

Linear Functions: Slope-Intercept, Point-Slope, Standard FormWRITING EQUATIONS FOR HORIZONTAL AND VERTICAL LINES.

- $y=b$
- $x=k$
- A horizontal line represents all the places where y is a specific number and is a constant function. Its graph will never cross the X-axis, so its equation will always be: $y=b$, where b is a constant ($m=0$)
- A vertical line represents all the places where x is a specific number. This is not a function and cannot be solved for y . Its graph will never cross the y-axis, so its equation will always be: $x=k$, where k is constant ($m=undefined$)

WRITING LINEAR EQUATIONS FROM WORD PROBLEMS

You want to use the given information to decide which form will be the easiest to use to write the equation. To write a linear equation you will:

- IDENTIFY THE SLOPE (if given)
 - Identify 2 points given to calculate slope.
- IDENTIFY THE START VALUE (Y-intercept)
 - Use the slope and one point to calculate the y-intercept (b)
- IF **SLOPE AND Y-INTERCEPT ARE GIVEN USE SLOPE-INTERCEPT**
- IF **SLOPE AND POINT ARE GIVEN USE POINT-SLOPE**
- IF **TWO POINTS GIVEN, USE EITHER. ~ REMEMBER TO FIND SLOPE!**

Word problems in Slope-intercept form

When a word problem involves a slope (constant rate) and a y-intercept (start value), it can be written in slope-intercept form. To do this, recognize which number will represent slope (m), and which number will represent start value (b). The equation will be written in the form $y=mx+b$.

↙ negative slope (going down)

1. An airplane 30,000 feet above the ground begins descending at the rate of 2000 feet per minute.

Assume the plane continues at the same rate of descent. The plane's height and minutes above the ground are related to each other.

Identify the variables in this situation: $x =$ minutes (# of) $y =$ height (ft)

What is the given information in this problem (find all that apply, some may be left blank)?

y-intercept 30,000 slope -2000 one point (0, 30,000) a second point: (____, ____)

- a. Write an equation to model the situation. $y=mx+b$ $y = -2000x + 30,000$

- b. Use your equation to find the altitude of the plane after 5 minutes.

After 5 minutes, the plane was 20,000 feet above ground.

$x=5$ ← Plug into equation and solve.
 $y = -2000(5) + 30,000$
 $y = 20,000$

2 #'s in prob
3 #'s in prob
4 #'s in prob

2. Suppose you receive \$100 for a graduation present, and you deposit it in a savings account. Then each week thereafter, you add \$5 to the account but no interest is earned. The amount in the account is a function of the number of weeks that have passed.

Identify the variables in this situation: $x =$ # of weeks $y =$ total amount

What is the given information in this problem (find all that apply)?

y-intercept 100 slope 5 one point (0, 100) a second point: (,)

- a. Find an equation for the amount y you have after x weeks.

$$y = 5x + 100$$

- b. Use your equation to find when you will have ~~\$310~~ \$310 in the account.

After 42 weeks you will have saved \$310.00.

$$y = 310 \leftarrow$$

$$\begin{array}{r} 310 = 5x + 100 \\ -100 \quad -100 \\ \hline 210 = 5x \end{array}$$

$$\frac{210}{5} = \frac{5x}{5}$$

$$x = 42$$

— slope rate of change

→ **Word Problems in Point-slope form**

When a word problem involves a constant rate and gives a relationship at one moment in time between each variable, an equation can be written in point-slope form to model the relationship. The equation will be written in the form

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

— going down!

a point (x, y)

1. Marty is spending money at the average rate of \$3 per day. After 14 days he has \$68 left. The amount left depends on the number of days that have passed.

Identify the variables in this situation: $x =$ # of days $y =$ amount \$ left

What is the given information in this problem (find all that apply)?

y-intercept slope $\frac{-3}{m}$ one point (14 , 68) a second point: (,)

- a. Write an equation for the situation.

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

$$y - 68 = -3(x - 14)$$

$$y - 68 = -3(x - 14)$$

$$y - 68 = -3x + 42$$

$$y + 68 = -3x + 42 + 68$$

$$y = -3x + 110$$

- b. Use your equation to find the amount of money he began with.

time = 0
when $x = 0$ what is y ?

$$y = -3(0) + 110$$

$$y = 110$$

Marty started out with \$110.00.

2. Diane knows a phone call to a friend costs 25 cents for the first 3 minutes and 10 cents for each additional minute. The number of minutes you call and the cost of the call are related.

Identify the variables in this situation: $x = \# \text{ of min (after 3)}$ $y = \text{cost}$

What is the given information in this problem (find all that apply)?

y-intercept — slope .10 one point (3 , .25) a second point: (,)

a. Write an equation for the situation. $y - .25 = .10(x - 3)$

- b. Use your equation to find the cost of a 30-minute call.

$$y - .25 = .10(30 - 3)$$

A 30 minute call will cost \$2.95.

$$y - .25 = .10(27)$$

$$+ .25 \quad + .25$$

$$y = 2.95$$

More Word Problems in Point-slope form

Sometimes instead of giving a slope, a word problem gives two relationships at different moments in time between variables. This kind of problem is giving you two points. You must find the slope and then use one of the points to write an equation. The equation will be written in the form $y - y_1 = m(x - x_1)$.

