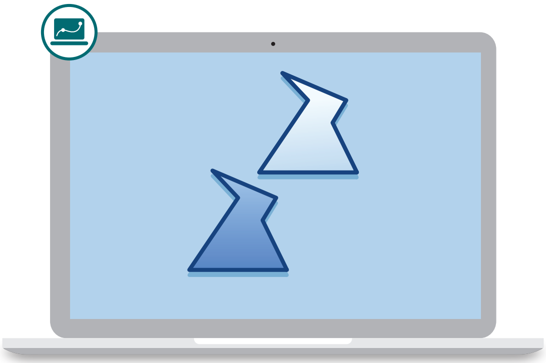
Unit 1
Lesson
2

Name: ______ Date: ______ Period: ______



Spinning, Flipping, Sliding

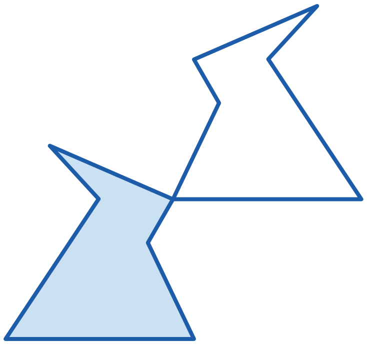
Let's learn some ways to describe how figures move.

Warm-Up

1 Annika created this shaded figure in the previous lesson.

Let's watch a video of a **transformation**.

What happened to the figure?



Activity 1

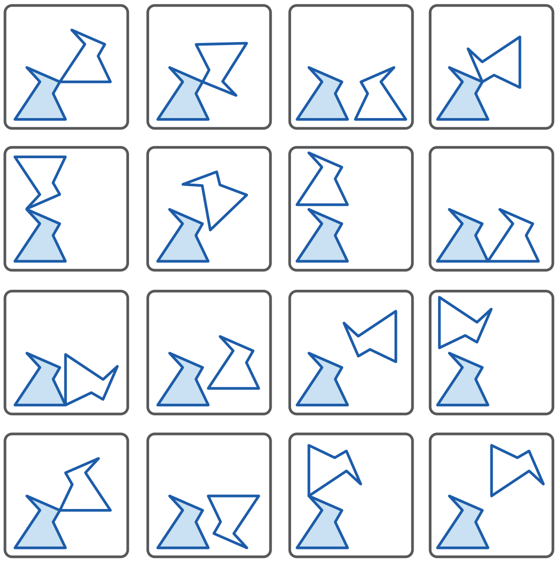
Name: .... Date: .... Period: ....

Describing Transformations

2 Play a few rounds of Polygraph with your classmates!

You will use an Activity 1 Sheet with different *transformation* images for four rounds. For each round:

- You and your partner will take turns being the Picker and the Guesser.
- Picker: Select an image from the Activity 1 Sheet. Keep it a secret!
- Guesser: Ask the Picker yes-or-no questions, eliminating images until you're ready to guess which image the Picker chose.



Record helpful questions from each round in this workspace:

Activity
1

Name: ____________ Date: ____________ Period: ____________

Describing Transformations (continued)

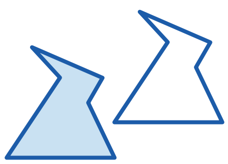
In Polygraph, you saw three types of transformations: **rotations**, **reflections**, and **translations**.

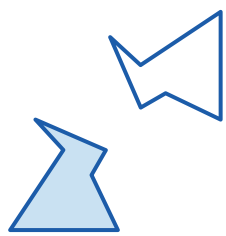
3 Match each word with one of these transformations.

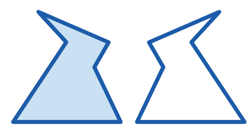
Flip	Mirror	Slide	Spin	Turn

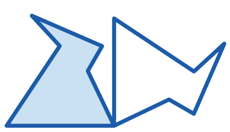
Rotation	Reflection	Translation

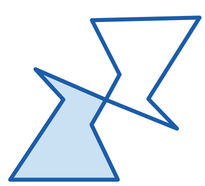
4 For each picture, circle the word that best describes how one figure can move onto the other in a single transformation.

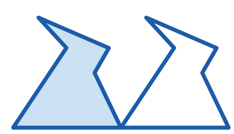
a

Rotation Reflection
Translation

b

Rotation Reflection
Translation

c

Rotation Reflection
Translation

d

Rotation Reflection
Translation

e

Rotation Reflection
Translation

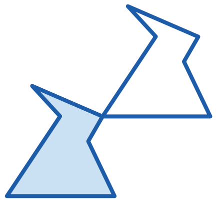
f

Rotation Reflection
Translation

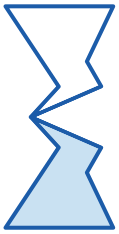
Activity 2

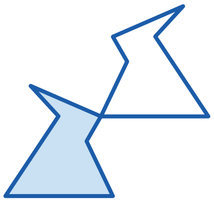
Name: ______ Date: ______ Period: ______

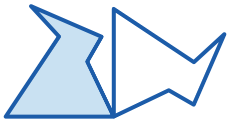
Rotations, Reflections, Translations

5 Circle an image. Then describe how to move the shaded figure onto the unshaded one. Use at least one of these words in your description: *reflection*, *rotation*, *translation*.

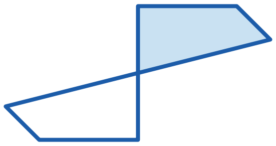
A. 

B. 

C. 

D. 

6 Mar says you can use one *reflection* to move the shaded figure onto the unshaded one.



Dyani says you can use *one rotation*.

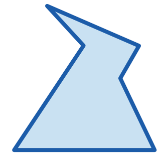
Whose claim is correct? Circle one.

Mar's Dyani's Both Neither

Explain your thinking.

7 Synthesis

In your own words, describe what each *transformation* does to a figure.



Rotation:

Reflection:

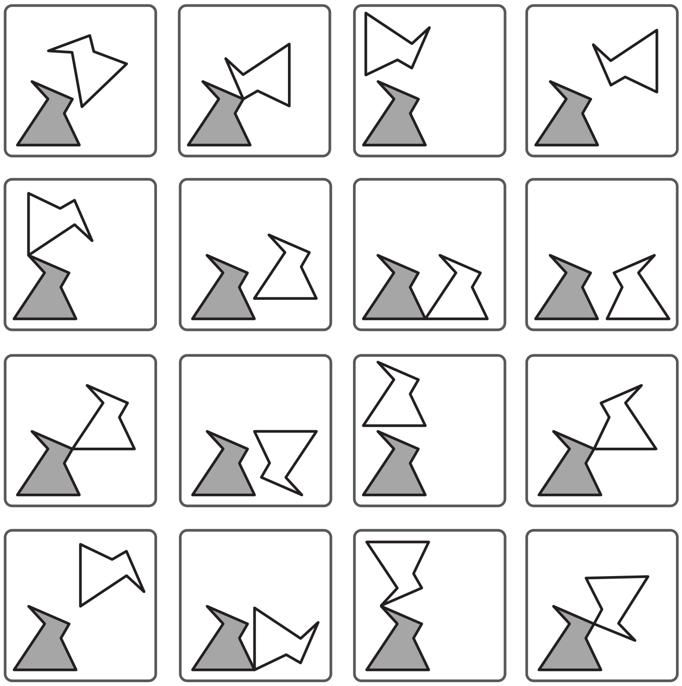
Translation:

Things to Remember:

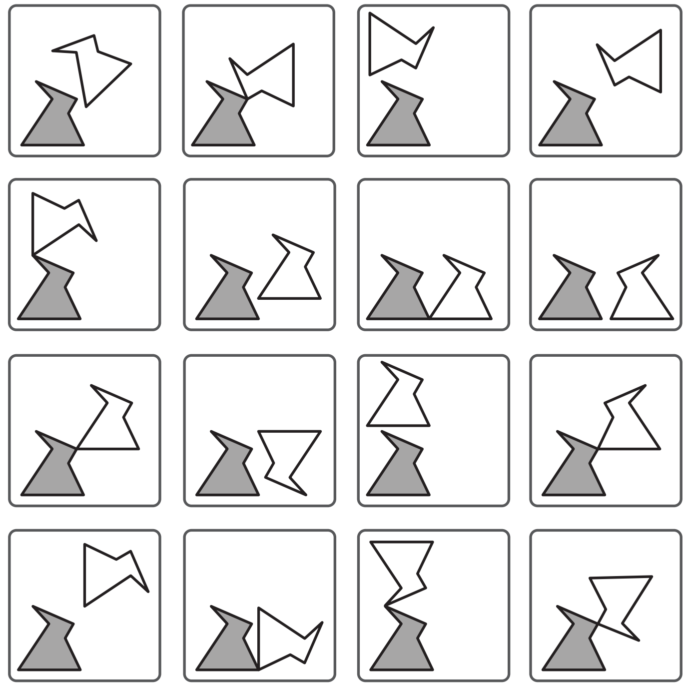
Name: ______________ Date: ______________ Period: ______________

Polygraph Set A

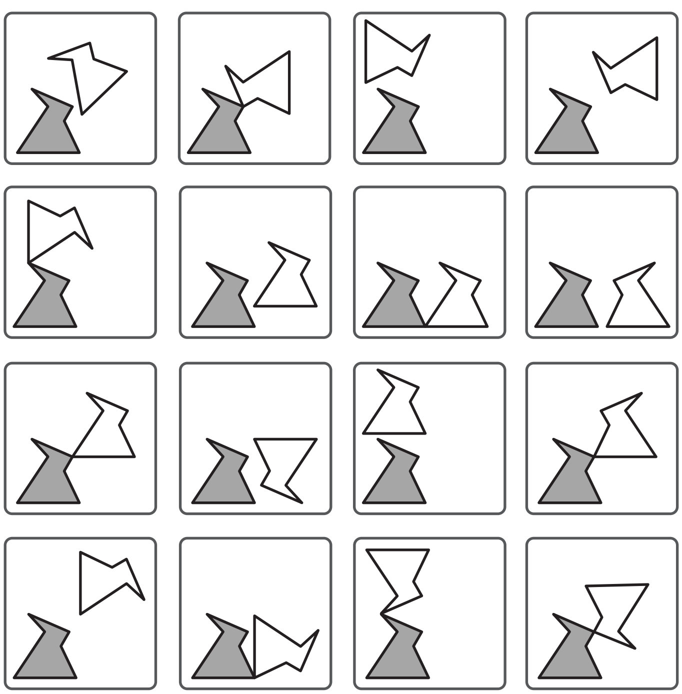
Round 1



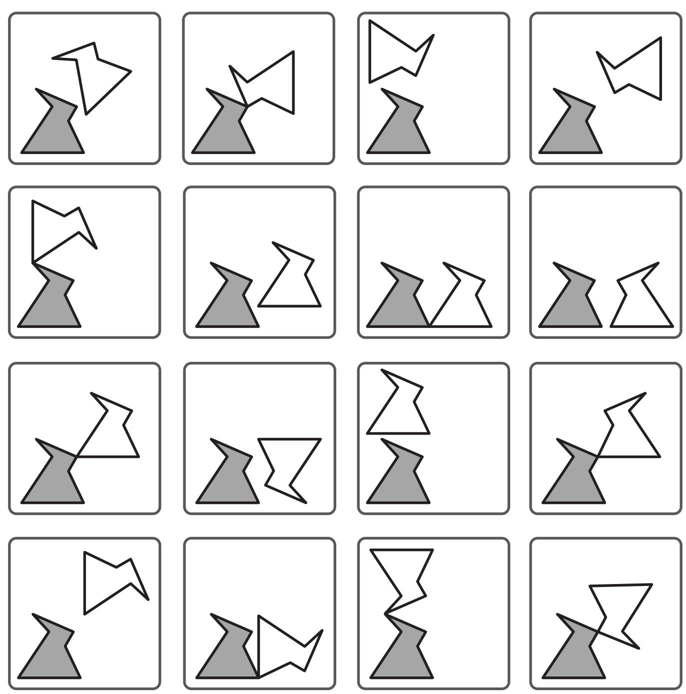
Round 2



Round 3



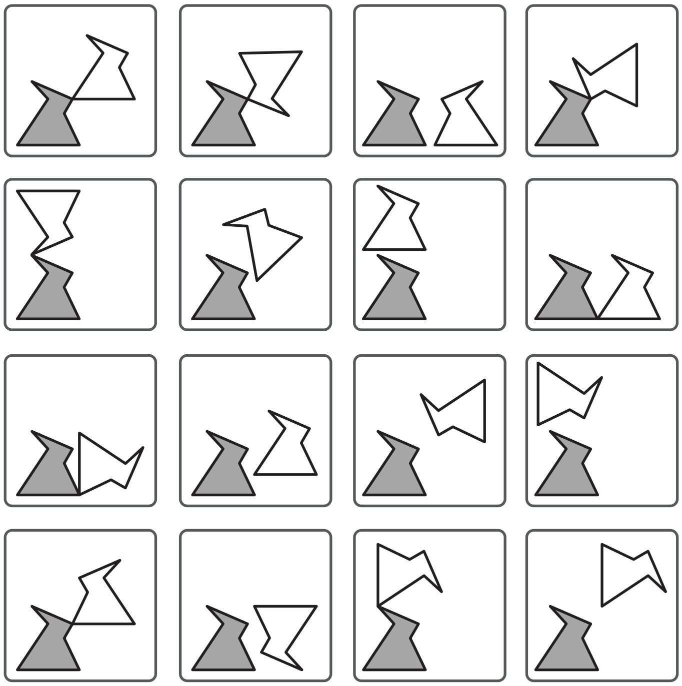
Round 4



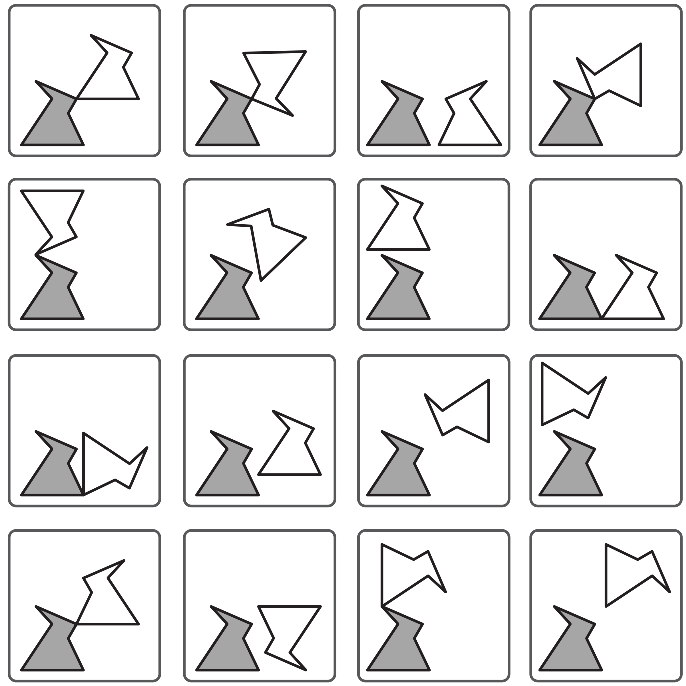
Name: ______________ Date: ______________ Period: ______________

Polygraph Set B

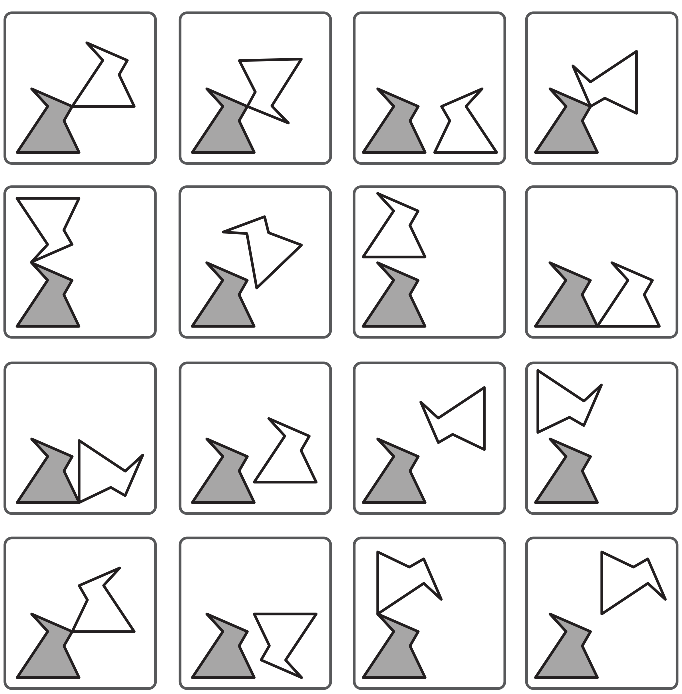
Round 1



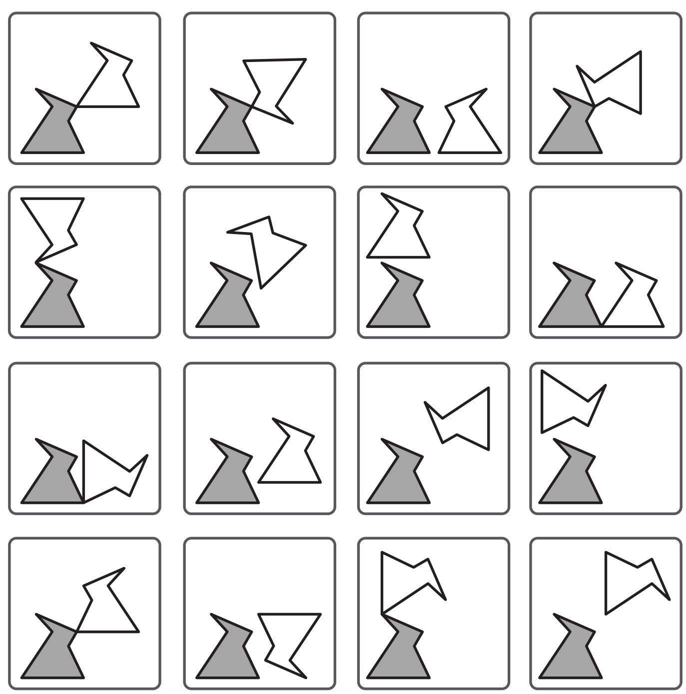
Round 2



Round 3

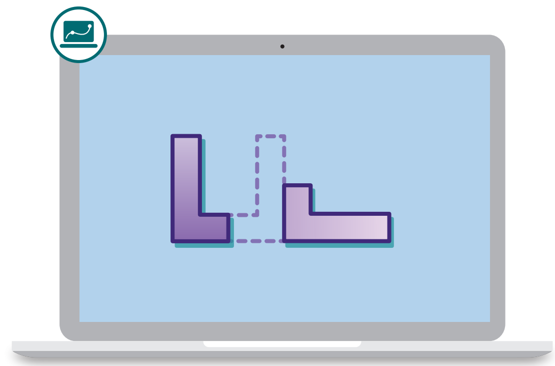


Round 4



Unit 1
Lesson
3

Name: ______ Date: ______ Period: ______



Transformation Targets

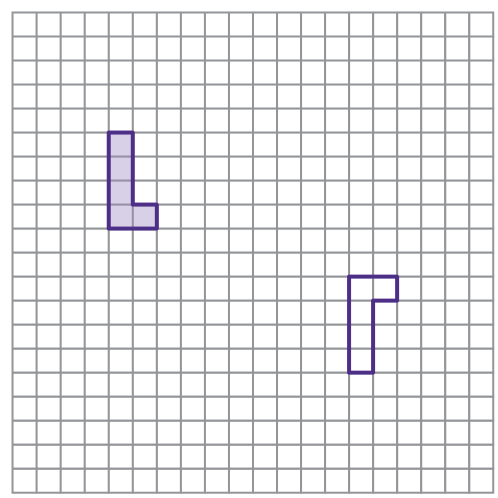
Let's explore sequences of transformations.

Warm-Up

1 We have previously seen three types of transformations: translation, rotation, and reflection.

a Let's watch the shaded figure move onto the unshaded figure.

b Describe the **sequence of transformations** you saw.

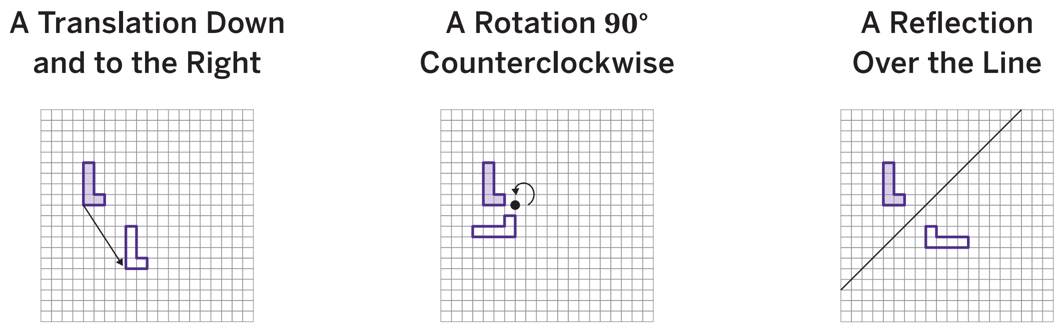


Activity 1

Name: ______ Date: ______ Period: ______

Transformation Targets

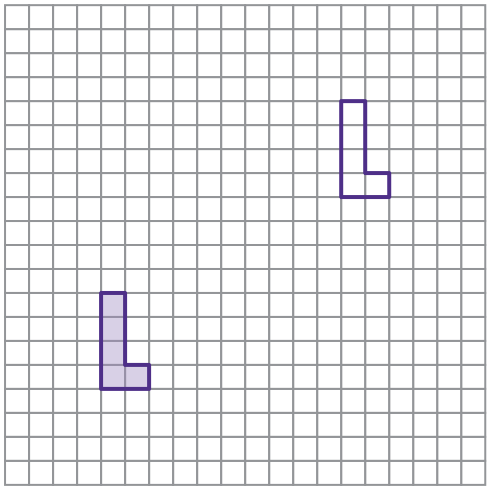
Take a look at examples of a translation, rotation, and reflection.



You will solve a variety of challenges. For each challenge:

- Show or describe a *sequence of transformations* that moves the shaded figure onto the unshaded figure.
- If it's helpful, draw the new figure after *each* transformation.
- Try to use two or fewer transformations.

2 Challenge #1



3 Let's look at the different translations Ama and Basheera used on the previous challenge. Whose translation is correct? Circle one.

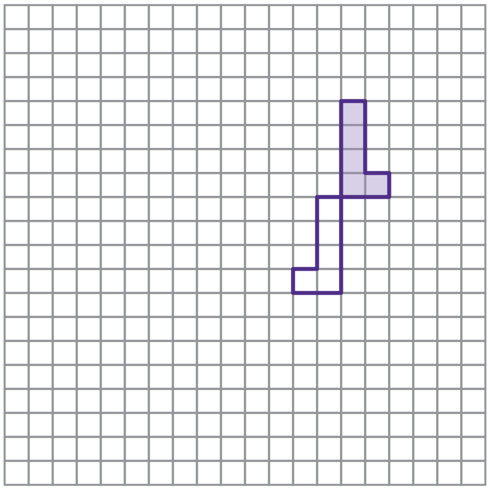
Ama's Basheera's Both Neither

Explain your reasoning.

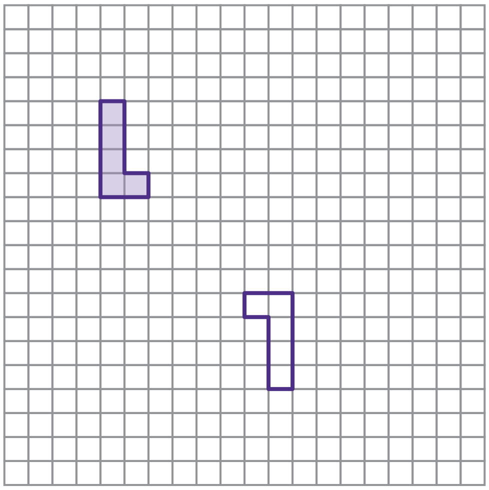
Name: .... Date: .... Period: ....

Sequences of Transformations

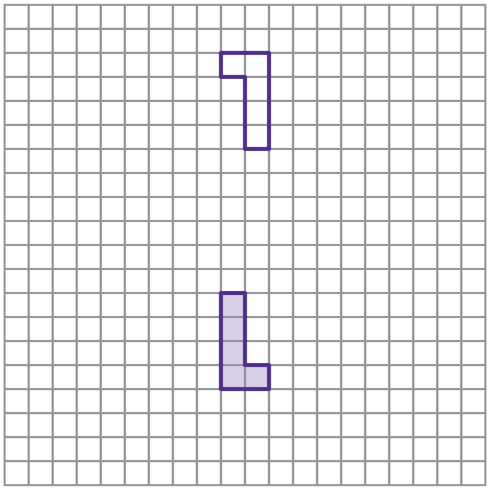
4 Challenge #2



5 Challenge #3



6 Describe a sequence of transformations to complete this challenge.



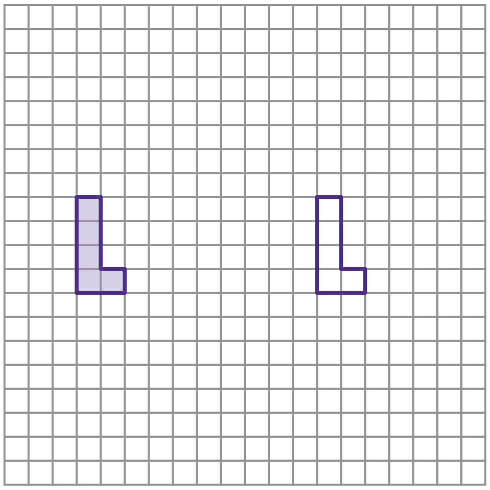
Activity
3

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

More Transformation Targets

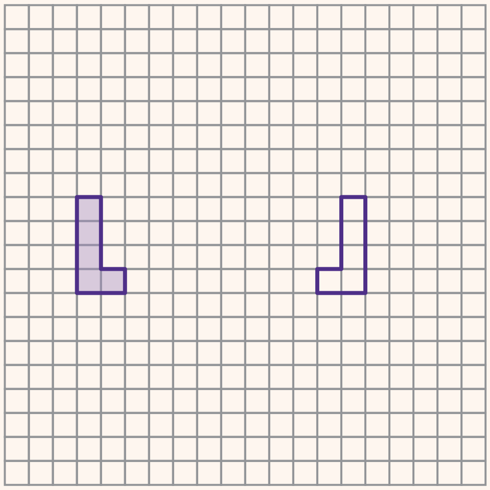
7 Let's try a sequence of transformations for the previous challenge.

8 Challenge #4: Try to solve this challenge using only rotations or only reflections.



Explore More

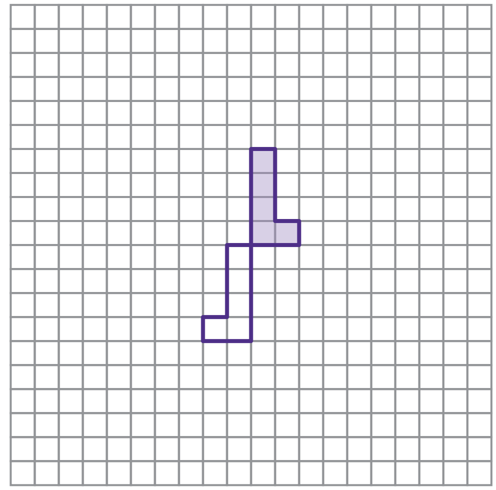
9 **Discuss:** Is it possible to solve this challenge using only translations and rotations? Explain your thinking.



10 Synthesis

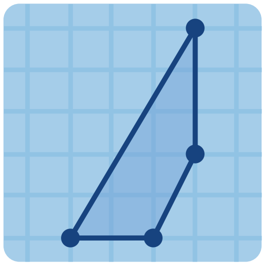
Describe some strategies to determine a sequence of transformations to move a shaded figure onto an unshaded figure.

Use the example if it helps with your thinking.



Things to Remember:

Name: ____________ Date: ________ Period: ________

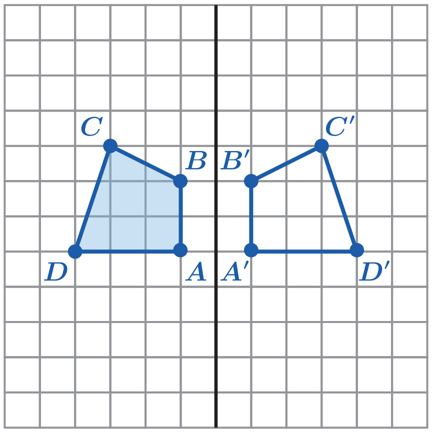


Moving Day

Let's do transformations by hand.

Warm-Up

1. Here is a transformation. The **pre-image** is shaded and the **image** is unshaded.



What do you notice? What do you wonder?

I notice:

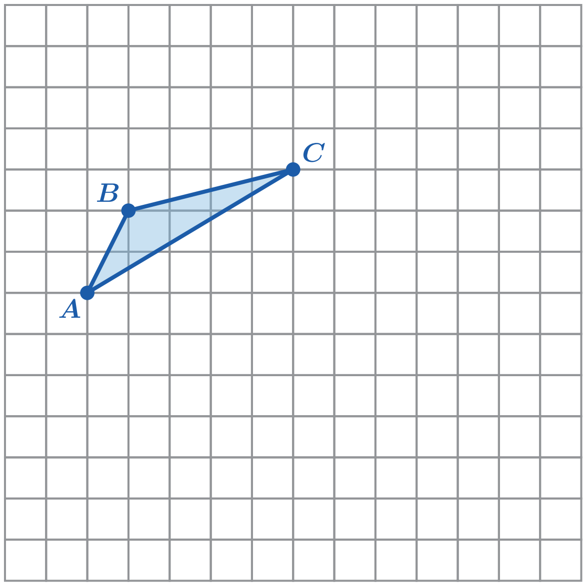
I wonder:

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

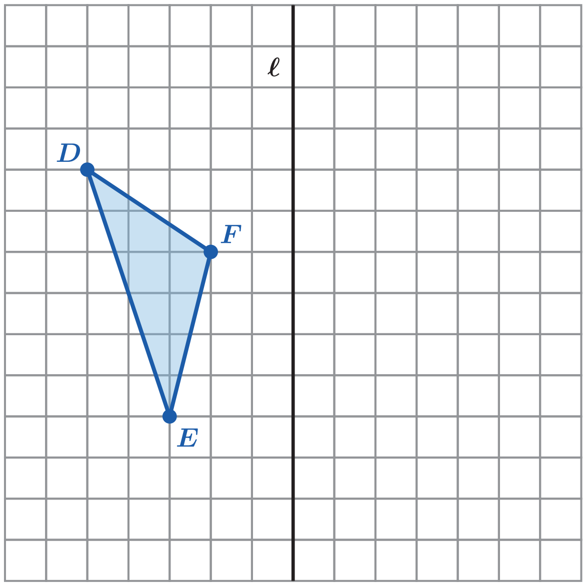
Move It

Perform each transformation. Then label the points in the image to **correspond** with the points in the pre-image.

2. Translate triangle ABC 3 units right and 1 unit down.



3. Reflect triangle DEF over line ℓ.

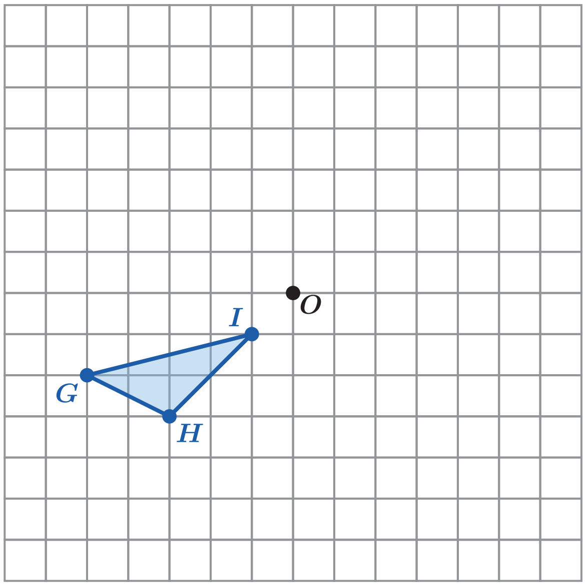


Activity 1

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

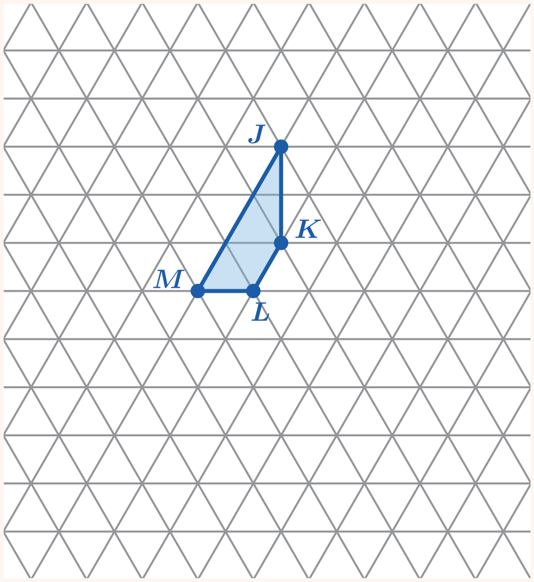
Move It (continued)

4. Rotate triangle GHI $180°$ counterclockwise around point O.



Explore More

5. Rotate figure $JKLM$ $180°$ clockwise around point L.



Activity
2

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

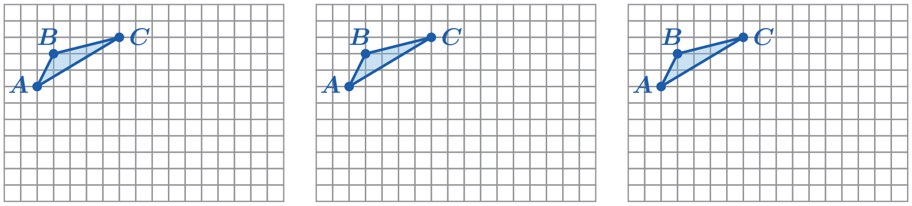
Transformation Information

6. You and your partner will get a set of transformation cards. Place them grid-side down without looking at them.

- Decide who will describe the transformation on a card and who will sketch the image. Start with Card 1.
- Describer: Give enough information about the transformation so that the Sketcher can sketch it.
- Sketcher: Pause after sketching and share what you think the transformation is.
- Together: Compare the card with the sketch and make adjustments as needed. Write a precise description of the transformation.
- Switch roles for Card 2 and repeat. Then do the same for Cards 3 and 4.

a **Sketch 1:** Card 1 or Card 2 (Circle one.)

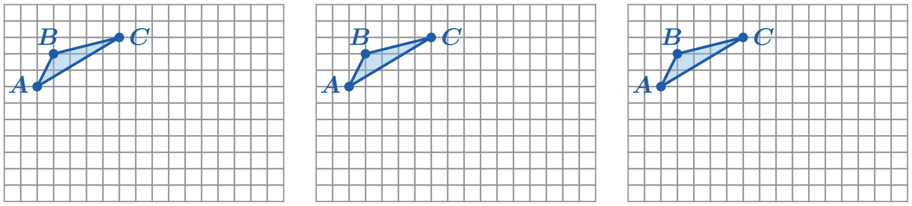
Use as many grids as you need to revise your work.



Description of Transformation:

b **Sketch 2:** Card 3 or Card 4 (Circle one.)

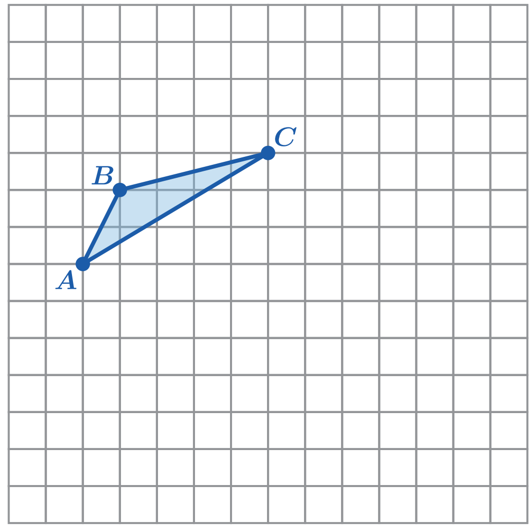
Use as many grids as you need to revise your work.



Description of Transformation:

Synthesis

7. What details are helpful to include when precisely describing a transformation?



Translation:

Reflection:

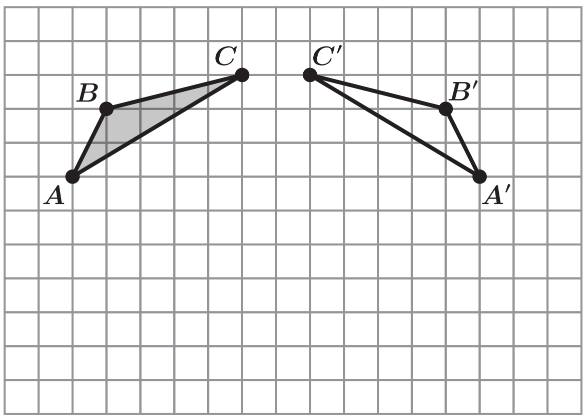
Rotation:

Things to Remember:

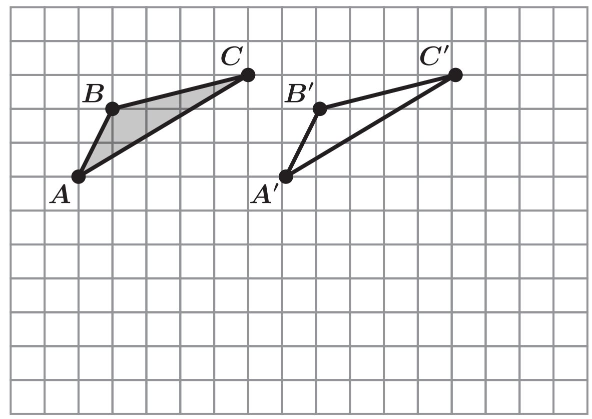
Transformation Information

Directions: Make one copy per pair of students. Then pre-cut the cards and give each pair one set.

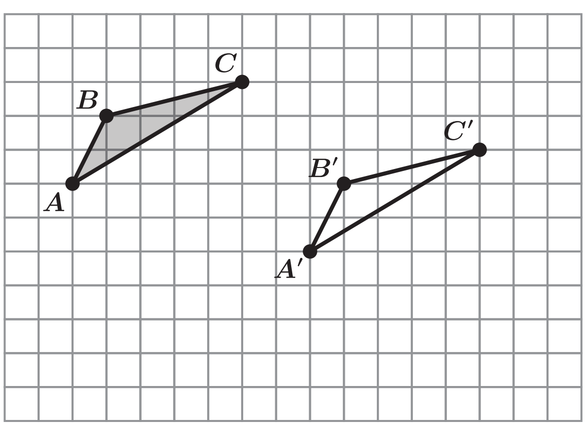
Card 1



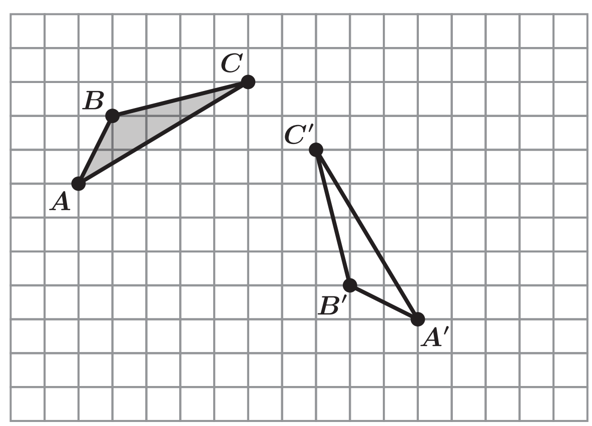
Card 2



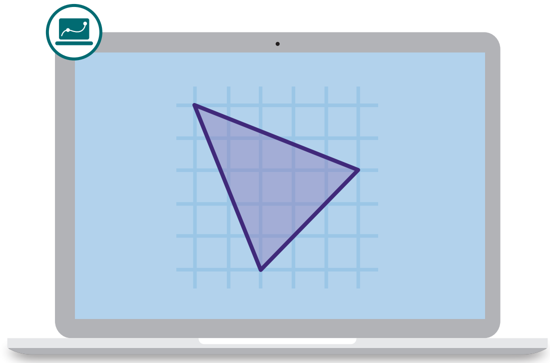
Card 3



Card 4



Name: ______ Date: ______ Period: ______



Getting Coordinated, Part 1

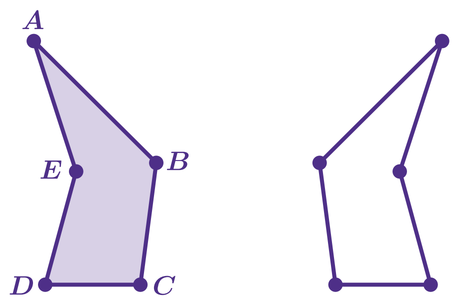
Let's explore how translations and reflections affect points on the coordinate plane.

Warm-Up

1 The pre-image (shaded) has been reflected to create the image (unshaded).

Label each corresponding point on the image.

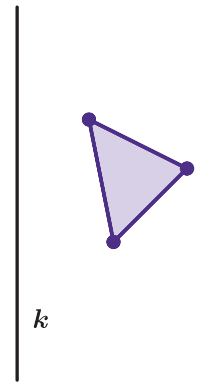
A'	B'	C'	D'	E'



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

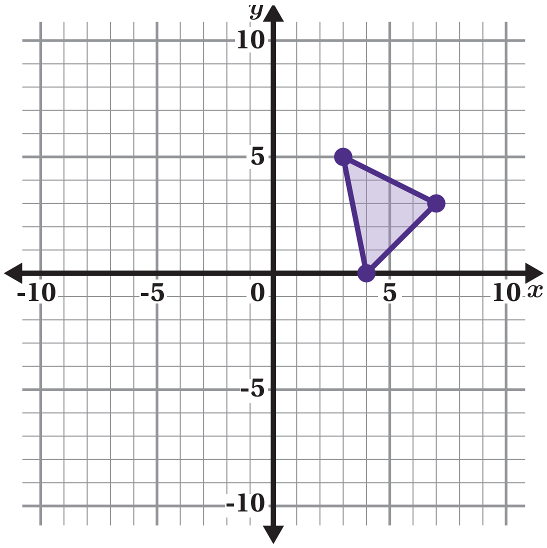
Do Coordinates Help?

2 Draw the image of the triangle after a reflection over line k.



3 Let's try that again, but with a coordinate plane.

Draw the image of the triangle after a reflection over the y-axis.



4 Let's look at some responses to the previous two problems.

Discuss: What do you notice about the two sets of reflections?

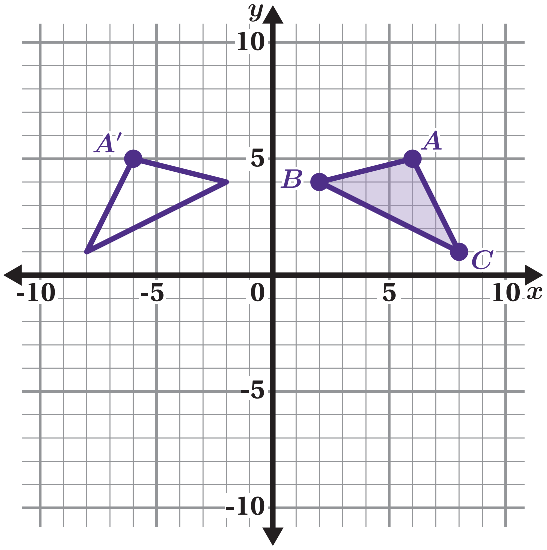
Activity 2

Name: ______ Date: ______ Period: ______

Coordinate Patterns, Part 1

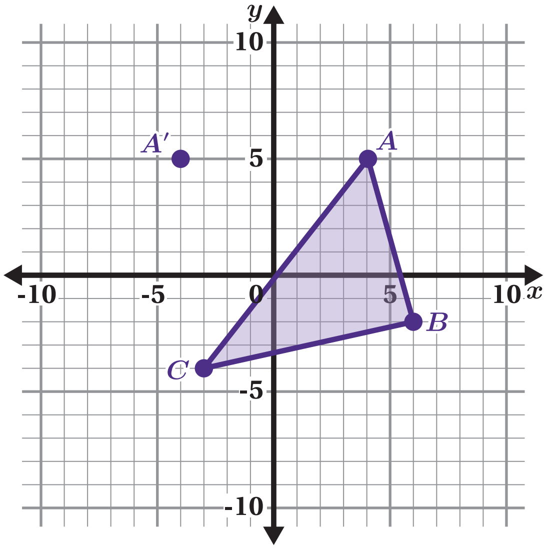
5 Identify the coordinates of each point after a reflection over the y-axis.

Pre-Image Coordinates	Image Coordinates
(6, 5)	(-6, 5)
(2, 4)	
(8, 1)	



6 Determine the coordinates of each point after a reflection over the y-axis.

Pre-Image Coordinates	Image Coordinates
(4, 5)	(-4, 5)
(6, -2)	
(-3, -4)	



7 Take a look at your tables from Problems 5 and 6. Those points show a reflection over the y-axis.

a **Discuss:** What patterns do you see between the pre-image coordinates and the image coordinates?

b Complete the table for the same transformation.

Pre-Image Coordinates	Image Coordinates
(3, 1)	
(x, y)	

Name: ________ Date: ________ Period: ________

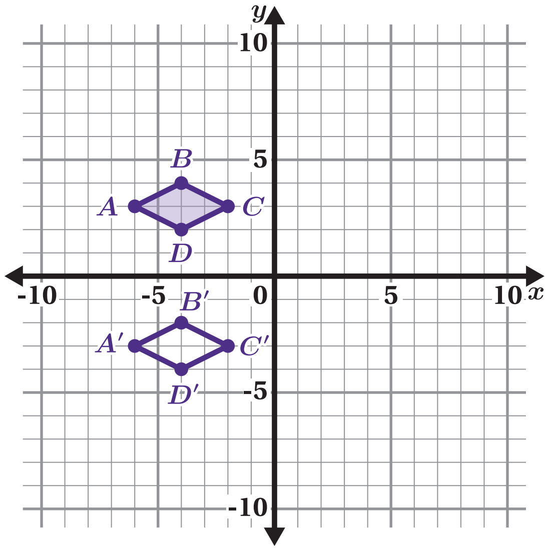
Coordinate Patterns, Part 2

8 Amari says that figure $A'B'C'D'$ is the image of figure $ABCD$ after a reflection over the x-axis.

Is Amari's claim correct? Circle one.

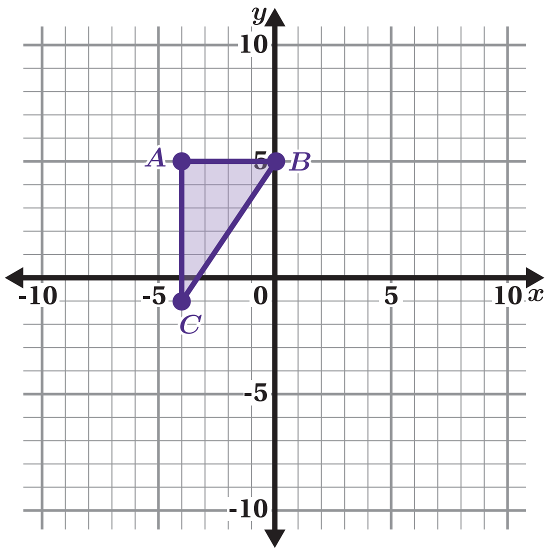
Yes No I'm not sure

Explain your thinking.



9 Determine the coordinates of each point after a translation 4 units right and 3 units down.

Pre-Image Coordinates	Image Coordinates
(-4, 5)	
(0, 5)	
(-4, -1)	



10 Take a look at your table from Problem 9. Those points show a translation 4 units right and 3 units down.

a **Discuss:** What patterns do you see between the pre-image coordinates and the image coordinates?

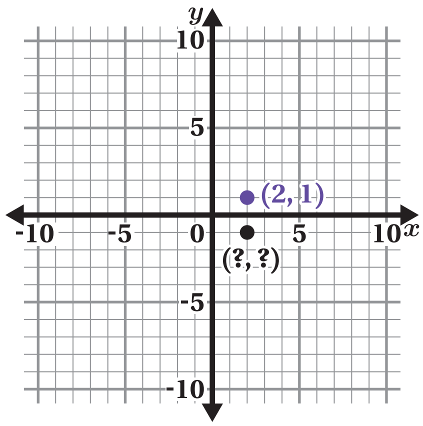
b Complete the table for the same transformation.

Pre-Image Coordinates	Image Coordinates
(3, 1)	
(x, y)	

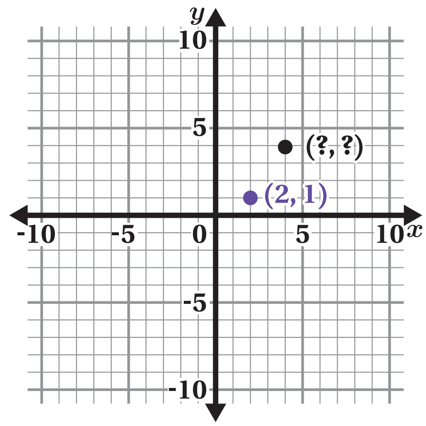
11 Synthesis

If you know the pre-image coordinates, how can you find the image coordinates for any reflection or translation?

Reflection



Translation



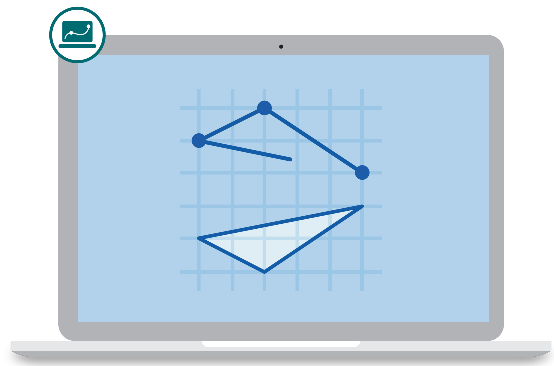
Use the examples if they help with your thinking.

Reflection:

Translation:

Things to Remember:

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



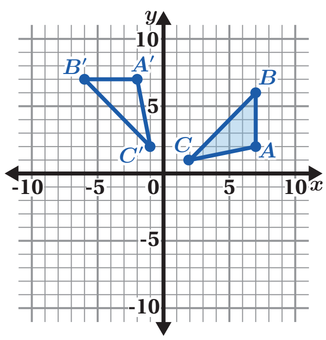
Getting Coordinated, Part 2

Let's explore how rotations affect coordinates.

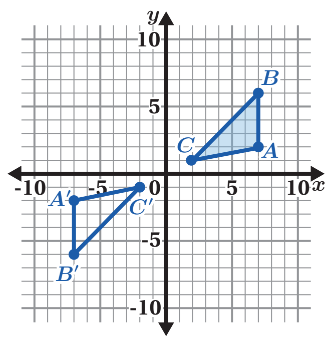
Warm-Up

1 **a** Take a look at several different rotations.

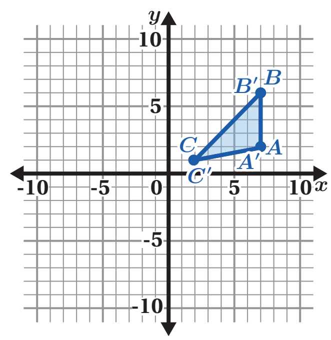
Counterclockwise 90°



Clockwise 180°



Counterclockwise 360°

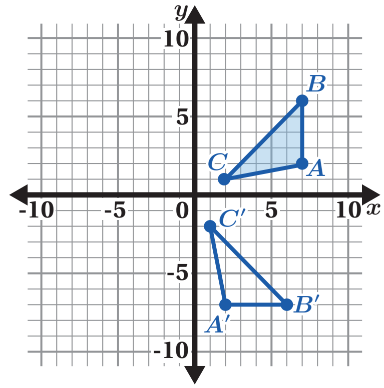


b **Discuss:** What do you notice? What do you wonder?

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

Coordinate Patterns

2 Tyani says this is a rotation of figure ABC $90°$ clockwise around center $(0, 0)$. Anushka says this is a rotation of figure ABC $270°$ counterclockwise around the *origin*.

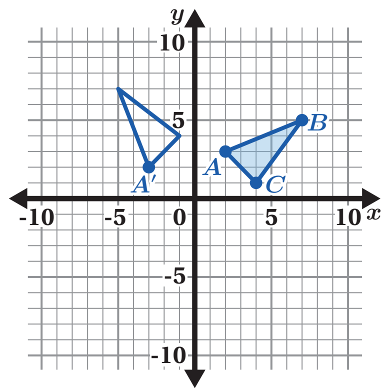


Whose claim is correct? Circle one.

Tyani's   Anushka's   Both   Neither

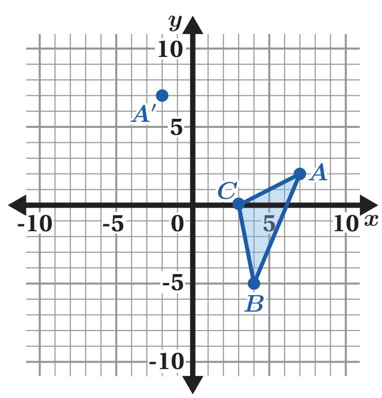
Explain your thinking.

3 Identify the coordinates for the image of figure ABC after a rotation $90°$ counterclockwise around center $(0, 0)$.



Pre-Image Coordinates	Image Coordinates
$(2, 3)$	$(-3, 2)$
$(7, 5)$	
$(4, 1)$	

4 Determine the coordinates for the image of figure ABC after a rotation $90°$ counterclockwise around center $(0, 0)$.

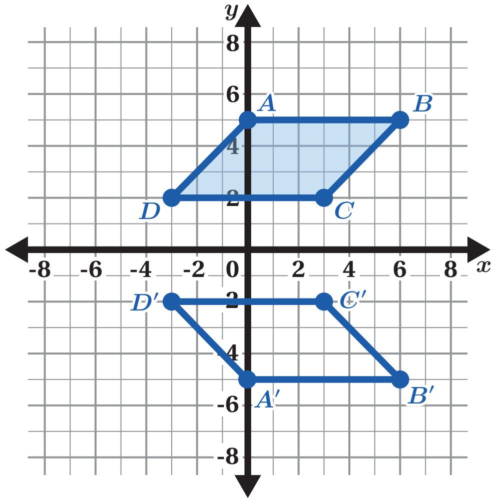


Pre-Image Coordinates	Image Coordinates
$(7, 2)$	$(-2, 7)$
$(4, -5)$	
$(3, 0)$	

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

Coordinate Patterns (continued)

5 Ayo says this is a $180°$ clockwise rotation of figure $ABCD$ around center $(0, 0)$. Cameron says this is a reflection over the x-axis.



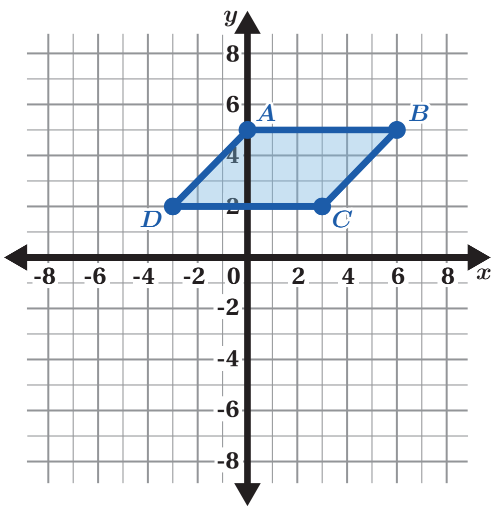
Whose claim is correct? Circle one.

Ayo's (Rotation) Cameron's (Reflection) Both Neither

Explain your thinking.

6 Determine the coordinates for the image of figure $ABCD$ after a rotation $180°$ clockwise around center $(0, 0)$.

Pre-Image Coordinates	Image Coordinates
$(0, 5)$	
$(6, 5)$	
$(3, 2)$	
$(-3, 2)$	



Activity 2

Name: ______ Date: ______ Period: ______

Challenge Creator

7 You will use the Activity 2 Sheet to create your own transformation challenge.

a **Make It!** On the Activity 2 Sheet, create a transformation challenge.

b **Solve It!** On this sheet, write the pre-image and image coordinates for your transformation.

Pre-Image Coordinates	Image Coordinates

c **Swap It!** Swap your challenge with one or more partners. Write the pre-image and image coordinates for their transformation.

Partner 1's Challenge

Pre-Image Coordinates	Image Coordinates

Partner 2's Challenge

Pre-Image Coordinates	Image Coordinates

Partner 3's Challenge

Pre-Image Coordinates	Image Coordinates

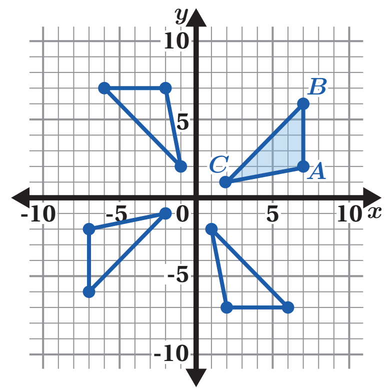
Partner 4's Challenge

Pre-Image Coordinates	Image Coordinates

8 Synthesis

Describe some patterns in the pre-image and image coordinates for rotations around center $(0, 0)$.

Use the examples if they help with your thinking.



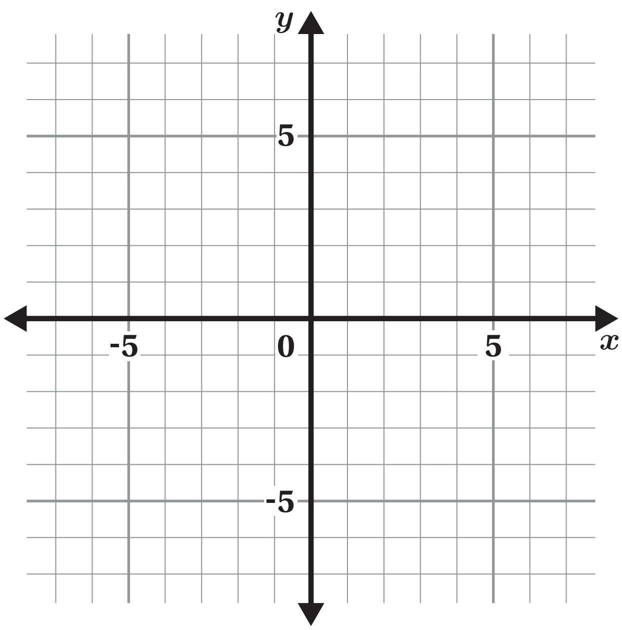
Things to Remember:

Name: Date: Period:

Challenge Creator

- On the graph, plot four points and connect them to make your own figure. Your figure will be the pre-image.
- Label each point with its coordinate pair (x, y).
- Choose and define a transformation.
  - For a translation, include the number of units and the direction.
  - For a rotation, include the direction and degrees.
  - For a reflection, include whether it is over the x- or y-axis.
- Don't show the image or write its coordinates on this sheet. You and your classmates will determine the image coordinates of each other's transformations on the lesson sheet.

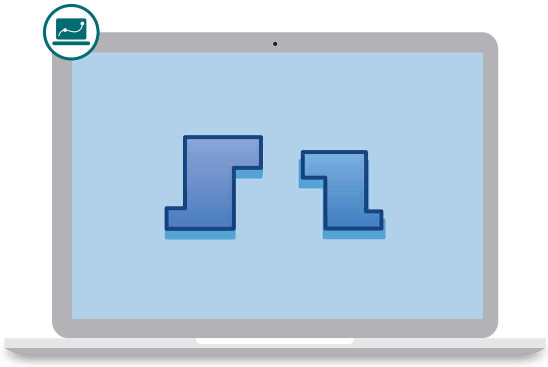
My Pre-Image Polygon:



My Transformation:

Unit 1
Lesson
8

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



Are They the Same?

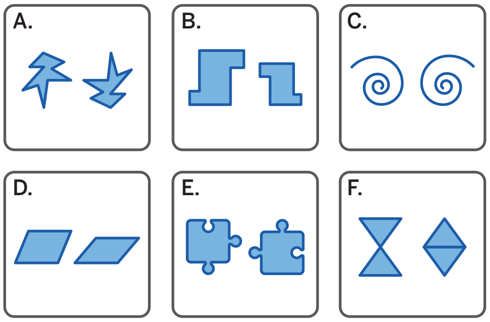
Let's explore a type of sameness.

Warm-Up

1 Here are six pairs of figures.

a Circle *all* the pairs with figures that are the same.

b **Discuss:** Which pairs did you choose? Why?



2 Why might someone say Pair B's figures are the same? Are *not* the same?

They are the same because . . .

They are not the same because . . .

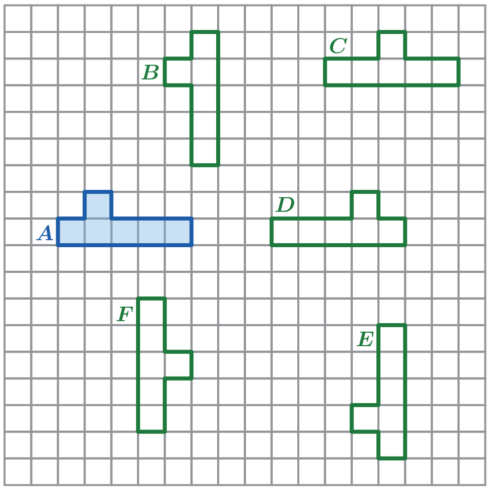
Activity 1

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

Defining Congruence

3 One figure is **congruent** to another if it can be moved with translations, rotations, and reflections to fit exactly over the other.

Circle *all* the figures that are congruent to figure A.



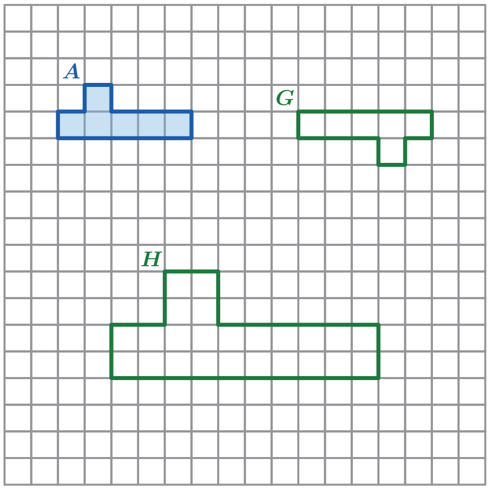
4 Describe a sequence of rigid transformations that would move figure A onto one of the congruent figures you circled in the previous problem.

5 Kweku says figures A and G are congruent. Lan says figures A and H are congruent.

Whose claim is correct? Circle one.

Kweku's Lan's Both Neither

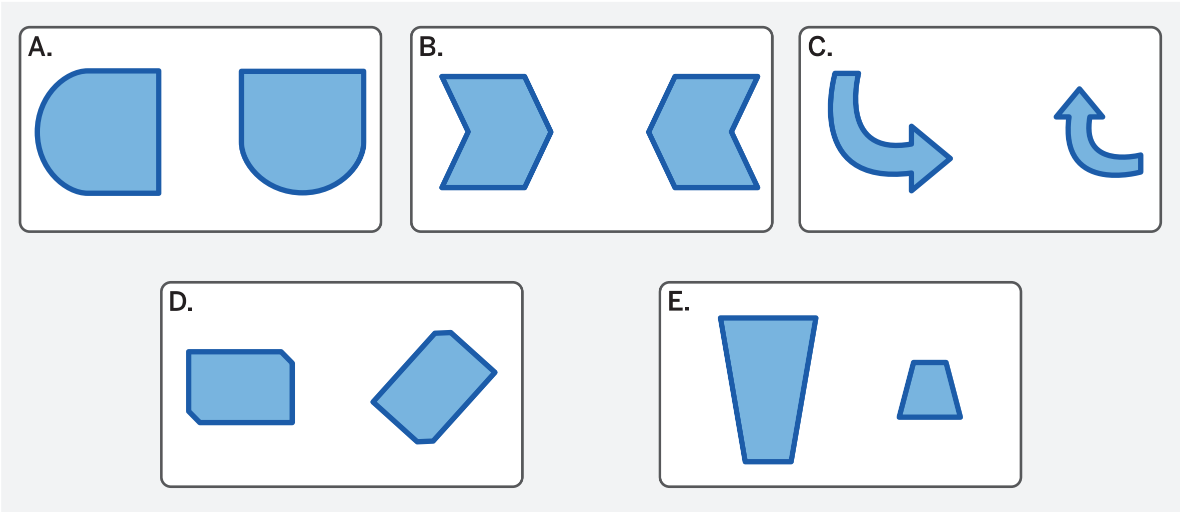
Explain your thinking.



