MATHEMATICS
Secondary ONE
Year 2021

SCHOOL OF SCIENCE AND TECHNOLOGY, SINGAPORE

Name: ( ) **Class:**

Unit 7 Linear Functions and Graphs

Topical Enduring Understanding

- A **function** is an input-rule-output relationship between an independent variable (input) and a dependent variable (output).
- A function can be used to **model** real world situations.
- A **function** can be represented using an equation, a table of values, and a graph to show different perspectives of the same growth phenomenon.
- Relationships between two variables can be represented with lines in a Cartesian plane (2-dimensional).
- A linear relationship can be expressed in the form $y = mx + c$ where m corresponds to the gradient and c corresponds to the vertical intercept.

Topical Essential Questions

- What are the key features of a linear graph? (Factual)
- Do we always need to know the exact numerical values of quantities to model relationship? (Conceptual)
- How would knowledge of ratios and rates help us facilitate testing and prediction in real life? (Debatable)

Key Points

- Linear relationship of 2 variables described in a linear equation.
- Plotting and sketching of linear graphs
- Gradient and vertical intercepts of straight lines
- Useful application of linear functions and graphs in real world contexts

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Textbook: *Think! Mathematics New Syllabus Mathematics 1A (8th edition)* **Chapter 6**

Online resource: **Student Learning Space (learning.moe.edu.sg)** SLS
Lessons from the SLS are assigned to selected sub-topics.
You are strongly encouraged to watch the clips in these SLS lessons before the start of the sub-topic.

Pre-requisites

- *Solving simple linear equations (Unit 5)*
- *Algebraic expressions and formulae (Unit 4)*
- *Representation and ordering of numbers on the number line (Unit 2)*

Building Vocabulary via Word Search

7		H	V	W	E	P	G	Q	R	S	F	B	S	U	T	O
6		V	A	R	I	A	B	L	E	O	X	Q	E	N	N	Q
5		N	A	I	S	E	T	R	A	C	K	F	E	R	A	O
4		K	A	U	I	H	B	D	T	N	I	I	B	E	R	R
3		A	L	D	J	I	C	X	I	N	D	L	V	L	D	I
2		O	R	D	E	R	E	D	P	A	I	R	H	A	A	G
1		P	T	L	V	Q	I	G	R	N	G	O	W	T	U	I
0		T	R	P	X	E	K	G	E	Y	R	F	P	I	Q	N
-1		S	K	B	E	P	R	A	N	I	G	X	C	O	A	Z
-2		C	N	B	H	C	R	T	Z	M	U	D	K	N	A	P
-3		E	N	A	L	P	R	O	I	P	Q	U	I	S	N	S
-4		E	I	F	X	M	N	E	J	C	T	T	P	H	E	B
-5		S	C	Q	Y	T	O	M	T	W	A	J	H	I	R	Q
-6		H	B	V	A	C	M	T	F	N	W	L	Q	P	I	S
-7		Z	T	L	U	C	O	V	F	Z	I	L	S	D	T	D
		-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7

You are going to learn **13 words** that are commonly used in this topic.
These words are hidden in the 25 x 25 matrix of letters, in different directions (horizontal, vertical, diagonal; forward, backward, up, down)

The position of the 1st character as well as the number of characters of the word are given to you.

	1st letter position	No. of characters	The word		1st letter position	No. of characters	The word
1	(1, 5)	9		8	(-3, -3)	5	P L A N E
2	(-1, 0)	8		9	(4, 0)	5	
3	(4, 2)	10		10	(6, 0)	8	
4	(2, -7)	9		11	(5, 5)	12	
5	(3, 3)	6		12	(-7, 6)	8	
6	(-7, 2)	11 (2 words)		13	(-4, 1)	8	
7	(7, 5)	6					

Lesson 1 Cartesian Coordinate System

At the end of the lesson, you should be able to
- understand how the Cartesian coordinate system work
- read, write and plot coordinates of given points

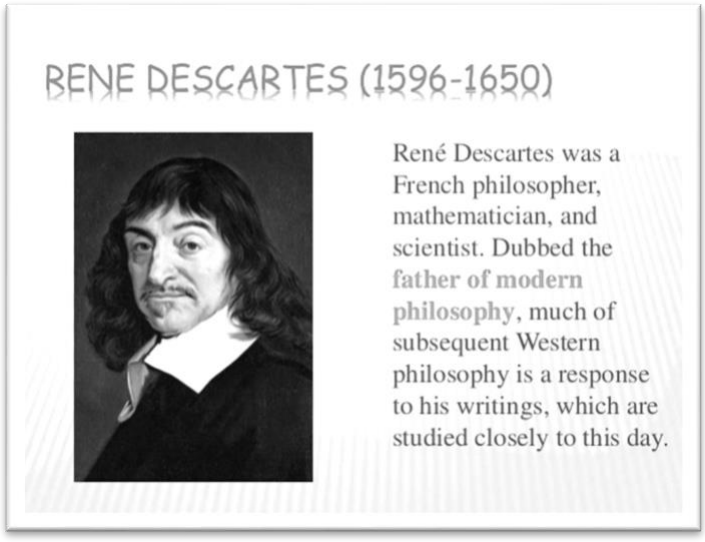
Background

A Cartesian coordinate system is one that specifies each **point** uniquely in a **plane** by a pair of numerical coordinates (**ordered pair**). This **notation** is used to express relationships between mathematical objects.

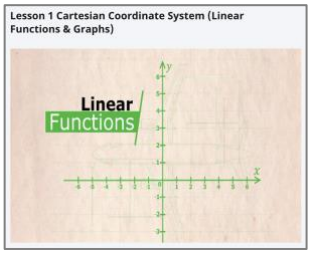
The invention of Cartesian coordinates in the 17th century by René Descartes (Latinised name: Cartesius) (1596-1630) revolutionised mathematics by providing the first systematic link between Euclidean geometry and algebra.

Using the Cartesian coordinate system, geometric shapes (such as curves) can be described by Cartesian equations: algebraic equations involving the coordinates of the points lying on the shape.

For example, a circle of radius 2 may be described as the set of all points whose coordinates x and y satisfy the equation $x^2 + y^2 = 4$.



Cartesian graphs are **diagrams** used to represent the relationships between two variable quantities. They can be used to study and communicate the relationship between the two quantities and solve problems involving them.



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Lesson 1 Cartesian Coordinate System (Linear Functions & Graphs)

- How to read and write the ordered pairs (i.e. x and y coordinates) correctly
- How to use an ordered pair to describe the location of a point

(I) Introduction

- In order to plot points in the plane, we need to draw a pair of _____ **axes**, one horizontal (x–axis) and the other vertical (y–axis). These axes resemble **number lines**.

