

**MODULE 3: THE RECTANGULAR COORDINATE SYSTEM, GRAPHS OF  
LINEAR EQUATIONS, SLOPE****LEARNING OBJECTIVES**

By the time you finish this module, you should be able to:

- ☐ Identify the x-axis, y-axis, origin, and Quadrants I, II, III, and IV on a coordinate grid.
- ☐ Plot any point on the coordinate grid, including points on the axes
- ☐ Given the equation of any line, graph it by making a table.
- ☐ Recognize and graph the equation of any horizontal line and any vertical line.
- ☐ Recognize when a given equation is NOT linear, and graph it by making a table.
- ☐ Find the x-intercept and the y-intercept of any linear equation.
- ☐ Find the slope of any line by looking at the graph.
- ☐ Find the slope of any line if you know two points.
- ☐ Identify the slope of horizontal and vertical lines.
- ☐ Graph a line when you are given a point and a slope.
- ☐ Graph a line when you are given its equation in Slope-Intercept ( $y = mx + b$ ) form.
- ☐ Write any linear equation in Slope-Intercept ( $y = mx + b$ ) form.

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**IMPORTANT INFORMATION FROM MODULE 3:**

The x-axis is the horizontal axis, and the independent variable. The y-axis is the vertical axis, and the dependent variable. Every point has an x-coordinate and a y-coordinate written as an ordered pair (x,y). The origin has coordinates (0,0).

Points on the x-axis are called x-intercepts, and their y-coordinate is 0. (3, 0), (2, 0), etc.  
To find the x-intercept, plug 0 in for y and find the x-value that goes with it.

Points on the y-axis are called y-intercepts, and their x-coordinate is 0. (0, 3), (0, 2), etc.  
To find the y-intercept, plug 0 in for x and find the y-value that goes with it.

The equation  $y = \text{a number}$  is always horizontal. The slope of a horizontal line is 0.  
The equation  $x = \text{a number}$  is always vertical. The slope of a vertical line is undefined.

**SLOPE:** Given any two points  $(x_1, y_1)$  and  $(x_2, y_2)$ , the slope of the line containing them is  
 $m = \frac{y_2 - y_1}{x_2 - x_1}$ . Slope is also  $\frac{\text{rise}}{\text{run}}$ , or the rate of change.

**Adult Learning Academy**  
**Elementary Algebra Workbook**  
**MODULE 3 VIDEO & EXERCISE LIST**

Topic	Website	Videos	Exercises
Plotting Points	<a href="http://www.khanacademy.org">www.khanacademy.org</a>	Descartes & Cartesian Coordinates	Graphing Points
		The Coordinate Plane	Graphing Pts & Naming Quad.
		Plot Ordered Pairs	Points on the Coordinate Plane
		Quadrants of Coordinate Plane	
Points & Equations	<a href="http://www.khanacademy.org">www.khanacademy.org</a>	Ordered Pair Solutions of Eq 2	Ordered Pair Sol's to Linear Eq.
		Plotting (x,y) Relationships	Identifying Linear Relationships
		Graphs of Linear Equations	
		Application Problem with Graph	
		Interpreting Linear Graphs	
		Exploring Linear Relationships	
		Recognizing Linear Functions	
		Graphing Lines 1	
Intercepts	<a href="http://www.khanacademy.org">www.khanacademy.org</a>	Graphing Using x and y Intercepts	Solving for the X-Intercept
		Graphing Using Intercepts	
		X and Y Intercepts	
		X and Y Intercepts 2	
Horizontal & Vertical	<a href="http://www.youtube.com/watch?v=KwBE2pJDWvU">http://www.youtube.com/watch?v=KwBE2pJDWvU</a>	Horizontal and Vertical Lines	
	<a href="http://www.youtube.com/watch?v=VMitkRc5jHA">http://www.youtube.com/watch?v=VMitkRc5jHA</a>	Horizontal and Vertical Lines	
Slope	<a href="http://www.khanacademy.org">www.khanacademy.org</a>	Slope of a Line	Identifying Slope of a Line
		Slope of a Line 2	Line Graph Intuition
		Slope and Rate of Change	
		Graphical Slope of a Line	
		Slope of a Line 3	
		Slope and y-intercept Intuition	
Slope-Intercept Form	<a href="http://www.khanacademy.org">www.khanacademy.org</a>	Graph Line in Slope-Intercept Form	Graphing Linear Equations
		Converting to Slope-Intercept Form	Slope-Intercept Form
		Linear Eq in Slope-Intercept Form	

Topic	Website	Videos	Exercises
Slope-Intercept Form	<a href="http://www.khanacademy.org">www.khanacademy.org</a>	Graphs Using Slope-Intercept Form	
(Cont.)		Equation of a Line 1	
		Equation of a Line 2	
Module 3 Test Review	<a href="http://www.stlcc.edu">www.stlcc.edu</a>	Blackboard PowerPoint	Ten-Second Graphing
		Blackboard PowerPoint	Ten-Second Graphing Version 2
		Blackboard PowerPoint	Module 3 Review Flashcards



MoSTEMWINS

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There are 4 parts to this picture.

**What do you see?**

Plot the points on the left hand side to find out!

1. Plot these points and connect them in order:

(6, 8) (5, 6) (6, 4) (2, -4) (0, -5)  
(-1, -6) (-2, -9) (-1, -11) (0, -12)

(0, -13) (-3, -12) (-3, -11) (-4, -9)  
(-4, -6) (-6, -9) (-8, -11) (-8, -12)

(-1, -14) (-7, -14) (-10, -13)  
(-10, -11) (-8, -9) (-6, -3) (-5, 1)  
(-3, 3)

(2, 6) (2, 10) (3, 11) (5, 12)  
(9, 10) (9, 9) (6, 9) (9, 8) (8, 7)  
(6, 8)

2. Plot these points and connect them in order:

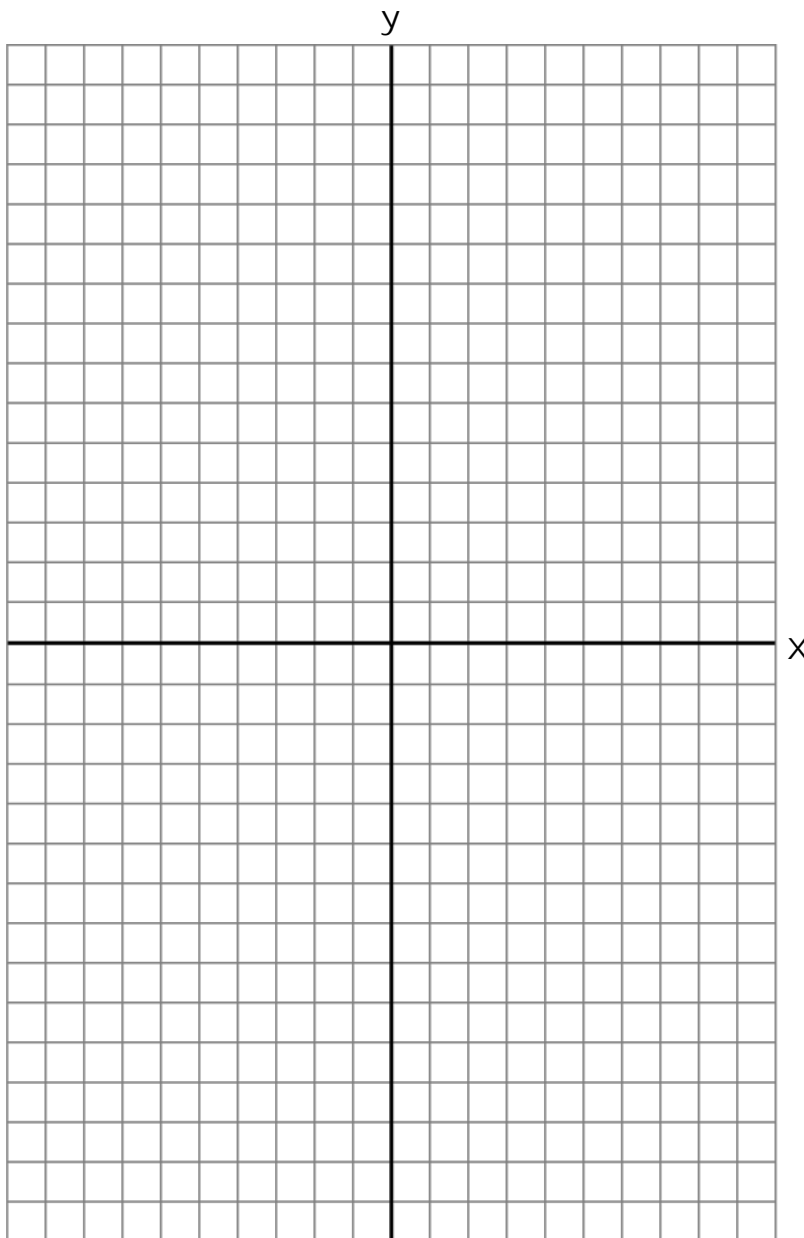
(5.5, 3) (7, 3) (7, 2) (5, 2)

