

**Chapter 3 Notes**

**3.1 – Graph Using Intercepts**

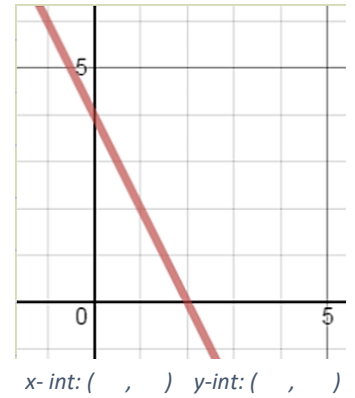
**x – intercept:**

**y – intercept:**

To find the x – intercept, set  $y =$  \_\_\_\_\_

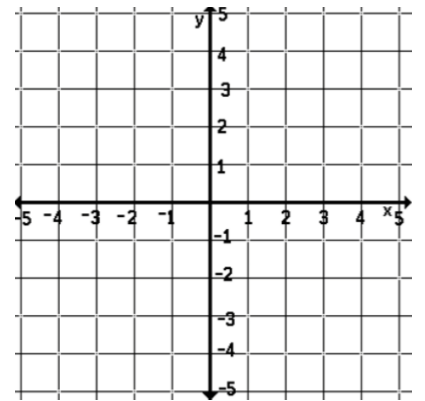
To find the y – intercept, set  $x =$  \_\_\_\_\_

**Standard Form:**

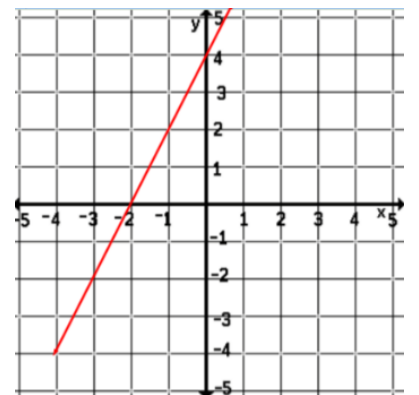


Example: Find the x and y – intercept of the line  $2x + 7y = 28$ .

Example: Find the x and y – intercept of the line  $x + 2y = 4$ . Then use them to graph the line.



Example: Use the graph to find the values of A and B for the equation of the line:  $Ax + By = 12$ .



### 3.3 - Slope

KEY CONCEPT
For Your Notebook

Finding the Slope of a Line

**Words**

The slope  $m$  of the nonvertical line passing through the two points  $(x_1, y_1)$  and  $(x_2, y_2)$  is the ratio of the rise (change in  $y$ ) to the run (change in  $x$ ).

slope =  $\frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$

**Symbols**

$m = \frac{\text{rise}}{\text{run}}$

**Graph**

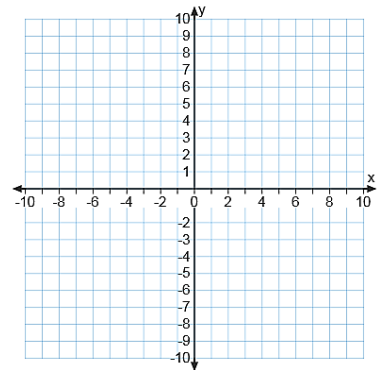
**Example:** Find the slope of the line that passes through the points (3,5) and (6,-1). Check with a graph!!!

**Example:** Find the slope of the lines shown.

$x = -2$

$y = 1$

**Challenge Example:** If the first point on a line is (4,1) and the second point on the line is (A, 7), what would the value of A have to be so that the line has a slope of 3?



**Rate of Change Example:** The table shows the cost of using a computer at an Internet cafe for a given amount of time. Find the rate of change in cost with respect to time.

Time (hrs)	2	4	6
Cost (\$)	7	14	21

CONCEPT SUMMARY

Classification of Lines by Slope

A line with positive slope ( $m > 0$ ) rises from left to right.

A line with negative slope ( $m < 0$ ) falls from left to right.

For Your Notebook

A line with zero slope ( $m = 0$ ) is horizontal.

A line with undefined slope is vertical.

