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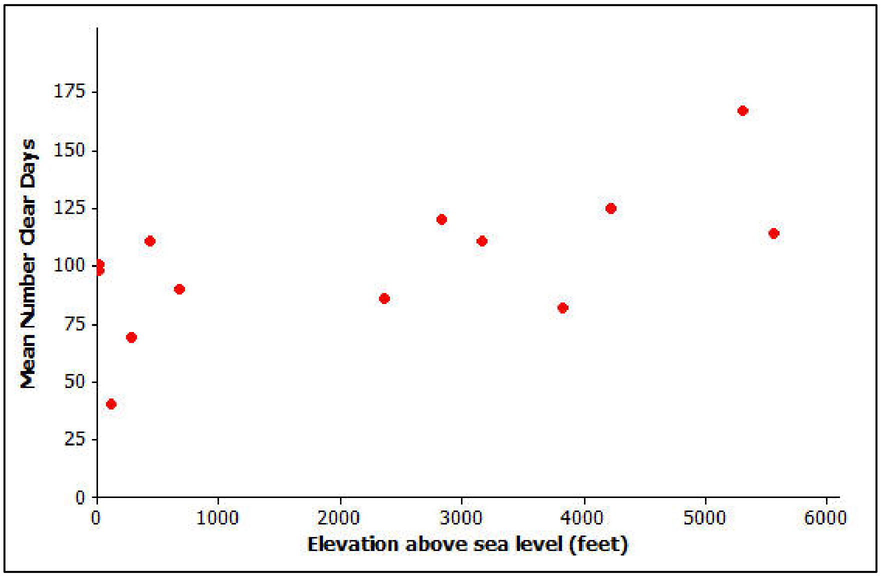
Algebra 1-2: 3.1a Relationships between Numerical Data

You will distinguish between scatter plots that displays a linear relationship and a non-linear relationship.

Scatter Plot: a graph of paired data in which the data values are plotted as (x, y) coordinates.

Shows the ___________________________ between two sets of _____________________________________data.

Here is a scatter plot of the data on elevation and mean number of clear days.



1. Do you see a pattern in the scatter plot, or does it look like the data points are scattered?

2. How would you describe the relationship between elevation and mean number of clear days for these 14 cities? That is, does the mean number of clear days tend to increase as elevation increases, or does the mean number of clear days tend to decrease as elevation increases?

3. Do you think that a straight line would be a good way to describe the relationship between the mean number of clear days and elevation? Why do you think this?

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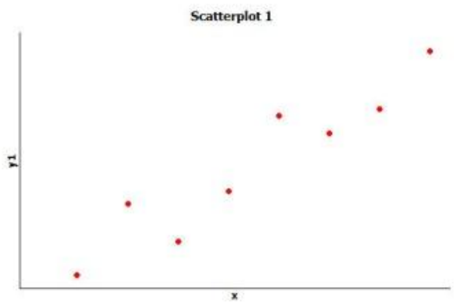
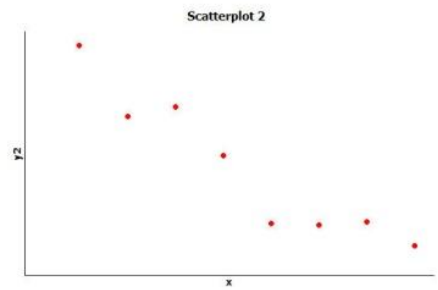
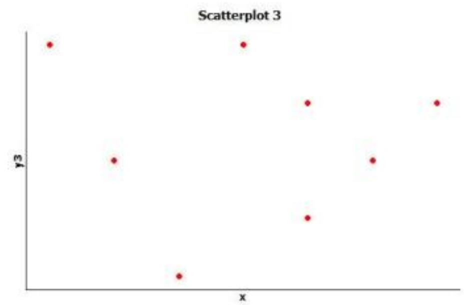
Below are three scatter plots. Each one represents a data set with eight observations.

