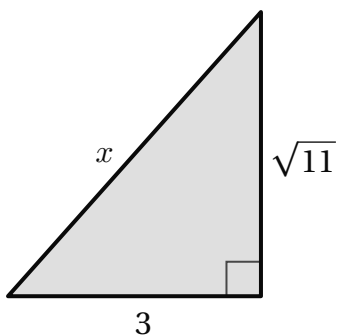
Triangle	Work	Side Length
		
		
		



Check



Calculate the exact value of the unknown side length, x , in the right triangle.



$x = \underline{\hspace{2cm}}$

Identifying Rational and Irrational Numbers

ML 8.14



Modeled Review



Rational				Irrational		
all positive and negative numbers that can be written as fractions, including whole numbers				a number that cannot be written as a fraction of two non-zero integers		
Examples				Examples		
$\frac{3}{4}$	$2.5 = \frac{5}{2}$	$0.\overline{66}$	$\sqrt{16}$	π	$\sqrt{7}$	$\sqrt{3} = 1.732050\dots$



Guided Practice



- Determine if the numbers in the bank are rational or irrational. Then add them to the correct column.

1.75	$\sqrt{3}$	9π	$\frac{1}{2}$
$-\frac{1}{4}$	$0.\overline{33}$	$\sqrt{10}$	$\sqrt{15} = 3.872983\dots$

Rational	Irrational
$\frac{1}{2}$	$\sqrt{15} = 3.872983\dots$



Guided Practice



2. Is the number rational or irrational? Add a check mark to the correct column.

Rational	Rational	Irrational
$\sqrt{36}$		
$0.\overline{72}$		
$1 + \sqrt{2} = 2.414213\dots$		
$-\frac{7}{8}$		
$\sqrt{11}$		
$\pi^2 = 9.869604\dots$		
8π		
$0.\overline{11}$		
4		



Check



Is the number rational or irrational? Add a check mark to the correct column.

Number	Rational	Irrational
$\sqrt{14}$		
5π		
$-\frac{11}{5}$		

**Prerequisite Skills
and Concepts**

Mini-Lessons

Solving One-Step Interpretation Questions

ML 1.17



Modeled Review

Name: Clare

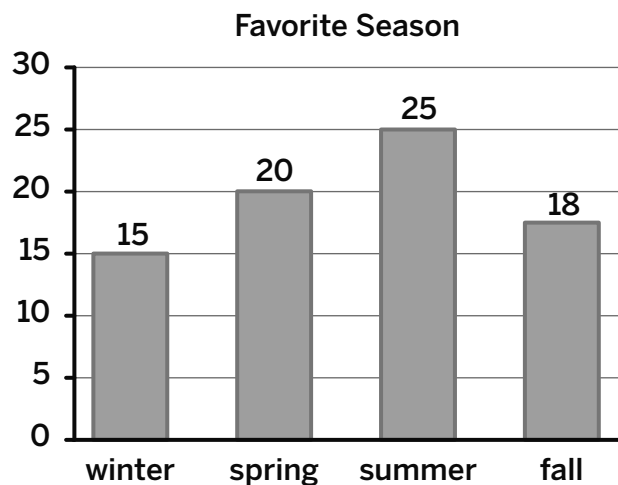
Use the bar graph to answer the questions.

1. How many students chose winter or spring as their favorite season?

$$15 + 20 = 35 \text{ students}$$

2. How many *fewer* students chose fall than summer?

$$25 - 18 = 7 \text{ students}$$



Guided Practice

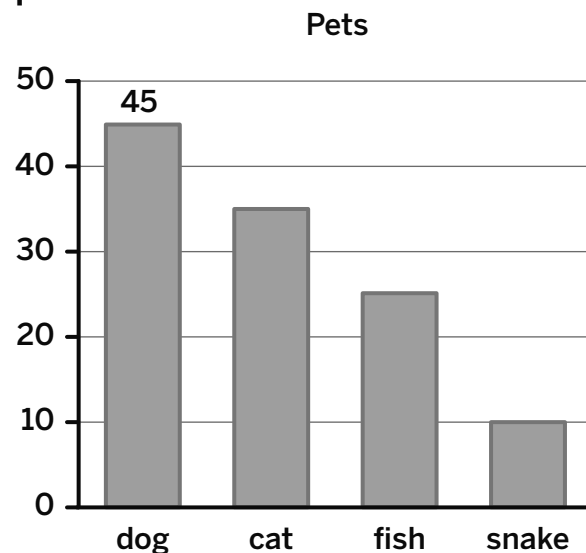


Use the bar graph to answer the question.

1. How many dogs and cats are there?

$$45 + \underline{\quad} = \underline{\quad}$$

answer: dogs and cats





Guided Practice



Use the bar graph to answer the questions.

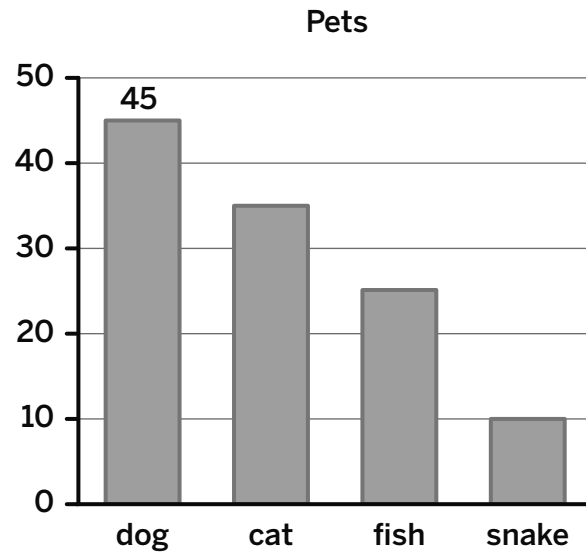
2. How many *more* cats are there than snakes?

_____ - _____ = _____

answer: _____ cats

3. How many *fewer* fish are there than dogs?

answer: _____



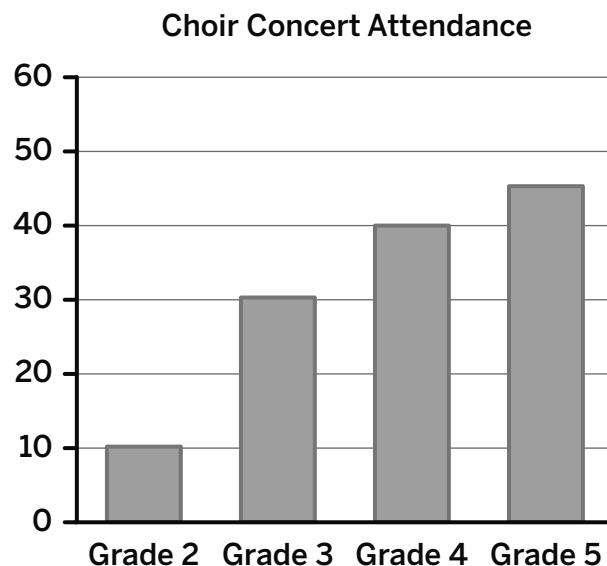
Check



Use the bar graph to answer the question.

How many *fewer* people attended the Grade 3 concert than the Grade 5 concert?

answer: _____



Identifying and Drawing Intersecting, Perpendicular, and Parallel Lines

ML 7.03



Modeled Review



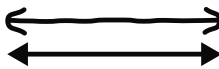
Name: Santiago

1. Are these two lines perpendicular? Explain your thinking.



No. These are intersecting lines. If they were perpendicular they would create right angles.

2. Draw a line that is parallel to the given line.

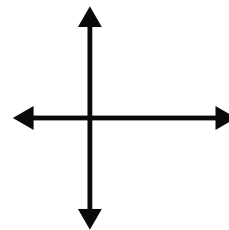


Guided Practice

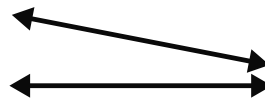


1. Match the term to the correct image by writing the number on the line.

A. intersecting lines



B. parallel lines



C. perpendicular lines



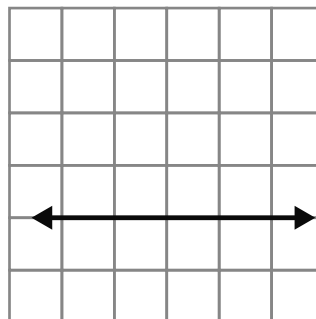


Guided Practice



For Problems 4 and 5, use the grid and the given line.

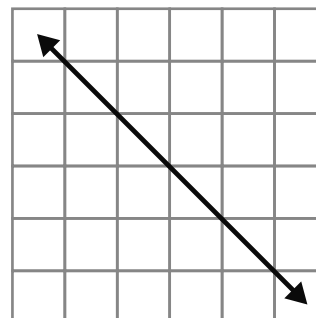
4. Draw a line that is parallel.



5. Draw a line that intersects.

For Problems 6 and 7, use the grid and the given line.

6. Draw a line that is parallel.



7. Draw a line that is perpendicular.

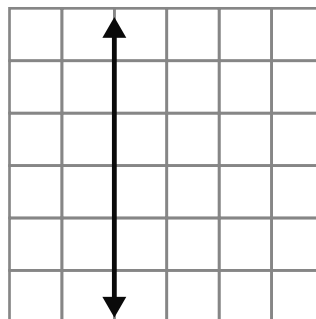


Check



For Problems 1 and 2, use the grid and the given line.

1. Draw a line that is parallel.



2. Draw a line that intersects.

Identifying Acute, Obtuse, Right, and Straight Angles

ML 7.09

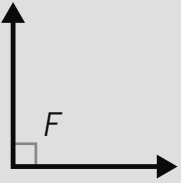
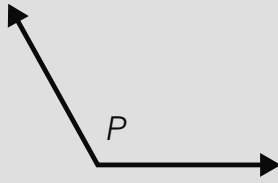
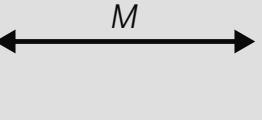
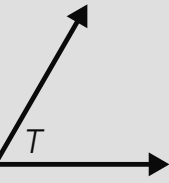


Modeled Review



Name: Avery

Identify each angle as acute, right, obtuse, or straight. Then record the angle measure.

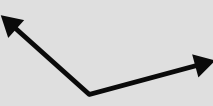

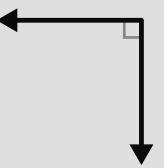
			
right 90°	obtuse 120°	straight 180°	acute 60°



Guided Practice



- Complete the table by labeling each angle. Use a protractor to measure if it is helpful.


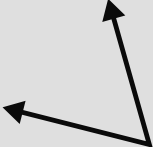

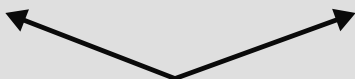
	Acute, right, or obtuse	Greater than, less than, or equal to 90°
		greater than 90°
	acute	
		equal to 90°



Guided Practice



2. Identify each angle as acute, right, obtuse, or straight. Then record the angle measure.

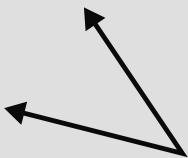
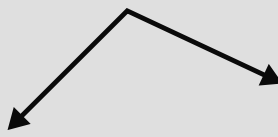
	Acute, right, obtuse, or straight	Measurement in degrees
		
		
		
		



Check



- Identify each angle as acute, right, obtuse, or straight. Then record the angle measure.

	Acute, right, obtuse, or straight	Measurement in degrees
		
		

Multiplying by Powers of 10

ML 6.03



Modeled Review

Name: Tristan

Determine the product. Show your thinking.

$$6 \times 10^5 = \underline{600,000}$$

$$10^5 = 10 \times 10 \times 10 \times 10 \times 10 = 100,000$$

$$6 \times 100,000 = 600,000$$



Guided Practice



1. Use the information in the table to find the product.

Original Expression	Equivalent Expression	Product in standard form
4×10^1	4×10	
4×10^2	$4 \times 10 \times 10$	
4×10^3		
4×10^4		



Guided Practice



2. Determine the product.

Original Expression	Equivalent Expression	Product in standard form
7×10^5	$7 \times 10 \times 10 \times 10 \times 10 \times 10$	
77×10^5	$77 \times 100,000$	
3×10^2		
30×10^2		

Determine the product. Show your thinking.

3. $9 \times 10^4 =$ _____

4. $8 \times 10^3 =$ _____

$10^4 = 10,000$



Check



Determine the product. Show your thinking.

1. $3 \times 10^5 =$ _____

2. $5 \times 10^2 =$ _____

Dividing by Powers of 10

ML 6.04



Modeled Review

Name: Jack

Evaluate each expression. Show your thinking.

1. $22 \div 10^3 = \underline{0.022}$

$10^3 = 10 \times 10 \times 10 = 1,000$

$22 \div 1,000 = 0.022$

tens	ones	tenths	hundredths	thousandths
2	2			
	0	0	2	2

2. $45.7 \div 10^2 = \underline{0.457}$

$10^2 = 10 \times 10 = 100$

$45.7 \div 100 = 0.457$

tens	ones	tenths	hundredths	thousandths
4	5	7		
	0	4	5	7



Guided Practice



Evaluate each equation.

1. $4,720 \div 10^1 = 4,720 \div 10 = 472.0$

2. $4,720 \div 10^2 = 4,720 \div 100 = \underline{\hspace{2cm}}$

3. $4,720 \div 10^3 = \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$

4. $4,720 \div 10^4 = \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$

5. $4,720 \div 10^5 = \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$



Guided Practice



Evaluate each equation.

6. $841 \div 10^2 =$ _____ $=$ _____

7. $841 \div 10^3 =$ _____ $=$ _____

8. $387.5 \div 10^1 =$ $387.5 \div 10 =$ 38.75

9. $387.5 \div 10^2 =$ _____ $=$ _____

10. $387.5 \div 10^3 =$ _____ $=$ _____

11. $387.5 \div 10^4 =$ _____ $=$ _____

12. $152.1 \div 10^1 =$ _____ $=$ _____

13. $152.1 \div 10^2 =$ _____ $=$ _____



Check



Evaluate each equation.

1. $45,736 \div 10^4 =$ _____

2. $41.3 \div 10^2 =$ _____

Calculating Areas of Triangles

ML 1.08

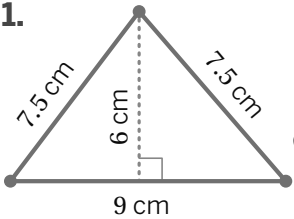


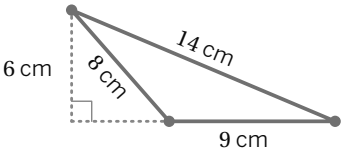
Modeled Review



Name: Clare

Determine the area of each triangle in square centimeters.

1.  $= \frac{1}{2} (9 \cdot 6)$
 $= 27$ square centimeters

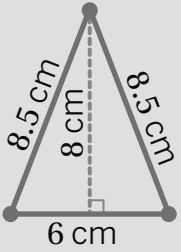
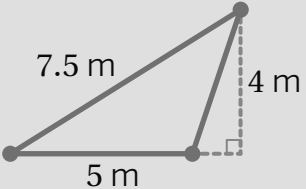
2.  $= \frac{1}{2} (9 \cdot 6)$
 $= 27$ square centimeters



Guided Practice



1. Determine the base, height, and area of each triangle.

Triangle	Base	Height	Area
	6 cm	8 cm	
	5 m		



Guided Practice



2. Determine the base and height of each triangle and write an equation to represent the area of each triangle.

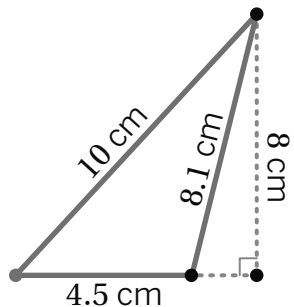
Triangle	Base	Height	Equation	Area
		8 cm		26 square centimeters
				28.5 square centimeters



Check



Determine the area of the triangle. Show or explain your thinking.



Calculating Unknown Percentages

ML 3.13



Modeled Review

Name: Tristan

What is 9 out of 12 as a percent?



75%

Name: Santiago

What is 9 out of 12 as a percent?

$$\frac{9}{12} \cdot 100 = \underline{75}$$

75%

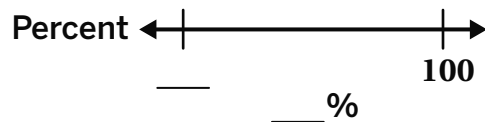
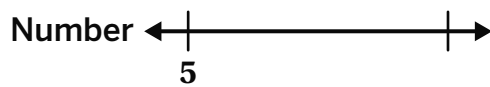


Guided Practice



For Problems 1 and 2, calculate the unknown percentage. Show your thinking.

1. What is 5 out of 10 as a percent?



2. What is 5 out of 50 as a percent?

$$\frac{5}{50} \cdot 100 = \underline{\quad}$$

_____ %



Guided Practice



Calculate the unknown percentage. Show your thinking.

3. What is 18 out of 24 as a percent?

$$\frac{18}{24} \cdot 100 = \underline{\hspace{2cm}}$$

4. What is 4 out of 16 as a percent?

$$\underline{\hspace{2cm}} \cdot 100 = \underline{\hspace{2cm}}$$

5. What is 13 out of 26 as a percent?

6. What is 3 out of 15 as a percent?

7. What is 7 out of 70 as a percent?

8. What is 19 out of 38 as a percent?



Check



What is 16 out of 64 as a percent? Show your thinking.