3. Plot these points and connect them in order:

(3, 3) (5, 1) (7, 1) (7, 0) (4, 0)  
(2, 2)

4. Plot these points and connect them in order:

(2, -4) (3, -11) (4, -12) (4, -13)  
(1, -12) (1, -11) (0, -5)

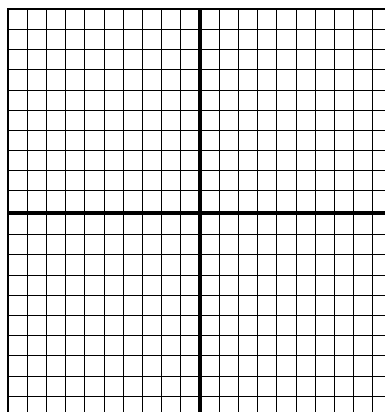
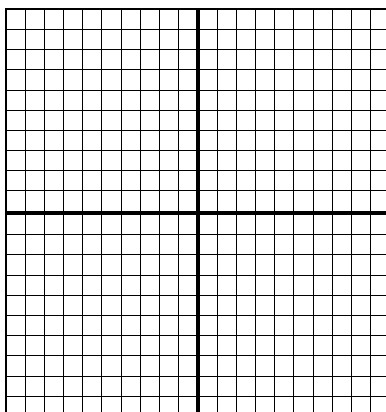


**Make a table** and plot points to graph the equations.

1.  $2x - y = 1$

2.  $y = \frac{1}{2}x - 3$

X	Y

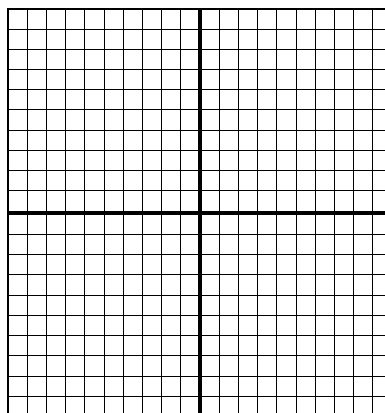
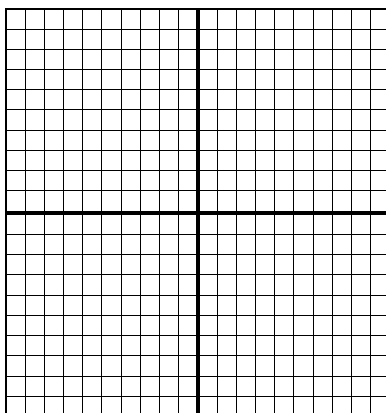


X	Y

3.  $y = -3x$

4.  $y = x^2$

X	Y

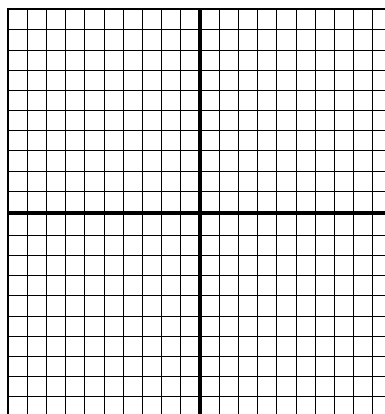
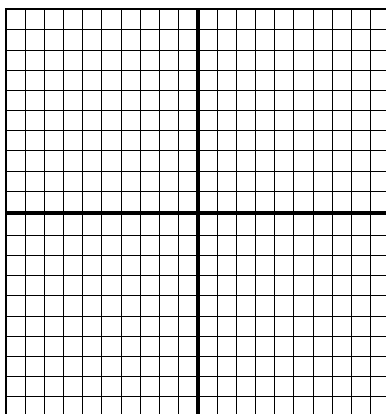


X	Y

5.  $y = x$

6.  $x + y = 5$

X	Y



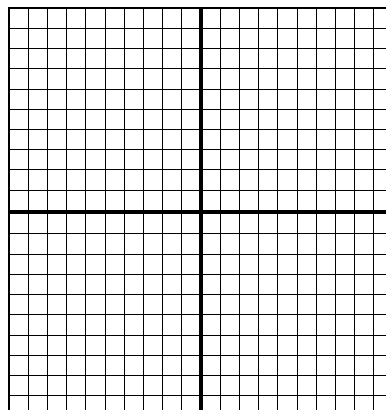
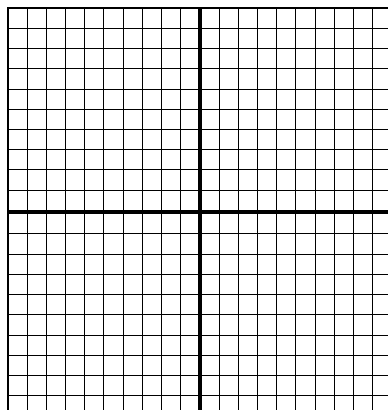
X	Y

**Make a table** and plot points to graph the equations.

7.  $x - y = 1$

8.  $y = -2x + 3$

X	Y

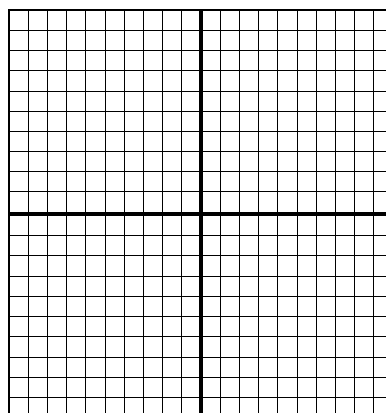
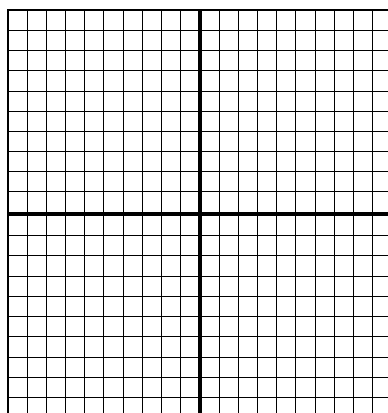


X	Y

9.  $y = \frac{3}{4}x$

10.  $y = x - 3$

X	Y

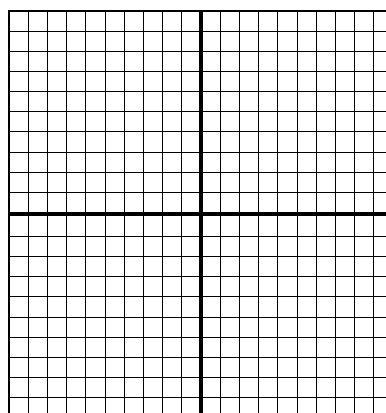
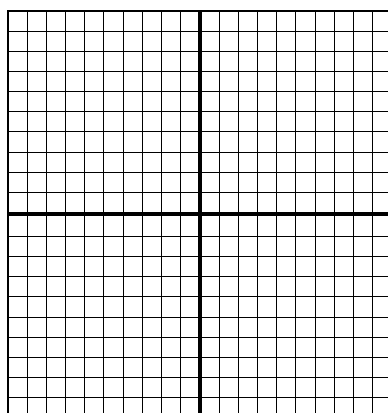


X	Y

11.  $y = |x|$

12.  $y = -2x + 3$

X	Y

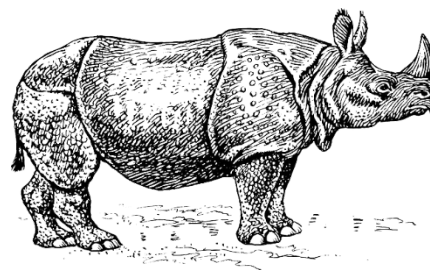


X	Y

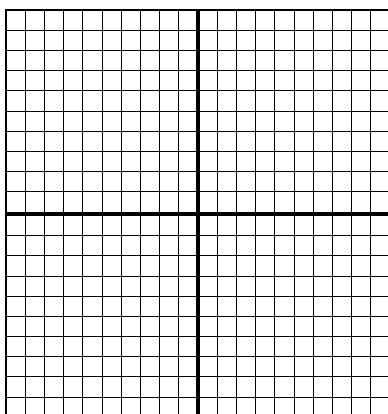
**Special Lines: Horizontal, Vertical**

**Question:** Where does a 3,000-pound rhinoceros sleep?

**Answer:** Anywhere it wants to!



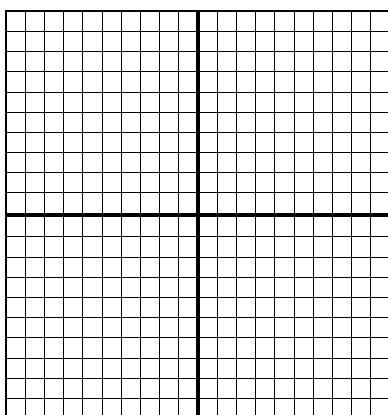
13.  $y = 3$



x	y

A Horizontal line  
ALWAYS has the  
equation  
 **$y = \text{a number}$**

14.  $x = 5$

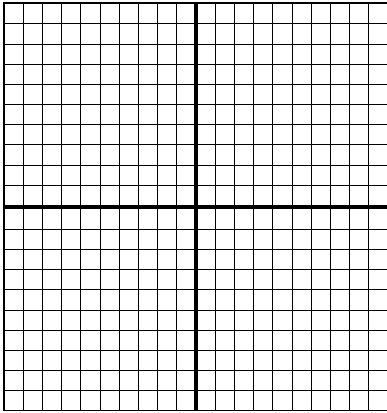


x	y

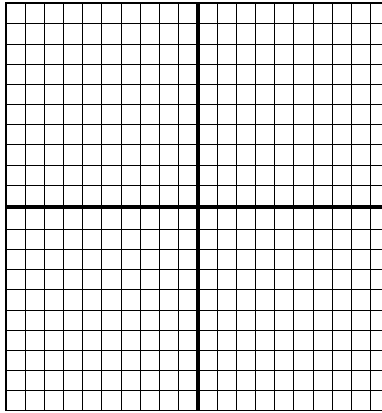
A Vertical line  
ALWAYS has the  
equation  
 **$x = \text{a number}$**

