Algebra 1

Quarter 1

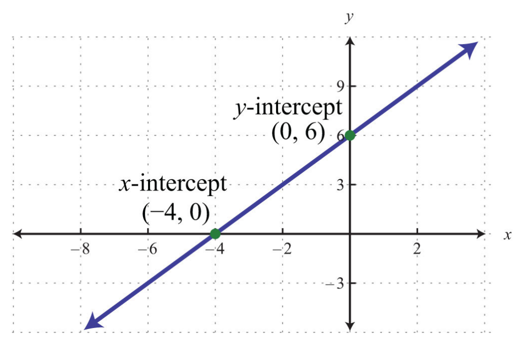
- *The Prelude*
- *Functions*
- *Linear Functions*

x^4 → "x to the fourth power" means "4 factors of x"

3^4 → "3 to the fourth power" means "4 factors of 3"

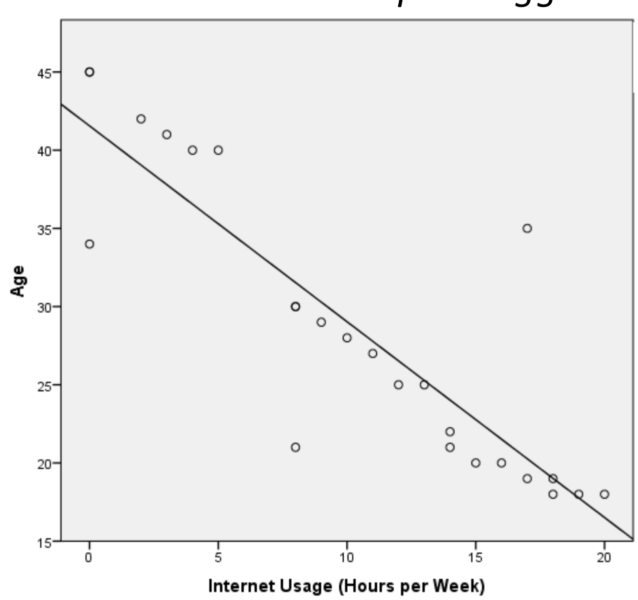
$= 3 \cdot 3 \cdot 3 \cdot 3$

$= 81$



For a survey, 23 people were asked their age and how many hours per week they use the internet. The data was graphed to make the scatter plot below.

What does this scatter plot suggest?



Solving Equations: *find the number that will make the statement true.*

$$25x + 800 = 1300$$

$$\begin{array}{r|l} 25x + 800 & = 1300 \\ -800 & -800 \\ \hline 25x & = 500 \\ \dfrac{25x}{25} & = \dfrac{500}{25} \\ 1x & = 20 \end{array}$$

Therefore, **x = 20**.

Check: does **x = 20** make the original equation a true statement?

$25x + 800 = 1300$

$25(\mathbf{20}) + 800$

$500 + 800$

1300 ✓

A Refresher: Operations with Positive and Negative Numbers

	Addition/Subtraction	Multiplication/Division
If the 2 numbers have the **same** signs:	**add** Example A: $31 + 10 = 41$ Example B: ${}^{-}9 + ({}^{-}4) = {}^{-}13$ Example C: ${}^{-}413 - 200 =$ ____ ➔ *You should see this as negative 413 and negative 200* ${}^{-}413$ -200 = ____ ➔ *Since they have the* ***same*** *signs, we* ***add*** *them.* ${}^{-}413$ -200 $= {}^{-}613$ Example D: $50 - ({}^{-}40) =$ ____ ➔ $-({}^{-}40) = 40$, *therefore, you should think of this as positive 50 and* ***positive*** *40* 50 $-({}^{-}40)$ $=$ 50 $+\ 40$ $= 90$	the answer is **positive** Example H: $7 \bullet 9 = 63$ Example I: ${}^{-}7 \bullet {}^{-}8 = 56$ Example J: ${}^{-}7 \bullet {}^{-}7 = 49$ Example K: $64 \div 8 = 8$ Example L: ${}^{-}72 \div {}^{-}8 = 9$
If the 2 numbers have *DIFFERENT* signs:	*SUBTRACT* Example E: $31 - 45 =$ ____ ➔ 31 $-\ 45$ = ____ ➔ *Think about this as positive 31 and negative 45* ➔ *Since the numbers have DIFFERENT signs, we SUBTRACT.* ➔ *The sign of the larger quantity is also the sign of the answer.* 31 $-\ 45$ $= {}^{-}14$ Example F: ${}^{-}123 + 100 =$ ____ ➔ ${}^{-}123$ $+100$ ➔ *You should see this as negative 123 and positive 100; since they have DIFFERENT signs, we SUBTRACT.* ➔ *The sign of the larger quantity is also the sign of the answer.* ${}^{-}123$ $+100$ $= {}^{-}23$ Example G: ${}^{-}12 - ({}^{-}19) =$ ____ ➔ ${}^{-}12$ $-({}^{-}19)$ ➔ $-({}^{-}19) = 19$, therefore, we should think of this problem as *negative 12 and* ***positive*** *19* ${}^{-}12$ $+\ 19$ $= 7$ ➔ *since they have DIFFERENT signs, we SUBTRACT.* ➔ *The sign of the larger quantity is also the sign of the answer.*	The answer is *NEGATIVE* Example M: ${}^{-}6 \bullet 9 = {}^{-}54$ Example N: $6 \bullet {}^{-}8 = {}^{-}48$ Example O: ${}^{-}42 \div 6 = {}^{-}7$ Example P: $36 \div {}^{-}6 = {}^{-}6$

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Part I: Use the Order of Operations to determine the value of each expression.

A. $-30 \div (2 + 8 - 8) =$ ___________

B. $-8 \div (2 - 4) + 3^2 =$ ___________

C. $44 \div (-5 - 6) + [-5 - (-6)] =$ ___________

D. $(-15 + 13) * (5 - 13) =$ ___________

E. $7 * 3 \div [(-15 - (-12)] =$ ___________

F. $4(10) - 2(20) - 3(30) =$ ___________

G. $(11 - 12 - 13)*(-1)^2 =$ ___________

H. $(-7 - 7) * (-7 + 7) =$ ___________

I. $\dfrac{25-15}{5-15} =$ ___________

J. $\dfrac{3^2}{2^3 - 2*3} =$ ___________

K. $(10-1)*(10+1)*(0-1) =$ ___________

L. $-4 * [12 - (-13)] =$ ___________

M. $\dfrac{5-(-6)}{-6+(-7)} =$ ___________

N. $-6 + [-12 - (-13)] + 6 =$ ___________

O. $(0-5)^2 - (1-7)^2 =$ ___________

P. $\dfrac{-9+11}{(2+3)^2} =$ ___________

Q. $15 - (-1-1)^4 =$ ___________

R. $2 - (-3)*(-4) =$ ___________

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Part II: Reading an equation as a question.

An equation that contains a variable is essentially asking you a question. For example:

- The equation 5x + 13 = 43 is asking you to answer the question,

  "What number, when I multiply it by 5 and then add 13 is equal to 43?"

Translate each of the following equations into a complete sentence/question. (Do NOT solve the equations; just translate them into words.)

S. $\frac{x}{3} - 7 = 2$ ____

T. $100 = 2(x+5)$ ____

U. $x^2 + 1 = 50$ ____

Part III: Verifying Solutions

A **solution** is a value makes an equation a true statement (i.e., when you substitute the solution in place of the variable, the value on one side of the equal sign is the same as the value on the other side).

For example, let's verify that ***x* = *6*** is a solution for the equation **4x + 11 = 3(2x – 1)**:

4x + 11	= 3(2x – 1)	
4(6) + 11	3(2*6 – 1)	➔ *since BOTH sides of the equation result in the same value (33), then x = 6 is a solution to the equation.*
24 + 11	3(12 – 1)	
33	3(11)	
	33 ✓	

Lance solved each of the following equations; his solutions are stated below. Determine if Lance's solutions are correct. Justify your answer.

V. 3n – 14 = 26 ➔ Lance's solution: n = 4 Is Lance's solution correct? Yes or No

W. 25 – 2x = 7x - 20 ➔ Lance's solution: x = 5 Is Lance's solution correct? Yes or No

X. $\frac{1}{2}$(c – 13) = 19 – c ➔ Lance's solution: c = 25 Is Lance's solution correct? Yes or No

Y. 100 = 4v - 20 ➔ Lance's solution: v = 30 Is Lance's solution correct? Yes or No

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Part I: Reviewing the Algebraic Properties of Equality

Addition Property of Equality	**Subtraction Property of Equality**
If a = b, then ______________________________ . *In other words, this property allows us to* _______________________________________ *and still have equality.* For example, given $4(3) = 2(6)$ If we add 5 to both sides: $4(3) + \mathbf{5} = 2(6) + \mathbf{5}$ We end up with: $17 = 17$ ✓	If a = b, then ______________________________ . *In other words, this property allows us to* _______________________________________ *and still have equality.* For example, given $6(3) = 2(9)$ If we subtract 5 from both sides: We end up with:
Multiplication Property of Equality	**Division Property of Equality**
If a = b, then ______________________________ . *In other words, this property allows us to* _______________________________________ *and still have equality.* For example, given $6 + 1 = 2 + 5$ If we multiply both sides by 3: We end up with:	If a = b, then ______________________________ . *In other words, this property allows us to* _______________________________________ *and still have equality.* For example, given $5 + 9 = 11 + 3$ If we divide both sides by 2: We end up with:

Part II: Using Algebraic Properties of Equality to Build Equations

Each chart below shows a series of equations that were created by applying one of the Properties of Equality.

- first, simply analyze the steps and try to identify what was done to each side of equation to get from one step to the next;
- then, complete the chart by stating the Property of Equality that justifies each step;
- finally, verify that the given solution makes the final equation a true statement.

1.

Equation	Justification
$x = 2$	Given
$3x = 6$	
$3x + 7 = 13$	
Check:	

2.

Equation	Justification
$c = -9$	Given
$c + 4 = -5$	
$2(c + 4) = -10$	
Check:	

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3.

Equation	Justification
$x = 16$	Given
$\frac{x}{2} = 8$	
$\frac{x}{2} - 5 = 3$	
Check:	

4.

Equation	Justification
$y = -7$	Given
$-2y = 14$	
$5 - 2y = 19$	
Check:	

5.

Equation	Justification
$m = -8$	Given
$\frac{m}{4} = -2$	
$\frac{5m}{4} = -10$	
$\frac{5m}{4} - 3 = -13$	
Check:	

6.

Equation	Justification
$r = 1$	Given
$-25r = -25$	
$-25r + 13 = -12$	
$\frac{-25r + 13}{4} = -3$	
Check:	

7. Complete the chart below by writing the equation that would result from applying the justification provided to the equation in the previous step.

Equation	Justification
$n = 5$	Given
	Multiply both sides by 3
	Subtract both sides by 7
	Multiply both sides by –10
Check:	

8. ***Build your own equation***: starting with the equation that is given ($t = 3$), show 3 steps using any Algebraic Properties of Equality to build an equation.

Equation	Justification
$t = 3$	Given
Check:	

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Part III: Solving Equations

Recall: Fill in each blank with 1 word to complete each sentence.

An equation is simply asking you a _____________.
A solution to an equation is the value that makes the equation a ___________ statement.

For each equation below,

- first, write in words the question that the equation is asking you;
- then, solve the equation to find the value that makes the equation a true statement. Show your steps to justify your solution.

9. $10x - 20 = 30$

10. $14 = \frac{x}{5} + 20$

11. $3(x+2) = 9$

12. $12 - 7c = 54$

13. $\frac{1}{2}x = 50$

14. $5(3 - 2a) = -75$

15. $-50 = \frac{1}{3}m$

16. $2(3w + 4) = 5$

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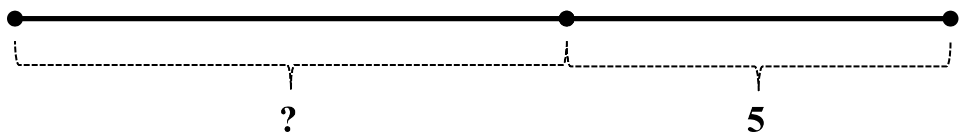
Part I: Each diagram below shows line segments with a common endpoint. The lengths of some of the segments are provided. In each particular diagram, assume that any segment labeled with "?" is the same length.

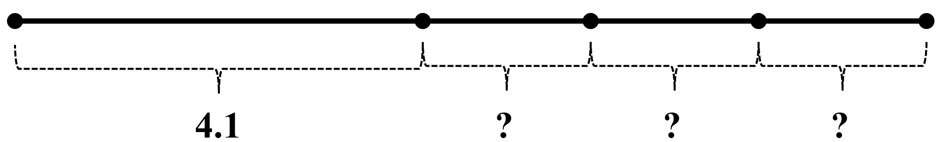
- first, in your mind, think of a sentence (in words) that describes the mathematics represented in the diagram;
- then, translate your phrase into an algebraic expression.

1.



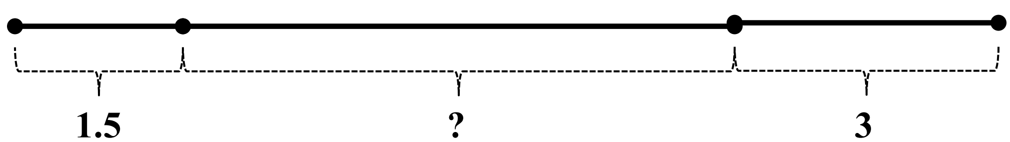
algebraic expression: ____

2.



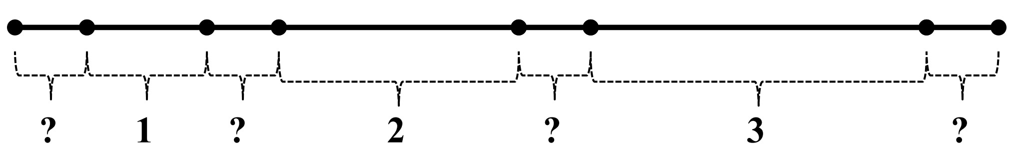
algebraic expression: ____

3.



algebraic expression: ____

4.



algebraic expression: ____

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Part II:

5. At the high school swimming state championship meet Matt, Kurt, Elijah and Ryan swam in the 4 x 100 freestyle relay race for their school (each person swam 4 lengths of the pool). The following variables represent the time it took each person to swim their 4 lengths of the pool in the relay race:

- **M** = Matt's time (in seconds)
- **K** = Kurt's time (in seconds)
- **E** = Elijah's time (in seconds)
- **R** = Ryan's time (in seconds)

Use the variables above to interpret the expressions below:

a. $\mathbf{M} + \mathbf{K}$ represents ____

b. $\mathbf{M} + \mathbf{K} + \mathbf{E} + \mathbf{R}$ represents ____

c. $\dfrac{\mathbf{M} + \mathbf{K} + \mathbf{E} + \mathbf{R}}{\mathbf{4}}$ represents ____

d. $\mathbf{E} - \mathbf{R}$ represents ____

6. A movie theater charges a different price for tickets for people of different ages:

- **c** = the cost for a children's ticket (for ages 4 – 12 years old)
- **g** = the cost for a general admission ticket (for ages 13 – 65)
- **s** = the cost for a senior citizen ticket (for ages 65 and older)

Use the information above to interpret the expressions below:

a. $\mathbf{c} + \mathbf{g} + \mathbf{s}$ represents ____

b. $3\mathbf{g} + 2\mathbf{c}$ represents ____

c. $4(\mathbf{c} + \mathbf{s})$ represents ____

d. $4\mathbf{c} + \mathbf{s}$ represents ____

e. $\mathbf{g} - \mathbf{s}$ represents ____

f. Write an expression that represents the total cost of 3 children, 1 adult and 2 seniors:

____

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Part I: Below are 4 equations that look quite similar, but are actually very different (and have different solutions).

- First, simply examine each equation and make some mental notes about how they differ from each other.
- Then, translate each equation into a complete sentence/question (do NOT solve the equations; just translate them into words). Fill in the blanks with the appropriate phrases to complete the sentence/question that the equation is asking.

1. $\frac{3x+4}{5}=11$ "What number, when ________________________ then ________________________ then ________________________ then ________________________ is equal to ___________________ ?"	2. $\frac{3(x+4)}{5}=11$ "What number, when ________________________ then ________________________ then ________________________ then ________________________ is equal to ___________________ ?"
3. $3\left(\frac{x}{5}+4\right)=11$ "What number, when ________________________ then ________________________ then ________________________ then ________________________ is equal to ___________________ ?"	4. $\frac{3x}{5}+4=11$ "What number, when ________________________ then ________________________ then ________________________ then ________________________ is equal to ___________________ ?"

Part II: Solve the following equations. Show how you arrived at your solution.

5. $2(m+5)=7$

6. $7=5-2k$

7. $\frac{r}{2}+5=-7$

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Part I: Equations where the ***same variable appears more than once***.

Four examples are shown below. Work with a partner to

a. verbalize the question that each equation is asking you; and then,
b. compare the equations to each other (discuss how are they similar and how are they different):

Example 1: $2x+8+3x-6=37$ Example 2: $2x+8=3x-6$

Example 3: $3(2x-5)+5(x-6)=-1$ Example 4: $3(2x-5)=5(x-6)$

****

In all 4 equations, the variable x appears twice. However,

- in examples 1 and 3, both x's are on the same side of the equation; but,
- in examples 2 and 4, the x's are on opposite sides of the equation.

Now, let's compare the methods for solving equations like these examples.

Example 1: $2x+8+3x-6=37$ Example 2: $2x+8=3x-6$

Example 3: $3(2x-5)+5(x-6)=-1$ Example 4: $3(2x-5)=5(x-6)$

Solve each equation to find the value that makes the equation a true statement. Show your steps to justify your solution. (**HINT**: before writing down any steps, first ask yourself, "Are all the variables on one side of the equation, or are there variables on both sides of the equation?)

A. $5x+7+x=91$ B. $5x=7+x$ C. $40+10x=5x-30$

D. $2(3x+4)+x=1$ E. $50=5x-2+6x-3$ F. $5(2x-5)=\frac{1}{2}(18x+40)$

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Part II: Equations that have 2 ***different*** variables.

Recall: to solve an equation means to find the value that makes the equation a true statement.

Consider the equation $y = -3x + 5$.

- Since there are 2 different variables, the solution to this equation will be the PAIR of values that make the equation a true statement.
- Therefore, the solution will be written as a coordinate pair: $(\boldsymbol{x}, \boldsymbol{y})$.

If a coordinate pair is a solution to an equation, then

- substituting the values for $\boldsymbol{x}$ and $\boldsymbol{y}$ into the equation will result in a true statement; and,
- the coordinate pair will be a point that lies on the graph of the equation.

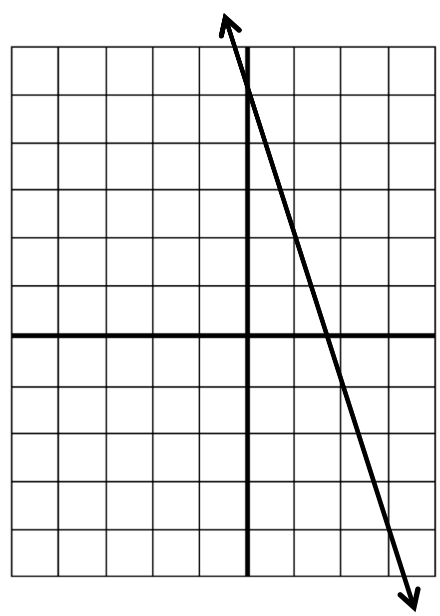
First, let's determine if a coordinate pair is a solution using substitution.

Is (1, –5) a solution to the equation y = -3x + 5 ?

Is (2, –1) a solution to the equation y = -3x + 5 ?

Now let's take a look at the graph of the equation.

The equation $y = -3x + 5$ is graphed in the coordinate plane to the right.



Discuss with your partner the following:

- Just by looking at the graph, determine if (1, –5) is a solution to the equation $y = -3x + 5$? How do you know?
- Just by looking at the graph, determine if (2, –1) is a solution to the equation $y = -3x + 5$? How do you know?
- Identify one other coordinate pair that must be a solution to the equation $y = -3x + 5$. How do you know?

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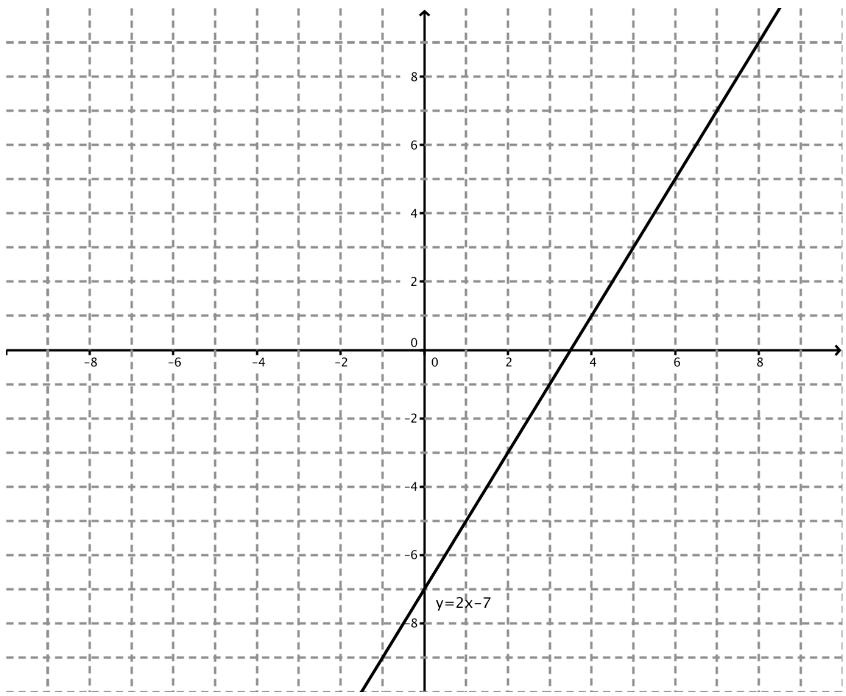
1. Without graphing, determine if the coordinate pair is a solution to the equation $y = -3x+2$? Show your work to justify your conclusions.

   a. (1, 5)   b. (0, 2)   c. (2, 0)

2. Below is given the graph of $y = 2x - 7$. Use this graph to decide if the following points are solutions to $y = 2x - 7$.



Just by looking at the graph, determine if each of the following coordinate pairs are solutions to the equation $y = 2x - 7$? Circle YES or NO.

a. **(-7, 0)** YES NO   b. **(0, -7)** YES NO   c. **(2, -2)** YES NO   d. **(2, -3)** YES NO

e. **(6,5)** YES NO   f. **(5,4)** YES NO   g. **(4,0)** YES NO   h. **(4,1)** YES NO

3. Solve the following equations. Show your work.

   a. $5x - 11 + 13 - x = 14$ b. $5x - 11 = 13 - x$ c. $8 = \frac{x}{7} + 9$

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Learning math helps us to develop important skills for identifying and generalizing patterns (i.e., creating an algebraic expression to represent a pattern).

Part I: Visual Patterns

Malia used square tiles to make the sequence of 4 figures is shown below.

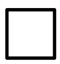

Figure 1

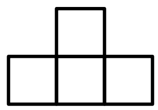

Figure 2

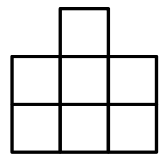

Figure 3

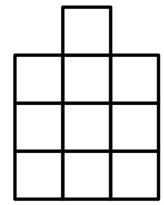

Figure 4

A. Study the sequence of figures and discuss with your partner how you see the design changing from one figure to the next. Explain in words how the design changes from one figure to the next.

B. If Malia continued her pattern to create the next 2 figures in the sequence, how many total tiles will there be in Figure 5 and Figure 6 (try to determine these without drawing the figures).

C. Caleb studied Malia's sequence and created the following equation to generalize the pattern he noticed: $T = 3r + 1$. In Caleb's equation,

- **T** represents the total number of tiles in a figure
- **r** represents the number of rows that have 3 tiles.

Complete the table below using Caleb's equation.

	r (number of rows with 3 tiles)	**T** (total number of tiles in the figure)
Figure 1:		
Figure 2:		
Figure 3:		
Figure 4:		

D. In Caleb's equation ($T = 3r + 1$), explain how the "3" relates to the pattern in the table.

E. In Caleb's equation ($T = 3r + 1$), explain what the "3" refers to in the figures and what the "1" refers to in the figures.