The scales on the x and y axes have been left off these plots on purpose so you will have to think carefully about the relationships.







4. If one of these scatter plots represents the relationship between height and weight for eight adults, which scatter plot do you think it is and why?

5. If one of these scatter plots represents the relationship between height and SAT math score for eight high school seniors, which scatter plot do you think it is and why?

6. If one of these scatter plots represents the relationship between the weight of a car and fuel efficiency for eight cars, which scatter plot do you think it is and why?

7. Which of these three scatter plots does not appear to represent a linear relationship? Explain the reasoning behind your choice.

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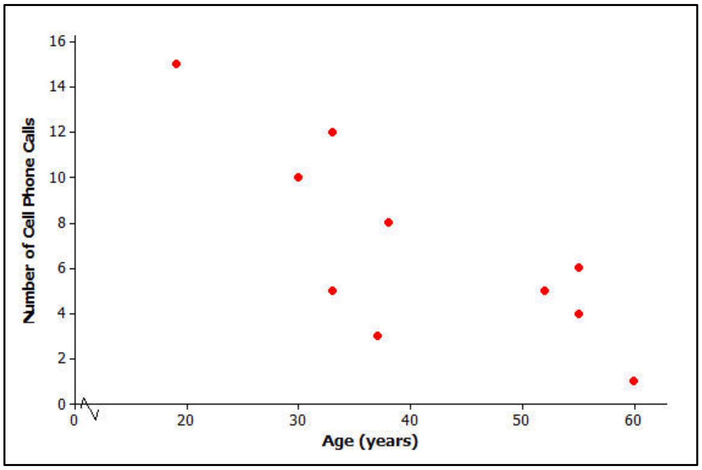
Linear and Nonlinear Relationships

When a straight line provides a reasonable summary of the relationship between two numerical variables, we say that the two variables are *linearly related* or that there is a *linear relationship* between the two variables. Examine the three scatter plots below and answer the questions that follow.

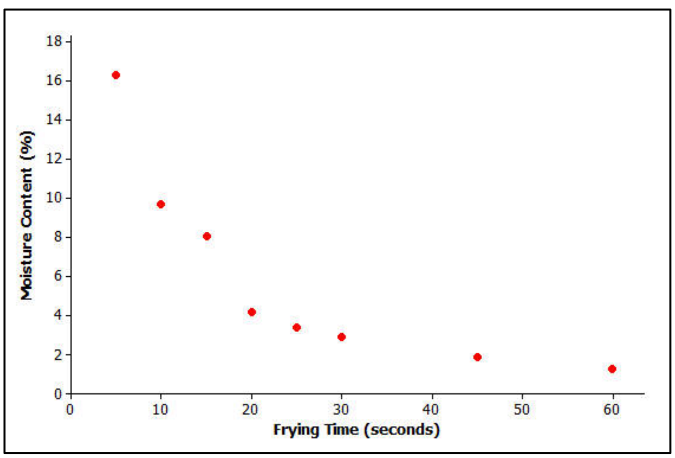
Scatter Plot 1:



a) Is there a relationship between number of cell phone calls and age, or does it look like the data points are scattered?

b) If there is a relationship between number of cell phone calls and age, does the relationship appear to be linear?

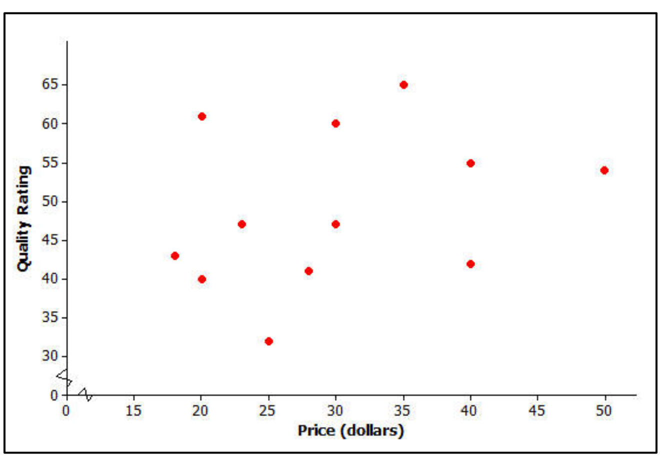
Scatter Plot 2:



c) Is there a relationship between moisture content and frying time, or do the data points look scattered?

d) If there is a relationship between moisture content and frying time, does the relationship look linear?

