Focus

TEKS

Plan

Talk

October 20, 2014
TASM Professional Development Meeting
Grades 9-12

Love Kids. Love Math.
region 4

Slope

Mathematical Process Standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. 1(D) The student is expected to communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.

Acquire	Demonstrate

STAAR Problems

The table shows the playing time in minutes of high-definition videos and the file size of these videos in megabytes (MB).

Videos

Playing Time, x (min)	File Size, y (MB)
0.5	60
1.5	180
2	240
4.5	540
5	600

What does the slope of the graph of this situation represent?

Two functions are given below.

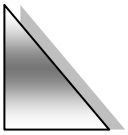
$$f(x) = -4x + 1$$

$$g(x) = -4x + \frac{1}{2}$$

How does the graph of f compare with the graph of g?

What knowledge and skills do students need in order to successfully answer these questions?

Stations

Slope Triangles 	What's My Rate 
Student Earnings 	Have a Seat 

Student Name: _____ Date: _____

What's the Rate?

Solve each of the following riddles. Circle the correct answer.

1. Martha drives 60 miles per hour.
   Sally drives 80 miles in 2.5 hours.
   I drive faster than Sally, but slower than Martha.
   Which of the following could be my rate?

25 mph	32 mph	55 mph	80 mph

2. Three siblings walk from home to school each day.
   Mark walked from home to school at a rate of 5 miles per hour.
   Madison walked the same route at a rate of 1 mile in 10 minutes.
   Michael walked 2 miles in half an hour.
   I am the sibling that walks at the fastest rate. Who am I?

Mark	Madison	Michael

3. Cassie can read 18 pages in 30 minutes.
   Jesse can read 45 pages in 1.5 hours.
   Homer can read 80 pages in 3 hours.
   Who reads the fastest?

Cassie	Jesse	Homer

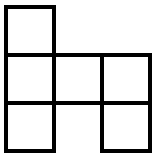
Communicating About Mathematics
At the rate Jesse reads, 45 pages in 1.5 hours, how many hours would it take him to read 225 pages? Justify your answer.

Student Name: _____ Date: _____

Have a Seat!

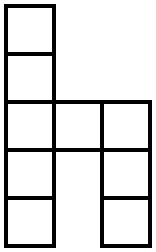
Examine the chairs and their descriptions below. Then answer the questions that follow.

Stage 1



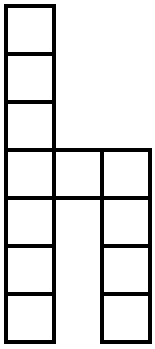
A chair with a seat made of 3 tiles and with leg and back heights of 1 tile each.

Stage 2



A chair with a seat made of 3 tiles and with leg and back heights of 2 tiles each.

Stage 3



1. How would you describe the third stage?

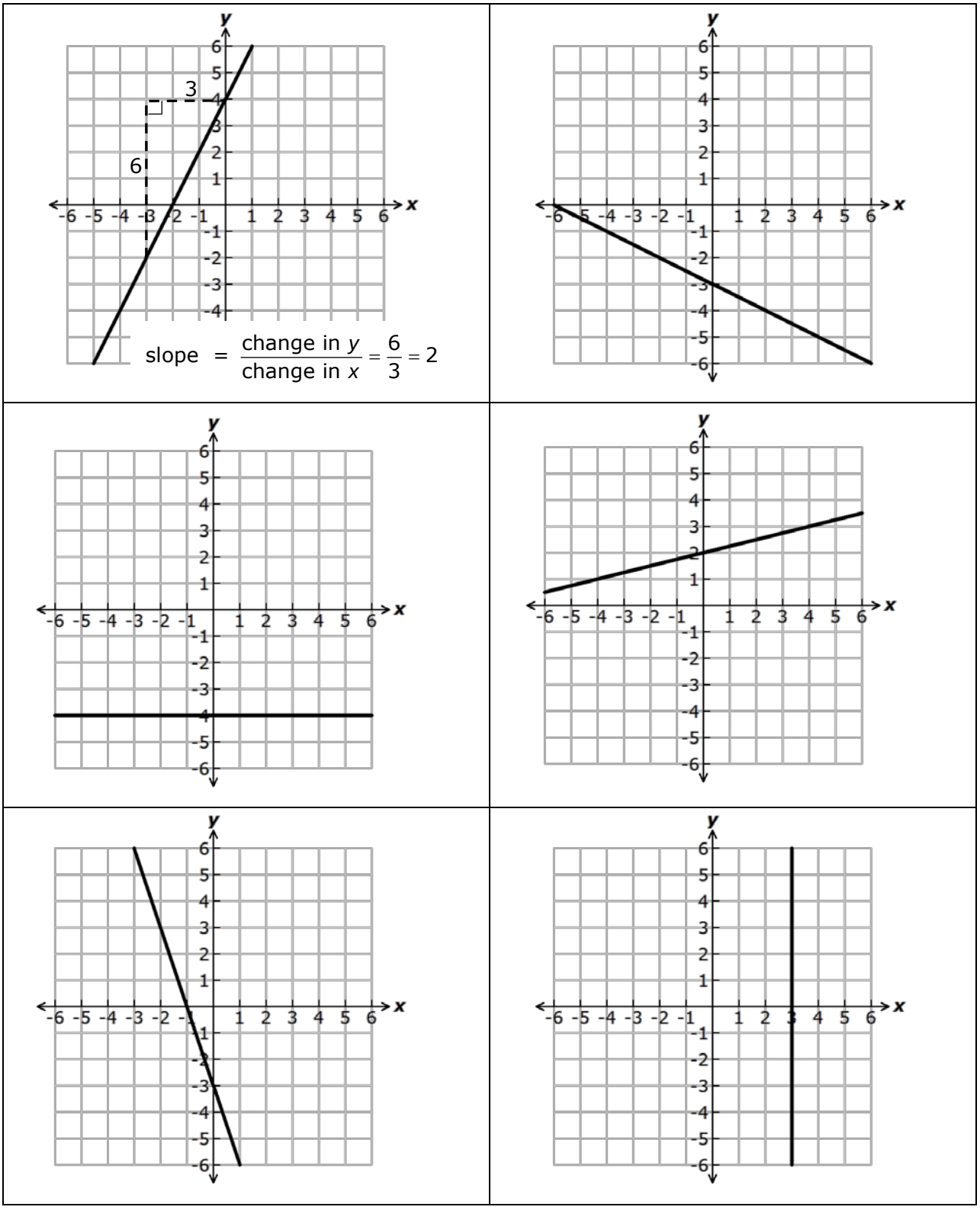
2. Draw the fourth stage. Write the description of this stage.

3. How many tiles are used in the fourth stage?

4. Describe the 48th stage. How many tiles would it take to build?

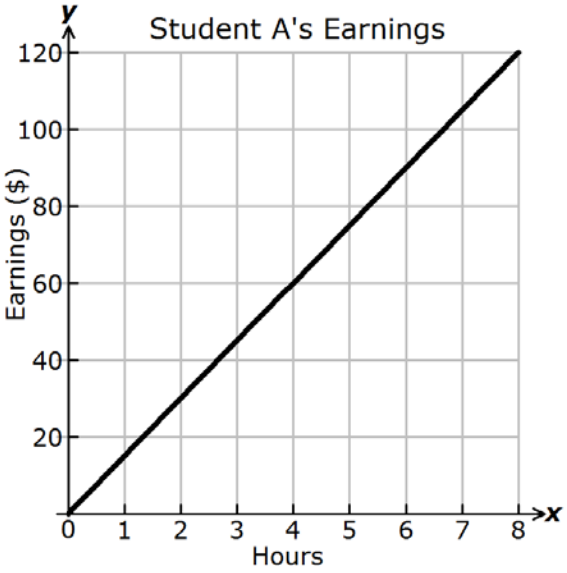
Slope Triangles

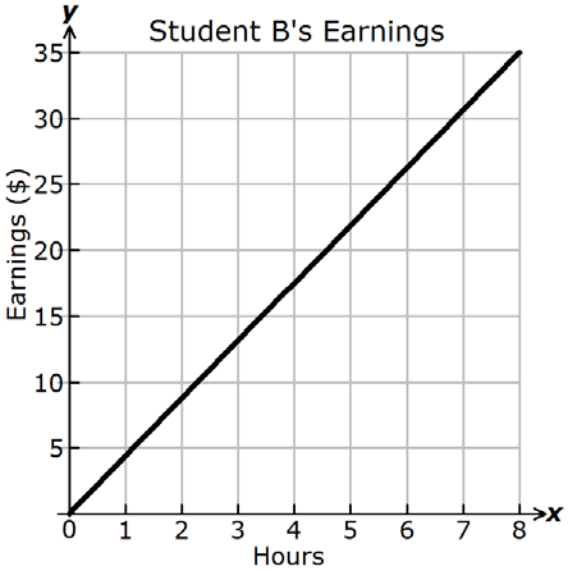
Determine the slope of each of these lines by creating slope triangles.

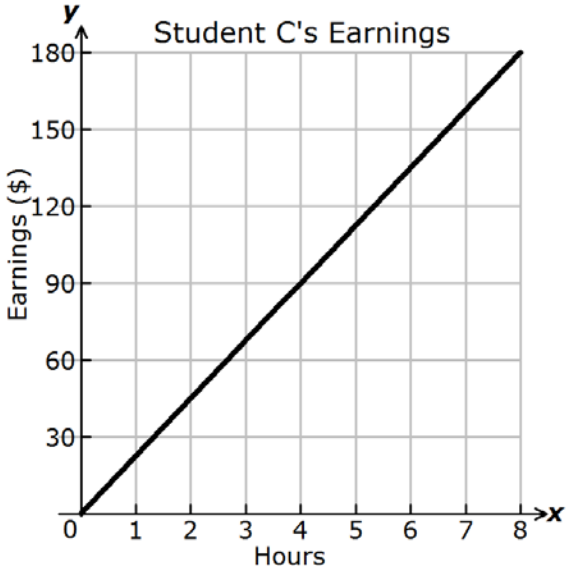


Student Earnings

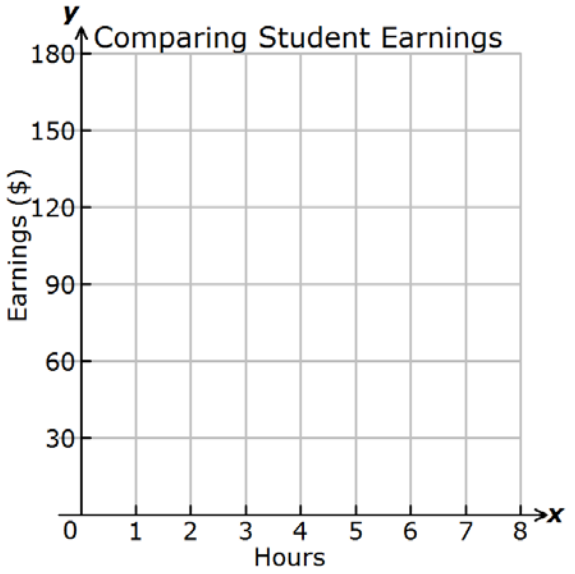
Did these students all get paid the same hourly rate? How do you know?