Graph each equation using any method

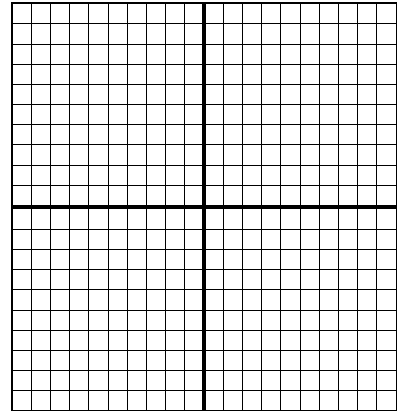
15.  $y = \frac{1}{4}x - 2$



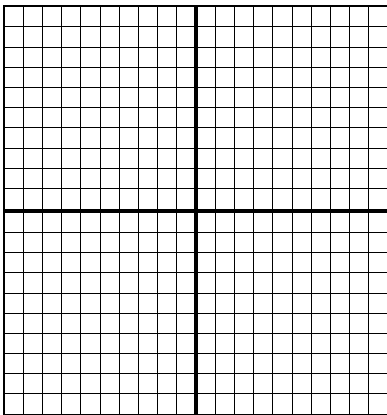
16.  $3x$



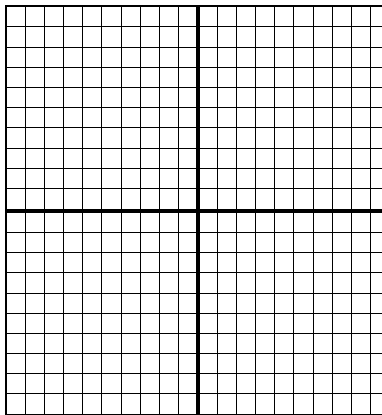
17.  $\frac{1}{2}x + 3$



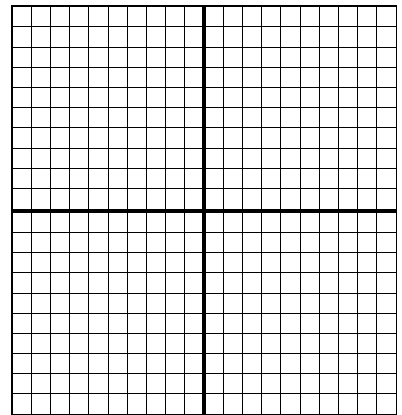
18.  $y = 7$



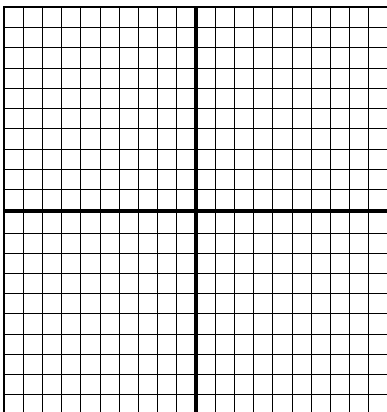
19.  $y = -\frac{2}{3}x + 1$



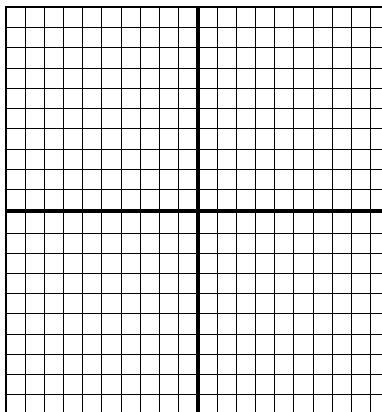
20.  $x = 4$



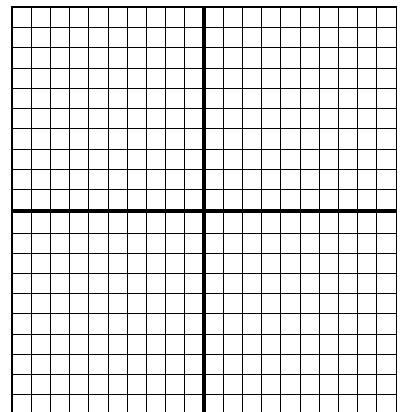
21.  $y = -\frac{3}{4}x + 2$



22.  $y - x = 3$

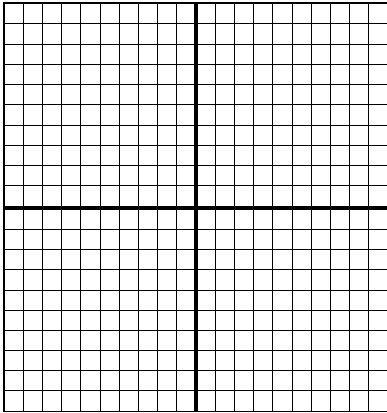


23.  $3x + 5y = 15$

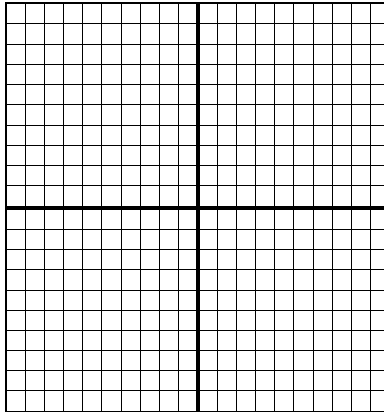


Graph each equation using any method

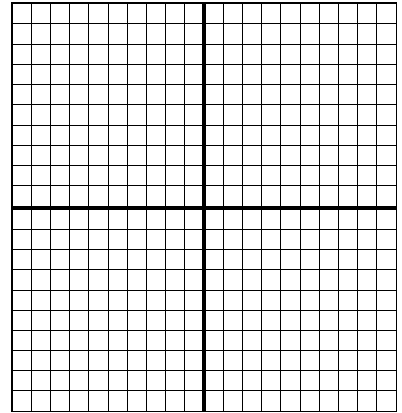
24.  $y = -2x + 1$



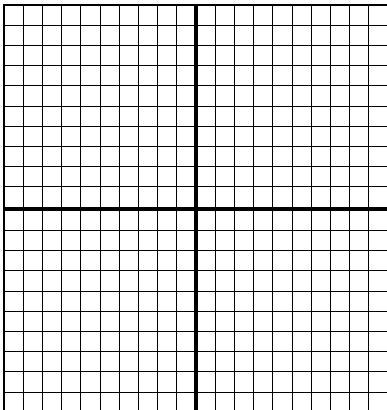
25.  $y = \frac{3}{5}x$



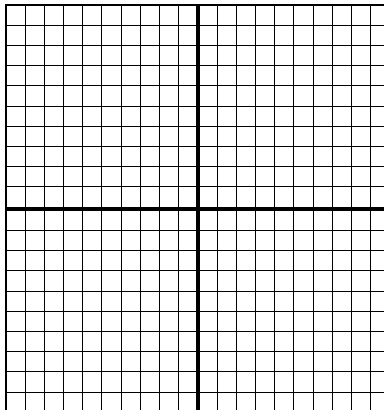
26.  $y = \frac{1}{2}x - 3$



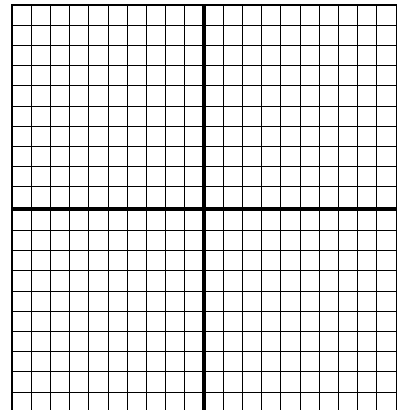
27.  $x = -4$



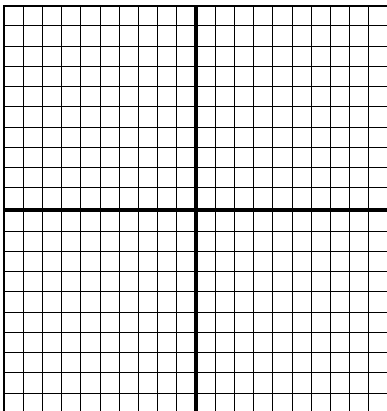
28.  $y = \frac{1}{5}x + 3$



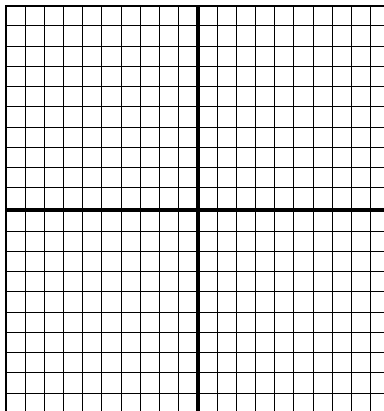
29.  $y = -2$



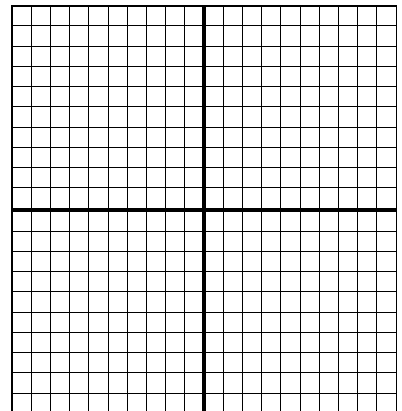
30.  $y = -\frac{4}{3}x$



31.  $x + y = 5$

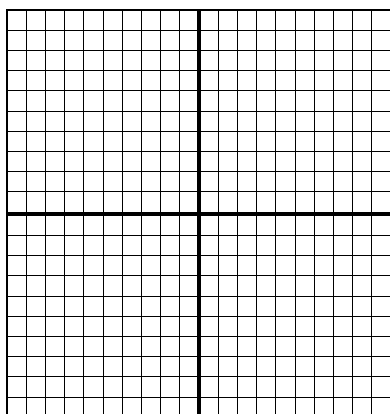


32.  $y = x^2 - 3$

