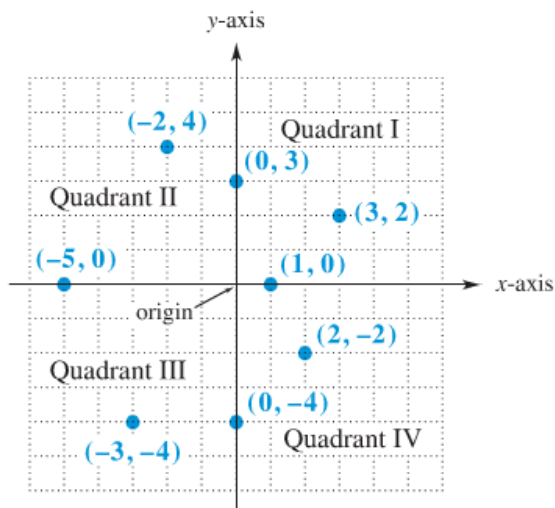


## 2.1, 2.2, 2.3 Linear Functions, Graphs, and Modeling

### Properties of Cartesian Coordinates:

System consists of a horizontal number line (i.e. the \_\_\_\_\_) and a vertical number line (i.e. the \_\_\_\_\_), with ordered pairs ( $x$ -coordinate,  $y$ -coordinate).

Graph of an Equation with Two Variables is the set of \_\_\_\_\_ points in the plane whose coordinates (ordered pairs) are \_\_\_\_\_ of the equation.



\*Note: There are often infinitely many solutions to our equations! To see if an ordered pair is a solution, substitute into the given equation to see if it produces a true statement.

### Definition :

i)  **$x$ -intercept:** the  $x$ -coordinate where the graph intersects the \_\_\_\_\_

Note: At the  $x$ -intercept, the  $y$ -coordinate is always \_\_\_\_\_!

Finding: To find the  $x$ -intercept, let \_\_\_\_\_, and \_\_\_\_\_

ii)  **$y$ -intercept:** the  $y$ -coordinate where the graph intersects the \_\_\_\_\_

Note: At the  $y$ -intercept, the  $x$ -coordinate is always \_\_\_\_\_!

Finding: To find the  $y$ -intercept, let \_\_\_\_\_, and \_\_\_\_\_

**Definition [Slope]:** Given  $(x_1, y_1)$  and  $(x_2, y_2)$ :  $\text{slope} = m = \frac{\text{change in } y}{\text{change in } x} = \frac{y_2 - y_1}{x_2 - x_1}$

i) **Slope intercept form:**  $y = mx + b$ , with  $m = \text{slope}$ ,  $b = y$ -intercept

ii) **Point-slope form:**  $y - y_1 = m(x - x_1)$ ,  $m = \text{slope}$ ,  $(x_1, y_1) = \text{any point on line}$

iii) **Parallel Lines:** lines that have the same slope

iv) **Perpendicular Lines:** lines whose slopes are negative reciprocals

v) **Vertical Line:** through  $(a, b)$  has undefined slope and equation  $x = a$ .

vi) **Horizontal Line:** through  $(a, b)$  has slope  $= 0$  and equation  $y = b$ .

**Properties of Slope:** We can use the slope of a linear function  $f(x) = mx + b$  to determine if the function is increasing, decreasing, or constant by the following:

- i)  $f(x)$  is increasing if  $m > 0$
- ii)  $f(x)$  is decreasing if  $m < 0$
- iii)  $f(x)$  is constant if  $m = 0$