F. If Malia continued her pattern to make several more figures, use Caleb's equation to determine the total number of tiles in figure 25.

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Part II: Patterns in a Table of Values

The current tuition at a university is $5,000, but the university just announced that starting next year they plan to raise tuition by the same amount each year for the next several years. The table below shows the university's tuition cost over the next several years.

	t (time: number of years after this year)	**C** (Cost of tuition)
This year:	0	$ 5,000
Next year:	1	$ 5,700
In 2 years:	2	$ 6,400
In 3 years:	3	$ 7,100
	4	
	5	
	9	
In **t** years:	**t**	

A. How does the cost of tuition, **C**, change each year over the next 3 years?

B. If the tuition continues to change in the same way, determine the cost of tuition, **C**, in 4 years and in 5 years. Write your answers in the table above.

C. If the university continued to raise the tuition by the same amount each year for several years, what will be the cost of tuition in 9 years? Show your work to justify your answer.

D. Chris analyzed the table and created the following equation to generalize the pattern she noticed:

$$C = 5{,}000 + 700t$$

Explain what each part of Chris's equation represents in this situation (the university's tuition).

"C" represents ______________________________________

"5,000" represents __________________________________

"700" represents ____________________________________

"t" represents ______________________________________

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Part I:
Lilia likes to use her cell phone to listen to music (and check her Instagram). She uses 10 megabytes by the end of each day. Her data plan starts tracking how much data she uses from the beginning of the first day of each month.

1. How many megabytes will Lilia use by the end of day on August 5^{th}? (The 5^{th} day of the month)

2. Using complete sentences, answer the following questions:

   a. How much data would Lilia have used by the end of August 7^{th}?

   b. How much data would Lilia have used by the end of August 9^{th}?

   c. How much data would Lilia have used by the end of August 11^{th}?

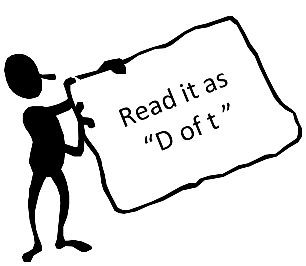
   d. How much data would Lilia have used by the end of August 20^{th}?

   e. How much data would Lilia have used by the end of August 25^{th}?

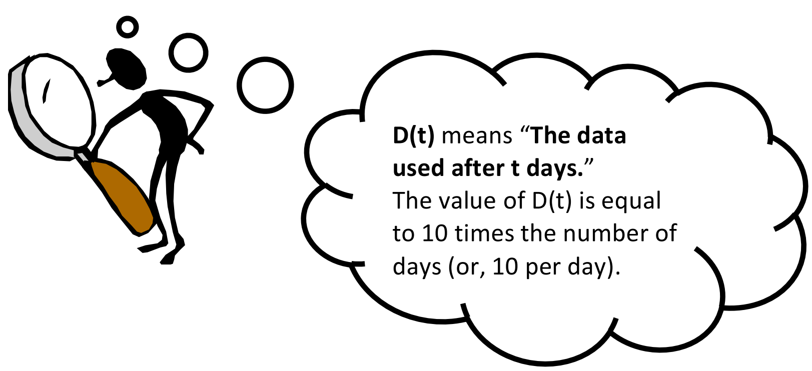
Part II: A simpler and more efficient way of doing things

Clearly, it gets annoying to have to write the same thing over and over again. Whenever possible, mathematicians love to make things simpler and more efficient.

So, instead of writing the sentence, "The data used by the end of _____," over and over again, mathematicians would simply write the situation as ***D(t) = 10t.***



$$D(t) = 10t$$



If we go back and look at the question 2a (on the previous page), instead of writing that complete sentence in words, we could have simply written ***D(7) = 70***.

Therefore:

- instead of writing, "At the end of the 8^{th} day she will have used 80 megabytes," we could simply write, ______________;
- instead of writing, "At the end of the 15^{th} day she will have used 150 megabytes," we could simply write, ______________; and,
- instead of writing, "At the end of the 24^{th} day she will have used 240 megabytes," we could simply write, ______________.
- instead of writing, "At the end of the 31^{st} day she will have used 310 megabytes," we could simply write, ______________.

Similarly, we can use this notation to easily represent many situations.

- If a UH Volleyball game costs \$7.50 per ticket, we could use ***C(t) = 7.5t*** to represent the cost, ***C(t)***, for buying any number of tickets, ***t***.
  - Then, to represent the cost for 2 tickets we could simply write, ***C(2) = 15***
  - And, to represent the cost for 10 tickets we could simply write, __________________ **.**
- To estimate the distance around a circle, we could use ***C(d) = 3.14d*** to represent the circumference, ***C(d)***, of a circle with any diameter length, ***d***.
  - To represent the circumference of a circle with a diameter of 20 centimeters we could simply write, __________________ **.**
- If you earn \$9 per hour at your job, we could use ***I(h) = 9h*** to represent your income, ***I(h)***, for working ***h*** hours.
  - To represent your income for working 20 hours we could simply write, ______________ **.**
- If a company charges \$1.29 per song to download music to your cell phone, we could use ______________ to represent ____.
  - To represent the cost for downloading 10 songs could simply write, ______________ **.**
- If a gym charges a \$45 initial payment to join and then \$17 per month, we could use ***C(m) = 45 + 17m*** to represent ____ .
  - To represent the total paid after being a member for 10 months, we could simply write, ______________ **.**

Name ______________________________
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Part III:

As a freshman, Kainoa was required to buy a lot of pencils at the beginning of the school year. He decided that when he grew up, he would open a factory that made pencils.

- The cost for making pencils is 5 cents per pencil.
- Kainoa also had to pay $1,000 to buy the machinery and equipment to make the pencils.

Therefore, the cost of making any number of pencils could be represented by $C(x) = .05x + 1000$

- x represents the number of pencils Kainoa will make
- $C(x)$ represents the cost for making that many (x) pencils.

Answer the following questions.

3. What is the value of C(100)?

4. Determine the value of C(300) and, in a complete sentence, what this means in context of the given situation.

5. Determine the value of C(8000) and, in a complete sentence, what this means in context of the given situation.

6. What is the meaning and value of C(½)? Does this make sense? Why or why not?

7. What is the meaning and value of C(-100)? Does this make sense? Why or why not?

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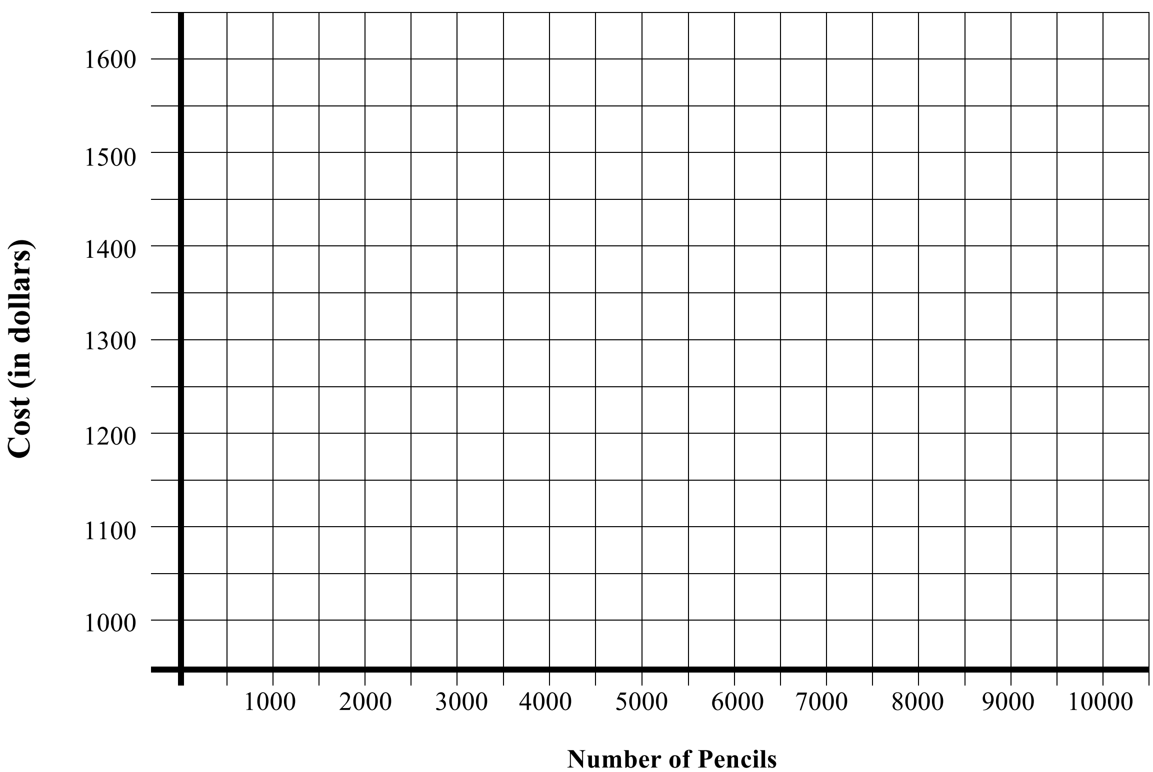
8. Use the function C(x) to complete the table below.

x	***C(x) = .05x + 1000***	***C(x)***
0	C(0) = .05(0) + 1000	$1,000
1,000		
2,000		
4,000		
6,000		
10,000		

9. The corresponding values for ***x*** and ***C(x)*** can be written as coordinate pairs. Use the values in the table above to identify the coordinate pairs and use them to create a graph of the function ***C(x).***



10. Can you tell from the table the approximate number of pencils Kainoa can make if he only has $1200? Explain.

11. Which do you think would be better to use, the table, graph, or symbolic expression if you wanted to determine how many pencils Kainoa can make with $1190? Explain.

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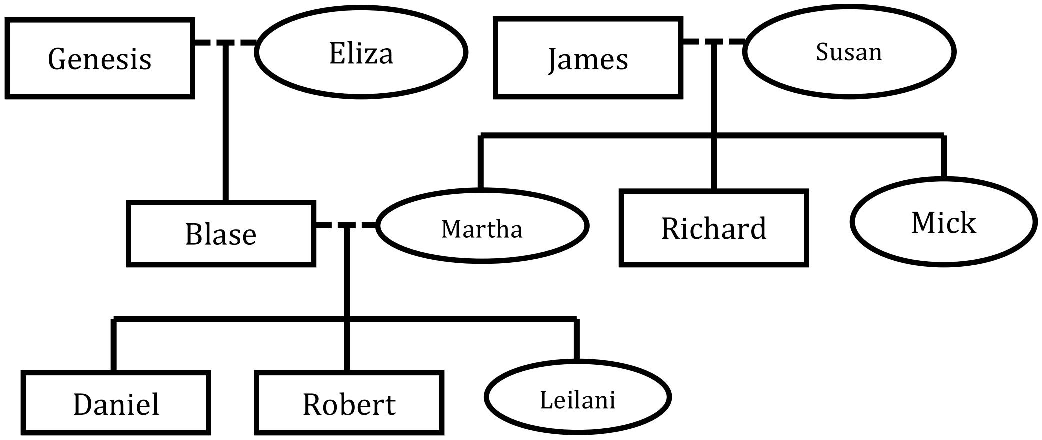
Part IV: Not all functions involve numbers, as the following example demonstrates.

Leilani made a family tree for her history class, shown below. All women are represented as ovals, while men are rectangles.



Answer the questions using the functions: M(x) means the mother of x
F(x) means the father of x
S(x) means the spouse of x (husband or wife)

1) S(Blase) =

2) S(Martha) =

3) F(Robert) =

4) F(Daniel) =

5) F(Martha) =

6) F(Blase) =

7) S(Susan) =

8) M(Leilani) =

9) M(Blase) =

10) M(Martha) =

11) F(Richard) =

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Part I: Rico and Stassi

Rico and Stassi are comparing the functions that tell them their scores on their favorite online game. Rico's score, after playing for *t* days is determined to be $R(t) = 32t$, while Stassi's score after *t* days is determined to be $S(t) = 76 + 20t$.

1. Rico says his score after 3 days plus his score after 7 days, $R(3) + R(7)$, is the same as his score after 10 days. Is this true?

2. Is the same thing true for Stassi? That is, is $S(3) + S(7) = S(10)$?

3. Is it always true that $F(3) + F(7) = F(3+7)$ for each function *F*?

4. Rico also says that if you double his score after 4 days, $2*R(4)$, that is the same as his score after 8 days, $R(8)$. Is this true?

5. Is the same thing true for Stassi? Check, is $2*S(4) = S(8)$?

6. Is it always true that $2*F(4) = F(2*4)$ for each function *F*?

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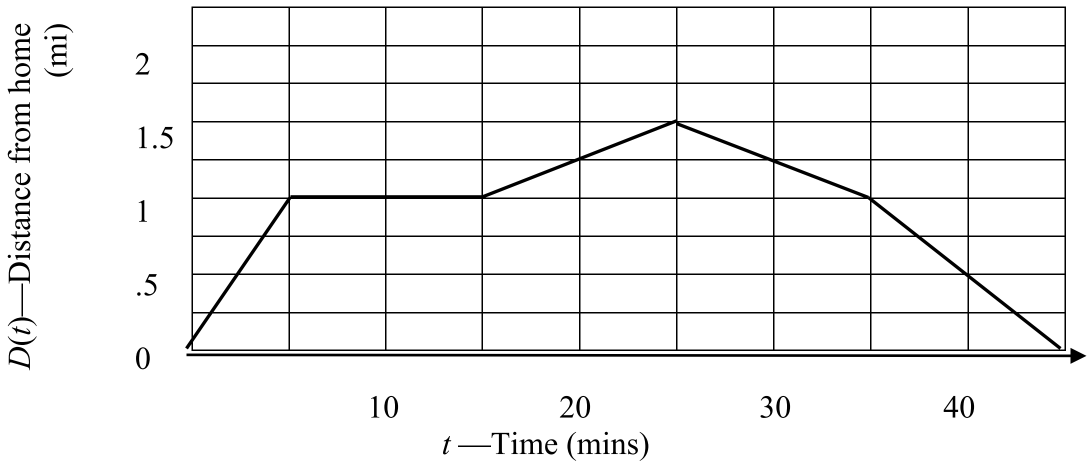
Part II: Lola's run

Lola, a very good Algebra 1 student, decided to graph the function that represented her distance from home when she went out for a run after school. Shown below is her graph.



7. What do the first coordinates of each point on this graph represent?

8. What do the second coordinates of each point on this graph represent?

9. What is the value of $D(10)$?

10. What does $D(10)$ represent, with units?

11. Use a complete sentence to describe in context the meaning of $D(1)$ in this graph, with units. (Note: you do not need to provide the value for $D(1)$, only its meaning.)

12. What does $D(45)$ represent in context in this graph, with units?

13. For which values of t does $D(t)$ equal 0.5 in this graph, and what is the contextual meaning of your answer

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Part III: Lunch Account Balance

14. Fill in the table below for the function defined by $M(t) = -2t + 10$, where $M(t)$ represents the amount of money left in your lunch account when you started out with \$10 and you spend \$2 each day, and t is the number of days since you started.

t	0	1	2	3	4	5	6	7
$M(t)$								

15. What is the value of $M(2)$?

16. What does $M(2)$ represent, with units?

17. For which value(s) of t does $M(t)$ equal 4 in this graph?

18. For which value(s) of t does $M(t)$ equal 0 in this graph and what is the significance of this value?

19. What is the value of $M(7)$ and what does it represent in context?

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1. Keoni plans to make metal bracelets to sell. His start-up cost is \$150 for the machine to make the bracelets. The supplies for each individual bracelet cost \$2. The function rule for this situation is $C(b) = 150 + 2b$, where $C(b)$ is the total cost of making b number of bracelets.

   a. Find the value of C(20) with units.

   b. What does C(20) represent in context?

   c. Find the value of C(100) with units.

   d. What does C(100) represent in context?

   e. Find the value of C(500) with units.

   f. What does C(500) represent in context?

   g. If Keoni only has \$450 to make his first batch of bracelets, how many bracelets can he make? (Hint: is \$450 the b, which represents the number of bracelets? Or is \$450 the $C(b)$, which represents the total cost of making the bracelets?)

   h. Keoni didn't have any start up money of his own, so his dad gave him \$1000 to get started. How many bracelets could Keoni make with \$1000?

Algebra 1 -- Module 1: Functions Name ______________________________
F – 2.1: Tables and Graphs Pd __________ Date ______________

n	$T(n)$
1	4.5
3	5.5
4	6
6	7
7	7.5
8	8
10	9
12	10
13	10.5
14	11
16	12
19	13.5

While talking about his math class, Charles notices that there seems to be a pattern for how long it takes him to do his homework problems, given how many problems he is assigned. He makes a table for the amount of time in minutes T, based on the number of homework problems, n.

1. What does $T(10)$ represent (in context, not its value)?

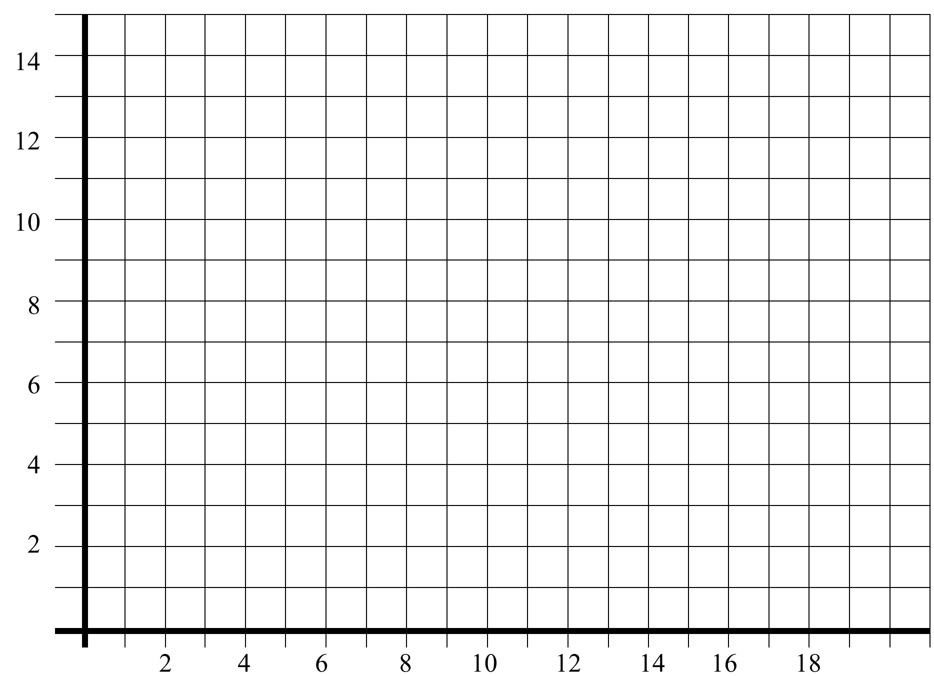
2. What is the value of $T(10)$? (including units)

3. What would it mean if 12 showed up twice in the n column? Would this make sense?

4. What would it mean if 15 showed up twice in the $T(n)$ column? Would this make sense?

5. Graph the points from the table above (and LABEL THE AXES) in the coordinate plane below.

Label for y-axis: ______________________



Label for x-axis: ______________________

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6. Do you think that it makes sense to connect the points? Why or why not?

7. Using your graph, approximately what would you expect to find for $T(5)$.

8. What are some of the advantages to having the graph?

9. A website shows the official daily high temperature in Honolulu for 2012 in a table of values and also represents the data in a graph. Which representation (table or graph) do you think it would be easiest to see that the temperatures increase in general during the summer and decrease in the winter? Explain.

10. For the same daily high temperatures described in the problem above, which representation (table or graph) do you think it would be easiest to find the official high Temperature on January 30, 2012? Explain.

11. For the same temperatures described in the problem above, which representation (table or graph) do you think it would be easiest to find all the days where the official high Temperature exceeded 85 degrees? Explain.

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When is a plot not the graph of a function?

For his birthday, Chaz wants to treat his friends to a day at Game-O-Rama, the local arcade. Since Chaz is on a budget, he needs to figure out how much this party would cost. So, when he calls Game-O-Rama, the manager tells him that they have special group pricing for birthday parties. The manager emails him the following cost sheet, where x is the number of friends he brings and C(n) is the cost of the party.

x	$C(x)$
1	20
2	25
3	30
4	30
5	35
6	35
7	35
8	40
9	40
10	40
11	40
12	45

1. How much would it cost to bring 6 of his friends?

2. How much would it cost to bring 7 of his friends?

3. How much would it cost to bring 8 of his friends?

Notice that it costs the same amount to bring 6 friends as it does to bring 7 friends (isn't group pricing great!). Thus, $C(6) = C(7)$, and the number 35 appears multiple times in the $C(\boldsymbol{x})$ column.

Name ________________________________
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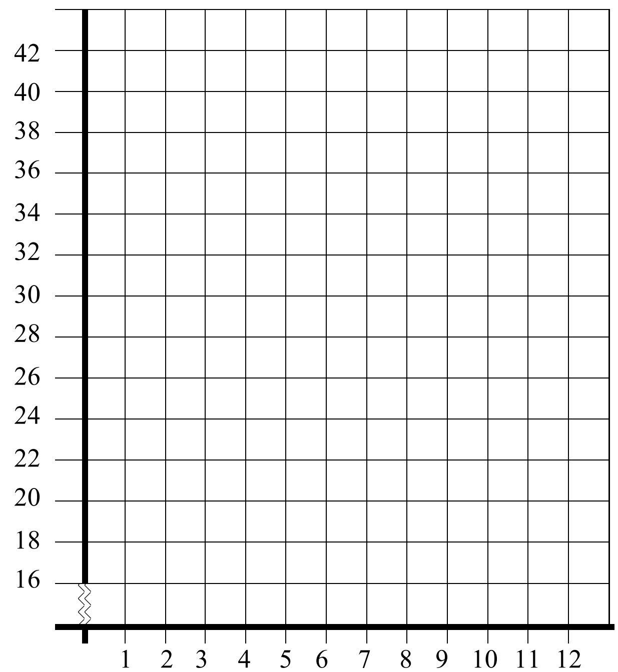
Now, let's explore what would happen if the same number appeared twice **in the *x* column**? For example, what if the table of values in Game-O-Rama cost sheet included the following rows:

x	$C(x)$
13	45
13	50

4. If this were included in the cost sheet, what would be the cost for bringing 13 friends? Why would this be confusing to Chaz?

5. On the coordinate plane below, label the axes and plot the points from the original table of values.

Label for y-axis: ____________________



x	$C(x)$
1	20
2	25
3	30
4	30
5	35
6	35
7	35
8	40
9	40
10	40
11	40
12	45

Label for x-axis: ______________________________

Notice that on your graph there are never two points with the same first coordinate. Therefore, no two points lie on the same vertical line.

6. In your graph, include the two additional points when $x = 13$. What do you notice now about the graph (about how the graph looks when $x = 13$)?

x	$C(x)$
13	45
13	50

Name ______________________________
Pd ____________ Date _______________

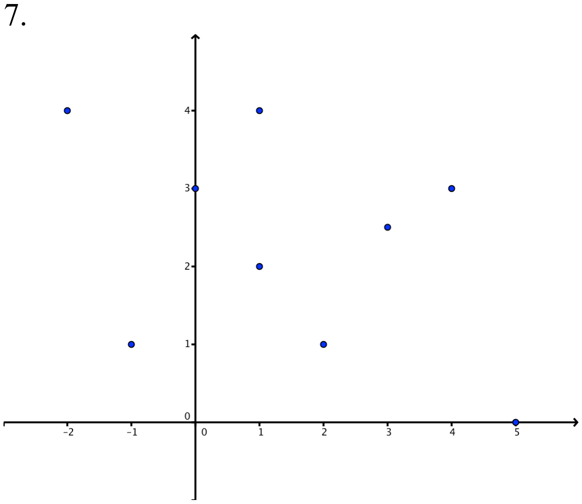
When we plot a table of values, in order for the graph to represent an actual **function**, there CANNOT be more than 1 point graphed at each ***x*** value.

- When you plotted the values for ***x*** = 1 to ***x*** = 12, the graph represented a function.
- However, when you plotted the values for ***x*** = 13, the graph no longer represented a function.