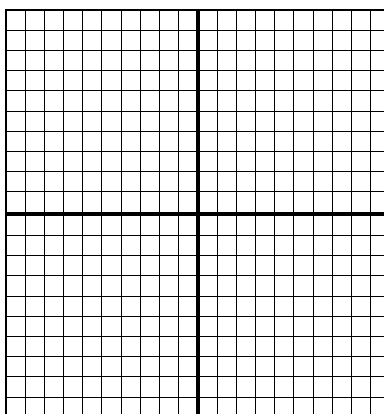


Graph the line through the given point, with the given slope

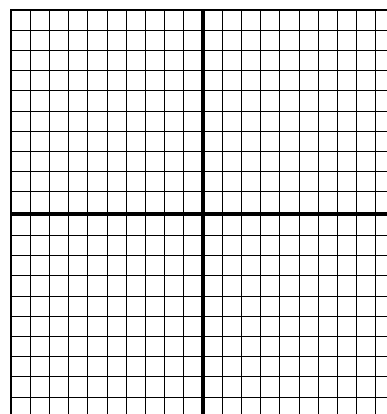
33. Point (3, 1) Slope  $\frac{1}{2}$



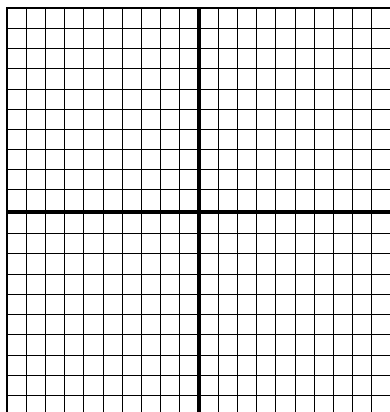
34. Point (-4, 1) Slope  $-\frac{2}{3}$



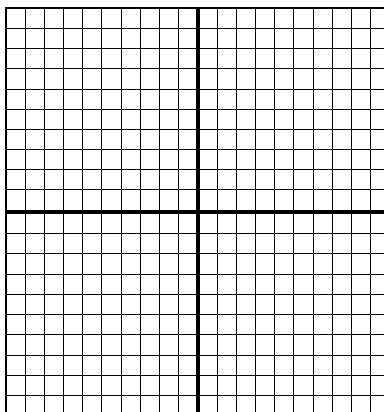
35. Point (0, 0) Slope  $\frac{1}{3}$



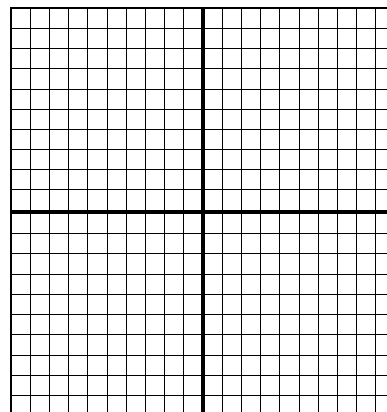
36. Point (-3, -2) Slope 4



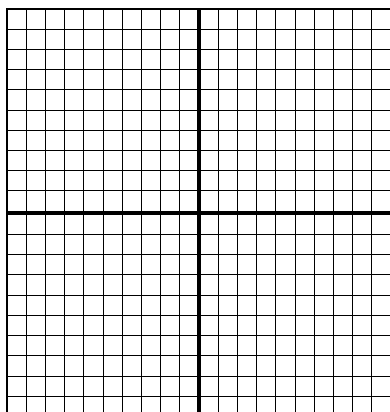
37. Point (-4, 0) Slope -2



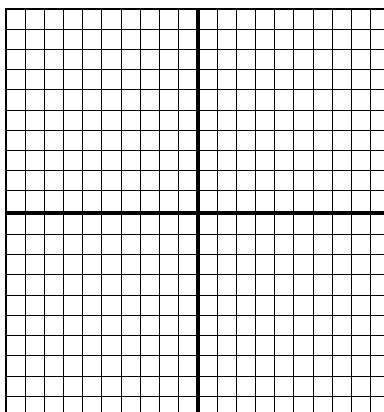
38. Point (-2, 3) Slope 0



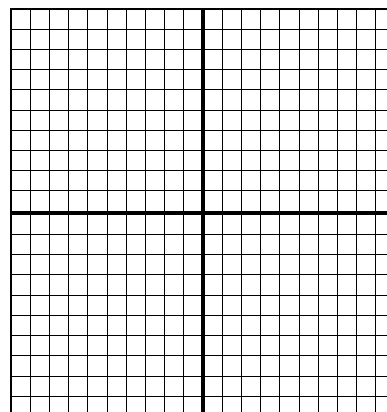
39. Point (2, -1) Slope  $-\frac{3}{2}$



40. Point (4, 0) Slope undefined

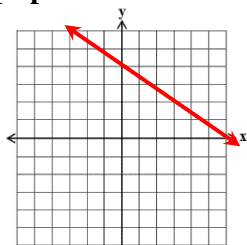


41. Point (-1, 0) Slope 1

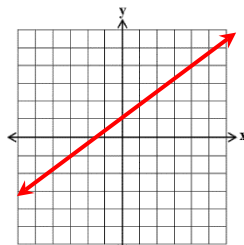


1. **Slope practice:** What is the slope of each line below?

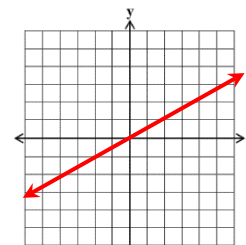
a.



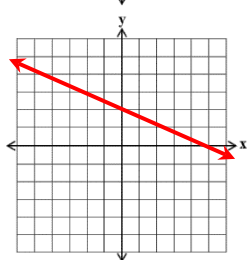
b.



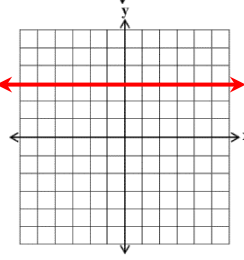
c.



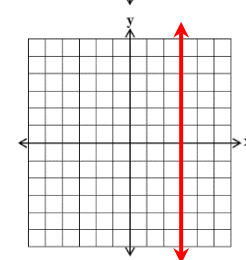
d.



e.

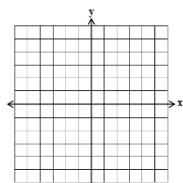


f.

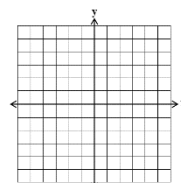


2. **Calculate the slope** of the line containing each pair of points.  
Graph each line.