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

Defining Congruence (continued)

6 Group the pairs of figures based on whether you think they are congruent or not congruent.



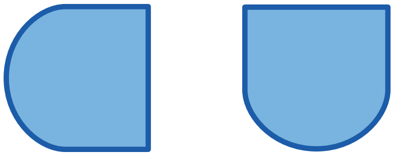
Congruent	Not Congruent

Activity
2

Name: ______ Date: ______ Period: ______

Sequence of Rigid Transformations

7 Which sequence of rigid transformations could be used to show that these two figures are congruent?



A. A translation

B. A rotation and a translation

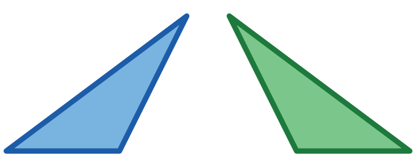
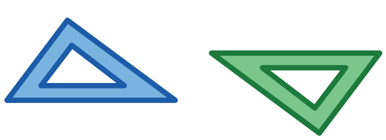
C. A reflection and a translation

D. None. They're not congruent.

Explain your thinking.

8 For each pair of figures, name a sequence of rigid transformations that could be used to show that they are congruent or write that they aren't congruent. Decide with a partner who will complete Column A and who will complete Column B.

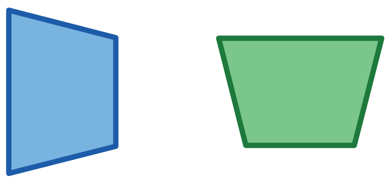
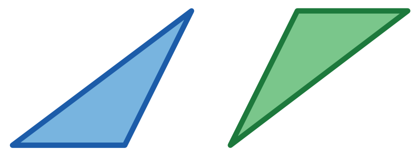
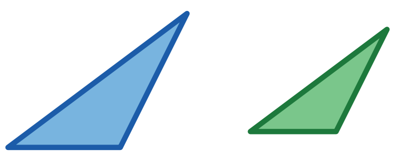
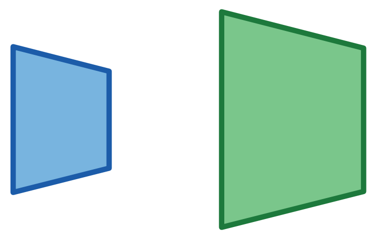
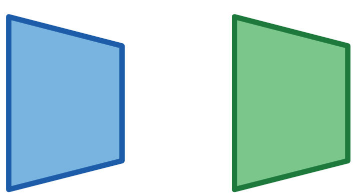
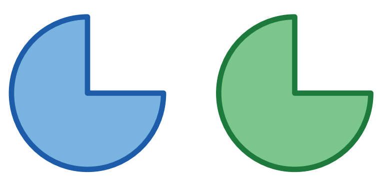
- After each problem, compare your answers. The answers in each row should be the same. Discuss and resolve any differences.
- Complete as many problems as you have time for.

Column A	Column B
 Sequence:	 Sequence:

Activity 2

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

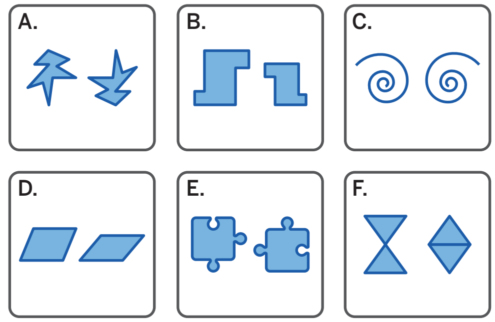
Sequence of Rigid Transformations (continued)

Column A	Column B
 Sequence:	 Sequence:
 Sequence:	 Sequence:
 Sequence:	 Sequence:

9 Synthesis

How can you determine whether two figures are congruent?

Use the examples if they help with your thinking.



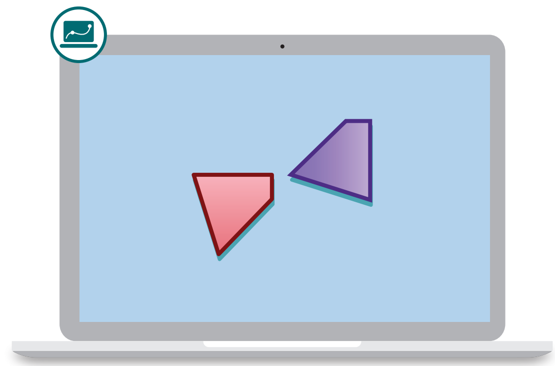
Things to Remember:

Unit 1
Lesson
9

Name: ______ Date: ______ Period: ______

Are They Congruent?

Let's make arguments about whether two figures are congruent.



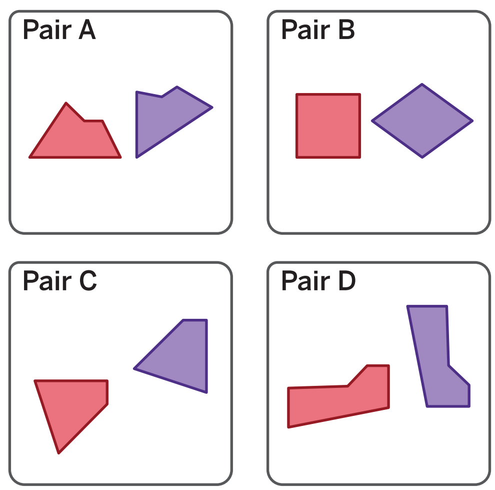
Warm-Up

1 Here are four pairs of figures.

a Make a prediction! Circle *all* pairs of figures that look congruent.

Pair A   Pair B   Pair C   Pair D

b **Discuss:** How can you be more sure which pairs of figures are congruent?

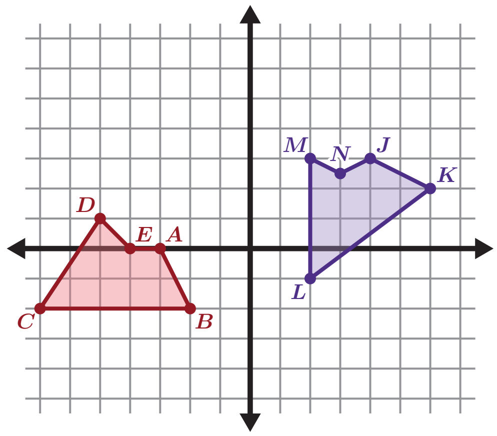


Name: ______ Date: ______ Period: ______

Congruent or Not?

Let's revisit each of the pairs from the Warm-Up.

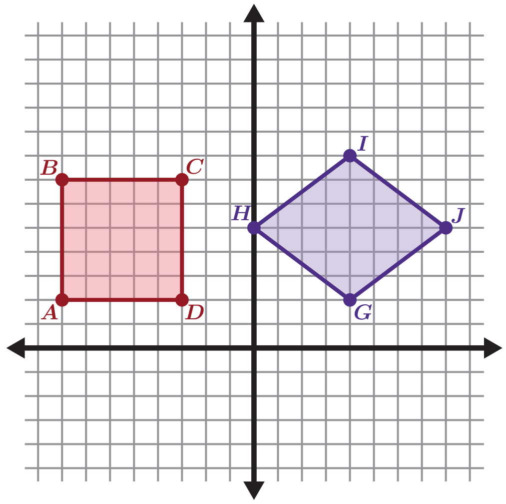
2 Let's watch a sequence of transformations.



a Precisely describe the sequence of transformations.

b Explain how you know the figures are *not* congruent.

3 Mauricio noticed that each side length in figure $ABCD$ is equal to each side length in figure $GHIJ$. He says this proves that $ABCD \cong GHIJ$ ($ABCD$ is congruent to $GHIJ$).



Is his claim correct? Circle one.

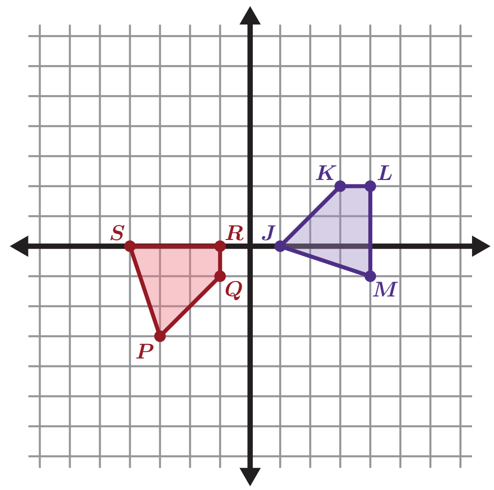
Yes No

Explain your thinking.

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

Congruent or Not? (continued)

4 Students in another class were asked to convince their peers that the figures in Pair C are congruent. Which of their arguments do you think is most convincing?



A. Both figures have 4 sides and an area of 5.5 square units.

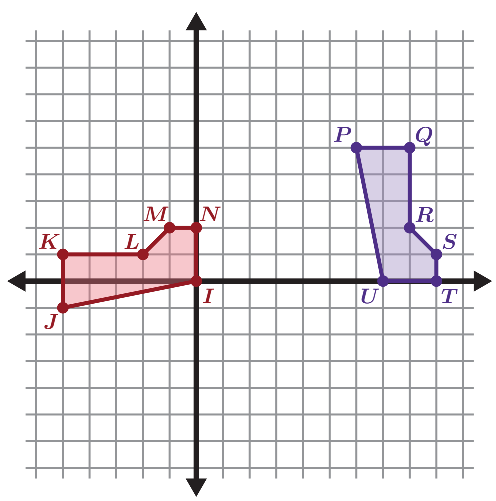
B. I can move the figures right on top of each other by translating figure $JKLM$ down 3 and left 4, and then reflecting over side QP.

C. When I measure the side lengths of figures $JKLM$ and $PQRS$, I get the same measurements.

Explain your thinking.

5 Describe a sequence of rigid transformations that will convince your classmates that the figures from Pair D are congruent.

Use tracing paper if it helps with your thinking.



Activity
2

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

Prove It!

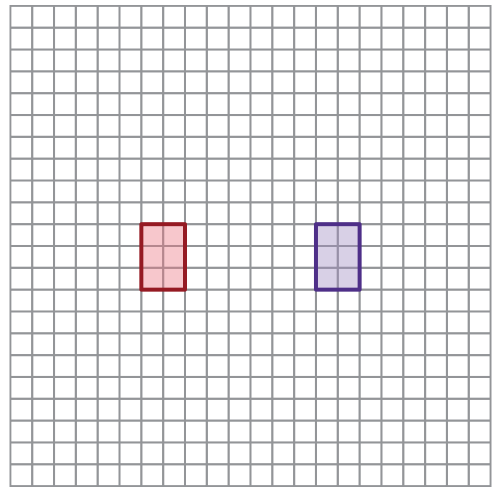
6 Angel says that any two rectangles with the same area are congruent.

Is Angel's claim correct? Circle one.

Draw some rectangles to help you decide.

Yes No I'm not sure

Explain your thinking.

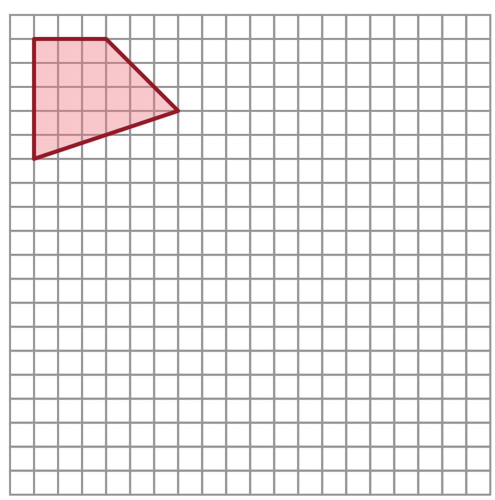


7 Which statement(s) are enough to prove that two figures are congruent? Select *all* that apply.

- ☐ **A.** The figures are both right triangles.
- ☐ **B.** You can trace one figure on tracing paper and move it perfectly on top of the other.
- ☐ **C.** The figures that have areas of 8 square units are both rectangles.
- ☐ **D.** You can move one figure right on top of the other by translating 8 units left.
- ☐ **E.** The figures are both isosceles right triangles.

8 **a** Draw a second figure to create two figures that are *not* congruent but that someone might think are.

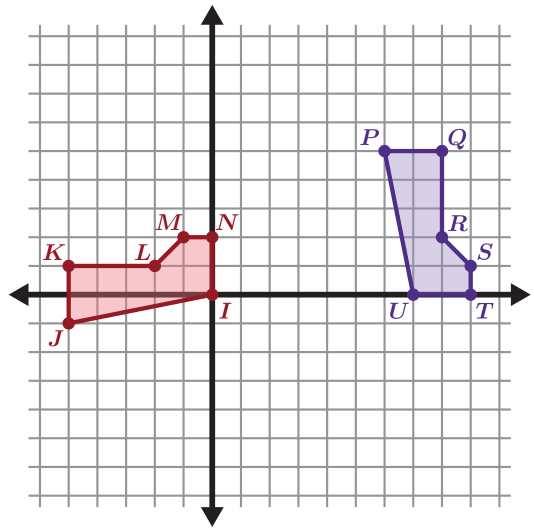
b Explain how you know the two figures are not congruent.



9 Synthesis

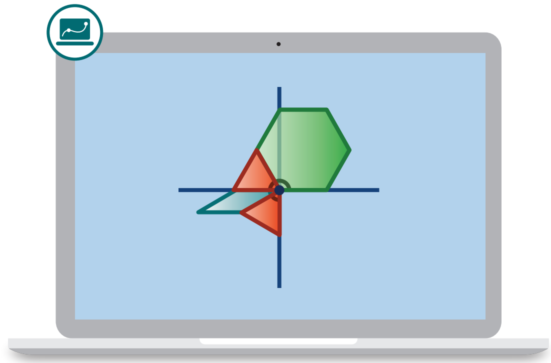
How can you prove that two figures are congruent?

Use the example if it helps with your thinking.



Things to Remember:

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

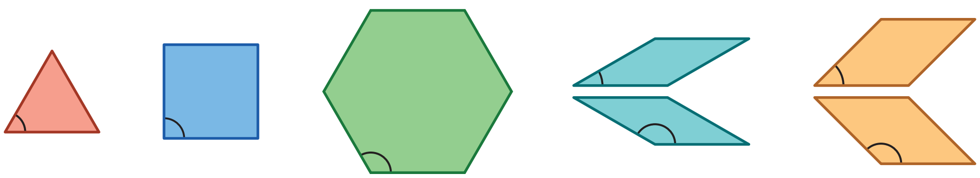


Friendly Angles

Let's explore complementary and supplementary angles.

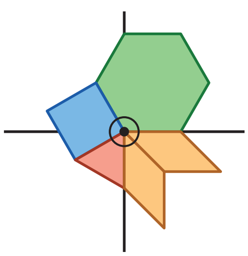
Warm-Up

1 These shapes were used to create four $360°$ designs.

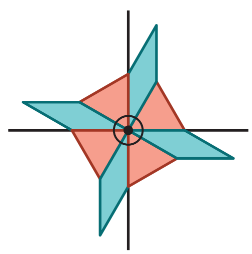


a Pick a design that you like.

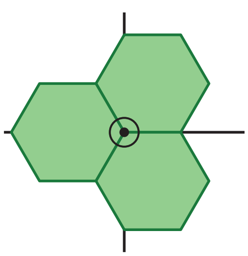
A.



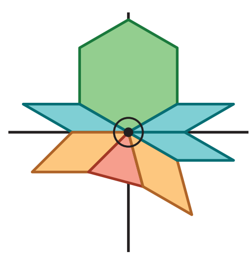
B.



C.



D.



b **Discuss:** What do you like about the design you chose?

Activity 1

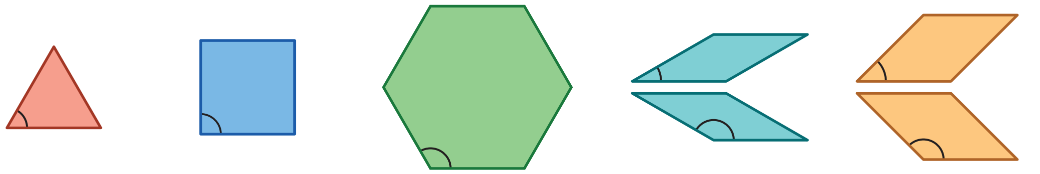
Name: .... Date: .... Period: ....

Mystery Measures

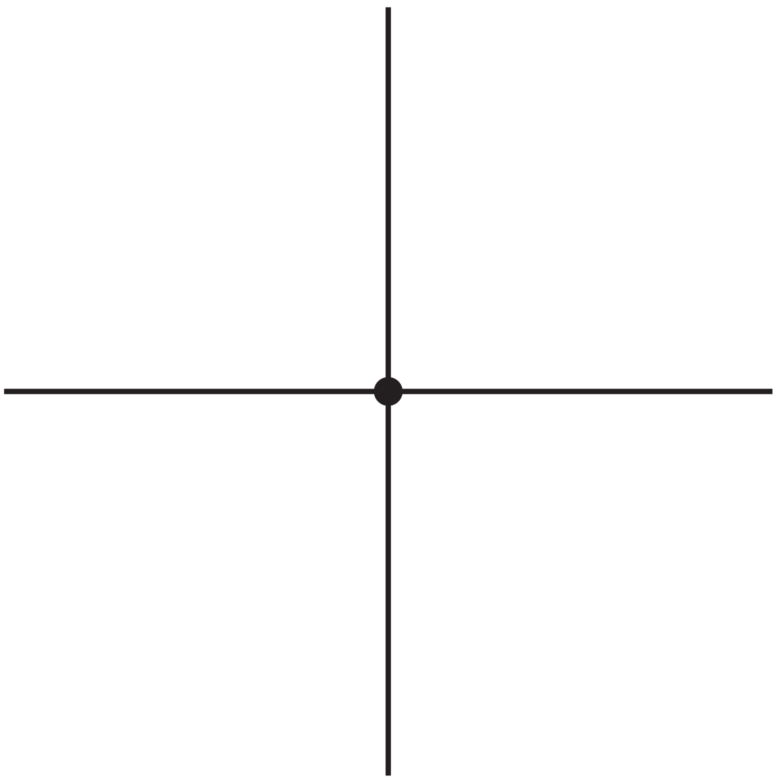
2 You and your partner will use a set of shapes or the digital screen for this activity.

Each shape has at least one unknown angle measure.

a Determine as many angle measures as you can by creating designs with your shapes. Label each shape with its angle measure.



Workspace:



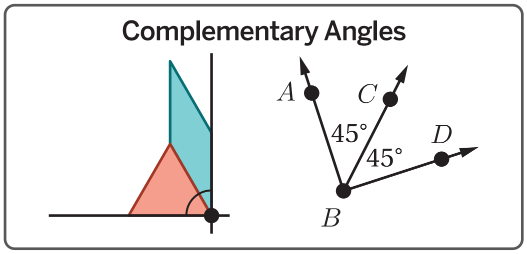
b Choose two angles. Explain how you determined their measures.

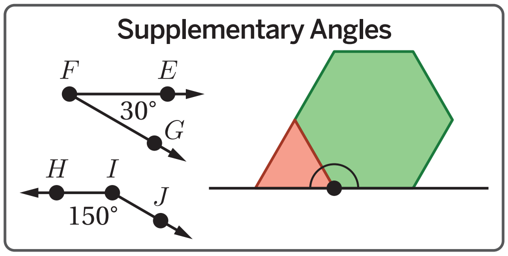
Activity 2

Name: ______ Date: ______ Period: ______

Relationships and Equations

3 The terms **complementary** and **supplementary** describe special pairs of angles.





Describe what you think these terms mean.

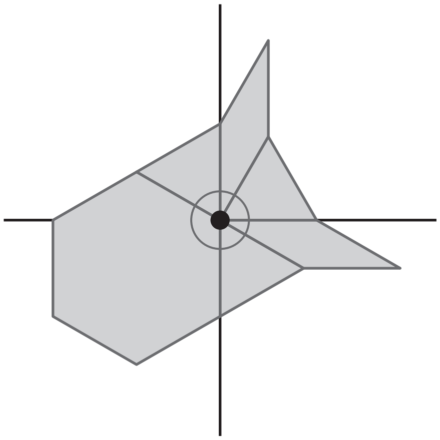
Complementary angles . . .

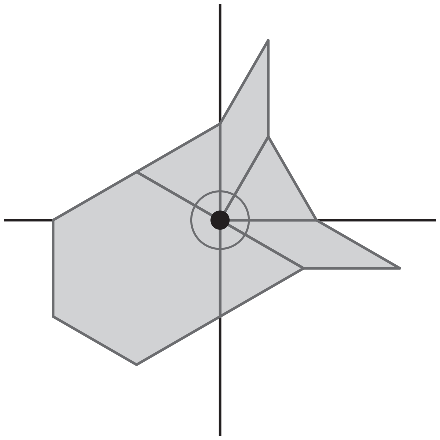
Supplementary angles . . .

4 Here is a new design.

a. Shade in a pair of complementary angles.

b. Shade in a pair of supplementary angles.



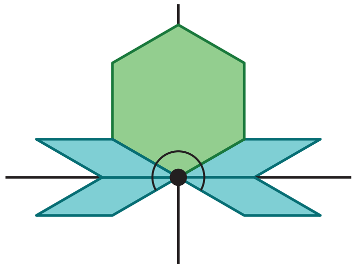


Name: .... Date: .... Period: ....

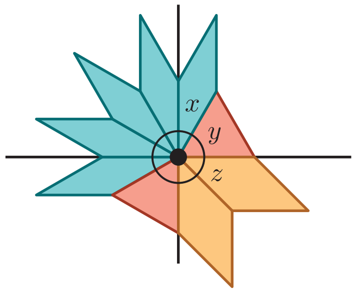
Relationships and Equations (continued)

5 Ivory used the equation $2x + 120 = 180$ to determine one angle measure in this diagram.

Explain or show what each part of Ivory's equation represents in the diagram.



6 Here is a new diagram.



a Select *all* the true equations.

☐ **A.** $3x = 90$

☐ **B.** $x + y = 90$

☐ **C.** $5x = 180$

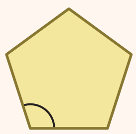
☐ **D.** $x + y + 2z = 180$

☐ **E.** $x + y + z = 360$

b **Discuss:** How did you decide which equations are true?

Explore More

7 Use the Explore More Sheet to determine as many of these unknown angle measures as you can by creating designs in the workspace provided. Record each angle measure below its shape.



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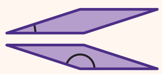

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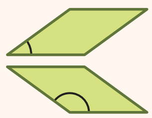

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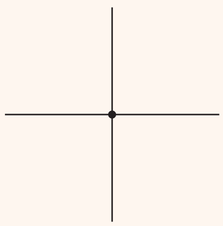
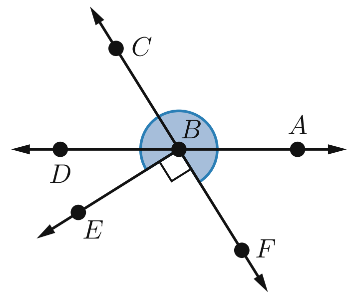


8 Synthesis

Here is a diagram. Describe or show as many angle relationships as you can.

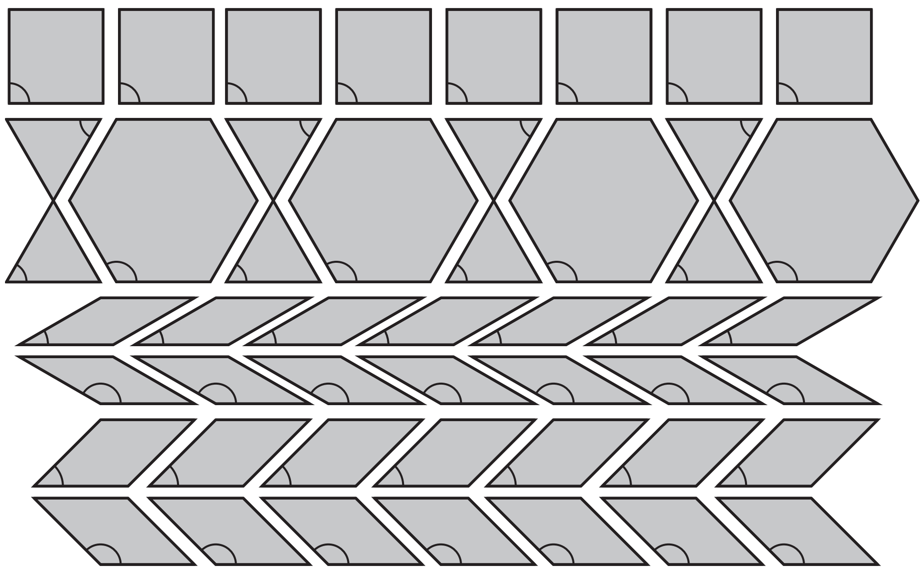
Use the terms *complementary* and *supplementary* in your description.

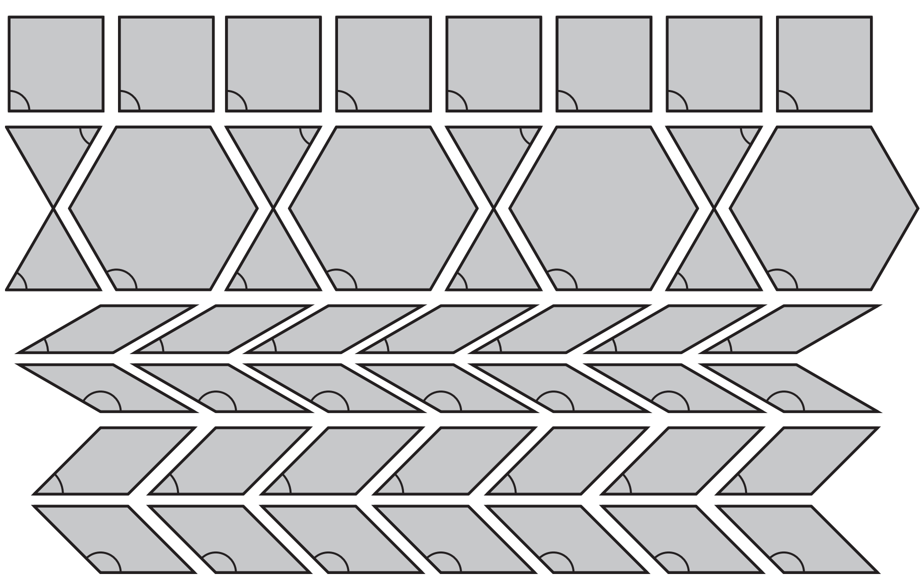


Things to Remember:

Mystery Measures

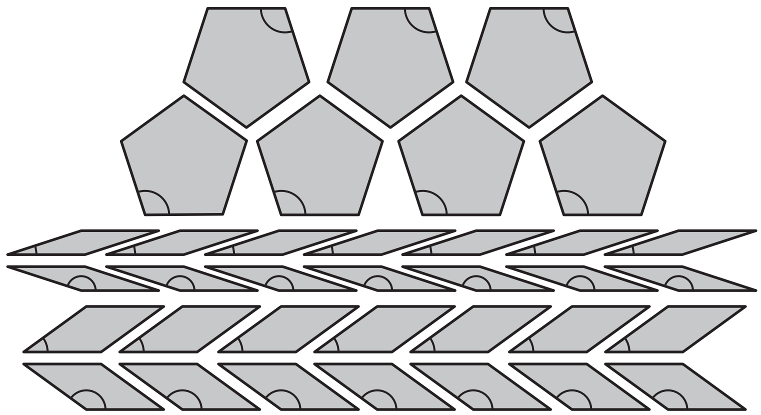
Directions: Make one copy per two pairs of students. Then pre-cut the shapes and give each pair of students one set.

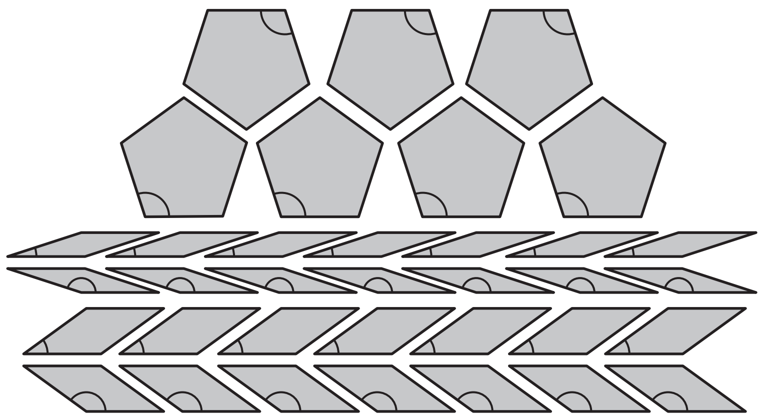




Explore More

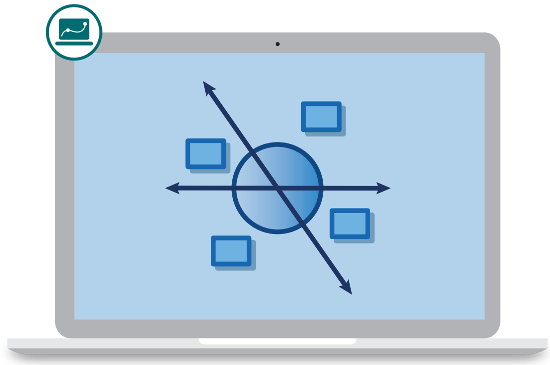
Directions: Make one copy per two pairs of students. Then pre-cut the shapes and give each pair of students one set.





Unit 7
Lesson
3

Name: ______ Date: ______ Period: ______

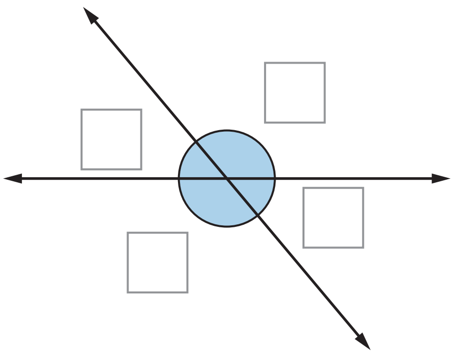


Angle Diagrams

Let's explore vertical angles.

Warm-Up

1 a Estimate each angle measure.



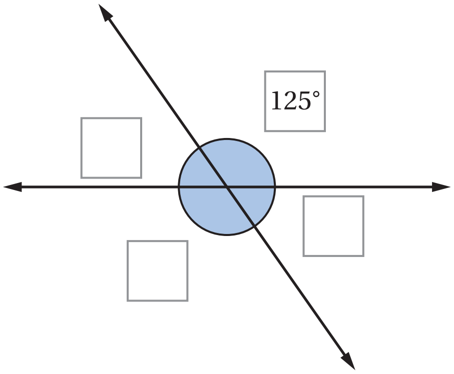
b **Discuss:** How did you choose your estimates?

Activity 1

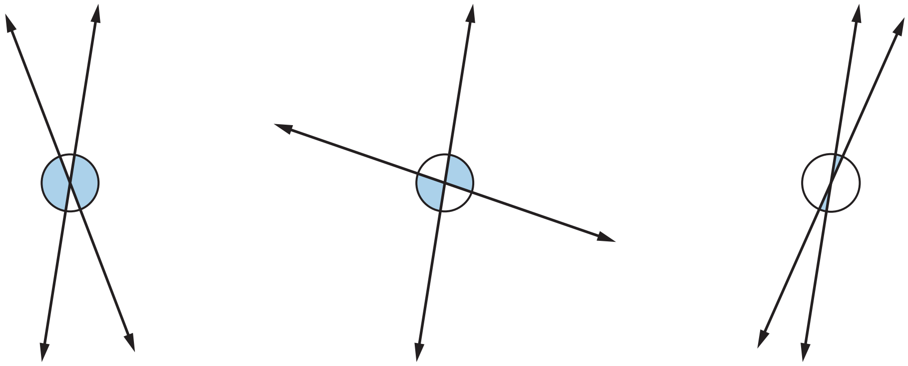
Name: .... Date: .... Period: ....

Vertical Angles

2 Here is an angle puzzle. Use the given angle measure to determine all the angle measures.



3 Lola noticed that when two lines cross, the angles that are opposite each other have the same measure. These angles are called **vertical angles**.



Are the measures of vertical angles *always*, *sometimes*, or *never* the same? Circle one.

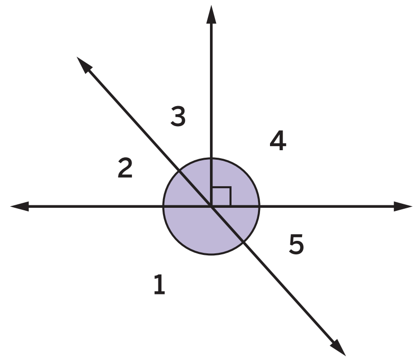
Always Sometimes Never

Explain your thinking.

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

Vertical Angle Puzzle

4 Here is a new angle puzzle. Which of these is a pair of vertical angles?



A. 1 and 4

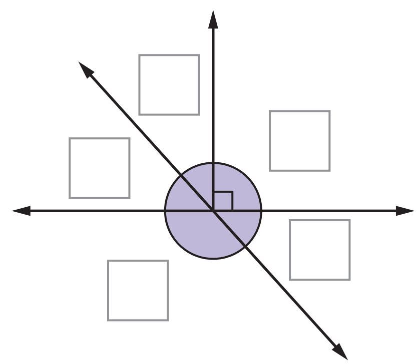
B. 2 and 3

C. 2 and 5

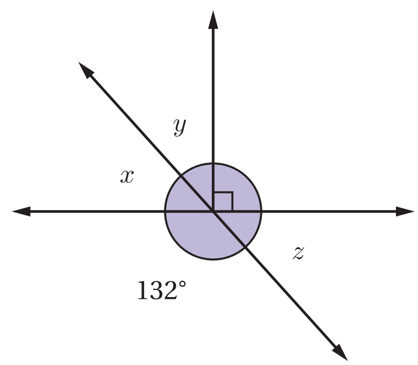
D. 3 and 5

Discuss: Choose one of the other pairs. How do you know they are *not* vertical angles?

5 Here is a new angle puzzle. You can ask for the measure of an angle. Determine all the angle measures using as few hints as you can.



6 Kwasi and Lola wrote equations to help them solve the previous angle puzzle.



Kwasi's equation: $x + 132 = 180$

Lola's equation: $132 + z = 180$

Whose equation is correct? Circle one.

Kwasi Lola Both Neither

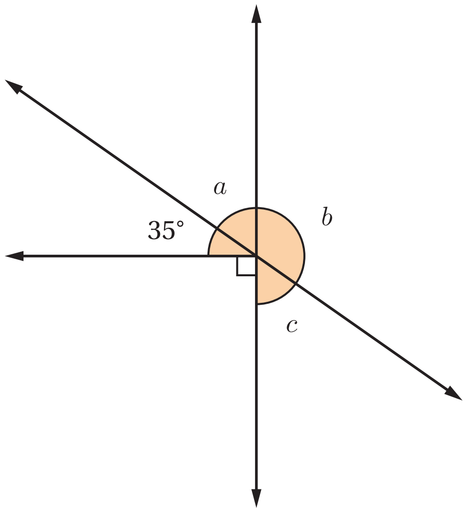
Explain your thinking.

Activity 3

Name: ________ Date: ________ Period: ________

Writing and Using Equations

Use the diagram for Screens 7–8.



7 Write a true equation based on this angle puzzle. Try to write an equation none of your classmates will.

8 Determine the values of a, b, and c.

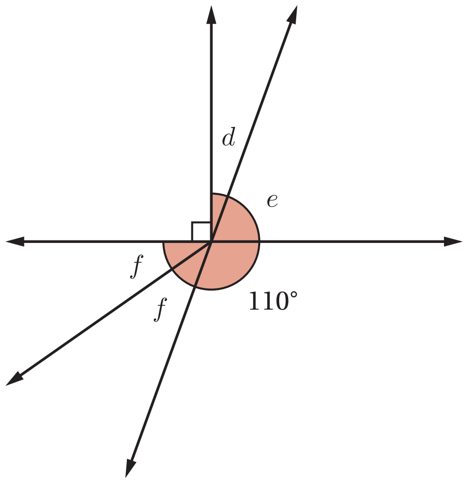
Activity
3

Name: Date: Period:

Writing and Using Equations (continued)

9 Here is a new angle puzzle.

Determine the values of d, e, and f.



10 Kwasi wrote the equation $f + 110 = 180$ for the previous puzzle. Change Kwasi's equation to make it true.

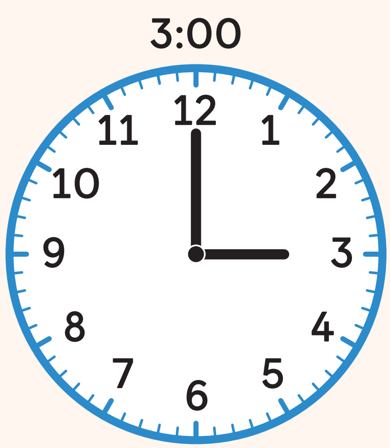
Explore More

11 Here is a clock.

a What is the angle between the clock's hour hand and minute hand at 3:00?

b What is the angle between the clock hands at 2:20? (Hint: It is not $60°$.)

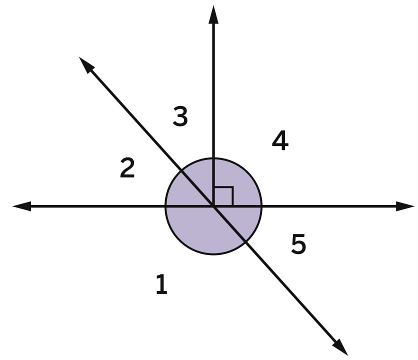
c What is one time when the angle between the clock hands is $40°$?



12 Synthesis

Describe what you know about vertical angles.

Use the example if it helps with your thinking.



Things to Remember:

Unit 1
Lesson
10

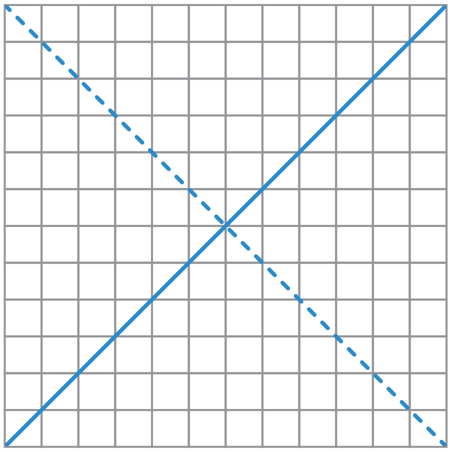
Name: ______ Date: ______ Period: ______

Transforming Angles

Let's explore congruent angles.

Warm-up

1 Select *all* the transformations that can be used to move the solid line onto the dashed line.

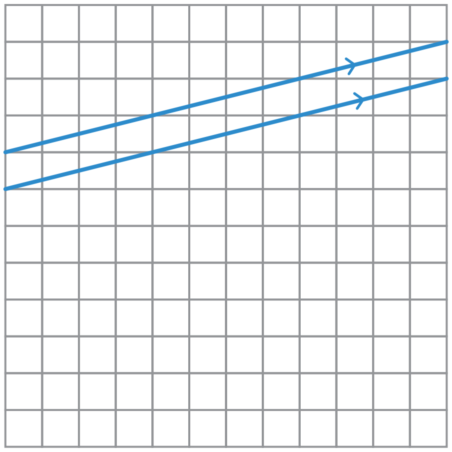


- ☐ **A.** Only translations
- ☐ **B.** Only rotations
- ☐ **C.** Only reflections

2 This pre-image is a pair of lines.

The arrowheads mean that the lines are *parallel*.

Draw two lines that *cannot* be a translation, rotation, or reflection of these lines.



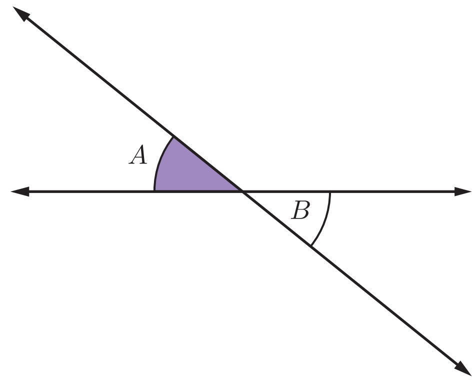
Activity 1

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

Vertical Angles

Angles that are opposite each other when two lines cross, like A and B, are called *vertical angles*. We can use transformations to prove whether angles are congruent.

3 Describe a single transformation to show that vertical angles A and B are congruent.



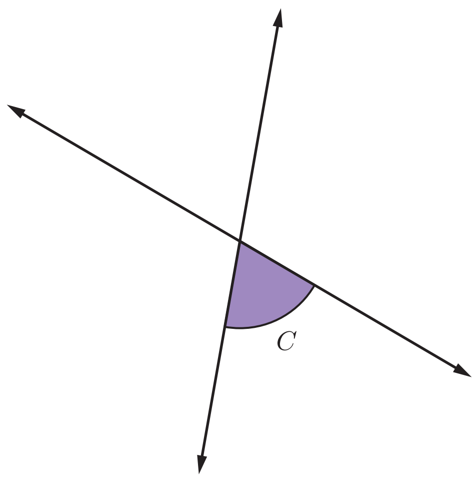
4 Here are another two lines that cross. $\angle C$ has a measure of $70°$.

With this information, Ariel says it's possible to determine the measure of the three remaining angles. Vihaan says it's only possible to determine the measure of one more angle.

Whose claim is correct? Circle one.

Ariel's　　Vihaan's　　Neither

Explain your reasoning.

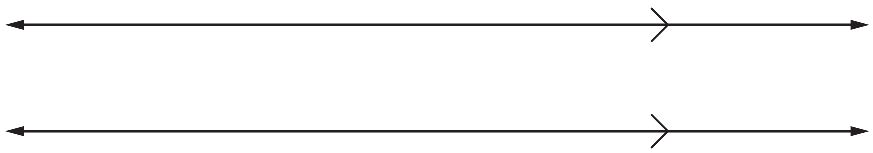


Activity 2

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

Parallel Lines and a Transversal

5 Here are two parallel lines.



a Draw a third line that intersects both the parallel lines. This line is called a **transversal**.

b Choose one angle. Label it with your favorite letter.

c Mark all of the angles that are congruent to your angle.

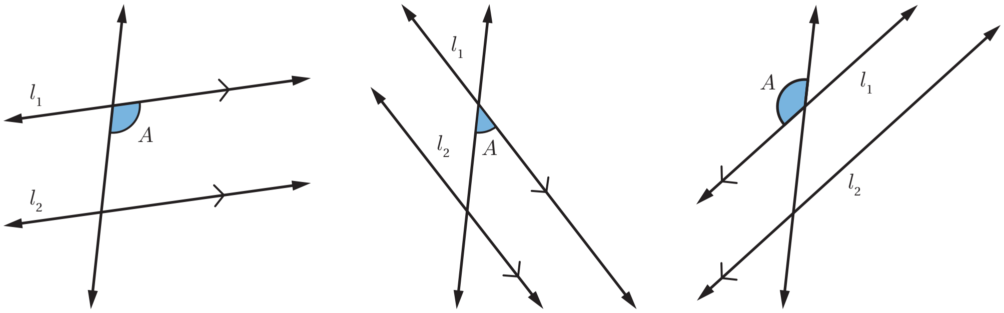
d Compare your drawing with a classmate's.

Activity 3

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

Congruent Angles?

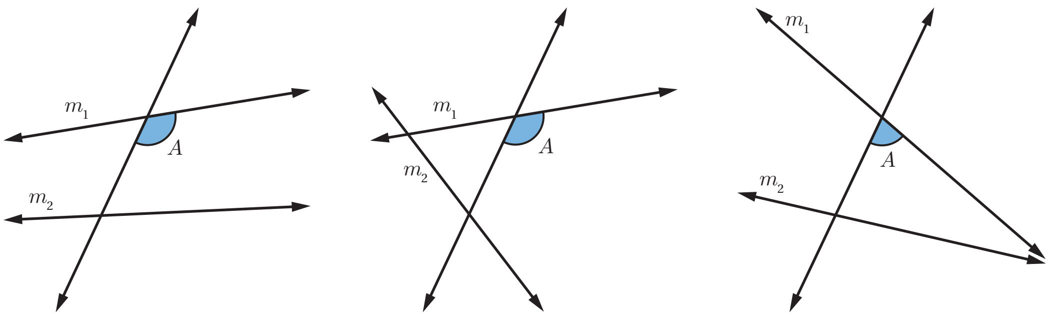
6 Lines l_1 and l_2 are parallel. Take a look at three different positions for l_1 and l_2.



a **Discuss:** How many angles in each diagram are *always* congruent to angle A?

b In each diagram, mark the angles that are congruent to angle A.

7 Lines m_1 and m_2 are *not* parallel. Take a look at three different positions for m_1 and m_2.



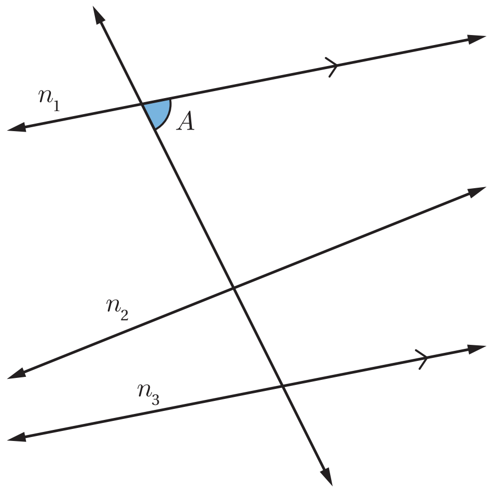
a **Discuss:** How many angles in each diagram are *always* congruent to angle A?

b In each diagram, mark the angles that are congruent to angle A.

Name: ______ Date: ______ Period: ______

Congruent Angles? (continued)

8 Here are three lines: n_1, n_2, and n_3.



a. **Discuss:** How many angles in the diagram *must* be congruent to angle A?

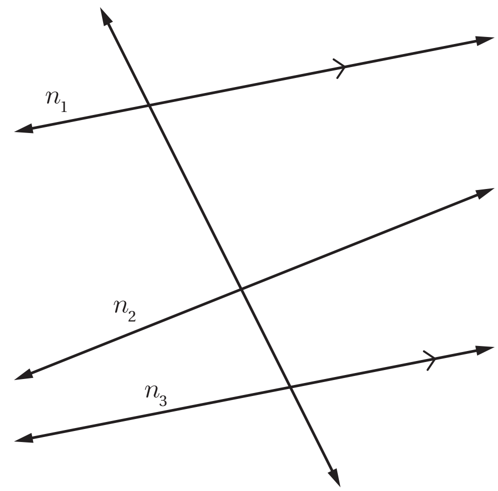
b. Mark the angles that are congruent to angle A. Label each one with a different letter.

9 For each angle you marked in the previous problem, describe a single transformation to show that the angle is congruent to angle A.

10 Synthesis

How can you use transformations to show that two angles are congruent?

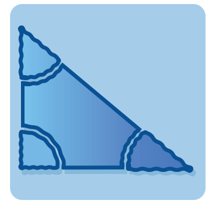
Use the example if it helps with your thinking.



Things to Remember:

Unit 1
Lesson
11

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

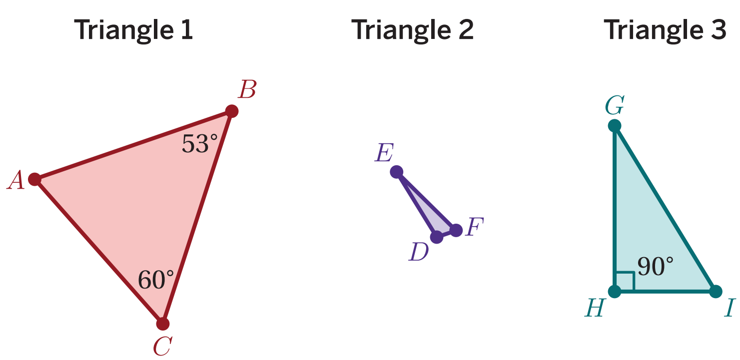


Tearing It Up

Let's explore the interior angles of triangles.

Warm-Up

1. Here are three triangles.



If you add up the three interior angles of each triangle, which triangle do you think has the greatest sum? Explain your thinking.

Activity 1

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

Find All Three

You will get a card with a picture of a triangle.

2. The measurement of one of the angles is labeled. Estimate the measures of the other two angles.

Labeled angle measure: ....

Estimated angle measure: .... Estimated angle measure: ....

3. Find two other students with triangles that look congruent to yours, but with a different labeled angle.

Name: .... Card number: ....

Name: .... Card number: ....

4. Confirm that all three triangles are congruent and that each card has a different labeled angle. How did you know that the triangles were congruent?

5. Record the three angle measures for your triangle in the table.

Card Numbers	Angle 1	Angle 2	Angle 3	Angle Sum

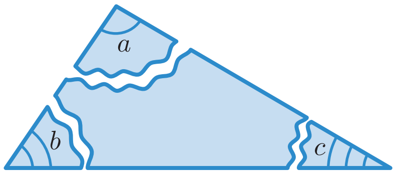
Activity 2

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

Tear It Up

6. You will use a blank sheet of paper to complete this activity. Use a straightedge to draw a triangle that you think will be different from the triangles your classmates will draw.

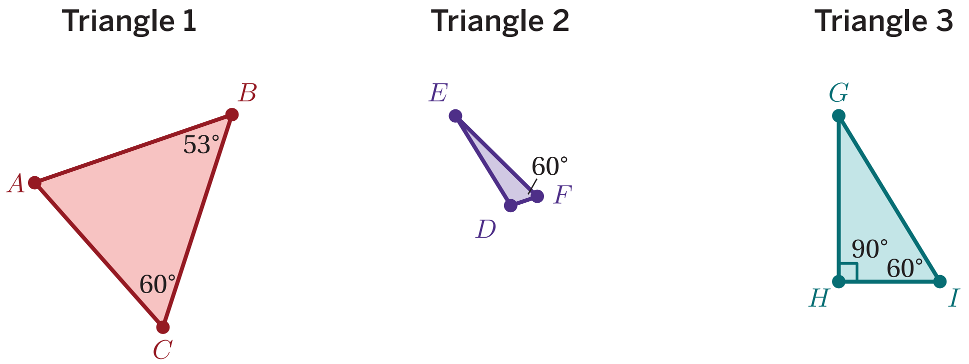
7. Label the angles of your triangle with the letters a, b, and c. Cut out the triangle, then tear the three angles off of the triangle like in this picture.



8. Rearrange the angles so that the three vertices meet with no overlap.

9. Compare your results with your classmates' results. What do you notice about your angles? What does this mean about the sum of the angles in a triangle?

10. Here are the triangles from the Warm-Up, with some additional angle measurements labeled. For each triangle, determine a possible value for the angle listed.

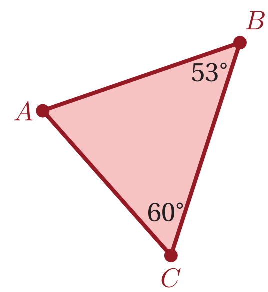


$m\angle A =$ .... $m\angle D =$ .... $m\angle G =$ ....

Synthesis

11. What is true about the sum of the three angle measures in a triangle?

Use the example if it helps with your thinking.

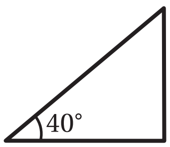


Things to Remember:

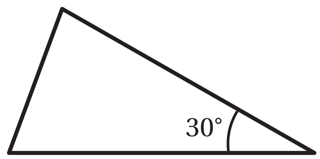
Find All Three

Directions: Make one copy for every 36 students. Then pre-cut the cards and give each student one card.

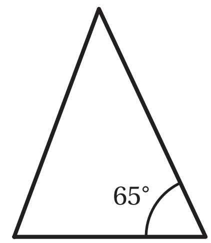
Card 1



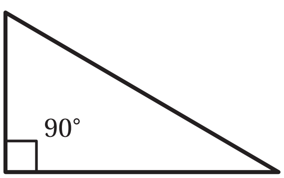
Card 2



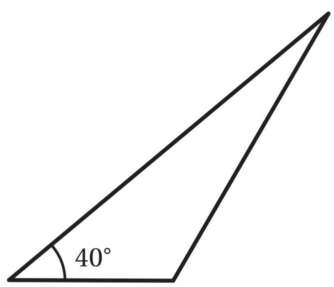
Card 3



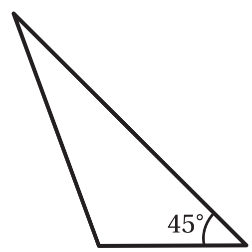
Card 4



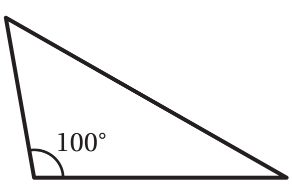
Card 5



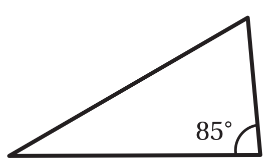
Card 6



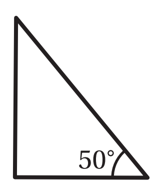
Card 7



Card 8

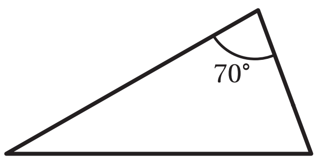


Card 9

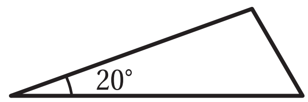


Find All Three

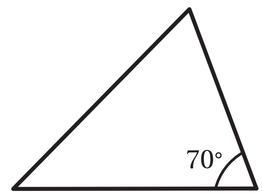
Card 10



Card 11

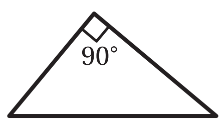


Card 12

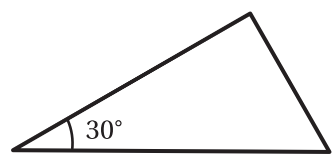


Card 13

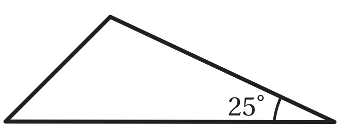
Card 14



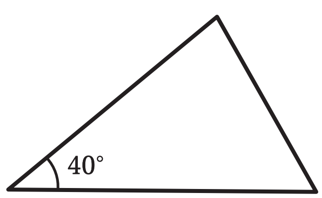
Card 15



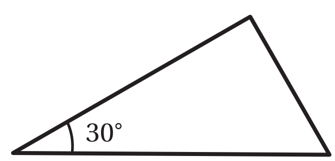
Card 16



Card 17

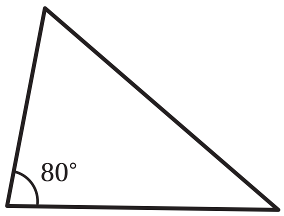


Card 18

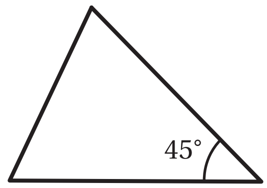


Find All Three

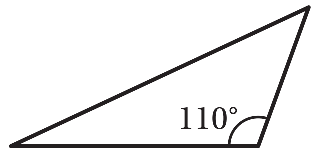
Card 19



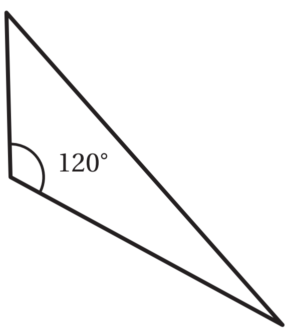
Card 20



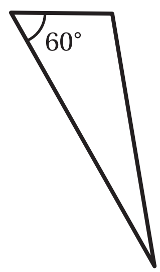
Card 21



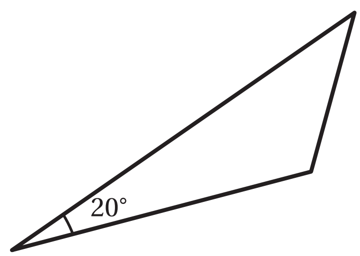
Card 22



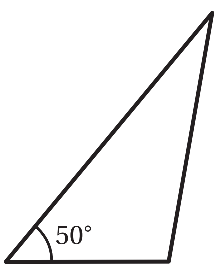
Card 23



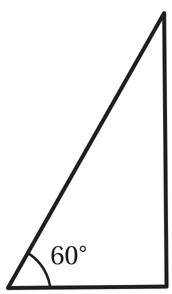
Card 24



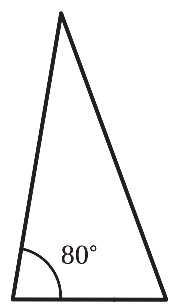
Card 25



Card 26

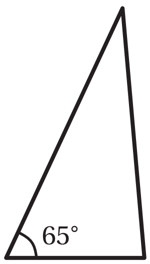


Card 27

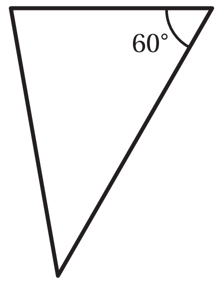


Find All Three

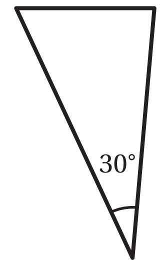
Card 28



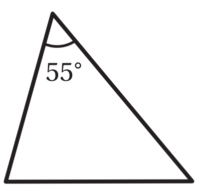
Card 29



Card 30

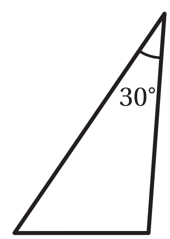


Card 31

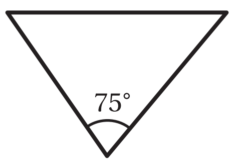


Card 32

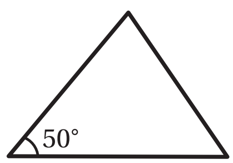
Card 33



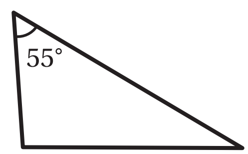
Card 34



Card 35

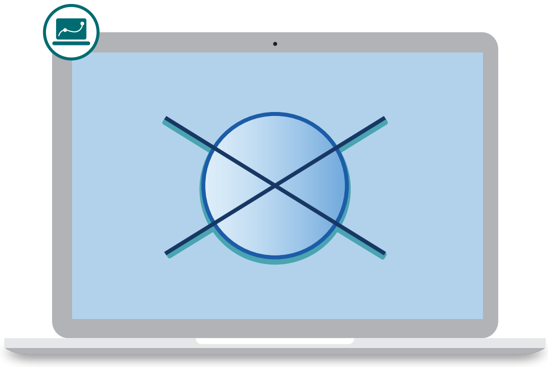


Card 36



Unit 1
Lesson
12

Name: ______ Date: ______ Period: ______



Puzzling It Out

Let's solve some puzzles using angle relationships.

Warm-Up

1 Point D is on line AC.

What are possible measures for angles ADB and CDB?

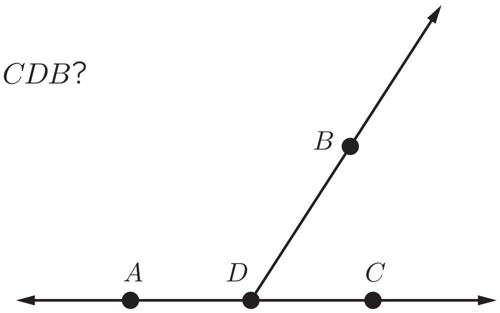


Figure may not be drawn to scale.

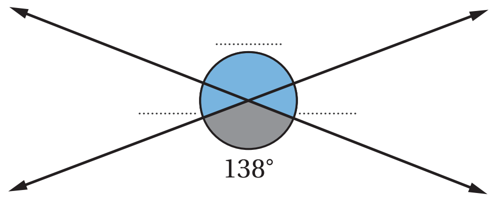
Activity
1

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

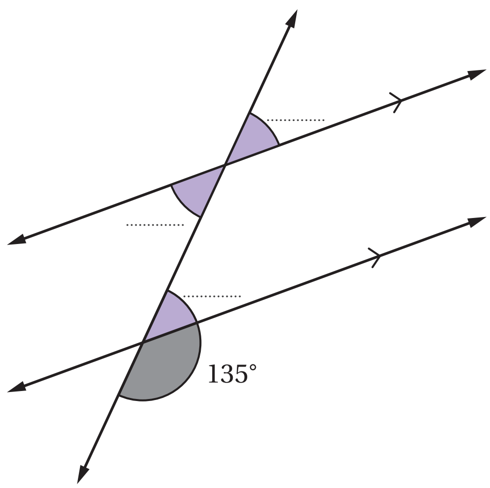
Angle Puzzles

Here are some angle puzzles. For each puzzle, one angle is revealed. You can ask for the measure of one or two more angles, if needed. Determine all the angle measures using as few hints as you can.

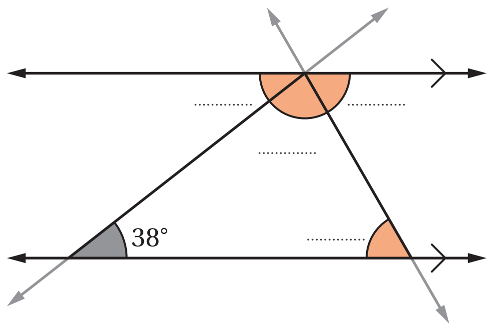
2 Angle Puzzle #1



3 Angle Puzzle #2



4 Angle Puzzle #3

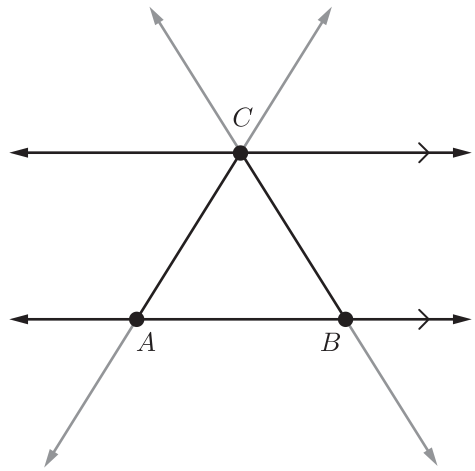


Activity 2

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

Triangles and Parallel Lines

5 Imagine that the two lines stay parallel, but you can drag points A, B, and C to make any triangle.



a Mark one set of two or more angles inside the parallel lines that you think will *always* be congruent no matter where you drag the points.

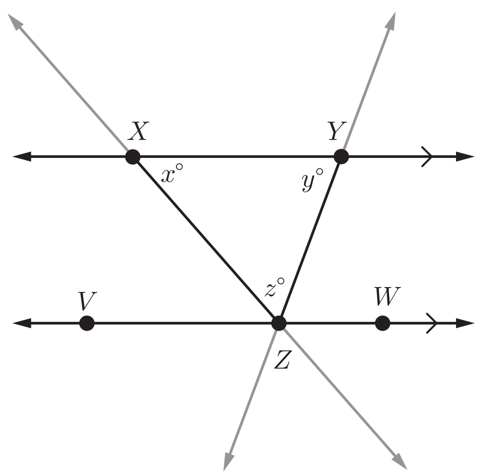
b Explain your thinking.

6 Let's see what happens when you drag points A, B, and C.

Discuss: Are the angles that you thought will always be congruent actually congruent?

7 Fabiana claims that if you tell her the value of x and y, she can use *transformations* to determine the value of z.

What might Fabiana be thinking? Do you believe her claim?



Activity 3

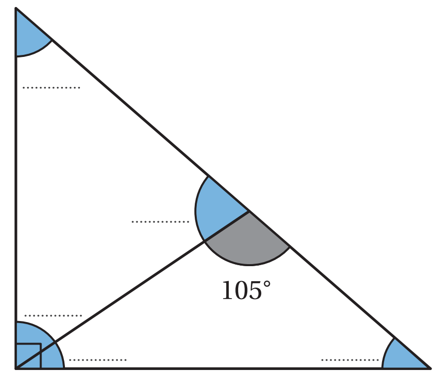
Name: .... Date: .... Period: ....