## Introduction to Calculus

The path of a rocket is shown below with its equation ( $x$  is measuring feet and  $f(x)$  is height). Find the slope between the pairs of points.

$$f(x) = -16x^2 + 144x$$

$$f(4) =$$

$$f(3) =$$

$$f(2.5) =$$

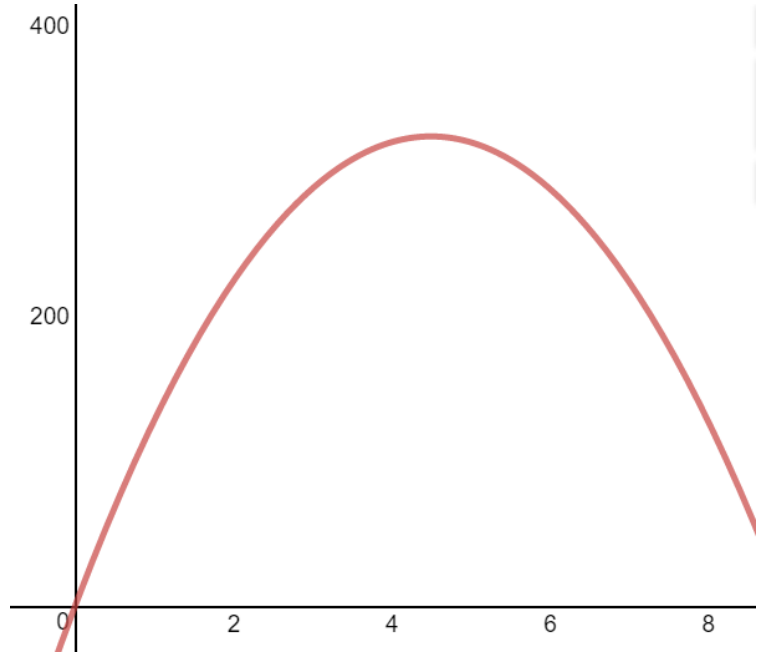
$$f(2) =$$

a)  $x = 2$  and  $x = 4$

b)  $x = 2$  and  $x = 3$

c)  $x = 2$  and  $x = 2.5$

d) estimate what the slope is at the point when  $x = 2$ .



## 4.1 – Slope Intercept Form

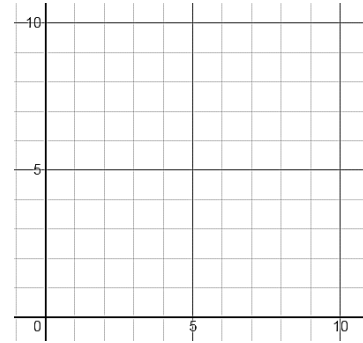
**Example:** Fill in the table, graph and then state what you notice.

$$y = 5 + 2x$$

x				
y				

y – intercept = (     ,     )

Slope =



**KEY CONCEPT**
*For Your Notebook*

**Finding the Slope and y-Intercept of a Line**

Words	Symbols	Graph
A linear equation of the form $y = mx + b$ is written in <b>slope-intercept form</b> where $m$ is the slope and $b$ is the y-intercept of the equation's graph.	$y = mx + b$ $\uparrow$ slope $\downarrow$ y-intercept $y = \frac{1}{3}x + 1$	

I think it's easier when first learning it to write it as  $y = b + mx$ , however, the rest of the world writes it as  $y = mx + b$ .

**Example:** State the y-int and slope of the following.

$y = -\frac{1}{2}x - 3$	$y = 3x$	$y = -2$
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**Example:** Find the slope and y-intercept of  $2y + 4x = 14$ . Then graph.

**Example:** Write the equation for the graph shown.

**Parallel Lines:** Two lines are parallel if they have the same \_\_\_\_\_.

**Example:** Tell if the following lines are parallel.

1. $y = 3x + 2$ and $-7 + 3x = y$	2. $4x + y = 3$ and $x + 4y = 3$
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## Bruin Point-Slope Form

### Lead-In

1. You are paid \$15 for each hour you work at Tropical Sno. After working for 12 hours total, you now have \$225 in your bank account. If you work 18 hours total, how much will you have in your bank account?

What if you work 30 hours total?

What if you work  $x$  hours total?

How much did you have in your bank account after working 0 hours total (that is, before you had the job)?

2. You are paid \$25 for each lawn you mow next summer. After mowing 8 lawns total, you now have \$275 in your bank account. If you were to mow 14 lawns total, how much will you have in your bank account?

What if you do 30 lawns total?

What if you work  $x$  lawns total?

How much did you have in your bank account after mowing 0 lawns total (that is, before you started mowing)?