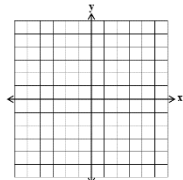
$$\text{Slope} = \frac{\text{rise}}{\text{run}} = \frac{\text{the change in } y}{\text{the change in } x} = \frac{y_2 - y_1}{x_2 - x_1}$$



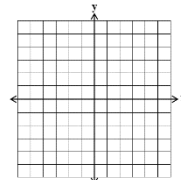
a. (0, 0) and (5, 3)



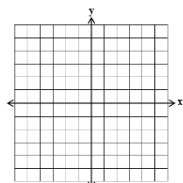
b. (0, 0) and (5, -3)



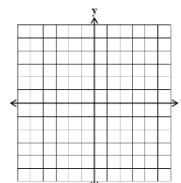
c. (3, -1) and (-4, 5)



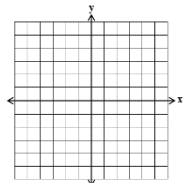
d. (3, -1) and (5, 2)



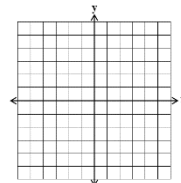
e. (4, -2) and (-2, -4)



f. (3, 6) and (7, 6)



g. (3, 6) and (3, 7)



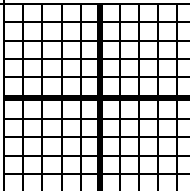
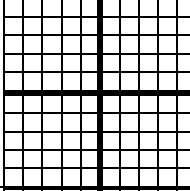
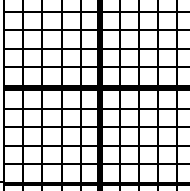
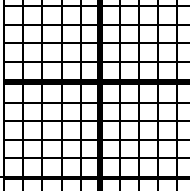
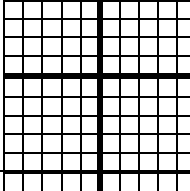
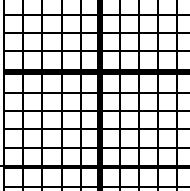
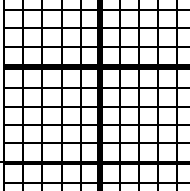
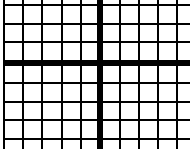
h. (-3, 4) and (1, -2)

3. If a line has positive slope, then its graph \_\_\_\_\_ from left to right.

4. If a line has negative slope, then its graph \_\_\_\_\_ from left to right.

### Slope-Intercept Form $y = mx + b$

Rewrite each equation in slope-intercept form and graph the line.

	EQUATION	SLOPE-INTERCEPT FORM	SLOPE	Y-INTERCEPT	GRAPH
A.	$3x + 2y = 6$			(0, )	
B.	$-2x + y = 4$			(0, )	
C.	$x + 2y = 3$			(0, )	
D.	$x - 2y = 5$			(0, )	
E.	$y - 3x = 0$			(0, )	
F.	$3x + y = 0$			(0, )	
G.	$y - 4 = \frac{1}{2}(x + 6)$			(0, )	
H.	$x - y = 2$			(0, )	

	EQUATION	SLOPE-INTERCEPT FORM	SLOPE	Y-INTERCEPT	GRAPH
I.	$y + 3 = 2(x - 1)$			(0, )	
J.	$5x - 3y = 15$			(0, )	
K.	Slope is $-\frac{3}{4}$ y-intercept is 5			(0, )	
L.	Slope is 0 y-intercept is -2			(0, )	
M.	Vertical line Through (-5, 1)			(0, )	
N.	Horizontal line through (3, 1)			(0, )	
O.	Through the points (1, 5) and (-2, 3)	You'll learn to create the equation for this line in the next module! For now, can you graph it?	Estimate if necessary	(0, )	
P.	Through the points (3, 0) and (-1, 4)	You'll learn to create the equation for this line in the next module! For now, can you graph it?	Estimate if necessary	(0, )	

1. Carefully graph each to create a design below:

a.  $y = \frac{3}{2}x + 8$

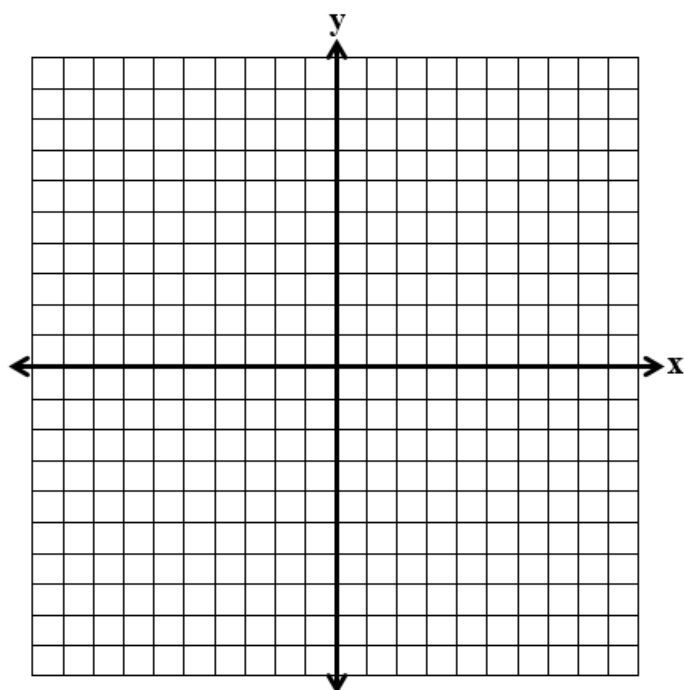
b. The line through the point  $(-6, 1)$  with slope  $\frac{-3}{2}$

c.  $y = 4$

d. The line through the point  $(2, -4)$  with a slope of 0.

e.  $y = \frac{3}{2}x - 8$

f.  $3x + 2y = 16$



2. Carefully graph each to create a design below:

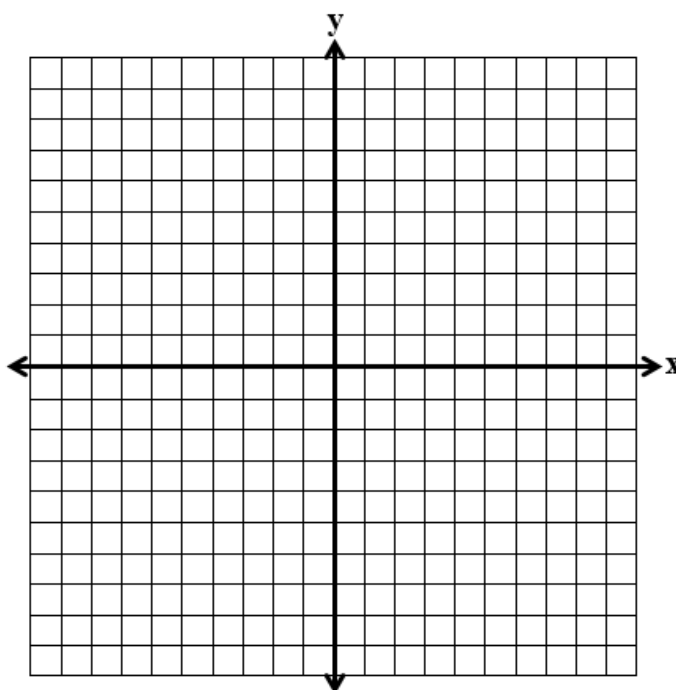
a.  $x + y = 8$

b.  $y = x + 8$

c.  $y = 8$

d.  $y = 3 - x^2$

e.  $y \leq 0$



Remember function notation from Module 2? Believe it or not,  $f(x)$  is just another way of saying “y”! Any equation that starts with  $y = mx + b$  could also be written as  $f(x) = mx + b$ . The advantage of the  $f(x)$  notation is that you can tell exactly what number to substitute in for  $x$ !

1. Forensic scientists can approximate a person’s height by measuring the person’s femur, which is the long bone that stretches from the hip socket to the kneecap. The relationship can be expressed as a function:

For females:

$$f(x) = 2.3x + 61 \quad \text{where } x \text{ is the length of the femur in cm,} \\ \text{and } f(x) \text{ is the woman's height in centimeters.}$$

For males:

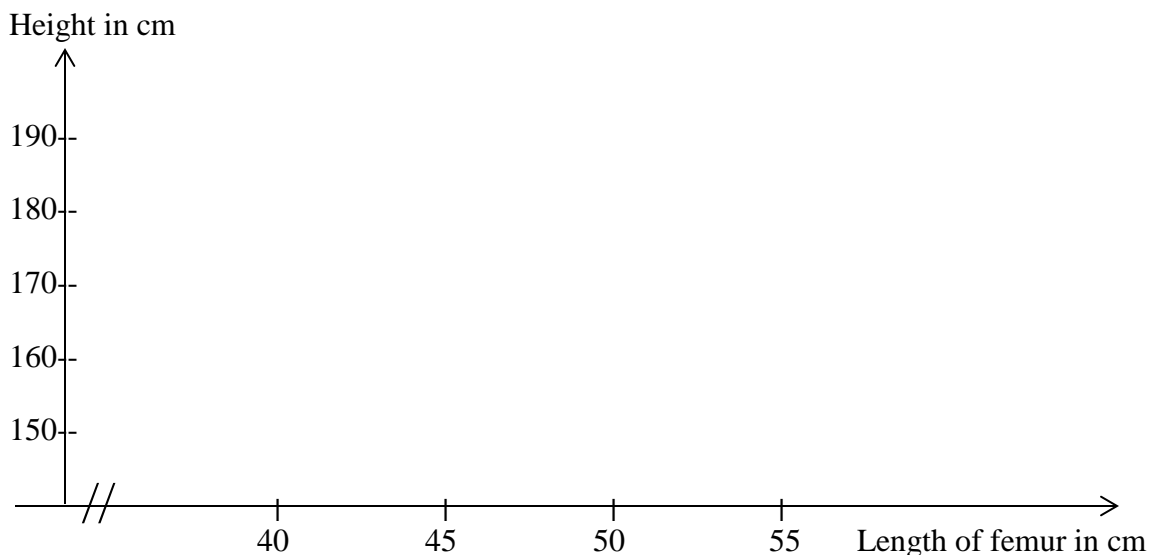
$$m(x) = 2.2x + 69 \quad \text{where } x \text{ is the length of the femur in cm,} \\ \text{and } m(x) \text{ is the man's height in centimeters}$$

- a. Fill in the tables:

WOMAN	
Length of femur, X	Height in cm, $f(x)$
40 cm	
45 cm	
50 cm	
55 cm	

MAN	
Length of femur, X	Height in cm, $f(x)$
40 cm	
45 cm	
50 cm	
55 cm	

- b. Graph it!



c. What is the slope and the f-intercept for the women’s equation?

d. What is the slope and they m-intercept for the men’s equation?