More Angle Puzzles

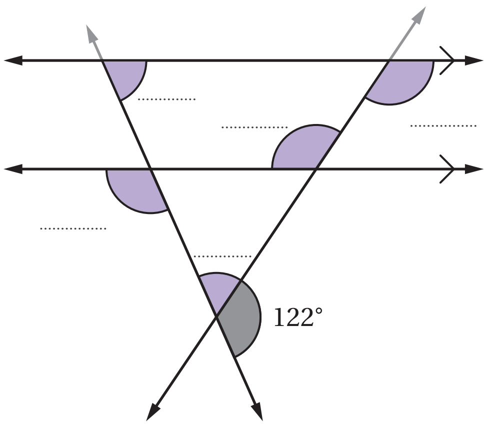
Here are some more angle puzzles. For each puzzle, one angle is revealed. You can ask for the measure of up to two more angles, if needed. Determine all the angle measures using as few hints as you can.

8 Angle Puzzle #4

Note: The square indicates a right angle (90°).



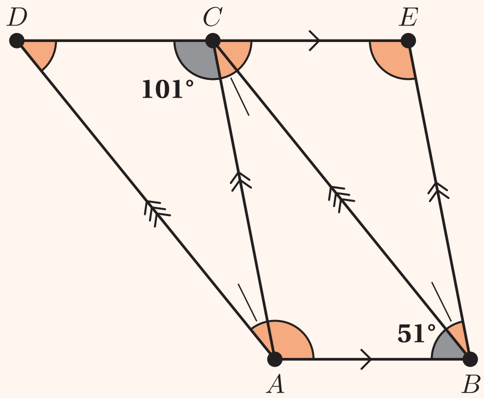
9 Angle Puzzle #5



Explore More

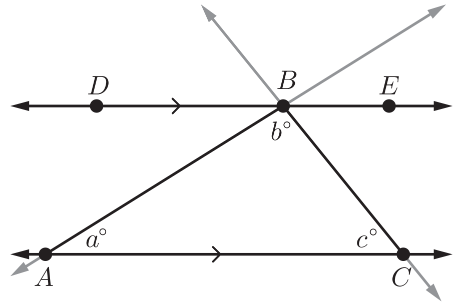
10 Here is a diagram with three pairs of parallel lines. Is it possible to determine all of the angle measures with the given information?

Show or explain your thinking.



11 Synthesis

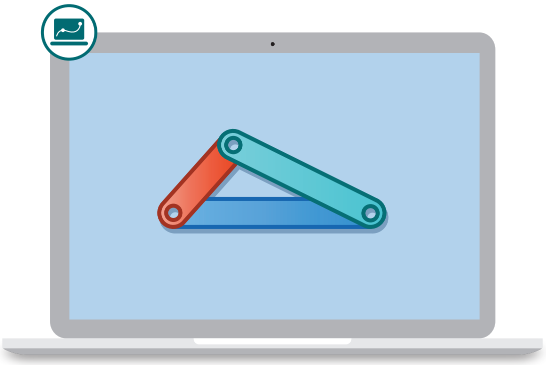
What are some angle relationships that can help you determine unknown angle measures?



Things to Remember:

Unit 7
Lesson
5

Name: ________ Date: ________ Period: ________

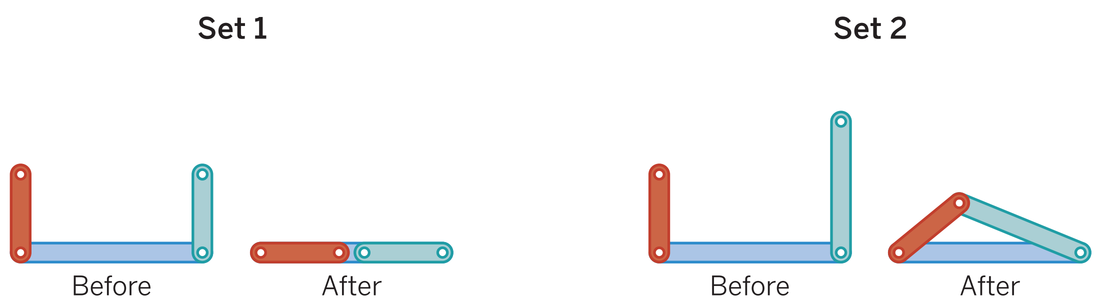


Can You Build It?

Let's explore what combinations of three line segments form a triangle.

Warm-Up

1 Here are two sets of line segments that were used to try to form a triangle.



What do you notice? What do you wonder?

I notice:

I wonder:

Activity
1

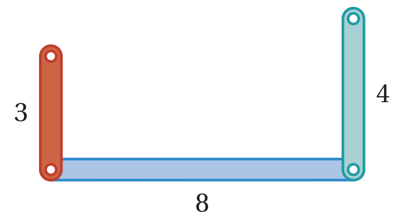
Name: .... Date: .... Period: ....

Length of the Third Side

You will use a set of line segments to complete this activity.

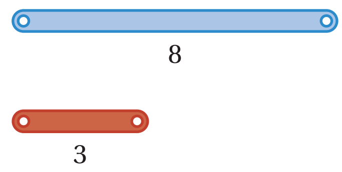
2 Will these three line segments form a triangle? Circle one.

Yes No I'm not sure



Explain your thinking.

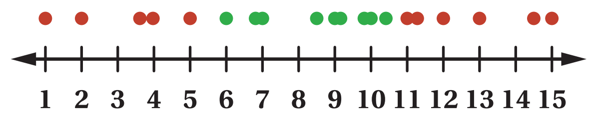
3 Set 1 and Set 2 from the Warm-Up each have one line segment that is 8 units long and one that is 3 units long. Set 1 does not form a triangle. Set 2 does.



Try other lengths for the third segment. Try to find several that do and do not form a triangle.

Forms a Triangle	**Does Not Form a Triangle**
• 10 units	• 2 units

4 Here is a graph of other lengths that students tried. The lengths that form a triangle are represented by green dots.



Describe what you notice about those lengths.

Activity 2

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

Not Too Long, Not Too Short

You will use a set of line segments to complete this activity.

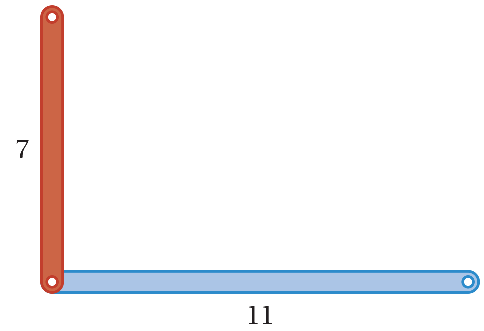
5 Jamya is convinced that a third segment that is 19 units long will form a triangle.

Mohamed thinks that 19 units is too long.

Whose claim is correct? Circle one.

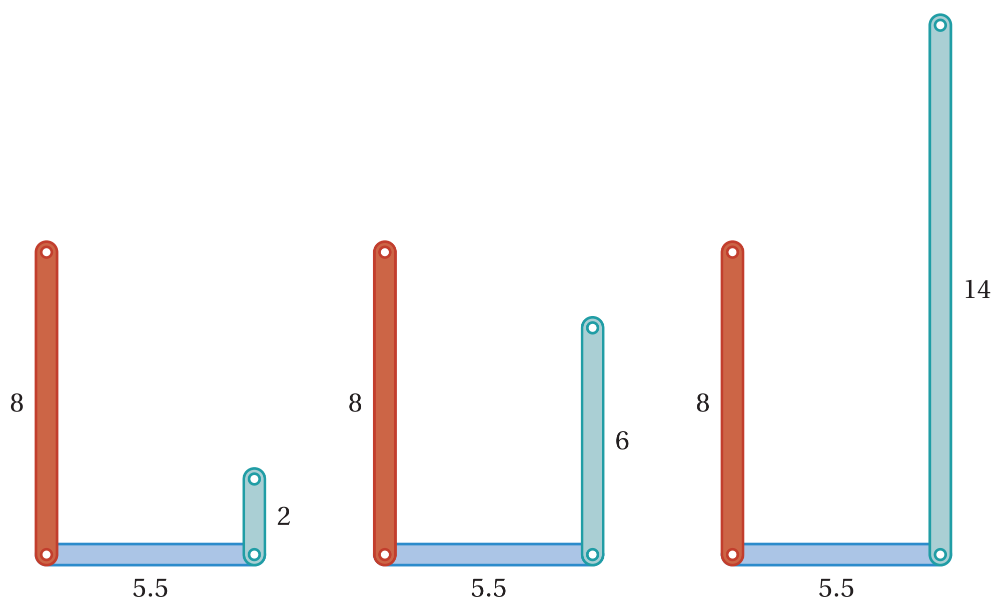
Jamya Mohamed

Explain your thinking.



6 Which of these lengths will form a triangle with side lengths 5.5 and 8 units? Circle one.

2 units 6 units 14 units



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

Not Too Long, Not Too Short (continued)

7 You will use a challenge card to create your own triangle challenge.

- Choose two line segments of any length.
- Determine three multiple choice options. One option should form a triangle with your other line segments, and two options should not.
- Swap your triangle challenge with one or more partners.
- Determine the lengths that will form a triangle for each of your partners' challenges.
- Complete as many challenges as you have time for.

	Given Length	Given Length	Correct Third Length
........'s Challenge			
........'s Challenge			
........'s Challenge			
........'s Challenge			
........'s Challenge			

Activity 3

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

Does It Add Up

You will use a set of line segments to complete this activity.

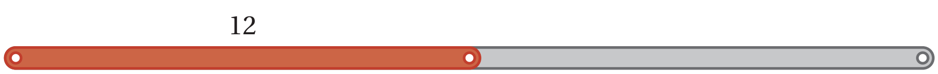
8 A triangle has a perimeter of 24 units.

Perimeter = 24 units

What are three possible lengths for the sides of this triangle?

Length 1	Length 2	Length 3

9 Abena made the first side 12 units long.



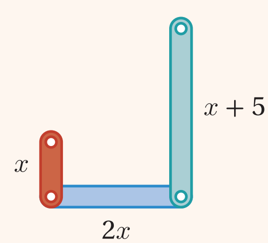
Perimeter = 24 units

Will Abena be able to form a triangle with a perimeter of 24 units? Explain your thinking.

Explore More

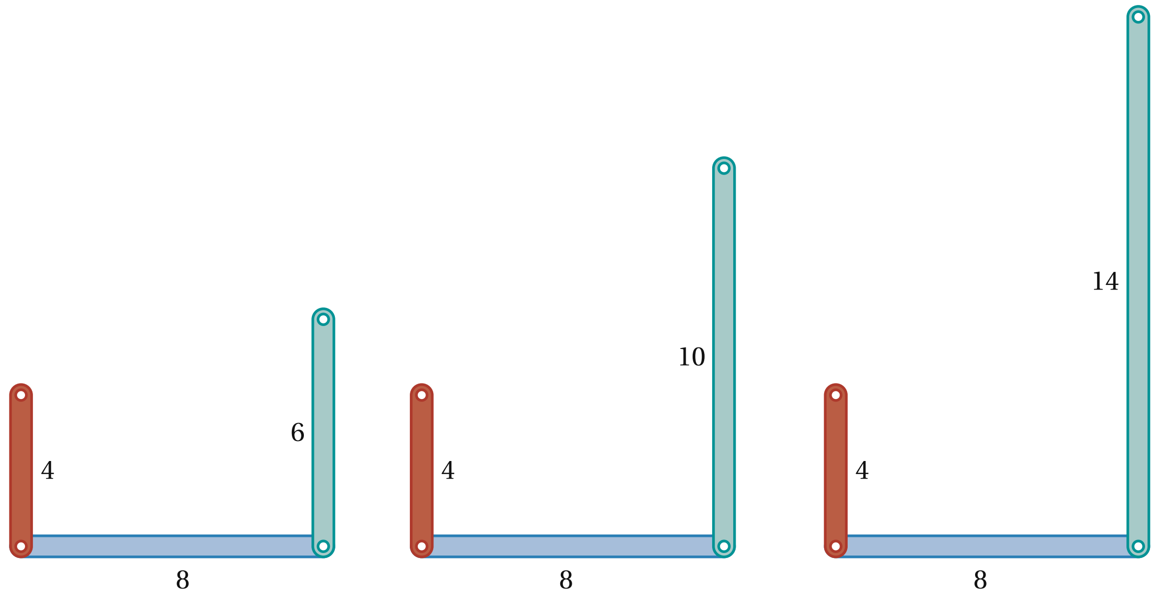
10 A triangle has sides that are x, $2x$, and $x + 5$ units.

What are some values of x that would form a triangle?



11 Synthesis

Explain how you can determine whether three line segments will form a triangle.



Things to Remember:

Not Too Long, Not Too Short

Lesson 7.05
Activity 2

Directions: Make one copy per four students. Then pre-cut the cards and give each student one card to record their own challenge.

____________’s Challenge

Given Length	Given Length

Select the correct length of the third segment.

A. ____________ units

B. ____________ units

C. ____________ units

____________’s Challenge

Given Length	Given Length

Select the correct length of the third segment.

A. ____________ units

B. ____________ units

C. ____________ units

____________’s Challenge

Given Length	Given Length

Select the correct length of the third segment.

A. ____________ units

B. ____________ units

C. ____________ units

____________’s Challenge

Given Length	Given Length

Select the correct length of the third segment.

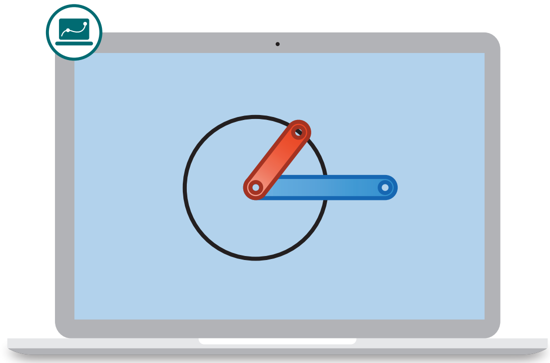
A. ____________ units

B. ____________ units

C. ____________ units

Unit 7
Lesson
6

Name: ______ Date: ______ Period: ______



Is It Enough?

Let's explore connections between line segments and circles.

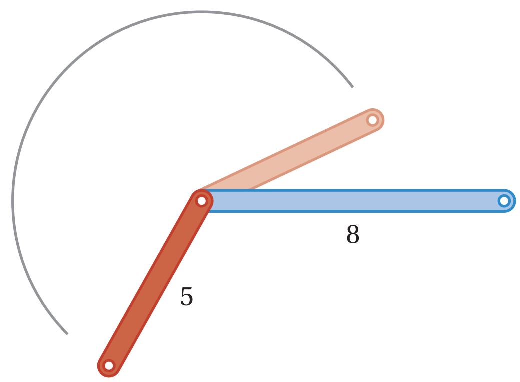
Warm-Up

1 Let's watch a line segment rotate around.

What shape does its path create? Explain why this makes sense.

The shape the path makes is . . .

This makes sense because . . .



Activity 1

Name: ______ Date: ______ Period: ______

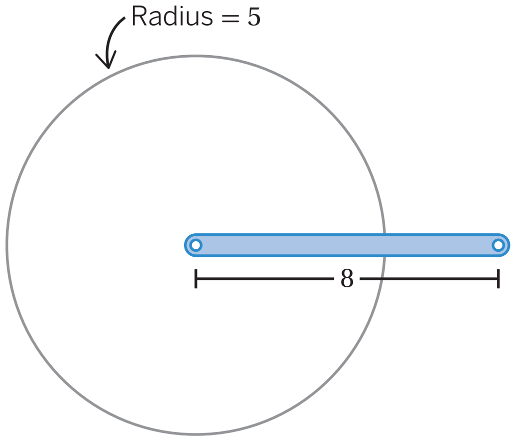
Building Triangles

You will use a set of line segments to help with your thinking.

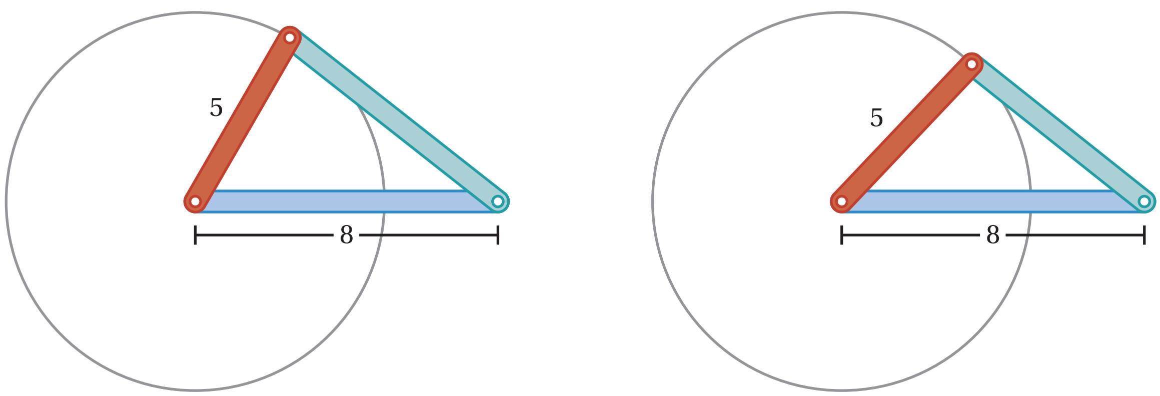
2 Use the circle and the segments to create different triangles.

Select each triangle you're able to make.

- ☐ A triangle with a very long third side
- ☐ A triangle with a short third side
- ☐ A triangle with a $90°$ angle
- ☐ A triangle with all acute angles
- ☐ An isosceles triangle



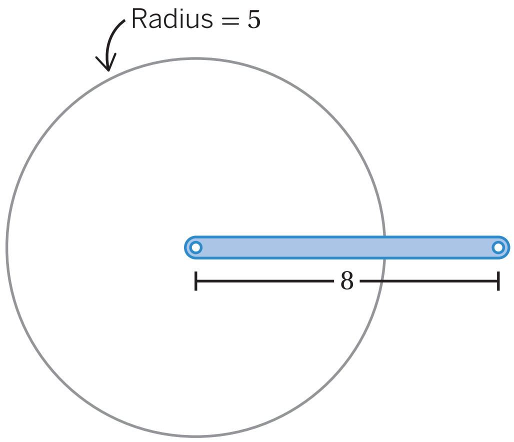
3 A student made these two triangles.



Discuss: How can you tell these triangles are not the same?

4 Angel wants to draw a triangle with sides that are 5, 8, and 9 units long.

Describe or show how Angel might draw a third side that is 9 units long.



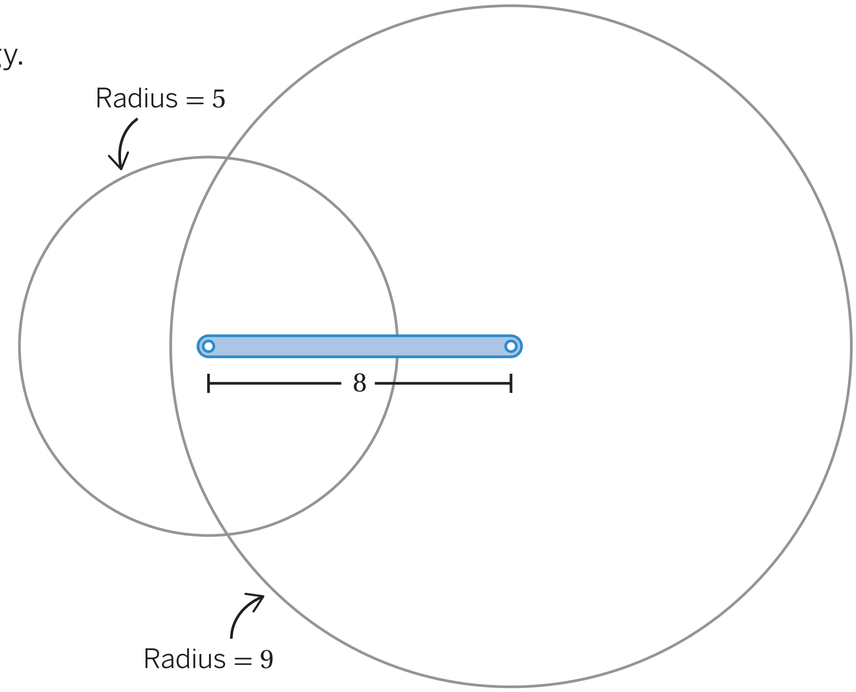
Activity 1

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

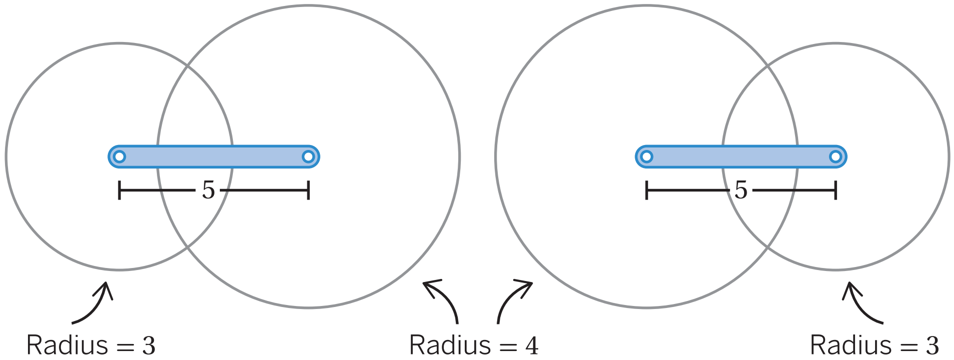
Building Triangles (continued)

5 Here is Angel's strategy.

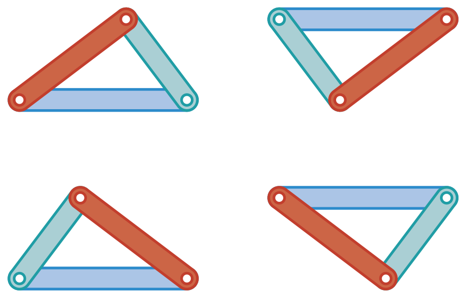
Draw a triangle that Angel could have drawn with side lengths that are 5, 8, and 9 units.



6 Use Angel's strategy to create two triangles with sides that are 3, 4, and 5 units long.



7 Here are four possible triangles with side lengths of 3, 4, and 5 units. Angel thinks these triangles are **identical copies**.



Do you agree? Circle one.

Yes No I'm not sure

Explain your thinking.

Activity 2

Name: ________ Date: ________ Period: ________

Uniqueness

You will use a set of line segments to help with your thinking.

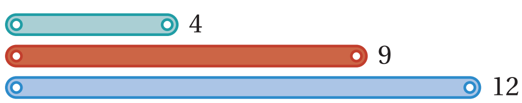
8 **a** Create two different triangles with the same side lengths. Then draw your triangles.

Triangle A **Triangle B**

b **Discuss:** Will these three side lengths always create *identical copies*?

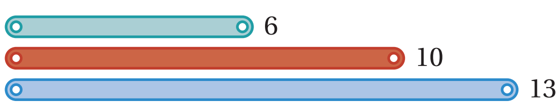
9 Circle the number of non-identical polygons that can be made using each set of line segments.

a



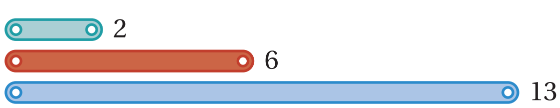
Zero One More than one

b



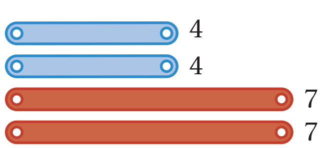
Zero One More than one

c



Zero One More than one

d



Zero One More than one

Activity
3

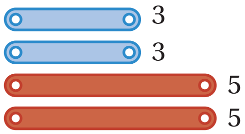
Name: .... Date: .... Period: ....

Quadrilaterals

You will use a set of line segments to help with your thinking.

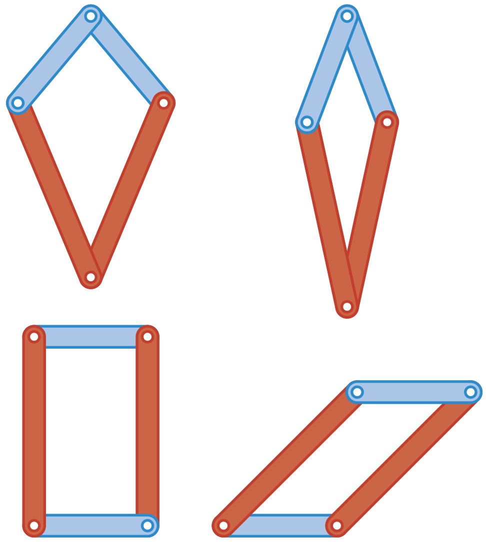
10 Lukas made a quadrilateral with sides that are 3, 3, 5, and 5 units long.

Draw the shape Lukas might have made.



11 Here are four quadrilaterals that Lukas made with the sides that are 3, 3, 5, and 5 units long.

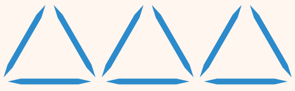
Describe why it's possible for Lukas to create quadrilaterals that are not identical copies.



Explore More

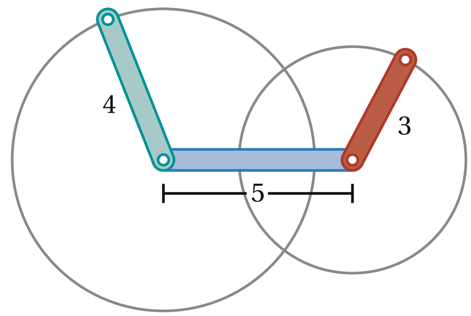
12 In the diagram, 9 toothpicks are used to make three equilateral triangles.

Draw or describe how you can move only 3 of the toothpicks to make a diagram that has exactly 5 equilateral triangles.



13 Synthesis

a Describe how to create a triangle given three side lengths.

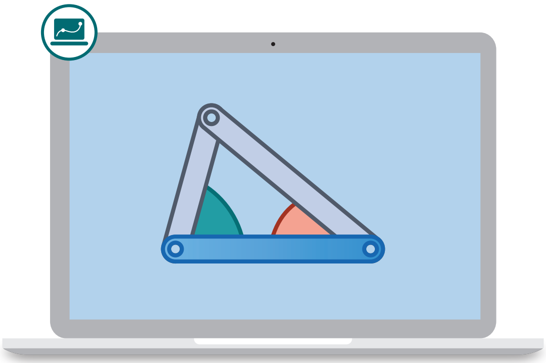


b Explain why there will be only one possible triangle.

Things to Remember:

Unit 7
Lesson
7

Name: ________ Date: ________ Period: ________



More Than One?

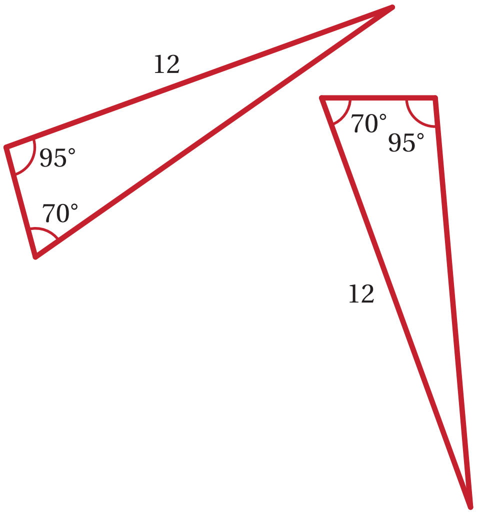
Let's build and compare triangles.

Warm-Up

1 Are these triangles identical? Circle one.

Yes   No   I'm not sure

Explain your thinking.



Activity 1

Name: Date: Period:

Two Angles, One Side

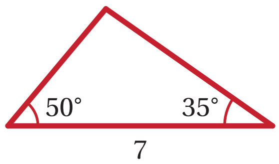
You will use a set of line segments and angles to help you with your thinking.

2 Sol made a triangle with these measurements:

- A side length of 7 units
- A $35°$ angle
- A $50°$ angle

Roberto wants to make a triangle with the same measurements. Will Roberto's triangle be identical to Sol's? Circle one.

Sol's Triangle



Definitely Maybe No way

Explain your thinking.

3 Create triangles with the same measurements as Sol's triangle.

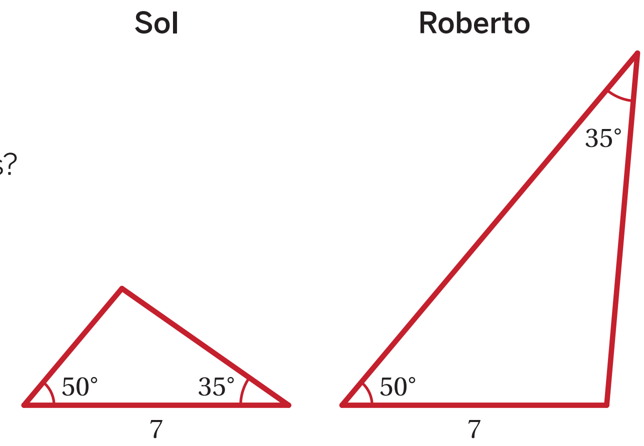
Try to create more than one non-identical triangle.

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

Two Angles, One Side (continued)

4 Here are the triangles that Sol and Roberto created.

What could you say to help Roberto create a triangle that is identical to Sol's?



Activity
2

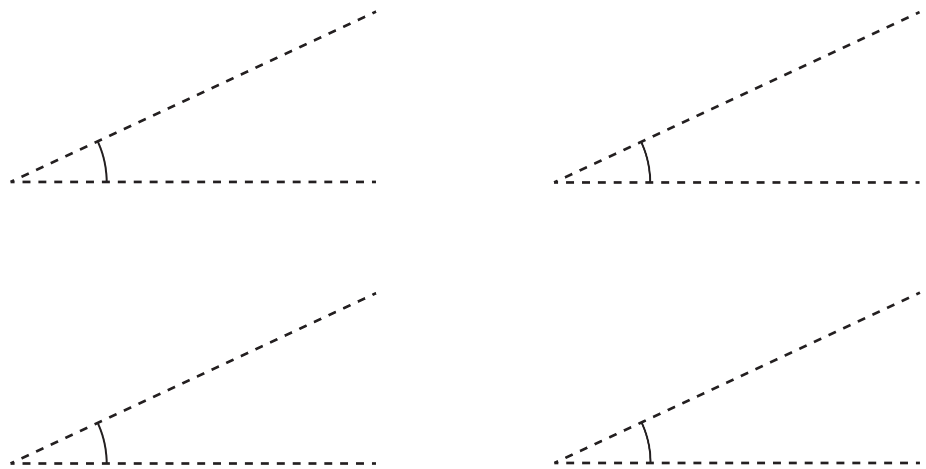
Name: .... Date: .... Period: ....

Side Angle Side

You will use a set of line segments and angles to help you with your thinking.

5 **a** Create as many non-identical triangles as you can with these measurements:

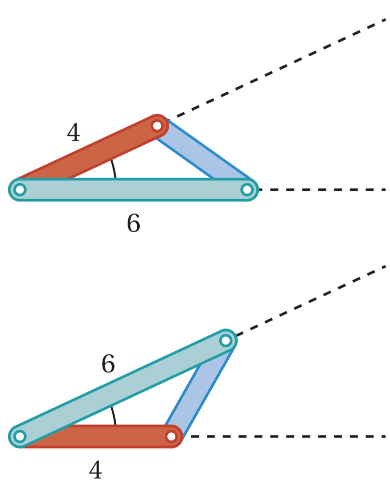
- Side lengths of 4 and 6 units
- One angle of $25°$



b **Discuss:** What was your strategy for making non-identical triangles?

6 Malik claims he will always get *identical copies* if the $25°$ angle is between the side lengths of 4 and 6 units.

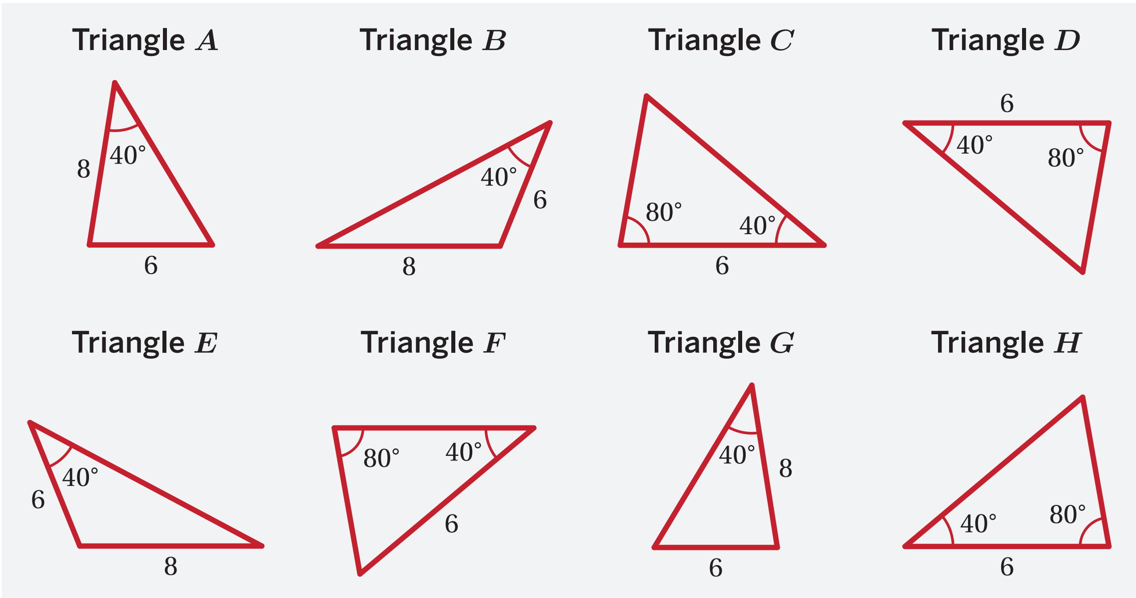
Is Malik's claim correct? Explain your thinking.



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

Side Angle Side (continued)

7 Make groups of identical copies. One triangle will not have a group.



Group 1	Group 2	Group 3

8 Isabelle claims Triangles A and E are identical copies and belong in the same group. Is Isabelle's claim correct? Circle one.

Yes, they're identical

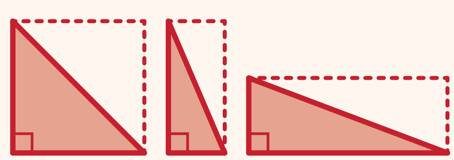
No, they're not identical

Explain your thinking.

Explore More

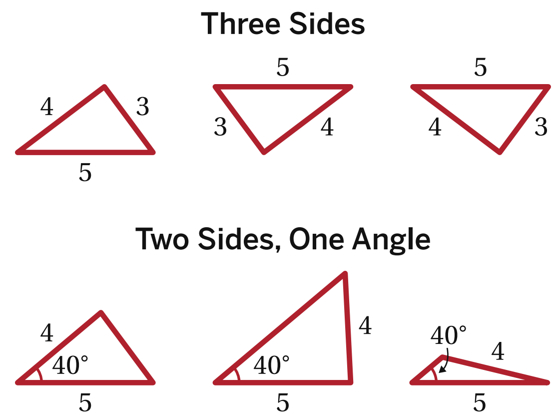
9 Fatima thinks that in a right triangle, the other two angles are *complementary* (add up to 90°).

Is Fatima correct? Explain your thinking.



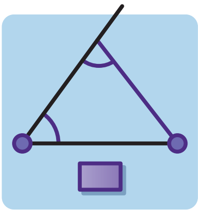
10 Synthesis

Explain why triangles with three of the same side lengths are *identical copies*, but triangles with the same two side lengths and one angle measure aren't always identical copies.



Things to Remember:

Name: ________ Date: ________ Period: ________



Can You Draw It?

Let's draw triangles.

Warm-Up

1. Sketch a shape or figure that includes:

- A line segment with a length of 3 centimeters.
- A 45° angle.

Activity
1

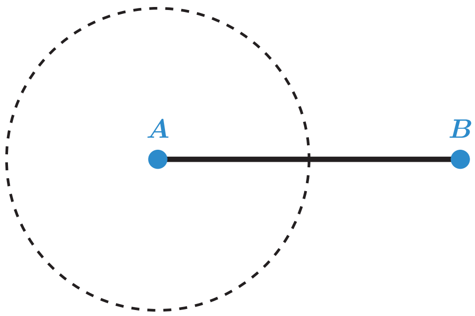
Name: ______ Date: ______ Period: ______

Complete the Triangles

2. Sadia is trying to draw a triangle with sides measuring 3 centimeters, 2 centimeters, and 4 centimeters. Here are the steps Sadia took so far:

- Step 1: Draw a 4-centimeter line segment AB.
- Step 2: Use a compass to draw a circle around point A with a radius of 2 centimeters.

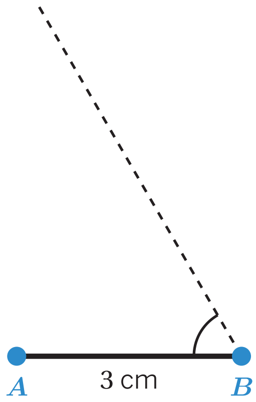
Describe or show how Sadia can finish drawing this triangle.



3. Nekeisha is trying to draw a triangle with one 3-centimeter side, one 4-centimeter side, and one 60° angle. Here are the steps Nekeisha took so far:

- Step 1: Draw a 3-centimeter line segment.
- Step 2: Use a protractor to draw a 60° angle at one end of the line segment.

Describe or show how Nekeisha can finish this drawing.



Name: ______ Date: ______ Period: ______

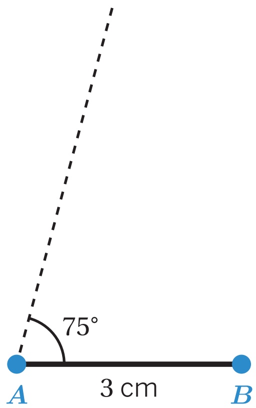
Complete the Triangles (continued)

4. Ahmed is trying to draw a triangle with one $45°$ angle, one $75°$ angle, and one 3-centimeter side.

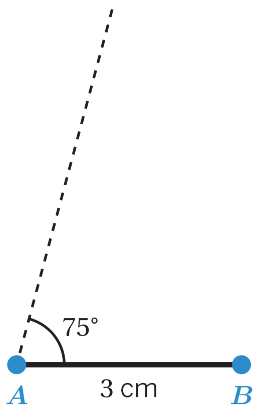
Here are the steps Ahmed took so far:

- Step 1: Draw a 3-centimeter line segment.
- Step 2: Use a protractor to draw a $75°$ angle.

Describe or show how Ahmed can finish this drawing.



5. Is it possible for Ahmed to draw another non-identical triangle that matches this description? Use the diagram to show or explain your thinking.



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

Drawing Challenges

For each description:

- Draw as many non-identical triangles as you can.
- Determine how many unique triangles can be made with these measurements.

6. Two 3-centimeter sides and one $50°$ angle.

How many unique triangles can be made with these measurements? Circle one.

Zero One More than one

7. Two 3-centimeter sides with a $50°$ angle between them.

How many unique triangles can be made with these measurements? Circle one.

Zero One More than one

8. One $30°$ angle, one $60°$ angle, and one $90°$ angle.

How many unique triangles can be made with these measurements? Circle one.

Zero One More than one

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

Drawing Challenges (continued)

9. One $60°$ angle, one $90°$ angle, and one 3-centimeter side.

How many unique triangles can be made with these measurements? Circle one.

Zero One More than one

10. Two $90°$ angles and one 3-centimeter side.

How many unique triangles can be made with these measurements? Circle one.

Zero One More than one

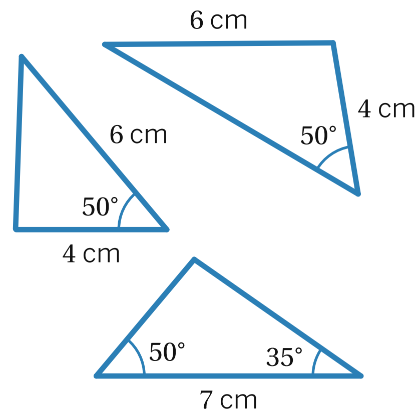
Explore More

11. What is the greatest number of non-identical triangles possible when you know the measurements of two sides and one angle?

Show or explain your thinking.

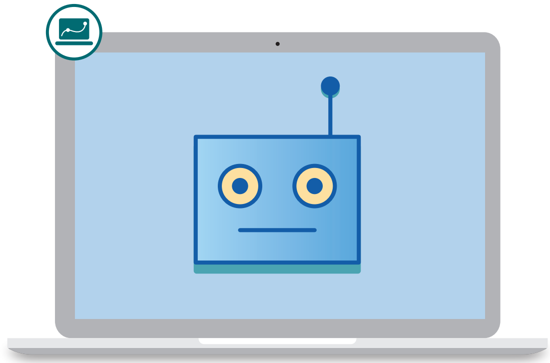
Synthesis

12. Describe how many non-identical triangles can be made with different combinations of measurements.



Things to Remember:

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



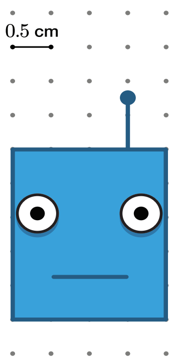
Scaling Robots

Let’s explore scaled copies further.

Warm-Up

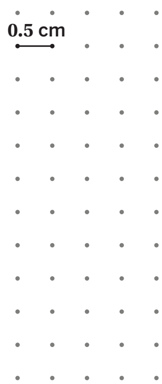
1 Create a robot face that you like. Your robot face should be a rectangle and include two eyes and an antenna. (See the example robot.) Then complete the table.

Example Robot



Height (cm)	2.5
Width (cm)	2
Eye Distance (cm)	1
Antenna (cm)	0.75

My Robot



Height (cm)	
Width (cm)	
Eye Distance (cm)	
Antenna (cm)	

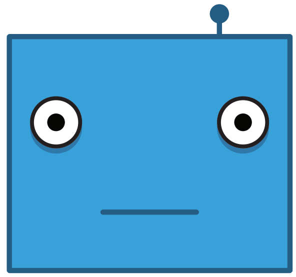
Activity
1

Name: ____________ Date: ________ Period: ________

Scaling Robots

2 Here's Felipe's robot. He wants to make a scaled copy of his robot. Complete the table so that the new measurements represent a scaled copy of his original robot.

Felipe's Robot



	Original Robot	New Robot
Height (cm)	5	10
Width (cm)	4	
Eye Distance (cm)	2.5	
Antenna (cm)	0.5	

3 Scaled copies always have a **scale factor**.

Imani and Anh built a robot and made a table for a scaled copy.

Imani

	Original Robot	New Robot
Height (cm)	5 $\xrightarrow{\times 2}$	10
Width (cm)	3	6
Eye Distance (cm)	2	4
Antenna (cm)	1.5 $\xrightarrow{\times 2}$	3

Anh

	Original Robot	New Robot
Height (cm)	5	10
Width (cm)	3	6
Eye Distance (cm)	2	4
Antenna (cm)	1.5	3

$$\frac{10}{5} = \frac{6}{3} = \frac{4}{2} = \frac{3}{1.5}$$

Show or describe where in their work you can see the scale factor is 2.

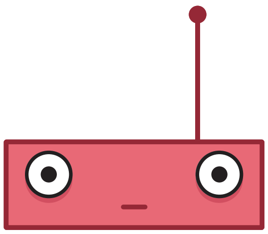
Activity
2

Name: ____ Date: ____ Period: ____

Analyzing Robots

4-5 Imani made another robot and tried to make a scaled copy.

Imani's Robot



	Original Robot	New Robot
Height (cm)	2	8
Width (cm)	6	12
Eye Distance (cm)	4	10
Antenna (cm)	1	7

Do you think the new robot will be a scaled copy?

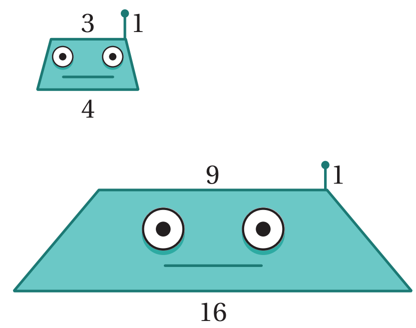
If yes, explain your thinking.

If no, cross out and replace one or more measurements so that the new robot *is* a scaled copy.

Name: ________ Date: ________ Period: ________

Analyzing Robots (continued)

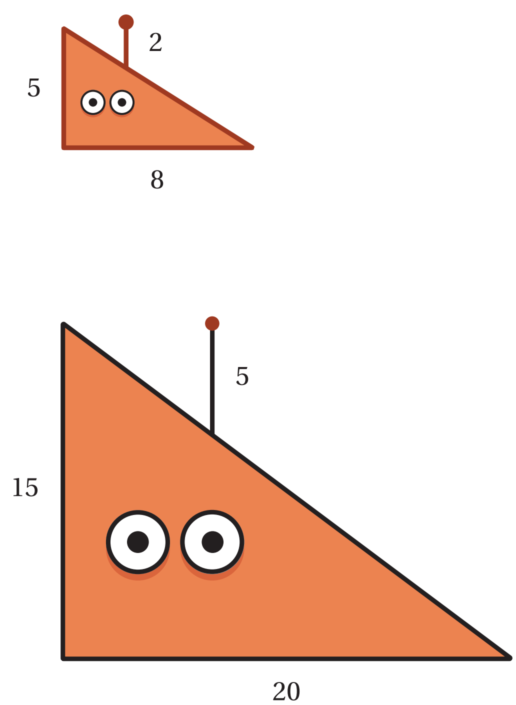
6 Anushka made the small robot. Then she tried to make a scaled copy of the robot.



a **Discuss:** What might Anushka's strategy have been?

b How could you help Anushka revise her work?

7 Na'ilah drew a small and a large robot. Help her make the large robot a scaled copy.



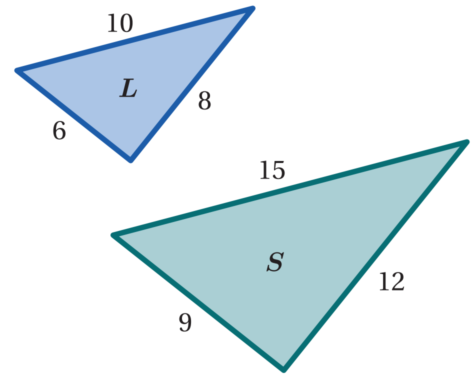
a Cross out and replace one or more measurements on the large robot that could make it a scaled copy.

b What is the scale factor from the small to the large robot?

8 Synthesis

How can you use lengths to determine whether a figure is a scaled copy of another figure?

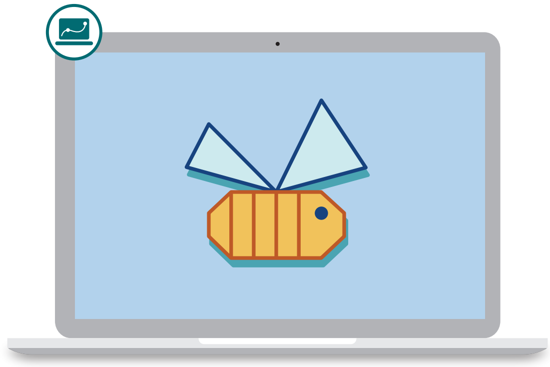
Use the example if it helps with your thinking.



Things to Remember:

Unit 1
Lesson
3

Name: ______ Date: ______ Period: ______

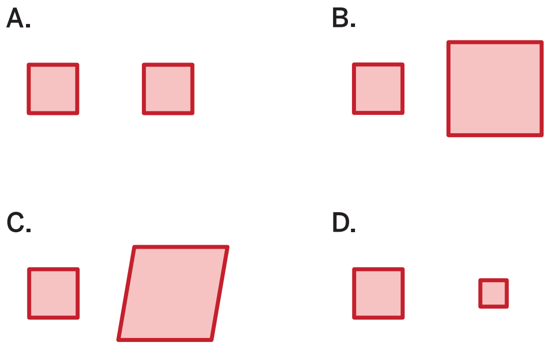


Make It Scale

Let's draw scaled copies.

Warm-Up

1 Which pair doesn't belong? Explain your thinking.

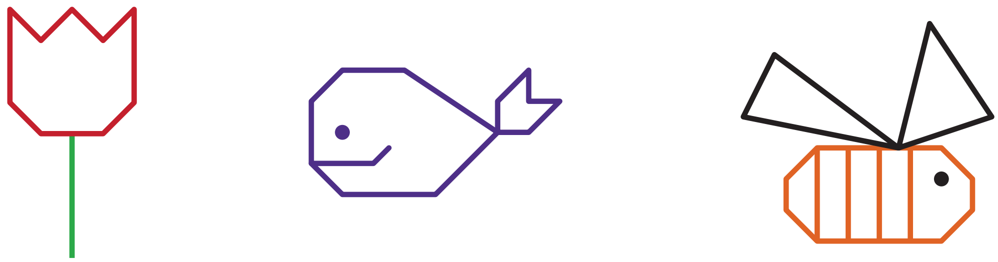


Activity 1

Name: ______ Date: ______ Period: ______

Drawing Scaled Copies Without a Grid

2-3 Choose *one* figure that you'd like to make a scaled copy of. Complete the scaled copy of the figure you chose. Use a scale factor of 2.



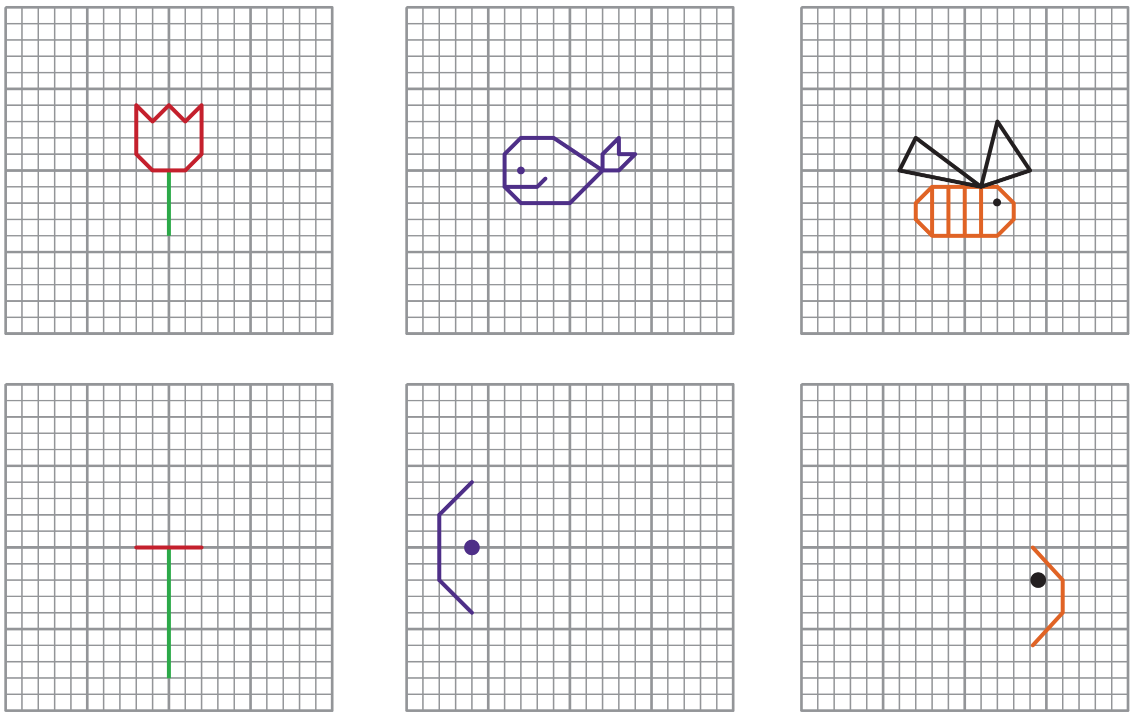
4 What might help you make a more accurate scaled copy?

Activity 2

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

Drawing Scaled Copies With a Grid

5 Make a new scaled copy of the figure you chose. Use a scale factor of 2.

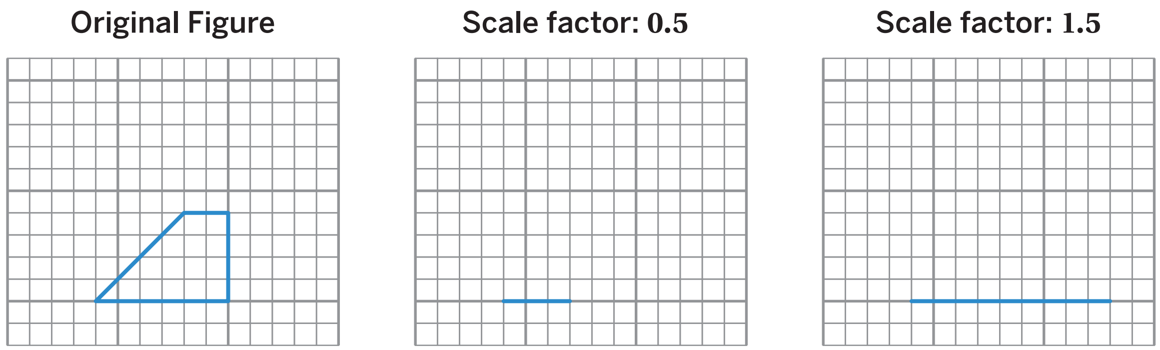


6 Explain the strategy you used to draw the new scaled copy.

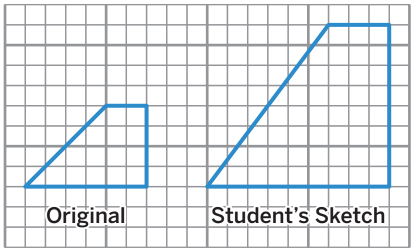
Name: ______ Date: ______ Period: ______

Drawing Scaled Copies With a Grid (continued)

7 Choose a scale factor of 0.5 or 1.5. Then complete the scaled copy.



8 Here is one student's sketch. Sasha thinks the student used a scale factor of 2. Randy thinks the student used a scale factor of 1.5. Who is correct? Circle one.

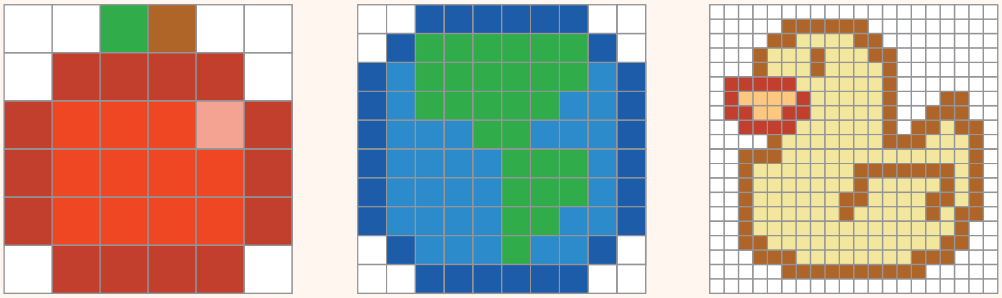


Sasha   Randy   Both   Neither

Explain your thinking.

Explore More

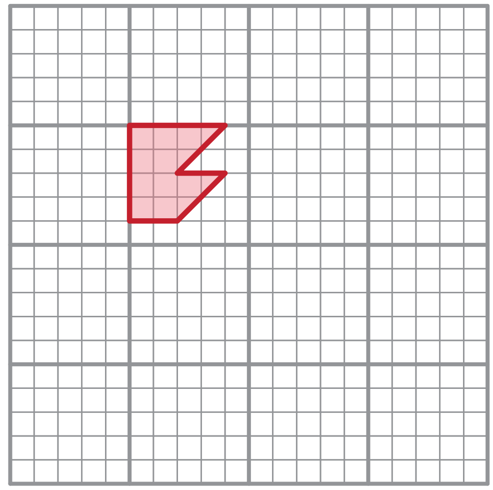
9 On a piece of graph paper, draw one of these images using a scale factor of 1.5. Or draw your own image and a scaled copy.



10 Synthesis

Describe how to draw a scaled copy.

Use the example if it helps with your thinking.



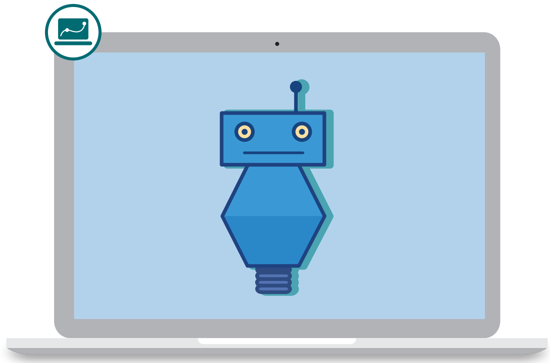
Things to Remember:

Unit 1
Lesson
4

Name: ______ Date: ______ Period: ______

Scale Factor Challenges

Let's explore how scale factors affect the size of scaled copies.



Warm-Up

1 a **Discuss:** How are these equations alike? How are they different?

A. $8x = 80$

B. $8x = 8$

C. $8x = 1$

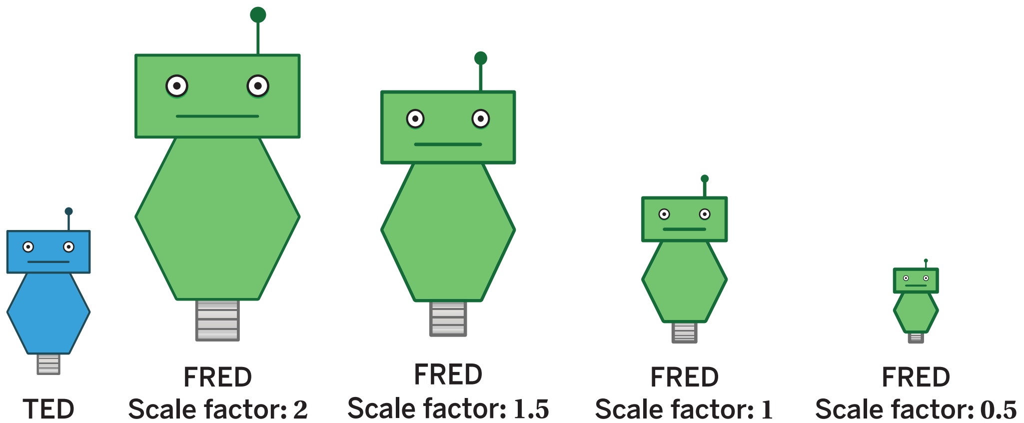
D. $\frac{1}{8}x = 1$

b Use what you noticed to solve each equation mentally.

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

Exploring Scale Factors

2 Here is a robot: TED. The other robots are scaled copies of TED with different scale factors.



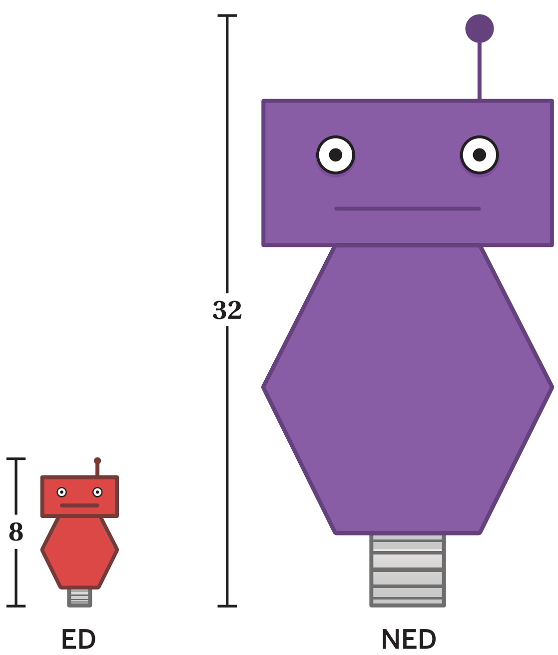
Discuss: What do you notice?

3 Here are two new robots: ED and NED. In this lesson, all measurements are in grid units.

What scale factor will make ED match NED?

4 What scale factor will make NED match ED?

Explain your thinking.



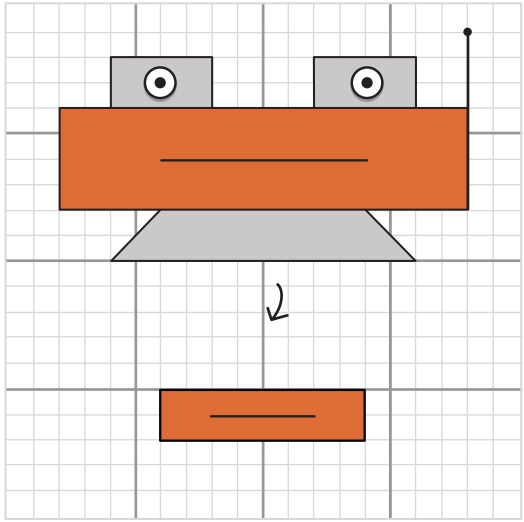
Activity 2

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

Scaled Down and Back Again

5 Here is a robot called ROVER.

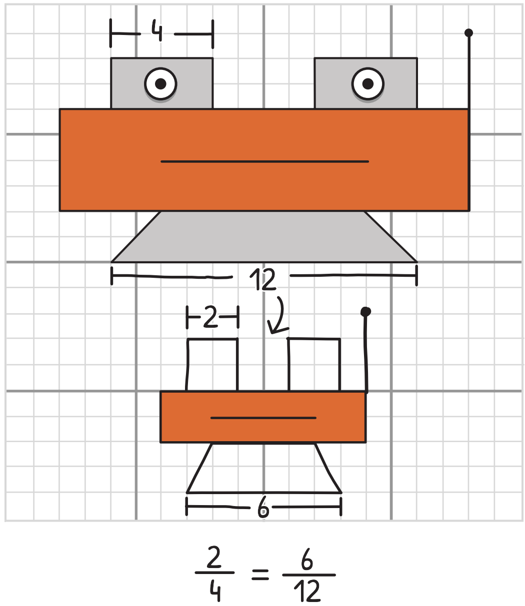
Complete the scale drawing of ROVER using a scale factor of $\frac{1}{2}$.



6 Here is Adhira's drawing from the previous problem.

a What is something Adhira did well?

b What is something Adhira can improve?



7 The scale factor from the original to the copy is $\frac{1}{2}$.

a What scale factor could you use to scale the copy back to the original?

b How are these two scale factors related?