Hint Cards

Which student earned the least amount after 8 hours?	What do the numbers on the *y*-axis represent?	 Redraw the three graphs to compare their hourly rates.

Have a Seat!

Additional Questions

1. Determine the rate of change for this situation. Show how the rate of change is demonstrated in the visual representation shown for Stages 1 through 3.

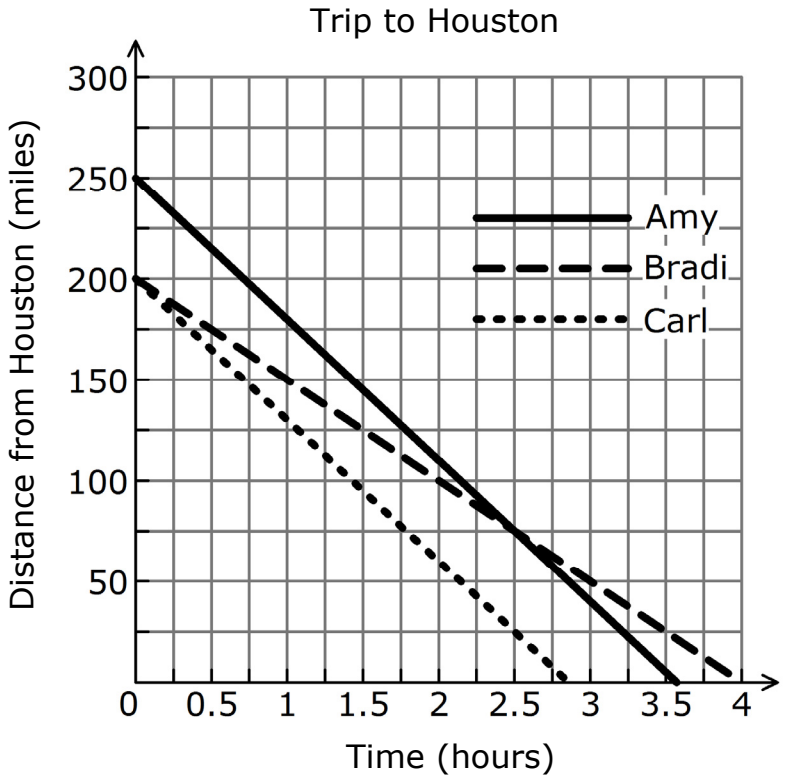
2. If there were a Stage 0, based on the pattern shown, how many tiles would be in Stage 0? Explain to your partner how you determined the number of tiles in Stage 0.

3. Choose a way to represent the relationship between the stages and the number of tiles.

4. Determine a function to model this set of data. What is the relationship between the visual representation of this situation and the algebraic representation?

Driving Home

Use the graph below to complete the paragraph.

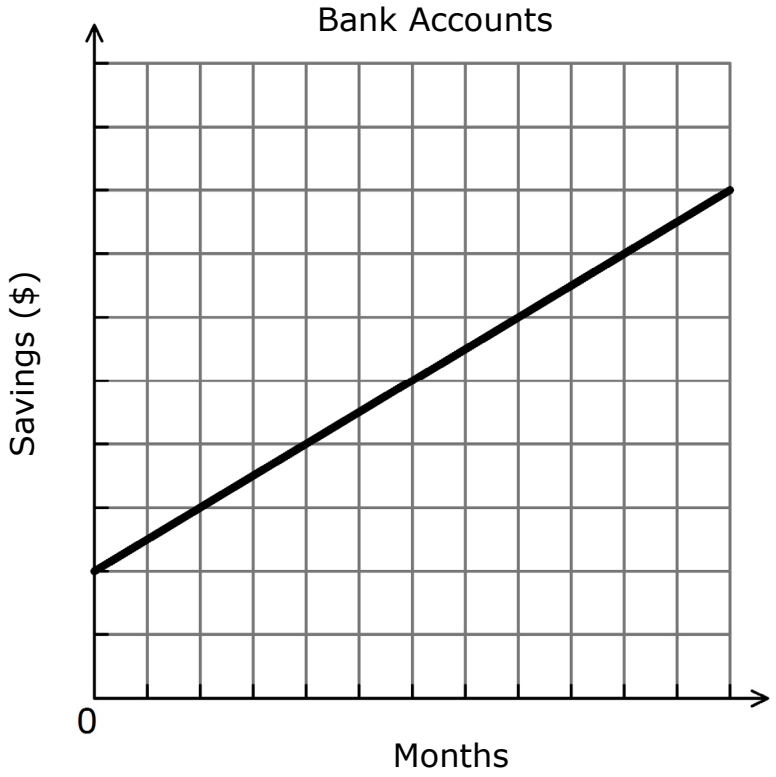


Amy, Bradi and Carl attend three different colleges and are driving home for a visit. They decided to all leave at _____ from their respective schools. _____ and _____ schools are the same distance from Houston and _____ school is further away. _____ has an additional _____ miles to drive. _____ and _____ both agreed to drive _____ miles per hour, but _____ said that was too _____ and decided to drive _____ miles per hour instead.

After driving 2.5 hours one sibling decided to call the others. _____ and _____ were both _____ miles from Houston. Then _____ said "I am _____ miles closer to home than you!" They were all happy when the final sibling arrived after driving almost _____ total hours. _____ was first to arrive and had been waiting about _____ hours.

Banking

Marco has decided to open a savings account and have money directly deposited into that account. The graph below shows Marco's projected savings account balance over the next year as he implements his plan.



Sketch a line to represent each of the following scenarios and label them accordingly.

- *Line a*: Marco deposits three times as much money as originally planned to open the account, and saves at the same rate.
- *Line b*: Marco does not change his initial deposit, but each month he only deposits half the amount originally intended.
- *Line c*: Marco deposits half the as much money as originally planned to open the account, but each month he saves twice as much.

1. Which lines have the same *y*-intercept? What does this mean in the situation?

2. Which lines have the same slope? What does this mean in the situation?

3. Write a set of equations that could represent this situation. Label the axes to match your equations.

Original Line	Line A	Line B	Line C

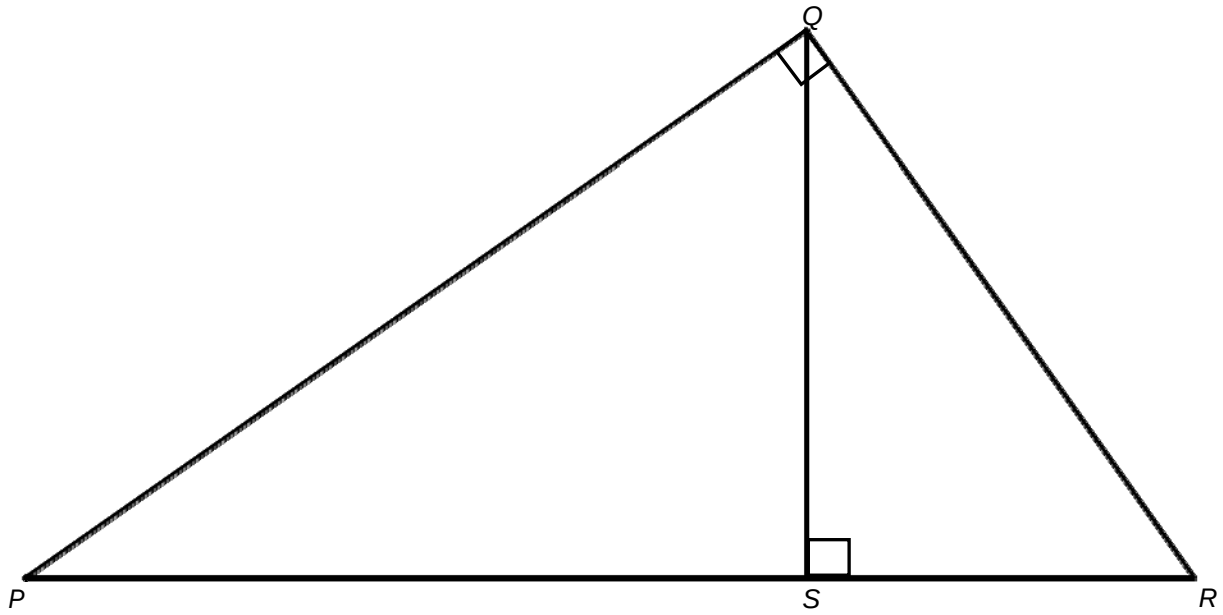
Logical Reasoning and Proof

Mathematical Process Standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. 1(G) The student is expected to display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

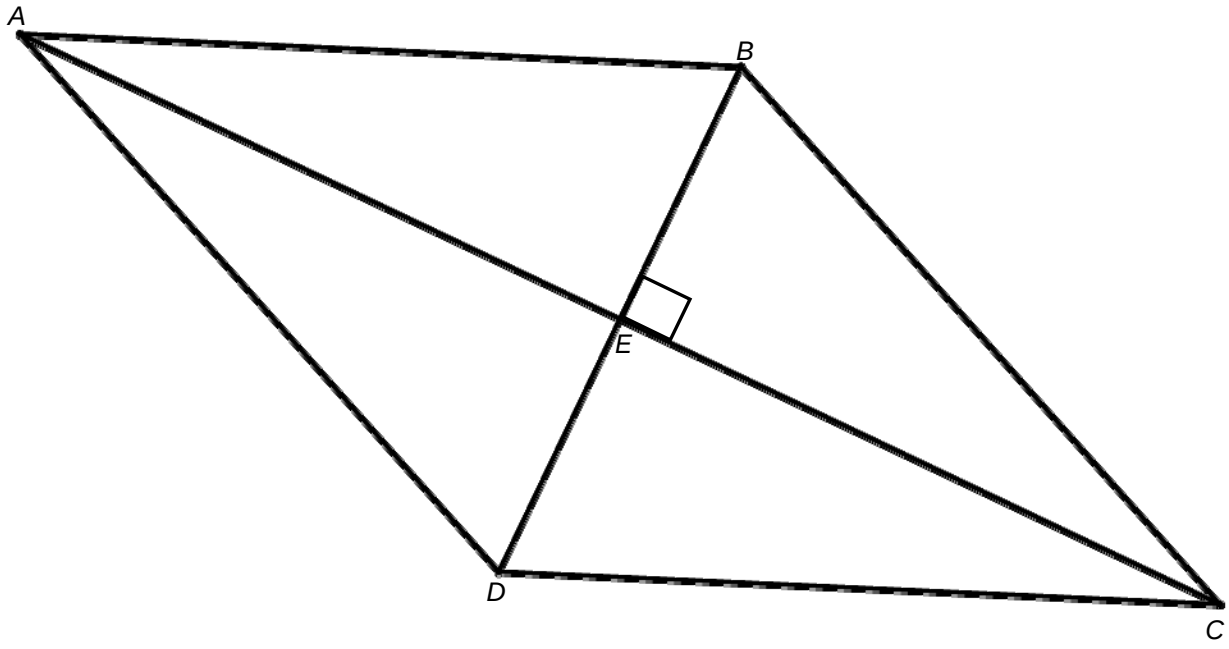
Acquire	Demonstrate

5 Things

ΔPQR is a right triangle with altitude $\overline{QS}$.