2. The dose for a particular medication is 5 milliliters per kilogram that the patient weighs. This relationship can be expressed as the function  $d(x) = 5x$ , where  $d$  is the dose in milliliters and  $x$  is the weight of the patient in kilograms.

a. Calculate the dose for patients whose weights are listed:

Weight in kilograms, $x$	Dose in milliliters, $d(x)$
Baby, 5 kg	
Child, 20 kg	
Woman, 50 kg	
Man, 60 kg	

b. What is the slope of this line? What is the d-intercept?

c. What does the slope mean in this problem? Why is it positive?

d. If we graphed this line, we would only show points in the first quadrant. Why?

3. In Module 2, you worked with the formula for converting Celcius temperature to Fahrenheit. Now you can see that this formula is a linear equation!

$$F = \frac{9}{5} C + 32$$

You can also write the fraction as a decimal, so the formula becomes

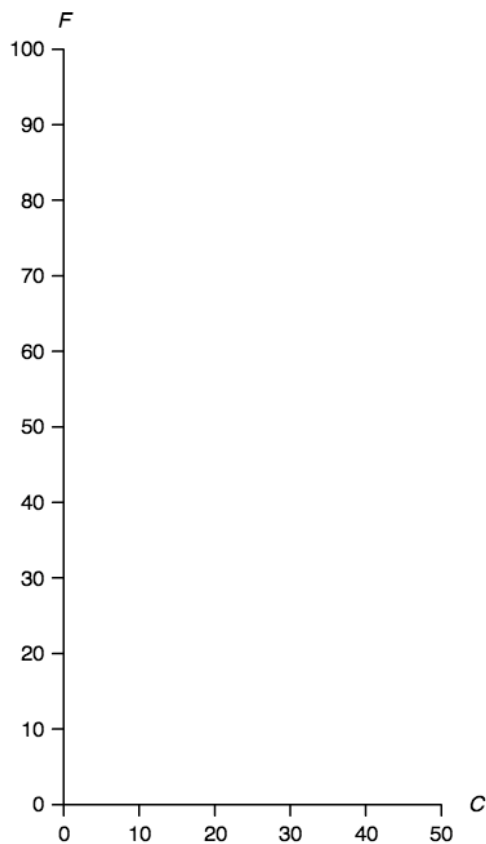
$$F = 1.8C + 32$$

- a. What is the slope of the equation? What is its F-intercept?

- b. Fill in the table:

C°	F°
0	
10	
20	
30	

- c. Sketch the graph:

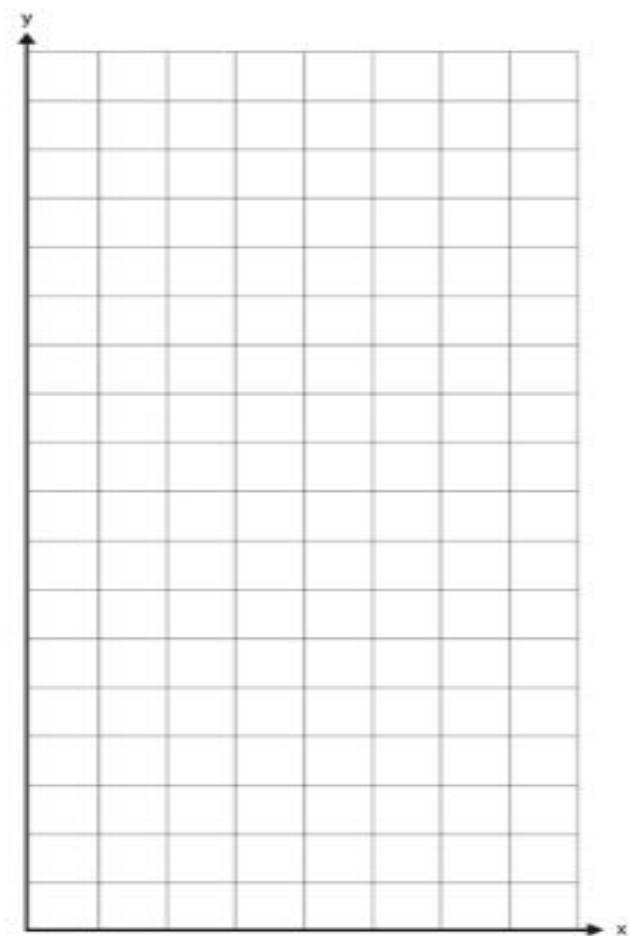


4. Remember the problem from Module 2 about how long it costs to take courses at St. Louis Community College? Now you can recognize that function as a linear equation!

St. Louis Community College charges \$101 per credit hour, plus \$12 in fees. If  $x$  = the number of credit hours a student takes, and  $y$  = total paid, the following function describes the situation:

$$y = 101x + 12$$

- What is the  $y$  intercept of this line? What does it tell you?
- What is the slope of the line? Why is it positive?
- The line for this problem should only be graphed in the first quadrant. Why?
- Graph it! Choose an appropriate scale for the  $x$ -axis and the  $y$ -axis.

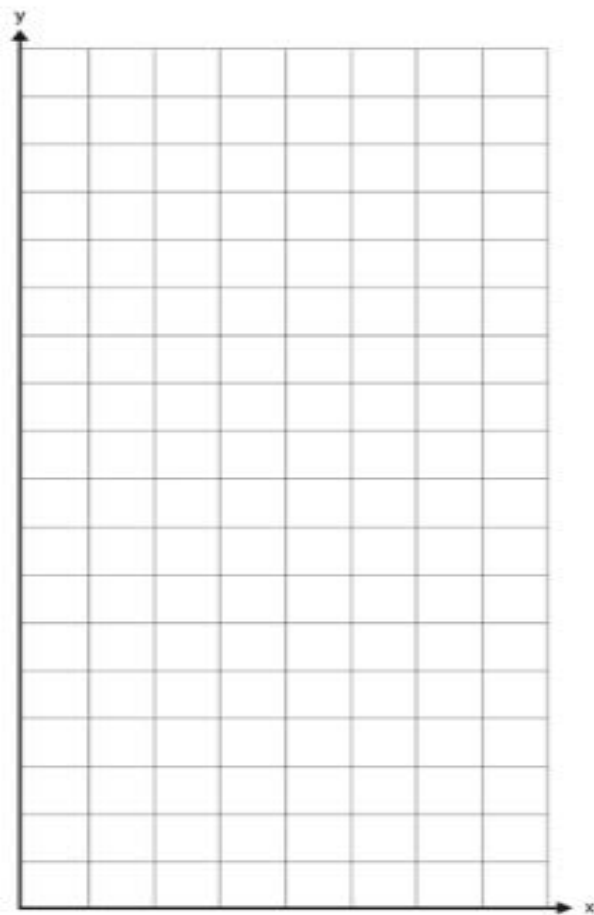


5. Remember the cricket problem from Module 2? You can now recognize the function as a linear equation!

It has been observed that the number of chirps a cricket makes per minute depends on the air temperature! Here is the function relating the temperature in degrees Fahrenheit,  $x$ , to the number of chirps,  $y$ .

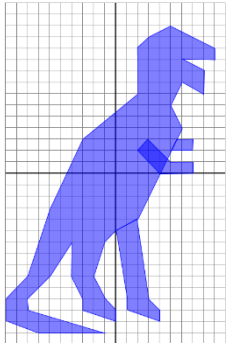
$$y = 4x - 160$$

- What is the slope of this line? Why is it positive?
- What is the  $x$ -intercept of the line? What does it tell you?
- Why does this graph make the most sense in the first quadrant?
- Graph it! Choose an appropriate scale for the  $x$ -axis and the  $y$ -axis.