Scatter Plot 3:



e) Scatter plot 3 shows data for the prices of bike helmets and the quality ratings of the helmets (based on a scale that estimates helmet quality). Is there a relationship between quality rating and price, or are the data points scattered?

f) If there is a relationship between quality rating and price for bike helmets, does the relationship appear to be linear?

Algebra 1-2: 3.1b Measuring the Strength of Linear Relationships

You will draw lines of best fit and describe the strength of linear model using the correlation coefficient.

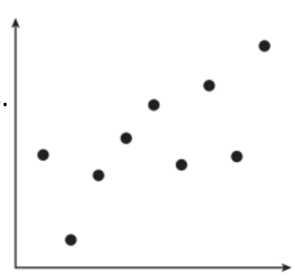
Correlation refers to the ______________________ of the relationship between two variables as shown on a scatter plot.

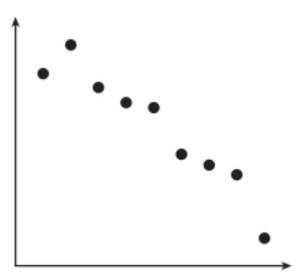
The **correlation coefficient**, r, describes the realtionship between the two varaibles				
________________ **Correlation**		___________ **Correlation**	________________ **Correlation**	
$r = 1$	$r = .5$	$r = 0$	$r = -.5$	$r = -1$
Perfect positive correlation. As x goes up, y ALWAYS goes up.	**Weak positive** correlation. As x goes up, y also tends to go up.	**No correlation.** x and y are not related.	**Weak negative** correlation. As x goes up, y tends to go down.	**Perfect negative** correlation. As x goes up, y ALWAYS goes down.

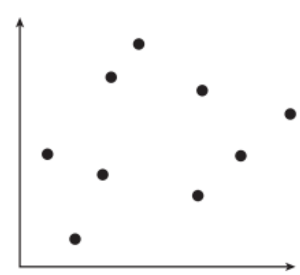
You can have r-values anywhere along the spectrum of +1 to -1:

+1	**+0.5**	**0**	**-0 .5**	**-1**
Strong Positive	**Weak +**	**none**	**Weak -**	**Strong Negative**

1) Estimate the r-value for each of these graphs.







CORRELATION DOES NOT IMPLY CAUSATION.

A common error when interpreting paired data is to observe a correlation and conclude that causation has been demonstrated. Causation means that a change in the one variable results directly from changing the other variable.

2) A traffic official in a major metropolitan area notices that the more profitable toll bridges into the city are those with the slowest average crossing speeds.

a. The variables are __________________________________and _______________________________.

b. It is [likely | doubtful | unclear] that increased profit causes slower crossing speed.

c. It is [likely | doubtful | unclear] that slower crossing speeds cause an increase in profits.