Quadrilateral *ABCD* has 4 congruent sides.



Vocabulary Sort

Figure A

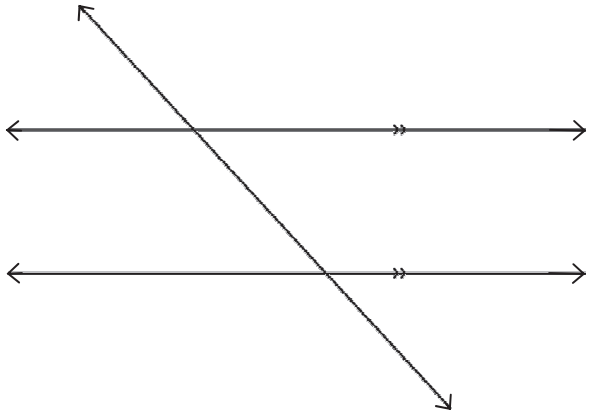
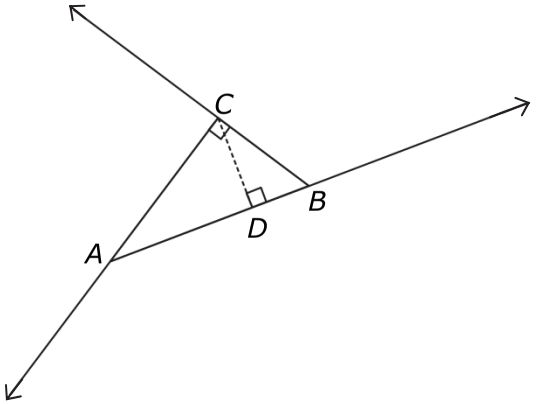


Figure B



A	Both	B

6

Cards to Sort

Parallel lines	Supplementary angles	Transversal
Angles	Rays	Interior angles
Sides	Adjacent angles	Intersecting lines
Points	Vertical angles	Linear pair
Lines	Triangle	Complementary angles
Perpendicular lines	Altitude	Vertices
Exterior angles	Base	Congruent angles

Name: _____ Date: _____

Always, Sometimes, Never

Determine if each statement is always true (**A**), sometimes true (**S**), or never true (**N**). Circle your choice.

- If the statement is always true, provide an example.
- If the statement is never true provide a counterexample.
- If the statement is sometimes true, provide an example of when it is true and an example of when it is false.
- Justify your thinking.

1. If two lines intersect, then the vertical angles formed are supplementary.	**A** **S** **N**
	Justification

2. An equilateral triangle is congruent to a right triangle.	**A** **S** **N**
	Justification

3. Isosceles triangles are similar if their vertex angles are congruent.	**A** **S** **N**
	Justification

Name: _____ Date: _____

4. If the diagonals of a quadrilateral are congruent, then the quadrilateral is a rectangle.	**A** **S** **N**
	Justification

5. An angle bisector of a triangle bisects the opposite side.	**A** **S** **N**
	Justification

6. A median in a triangle divides the triangle into two similar triangles.	**A** **S** **N**
	Justification

Name: _____ Date: _____

Proving Triangles Similar Recording Sheet

Cut out **Proving Triangles Similar Cards.** Sort the cards into two groups, those proofs that are correct and those that are incorrect proofs. If the proof is incorrect, state the reason it is incorrect and write the change needed that will remedy the mistake. If the proof is correct simply write the word *correct*.

Proof Card	Correct / Incorrect Reason
A	
B	
C	
D	
E	

Name: _____ Date: _____

Proving Triangles Similar Cards

Cut out cards along the dotted line.

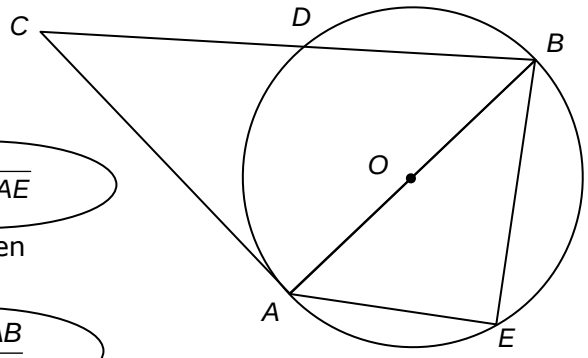
A

Given: $\overline{CA}$ is tangent to $\odot O$ at A

$\overline{AB}$ is a diameter of $\odot O$

$\overline{BC} \parallel \overline{AE}$.

Prove: $\triangle ABE \sim \triangle BCA$



$\overline{BC} \parallel \overline{AE}$

Given

$\frac{BC}{AB} = \frac{AB}{EA}$

Ratios of parallel segments to a diameter are proportional.

$\overline{CA}$ is tangent to $\odot O$ at A

$\overline{AB}$ is a diameter of $\odot O$

Given

$\angle CAB$ is a right angle

A tangent to a circle is perpendicular to a diameter drawn to the point of tangency.

$\triangle ABE \sim \triangle BCA$

SAS Similarity Theorem

$\angle BEA \cong \angle CAB$

Right angles are congruent.

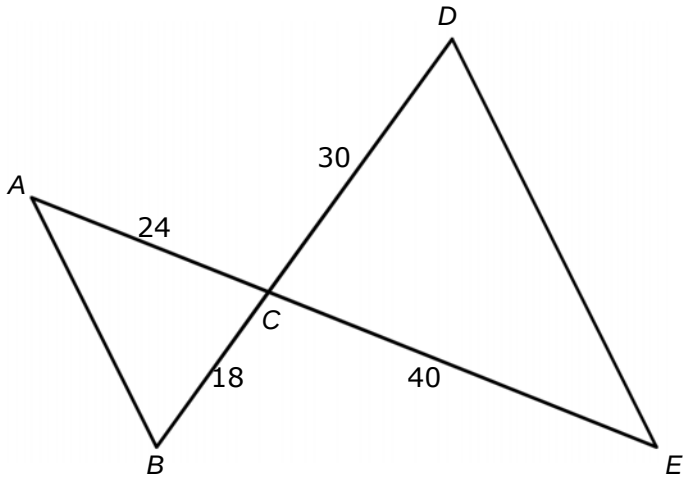
$\angle BEA$ is a right angle

$\angle BEA$ is an inscribed angle whose measure is half of its intercepted arc, semicircle BDA.

B

Given: $AC = 24$, $CE = 40$, $BC = 18$, and $CD = 30$.

Prove: $\triangle ABC \sim \triangle EDC$



AC = 24, CE = 40, BC = 18, and CD = 30.

Using the ratios of the corresponding sides to show that they are proportional, $\frac{BC}{CD} = \frac{18}{30} = \frac{3}{5}$ and $\frac{AC}{EC} = \frac{24}{40} = \frac{3}{5}$.

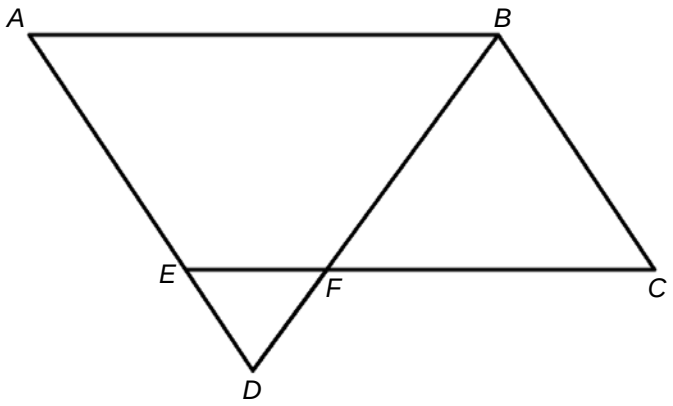
$\angle ACB \cong \angle ECD$ by the definition of vertical angles.

$\triangle ABC \sim \triangle EDC$ by SAS Similarity theorem.

Name: _____ Date: _____

C

Given: $ABCE$ is a parallelogram.
Prove: $\triangle CBF \sim \triangle EDF$

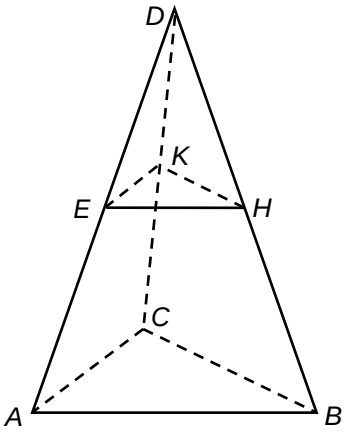


1. $ABCE$ is a parallelogram	1. Given
2. $\overline{AD} \parallel \overline{BC}$	2. Definition of parallelogram
3. $\overline{BD}$ is a transversal of $\overline{AD}$ and $\overline{BC}$	3. Definition of transversal
4. $\angle CBF \cong \angle EDF$	4. If two parallel lines are cut by a transversal, the alternate interior angles are congruent.
5. $\angle EFD \cong \angle CFB$	5. Vertical angles are congruent.
6. $\triangle CBF \sim \triangle EDF$	6. AA Similarity Theorem

D

Given: The triangular pyramid was intersected by a plane to form $\triangle EHK$. Point E is the midpoint of $\overline{AD}$; H is the midpoint of $\overline{BD}$.