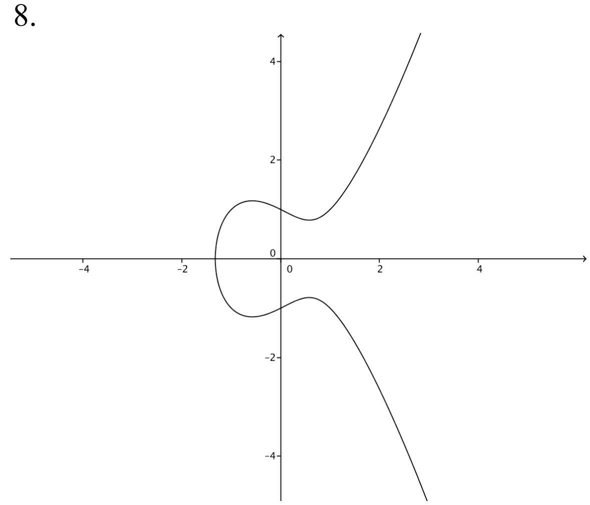
*To check if a graph actually represents a function, in your mind, picture the graph with several vertical lines drawn on it. If any vertical line touches the graph more than once, it does not represent a function. This is called the **vertical line test**.*

Explain why the following are not graphs of functions. It may help to draw the vertical line that fails the *vertical line test*.

7.



8.



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The m&m Game

Through a strange and crazy set of coincidences, our class has become host to a large number of radioactive m&ms. Your job is to model the remaining number of radioactive m&ms as we shake and remove the edible ones.

Directions:

A. Count the total number of m&ms and place all into your cup. Record the initial number of m&ms here ____________ and in the table below (this is trial 0 in your table below)

B. Shake your m&ms and pour them out onto your desk or table: any m&m that is face down (the "m" isn't showing) is no longer radioactive and can be safely removed! Put these aside.

- ❖ Note: if it isn't radioactive, you can eat it!

C. Count the remaining (radioactive) m&ms and place them back into your cup (be sure to record the number that are still radioactive—each time you do this represents a new trial).

D. Repeat steps 2 and 3 until two or fewer m&ms remain.

E. Graph the function $N(x)$, where x is the number of trials and $N(x)$ is the number of remaining m&ms.

x (trial)	***N*(*x*)** (# of radioactive m&ms)
0	
1	

Next, answer the following questions on the next page.

Name ________________________________
Pd ____________ Date _______________

1. What does the x-axis measure? What are its units?

2. What does the y-axis measure? What are its units?

3. What is the contextual meaning of $N(3)$?

4. What is the value of $N(3)$?

5. How could you find $N(3)$ from **your table**?

6. How could you find $N(3)$ from **your graph**?

7. Approximately how many trials does it take for the number of m&ms to be about 20? Should our answer be an x or y value?

8. Approximately how many trials does it take for the number of m&ms to be less than ¼ of what we began with?

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Part I: Carla's Fundraising Efforts

Carla belongs to a cheerleading squad. The cheerleaders need money to go travel to Las Vegas for a national competition. To raise funds, Carla will collect recyclable plastic bottles and soda cans and redeem them for money. Carla has been tracking her fund-raising progress. Let $T(d)$ represent the amount of travel funds Carla has been able to raise by the end of dth day of the school year, where $d = 1$ represents the first day of school. The table below is a record that Carla has kept through the first few months of school.

d	$T(d)$
15	15
25	50
30	250
45	250
50	350
60	400

1. What is the value of $T(30)$ and what does it represent in context?

2. How much money did Carla raise in the first 45 days?

3. How long did it take Carla to earn her first $50?

4. Carla was told that, by sharing rooms, the hotel cost would only be $350! How long did it take Carla to earn the hotel money?

Part II: Solve the following equations. Show how you determined your answer.

5. $\frac{c}{9} + 20 = 15$

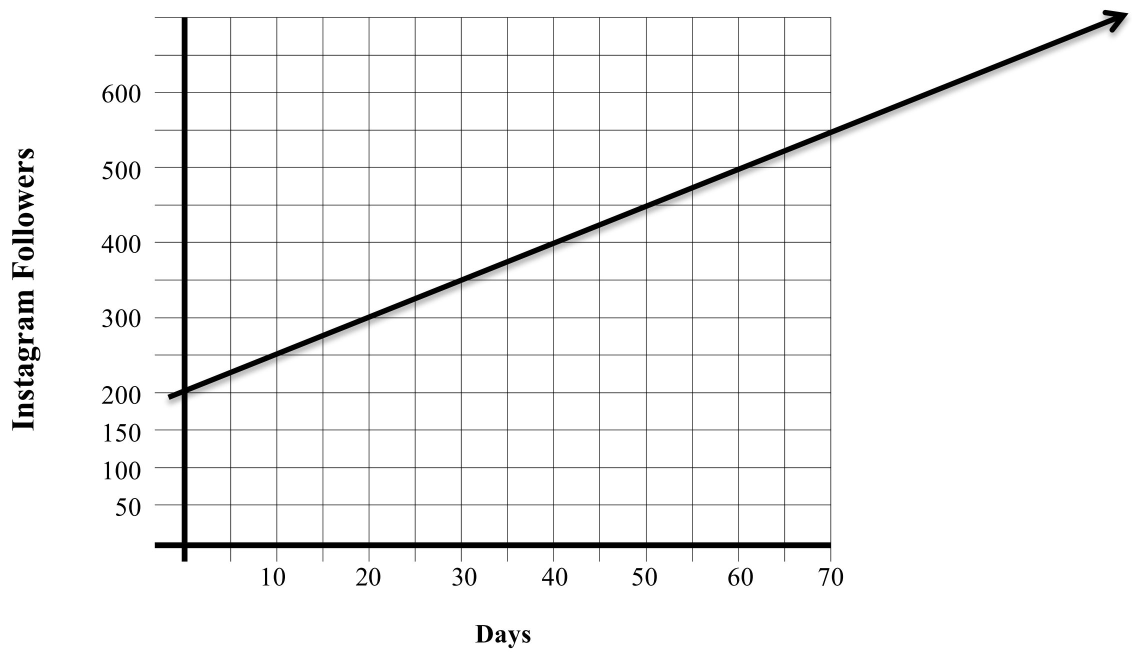
6. $2(3x - 5) - x - 6 = 24$

7. $7x - 13 = 4x - 21$

Name ______________________________
Pd ___________ Date ______________

Part III: Louis's Instagram Followers

Below is a graph that depicts the number of Instagram followers Louis has as the school year progresses. $F(d)$ represents his number of followers on the d^{th} day of the school year.



8. What is the value of $F(30)$ and what does it represent in context?

9. How long did it take Louis to reach the 500-level of Instagram followers?

The symbolic form of the function that represents Louis' followers is $F(d) = 200 + 5d$.

10. What is the value of $F(1)$ and what does $F(1)$ represent in context?

11. How long will it take Louis to reach the 1000 follower level?

Part IV: Kea's solutions to the equations below are provided. Determine if Kea's solutions are correct. Show your work or provide an explanation to support your conclusion.

12. $4x - 1 = 3x + 1$ ➔ Kea's solution: *x = 3*

13. $y = -\frac{1}{2}x + 5$ ➔ Kea's solution: (-6, 8)

Name ________________________________
Pd _____________ Date ________________

Station 1:	**Station 2:**
Station 3:	**Station 4:**

Name ______________________________
Pd ___________ Date _______________

Station 5:	**Station 6:**

Reflection: Which station(s) did you find easiest? Why?

Name ________________________________
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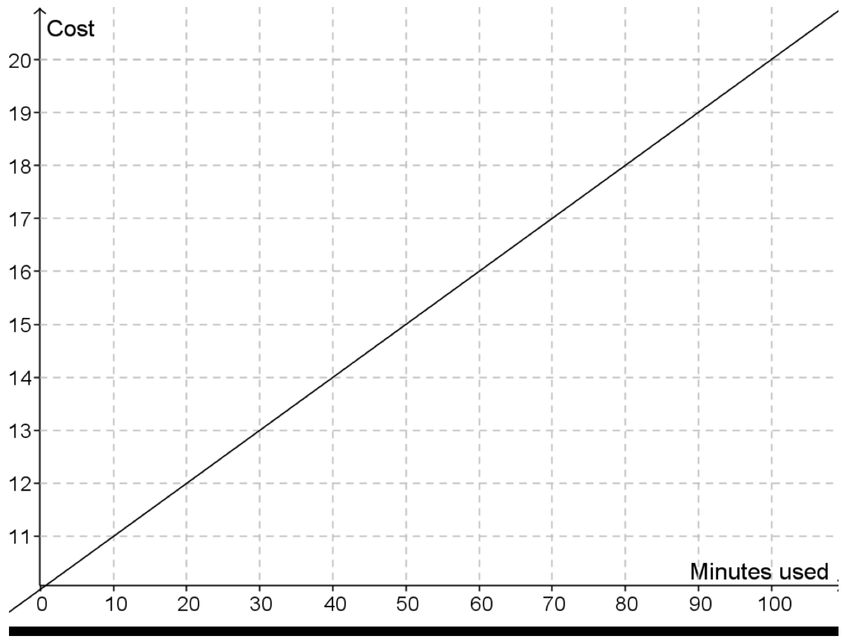
Leilani bought a rechargeable calling card for $10. It allows her to call anywhere in the world, but charges a certain fixed fee for each minute she talks. Let $C(m)$ represent her total cost in dollars for purchasing the card and talking for m minutes. The graph for $C(m)$ is given below.



1. What is the value for $C(60)$?

2. What is the contextual meaning of $C(60)$?

3. For which value(s) of m is $C(m) = 16$? What does this value of "m" represent in context?

4. Which of the following tables could also represent $C(m)$? Explain:

Table 1

m	*C*(*m*)
20	12
40	14
60	16
80	18
100	20

Table 2

m	*C*(*m*)
10	11
20	13
30	15
40	17
50	19

Table 3

m	*C*(*m*)
20	12
40	14
60	10
80	18
100	20

Table 4

m	*C*(*m*)
20	12
60	16
100	20
140	24
200	30

Name ________________________________
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Part I: Matt is selling kites to earn money for his upcoming trip to the Big Island. He had to buy equipment to make the kites for 56 dollars and he sells each kite he makes for 7 dollars. The function $\boldsymbol{P(k) = 7k - 56}$ models this situation, where k is the number of kites sold and $P(k)$ is the net profit he has made after selling k number of kites.

1) What is the value of $P(20)$ with units?

2) What does $P(20)$ mean in the context of this situation? *Use a complete sentence.*

3) What is the value of $P(8)$ with units?

4) What does $P(8)$ mean in the context of this situation? *Use a complete sentence.*

Part II: Leilani is measuring her brother Michael's height over his lifetime. The following table represents her data where y stands for Michael's age in years and $H(y)$ represents his height in feet at that age.

y	$H(y)$
0	1
3	2.3
6	4
9	4.5
12	5
15	5

5) What is the value of $H(9)$ with units?

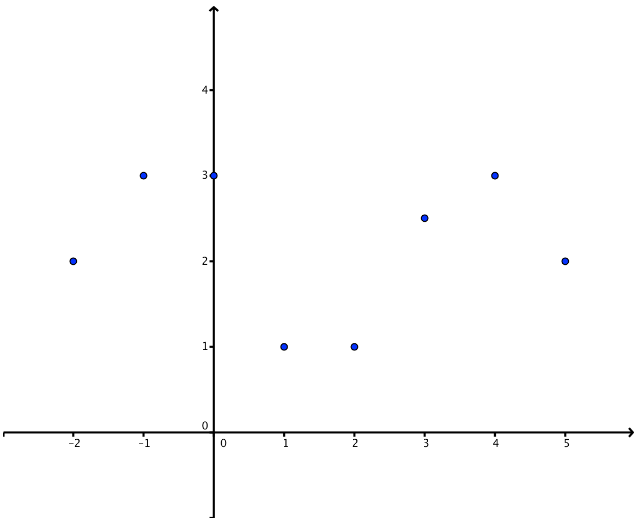
6) What does $H(9)$ mean in this context? *Use a complete sentence.*

7) What do you think happens between 12 and 15 years of age?

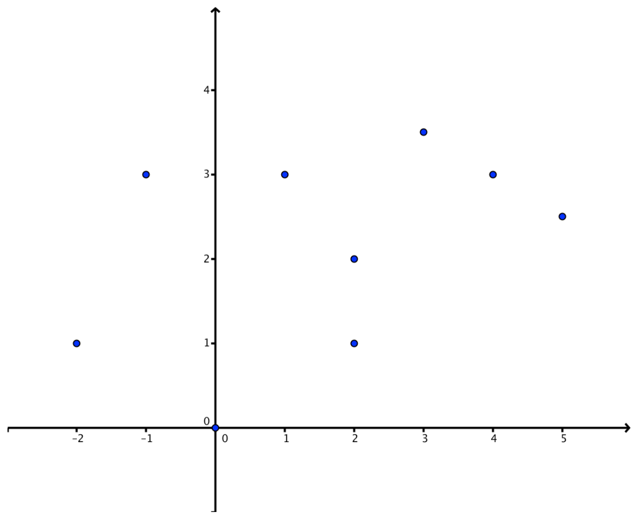
Name ________________________________
Pd _____________ Date ________________

Part III: Decide (circle either Yes or No) if the following plots represent the graph of a ***function***. If your answer is "No", draw a vertical line to indicate where the *vertical line test* failed.

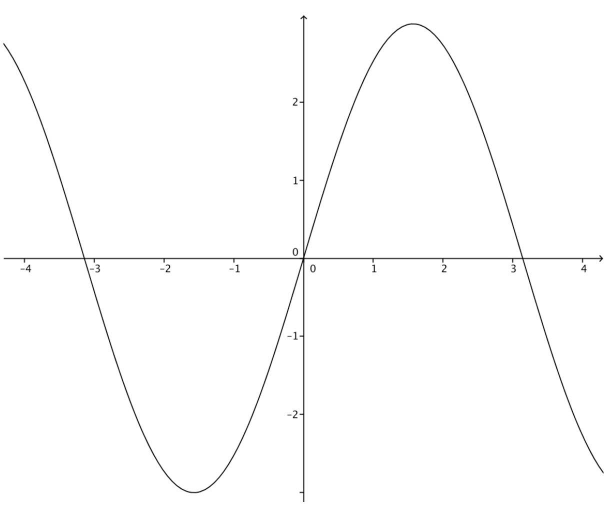
8. Yes No



9. Yes No



10. Yes No



Name ______________________________
Pd ____________ Date _______________

1. Function h is defined symbolically as $h(t) = -16t^2 + 40t + 4$.
   Evaluate each of the following. Show all work in the space provided.

a. $\boldsymbol{h}$**(0)**

$h(t) \ = -16t^2 + 40t + 4$
$h(0) = -16(0)^2 + 40(0) + 4$ *E (Exponents)*
$h(0) = -16(0) + 40(0) + 4$ *M (Multiply)*
$h(0) = 0 + 0 + 4$ *A (Add)*
$h(0) =$

b. $\boldsymbol{h}$**(1)**

$h(t) \ = -16t^2 + 40t + 4$
$h(1) = -16(1)^2 + 40(1) + 4$ *E*
$h(1) = -16(1) + 40(1) + 4$ *M*
$h(1) =$ *A*
$h(1) =$

c. $\boldsymbol{h}$**(2)**

$h(t) \ = -16t^2 + 40t + 4$
$h(2) =$

d. $\boldsymbol{h}$**(3)**

$h(t) \ = -16t^2 + 40t + 4$
$h(3) =$

2. Keoki tossed a ball in the air. The height h of the ball can be represented as a function of time t, with $t = 0$ representing the moment the ball left Keoki's hand. The function from problem one represents this scenario: $h(t) = -16t^2 + 40t + 4$

- The **height** of the ball, $h(t)$, is measured in feet.
- The amount of **time** that the ball is in the air, t, is measured in seconds.

a. From problem 1c, $\boldsymbol{h(2) = 20}$. Translate this complete mathematics sentence into a complete sentence using words. Your translation should include what the "2" represents and what the "20" represents in the context of Keoki's ball toss.

b. Knowing now that function h represents the height of a ball, explain why $h(3)$ does not make sense in the context of Keoki's ball toss. What was the value of $h(3)$? What would this mean in the context of Keoki's ball toss?

3. Keoki notices that based on your work from problem 1, the ball reached a height of 28 feet one second after it left his hand. He was curious whether 28 feet was the maximum height the ball attained. He decided to investigate this by evaluating function $h(t)$ at several times that are near one second. The results of Keoki's computations are provided in the table to the right.

t	h(t)
0.9	27.04
1.0	28
1.1	28.64
1.2	28.96
1.3	28.96
1.4	28.64
1.5	28

Based on this table of values:

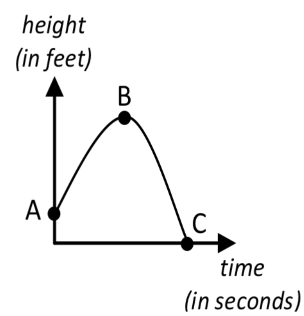
a. How high do you think this ball reached? (Note: make your best guess/estimate based on the values in the table.)

b. When would you predict this maximum height occurred?

4. Keoki's math teacher, Mr. Lee, informed Keoki that based on the function from problem 1, the ball reached its maximum height at exactly 1.25 seconds. Use the function $h(t)$ to determine the maximum height that the ball reached.

$h(t) = -16t^2 + 40t + 4$
$h(1.25) =$

5. Shown at the right is the graph of the function $h(t)$. Use your answers from previous questions (#1 and #4) to answer the following questions.



a. Determine the coordinates of points A and B on the graph. Write the coordinates as ordered-pairs:

A(,) B(,)

b. On the graph, point C represents the time, t, when the height of the ball, $h(t)$, was zero feet above the ground. In other words, $h(t) = 0$ means "the time when the ball hit the ground."

Analyze all four answers from question 1 (a – d) and think about what they mean in the context of Keoki's ball toss. Then, estimate the coordinates of point C and explain how you decided on this estimate.

C(,)

c. Come up with 2 additional questions (related to the context of Keoki's ball toss) that you could use $h(t)$ to help you answer.

 Name ______________________________

 Pd ____________ Date ______________

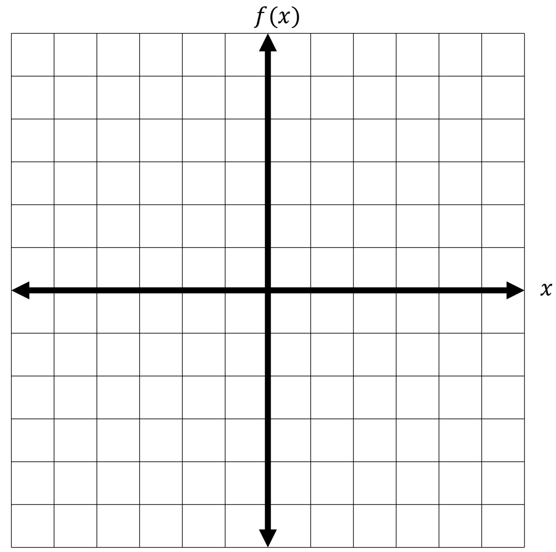
1. In previous math classes you worked with **linear functions**: those of the form $y = mx + b$. With our function notation, these **linear functions** will now often be written as $f(x) = mx + b$.

   Complete the table below and use the resulting ordered-pairs to create the graph for $f(x) = \frac{1}{2}x - 3$.

x	***f(x)***
-4	-5
-2	
0	
2	
4	

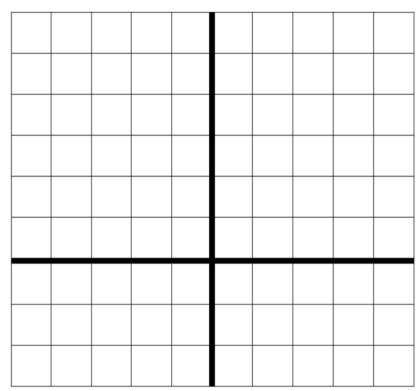
$f(x) = \frac{1}{2}x - 3$

$$\begin{aligned} f(-4) &= \tfrac{1}{2}(-4) - 3 \\ &= -2 - 3 \\ &= -5 \end{aligned}$$



2. Complete the table below and use the resulting ordered-pairs to create the graph for $g(x) = 5 - 3x$

x	***g(x)***
0	
1	
2	



3. Analyze the following tables and then answer the questions that follow.

$f(x) = \frac{1}{2}x$ $g(x) = \frac{1}{3}x$ $h(x) = \frac{1}{4}x$

x	***f(x)***	***x***	***g(x)***	***x***	***h(x)***
-100	-50	-15	-5	-40	-10
-6	-3	-6	-2	-12	-3
4	2	3	1	4	1
10	5	12	4	44	11
18	9	33	11	100	25

Summarize

a. Multiplying by ½ has the same result as ______________________________ .

b. Multiplying by ⅓ has the same result as ______________________________ .

c. Multiplying by ¼ has the same result as ______________________________ .

d. Multiplying by $1/x$ has the same result as ______________________________ .

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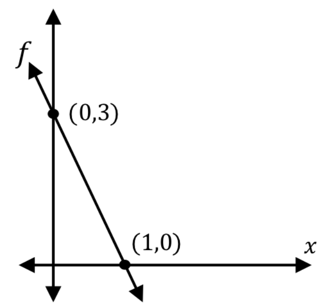
Throughout Algebra 1 you will be working with 4 ways to represent functions:

- Symbolically (an equation or function)
- Visually (a graph)
- Numerically (a table of values and ordered pairs)
- Descriptively (using words, often to represent a real world situation)

First, let's focus on the relationship between the symbolic representation (the equation) and the visual representation (the graph).



1. Function f graphed at the right is linear.
   a. The x-coordinate, (1, 0), tells us that f(1) = _______
   b. The y-coordinate, (0, 3), tells us that f(0) = _______
   c. Use the information from a and b (above) to determine which one of the following functions is the graph of f.

      i. $f(x) = \frac{-1}{3}x + 3$ ii. $f(x) = \frac{-1}{3}x + 1$

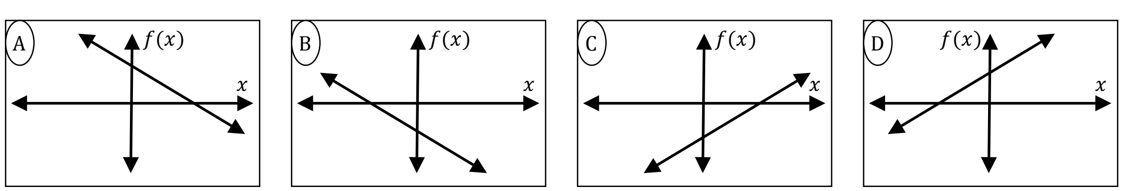
      iii. $f(x) = -3x + 1$ iv. $f(x) = -3x + 3$

   d. Explain how you determined your answer for question 1c (above).

   e. Verify that your answer for question 1c is correct by determining the values of f(0) and f(1) for the function you chose.

2. Determine the following values for the function $f(x) = \frac{1}{3}x - 5$.
   a. f(0) = _____________ b. f(15) = ____________ c. f(12) = ___________

3. Use your answers from question 2 (above) to determine which one of the following graphs could be graph of $f(x) = \frac{1}{3}x - 5$.



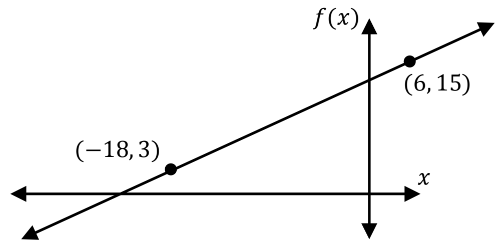
3. Which one of the following functions represents the graph shown to the right?

a. $f(x) = 2x + 3$

b. $f(x) = \frac{1}{3}x + 3$

c. $f(x) = x + 21$

d. $f(x) = \frac{1}{2}x + 12$



Verify that your answer is correct by determining the values of f(-18) and f(6) for the function you chose and comparing these values to the coordinates of the points shown in the graph.

4.

A. The equations for six linear functions are given below. Complete each table by determining 2 solutions for each equation.

- $x = 0$ has already been selected for each problem.
- Choose your own x-value for the second solution.

