**Math 9 – Unit 7: Coordinate Geometry** Name: Mr. Hagen

**Lesson #4: Slope as a Rate of Change** Date: Feb 9, 2022

**Learning Goal:** We are learning to connect rate of change to the slope of a line.

To explore what "rate of change" is, we first need to refamiliarize ourselves with "rate". A **rate** is a comparison of two quantities expressed as different units:

Examples: 80 km/h   50 words/min   $3.20/kg

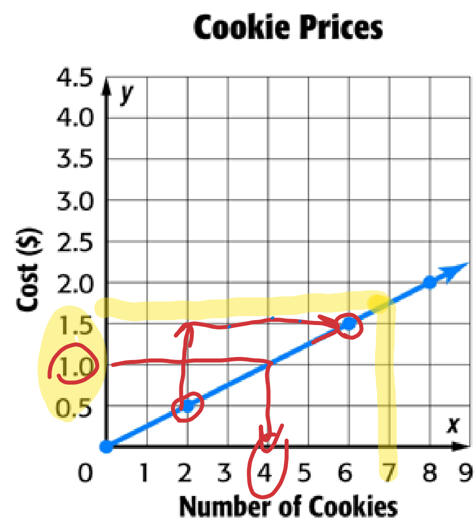
all one unit

A line on a graph is always changing (unless it is flat or $m = 0$). Rate of change, then, is the rate at which a line on a graph is changing. Thankfully, we know how to calculate this change by calculating the slope! Thus,

$$\text{Rate of change} = \text{slope} = m = \frac{Rise}{Run} = \frac{y_2 - y_1}{x_2 - x_1} = \text{Rate of change}$$

$\Delta y$ / $\Delta x$

**Example 1:** Given the graph to the right:




**a)** Calculate the rate of change. Include the units (always include units).

slope

$m = \frac{\text{Rise}}{\text{Run}} = \frac{\$1.00}{4 \text{ cookies}} = \$0.25/\text{cookie}$

**b)** What does the rate of change represent?

The represents the cost of one cookie

**c)** How much would 7 cookies cost? If I spent one dollar, how many cookies would I get?

$0.25 × 7 = $1.75   x-value

$1.00 ÷ $0.25 = 4   y-value

Interpolation (within given graph)

**d)** The information for question c) was in the graph. The rate of change allows us to go beyond the graph. How much would 20 cookies cost?

Extrapolation

$0.25 × 20 = $5.00

**Rate of Change Without a Graph**

Having a graph is great as it allows us to visualize the information and actually see the steepness (or its flatness, yes, that's a word). However, we do not always have a graph:

**Example 1**: A climber is on a hike. After 2 hours, he is at an altitude of 400 feet. After 6 hours, he is at an altitude of 700 feet. What is the average rate of change?

**Wait—**why are we asking for the average rate of change?

because the rate of change is not constant, he could take a break or have different hills.

Since rate of change = slope, the rate of change is also $m = \frac{y_2 - y_1}{x_2 - x_1}$. If we could create two points, we could then calculate the slope/RoC!

$(x, y)$

**Solve Example 1:**

time determines height

x y

(2, 400)

(6, 700)

h, ft

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

$m = \frac{700 - 400}{6 - 2}$

$m = \frac{300\text{ft}}{4\text{h}} = 75 \text{ ft/h}$

∴ the climber was ascending at 75 ft/h

**Example 2:** A scuba diver is 30 feet below the surface of the water 10 seconds after he entered the water and 100 feet below the surface after 40 seconds. What is the scuba diver's rate of change?

(seconds, feet below)

1 (10, 30)

2 (40, 100)

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

$m = \frac{100 - 30}{40 - 10}$

$m = \frac{70}{30} = \frac{7}{3} = 2.33 \text{ ft/sec}$

∴ The scuba diver is descending 2.33ft/sec.

**Success Criteria**

- I can recognize that slope and rate of change are the same thing
- I can find rate of change on a graph, by finding its slope
- I can create two ordered pairs from a given scenario or equation and find the average rate of change between them
- I can use the slope formula to calculate average rate of change