### Graphing in Bruin Point-Slope Form

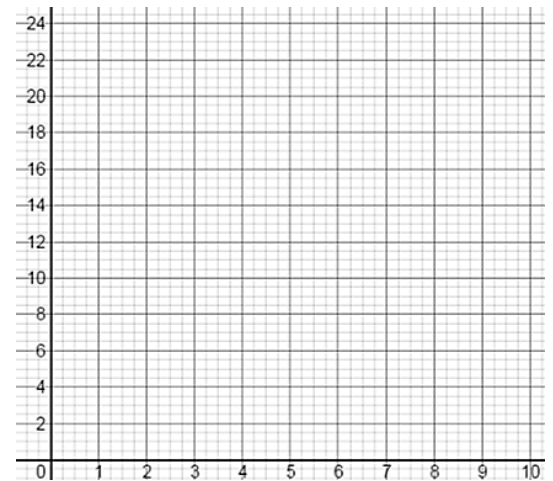
Example: You are paid \$2 for each foul ball you turn in as a bat boy for the Helena Brewers. After turning in 3 foul balls, you now have \$10 in your pocket.

#### **BRUIN POINT - SLOPE FORM**

To describe a line that goes through the point  $(x_1, y_1)$  with a slope of  $m$ , we write the following:

$$y = y_1 + m(x - x_1)$$

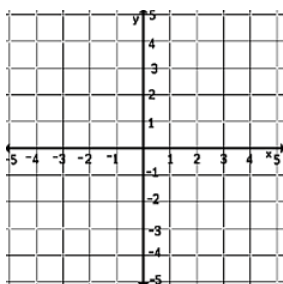
↑ Slope  
↑ Variable  
↑ y-coordinate of point  
↑ x-coordinate of point



Examples: Describe and graph the lines.

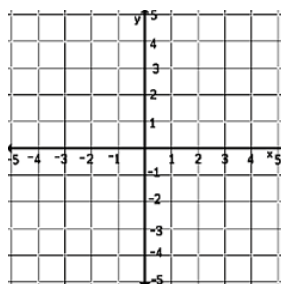
1.  $y = -2 + \frac{3}{2}(x - 1)$

You start at a  $y$  - coordinate of \_\_\_\_\_ and \_\_\_\_\_ for every interval past  $x$ -coordinate \_\_\_\_\_.



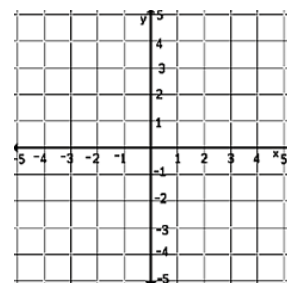
2.  $y = 4 - \frac{1}{2}(x - 3)$

You start at a  $y$  - coordinate of \_\_\_\_\_ and \_\_\_\_\_ for every interval past  $x$ -coordinate \_\_\_\_\_.



3.  $y = -3 + 2(x + 4)$

You start at a  $y$  - coordinate of \_\_\_\_\_ and \_\_\_\_\_ for every interval past  $x$ -coordinate \_\_\_\_\_.

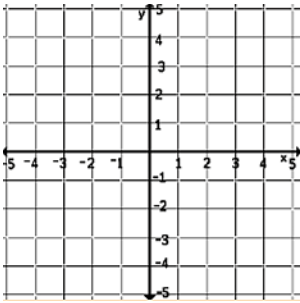
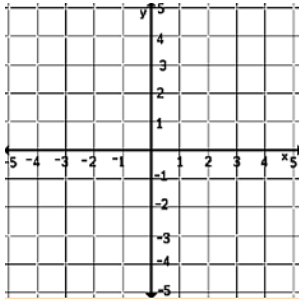


### 4.3 – Write Linear Equations in Point-Slope Form

**Example:** Write an equation of the line that goes through the point (3,4) and has a slope of 3.

<p style="text-align: center;"><b>BRUIN POINT - SLOPE FORM</b></p> $y = y_1 + m(x - x_1)$ <p style="text-align: center;"> <span style="margin-right: 100px;">Slope</span> <span style="margin-right: 100px;">Variable</span> <span>Variable</span> </p> <p style="text-align: center;"> <span style="margin-right: 100px;">y-coordinate of point</span> <span>x-coordinate of point</span> </p> <p>Equation: _____</p> <p>*this is the way I think is best if you're first learning it</p>	<p style="text-align: center; color: blue;"><b>Point-Slope form</b></p> <div style="border: 1px solid black; padding: 10px; text-align: center; margin: 10px auto; width: 80%;"> <math display="block">y - y_1 = m(x - x_1)</math> </div> <p>Equation: _____</p> <p>*this is the way the rest of the world writes it</p>
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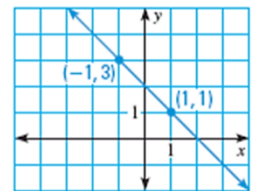
**Examples:** Describe and graph the lines.