$y = 2x$

x	**y**
0	

$y = \frac{2}{3}x + 2$

x	**y**
0	

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

x	**y**
0	

$y = -2(x - 2)$

x	**y**
0	

$y = 2$

x	**y**
0	

$y = \frac{3}{2}x - 3$

x	**y**
0	

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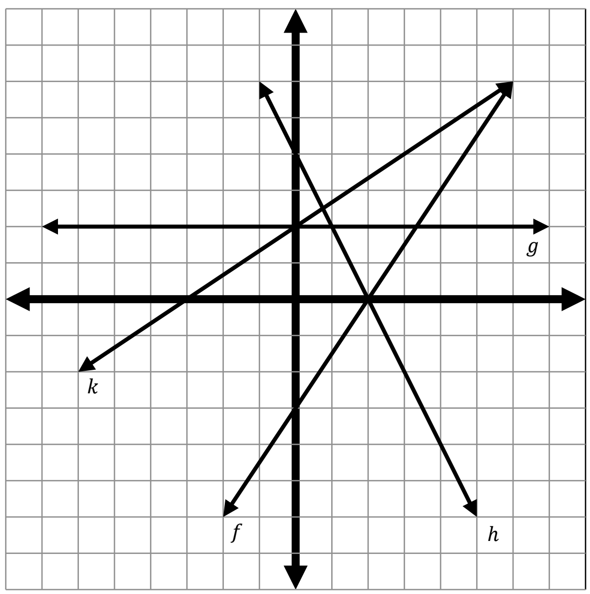
B. Matching:

The same linear equations from 4A are now represented graphically as functions f, g, h, and k. Match each graph to its symbolic representation by filling in the appropriate box with $f(x), g(x), h(x)$, or $k(x)$. (Note: Two of the equations do not have a graphical match, so two boxes will remain blank for now.)



$\boxed{} = 2x$

$\boxed{} = \dfrac{-x+4}{2}$

$\boxed{} = 2$

$\boxed{} = \dfrac{2}{3}x + 2$

$\boxed{} = -2(x-2)$

$\boxed{} = \dfrac{3}{2}x - 3$

5. Nohea answered the question below by selecting the correct choice: "c".

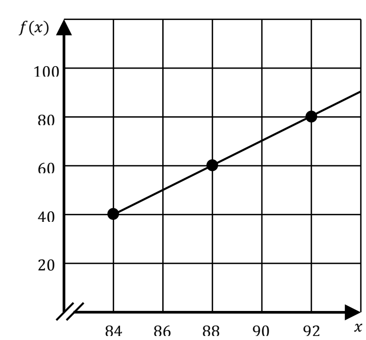
Multiple Choice:
Which equation corresponds to the linear function represented in the graph?

Ⓐ $f(x) = \frac{1}{2}x - 2$

Ⓑ $f(x) = 5x + 30$

Ⓒ $f(x) = 5x - 380$

Ⓓ $f(x) = \frac{1}{2}x + 16$



A. Use the equation to find the y-intercept. $f(0) =$________
Why does this value seem to NOT match the graph (even though it actually does)? Explain.

B. The functions for options A and D both had a slope of ½. What error might someone have made in order to think that the graph has a slope ½?

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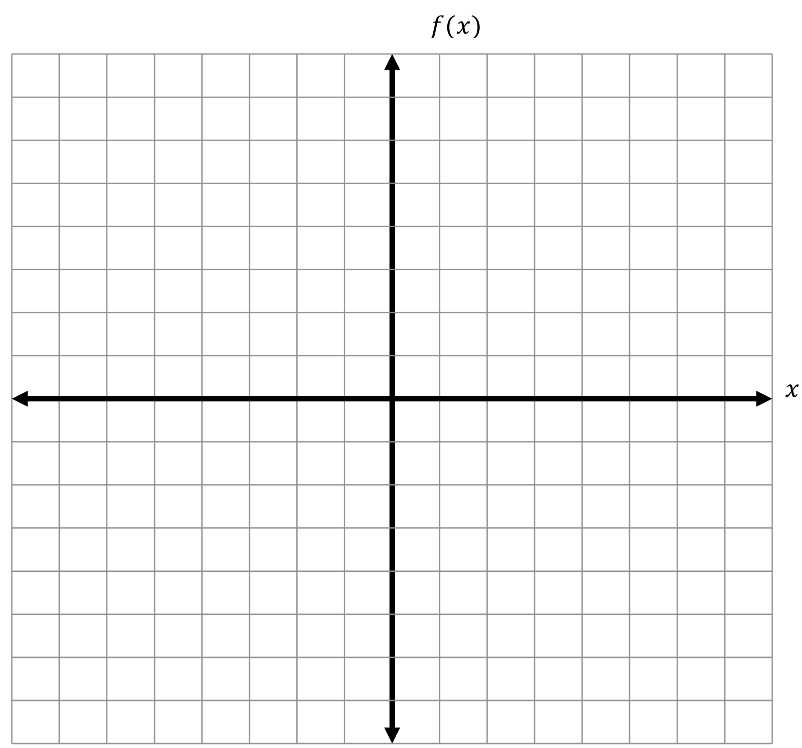
6.

A. Create a graph for a function f given the following conditions:

- $f(0) = 1$
  - *hint: what ordered pair is suggested by the statement f(0) = 1 ?*
- $f(1) = 2 \cdot f(0)$
  - *hint: you need to read this statement as, "the output of* f *at* $x = 1$ *is two times the output of function* f *at* $x = 0$*."*
- f is linear



B. Determine an equation for the function represented by your graph.

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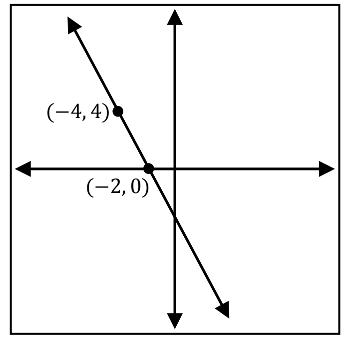
Lani needed to find the symbolic representation for the linear function graphed below. She selected choice B – **a wrong choice.**

Multiple Choice:
Which equation corresponds to the linear function represented in the graph?
A. $f(x) = -3x - 6$
B. $f(x) = -3x - 2$
C. $f(x) = -2x - 6$
D. $f(x) = -2x - 4$



1. Show or explain why Lani's selection is not the correct representation for the graph.

2. Which of the other multiple choice options is the correct equation for the graph shown above?

A $f(x) = -3x - 6$
B $f(x) = -3x - 2$
C $f(x) = -2x - 6$
D $f(x) = -2x - 4$

3. Justify your selection by evaluating the equation you chose for $x = -4$ and $x = -2$. Show your work.

$f(-4) =$ $f(-2) =$

4. Determine the y-intercept for the graph of *f(x)*.

   a. First, state the y-intercept using function notation: _____________

   b. Second, state the y-intercept as an ordered pair: _____________

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5. Review of exponents: Recall that

x^4 ➔ "x to the fourth power" means "4 factors of x"

3^4 ➔ "3 to the fourth power" means "4 factors of 3"

$3^4 = 3 \cdot 3 \cdot 3 \cdot 3$

$= 81$

a. 10^3 means "_______ factors of _______," therefore, 10^3 = ___________.

b. 2^4 means "_______ factors of _______," therefore, 2^4 = ___________.

c. 9^2 means "_______ factors of _______," therefore, 9^2 = ___________.

6. One of the Laws of Exponents tells us that $\frac{x^a}{x^b} = x^{a-b}$.

- This means that when you divide two expressions that have the same variable, you ***subtract the exponents***.
- Therefore, $\frac{x^7}{x^2} = x^5$ and $\frac{x^4}{x^1} = x^3$

Use this Law of Exponents to write an equivalent expression for the following quotients:

a. $\frac{x^9}{x^5} =$ ___________ b. $\frac{x^{24}}{x^{11}} =$ ___________ c. $\frac{x^6}{x^5} =$ ___________

7. A long time ago you learned that any time you divide a number by itself, the quotient is 1:

$\frac{4}{4} = 1$, $\frac{-13}{-13} = 1$, and $\frac{212}{212} = 1$.

The same result happens even when you divide a variable (with an exponent) by itself:

$\frac{x^9}{x^9} = 1$, $\frac{x^2}{x^2} = 1$, and $\frac{x^6}{x^6} = 1$.

But remember, the Law of Exponents that we used in question 6 (above) also tells us that when we are dividing the same variable, we can subtract the exponents to create an equivalent expression. So now we can say the following:

- Using that Law of Exponents, we know that $\frac{x^9}{x^9} = x^0$ ➔ but we also know that $\frac{x^9}{x^9} = 1$
- Using that Law of Exponents, we know that $\frac{x^2}{x^2} = x^0$ ➔ but we also know that $\frac{x^2}{x^2} = 1$
- Using that Law of Exponents, we know that $\frac{x^6}{x^6} = x^0$ ➔ but we also know that $\frac{x^6}{x^6} = 1$

a. **Complete the following sentence**: Based on the information above, I can conclude that x^0 = _____ . In other words, anything to the zero power will always equal _____ .

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We now continue to investigate the relationship between equations and graphs using functions other than linear functions; functions you are less familiar with or maybe not familiar with at all.

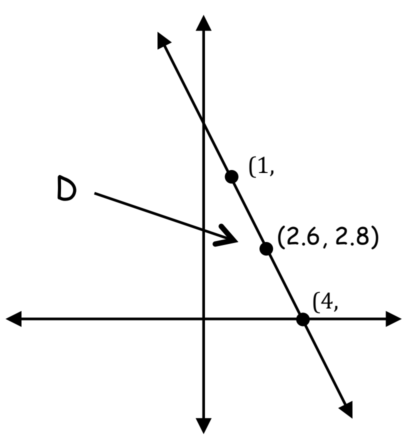
Consider the following 10 functions:

$f(x) = 3(x+5)(x-2)$	$f(x) = x^2 - 2x - 8$	$f(x) = 2 \cdot 3^x$	$f(x) = \frac{7x+5}{2}$
$f(x) = -2x + 8$	$f(x) = x^2 - x - 12$	$f(x) = 5 \cdot 2^x$	$f(x) = 3 \cdot 2^x$
$f(x) = -2(x-4)(x+2)$	$f(x) = 2x + 4$		

The pages that follow show the graphical representations of 6 of the functions in the table above. For each of the 6 graphs:

A. Identify which function (from the list above) matches the given graph. Write your answer in the box that appears below the graph.
B. Use 2 of the points shown on the graph to **justify your match**.
C. Answer the follow up question (in the box below the "justify your match" box).
D. Your answer to part C (the "follow-up question") will represent an additional point for the graph. Add this point to the appropriate location on the graph.

For example:



$f(x)$ = -2x + 8

A

B.

Justify your match:

f(1) = -2(1) + 8
f(1) = -2 + 8
f(1) = 6
(1, 6) ✓

f(4) = -2(4) + 8
f(4) =
f(4) =
(4,) ✓

C.

Follow-Up Question:
What is the value of f when $x = 2.6$?

f(2.6) = -2(2.6) + 8
f(2.6) = -5.2 + 8
f(2.6) = 2.8

Notice that you need to use the equation to answer this question because this exact value is not observable from the given graph.

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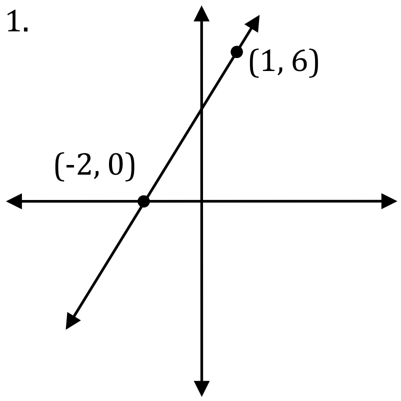
1.



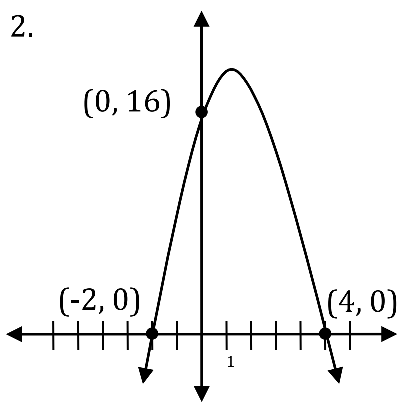
$f(x) =$

Justify your match:

Follow-Up Question:

What is the y-intercept for this linear function? (Remember, the y-intercept is always the y-value when x is zero.)

2.



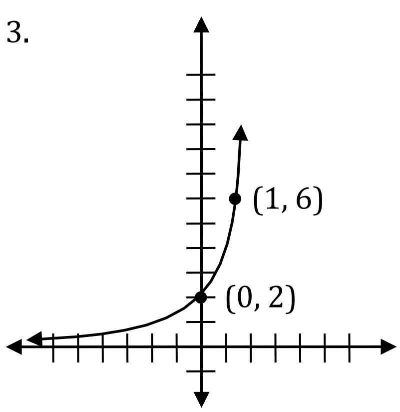
$f(x) =$

Justify your match:

Follow-Up Question:

This curve (called a parabola) reaches its maximum height at x=1. What is this maximum height?

3.



$f(x) =$

Justify your match:

Follow-Up Question:

What is the value of f(-2)?

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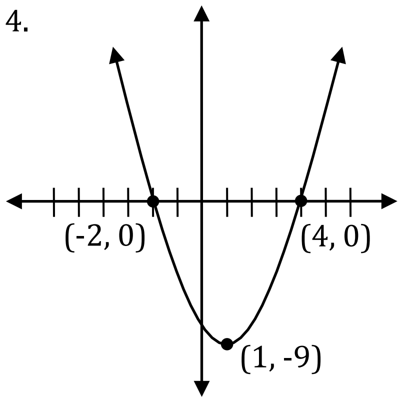
4.



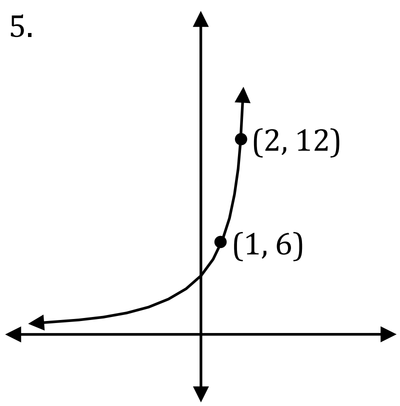
$f(x) =$

Justify your match:

Follow-Up Question:

What is the y-intercept for this parabola?

5.



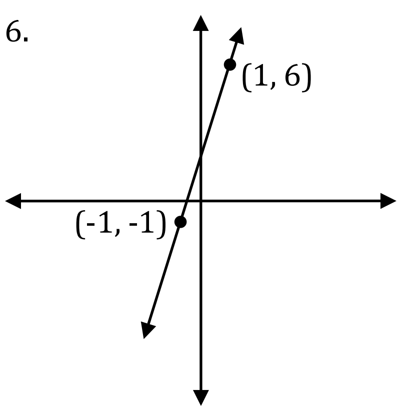
$f(x) =$

Justify your match:

Follow-Up Question:

What is the y-intercept for this function?

6.



$f(x) =$

Justify your match:

Follow-Up Question:

What is the y-intercept for this linear function?

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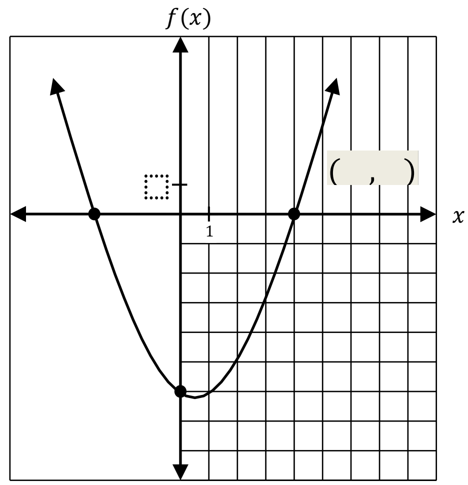
The Messed Up Copy Machine

Mr. Kealoha knew it was going to be a bad day from the start. First of all, it was a Monday with no holidays in sight. Then, he realized he was all out of coffee filters. To make things worse, he got stuck behind a school bus that stopped at every street on his way to school. And finally, once at school – after waiting patiently for Mrs. Denny to make copies of her Word Search (not sure why Mrs. Denny is still giving her students word searches) – the copies for his Algebra 1 class came out looking like this!

With only minutes before period 1, Mr. Kealoha decided to make the most of his rough start. He finished making copies and wrote the following problems on the white board in class.



$f(x) = (x+3)(x-4)$

Use the messed up graph and the equation for function f to answer Mr. Kealoha's problems. Show or explain how you answered each question.

1. What is the y-intercept for this function? Be careful, although the x-axis has a clearly marked scale of 1, the y-axis does not necessarily have a scale of 1.

2. Fill in the missing ⬚ on the graph indicating the scale of the y-axis.

3. What is the value of $f(5)$? Add this ordered pair to the graph and indicate its location with a "•". Note: Mr. Kealoha only drew the graph by hand and it's only an approximation to the actually graph, so your point may or may not seem to line up to where it should be.

   $f(\mathbf{5}) = (\mathbf{5}+3)(\mathbf{5}-4)$

4. Based on the graph, function f has a zero at $x = 4$. (Remember, a zero is an x-intercept). Verify this zero using the equation.

   $f(\mathbf{4}) = (\mathbf{4}+3)(\mathbf{4}-4)$

5. Function f has another zero at a negative x-value. This value, however, is not clear on this graph. Use the equation to find this value. Explain what you did and verify that this point is a zero.

   $f(\quad) = (\qquad)(\qquad)$

6. Function f has a minimum value (its lowest output) at $x = 0.5$. Use the graph to estimate this minimum value.

   (0.5, _____)

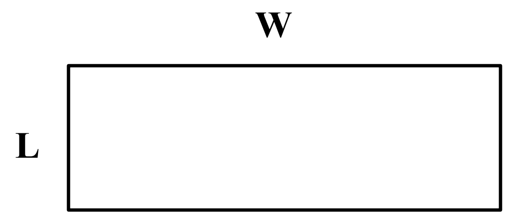
7. Calculate the actual minimum value by evaluating the function f at $x = 0.5$. How close was your estimate to the actual value?

   $f(0.5) = (\qquad)(\qquad)$

You've learned previously that there are a few different ways to represent the formula for the PERIMETER of a rectangle.

In the diagram to the right,

- **W** represents the horizontal distance (across) the rectangle
- **L** represents the vertical distance (up/down) the rectangle



Thus, we can represent the PERIMETER of the rectangle in 3 different (yet equivalent) ways:

P = L + W + L + W or **P = 2L + 2W** or **P = 2(L + W)**

1. Write a simple phrase to complete each sentence that explains what each version of the formula tells us to do to find the perimeter of any rectangle:

   a. The 1st version of the formula tells us we can just ________________________________ .

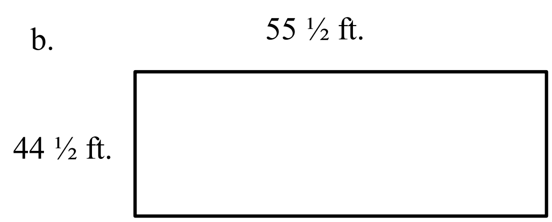
   b. The 2nd version tells us we could ____
   ____.

   c. Or, the 3rd version tells us we could ____
   ____.

2. Use the **P = 2(L + W)** version of the formula to determine the perimeter of the following rectangles (this version tells us to "*add the length and the width, then double that sum*").

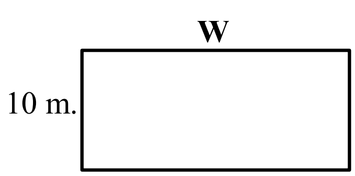
   a. A rectangle with a length of 13 cm. and a width of 21 cm.

   b.

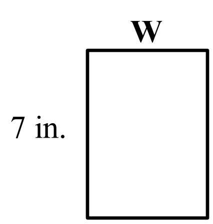


3. In the rectangles below, you are given the length and the perimeter.
   - The **P = 2(L + W)** version of the formula can also be thought of as $\frac{P}{2} = L + W$. This version tells us that <u>the sum of the Length and the Width</u> will equal ***one-half of the Perimeter***.
   - Use this idea (that "the sum of L and W will equal one-half of the Perimeter") to help you determine the width of the following rectangles.

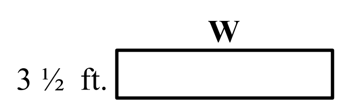
   a. P = 80 meters



   b. P = 24 inches



   c. P = 20 feet



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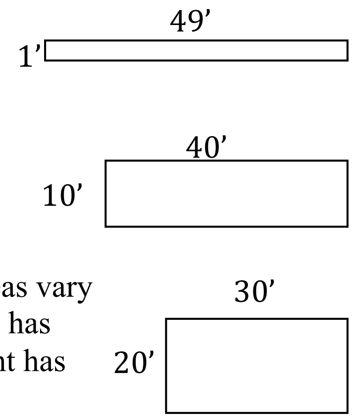
Gardening with Malama

Malama wants to fence in a rectangular area for a garden. Her mom, Mrs. Aina, provided her with 100 feet of fencing for this purpose.

There are many (infinitely many, actually) dimensions for the rectangular garden. Assume she uses all 100 ft of fencing. Here are diagrams for just a few of these possibilities.

Although each of these rectangles use 100ft of fencing, the areas vary greatly. The rectangle illustrated at the top-right, for example, has an area of 49 sq ft ($A = LW$). The bottom rectangle at the right has an area of 600 sq ft.

A=L•W



A=49•1
A=49 sq ft

A=10•40
A=400 sq ft

A=20•30
A=600 sq ft

1. Complete the table below relating the area A to the length L of the rectangle. Although the width (base) is not included in this table, this measure must be known in order to determine the area. The process for completing each row of this table is included for the first few rows.

L	A
1	
5	225
10	
24	624
25	
27	
30	600
35	
40	
48	

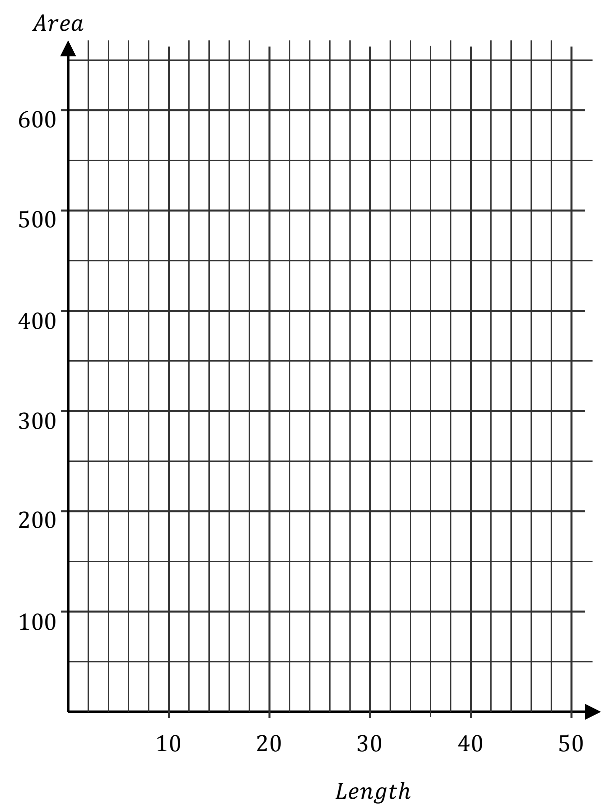
Recall from last night’s homework: “***the sum of L and W will equal one-half of the Perimeter***.”

- Therefore, if the perimeter of Malama’s garden must be 100 feet, then the sum of L and W must be _______.

So, if the length of Malama’s garden is 5 ft, to find the width I need to think, 5 + ___ = 50, so W = 45. Now I can determine the area: A = LW, so A = 5(45), therefore, A = 225 sq. ft.

If L = 30, I need to think, “30 + ___ = 50” so, the width has to be 20.
Now I can determine the area: A = LW, so A = 30(20), therefore, A = 600 sq. ft.

2. Use the values in your table above to sketch a graph for the area A as a function of the length L. Connect your points with a smooth curve.



