

RATU NAVULA COLLEGE**Y11 MATHEMATICS LIFESKILLS SUPPLEMENTARY NOTES 3****Lesson 40: Translate To Linear Equation**

LO: Solve practical situations using linear graphs and equations.

Sometimes, the trick to solving a word problem will be to translate it into a linear equation. Linear equation word problems usually involve some sort of rate of change, or steady increase (or decrease) based on a single variable. If you see the word rate, or even "per" or "each", it's a safe bet that a word problem is calling for a linear equation.

There are a couple steps when translating from a word problem to a linear equation.

- Find the y variable, or output. What is the thing you're trying to find? This will often be a price, or an amount of time, or something else countable that depends on other things.
- Find the x variable, or input. What is affecting the price, or amount of time, etc.?
- Find the slope. What's the rate in the problem?
- Find the y -intercept. Is there anything that's added or subtracted on top of the rate, no matter what x is?

Plug all the numbers you know into $y = mx + c$

Example 1

Wally and Cobb are starting a catering business. They rent a kitchen for \$350 a month, and charge \$75 for each event they cater. If they cater 12 events in a month, how much do they profit?

y variable - the problem asks how much Wally and Cobb profit. That means that their profit is the output we want from our equation.

$$y = \text{profit}$$

x variable - to find the x variable, look for words like "rate," "per," "each," or something else that implies change over time or a rate of change.

In this case, we can see that Wally and Cobb charge "\$75 for each event they cater" - which means the money they make in a month will have something to do with the number of events they cater.

$$x = \text{The number of events they cater}$$

slope m - Since they'll make \$75 for each event they cater, \$75 is their rate!

$$m = 75$$

y intercept (c) - each month, Wally and Cobb have to pay rent! That subtracts \$350 from their profits, so their y -intercept will always be -350 .

$$c = -350$$

Plugging this into the slope-intercept equation gives us: $y = mx + c$

$$y = 75x - 350$$

If Wally and Cobb cater 12 events in a month, how much money do they make after they pay rent?

$$\begin{aligned}y &= 75x - 350 \\y &= 75(12) - 350 \\y &= 550\end{aligned}$$

If they cater 12 events in a month, Wally and Cobb will make \$550 in profit.

ACTIVITY

1. Sam is on a diet. He currently weighs 270 pounds. He loses 4 pounds per month.
 - (a) Write a linear model that represents Mr. Thompson's weight after x months.
 - (b) After how many months will Mr. Thompson reach his goal weight of 200 pounds?

Lesson 41: Slope – Intercept Word Problems

LO : Solve practical situations using linear graphs and equations.

When a word problem involves a constant rate or speed and a beginning amount, it can be written in slope-intercept form $y = mx + c$. To do this, recognize which number will represent m , (the rate) and the number will represent c (***y-intercept***). Sometimes, a word problem will give you points that you have to pick out. If you know the independent and dependent variables, this helps when identifying the given information.

REMEMBER YOU NEED: SLOPE (m), AND Y-INTERCEPT (c) to write the equation of a line in this form.

Example 1

A town's population has been growing linearly. In 2004 the population was 6,200. By 2009 the population had grown to 8,100. Assume this trend continues.

- (a) Write an equation, in slope-intercept form to find the town's population for any year.
- (b) Predict the population in 2013.
- (c) Identify the year in which the population will reach 15,000.

To make computation a little nicer, we will define our input as the number of years since 2004.

Input (x): t , years since 2004

Output (y): $P(t)$, the town's population

To determine the rate of change, we will use the change in output per change in input.

$$m = \frac{\text{change in output}}{\text{change in input}}$$

The problem gives us two input-output pairs. Converting them to match our defined variables, the year 2004 would correspond to $t = 0$, giving the point $(0, 6200)$.

The year 2009 would correspond to $t = 5$, giving the point $(5, 8100)$.