Prove: $\triangle ABD \sim \triangle EHD$



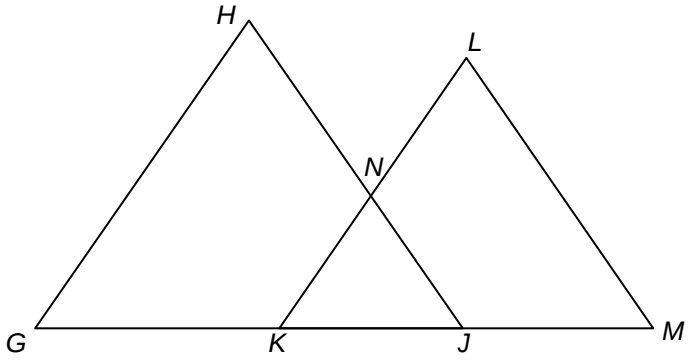
1. E is the midpoint of $\overline{AD}$. H is the midpoint of $\overline{BD}$.	1. Given
2. $\overline{DE} \cong \overline{EA}$; $\overline{DH} \cong \overline{HB}$	2. Definition of midpoint
3. $DE=EA$; $DH=HB$	3. Definition of congruent segments
4. $DA=DE+EA$; $DB=DH+HB$	4. Segment Addition Postulate
5. $DA=DE+DE$; $DB=DH+DH$	5. Substitution Property
6. $DA=2DE$; $DB=2DH$	6. Simplify
7. $\frac{DA}{DE}=2$; $\frac{DB}{DH}=2$	7. Division Property of Equality
8. $\frac{DA}{DE}=\frac{DB}{DH}$	8. Transitive Property of Equality
9. $\angle D \cong \angle D$	9. Reflexive Property of Equality
10. $\triangle ABD \sim \triangle EHD$	10. SAS Similarity Theorem

Name: _____ Date: _____

E

Given: $\triangle KNJ$ is isosceles with $\angle N$ as a vertex angle.
$\angle H \cong \angle L$

Prove: $\Delta GHJ \sim \Delta MLK$



1. $\triangle KNJ$ is isosceles with $\angle N$ as a vertex angle.	Given
2. $\overline{KN} \cong \overline{JN}$	Definition of isosceles triangle
3. $m\angle NKJ + m\angle NJK = 90$	Isosceles triangle theorem
4. $\angle H \cong \angle L$	Given
5. $\Delta GHJ \sim \Delta MLK$	SAS Similarity Theorem

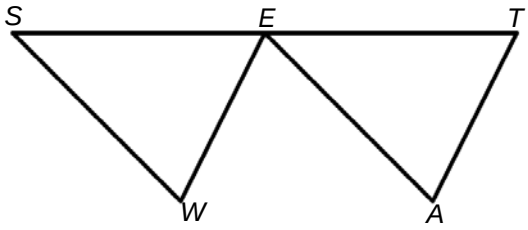
Name: _____ Date: _____

Station Proofs

Station One

Given: $\overline{WS} \cong \overline{AE}$, $\overline{WE} \cong \overline{AT}$, E is the midpoint of $\overline{ST}$.

Prove: $\angle W \cong \angle A$



Statement	Reason
1.	1. Given
2. $\overline{WE} \cong \overline{AT}$	2.
3. E is the midpoint of $\overline{ST}$	3.
4.	4. Definition of midpoint
5. $\Delta SWE \cong \Delta EAT$	5.
6.	6. Corresponding Parts of Congruent Triangles are Congruent (CPCTC)

Choice Box

Given	$\overline{WS} \cong \overline{AE}$	Side-Side-Side (SSS)
$\angle W \cong \angle A$	$\overline{SE} \cong \overline{ET}$	Given
Side-Angle-Side (SAS)	Definition of congruent segments	Angle-Side-Angle (ASA)

How did you use the picture to help you?

What does it mean for two triangles to be congruent?

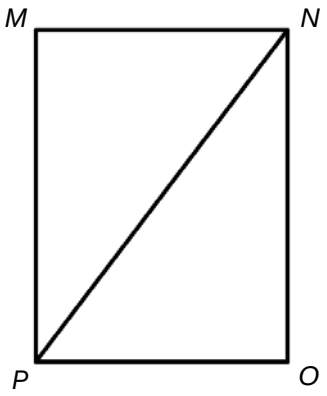
Name: _____ Date: _____

Station Two

Place the cards in the correct order to complete the proof.

Given: $\angle M$ and $\angle O$ are right angles, $\overline{MP} \parallel \overline{NO}$

Prove: $\angle MNP \cong \angle OPN$

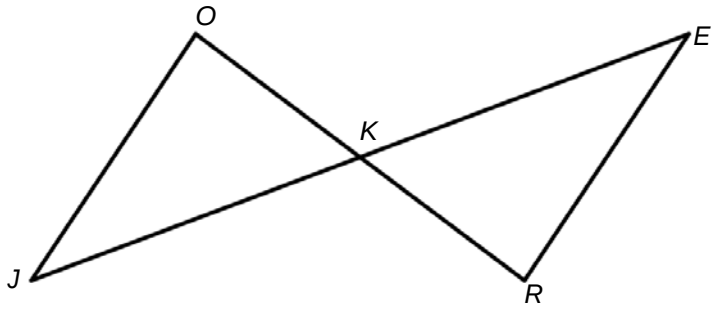


Statement	Reason
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Name: _____ Date: _____

Station Three

Given: $\overline{JO} \| \overline{RE}$, $\overline{OR}$ bisects $\overline{EJ}$
Prove: $\Delta JKO \cong \Delta EKR$



Statement	Reason
1. $\overline{JO} \parallel \overline{RE}$	1.
2. $\angle J \cong \angle E$	2.
3. $\overline{OR}$ bisects $\overline{EJ}$	3.
4. $\overline{JK} \cong \overline{EK}$	4.
5. $\angle OKJ \cong \angle RKE$	5.
6. $\Delta JKO \cong \Delta EKR$	6.

Reason Hint Box

Alternate interior angles theorem	Vertical angles are congruent	Side-Side-Side (SSS)
Given	Corresponding Parts of Congruent Triangles are Congruent (CPCTC)	Given
Side-Angle-Side (SAS)	Definition of segment bisector	Angle-Side-Angle (ASA)

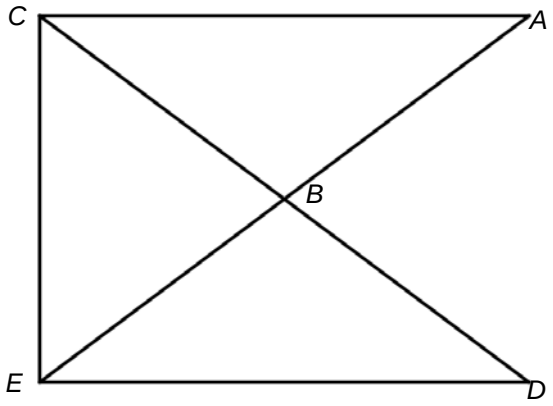
Name: _____ Date: _____

Station Four

Justify each statement with the most appropriate reason.

Given: $\angle ACD \cong \angle DEA,\ \angle DCE \cong \angle AEC$

Prove: $\Delta AEC \cong \Delta DCE$



Statement	Reason
1. $\angle ACD \cong \angle DEA$ $\angle DCE \cong \angle AEC$	1.
2. $m\angle ACD = m\angle DEA$ $m\angle DCE = m\angle AEC$	2.
3. $m\angle ACD + m\angle DCE = m\angle DEA + m\angle AEC$	3.
4. $m\angle ACE = m\angle DEC$	4.
5. $\angle ACE \cong \angle DEC$	5.
6. $\overline{CE} \cong \overline{CE}$	7.
7. $\Delta AEC \cong \Delta DCE$	8.

Name: _____ Date: _____

Station Proof Cards

Cut along the dotted lines.

Station 2 Cards

$\angle MNP \cong \angle OPN$	Corresponding Parts of Congruent Triangles are Congruent (CPCTC)
$\angle M$ and $\angle O$ are right angles	Given
$\Delta NOP \cong \Delta PMN$	Angle-Angle-Side (AAS)
$\overline{PN} \cong \overline{PN}$	Reflexive property
$\overline{MP} \parallel \overline{NO}$	Given
$\angle MPN \cong \angle ONP$	Alternate interior angle theorem
$\angle M \cong \angle O$	Right angle theorem

Station 4 Cards

Given	Reflexive property	Definition of congruent angles
Definition of congruent angles	Given	Side-Side-Side (SSS)
Addition property of equality	Angle addition postulate	Angle-Side-Angle (ASA)
Substitution	Corresponding Parts of Congruent Triangles are Congruent (CPCTC)	Side-Angle-Side (SAS)

Name: _____ Date: _____

Hint Card

Two cards are provided.

Questions to ask myself
What am I to prove?
How do I identify the given information?
What information does the diagram provide?
What rules of algebra may help?
What definitions do I know that could help?

Hints if I am stuck
Label the diagram with any given measures and congruent parts.
Label any congruent angles.
Label any congruent sides.
Following the rules of geometry, are there any auxiliary lines that could help?
Focus on definitions that will support the given diagram.

Questions to ask myself
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Systems of Inequalities

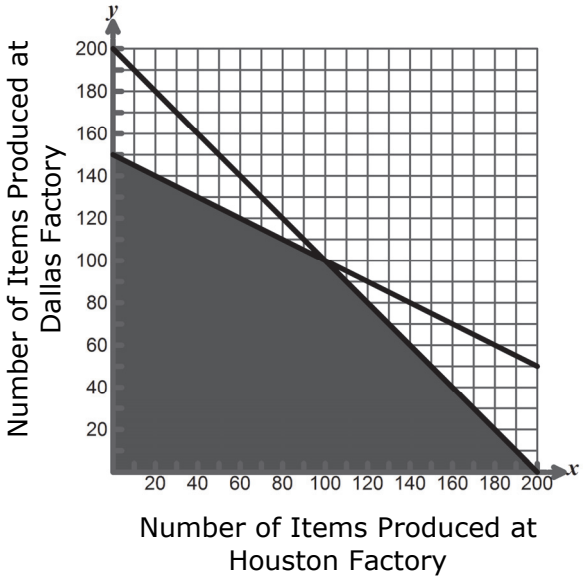
Mathematical Process Standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. 1(D) The student is expected to communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.