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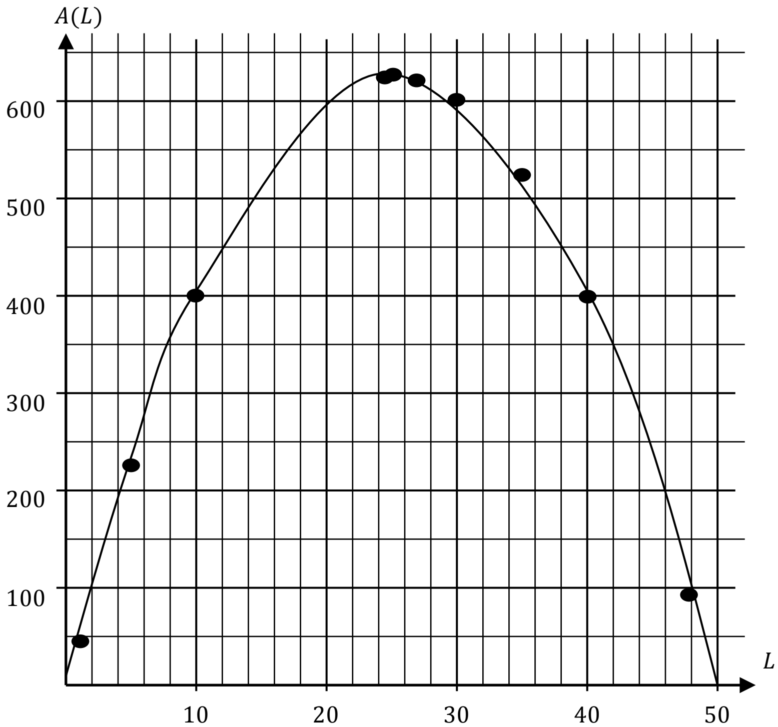
Below is a review of the table and graph you created from problems 1 and 2 on the previous page.

Along with the graph and table, a function representing the area of Malama's rectangular garden is also provided. The function, $A(L) = L(50 - L)$, will gives us the Area of any rectangle (with a perimeter of 100) if we know it's length. In other words, "Area as a function of the length."



$$A(L) = L(50 - L)$$

L	A
1	49
5	225
10	400
24	624
25	625
27	621
30	600
35	525
40	400
48	96

The next page asks 5 questions about different scenarios regarding Malama's rectangular garden.

- Use the table of values, the symbolic representation (i.e., the function), or the graph to answer the questions.
- Then, indicate which representation(s) you used to answer the question, and provide a brief explanation/reason why you chose that representation to help you answer the question.

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3. Answer the questions below about different scenarios regarding Malama's rectangular garden.
   - Use the table of values, the **symbolic representation** (i.e., the function), or the *graph* on the previous page to help you answer each question.
   - Then, indicate which representation(s) you used to answer the question, and provide a brief explanation/reason why you chose that representation to help you answer the question.

A. Malama's garden would have an area of 500 sq ft if the length was about 14 ft long. At about what other length would give Malama this same area of 500 sq ft?	☐ symbolic representation ☐ table of values ☐ graph Reason why you used that representation:
B. Your response to question 3A (above) was most likely an estimate. How close was your estimated length to the desired area of 500 sq ft?	☐ symbolic representation ☐ table of values ☐ graph Reason why you used that representation:
C. What is the area of Malama's garden if her rectangle is also a square (the length and width are the same)?	☐ symbolic representation ☐ table of values ☐ graph Reason why you used that representation:
D. A garden length of 48 ft gave Malama a garden area of 96 sq ft. What other length would give her the same area (96 sq ft)?	☐ symbolic representation ☐ table of values ☐ graph Reason why you used that representation:
E. What length(s) would give Malama an area of 600 sq ft?	☐ symbolic representation ☐ table of values ☐ graph Reason why you used that representation:

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Nalu is training for the upcoming wrestling season. His coach told him that sit-ups are a good conditioning exercise. After one day of conditioning, Nalu was able to perform 40 sit-ups without stopping. By the end of the second day of conditioning this number improved to 45. By the end of each consecutive day, Nalu improved the number of continuous sit-ups by 5.

d	$N(d)$
0	
1	40
2	45
3	
6	
10	
37	

1. Complete the table for the function $N(d)$ which represents the number of sit-ups Nalu is able to perform without stopping at the end of the d^{th} day of training.

2. Provide a brief explanation of what d = 0 and what N(0) means in this situation?

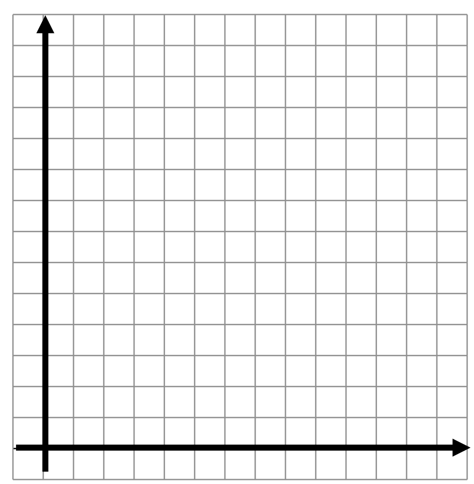
3. To complete the table, Nalu felt it would take way too long to keep adding 5 over and over again in order to find the value of $N(37)$. Instead, to find N(37) more efficiently, he used the following expression: $5 \bullet 37 + 35$.

   Fill in each blank to indicate what each part of Nalu's expression represents in the context of this situation.

   In Nalu's expression, $5 \bullet 37 + 35$ ➔
   - the "5" represents ________________________
   - the "37" represents _______________________
   - the "35" represents _______________________

4. Determine the linear function, *N(d)*, that represents this situation. Since it's linear, it should be in the form $y = mx + b$, or in this case, $N(d) = md + b$.

   N(*d*) =



5. Graph $N(d)$. Label and identify the scale for each axis.

6. Confirm that your function is correct by determining the value of *N(0)* and *N(6)* and then comparing it to the table of values in question 1 (above).

7. How many sit-ups would Nalu be able to do at the end of the 50^{th} day? Show or explain how you arrived at your answer.

8. How many days would he need to train in order to be able to do 1000 sit-ups without stopping? Show or explain how you arrived at your answer.

Kina Kealoha decided to set up a liliko'i-orange juice stand at the community farmer's market held on the first Saturday of each month. The Kealohas have several orange trees, and the liliko'i vine – well let's just say you can no longer see the ohi'a tree it's climbing up, so it cost her nothing for the fruit. She did, however, need to borrow $6 from her dad to purchase the cups needed for this entrepreneurial endeavor. She decided to sell her juice for $0.50 a cup.

9. Kina wants to pay her dad back as soon as possible. How many cups must she sell in order to have enough money to pay back her dad? Show or explain how you determined your answer.

10. Create a table of values representing her profit, ***P***, as a function of the number of cups, ***c***, that Kina sells.

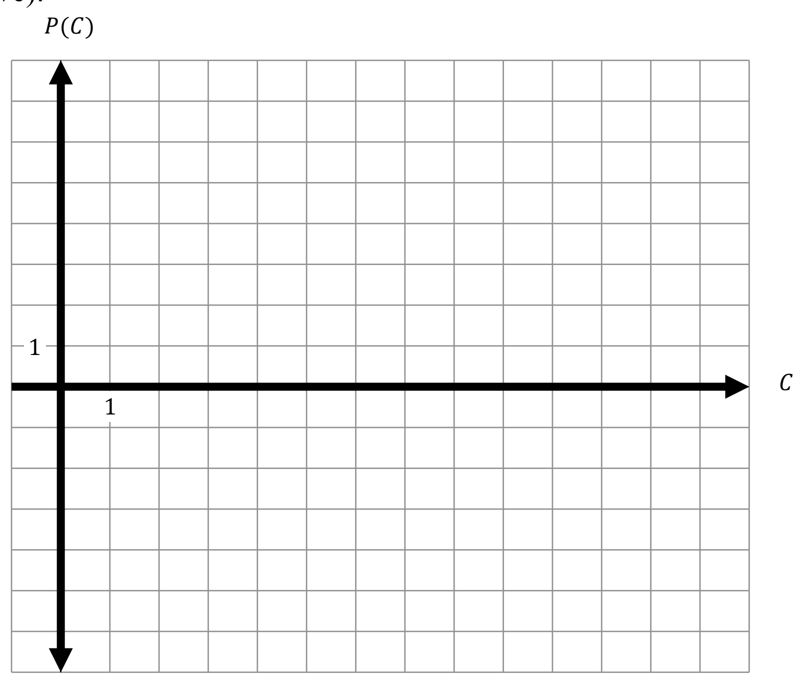
- Remember, Kina first had to borrow money from her dad. Therefore, in the beginning, she had a negative profit.
- Select 3 additional values for ***c*** and add them to the table (in the empty rows). Be sure to include your answer to question 9 (above) in the table as well.

$\boldsymbol{c}$	$\boldsymbol{P(c)}$
0	
4	
14	
188	

11. Think about the process that you used to determine each of the values in the P(c) column in the table. Use that process to create a linear function that represents this situation. Since it's linear, it should be in the form $y = mx + b$, or in this case, $P(c) = mc + b$.

12. Confirm that your function is correct by determining the value of *P(0)* and *P(14)* and then comparing it to the table of values in question 10 (above).

13. Graph your function ***P(c)***.



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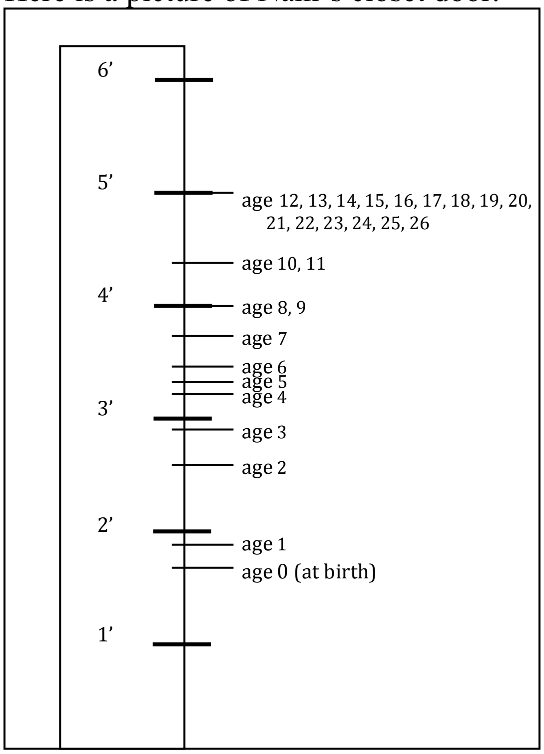
Nani's Height

Nani's mom had a tradition of marking the height of each of her children on the back of a closet door on their birthday. Even as an adult, Nani would visit her mom each birthday and get her height recorded on this same door.

Here is a picture of Nani's closet door.



14. Nani's height on each birthday, ***H(a)***, is a function of her age, ***a***, (i.e., her ***a***th birthday).

    Use the picture of the door to estimate the following. If necessary, round your estimates to the nearest tenth of a foot.

    A. $H(1)$=

    B. $H(4)$=

    C. $H(8)$=

    D. $H(12)$=

    E. $H(25)$=

15. Take the information from the door and translate it to a graph. Although this data only goes up until age 26, include what you think the graph would look like for Nani's entire life (from birth to death). For this graph, don't be concerned with all the details; in fact, don't even mark any scale on the axes. Here, your only concern is the "shape" of the graph.

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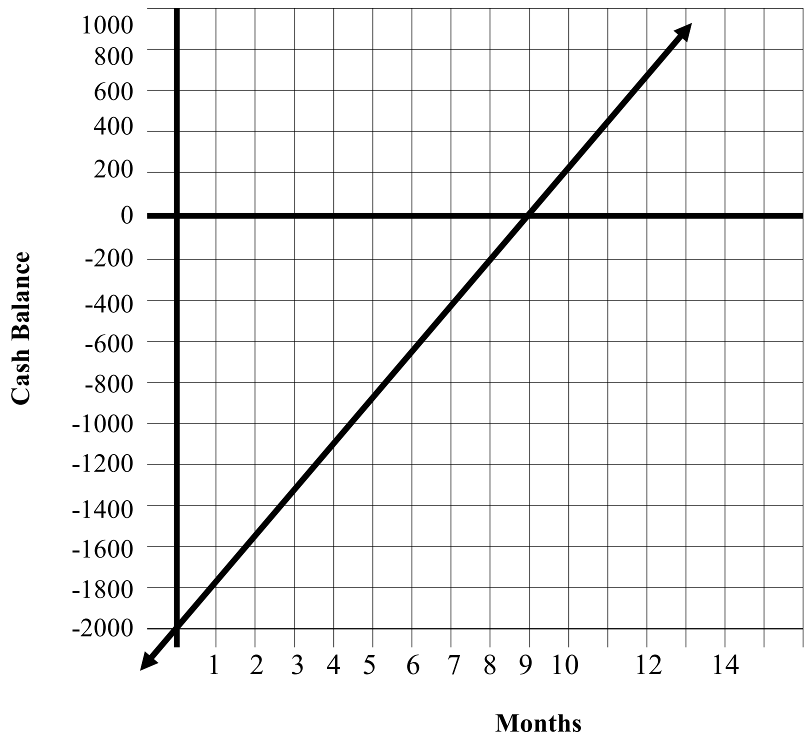
Jessie wants a new paddleboard, however, she doesn't want to buy the paddleboard until she gets herself out of debt (she currently owes other people money so her cash balance is actually a negative value right now).

The following function, ***C(m)***, is represented symbolically, by a table, and by a graph. The function, the table and the graph represent Jessie's cash balance based upon how many months, ***m***, she has been working to get out of debt with a goal of saving enough money to buy a new paddleboard.

$$C(m) = -1980 + 220m$$

m	*C(m)*
0	– 1980
5	– 880
10	220



1. What is Jessie's cash balance after 5 months of working? (include units)

2. Which representation did you use to answer question 1 (the function, the table or the graph)? Explain why you used that representation.

3. What is Jessie's cash balance after 16 months of working? (include units)

4. Which representation did you use to answer question 3 (the function, the table or the graph)? Explain why you used that representation.

Name ______________________________
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1. Analyze how the values in each table change and use any patterns you observe to fill in the last row of each table.

A.

x	f(x)
0	0
1	2
2	4
3	6
4	8

B.

x	g(x)
0	1
1	3
2	9
3	27
4	81

C.

x	h(x)
-2	5
-1	10
0	20
1	40
2	80

D.

x	y
-2	11
-1	8
0	5
1	2
2	-1

E.

x	r(x)
0	5/2
1	2
2	3/2
3	1
4	½

F.

x	d(x)
-2	1
-1	2
0	4
1	8
2	16

2. For Table A, how did you know what the next x and $f(x)$ values were? Explain your observations about the change from one value to the next.

3. For Table B, how did you know what the next x and $g(x)$ values were? Explain your observations about the change from one value to the next.

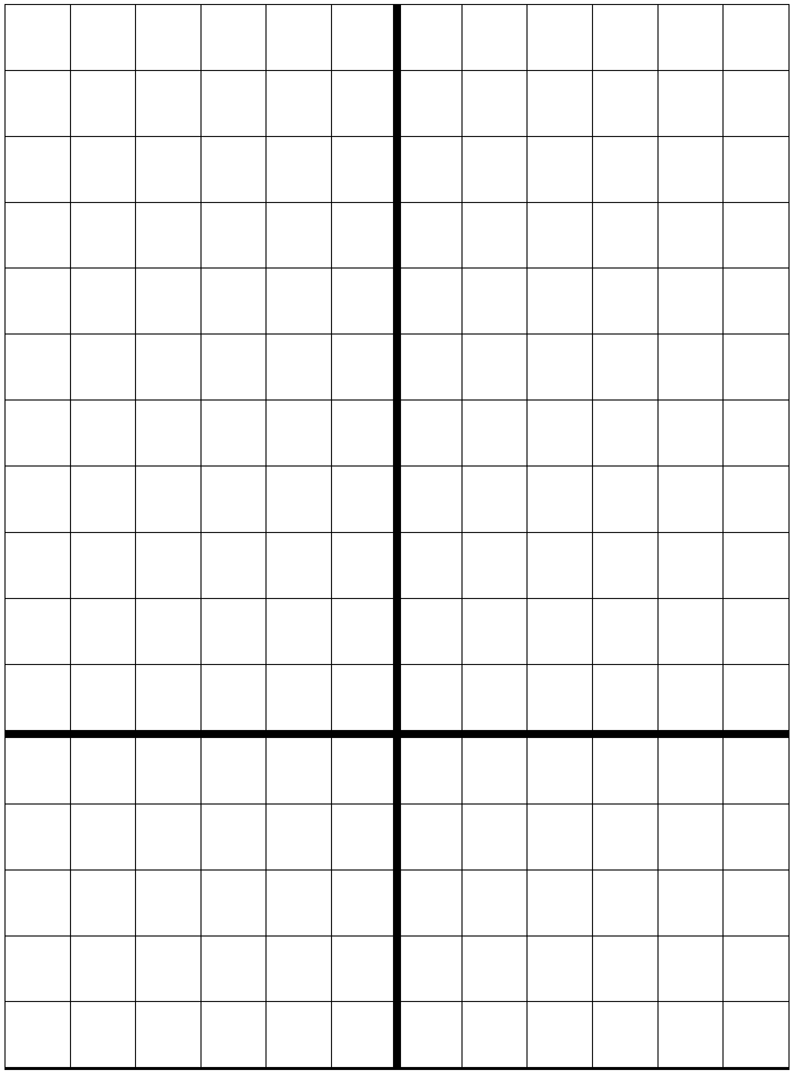
4. For Table E, how did you know what the next x and $r(x)$ values were? Explain your observations about the change from one value to the next.

5. For Table F, how did you know what the next x and $d(x)$ values were? Explain your observations about the change from one value to the next.

6. For which Tables did you have to *add* to get to the last value?

7. For which Tables did you have to *multiply* to get to the last value?

7. Graph the functions represented by tables A, D and E in the coordinate plane below.



8. What do you notice about all 3 graphs? (What is similar about their shapes?)

9. If you graphed all 6 tables (in question 1), list which tables would have graphs that are increasing and which graphs would be decreasing? (Note: you do NOT have to graph all 6; simply analyze each table of values and state the letter for each table in the appropriate box below.)

Tables with graphs that INCREASE	**Tables with graphs that *decrease***

Name ______________________________
Pd ____________ Date ______________

1. Clarissa goes to Foodland and that apples cost $1.50 per pound.

A) Fill in the table, where x represents the pounds of apples and $f(x)$ represents the price she pays for x pounds of apples.

x	$f(x)$
0	0
1	$1.50
2	$3.00
3	
4	

B) Is the price of apples a linear or nonlinear function of the number of pounds purchased? Why?

C) Clarissa's grandma's apple pie recipe calls for 1.5 pounds of apples per pie. She needs to make six pies. What is her total cost for the amount of apples she needs to buy?

D) What is the maximum number of pies she could make if she had $17 with which to buy apples? (Note: assume her grandma has all other necessary ingredients.)

2. On the average your car gets 30.1 miles to each gallon of gas.

A) Complete the table: x represents the number of gallons of gas and f(x) represents the average number of miles driven.

x	$f(x)$
0	0
1	30.1
2	60.2
3	
4	
5	

B) Is the average number of miles driven a linear or nonlinear function of the number of gallons of gas? Why?

C) How many gallons of gas must your car hold if you'd like to drive 400 miles between fill ups?

D) On the average how many miles can you travel on seven gallons of gas?

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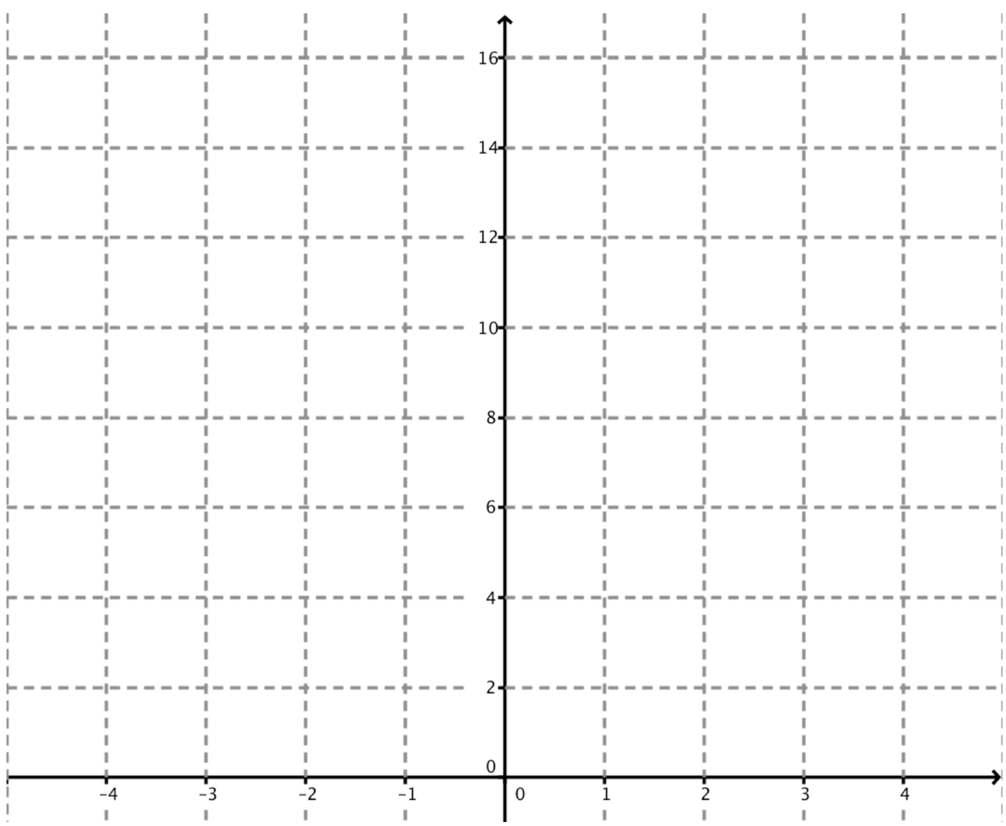
3. Answer the following questions based on the function definition $f(x) = x^2$.

A) Fill in the table for the function $f(x) = x^2$

x	$f(x) = x^2$
-4	
-3	
-2	
-1	
0	
1	
2	
3	
4	

C) What do you notice about the shape of the graph? Is f linear or non-linear? Explain.

B) Graph the function.



Name ____________________
Pd __________ Date __________

1. A caterpillar fell down a well and tried to climb back up. During each day, it would climb 5 feet up at a constant rate, but each night it slipped back 0.5 feet, again at a constant rate.

A) Fill out the rest of the table below, where x represents the start of each day and f(x) represents the caterpillar's distance from the bottom of the well at the start of day x.

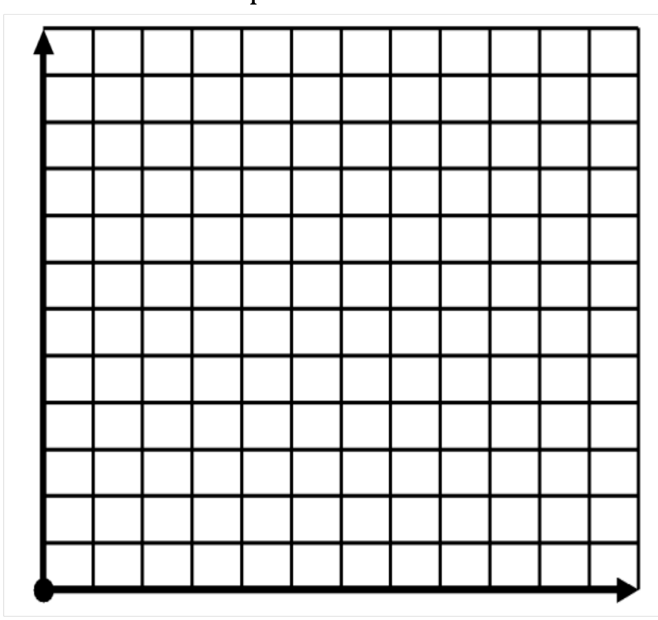
x	f(x)
1	0
2	4.5
3	9
4	
5	

B) Is the caterpillar's distance from the bottom of the well a linear or nonlinear function of time? Why?

C) What is the domain and range of the function f?

D) About how long does it take the caterpillar to get out of the well, if it originally fell 50 feet into the well?

E) Graph the distance the caterpillar travelled versus time.