Converting Between Fractions, Percents, and Decimals

ML 5.15



Modeled Review

Name: Tristan

Write 45% as its fraction and decimal equivalent. Show your thinking.

$$\frac{45}{100} = 45\% = 0.45$$

$$\frac{45}{100} \div \frac{5}{5} = \frac{9}{20}$$

A percent is always out of 100.



Guided Practice



Convert the fraction to determine its decimal and percent equivalents.

1. Convert $\frac{1}{4}$ to its decimal equivalent. 2. Convert $\frac{1}{5}$ to its decimal equivalent.

Convert $\frac{1}{4}$ to its percent equivalent.

$$\underline{\quad} \cdot 100 = \underline{\quad}$$

Convert $\frac{1}{5}$ to its percent equivalent.

$$\underline{\quad} \cdot \underline{\quad} = \underline{\quad}$$



Guided Practice



3. Determine the missing values in each row.

Percent (%)	Decimal	Fraction
15	$\frac{\quad}{100} =$	$\frac{15}{100} \div \frac{5}{5} = \underline{\quad}$
	0.40	
5		
		$\frac{7}{20}$



Check



Write 55% as its fraction and decimal equivalents. Show your thinking.

Evaluating Expressions With Exponents

ML 6.11



Modeled Review



Name: Kai

Determine the value of each expression.

1. $2 \cdot 3^2 = 18$ _____

$$\begin{aligned} &2 \cdot (3 \cdot 3) \\ &2 \cdot (9) \\ &18 \end{aligned}$$

I need to evaluate the part of the expression with the exponent first and then multiply.

2. $5 + (4 - 3)^2 = 6$ _____

$$\begin{aligned} &5 + (1)^2 \\ &5 + (1 \cdot 1) \\ &5 + 1 \\ &6 \end{aligned}$$

I need to evaluate the grouped part of the expression first, then the exponent part. Then I can add.



Guided Practice



Determine the value of each expression.

1. 2^2

$$\begin{aligned} &2 \cdot \underline{\quad} \\ &\underline{\quad} \end{aligned}$$

2. $2 + 3^2$

$$\begin{aligned} &2 + (\underline{\quad} \cdot \underline{\quad}) \\ &\underline{\quad} + \underline{\quad} \\ &\underline{\quad} \end{aligned}$$

3. $(6 - 2)^2$

$$\begin{aligned} &(\underline{\quad})^2 \\ &(\underline{\quad}) \\ &\underline{\quad} \end{aligned}$$

4. $1 + (3 - 2)^2$

$$\begin{aligned} &1 + (\underline{\quad})^2 \\ &\underline{\quad} \\ &\underline{\quad} \\ &\underline{\quad} \end{aligned}$$



Guided Practice



5. Determine the value of each expression.

Expression	Value
$3^2 + 6$	
$(4 + 3)^2$	
$3 + (4 + 1)^2$	
$2 \cdot 4^2$	
$(7 - 1)^2 + 2$	
$6 + 7^2$	



Check



Determine the value of each expression.

1. $3 \cdot 5^2$ _____

2. $7 + (5 - 2)^2$ _____

Interpreting Graphs

ML 6.14

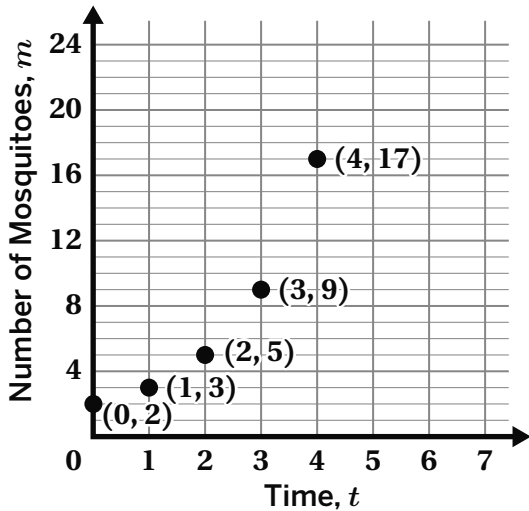


Modeled Review



Name: Shawn

The graph represents the relationship between time, t , and the number of mosquitoes, m . Complete the table so it reflects the values in the graph.



t	m
0	2
1	3
2	5
3	9
4	17

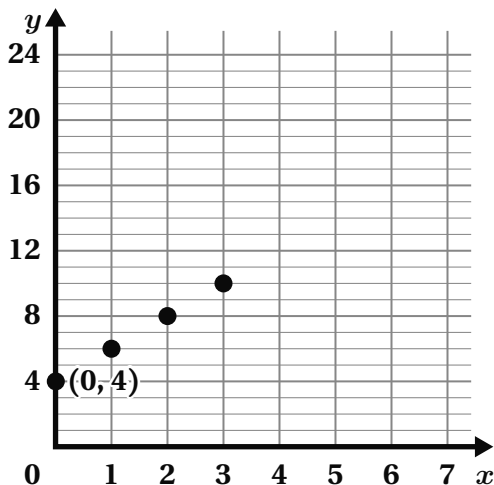
Time is the independent variable, so it represents the x-values. The number of mosquitos is the dependent variable, so it represents the y-values.



Guided Practice



- The graph represents the relationship between the independent variable, x , and the dependent variable, y . Complete the table so it reflects the values in the graph.



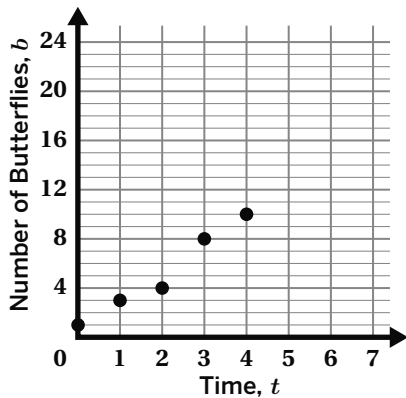
x	y
0	4



Guided Practice

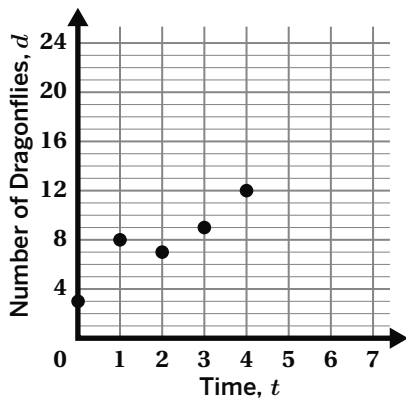


2. This graph represents the relationship between time, t , and the number of butterflies, b . Complete the table so it reflects the values in the graph.



t	b

3. This graph represents the relationship between time, t , and the number of dragonflies, d . Complete the table so it reflects the values in the graph.



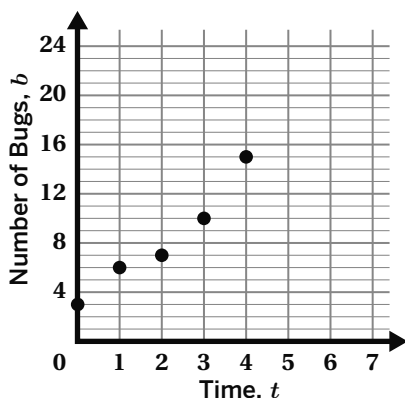
t	d



Check



This graph represents the relationship between time, t , and the number of bugs, b . Complete the table so it reflects the values in the graph.



t	b

Creating Dot Plots

ML 8.03



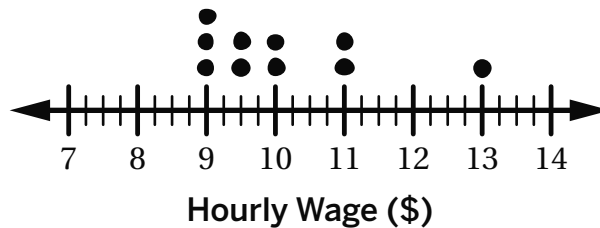
Modeled Review



Name: Clare

10 fast food companies in Nebraska reported their hourly wages for new employees. Complete the dot plot to display this data.

Hourly Wage				
\$11.00	\$9.00	\$9.00	\$10.00	\$9.50
\$10.00	\$9.00	\$11.00	\$9.50	\$13.00

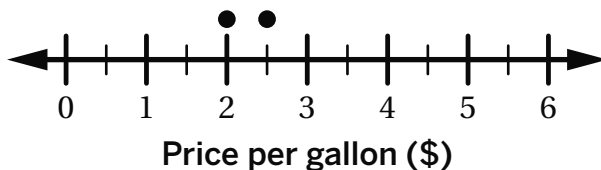


Guided Practice



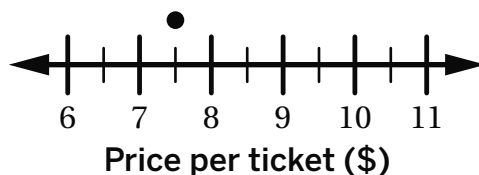
- Here are the prices per gallon of gasoline at 6 gas stations in Georgia. Complete the dot plot that shows this data.

Price per gallon		
\$2.00	\$3.00	\$2.50
\$2.00	\$3.50	\$4.00



- Here are the ticket prices for movies at 6 theaters in Texas. Complete the dot plot to display this data.

Price per ticket		
\$10.00	\$8.00	\$7.50
\$8.50	\$7.00	\$8.00



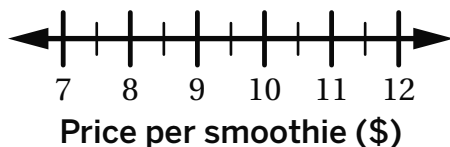


Guided Practice



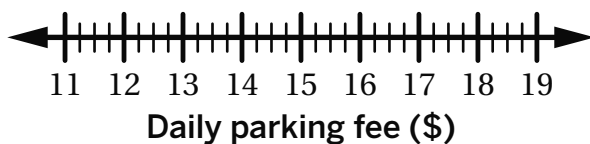
3. 8 smoothie shops in Arizona reported the price of their large smoothie. Complete the dot plot to display this data.

Price per smoothie			
\$10.00	\$9.50	\$9.00	\$10.50
\$11.00	\$10.00	\$9.50	\$11.00



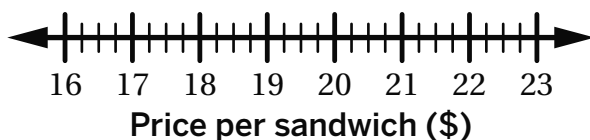
4. 10 parking lots in Chicago reported their daily parking fees. Complete the dot plot to display this data.

Daily parking fee				
\$12.50	\$14.00	\$18.00	\$18.00	\$12.00
\$18.00	\$15.00	\$12.00	\$15.50	\$15.00



5. 10 deli shops in New York reported the price of a large sandwich. Complete the dot plot to display this data.

Price per sandwich				
\$18.00	\$21.00	\$21.00	\$23.00	\$19.50
\$20.50	\$19.00	\$20.00	\$22.00	\$20.00

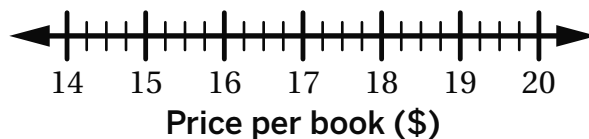


Check



- 10 bookstores in Illinois reported the price of their best-selling book. Complete the dot plot to display this data.

Price per book				
\$15.00	\$20.00	\$16.00	\$15.00	\$16.00
\$18.00	\$18.50	\$15.00	\$17.00	\$18.50



Connecting Scale Factors to Scaled Copies

ML 1.04

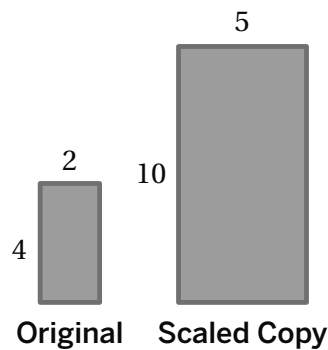


Modeled Review



Name: Shawn

What scale factor takes the original rectangle to its scaled copy? Show or explain your reasoning.



$$\frac{\text{new length}}{\text{original length}} = \frac{5}{2} \text{ or } \frac{10}{4}$$

$\frac{5}{2}$ is the scale factor.



Guided Practice



- Each original robot has a scaled copy. Complete the table by using the corresponding side lengths to determine the scale factor.

Original	Scaled copy	Ratio = $\frac{\text{New Length}}{\text{Original Length}}$	Scale factor
		$\frac{15}{5}$ or $\frac{24}{8}$	
		$\frac{\square}{\square}$ or $\frac{\square}{\square}$	



Guided Practice



2. For each pair of objects, determine the scale factor that takes the original to the scaled copy.

Original	Scaled copy	Scale factor
<p>Original hot air balloon with height 15 and width 9.</p>	<p>Scaled hot air balloon with height 30 and width 18.</p>	
<p>Original hot air balloon with height 30 and width 18.</p>	<p>Scaled hot air balloon with height 15 and width 9.</p>	
<p>Original truck with height 3 and width 4.</p>	<p>Scaled truck with height 7.5 and width 10.</p>	



Check



What scale factor takes the original to the scaled copy?

Original	Scaled copy	Scale factor
<p>Original right triangle with vertical side 20 and horizontal side 15.</p>	<p>Scaled right triangle with vertical side 12 and horizontal side 9.</p>	

Determining the Constant of Proportionality

ML 2.03



Modeled Review



Name: Clare

Determine the constant of proportionality for the relationship and complete the table. What does the constant of proportionality tell you about the situation?

The constant of proportionality is 5.

The paint is made with 5 cups of yellow paint for every 1 cup of blue paint.

$2 \cdot 5 = 10$
 $6 \cdot 5 = 30$

Blue paint (cups)		Yellow paint (cups)
2	$\times 5 \rightarrow$	10
1		5
6	$\times 5 \rightarrow$	30
52		260



Guided Practice



Determine the constant of proportionality for the relationship and complete the table.

- $8 \cdot 3 = 24$
 $12 \cdot \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$
 $128 \cdot \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$

The constant of proportionality is _____.

Lemonade

	Volume (oz)	Sugar (g)
glass	8	$\times 3 \rightarrow 24$
bottle	12	
carton	32	96
jug	128	

- $8 \cdot \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$
 $12 \cdot \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$
 $128 \cdot \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$

The constant of proportionality _____.

Apple juice

	Volume (oz)	Sugar (g)
glass	8	
bottle	12	
carton	32	80
jug	128	



Guided Practice



Determine the constant of proportionality for the relationship and complete the table. What does the constant of proportionality tell you about the situation?

3. The constant of proportionality is _____.

The paint is made with _____ cups of blue paint for every _____ cup of red paint.

Red paint (cups)	Blue paint (cups)
2	3
1	
6	
40	60

4. The constant of proportionality is _____.

Red paint (cups)	Yellow paint (cups)
2	8
1	
	32
50	



Check



Determine the constant of proportionality for the relationship and complete the table. What does the constant of proportionality tell you about the situation?

White paint (cups)	Red paint (cups)
2	4
1	
7	
	80

Finding More Than One Equation to Represent Proportional Relationships

ML 2.06



Modeled Review

Name: Jason

A car traveled 150 miles in 2 hours at a constant speed.

1. What are two constants of proportionality for the relationship between distance in miles, d , and number of hours, t , that the car traveled?

$$\frac{150}{2} \text{ and } \frac{2}{150}$$

2. Write two equations that relate d and t in this situation.

$$d = \frac{150}{2}t \text{ and } t = \frac{2}{150}d$$



Guided Practice



Complete the table and determine the constant of proportionality. Write an equation to represent the situation.

1.

x	y
1	
2	10
4	
t	$5t$

constant of proportionality: _____

equation: _____

2.

x	y
1	
4	
8	
w	$\frac{1}{4}w$

constant of proportionality: _____

equation: _____



Guided Practice



There are 400 centimeters in every 4 meters.

- Determine two constants of proportionality for the relationship between meters, x , and centimeters, y .
- Write two equations that relate x and y in this situation.

It took 6 minutes, t , to fill a cooler with 8 gallons of water, w , at a steady rate.

- Determine two constants of proportionality for the relationship between time, t , and gallons of water, w .
- Write two equations that relate t and w in this situation.



Check



A polar bear swam 426 miles across the Beaufort Sea, north of Alaska, in 9 days.

- Determine two constants of proportionality for the relationship between distance in miles, d , and number of days, t , that the polar bear swam.
- Write two equations that relate d and t in this situation.

Determining the Circumference of a Circle

ML 3.03



Modeled Review



Name: Shawn

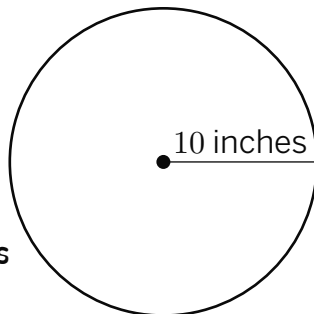
What is the approximate circumference of this circle? Show your thinking.

$$C = 2\pi r$$

$$C = 2\pi 10$$

$$C = 20\pi$$

Circumference: 20π inches



The radius is given because it is the distance from the center to the edge.