Acquire	Demonstrate

The manufacturing company has two factories, one in Houston and one in Dallas. The following system of inequalities represents the cost restraints for material and distribution for the two plants. Let x represent the number of items produced at the Houston factory and y represent the number of items produced at the Dallas factory.

Material Costs: $60x + 60y \leq 12{,}000$

Distribution Costs: $20x + 40y \leq 6{,}000$



Which of the following statements is not true about this situation?

A The company can produce 100 items in Houston and 100 items in Dallas.

B The company can produce 90 items in Houston and 90 items in Dallas.

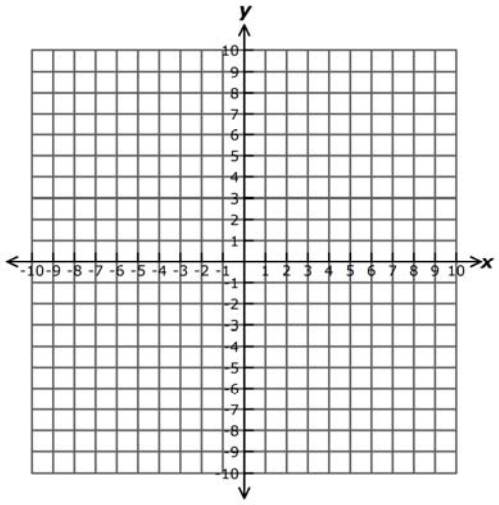
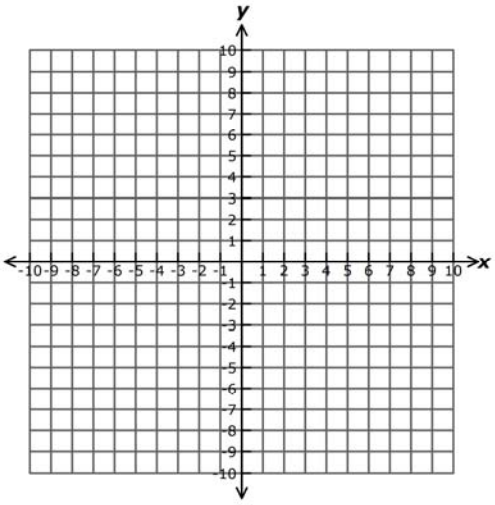
C The company can produce 30 items in Houston and 150 items in Dallas.

D The company can produce 170 items in Houston and 30 items in Dallas.

What knowledge and skills do students need in order to successfully answer this question?

One-Variable Inequalities on the Coordinate Plane

1. Represent the solution to each inequality on the coordinate plane.

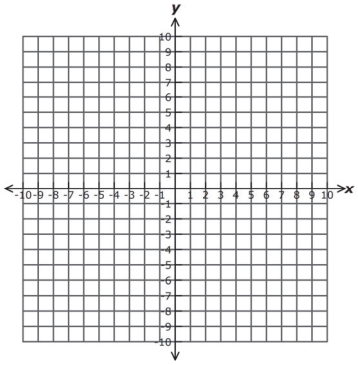
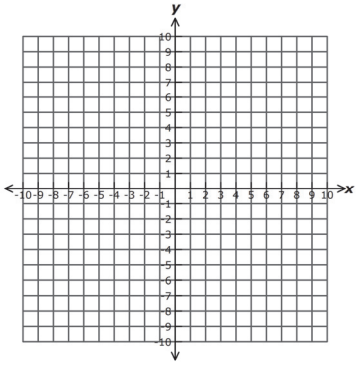
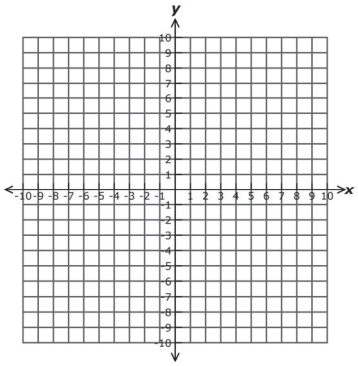
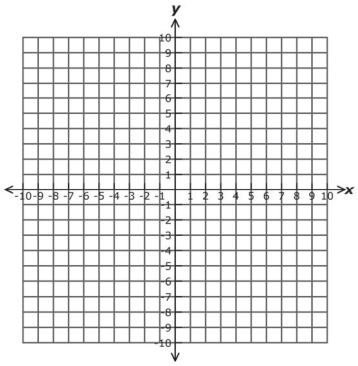
$4(x+5)-3x \geq 17$	$-2y+7 \leq 3(y-3)-4$
	

2. Plot each point on both coordinate planes. Shade the appropriate box if it satisfies that inequality.

Point	Solution to $4(x+5)-3x \geq 17$	Solution to $-2y+7 \leq 3(y-3)-4$
$(-3,0)$		
$(2,7)$		
$(-3,4)$		
$(-1,4)$		
$(-6,2)$		
$(5,9)$		
$(-3,-8)$		

Two-Variable Inequalities

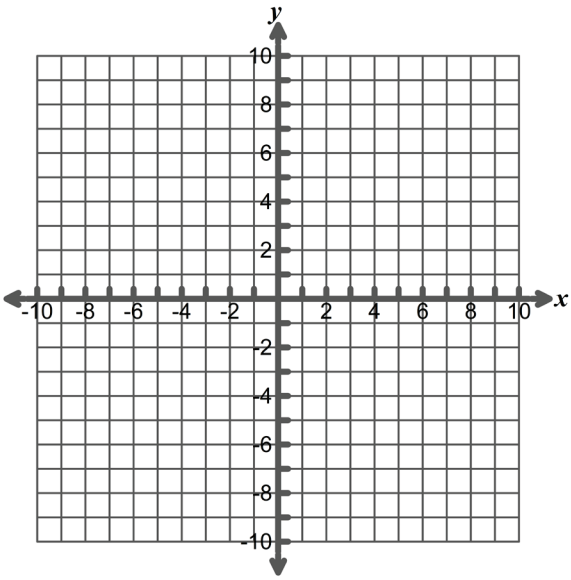
Graph the solution to each system of inequalities on the coordinate plane. Where possible, write a statement that is always true about the solution, a statement that is sometimes true about the solution, and a statement that is never true about the solution.

1	$y \geq x + 1$ $x \leq -3$		Always Sometimes Never
2	$y \geq x + 1$ $x \leq 3$		Always Sometimes Never
3	$y \leq x + 1$ $x \leq -3$		Always Sometimes Never
4	$y \leq x + 1$ $x \leq 3$		Always Sometimes Never

Inequality Notes Page

Inequality:

$x + 2y < -2$



What line do I graph?

How do I know?

Solid or dashed line?

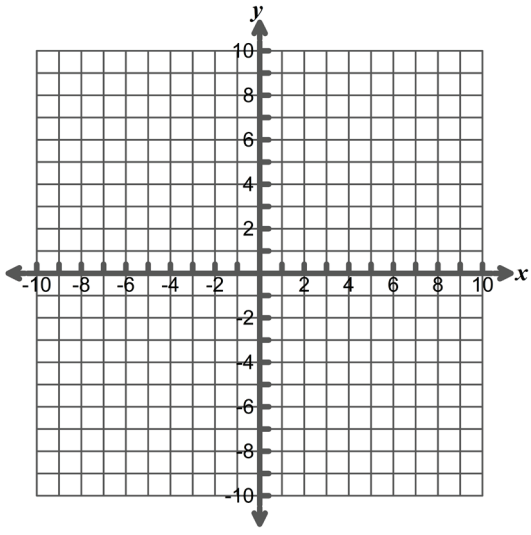
How do I know?

Where to shade?

How do I know?

Inequality:

$2x - 4y \leq 10$



What line do I graph?

How do I know?

Solid or dashed line?

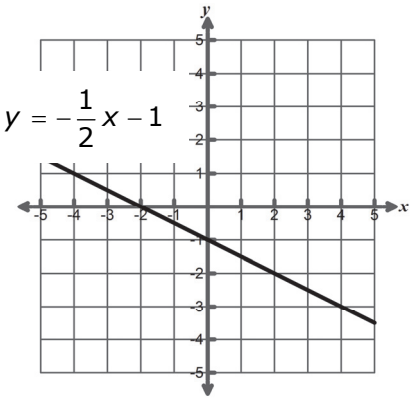
How do I know?

Where to shade?

How do I know?

Graphing Inequalities

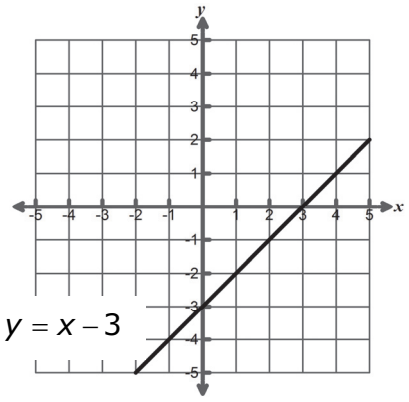
The line $y = -\frac{1}{2}x - 1$ is graphed below. Shade the portion of the graph that represents $y \leq -\frac{1}{2}x - 1$.



Record two points that satisfy the inequality above.

_____

The line $y = x - 3$ is graphed below. Shade the portion of the graph that represents $y \geq x - 3$.

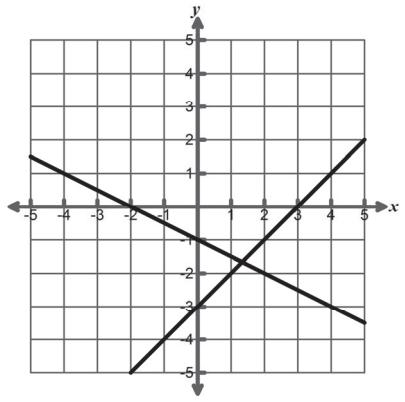


Record two points that satisfy the inequality above.

_____

Both lines are graphed below. Shade the portion of the graph that represents the solutions to the system of inequalities.

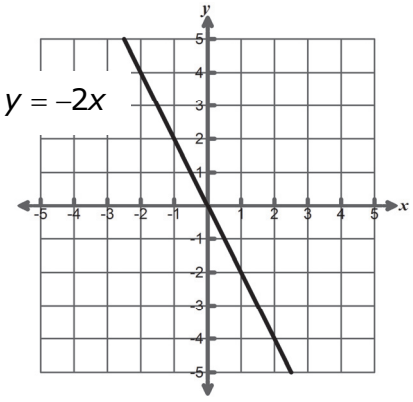
$$y \leq -\frac{1}{2}x - 1$$
$$y \geq x - 3$$



Record two points that satisfy the system of inequalities.