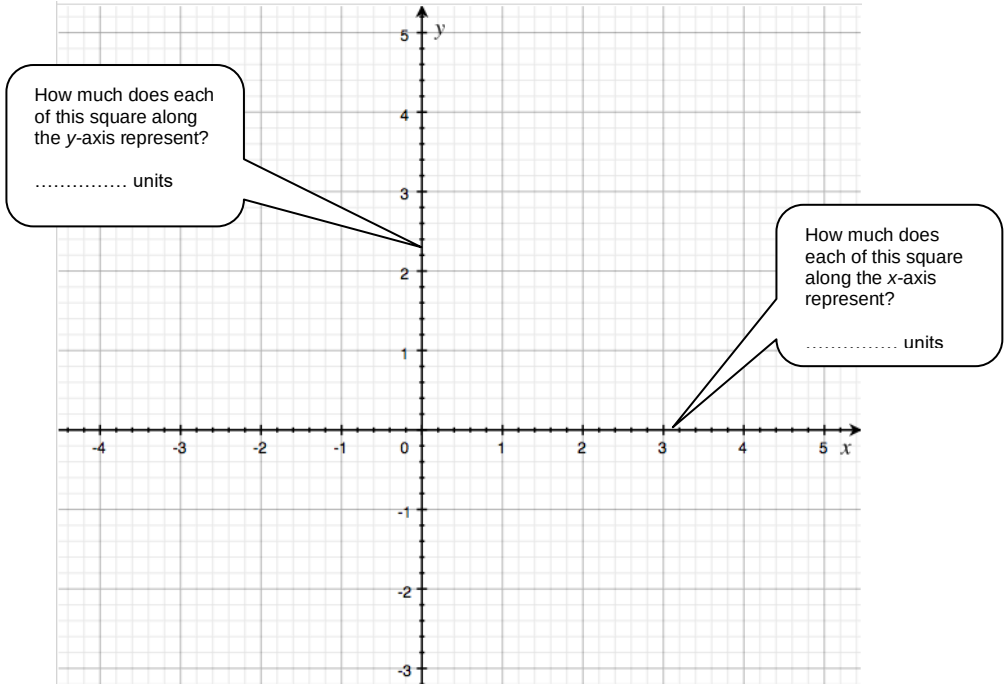
- The two axes divide the plane into **four** _____ that are numbered in an anticlockwise direction.

- The point where both axes meet is called the _____ (0, 0) and is labelled *O*.

- The position of any point in the Cartesian plane can be indicated in terms of its coordinates. Each point has two coordinates: the x-coordinate, the horizontal step from *O,* and the y-coordinate, the vertical step from *O.*

- <u>Point to ponder</u>:

  How much does each small square (horizontally & vertically) represent?

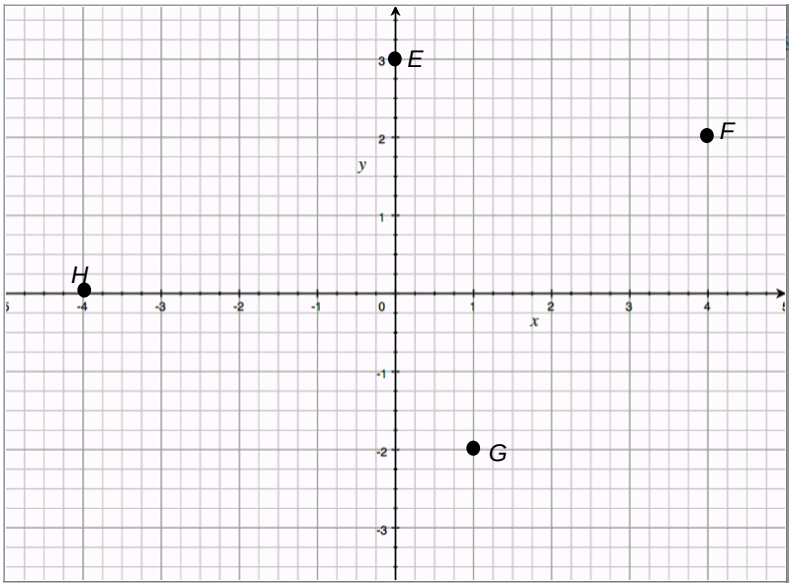


Activity 1

(a) Write down the coordinates of the following points:

E (,) F (,) G (,) H (,)

(b) Write down the point(s) that lies in the 1st quadrant: _____



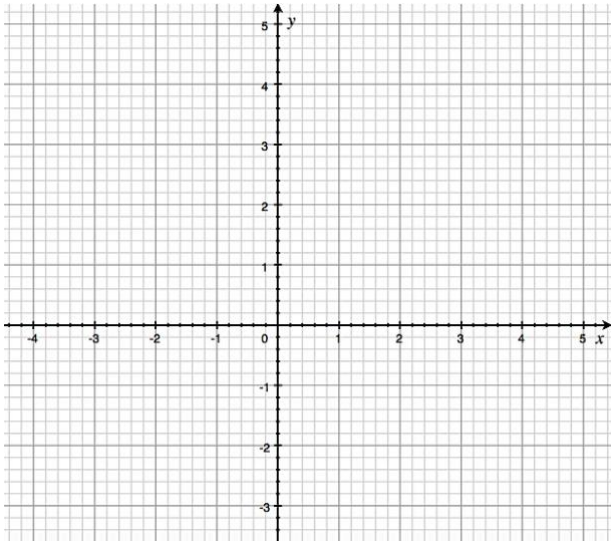
On Your Own: ***MORE PRACTICE in Textbook 1A*** Exercise 6A Q1

Activity 2

(a) Plot the following points in the plane: A(-4, 4), B(1, 1), C(1, -3) and D(-4, -2). Label the points clearly.