Line of Best Fit (Trend Line):

A straight line that matches the shape of the data with approximately the same number of points:

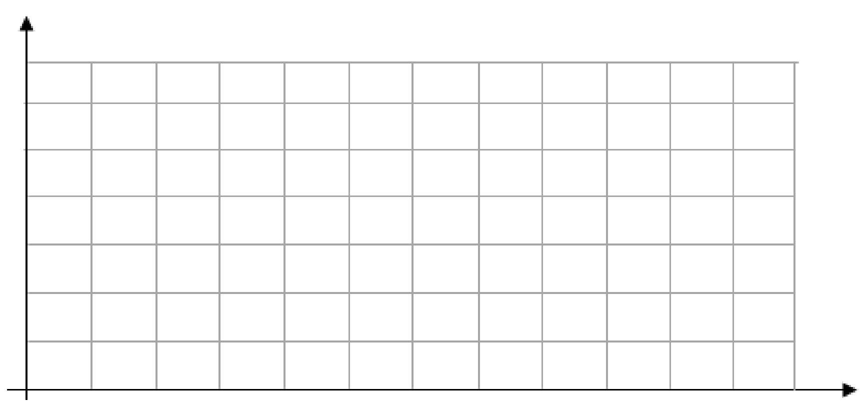
___________________ the line as there are _____________________the line.

Example:

The table shows the number of hours worked and the amount of money each person earned.

Name	Janel	Roscoe	Victoria	Alex	Jordan	Jennifer
Hours Worked	6	12	11	9	15	10
Amount Earned	$ 25.50	$ 51.00	$ 46.75	$ 38.25	$ 63.75	$ 42.50

a) Make a scatter plot of the data and draw a line of best fit.



b) Is there a positive correlation, negative correlation, or no correlation? If there is a positive or negative correlation, describe its meaning.

c) Using the trend line, estimate the amount someone would earn if they worked for 8 hours.

Try it out!

1) 2) 3)

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Algebra 1-2: 3.2a Introduction to Rate of Change (Textbook Section 5.3)

You will calculate average rates of change to determine when linear functions appropriately model a two variable relationship

$$\textbf{\textit{Rate of Change}} = \frac{\text{Change in the dependent variable}}{\text{Change in the independent variable}} = \frac{\text{Change in } y}{\text{Change in } x} = \frac{y_2 - y_1}{x_2 - x_1}$$

DATA SET #1		DATA SET #2		DATA SET #3	
x	y	x	y	x	y
-10	-10	-10	0.00098	-10	100
-4	-4	-4	0.0625	-4	16
-1	-1	-1	0.5	-1	1
0	0	0	1	0	0
1	1	1	2	1	1
4	4	4	16	4	16
10	10	10	1024	10	100

1) Calculate the rate of change across the given intervals for each function.

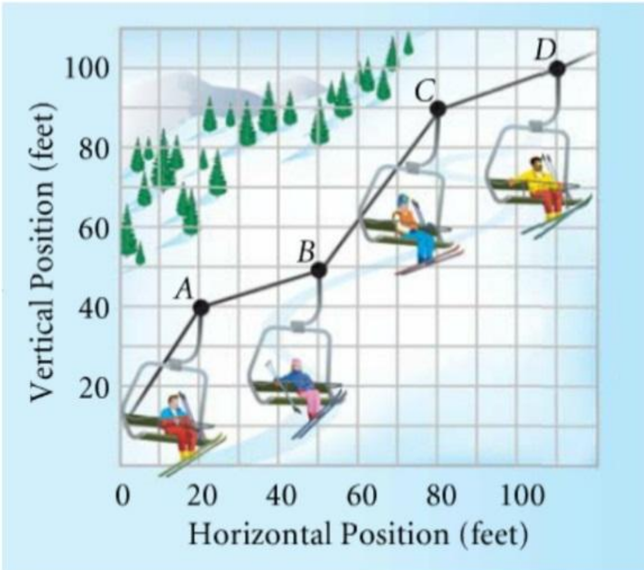
Interval	DATA SET #1	DATA SET #2	DATA SET #3
$-10 \le x \le -4$	$\frac{-4-(-10)}{-4-(-10)} =$	$\frac{0.0625-0.00098}{-4-(-10)} =$	$\frac{16-100}{-4-(-10)} =$
$-1 \le x \le 1$	$\frac{1-(-1)}{1-(-1)} =$	$\frac{2-0.5}{1-(-1)} =$	$\frac{1-1}{1-(-1)} =$
$4 \le x \le 10$	$\frac{10-4}{10-4} =$	$\frac{1024-16}{10-4} =$	$\frac{100-16}{10-4} =$

2) Compare the rates of change for each function. What do you notice?