_____

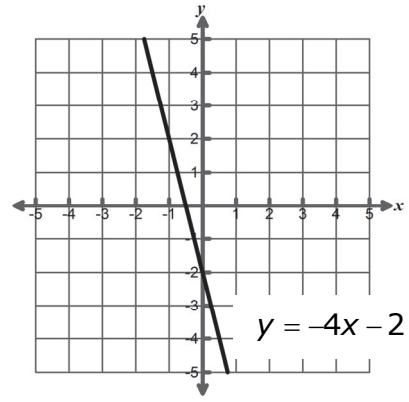
The line $y = -2x$ is graphed below. Shade the portion of the graph that represents $y \leq -2x$.



Record two points that satisfy the inequality above.

_____

The line $y = -4x - 2$ is graphed below. Shade the portion of the graph that represents $y \leq -4x - 2$.

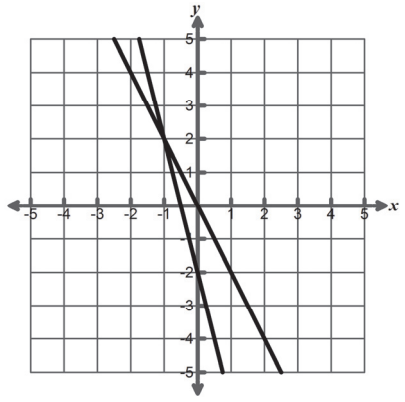


Record two points that satisfy the inequality above.

_____

Both lines are graphed below. Shade the portion of the graph that represents the solutions to the system of inequalities.

$$y \leq -2x$$
$$y \leq -4x - 2$$



Record two points that satisfy the system of inequalities.

_____

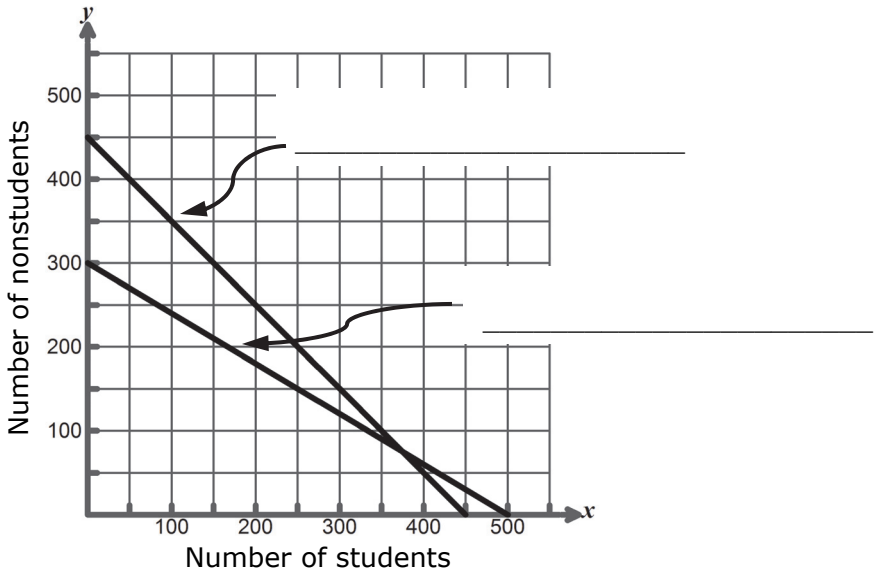
Tickets

The school has hired a band to perform at the homecoming dance. The school is charging $15 a ticket for students and $25 a ticket for nonstudents. The school must receive at least $7500 from the ticket sales to cover expenses. The maximum capacity of the room is 450 people. Let *x* represent the number of students and let *y* represent the number of nonstudents.

1. Write an inequality to represent the number of people in attendance.

2. Write an inequality to represent the amount of money collected from ticket sales.

3. Solve both inequalities for *y.* Write the related equation on the corresponding line in the graph below.



4. Shade the appropriate area of the graph to represent the solutions to the system of inequalities created.

Tickets Hint Card

Use the graphic organizer below to write a system of inequalities to represent the situation.

	Number of students, x	Number of nonstudents, y	$\leq$ $\geq$ $<$ $>$	Total
Attendance				
Ticket Sales				

Tickets Hint Card

Use the graphic organizer below to write a system of inequalities to represent the situation.

	Number of students, x	Number of nonstudents, y	$\leq$ $\geq$ $<$ $>$	Total
Attendance				
Ticket Sales				

Tickets Hint Card

Use the graphic organizer below to write a system of inequalities to represent the situation.

	Number of students, x	Number of nonstudents, y	$\leq$ $\geq$ $<$ $>$	Total
Attendance				
Ticket Sales				

Inequalities Hint Card

Have you tried . . .

- solving for y?
- using a test point above the line?
- using a test point below the line?
- using a test point on the line?

Have you tried . . .

- solving for y?
- using a test point above the line?
- using a test point below the line?
- using a test point on the line?

Have you tried . . .

- solving for y?
- using a test point above the line?
- using a test point below the line?
- using a test point on the line?

Have you tried . . .

- solving for y?
- using a test point above the line?
- using a test point below the line?
- using a test point on the line?

Have you tried . . .

- solving for y?
- using a test point above the line?
- using a test point below the line?
- using a test point on the line?

Have you tried . . .

- solving for y?
- using a test point above the line?
- using a test point below the line?
- using a test point on the line?

Tickets Discussion Questions

Determine if each of the statements is always true, sometimes true, or never true. Justify your response.

1. The school will cover their expenses if 400 student tickets are sold.
2. The school will cover their expenses if 150 student tickets are sold and 250 nonstudent tickets are sold.
3. The school will cover their expenses if 350 nonstudent tickets are sold.
4. The school will cover their expenses if 150 student tickets and 150 nonstudent tickets are sold.
5. The school will cover their expenses if 75 nonstudent tickets are sold.

Tickets Discussion Questions

Determine if each of the statements is always true, sometimes true, or never true. Justify your response.

1. The school will cover their expenses if 400 student tickets are sold.
2. The school will cover their expenses if 150 student tickets are sold and 250 nonstudent tickets are sold.
3. The school will cover their expenses if 350 nonstudent tickets are sold.
4. The school will cover their expenses if 150 student tickets and 150 nonstudent tickets are sold.
5. The school will cover their expenses if 75 nonstudent tickets are sold.

Tickets Discussion Questions

Determine if each of the statements is always true, sometimes true, or never true. Justify your response.

1. The school will cover their expenses if 400 student tickets are sold.
2. The school will cover their expenses if 150 student tickets are sold and 250 nonstudent tickets are sold.
3. The school will cover their expenses if 350 nonstudent tickets are sold.
4. The school will cover their expenses if 150 student tickets and 150 nonstudent tickets are sold.
5. The school will cover their expenses if 75 nonstudent tickets are sold.

Things to Remember

Maria takes band lessons and drama lessons. The number of hours she spends per week taking lessons is limited by time and money as represented by the inequalities below.

Let x represent the number of hours spent at band lessons. Let y represent the number of hours spent at drama lessons.	The system of inequalities represents the constraints. Time constraint: $x + y \leq 5$ Money constraint: $25x + 15y \leq 100$

When writing

I must define the . . .

Identify the . . .

Remember to . . .

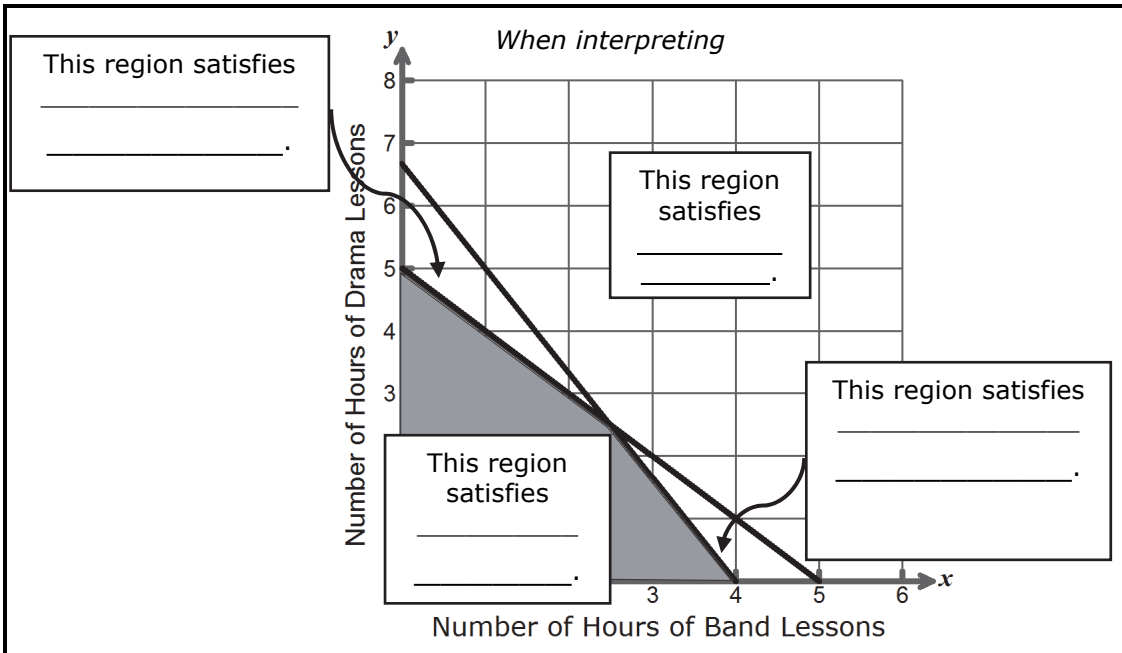
When graphing

I graph . . .

I know where to shade . . .

Remember to . . .

