Constant Rate of Change 1-7

https://www.youtube.com/watch?v=aVgMyF69mg8

Vocabulary Start-Up

Vocab

A **rate of change** is a rate that describes how one quantity changes in relation to another. In a linear relationship, the rate of change between any two quantities is the same. A linear relationship has a **constant rate of change**.

To find the constant rate of change: $\frac{\text{The constant change in the y-values}}{\text{The constant change in the x-values}}$ or $\frac{\Delta y}{\Delta x}$

Δ delta symbol - means "the change in"

Using charts...

Real-World Link

A computer programmer charges customers per line of code written. Fill in the blanks with the amount of change between consecutive numbers.

Figure out the constant change in the x-values

Figure out the constant change in the y-values

		+50	+50	+50	
Lines of Code	x	50	100	150	200
Cost ($)	y	1,000	2,000	3,000	4,000
		+1,000	+1,000	+1,000	

Reminder: The unit of money is always placed in the numerator position so it is your y-value

In this case, the y value is constantly increasing by $1,000 each time and the x value is constantly increasing by 50 lines of code each time.

$\frac{\Delta y}{\Delta x}$ $\frac{\text{change in cost}}{\text{change in lines of code}} = \frac{\$1{,}000}{50 \text{ lines}} = \frac{\$20}{1 \text{ line}}$ → Note: Try to simplify the result until you get a denominator of 1 unit.

The constant rate of change is $20 per line of programming code.

Make sure you include both units in your answer.

Example

1. **The table shows the amount of money a booster club makes washing cars for a fundraiser. Use the information to find the constant rate of change in dollars per car.**

Remember: $\frac{\Delta y}{\Delta x}$

Cars Washed	
Number	Money ($)
5	40
10	80
15	120
20	160

+5, +5, +5 (x-values) +40, +40, +40 (y-values)

The x-value is constantly increasing by 5 each time

The y-value is constantly increasing by $40 each time

In this case, the y value is constantly increasing by \$40 each time and the x value is constantly increasing by 5 cars each time.

$\frac{\Delta y}{\Delta x} = \frac{40}{5} = \frac{\$8}{1 \text{ car}}$

Make sure you include both units in your answer.

So the number of dollars earned increased by \$8 for every car washed.

Got It? Do these problems to find out.

a. The table shows the number of miles a plane traveled while in flight. Use the information to find the approximate constant rate of change in miles per minute. Round your answer to the nearest whole mile per minute.

		+30	+30	+30
Time (min) X	30	60	90	120
Distance (mi) Y	290	580	870	1,160
	+290	+290	+290	

Note: $\frac{\text{miles}}{\text{minutes}}$

In this case, the y value is constantly increasing by 290 miles each time and the x value is constantly increasing by 30 minutes each time.

$\frac{\Delta y}{\Delta x}$ $\frac{290}{30} = \frac{9.66 \text{ miles}}{1 \text{ min}} = \frac{10 \text{ mi}}{1 \text{ min}}$

Make sure you include both units in your answer.

The constant rate of change is about 10 miles per minute.

b. The table shows the number of students that buses can transport. Use the table to find the constant rate of change in students per school bus.

Note: # of students / # of buses

	+1	+1	+1
Number of Buses X	2	3	4	5
Number of Students Y	144	216	288	360
	+72	+72	+72	

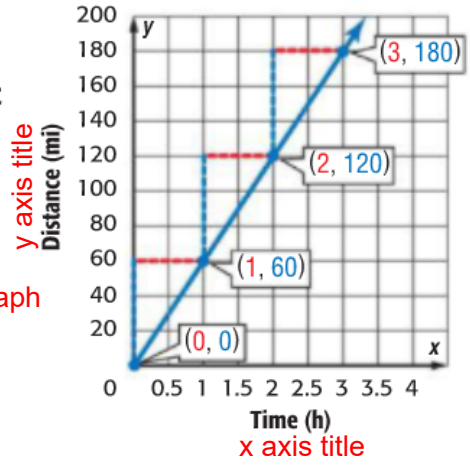
In this case, the y value is constantly increasing by 72 students each time and the x value is constantly increasing by 1 bus each time.