Guided Practice



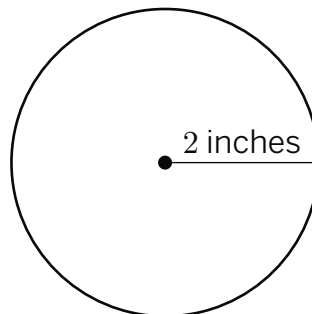
Determine the circumference using $C = 2\pi r$ or $C = \pi d$. Show your thinking.

1. $C = 2\pi r$ radius = 2

$$C = 2\pi \underline{\hspace{2cm}}$$

$$C = \underline{\hspace{2cm}}$$

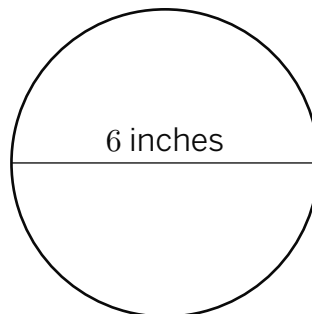
$$C = \underline{\hspace{2cm}} \text{ inches}$$



2. $C = \pi d$ diameter = $\underline{\hspace{2cm}}$

$$C = \underline{\hspace{2cm}}$$

$$C = \underline{\hspace{2cm}} \text{ inches}$$





Guided Practice



3. Use the given information to determine the circumference of each object.

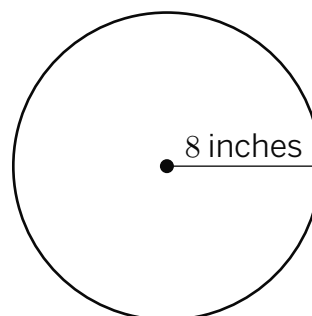
Object	Radius (cm)	Diameter (cm)	Circumference (cm)
Magnifying glass	5	10	
Lid	4		
Salad Plate		14	
Hand Mirror	6		
Clock		18	



Check



What is the approximate circumference of this circle?



Writing Equations From Descriptions and Tape Diagrams

ML 6.03

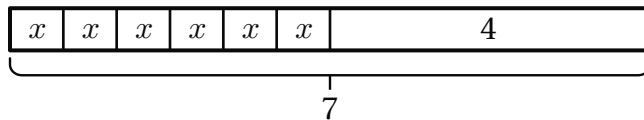


Modeled Review



Name: Priya

Ella ran 6 times around her school building. Then she ran 4 miles home. Her phone told her that she ran 7 miles total.



x appeared six times while 4 appeared only once. The sum is represented by 7, so the equation can be written as $6x + 4 = 7$.

Write an equation that represents this situation.

$$6x + 4 = 7$$

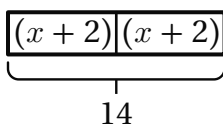


Guided Practice



- Match each equation to the correct tape diagram on the left and description on the right.

Tape diagram

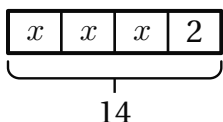


Equation

$$3x + 2 = 14$$

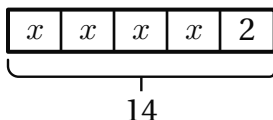
Description

Caleb collected 14 seashells at the beach, saving 2 for his collection and sharing the rest equally among his 3 teammates.



$$2(x + 2) = 14$$

Fatima gathered 14 marbles and set aside 2 for herself before splitting the remainder equally among her 4 cousins.



$$4x + 2 = 14$$

Felipe bought 2 books, one for each of his siblings to read. They each spent \$2 on bookmarks. The total bill was \$14.

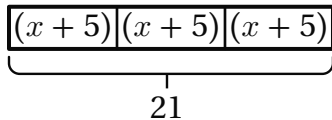


Guided Practice

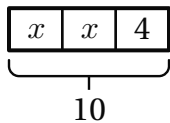


Write an equation that matches the description and tape diagram.

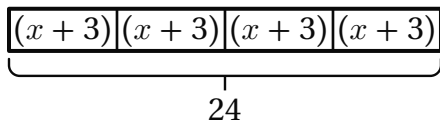
2. Ava ordered 3 slices of pizza, one for each friend at the sleepover. Each guest contributed \$5 for dessert. The total bill was \$21.



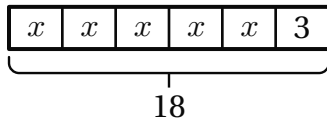
3. Mia baked 10 cupcakes and reserved 4 for herself before sharing the remaining treats equally among her 2 siblings.



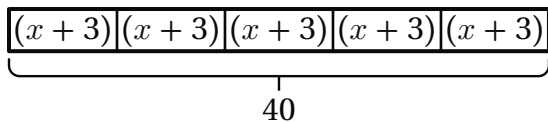
4. Maya purchased 4 tickets for a movie night, one for each family member. Afterward, each person bought a snack for \$3. The total bill was \$24.



5. Emma bought 18 stickers and decided to keep 3 for her collection before distributing the remaining stickers equally among her 5 cousins.



6. Alexis bought 5 servings of ice cream, one for each friend at the game. Each person chipped in \$3 for toppings. The total bill was \$40.

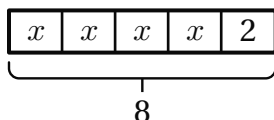


Check



Write an equation that matches the description and tape diagram.

Esteban walked 4 times around the park. Then he walked 2 miles to the school. His watch told him that he walked 8 miles total.



Solving Equations With Positive and Negative Numbers

ML 6.07



Modeled Review

Name: Jack

Solve the equation. Show your thinking.

$$-4(x - 2) = 12$$

$$\frac{-4}{-4}(x - 2) = \frac{12}{-4}$$

$$x - 2 = -3$$

$$x - 2 = -3$$

$$+ 2 \quad + 2$$

$$x = -1$$

Check:

$$-4(x - 2) = 12$$

$$-4(-1 - 2) = 12$$

$$-4(-3) = 12$$

$$12 = 12$$



Guided Practice



1. Solve the equations by completing the blanks in the equations and descriptions.

Equation	Moves
$-2x + 3 = 7$ $-2x = \underline{\quad}$ $x = \underline{\quad}$	<p>Step 1: Subtract <u> </u> from each side.</p> <p>Step 2: Divide each side by <u> </u>.</p>
$2(x + 1) = 6$ $x + 1 = \underline{\quad}$ $x = \underline{\quad}$	<p>Step 1: <u> </u> each side by <u> </u>.</p> <p>Step 2: <u> </u> from each side.</p>



Guided Practice



For Problems 2–5, solve the equation. Show your thinking.

2. $-4x - 2 = 10$

3. $3(x - 2) = 9$

4. $-3x + 5 = -1$

5. $-4(x + 3) = 20$



Check



Solve each equation. Show your thinking.

1. $-4x - 3 = 13$

2. $-3(x - 4) = 27$

Determining Unknown Angle Measures

ML 7.04

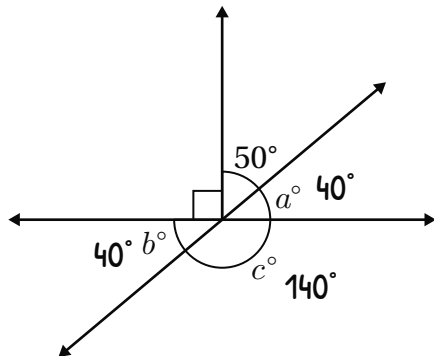


Modeled Review



Name: Gabriel

Determine the values of a , b , and c .



$$\begin{array}{rcl}
 a + 50 = 90 & a = b & c + a = 180 \\
 - 50 & - 50 & \\
 a = 40 & b = 40 & c + 40 = 180 \\
 & & - 40 & - 40 \\
 & & c = 140
 \end{array}$$

$$a = 40, b = 40, c = 140$$

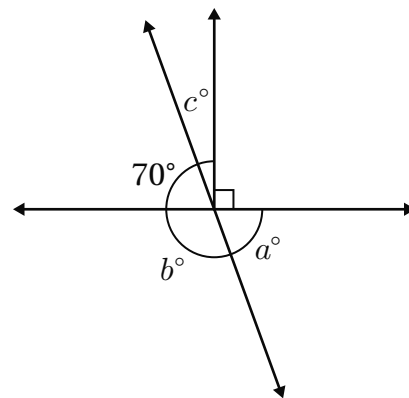


Guided Practice



- Fill in the missing values and solve the equations to determine the values of a , b , and c .

Equation	Relationship
$a = 70$	vertical angles
$c + \underline{\hspace{2cm}} = 90$	complementary angles
$b + \underline{\hspace{2cm}} = 180$	supplementary angles



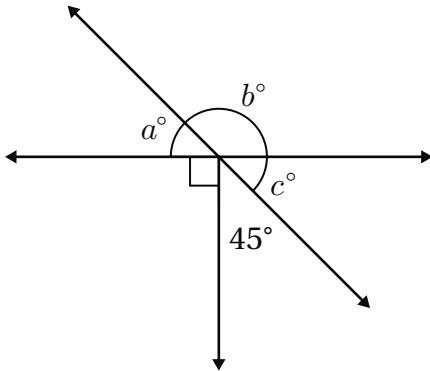


Guided Practice

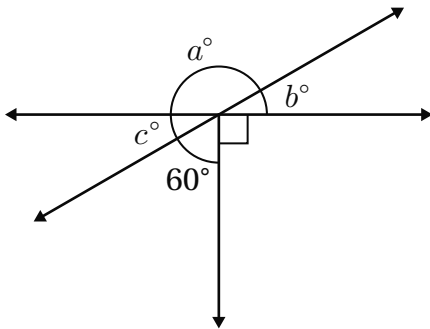


Determine the values of a , b , and c for each diagram.

2.



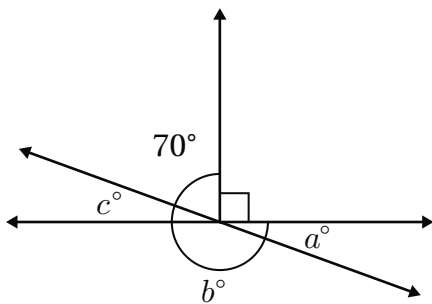
3.



Check



Determine the values of a , b , and c .



Calculating the Surface Area of Prisms

ML 7.12

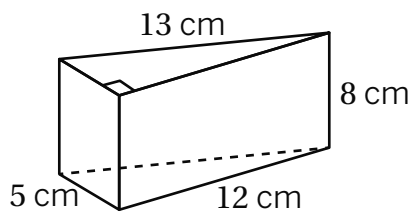


Modeled Review



Name: Fatima

Calculate the surface area of this prism.



$$A = \frac{l \cdot w}{2} = \frac{12 \cdot 5}{2} = \frac{60}{2} = 30$$

There are two triangle faces and three rectangular faces.

$$A = 5 \cdot 8 = 40$$

$$A = 12 \cdot 8 = 96$$

$$A = 13 \cdot 8 = 104$$

$$30 + 30 + 40 + 96 + 104 = 300$$

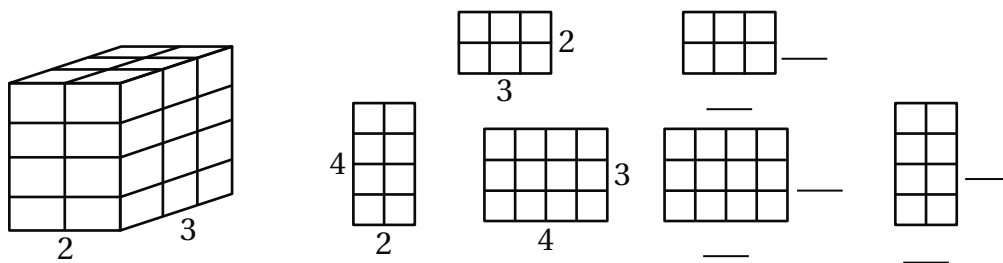
Surface area: 300 square centimeters



Guided Practice



1. Calculate the surface area of the prism.



_____ + _____ + _____ + _____ + _____ + _____ = _____

Surface area: _____ square units

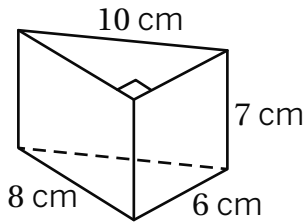


Guided Practice

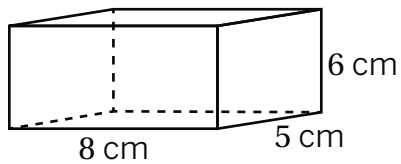


Calculate the surface area of each prism.

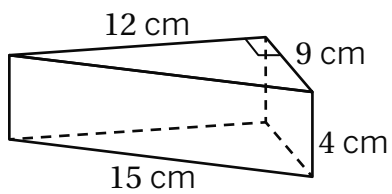
2.



3.



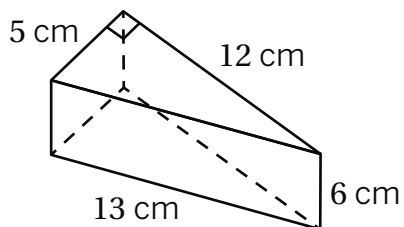
4.



Check



Calculate the surface area of the prism.





Extensions

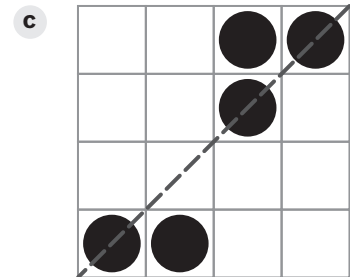
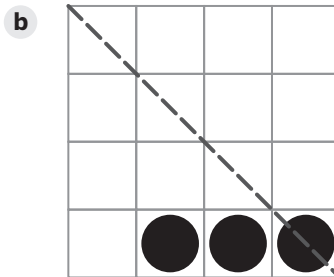
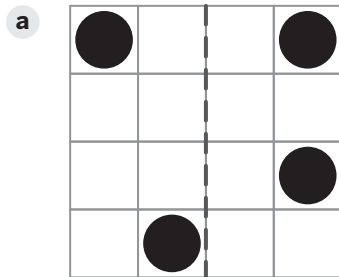
Name: Date: Period:

Student Choice

Start with any problem. Remember to show or explain your thinking.

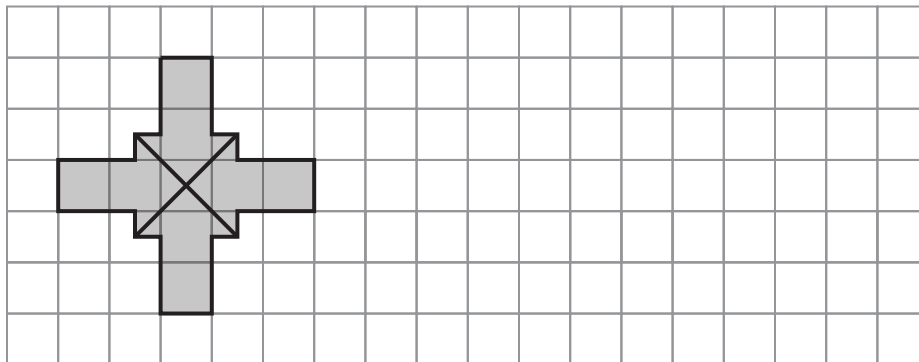
1

Here are three figures. Move one dot so all the dots reflect across the dashed mirror line. How many different solutions can you come up with?



2

Here are four identical arrows. Rotate, translate, and reflect the arrows to create a design that looks like there are five arrows.



Name: Date: Period:

3

A design formed from pentominoes is shown on the left. Create an identical design using pentominoes. The first pair is completed for you.

Set of Pentominoes

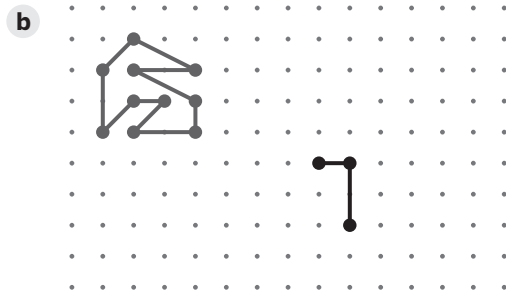
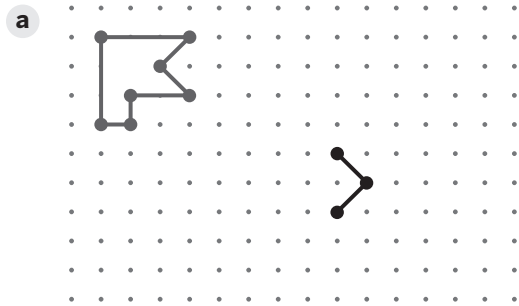
Name: Date: Period:

Student Choice

Start with any problem. Remember to show or explain your thinking.

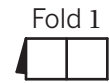
1

Here are two figures. A portion of a congruent figure is shown. Add lines to each drawing to finish the congruent figures.



2

A square piece of paper is folded in half and half again, as shown.



Two different-shaped figures are cut through the folded paper.

Circle the pattern that results from each folded cut.

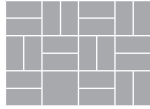


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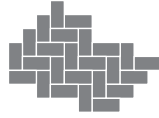
3

A *tessellation* is a pattern that tiles a plane without any gaps or overlaps. Here are some examples.