(b) Join the points to form a quadrilateral ABCD. Name the shape formed: _____

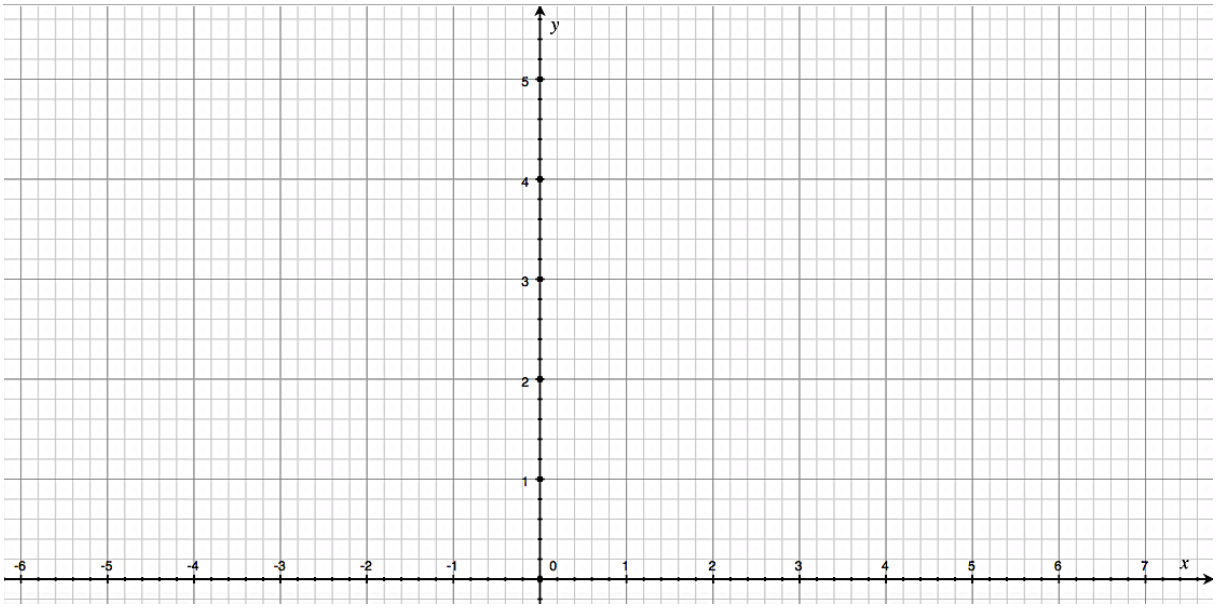
(c) Calculate the area of quadrilateral ABCD Ans: _____unit^2



On Your Own: ***MORE PRACTICE in Textbook 1A*** Exercise 6A Q6

Class work 1 (Tier C)

Two of the vertices of a triangle ABC are A(1, 1) and B(5, 5). The area of ΔABC is 12 units^2 and the y coordinate of C is 1. By plotting the points A and B on the grid below, determine the possible x coordinates of C. [3]



ASSIGNMENT 1 (Lesson 1) (updated on 26 July)

~~Textbook 1A (p151) Exercise 6A Q9*~~

Textbook 1A (p174) Review Exercise 6 Q2

Lesson 2 Linear Functions

At the end of the lesson, you should be able to

- understand that a function is a relationship between an independent variable (input) and a dependent variable (output)
- describe a linear relationship using an equation with 2 variables

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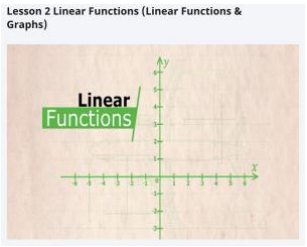
(I) Introduction: Linear Function

A function performs one or more operations on the **inputs** (i.e. values it takes in) to produce **outputs** (i.e. the results). The **operations** performed on the inputs are known as **the rule of the function**.

Formally, function describes the **relationship** between two sets in which each element of the first set, called the **domain** of the function, is matched with exactly one element in the second set, called the **range** of the function.



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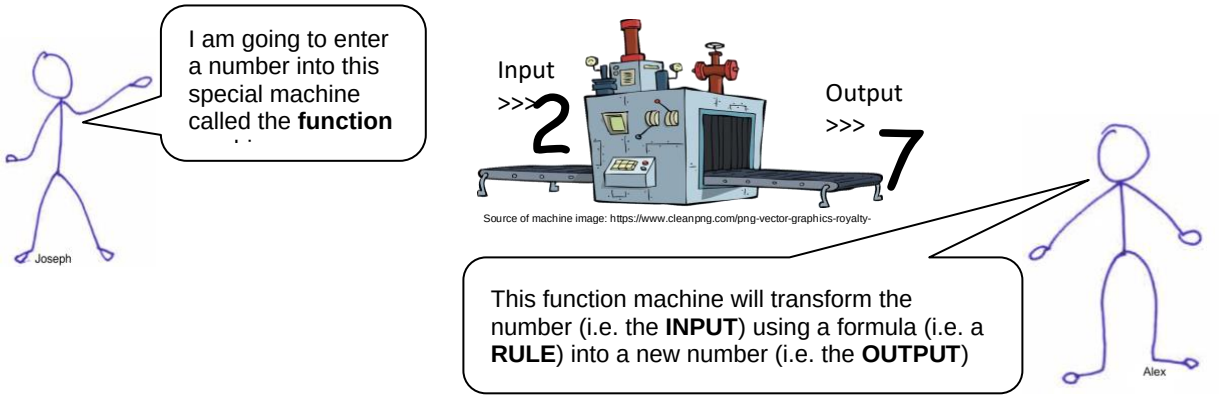
Lesson 2 Linear Functions (Linear Functions & Graphs)

☞ Look out for the "function machine" – What does it do?

☞ Watch the examples closely: How is the RULE 'transformed' into a linear equation?

Activity 1 Rule of the function



Observe the patterns between the inputs and outputs.
Guess what's the RULE that transform the numbers.

Input (x)	The **RULE** is	**Output** (y)	**Representing each pair of input and output as an ordered pair**
2		7	
3		9	
4		11	

(II) Understanding and Establishing Relationships

Discussion 1

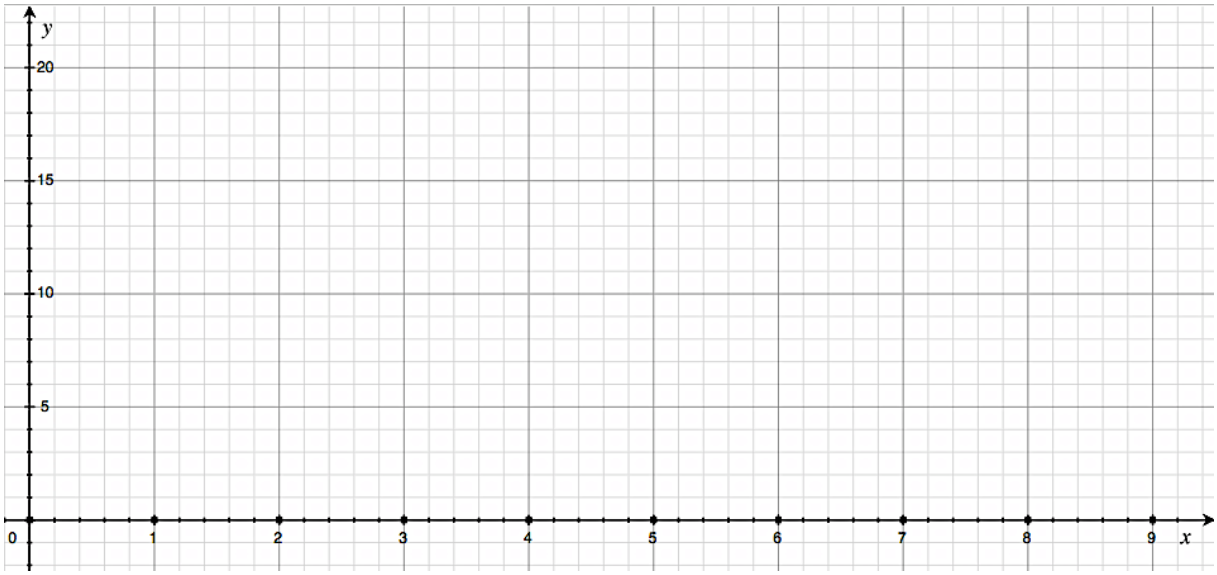
The tap in the bathroom leaks at the **rate of 2 cm^3 per minute**.