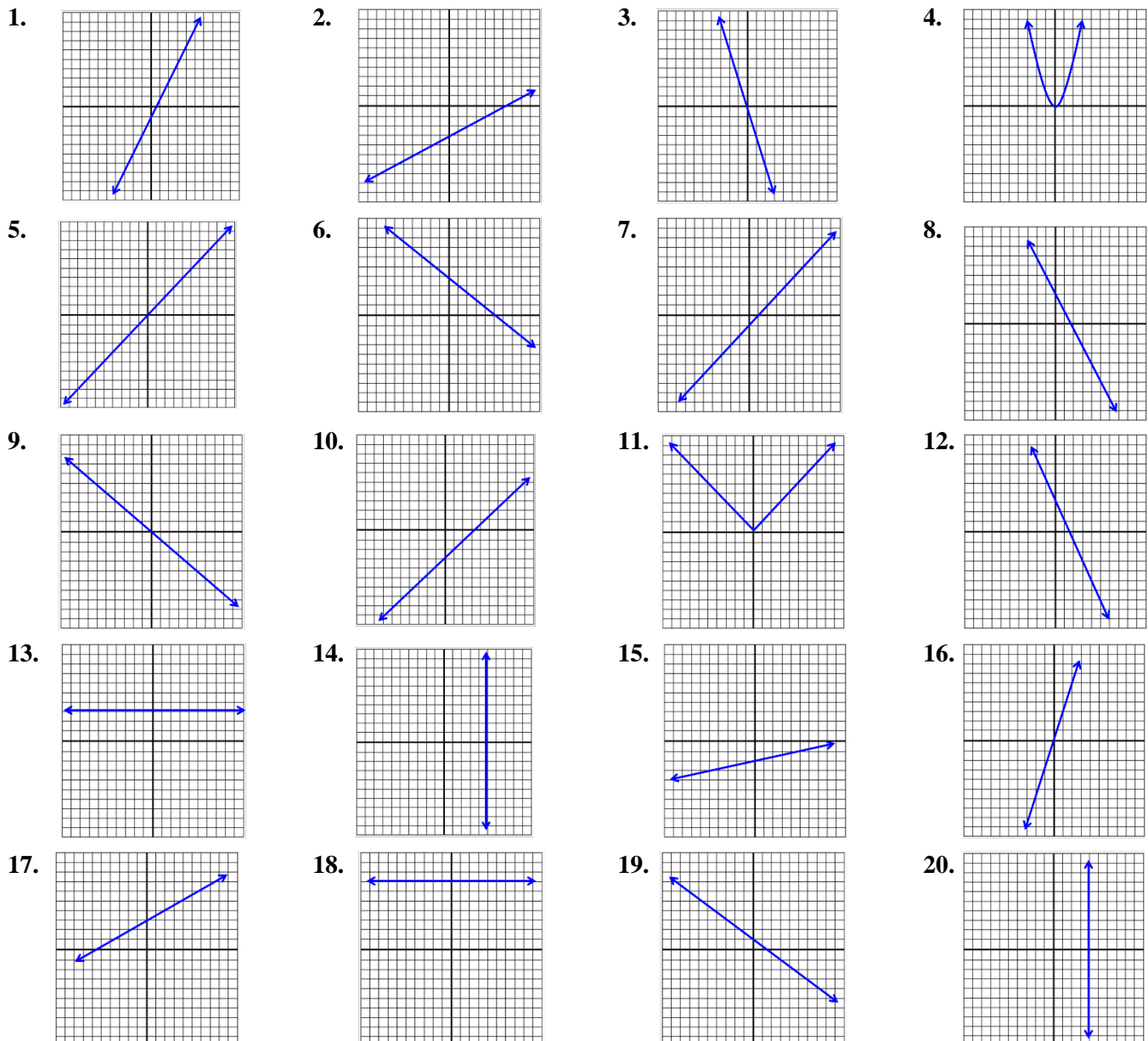


### 3.1 Point-Plotting Practice

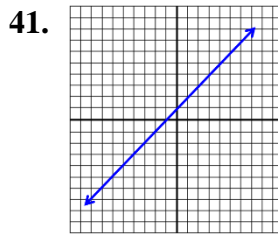
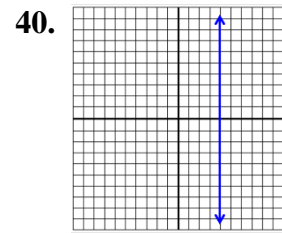
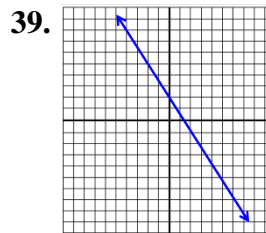
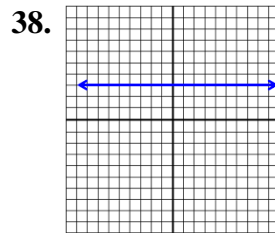
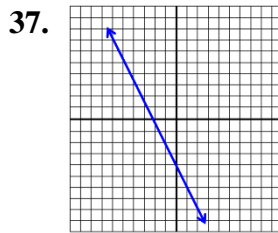
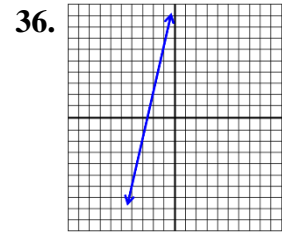
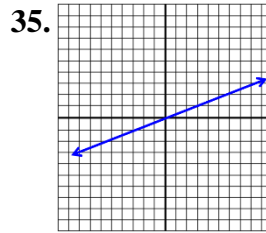
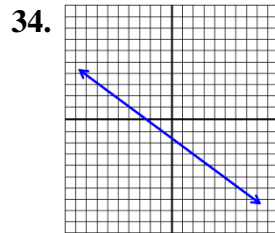
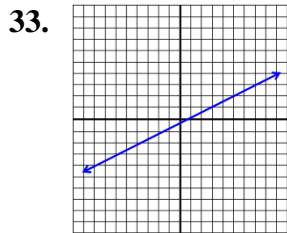
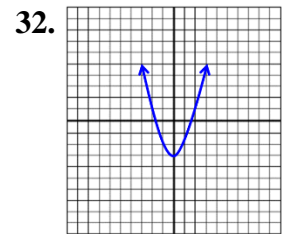
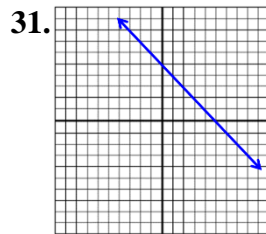
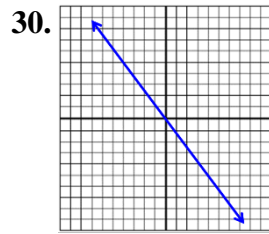
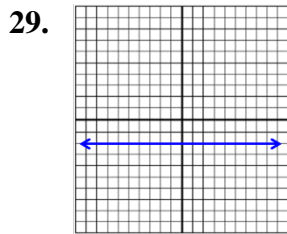
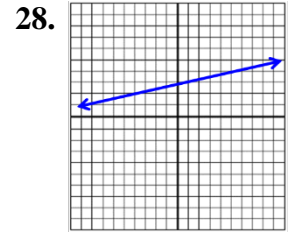
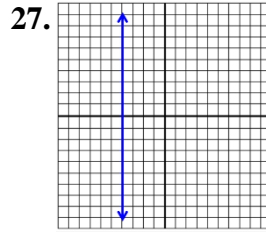
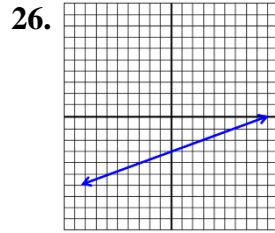
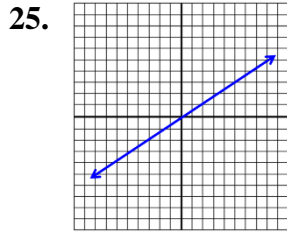
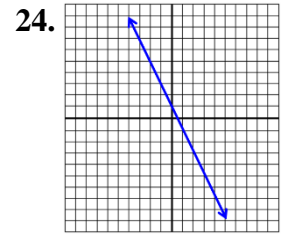
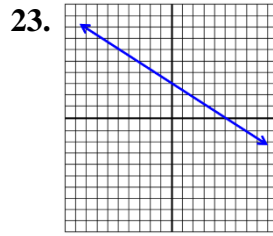
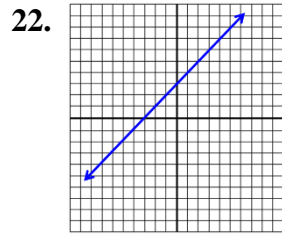
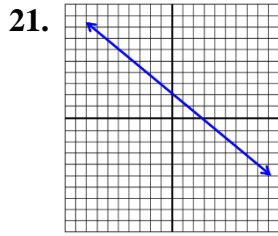
A tyrannosaurus rex



### 3.2 Graphing Practice



### 3.2 Graphing Practice (cont.)



Graphs are approximate.