Design A



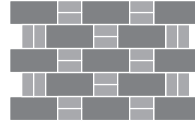
Design B



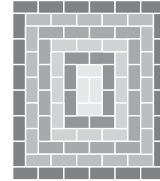
Design C



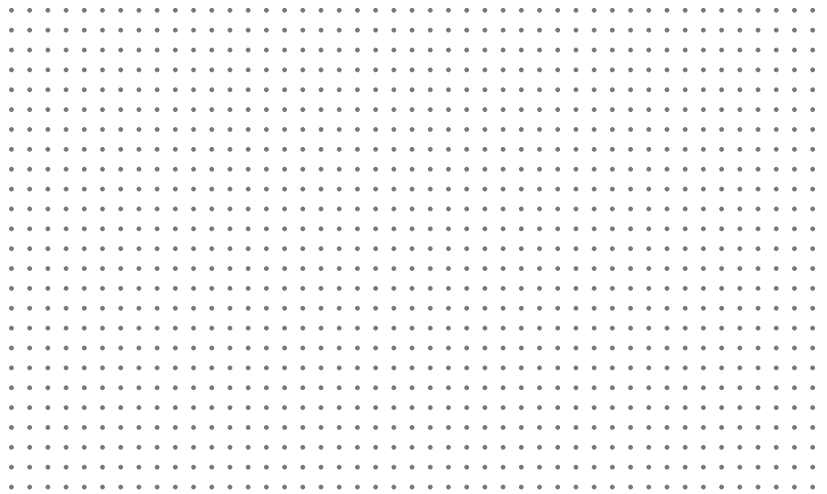
Design D



Design E



- a** Create a tessellation and identify the transformations you use to create your design.



- b** What do you notice about tessellations and transformations?

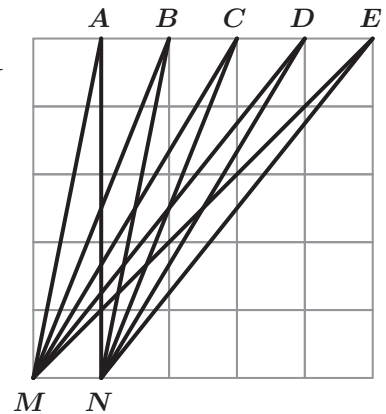
Name: Date: Period:

Student Choice Start with any problem. Remember to show or explain your thinking.

1

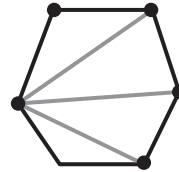
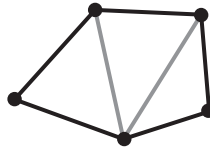
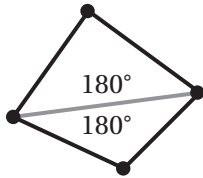
Use the figure to determine the sum of these five angles:

$$m\angle MAN + m\angle MBN + m\angle MCN + m\angle MDN + m\angle MEN$$



2

You can determine the sum of the interior angles of a polygon by dividing the polygon into triangles. Here are three examples for a polygon with 4, 5, and 6 sides.



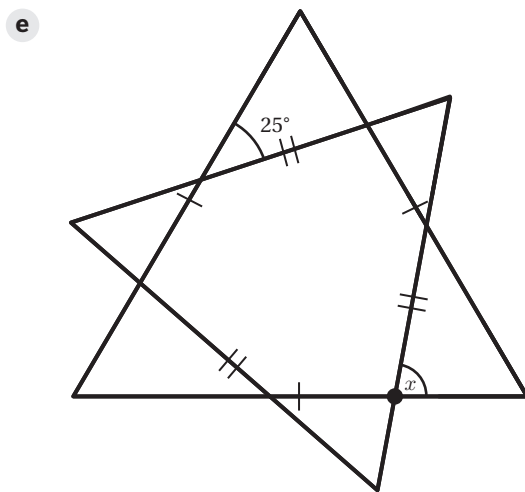
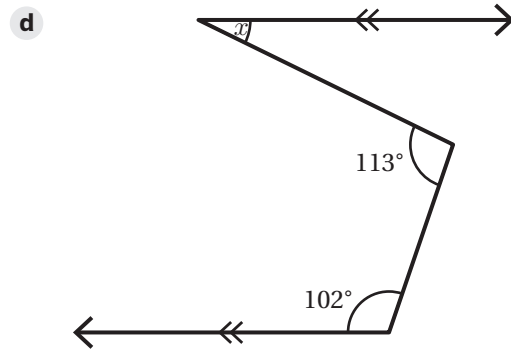
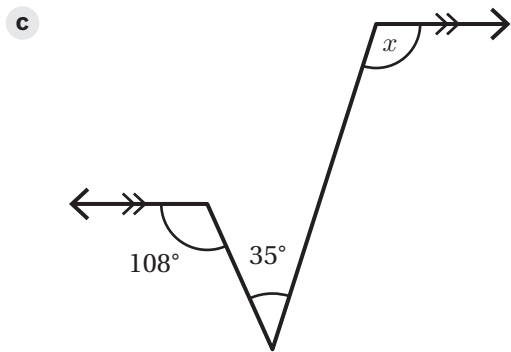
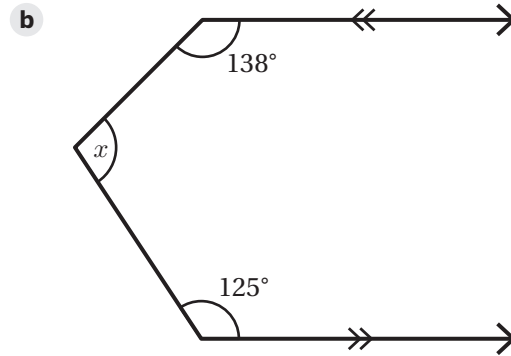
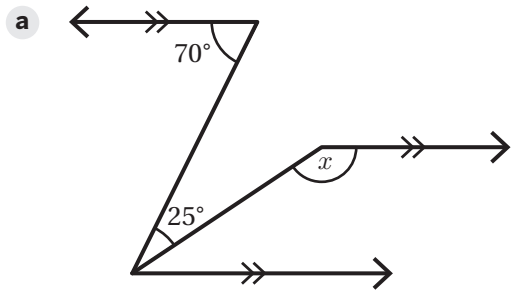
a What is the sum of the interior angles of a 12-gon?

b What is the sum of interior angles of a n -gon?

Name: Date: Period:

3

For each diagram shown, determine the value of angle x . Can you find all the unknown angles?



Name: Date: Period:

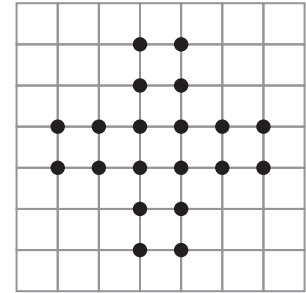
Student Choice

Start with any problem. Remember to show or explain your thinking.

1

20 points are shown on the square grid.

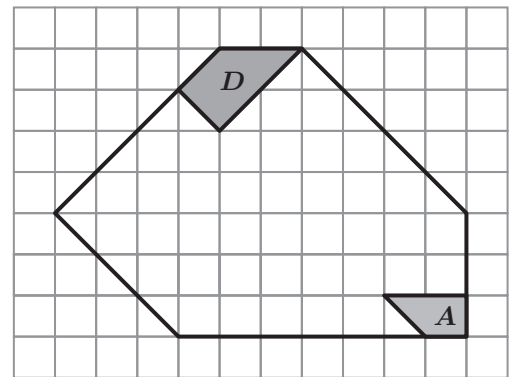
- a** How many squares can you form by connecting any 4 points on this shape?



- b** How many *different-sized* squares can you form by connecting any 4 points on this shape?

2Here is a hexagon with trapezoids *A* and *D* labeled.Divide the hexagon into five trapezoids labeled *A*, *B*, *C*, *D*, and *E* so that the scale factor between

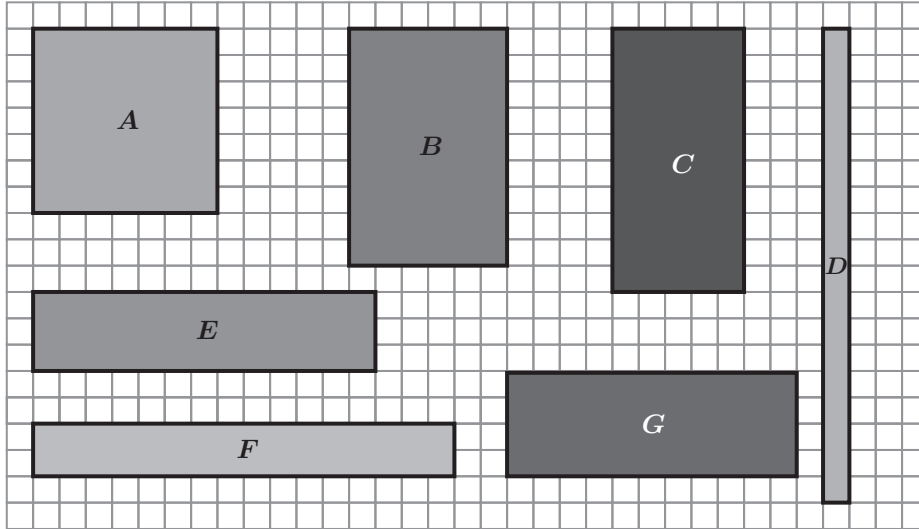
- *A* to *B* is 1 : 2
- *D* to *C* is 1 : 2
- *D* to *E* is 1 : 3



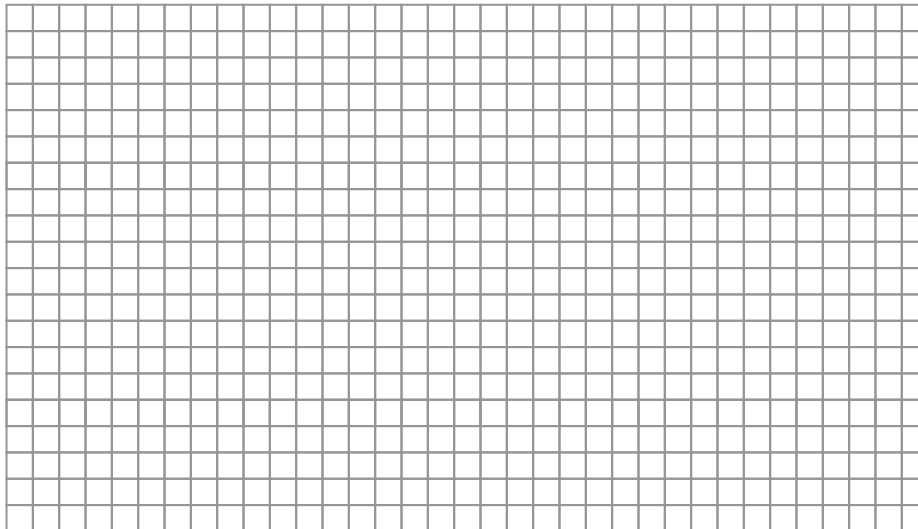
Name: Date: Period:

3

Here are several rectangles in different sizes.



- a Are any of these rectangles scaled copies of each other?
- b Arrange rectangles $A-F$ to form one large rectangle.



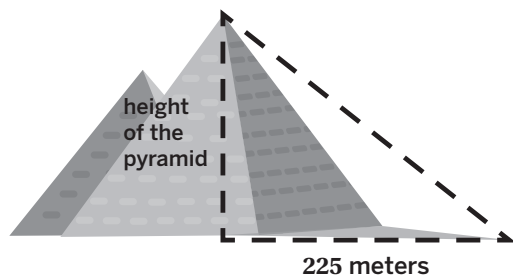
- c Are any rectangles $A-F$ scaled copies of the newly formed large rectangle?

Name: Date: Period:

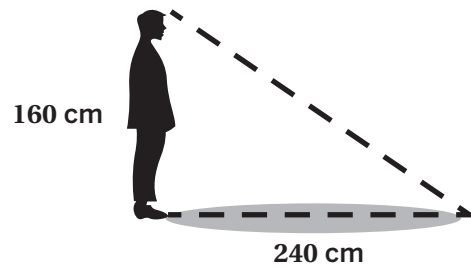
Remember to show or explain your thinking.

1

According to historical sources, 2500 years ago, the Greek mathematician Thales successfully calculated the Great Pyramid's height.



First, he measured the length of the Great Pyramid's shadow as 225 meters.

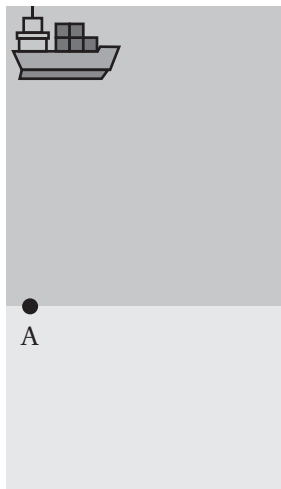


At the same time of day and in the same place, he measured the shadow of his 160-centimeter-tall friend to be 240 centimeters.

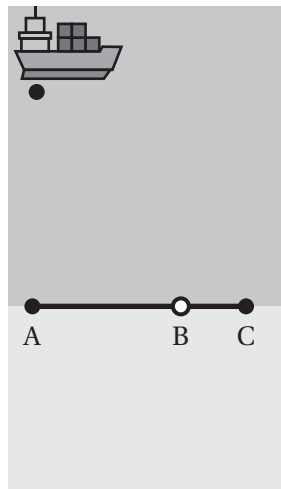
Use Thales' measurements to determine the height of the pyramid.

2

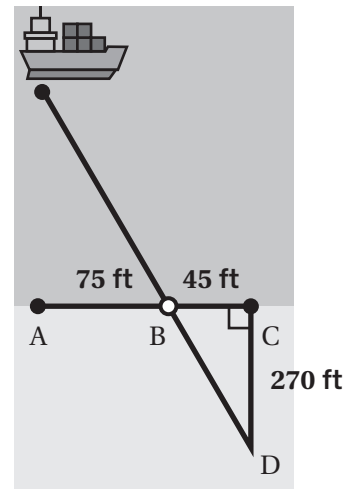
Thales also calculated the width of rivers and the distances of ships from the shoreline.



Here is a ship a certain distance from the shoreline, as shown.



Thales walked along the shoreline and placed sticks in the ground at points *B* and *C*.



From there, he walked directly away from the sea at a 90° angle until the stick he placed in the ground at point *B* lined up with the ship, point *D*.

Use Thales' measurements to determine the distance of the ship from the shoreline.

Name: Date: Period:

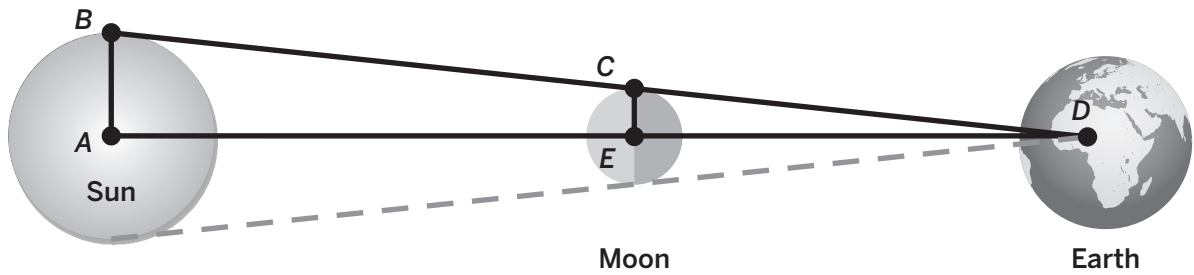
3

Years later, Galileo used the similarity of triangles to study solar eclipses and calculate the distances between planets.

The distance of the Sun from the Earth is about 150 million kilometers.

During a solar eclipse, the Moon is in line with the Sun and blocks the Sun's rays. The mighty Sun has a diameter of almost 1.4 million kilometers whereas the Moon's diameter is about 3500 kilometers.

How can the Moon block the Sun even though the Sun is much larger than the Moon?



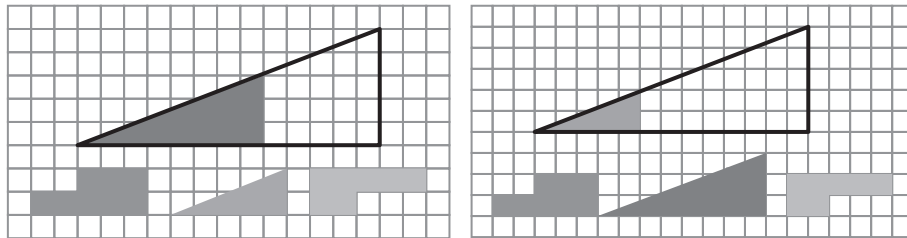
Name: Date: Period:

Remember to show or explain your thinking.

1

You will use a set of two identical triangles and four identical pieces to complete this problem.

- a Each triangle has one piece placed inside, as shown. Use the remaining pieces to complete each triangle.