<p>1. <math>y + 2 = \frac{3}{2}(x - 1)</math></p> <p>Rewrite in Bruin Point-Slope Form:</p> <p>You start at a y - coordinate of _____ and _____ for every interval past x-coordinate _____.</p> 	<p>2. <math>y - 4 = -\frac{2}{5}(x + 3)</math></p> <p>Rewrite in Bruin Point-Slope Form:</p> <p>You start at a y - coordinate of _____ and _____ for every interval past x-coordinate _____.</p> 
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**Example:** Write an equation for the line shown (see if you can write two!)

First find the slope. Slope =

You start at a y - coordinate of \_\_\_\_\_ and \_\_\_\_\_ for every interval past x-coordinate \_\_\_\_\_.



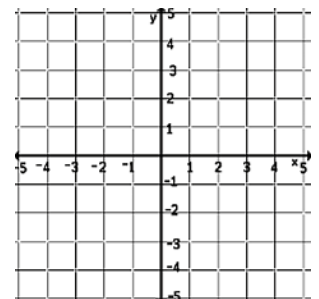
You start at a y - coordinate of \_\_\_\_\_ and \_\_\_\_\_ for every interval past x-coordinate \_\_\_\_\_.

**Example:** Write an equation for the line through these two points: (0,2) and (1,-1).

Step 1: find slope

Step 2: Write in Bruin Point-Slope Form

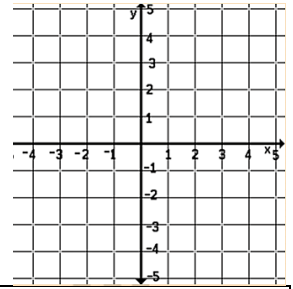
\*\*\*What happens if we simplify the equation above? Does it become something we recognize?



#### 4.2– Write Linear Equations in Slope-Intercept Form

How does our Bruin Point-Slope Form change when we start with an x - coordinate of 0?

$$y = y_1 + m(x - x_1)$$



Example: Translate from English to Math and then graph the equation:

You start at a y - coordinate of -4 and go up 2 for every interval past x = 0.

<p><b>Slope – Intercept Form</b></p> <div style="display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; padding: 5px; margin-right: 10px;"> <math>y = b + mx</math>  <small>↑            ↑</small>  <small>y-Intercept   Slope</small> </div> <span style="margin: 0 10px; color: green;">or</span> <div style="border: 1px solid black; padding: 5px; margin-left: 10px;"> <math>y = mx + b</math>  <small>          ↑            ↑</small>  <small>Slope    y-Intercept</small> </div> </div>	<p>What changes when we look at slope-intercept form using function notation?</p>
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Example: Write an equation of the line with a slope of -2 and a y-intercept of 5.     m = \_\_\_\_\_ and b = \_\_\_\_\_

Equation: \_\_\_\_\_

Example: Write equation for a line, in slope-intercept form, that goes through the point (3,1) and has a slope of 2.

<p>Method 1: Bruin Point-Slope and Simplify</p>	<p>Method 2: Slope Intercept Form and Solve for “b”</p>
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Example: Write an equation for the linear function f with value of f(9) = -2 and f(4) = 3.

Step 1: Find m.

Step 2: Find b using either method below.

