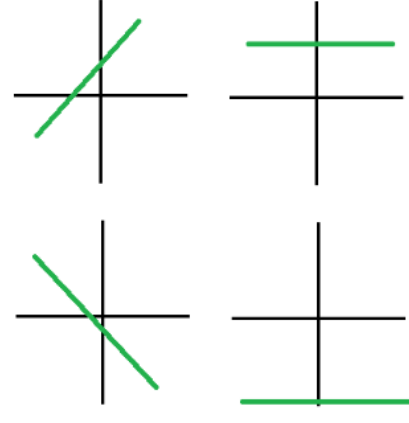
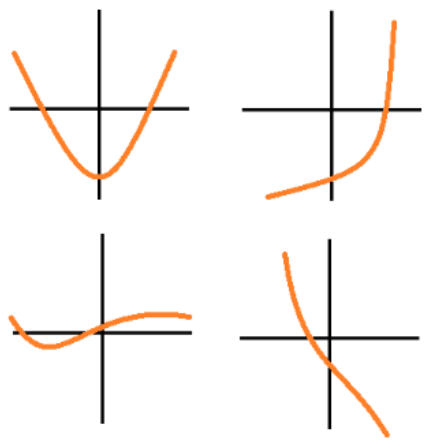


**Strand 3 :**  
**Analytical Geometry**  
**&**  
**Linear Relations**

### 3-1 Linear vs. Non-linear

#### Key Concepts

|                        | Linear  | Non-linear  |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
|------------------------|---|---|---|---|---|---|---|---|----|---|----|--|---|---|---|---|---|---|---|----|---|----|
| <b>Table of values</b> | First differences are constant<br><table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>4</td> </tr> <tr> <td>1</td> <td>7</td> </tr> <tr> <td>2</td> <td>10</td> </tr> <tr> <td>3</td> <td>13</td> </tr> </tbody> </table> Y values increase by 3 every time | x   | y | 0 | 4 | 1 | 7 | 2 | 10 | 3 | 13 | First differences are not constant<br><table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>4</td> </tr> <tr> <td>1</td> <td>8</td> </tr> <tr> <td>2</td> <td>16</td> </tr> <tr> <td>3</td> <td>32</td> </tr> </tbody> </table> Y values are doubling. | x | y | 0 | 4 | 1 | 8 | 2 | 16 | 3 | 32 |
| x                      | y   |   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| 0                      | 4   |   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| 1                      | 7   |   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| 2                      | 10  |   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| 3                      | 13  |   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| x                      | y   |   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| 0                      | 4   |   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| 1                      | 8   |   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| 2                      | 16  |   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| 3                      | 32  |   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| <b>Graph</b>           |   |  |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| <b>Equation</b>        | Are first degree equations<br>$y = 2x - 4$<br>$3x - 6y + 7 = 0$   | Are anything but first degree equations<br>$y = 3x^2 - 2x + 9$<br>$y = \frac{2}{x}$ |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |
| <b>Description</b>     | The cost of renting a bus is \$8/ student, plus a flat rate of \$150.   | An investment doubles in value every month.   |   |   |   |   |   |   |    |   |    |  |   |   |   |   |   |   |   |    |   |    |

#### 1. Identify the relationships below as linear or non-linear

a)



Figure 1



Figure 2

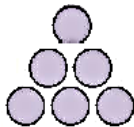


Figure 3

b)



Figure 1



Figure 2



Figure 3

2. Identify which table of values below is Linear

| x | y |
|---|---|
| 0 | 1 |
| 1 | 3 |
| 2 | 5 |
| 3 | 7 |
| 4 | 9 |

| x  | y    |
|----|------|
| -5 | 0.25 |
| -4 | 0.50 |
| -3 | 1    |
| -2 | 2    |
| -1 | 4    |

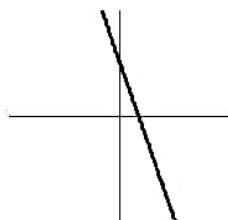
| x  | y  |
|----|----|
| -1 | 2  |
| 1  | 4  |
| 3  | 8  |
| 5  | 16 |
| 7  | 32 |