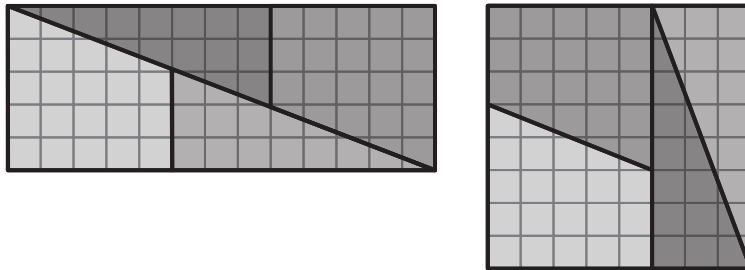
- b What do you notice?
- c This exploration is called *Curry's Paradox*. A paradox is a seemingly contradictory situation.
Here, we have the same four shapes that seem to have different areas based on how we arrange them. That does not fit with our understanding of area.
How do you explain the empty 1 square unit area?

Name: Date: Period:

2

Here is another geometrical paradox.

The two figures shown are composed of the same four pieces.

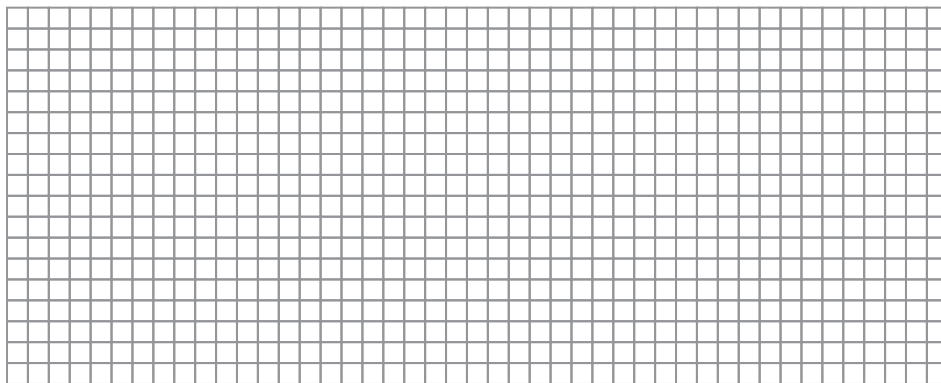


- a Determine the area of each figure.

- b What do you think causes this paradox?

3

Create your own geometric paradox.



Proportionality Revisited

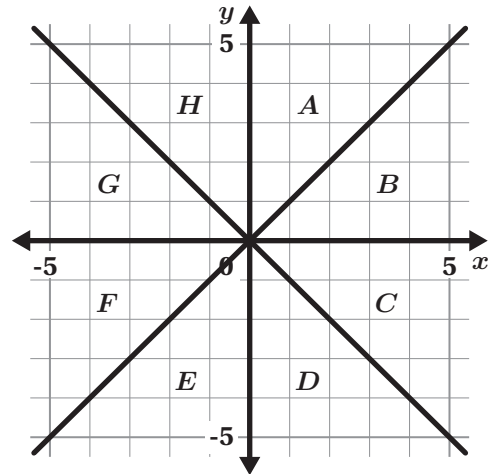
Name: Date: Period:

Student Choice

Start with any problem. Remember to show or explain your thinking.

1

- a** What are the equations of the two lines in the graph?



- b** Consider a line in the form $y = mx$ that passes through the origin. Complete the table to show what values of m result in a line passing through the given regions

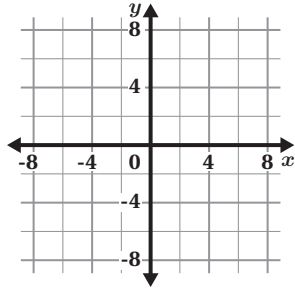
For the lines in the regions	A and E	B and F	C and G	D and H
m is	greater than 1			

Name: Date: Period:

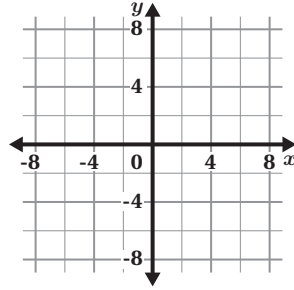
2

- a Sketch the graph of equations on the given coordinate planes.

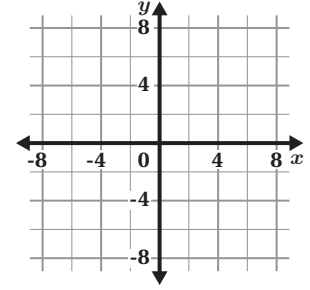
$$y = 4x \text{ and } y = -\frac{1}{4}x$$



$$y = -2x \text{ and } y = \frac{1}{2}x$$



$$y = \frac{2x}{5} \text{ and } y = -\frac{5}{2}x$$



- b What do you notice?
- c Write the equation of the line that is perpendicular to $y = -5x$ and passing through the origin.

Name: Date: Period:

Remember to show or explain your thinking.

1

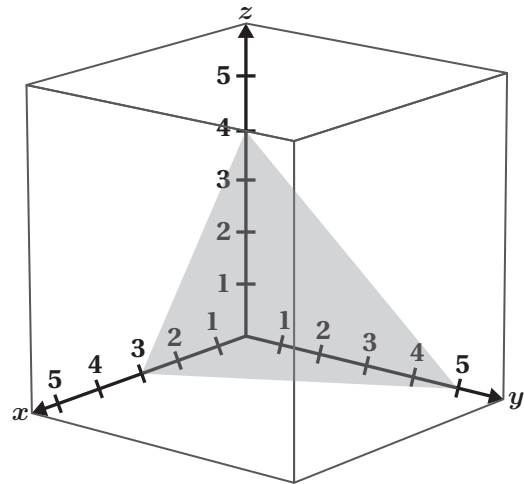
One form that a linear equation may be written in is the *intercept form*.

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

The constants a and b are the x - and y - intercepts of the graph. In three dimensional space, the *equation of a plane* takes a similar form.

$$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$$

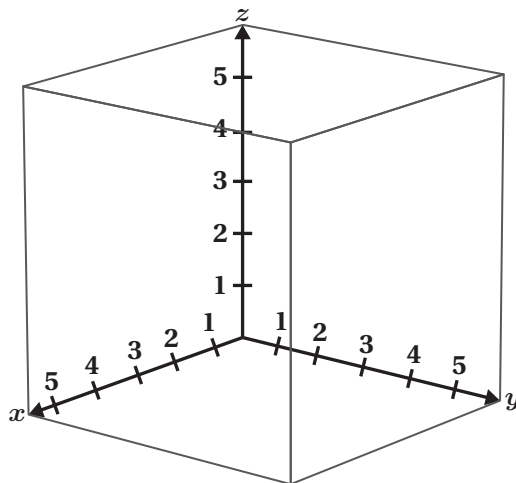
For example, plane of $\frac{x}{3} + \frac{y}{5} + \frac{z}{4} = 1$ intersects with x -axis at $(3, 0, 0)$, y -axis at $(0, 5, 0)$, z -axis at $(0, 0, 4)$



- a Graph the equations

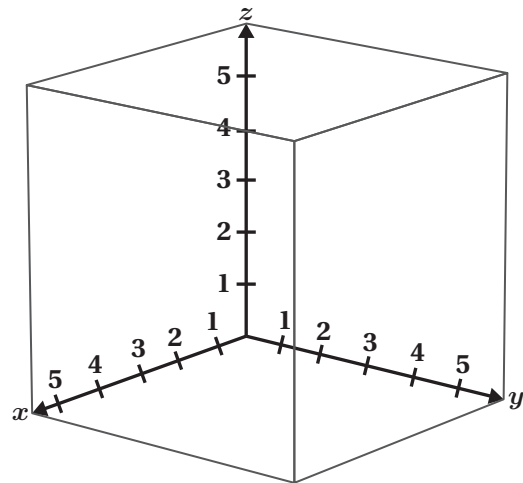
Graph A

$$\frac{x}{3} + \frac{y}{5} + \frac{z}{2} = 1$$



Graph B

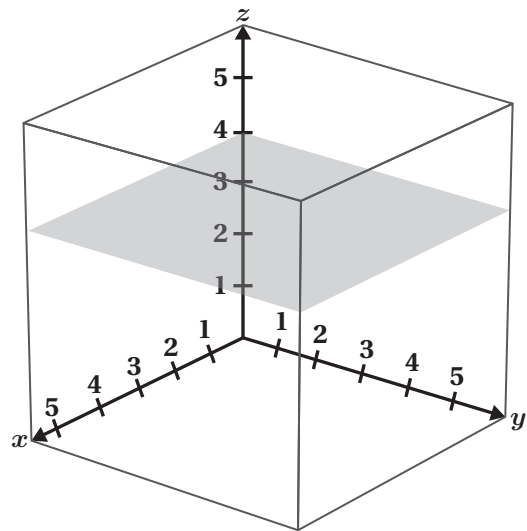
$$\frac{x}{3} + \frac{y}{1} + \frac{z}{5} = 1$$



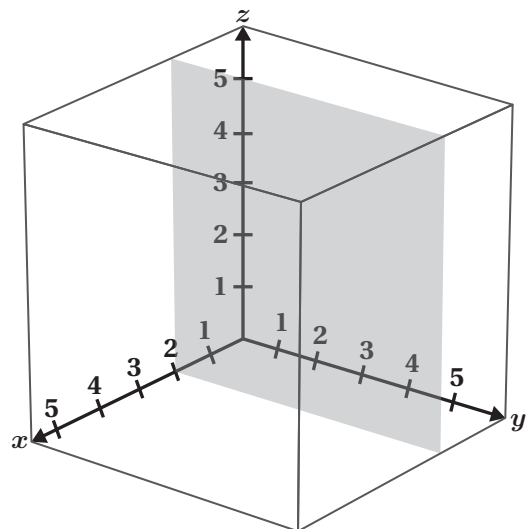
Name: Date: Period:

For Graph A, write the equation of the line where the plane ...

- b** intersects the xy -plane.
- c** intersects the xz -plane.
- d** intersects the yz -plane.
- e** In three dimensional space, the equation for the xy -plane is $z = 0$. Write an equation for the xz -plane.
- f** Write an equation for the yz -plane.
- g** Write an equation for a plane parallel to the xy -plane with a z -intercept of 4.



- h** Write an equation for a plane parallel to the yz -plane with an x -intercept of 2.



Name: Date: Period:

Remember to show or explain your thinking.

1

Use the digits 1–9, without repeating, to fill each blank and create parallel lines.

$$\square x + \square y = \square$$

$$\square x + \square y = \square$$

2

Use the digits 1–9, without repeating, to fill each blank and create parallel lines.

$$y = \frac{\square}{\square}(x - \square) + \square$$

$$y = \frac{\square}{\square}(x - \square) + \square$$

Name: Date: Period:

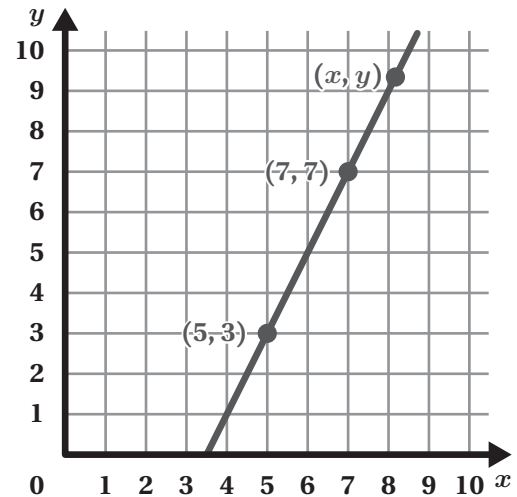
3

Consider the line shown.

a Does $\frac{y - 3}{x - 6} = 2$ represent the line?

b Does $\frac{y - 6}{x - 4} = 5$ represent the line?

c Does $\frac{y + 5}{x + 1} = 2$ represent the line?

**4**

The following table shows the freezing and boiling points of water in four temperature scales: Celsius, Fahrenheit, Kelvin, and Rankine.

	°C	°F	°K	°R
Boiling point	100	212	373	672
Freezing Point	0	32	273	492

Assume that the average human temperature is 97°F. Determine the average human temperature in the other three scales.

Solving Linear Equations

Name: Date: Period:

Student Choice

Start with any problem. Remember to show or explain your thinking.

1

A *magic square* is a square array of distinct numbers, arranged in a way that the sum of the numbers in every row, in every column and in each of the main diagonals is equal.

4	9	2
3	5	7
8	1	6

- a** Here is a different version of a magic square. Darryl thinks that 7 must go in the bottom right corner. Explain why it is true.

1		3
5		

- b** Place the numbers in the cells so that the sum of the numbers along both diagonals, columns, and rows are the same.
- c** How many solutions does this problem have?

Name: Date: Period:

2

- a** Take any two-digit number. Reverse the digits, and subtract your answer from your original number. Try several different two-digit numbers. What do you notice?
- b** How many positive two digit numbers increase by 36 when their digit is reversed?
- c** Take any two-digit number. Add its digits, and subtract the sum from your original number. What do you notice?
- d** Take any three-digit number. Reverse the digits, and subtract your answer from your original number. What do you notice?

3

The English mathematician Augustus de Morgan, who died in 1871, claimed that he became x years old in the year x^2 . When was he born?

Name: Date: Period:

Student Choice

Start with any problem. Remember to show or explain your thinking.

1

- a**
- Determine
- x
- ,
- y
- ,
- z
- and
- w
- .

$$w + x + y = 49$$

$$x + y + z = 40$$

$$y + z + w = 37$$

$$z + x + w = 42$$

- b**
- Determine
- $x + y + z$
- .

$$-2x + 4y + z = 10$$

$$10x + 15y - 5z = 55$$

$$3x - y + 4z = 33$$

2

A magician asked everyone in the audience to think of two whole numbers less than 10, and then follow these steps.

Take one of them and add 1.

Multiply by 5.

Add 1 again.

Double your answer.

Subtract 1.

Add your second number.

Add 2.

Double again.

Subtract 8.

Halve this number and tell me your answer.

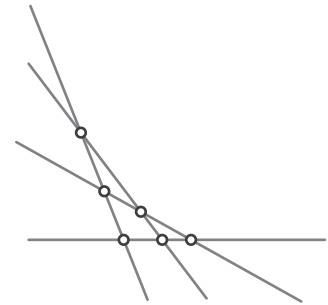
- a**
- Try the magician's trick with at least two different pairs of answers.
-
- b**
- Subtract 9 from both of your answers. What do you notice?
-
- c**
- How did the magician work out both of the numbers from the answers quickly?

Name: Date: Period:

3

Two lines can intersect maximum in 1 point.

- a** What is the maximum point of intersections for 3 lines? 4 lines?
- b** Draw 5 lines in a way that they intersect with the maximum point of intersections.
- c** What is the maximum point of intersections for 6 lines? 7 lines?
- d** What is the maximum number of intersection points for n lines?



Name: Date: Period:

Remember to show or explain your thinking.

1

- a**
- Use the given numbers only once to create three linear functions below.

-3 -2 -1 0 1 2 3

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

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

Input	Output
-2	
-1	1
0	0
1	
2	

- b**
- Write
- y
- as a function of
- x
- for each table.

2

Determine the rule for each input-output table.

a

Input	Output
A	Y
B	X
E	U
M	M
Q	I

b

Input	Output
2	1
7	14
10	5
13	26
34	17

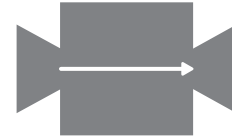
c

Input	Output
1	0
2	0
-4	1
-5	1
17	0

Name: Date: Period:

3

Determine as many functions as possible that assign the y -value 4 to the x -value 1. Write as many functions which fit this model as you can.

1**4****4**

Here are two more input-output tables.

Input (x)	Output (y)
	-12
-5	
-2	4
1	16
3	24
6	36

Input (x)	Output (y)
-4	-32
-1	
2	4
3	10
	34
9	46

- Describe each rule that allows you to get y from x .
- Use the rule to determine the missing numbers.
- Write y as a function of x .

Name: Date: Period:

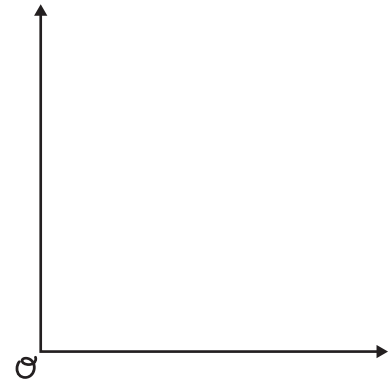
Student Choice

Start with any problem. Remember to show or explain your thinking.

1

Han gets in his car to pick up his little brother from school.

- He starts the car and speeds up at a constant rate until he reaches the speed limit, then he drives the speed limit for a while.
- He thinks he might be able to get through the next light so he speeds up, but it turns yellow so he quickly slows down and comes to a complete stop for the duration of the light.
- When the light turns green, Han speeds up then drives the speed limit again.
- He slows down as he approaches his brother's school, and then comes to a complete stop to pick up his brother.

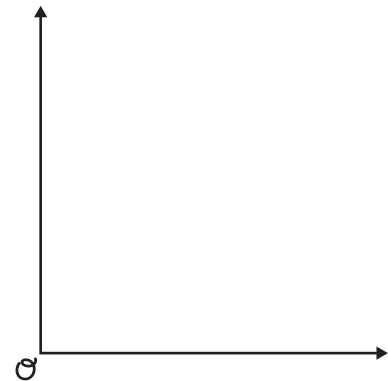


Sketch a graph that represents this situation. Be sure to label the axes.