<p>Method 1: Bruin Point-Slope and Simplify</p>	<p>Method 2: Slope Intercept Form and Solve for “b”</p>
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#### 4.4 – Write Equations of Parallel and Perpendicular Lines

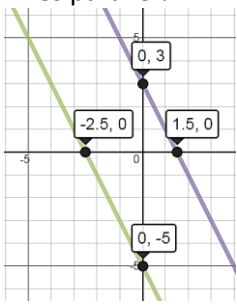
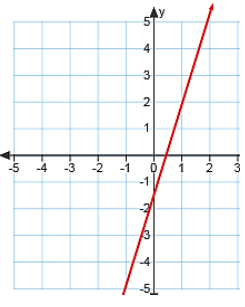
Parallel lines are lines that \_\_\_\_\_ intersect

Perpendicular lines are lines that intersect at \_\_\_\_\_ angles

Parallel lines: if two nonvertical lines have the same slope, then they are \_\_\_\_\_

if two lines are parallel, then they have the same \_\_\_\_\_

Example:  $y = 5x + 12$  and \_\_\_\_\_ are parallel lines

<p><u>Example:</u> Are the two lines parallel?</p> 	<p><u>Example:</u> Write an equation of the line that passes through <math>(-2, -4)</math> and is parallel to the line <math>y = 3x - 1</math>. <b>FIRST DRAW A PICTURE!!!</b></p> <ol style="list-style-type: none"> <li>1) Identify slope.</li> <li>2) Solve for y-intercept.</li> <li>3) Write equation.</li> </ol>	
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**Perpendicular Lines:** Perpendicular lines are lines that have slopes that are:

- 
- 

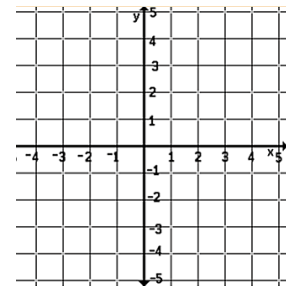
Example: For the following lines, write the equation for a line that would be perpendicular to the original.

1. $y = 2x$	2. $y = \frac{5}{3}x$	3. $y = -15x$	4. $y = -\frac{1}{2}x$
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Example: Write an equation of the line that passes through  $(4, -5)$  and is perpendicular to the line  $y = 2x + 3$ .

FIRST DRAW A PICTURE if you need to, it really helps!!!

- 1) Identify slope.
- 2) Solve for y-intercept.
- 3) Write equation of line.



Example: Determine which of the lines are parallel or perpendicular to one another.

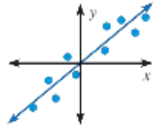
**Line a:**  $y = 5x - 3$       **Line b:**  $x + 5y = 2$       **Line c:**  $-10y - 2x = 0$



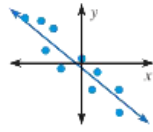
## 4.5 – Fitting a Line to Data



A **scatterplot** is a graph used to determine whether there is a relationship between paired data. Scatterplots can show trends in the data.



If  $y$  tends to increase as  $x$  increases, the paired data are said to have a **positive correlation**.



If  $y$  tends to decrease as  $x$  increases, the paired data are said to have a **negative correlation**.



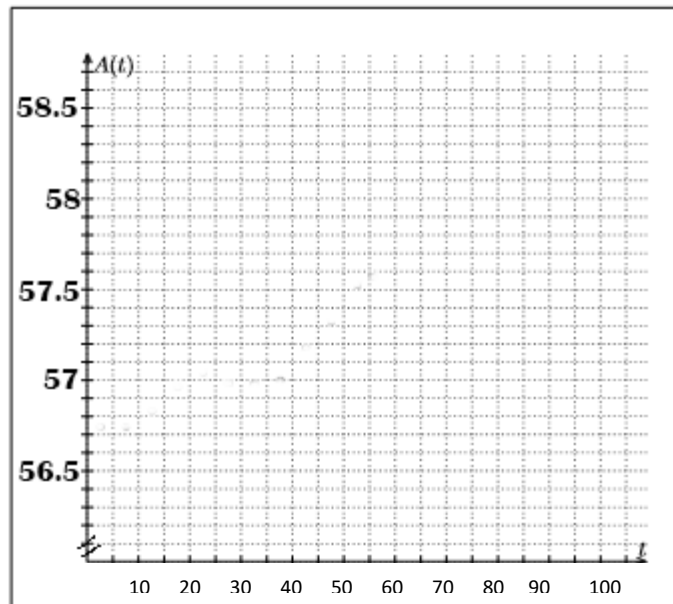
If  $x$  and  $y$  have no apparent relationship, the paired data are said to have **relatively no correlation**.

Based on data provided by NASA's Goddard Institute for Space Studies, we are going to investigate the relationship between Earth's Average Global Temperature and Time. For introduction video, click [here](#).

Every year since 1900, the Earth's average global temperature has been recorded. This data is given in the table below.

