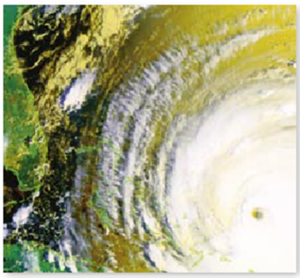
1.2 Graphing Linear Functions

Objectives:

- Determine whether a function is linear.
- Graph a linear function given two points, a table, an equation, or a point and a slope.

Meteorologists begin tracking a hurricane's distance from land when it is 350 miles off the coast of Florida and moving steadily inland.The meteorologists are interested in the rate at which the hurricane is approaching land.



+1 +1 +1 +1

Time (h)	0	1	2	3	4
Distance from Land (mi)	350	325	300	275	250

−25 −25 −25 −25

This rate can be expressed as $\frac{\text{change in distance}}{\text{change in time}} = \frac{-25 \text{ miles}}{1 \text{ hour}}$
Notice that the rate of change is constant.
The hurricane moves 25 miles closer each hour.

slope = m

to climb = monter

Functions with a constant rate of change are called linear functions. A linear function can be written in the form $f(x) = mx + b$, where x is the independent variable and m and b are constants. The graph of a linear function is a straight line made up of all points that satisfy $y = f(x)$.

$y = mx + b$

Determine whether the data set could represent a linear function.

1A.

x	−2	0	2	4
$f(x)$	2	1	0	−1
		+2	+2	+2
		−1	−1	−1

is linear

1B.

x	~~−2~~ 2	~~0~~ 3	~~2~~ 4	~~4~~ 5
$f(x)$	2	~~1~~ 4	~~0~~ 8	~~−1~~ 16
		+1	+1	+1
		+2	+4	+8

not linear

The constant rate of change for a linear function is its *slope*. The **slope** of a linear function is the ratio:

$$m = \frac{\text{change in } f(x)}{\text{change in } x} \text{ or } \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$

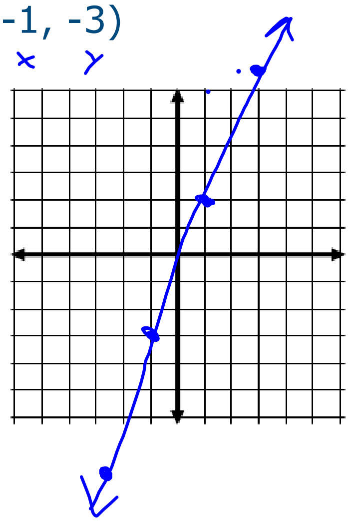
$$m = \frac{y - y}{x - x}$$

Graphing Lines Using **Slope and a Point**

Graph each line.

Ex 2A the line with slope $\frac{5}{2}$ (up / right) that passes through (-1, -3)

x y

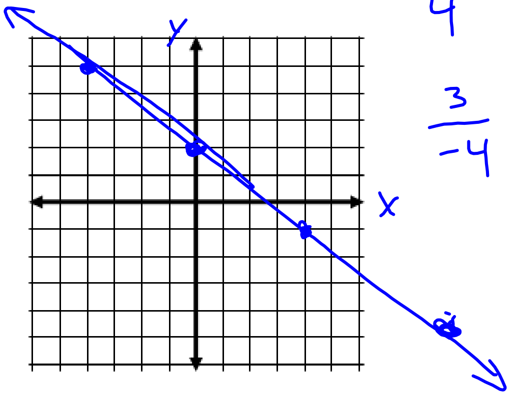


Ex 2B the line with slope that passes through (0, 2)

$-\frac{3}{4}$

$\frac{-3}{4}$

$\frac{3}{-4}$



Graphing Lines
Using the Intercepts

The y-intercept is the y-coordinate of a point where the line crosses the y-axis.
The x-intercept is the x-coordinate of a point where the line crosses the x-axis.

$m = \frac{8}{4} = \frac{2}{1}$

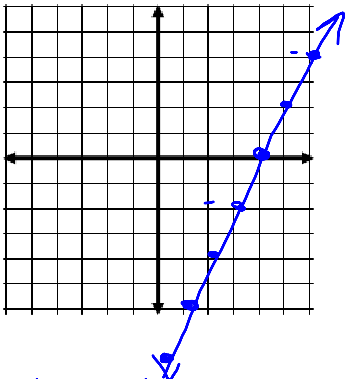
Ex 3A Find the intercepts of 4x - 2y = 16 and graph the line.

