Lesson 5.1 – Rate of Change (Slope)

Goal: Calculate and interpret rates of change from a table and a graph

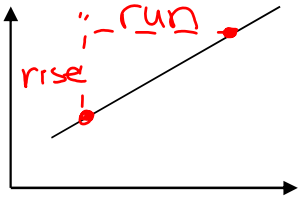
Rate of Change (ROC): The rate at which something is changing
The ROC is often indicated by the slope of a graph

We can determine an average rate of change using a table or graph

Table:

Independent Variable (x)	Dependent Variable (y)
x_1	y_1
x_2	y_2

Graph:



Average ROC (m) = $\frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{rise}}{\text{run}}$

Calculating and Interpreting Rates of Change

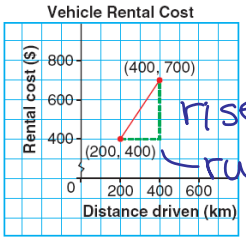
EXAMPLE 1 Calculate the average rate of change between each pair of points. Explain what the rate of change means.

a) Altitude of an Airplane

Time (min)	Airplane Height (m)
0	2000
4	1400

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1400 - 2000}{4 - 0} = \frac{-600}{4} = -150$

b)



rise = 300
run = 200

$m = \frac{\text{rise}}{\text{run}} = \frac{300}{200} = \frac{3}{2}$ (or 1.5)

Comparing Rates of Change

EXAMPLE 2 The distance required to stop a car depends on the speed at which the car is travelling. Use the tables below (showing the reaction distance and breaking distance needed to stop a car on dry pavement for given speed) to answer the following.

a) Calculate the average rate of change between consecutive points in each table. Describe the rates of change revealed in each table.

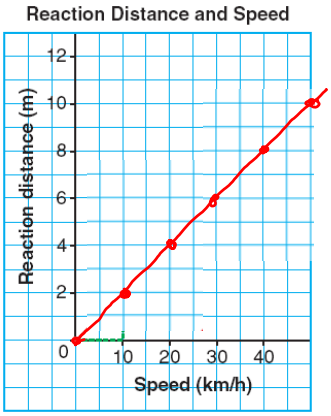
Speed (km/h)	Reaction Distance (m)	First Difference
0	0	
10	2	2 − 0 = +2
20	4	4 − 2 = +2
30	6	6 − 4 = +2
40	8	8 − 6 = +2
50	10	10 − 8 = +2

* First differences are constant.

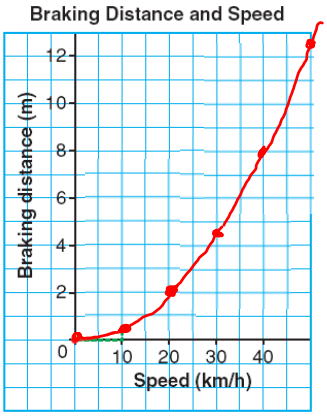
Speed (km/h)	Stopping Distance (m)	
0	0.0	
10	0.5	0.5 − 0 = +0.5
20	2.0	2.0 − 0.5 = +1.5
30	4.5	4.5 − 2.0 = +2.5
40	8.0	8.0 − 4.5 = +3.5
50	12.5	12.5 − 8.0 = +4.5

* First differences are not constant. But they increase by the same amount

b) Graph the data in the tables. Describe how the graph reflects the rates of change across the data.

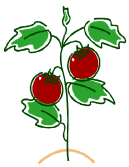


→ Linear



→ Non Linear (quadratic)

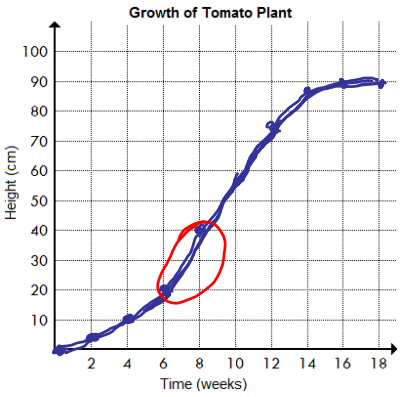
Identifying Rates of Change in a Table and a Graph



EXAMPLE 3 The table below shows the change in height of a tomato plant from germination until the tomato ripens.

Time (wks)	Height (cm)
0	0
2	5
4	10
6	20
8	40
10	58
12	75
14	86
16	90
18	90

+5, +5, +10, 20, 18, 17, 11, 4, 0 → Non linear



a) Determine when the rate of change in the height is:

i) **Zero**: 16 - 18 wks. (horizontal line) ii) **Constant**: 0 – 4 wks (straight line) iii) **Changing**: 4 – 16 wks (curve)

b) When is the rate of change in height the greatest?

6 - 8 weeks (steepest part of graph)

c) Describe the growth of the plant.

as time increases, height increases

SUMMARY

Rate of Change	Table	Example on Graph
Zero	First differences are 0	horizontal line
Constant	First differences are constant	Straight line
Changing	First differences are changing	Curve

Practice:
Page 284
#1 – 7, 9, 11