3. Identify which graphs are linear.

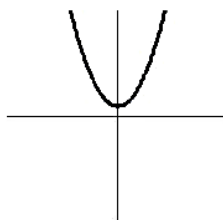
a)



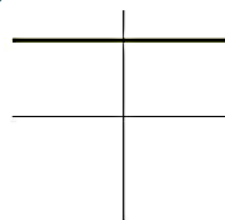
b)



c)



d)



4. Identify the following equations as being linear or non-linear.

a)  $2xy + 9 = 0$

b)  $x - 5y = 13$

c)  $4(x - 8)^2 + 8 = 0$

d)  $\frac{2}{x} = y$

e)  $y = \frac{2}{3}x + 9$

f)  $x = 9$

g)  $y = -7$

3-2 Forms of Representing Linear Equations

**Key Concepts**

**Slope-intercept form:**  $y = mx + b$ , where  $m$  represents the slope and  $b$  represents the  $y$ -intercept.

**Standard Form:**  $Ax + By + C = 0$

**Slope:** is the measure of how steep a line is. The slope can be calculated from:

- a graph: by determining the rise and run  $m = \frac{\text{rise}}{\text{run}}$

- two points: using their coordinates  $m = \frac{y_2 - y_1}{x_2 - x_1}$

**$y$ -intercept:** the point where the line passes through the  $y$ -axis.

1. Write the following equations in slope intercept form.

a)  $3x - 2y = -16$

b)  $13x - 11y = -12$

c)  $9x - 7y = -7$

d)  $x - 3y = 6$

e)  $6x + 5y = -15$

f)  $4x - y = 1$

2. Write the following equations in standard form.

a)  $y = \frac{11}{4}x - 8$

b)  $y = -24x + \frac{5}{6}$

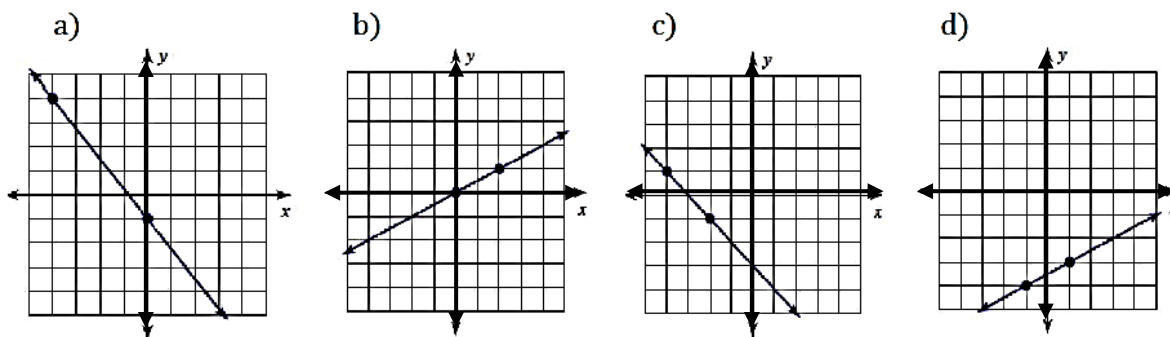
c)  $y = -\frac{7}{3}x + 5$

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

e)  $y = -\frac{8}{15}x + \frac{1}{20}$

f)  $y = \frac{5}{6}x - 7$

3. Find the slope and y-intercept of the following graphs and state the equation



### 3-3 Methods of Graphing

#### Key Concepts

**Table of Values:** plot 5 points on the graph and connect them with a straight line.

**Slope & y-intercept:** plot the “ $b$ ” value on the  $y$ -axis. Use the “ $m$ ” value to determine the slope from that point, rise up if a positive slope or down if a negative slope and over to the right.

**$x$  &  $y$ -intercepts:** calculate the  $x$ -intercept by subbing in  $y = 0$  then calculate the  $y$ -intercept by subbing in  $x = 0$ . Plot these two intercepts and connect them with a straight line.