2) Now, enter the data into your graphing calculator. What do you notice?

Data that has a *constant* rate of change can be modeled with a ______________________________________

3) Find an average rate of change for the ski lift.



4) The table shows data collected at a school dance. Which time period had the greatest rate of change?

Time	3:30 pm	5:30 pm	6:30 pm	9:30 pm	11:30 pm
# Students	25	54	76	158	223

5) Rebecca is climbing up a 500 foot cliff. By 1pm she has climbed 125 feet up the cliff. By 4pm she has reached 290 feet. Find the average rate of change.

Try it out:

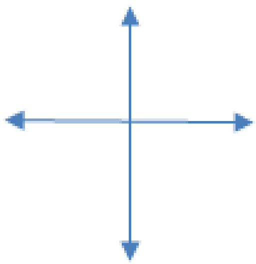
Algebra 1-2: 3.2b Linear Functions and Slope

You will calculate slope and interpret its meaning in context

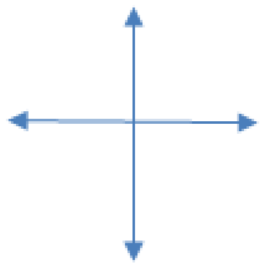
The Slope of a line is its ____

Calculating Slope: **Slope:** = ______________________________ = ____________________ = $m = \frac{y_2 - y_1}{x_2 - x_1}$

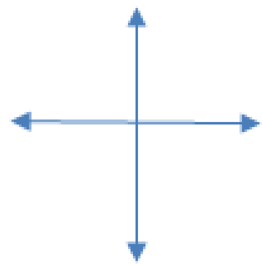
Positive Slope:



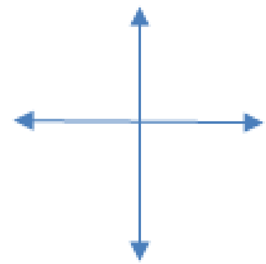
Negative Slope:



Zero Slope:



Undefined Slope:



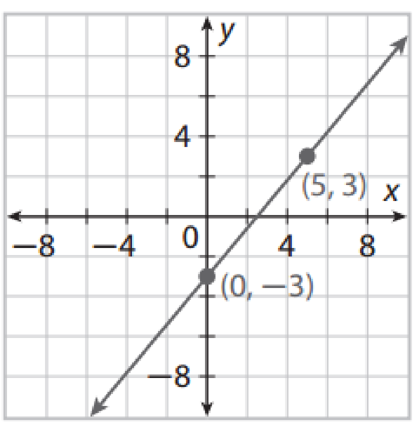
1) Find the slope in the following linear relationships:

a. $(-1,\ -2)$ *and* $(-4,\ 1)$

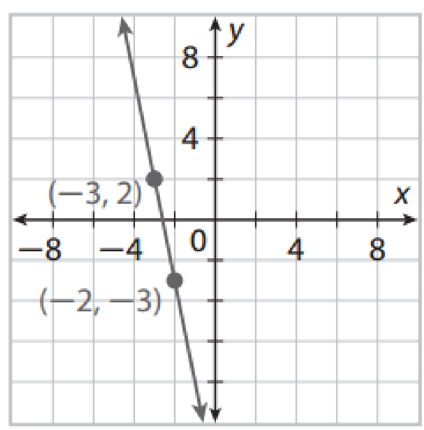
b. $(-2, 5)$ *and* $(8,\ -1)$

c. $(-1,\ 4)$ *and* $(-1,\ -2)$

d.



e.