Name ________________________________
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2. Answer the following questions using the following functions:

$f(x) = 3x$ $g(x) = x^2 + 1$ $h(x) = ½ x + 1$

A) Complete the table for the function f(x)

x	f(x)
-2	
-1	
0	
1	
2	

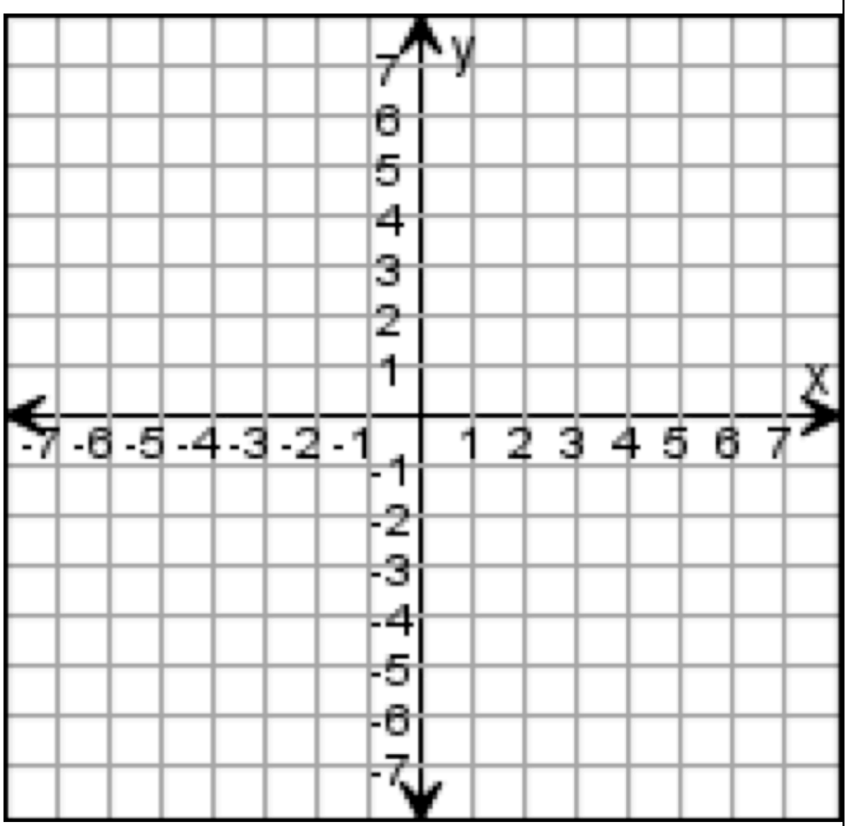
B) Complete the table for the function g(x)

x	g(x)
-2	
-1	
0	
1	
2	

C) Complete the table for the function h(x)

x	h(x)
-4	
-2	
0	
2	
4	
6	

D) Graph all three functions.



E) Which two graphs have similar shapes? Why do you think this is true?

F) How does the shape of g(x) differ from the other graphs?

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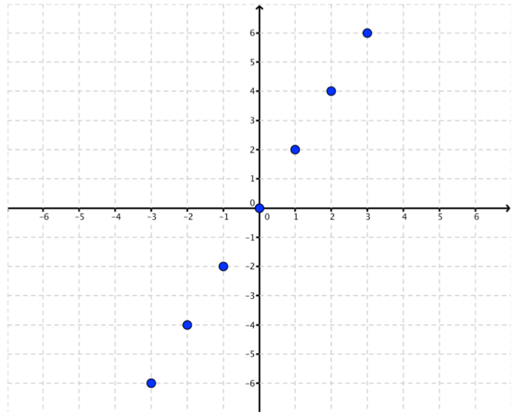
Below are a table of values and the graph of the function $f(x) = 2x$:

x	*f(x)*
-3	-6
-2	-4
-1	-2
0	0
1	2
2	4
3	6



1. Analyze the table and the graph to help you complete the following sentences:

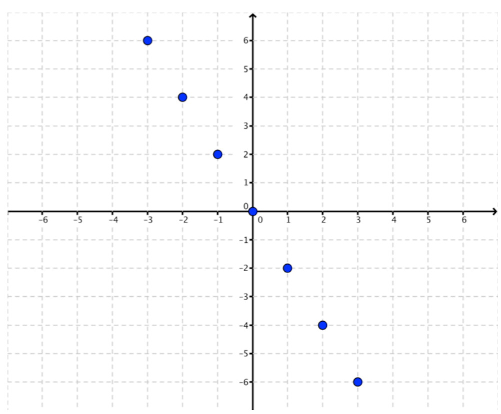
   a. In the table, as the value of x increases by 1, the value of ***f(x)*** _________________ by _________.

   b. In the graph, if we traced our pencil along the grid lines to move from one point to the next, every time we move to the right by 1 unit, we then have to move ________ by ________ unit(s).

2. If you graphed the points for the function ***g(x) = 3x***, to go from one point to the next, every time we move to the right by 1 unit, we then have to move ________ by ________ unit(s).

Below are a table of values and the graph of the function ***c(x) = –2x***:

x	*c(x)*
-3	6
-2	4
-1	2
0	0
1	-2
2	-4
3	-6



3. Analyze the table and the graph to help you complete the following sentences:

   a. In the table, as the value of x increases by 1, the value of c(x) _________________ by _________.

   b. In the graph, if we traced our pencil along the grid lines to move from one point to the next, every time we move to the right by 1 unit, we then have to move ________ by ________ unit(s).

4. If you graphed the points for the function d(x) = –4x, to go from one point to the next, every time we move to the right by 1 unit, we then have to move ________ by ________ unit(s).

Name ______________________________
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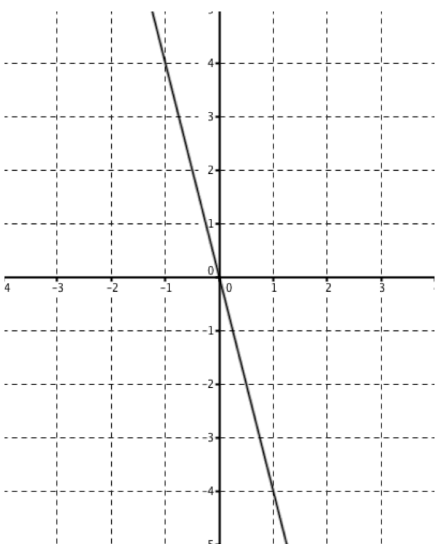
In any linear function, $f(x) = mx$, the coefficient "**m**" is called the **slope**.

The slope, **m**, informs us how to move from one point to the next in a graph:
As we move to the right by 1 unit, we move **m** units up (or down).

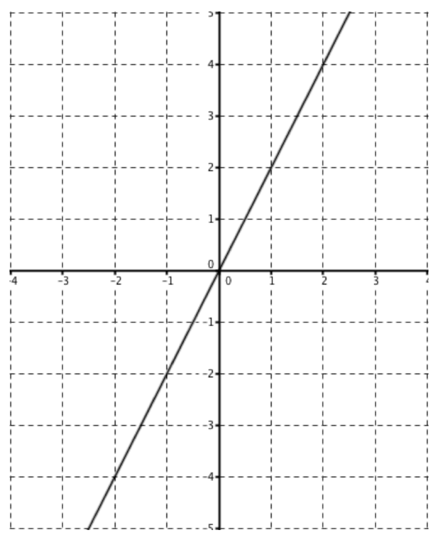
If **m** is POSITIVE, then the graph is INCREASING.
If **m** is negative then the graph is decreasing.

5. Match each graph with one of the functions listed below (write the function on the appropriate graph) and then indicate whether the function is increasing or decreasing.

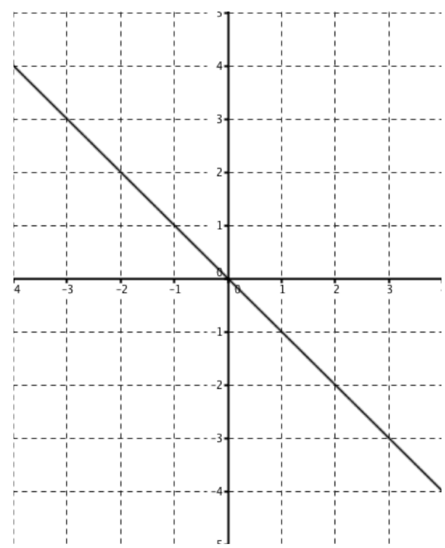
$F(x) = 2x$ $G(x) = -x$ $H(x) = -4x$ $K(x) = 4x$



Increasing or Decreasing

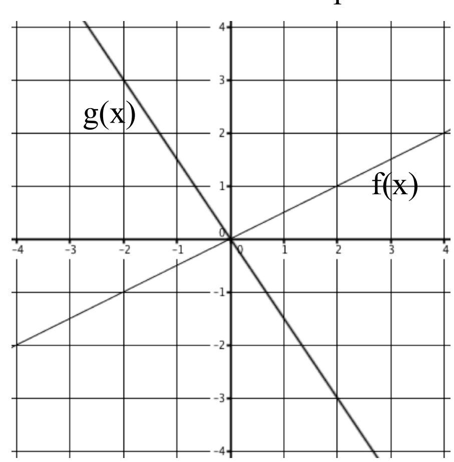


Increasing or Decreasing



Increasing or Decreasing

6. The graphs of 2 functions are shown in the coordinate plane below. Determine the slope of each graph and then fill in the blanks to complete the statement that describes the slope.



a. f(x): slope = _______________
   - This means that as we move 1 unit to the right, we move ____________ by ________ unit(s).

b. g(x): slope = _______________
   - This means that as we move 1 unit to the right, we move ____________ by ________ unit(s).

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The **slope-intercept form** of a linear function is ***f(x) = mx + b***:

- the coefficient "m" is called the slope.
- the constant term, **b**, represents the **y-intercept**.

The y-intercept tells us some very important information about the function:

- It tells us the point where the graph of f(x) crosses the y-axis.
  - In other words, the point (0, b) will lie on the graph.
- It tells us the value of the function when x = 0.
  - In other words, f(0) = b

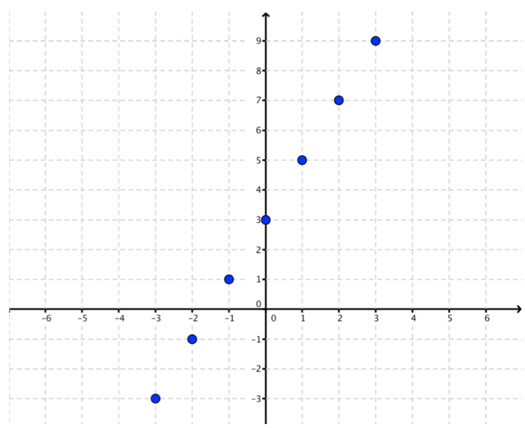
Consider the function f(x) = 2x + 3.

1. State the slope and the y-intercept of f(x)?

   Slope: m = ________ y-intercept: (_____, _____)

2. Below are a table of values and the graph of the function f(x) = 2x + 3.

x	*f(x)*
-2	-1
-1	1
0	3
1	5
2	7
3	9



   a. On the graph, as we move to the right by 1 unit, we move __________ by ________ unit(s).

   b. Circle the row in the table of values that tells us what the y-intercept of f(x) is. Briefly explain why you circled that particular row.

   c. Circle the point on the graph that tells us the value of f(0). Briefly explain why you circled that particular point.

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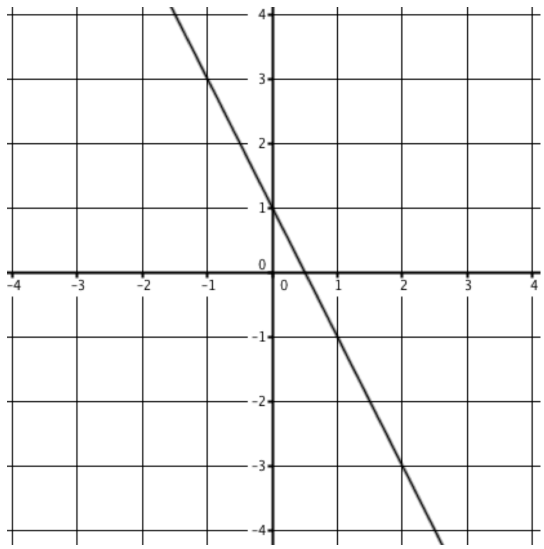
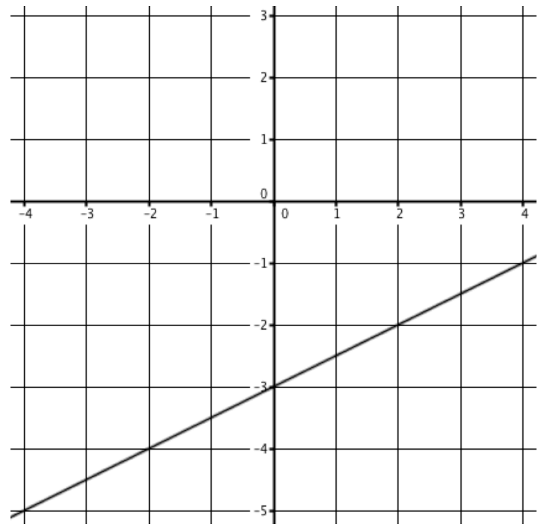
3. Write the function (in slope-intercept form) that is represented by each graph below.

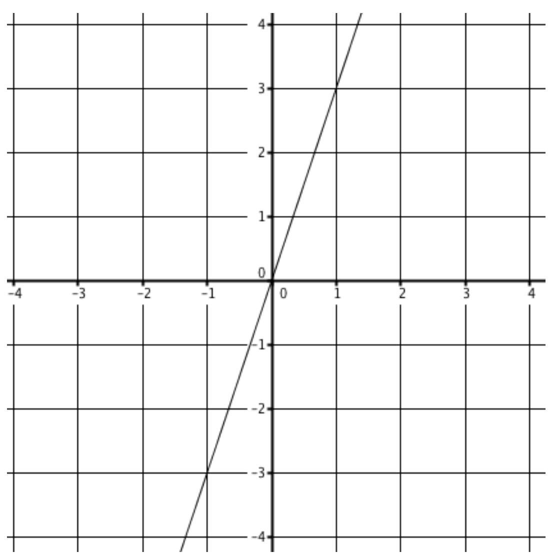
a. _________________________



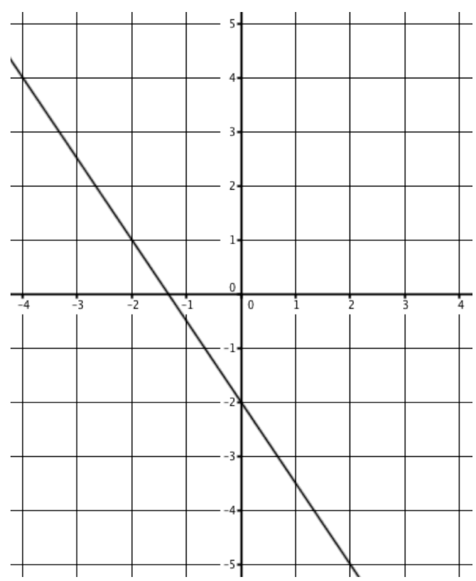
b. _________________________



c. _________________________



d. _________________________



4. The formula for converting temperature described in degrees Celsius (c) to degrees Fahrenheit (F) is a linear function (in slope-intercept form): $F(c) = \frac{9}{5}c + 32$.

a. State the slope of this function and explain what it means in the context of the given situation.

b. State the y-intercept of this function and explain what it means in the context of the situation.

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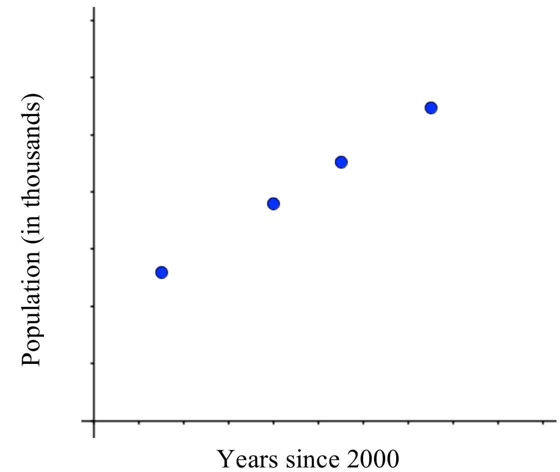
So far our discussion about slope has been limited to just describing how far we have to move up or down when we move the right by 1 unit.

However, many times when we are using linear functions to represent real-world situations we need to be able to discuss the slope when we move to the right by ANY number of units (not just by 1 unit).

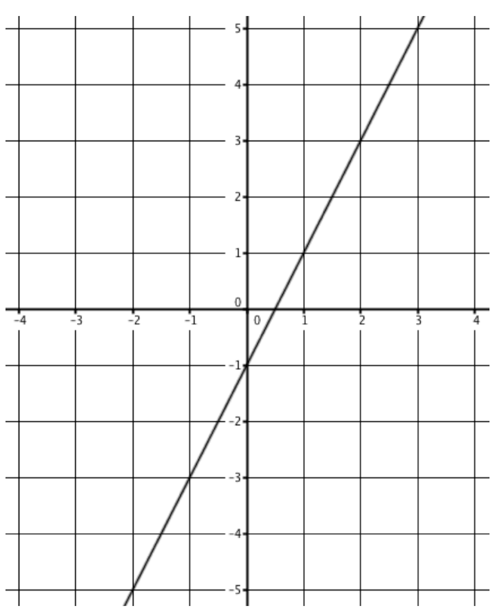
For example, consider the table of values and graph below.

x year	***f(x)*** population of the town
2003	13,000
2008	19,000
2011	22,600
2015	27,400



We need to develop a better understanding of slope so we can make sense of any situation (not only the kind of situations where the x-values increase by 1 unit at a time).

The graph of the linear function $f(x) = 2x - 1$ is given below.



1. Verify that the following points lie on the graph of $f(x)$.

a. (-1, -3)

b. (1, 1)

c. (0, -1)

d. (3, 5)

Name ______________________________
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To develop a better understanding of slope, we want to be able to pick any 2 points on the graph and compare **how much the y-coordinates change** in relation to **how much the x-coordinates change**.

Refer back to the graph of f(x) = 2x – 1 (on the previous page).

- Let's try to understand the change between the points (0, -1) and (3, 5).
- First, let's compute "**change in *y***" by subtracting the *y*-coordinates of each point:

  Change in *y*: -1 – 5 = -6

- Next, we compute "**change in *x***" by subtracting the *x*-coordinates of each point (note: you must subtract in the "same order" that you subtracted the y-coordinates):

  Change in *x*: 0 – 3 = -3

Since we want *compare* these two changes, we need to use a *ratio*:

$$\frac{\text{Change in } y}{\text{Change in } x}: \ \frac{-6}{-3} = \frac{2}{1}$$

- This ratio tells us that the **change in y** is twice as much as the **change in x**.
- Therefore, we can conclude that the slope is $\frac{2}{1}$ (which is equivalent to 2).

2. All of the points listed below are solutions to the function f(x) = 2x – 1. Determine the ratio that compares $\frac{\text{Change in } y}{\text{Change in } x}$ for the following pairs of points.

a. (1, 1) and (0, -1)

$\frac{\text{Change in } y}{\text{Change in } x} =$

b. (-1, -3) and (0, -1)

$\frac{\text{Change in } y}{\text{Change in } x} =$

c. (1, 1) and (2, 3)

$\frac{\text{Change in } y}{\text{Change in } x} =$

d. (0, -1) and (2, 3)

$\frac{\text{Change in } y}{\text{Change in } x} =$

Name ______________________________
Pd ____________ Date _______________

In question #2 (previous page), for every pair of points you used for the graph of $f(x) = 2x-1$, when you computed $\frac{\text{Change in } y}{\text{Change in } x}$, you always ended up with a result of $\frac{2}{1}$ (or something equivalent to 2). And by simply looking at the function $f(x) = 2x - 1$, it is easy to see that the slope for the graph of the function must be 2. And, this will be true for ***all*** linear functions.

In general, the slope of any linear function should be thought of in the following way:

$$\text{slope:} \quad m = \frac{\text{Change in } y}{\text{Change in } x}$$

3. Find the slope of the linear function that contains the following pairs of points:

a. (2, 4) and (7, 19)

slope: $\frac{\text{Change in } y}{\text{Change in } x} =$

b. (3, -1) and (-2, 9)

slope: $\frac{\text{Change in } y}{\text{Change in } x} =$

c. (0, 3) and (-4, 7)

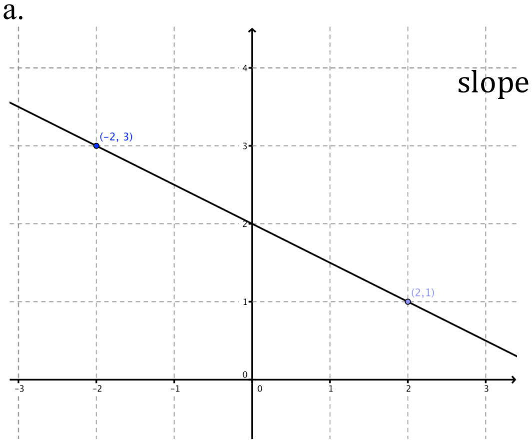
slope: $\frac{\text{Change in } y}{\text{Change in } x} =$

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

slope: $\frac{\text{Change in } y}{\text{Change in } x} =$

4. The graph and the table below represent 2 different linear functions. Find the slope of each function.

a.



slope: $\frac{\text{Change in } y}{\text{Change in } x} =$

b.

x	$f(x)$
2	7
4	12

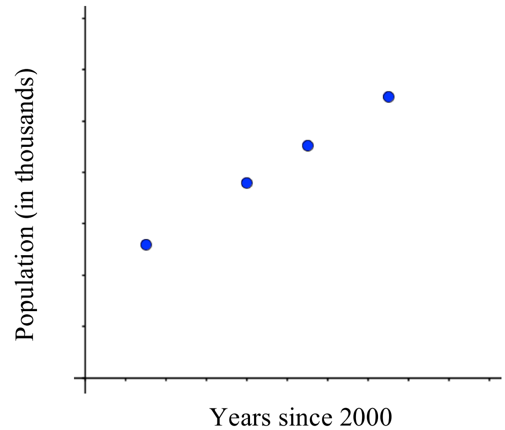
slope: $\frac{\text{Change in } y}{\text{Change in } x} =$

Name ________________________________
Pd _____________ Date ________________

5. Finally, let's go back to the original situation we looked at in this section.

The table of values and the graph below represent the population of a town at various years.

x year	***f(x)*** population of the town
2003	13,000
2008	19,000
2011	22,600
2015	27,400



a. Without doing any computations, simply make a conjecture (a good guess or estimate) for what the slope of f(x) might be. Don't worry about being exact or about being wrong. Simply make a reasonable conjecture.

b. Compare the "change in y" to the "change in x" for the years 2008 and 2003.

c. Compare the "change in y" to the "change in x" for the years 2011 and 2008.

d. Compare the "change in y" to the "change in x" for the years 2015 and 2008.

e. Compare the "change in y" to the "change in x" for the years 2015 and 2003.

f. What can you conclude is the slope of f(x)? Explain what this means in the context of the given situation.

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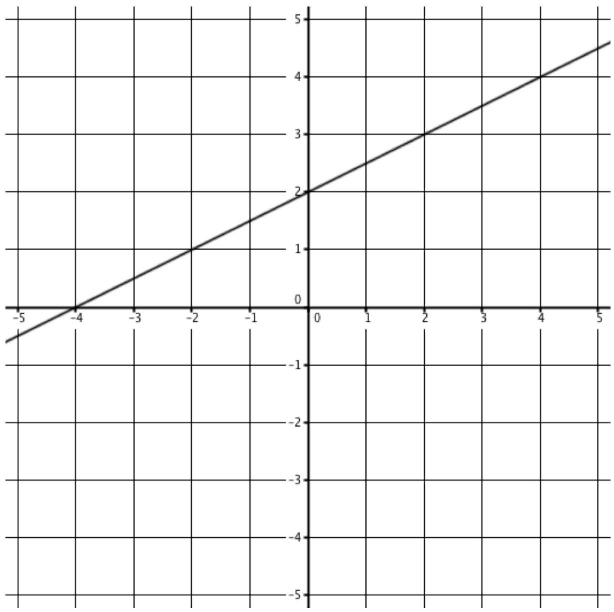
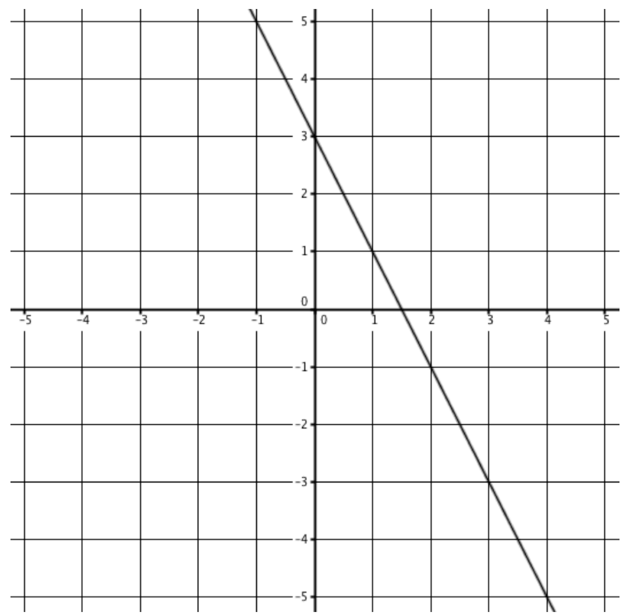
1. Determine the function that is represented by each graph below. Write your answer in slope-intercept form: ***f(x) = mx + b***.