### 3.3 Slope Practice

1a.  $-1/3$

1b.  $2/3$

1c.  $1/2$

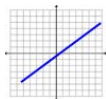
1d.  $-1/2$

1e.  $0$

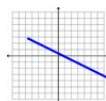
1f. **Undefined**

Graphs are approximate!

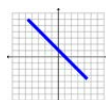
2a.  $m = \frac{3-0}{5-0} = 3/5$



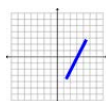
2b.  $m = \frac{-3-0}{5-0} = -3/5$



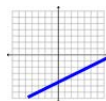
2c.  $m = \frac{5-(-1)}{-4-3} = -6/7$



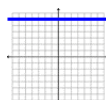
2d.  $m = \frac{2-(-1)}{5-3} = 3/2$



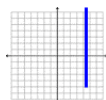
2e.  $m = \frac{-4-(-2)}{-2-4} = \frac{-2}{-6} = 1/3$



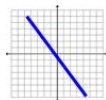
2f.  $m = \frac{6-6}{7-3} = \frac{0}{4} = 0$   
(horizontal)



2g.  $m = \frac{7-6}{3-3} = \frac{1}{0} = \text{Undefined}$   
(vertical)



2h.  $m = \frac{-2-4}{1-(-3)} = \frac{-6}{4} = -3/2$



3. goes uphill

4. goes downhill

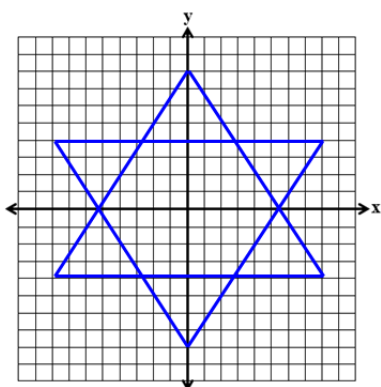
### 3.4 Slope-Intercept Form

	SI FORM	SLOPE	Y-INT.	GRAPH
A.	$y = -3/2 x + 3$	$m = -3/2$	$(0, 3)$	
B.	$y = 2x + 4$	$m = 2$	$(0, 4)$	
C.	$y = -1/2 x + 3/2$	$m = -1/2$	$(0, 3/2)$	
D.	$y = 1/2 x - 5/2$	$m = 1/2$	$(0, -5/2)$	
E.	$y = 3x$	$m = 3$	$(0, 0)$	
F.	$y = -3x$	$m = -3$	$(0, 0)$	
G.	$y = 1/2 x + 7$	$m = 1/2$	$(0, 7)$	
H.	$y = x - 2$	$m = 1$	$(0, -2)$	

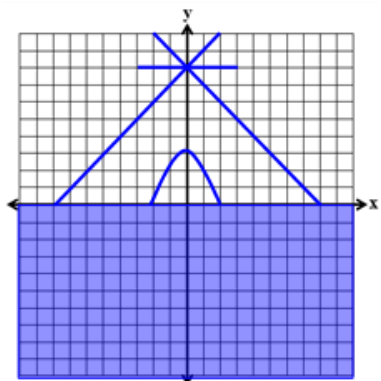
	SI FORM	SLOPE	Y-INT.	GRAPH
I.	$y = 2x - 5$	$m = 2$	$(0, -5)$	
J.	$y = 5/3 x - 5$	$m = 5/3$	$(0, -5)$	
K.	$y = -3/4 x + 5$	$m = -3/4$	$(0, 5)$	
L.	$y = -2$	$m = 0$	$(0, -2)$	
M.	$x = -5$	undefined	n/a	
N.	$y = 1$	$m = 0$	$(0, 1)$	
O.	You'll learn to create the equation for this line in the next module!	$m = 2/3$	Estimate if necessary	
P.	You'll learn to create the equation for this line in the next module!	$m = -1$	Estimate if necessary	

### 3.5 Line Designs!

#### 1. Star



#### 2. Tee-pee



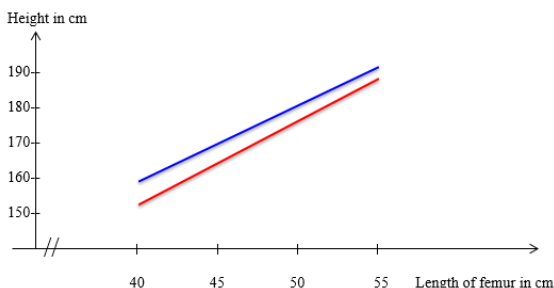
### 3.6 Career Applications – STEM

#### 1a.

WOMAN	
Length of F X	Height in cm, f(x)
40 cm	153 cm
45 cm	164.5 cm
50 cm	176 cm
55 cm	187.5 cm

MAN	
Length of F X	Height in cm, f(x)
40 cm	157 cm
45 cm	168 cm
50 cm	179 cm
55 cm	190 cm

#### 1b.



#### 1c. $m = 2.3$ , f-intercept = 61

#### 1d. $m = 2.2$ , f-intercept = 69

### 3.6 Career Applications – STEM (cont.)

#### 2a.

Weight in kg x	Dose in mL d(x)
Baby, 5 kg	$d(5) = 5(5) = 25$
Child, 20 kg	$d(20) = 5(20) = 100$
Woman, 50 kg	$d(50) = 5(50) = 250$
Man, 60 kg	$d(60) = 5(60) = 300$

#### 2b. $m = 5$ , d-intercept = 0

2c. for every kilogram you add in weight, the dose increases by 5 milliliters; the slope is positive because as weight increases, so does size of the dose

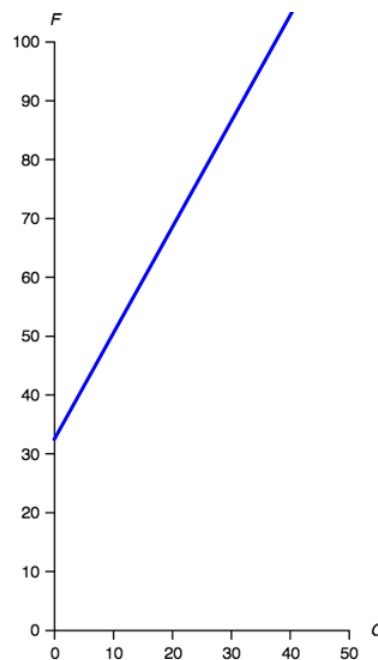
#### 2d. Weight and doses are non-negative quantities

#### 3a. $m = 1.8$ , F-intercept = 32

#### 3b.

C°	F°
0	32
10	50
20	68
30	86

#### 3c.

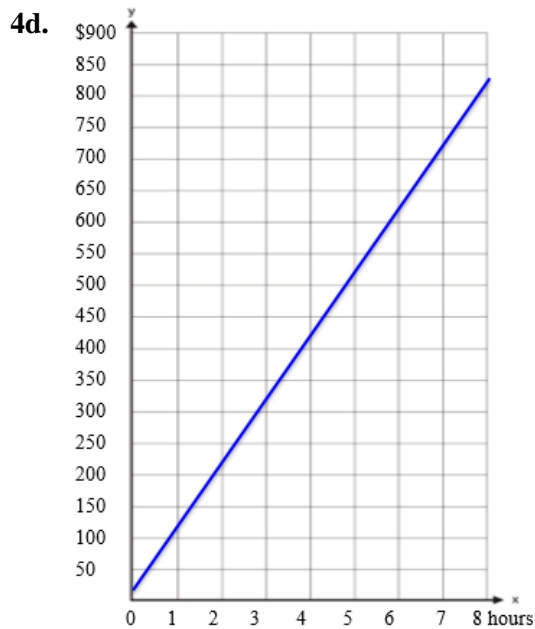


4a. y-int. = 12; this tells you the fee, regardless of the number of credit hours

4b.  $m = 101$ , this number is positive because as credit hours increase, so does the cost

4c. Both credit hours and fees are positive quantities

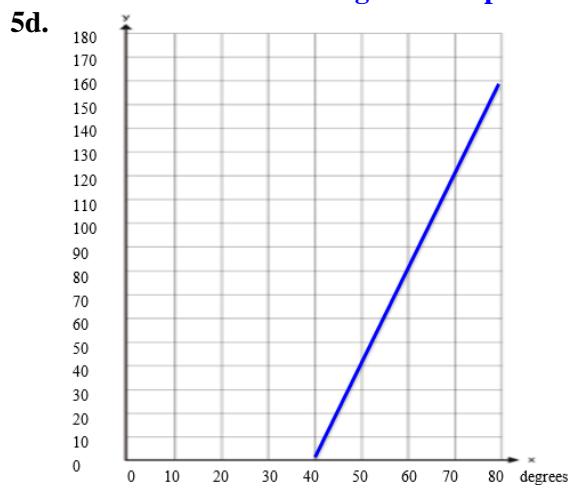
### 3.6 Career Applications – STEM (cont.)



5a.  $m = 4$ ; slope is positive because the higher the temperature, the faster they chirp

5b. x-intercept = 40; this tells you that crickets stop chirping at 40 degrees

5c. The number of chirps must be positive, and crickets aren't out in negative temperatures



MoSTEMWINS

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