Activity 3

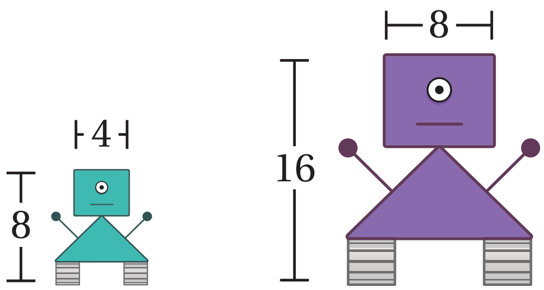
Name: ______ Date: ______ Period: ______

Practicing With Scale Factors

8 In this activity, all pairs of bots have corresponding measurements that are proportional.

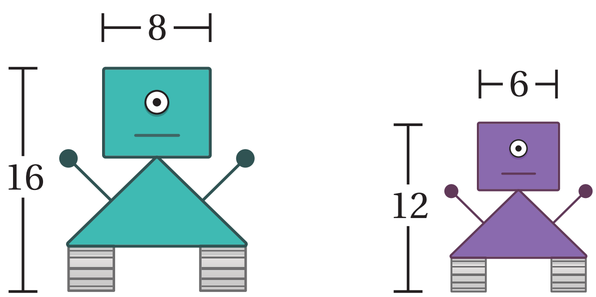
Determine a scale factor to make the bot on the left match the bot on the right.

a



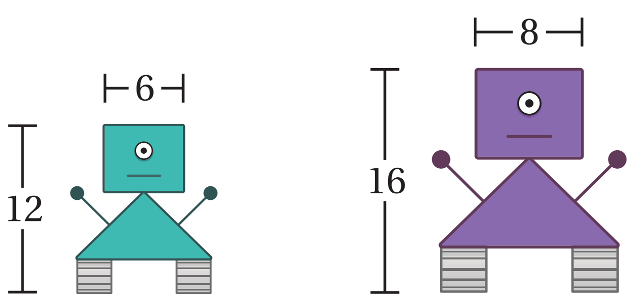
Scale factor: ______

b



Scale factor: ______

c

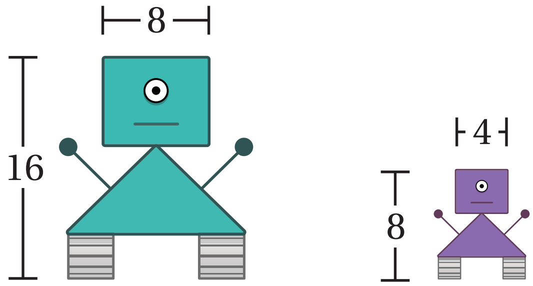


Scale factor: ______

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

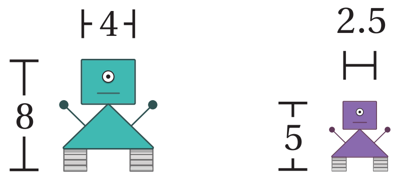
Practicing With Scale Factors (continued)

d



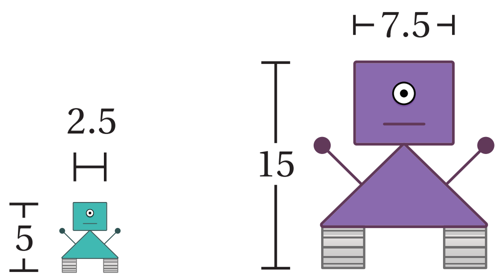
Scale factor: ....

e



Scale factor: ....

f



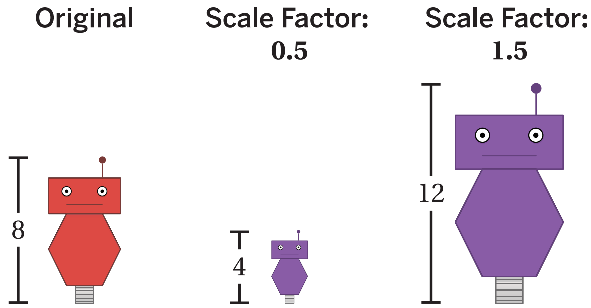
Scale factor: ....

Explore More

9 Use the Explore More Sheet to design your own robot. Then complete its scaled copy.

10 Synthesis

Describe how you can tell from the scale factor whether a scaled copy will be larger than, smaller than, or the same size as the original.

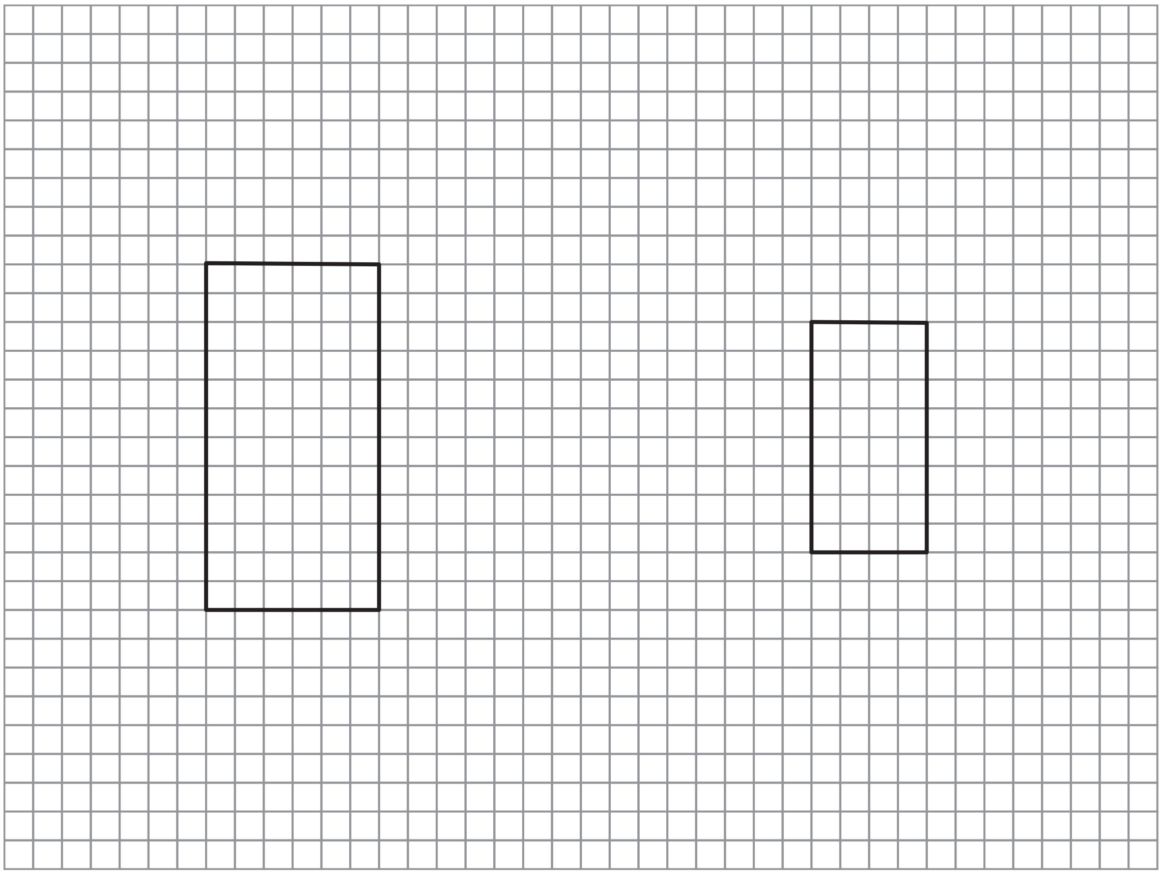


Things to Remember:

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

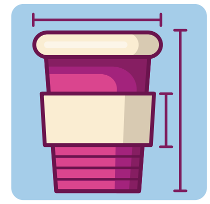
Explore More

Design your own robot on the left. Then complete its scaled copy on the right.



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

Will It Fit?

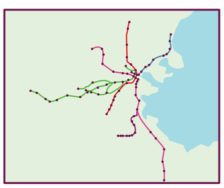


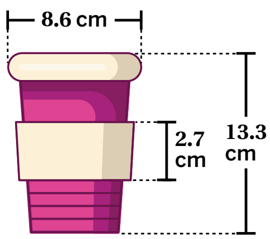
Let's analyze scale drawings.

Warm-Up

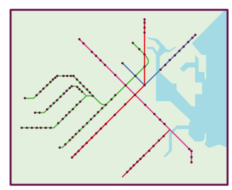
Here are some drawings of the Boston subway system and a coffee cup.

Scale Drawings





Might Not Be Scale Drawings



1. **Discuss:** What makes a drawing a **scale drawing**?

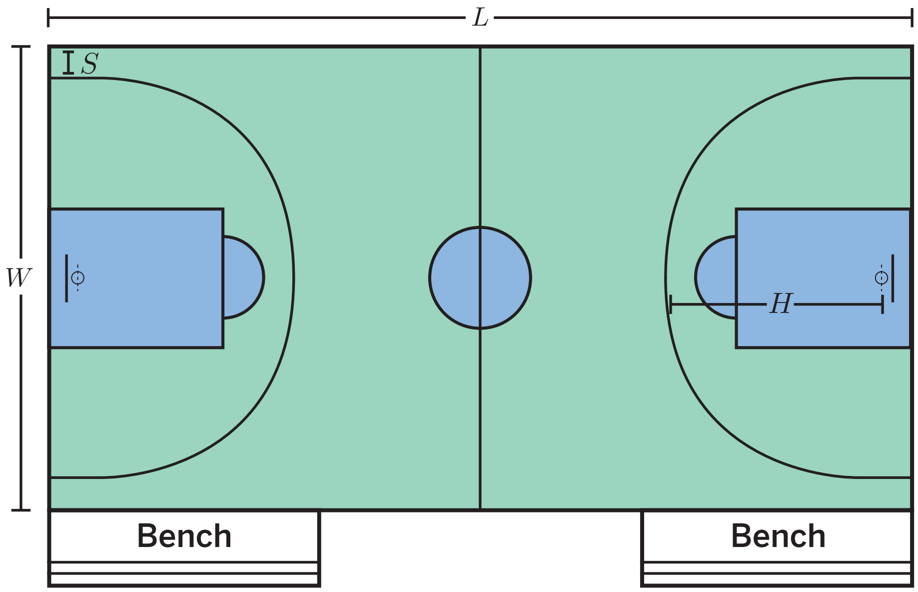
Activity 1

Name: Date: Period:

Will the Court Fit?

Karima heard from students that they would like a basketball court in their community park. When Karima presented the idea to the park's board of directors, they approved building the court in a 20-by-20-meter area of the park.

Here is the scale drawing that Karima presented.



2. The scale for Karima's drawing is 2 centimeters to 5 meters. Explain what this means in your own words.

Activity 1

Name: ______ Date: ______ Period: ______

Will the Court Fit? (continued)

Will Karima's court fit in the 20-by-20-meter square area the park directors designated for the court?

3. Use your ruler to measure the scale drawing. Record the measurements in the table. Then determine the dimensions of the actual court.

	Length of Court, L	Width of Court, W	Hoop to 3-Point Line, H	3-Point Line to Side Line, S
Scale Drawing				
Actual Court				

4. Explain how you know whether the court will fit.

Explore More

5. On an actual basketball court, the bench area is typically 9 meters long. Determine how long the bench area should be on the scale drawing.

Does your answer match Karima's drawing?

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

Superior Court

6. How would you recommend Karima adjust her proposal so that it fits in the 20-by-20-meter park area? Explain your thinking.

7. Sketch your proposed court that would fit in the 20-by-20-meter park area. Label your sketch with all necessary distances.

8. The basketball court will share the 20-by-20-meter park area with an outdoor seating area. After your court is built, how much area will remain for outdoor seating? Explain your thinking.

Synthesis

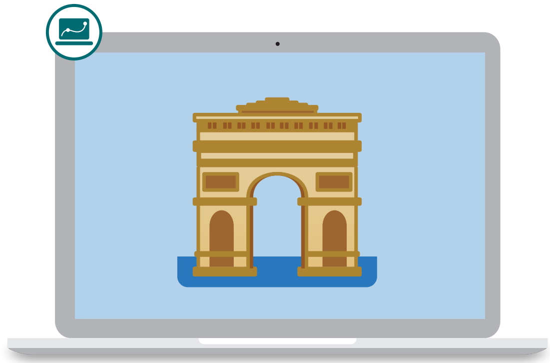
9. Explain how you could use Karima's scale drawing to calculate the actual distance across the center court circle. Remember that the scale for Karima's drawing was 2 centimeters to 5 meters.

	Distance Across the Center Court Circle
Scale Drawing	1.8 cm
Actual Court	

Things to Remember:

Unit 1
Lesson
10

Name: ______ Date: ______ Period: ______



Scaling Buildings

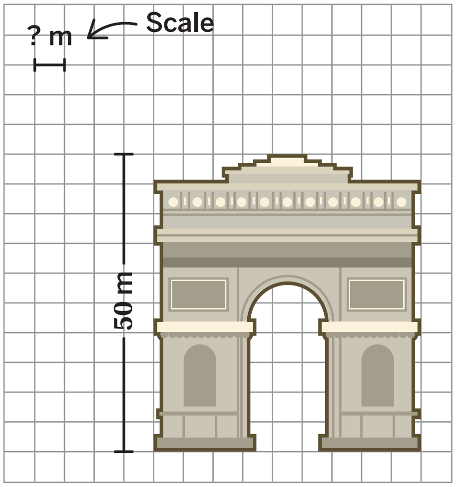
Let's see how different scales can describe the same thing.

Warm-up

1 Here is a scale drawing of the Arc de Triomphe in Paris, France.

The Arc de Triomphe is 50 meters tall.

What is the unknown value in the scale?

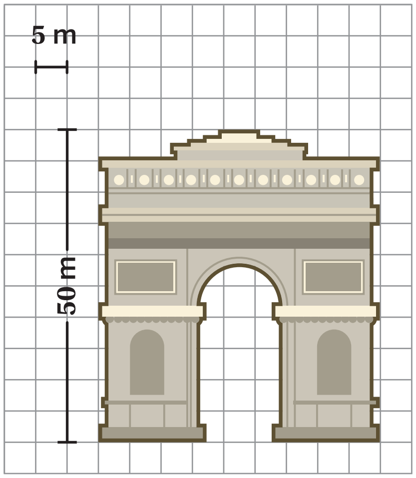


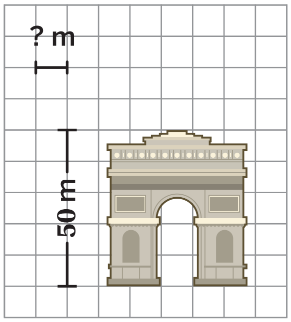
Arc de Triomphe, France (1836)

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

Same Object, Different Scale

Here are two scale drawings of the Arc de Triomphe: one from the Warm-Up and a new scale drawing.





2 On the new scale drawing, the unknown segment represents:

A. More than 5 meters.

B. Less than 5 meters.

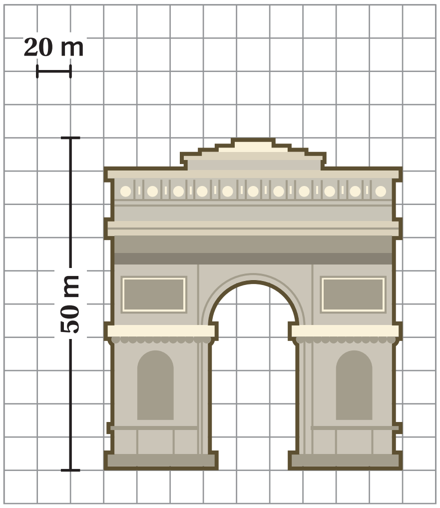
C. Exactly 5 meters.

Explain your thinking.

3 What is the unknown value in the scale?

4 The scale in this scale drawing is the wrong size. Update the scale so that it shows the correct number of grid units for 20 meters.

Explain your thinking.

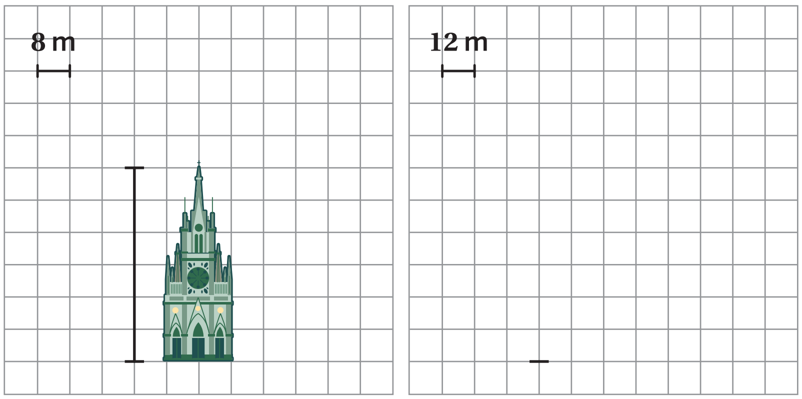


Name: ________ Date: ________ Period: ________

Same Object, Different Scale (continued)

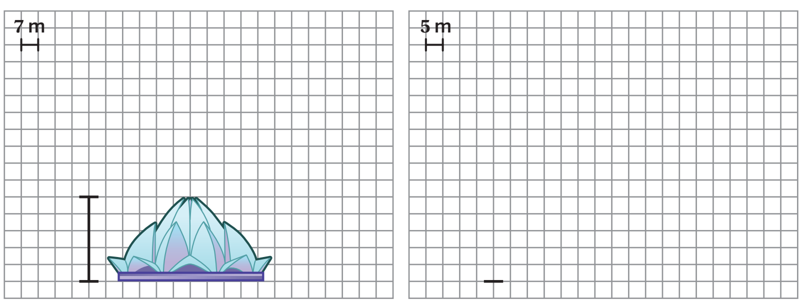
For each scale drawing, look at the building's height. Then show what the height of each building would be with the new scale.

5



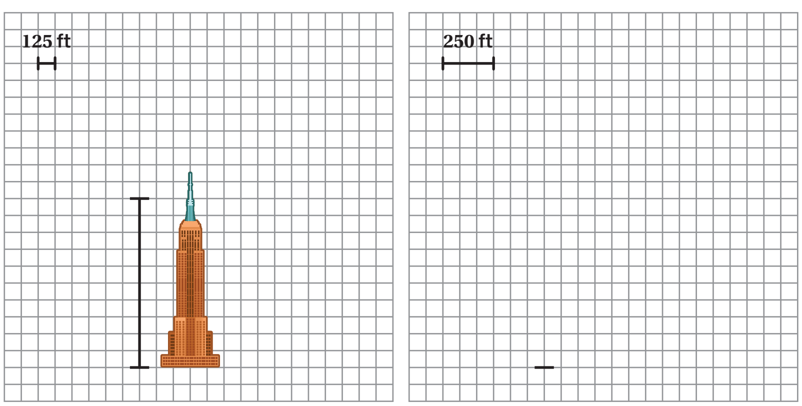
Las Lajas Sanctuary, Colombia (1949)

6



Lotus Temple, India (1986)

7

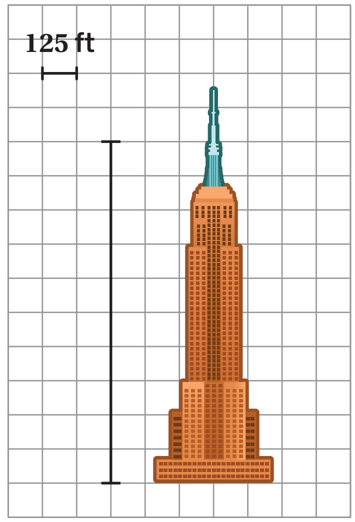


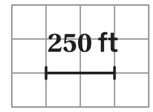
Empire State Building, U.S.A. (1931)

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

When are Scales Equivalent?

8 Here is a scale drawing of the Empire State Building, with a scale of 1 unit to 125 feet. Imagine a new scale drawing with a scale of 2 units to 250 feet.





Will the new drawing be smaller, larger, or the same size as this drawing?

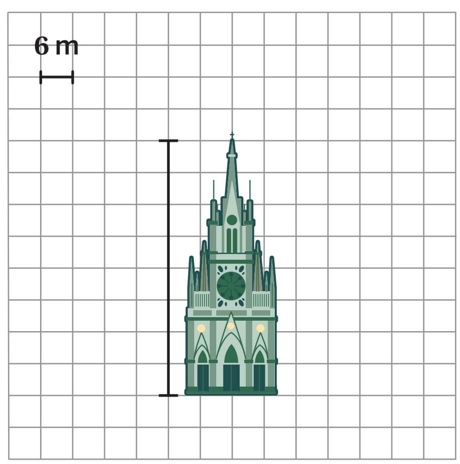
A. Smaller

B. Larger

C. The same size

Explain your thinking.

9 Here is a scale drawing of Las Lajas Sanctuary with a scale of 1 unit to 6 meters.



Select *all* the scales that will make a scale drawing of the same size.

- ☐ **A.** 2 units to 3 meters
- ☐ **B.** 2 units to 6 meters
- ☐ **C.** 2 units to 12 meters
- ☐ **D.** 3 units to 9 meters
- ☐ **E.** 3 units to 18 meters

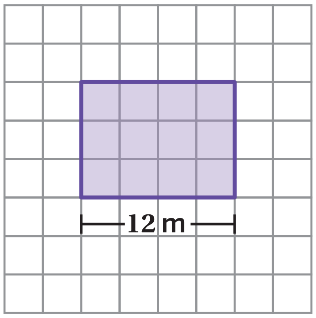
Name: ______ Date: ______ Period: ______

When are Scales Equivalent? (continued)

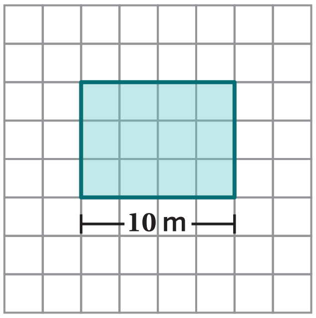
10 Match each scale drawing with one or more possible ways of describing its scale. One scale description will have no match.

Scale Drawing

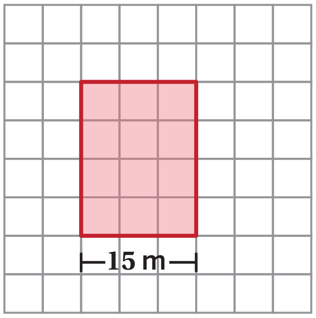
a.



b.



c.



Scale Description

______ 2 units to 10 meters

______ 2 units to 6 meters

______ 3 units to 9 meters

______ 1 unit to 2.5 meters

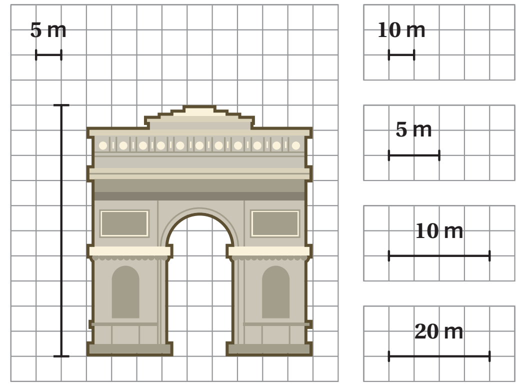
______ 3 units to 5 meters

______ 2 units to 5 meters

11 Synthesis

How can you tell whether a new scale drawing will be smaller than, larger than, or the same size as the original just by looking at the scales?

Use these examples if they help with your thinking.



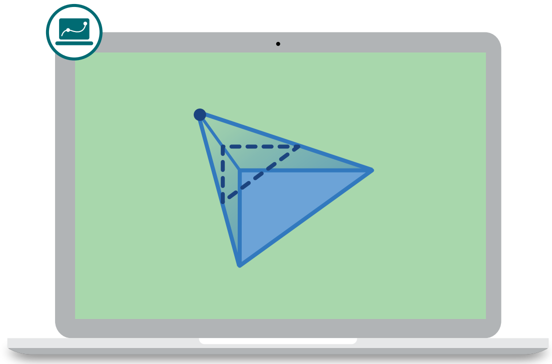
Things to Remember:

Unit 2

Lesson

1

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



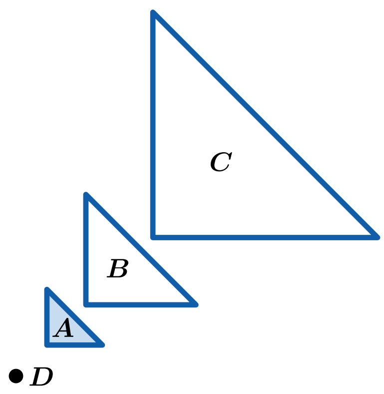
Sketchy Dilations

Let's explore scaled copies and dilations.

Warm-Up

1 Triangles B and C are images of triangle A.

What do you notice? What do you wonder?



I notice:

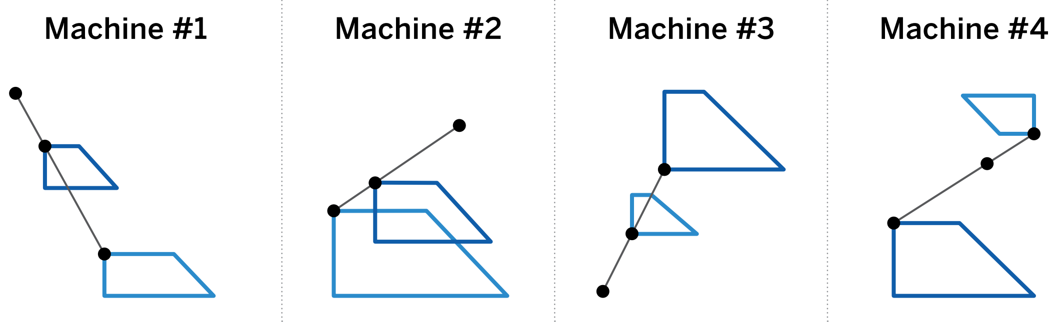
I wonder:

Activity 1

Name: ______ Date: ______ Period: ______

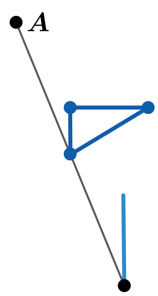
Dilations and Scaled Copies

2 **a** Take a look at these sketches, each created by a different stretching machine.



b **Discuss:** How does each stretching machine work?

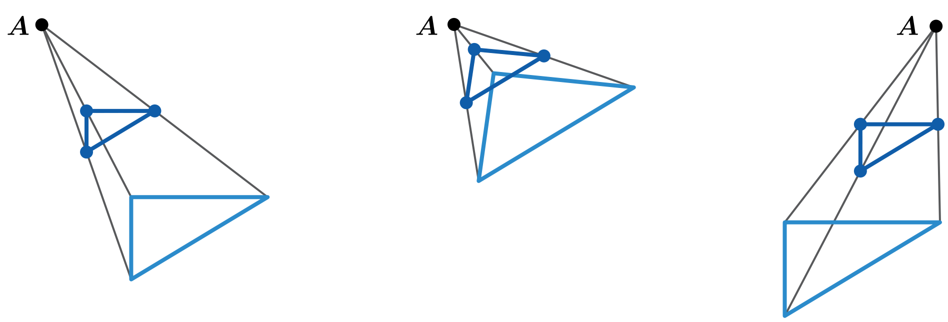
3 Here is a *pre-image* and part of its *image* in a stretching machine.



a Sketch the rest of its image.

b How would the image be different if point A were closer to the triangle?

4 Stretching machines create **dilations**. A dilation is a new type of transformation that creates a scaled copy from a given point.



Does moving point A change the size of the image, its location, or both? Circle one.

Size Location Both

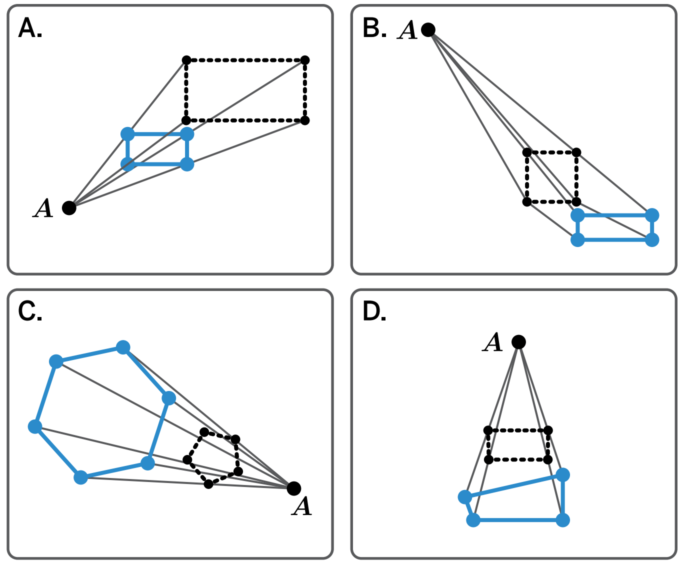
Explain your thinking.

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

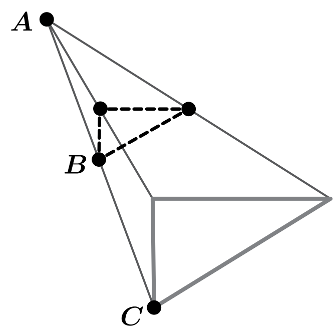
Dilation Play

5 Circle one image that is *not* a dilation (in other words, it could not have been created using a stretching machine).

Explain your thinking.



6 Let's watch what happens when points A and C move.



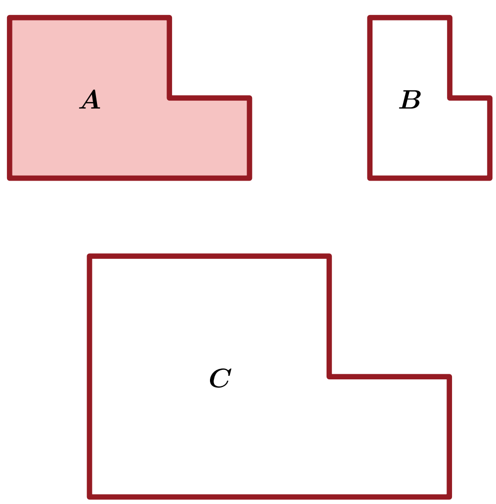
Here are several dilation challenges. Select *all* the ones you think are possible.

- ☐ **A.** Make the image smaller than the pre-image.
- ☐ **B.** Make the image the same size as the pre-image, but in a different location.
- ☐ **C.** Make the distance between A and B twice the distance between B and C.
- ☐ **D.** Make points A, B, and C form a triangle.

7 Which figure could be a *dilation* of figure A? Circle one.

Figure B Figure C Both Neither

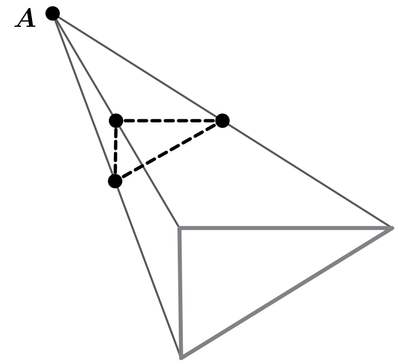
Explain your thinking.



8 Synthesis

Describe how dilations work.

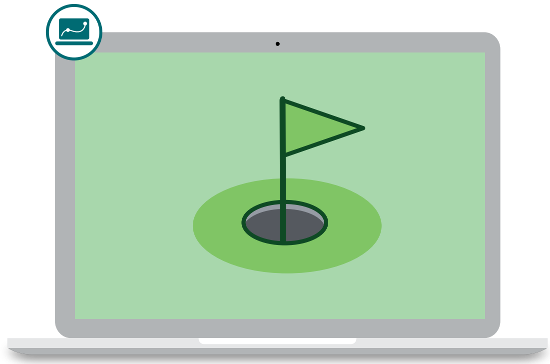
Use this example if it helps with your thinking.



Things to Remember:

Unit 2
Lesson
2

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



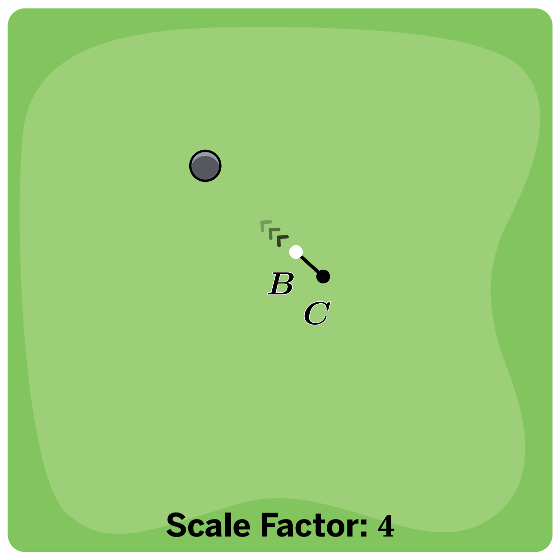
Dilation Mini Golf

Let's dilate points using measurement tools.

Warm-Up

1 Welcome to Dilation Mini Golf.

Your goal is to get the ball into the hole by dilating point B.



a Let's watch an animation to see what we mean.

b **Discuss:**

- In this situation, what is the pre-image? What is the image?
- What do you think *scale factor:* 4 means?

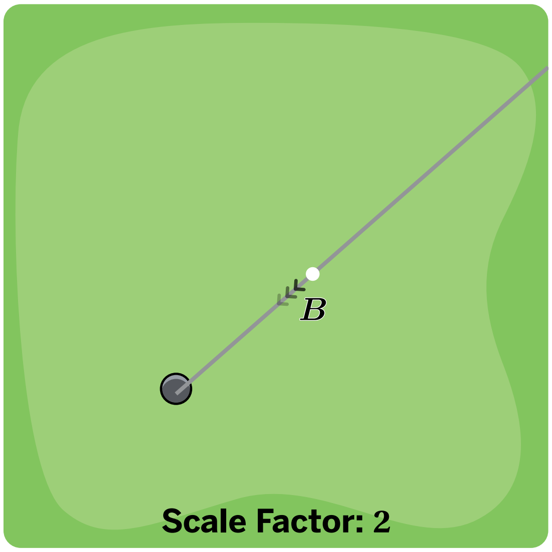
Activity
1

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

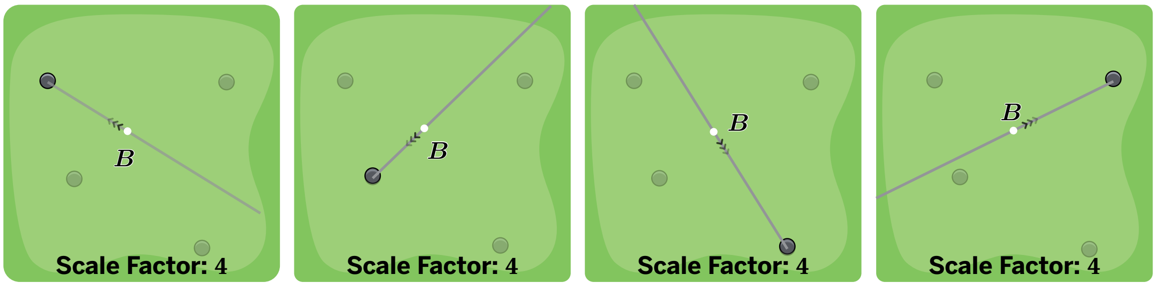
Rounds of Mini Golf

2 Point B will be dilated using point C as the **center of dilation** and a *scale factor* of 2.

Mark where point C should be so that the image of point B lands in the hole.



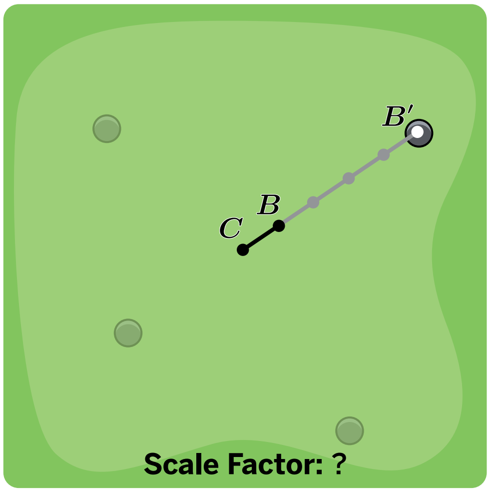
3 Point B will be dilated using point C as the center of dilation and a scale factor of 4. For each hole, mark where point C should be so that the image of point B lands in the hole.



4 Point B was dilated using point C as the center of dilation.

What is the scale factor?

Explain your thinking.



Activity 2

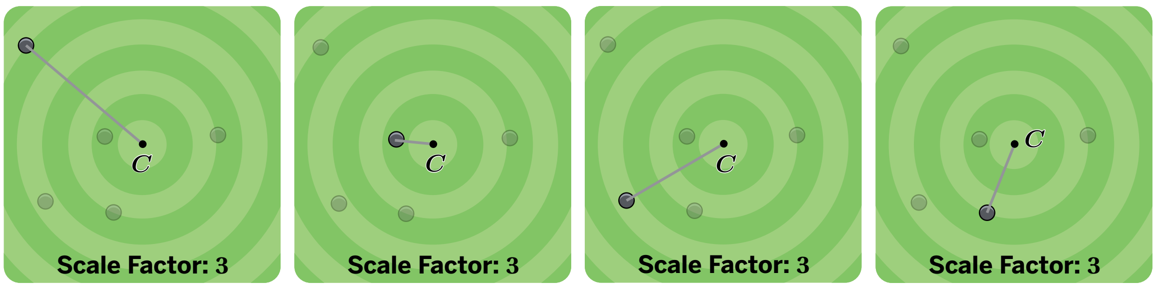
Name: ____________ Date: ________ Period: ________

Dilation Distances

5 Now let's place the ball (point B). This will be your pre-image.

Point B will be dilated using point C as the center of dilation and a scale factor of 3.

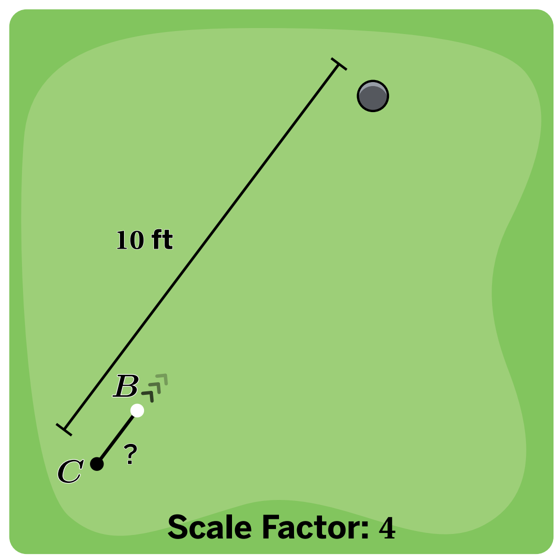
For each hole, mark point B so that its image lands in the hole.



6 Point B will be dilated using point C as the center of dilation and a scale factor of 4.

What should the distance between point C and point B be so that the image is in the hole?

Explain your thinking.

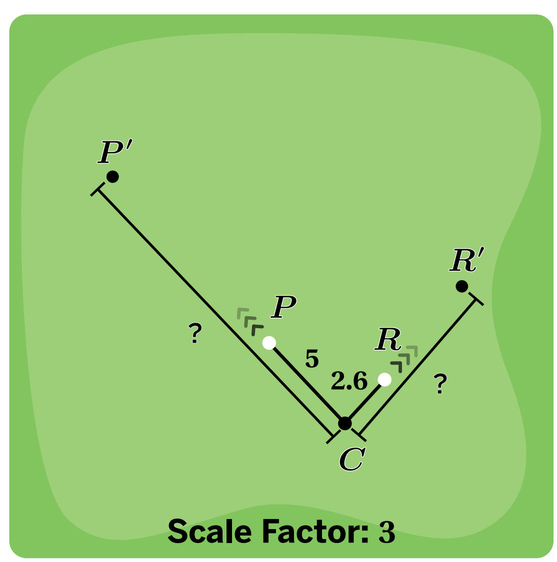


7 We can dilate more than one point at a time!

Points P and R will be dilated using point C as the center of dilation and a scale factor of 3.

What is the distance between point C and the image of point P?

What is the distance between point C and the image of point R?

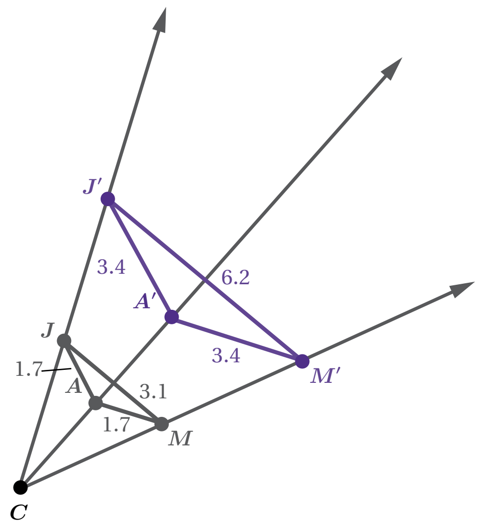


Activity
3

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

Dilating a Triangle

8 Let's watch an animation to see how triangle JAM is dilated using point C as the center of dilation and a scale factor of 2.



a Describe all of the ways you see a scale factor of 2 represented in this diagram.

b Select at least one more scale factor.

3 $\quad$ 1.5 $\quad$ $\frac{3}{4}$ $\quad$ Other: ....

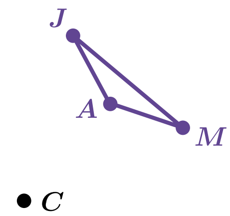
c On the same diagram, dilate triangle JAM using center C and each scale factor you chose.

d List everything that's alike about triangle JAM and its dilations.

9 Synthesis

Describe how to dilate a point or a figure given a center of dilation and a scale factor.

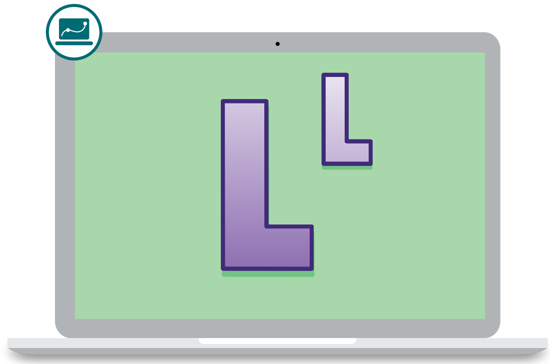
Use the example if it helps you with your thinking.



Scale Factor: 2

Things to Remember:

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

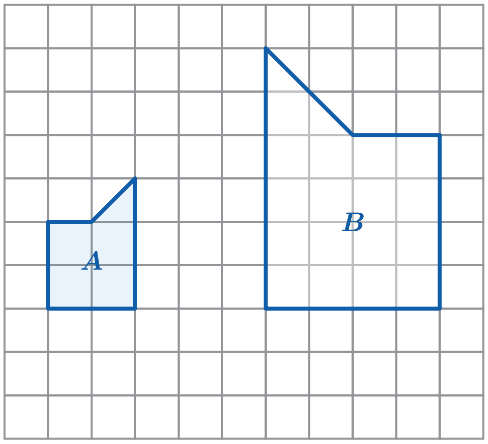


Transformation Targets With Dilations

Let's play Transformation Targets with dilations.

Warm-Up

1 Describe a *sequence of transformations* that could move polygon A onto polygon B.



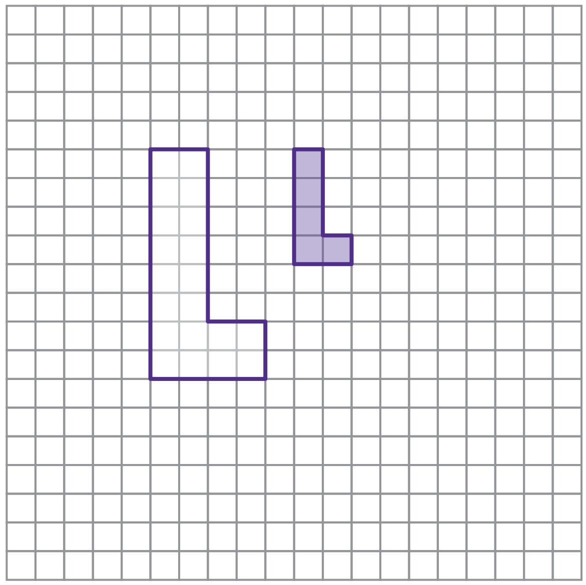
Activity 1

Name: ________ Date: ________ Period: ________

Transformation Targets

2 **Challenge #1:** Show or describe a sequence of transformations to move the pre-image (shaded) onto the image.

Draw any points or lines that you use in your sequence of transformations.



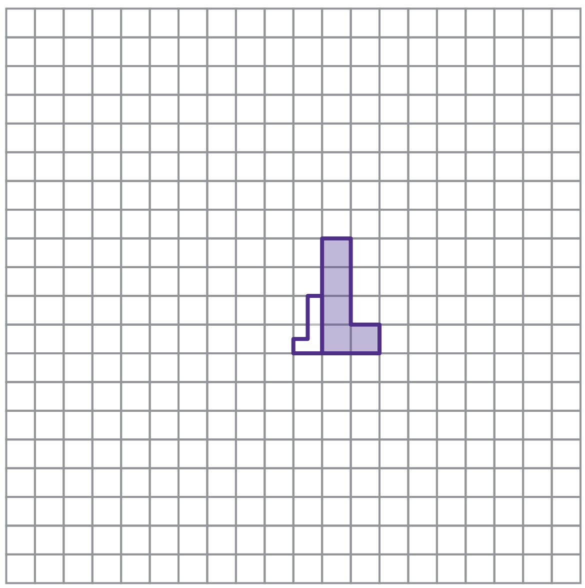
3 Aditi says you can complete the previous challenge with a dilation and a translation. Emiliano says you can complete this challenge with only a dilation. Whose claim is correct?

Aditi's Emiliano's Both Neither

Explain your thinking.

4 **Challenge #2:** Show or describe a sequence of transformations to move the pre-image (shaded) onto the image.

Draw any points or lines that you use in your sequence of transformations.



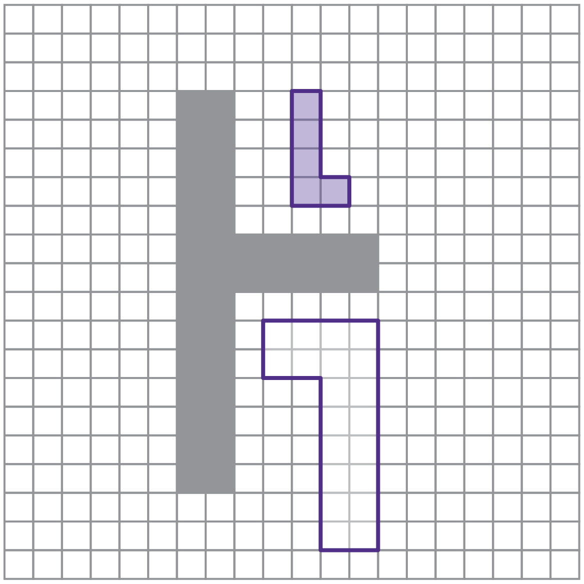
Name: ____ Date: ____ Period: ____

Now With Obstacles!

5 **Challenge #3:** Show or describe a sequence of transformations to move the pre-image (shaded) onto the image.

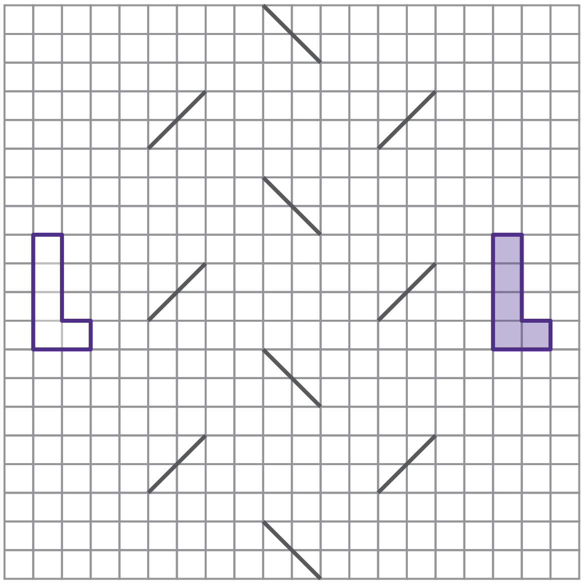
Avoid the obstacles!

Draw any points or lines that you use in your sequence of transformations.



6 Describe a sequence of transformations that you think will move the pre-image (shaded) onto the image.

Avoid the obstacles!



7 Sketch the result of each transformation you described in the previous problem on the grid.

Draw any points or lines that you use in your sequence of transformations.

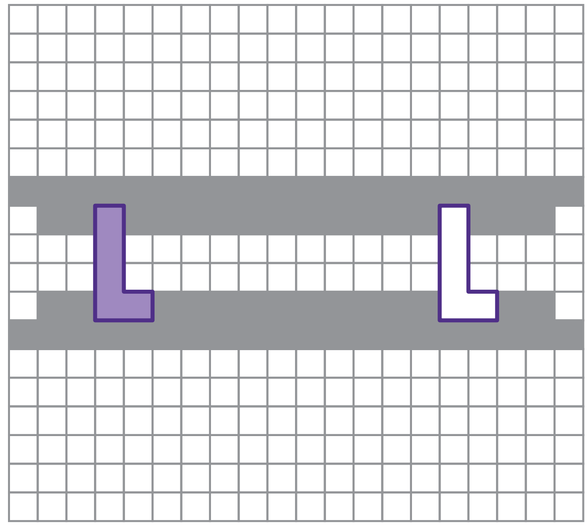
Name: .... Date: .... Period: ....

Now With Obstacles! (continued)

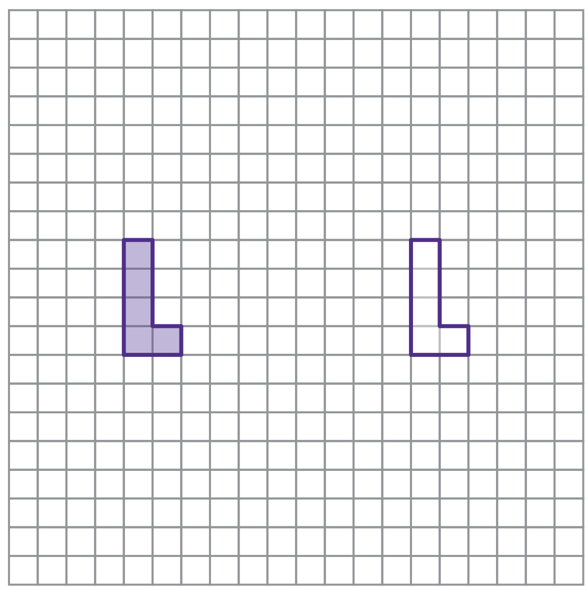
8 **Challenge #4:** Describe a sequence of transformations to transform the pre-image (shaded) onto the image.

Avoid the obstacles!

Draw any points or lines that you use in your sequence of transformations.



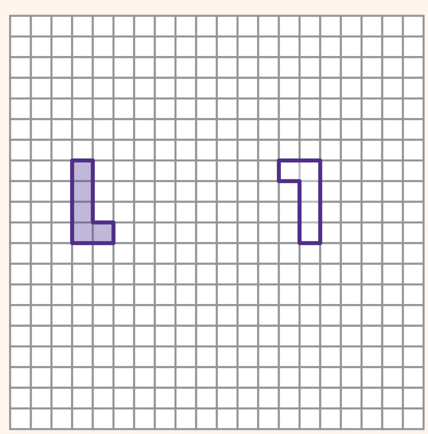
9 **Challenge #5:** Use only dilations to transform the pre-image (shaded) onto the image!



Explore More

10 Describe a sequence of transformations that uses *only* dilations to move the pre-image (shaded) onto the image!

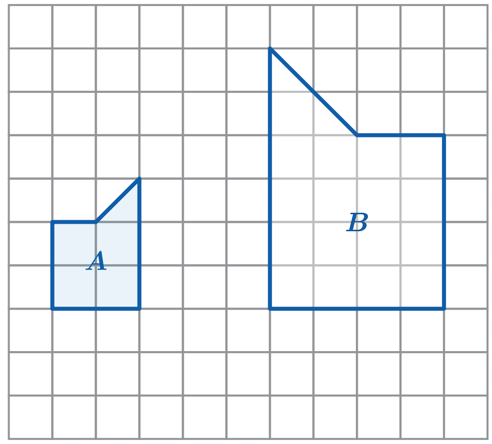
Draw the center of dilation and the result of each dilation.



11 Synthesis

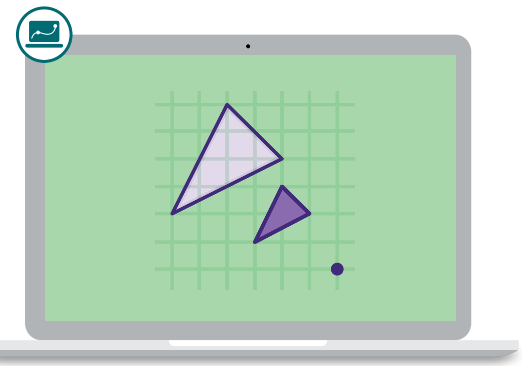
Describe some strategies for determining a sequence of transformations that moves a pre-image onto an image.

Use the example if it helps you with your thinking.



Things to Remember:

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



Match My Dilation

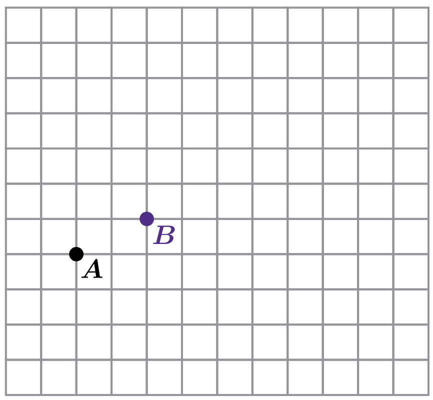
Let's dilate figures on a square grid.

Warm-Up

Plot a point C that is the image of point B dilated using point A as the center of dilation and a scale factor of 3.

1 Try it *without* a grid.

2 Try it *with* a grid.



Describe your strategy for dilating *with* a grid.

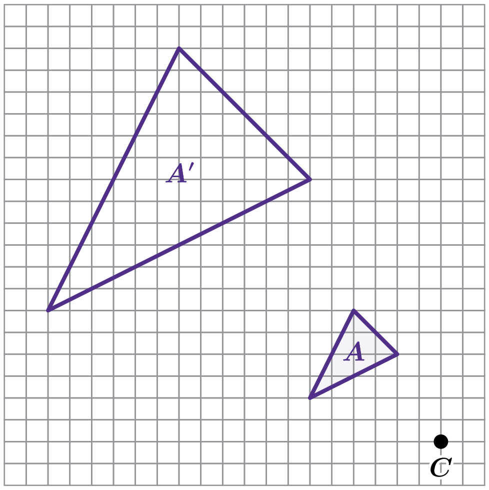
Activity 1

Name: ________ Date: ________ Period: ________

Dilation Challenges

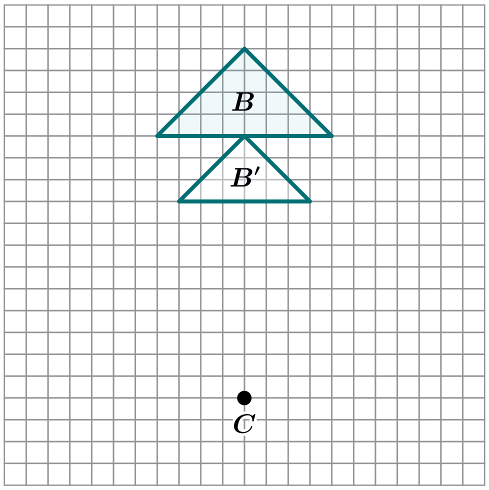
3 Triangle A' is the image of triangle A dilated using point C as the center of dilation.

What was the scale factor used in the dilation?

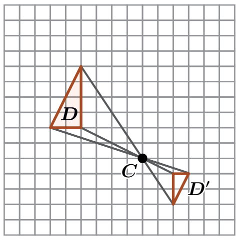


4 Triangle B' is the image of triangle B dilated using point C as the center of dilation.

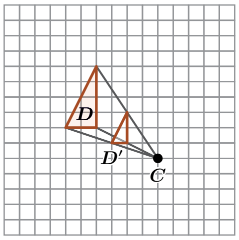
What was the scale factor used in the dilation?



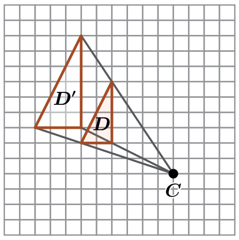
5 **a** Take a look at these dilations of triangle D.



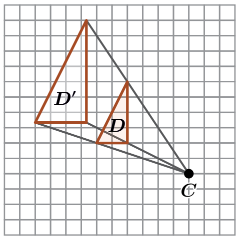
Scale factor: -0.5



Scale factor: 0.5



Scale factor: 1.5



Scale factor: 1.8

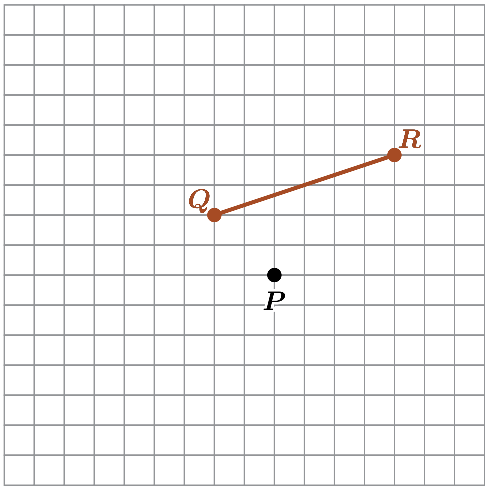
b How does the scale factor affect the size of the image? How does it affect the location of the image?

Activity 2

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

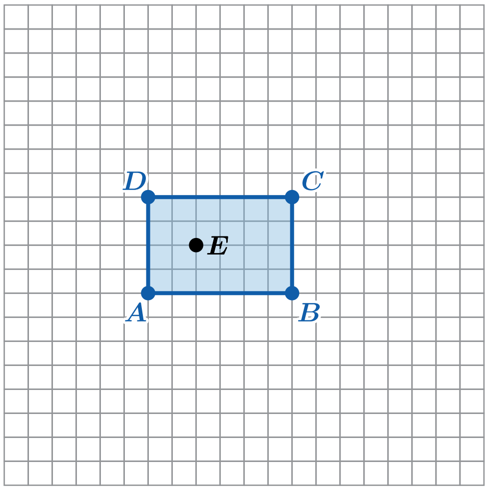
Match My Dilation

6 Show or explain how to dilate segment QR using point P as the center of dilation and a scale factor of $\frac{1}{2}$.



7 **a** Dilate quadrilateral $ABCD$ using point E as the center of dilation and a scale factor of 2.

b **Discuss:** How would the size and location of the image change if point E were in a different location?



Name: ________ Date: ________ Period: ________

Challenge Creator

8 You will use the Activity 3 Sheet to complete this activity.

- **a** **Make It!** On the Activity 3 Sheet, create a dilation challenge.
- **b** **Solve It!** On this page, redraw your pre-image. Then draw your image using the center of dilation and scale factor you chose. Label the vertices A', B', and C'.
- **c** **Swap It!** Swap your challenge with one or more partners. Draw your partners' pre-images. Then draw each image using the center of dilation and scale factor.

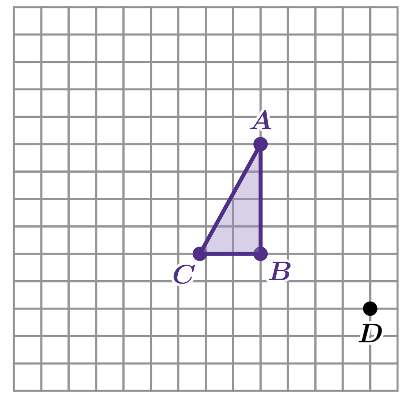
My Dilation Challenge	Partner 1
Scale Factor: ________	Scale Factor: ________

Partner 2	Partner 3
Scale Factor: ________	Scale Factor: ________

9 Synthesis

What is important to remember when dilating a figure using a center of dilation and a scale factor?

Use the example if it helps you with your thinking.



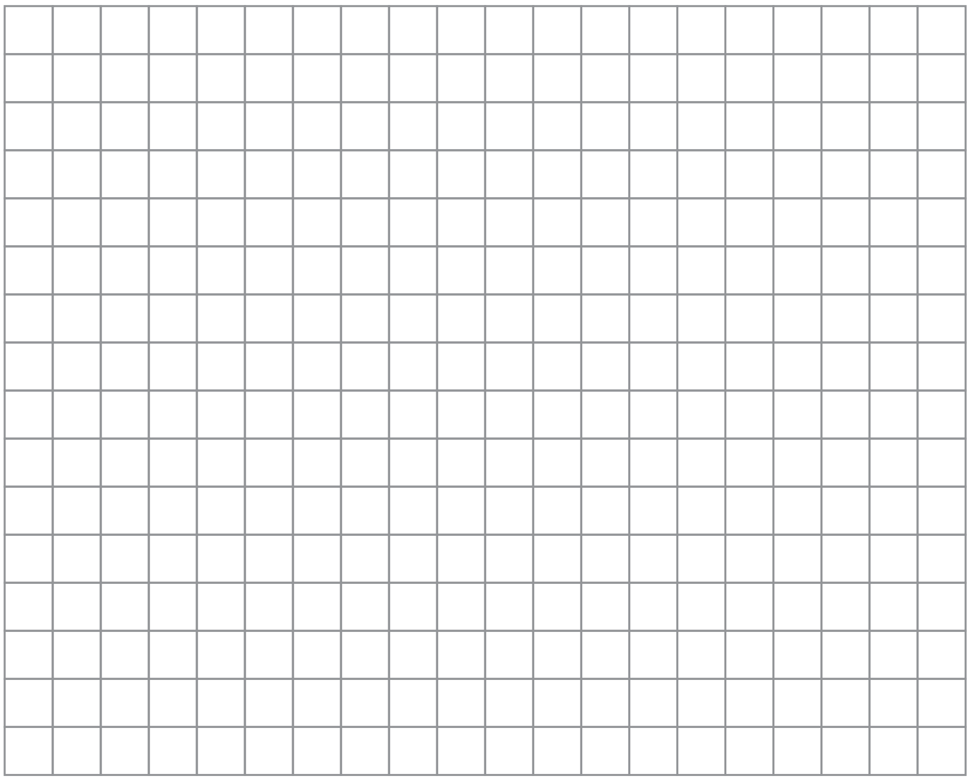
Things to Remember:

Name: ________ Date: ________ Period: ________

Challenge Creator

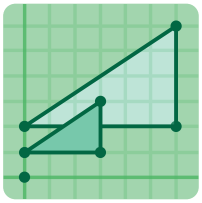
Create your own dilation challenge by completing these steps:

- Draw a triangle and label the vertices A, B, and C.
- Choose a center of dilation and label it D.
- Choose a scale factor: ____________



Name: ______ Date: ______ Period: ______

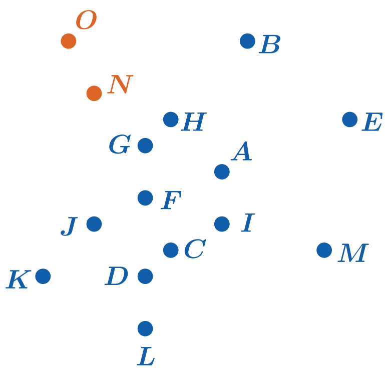
Dilations on a Plane



Let's look at dilations on the coordinate plane.

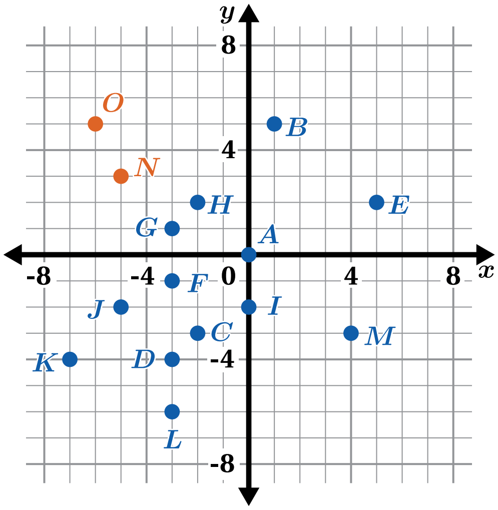
Warm-Up

1. Determine which point is a dilation of point N using point O as the center of dilation and a scale factor of 3.



2. Here is the same task, but with a coordinate plane.

Determine which point is a dilation of point N using point O as the center of dilation and a scale factor of 3.

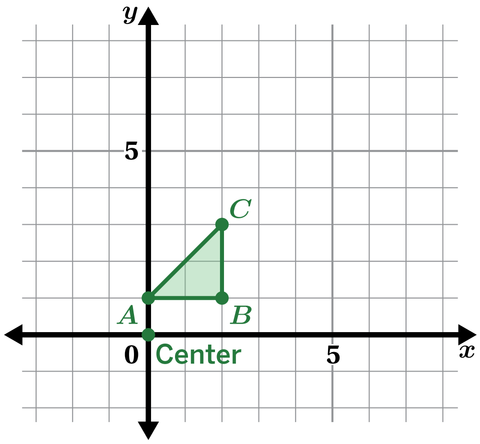


Name: .... Date: .... Period: ....

Dilate It!

Use any strategy or tool to perform each dilation. Label the corresponding points in the image using the ′ symbol.