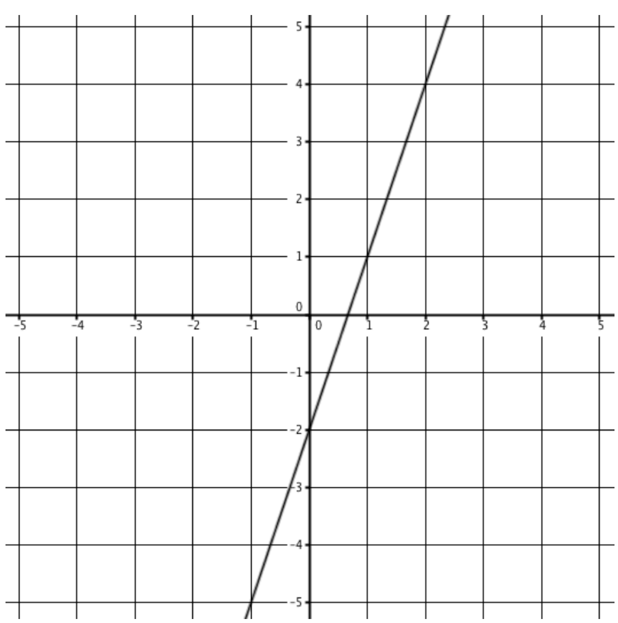
a. ______________________________



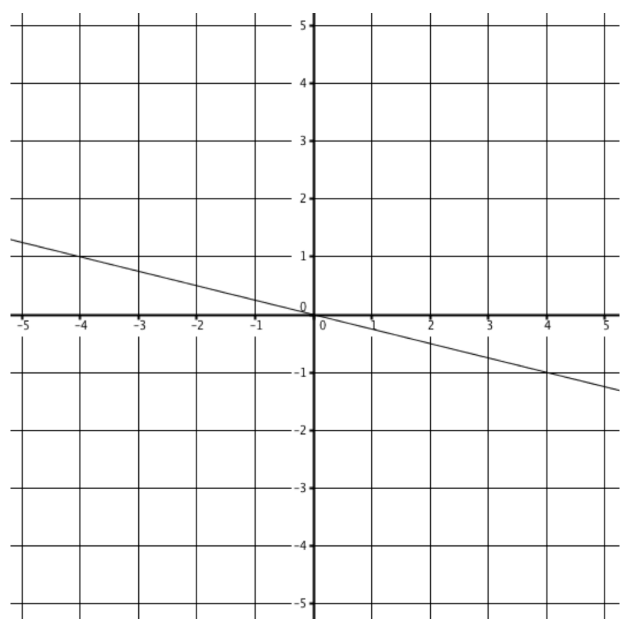
b. ______________________________



c. ______________________________



d. ______________________________



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2. Determine the slope of the line that contains the following pairs of points by comparing the "change in y" to the "change in x".

a. (2, 4) and (6, 9) b. (-1, 4) and (3, 0) c. (-6, 5) and (-2, -4)

3. Determine the function that is represented by each table below (use the given values in the table to determine the slope and the y-intercept). Also, briefly explain what the slope means for the given context.

a. Getting healthy: weight loss while on a new exercise program

x Number of weeks on the program	***f(x)*** Weight (in pounds)
0	185
1	182
2	179
3	176
4	173

Function: ____________________

What the slope means for this context:

b. Caring for the environment: predicting the population of Hawaiian monk seals

x Number of years from now	***g(x)*** Number of Monk Seals in the Hawaiian Islands
0	200
5	325
10	450
15	575
20	700

Function: ____________________

What the slope means for this context:

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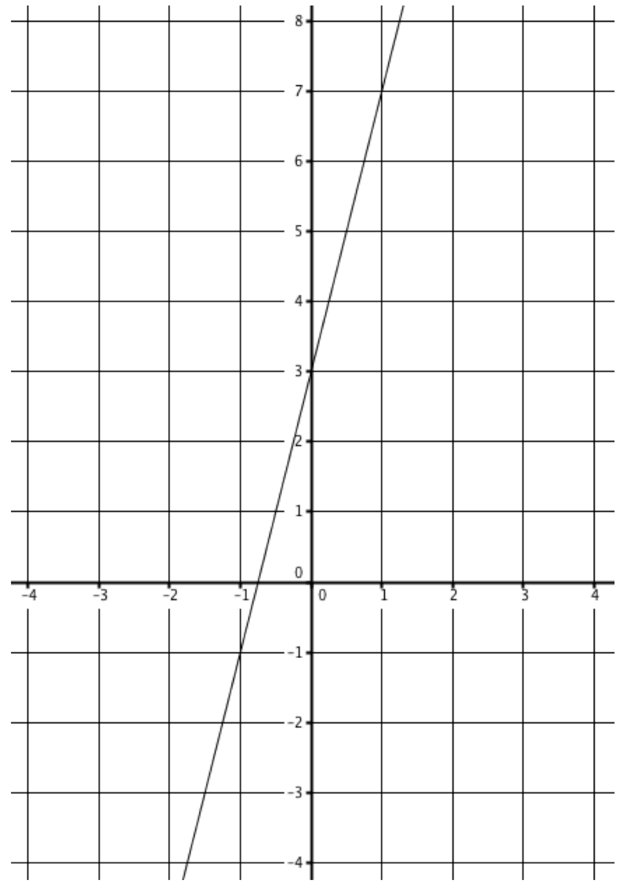
The graph to the right represents a linear function, $f(x)$.



1. What is the y – intercept of $f(x)$?

2. What is the slope of the graph of $f(x)$?

3. State the function that is represented by the graph (write your function in slope-intercept form: $f(x) = mx + b$).

4. Use your function to determine the value of $f(-1)$. Does it match what you expect from looking at the graph?

5. Using ONLY the graph, determine the value of $f(1)$.

6. Use your function to determine the value of $f(3)$.

7. Use your function to determine the value of $f(-4)$.

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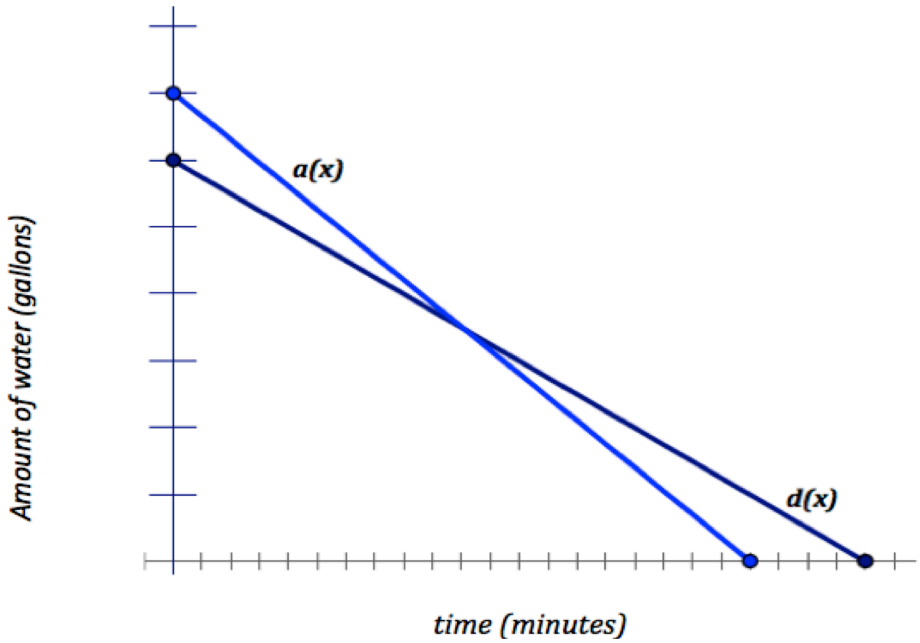
Aly and Dayne work at a water park and have to drain the water at the end of each month for the ride they supervise. Each uses a pump to remove the water from the small pool at the bottom of their ride. The graph below represents the amount of water in Aly's pool, a(x),and Dayne's pool, d(x), over time.

1. Discuss with a partner a few significant things you notice about the graphs. (Note: do **NOT** try to solve for any values; just take a couple of minutes to talk about what you notice about the graphs in relation to the given context.)



2. Dayne figured out that the pump he uses drains water at a rate of 1000 gallons per minute and takes 24 minutes to drain the entire pool.
   a. Determine the function, d(x), that represents the water being drained from the pool that Dayne is in charge of.

   b. Based on this new information, correctly label the units for the axes in the graph above.

   c. Now that you have the correct units labeled on both axes, determine the function, a(x), that represents the water being drained from the pool that Aly is in charge of.

3. For what value of x is a(x) = d(x)? What does this mean in the context of the given situation?

4. Determine the following values and explain what each means in the context of the given situation.

   a. d(0) = _______ b. a(20) = _______ c. a(5) – d(5) = _______

Note: This task is adapted from the Mathematics Vision Project's (MVP) Secondary One Curriculum (Module 5, pages 18-19). MVP grants permission to use these materials via a Creative Commons License.

Name ________________________________
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Station 1

1.

2.

3.

4.

5.

6.

7.

8.

Station 2

1.

2.

3.

4.

5.

6.

7.

8.

Station 3

1.

2.

3.

4.

5.

6.

7.

8.

Station 4

1.

2.

3.

4.

5.

6.

7.

8.

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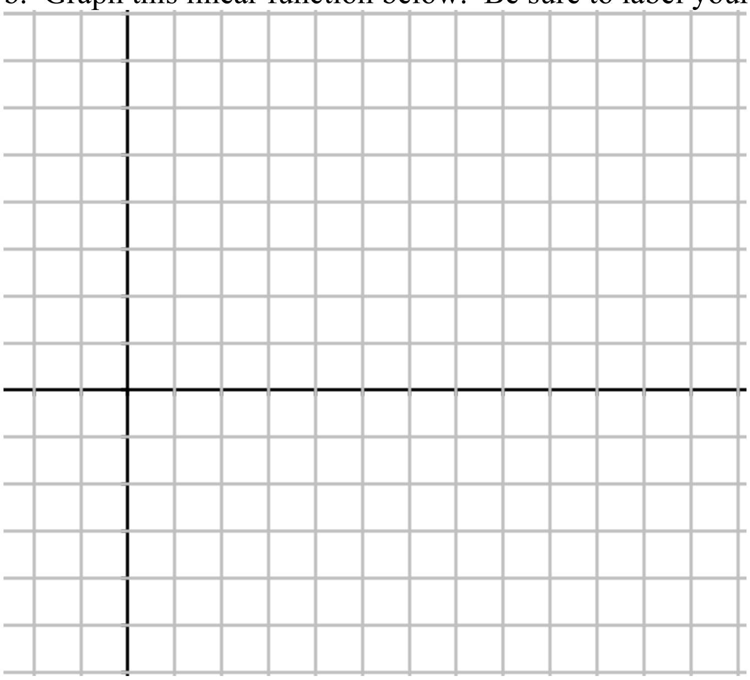
You are selling your own fruit at a stand in the weekly Swap Meet. In order for you to set up a table at the Swap Meet you must first pay the organizers \$40. You sell fruit, such as, apples, bananas, oranges, mangos, limes, lemons, papayas, and guavas. You price your fruit at the competitive price of \$1 per item.

a. Find the symbolic representation for $P(x)$, describing your profits made at the Swap Meet if you sell x fruit items.

$P(x) =$ _________________

b. Graph this linear function below. Be sure to label your axis and indicate the scale you are using.



c. How many fruit items do you need to sell in order to break-even?

d. How much profit do you earn if you sell 50 fruit items?

e. Your fruit is selling so well, that you decide to increase the price to \$2 apiece for the second week. Describe the new profit formula $Q(x)$.

$Q(x) =$ _________________

f. How many fruit items do you need to sell with the new profit formula to break-even?

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In previous lessons, we learned about the **slope-intercept form** of a linear function: $\boldsymbol{f(x) = mx + b}$.

- **m** represents the **slope** of the graph of the function
- *b* represents the *y*-coordinate of the *y-intercept*.

1. For the following linear functions, identify the slope and *y*-intercept.

a. $f(x) = 3x - 1$

slope:

y-intercept:

b. $f(x) = 2 - 5x$

slope:

y-intercept:

c. $f(x) = x - 4$

slope:

y-intercept:

d. $f(x) = \frac{3}{2}x$

slope:

y-intercept:

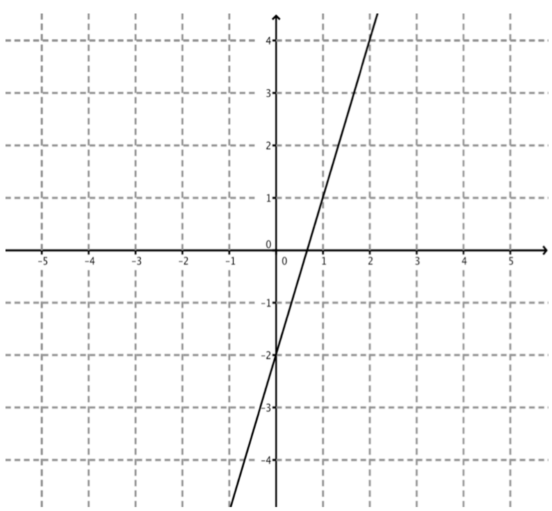
e.

x	**f(x)**
-1	2
0	-1
1	-4
2	-7

slope:

y-intercept:

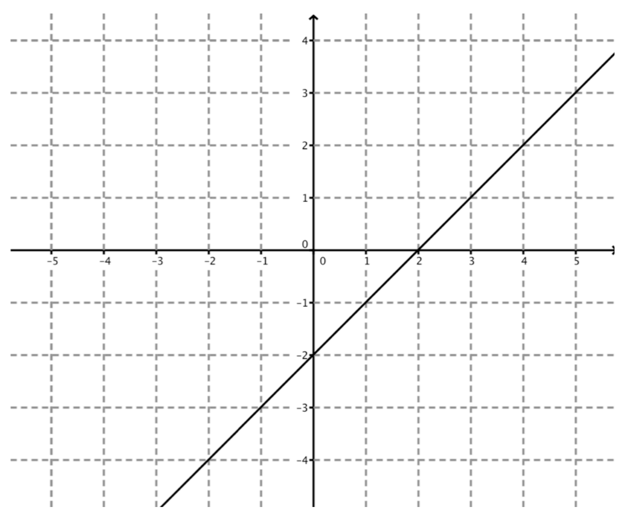
f.



slope:

y-intercept:

g.



slope:

y-intercept:

2. Solve each equation.

a. $-4(2x + 5) = 60$

b. $-11 = -2(6 - x)$

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Recall: if we know that a linear function *f(x)* has slope *m* and has a y-intercept at the point (0, *b*), then we can write the function in slope-intercept form: $f(x) = mx+b$.

However, sometimes, we are not given the information we need to easily determine the function. Thus, now we will learn how to determine the function when we are given the slope *and any other point on the graph* (i.e., a point that is NOT the y-intercept).

1. If we know that f(x) has a slope of 3 and goes through the point (-1, 2), then we can use that information to create a table of values which will help us determine the symbolic representation of the function.

   a. Since we know that the point (1, -2) is on the graph, we can let that be the first values in our table. Now, use your understanding of what "slope of 3" means to complete the table of values.

x	*f (x)*
-1	2
0	
1	
2	

Recall: if a function has a slope of 3, that means as *x* increases by _______ , *f*(*x*) increases by _______ .

   b. Determine the symbolic representation for f(x).

Or, we could use a more efficient method determine the function (when all we are given is the slope and any point on the graph of the line).

Given: a linear function, f(x), has a slope of 3 and f(-1) = 2

- We know that m = 3, so we can substitute that value into the slope-intercept form of a linear function: ***f(x) = mx + b***. Therefore,

  f(x) = 3x + b

- Now we need to determine the value of b (i.e., the y-coordinate of the y-intercept).
  - We also know that f(-1) = 2, therefore the point (-1, 2) lies on the graph (i.e., when you input -1 into the function, the output will be 2). So now, we can substitute these values into our function and then solve the equation to determine the value of b:

    f(x) = 3x + b

    2 = 3(-1) + b

    2 = -3 + b

    5 = b ➔ therefore, ***f(x) = 3x + 5***

2. The information below gives the slope and some point on the graph of a linear function. Use the given information to determine the symbolic form of the function, $f(x) = mx + b$.

a. f(x) has a slope of 2 and goes through the point (2, -1)

b. f(x) has a slope of -4 and $f(-1) = 3$

c. f(x) has a slope of 5 and $f(-2) = -7$

d. m = ½ and goes through the point (1,3)

3. Paul's grandmother started a savings account for him to be used when he starts college. She started off with a big initial deposit, and then put in $10 every month after that. Paul asked his grandmother how much was in the savings account, and she told him that she started the account 13 months ago and that it currently has $430 in it. Let *m* be the number of months since Paul's grandmother started the savings account and let *S*(*m*) be the amount in the savings account after *m* months.

a. Use function notation to represent that after 13 months there is $430 in the account.

b. *S*(*m*) is a linear function. What is the slope of *S(m)*? Briefly explain how you determined the slope.

c. Determine the symbolic representation of the function *S*(*m*), in slope-intercept form.

d. Determine the value of S(0) and explain what it means in the context of this situation.

e. If his grandma continues to deposit money at the same rate, how much money will be in the account after 3 years?

In a previous lesson, we learned how to compute the slope of a linear function using two different points on that line. The equation is given by

$$\text{slope} = \frac{\text{Change in } y}{\text{Change in } x}$$

For example, if a line goes through the points (-2, -7) and (1, -1), then its slope can be determined as follows:

$$\text{slope} = \frac{\text{Change in } y}{\text{Change in } x} \quad \Rightarrow \quad \frac{-1-(-7)}{1-(-2)} = \frac{6}{3} \quad \Rightarrow \quad m = \frac{2}{1}$$

Since this section focuses on building the equation of a line given a slope and point, we can use the above formula, but in a different, clever way.

For example, let's say we know that the slope of a line is 3 and the line goes through the point (-4, 1), but we don't know any other points on the line.

- We know that m = 3
- We have one point: (-4, 1)
- Since we don't know any other points, the only thing we can do is use the general coordinates for any point: (x, y)
- Therefore, "change in y" will be **y – 1**.
- And, "change in x" will be x – (-4) ➔ which is equivalent to simply **x + 4**

Now using our understanding of slope as $\frac{\text{Change in } y}{\text{Change in } x}$ we can set up the following equation:

$$\frac{y - 1}{x + 4} = 3$$

Next, we can use the Multiplication Property of Equality to multiply both sides of the equation by (x + 4), and we end up with

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

This is form is called the **Point-Slope Form** for the equation of a line.

We can generalize this. If a line has slope m and goes through the point (x_1, y_1), then the **Point-Slope Form** for the equation of any line is $\boldsymbol{y - y_1 = m(x - x_1)}$.

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Determine the **Point-Slope Form** for the equation of the line with the given slope and point.

1. $m = 3$ and goes through the point (1, 5)

2. $m = -4$ and goes through the point (-2, 4)

3. $m = \frac{1}{2}$ and goes through the point (2, 7)

4. Both of these equations represent a linear function: $f(x) = 3x + 1$ and $y + 5 = 3(x + 2)$

   a. Complete the table of values below for each equation:

$f(x) = 3x + 1$

x	***f(x)***
0	
1	
2	
3	
8	
13	

$y + 5 = 3(x + 2)$

x	***y***
0	
1	
2	
3	
8	
13	

   b. What do you notice about all of the output values for both tables?

   c. Analyze each table to determine the slope and the y-intercept of each linear function.

   $f(x) = 3x + 1$ ➔ slope: ___________ y-intercept: ________________

   $y + 5 = 3(x + 2)$ ➔ slope: ___________ y-intercept: ________________

   d. Based on your answers above, if you graphed both functions in the same coordinate plane, what do you think you would see?

   e. What can you conclude about these 2 functions?

   f. Rewrite the equation $y + 5 = 3(x + 2)$ in an equivalent form (i.e., solve the equation for y). What do you notice about the result?

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1. Information about a linear function is given. Determine the **slope-intercept form** of the function.

   a. m = 4 and goes through the point (2, 8)

   b. f(-15) = -3 and m = $\frac{1}{3}$

2. Information about a linear function is given. Determine the Point-Slope form for the equation of the linear function.

   a. f(-3) = 16 and m = 25

   b. m = -2 and goes through the point (1, 6)

3. Your answers to 2a and 2b above are likely written in the form $y - y_1 = m(x - x_1)$. Rewrite each of your answers to 2a and 2b into **slope-intercept form** to show another (equivalent) way to represent the same function. (In other words, take your answer above and solve for y.)

   a.

   b.

4. Gustavo's Game Center is a popular place that parents take their children so they can play various video and arcade games. For many of the games you can earn tickets that can be redeemed for prizes. Gustavo's Game Center charges \$3 as an entrance fee and then \$.50 for each game played.

   Let *n* be the number of games played and *C*(*n*) be the cost of playing *n* games.

   a. Determine the value of C(8) and explain what this means in the context of the given situation.

   b. Determine the function *C*(*n*) that represents the total cost of playing *n* games at Gustavo's Game Center.

   c. What is the slope of your function? Explain what this represents in the context of the given situation.

   d. Determine the value of C(0) and explain what this means in the context of the given situation.

Algebra 1 -- Module 2: Linear Functions
L – 5.1: Warm-up

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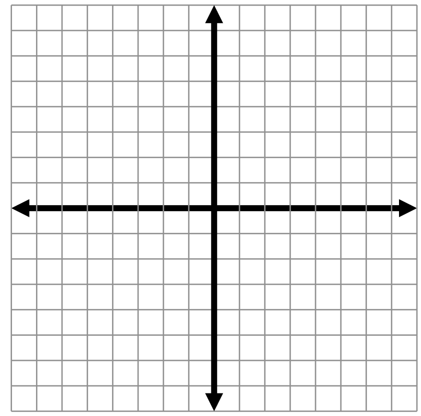
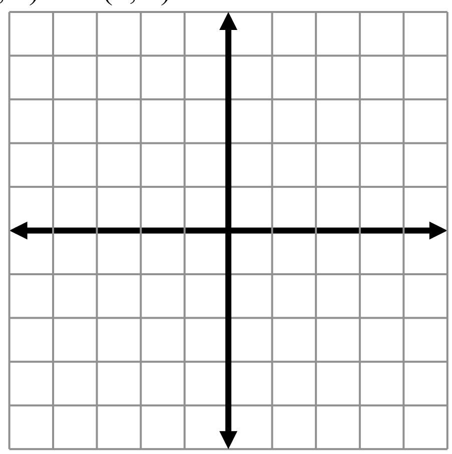
1. Graph the linear function $f(x) = \frac{2}{3}x - 5$.



2. Graph the linear function that passes through the points (-3, 2) and (4, 0).



3. Determine the slope for this same linear function.

x	$f(x)$
-3	2
4	0

4. Use your graph to <u>estimate</u> the *y*-intercept value for this line.

5. Use one of the points from question 2 and your answer for the slope (in question 3) to find the exact value of the the y-intercept for this linear function.

$f(x) = mx + b$ ➔ Slope-Intercept Form for the equation of a line

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1. Mahalo Middle School rented a movie theater for a 7th grade field trip. The theater charges an initial fee for reserving the facility for a private showing, and then charges a fee for each person in attendance.

   When the school initially called the theater, 120 students and teachers were going to attend. The quote they got for this number of people was \$710. However, at the last minute, more students turned in their forms. For the actual field trip 144 students and teachers attended, costing the school \$812.

A. How much money does the theater charge per person (excluding the initial fee for renting the theater)? Use the table at the right to organize the given information to help answer this question.

# of people	cost

B. Using how much it cost per person, how much would it cost for 120 people to attend the movie (excluding the cost to rent the theater)? Show or explain how you arrived at this amount.

