MTH1W Grade 9 Mathematics

3.1 Talking About Change

Goal(s)
- *Identify independent and dependent variables in a graph or table of values and explain their relationship.*
- *Interpret information from a table of values or graph.*
- *Explain the meaning of rate of change and describe a rate of change as constant, increasing or decreasing, positive, negative or zero.*

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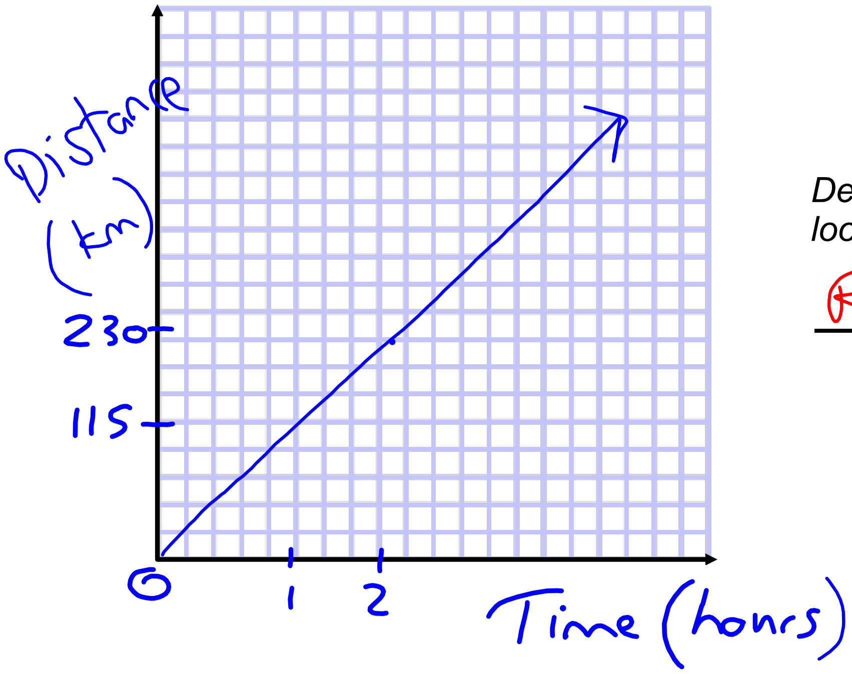
A car travels at a constant speed of 115 km/h. How far will the car travel in...

Time (h)	Distance (km)
0	0
1	115
2	230
3	345
4	460
5	575

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Graph the data from the table, where the variable **Time** is along the *horizontal axis* and the variable **Distance** is along the *vertical axis*.



Describe what your graph looks like?

Rising to the right (increasing)

In this example, how far the car travels is determined by how long it is driven for.

The relationship between distance and time is a ***relationship** between two variables* in which *one variable is a **constant multiple** of the other*.

In other words, one variable, *Time*, is **independent** *(can be anything)*, and the other variable, *Distance*, is **dependent** *(changes each time the other variable changes)* on the first variable.

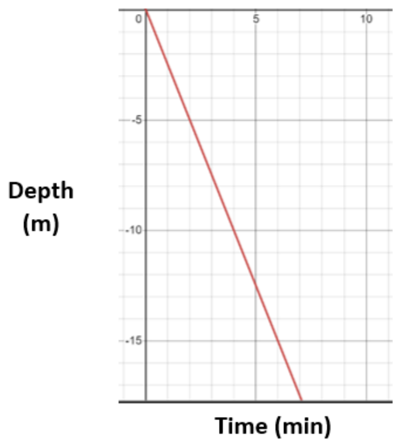
The **rate of change** is how the dependent variable is changing each time. In the above example, the rate of change is an increase of ***115 km*** for every hour driven.

This is an example of a **positive** rate of change. The *graph rises to the right*.

The rate of change can also be **negative**.

The example to the right shows the depth of a submarine as it travels towards the bottom of the ocean at a rate of *-2.5* metres/minute.

The graph of the *negative rate of change falls to the right*.



For both positive and negative rates of change, ***the steeper the line***, ***the faster the rate of change***.

We can determine the rate of change from a graph by comparing how fast the vertical distance is changing (**rise**) and compare it to how fast the horizontal distance is changing (**run**).

When determining the rate of change from a graph, always **count upwards or downwards** first and then **count to the right**.

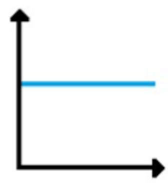
On this graph the vertical change (**rise**) is _3_ and the horizontal change (**run**) is _5_.

The **rate of change** of this graph is $\frac{3}{5}$.

If the graph is of a **straight line**, the *rate of change is constant*.

If the graph is of a **curved** or **wavy line**, the *rate of change is not constant*.

If the graph is a **horizontal line**, the *rate of change is 0*.

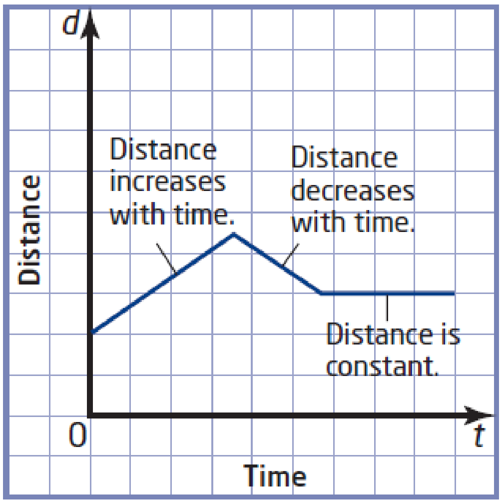


A **distance-time graph** shows an object's distance from a fixed point over a period of time.

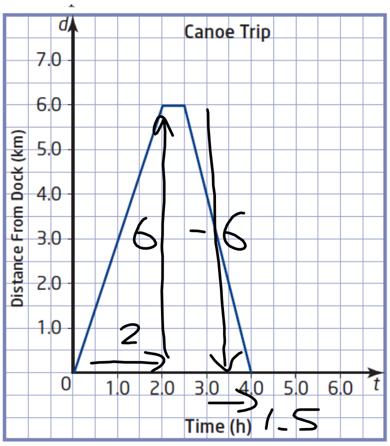
On these graphs, a **rising line** shows that the *distance increases as time increases*.

A **falling line** shows that the *distance decreases as time increases*.

A horizontal line shows that the *distance remains constant*.



A canoeist starts from a dock and paddles to the end of a lake and back. The graph shows the canoeist's distance from the dock during this trip.



a) How long did the trip take?

4 hours

b) How far is it to the end of the lake?

6 km

c) How long did they spend on the other side of the lake?

0.5 hours

d) Did they travel faster on the trip across the lake or on the trip back to the dock? How do you know?

$$\text{Speed}_{\text{out}} = \frac{\text{rise}}{\text{run}} = \frac{6}{2} = 3\text{ km/h}$$

$$\text{Speed}_{\text{back}} = \frac{\text{rise}}{\text{run}} = \frac{-6}{1.5} = -4\text{ km/h}$$

NOTE: negative speed means travelling in the opposite direction