When interpreting



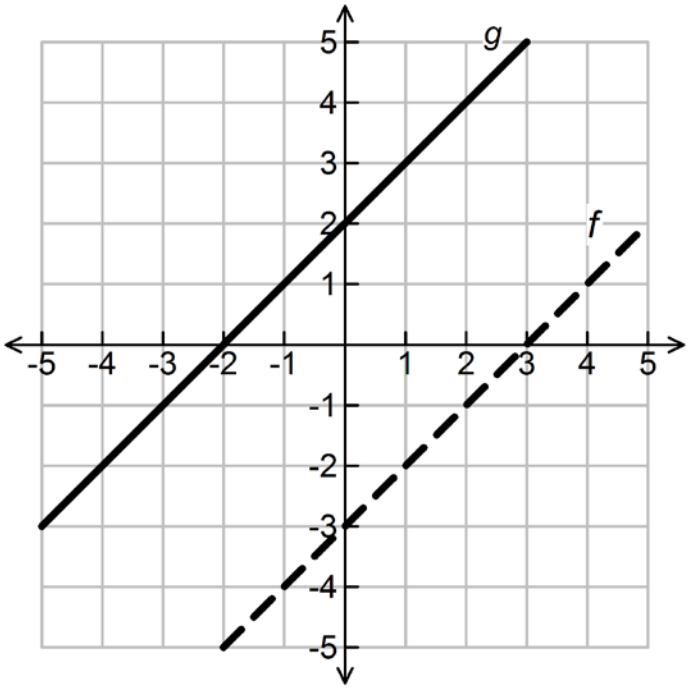
Word Bank

$25x + 15y \leq 100$	$x + y \leq 5$	Both	Neither

Function Transformations

Mathematical Process Standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. 1(D) The student is expected to communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.

Acquire	Demonstrate



1. Write the linear equation for the both lines.

2. Compare the two lines.

Describe the process that most students would currently use to answer the questions above.

Transforming Quadratic Functions

Record observations about each change made in the GeoGebra sketch.

Question 1: What will happen if I change the value of *d*?

1. Reset the sliders so that $a = 1$, $b = 1$, $c = 0$, $d = 0$.
2. Use the slider in the GeoGebra sketch to change the value of *d*.
3. Observe changes made to the graph, table, and function.
4. Record your observations in the table below.

$f(x) = x^2$	$f(x) + d = x^2 + \square$		
Parameter Change	**Effect on Graph**	**Effect on Table**	**Example Function**
$d = 0$			$f(x) + d = x^2 + \square$
$d > 0$			$f(x) + d = x^2 + \square$
$d < 0$			$f(x) + d = x^2 + \square$

Question 2: What will happen if I change the value of *c*?

5. Reset the sliders so that $a = 1$, $b = 1$, $c = 0$, $d = 0$.
6. Use the slider in the GeoGebra sketch to change the value of *c*.
7. Observe changes made to the graph, table, and function.
8. Record your observations in the table below.

$f(x) = x^2$	$f(x - c) = \left(x - \square\right)^2$		
Parameter Change	**Effect on Graph**	**Effect on Table**	**Example Function**
$c = 0$			$f(x - c) = \left(x - \square\right)^2$
$c > 0$			$f(x - c) = \left(x - \square\right)^2$
$c < 0$			$f(x - c) = \left(x - \square\right)^2$

9. What do you notice about the effect of changing the parameters *d* and *c*?

Question 3: What will happen if I change the value of *a*?

10. Reset the sliders so that $a = 1$, $b = 1$, $c = 0$, $d = 0$.
11. Use the slider in the GeoGebra sketch to change the value of *a*.
12. Observe changes made to the graph, table, and function.
13. Record your observations in the table below.

$f(x) = x^2$	$a \cdot f(x) = \square \cdot x^2$		
Parameter Change	**Effect on Graph**	**Effect on Table**	**Example Function**
$\lvert a \rvert > 1$			$a \cdot f(x) = \square \cdot x^2$
$0 < \lvert a \rvert < 1$			$a \cdot f(x) = \square \cdot x^2$
a is negative			$a \cdot f(x) = \square \cdot x^2$

Question 4: What will happen if I change the value of *b*?

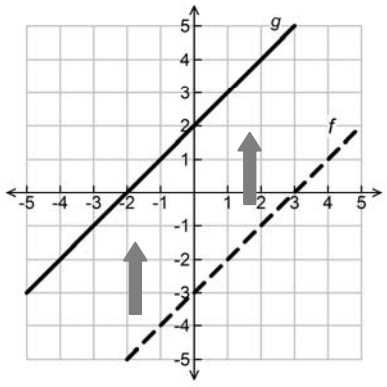
14. Reset the sliders so that $a = 1$, $b = 1$, $c = 0$, $d = 0$.
15. Use the slider in the GeoGebra sketch to change the value of *b*.
16. Observe changes made to the graph, table, and function.
17. Record your observations in the table below.

$f(x) = x^2$	$f(b \cdot x) = \left(\square \cdot x\right)^2$		
Parameter Change	**Effect on Graph**	**Effect on Table**	**Example Function**
$\lvert b \rvert > 1$			$f(b \cdot x) = \left(\square \cdot x\right)^2$
$0 < \lvert b \rvert < 1$			$f(b \cdot x) = \left(\square \cdot x\right)^2$
b is negative			$f(b \cdot x) = \left(\square \cdot x\right)^2$

18. What do you notice about the effect of changing the parameters *a* and *b*?

Vertical Transformations, $f(x) + d$

The function f is transformed to create function g. Complete the tables and the statement.



The graph of g is shifted ___ units _____ from the graph of f.

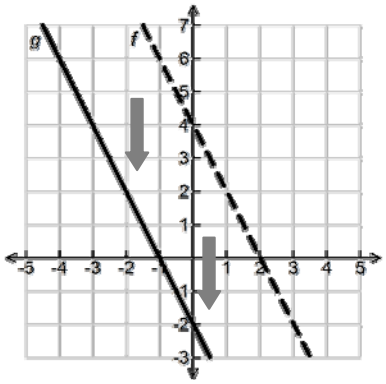
x	$f(x) = x - 3$	$g(x) = (x - 3) + \_\_$
–1	–4	1
0		2
1	–2	
2		4

If $f(x) = x - 3$ the $g(x) = (x - 3) + \_\_\_\_\_$.

Verify that this function represents g.

If a function f is shifted 5 units up the resulting function g can be described as

$g(x) = f(x) + \_\_\_\_\_$.



The graph of g is shifted ___ units _____ from the graph of f.

x	$f(x) = -2x + 4$	$g(x) = (-2x + 4) + \_\_$
–4	12	
–2		
0		–2
2	0	

If $f(x) = -2x + 4$ then $g(x) = (-2x + 4) + \_\_$.

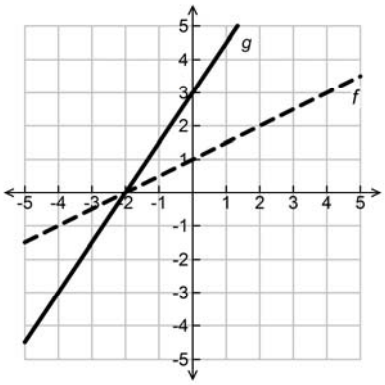
Verify that this function represents g.

If a function f is shifted 6 units down the resulting function g can be described as

$g(x) = f(x) + \_\_\_\_\_$.

Vertical Transformations, a $f(x)$

The function f is transformed to create function g. Complete the tables and the statement.



The graph of g is the graph of f vertically_____ by a factor of _____.

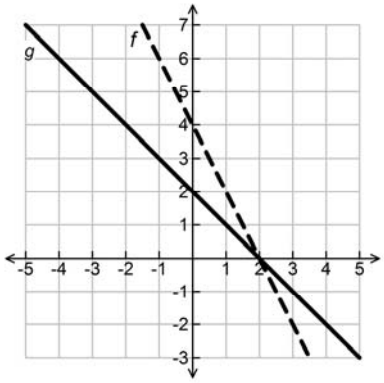
x	$f(x) = 0.5x + 1$	$g(x) = \_\_ \cdot (0.5x + 1)$
–4		–3
–2	0	
0		3
2		

If $f(x) = 0.5x + 1$ then $g(x) = \_\_ \cdot (0.5x + 1)$.

Verify that this function represents g.

If a function f is vertically stretched by a factor of 3 the resulting function g can be described as

$g(x) = \_\_\_\_ \cdot f(x)$.



The graph of g is the graph of f vertically _____ by a factor of _____.

x	$f(x) = -2x + 4$	$g(x) = \_\_ \cdot (-2x + 4)$
–1	6	3
0		2
1	2	
2		

If $f(x) = -2x + 4$ then $g(x) = \_\_ \cdot (-2x + 4)$.

Verify that this function represents g.

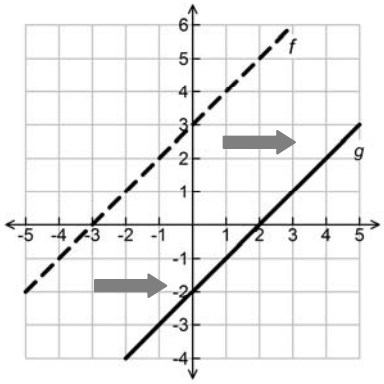
If a function f is vertically compressed by a factor of ½ the resulting function g can be described as

$g(x) = \_\_\_\_\_ f(x)$.

Horizontal Shifts, $f(x - c)$

The function f is transformed to create function g. Complete the tables and the statement.

The graph of g is shifted ____ units to the _____ of f.



Consider points on the graph when $f(x) = g(x)$.

x *values in function f*	x *values in function g*	$f(x)$ and $g(x)$
–4	1	–1
–3	2	0
–2	3	1
–1	4	2
0	5	3

Describe the relationship between the x values for points where $f(x)$ and $g(x)$ are equal.

_____

If $f(x) = x + 3$, then

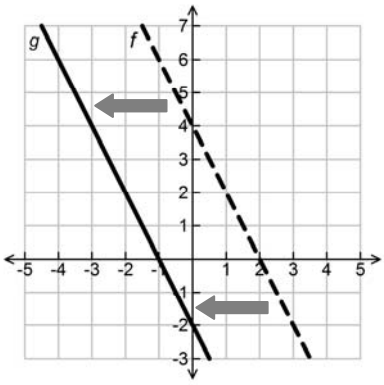
$$g(x) = (x - \_\_\_\_) + 3$$

Verify that this function represents g.

If a function f is shifted 5 units to the right, the resulting function g can be described as

$g(x) = f(x - \_\_\_\_)$.

The graph of g is shifted ____ units to the _____ of f.



Consider points on the graph when $f(x) = g(x)$.

x *values in function f*	x *values in function g*	$f(x)$ and $g(x)$
–1	–4	6
0	–3	4
1	–2	2
2	–1	0
3	0	–2

Describe the relationship between the x values for points where $f(x)$ and $g(x)$ are equal.