2

In an experiment, a ball is launched straight up by some device and its height above the ground is recorded each second.

In the first and fifth seconds, the ball was 25 meters high. In the second and fourth seconds, it was 40 meters high. It reached its highest level, 45 meters high, at the third second. After six seconds, it was on the ground.



- Sketch a graph that represents this situation. Be sure to label the axes.
- Estimate the one-second interval(s) where the ball moved the fastest.
- Estimate the time(s) where the ball changed direction.
- Estimate the times the ball was at the following heights:

42 meters	35 meters	24 meters	10 meters

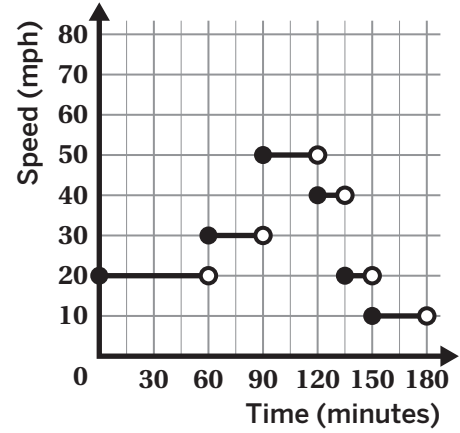
Name: Date: Period:

3

The graph models the speed of a car over a function of time during a 3-hour trip.

- a How far did the car travel over the course of the trip?

- b How can you visualize the distance the car traveled over 3 hours on the graph?



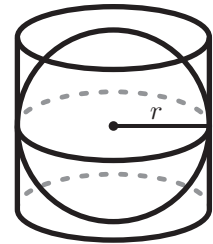
Name: Date: Period:

Student Choice Start with any problem. Remember to show or explain your thinking.

1

Archimedes made many significant mathematical discoveries, but he was most proud of his work involving a sphere inscribed in a cylinder. According to a legend, he even requested that his tombstone feature this discovery!

Determine the ratio of the volume of the sphere to the volume of the cylinder when the sphere is perfectly inscribed within the cylinder. ($V_{cylinder} = \pi \cdot r^2 \cdot h$, $V_{sphere} = \frac{4}{3} \pi \cdot r^3$)

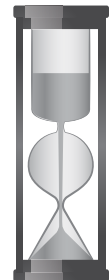


2

Rod designs an hourglass that is made up of three parts: a cylinder, a sphere, and a cone, all with the same radius r .

Determine the height h of the cylinder and the cone so that the sand from the cylinder completely fills the sphere and the cone.

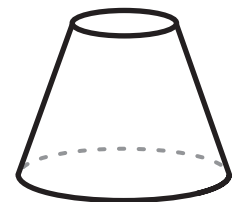
$$(V_{cylinder} = \pi \cdot r^2 \cdot h, V_{sphere} = \frac{4}{3} \pi \cdot r^3, V_{cone} = \frac{1}{3} \pi r^2 h)$$



3

A frustum is the result of taking a cone and slicing off a smaller cone using a cut parallel to the base. Determine a formula to calculate the volume of a frustum.

$$(V_{cone} = \frac{1}{3} \pi r^2 h)$$

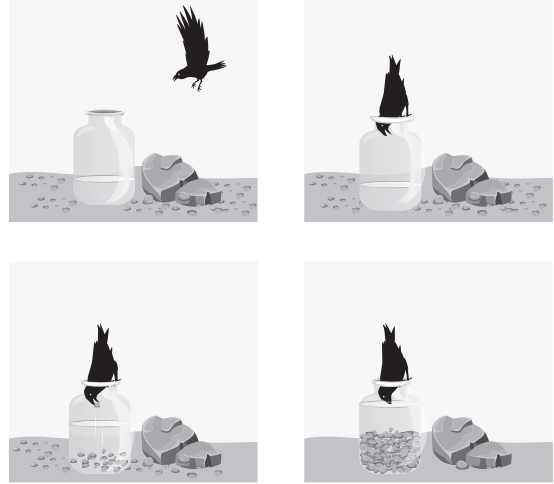


Name: Date: Period:

4

A thirsty crow wants to raise the level of water in a cylindrical container so that it can reach the water with its beak.

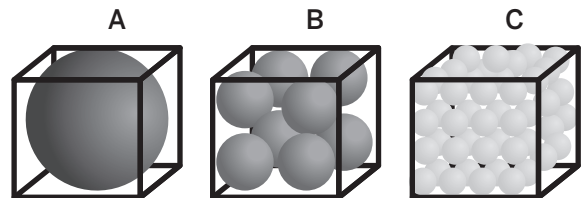
- The container has a diameter of 2 inches and a height of 9 inches.
- The crow needs to raise the water level from 6 inches to 8 inches in order to drink from it.



In order to raise the water level, the crow puts spherical pebbles in the container. If the pebbles are approximately $\frac{1}{2}$ inch in diameter, what is the fewest number of pebbles the crow needs to drop into the container in order to reach the water?

5

Here are three identical cubic tanks. The spheres in a given tank are the same size and packed wall-to-wall. If the tanks are filled to the top with water, which tank will hold the most water?



Name: Date: Period:

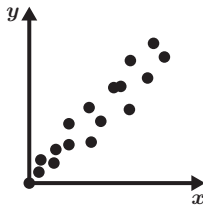
Student Choice

Start with any problem. Remember to show or explain your thinking.

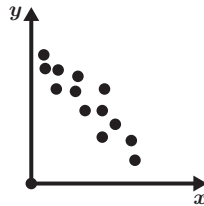
1

Here are different scatter plot diagrams.

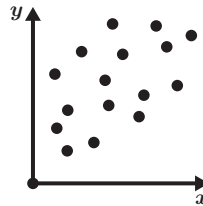
Scatter Plot A



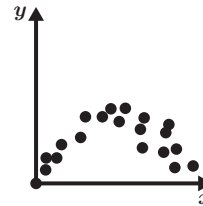
Scatter Plot B



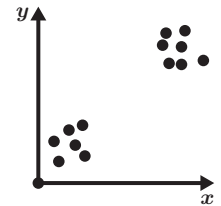
Scatter Plot C



Scatter Plot D



Scatter Plot E



Which scatter plot diagram would you expect to match each of the following?

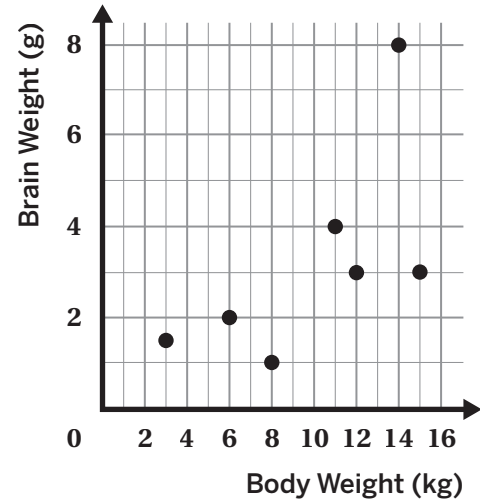
- a** The physical fitness of a dog and the physical fitness of the owner.
- b** Number of salespersons and total dollar sales for real estate firms.
- c** Age of a person and their working memory.
- d** Total payroll and percent of wins of national league baseball teams.
- e** The amount spent on a week of TV advertising and sales of a cola.
- f** The number of swim suits owned and the distance to the nearest swimming area.
- g** Weight and the amount of physical activity for a thirty-year-old.
- h** The amount of chit-chat and guests' ages at a five-year-old's birthday party.

Name: Date: Period:

2

The scatter plot shows the body weight and brain weight, in grams, of seven small animals.

- a Compare the points (3, 1.5) and (12, 3). Which body weight to brain weight ratio is larger?
- b Determine the average brain weight of the animals.
- c Determine the average body weight of the animals.
- d Circle the point that represents the animal with the smallest brain weight to body weight ratio.



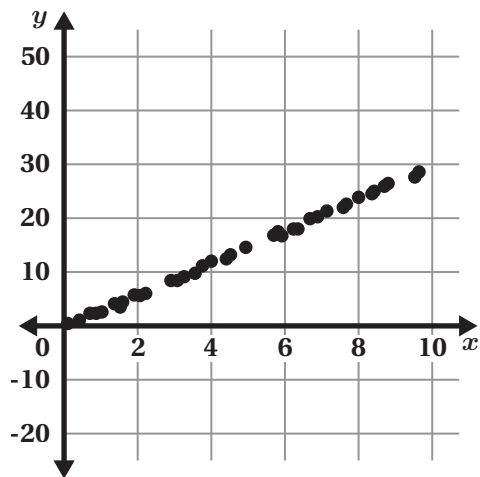
Name: Date: Period:

1

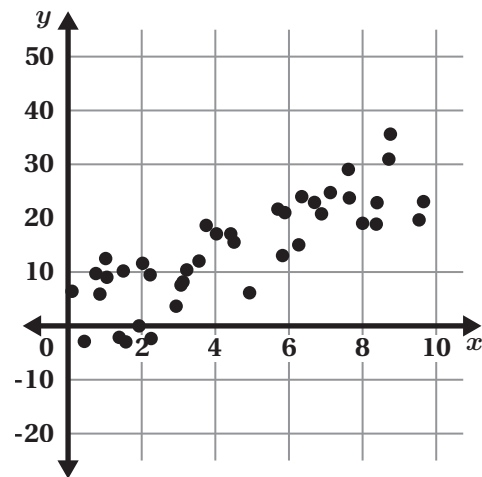
Each point on these scatterplots was created by randomly choosing an x -value between 0 and 10, then multiplying by 3 and adding a different random number to get the y -value.

- In Scatter Plot A, a random number between -0.5 and 0.5 was added to the y -coordinate.
- In Scatter Plot B, a random number between -8 and 8 was added to the y -coordinate.
- In Scatter Plot C, a random number between -20 and 20 was added to the y -coordinate.

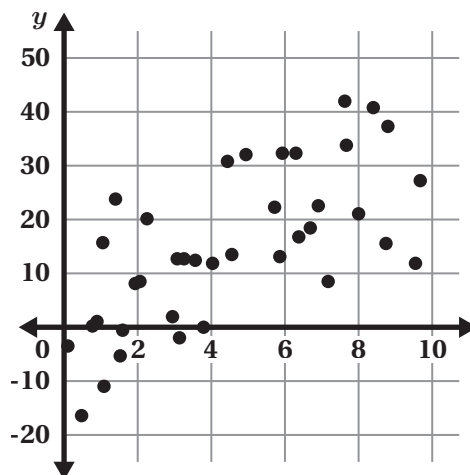
Scatter Plot A



Scatter Plot B



Scatter Plot C



- a For each scatter plot, draw a line that fits the data.

Name: Date: Period:

Student Choice

Start with any problem. Remember to show or explain your thinking.

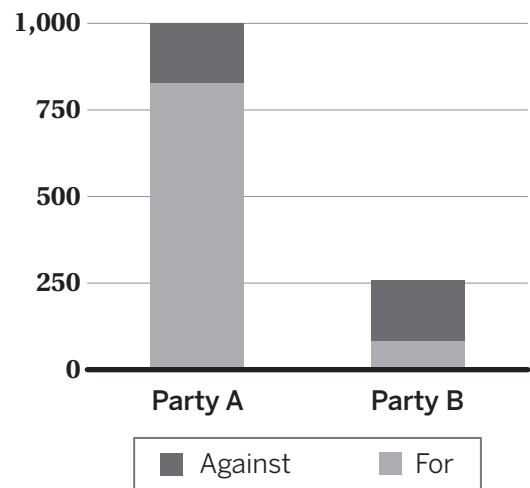
1

A pollster attends a rally and surveys many of the participants about whether they associate with political Party A or political Party B and whether they are for or against Proposition 3.14. The two-way table displays the results.

	For proposition	Against proposition
Party A	813	186
Party B	79	182

News Center One reports the results shown in the graph.

A different news station, NewsNewsNews, reports the results by saying, “A poll shows that about the same number of people from both parties are voting against Proposition 3.14.”



- a** Explain why both of the news reports are misleading. Why might a reporter want to use the misleading data display?
- b** Create a headline, graph, and short description that more accurately represents the data in the table.

Name: Date: Period:

2

The following table shows government budgets for 2009, in billions of U.S. dollars.

	United States	Japan	United Kingdom
Defense	718.4	42.8	49.2
Education	44.9	47.5	113.9

- a** Why would a segmented bar graph be more useful than the table of data to see any associations between the country and where government money is spent?

- b** Create a segmented bar graph that represents the data from the table.

- c** Is there an association between each country's budget and their spending in the areas of defense and education?

Name: Date: Period:

Student Choice

Start with any problem. Remember to show or explain your thinking.

1

The Tower of Hanoi was invented by the French mathematician Édouard Lucas in 1883. The rules of this famous puzzle are:

- Only one disk may be moved at a time.
- Only the uppermost disk can be moved from one of the stacks and to the top of another stack or on an empty rod.
- No disk may be placed on top of a disk that is smaller than it.



In 2 moves, you can transfer 2 disks to another tower. In 7 moves, you can transfer 3 disks to another tower.

What is the minimum number of moves to transfer all the disks to another tower without placing a larger disk onto a smaller disk?

2

Consider this statement, $2^{12} = 4096$. What other whole numbers can you raise to a power to equal 4096?

Name: Date: Period:

3

Without calculating, compare each pair of values to determine which value is greater.

- a 3^{400} or 4^{300}
- b π^{12} or 2^{25}
- c 2^{20} or 10^6

4

Here is a way of coding numbers using specific playing cards.

- a How are the numbers coded?
- b In *binary systems*, one can code situations like open and closed cards using 1 and 0. Ava writes 1111_2 for 15, 1101_2 for 13, and 1010_2 for 10. The subscript 2 is used to show that the number is coded in a binary system. How can Ava code 11 using binary coding?

15	
13	
10	

- c Compare the place value of the digits between the number system we use today (base-10) and the binary system (base-2).
- d Complete the table.

Base-10	26	
Base-2 (binary)		100010_2

Name: Date: Period:

Student Choice

Start with any problem. Remember to show or explain your thinking.

1

This problem requires multiple steps to solve. You may not know all the facts needed to solve the problem. You may also need to make some assumptions. That is okay — make a conjecture or estimate about anything that you do not know.

If everyone alive on Earth right now stood next to each other, how much area would they cover?

2

Humans tend to calculate with numbers using powers of 10, but computers calculate with numbers using powers of 2.

Binary System (Powers of 2)	
Binary kilobyte	2^{10} bytes
Binary megabyte	2^{20} bytes
Binary gigabyte	2^{30} bytes
Binary terabyte	2^{40} bytes

Decimal System (Powers of 10)	
Kilobyte (KB)	10^3 bytes
Megabyte (MB)	10^6 bytes
Gigabyte (GB)	10^9 bytes
Terabyte (TB)	10^{12} bytes

- a** Which is greater: a binary gigabyte or a regular gigabyte? How many more bytes is it?
- b** Which is greater: a binary terabyte or a regular terabyte?

Name: Date: Period:

3

Here is a table showing the speed of light in different mediums. In which medium does light travel the fastest? Slowest?

Medium	Speed
Air	2.99×10^8 m/s
Water	2.3×10^{10} cm/s
Ice	2.2×10^5 km/s
Glass	6.6×10^8 ft/s
Vacuum	3.0×10^8 m/s

4

The mass of the sun is 1.98×10^{33} grams. If a single proton has a mass of 1.6×10^{-24} grams, how many protons are in the sun?

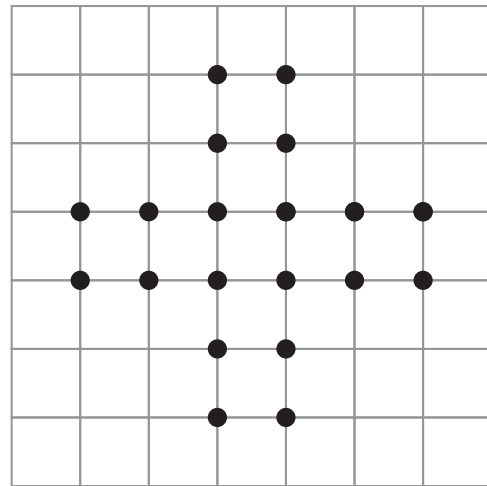
Name: Date: Period:

Student Choice

Start with any problem. Remember to show or explain your thinking.

1

- a** How many squares can you form by connecting any 4 points on this shape?
- b** How many different areas of squares can you form?