$t$ (years after 1900)	5	15	25	35	45	55	65	75	85	95	105
$A$ (avg. temp in degrees F)	56.73	56.73	56.89	57.13	57.27	57.17	57.17	57.2	57.53	58.14	58.60

1) Using the data from the table above, make a scatterplot on the graph below.



2) What type of trend do you see?

3) Does there appear to be a positive, negative, or no correlation?

4) Once you have plotted the points, sketch in a **line of best fit**, since the data tend to be fairly linear.

Note: the line of best fit does not necessarily need to go through any of our data points, however it certainly can. It simply represents the line that most closely follows the trend of the data.

5) Using two points that are on your line of best fit, find the equation for the line. Show your work below.

**Equation for line of best fit:** \_\_\_\_\_

**Note: You could also use Desmos:** <https://www.desmos.com/calculator/payyemzsoh>

6) Interpret the slope and y-intercept of your equation in the context of the situation. That is, what do they actually represent?

Slope:

Y-intercept:

#### **4.6 – Predicting with Linear Models**

The process of finding the best-fitting line to model a set of data is called \_\_\_\_\_.

We will perform linear regression by using technology (TI calculators).

##### **Step 1 – Entering the Data**

- Hit **STAT**
- Choose **1:Edit** by either hitting **1** or **ENTER**.  
*If necessary, clear out any old data in the lists:*  
*Use **▲** to get cursor to cover L1 at top of list; press **CLEAR/ENTER**. Repeat process for L2.*
- Type the data values for the independent ( $x$ ) variable in column L1. Hit **ENTER** after each entry.
- When you finished entering data in L1, hit **▶** and then enter the data values for the dependent ( $y$ ) variable in column L2.

(independent variable in our case is \_\_\_\_\_ dependent variable in our case is \_\_\_\_\_)

##### **Step 2 – Getting the Equation for the Line of Best Fit**

- Hit **STAT** then **▶** to **CALC**
- Choose **4:LinReg(ax+b)** (Either scroll down to 4 and then hit **ENTER**, or simply hit **4**)

In the calculator the a-value represents the slope and the b-value represents the y-intercept

The equation for our line of best fit is \_\_\_\_\_

1) Write down and interpret what the slope and y-intercept of your equation in the context of the situation mean. That is, what do they actually represent?

Slope:

Y-intercept:

2) **Linear Interpolation:** using the equation for the line of best fit to estimate a value between two known values.

Use your calculated line of best fit to estimate the average Earth temperature in 1950.

3) **Linear Extrapolation:** using the equation for the line of best fit to estimate outside the range of known values.

Use your calculated line of best fit to estimate the average Earth temperature in 2013.

4) Use Google to look up the average Earth temperature in 2013. How close were you?

5) Is interpolation or extrapolation safer? Why?

6) Use your calculated line of best fit to find when Earth's average temperature will be 60° F.

## 4.7 – Inverse Linear Functions

Biologists have found that the number of cricket chirps per minute is a function of the outside temperature. The function is:  $C(t) = 4(t-40)$ . Use this function to calculate the following and interpret them.

$$C(75)$$

$$C(40)$$

Biologists also find it useful to be able to count the number of chirps and then use that to calculate an estimate for the temperature. In order to do so, one would need to solve the following equation for  $t$ .

**Original:**  $C = 4(t-40)$

**Inverse:**

*Inverse Function (definition):*

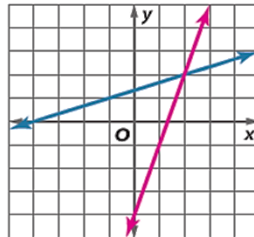
Example: Based on the cricket example, describe in words what the following represent:

$$C(60) = 80$$

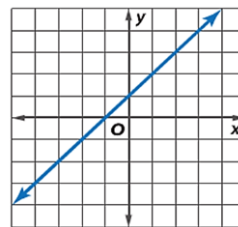
$$C^{-1}(16) = 44$$

### **Graphs of Inverse Functions:**

When you graph inverse functions, they are reflections of one another across the line \_\_\_\_\_. Why is this so?



Example: Given the line, graph its inverse. Any good strategies?



**Finding the Inverse of ANY Function:** 1) Solve for your original input 2) Rename your inverse function  $f^{-1}(x)$

Example: Find the inverse of each function (might be good to first rename  $f(x)$  as  $y$ )

$$f(x) = 5x - 3$$

$$f(x) = \frac{3}{2}x - 9$$