_____

If $f(x) = -2x + 4$, then

$$g(x) = -2(x - \_\_\_\_) + 4$$

Verify that this function represents g.

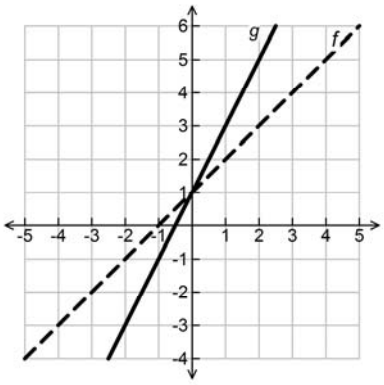
If a function f is shifted 3 units to the left, the resulting function g can be described as

$g(x) = f(x - \_\_\_\_)$.

Horizontal Stretches and Compressions, $f(bx)$

The function f is transformed to create function g. Complete the tables and the statement.

The graph of g is the graph of f horizontally _____ by a factor of _____.



Consider points on the graph when $f(x) = g(x)$.

x *values in function f*	x *values in function g*	$f(x)$ and $g(x)$
–1	–0.5	0
0	0	1
1	0.5	2
2	1	3
3	1.5	4

Describe the relationship between the x values for points where $f(x)$ and $g(x)$ are equal.

_____

If $f(x) = x + 1$, then

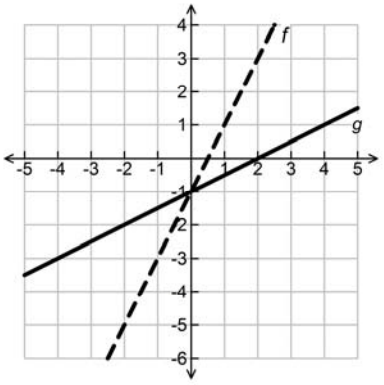
$$g(x) = (\_\_\_\_\_ \cdot x) + 1$$

Verify that this function represents g.

If a function f is horizontally compressed by a factor of ½, the resulting function g can be described as

$$g(x) = f(\_\_\_\_\_ \cdot x).$$

The graph of g is the graph of f horizontally _____ by a factor of _____.



Consider points on the graph when $f(x) = g(x)$.

x *values in function f*	x *values in function g*	$f(x)$ and $g(x)$
–1	–4	–3
–0.5	–2	–2
0	0	–1
0.5	2	0
1	4	1

Describe the relationship between the x values for points where $f(x)$ and $g(x)$ are equal.

_____

If $f(x) = 2x - 1$, then

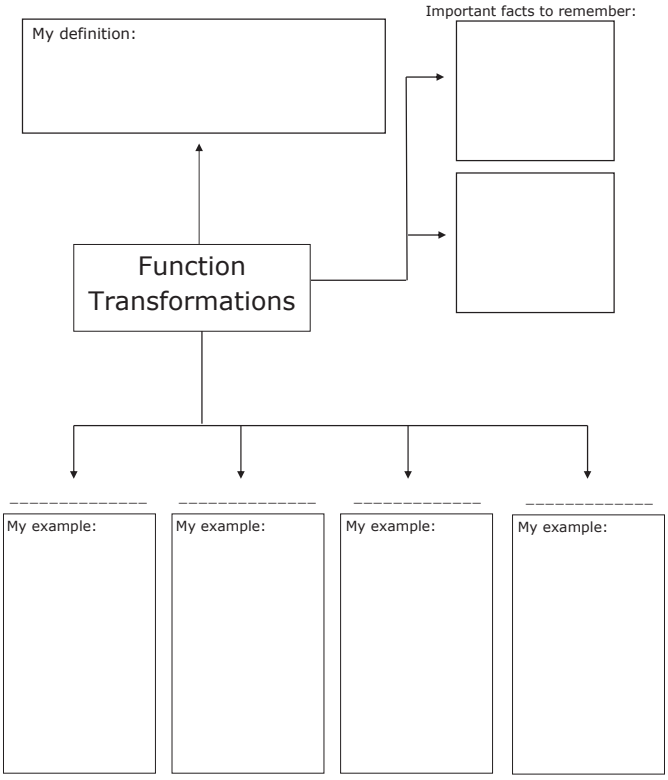
$$g(x) = 2(\_\_\_\_\_ \cdot x) - 1$$

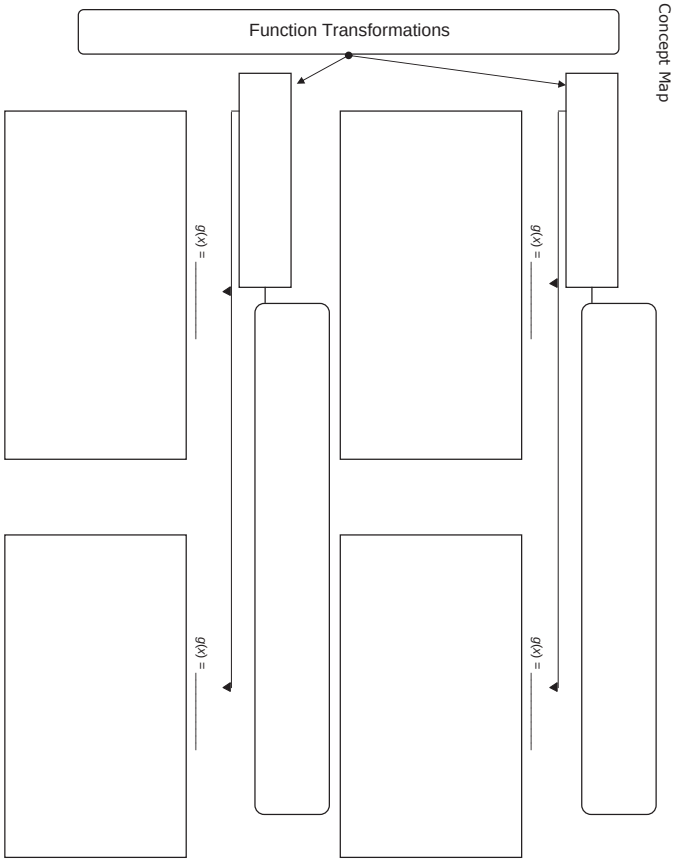
Verify that this function represents g.

If a function f is horizontally stretched by a factor of 4, the resulting function g can be described as

$$g(x) = f(\_\_\_\_\_ \cdot x).$$

Concept Map


Important facts to remember:
My definition:
Function Transformations
My example:
My example:
My example:
My example:


Concept Map
Function Transformations
g(x) =
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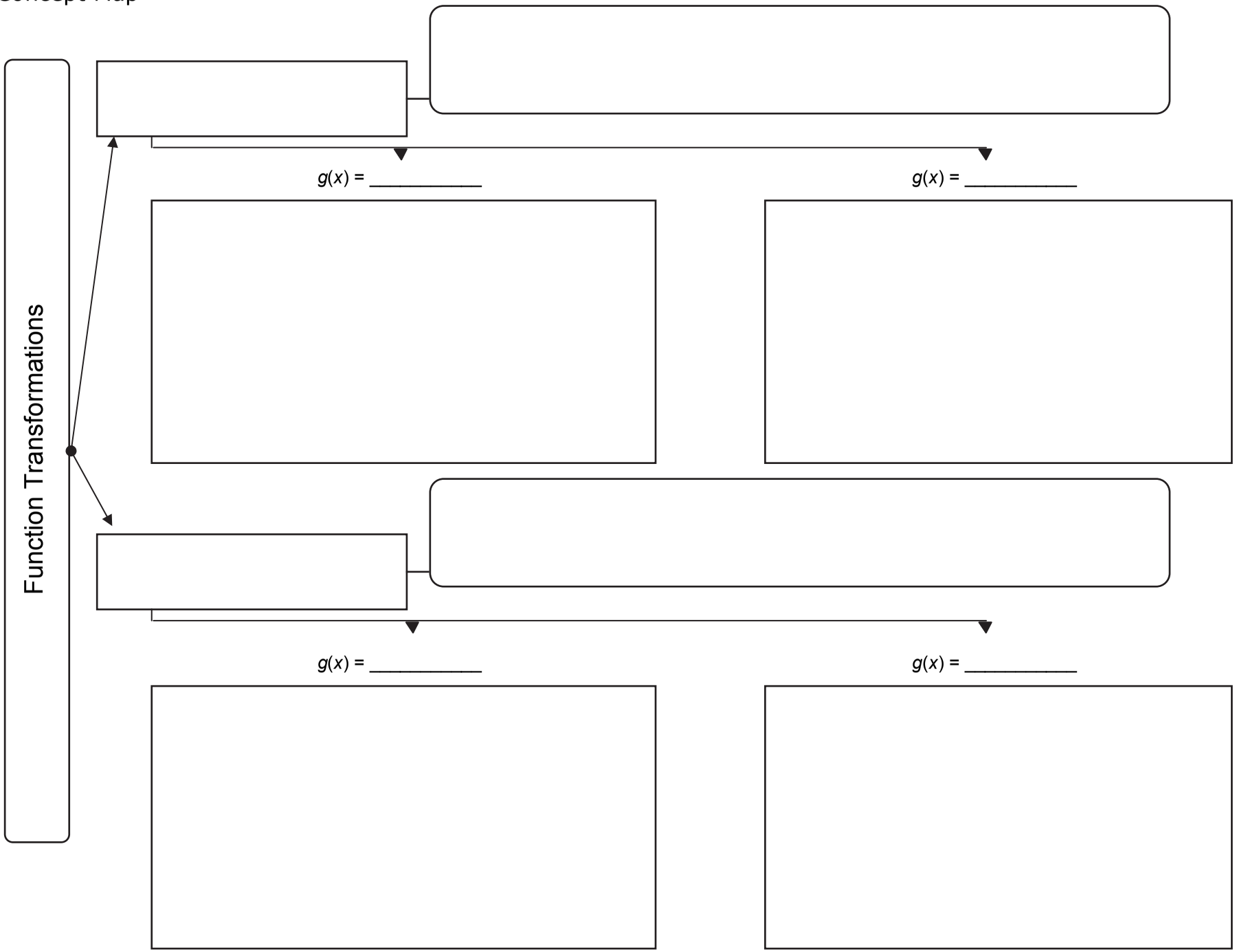
g(x) =

Concept Map



Concept Map

Important facts to remember:

My definition:

Function Transformations

My example:

My example:

My example:

My example:

Never stray from a dogged focus on classroom instruction.

Steve Leinwand

References

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