1. Graph the following by creating a table of values.

a)  $y = 2x - 8$

b)  $y = \frac{2}{3}x - 5$

2. Graph the following using slope and y-intercept.

a)  $y = 4x + 3$

b)  $y = \frac{4}{3}x - 4$

c)  $y = \frac{11}{4}x - 8$

d)  $y = -3x - 3$

e)  $y = \frac{3}{5}x + 1$

f)  $y = -x + 2$

3. Graph the following using intercepts.

a)  $4x - 2y = 6$

b)  $y = \frac{11}{4}x - 8$

c)  $4x - 12y + 9 = 0$

d)  $-8x + 4y = -16$

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

f)  $2x + 5y = 12$

### 3-4 Generating an equation of a line

#### Key Concepts:

**General form:**  $y = mx + b$ , this form requires a slope and y-intercept

**Given a slope and point:** Use the GUESS method to substitute for m, x and y to solve for b.

**Given two points:** use the slope formula to find m then the GUESS method to substitute for m, x and y to solve for b.

1. Write an equation for each of the following lines.

a) slope of 2 passing through (2, 1)      b) slope of  $\frac{3}{4}$  passing through (12, -5)

c) passes through (3, -1) and (10, 5)      d) passes through (1, 2) and (-2, 5)

2. Write an equation of a line that passes through (-1, 4) and is parallel to  $y = -5x + 2$

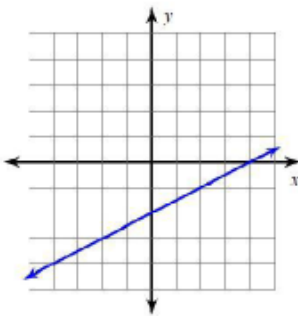
3. Write an equation of a line that passes through (-1, 2) and is perpendicular to

$y = \frac{1}{4}x + 5$ .

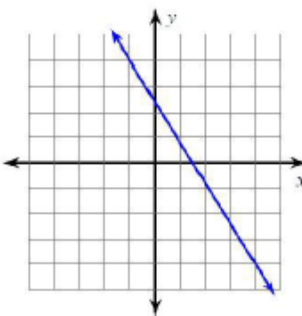
4 Write an equation of a line that is parallel to  $3x + 6y = 7$  and has the same x-intercept as  $2x + y = 4$ .

5. Write an equation for the linear equations shown below in slope y-intercept form.

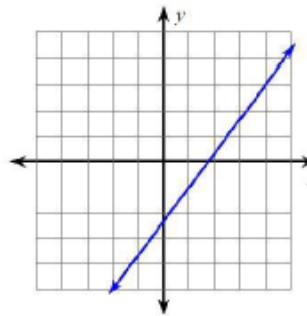
a)



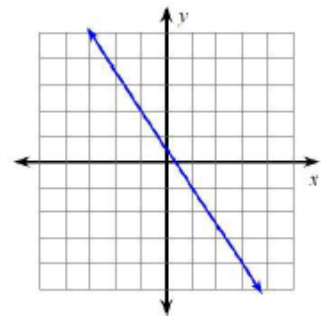
b)



c)



d)



### 3-5 Special Lines:

#### Key Concepts

**Horizontal Lines:** lines that are parallel to the x-axis and have a slope of 0.

**Vertical Lines:** lines that are parallel to the y-axis and have an undefined slope.

Remember: **H**orizontal

**O** slope

**Y** = b

**V**ertical

**U**ndefined slope

**X** = a

Graph the following horizontal lines.

a)  $y = -1$

b)  $y = -4$

c)  $y = 8$

d)  $y = 7$

2. Graph the following vertical lines.

a)  $x = 2$

b)  $x = -5$

c)  $x = -3$

d)  $x = 6$

3. Make a sketch of the horizontal line that passes through the point given below. What is the equation of this line?

a) (3, -4)

b) (-7, 3)

c) (0, 5)

d) (-2, 6)

4. Make a sketch of the vertical line that passes through the point given below. What is the equation of this line?

a) (-5, 4)

b) (5, 7)

c) (-4, -8)

d) (8, -2)