**2**

Determine the value of each expression.

a $\sqrt{1.21} - \sqrt{0.09} + \sqrt{0.25}$

b $\frac{\sqrt{1.44} - \sqrt{0.64}}{\sqrt{0.04}}$

c $\sqrt{14 + \sqrt{7 - \sqrt{1 + \sqrt{64}}}}$

d $\frac{\sqrt{6^2 + 8^2}}{\sqrt{5^2 + 12^2}}$

e $\sqrt{\frac{1}{24} \cdot \sqrt{\frac{1}{18} \cdot \sqrt{\frac{1}{4}}}}$

f $\sqrt{2 + \frac{1}{4}} - \sqrt{1 + \frac{7}{9}} + \sqrt{2 - \frac{8}{36}}$

Name: Date: Period:

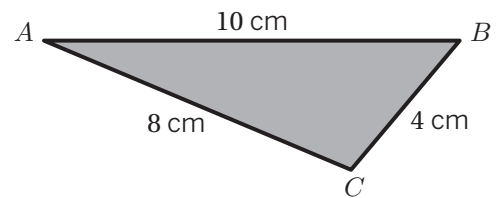
3

Heron of Alexandria, Egypt (60 B.C.E) derived a formula to determine the area of a triangle using only its side lengths. Here are his calculations with different triangles.

- a** For a triangle with side lengths a , b and c , can you figure out his formula?

Triangle	Half of the perimeter	Results of Heron's calculations	Area
$a = 3, b = 4, c = 5$	6	3, 2, 1	$\sqrt{6 \cdot 3 \cdot 2 \cdot 1} = 6$
$a = 8, b = 15, c = 17$	20	12, 5, 3	$\sqrt{20 \cdot 12 \cdot 5 \cdot 3} = 60$
$a = 7, b = 24, c = 25$	28	21, 4, 3	$\sqrt{28 \cdot 21 \cdot 4 \cdot 3} = 84$
a, b, c	s	_____, _____, _____	$\sqrt{s \cdot \dots\dots\dots}$

- b** Determine the area of triangle ABC .

**4**

According to a legend, the ancient city of Delos faced a terrible plague. An oracle told them the plague would go away if they built a new temple that was exactly twice the volume of the existing one. Delians doubled the edges of the temple, but the plague did not stop. Instead of doubling the side lengths of the temple, what should Delians do to stop the plague?

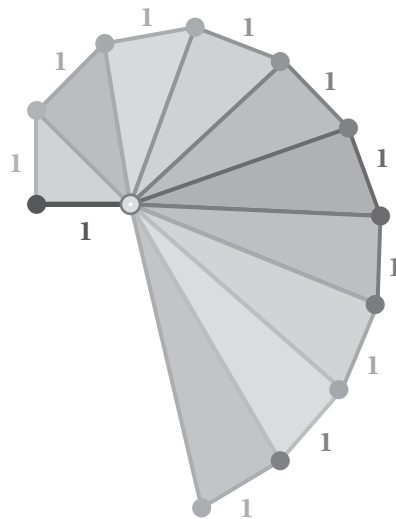
The Pythagorean Theorem

Name: Date: Period:

Student Choice Start with any problem. Remember to show or explain your thinking.**1**

Here is a shape made up of right triangles called the *Spiral of Theodorus*.

- Determine the length of each hypotenuse.
- What do you notice? What do you wonder?
- Measure the length of each hypotenuse to write the decimal approximation for each square root.

**2**

A *Pythagorean triple* consists of three positive integers a , b , and c , such that $a^2 + b^2 = c^2$. For example, (3, 4, 5) and (5, 12, 13) are Pythagorean triples. There are infinitely many Pythagorean triples and there are many different ways to determine them.

Can you find the relationship between side length a and side lengths b and c .

- When a is an odd positive integer?

a	3	5	7	9	11
b and c	4, 5	12, 13	24, 25	40, 41	60, 61

- When a is an even positive integer?

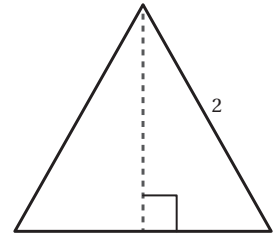
a	4	6	8	10	12
b and c	3, 5	8, 10	15, 17	24, 26	35, 37

Name: Date: Period:

3

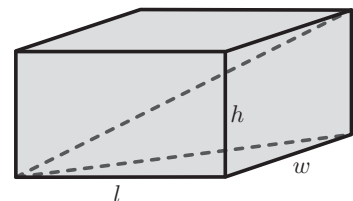
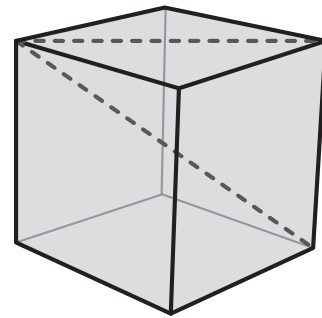
Here is an equilateral triangle. The length of each side is 2 units and the height is drawn. In an equilateral triangle, the height divides the opposite side into two pieces of equal length.

- a** Determine the exact height.
- b** Determine the area of the equilateral triangle.
- c** If a is the length of each side in the equilateral triangle, express its area in terms of a .

**4**

Determine the length of the solid diagonal (the line segment that connects two opposite vertices of the solid) of a cube . . .

- a** When the side length is 2 cm.
- b** When the side length is 5 cm.
- c** When the side length is a cm.
- d** Express the length of the solid diagonal of a rectangular prism in terms its length, l , width, w , and height, h .



Name: Date: Period:

Student Choice

Start with any problem. Remember to show or explain your thinking.

1

$\sqrt{1.\square\square}$ is a rational number. List *all* pairs of digits that would make the expression rational?

2

Give an example of a rational and an irrational number that is between the following numbers.

a 2 and 2.1

b 3.14 and 3.15

c $\frac{1}{7}$ and $\frac{2}{7}$

3

Estimate the value of $\sqrt[3]{75}$ to the nearest hundreds.

Name: Date: Period:

4

Luca knows how to convert repeating decimals such as $0.\overline{7}$, $0.\overline{52}$, or $0.\overline{125}$ to fractions easily.

$$0.\overline{7} = \frac{7}{9}$$

$$0.\overline{52} = \frac{52}{99}$$

$$0.\overline{125} = \frac{125}{999}$$

Here are more repeating decimals Luca wrote as fractions using the equations.

$0.0\overline{7} = \frac{7}{90}$	$0.1\overline{7} = \frac{16}{90}$	$0.3\overline{5} = \frac{32}{90}$	$0.00\overline{2} = \frac{2}{900}$
$0.01\overline{4} = \frac{14}{990}$	$0.\overline{25} = \frac{25}{990}$	$0.\overline{125} = \frac{124}{990}$	

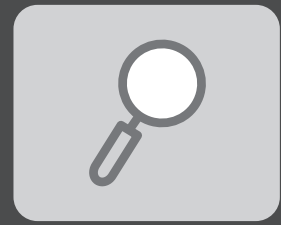
What do you notice? Can you find a relationship between the repeating and non-repeating digits of the decimal and the numerator and the denominator of the fraction?



Investigations

Investigation 1

Packing Spheres



Cylindrical Investigations Shape, Number, and Expressions 8.G.9, SMP.1

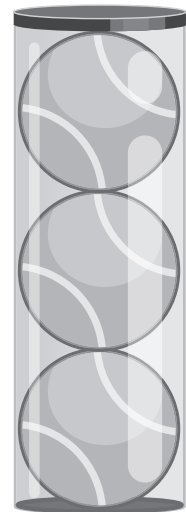
Task 1

Name: Date: Period:

Tennis Balls

Every day, companies make decisions about how they can package different items that they are selling. These pertain to cost, reducing waste, and maintaining the quality of the product (especially during transportation). Objects such as spheres can be a challenge because of the gaps created between the spheres.

Consider a package of three tennis balls packed snugly in a cylindrical container.



1. What are some mathematical questions that companies might have to consider when creating the container?
2. According to the International Tennis Federation, the maximum diameter of a tennis ball is 2.7 inches. What is the volume of 1 tennis ball? Explain your thinking.



Task

2

Name: Date: Period:

Designing a Container

Your group will use 5 spheres of the same size to complete this task.

1. Design a container that you could use to pack your spheres. Sketch the container and the arrangement of how to package the spheres. Include measurements of the dimensions.



Task

3

Name: Date: Period:

Gallery Tour

You will now communicate the results of your Investigation.

Your group will prepare a poster about the results of your Investigation and participate in a Gallery Tour.

Use the **Display Checklist Sheet** if you find it helpful.

Display Checklist

Use this checklist to help you plan and organize your poster. You should include these items. Check them off as you complete them.

Design Sketches

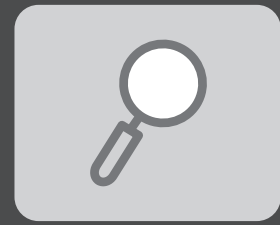
- Sketch of container and arranged spheres
- Measurements and units labeled

Calculations

- Determines volume of container
- Determines volume of spheres
- Determines empty space of container
- Determines percent of container filled with spheres

Investigation 2

The Ozone Layer Over Time



Interpret Scatter Plots Data Explorations 8.SP.1, 8.SP.2, 8.F.5, SMP.1, SMP.4

Name: Date: Period:

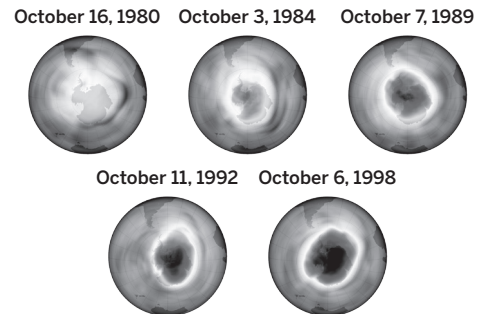
We need your help! The ozone layer is in trouble!

The ozone layer is a layer of ozone gas in the stratosphere that absorbs most of the Sun's UV radiation and acts as an invisible shield. Ozone protects the Earth and human well being from being exposed to the Sun's ultraviolet (UV) radiation.

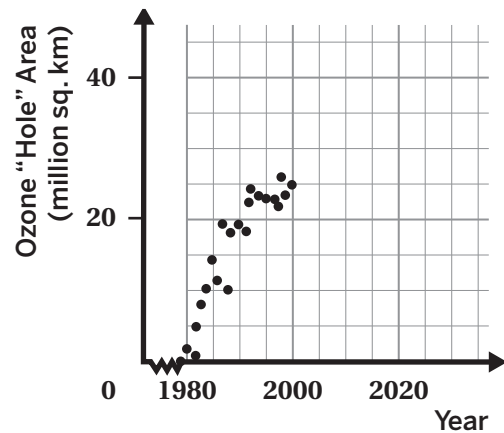
In the 1980s, scientists found some areas of the ozone were much thinner than others and called them "holes" (the darker spots). The graph shows the largest ozone "hole" area from 1979–2000. It was discovered that as the size of these ozone "holes" increase, the less protection we have from ultraviolet radiation.

Health care scientists have found increased UV exposure due to ozone depletion has been linked to health risks such as skin cancer, cataracts, and immune suppression.

In this investigation, we need your help analyzing data to see how the ozone layer interacts with the Earth and the human race.



"World of Change: Ozone Hole." Nasa Earth Observatory



Reflect and Predict

- What do you notice about the graph of the ozone "hole" area?
- What additional data would be helpful to investigate whether the ozone layer could be related to someone's health?
- If these trends continue, what do you think the ozone "hole" area will be in 2030?



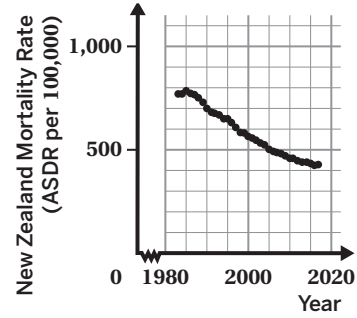
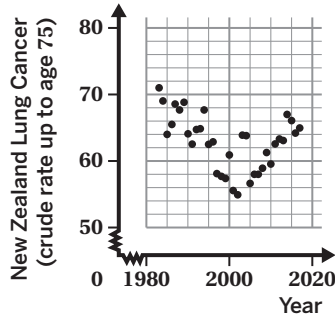
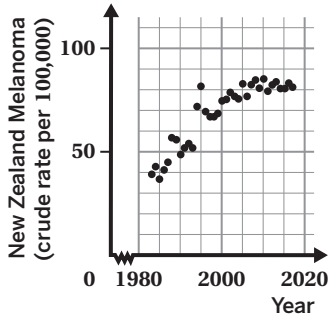
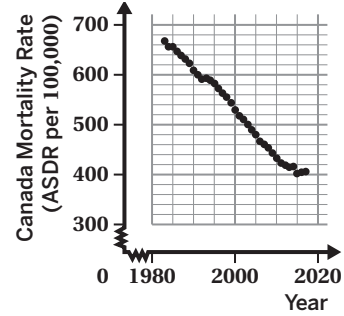
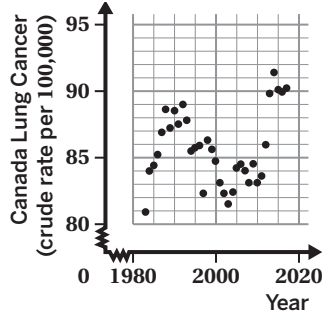
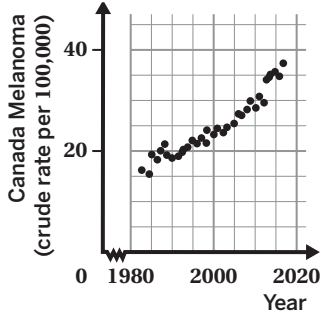
Task

Name: Date: Period:

1

Analyzing Data

1. Here are some scatter plots.



Data Talk! What do you notice about the data? What do you wonder?

I notice:

I wonder:





Task

1

Name: Date: Period:

Analyzing Data (continued)

Health care scientists want to conduct preliminary research between ozone “hole” size and a person's health. They decide to compare the ozone “hole” size and a person's health 5 years later from 1979 to 1996. Your group will be given one data set to further explore and analyze.

2. Create a scatter plot of the data.
3.  **Discuss:** How does your graph compare to the graph showing the year and ozone “hole” area on Page 1?
4.  **Data Talk!** Discuss the following:
 - What do you notice about the data you plotted? What do you wonder?
 - Are there associations between the variables? If yes, what are the types of associations?
 - Are there any outliers in your data? What does this point represent in context?
5. Pick one point. What are the coordinates of this point? What does this point represent in context?
6. Draw a line of fit for the data. Can your line of fit be used to make reasonable predictions? Explain your thinking.



Task

2

Name: Date: Period:

Gallery Tour

Part 1

1. Your group will prepare a poster or infographic about the results of your Investigation and participate in a Gallery Tour.

Use the **Display Checklist Sheet** if you find it helpful.

Part 2

2. While health care scientists would need to complete more research to investigate whether there is a connection or direct cause between ozone “hole” size and a person’s health, which graphs do you think they would find helpful in their preliminary research? Explain your thinking.



Task

3

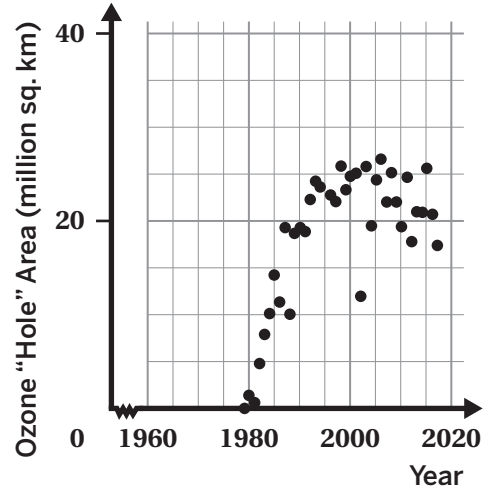
Name: Date: Period:

Decisions and Protocols

- 1. This graph shows the ozone “hole” size from 1979–2017. What do you notice? What do you wonder?

I notice:

I wonder:



- 2. You will be given additional data for the ozone “hole” size and a person’s health 5 years later from 1997 to 2013. Plot the data using a different color on the same graph from Task 1.
- 3. Does the additional data change your thinking about the possible connections between the ozone “hole” area and a person’s health? Explain your thinking.



Task

3

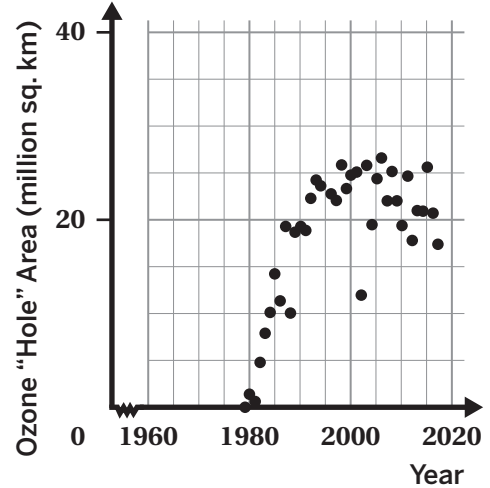
Name: Date: Period:

Decisions and Protocols (continued)

4. In 1987, nearly 200 countries, including the United States, agreed to take action and protect the ozone layer. The goal of their international treaty called the Montreal Protocol, was to limit and eliminate Ozone-depleting substances (ODS).

This graph shows ODS emissions from 1979–2013.

Discuss: Does this graph seem to support the actions taken to limit harmful emissions? Explain your thinking.



Connecting to Your Community Think about your community or its surrounding area.