(a) Complete the table below:

Time (x min)	0	1	2.5	4	6
Volume of water (y cm^3)	0				

How do you find the y values?

(b) Plot the points in the Cartesian plane below.
(i) Label the axis (ii) Join the points



Note: Horizontal axis (x): Each small square represents …… unit(s)

Vertical axis (y): Each small square represents …… unit(s)

(c) Describe the line formed by the points.

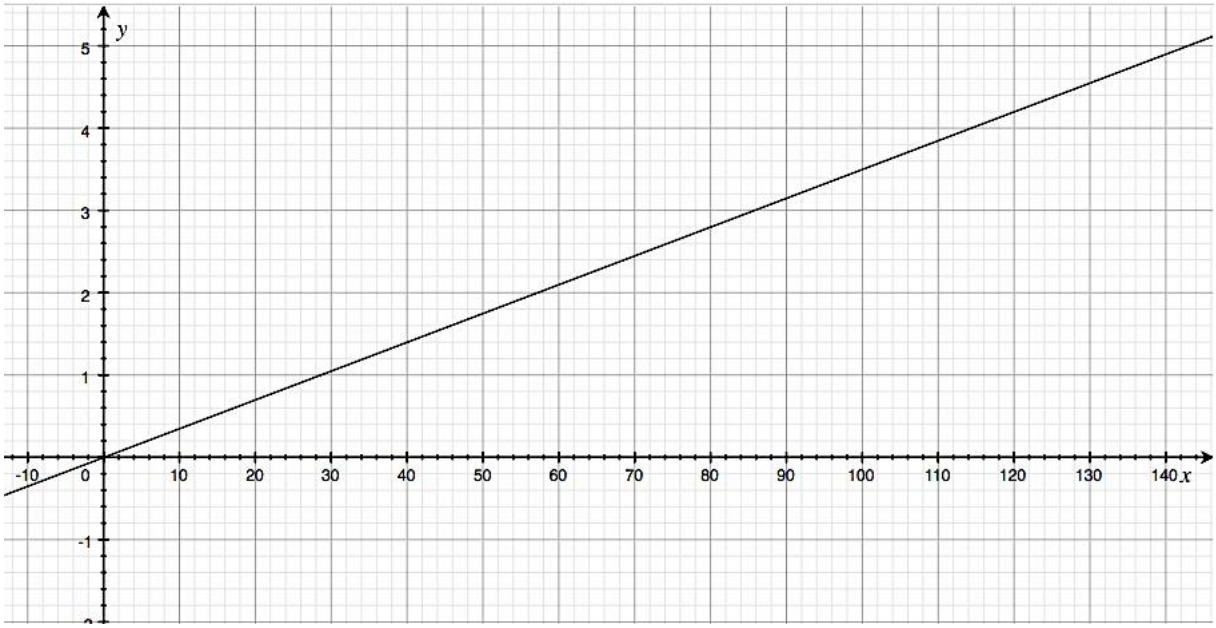
(d) What can you conclude about the relationship between the variables x (time) and y (volume of water)?

The process of examining a situation and then developing a model that accurately represents that situation is called **mathematical modelling**. Constructing and interpreting mathematical models is one of the most important uses of mathematics in the real world.

Activity 1

At the Changi Airport, the car parks are managed by the electronic parking system. Payment is at the exit via cash card or autopass card. At the south car park (open air car park between Terminal 2 and JetQuay, the parking charges for motor cars, including vans is $0.035 per minute (capped at $35 per 24 hour).
Source: https://www.changiairport.com/en/airport-guide/facilities-and-services/airport-parking.html

The following graph is generated.



(a) Label the horizontal and vertical axes of the graph.
Take note of how much each small square represents in each axis.

(b) From the graph,

(i) what is the cost of the parking fee after 80 minutes? Ans: $_____

(ii) what is the cost of the parking fee after 2 hours? Ans: $_____

(ii) what is the cost of the parking fee after 18 hours? Ans: $_____

(c) Based on the context given, point out an error in the way the graph was plotted.

(d) "A straight line graph is not an accurate model of the given context". Do you agree? Why?

(e) Describe the relationship between the parking fee (y) and time (x) using an equation (before it reaches the cap value of $35).

Activity 2

Jack and Jill run a catering business. Their fee for catering banquets is **$150 plus $4 per person**.

Let the y **represents the fee** and x **be the number of people attending the banquet**.

(a) Complete the following a table to illustrate this relationship

Number of people, x	5	10	15	20
Fee ($), y				

(b) Express the relationship with a graph.
Remember to **label the axes** and **indicate the values** at the markings along the axes.

(c) Express the **relationship** with an equation, in terms of x and y.

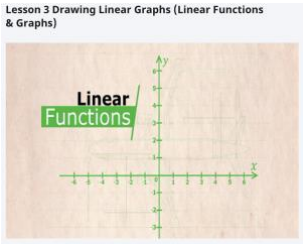
$y =$

Lesson 3 Drawing Linear Graphs

At the end of the lesson, you should be able to
- plot a straight line (linear) graph

(I) Plotting a Straight Line Graph

Point to Ponder…
We only need to plot 3 points to obtain the graph of a linear function. In fact, a straight line can be determined by plotting 2 points. **What is the purpose of the 3rd point?**



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Lesson 3 Drawing Linear Graphs (Linear Functions & Graphs)
☞ Watch closely how the ordered pairs are obtained through the function (equation)
☞ The video shows how to plot a graph on a grid (square) paper. Compare the grid paper and the graph paper you have. What is the difference?
☞ What other skill do we need in order to plot a graph?

When plotting a graph on a *graph* paper:
You will need a sharp pencil, ruler and eraser.

