E.Q.: How do we create and solve linear equations in two variables?

Standard: **MGSE9-12.A.CED.2**

Create linear equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

(The phrase "in two or more variables" refers to formulas like the compound interest formula, in which A = P(1 + r/n) nt has multiple variables.)

Vocabulary:

linear equation:

4 or -2

- an algebraic equation in which each term is either a constant or the product of a constant and (the first power of) a single variable. 4x or -2x or $\frac{3}{4}x$

Linear equations can have one or more variables.

slope - intercept form

$y = mx + b$ (y-int)

$y = 4x - 2$

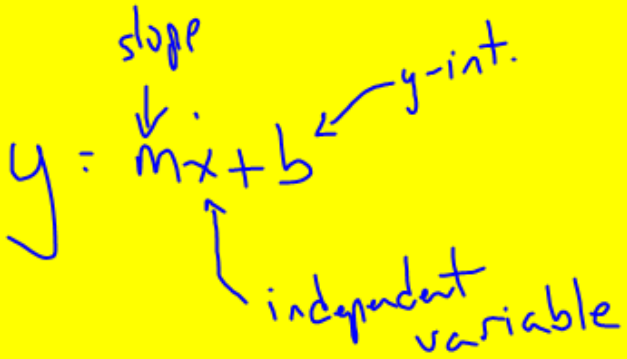
$y = 4x$

$y = x - 3$

$y = 5$

independent variable: (x)

- It is a variable that stands alone and isn't changed by the other variables you are trying to measure.
- For example, someone's age might be an independent variable.



dependent variable: (y)

- A dependent variable is what you measure in the experiment and what is affected during the experiment.
- The dependent variable responds to the independent variable.
- It is called dependent because it "depends" on the independent variable.

(m)

Slope and Rate of Change:

- The word slope (gradient, incline, pitch) is used to describe the measurement of the steepness of a straight line.
- The higher the slope, the steeper the line.
- The slope of a line is a rate of change.

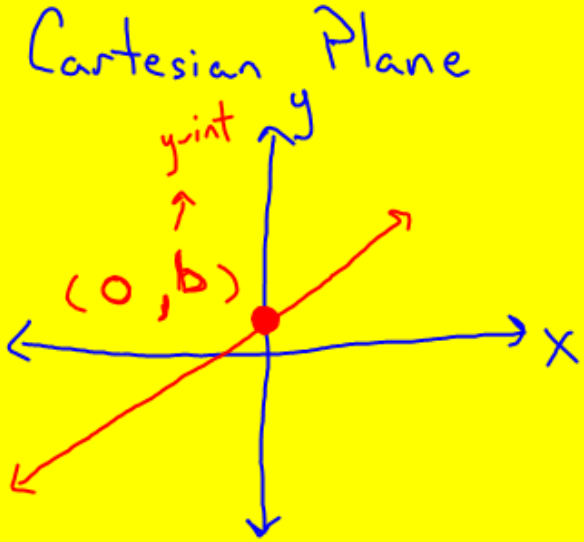
delta

$$m = \frac{\text{rise}}{\text{run}} = \frac{\text{change in } y}{\text{change in } x} = \frac{\Delta y}{\Delta x}$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

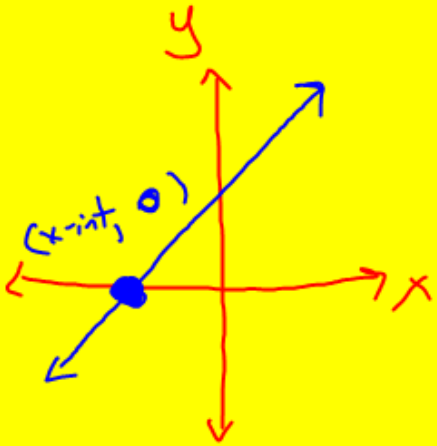
y-intercept:

- is a point where the graph of an equation intersects with the y-axis of the coordinate system.
- these points satisfy x = 0.



x-intercept:

- is a point where the graph of a function or relation intersects with the x-axis.
- these points satisfy y=0



Multiple Representations of a Linear Relationship

slope $= \frac{\text{rise}}{\text{run}} = \frac{2}{1}$

Equation

$y = mx + b$

$y = 2x + 1$

slope - intercept

$y - 3 = 2(x - 1)$

point - slope form

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

$y - 7 = 2(x - 3)$

$y + 3 = 2(x + 2)$

Table

X	Y	
-2	-3	+2
-1	-1	+2
0	1	+2 (y-intercept)
1	3	+2
2	5	+2
3	7	

(+1 between each pair of x-values)