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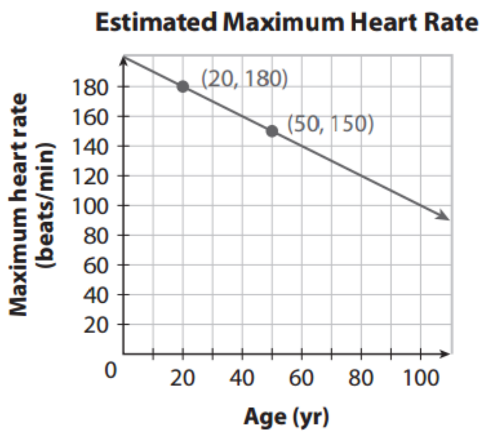
Interpreting Slope: = ____

Usually expressed as a unit rate.

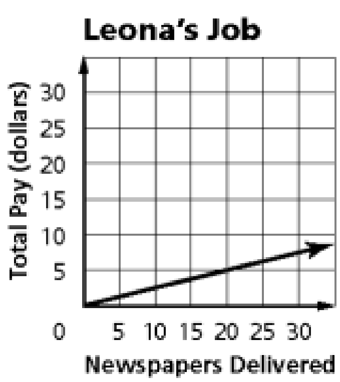
2) Find and ***interpret*** the slope of the line in the following scenarios:

a.



b. The height of a plant y in centimeters after x days is a linear relationship. The points (30, 5) and (40, 25) are on the line.

c.



d.

Dionne's Boat Rental					
Hours Rented	1	2	3	4	5
Amount Paid	$27	$39	$51	$63	$75

Try it out:

1)

2)

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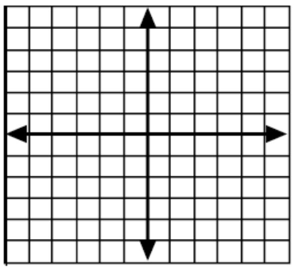
Algebra 1-2: 3.3a Graphs of Linear Functions

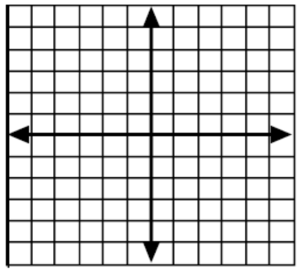
You will explore the relationships between the constant and the coefficient of a linear equation in slope-intercept form.

1) Use your graphing calculator to graph the following linear equations. Sketch the results on the grid.

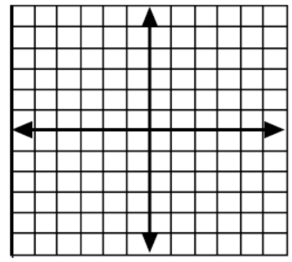
A. $y = 3x + 5$



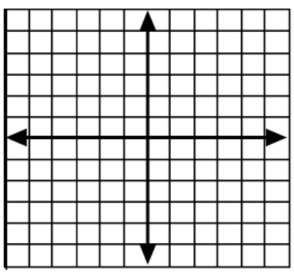
B. $y = -3x + 5$



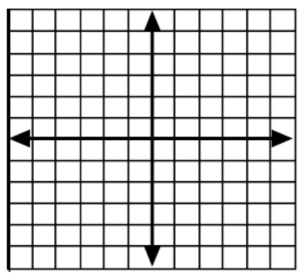
C. $y = 0.3x + 5$



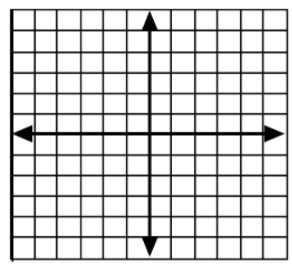
D. $y = x - 1$



E. $y = x + 6$



F. $y = x - 5$



2) Examine the first three graphs. What is the relationship between the ***coefficients*** of x and the way the lines appear on your screen?

3) Examine the last three graphs. What is the relationship between the ***constants*** and the way the lines appear on your screen?