$\frac{\Delta y}{\Delta x}$ $\frac{72 \text{ students}}{1 \text{ bus}}$

The constant rate of change is 72 students per bus.

Using graphs...

2. The graph represents the distance traveled while driving on a highway. Find the constant rate of change.



Method 1:

Set up a table using the ordered pairs in the graph

	x miles	y Hours	
	0	0	
+1	1	60	+60
+1	2	120	+60
+1	3	180	+60

In this case, the y value is constantly increasing by 60 hours each time and the x value is constantly increasing by 1 mile each time.

$\frac{\Delta y}{\Delta x} = \frac{60\ mi}{1\ hr}$

The constant rate of change is 60 miles per hour

Method 2:

Use the slope formula - slope is the same thing as the constant rate of change.

"m" is the symbol for slope.

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

1) Choose any two ordered pairs that fall on the line: (2, 120) and (3,180)

2) Label each of the order pairs (x_1, y_1) (x_2, y_2)

x_1 y_1 x_2 y_2

(2,120) (3, 180)

3) Substitute into the formula: $m = \frac{y_2 - y_1}{x_2 - x_1}$

$m = \frac{180 - 120}{3 - 2} = \frac{60mi}{1\ hr}$

The constant rate of change is 60 miles per hour

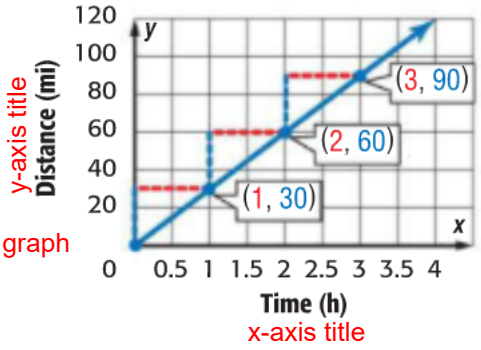
3) Explain what the points (0,0) and (1,60) represent.

The point (0,0) represents traveling zero miles in zero hours.

The point (1,60) represents traveling 60 miles in 1 hour.

Got It? Do these problems to find out.

c. Use the graph to find the constant rate of change in miles per hour while driving in the city.



x-axis title

Method 1:

Set up a table using the ordered pairs in the graph

	x (hours)	y (miles)	
	1	30	
+1			+30
	2	60	
+1			+30
	3	90	

In this case, the y value is constantly increasing by 30 hours each time and the x value is constantly increasing by 1 mile each time.

$\frac{\Delta y}{\Delta x} = \frac{30 \text{ mi}}{1 \text{ hr}}$

The constant rate of change is 30 miles per hour

Method 2:

Use the slope formula - slope is the same thing as the constant rate of change.

"m" is the symbol for slope.

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

1) Choose any two ordered pairs that fall on the line: (1, 30) and (3,90)

2) Label each of the order pairs (x_1, y_1) (x_2, y_2)

x_1 y_1 (1,30) x_2 y_2 (3, 90)

3) Substitute into the formula: $m = \frac{y_2 - y_1}{x_2 - x_1}$

$m = \frac{90 - 30}{3 - 1} = \frac{60}{2} = \frac{30 \text{ mi}}{1 \text{ hr}}$

The constant rate of change is 30 miles per hour

d. On the lines below, explain what the points (0, 0) and (1, 30) represent.

The point (0,0) represents traveling zero miles in zero hours.

The point (1,30) represents traveling 30 miles in 1 hour.