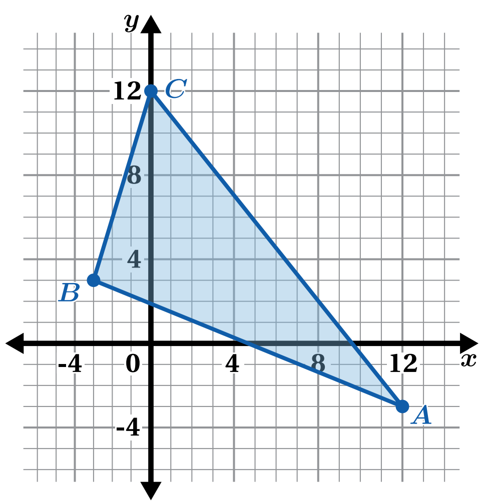
3. **a** Dilate triangle ABC using $(0, 0)$ as the center of dilation and a scale factor of 2.



b Write the image coordinates in the table.

Pre-Image Coordinates	Image Coordinates
(0, 1)	
(2, 1)	
(2, 3)	

4. **a** Dilate triangle ABC using $(0, 0)$ as the center of dilation and a scale factor of $\frac{1}{3}$.



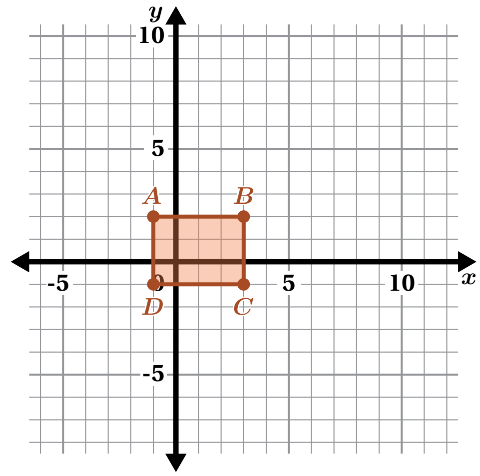
b Write the image coordinates in the table.

Pre-Image Coordinates	Image Coordinates
(12, -3)	
(-3, 3)	
(0, 12)	

Name: ________ Date: ________ Period: ________

Dilate It! (continued)

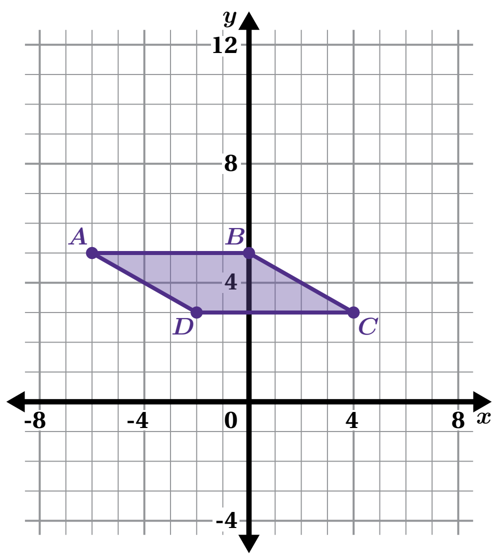
5. **a** Dilate rectangle $ABCD$ using $(0, 0)$ as the center of dilation and a scale factor of 3.



b Write the image coordinates in the table.

Pre-Image Coordinates	Image Coordinates
(-1, 2)	
(3, 2)	
(3, -1)	
(-1, -1)	

6. **a** Dilate parallelogram $ABCD$ using (-6, 5) as the center of dilation and a scale factor of $\frac{1}{2}$.



b Write the image coordinates in the table.

Pre-Image Coordinates	Image Coordinates
(-6, 5)	
(0, 5)	
(4, 3)	
(-2, 3)	

c How is this problem different from the other problems in this activity?

Activity

2

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

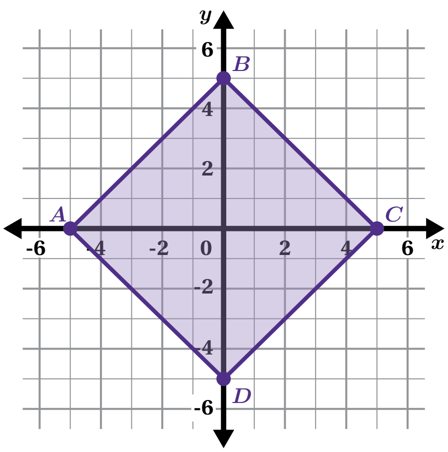
Dilation Information

You and your partner will get a set of dilation cards. Place them grid-side down without looking at them.

- Decide who will describe the dilation on a card and who will sketch the image. Start with Card 1.
- Describer: Give enough information about the dilation so that the Sketcher can sketch it.
- Sketcher: Pause after sketching and share what you think the dilation is.
- Together: Compare the card with the sketch and make adjustments as needed. Write a precise description of the dilation.
- Switch roles for Card 2 and repeat. Then do the same for Cards 3 and 4.

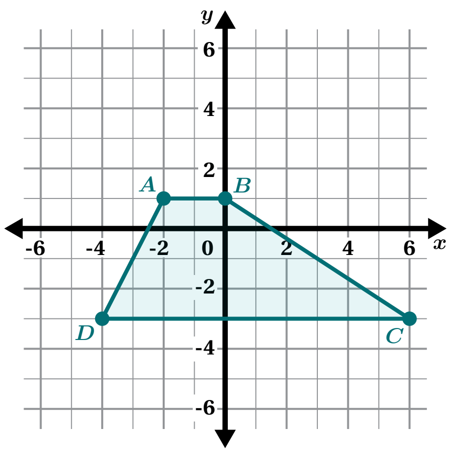
7. **Sketch 1:** Card 1 or Card 2 (Circle one.)

Card 1



Description of Transformation:
Dilate figure $ABCD$ by . . .

Card 2



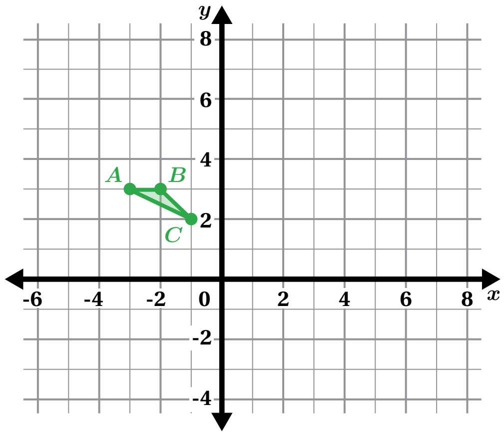
Description of Transformation:
Dilate figure $ABCD$ by . . .

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

Dilation Information (continued)

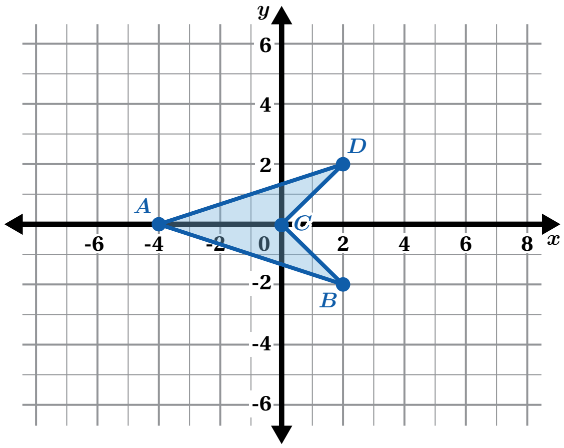
8. **Sketch 2:** Card 3 or Card 4 (Circle one.)

Card 3



Description of Transformation:
Dilate figure ABC by . . .

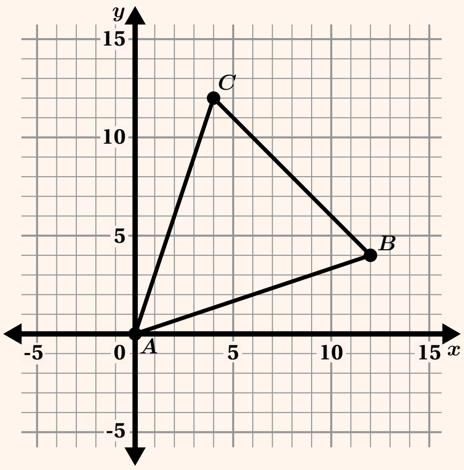
Card 4



Description of Transformation:
Dilate figure $ABCD$ by . . .

Explore More

9. Here is triangle ABC.



a Dilate triangle ABC using center $(0, 0)$ and a scale factor of $\frac{3}{4}$. Label the vertices $A'B'C'$.

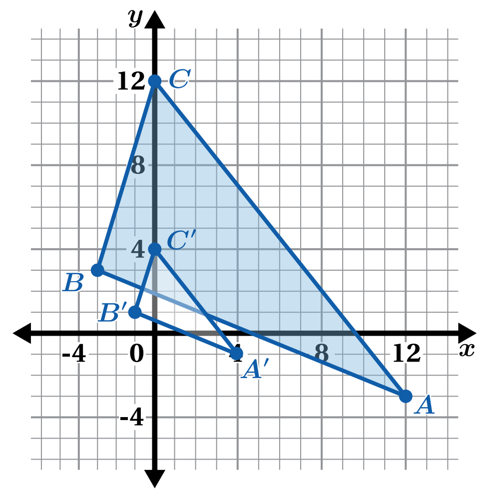
b Dilate triangle ABC using center $(12, 4)$ and a scale factor of $\frac{1}{4}$. Label the vertices $A''B''C''$.

c Explain why A'' and B' must be at the same coordinates.

Synthesis

10. What is important to remember when dilating figures on a coordinate plane?

Use the example if it helps with your thinking.

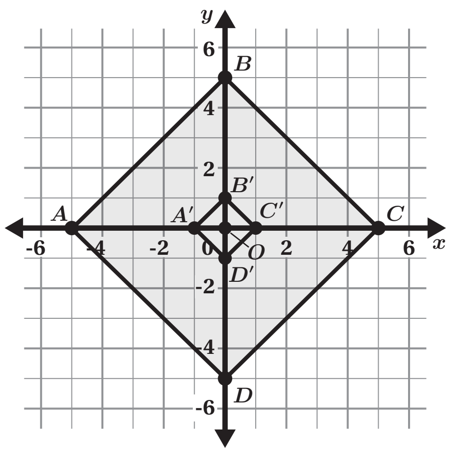


Things to Remember:

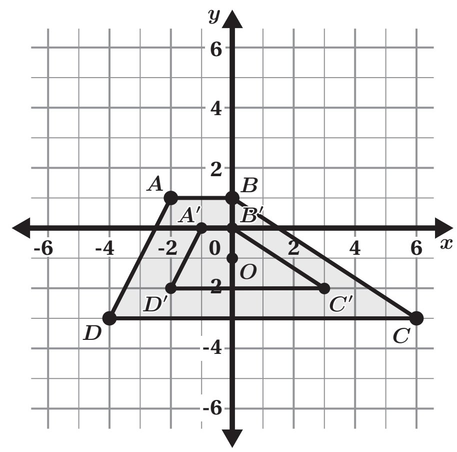
Dilation Information

Directions: Make one copy per pair of students. Then pre-cut the cards and give each pair one set.

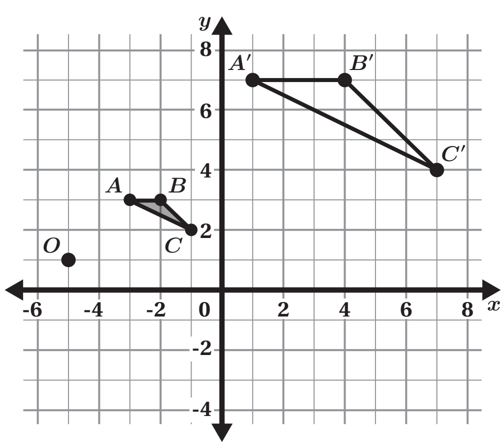
Card 1



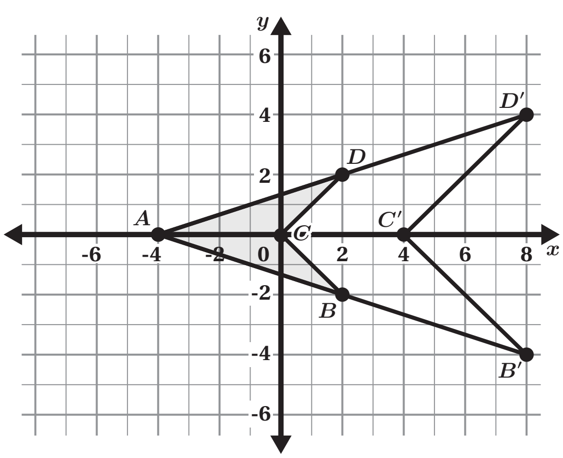
Card 2



Card 3



Card 4

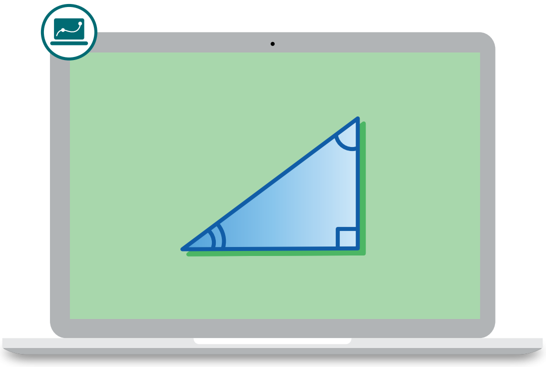


Unit 2

Lesson

7

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

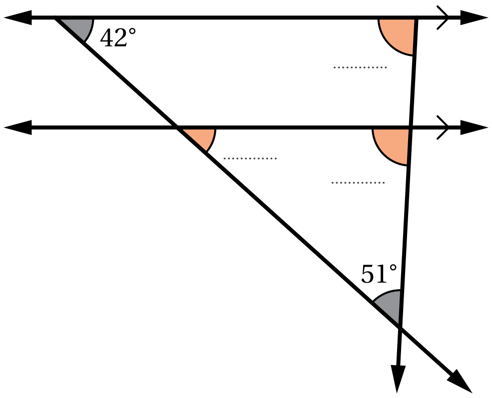


Are Angles Enough?

Let's determine whether congruent corresponding angles are enough to know whether triangles are similar.

Warm-Up

1 Determine the measure for each missing angle.

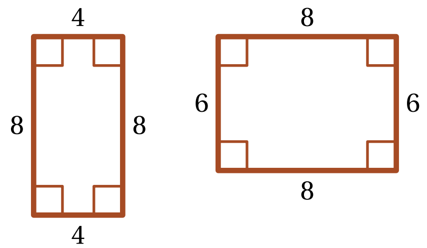


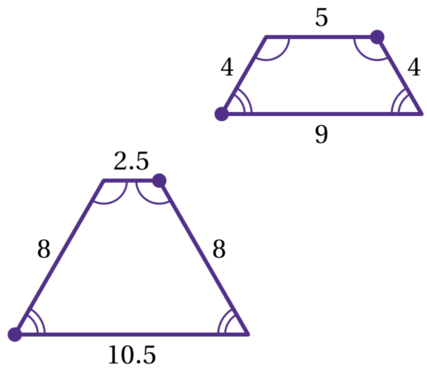
Activity 1

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

Are Angles Enough?

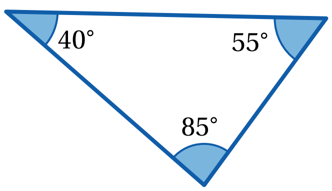
2 Take a look at these pairs of figures that have congruent corresponding angles.





Discuss: How do you know that the figures in each pair are *not* similar?

3 **a** Take a look at this triangle with angle measures $40°$, $55°$, and $85°$.



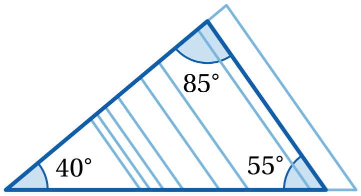
b If all of your classmates made triangles with the same angle measures as this one, would all the triangles be similar? Circle one.

Yes No I'm not sure

Explain your thinking.

4 Here are some triangles that all have $40°$, $85°$, and $55°$ angles.

a Let's watch an animation of these triangles.

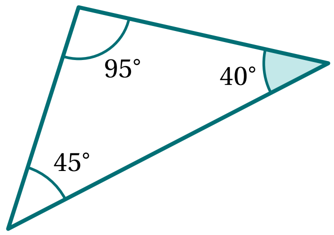


b **Discuss:** Are these triangles all similar?

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

Are Angles Enough? (continued)

5 **a** Take a look at this triangle with one angle measuring $40°$.



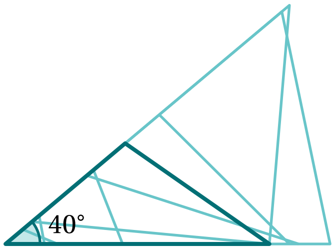
b If all of your classmates made triangles with one angle measuring $40°$, would all the triangles be similar? Circle one.

Yes   No   I'm not sure

Explain your thinking.

6 Here are some triangles that all have a $40°$ angle.

a Let's watch an animation of these triangles.



b **Discuss:** Are these triangles all similar?

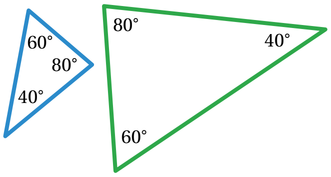
Activity
2

Name: ______ Date: ______ Period: ______

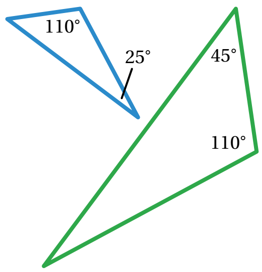
Similar Sort

7 Sort the pairs of figures into three groups. (Images are not to scale.)

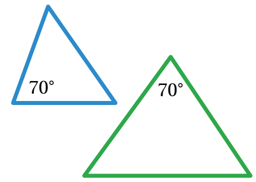
A.



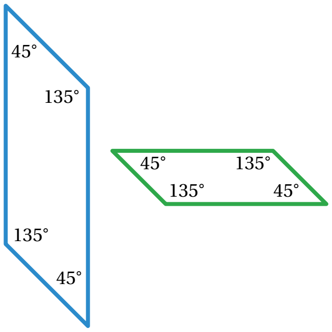
B.



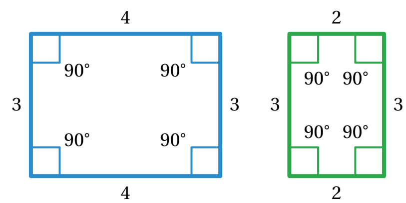
C.



D.



E.

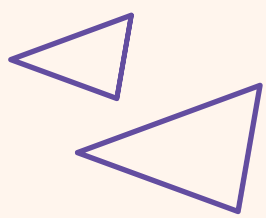


Similar	Not Similar	Not Enough Information

Explore More

8 Here are two similar triangles. Rio says that in similar triangles, if you match up two pairs of sides at a vertex, then the third sides are always parallel. Is Rio's claim correct?

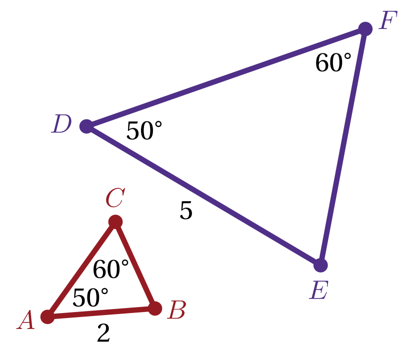
Explain your thinking.



9 Synthesis

Describe how you can use angles to determine whether triangles are similar.

Use the example if it helps you with your thinking.



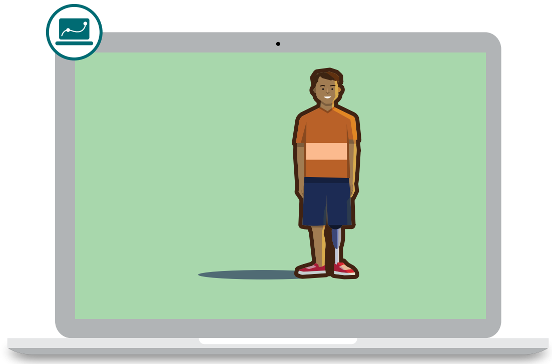
Things to Remember:

Unit 2

Lesson

8

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

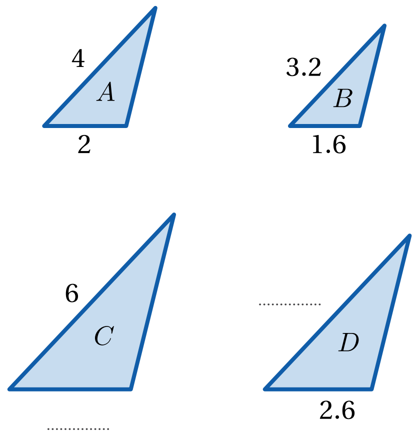


Shadows

Let's use what we know about similar triangles to determine missing side lengths.

Warm-Up

1 Here are four similar triangles.



a Examine the given side lengths. Then write in the missing values.

b **Discuss:** How did you determine these values?

Activity 1

Name: ______ Date: ______ Period: ______

Similar Triangles in Shadows

2 Let's watch a slider control the time of day.

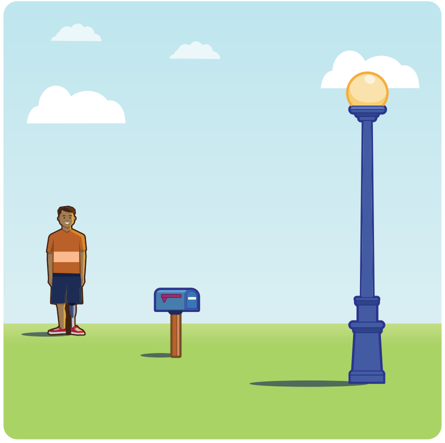
What do you notice? What do you wonder?

I notice:

I wonder:

3 Kayla noticed that similar triangles could be formed using the shadows of these figures.

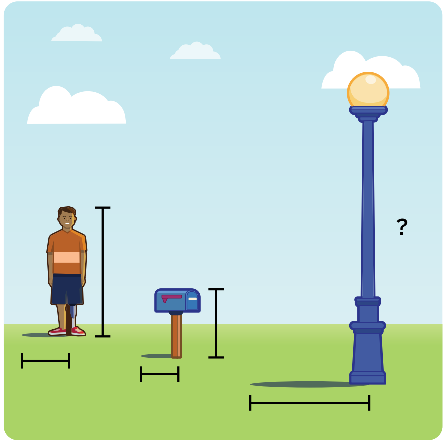
Where do you think Kayla saw triangles? Why might Kayla think these triangles are similar? Draw on the picture if it helps to show your thinking.



4 Your task is to determine the height of this lamppost.

a Decide which of these measurements you need and request them from your teacher:

- ☐ Height of the person
- ☐ Length of the person's shadow
- ☐ Height of the mailbox
- ☐ Length of the mailbox's shadow
- ☐ Length of the lamppost's shadow



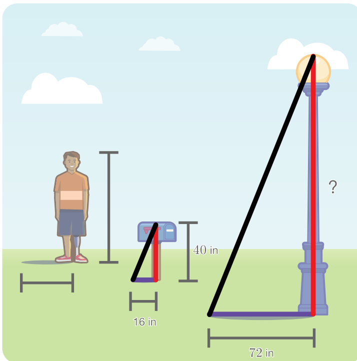
b Once you have enough information, determine the height of the lamppost.

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

Similar Triangles in Shadows (continued)

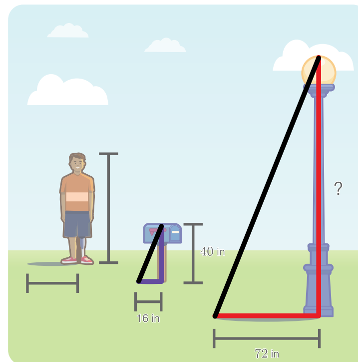
5 Here are Ama's and Neena's strategies for determining the height of the lamppost.

Ama



$$\frac{40}{?} = \frac{16}{72}$$

Neena



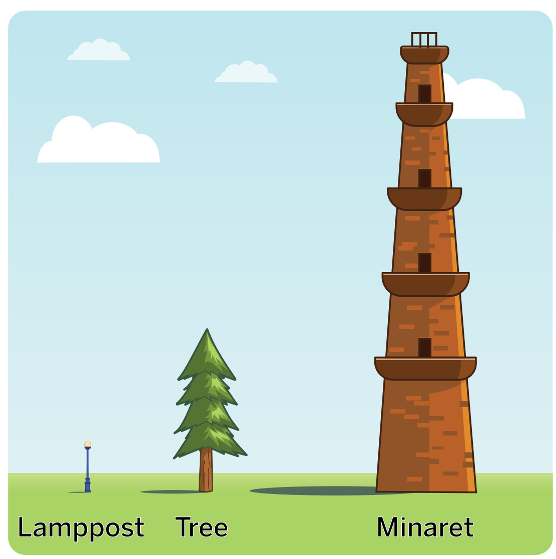
$$\frac{40}{16} = \frac{?}{72}$$

Discuss: How are their strategies alike? How are they different?

6 Here is the lamppost from the previous problem, as well as two new objects.

Determine the missing heights.

	Lamppost	Tree	Minaret
Height (ft)	15		
Shadow Length (ft)	6	20	56

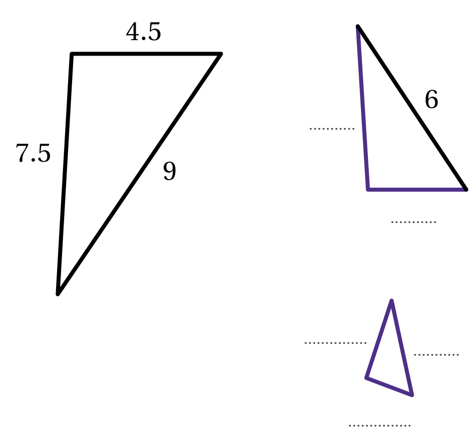


Activity
2

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

Similar Triangles Puzzle

7 Here are three similar triangles.

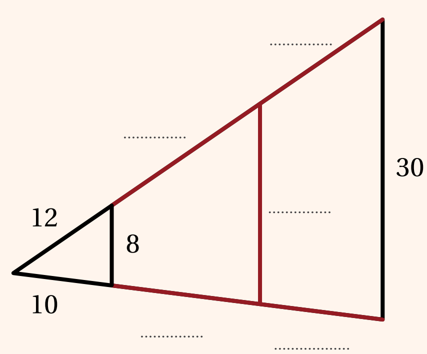


a Determine all the side lengths using as few hints as you can. You can ask for the measure of up to two side lengths, if needed.

b What was your strategy?

Explore More

8 Here are three similar triangles.



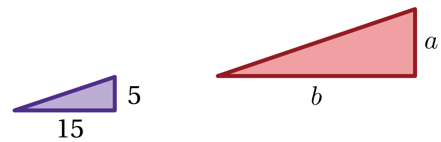
a Determine all the side lengths using as few hints as you can. You can ask for the measure of two or three additional side lengths, if needed.

b What was your strategy?

9 Synthesis

What are some strategies for determining unknown side lengths in similar triangles?

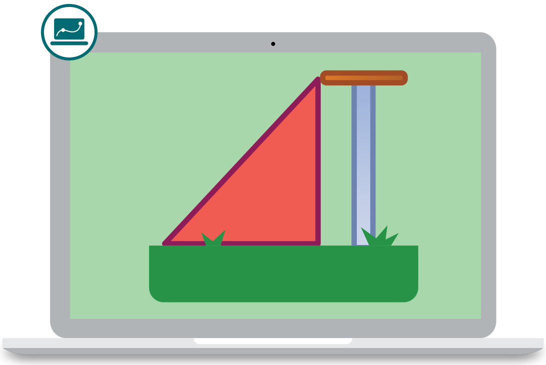
Use the example if it helps with your thinking.



Things to Remember:

Unit 2
Lesson
9

Name: ______ Date: ______ Period: ______



Water Slide

Let's look at similar triangles and lines.

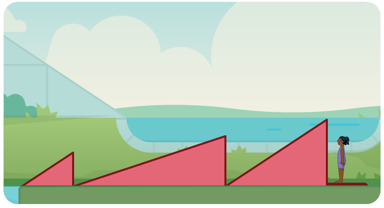
Warm-Up

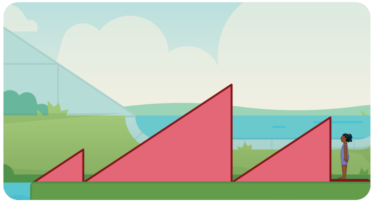
1 Let's watch someone try two different slides.

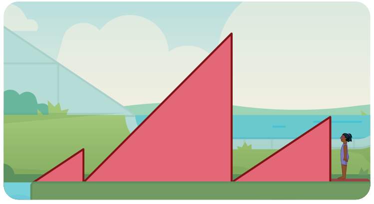
Discuss: What makes a smooth slide? What makes a bumpy slide?

2 Your goal is to create a smooth slide.

Which set of ramps do you think would make a smooth slide?

A.


B.


C.


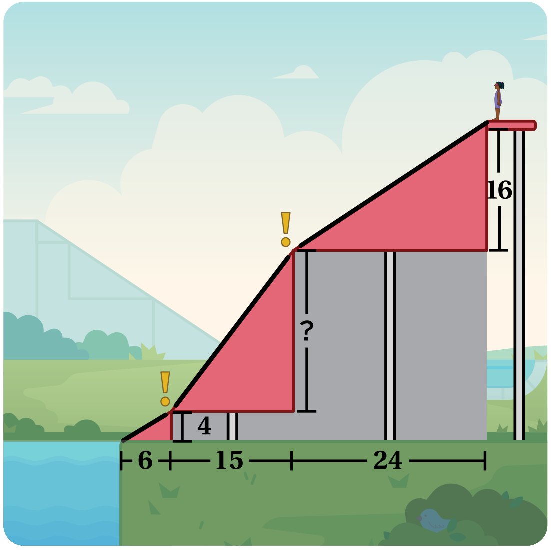
Name: .... Date: .... Period: ....

Smooth Slides

3 These ramps will make a bumpy slide!

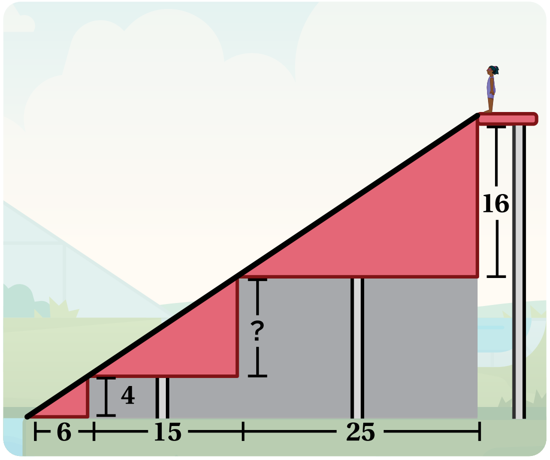
Fill in the height for Ramp 2 to make a smooth slide.

Ramp	Base (ft)	Height (ft)
Ramp 1	6	4
Ramp 2	15	
Ramp 3	24	16



4 Jada says: *The ramps are all similar triangles*.

How can Jada use the properties of similar triangles to find the height of the middle ramp?

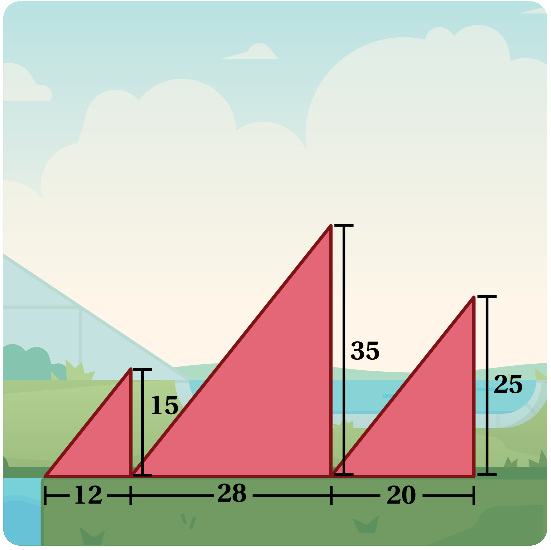


5 Here is a new set of ramps.

Will these ramps make a smooth slide? Circle one.

Yes No I'm not sure

Explain your thinking.



Activity 2

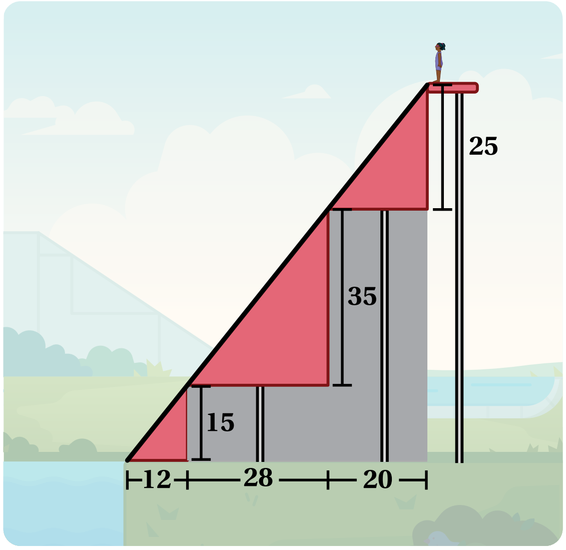
Name: ________ Date: ________ Period: ________

Introducing Slope

6 **Slope** measures the steepness of a line.

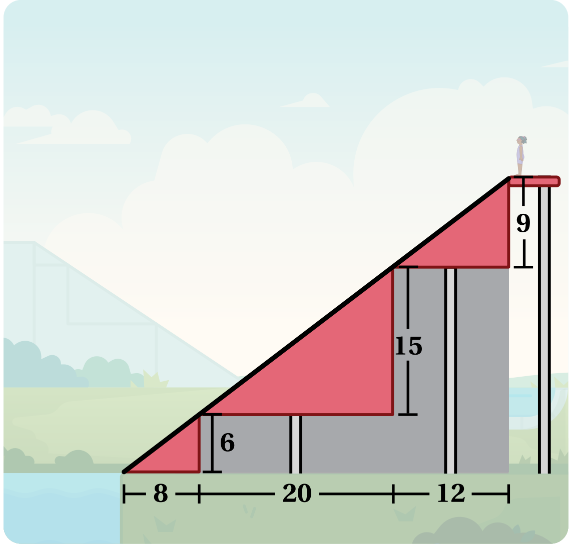
This slide forms a line with a slope of $\frac{5}{4}$.

How do you think slope is calculated?



7 What is the slope of this slide?

Explain your thinking.



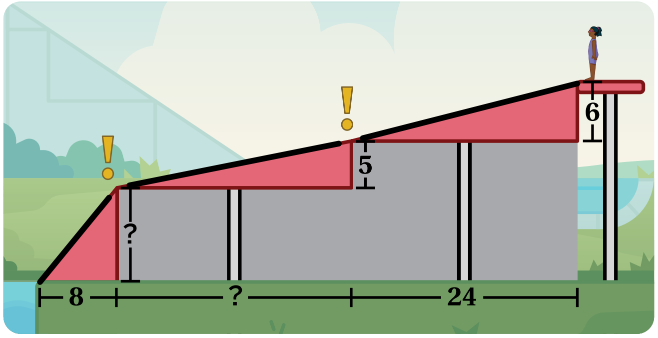
Name: .... Date: .... Period: ....

Introducing Slope (continued)

8 These ramps will make a bumpy slide!

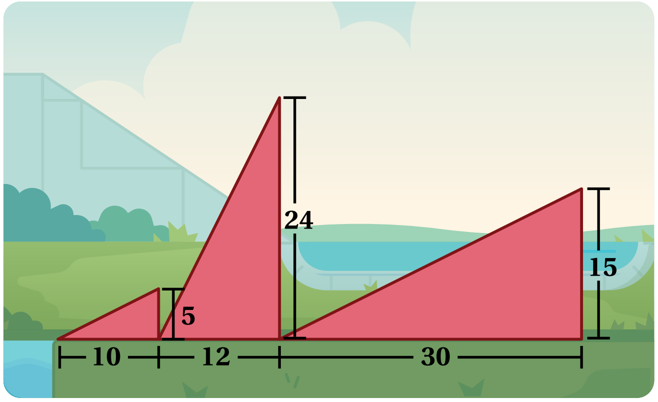
Fill in the missing values so that the slide has a slope of $\frac{1}{4}$.

Ramp	Base (ft)	Height (ft)
Ramp 1	8	
Ramp 2		5
Ramp 3	24	6



9 Issa tried to create a slide with a slope of $\frac{1}{2}$.

Ramp	Base (ft)	Height (ft)
Ramp 1	10	5
Ramp 2	12	24
Ramp 3	30	15



These ramps didn't create a smooth slide!

a **Discuss:** What do you think Issa did well?

b Describe what the mistake might be in Issa's work.

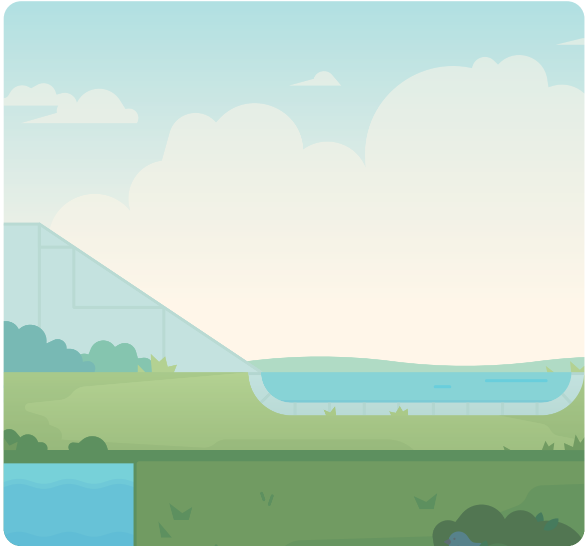
Activity
3

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

Your Water Slide

10 Draw a triangle to create a slide that will be fun, but not too scary.

Decide and write the slope of your slide.

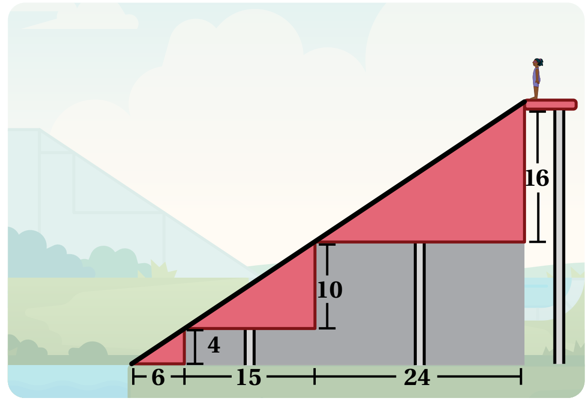


11 Now create three possible ramps for a smooth ride using the slope from the previous question.

Ramp	Base (ft)	Height (ft)
Ramp 1		
Ramp 2		
Ramp 3		

12 Synthesis

Define *slope* in your own words and describe how to calculate it.



Things to Remember:

Unit 2
Lesson
10

Name: ________ Date: ________ Period: ________

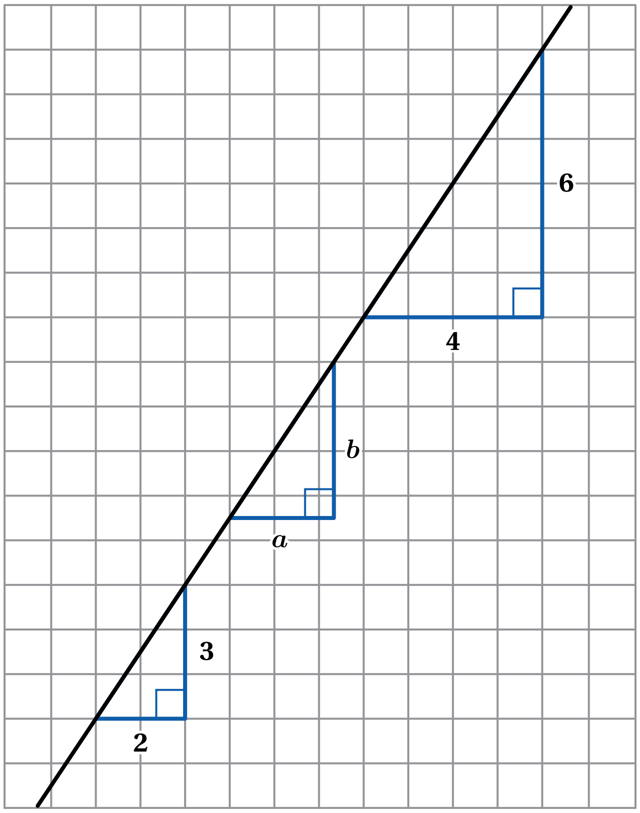
Slope Challenges

Let's figure out the slopes of lines.

Warm-Up

1 Here are three **slope triangles**.

What do you notice? What do you wonder?



I notice:

I wonder:

Activity 1

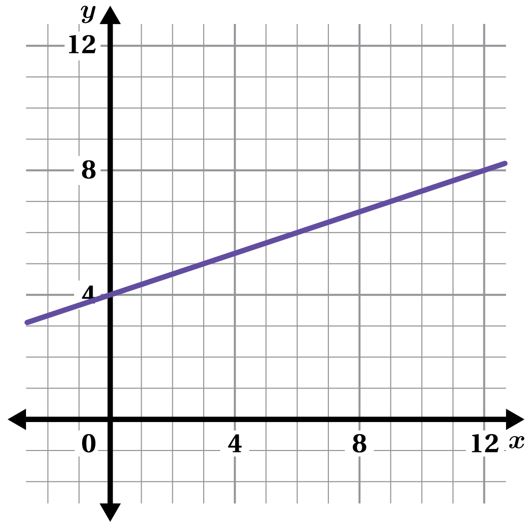
Name: .... Date: .... Period: ....

Determining Slope

2 Here is a line.

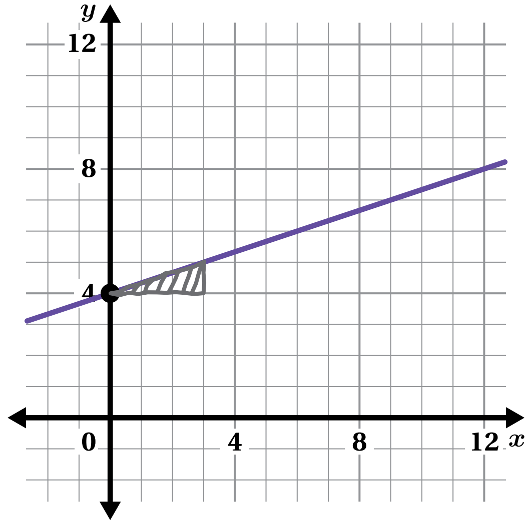
a Draw at least two *slope triangles* along the line.

b What is the slope of the line?



3 Luke-Josephine says the slope of this line is 3.

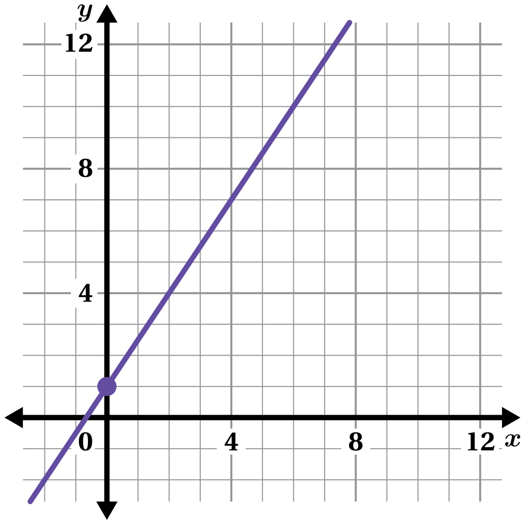
What would you say to help Luke-Josephine understand that the slope is $\frac{1}{3}$?



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

Determining Slope (continued)

4 What is the slope of this line?



5 Kweku says the slope of the line in the previous problem is $\frac{6}{4}$.

Liam says the slope is $\frac{2}{3}$.

Whose thinking is correct? Circle one.

Kweku's | Liam's | Both | Neither

Explain your thinking.

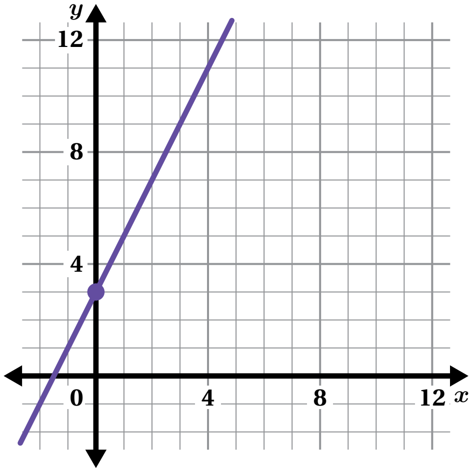
Activity 2

Name: ____________ Date: ________ Period: ________

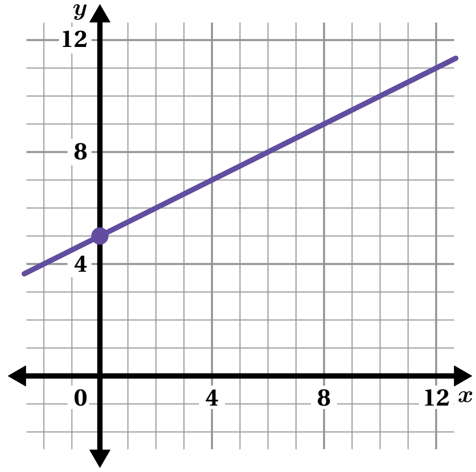
Repeated Challenges

6 What is the slope of each line? Solve as many challenges as you have time for. It's more important to make sense of the challenges than it is to work quickly!

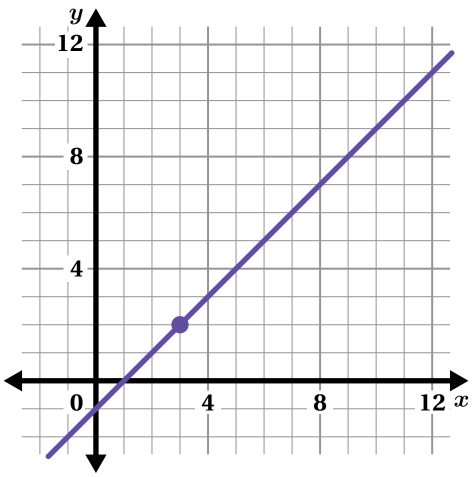
a



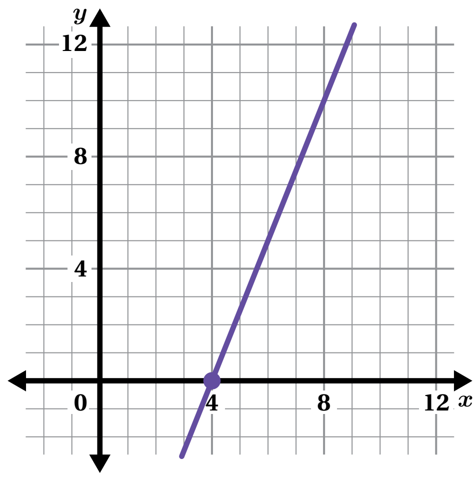
b



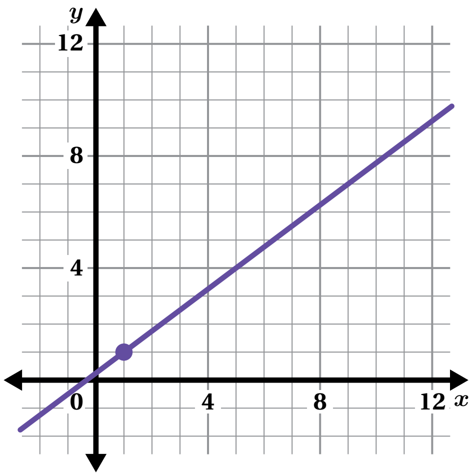
c



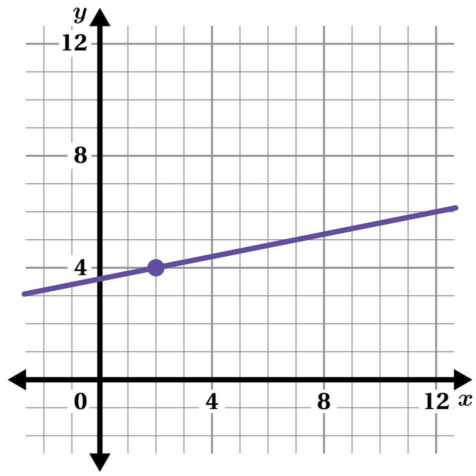
d



e



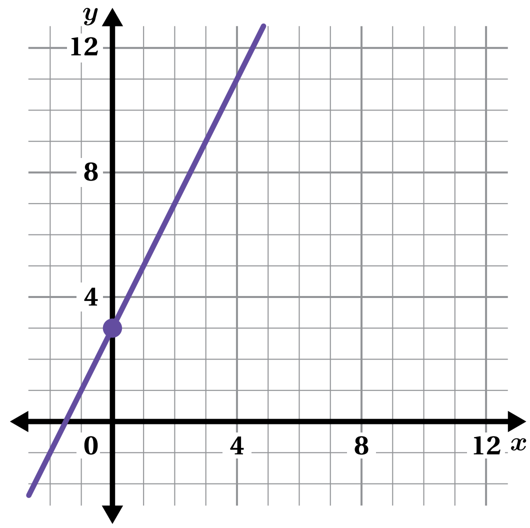
f



7 Synthesis

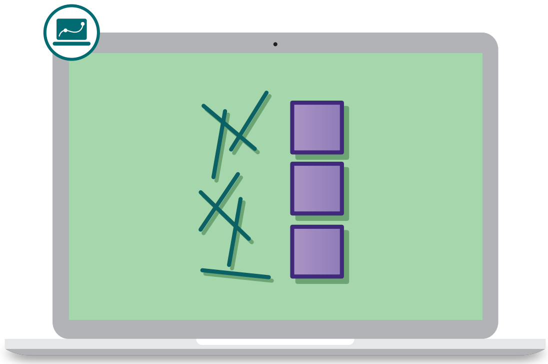
Describe a strategy for determining the slope of any line.

Use the example if it helps you with your thinking.



Things to Remember:

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



Toothpicks and Tiles

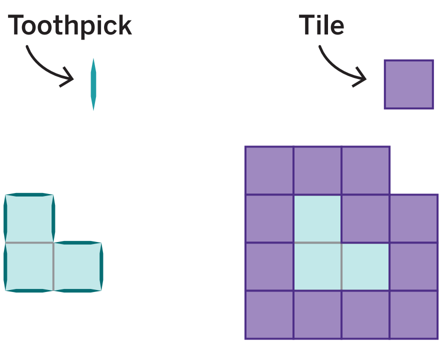
Let's make predictions about relationships.

Warm-Up

1 Here are two identical copies of the same shape. One has a border of toothpicks around it. The other has a border of tiles.

Border toothpicks: ....

Border tiles: ....



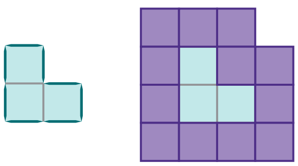
Activity 1

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

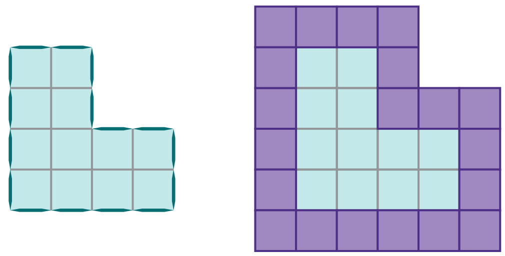
Patterns and Predictions

2 Stage 1 shows two figures. Stage 2 is a *scaled copy* of Stage 1. Stage x is a scaled copy of Stage 1 with a *scale factor* of x.

Stage 1



Stage 2



How many border toothpicks and tiles are in Stage 2? How many will there be in Stage 3?

Stage	Border Toothpicks	Border Tiles
1	8	12
2		
3		

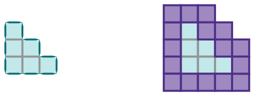
3 Will there ever be a stage with exactly 100 toothpicks? Explain your thinking.

4 There is a stage that uses 100 border tiles. Which stage? Explain your thinking.

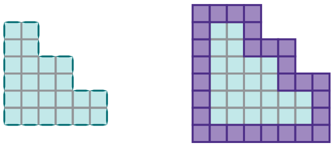
Patterns and Predictions (continued)

5 Here is a new design.

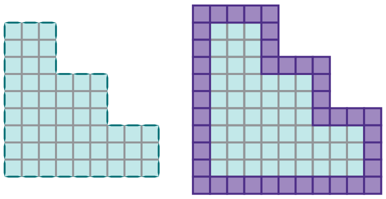
Stage 1



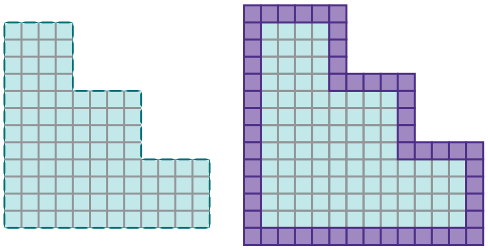
Stage 2



Stage 3



Stage 4



How many border tiles will there be in Stage 5? Explain your thinking.

Stage	Border Toothpicks	Border Tiles
1	12	16
2	24	28
3	36	40
4	48	52

6 Which stage uses 100 border tiles?

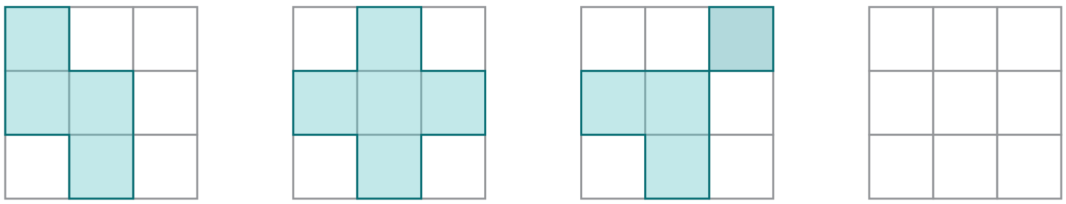
Activity 2

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

Unique Designs

7 Choose one of these Stage 1 designs or create your own.

Design A **Design B** **Design C** **Create Your Own**



a Use the Activity 2 Sheet to determine the number of border toothpicks and tiles for Stages 1–3 of the design you chose.

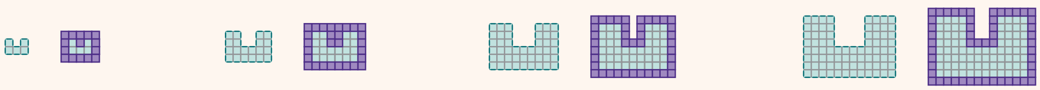
Stage	Border Toothpicks	Border Tiles
1		
2		
3		

b Predict how many border tiles are used in Stage 4.

Explore More

8 There's something unusual about the number of border tiles in Stage 1 of this design.

Stage 1 **Stage 2** **Stage 3** **Stage 4**



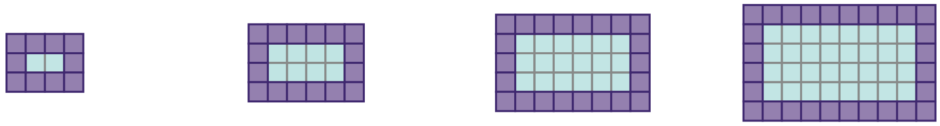
Why is Stage 1 different from Stages 2 and beyond?

Stage	Border Toothpicks	Border Tiles
1	12	15
2	24	28
3	36	40
4	48	52

9 Synthesis

Here is a new pattern.

Stage 1	Stage 2	Stage 3	Stage 4



Border tiles: 10	Border tiles: 16	Border tiles: 22	Border tiles: 28

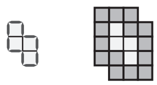
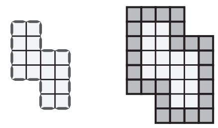
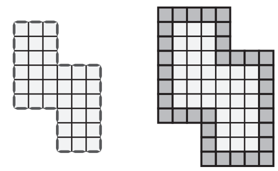
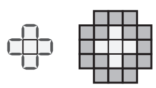
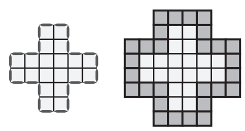
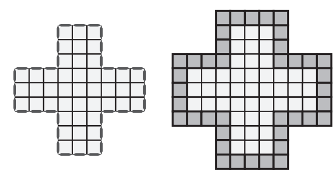
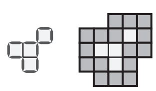
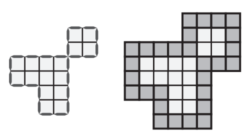
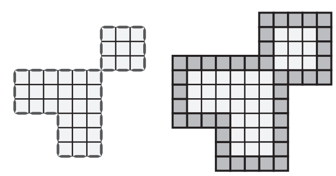
Describe how you can determine the number of border tiles at any stage.

Things to Remember:

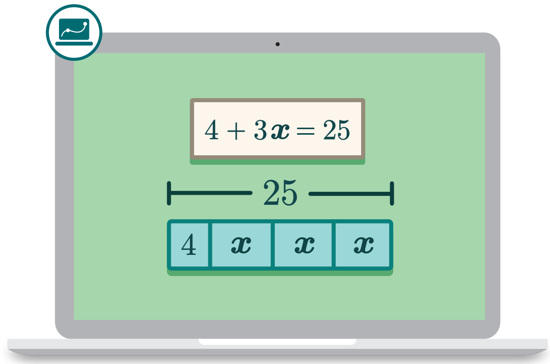
Name: ________________ Date: ________ Period: ________

Unique Designs

Use the table to help you determine how many border toothpicks and tiles are used for Stages 1–3 for the design you chose.

	Stage 1	Stage 2	Stage 3
Design A			
Design B			
Design C			
Create Your Own			

Name: ______ Date: ______ Period: ______

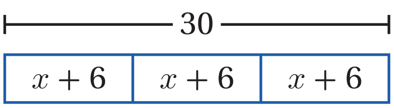


Equations

Let's connect representations of relationships.

Warm-Up

1 Here is a tape diagram.



a Which equation matches the tape diagram?

A. $3x + 6 = 30$

B. $3 + 6x = 30$

C. $3(x + 6) = 30$

b Draw a tape diagram for one of the equations that you *did not* select.

Activity 1

Name: ______ Date: ______ Period: ______

Connecting Representations

Liam plans to bake 25 cookies. He wants to keep 4 cookies for himself, and then split the rest evenly between his 3 friends.

2 Which equation and tape diagram match Liam's situation?

A. $4 + 3x = 25$

25

4	x	x	x

B. $4x + 3 = 25$

25

x	x	x	x	3

C. $3(x + 4) = 25$

25

$x + 4$	$x + 4$	$x + 4$

D. $4(x + 3) = 25$

25

$x + 3$	$x + 3$	$x + 3$	$x + 3$

3 How many cookies should each of Liam's friends receive?

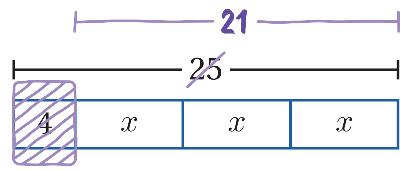
Activity
1

Name: Date: Period:

Connecting Representations (continued)

4 Liam used this tape diagram and equation to represent his situation. Here is his first step. What equation would represent his new tape diagram? Explain why this equation is helpful.

$$4 + 3x = 25$$



5 Liam ended up baking 33 cookies. He kept 5 for himself and split the rest evenly between 7 friends.

a Write an equation to represent Liam's new situation.

b Draw a tape diagram for Liam's new situation.

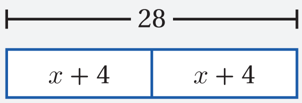
Activity 2

Name: ______ Date: ______ Period: ______

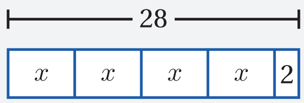
Missing Representations

6 Make groups that represent the same situation. Some groups will be missing a representation.

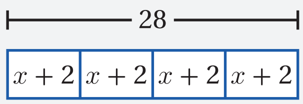
a.



b.



c.



d. A cake-baking kit says: 28 tablespoons of sugar is provided for 2 cakes. For each cake, save 4 tablespoons of sugar for frosting and put the rest in the batter.

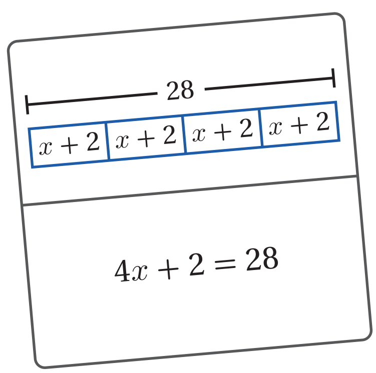
e. Riku's mom buys 4 cinnamon buns, one per family member. Each person also gets \$2 to spend on a beverage. The bill is \$28.

f. $2(x + 4) = 28$

g. $4x + 2 = 28$

Group 1	Group 2	Group 3
a	b	c

7 Irene incorrectly matched these two representations. What could you say to convince Irene that these don't match?

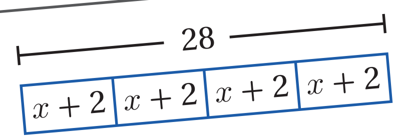


Name: .... Date: .... Period: ....

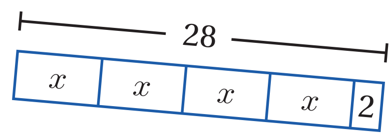
Missing Representations (continued)

8 One group did not have a matching equation. Write an equation that matches.

Riku's mom buys 4 cinnamon buns, one per family member. Each person also gets \$2 to spend on a beverage. The bill is \$28 total.



9 One group did not have a matching situation. Write a situation that matches.



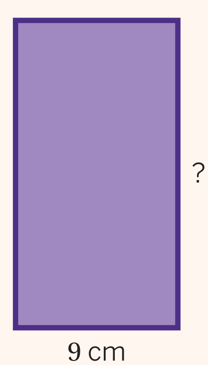
$$4x + 2 = 28$$

Explore More

10 This rectangle has an unknown length, a width of 9 centimeters, and a perimeter of 52 centimeters.

a Write an equation or draw a tape diagram to represent this situation.

b Determine the length of the rectangle.



11 Synthesis

Here is a new situation. Explain how the number 9 is important in each representation.

In the story . . .

In the equation . . .

In the tape diagram . . .

Story

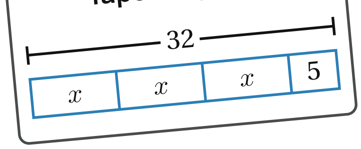
Jaylin buys 3 bags of bagels.

The store gives her 5 bagels for free, making it 32 bagels total.

Equation

$3x + 5 = 32$

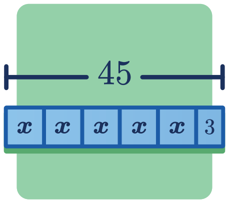
Tape Diagram



Things to Remember:

Unit 6
Lesson
4

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



Seeing Structure

Let's analyze and solve questions in context.

Warm-Up

Here are six equations.

Equation A $100 = 8(x + 9)$	**Equation B** $9(x + 7) = 100$	**Equation C** $100 = 8x + 72$
Equation D $9x + 63 = 100$	**Equation E** $100 = 72 + 8x$	**Equation F** $(x + 7) \cdot 9 = 100$

1. Select two equations that have something in common. How are the two equations alike?

2. Create two groups so that the equations in each group have something in common. Then explain what your groups have in common.

Group 1	Group 2
Equations:	Equations: ....
All the equations in this group . . .	All the equations in this group . . .

Activity 1

Name: ______ Date: ______ Period: ______

Which Diagram?

For each situation, first choose the diagram that best represents it. Then write an equation, determine the solution, and explain what the solution means in the situation.

Diagram A

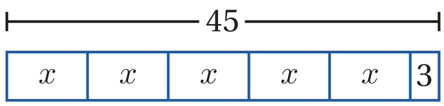
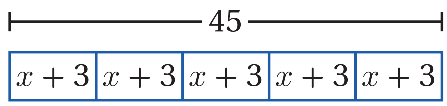


Diagram B



3. A postal worker weighs 5 identical cardboard packages and a 3-pound plastic box. Everything weighs a total of 45 pounds.

Diagram	Equation	Solution	Meaning of Solution

4. Tyani is making 5 gift bags. Each bag contains x pencils. Tyani adds 3 more pencils to each bag. Altogether, the gift bags contain 45 pencils.

Diagram	Equation	Solution	Meaning of Solution

5. A national park charges \$3 for each car that enters and also a fee for each person that enters. A family of 5 enters the park in 1 car and pays a total of \$45.