1. Suppose a 5-minute overseas call costs \$5.91 and a 10-minute call costs \$10.86. The cost of the call and the length of the call are related.

Identify the variables in this situation: $x = \# \text{ min}$ $y = \text{cost}$

What is the given information in this problem (find all that apply)?

y-intercept — slope — one point (5 , 5.91) a second point: (10 , 10.86)

- a. What is the cost y of a call x minutes duration? (Assume this is a constant-increase situation)

$$m = \frac{5.91 - 10.86}{5 - 10} = \frac{-4.95}{-5} = .99$$

$$m = .99$$

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

$$y - 5.91 = .99(x - 5)$$

- b. How long can you talk on the phone if you have \$12 to spend?

You can't talk for a little over 11 minutes for \$12.00

$y = 12$ Plug in 12 for y and solve for x .

$$12 - 5.91 = .99(x - 5)$$

$$6.09 = .99x - 4.95$$

$$+ 4.95 \quad + 4.95$$

$$11.04 = .99x$$

$$\frac{11.04}{.99} \quad \frac{.99}{.99}$$

$$x = 11.15$$

2. Biologists have found that the number of chirps some crickets make per minute is related to temperature. The relationship is very close to being linear. When crickets chirp 124 times a minute, it is about 68 degrees Fahrenheit. When they chirp 172 times a minute, it is about 80 degrees Fahrenheit.

Identify the variables in this situation: $x = \frac{\# \text{ of chirps per minute}}{\text{minute}}$ $y = \text{degrees } (^{\circ}\text{F})$

What is the given information in this problem (find all that apply)?

y-intercept _____ slope _____ one point (124, 68) a second point: (172, 80)

a. Find an equation for the line that models this situation.

$$\frac{80 - 68}{172 - 124} = \frac{12}{48} = m = .25$$

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

$$y - 68 = .25(x - 124)$$

b. How warm is it when the crickets are chirping 150 times a minute?

$$y - 68 = .25(150 - 124)$$

When THE CRICKETS ARE CHIRPING 150 TIMES PER MINUTE, IT IS 74.5°F

$$y - 68 = 6.5$$

$$+68 \quad +68$$

$$y = 74.5$$

MORE WORD PROBLEM PRACTICE: Choose the BEST form of equation to use for each problem.

1. Nick is given \$50 to spend on a vacation. He decides to spend \$5 a day. The amount Nick has left and the number of days are related.

Identify the variables in this situation: $x = \# \text{ of days}$ $y = \$ \text{ left}$

What is the given information in this problem (find all that apply)?

y-intercept 50 slope -5 one point (0, 50) a second point: (,)

a. Write an equation relating x and y .

$$y = -5x + 50$$

$$y = mx + b$$

b. Use your equation to find out when Nick will have \$15 left.

$$15 = -5x + 50$$

$$-50 \quad -50$$

AFTER 7 DAYS, NICK WILL HAVE \$15 LEFT.

$$\frac{-35 = -5x}{-5}$$

$$x = 7$$

2. Julio plans a diet to gain 0.2 kg a day. After 14 days, he weighs 40 kg. The number days he diets and his weight are related.

Identify the variables in this situation: $x = \text{\# of days}$ $y = \text{weight (kg)}$

What is the given information in this problem (find all that apply)?

y-intercept _____ slope .2 one point (14 , 40) a second point: (,)

a. Write an equation relating Julio's weight, w , to the number of days, d , on his diet.

$$y - 40 = .2(x - 14) \qquad y - y_1 = m(x - x_1)$$

b. How long will it take Julio to reach his goal weight of 50 kg?

$$50 - 40 = .2x - 2.8$$

IT WILL TAKE 64 DAYS FOR JULIO TO ~~LOSE~~ GET TO HIS GOAL WEIGHT OF 50KG

$$10 = .2x - 2.8$$

$$\frac{12.8 = .2x}{.2} \qquad x = 64$$

3. A plane loses altitude at the rate of 5 meters per second. It begins with an altitude of 8500 meters. The plane's altitude is a function of the number of seconds that pass.

Identify the variables in this situation: $x = \text{\# of seconds}$ $y = \text{altitude of plane}$

What is the given information in this problem (find all that apply)?

y-intercept 8500 slope -5 one point (,) a second point: (,)

a. Write an equation modeling this situation.

$$y = -5x + 8500 \qquad y = mx + b$$

b. Use your equation to find out how much time will pass before the plane will land (hint: what is the altitude when the plane lands?)

$$0 = -5x + 8500$$

$$\frac{-8500 = -5x}{-5}$$

$$x = 1700$$

IT WILL TAKE 1700 SECONDS FOR THE PLANE TO LAND.