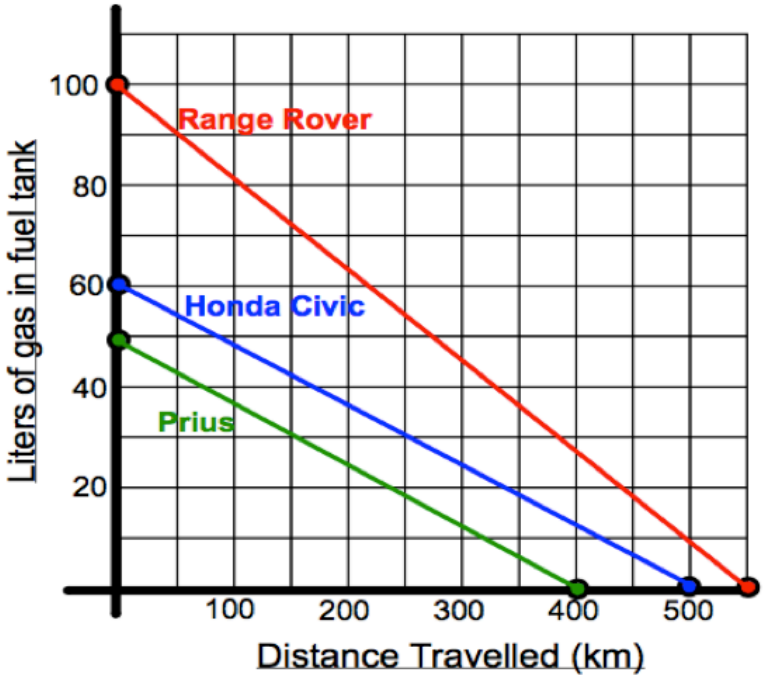
5.4 Slope as a Rate of Change

Part 1: Do It Now



1. The independent variable is DISTANCE TRAVELLED
The dependent variable is LITRES OF GAS IN TANK

2. How can you determine the rate of fuel consumption using this data?

Find the slope of each line.

$m = \frac{rise}{run}$

3. Determine the rate of gas consumption for each vehicle and then rank them in order of efficiency.

Vehicle	2010 Range Rover	2011 Prius	2007 Honda Civic
Rate of gas consumption	$m = \frac{-100}{550}$ $= -0.182$ L/km	$m = \frac{-50}{400}$ $= -0.125$ L/km	$m = \frac{-60}{500}$ $= -0.12$ L/km
Efficiency ranking	3	2	1

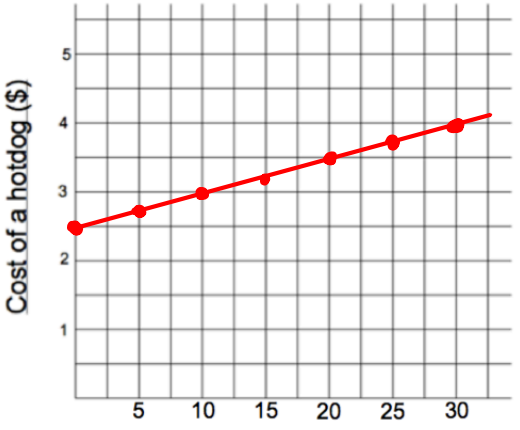
Part 2: Connecting Slope and Rate of Change

From the Do It Now question we have discovered that slope = rate of change. Look at the following table to see further how they are connected. How the linear equation is represented determines the terminology we use describe the slope.

Word problem	Table	Graph	Equation
m is the rate of change	$m = \frac{\Delta y}{\Delta x}$	$m = \frac{rise}{run}$	$m = slope$

Years since July 1980	Cost of a hotdog ($)
0	2.50
5	2.75
10	3.00
15	3.25
20	3.50
25	3.75
30	4.00

Example 1:
The cost of a hot dog at the Rogers Centre has been going up for several years. Graph the data. Let x be the number of years since July 1980.



a) Determine the slope using the graph

Rise = 0.25 Run = 5 Slope = $\frac{0.25}{5} = 0.05$

b) Determine the rate of change of the cost of hot dogs using the table.

rate of change = $m = \frac{\Delta y}{\Delta x} = \frac{2.75-2.50}{5-0} = \frac{0.25}{5} = 0.05$

Remember:

Rate of change = $\frac{\Delta y}{\Delta x}$

c) Write an equation to represent the cost of a hot dog based on the number of years since July 1980. What part of the equation represents the slope?

$m = 0.05$

$b = 2.50$

$y = 0.05x + 2.50$

Example 2: Mr. Jensen is training for a triple marathon and runs every day before school. This morning he ran 5 km in 20 minutes.

a) Calculate the rate of change of Mr. Jensen's distance from his starting point. (in this case rate of change is = average speed)

Rate of change = $\frac{\Delta dependent\ variable}{\Delta independent\ variable}$

Dependent variable: Distance (km)

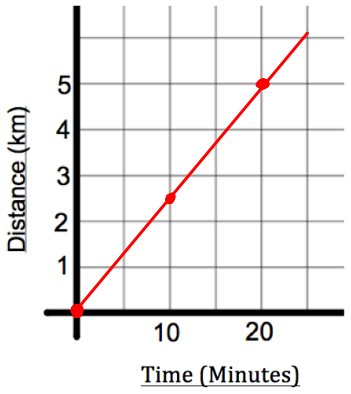
Independent variable: Time (minutes)

Rate of change (speed) = $\frac{\Delta distance}{\Delta time} = \frac{5\ km}{20\ min} = 0.25\ km/min$

b) Graph distance as it relates to time

$y = mx$

$y = 0.25x$



c) Calculate the slope of the line from the graph

Slope = $\frac{rise}{run}$

$m = \frac{rise}{run} = \frac{2.5}{10} = 0.25$

d) Explain the meaning of the rate of change and how it relates to the slope of the graph

The rate of change is the speed of the runner in this scenario. The steeper the slope, the higher the rate of change (faster the speed).