Slope-Intercept Form $y = mx + b$	
$y:$	$x:$
$m:$	$b:$

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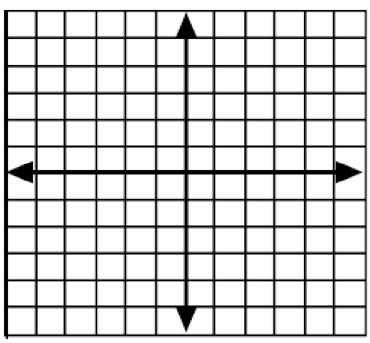
Algebra 1-2: 3.3b Graphing Linear Functions

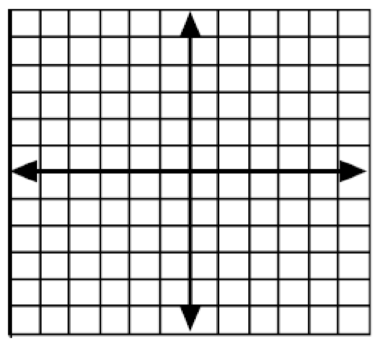
You will graph linear equations in slope-intercept form.

Slope-Intercept Form	$y = mx + b$	**Think:** b is where you **begin** m is how you **move**

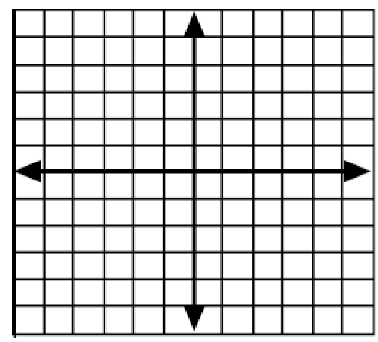
1) $y = -4x + 2$



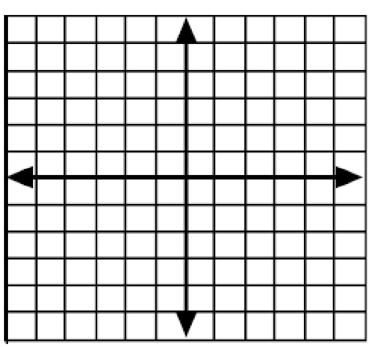
2) $y = \frac{1}{4}x + 2$



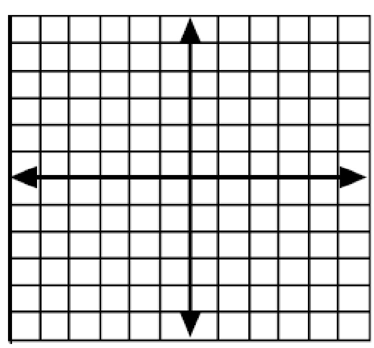
3) $y = -2x$



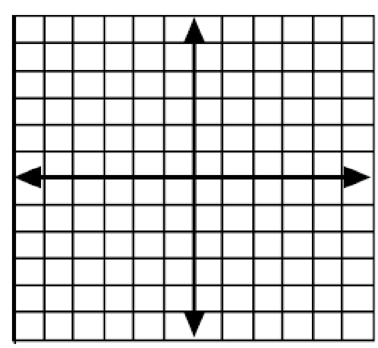
4) $3x + y = -2$



5) $3y + 4x = 12$



Try It out:



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Algebra 1-2: 3.3c Modeling Linear Relationships

You will model real-world linear relationships and interpret the meaning of slope and intercept.

A Day at the Fair: You and your friends plan to attend the annual county fair this weekend. The entry fee for the carnival is $5.00 and the cost per ticket is $0.50.

a) Complete the table.