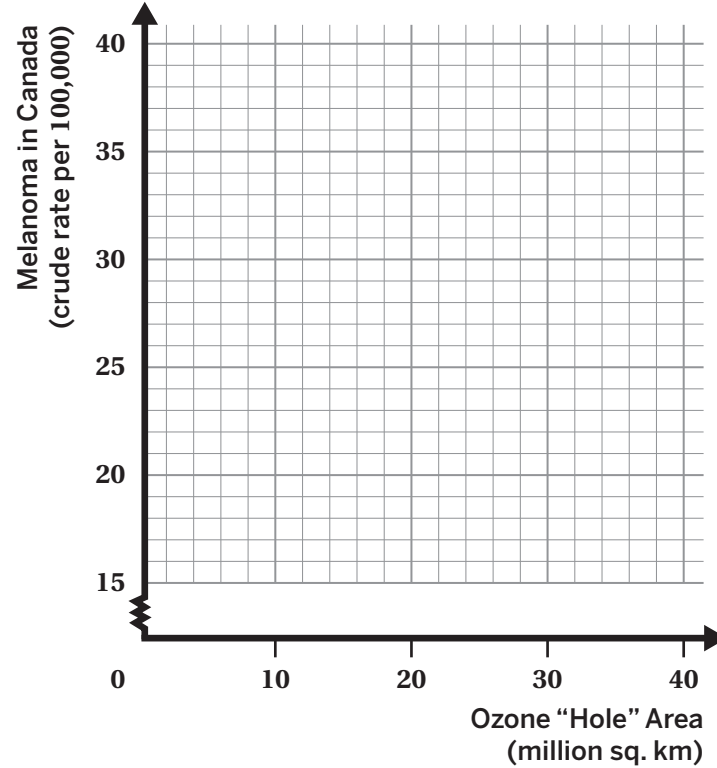
Investigate your area. Here are some questions that may inspire your investigation. Or think of your own questions!

- What other environmental problems might be harmful for human health? How can your school or community help with this problem?
- Can you recall any other problems in your community that were successfully addressed through collaboration?

Analyzing Data

Data Set A: Ozone “Hole” Area and Melanoma in Canada

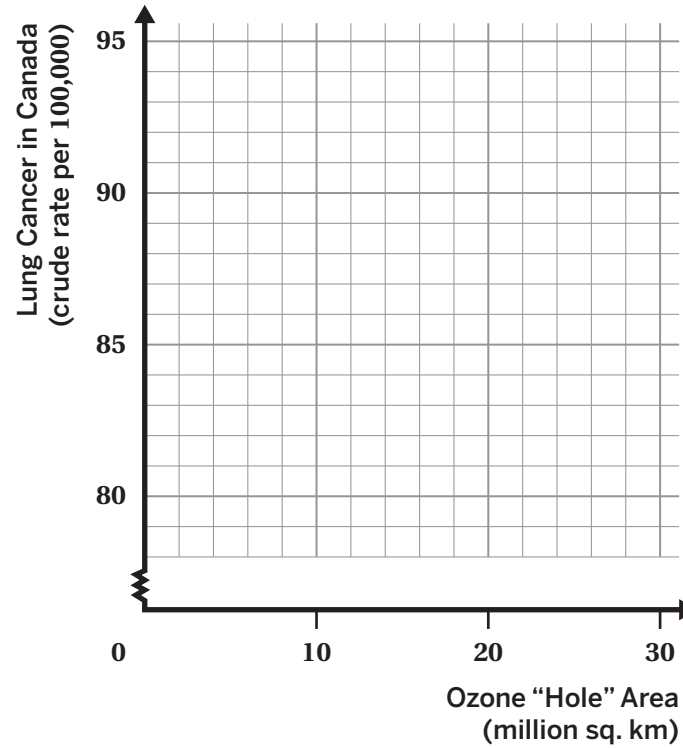
Ozone “Hole” Area (million sq. km)	Melanoma in Canada (crude rate per 100,000)
0.1	15.6
1.4	19.1
0.6	17.9
4.8	20.2
7.9	21.2
10.1	19.3
14.2	19.0
11.3	19.1
19.3	19.8
10.0	20.0
18.7	20.5
19.2	21.9
18.8	21.5
22.3	22.3
24.2	21.5
23.6	23.7
22.8	23.4



Analyzing Data

Data Set B: Ozone "Hole" Area and Lung Cancer in Canada

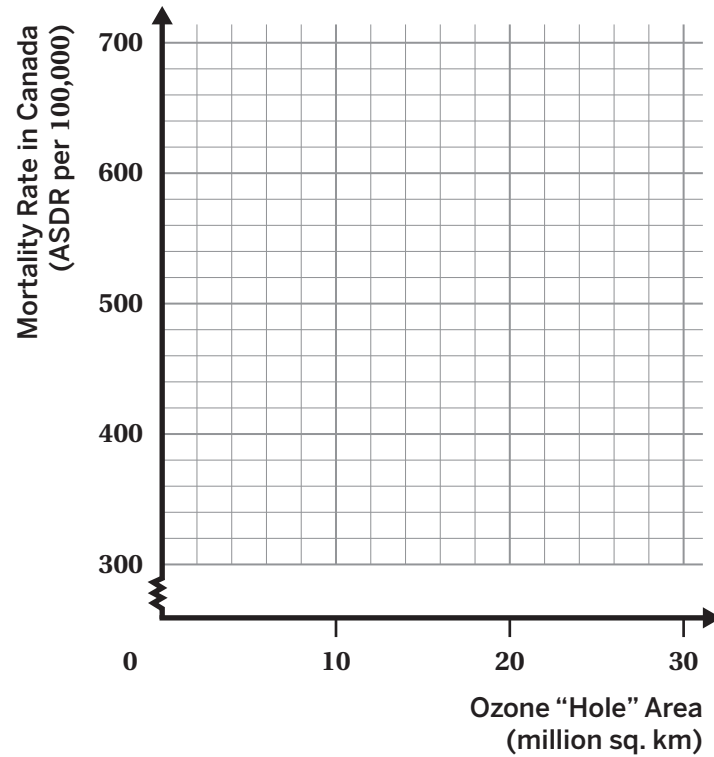
Ozone "Hole" Area (million sq. km)	Lung Cancer in Canada (crude rate per 100,000)
0.1	84.0
1.4	84.4
0.6	85.2
4.8	86.9
7.9	88.6
10.1	87.2
14.2	88.5
11.3	87.5
19.3	89.0
10.0	87.8
18.7	85.5
19.2	85.7
18.8	85.9
22.3	82.3
24.2	86.3
23.6	85.6
22.8	87.7



Analyzing Data

Data Set C: Ozone "Hole" Area and Mortality Rate in Canada

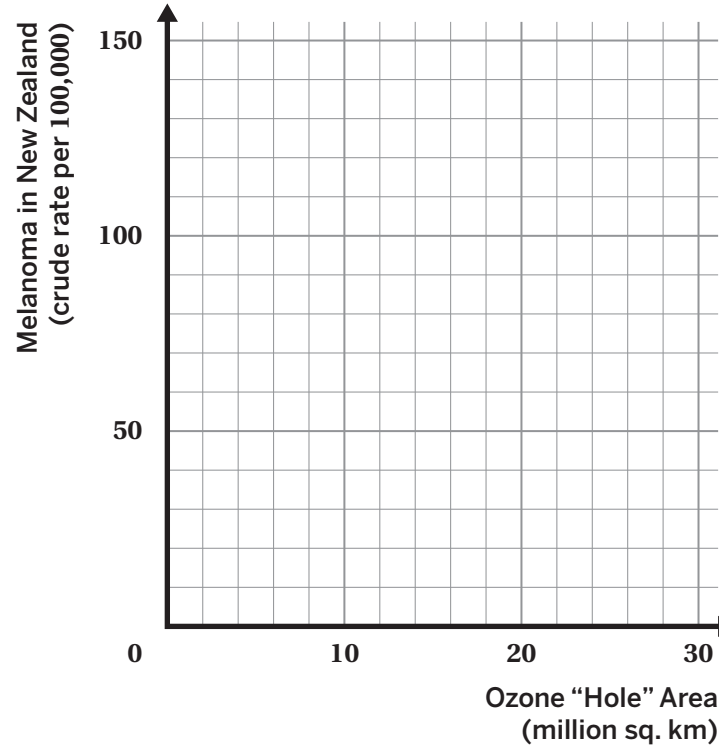
Ozone "Hole" Area (million sq. km)	Mortality Rate in Canada (ASDR per 100,000)
0.1	656.2
1.4	656.3
0.6	647.5
4.8	638.4
7.9	630.8
10.1	622.0
14.2	608.4
11.3	599.0
19.3	591.8
10.0	592.4
18.7	587.6
19.2	581.8
18.8	572.0
22.3	563.0
24.2	555.0
23.6	544.2
22.8	528.7



Analyzing Data

Data Set D: Ozone “Hole” Area and Melanoma in New Zealand

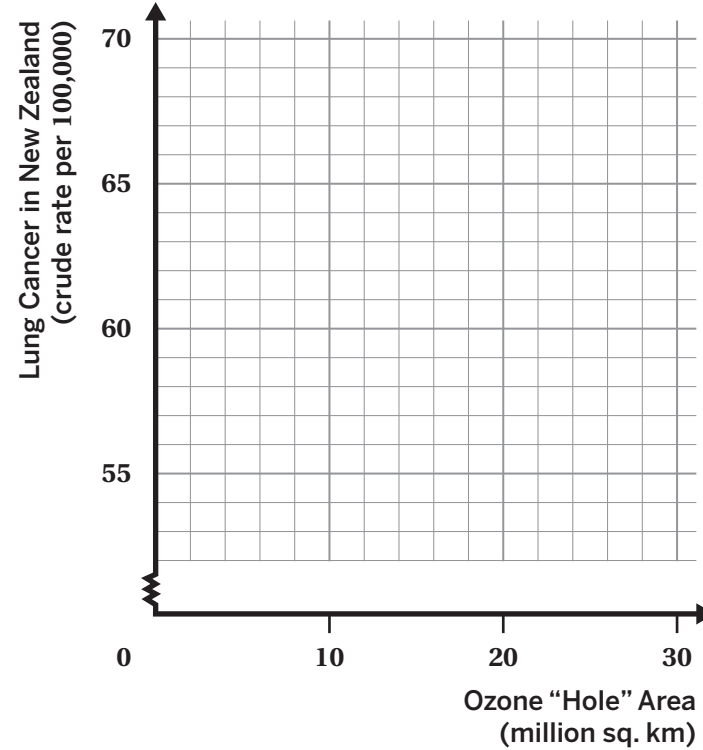
Ozone “Hole” Area (million sq. km)	Melanoma in New Zealand (crude rate per 100,000)
0.1	42.6
1.4	36.3
0.6	41.0
4.8	44.8
7.9	56.5
10.1	55.4
14.2	48.3
11.3	51.7
19.3	53.9
10.0	51.4
18.7	71.4
19.2	81.1
18.8	69.0
22.3	66.4
24.2	66.6
23.6	68.1
22.8	74.1



Analyzing Data

Data Set E: Ozone "Hole" Area and Lung Cancer in New Zealand

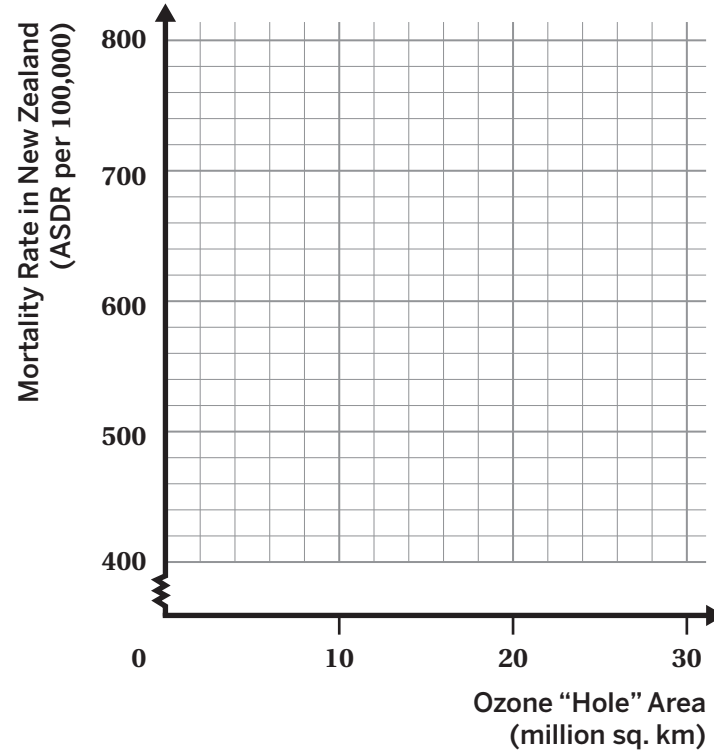
Ozone "Hole" Area (million sq. km)	Lung Cancer in New Zealand (crude rate per 100,000)
0.1	69.0
1.4	64.0
0.6	65.5
4.8	68.5
7.9	67.6
10.1	68.8
14.2	64.2
11.3	62.6
19.3	64.8
10.0	64.9
18.7	67.7
19.2	62.6
18.8	62.8
22.3	58.2
24.2	57.7
23.6	57.4
22.8	61.0




Analyzing Data

Data Set F: Ozone “Hole” Area and Mortality Rate in New Zealand

Ozone “Hole” Area (million sq. km)	Mortality Rate in New Zealand (ASDR per 100,000)
0.1	768.1
1.4	784.6
0.6	771.3
4.8	764.9
7.9	749.5
10.1	726.7
14.2	700.8
11.3	680.8
19.3	674.8
10.0	666.3
18.7	649.6
19.2	647.2
18.8	631.0
22.3	608.5
24.2	583.2
23.6	580.1
22.8	563.1



Additional Data Cards

 **Directions:** Make enough copies so that each group receives one data set. Then pre-cut the cards and give each group one card.

Data Set A: Ozone “Hole” Area and Melanoma in Canada Additional Data

Ozone “Hole” Area (million sq. km)	Melanoma in Canada (crude rate per 100,000)
22.1	24.2
25.9	23.7
23.3	24.4
24.8	24.5
25.0	25.4
12.0	27.0
25.8	27.0
19.5	28.0
24.4	29.6
26.6	28.3
22.0	30.4
25.2	29.4
22.0	34.2
19.4	34.6
24.7	35.2
17.8	34.4
21.0	37.0

Data Set B: Ozone “Hole” Area and Lung Cancer in Canada Additional Data

Ozone “Hole” Area (million sq. km)	Lung Cancer in Canada (crude rate per 100,000)
22.1	83.1
25.9	82.3
23.3	81.5
24.8	82.4
25.0	84.2
12.0	84.5
25.8	84.0
19.5	83.1
24.4	84.5
26.6	83.1
22.0	83.6
25.2	85.9
22.0	89.8
19.4	91.4
24.7	90.1
17.8	90.0
21.0	90.2

Additional Data Cards (continued)**Data Set C: Ozone “Hole” Area and Mortality Rate in Canada Additional Data**

Ozone “Hole” Area (million sq. km)	Mortality Rate in Canada (ASDR per 100,000)
22.1	517.4
25.9	509.6
23.3	501.2
24.8	490.1
25.0	480.4
12.0	467.3
25.8	461.3
19.5	453.6
24.4	443.1
26.6	433.3
22.0	423.6
25.2	419.1
22.0	415.8
19.4	415.8
24.7	403.3
17.8	405.1
21.0	406.4

Data Set D: Ozone “Hole” Area and Melanoma in New Zealand Additional Data

Ozone “Hole” Area (million sq. km)	Melanoma in New Zealand (crude rate per 100,000)
22.1	75.1
25.9	78.4
23.3	76.4
24.8	75.3
25.0	82.4
12.0	76.3
25.8	82.0
19.5	84.3
24.4	80.3
26.6	84.8
22.0	78.9
25.2	81.9
22.0	83.4
19.4	80.3
24.7	80.4
17.8	82.9
21.0	80.7

Additional Data Cards (continued)**Data Set E: Ozone “Hole” Area and Lung Cancer in New Zealand Additional Data**

Ozone “Hole” Area (million sq. km)	Lung Cancer in New Zealand (crude rate per 100,000)
22.1	55.6
25.9	54.9
23.3	63.9
24.8	63.8
25.0	56.6
12.0	58.0
25.8	58.0
19.5	58.9
24.4	61.3
26.6	59.5
22.0	62.6
25.2	63.3
22.0	63.1
19.4	67.0
24.7	66.1
17.8	64.2
21.0	65.0

Data Set F: Ozone “Hole” Area and Mortality Rate in New Zealand Additional Data

Ozone “Hole” Area (million sq. km)	Mortality Rate in New Zealand (ASDR per 100,000)
22.1	556.6
25.9	645.2
23.3	532.2
24.8	520.6
25.0	502.4
12.0	492.3
25.8	486.1
19.5	480.4
24.4	469.0
26.6	457.2
22.0	457.5
25.2	446.8
22.0	436.8
19.4	437.2
24.7	432.0
17.8	423.9
21.0	425.5

Name: Date: Period:

Display Checklist

Use this checklist to help you plan and organize your poster. You should include these items. Check them off as you complete them.

- Table of your data.
- Scatter plot of your data with line of fit drawn.
- Indicate any potential associations between the variables.
- Indicate any potential outliers and what they mean in context.
- Description of a point in context.