5. Write the equation for the line that is perpendicular to each of the lines in #4.

### 3-6 Linear Systems:

#### Key Concepts

**Linear System:** two or more linear equations considered at the same time.

**Solution:** the point where the two linear equations intersect.

1. Solve each system graphically.

a)  $y = -\frac{5}{3}x + 3$

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

c)  $y = -\frac{1}{2}x - 1$

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

e)  $y = 3x - 4$   
 $y = -\frac{1}{2}x + 3$

g)  $y = -\frac{1}{2}x - 2$

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

b)  $y = 4x + 3$   
 $y = -x - 2$

d)  $y = -1$   
 $y = -\frac{5}{2}x + 4$

f)  $y = -2x + 2$   
 $y = -2x - 2$

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

2. Jack and Liam just had business cards made. Jack's printing company charged a one-time setup fee of \$20 and then \$4 per box of cards. Liam ordered his cards online. They cost \$5 per box. There was no setup fee, but he had to pay an additional \$10 to have them shipped to his house. After purchasing how many boxes, would Jack and Liam end up spending the same amount?

3. Paula and Megan each regularly buy books at Chapters. Paula decided to buy the store discount card which cost \$50 initially but saves her \$2 a book for the entire year. Each book the girls bought was \$20. Who made the smarter decision?

### 3-7 Scatter Plots & Lines of Best Fit:

#### Key Concepts

**Scatter Plot:** a graphical method of showing the relationship between two variables.

**Partial variation:** the dependent variable is related to the independent variable; the y-intercept is not zero.

**Direct variation:** the dependent variable is directly related to the independent variable; the y-intercept is zero.

**Correlation:** a relationship between the dependent and independent variable. Can be classified as: **positive, negative, no correlation.**

#### Strength of Correlation:

**Perfect correlation:** all points lie on the line of best fit

**Strong correlation:** points are close to the line or best fit

**Moderate correlation:** points are spread out but there is a definite trend

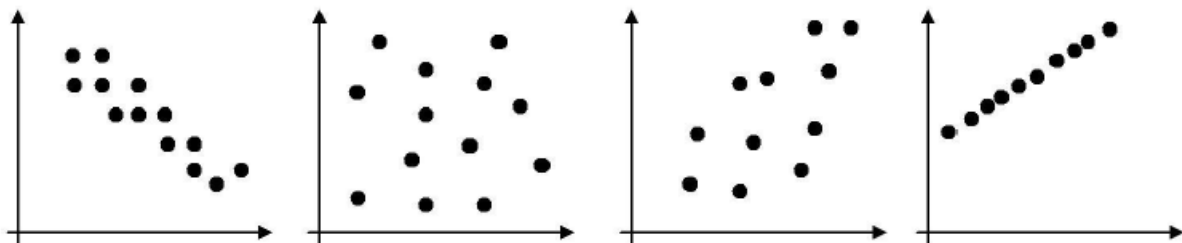
**Weak correlation:** points are more spread out and trend is less obvious

**Line of Best Fit:** a line that follows the trend of the data and has the same number of points above and below the line.

**Interpolation:** method of prediction that reads information within the given range of data.

**Extrapolation:** method of prediction that requires the line of best fit to be extended to read information outside of the given range of data.

1. Describe the relationship between the two variables.





2. Describe the relationship between the following:

- a) Your average mark in school and the amount of time spent in front of the television
- b) Your shoe size and your score playing angry birds
- c) Freeze sales and the temperature outside
- d) The weight in your backpack and your level of back pain

3. A tree trunk's diameter was measured over the course of its life. The data is found in the table below.

|                      |    |    |    |    |    |    |    |     |     |
|----------------------|----|----|----|----|----|----|----|-----|-----|
| <b>Age (years)</b>   | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80  | 90  |
| <b>Diameter (cm)</b> | 15 | 25 | 40 | 53 | 65 | 80 | 90 | 102 | 115 |

Create a scatter plot and draw in the line of best fit.

What was the diameter of the tree trunk after 7 years? What method was used to determine this? What will diameter of the tree trunk be when it is 65 years old? What method was used to determine this?