4. **The table and graph below show the hourly charge to rent a bicycle at two different stores. Which store charges more per bicycle? Explain.**

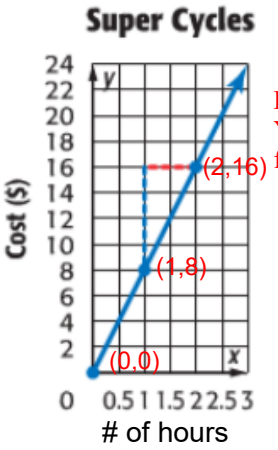
Pedals Rentals	
Time (hour)	Cost ($)
2	24
3	36
4	48

+1 +12
+1 +12

In this case, the y value is constantly increasing by $12 each time and

the x value is constantly increasing by 1 hour each time.

$\frac{\Delta y}{\Delta x}$ $\frac{\$12}{1\ hr}$



Reminder:
You can create a chart or use the slope formula - your choice.

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

x_1 y_1	x_2 y_2
(0,0)	(2,16)

$m = \frac{16-0}{2-0} = \frac{16}{2} = \frac{\$8}{1\ hr}$

Pedals Rental charges more per hour to rent a bicycle. Pedals Rental charges $12 per hour. Super Cycles only charges $8 per hour.

Guided Practice

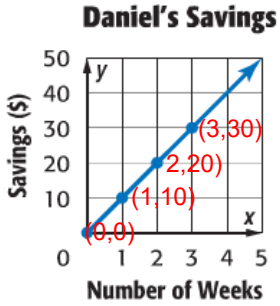
1. The table and graph below show the amount of money Mi-Ling and Daniel save each week. Who saves more each week? Explain. (Examples 1, 2, and 4)

Mi-Ling's Savings	
Time (weeks) (x)	Savings ($) (y)
2	$30
3	$45
4	$60

+1 +15
+1 +15

In this case, the y value is constantly increasing by $15 each time and the x value is constantly increasing by 1 week each time.

$\frac{\Delta y}{\Delta x}$ $\frac{\$15}{1\ wk}$



Reminder:
You can create a chart or use the slope formula - your choice.

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

x_1 y_1 x_2 y_2
(1,10) (2,20)

$m = \frac{20 - 10}{2 - 1} = \frac{\$10}{1\ wk}$

Mi-Ling saves more money each week. Mi-Ling saves $15 per week. Daniel only saves $10 per week.

2. Refer to the graph in Exercise 1. Explain what the points (0, 0) and (1, 10) represent. (Example 3)

The point (0,0) represents zero dollars in zero hours.

The point (1,10) represents $10 in one week.

3. **Building on the Essential Question** How can you find the unit rate on a graph that goes through the origin?

Sample answer: Use the y-coordinate of the point where the x-coordinate is 1.

Day 2
Page 72 questions 8, 9
Page 73 questions 10-13

8. **Persevere with Problems** The constant rate of change for the relationship shown in the table is $8 per hour. Find the missing values.

$x =$ _____ $y =$ _____ $z =$ _____

Time (h)	1	2	3
Earnings ($)	x	y	z

Standardized Test Practice

9. The information in the table represents a constant rate of change. Find the missing value.

Ⓐ 30 Ⓒ 105
Ⓑ 90 Ⓓ 120

Number of Packages	2	4	7
Number of Raisins	30	60	x

You may want to fill in the blanks...

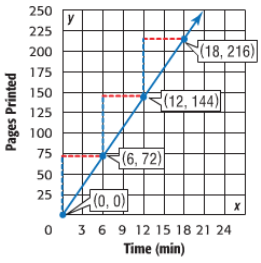
2	3	4	5	6	7
30		60			x

11.

Minutes	1,000	1,500	2,000	2,500
Cost ($)	38	53	68	83

_____

12. Use the graph to find the constant rate of change. Then, explain what the points (0, 0) and (6, 72) represent.



13. **Justify Conclusions** Ramona and Josh earn money by babysitting. The amounts earned for one evening are shown in the table and graph. Who charged more per hour? Explain.

Ramona's Earnings	
Time (hours)	Earnings ($)
2	18
3	27
4	36