x int $(\_, 0)$ y = 0

$4x - \cancel{2y} = 16$

$\frac{4x}{4} = \frac{16}{4}$

$x = 4$



y int $(0, \_)$ x = 0

$\cancel{4x} - 2y = 16$

$\frac{-2y}{-2} = \frac{-16}{-2}$

$y = -8$

write intercepts as ordered pairs

$(4, 0)$ $(0, -8)$

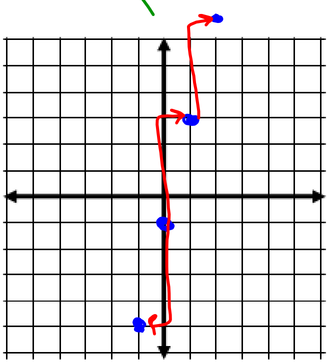
Graphing Lines Using **Slope-Intercept Form**

y = mx + b
m is the slope $\frac{m}{1}$
b is the y-intercept.

$(0, b)$

Write each function in slope-intercept form. Then graph the function.

Ex 4A $\cancel{-4x} + y = -1$
$\quad +4x \qquad +4x$



$y = -1 + 4x$

or

$y = 4x - 1$

$\quad mx + b$

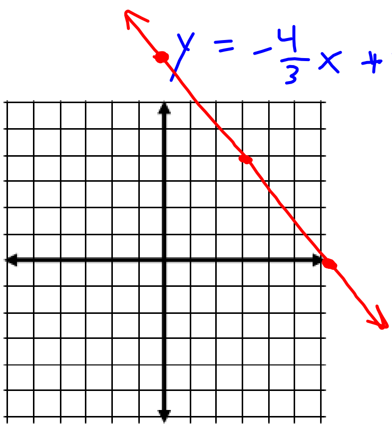
$m = \frac{4}{1}$ $\frac{-4}{-1}$

$(0, -1)$

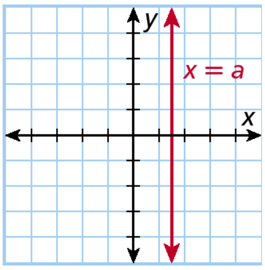
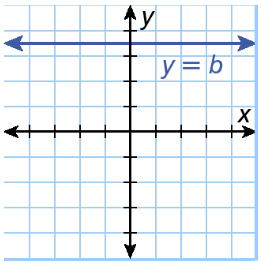
Ex 4B $x + \frac{3}{4}y = 6$
$-x \qquad -x$

$\frac{4}{3}\left(\frac{3}{4}y\right) = \left(-x + 6\right)\frac{4}{3}$

$y = -\frac{4}{3}x + 8$



An equation with only ONE variable can be represented by either a vertical or a horizontal line.

Vertical and Horizontal Lines	
Vertical Lines	**Horizontal Lines**
The line $x = a$ is a vertical line at a. 	The line $y = b$ is a vertical line at b. 

Vertical Lines have NO slope.

undefined

$\frac{\#}{0}$

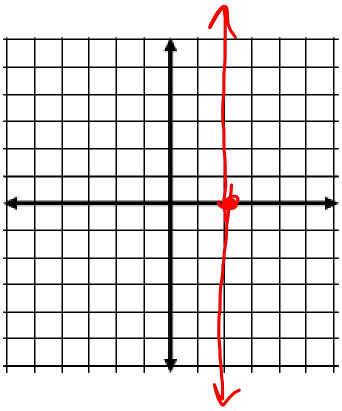
Horizontal Lines have 0 slope.

$\frac{0}{\#}$

Graphing Vertical and Horizontal Lines

Graph each.

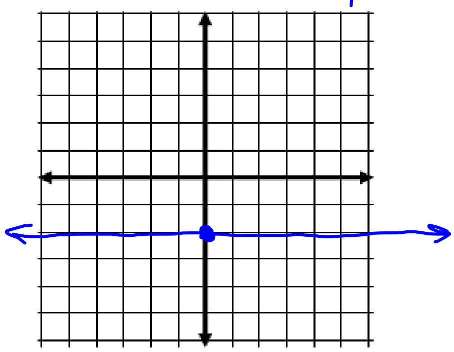
Ex 5A $x = 2$



Ex 5B $2y = -4$

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

$y = -2$



Ex. 6

A ski lift carries skiers from an altitude of 1800 feet to an altitude of 3000 feet over a horizontal distance of 2000 feet. Find the average slope of this part of the mountain.

$$m = \frac{3000 - 1800}{2000} = \frac{12\cancel{00}}{20\cancel{00}} = \frac{12}{20} = \frac{6}{10} = \frac{3}{5}$$

$$\left(\frac{4}{1}\right) \cdot \frac{-1}{-1} = \left(\frac{-4}{-1}\right)$$

$$-\frac{3}{4} = \frac{3}{-4}$$