**Example:** Find the slope of the line through the points below:

i)  $(-6, 8)$  and  $(5, 4)$

ii)  $(-3, -5)$  and  $(2, -5)$

iii)  $(-4, 2)$  and  $(-2, -7)$

iv)  $(4, -2)$  and  $(4, 1)$

**Example:** Find the slope and  $y$ -intercept for each of the following lines:

i)  $5x - 3y = 1$

Slope: \_\_\_\_

$y$ -int: \_\_\_\_

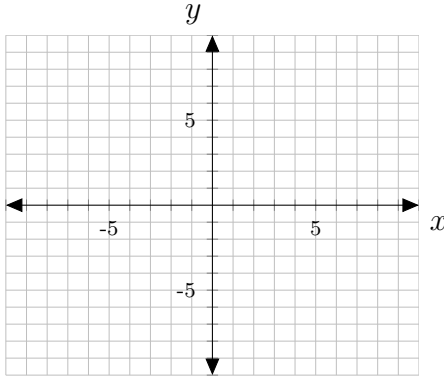
ii)  $9x + 6y - 2 = 0$

Slope: \_\_\_\_

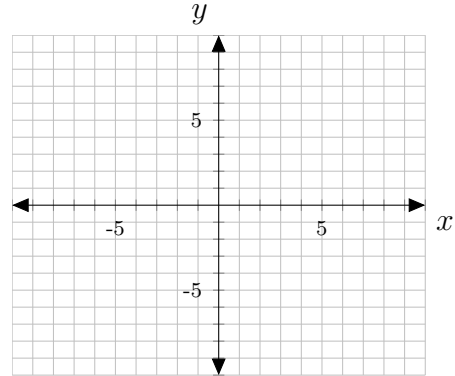
$y$ -int: \_\_\_\_

**Example:** Sketch each of the functions below and label the intercepts:

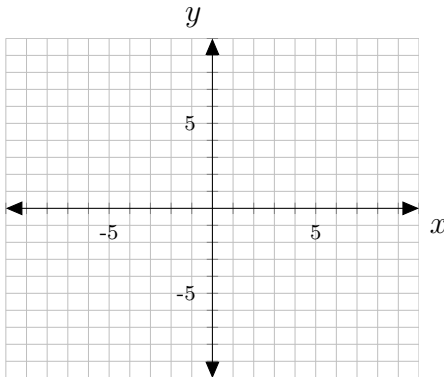
i)  $x + 2y = 5$



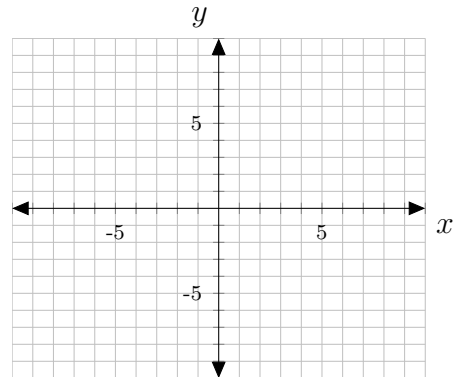
ii)  $3x - 4y = 12$



iii)  $y + 4 = 0$



iv)  $5x - 15 = 0$



**Example:** Determine whether the given pairs of lines are parallel, perpendicular, or neither.

i)  $x - 2y = 6$

$2x + y = 5$

ii)  $3x + y = 8$

$x + 3y = 2$

iii)  $2x - y = 7$

$2y = 4x - 5$

**Example:** Find the equation (in Slope intercept form) for each line described below:

i)  $y$ -intercept =  $\frac{7}{2}$  and slope =  $-\frac{5}{2}$

ii) Through  $(-4, 1)$  with slope =  $-3$

iii) Horizontal Line through  $(4, -7)$

iv) Through  $(5, 4)$  and  $(-10, -2)$

v) Through  $(1, 3)$ , parallel to  $2x - y = -6$

vi) Through  $(-5, 2)$ , perpendicular to the line that passes through  $(1, 2)$  and  $(4, 3)$

\*Note: To find the point of intersection of lines, solve one equation for a variable, substitute into the other equation, and solve for the remaining variable. If you can solve, that is your point; if you find  $0 = 0$ , the lines are the same line; if you find  $0 = a$ ,  $a \neq 0$ , they are parallel.

**Example:** According to data from the National Center for Education Statistics, the average cost of tuition and fees in public four year colleges was \$2987 in the fall of 1996 and grew in an approximately linear fashion to \$5685 in the fall of 2006.

i) Find a linear equation for this data, by letting  $x = 2$  correspond to the year 1992.

ii) Use this equation to estimate the average cost of tuition and fees in the fall of 2004.

iii) Assuming the equation remains valid beyond fall 2006, estimate when the average cost of tuition and fees will be \$7843.

**Example:** Charges for Brighton Electric are as follows:

i) Write a linear model for the cost of electricity, stating what slope and y-intercept represent.

	kWh used	Cost
George	258	\$43.38
Mabel	346	\$53.06
Luis	300	\$48

ii) How much would you pay for using 500 kWh?

**2.1 Problems:** 30, 37, 38, 43, 45, 47-49, 64, 65, 70, 75, 76

**2.2 Problems:** 24, 26, 32-37, 59, 65      **2.3 Problems:** 31-34, 49, 51