Number of Tickets (*n*)	8	12		23
Total Cost C(*n*)	$9.00	$11.00	$12.50	

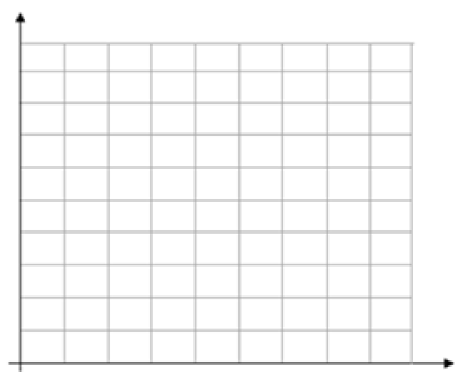
b) Write a function rule in which $C(n)$ represents the total cost and n represents the number of rides selected. ___________________________________

c) Identify the slope and *y*-intercept in the equation and explain what each of them represents in the context of the problem.

slope (*m*) =

y-intercept (*b*) =

d) Graph the linear function.



e) Your parents have decided to give you $30.00 to spend at the fair. If you need seven tickets for each ride, how many rides will you be able to go on? Use mathematics to explain your answer. Use words, symbols, or both.

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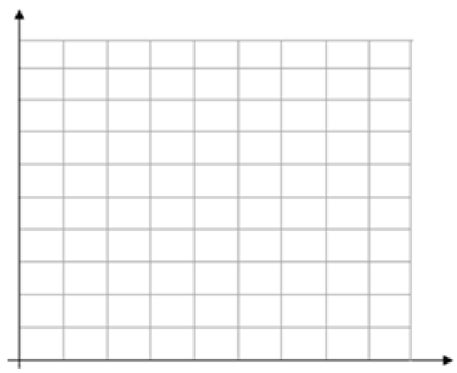
A Sweet Ride: Your parents have decided to buy a Toyota 4Runner for $25,635 and they have promised that it will be yours when the car is worth $15,000. According to the car dealer, your parents' SUV will depreciate in value approximately $3,000 per year.

a) Write a function rule in which $v(t)$ represents the value of the car after t years. ________________________________

b) Identify the slope and *y*-intercept in the equation and explain what each of them represents in the context of the problem.

slope (*m*) = y-intercept (*b*) =

c) Graph the linear function.



d) Based on the information above, will the Toyota 4Runner be yours on your sixteenth birthday? If not, how old you will be when the SUV is finally yours? Use mathematics to explain your answer. Use words, symbols, or both.

Try it out:

Algebra 1-2: 3.3d Slope-Intercept in the Real World

You will model real-world linear relationships and interpret the meaning of slope and intercept.

1) The equation for the speed (not the height) of a ball that is thrown straight up in the air is given by $v(t) = 128 - 32t$ where *v(t)* is the velocity (in feet per second) and *t* is the number of seconds after the ball is thrown.

a. Complete the table for the specified values:

t (seconds)	0	1	2	3	4
v(t) (velocity/speed)					

b. Explain each of these 5 data values in the context of the problem. Be specific!

(0,______)

(1,______)

(2,______)

(3,______)

(4,______)

c. What is the rate of change? Explain what it means in the context of the problem.

d. Identify factors that could increase or decrease the rate of change.

Increase Decrease

e. What is the y-intercept? Explain what it means in the context of the problem

f. What would change the starting value in your problem?

2) Jump-for-your-Life is a company that allows customers to bungee jump from a 220 foot crane. The equation of $l(w) = .3w + 110$ models the situation where the length $l(w)$ represents the bungee cords' stretch and the weight w in pounds represents the person jumping. Complete the table for the specified values:

w (weight of jumper)	0	100	150	200	250
$l(w)$ (length of rope stretched)					

a. Explain each of these 5 data values in the context of the problem. Be specific!

(0, ______)

(100, ______)

(150, ______)

(200, ______)

(250, ______)

b. What is the rate of change? Explain what it means in the context of the problem.

c. Identify factors that could increase or decrease the rate of change.

Increase Decrease

d. What is the y-intercept? Explain what it means in the context of the problem

e. What would change the starting value in your problem?

Homework:
Create three questions that can be answered for each linear model from today's lesson. Find the answer.