Step 1: Using the given function (equation), draw up a table that allows us to determine the coordinates of the points to be used for graph plotting.
- The coordinates can be determined by substituting the values of x into the given equation.

e.g. Plot a graph of $y = 4x + 1$ for $-2 \le x \le 2$

x	-2	0	2
y	-7	1	9

Step 2: The domain and range of the graph determines the **scale** to be used for the graph.
- The **domain** refers to the _____ and _____ values of ***x*-axis** (on the horizontal axis).
  e.g. in the above example, $-2 \le x \le 2$
- The **range** refers to the _____ and _____ values of ***y*-axis** (on the vertical axis).
  e.g. based on the computed y values in the above example, $-7 \le y \le 9$

Step 3: A good scale is achieved when the domain and range of the graph covers **at least 2/3** of the graph paper.
- Write the scale at the top right corner of the graph.

Step 4: With reference to the domain, decide where "zero" lies. Use pencil and ruler to draw the vertical axis. Using the range as a guide, decide where the horizontal axis should cut the vertical axis.
- Label the origin, horizontal axis x and the vertical axis y.
- Mark intervals (that are equally spaced) on both x- and y-axes.

Step 5: Plot the points (mark "**X**") on the graph paper and join them using a ruler and sharp pencil.

Step 6: Label the graph with the given equation.

Activity 1

(a) Complete the following tables.

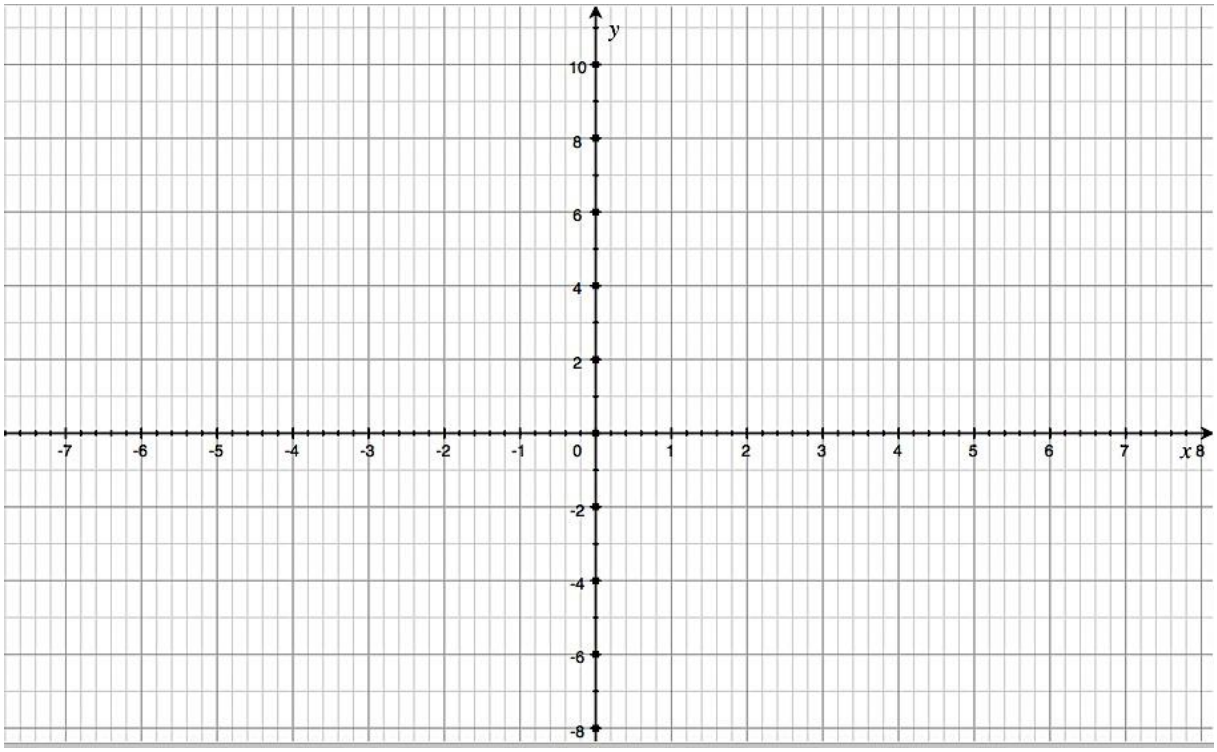
(i) $y = -2x$

x	–3	0	3
y			

(ii) $y = 6x + 8$

x	–2	–1	0
y			

(b) On the **same grid**, plot the points (from the two tables) and draw the graphs.
Label the graphs clearly.



(c) The two lines meet at a point.
Write down the x and y coordinates of this point: x = …….. , y = ……..

What is the significance of this point?

Do the following tasks on Graph Papers

Class work 1 (Tier B)

(a) Draw a graph of $y = -2x + 5$ from $x = -2$ to $x = 5$ [3]

x	–2	2	5
y			

Note: Attach the graph paper to the back of this set of notes.
Scale: x axis 2 cm : 1 unit *y* axis 2 cm : 2 units

Use the graph to answer the following questions:

(b) A is a point on the graph.

(i) Find the coordinates of A if its *x*-coordinate is $-1\frac{1}{2}$. Ans: A (,) [1]

(ii) State the quadrant in which A lies. Ans: _____ [1]

(c) B is a point on the graph.

(i) Find the coordinates of B if its *y*-coordinate is –4 Ans: B (,) [1]

(ii) State the quadrant in which B lies. Ans: _____ [1]

Class work 2 (Tier C)

(a) Draw the graph of $y = 2(2x - 3)$ from $x = -4$ to $x = 4$. [3]

Note: On the top left corner of the graph paper, draw a table to find points to be used for plotting
Scale: x axis 2 cm : 1 unit *y* axis 2 cm : 5 units

Use the graph to answer the following questions:

(b) (i) The point A $(1\frac{1}{2}, p)$ and B $(q, 0)$ lie on the graph. Find the values of *p* and *q* graphically.

Ans: *p* = _____ [1] *q* = _____ [1]

(ii) Hence, write down a relationship between the points A and B.

Ans: _____ [1]

(c) Locate and write down a point on the graph in which the *y*-coordinate of the point is twice its *x*-coordinate. [1]

On Your Own: ***MORE PRACTICE in Textbook 1A*** Exercise 6B Q1 Q2 Q3

ASSIGNMENT 2 (Lesson 3)

Textbook 1A (p162, p164) Exercise 6B Q1(a) change the scale of the *x*-axis to 2 cm : 1 unit
Q2(c), Q3(b)(c), Q9, Q10

Lesson 4 Concepts of Gradient and Vertical Intercepts

At the end of the lesson, you should be able to
- describe the gradient of a straight line
- state the y-intercept of a straight line

The equation of a straight line is in the form of $y = mx + c$ where m and c are constants.