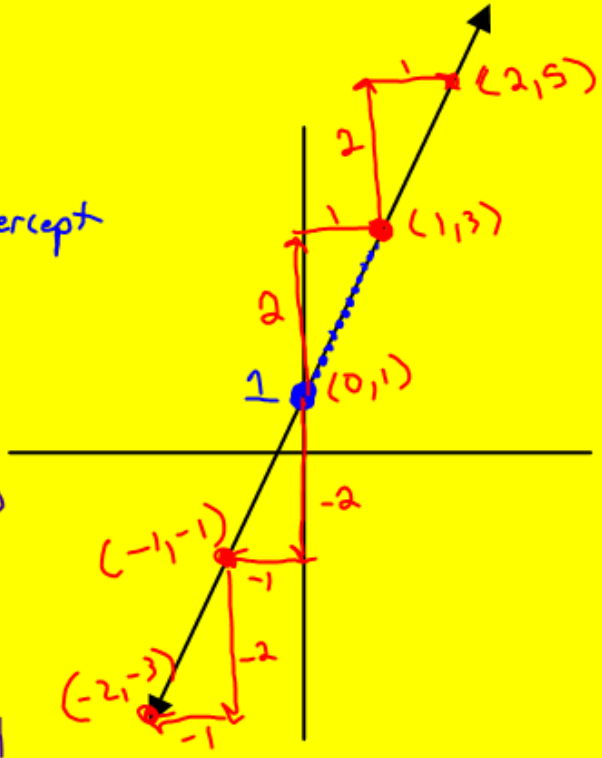
$y - 3 = 2(x - 1)$

$y - 3 = 2x - 2$

$+3 \quad +3$

$y = 2x + 1$

Graph



Given the following equation, **y = 4x + 3**, create a table of values that is representative of that equation.

$y = 4x + 3$

x	y
-2	4(-2)+3 = -5
-1	4(-1)+3 = -1
0	4(0)+3 = 3
1	4(1)+3 = 7
2	4(2)+3 = 11
3	4(3)+3 = 15

+1 +1 +1

+4 +4 +4

Given the following equation, $y = -2x + 5$, create a table of values that is representative of that equation.

x	y	
-2	9	$-2(-2)+5$
-1	7	
0	5	y-int
1	3	-2
2	1	-2
3	-1	-2

Given the following table,
is this table representative of a linear relationship?

If so, what is the equation?

x	y
-2	-15
-1	-10
0	-5
1	0
2	5
3	10

+5
+5
+5

$y = mx + b$

$y = 5x - 5$

$-5 = 5(0) - 5$

$-5 = 0 - 5$

$-5 = -5$ ✓

$5 = 5(2) - 5$

$= 10 - 5$

$= 5$ ✓

Given the following table,
is this table representative of a linear relationship?

If so, what is the equation?

x	y
-5	-15
0	-10
5	-5
10	0
15	5
20	10

+5 +5 +5 +5 +5 +5

$y = 5x - 10$

$-10 = 5(0) - 10$

$-10 = 0 - 10$

$-10 = -10$

$0 = 5(10) - 10$

$= 50 - 10$

$0 = 40$ X

$y = x - 10$

$slope = \frac{rise}{run} = \frac{\Delta y}{\Delta x} = \frac{5}{5} = 1$

Given the following table,
is this table representative of a linear relationship?

No
There is no constant rate of change!

If so, what is the equation?

~~$y = mx + b$~~

~~$y = mx - 10$~~

x	y
-2	-15
0	-10
3	-5
10	0
15	5
50	10

2 → 5
3 → 5

$m = \frac{5}{2} = 2.5$

$m = \frac{5}{3} = 1.\overline{6}$

Ex. The data below represent the value of a car as it depreciates over a period of 5 years.

Years	0	1	2	3	4	5
Value	15000	12400	9800	7200	4600	2000

1

−2600

independent variable = # of years = x

dependent variable = value of car = y

Calculate and interpret the slope.

$\frac{-2600}{1}$

m = −2600

For each additional year, the car's value decreased by 2600.

Ex. The data below represent the value of a car as it depreciates over a period of 5 years.

Years	0	1	2	3	4	5
Value	15000	12400	9800	7200	4600	2000

State and interpret the y-intercept.

15,000

When the car is new, at *time* = 0 years, the car is worth $15,000.

Ex. The data below represent the value of a car as it depreciates over a period of 5 years.

Years	0	1	2	3	4	5
Value	15000	12400	9800	7200	4600	2000

Write an equation that models this relationship:

$y = mx + b$

$y = -2600x + 15000$

Use your model to determine the value of the car at 3.5 years.

"y" "x"

$y = -2600x + 15000$

$y = -2600(3.5) + 15000$

$y = \cancel{\$8500}$ $\$5900$

Use your model to determine when (x) the car will be worth $700? (y)

$y = -2600x + 15000$

$700 = -2600x + 15000$

$-15000 \quad -15000$

$-14300 = -2600x$

$\frac{-14300}{-2600} = \frac{-2600x}{-2600}$

$x = 5.5$ years

The table below shows the depth in meters of a scuba diver after a certain amount of time under water.

Position of Scuba Diver	
Time (s)	Depth (m)
x	y
0	−24
3	−18
6	−12
9	−6
12	0

independent variable =

dependent variable =

Find the average rate of change for this relationship. Interpret this value.

average rate of change = _____

For each additional _____ that elapses, the diver has risen _____ meters under the surface of the water.

State and interpret the y-intercept. y-intercept = _____

At time = _____, the scuba diver is _____ meters under the surface of the water.

Position of Scuba Diver	
Time (s)	Depth (m)
x	y
0	−24
3	−18
6	−12
9	−6
12	0

Write an equation that models this relationship:

$y = mx + b$

Position of Scuba Diver	
Time (s)	Depth (m)
x	y
0	−24
3	−18
6	−12
9	−6
12	0

Use your model to determine the diver's depth at 5 seconds._____

Use your model to predict how many seconds it takes the diver reach 9 meters below the surface. _____

Homework #4: Two Variable Equations