C. Using how much it cost per person, how much would it cost for 144 people to attend the movie (excluding the cost to rent the theater)? Show or explain how you arrived at this amount.

D. How much is the initial fee for renting the theater? Show or explain how you arrived at this amount.

The total cost in dollars of renting this theater, $C(p)$, is a linear function of p, the number of people who attend. From our example above $C(120) = 710$ and $C(144) = 812$.

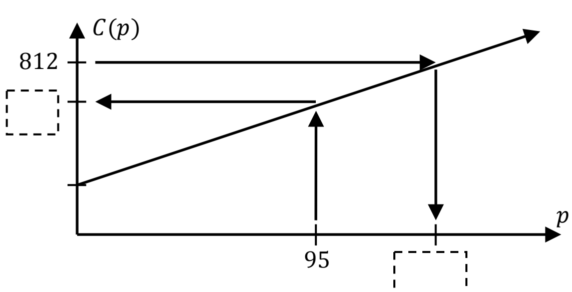
E. Use your answers from above to give the symbolic representation (the equation) for this function. Your equation should be in $y = mx + b$ form, or in this case $C(p) = mp + b$ form.

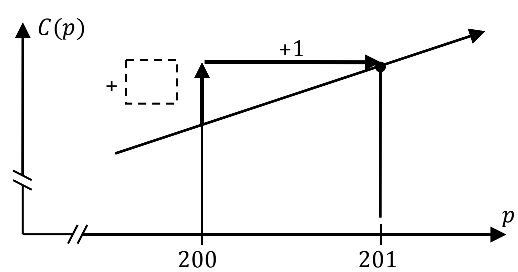
$C(p) =$ ____________

F. What would be the total cost to rent the theater for 95 people? Use your equation from 1E to show your work.

$C(95) =$ ________

G. Here are two graphs of function C. Use what you know about the cost of renting this theater to fill in the indicated blanks.



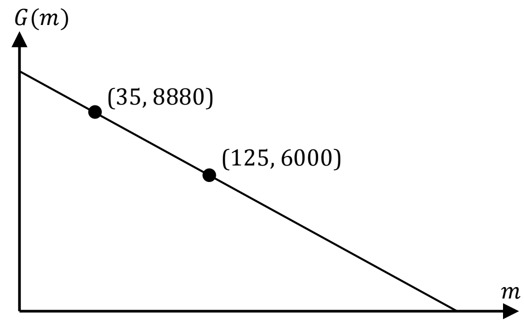


2. The Kealohas need to drain their swimming pool in order to repair a leak. For this project they decide to rent a pump to remove the water.

The graph provided represents the number of gallons G of water remaining in their pool as a function of the number of minutes m the pump is used. Notice that this graph indicates that after 35 minutes of running the pump, 8,880 gallons of water remained in the pool, and after 125 minutes of running the pump, 6,000 gallons remained.

A. How fast is the pump removing water from the pool (in gal/minute)? Use the table provided to organize the given information to help answer this question.

minutes	gallons



B. Your answer from part A is the slope of this linear function. Was your answer from part A positive or negative? Explain how this makes sense from the scenario.

C. Use your answer from part A to determine the amount of water removed from the Kealoha's pool in 35 minutes. Show or explain how you arrived at this amount.

Add this information (the number of gallons removed from the pool in 35 minutes) to the graph above. You may use arrows similar to the information shown in problem 1G.

D. Use your answer from part A to determine the amount of water removed from the Kealoha's pool in 125 minutes. Show or explain how you arrived at this amount.

Add this information (the number of gallons removed from the pool in 125 minutes) to the graph above.

E. Using either your answer from part C or part D (or both), to determine the number of gallons the Kealoha's pool holds when full. Show or explain how you arrived at this amount.

F. Determine the equation for function G in slope-intercept form. $G(m) =$ __________

G. How many gallons of water would there be in this pool after 1 hour (60 minutes)? Show or explain how you arrived at this amount.

Previously you learned how to find the symbolic representation of a linear function given the slope and one point using 2 different (but related) forms: **Slope-Intercept Form** ($y = mx + b$) and the Point-Slope Form [$y - y_1 = m(x - x_1)$].

Now we want to learn how to determine the equation of a linear function when we know ONLY two points on the line (i.e., we don't know the slope).

First, let's review one of the problems you solved in the previous lesson. This will help to illustrate how the Slope-Intercept Form of a linear function can provide you with the framework for finding the equation of a linear function given two points.

All linear functions can be written in the form $f(x) = mx + b$ where m is the slope and b is the y-intercept. In problem 1 (previous lesson) we wrote the equation as $C(p) = mp + b$ (so that it would be a little easier to see that the total cost, ***C(p)***, is a function of the number of people, ***p***, who attended).

Then, you calculated the cost per person. This amount, $4.25, was determined by dividing the change in cost by the change in number of people. This rate of change (cost per person) is the function's slope.

change in p: +24

# of people p	cost $C(p)$
120	710
144	812

change in $C(p)$: +102

$$slope = \frac{change\ in\ C(p)}{change\ in\ p} = \frac{102}{24} = 4.25$$

After determining the slope, next you used the Slope-Intercept form to determine the y-intercept:

$y = mx + b$	Slope-Intercept Form
$C(p) = mp + b$	Slope-Intercept Form customized to this function
$710 = (\mathbf{4.25})(\mathbf{120}) + b$	Substitute $m = 4.25$ and using the ordered-pair (120, 710)
$710 = \mathbf{510} + b$	Simplify: $(4.25)(120) = 510$
-510 -510	Addition Property of Equality (adding -510 to both sides)
$200 = b$	
$C(p) = mp + b$	Slope-Intercept Form
$\boxed{C(p) = 4.25p + 200}$	Substitute $m = 4.25$ and $b = 200$

Now we want to learn how to use the Slope-Intercept form to determine the equation of a line when we do not know the slope but we do know at least two points that the line goes through.

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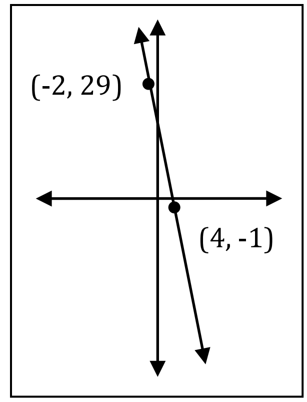
Example: Find an equation for the line passing through the points (4, 1) and (-2, 29).

Step 1: Use the two ordered-pair solutions to calculate the slope.



Change in x:
-6

x	f(x)
4	-1
-2	29

Change in $f(x)$:
+30

$$\boldsymbol{slope\ (m)} = \frac{change\ in\ f(x)}{change\ in\ x} = \frac{+30}{-6} = \mathbf{-5}$$

Step 2: Substitute the value of the slope AND the coordinates of one of the points into the Slope-Intercept Form of a linear function (you can pick any point, both will lead you to the same result). Then, solve the equation to determine the value of ***b***.

$y = mx + b$	Slope-Intercept Form
$f(x) = mx + b$	Slope-Intercept Form customized to this function
$-1 = (-5)(4) + b$	Substitute $m = -5$ and the ordered-pair (4, -1)
$-1 = -20 + b$	Solve for ***b***
+20 +20	Addition Property of Equality (adding 20 to both sides)

$$\mathbf{19} = \boldsymbol{b}$$

Notice that 19 appears to be a reasonable value for the y-intercept on the graph provided above.

Step 3: Now, put it all together. Use the values that you determined for the slope and y-intercept to write an equation in Slope-Intercept Form.

$f(x) = mx + b$	Slope-Intercept Form
$\boxed{\boldsymbol{f(x) = -5x + 19}}$	Substitute $m = -5$ and $b = 19$

Step 4: Verify that your equation works. Substitute the coordinates of the other ordered-pair into the equation and confirm that the result is a true statement.

$f(x) = -5x + 19$	Equation from Step 3
$29 = (-5)(-2) + 19$	Substitute the ordered-pair (-2, 29)
$29 = 10 + 19$	Simplify and verify that this ordered-pair works
$29 = 29$ ✓	

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Let's practice creating equations when all we know are 2 points that the line goes through.

A. Use the given points to sketch a graph of the linear function.

B. Find the symbolic representation (i.e., the equation) for the linear function using the Slope-Intercept Form.

C. Verify that your symbolic representation works for the other ordered-pair (the one you did not use to determine the y-intercept value).

D. Use the equation you created (i.e., your answer to step B) to answer the follow-up question.

---

1. This line passes through (3, 1) and (-4, 15).

A.

B.

C.

D. Follow-up: Determine the value of $f(-2)$? $f(-2) =$ _____________

2. This line passes through (2, -5) and (8, 13).

A.

B.

C.

D. Follow-up: For what value of x does $f(x) = 19$? x = ________________

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3. This line passes through (24, 885) and (13, 533).

A.

B.

C.

D. Follow-up: What is the y-coordinate of the point where x = 15? (15, _____)

4. Mr. Lee sells lychee at his neighborhood farmers' market. He must pay the association a booth fee to rent the booth at the market, and he then sells the lychee by the pound. Since the lychee is from his own trees, he has no other expense other than the booth fee.

If Mr. Lee sells 80 pounds, his profit is $198. If he sells 150 pounds, his profit is $408.

# of pounds n	Profit P
80	198
150	408
.	.
?	0

A.

B. Find an equation for Mr. Lee's profit P as a function of the number n of pounds of lychee he sells.

C.

D. Follow-up: How many pounds of lychee does Mr. Lee need to sell in order to break even (pay for the booth but not yet make a profit)? See table above.

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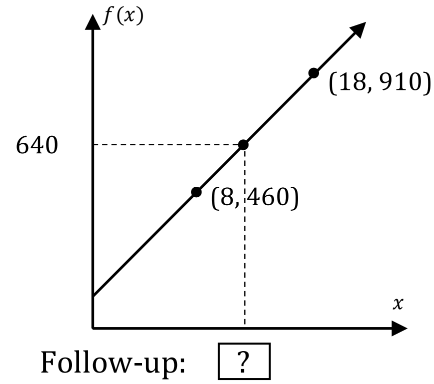
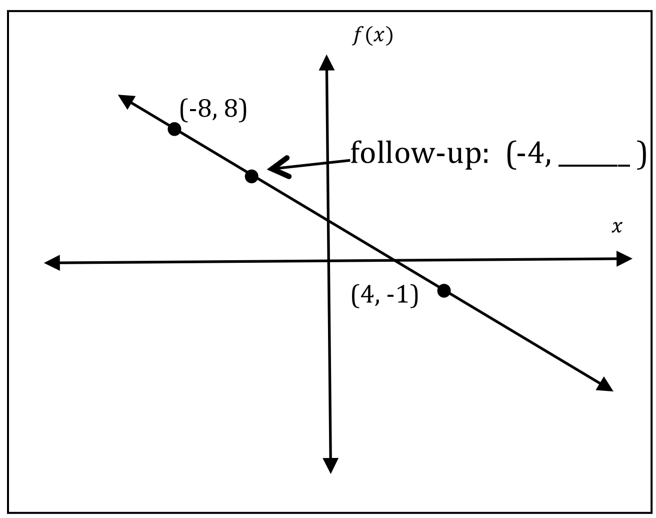
5.
A. The graph is provided.
B.



C.

D. Follow-up: Determine the value that should be placed in the box to accurately represent the graph of the function.

6.
A. The graph is provided.
B.



C.

D. Follow-up: Determine the value that should be placed in the blank to accurately represent the graph of the function.

Name ______________________________
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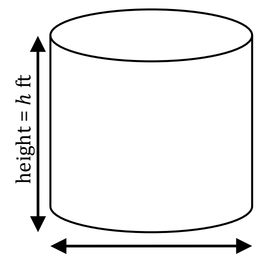


Diesel Storage Industries (DSI) fabricates diesel storage tanks for electric power plants and large manufacturers. The tanks they produce are cylindrical and have a standard diameter of 20 ft. The heights of these storage tanks, however, can be produced to any specification.

Union Power, in Dallas, Texas, ordered a tank from DSI that had a height of 120 ft. This tank was purchased for $163,280. Southern Regional Power, in northern Alabama purchased a tank for $120,576. This fuel tank had a height of 86 ft.

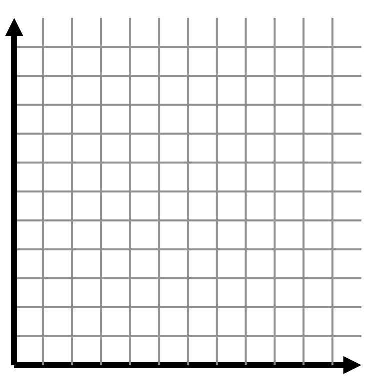
The cost of these tanks is determined by a linear function with the cost in dollars C of producing these diesel storage tanks a function of h, the height of the tank in feet.

1. Organize the data from this problem in the table below.
2. Create a rough sketch for this function. Be sure to label the axes and indicate the scale you selected for each.
3. Find the symbolic representation for this function using the Slope-Intercept Form of a linear function. Show all work. Verify that your equation reasonably matches the sketch you made.
4. Explain from the context of this problem the meaning of the slope. What does this number represent?
5. Explain from the context of this problem the meaning of the y-intercept. What does this number represent?
6. Union Power now needs a storage tank with a height of 150 ft. How much will this tank cost?
7. DSI recently sold a tank for $96,712. How tall was this tank?

1.

h	$C(h)$

2.



3.

4.

5.

6.

7.

So far we have been working with 2 different (but related) forms for the equation of linear function:

- Slope-Intercept Form: f(x) = mx + b
- Point-Slope Form: $y - y_1 = m(x - x_1)$

The previous activity asked you to create equations using only the Slope-Intercept form. Now, we want to build upon that knowledge to create equations using the Point-Slope form.

Example: Use the Point-Slope form to determine the equation of the line graphed to the right.

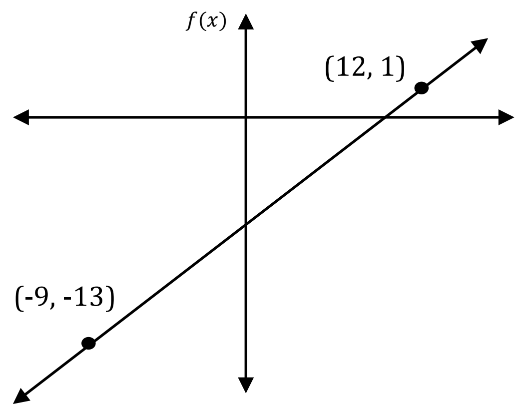
Step 1: Calculate the slope.

x	f(x)
-9	-13
12	1

Change in x: +21

Change in $f(x)$: +14

$$m = \frac{change\ in\ f(x)}{change\ in\ x} = \frac{+14}{+21} = \frac{2}{3}$$



Step 2: Use the **Point-Slope form** and then solve for y. Note: EITHER ordered-pair solution can be used for (x_1, y_1).

$y - y_1 = m(x - x_1)$ **Point-Slope form** for the equation of a line

$y - 1 = \frac{2}{3}(x - 12)$ Substitute $m = \frac{2}{3}$ and use $x_1 = 12$ and $y_1 = 1$

$y - 1 = \frac{2}{3}x - 8$ Distributive Property: multiply $\frac{2}{3}$ by x, then by -12

$+1 \quad +1$ Addition Property of Equality (add 1 to both sides)

$$\boxed{y = \frac{2}{3}x - 7}$$

Notice that a y-intercept of -7 is reasonable with the graph provided.

Step 3: Verify that the other ordered-pair solution works for your equation.

$y = \frac{2}{3}x - 7$

$-13 = \frac{2}{3}(-9) - 7$

$-13 = -6 - 7$

$-13 = -13$ ✓

Notice that whether you use the Point-Slope Form or the Slope-Intercept Form, you end up with equivalent results: the equation for the linear function.

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Now we're going to practice creating equations (when all we know are 2 points that the line goes through) using the **Point-Slope form** for the equation of a line: $y - y_1 = m(x - x_1)$

A. Use the given points to sketch a graph of the linear function.

B. Find the symbolic representation (i.e., the equation) for the linear function using the **Point-Slope form**: $y - y_1 = m(x - x_1)$.

C. Verify that your symbolic representation works for the other ordered-pair (the one you did not use to determine the y-intercept value).

D. Use the equation you created (i.e., your answer to step B) to answer the follow-up question.

---

1. This line passes through (2, 13) and (5, -2).

A.

B.

C.

D. Follow-up: For what value of x is $f(x) = 33$? $x =$ ___________

2. This line passes through (6, -2) and (-9, -7).

A.

B.

C.

D. Follow-up: What is the value of $f(21)$? $f(21) =$ ______________

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3. This line passes through (-3, -7) and (5, 13).

A.

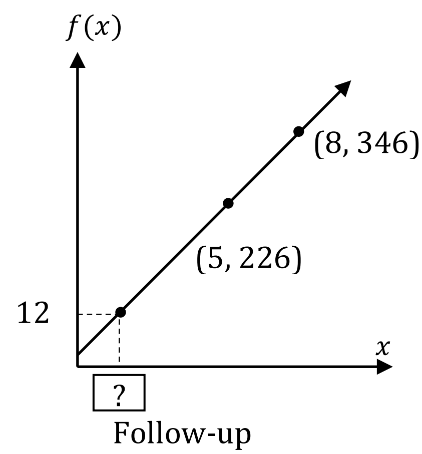
B.

C.

D. Follow-up: What is the y-coordinate of the point where x = 8? (8, _____)

4. A. The graph is provided.

B.



C.

D. Follow-up: Determine the value that should be placed in the box to accurately represent the graph of the function.

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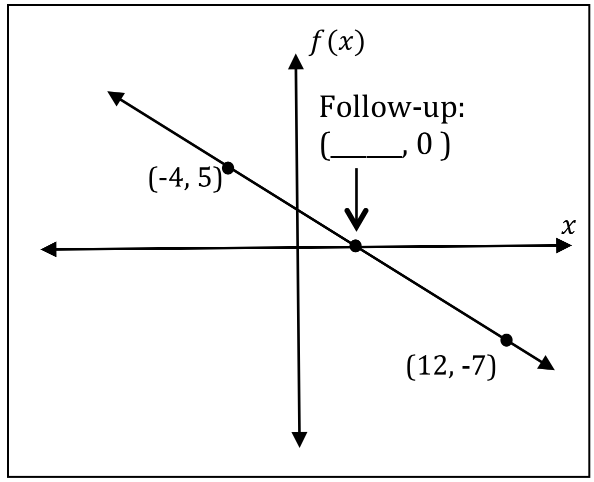
Pd ____________ Date _______________

5. A. The graph is provided.



B.

C.

D. Follow-up: Determine the value that should be placed in the blank to accurately represent the graph of the function.

9. Keoki works at Best Purchase selling electronics. He is paid at the end of each 40-hour week. His pay includes his base pay (which is a set amount that he will earn each week) for working the 40 hours plus a percent commission on the sales he had for the week. The table below shows two possible amounts that Keoki would earn for a 40-hour week.

Sales [i.e., the value of all the merchandise Keoki sold this week] **(in dollars)**	**Total Pay = Base pay + Commission (in dollars)**
5,000	820
8,000	1,120

A. Sketch a graph

B. Determine the linear function that will represent Keoki's total pay $\boldsymbol{T(s)}$ for the week as a function of $\boldsymbol{s}$, the amount of his sales for the week.

C. Verify that your function is correct by substituting the ordered-pair that you did not use.

D. Follow-up: Determine the value of T(0) and explain what this represents in the context of the given situation.

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1. Lono is analyzing the following sequence of numbers:

   2, 8, 14, 20, 26, …

   He wants to create a linear function so that he would be able to quickly determine the value of any term in this sequence.

   For example, if he wanted to know the value of the 3rd term he would simply use his function to find the value of $f(3)$ – which we already know is 14. If he wanted to know the value of the 100th term he would find the value of $f(100)$ using this equation.

term	value
1	2
2	8
3	14
4	20
5	26
100	
	824

A. Determine the symbolic representation for this linear function. Use $V(t)$ to represent the value of term t. Show your work to justify how you cam up with your function.

   $V(t) =$ ____________________

B. Use your function, $V(t)$, to determine the 2 values that are missing from the table above.

2. The figures below are made by arranging square tiles.

figure 1 figure 2 figure 3 figure 4 figure 5

A. Sketch (in the space above) what the 5th figure in this sequence would look like, then complete the table of values using the information form the figures.

Figure					
Number of square tiles in the figure					

B. Create a linear function that represents the number of square tiles needed as a function of the number of the figure in the sequence.

C. Use your function to determine which figure would require 247 square tiles.

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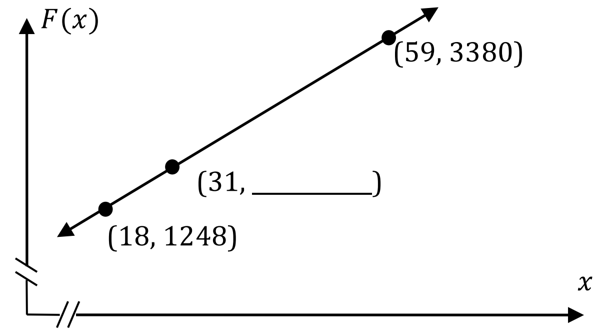
3. Determine the value that should be placed in the blank to accurately represent the graph of the function.



For the following questions, use either the Slope-Intercept Form or the Point-Slope Form for finding symbolic representations of linear functions (pick your method, it's entirely your choice).

- Although some questions may not specifically ask you to state the symbolic representation of the linear function, it is often the easiest way to answer the question so you may want to do so even though the question doesn't ask for it.
- Also, even though the problems may not specifically ask for certain parts, you should continue to do the following as best practice to help you solve the problems:
  - Use tables to organize your information when finding slopes.
  - Create graphs to get a picture of what is going on and to make sure your solutions are reasonable.
  - Verify that your equation works for both ordered-pairs.

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4. Ikaika's Gym charges an initial fee to join and then a monthly membership fee. To join this gym for 5 months would cost $250. It would cost $488 to join for a year. How much would it cost to join Ikaika's Gym for 2 years?

5. A linear function, g(x), passes through the points (8, -13) and (-2, 17). What is the value of g(5)?

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6. Some forms of bamboo grow extremely quickly. To document this rapid growth, Leahi recorded the height of a particular bamboo plant over several weeks. The bamboo measured 23.2" on day 5 of her observation, and 27.1" on day 7.

   A. Assuming the bamboo grows at a constant rate, find the symbolic representation for $H(d)$, the height of the bamboo in inches, on the d^{th} day of Leahi's observation.

   B. What is the meaning (in the context of the given situation) of the y-intercept for *H(d)*?

7. An arithmetic sequence is given below. Notice that the 4^{th} term in the sequence is 29 and the 7^{th} is 56:

   2, 11, 20, 29, 38, 47, 56, 65, …

   A. How can you tell that the sequence is linear?

   B. What is the value of the 500^{th} term in this sequence?

   C. Which term in the sequence will have a value of 1,109?

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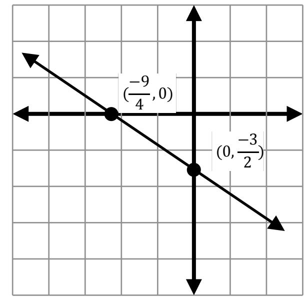
8. *Multiple Choice*: Which equation corresponds to the given graph?



(A) $y = \frac{-2}{3}x - \frac{3}{2}$ (C) $y = \frac{-3}{2}x - \frac{3}{2}$

(B) $y = \frac{2}{3}x - \frac{3}{2}$ (D) $y = \frac{3}{2}x - \frac{3}{2}$

9. Tanya's Taxi charges an initial fee plus a certain amount per minute. Below is a table showing two different charges based on a certain number of minutes. How much would a 35 minute ride cost using Tanya's Taxi?

m minutes	T Total Cost (in dollars)
8	7.50
20	11.70

8. Standard thermometers display the temperature in both degrees Fahrenheit and degrees Celsius. Every country in the world except the United States uses the Celsius scale to measure temperature. Therefore, often it is necessary to convert from one temperature scale to the other.

A temperature of 20°C is equivalent to 68°F. The boiling temperature of water is 100°C and 212°F.

°C	°F
20	68
100	212

A. Use these equivalencies to find the linear function, F(c), representing degrees Fahrenheit as a function of degrees Celsius.

B. While chatting with your friend Liam, he said that it was 34°C today where he lives in Hamburg, Germany. What is the equivalent Fahrenheit measure for this temperature? Is it hot or cold today in Hamburg?