SLS

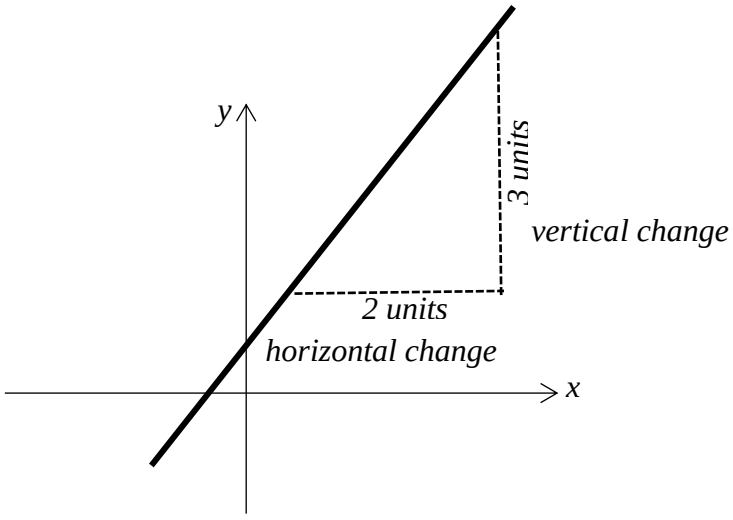
Lesson 4 Concept of Gradient (Linear Functions & Graphs)

☞ Watch the clip to find out what is the measure used to describe how steep or gentle a slope is

☞ In the video, a linear graph is always present in the question so that we can determine the rise and run to calculate the gradient. Can we still find the gradient if the information is only presented text without any visual (i.e. when the graph is not given)?

(I) Concept of Gradient

The gradient of a linear graph can be defined as the **ratio** of the vertical change (*y*) to the horizontal change (*x*).



$$Gradient = \frac{vertical\ change}{horizontal\ change} = \frac{rise}{run}$$

Reading from left to right,

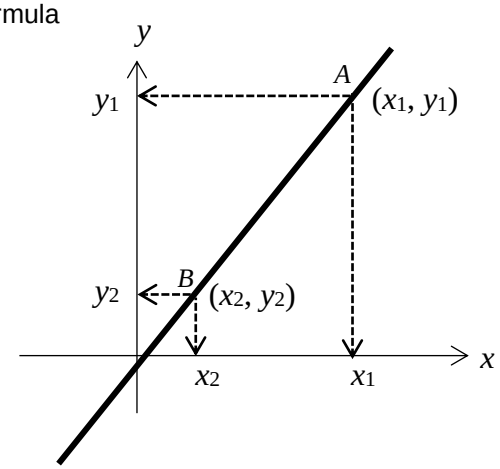
- When the line slopes **upwards**, the gradient is _____
- When the line slopes **downwards**, the gradient is _____

The gradient of the above line graph is _____.

For every _____ units increase in the value of *y*, there is a corresponding _____ units increase in the value of *x*.

Relating "rise over run" to the following 'formula':

When given the coordinates of 2 points, A (x_1, y_1) and B (x_2, y_2), we can calculate the gradient using the formula



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

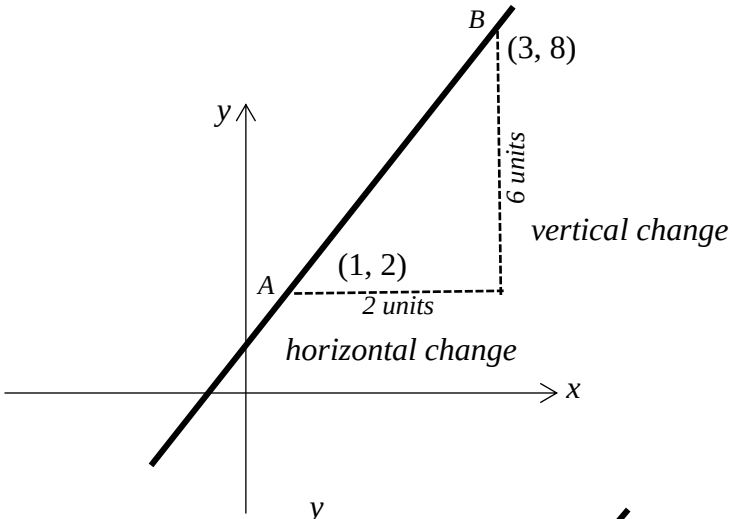
Let's compare the "2 methods":

Task: Find the gradient of the line, given that A(1, 2) and B(3, 8) are two points on the line.

Method 1:

Using $Gradient = \frac{vertical\ change}{horizontal\ change}$

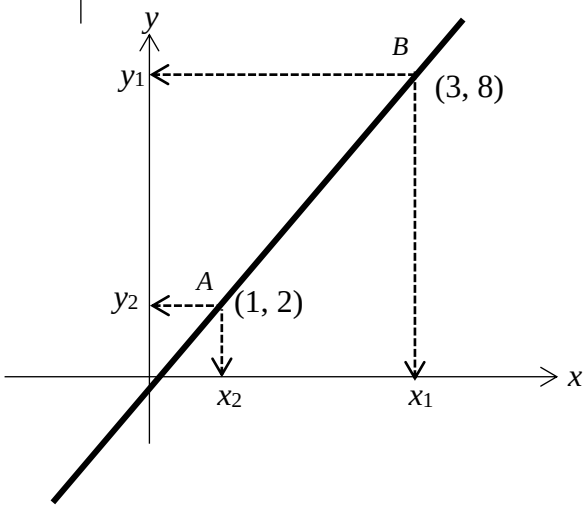
- $Gradient = \frac{6}{2}$
- $Gradient = 3$



Method 2:

Using $Gradient = \frac{y_1 - y_2}{x_1 - x_2}$

- $Gradient = \frac{2 - 8}{1 - 3}$
- $Gradient = \frac{-6}{-2}$
- $Gradient = 3$



Compare Method 1 & Method 2.