Diagram	Equation	Solution	Meaning of Solution

Activity 2

Name: ______ Date: ______ Period: ______

Questions and Answers

6. Natalia's family wants to inflate a total of 60 balloons for a party. Yesterday, they inflated 24 balloons. Today, they want to split the remaining balloons equally between 4 family members.

a Use this information to write a question that you don't already have the answer to.

b Write an equation or draw a tape diagram to represent the situation and your question.

c Solve the equation to answer your question.

d Use the equation to check your solution.

7. An art class charges each student $\$15$ to attend, plus a fee for supplies. The instructor hopes to collect $\$240$ total from the 12 students who attend the class.

a Use this information to write a question that you don't already have the answer to.

b Write an equation or draw a tape diagram to represent the situation and your question.

c Solve the equation to answer your question.

d Use the equation to check your solution.

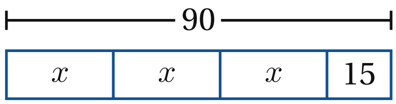
Explore More

8. Write your own problem that can be solved with an equation or tape diagram. Then swap problems with a classmate and solve your classmate's problem.

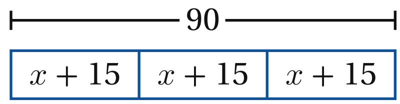
Synthesis

9. Here are two equations and their tape diagrams.

$3x + 15 = 90$



$3(x + 15) = 90$

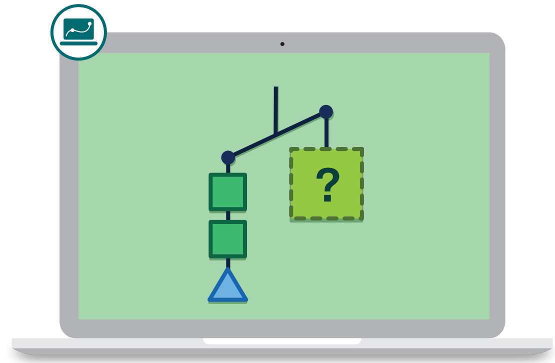


Describe how the tape diagrams are alike and different.

Things to Remember:

Unit 6
Lesson
5

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

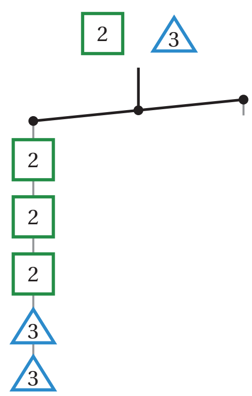


Balancing Moves

Let's see how hangers can represent balanced relationships.

Warm-Up

1 Balance the hanger by adding shapes to either side. Be sure to make the sides different.

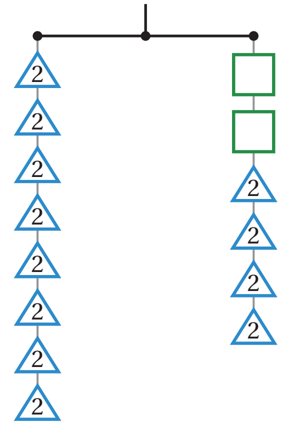


Activity 1

Name: ______ Date: ______ Period: ______

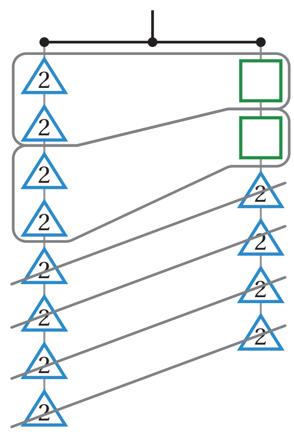
Unknown Weights

2 Determine the weight of the square so that the hanger stays balanced. Describe your strategy.



Weight of Triangle (lb)	Weight of Square (lb)
2	

3 This diagram shows Adnan's strategy for determining the weight of a square in the previous problem. Describe this strategy.

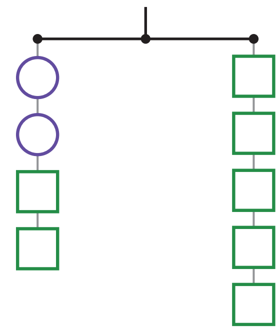


Name: ______________ Date: ______ Period: ______

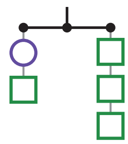
Unknown Weights (continued)

4 Hanger A is balanced. Select *all* the other hangers that must also be balanced.

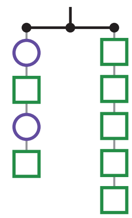
Hanger A



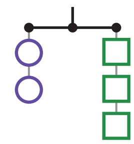
☐ **Hanger B**



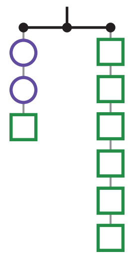
☐ **Hanger C**



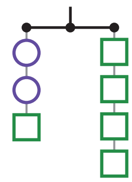
☐ **Hanger D**



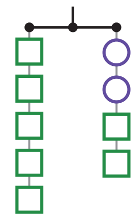
☐ **Hanger E**



☐ **Hanger F**

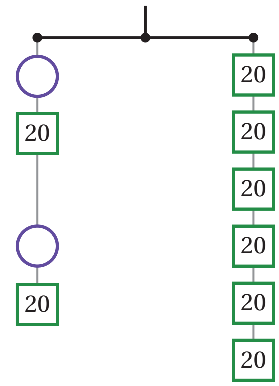


☐ **Hanger G**



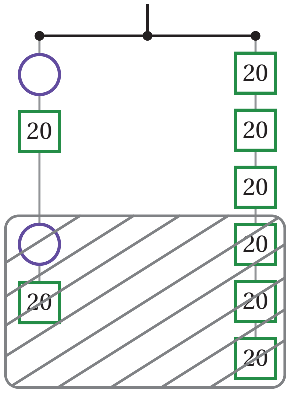
5 **a** Determine the weight of a circle so the hanger stays balanced.

Weight of Square (lb)	Weight of Circle (lb)
20	



b Describe your strategy.

6 This is how Theo made a hanger with fewer objects. Will the new hanger be balanced? Explain your thinking.



Activity 2

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

Challenge Creator

7 Now it's your turn to create your own hanger diagram challenge.

a **Make It!** On the Activity 2 Sheet, design your challenge.

b **Solve It!** On this page, copy the weight of the first shape from the challenge you designed. Then determine the weight of the second shape.

Weight of	**Weight of** ....

c **Swap It!** Swap your challenge with one or more partners. Write the weight of your partner's first shape. Then determine the weight of your partner's second shape.

Partner 1: ....

Weight of	**Weight of** ....

Partner 2: ....

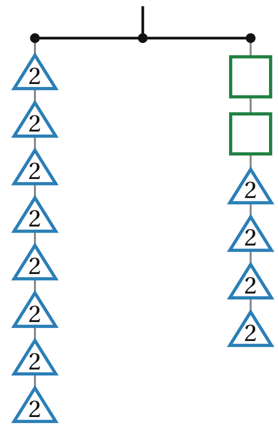
Weight of	**Weight of** ....

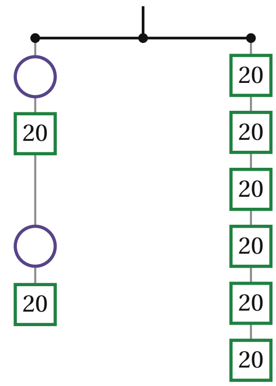
Partner 3: ....

Weight of	**Weight of** ....

8 Synthesis

Describe strategies for making a balanced hanger with fewer objects. Use the diagrams if they help with your thinking.





Things to Remember:

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

Challenge Creator

Follow the steps below to create your own hanger diagram challenge.

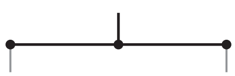
a Choose two shapes for your hanger.

Square Circle Triangle Pentagon

b Write the names of the shapes you chose below. Then write a weight for the *first shape only*.

Weight of	**Weight of** ....

c Create a balanced hanger using your two chosen shapes.



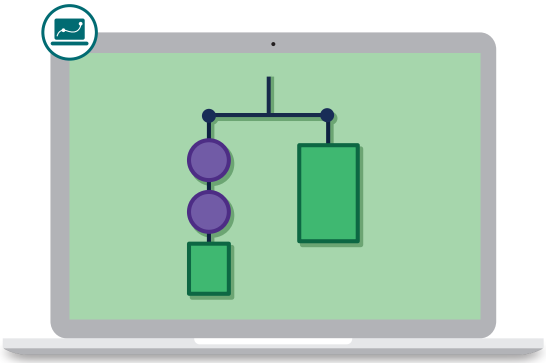
d Do not determine the weight of the second shape on this page. You and your classmates will determine the weight in the Student Edition.

Unit 6
Lesson
6

Name: ______ Date: ______ Period: ______

Balancing Equations

Let's use hanger diagrams to help us solve equations.

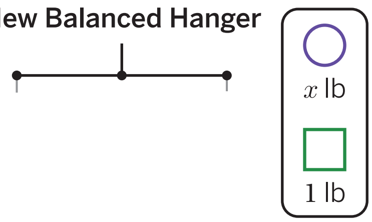


Warm-Up

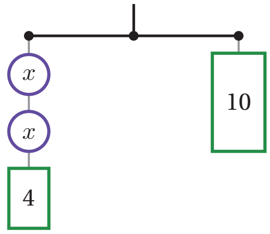
1 Hanger A is balanced.

Create a new balanced hanger that has the same weight for x.

New Balanced Hanger



Hanger A



$2x + 4 = 10$

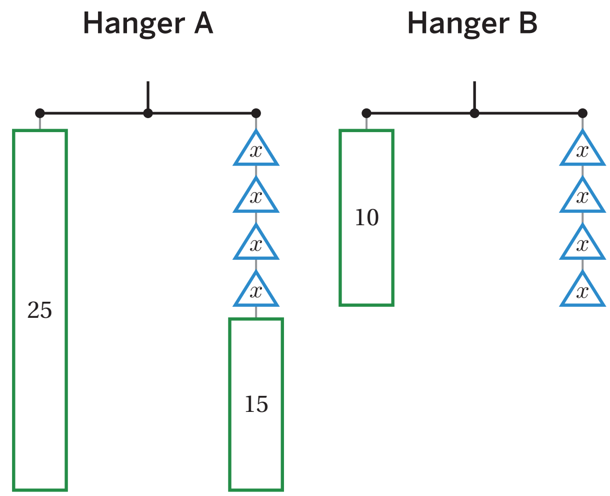
Name: ______ Date: ______ Period: ______

Connecting Hangers to Equations

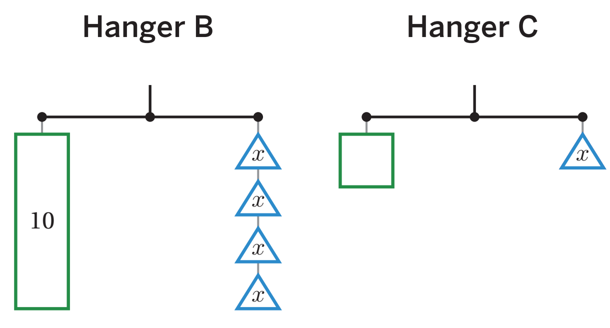
2 The equation $25 = 4x + 15$ represents Hanger A.

a Write an equation that represents Hanger B.

b What balanced move gets you from Hanger A to Hanger B?



3 What is the weight of one triangle?



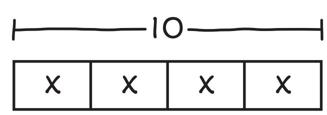
4 Here are Terrance's and Nikhil's strategies for determining the weight of one triangle on Hanger B.

Discuss: How are the two strategies alike? How are they different?

Terrance

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

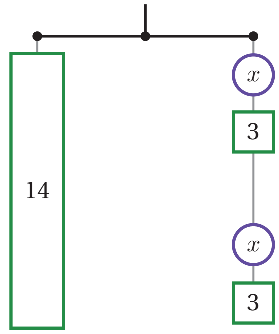
Nikhil



Name: ________ Date: ________ Period: ________

Connecting Hangers to Equations (continued)

5 Here is a new hanger. What is the value of x?



6 Anand and Darius used equations to determine the value of x in the previous problem.

Darius wrote the equation $14 = 2x + 6$.
Anand wrote the equation $14 = 2(x + 3)$.

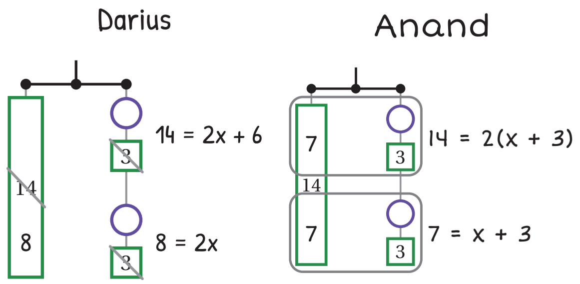
Who is correct? Circle one.

Darius Anand Both Neither

Explain your thinking.

7 Here are Darius's and Anand's work.
Select a question to answer.

- ☐ Why did Darius write $8 = 2x$?
- ☐ Why did Anand write $7 = x + 3$?

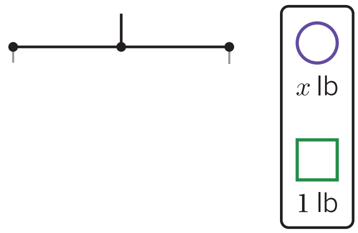


Activity 2

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

Solving Equations

8 **a** Create a hanger to represent $7 = 4x + 2$.



b What value of x makes the equation true?

9 **a** Determine the value of x that makes the equation $4(x + 2) = 40.4$ true.

b Describe the steps you used to determine the value of x.

10 What value of x makes each equation true? Solve as many challenges as you have time for.

a $3x + 1 = 7$

b $2(x + 5) = 16$

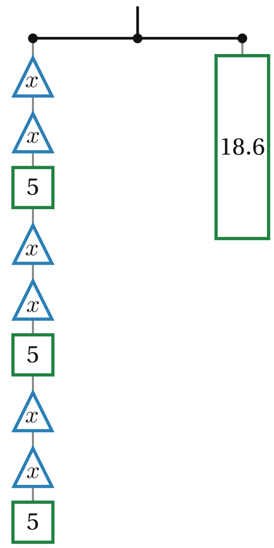
c $2x + 2.2 = 6.8$

d $4(x + 1.1) = 20.8$

e $4x + \frac{3}{2} = \frac{17}{2}$

11 Synthesis

Describe how solving an equation is like solving for the weight of an object on a balanced hanger. Use the diagram if it helps with your thinking.



$3(2x + 5) = 18.6$

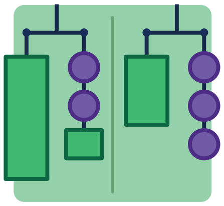
Things to Remember:

Unit 6
Lesson
7

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

Keeping It True

Let's solve equations with positive and negative numbers.



Warm-Up

Solve each equation mentally. Try to think of more than one strategy.

1. $x + 4 = 6$

2. $x + 6 = 4$

3. $-2x = 4$

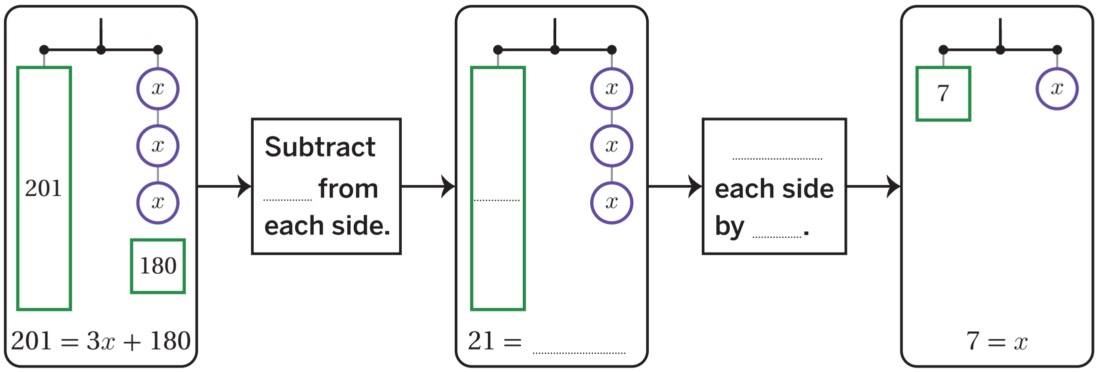
4. $-2x + 6 = 4$

Name: ______ Date: ______ Period: ______

Keep It True

Solve each equation by completing the blanks in the hangers, equations, and descriptions.

5.



6. **Equation** **Steps**

$5 = 2x + 8$

______ $= 2x$

______ $= x$

Step 1: ______ from each side.

Step 2: ______ each side ______.

7. **Equation** **Steps**

$2(x - 5) = \text{-}6$

$x - 5 = \text{-}3$

______ $=$ ______

Step 1: Divide each side ______.

Step 2: ______.

8. How can you check if the *solutions to the equations* in Problems 5–7 are correct?

Activity 2

Name: ______ Date: ______ Period: ______

Solve 'em

Here are two groups of equations.

Group A	Group B
$x - (-4) = -6$	$2(x - 1) = -200$
$50x + 200 = 1700$	$900 = -100(x - 3)$
$8.6 = 3x - 3.4$	$3(x + 4.5) = 36$

9. **Discuss:** How are the equations in each group alike or different?

10. Which group do the equations $-3x + \left(-\frac{1}{6}\right) = \frac{5}{6}$ and $-\frac{1}{2}(2x - 6) = -2$ belong to? Explain your thinking.

11. Choose two equations from *each* group to solve.

	Group A	Group B
Equation 1		
Equation 2		

Synthesis

12. **a** Write an equation that would belong in Group B.

b What advice would you give to help someone solve an equation like yours?

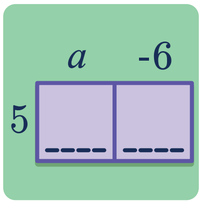
Group B
$2(x - 1) = -200$
$900 = -100(x - 3)$
$3(x + 4.5) = 36$

Things to Remember:

Unit 6
Lesson
8

Name: ________ Date: ________ Period: ________

Factoring and Expanding

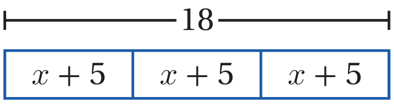


Let's think about efficient ways to solve equations with parentheses.

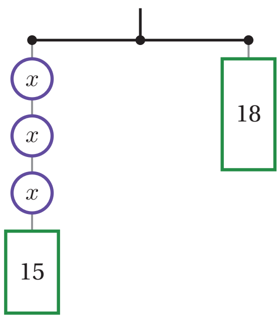
Warm-Up

1. Which one doesn't belong? Explain your thinking.

A.



B.



C. $3(x + 5) = 18$

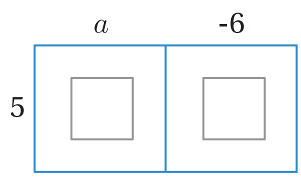
D. $3x + 5 = 6$

Name: ______ Date: ______ Period: ______

Factoring Puzzles

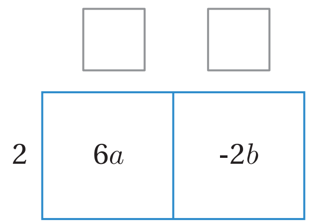
Complete the missing information in each puzzle.

2.



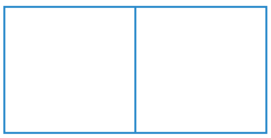
Factored	Expanded
$5(a - 6)$	

3.



Factored	Expanded
	$6a - 2b$

4.



Factored	Expanded
	$-25x + 15$

5.

Factored	Expanded
$-(2c + 3)$	

Name: ________ Date: ________ Period: ________

Step by Step by Step by Step

6. Here are Amir's and Sadia's first steps for solving $2(x - 9) = 10$.

Amir	Sadia
$2(x - 9) = 10$	$2(x - 9) = 10$
$2x - 18 = 10$	$x - 9 = 5$

a Are each of their first steps correct? Explain your thinking.

b Finish solving each equation. Show your thinking.

Amir	Sadia

Activity 3

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

Different First Steps

Solve these equations for x using both Amir's and Sadia's methods. Check the box when your solutions match.

7. $3(x + 2) = 21$

Expand first:

Divide first:

☐

8. $200(x - 0.3) = 600$

Expand first:

Divide first:

☐

9. $-10\left(x - \frac{7}{10}\right) = -3$

Expand first:

Divide first:

☐

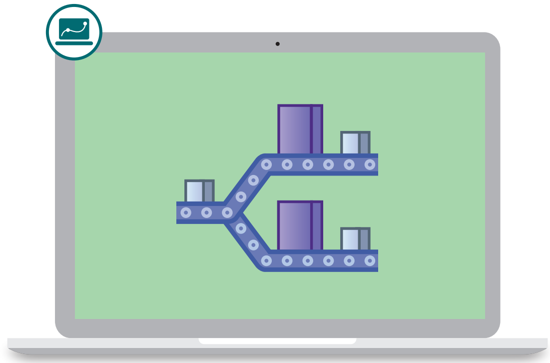
Synthesis

10. **a** What are two possible first steps you could use when solving an equation like $6(x + 4) = 30$?

b What are some advantages to having different ways to solve an equation?

Things to Remember:

Name: ______ Date: ______ Period: ______

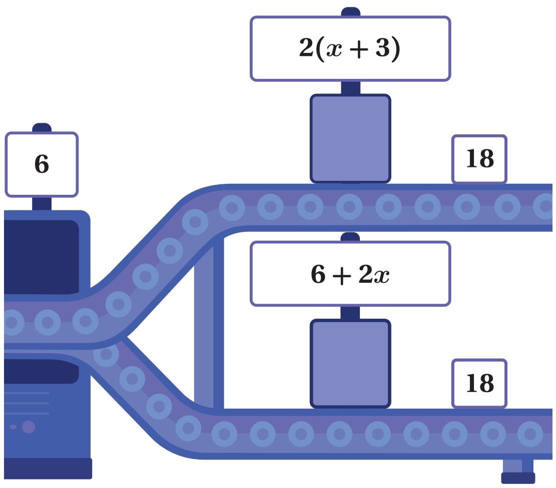


Always-Equal Machines

Let's explore equivalent expressions using always-equal machines.

Warm-Up

1 Here are two number machines. Let's watch what happens when an input goes into the machines. Record the results in the table.

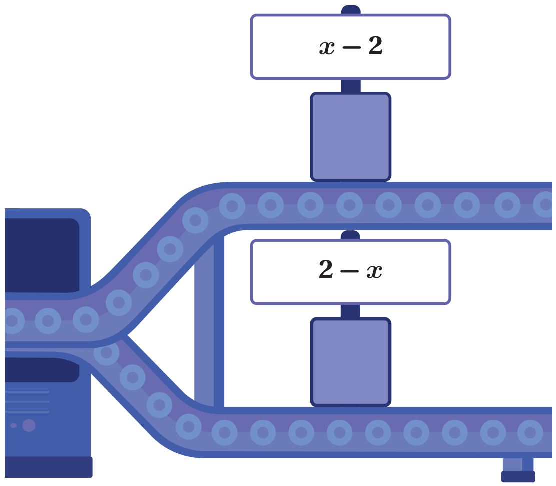


x	$2(x+3)$	$6+2x$

2 Here are two more number machines. When will these machines have equal outputs?

Always   Sometimes   Never

Explain your thinking.



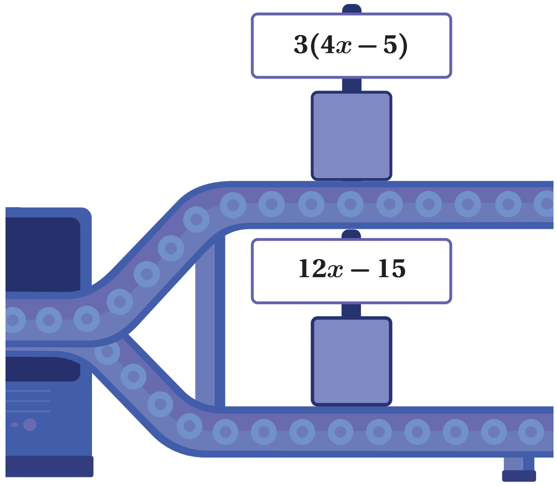
Activity 1

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

Equivalent Expressions

3 Expressions that give the same output for every input are called **equivalent expressions**.

Are these equivalent expressions? Explain how you know.



4 **a** Which expression is equivalent to $2(10 - x)$?

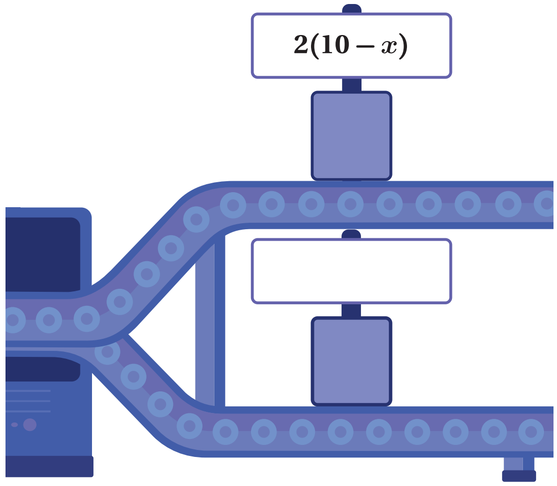
A. $20 - x$

B. $20 - 2x$

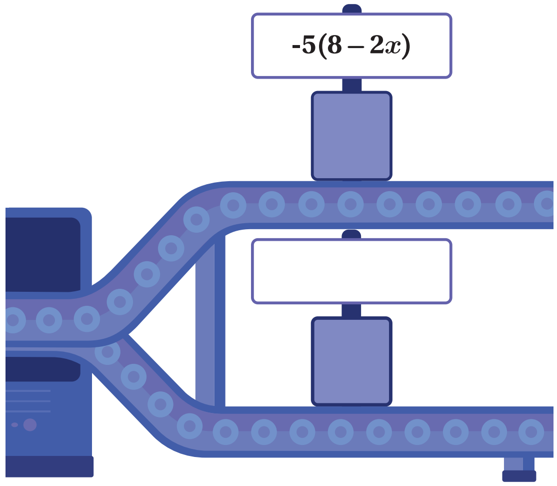
C. $2(x - 10)$

D. $2x - 20$

b Choose one input to test your expression.



5 Write an equivalent expression to $-5(8 - 2x)$.



Name: ______ Date: ______ Period: ______

Equivalent Expressions (continued)

6 Three students made mistakes writing an equivalent expression to $-5(8 - 2x)$.

$\boxed{-5(8 - 2x)}$

Zion	Juliana	Nickolas
$-5(2x - 8)$	$-40 - 10x$	$-40 + 2x$

Circle your favorite mistake.

Explain what you think is incorrect about the student's expression.

7 **a** Select *all* of the expressions equivalent to $-15 + 6x$.

- ☐ **A.** $-3(5 - 2x)$
- ☐ **B.** $3(2x - 5)$
- ☐ **C.** $3(5 - 2x)$
- ☐ **D.** $6x + (-15)$
- ☐ **E.** $15 + (-6x)$

b Choose one of the equivalent expressions. Explain how you know it is equivalent to $-15 + 6x$.

I know ______ is equivalent because . . .

Activity 2

Name: ______ Date: ______ Period: ______

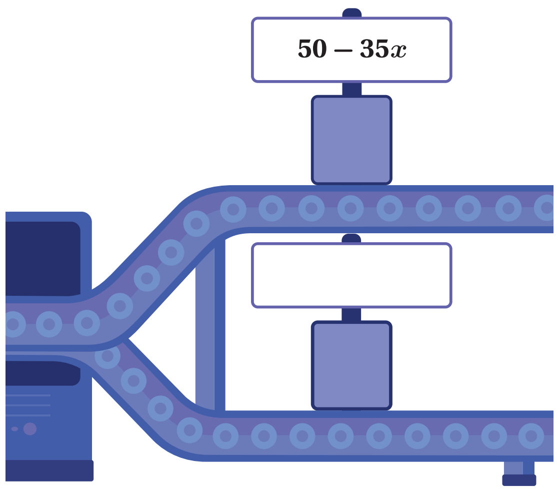
More Than One Way

8 Group the equivalent expressions. One expression will have no group.

$8(x - 3)$	$-4(-6 + 2x)$	$-8(x - 24)$	$8x - 24$
$-24 + 8x$	$24 - 8x$	$\frac{1}{2}(16x - 48)$	

9 Write an equivalent expression to $50 - 35x$.

Try to write more than one.



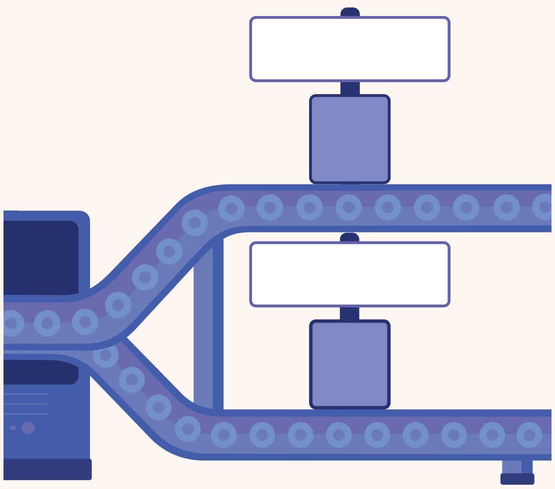
Name: ______ Date: ______ Period: ______

More Than One Way (continued)

10 Write at least three different equivalent expressions to $64x - 16$.

Explore More

11 Make a never-equal machine that will never give the same output for any input. Write your expressions on the two machines.



Explain how you know these are never equal.

12 Synthesis

How can you determine whether two expressions are equivalent to each other? Use these examples if they help with your thinking.

- $24 - 8x$
- $-4(-6 + 2x)$
- $-8(x - 24)$
- $\frac{1}{2}(16x - 48)$
- $8(x - 3)$
- $-24 + 8x$
- $8x - 24$

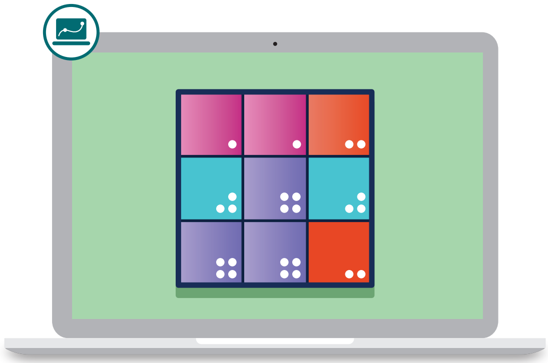
Things to Remember:

Unit 6
Lesson
10

Name: ________ Date: ________ Period: ________

Collect the Squares

Let's write equivalent expressions with fewer terms.



Warm-Up

Solve each equation mentally. Try to think of more than one strategy.

1. $6x = 12$

2. $3x + 3x = 12$

3. $4x + 2x = 12$

4. $6x + 3 = 27$

5. $2x + 4x + 3 = 27$

Activity 1

Name: ________ Date: ________ Period: ________

Collect the Squares

6 Collect all the squares by choosing two or more expressions to combine. Then write an equivalent expression using the fewest number of *terms*. There is an example in the first row.

$4x + 1$	$9x$
$-2x$	$-10x$

Original Expression	Equivalent Expression
$4x + 1 + (-10x)$ $= 4x - 10x + 1$ $= -6x + 1$	$-6x + 1$

Name: ______ Date: ______ Period: ______

Collect the Squares (continued)

7 Collect all the squares by choosing two or more expressions to combine. Then write an equivalent expression using the fewest number of terms.

$-2x - 2$	$8x + 8$
-3	$3(x + 1)$

Original Expression	Equivalent Expression

8 Leslie combined these expressions. Some of his work is correct and some is incorrect.

$-2x - 2$	$8x + 8$
-3	$3(x + 1)$

Original Expression	Equivalent Expression
$-2x - 2 + 8x + 8$ $= -2x + 8x - 2 + 8$ $= 6x + 6$ $= 12x$	$12x$

Explain what you think is incorrect about Leslie's work.

Activity 2

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

Collect More Squares

9 Collect all the squares by choosing two or more expressions to combine. Then write an equivalent expression using the fewest number of terms.

Original Expression	Equivalent Expression

$3x + 6$	$x - 2$	$8(x - 3)$
$-4x - 4$	$x + 1$	$-2(x + 2)$
6	$7x$	$-8x$

Name: ________ Date: ________ Period: ________

Collect More Squares (continued)

10 Collect all the squares by choosing two or more expressions to combine. Then write an equivalent expression using the fewest number of terms.

$-4(x - 5)$	$6(x + 1)$	$\frac{1}{4}x - 20$
$3x + 12$	$-1(x - 9)$	$-x - 12$
$8 - x$	$-2x$	$7(2x + 1)$

Original Expression	Equivalent Expression

Explore More

11 Use these squares to create expressions that are equivalent to $5x - 8$. Create as many different expressions as you can.

$-(3x + 2)$	$-3(x + 2)$	$8x - 6$
$-2x - 6$	$2(4x - 1)$	$-3x + 2$
$8x - 10$	$3x - 6$	$2x + 2 + x$

12 Synthesis

Describe how to write an equivalent expression using the fewest number of terms. Use this expression if it helps with your thinking.

$5x - 2(6x - 4)$

Things to Remember:

Unit 6

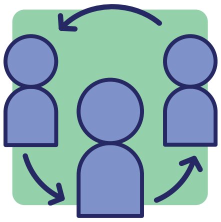
Lesson

11

Name: ________ Date: ________ Period: ________

Pass the Equation

Let's practice solving equations multiple ways.



Warm-Up

1. Explain some possible first steps you could take to solve the equation.

$2(4x - 3) = 30$

Activity 1

Name: ______ Date: ______ Period: ______

Equation Roundtable, Round 1

2. Follow the instructions on the Presentation Screen to solve these equations with your group.

$2x - 18 = 10$	$2(3 - x) = -8$
$5(x - 1) = 45$	$-6 = \frac{1}{2}(x - 8)$

Equation 1	Equation 2
Equation: Check:	Equation: Check:

Equation 3	Equation 4
Equation: Check:	Equation: Check:

3. What do you think is important to remember when solving these types of equations?

Activity 2

Name: ______ Date: ______ Period: ______

Equation Roundtable, Round 2

4. Here are four new equations. Solve them using the same instructions as Activity 1.

$8x - 6x - 18 = 10$	$55 = 5(x - 1) + 10$
$-10.5 = 6\left(x + \frac{1}{4}\right)$	$-2.8(x - 3) = 9\frac{4}{5}$

Equation 1	Equation 2
Equation: Check:	Equation: Check:

Equation 3	Equation 4
Equation: Check:	Equation: Check:

Synthesis

5. There are different ways to solve the equation $2(-3 + 8x) = -10$.

a List two different first steps you could take to solve this equation.

b Which first step do you prefer? Explain your thinking.

Things to Remember:

Unit 6

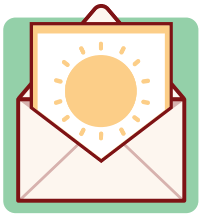
Lesson

12

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

Community Day

Let's represent and answer questions about situations in context.



Warm-Up

A baker put an equal number of cookies into 3 boxes. Then they put 2 more cookies in each box. They used 24 cookies total.

1. Which tape diagram best represents this situation?

A.

24		
$a+2$	$a+2$	$a+2$

B.

24			
a	a	a	2

2. Write an equation that represents the tape diagram you chose.

Activity
1

Name: ____________ Date: ____________ Period: ____________

Three Reads

3. Here is a situation. Let’s make sense of it together as a class.

Kyrie’s class is making invitations to their school’s Community Day.

They have already made invitations and want to finish the rest of them within 7 days.

The class plans to spread out the remaining work so that they make the same number of invitations each day.

a **Discuss:** What is this situation about?

b Create a tape diagram or sketch that represents this situation.

c Let’s look at the missing information. Adjust your diagram to represent that Kyrie’s class is making 122 invitations and has already made 66 invitations.

d Determine how many invitations Kyrie’s class should make each day.

Activity 2

Name: ____________ Date: ________ Period: ________

Similar Problems

4. You will use the Activity 2 Sheet to explore a set of situations. Choose Set 1, Set 2, or Set 3.

Set ____________

5. Create a poster. Here is what your poster should include *for each situation* in your set:

- ☐ The situation in words
- ☐ A visual representation of the situation (tape diagram, hanger, etc.)
- ☐ An equation that represents the situation, along with your work for solving it
- ☐ A check for the solution to the equation
- ☐ The answer (with units) to the question in the situation
- ☐ Connections between the visual representation, equation, and situation

Synthesis

6. What do you think is important to remember when solving problems using visual representations and equations?

Things to Remember:

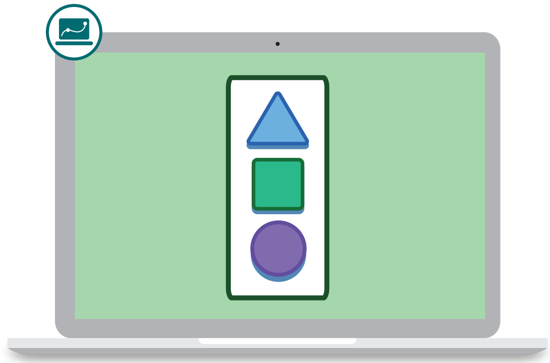
Similar Problems

Here are three sets of related situations.

	Situation A	Situation B
Set 1	6 members of the Martinez family are going to their school's Community Day. They have a coupon for \$4.50 off each ticket. If they pay \$40.50 for all their tickets, how much does one ticket cost without the coupon?	6 members of the Benton family are going to their school's Community Day. They have a coupon for \$4.50 off their total. If they pay \$40.50 for all their tickets, how much does one ticket cost without the coupon?
Set 2	Kwabena and Trevon are working together tossing bean bags to one side of a scale in order to balance a giant 15-pound stuffed animal. They're successful after Kwabena tosses 13 bean bags and Trevon tosses 8 bean bags onto the scale. How much does each bean bag weigh?	Adah and Samnang are working together tossing bean bags to one side of a scale in order to balance a giant 15-pound stuffed animal. They're successful after Adah tosses 13 small bean bags and Samnang tosses one giant 8-pound bean bag onto the scale. How much does each small bean bag weigh?
Set 3	Marquis and Yolanda plan to sell T-shirts at their school's Community Day. They make 25 shirts and each costs \$15 to make. If they would like to make \$320 in profit, how much should they sell each T-shirt for?	Moon and Cameron plan to sell T-shirts at their school's Community Day. They spend \$25 on supplies and make 15 shirts. If they would like to make \$320 in profit, how much should they sell each T-shirt for?

Unit 4
Lesson
3

Name: Date: Period:

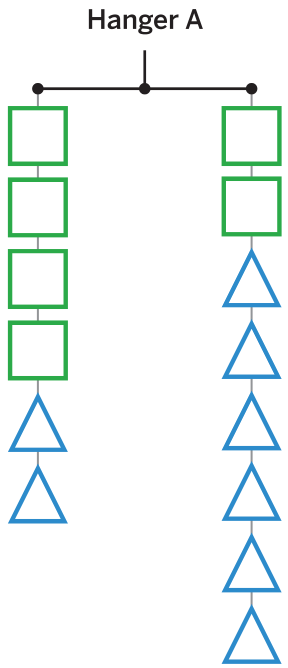


Balanced Moves

Let's rewrite equations while keeping the same solutions.

Warm-Up

1 Hanger A is balanced. Draw a different balanced hanger using the same shapes.



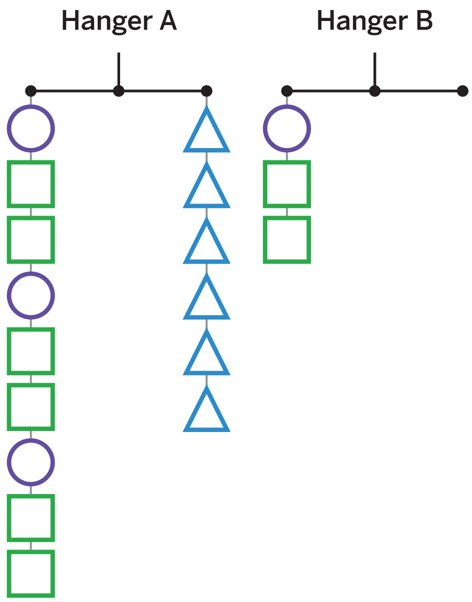
Activity 1

Name: ______ Date: ______ Period: ______

Multiplication and Division

2 We can balance hangers by adding or subtracting shapes from each side, or by multiplying or dividing.

If Hanger A is balanced, build the right side of Hanger B so that it also balances.

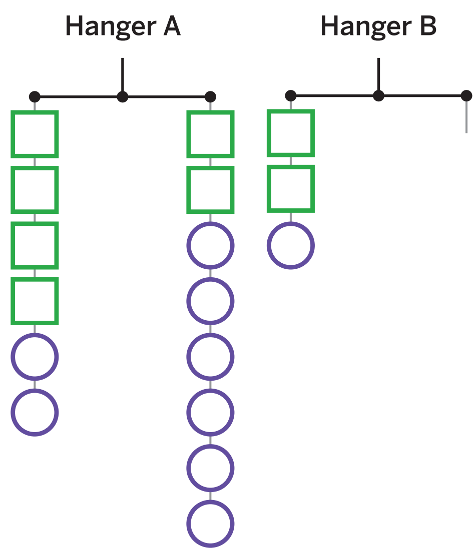


3 In this diagram:

- x represents the weight of each square.
- y represents the weight of each circle.

Ethan divided each side of Hanger A by 2 to make Hanger B.

Write an *expression* to represent the right side of Hanger B.



Activity 1

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

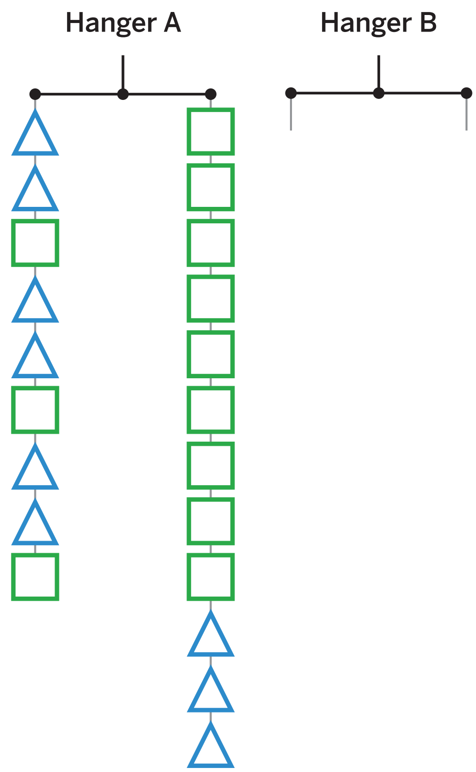
Multiplication and Division (continued)

4 In this diagram:

- x represents the weight of each triangle.
- y represents the weight of each square.

Jamir changed the number of shapes on each side of Hanger A to make Hanger B.

Write an *equivalent equation* that could represent a balanced Hanger B.



$3(2x + y) = 9y + 3x$? = ?

5 In this diagram:

- x represents the weight of each triangle.
- 2 pounds is the weight of each circle.

Select an equation that could represent a balanced hanger.

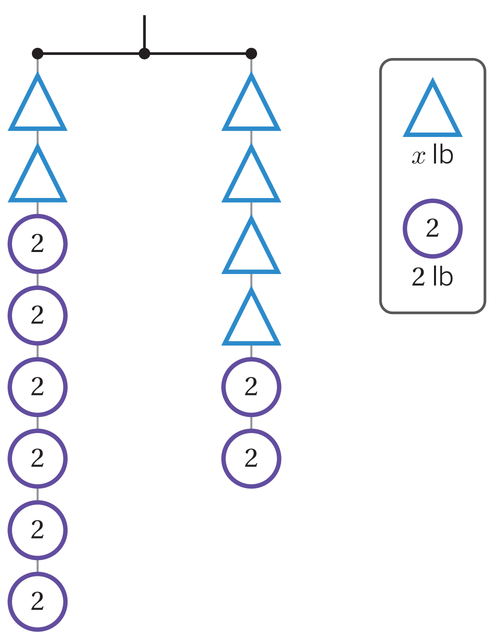
A. $x + 6 = 2x + 2$

B. $12 = 2x + 4$

C. $8 = 2x$

D. $2x + 8 = 4x$

Show or explain your thinking.



Activity 2

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

Solving Equations

6 Here's the first step Dalia took to solve the equation $6x + 12 = 10x - 4$.

What did she do to both sides to create a simpler equivalent equation?

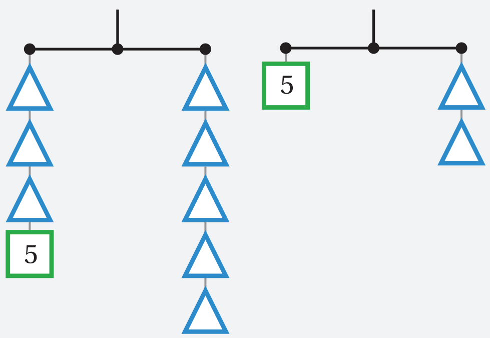
Dalia

$6x + 12 = 10x - 4$

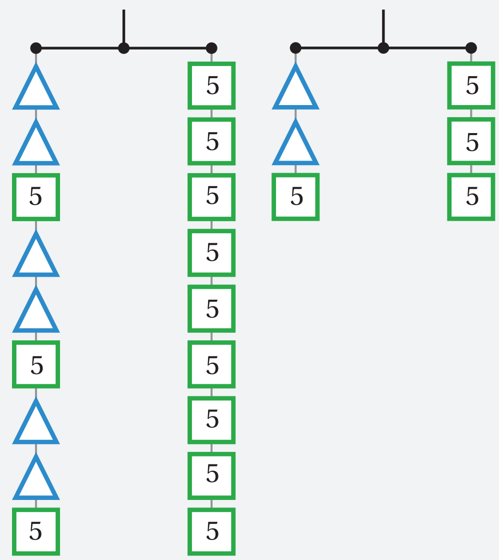
$12 = 4x - 4$

7 Match each hanger set or equation set with the balanced equation move that describes it.

Hanger Set A



Hanger Set B



Equation Set C

$$\frac{5x}{-3} = \frac{12}{1}$$

$$5x = -36$$

Equation Set D

$$15 - 7x = 3 + 5x$$
$$12 - 7x = 5x$$

Equation Set E

$$3x + 5 = 5x$$
$$5 = 2x$$

Equation Set F

$$6x + 15 = 45$$
$$2x + 5 = 15$$

Multiply each side by -3	Divide each side by 3	Subtract 3 from each side	Subtract $3x$ from each side

Name: ________ Date: ________ Period: ________

Solving Equations (continued)

8 Jaylin solved this equation from the card sort: $15 - 7x = 3 + 5x$.

Is Jaylin's solution correct? Circle one.

Yes No I'm not sure

Explain your thinking.

Jaylin

Equation Set D

$15 - 7x = 3 + 5x$

$12 - 7x = 5x$

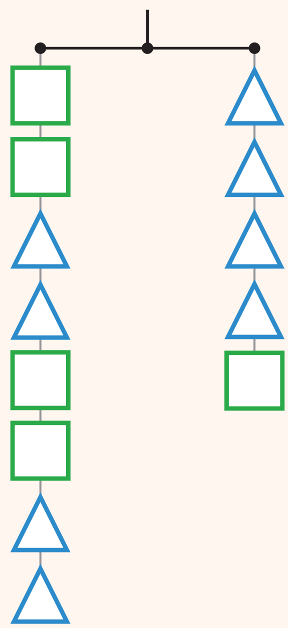
$12 = 12x$

$1 = x$

Explore More

9 What is the weight (in pounds) of a square in this balanced hanger?

Explain your thinking.



10 Synthesis

How can balanced equation moves be helpful when solving equations?

Use the example if it helps with your thinking.

Jaylin

Equation Set D

$15 - 7x = 3 + 5x$

$12 - 7x = 5x$

$12 = 12x$

$1 = x$

Things to Remember:

Name: ______ Date: ______ Period: ______

More Balanced Moves

Let's solve some equations.

Warm-Up

1. Here are several equations.

- Equation A: $12x + 3 = 3(5x + 9)$
- Equation B: $2x + 5x = x + 3$
- Equation C: $-3x + 12 = 9x - 4$
- Equation D: $x - 4 = \frac{1}{3}(6x - 54)$

a Draw a hanger diagram to represent one of the equations.

b **Discuss:** Why might it be useful to represent an equation with a hanger diagram? What limitations might this representation have?

Activity 1

Name: ________ Date: ________ Period: ________

Step by Step by Step by Step

Sadia and Amir started solving the same equation. Here is their work.

Sadia	Amir
$12x + 3 = 3(5x + 9)$	$12x + 3 = 3(5x + 9)$
$4x + 1 = 5x + 9$	$12x + 3 = 15x + 27$

2. In what ways are the steps they took alike and different?

Caleb and Roberto also solved the equation $12x + 3 = 3(5x + 9)$. Some of their work is correct and some of their work is incorrect.

Caleb	Roberto
$12x + 3 = 3(5x + 9)$	$12x + 3 = 3(5x + 9)$
$7x + 3 = 3(9)$	$12x + 3 = 15x + 27$
$7x + 3 = 27$	$27x + 3 = 27$
$7x = 24$	$27x = 24$
$x = \frac{24}{7}$	$x = \frac{24}{27}$

3. What are some moves they made that kept the equation balanced?

4. In each student's work, circle and explain the mistake you think they made.

Caleb's mistake:

Roberto's mistake:

Activity 2

Name: ________ Date: ________ Period: ________

Make Your Own Steps

5. Solve each equation for x. Show your thinking.

a $2x + 5x = x + 3$

b $-3x + 12 = 9x - 4$

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

d $8x + 7 = 6x - 13$

e $x - 4 = \frac{1}{3}(6x - 54)$

f $3(x - 2) + 2x = 25$

Explore More

6. There are 24 pencils and 3 cups. The second cup holds one more pencil than the first cup. The third cup holds one more pencil than the second cup. How many pencils does each cup contain? Show or explain your thinking.

Synthesis

7. What are some helpful moves when solving equations?

$12x + 3 = 3(5x + 9)$

$2x + 5x = x + 3$

$-3x + 12 = 9x - 4$

$x - 4 = \frac{1}{3}(6x - 54)$

Things to Remember:

Equation Roundtable

Directions: Make one copy per group. Then pre-cut the cards and give each group one set.

Card 1

$$-4x - 7 - 2x = 4x - 2$$

Card 2

$$\frac{1}{2}(7x - 6) = 6x - 8$$

Card 3

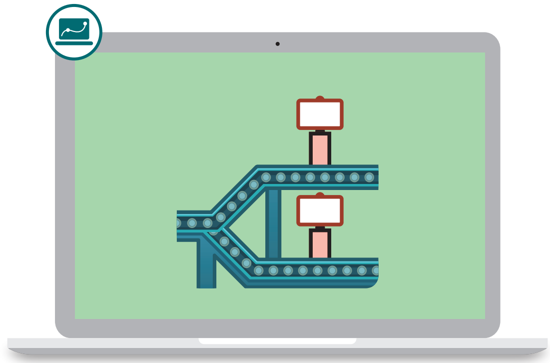
$$\frac{3}{4}x + 7 = x + 13$$

Card 4

$$-4x + 14 = 2(x + 7)$$

Unit 4
Lesson
6

Name: ________ Date: ________ Period: ________

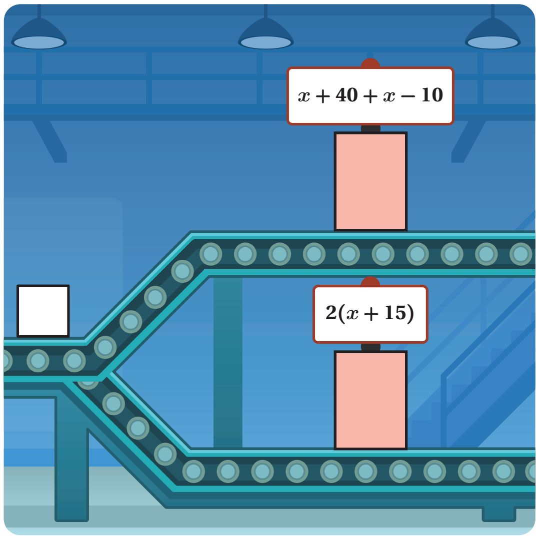


All, Some, or None? Part 1

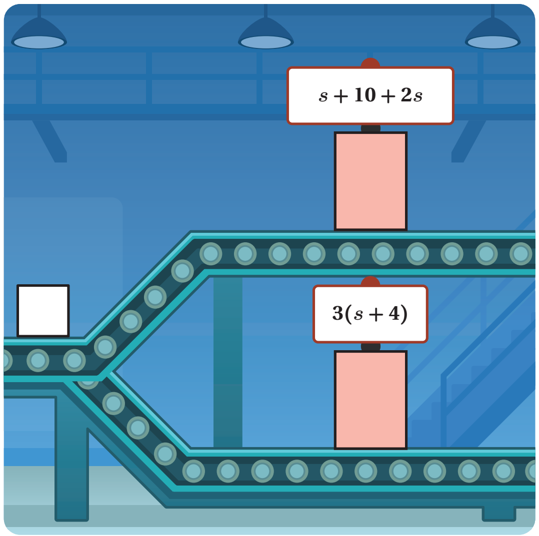
Let's think about how many solutions an equation can have.

Warm-Up

1 Here are two number machines. Tasia put a number into both machines, and the outputs were the same. What was Tasia's input?



2 Here are two new number machines. Try to find a number to put into both machines to get the same outputs.



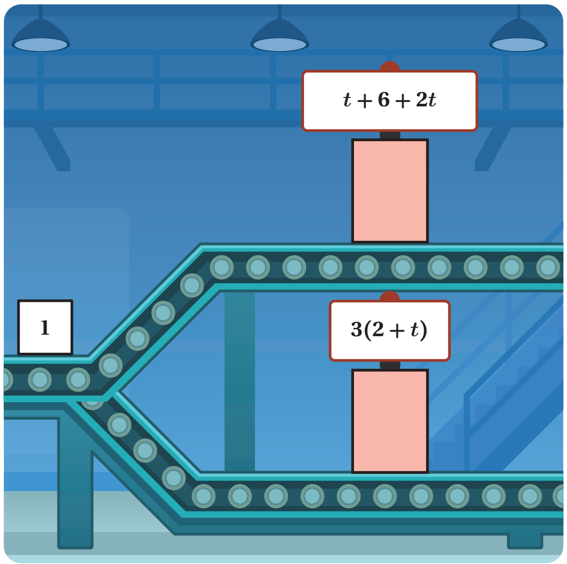
Activity 1

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

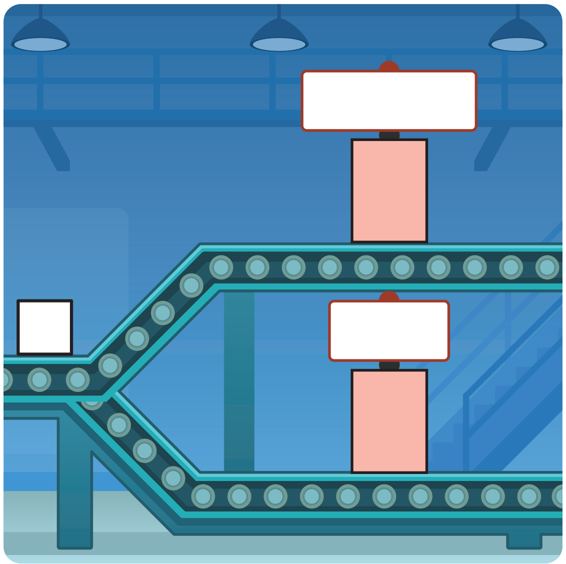
Always-Equal and Never-Equal

3 Let’s look at two number machines that *always* give the same outputs for any input.

Use the two expressions to explain why both machines will give the same outputs for any input.



4 Write two expressions to create two new number machines that will give the same outputs for any input.

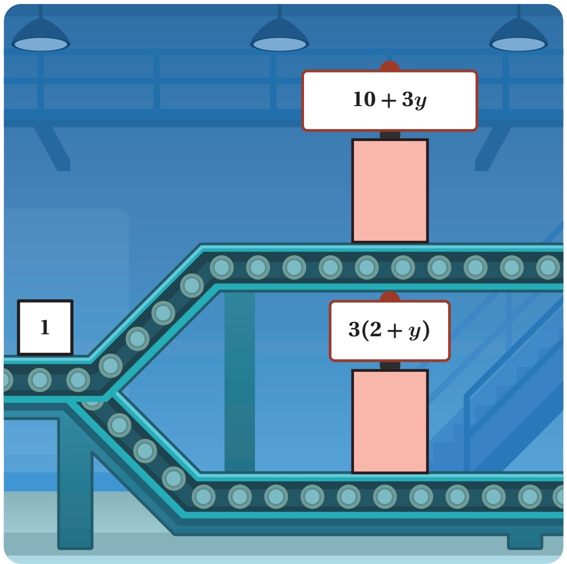


Name: ______________ Date: ______________ Period: ______________

Always-Equal and Never-Equal (continued)

5 Let's look at two number machines that *never* give the same outputs for any input.

Use the two expressions to explain why both machines will *never* give the same outputs for any input.



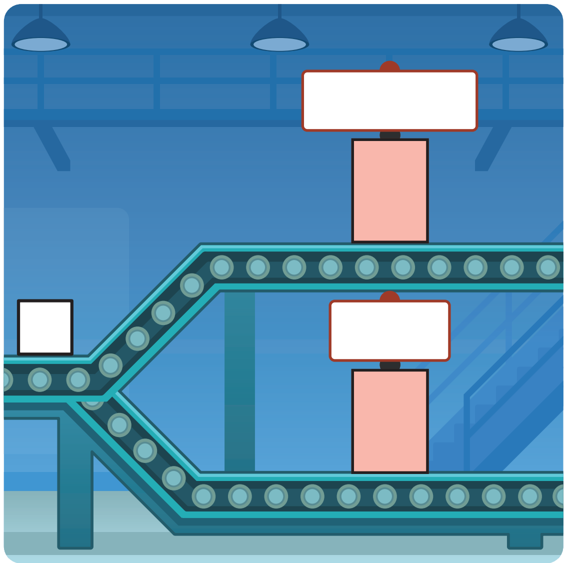
6 Select an equation made of two expressions that create number machines that will *never* give the same outputs for any input.

A. $2x + 3 = 3 + 2x$

B. $2x + 3 = 5 + 2x$

C. $2x + 3 = 2 + 3x$

D. $2x + 2 = 3 + 3x$



Activity 2

Name: ______ Date: ______ Period: ______

Number of Solutions

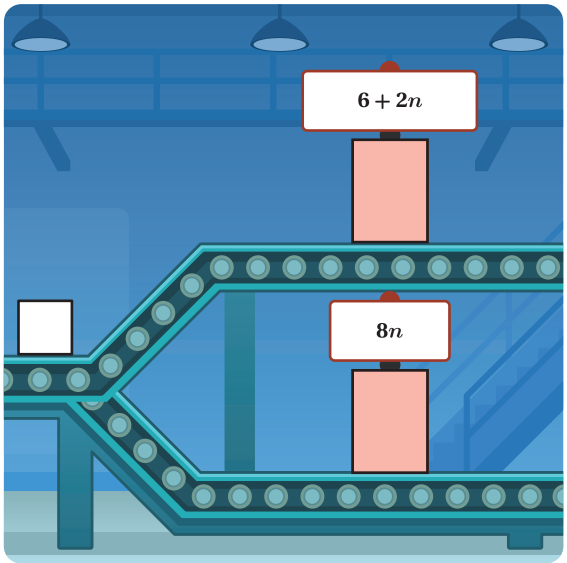
7 Here are two new number machines.

a Write an equation to find an input number that will produce the same outputs for each machine.

b For how many values of n will these machines produce the same output?

Circle one.

All values of n | One value of n | No values of n



8 Group the equations based on their number of solutions.

$v + 2 = v - 2$	$2n = n$	$7 - r = r - 7$	$\frac{1}{2} + x = \frac{1}{3} + x$
$y(\text{-}6) \bullet (\text{-}3) = 2 \bullet y \bullet 9$	$2t + 6 = 2(t + 3)$	$2n = 2n$	$3(n + 1) = 3n + 1$

No Solution (True for No Values)	One Solution (True for One Value)	Infinitely Many Solutions (True for All Values)

Name: ________ Date: ________ Period: ________

Number of Solutions (continued)

9 Kiandra looked at this equation and, without writing anything, said it must have no solution. What might she have noticed to lead her to this conclusion?

No Solution (True for No Values)
$\frac{1}{2} + x = \frac{1}{3} + x$

10 Write an equation for each number of solutions.

No solution:

One solution:

Infinitely many solutions:

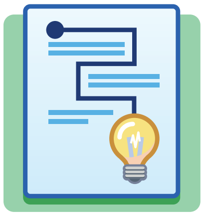
11 Synthesis

How can you determine whether an equation has no solution, one solution, or infinitely many solutions?

Things to Remember:

Name: ________ Date: ________ Period: ________

Strategic Solving, Part 1



Let's solve linear equations with no solution, one solution, and infinitely many solutions.

Warm-Up

1. Here are three equations:

- $13x = 3.25$
- $13x = 385x$
- $13x = 10x + 3x$

Choose one and write a situation that it could represent.

Activity 1

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

Predicting Solutions

2. Predict whether each equation has no solution, one solution, or infinitely many solutions. For equations with one solution, predict whether the solution will be *positive*, *negative*, or *zero*.

Equation	No Solution	One Solution			Infinite Solutions
$13x = 3.25$		$+$	$-$	0	
$13x = 385x$		$+$	$-$	0	
$13x = 10x + 3x$		$+$	$-$	0	
$13x + 42 = -584$		$+$	$-$	0	
$13x + 42 = 13x + -42$		$+$	$-$	0	

3. Choose one equation and explain how you made a prediction about its solution.

4. Why do you think it might be helpful to pause and try to predict the number of solutions or the sign of the solution before you start solving an equation?

Activity
2

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

What Happened?

5. Deven tried to solve the equation $13x + 42 = 13x + -42$. But Sam thinks Deven made a mistake.

Deven

$13x + 42 = 13x + -42$
$13x = 13x + -84$
$0 = -84$

Do you agree? Circle one.

Yes No I'm not sure

Explain your thinking.

6. Write an equation with infinitely many solutions.

7. What happens when you try to solve the equation you wrote?

Activity 3

Name: ______ Date: ______ Period: ______

The Choice Is Yours

Equation A	Equation B	Equation C
$2r + 49 = -8(-r - 5)$	$\frac{n}{7} - 12 = 5n + 5$	$\frac{4m - 16}{4} = \frac{-16 + 8m}{8}$

Equation D	Equation E
$p - 5(p + 4) = p - (8 - p)$	$3(c - 1) + 2(c - 1) = 5(c - 1)$

Equation F	Equation G	Equation H
$-\frac{1}{2}(t + 3) - 10 = -6.5$	$\frac{10 - v}{4} = 2(v + 17)$	$2(2q + 1.5) = 18 - q$

8. Examine these equations. Organize the equations into two or three groups based on the patterns you notice.

Group 1	Group 2	Group 3

9. **Discuss:** How did you group the equations?