The two coordinate pairs are $(0, 6200)$ and $(5, 8100)$. Recall that we encountered examples in which we were provided two points earlier in the chapter. We can use these values to calculate the slope.

$$m = \frac{\text{change in output}}{\text{change in input}} = \frac{8100 - 6200}{5 - 0} = 380 \text{ people per year}$$

(a) $P(t) = 380t + 6200$

(b) To predict the population in 2013, we evaluate our function at $t = 9$.

$$P(t) = 380t + 6200$$

$$P(t) = 380(9) + 6200$$

$$P(t) = 9620$$

(c) To find when the population will reach 15,000, we can set $P(t) = 15000$ and solve for t .

$$P(t) = 380t + 6200$$

$$0 = 380t + 6200$$

$$t = 23.16 \text{ years}$$

ACTIVITY

1. Sam has \$28,000 in his bank account. Every month he spends \$1,200. He does not add money to the account.

(a) Write a linear model that shows how much money will be in the account after x months.

(b) How much money will he have in his account after 8 months?

Lesson 42: Slope – Intercept Word Problems

LO: Solve practical situations using linear graphs and equations.

WORD PROBLEMS IN POINT-SLOPE FORM

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

$$Y - Y_1 = m (X - X_1)$$

EXAMPLE

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 = time (days) y = amt. left (\$)

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

y-intercept _____ slope -3 one point (14, 68) a second point:

- a. Write an equation for the situation.

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

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

$$y = 3x + 110$$

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

$$x = 0 \quad y = 3(0) + 110$$

$$y = 110$$

ACTIVITY

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

Let x = minutes after 3 y = cost of the call (\$)

Given information:

Slope : 0.10 One point (3, 0.25)

a. Write an equation for the situation.

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

Lesson 43: Slope – Intercept Word Problems

LO : Solve practical situations using linear graphs and equations.

More Word Problems in Point-slope form

Sometimes instead of giving a rate, a word problem gives two relationships at different points in time between variables. This kind of problems is giving you **two points**.

Find the slope and then use one of the points to write an equation.

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

$$Y - Y_1 = m (X - X_1)$$

MORE WORD PROBLEM PRACTICE:

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 = time (days) y = amt. left

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

y-intercept 50 slope -5 one point _____ a second point: _____

a. Write an equation relating x and y.

$$y = mx + b$$

$$y = -5x + 50$$

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

$$y = 15 \quad 15 = -5x + 50$$

$$-35 = -5x$$

$$\boxed{x = 7 \text{ days}}$$

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 = time (days) y = weight (kg)

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

y-intercept _____ slope 0.2 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.

$$y - 40 = 0.2(x - 14)$$

$$y - 40 = 0.2x - 2.8$$

$$y = 0.2x + 37.2$$

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

$$y = 50 \quad 50 = 0.2x + 37.2$$

$$12.8 = 0.2x$$

$$\boxed{x = 64 \text{ days}}$$

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:

$x =$ time (sec.) $y =$ plane's altitude (meters)

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.

$$y = -5x + 8500$$

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?)

$$y = 0$$

$$0 = -5x + 8500$$

$$5x = 8500$$

$$x = 1,700 \text{ seconds}$$

ACTIVITY

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.

Let $x =$ length of call $y =$ cost

Information given: one point (5, 5.91) second point (10, 10.86)

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

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

Lesson 44: Linear Modelling Word Problems

LO : Applications of linear modeling

ACTIVITY

1. 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.

Let $x = \text{no. of weeks}$ $y = \text{amount}$

a. Identify the information given:

y-intercept: ___ slope: ___ one point: (,) second point (,)

b. Find the equation for the amount, y you have after x weeks.

c. Use your equation to find out when (week) will you have \$310 in the account.

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

Let $x = (\text{time}) \text{ no. of days}$ $y = \text{amount}$

a. Identify the information given:

y-intercept: ___ slope: ___ one point: (,) second point (,)

b. Write an equation for the situation.

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