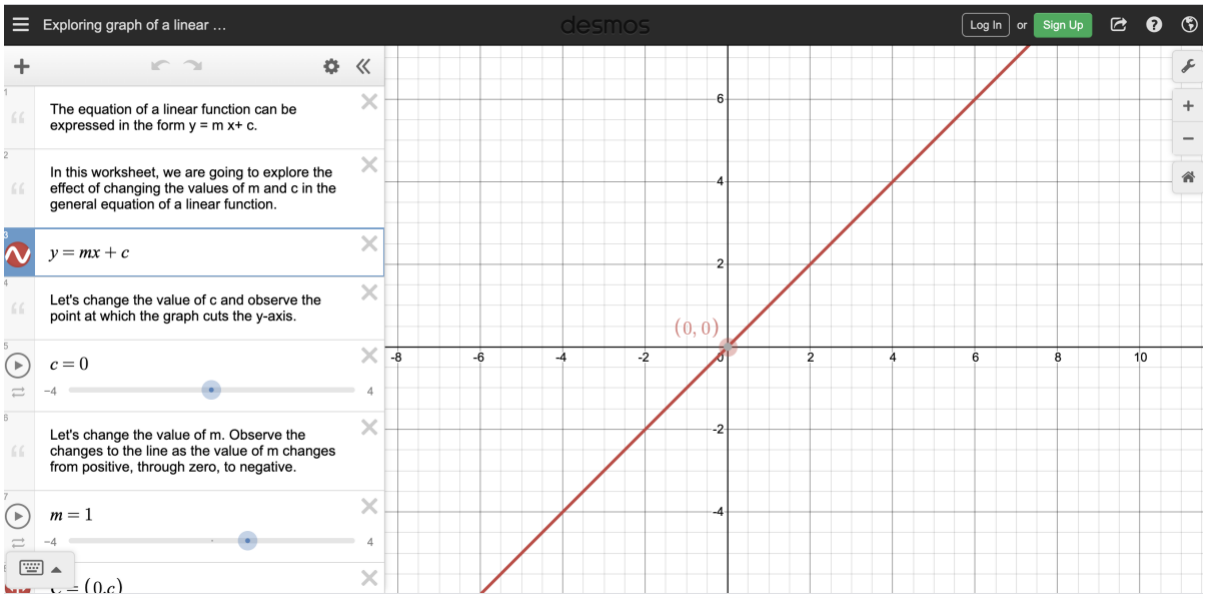
Which method is clearer and more efficient? Why?

(II) Significance of "c" and "m" in a linear equation (Investigative activity)

Adapted from (Textbook p153)

You are going to find out how the graph of a straight line in the form of y = m*x* + c changes when either *m* or *c* varies.

1. Go to the following website to access the online *Desmos* file
URL: https://www.desmos.com/calculator/9rwlqrptu2



2. Record your observations on the behaviour of the graph.

No.	Activity	Observation
1	Using the slider, change the value of c from –4 to 4 [Keep value of m = 1]	**(a)** What happens to the line? How has the line moved? **(b)** State the coordinates of the point where the line cuts the y-axis. When c = –4, point (……. , …….) When c = –2, point (……. , …….) When c = 0, point (……. , …….) When c = 2, point (……. , …….) When c = 4, point (……. , …….) **(c)** How do you describe these lines with **different values of c** but **same value for *m***? The lines are …… to each other.
2a	Set c = 1 Using the slider, change the value of *m* such that **1 ≤ *m* ≤ 4**.	Observe the behaviour of the line above the *x*-axis. What happens to the line when *m* **increases from 1 to 4**? The slope of the line becomes …… Direction of line from left to right:

No.	Activity	Observation
2b	Set c = 1 Using the slider, change the value of *m* such that **0 < *m* ≤ 1**.	Observe the behaviour of the line above the *x*-axis. What happens to the line when *m* **decreases from 1 to 0**? The slope of the line becomes …….
2c	Using the slider, change the value of *m* such that ***m* = 0**.	• The slope of the line becomes ……. • It is ……. to the ***x*-axis** OR it is ……. to the ***y*-axis**
2d	Set c = 1 Using the slider, change the value of *m* such that **–4 ≤ *m* < 0**.	What do you notice about the line as *m* **decreases from 0 to –4**? The slope of the line becomes ……. Direction of line from left to right:
2e	Based on your observations in 2a, 2b and 2c:	What is the difference between a line with a positive value for *m* and a line with a negative value for *m*?
4	Make a prediction: What will happen to the line when ***m* becomes very large**?	How will the line behave? • The slope of the line becomes ……. • It is ……. to the ***x*-axis** OR it is ……. to the ***y*-axis**

In summary…

The equation of a straight line is in the form of

$$y = \mathbf{m}x + \mathbf{c}$$

where the constant **m** is the ……. of the line

and the constant **c** is the ……..

The y-intercept refers to the …… of the point of ……. of the line with the y-axis.

Class work 1 (Tier A)

Source: Textbook 1A Exercise 6B Q4 Q5

1. State the **gradient** and **y-intercept** of each of the following

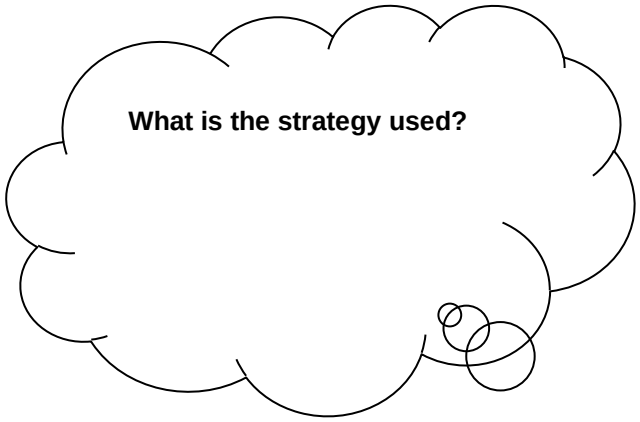
	Equation	**Gradient**	**y-intercept**
a	$y = 3x + 7$		
b	$y = -x - 1$		
c	$y = -6x + 6$		
d	$y = \frac{10}{3} - 4x$		
e	$y = 0.2x$		
f	$y = -11$		
G	$2y = 5x - 6$		

2. State the **equation** of each of the following lines, given its gradient and y-intercept.

	Gradient	**y-intercept**	**Equation**
a	2	4	
b	– 2	– 4	
c	1	$-\frac{1}{5}$	
d	– 1	3.78	
e	$-\frac{2}{3}$	0	
f	0	$-\frac{2}{3}$	

Class work 2 (Tier B)

Find the gradient of each of the following



(a) $2y + 3x = 7$

Ans: m = _____[2]

(b) $2x - 5y = 9$

Ans: m = _____[2]

(c) $4x + 6y + 1 = 0$

Ans: m = _____[2]

Class work 3 (Tier B)

In each of the following, find the gradient of each line that passes through the 2 given points.

(a) A (2, 1) and B (–5, –2)

Ans: m = _____[2]

(b) P (–3, 4) and Q (–7, –11)

Ans: m = _____[2]

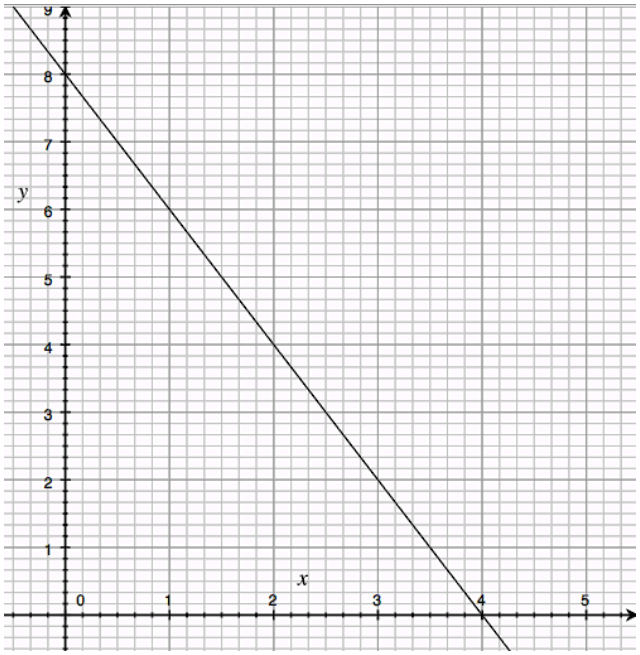
Class work 4 (Tier B)

Given that the equation of the line representing each of the following linear graphs is in the form of $y = mx + c$,

- find the gradient, m
- state the y-intercept, c
- hence, write down the equation of the graph.