10. Choose *three* equations to solve. (Choose at least one from each group.) Show your thinking.

Synthesis

11. What are some strategies for solving equations like these?

Equation B

$$\frac{n}{7} - 12 = 5n + 5$$

Equation C

$$\frac{4m - 16}{4} = \frac{-16 + 8m}{8}$$

Equation D

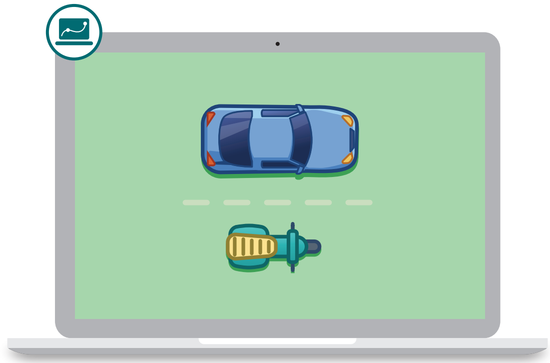
$$p - 5(p + 4) = p - (8 - p)$$

Things to Remember:

Unit 4
Lesson
8

Name: ____________ Date: ________ Period: ________

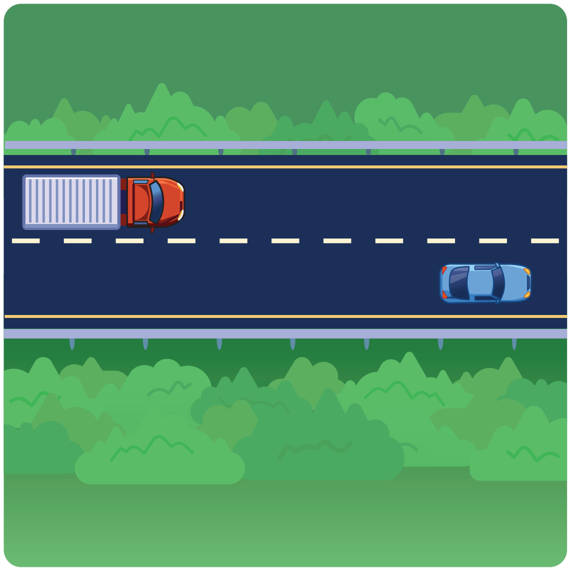
When Will They Meet?



Let's use equations to think about situations.

Warm-Up

1 Let's watch an animation of a truck and a car.



a Do you think the truck will meet the car? Circle one.

Yes No I'm not sure

b What information could help you prove your answer?

Activity 1

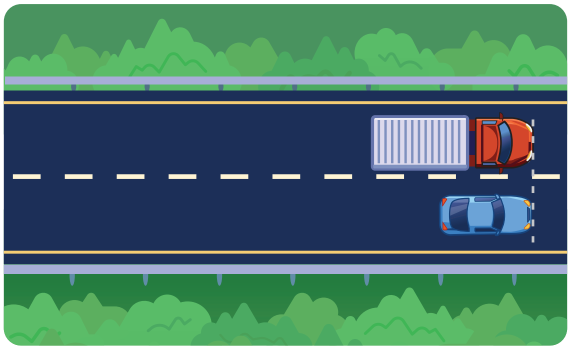
Name: .... Date: .... Period: ....

Distance and Time

2 The table shows each vehicle's position at certain times. The vehicles are moving at a constant *rate*. Fill in the missing information in the table.

Time (sec)	Truck Position (m)	Car Position (m)
0	0	18
1	15	29
2	30	40
3		
4		
...	...	...
t		

3 When will the truck meet the car?



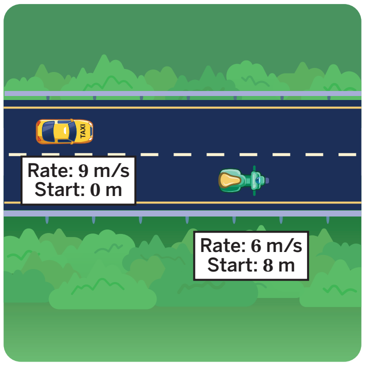
Activity
2

Name: ______ Date: ______ Period: ______

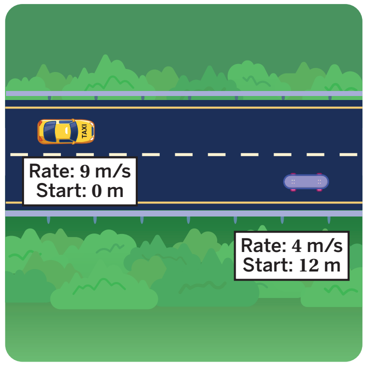
Choose Your Vehicle

4 Choose and circle a vehicle to compare to the taxi. The rate (in meters per second) and the starting point are displayed for each vehicle.

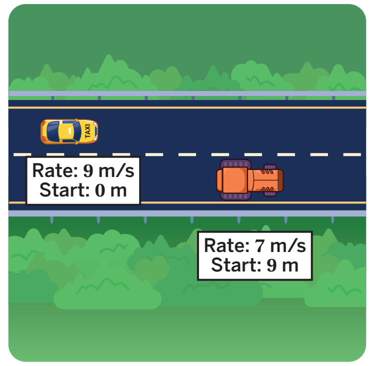
Scooter



Skateboard



Tractor



5 Let t represent time in seconds. For the vehicle you chose, which equation could you solve to determine when the two vehicles meet?

Scooter

A. $6 + 8t = 9t$

B. $8t + 6 = 9$

C. $6t + 8 = 9t$

Skateboard

A. $4t + 12 = 9t$

B. $12t + 4 = 9$

C. $4 + 12t = 9t$

Tractor

A. $7 + 9t = 9t$

B. $7t + 9 = 9t$

C. $9t + 7 = 9$

Explain your thinking.

6 When will the vehicle you chose meet the taxi?

Activity 3

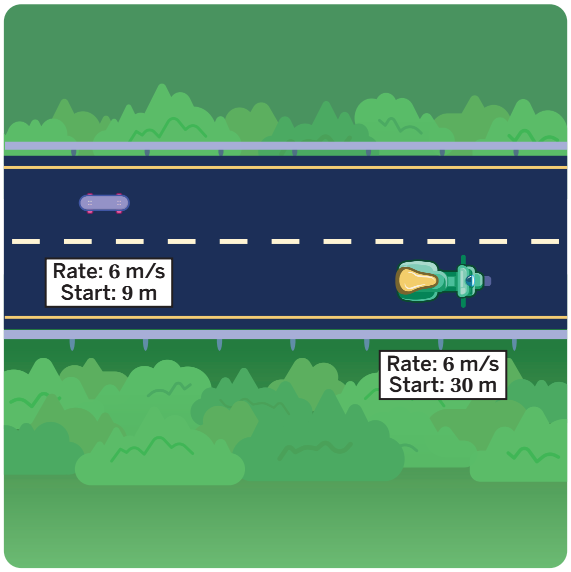
Name: ________ Date: ________ Period: ________

Meet Up

7 Demetrius wants to figure out when these vehicles will meet, so he wrote these expressions.

Skateboard Position (m)	Scooter Position (m)
$6t + 9$	$6t + 30$

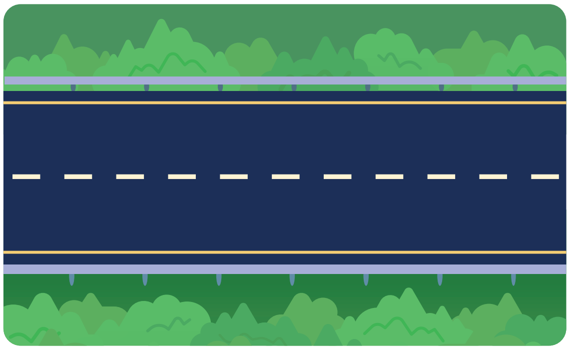
Without solving an equation, Demetrius knew the vehicles would never meet. How might he have figured this out?



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

Meet Up (continued)

8 Write expressions, in terms of t, that could represent two vehicles traveling at different rates with different starting positions that will eventually meet.



Truck position expression: ....

Car position expression: ....

9 When will the two vehicles meet?

Explore More

10 A tractor and a scooter are in a race. Write expressions, in terms of t, for each vehicle so that the vehicles start separated and meet at 10 seconds.

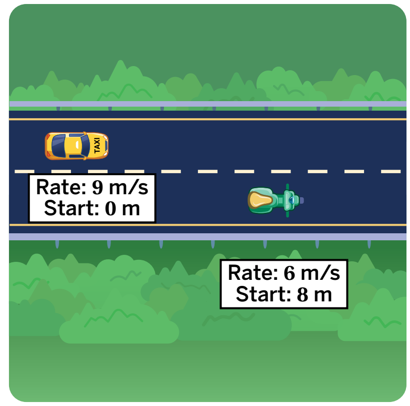
Tractor position expression: ....

Scooter position expression: ....

11 Synthesis

How can writing expressions to represent the position of vehicles at time t help you determine when they will meet?

Use the example if it helps with your thinking.



Things to Remember:

Unit 7
Lesson
7

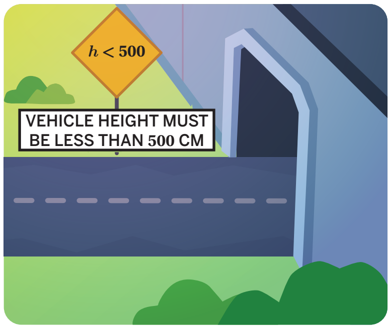
Name: Date: Period:

Tunnel Travels

Let's explore inequalities using words, symbols, and a number line.

Warm-Up

1 Select *all* of the vehicles that can fit in this tunnel.

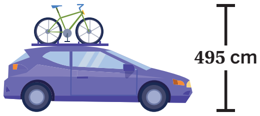


☐ A.

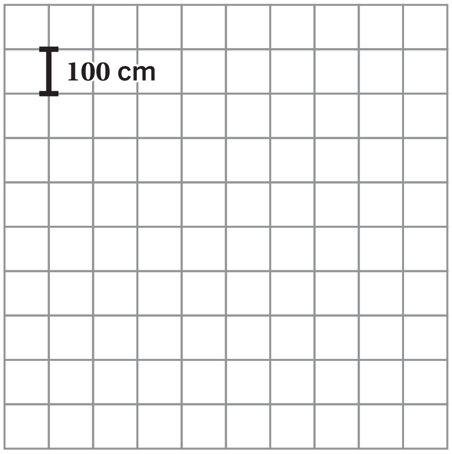
☐ B.

☐ C.

☐ D.



2 Sketch a vehicle that will fit in the tunnel.

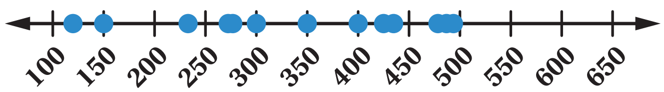


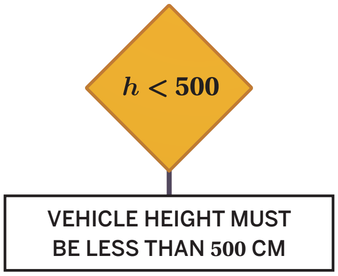
Activity 1

Name: ______________ Date: ________ Period: ________

Inequalities in Context

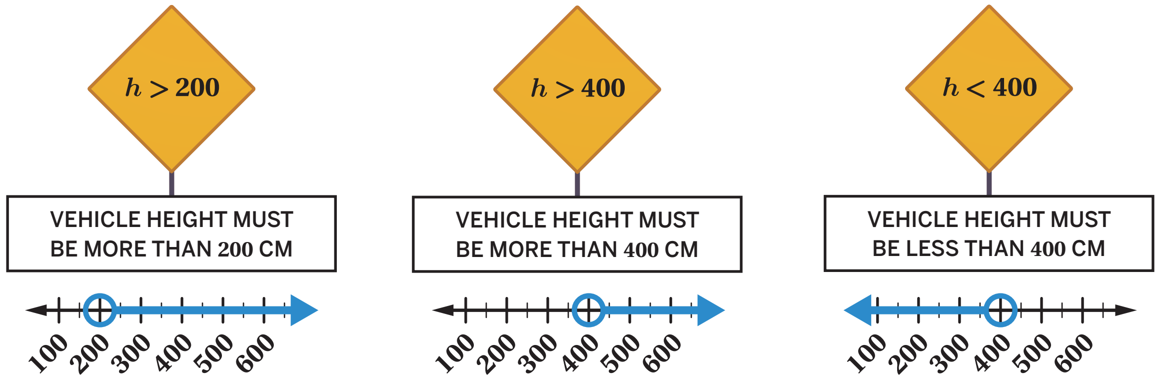
3 Here are the heights of several vehicles that fit in the tunnel.





What do you think a graph of *all* the vehicle heights that fit would look like?

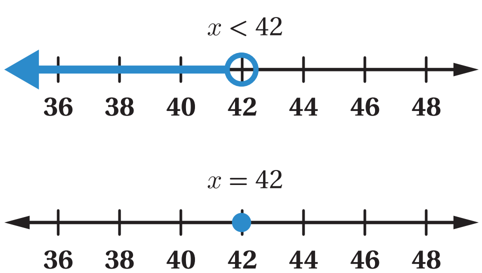
4 Here are three signs with inequalities and their number line graphs.



Discuss: What do you notice? What do you wonder?

5 Here are the graphs for $x < 42$ and $x = 42$.

Discuss: How are the graphs alike? How are they different?

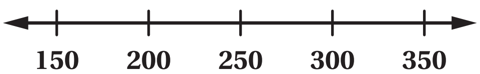


Name: .... Date: .... Period: ....

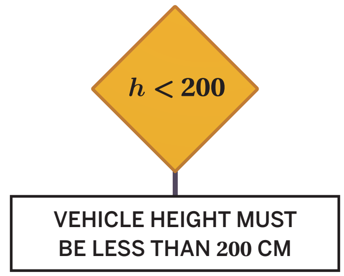
Inequalities in Context (continued)

6 Norma Merrick Sklarek was the first Black woman to become a licensed architect in California. In 1975, she helped design the Pacific Design Center in Los Angeles, California. The parking garage at the Center can fit vehicles that are less than 200 centimeters tall.

Graph all the possible vehicle heights that fit in this parking garage.

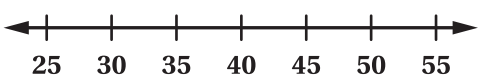


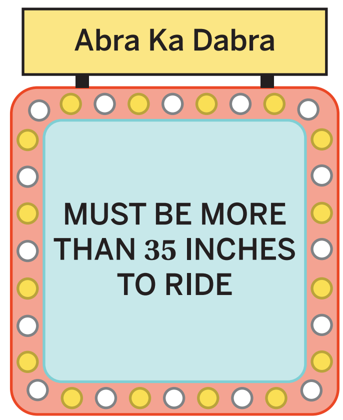
Pacific Design Center



7 Fri Forjindam is co-owner and chief development officer of a company that develops theme parks. In 2016, she designed Bollywood Parks in Dubai. One ride at that park, Abra Ka Dabra, only allows passengers who are taller than 35 inches.

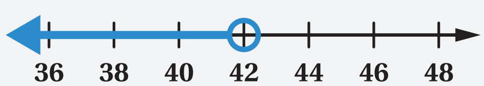
Graph all the possible heights for this ride.



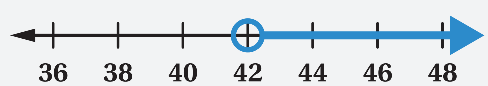


8 Group the choices that represent the same situation. One choice will have no match.

a.



b.



c. You must be over 42 inches tall to ride The Whipper.

d. You must be under 42 inches tall to ride the kiddie swings.

e. You must be at least 42 inches to ride the roller coaster.

f. $x < 42$

g. $x > 42$

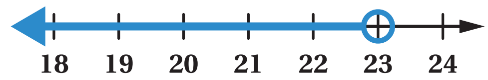
Group 1	Group 2

Activity
2

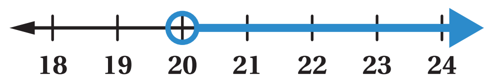
Name: ______ Date: ______ Period: ______

Inequalities Out of Context

9 Rewrite the inequality $x > 23$ so that it matches the graph.



10 To represent this graph:



- Martina wrote the inequality $20 < x$.
- Nasir wrote the inequality $x < 20$.

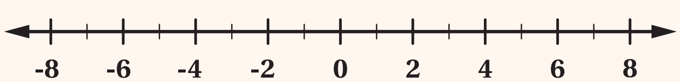
Whose inequality is correct? Circle one.

Martina's Nasir's Both Neither

Explain your thinking.

Explore More

11 Here is a number line.



a Determine three possible values for x if $|x| < 5$.

b Plot these values on the number line.

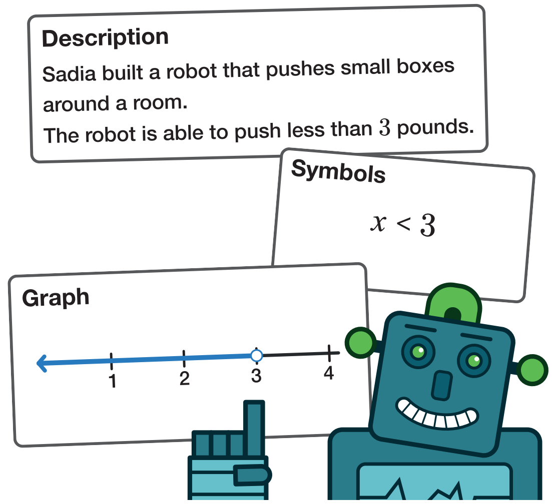
c Plot as many other possible values for x as you can.

12 Synthesis

Circle one representation and explain how it shows that Sadia's robot can push a 2-pound box.

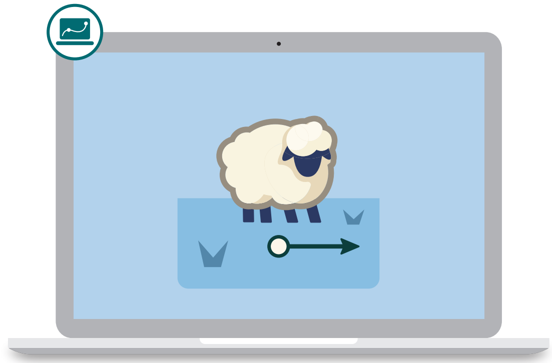
Description Symbols Graph

Explain your thinking.



Things to Remember:

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



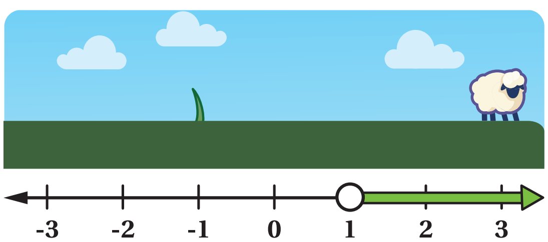
Shira's Solutions

Let's find solutions to an inequality using a number line.

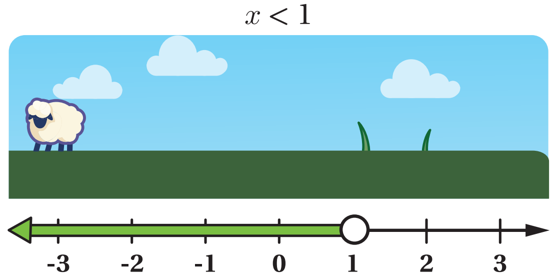
Warm-Up

1 Shira the Sheep loves eating all the blades of grass. These graphs show what happens when Shira eats grass based on different inequalities.

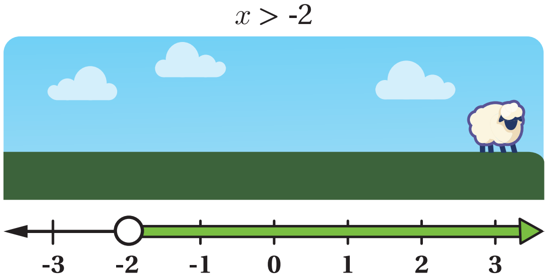
$x > 1$



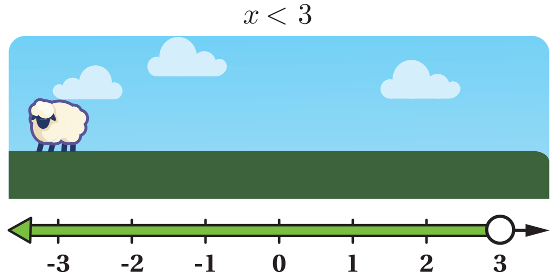
$x < 1$



$x > -2$



$x < 3$



Discuss: What do you notice?

Activity 1

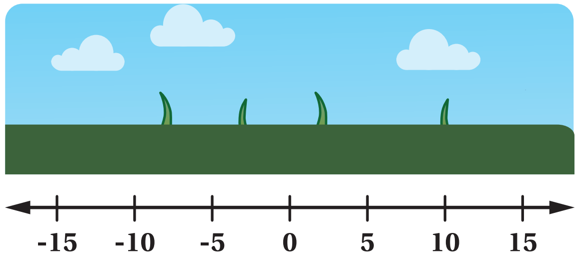
Name: ________ Date: ________ Period: ________

Connecting Graphs and Inequalities

2 Shira wants to eat these four blades of grass.

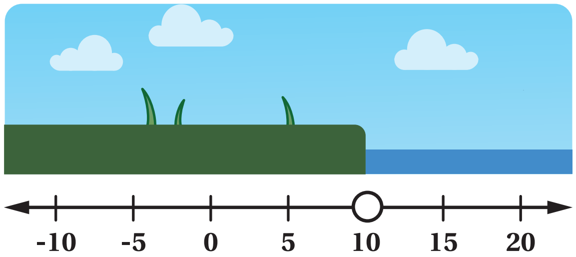
The inequality $11 < x$ did not work.

Fix this inequality to help Shira eat all the grass.



3 Shira the Sheep loves eating grass. She does not like water.

Write an inequality to help Shira the Sheep eat all the grass without falling in the water.



Explain your thinking.

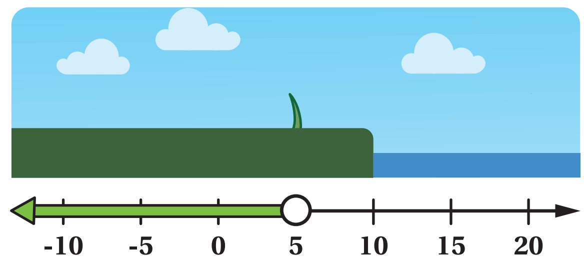
Activity
1

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

Connecting Graphs and Inequalities (continued)

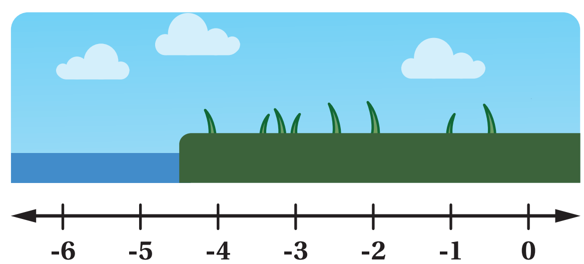
4 Kiana wrote $x < 5$ and was surprised that there was one blade of grass remaining.

Explain why 5 is not a **solution to the inequality** $x < 5$.

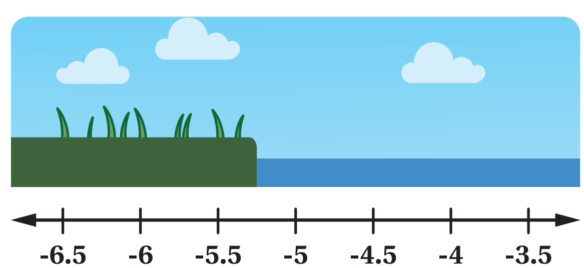


5 Write an inequality so that all the blades of grass are solutions and none of the water is.

Use the number line if it helps with your thinking.



6 Write an inequality so that all the blades of grass are solutions and none of the water is.

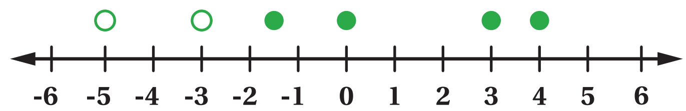


Activity
2

Name: ______________ Date: __________ Period: __________

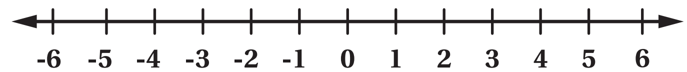
Solutions to an Inequality

7 Write an inequality so that all of the solid points are solutions and none of the open points are.



8 Write at least three solutions to the inequality $2.7 > x$.

Plot the solutions on the number line.



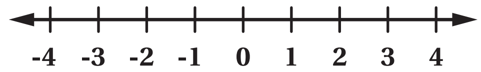
9 Let's look at other solutions to $2.7 > x$.

How many solutions does this inequality have? Explain your thinking.

Name: ______ Date: ______ Period: ______

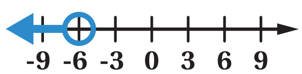
Solutions to an Inequality (continued)

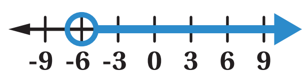
10 Make a graph of *all* the solutions to the inequality $x > -1.5$.

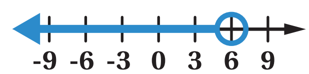


11 Match each inequality or solution with the graph that represents it.

a. Some solutions: 5500, 6.5, -3
b. Some solutions: -100, 0.5, -6
c. $x < -6$
d. $-6 > x$
e. $x < 6$

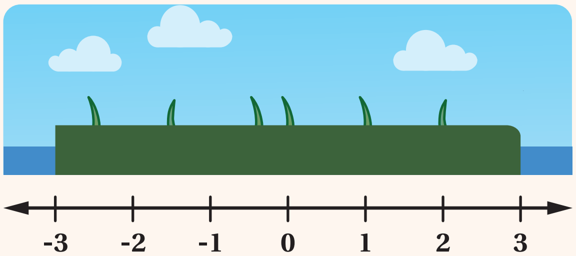






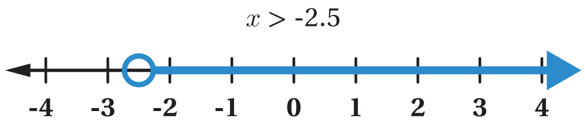
Explore More

12 Write inequalities or describe how you can use inequalities to help Shira the Sheep eat all the blades of grass without falling in the water.



13 Synthesis

What does it mean for a number to be a solution to an inequality?



Things to Remember:

Unit 6
Lesson
13

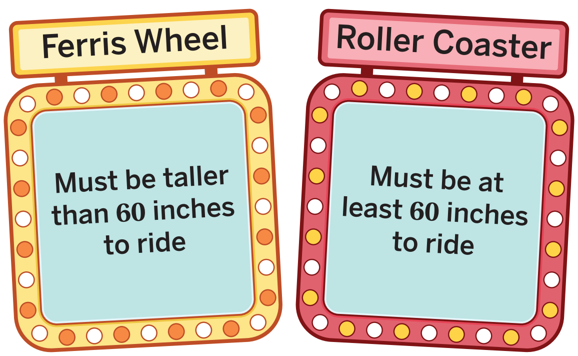
Name: ______ Date: ______ Period: ______

I Saw the Signs

Let's work with inequalities.

Warm-Up

1 Here are two signs for two different rides at an amusement park.



Habib is exactly 60 inches tall. Which ride can he go on?

A. Ferris wheel **B.** Roller coaster **C.** Both **D.** Neither

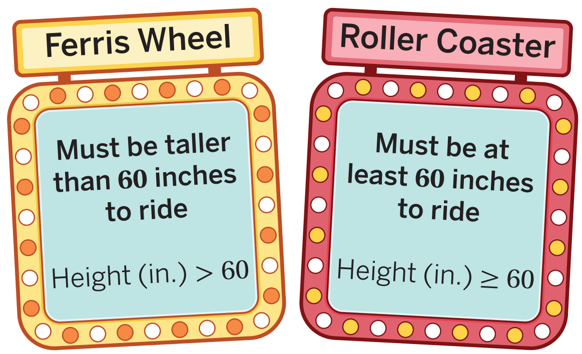
Explain your thinking.

Activity 1

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

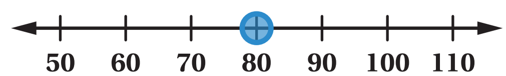
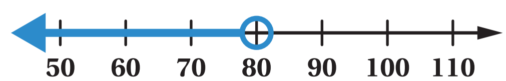
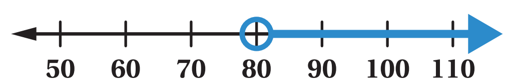
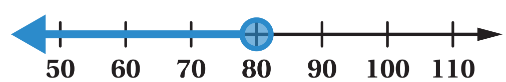
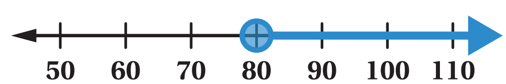
Riding the Rides

The park added symbols to make the signs clearer. The symbol > means greater than. The symbol ≥ means **greater than or equal to**.



2 What is the shortest height Makayla can be and still ride both rides?

3 Here are some equations and inequalities, along with their graphs on a number line.

Equation/Inequality	Graph
$x = 80$	
$x < 80$	
$x > 80$	
$x \leq 80$	
$x \geq 80$	

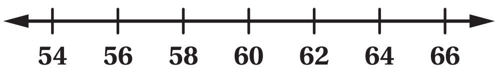
Discuss: What do you notice?

Activity
2

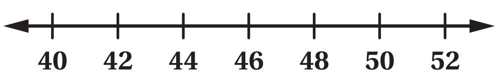
Name: ______________ Date: ______________ Period: ______________

Riding More Rides

4 You are in charge of determining the height restriction for your ride. Create a graph and complete the sign for your ride.



5 You must be 48 inches or shorter to ride the kiddie swings. Make a graph on the number line to represent the possible heights of the riders.



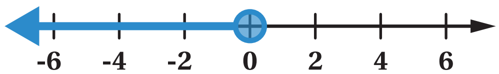
6 Luis is allowed to ride the kiddie swings. Omar is 6 inches shorter than Luis. Can Omar ride this ride? Explain your thinking.

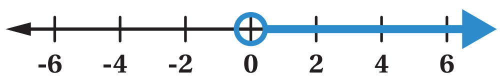
Activity
3

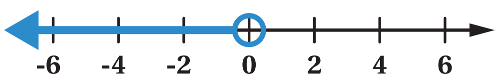
Name: .... Date: .... Period: ....

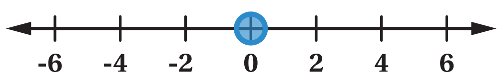
Inequalities Out of Context

7 Match each inequality or description with the graph that represents it. A graph may have more than one match.

a. 

b. 

c. 

d. 

.... $x < 0$

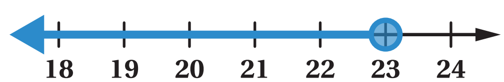
.... $0 < x$

.... $x \leq 0$

.... The temperature of a freezer must be less than $0°$F.

.... The temperature of a freezer must be $0°$F.

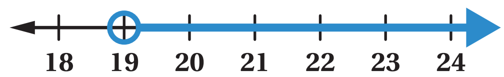
8 Fix the inequality $x > 23$ so that it represents the graph.



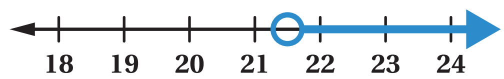
Name: .... Date: .... Period: ....

Inequalities Out of Context (continued)

9 Write an inequality that represents this graph.



10 To represent this graph, Tiara wrote the inequality $21.5 < x$. Devon wrote the inequality $x < 21.5$.



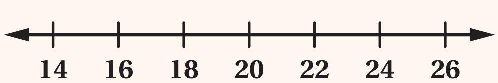
Whose inequality is correct? Circle one.

Tiara Devon Both Neither

Explain your thinking.

Explore More

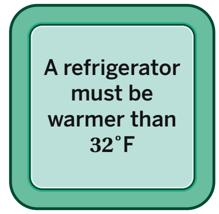
11 Create a graph that represents all the values that make the inequality $x + 10 \le 25$ true.



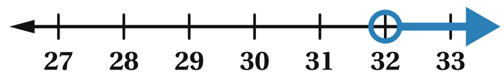
Explain your thinking.

12 Synthesis

Describe how you can tell from each representation that 32 is *not* included in the inequality.



$x > 32$



Things to Remember:

Unit 6
Lesson
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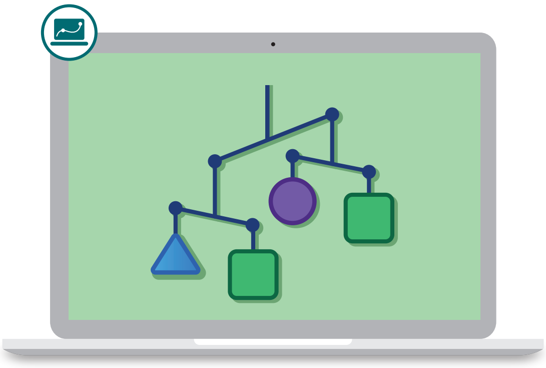
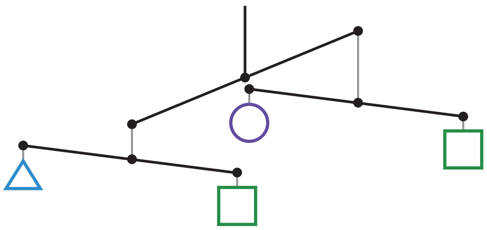


Unbalanced Hangers

Let's solve inequalities using hangers.

Warm-Up

1 Order the shapes in the hanger from *lightest* to *heaviest*.



	Lightest
	Heaviest

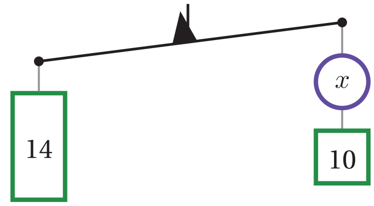
Explain how you decided which shape was lightest.

Activity 1

Name: ______ Date: ______ Period: ______

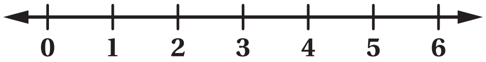
Unbalanced Hangers

2 Here is a hanger that is not balanced. What is one possible value of x?



3 Plot your response from the previous problem on the number line. Determine at least two more possible weights and plot those on the number line.

$14 > x + 10$



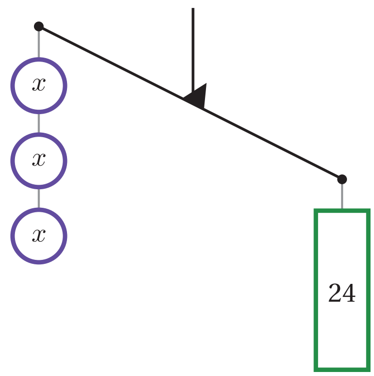
4 Describe *all* of the possible values of x that keep the right side lighter.

Name: ______ Date: ______ Period: ______

Unbalanced Hangers (continued)

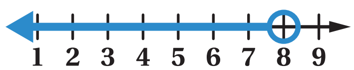
The **solutions to an inequality** include all of the possible values that make an inequality true.

5 This hanger represents the inequality $3x < 24$. What are the solutions to this inequality?

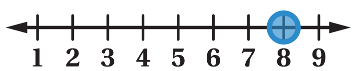


$3x < 24$

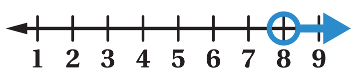
A. $x < 8$



B. $x = 8$

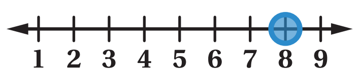


C. $x > 8$



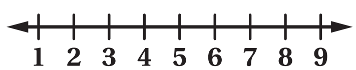
6 Here is the graph of the solution to the equation $3x = 24$.

$3x = 24$



a Graph what you think the solutions to $3x \le 24$ look like.

$3x \le 24$

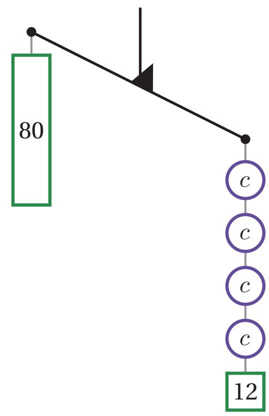


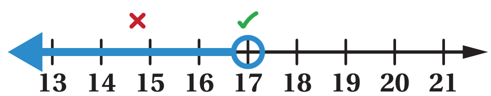
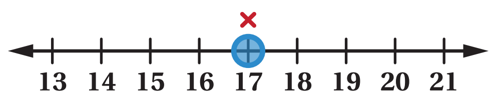
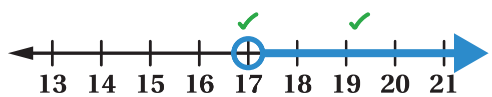
b **Discuss:** How are the graphs of the solutions to $3x < 24$, $3x = 24$, and $3x \le 24$ alike? How are they different?

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

Solving Inequalities

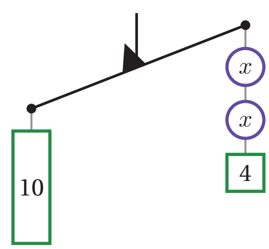
7 Here are three possible solutions to the inequality $80 < 4c + 12$ and their graphs.



Possible Solution	Graph
$17 > c$	
$17 = c$	
$17 < c$	

Discuss: What do the checks and x's in the graphs mean?

8 What are the solutions to the inequality $10 \geq 2x + 4$? Explain your thinking. Use the hanger if it helps with your thinking.



9 Jasmine and Terrance solved the inequality $10 \geq 2x + 4$. Jasmine says the solutions are $x \leq 3$. Terrance says the solutions are $3 \geq x$. Who is correct? Circle one.

Jasmine Terrance Both Neither

Explain your thinking.

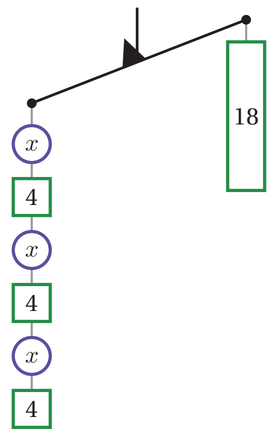
Activity 3

Name: ______ Date: ______ Period: ______

Repeated Challenges

10 What are the solutions to the inequality $3(x + 4) \geq 18$?

Use the hanger if it helps with your thinking.

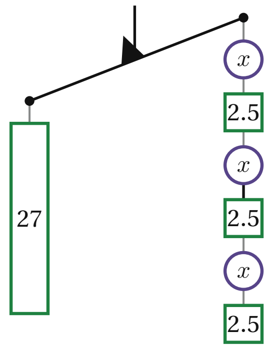


11
- Decide with a partner who will complete Column A and who will complete Column B.
- The solutions in each row should be the same. Compare your solutions, then discuss and resolve any differences.
- Solve as many inequalities as you have time for. Sense-making is more important than speed.

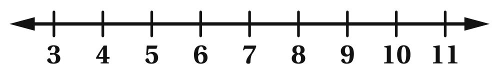
Column A	Column B
$4x + 2 \leq 10$	$6x + 4 \leq 16$
$12 > 2(x + 1)$	$24 > 3(x + 3)$
$10.4 \leq 2(x + 2.2)$	$8(x + 1.1) \geq 32.8$
$2x + \frac{3}{2} > \frac{17}{2}$	$4x + \frac{2}{3} > \frac{44}{3}$

12 Synthesis

Describe a process you can use to determine the solutions to an inequality.
Use the hanger if it helps show your thinking.



$27 > 3(x + 2.5)$



Things to Remember:

Unit 6
Lesson
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Name: ______ Date: ______ Period: ______

Budgeting

Let's solve problems about budgeting and spending money.

Warm-Up

1. Here is a situation with hidden information. Let's make sense of it together as a class.

Mariana is selling magazine subscriptions. She earns ______ per week, plus ______ for every subscription she sells. She plans to buy soccer equipment with the money she earns.

This week, Mariana wants to buy a new ball. The cheapest ball she wants costs ______.

a. **Discuss:** What is this situation about?

b. Choose a value for each blank that could make sense.

c. For the values you chose, how many magazine subscriptions could Mariana sell in order to buy the ball?

Name: ______ Date: ______ Period: ______

Mariana's Magazines

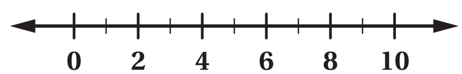
2. Mariana is selling magazine subscriptions. She earns $19 per week, plus $3 for every subscription she sells. She plans to buy soccer equipment with the money she earns.

This week, Mariana wants to buy a new ball. The cheapest ball she wants costs $43.

a Write and solve an equation to determine how many magazine subscriptions Mariana needs to sell to make $43.

b List other numbers of magazine subscriptions Mariana could sell and still buy the ball.

c Write and graph an inequality to represent *all* the number of subscriptions Mariana could sell and still buy the ball.



3. The next week, Mariana earns $37. She wants to use it to buy soccer shorts and 5 pairs of socks. The shorts she wants each cost $22.05.

a What do each pair of socks cost if Mariana spends exactly $37 on the socks and shorts? (In Mariana's city, there is no sales tax.) Write and solve an equation if it helps you with your thinking.

b Write an inequality to represent *all* the sock prices that Mariana could afford with $37.

Activity 2

Name: ________ Date: ________ Period: ________

Bao's Budgeting

4. Bao has $\$175$ saved in his bank account. He wants to know how much money he can take out each month and still have at least $\$25$ in the account a year from now.

a Which inequality represents Bao's situation?

A. $175 - 12x \le 25$

B. $175 + 12x \le 25$

C. $175 - 12x \ge 25$

D. $175 + 12x \ge 25$

b What does 12 represent?

c What does x represent?

d Bao and his friend try to solve the inequality. Bao's solutions start with $x \le$. His friend's solutions start with $x \ge$. Which symbol makes sense for this situation? Explain your thinking.

e Solve the inequality you chose and explain what the solutions mean in Bao's situation.

5. Bao is considering getting a part-time job. Instead of taking money out of his account each month, he would put money in. His account still has $\$175$, and his goal is to have at least $\$1,000$ in the account a year from now.

a Write an inequality where x represents the amount of money Bao should put in each month to reach his goal.

b Solve the inequality you wrote and explain what the solutions mean in Bao's situation.

Synthesis

6. A student spends $\$2.50$ on a tasty beverage every school day. They have a $\$30$ gift card to Tea Time Cafe, and want to know how many beverages it can buy. Explain how the inequality $30 - 2.50x \geq 0$ represents this student's situation.

Things to Remember:

Unit 6
Lesson
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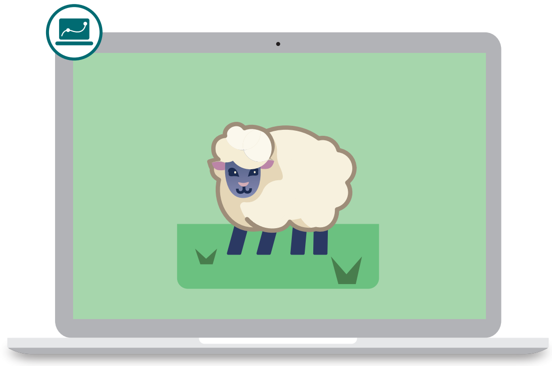
Name: ______ Date: ______ Period: ______



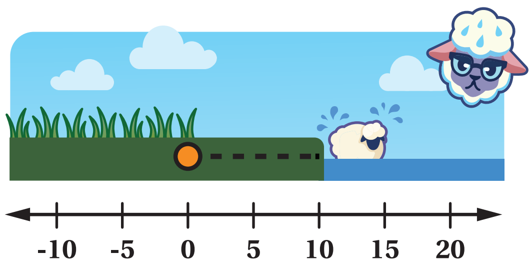
Shira the Sheep

Let's practice solving inequalities with positive and negative coefficients.

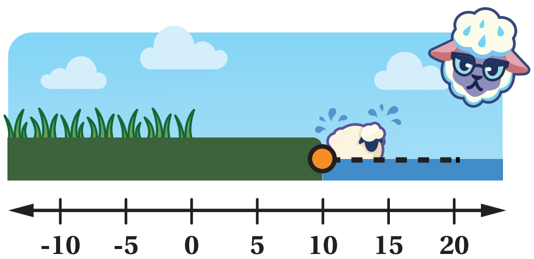
Warm-Up

1 a Shira the Sheep loves eating grass. She does not like water. Here are the graphs and results of different inequalities.

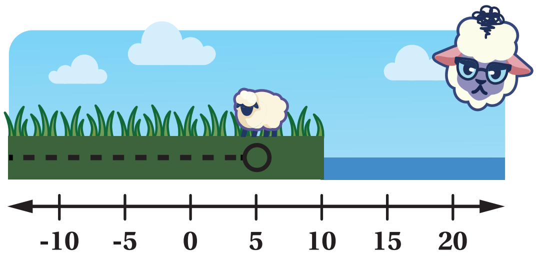
$x \geq 0$



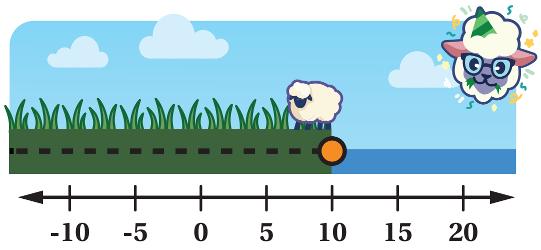
$x \geq 10$



$x < 5$



$x \leq 10$



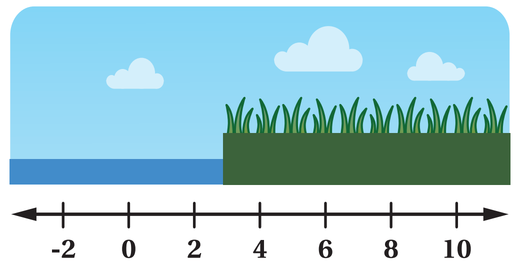
b **Discuss:** What do you notice?

Activity 1

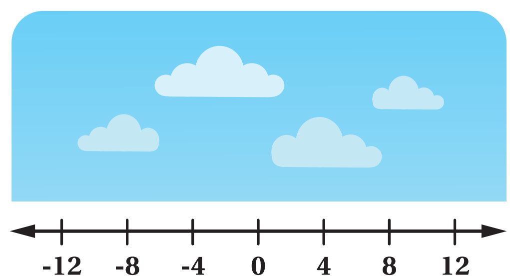
Name: ________ Date: ________ Period: ________

Shira the Sheep

2 The grass is represented by the inequality $5x > 15$. Solve the inequality to help Shira eat all the grass without falling in the water.

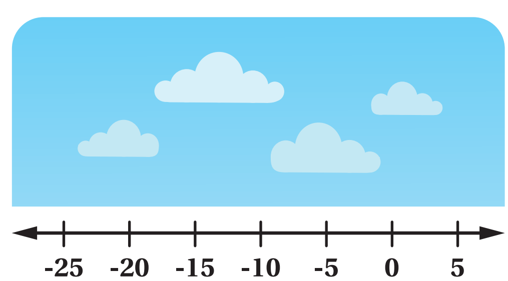


3 **a** Write the solutions to this inequality to help Shira eat all the grass.
$11 \geq 2x - 5$



b Sketch the solutions to this inequality on the number line.

4 **a** Write the solutions to this inequality to help Shira eat all the grass.
$10 - 6x < 70$



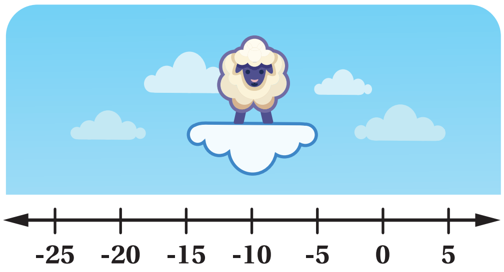
b Sketch the solutions to this inequality on the number line.

Name: ______ Date: ______ Period: ______

Shira the Sheep (continued)

5 Alma was solving the previous inequality, $10 - 6x < 70$. She knew the sheep needed to land at -10, but didn't know if the grass was to the right or left.

She wrote $10 - 6(0) < 70$. How might Alma's inequality help her decide where the grass is?



6 Solve this inequality to help Shira eat all the grass.

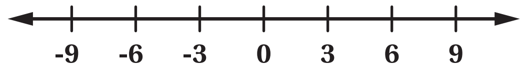
$-\frac{1}{2}x + 2 \leq 3$

Activity 2

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

Help Shira and Chloe

7 a) Solve $25 - 4x < 1$.



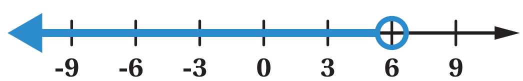
b) Graph its solutions.

8 Chloe made a mistake solving the inequality $25 - 4x < 1$ and wrote $x < 6$. Explain what you think is incorrect about Chloe's work.

Chloe

25 – 4x < 1

x < 6



9 Solve as many inequalities as you have time for to help Shira eat all the grass.

a) $8 \geq 3x - 13$

b) $-6x - 3 > 15$

c) $\frac{2}{3}x + 9 \leq 15$

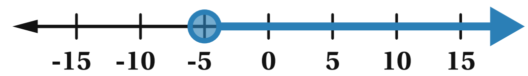
d) $-89 \geq -12x - 5$

e) $3x - 5 > 4$

f) $0.2x + 0.6 \geq 0.8$

10 Synthesis

Explain how you solve and graph the solutions to any inequality. Use the inequality $4 - 3x \leq 19$ if it helps you with your thinking.



Things to Remember:

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

Write Them and Solve Them

Let's write and solve inequalities and examine what the solutions to those inequalities mean in context.

Warm-Up

1. Jamal volunteers to pass out sandwiches to people who are hungry in his community. He raised $\$85$ and is trying to determine how many sandwiches he can buy for $\$6.25$ each.

He writes the inequality $6.25x \leq 85$.

Then he solves the inequality and gets $x \leq 13.6$.

Select *all* the statements that are true about this situation.

- ☐ **A.** He can buy 13.6 sandwiches.
- ☐ **B.** He can buy 14 sandwiches.
- ☐ **C.** He can buy 12 sandwiches.
- ☐ **D.** He can buy 10 sandwiches.
- ☐ **E.** He can buy -4 sandwiches.

Activity 1

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

Orange Juice and Donuts

Kiandra wanted to surprise some friends before school with orange juice and donuts. At the store, an orange juice costs $2.15 and a donut costs $0.75. There is no sales tax. The store has a $10 purchase minimum for credit cards. Kiandra paid with her credit card.

2. Write an inequality that describes Kiandra's situation.

3. Solve the inequality you wrote. Show your thinking.

4. What is the meaning of the solutions to your inequality in this situation?

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

Solve It!

5. You will use four pairs of cards for this activity. Each pair has a situation card and a corresponding support card.

- Decide with a partner who will have the situation card and who will have the support card.
- Switch roles after each round.

Situation Card Instructions

- Read the situation aloud.
- Write an inequality that represents the situation.
- Solve the inequality you wrote.
- Answer the question on the card using your solutions.

Support Card Instructions

- Help your partner by asking the questions on the card or other questions you think will support them.

You may use this page for workspace.

Synthesis

6. Sahana works at the pet store and gets paid $9.50 per hour. She needs to make at least $235 each week in order to pay her bills. Describe how to write an inequality that represents Sahana's situation.

Things to Remember:

Solve It!

Directions: Make one copy per pair of students. Then pre-cut the cards and give each pair of students one set of four situation cards and four support cards.

Situation Card A

The school marching band has a $750 budget. They paid $300 in competition fees, and still need to buy 15 new uniforms. How much could the marching band spend on each uniform?

Support Card A

After reading the problem:

1. What information is important?

After your partner writes an inequality:

2. How could you start solving?

After your partner solves the inequality:

3. What does your solution mean?
4. Do you need to round your solution?

Situation Card B

LaShawn is a farmer in a city and needs to cover the plants when the temperature gets below 0°C. At noon, the temperature was 5°C and dropped at a steady rate of 0.6 degrees per hour. When do LaShawn's plants need to be covered?

Support Card B

After reading the problem:

1. What is the problem about?
2. What information is important?

After your partner writes an inequality:

3. What does each number represent?

After your partner solves the inequality:

4. Is the boundary included in the solution?
5. What does your solution mean?

Solve It!

Situation Card C

Rudra is taking 3 friends to dinner. If Rudra has $\$65$ and a coupon for $\$5$ off each meal, how much can each person spend?

Support Card C

After reading the problem:

1. What information is important?

After your partner writes an inequality:

2. How is Rudra's total amount represented?
3. How could you start solving?

After your partner solves the inequality:

4. Is the boundary included in the solution?
5. What does your solution mean?

Situation Card D

Adriana's apartment building has a washing machine that uses a card for payment. The card automatically reloads when the balance falls below $\$15$. If the card balance is currently $\$50$ and a load of laundry costs $\$1.65$, how many loads can Adriana's family do before the card reloads?

Support Card D

After reading the problem:

1. What is the problem about?
2. What information is important?

After your partner writes an inequality:

3. How is each load's cost represented?
4. How could you start solving?

After your partner solves the inequality:

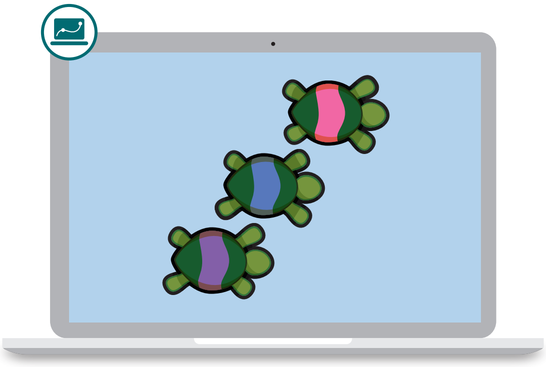
5. What does your solution mean?

Unit 3
Lesson
1

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

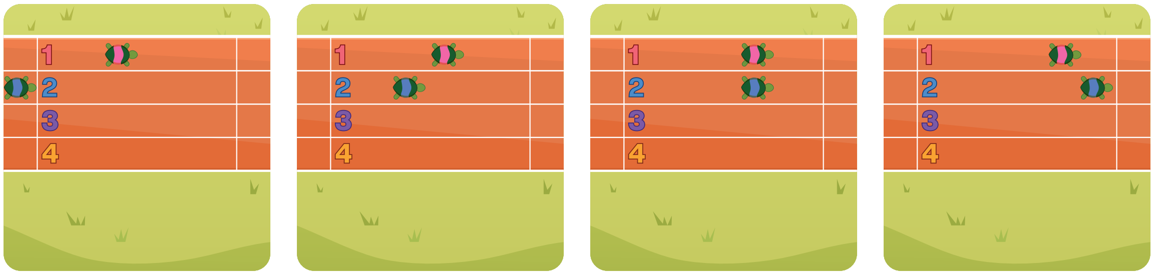
Turtle Time Trials

Let's explore a turtle race with multiple representations.



Warm-Up

1 Let's watch a short animation. Write a story about what you see.

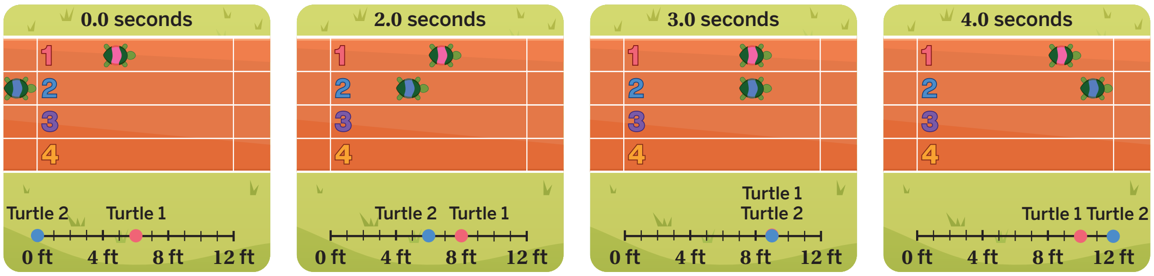


Activity
1

Name: ____________ Date: ________ Period: ________

Turtle Race

2 Let's watch the same animation from the Warm-Up, but with additional information.



Complete the table.

Time (sec)	Distance of Turtle 1 (ft)	Distance of Turtle 2 (ft)
0	6	0
1	7	3
2	8	
3	9	

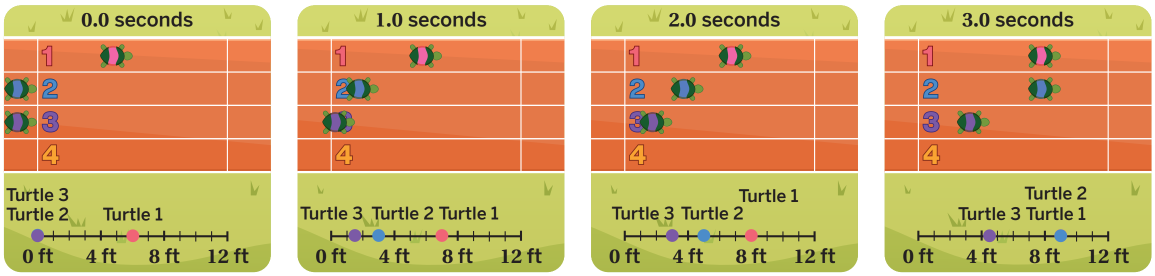
3 What is Turtle 2's speed as a *unit rate*? Explain your thinking.

4 Let's watch an animation showing Turtle 3 running in the same race.

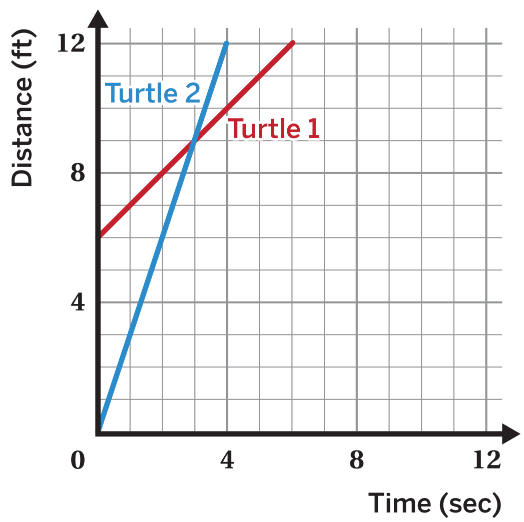
Name: ________ Date: ________ Period: ________

Turtle Race (continued)

5 Here is some information from the race with Turtle 3.



Graph the relationship between distance and time for Turtle 3.



6 Evan says that the relationship between distance and time is *proportional* for all three turtles.

Is Evan's claim correct?

Yes　　　　No　　　　I'm not sure

Explain your thinking.

7 **a** What is Turtle 3's speed as a *unit rate*? Explain your thinking.

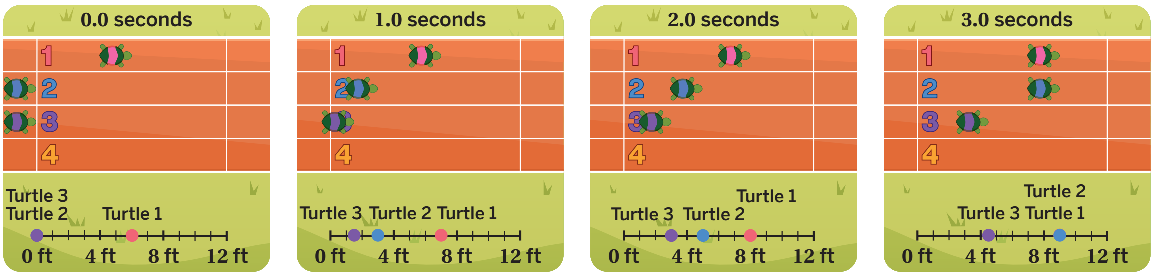
b How does this unit rate relate to the *slope* of Turtle 3's line?

Activity 2

Name: ______ Date: ______ Period: ______

Ready Turtle Four

8 Here is some information from the race with three turtles. In Lane 4, another turtle is running in the same race.

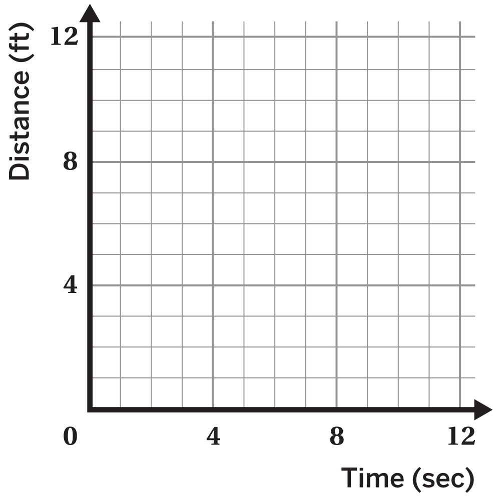


a Write an equation for Turtle 4 to make it finish in whatever place you want.

b **Discuss:** Based on your equation, how does Turtle 4's race compare to the other turtles?

Turtle	Equation
1	$d = 6 + 1t$
2	$d = 3t$
3	$d = 1.5t$
4	

9 **a** Create your own turtle race by sketching lines for up to four turtles. At least one line should be proportional. Use a different color for each turtle.

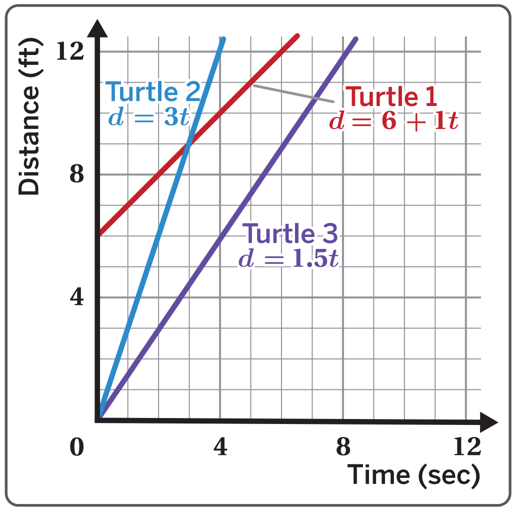


b **Discuss:** Using the information in your graph, tell a story about your turtle race.

10 Synthesis

How do you use tables, graphs, and equations to compare the turtles in a race?

Use the example if it helps with your thinking.



Time (sec)	Distance of Turtle 1 (ft)	Distance of Turtle 2 (ft)	Distance of Turtle 3 (ft)
0	6	0	0
1	7	3	1.5
2	8	6	3

Things to Remember:

Unit 3
Lesson
2

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

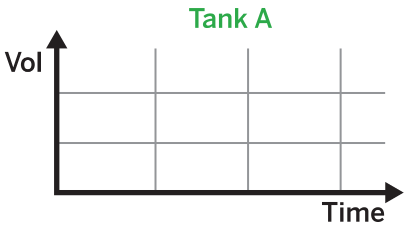
Water Tank

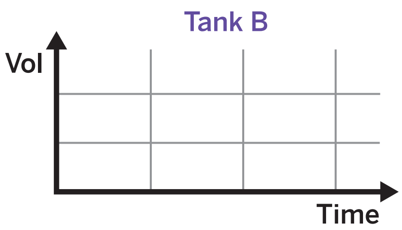
Let's analyze graphs of proportional equations.

Warm-Up

1 Let's watch two tanks fill up with water.

Draw a graph that represents the relationship between water volume and time for each tank.





2 Let's watch the tanks fill up with water again, but this time with more information.

Discuss: How are the graphs like your drawing from the previous question? How are they different?

Activity 1

Name: ______ Date: ______ Period: ______

Two Tanks

3 Erendirani and Jamal both calculated slopes.

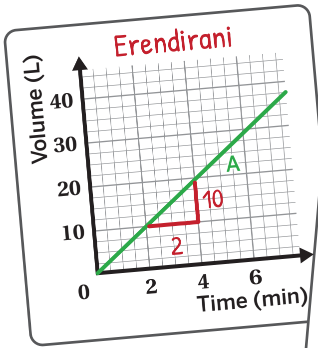
Erendirani says the slope of Tank A's line is $\frac{10}{2}$.

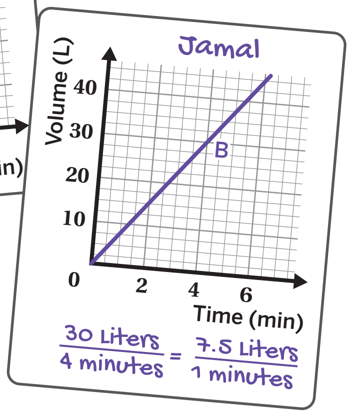
Jamal says the slope of Tank B's line is 7.5.

Whose claim is correct?

Erendirani's Jamal's Both Neither

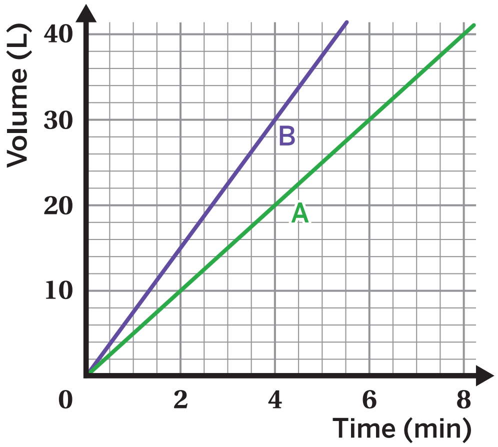
Explain your thinking.





4 Here are the graphs of Tank A and Tank B, shown on the same coordinate plane.

Explain what the slopes of each line represent for Tank A and Tank B.



5 For Tank A, the equation $V = 5t$ represents the volume, V, after t minutes.

a For Tank B, write an equation to represent the volume, V, after t minutes.

b How can you tell from the equations that these relationships are proportional?

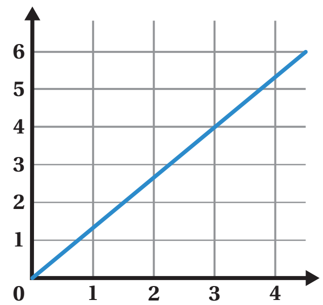
Activity
2

Name: ________________ Date: ________ Period: ________

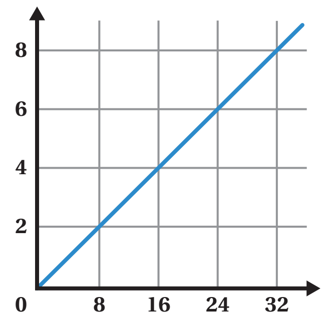
Pairing Graphs and Equations

6 Match each graph to the equation that represents the same proportional relationship.

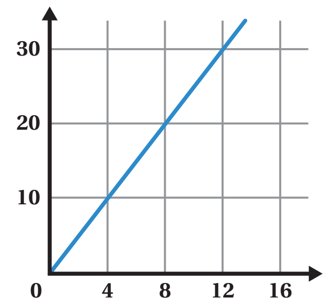
A.



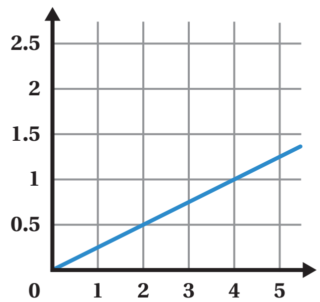
B.



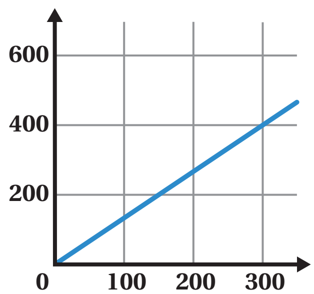
C.



D.



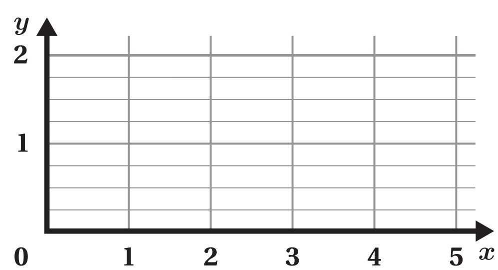
E.

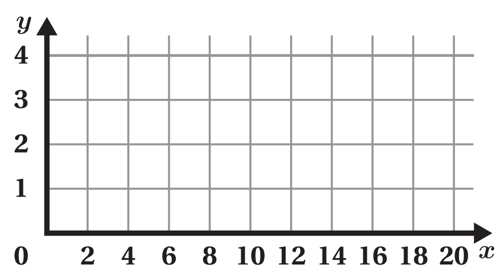


Equation	$y = \frac{4}{3}x$	$y = \frac{1}{4}x$	$y = 2.5x$
Graph			

7 **a** Draw the graph of $y = 0.75x$ on each set of axes.

b Explain how you decided where to draw the lines.

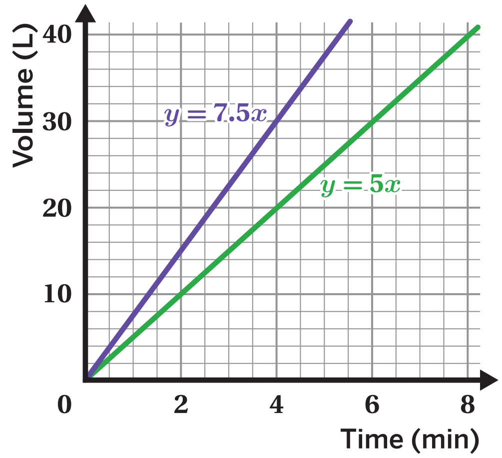




8 Synthesis

How are the equations of proportional relationships related to their graphs?

Use the examples if it helps with your thinking.



Things to Remember:

Name: ________ Date: ________ Period: ________

Proportional Posters

Let's compare proportional relationships.

Warm-Up

1. The table, graph, and equation all represent the same situation.

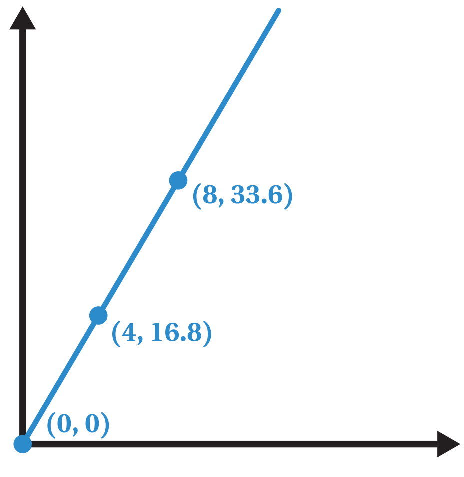
Table

x	y
0	0
4	16.8
8	33.6

Equation

$y = 4.2x$

Graph



a Describe a situation that could be represented by the table, graph, and equation.

b What does x and y represent in your situation?

c Label the axes of the graph to match your situation.

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

Comparing Two Different Representations

2. You will use the Activity 1 Sheet to select a situation to explore.

Situation: ....

3. Create a poster. Here is what your poster should include:

- ☐ Your names.
- ☐ The name of the situation you chose.
- ☐ Your answers to the questions about the situation.
- ☐ Explanations or calculations that show your reasoning for each of the answers.
- ☐ At least two new mathematical representations that allow you to compare the proportional relationships in your situation. Representations can include graphs, equations, and/or tables.

Explore More

Situation A: Maki and Ren

4. Maki and Ren earned a total of $210. They each worked the same number of hours. Who earned more money? How much more?

5. Maki and Ren earned a total of $315. They each earned the same amount of money. Who worked more hours? How many more?

Situation B: Ahmed's Lemonade

4. Ahmed used 30 cups of water to make some lemonade. According to Recipe 1, how much lemonade mix should Ahmed use?

5. Ahmed tried to follow Recipe 2 by using 4 cups of water and 20 cups of lemonade mix. What was the mistake? How can this be fixed?

Activity 2

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

Gallery Tour

As a class, you will take a gallery tour.

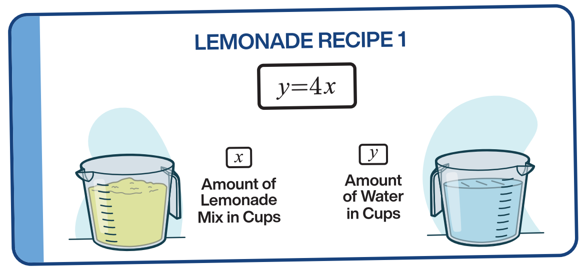
6. What features of your classmates' posters helped you understand their thinking?

7. Describe something you would change about your poster now that you have seen other groups' work.

Synthesis

8. How can you compare proportional relationships when they are represented differently?

Use the example if it helps with your thinking.



LEMONADE RECIPE 2

Lemonade Mix (cups)	Water (cups)
10	50
13	65
21	105

Things to Remember:

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

Comparing Two Different Representations

Choose one of the situations. Then complete the problems by creating a poster.

Situation A: Maki and Ren

Maki babysits a neighbor's children. Ren mows another neighbor's lawn.

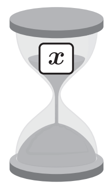
a Who makes more money after working 12 hours? Show or explain your thinking.

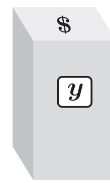
b What is the rate of change for each situation and what does it mean?

c How long would it take each person to earn \$150? Show or explain your thinking.

MAKI'S EARNINGS

$\boxed{y = 8.40x}$





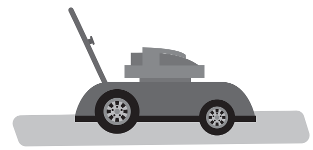
# of hours worked

Amount of money earned

REN EARNS:

$\boxed{\$7}$

PER HOUR



Situation B: Ahmed's Lemonade

Ahmed plans to start a lemonade stand and is trying to perfect the recipe.

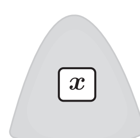
a If Ahmed has 16 cups of lemonade mix, how many cups of water are needed for each recipe?

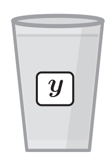
b What is the rate of change for each situation and what does it mean?

c Ahmed has 5 gallons (80 cups) of water and 20 cups of lemonade mix. Which lemonade recipe should Ahmed use? Show your thinking.

LEMONADE RECIPE 1

$\boxed{y = 4x}$





Amount of lemonade mix in cups

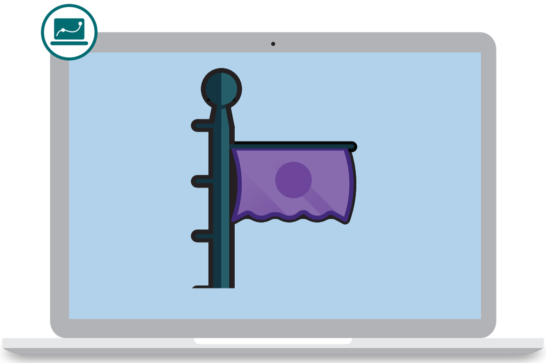
Amount of water in cups

LEMONADE RECIPE 2

Lemonade mix (cups)	Water (cups)
10	50
13	65
21	105

Unit 3
Lesson
4

Name: ______ Date: ______ Period: ______



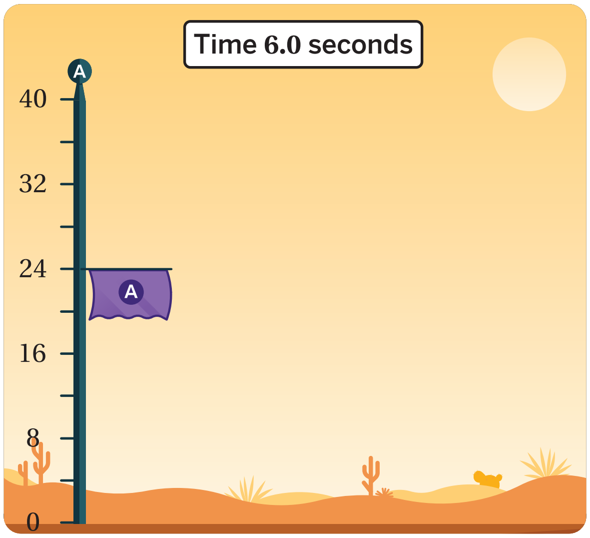
Flags

Let's explore non-proportional linear relationships.

Warm-Up

1 Let's watch an animation of a flag and its graph.

Discuss: What do you notice? What do you wonder?



Activity 1

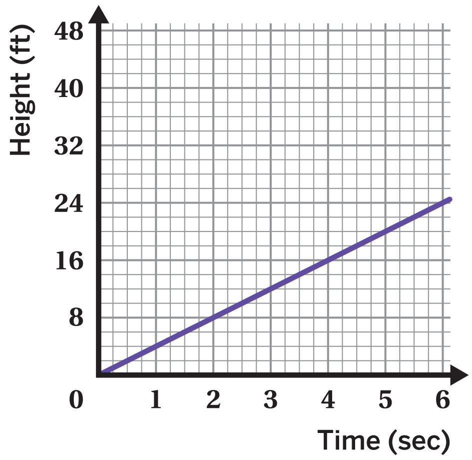
Name: Date: Period:

Forming an Equation

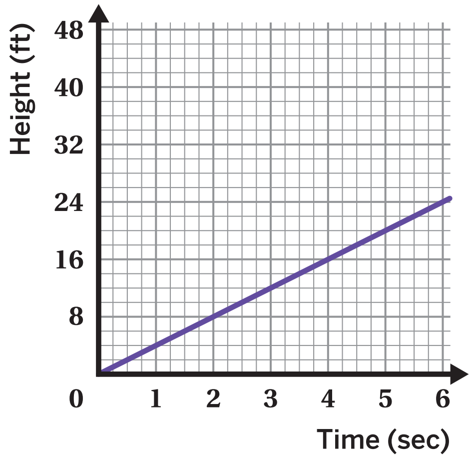
2 This line represents the relationship between height and time for the flag.

a What is the slope of the line?

b What does this number represent in the situation?



3 Write an equation for the flag's height, h, after t seconds.



Activity 2

Name: ______ Date: ______ Period: ______

Comparing Two Flags

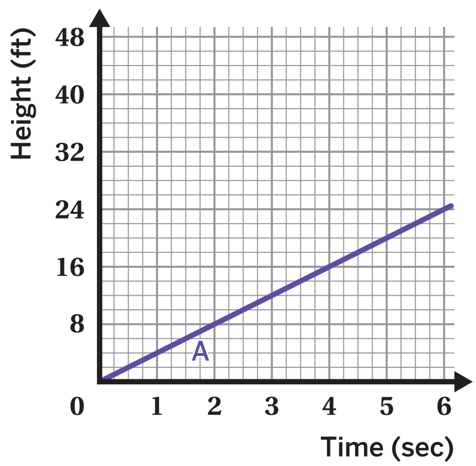
Let's explore the relationship between height and time for a new flag, Flag B.

4 Let's watch an animation of Flag A and Flag B.

Describe the behavior of Flag B.

5 Here is a graph representing the height of Flag A over time.

Draw a graph representing the height of Flag B over time.

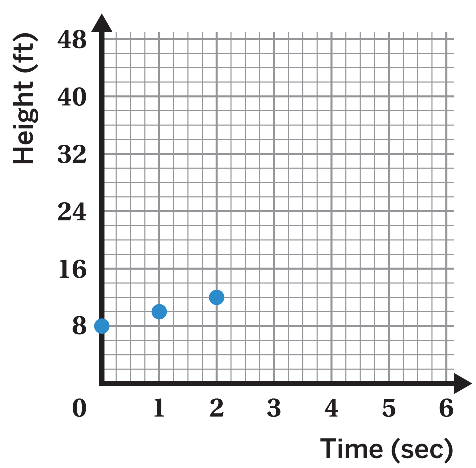


6 Here is a graph and a table with information about Flag B.

Cho claims: *Flag B rises at* 2 *feet per second, so its equation is* $h = 2t$.

Part of Cho's claim is correct and part of it is incorrect.

- What about Cho's claim is correct?



- What is incorrect?

Time (sec)	0	1	2
Height (ft)	8	10	12

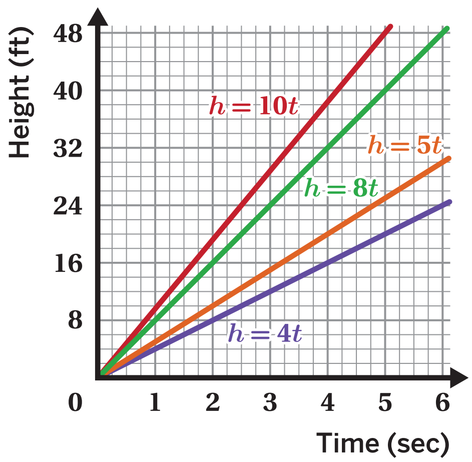
Name: .... Date: .... Period: ....

Exploring Linear Relationships

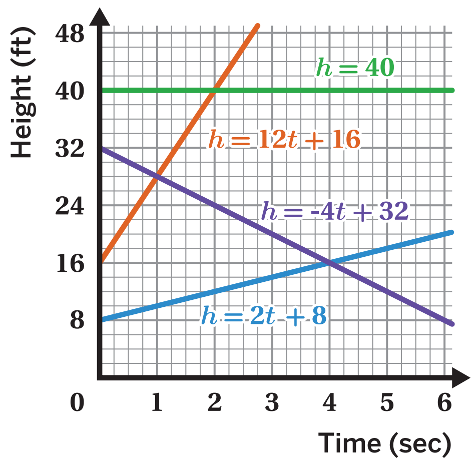
7 A relationship between two quantities is linear if there is a constant rate of change. It's called a **linear relationship** because its graph is a line.

Some linear relationships are proportional and some are non-proportional. Here are some examples.

Proportional Linear Relationships



Non-Proportional Linear Relationships



What are some differences between proportional and non-proportional linear relationships?

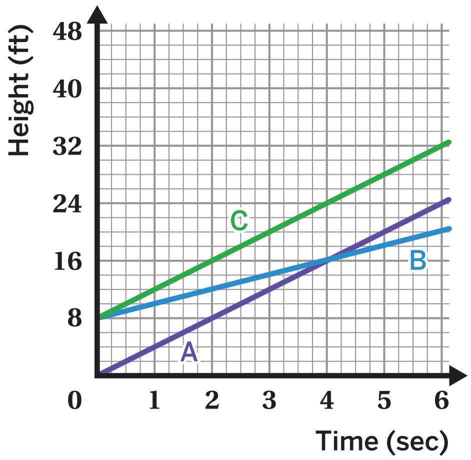
Name: .... Date: .... Period: ....

Exploring Linear Relationships (continued)

Now let's explore the relationship between height and time for a new flag, Flag C.

8 Based on the graph, select *all* the true statements.

- ☐ **A.** Flag C's graph is proportional.
- ☐ **B.** Flag C's graph is linear.
- ☐ **C.** The slope of Flag C's line is 8.
- ☐ **D.** Flag C rises at 8 feet per second.
- ☐ **E.** Flag C rises at 4 feet per second.



9 Write an equation for the height of Flag C.

Flag	Equation
A	$h = 4t$
B	$h = 2t + 8$
C	

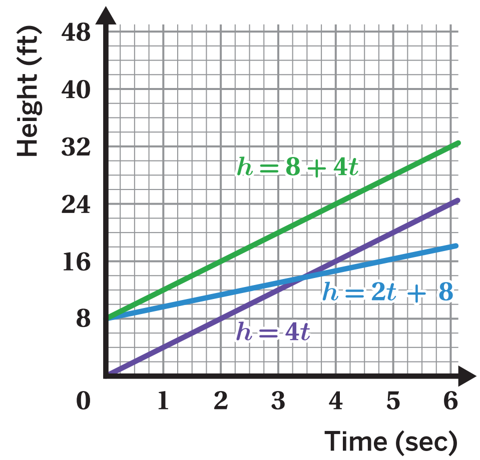
10 Can you write a new equation for Flag C so that the flag:

- Starts high?
- Starts low?
- Moves fast?
- Moves slow?

11 Synthesis

How can you identify a non-proportional linear relationship in a graph and in an equation?

Use the example if it helps with your thinking.



Things to Remember:

Unit 3
Lesson
5

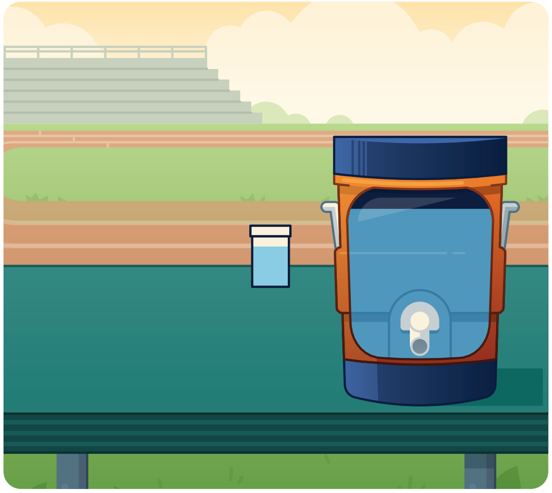
Name: ______ Date: ______ Period: ______

Water Cooler

Let's explore lines with different slopes.

Warm-Up

1 Let's watch a short animation about a water cooler.



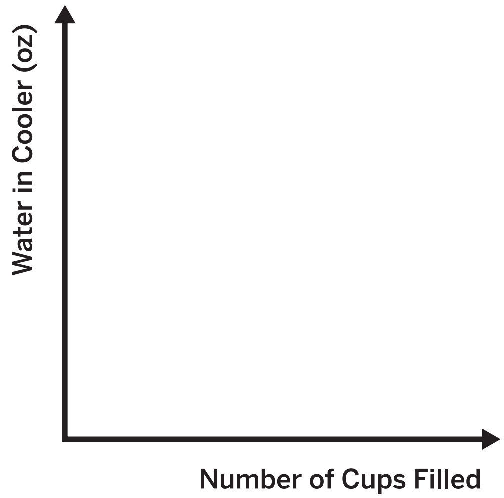
a **Discuss:** What do you notice? What do you wonder?

b Make an initial prediction. After how many cups do you think the cooler will run out of water?

Name: ________ Date: ________ Period: ________

Cooler Cups

2 **a** Sketch the relationship between the ounces of water remaining in the cooler and number of cups filled.



b **Discuss:** How can you see this relationship in your sketch?

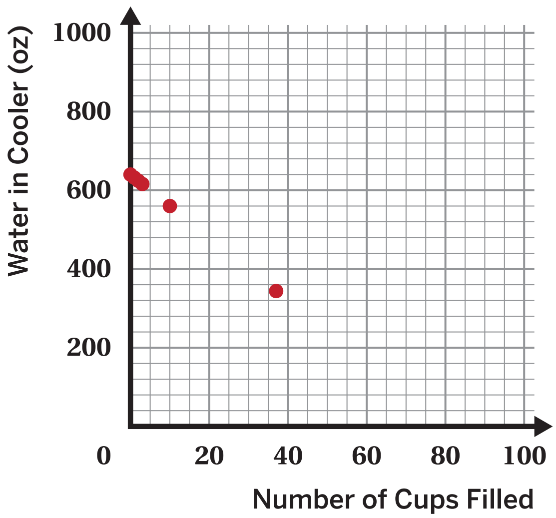
3 The table shows the amount of water remaining in the cooler after 0, 1, and 2 cups have been filled.

Determine the missing values.

Number of Cups Filled	0	1	2	3	. . .	10	37
Water in Cooler (oz)	640	632	624		. . .		

4 A classmate plotted their points from the table onto a graph.

Write an equation representing the amount of water in the cooler, y, after filling x cups.



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

Cooler Cups (continued)

5 Make a final prediction:

After how many cups will the cooler run out of water?

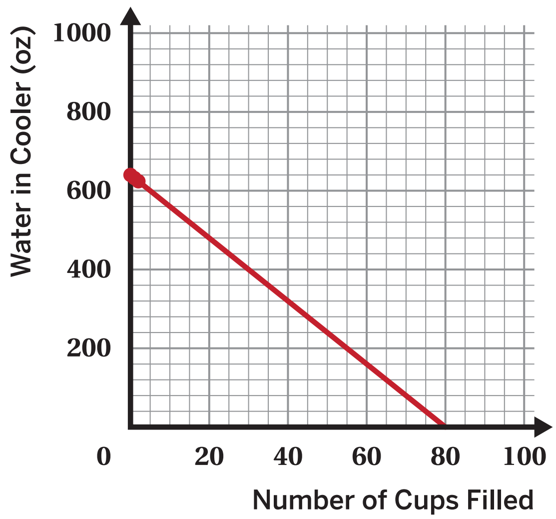
Explain your thinking.

6 Let's watch an animation to see how many cups the cooler actually fills!

7 Here is the equation that a classmate wrote for the relationship between the water in the cooler and the number of cups:

$y = 640 - 8x$

The **vertical intercept** is the point where the graph of a line crosses the vertical axis.



a What is the vertical intercept of this graph, and what does it represent in this situation?

b What is the slope of the line, and what does it represent in this situation?

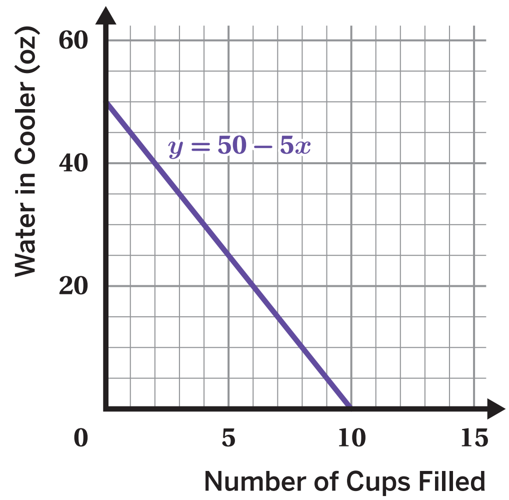
Activity
2

Name: ____________ Date: ________ Period: ________

A New Water Cooler

The line $y = 50 - 5x$ represents a different water cooler situation.

8 Write a story that this graph could represent.



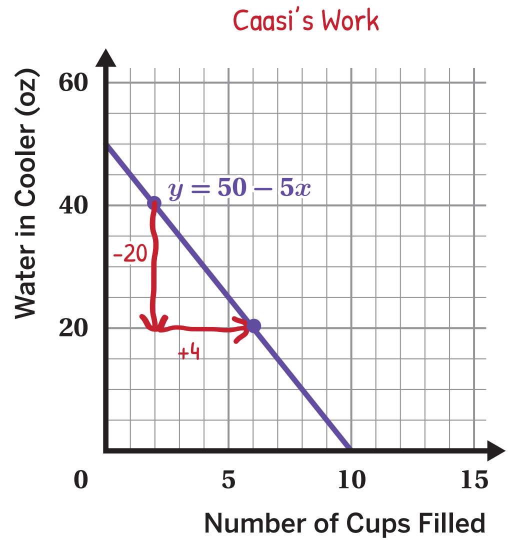
9 Caasi says that the water in the cooler decreases by 20 ounces for every 4 cups filled.

Jamar says that the water in the cooler decreases by 5 ounces for every 1 cup filled.

Whose claim is correct?

Caasi's Jamar's Both Neither

Explain your thinking.



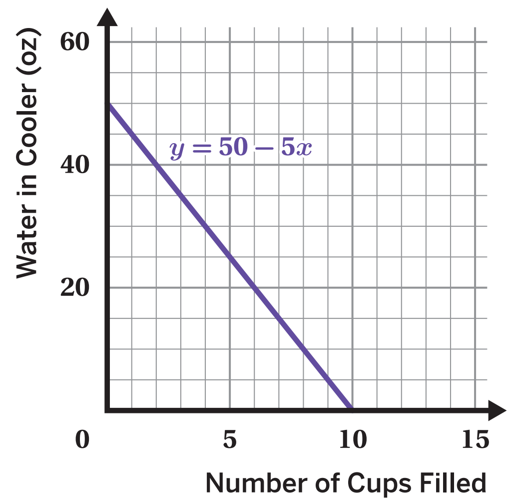
10 Look at the graph of $y = 50 - 5x$ from the previous problems. The line crosses the horizontal axis at the point $(10, 0)$. This point is called the **horizontal intercept**.

What does this intercept represent in this situation?

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

A New Water Cooler (continued)

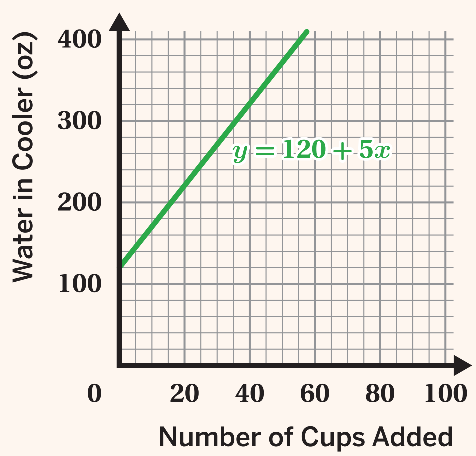
11 Revise your original story so that it is stronger and clearer.



Explore More

12 The line $y = 120 + 5x$ represents a third water cooler situation.

a. Write a story that this graph could represent.

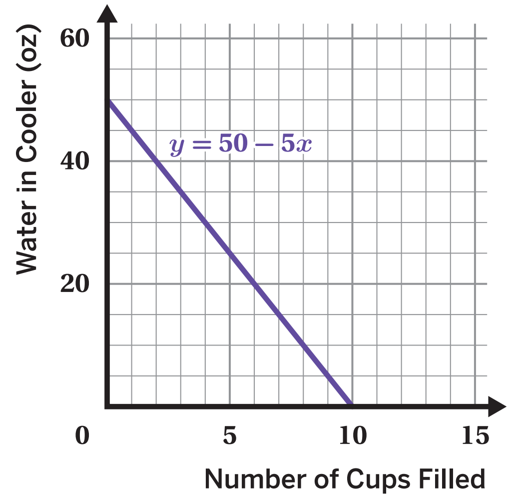


b. How is this situation like the other two water cooler situations? How is it different?

13 Synthesis

What are 2–3 things you can determine about a situation from its graph?

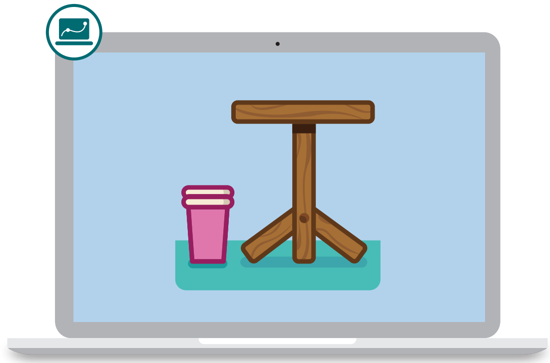
Use the graph if it helps with your thinking.



Things to Remember:

Unit 3
Lesson
7

Name: ________ Date: ________ Period: ________

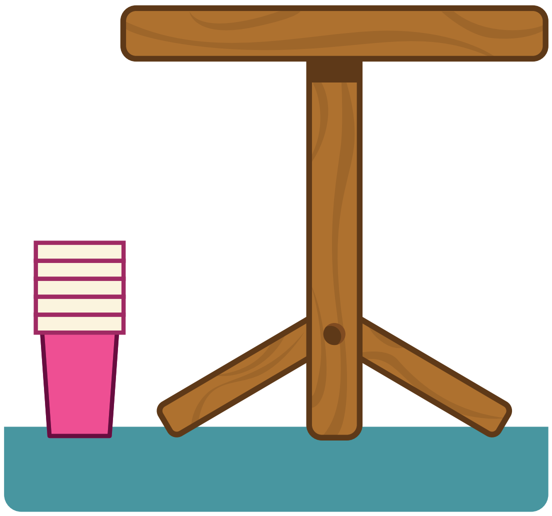


Stacking Cups

Let's use a linear relationship to make a prediction

Warm-Up

1 a How many stacked cups do you think you need to reach the top of this table?

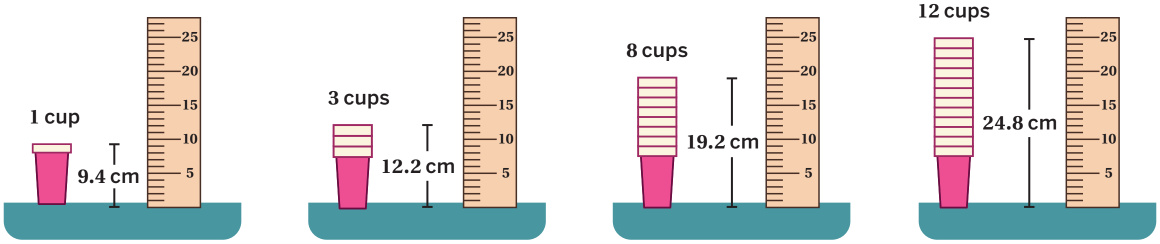


b What information would help you make a more precise prediction?

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

Stacking Cups (continued)

2 Let's look at different stacks of cups.



Record *at least two* data points.

Number of Cups	Height (cm)

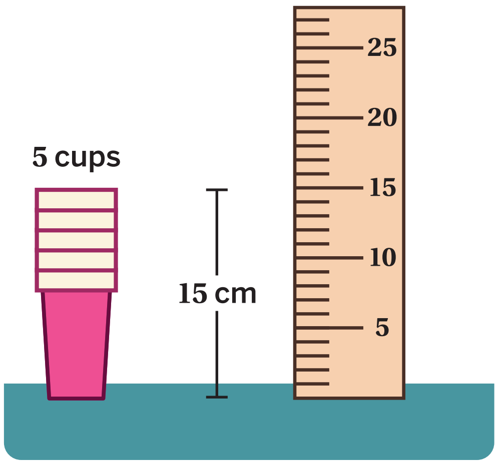
3 Sylvia found that a stack of 5 cups has a height of 15 centimeters.

She thinks that a stack of 10 cups will have a height of 30 centimeters.

Is she correct? Circle one.

Yes No

Explain your thinking.



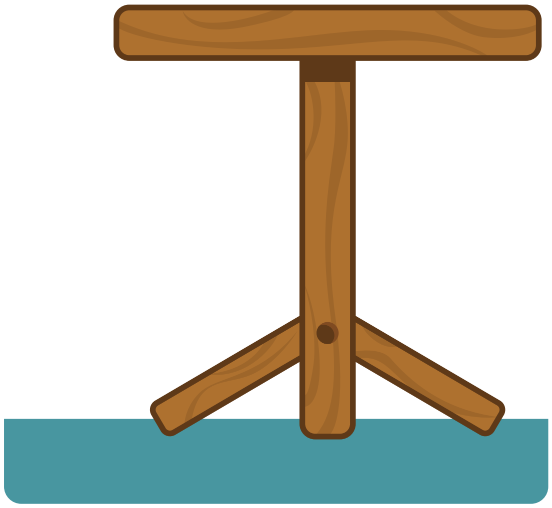
Name: .... Date: .... Period: ....

Stacking Cups (continued)

4 The height from the floor to the top of the table is 50 centimeters.

Previously, you predicted a number of cups to reach the top of the table.

Now that you have more information, calculate the exact number of stacked cups you need.



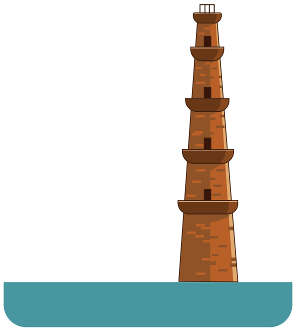
5 Let's see how many cups you actually need to reach the top of the table!

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

More and More Cups

6 This minaret is 42.5 meters (or $4{,}250$ centimeters) tall.

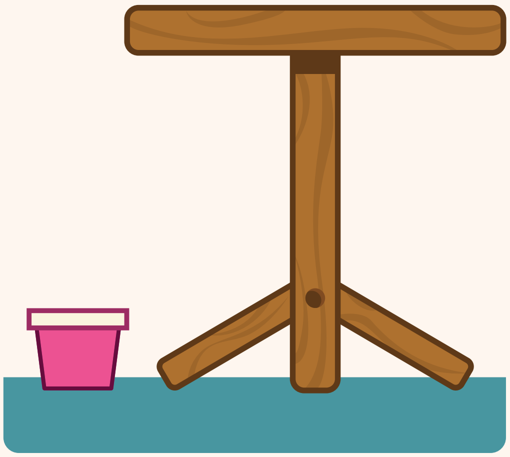
How many stacked cups do you need to reach the top of the minaret?

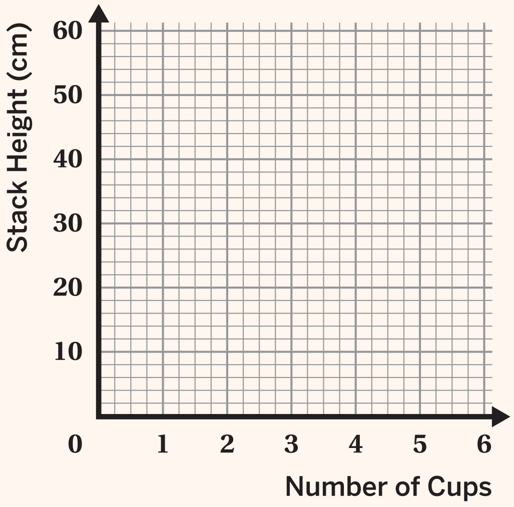


7 Let’s see how many cups you actually need to reach the top of the minaret!

Explore More

8 What cup and lip heights would you use so that 5 of your cups will reach the exact height of the table (50 centimeters)? Use the graph if it helps with your thinking.





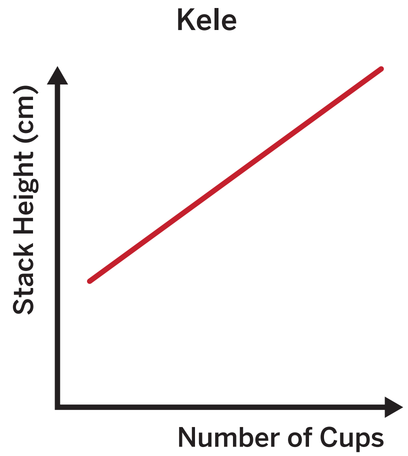
Activity 3

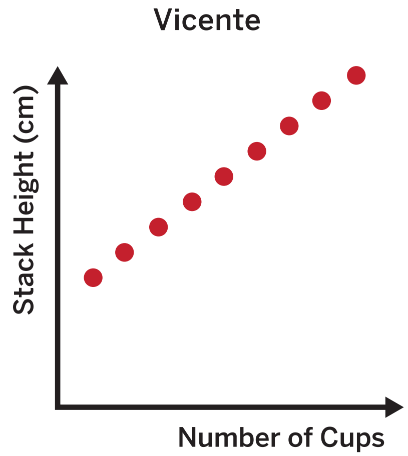
Name: ________ Date: ________ Period: ________

Modeling the Relationship

9 Graphs can help us understand a relationship better.

Kele and Vicente each made a graph.



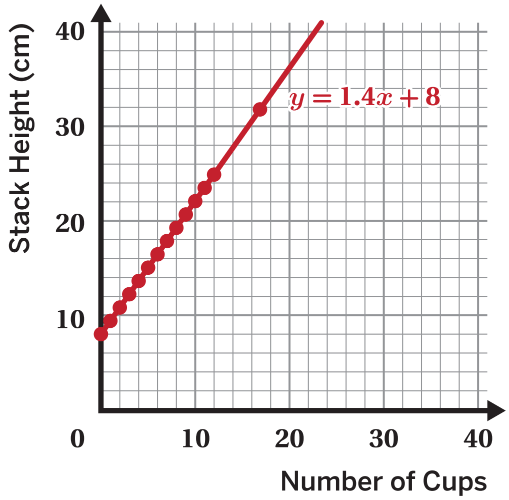


When might Kele's graph be useful? When might Vicente's graph be useful?

10 Here is a graph with a line and an equation that represent the relationship between number of cups and stack height.

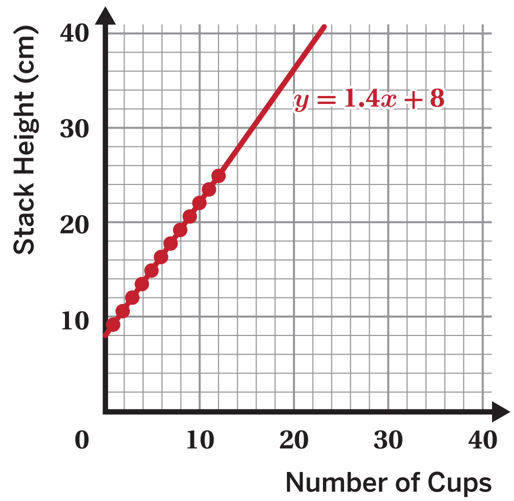
Discuss:

- What is the slope of the line? What does it represent in this situation?
- What is the y-intercept (vertical intercept) of the line? What does it represent in this situation?



11 Synthesis

How can you use a linear relationship to model a situation and make predictions?



Things to Remember:

Unit 3
Lesson
8

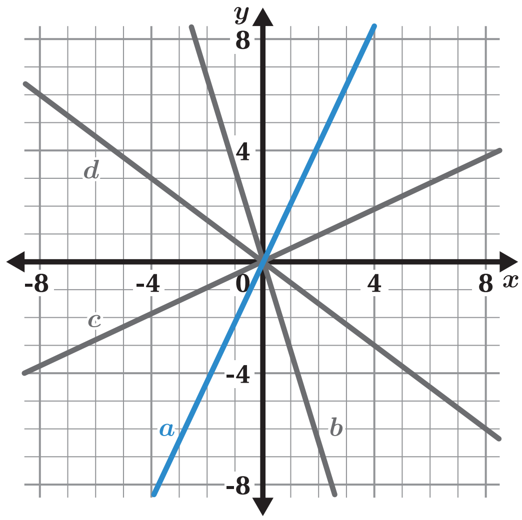
Name: .... Date: .... Period: ....

Translations

Let's see what happens to the equations of translated lines.

Warm-Up

1 Let's adjust the equation $y = 3x$ to match line a.



2 Write equations to match the lines on the graph.

Line	Equation
a	
b	
c	
d	

Activity 1

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

Translating Lines

3 Here are several lines.

You can only see part of them, but they actually continue forever in both directions.

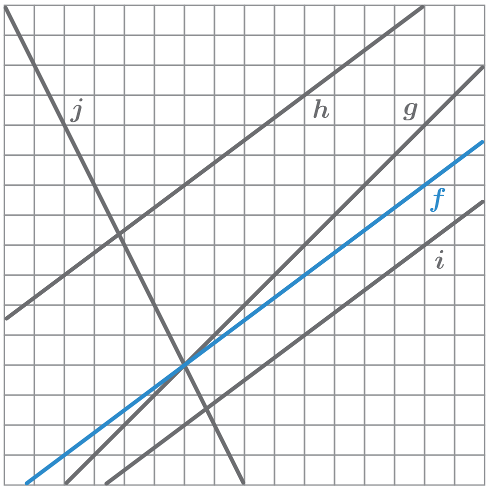
Which lines are images of line f after a *translation*? Select *all* that apply.

☐ **A.** Line g

☐ **B.** Line h

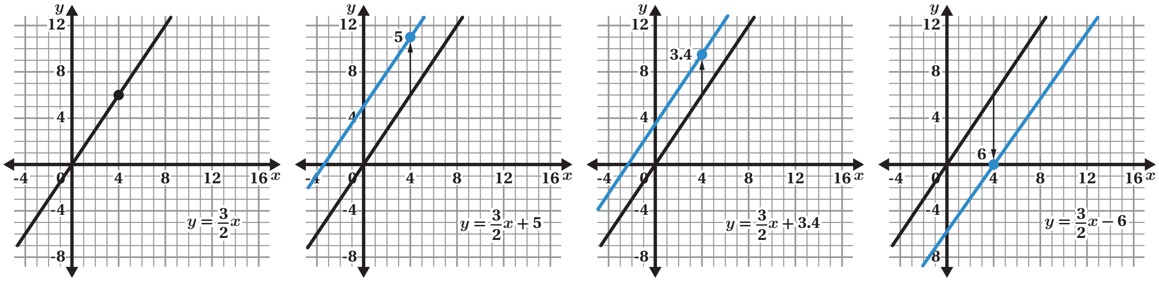
☐ **C.** Line i

☐ **D.** Line j



4 Describe a translation that moves line f onto each of the lines that are images of line f.

5 Take a look at equations for three different translations of the line $y = \frac{3}{2}x$.



What do you notice about the relationship between the y-intercept (vertical intercept) of the translated line and its equation?

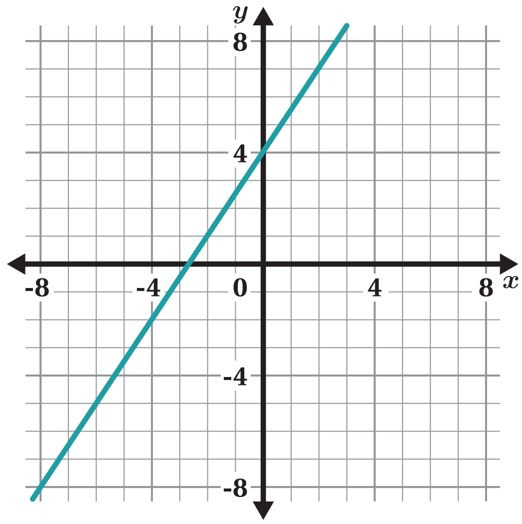
Activity

2

Name: ______ Date: ______ Period: ______

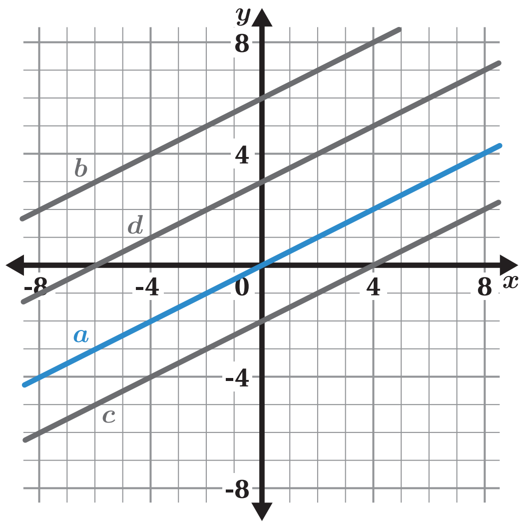
Equations of Lines

6 Adjust one number in the equation $y = \frac{3}{2}x + 1$ to match the line.



7 Write equations to match the lines on the graph. The first one has been done for you.

Line	Equation
a	$y = \frac{1}{2}x$
b	
c	
d	



Name: ______ Date: ______ Period: ______

Equations of Lines (continued)

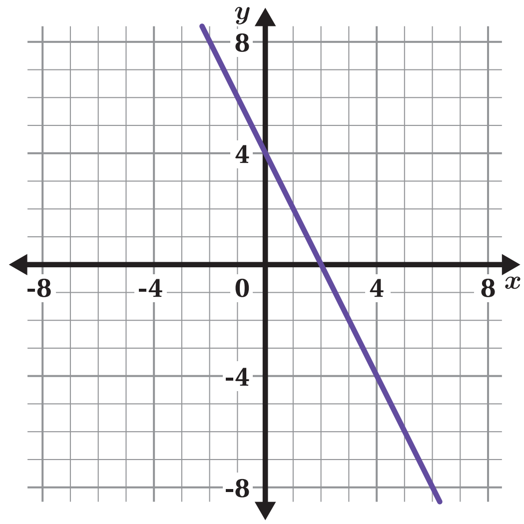
8 What is the equation of this line?

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

B. $y = 4x - 2$

C. $y = -x + 4$

D. $y = -2x + 4$



Explain your thinking.

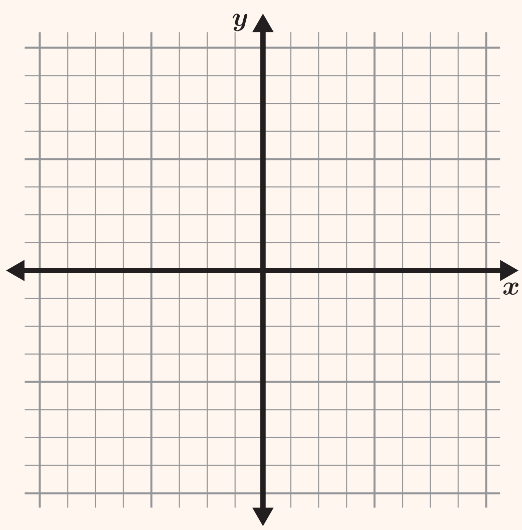
Explore More

9 Zoe says that the graph of $y = 3(x + 4)$ is the same as the graph of $y = 3x$, but translated up 4 units.

Is Zoe's claim correct?

Yes No

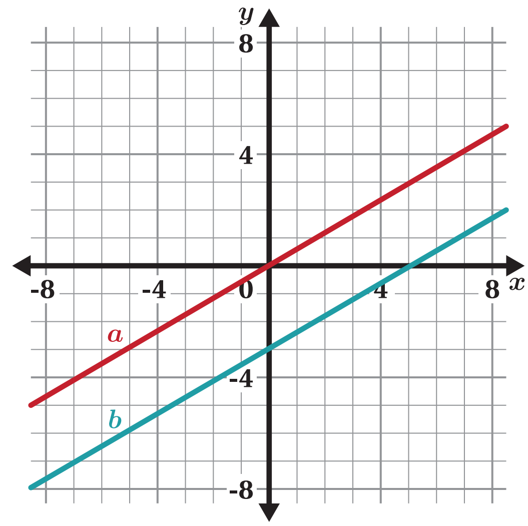
Show or explain your thinking.



10 Synthesis

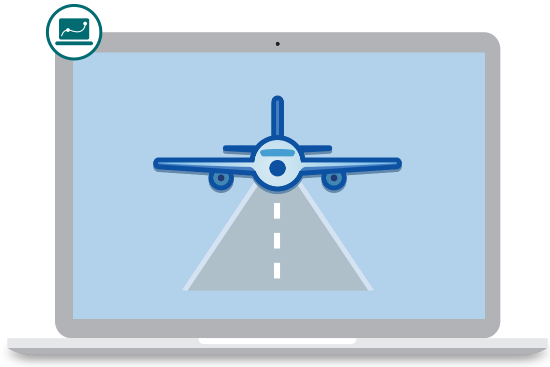
Here is a graph of two equations.

How are the equations of line a and line b alike and different?



Things to Remember:

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



Landing Planes

Let's think about strategies for calculating slope.

Warm-Up

1 Determine possible values for each variable to make the equations true.

$$\frac{a}{b} = -2$$

$$\frac{m}{n} = 2$$

$$q - r = -2$$

Activity 1

Name: ________ Date: ________ Period: ________

Planes, Lines, and Slopes

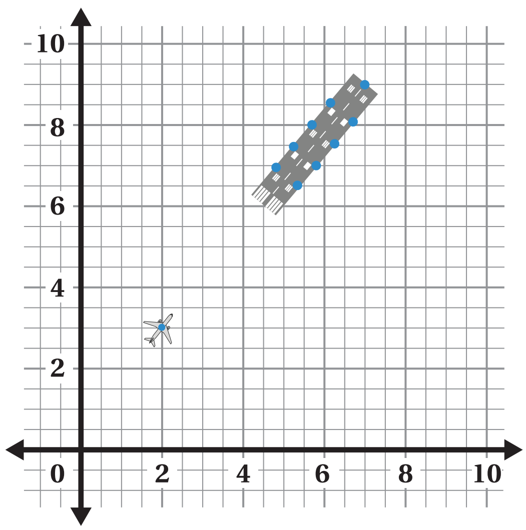
2 Predict whether the slope of the line through each set of points is positive, negative, or zero.

- (600, 500) and (400, 500)
- (7, 1) and (12,7)
- (10, 40) and (30, 20)

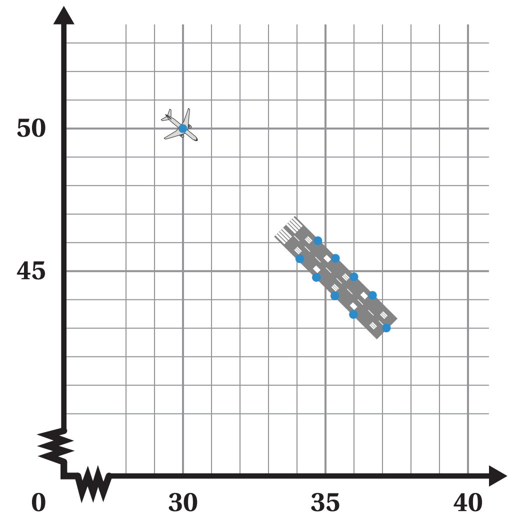
Positive Slope	Negative Slope	Zero Slope

3 Your task is to land the plane.

To do that, calculate the slope of the line that goes through (2, 3) and (7, 9).



4 To land the plane, calculate the slope of the line that goes through (30, 50) and (37, 43).

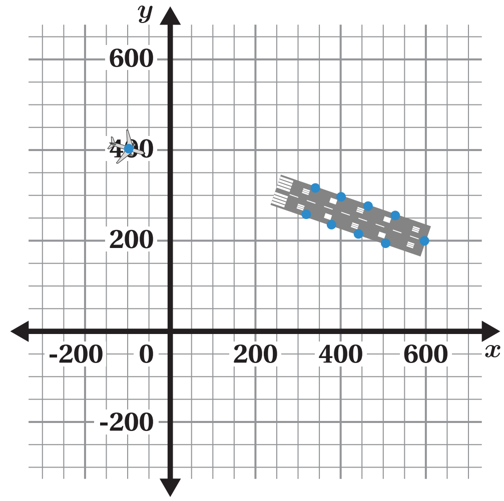


Activity
2

Name: ______________ Date: ______________ Period: ______________

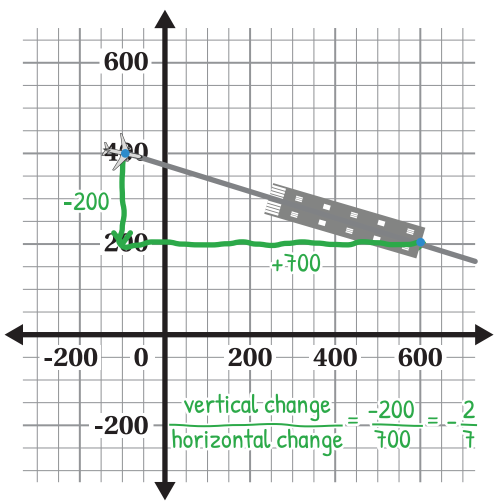
Strategies for Calculating Slope

5 To land the plane, calculate the slope of the line that goes through $(-100, 400)$ and $(600, 200)$.



6 Here are two students' strategies for calculating the slope of the line that goes through $(-100, 400)$ and $(600, 200)$.

Kwame's work



Wey Wey's work

x	y
-100	400
600	200

+700 -200

$$\frac{\text{change in y}}{\text{change in x}} = \frac{-200}{700} = -\frac{2}{7}$$

Discuss: How are their strategies alike? How are they different?

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

Challenge Creator

7 **a** **Make It!** Create your own plane-landing challenge.

- Choose a pair of coordinates to represent the starting position (Point 1) and ending position (Point 2) of your plane. Record the points on this page.
- On graph paper, choose a scale and label your axes, then plot your two points. Label the points with their coordinates.

b **Solve It!** On this page, calculate the slope that passes through your two points.

c **Swap It!** Trade graphs with one or more partners. On this page, calculate the slope of the line that passes through their two points.

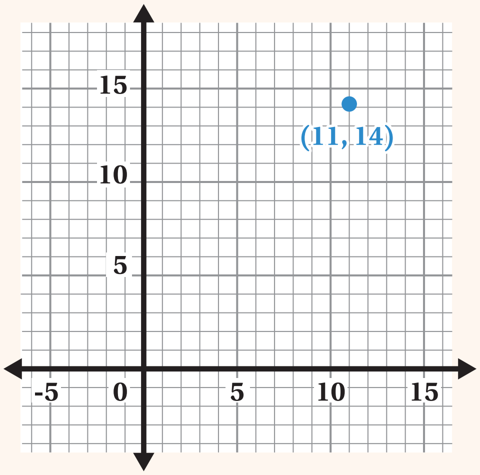
d With each partner, compare your strategies for calculating the slope of a line that passes through two given points.

My Challenge	Partner 1's Challenge	Partner 2's Challenge
Point 1:	Point 1:	Point 1: ....
Point 2:	Point 2:	Point 2: ....
Slope:	Slope:	Slope: ....

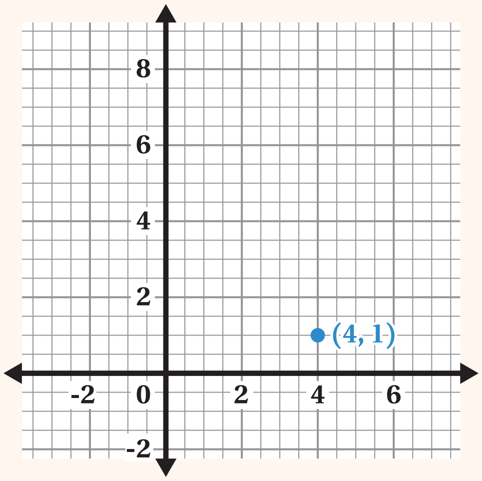
Explore More

8 We know the slope of the path of each of these planes, but not their starting positions. Determine the value of p so that the line passing through the points has the indicated slope.

a Plane A starts at $(p, 2)$ and stops at $(11, 14)$. Its path has a slope of 2.



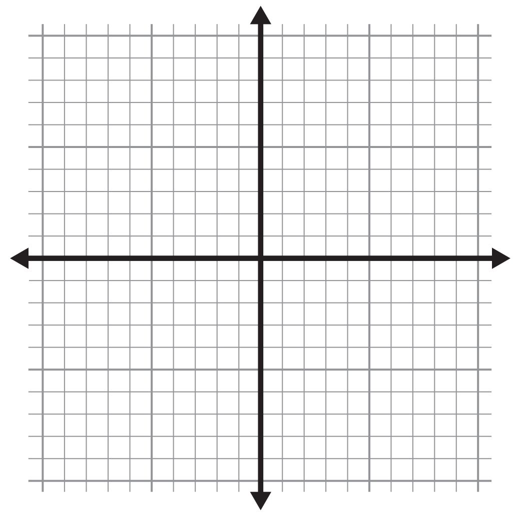
b Plane B starts at $(1, p)$ and stops at $(4, 1)$. Its path has a slope of -2.



9 Synthesis

What are some strategies for finding the slope of a line that goes through two given points?

Use the graph if it helps to show your thinking.



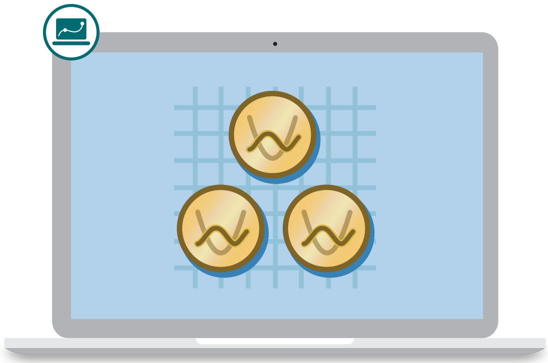
Things to Remember:

Unit 3

Lesson

10

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



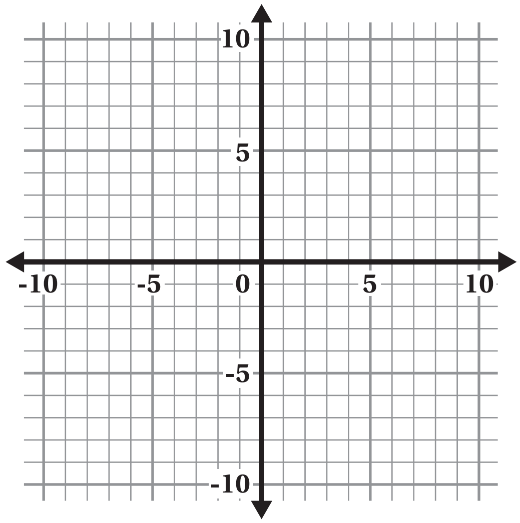
Coin Capture

Let's write equations for vertical and horizontal lines.

Warm-Up

1 **a** Plot four points in different locations. The x-coordinate of each point should be 7.

b **Discuss:** What would your and your classmates' points look like if they were all on one graph?



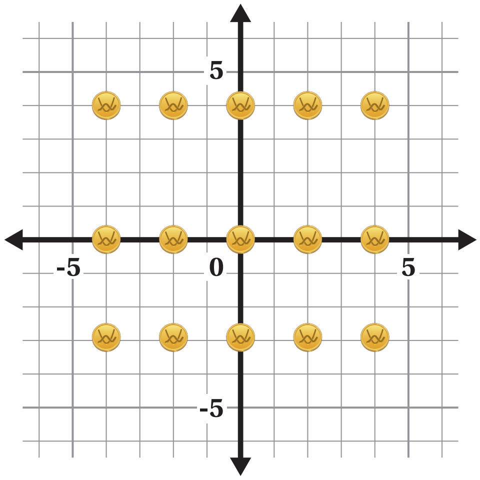
2 Let's look at the points that some other students graphed. Write an equation to represent all the points with an x-coordinate of 7.

Activity 1

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

Capture the Coins

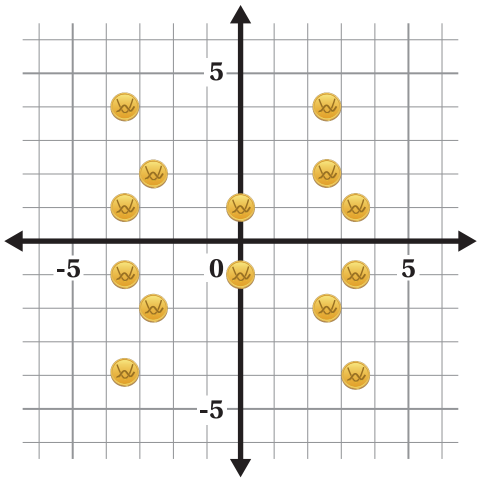
3 **a** Draw lines through the coins to “capture” them. Try to draw as few lines as possible.



b Write an equation for each line you drew.

Equations:

4 **a** Draw lines through the coins to “capture” them. Try to draw as few lines as possible.



b Write an equation for each line you drew.

Equations:

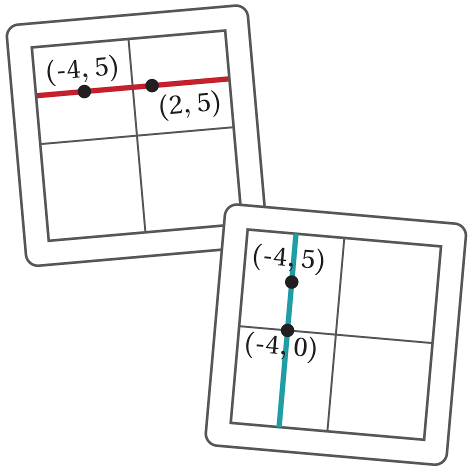
5 Lupe says that vertical lines have a slope of zero.

Nekeisha says that horizontal lines have a slope of zero.

Whose claim is correct?

Lupe’s   Nekeisha’s   Both   Neither

Explain your thinking.



Activity 2

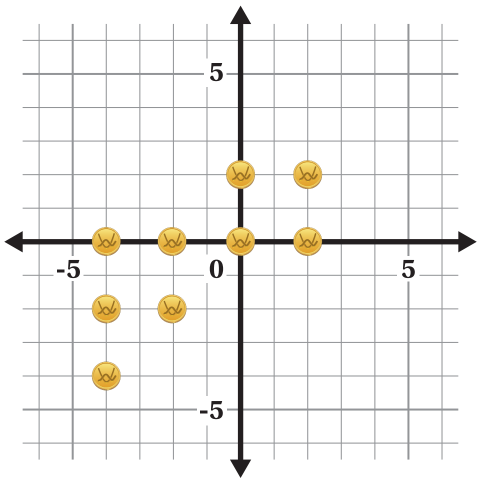
Name: ________ Date: ________ Period: ________

Challenge Creator

6 a. Draw lines through the coins to "capture" them. Try to draw as few lines as possible.

b. Write an equation for each line you drew.

Equations:



7 Create your own Coin Capture challenge!

a. **Make It!** Use the Activity 2 Sheet to create your challenge.

b. **Solve It!** On this page, write equations for the lines you would use to capture all the coins in your challenge. Try to use as few lines as you can.

c. **Swap It!** Trade graphs with a partner and solve each other's challenges.

My Challenge
Equations:

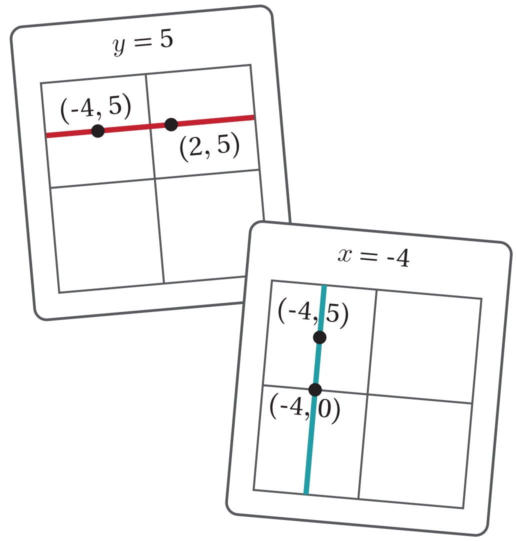
Partner 1's Challenge
Equations:

Partner 2's Challenge
Equations:

Partner 3's Challenge
Equations:

8 Synthesis

How can you tell from looking at a linear equation if its graph is a horizontal or vertical line?



Things to Remember:

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

Challenge Creator

Draw 8 coins on the graph.