What is the strategy used?

(a)

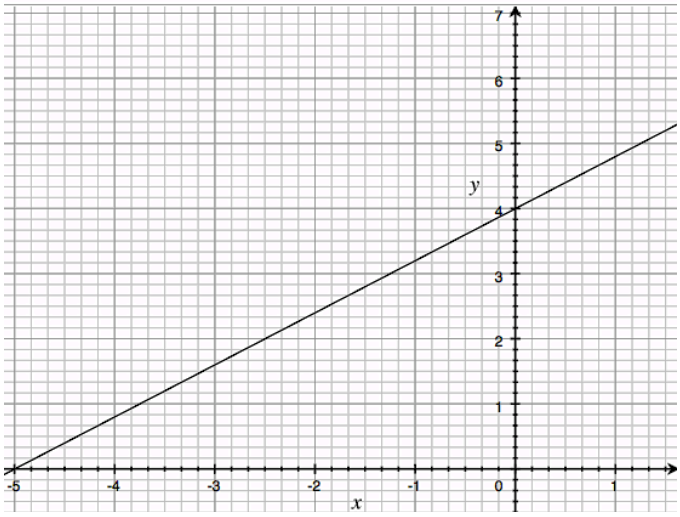


Ans: Gradient, m = _____[2]

y-intercept, c = _____[1]

Equation: _____[1]

(b)



Ans: Gradient, m = _____[2]

y-intercept, c = _____[1]

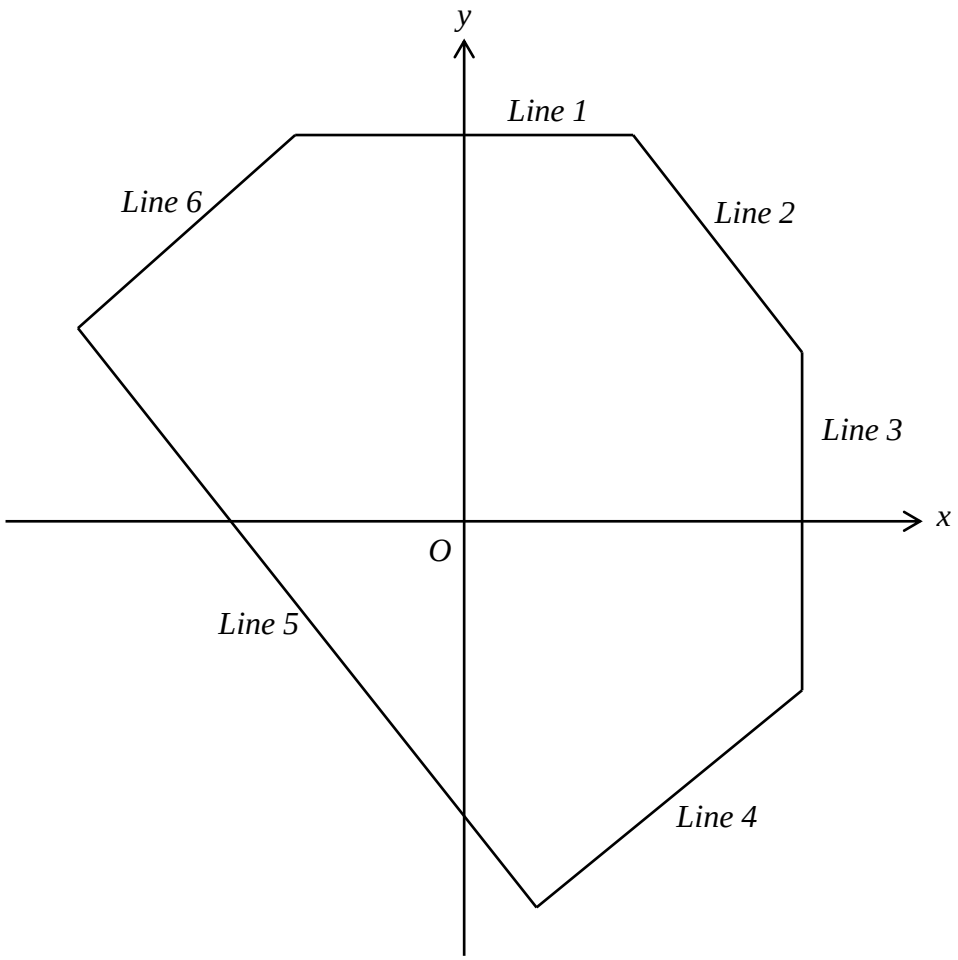
Equation: _____[1]

On Your Own: ***MORE PRACTICE in Textbook 1A*** Exercise 6B Q6

Challenge (Tier C)
Source: Textbook 1A Exercise 6B Q12

In the figure, Line 1 is parallel to the *x*-axis and Line 3 is parallel to the *y*-axis. Line 2 is parallel to Line 5 and Line 4 is parallel to Line 6.

If the gradients of Line 5 and Line 6 are -3 and ½ respectively, write down the gradients of Line 1, Line 2, Line 3 and Line 4.



Gradient of Line 1: _____

Line 2: _____

Line 3: _____

Line 4: _____

ASSIGNMENT 3 (Lesson 4)
Textbook 1A (p164) Exercise 6B Q11

Lesson 5 Sketching Linear Graphs

At the end of the lesson, you should be able to
- identify information necessary to sketch a graph
- sketch a straight line (linear) graph

(I) What's the difference between Plotting and Sketching?

What is the purpose of sketching?

When sketching a graph:

You do **not** require any graph paper. Sketching usually takes place on any plain space.
You will need a sharp pencil, ruler and eraser.

Step 1: Find out all the information that you need to sketch a graph

- Gradient: Is it positive or negative? (hence, slope upwards or downwards)
  Is it going to be steep or gentle?
- ***y***-intercept: This is where the line cuts the *y*-axis
  Is it available in the equation?
  If not, find the *y*-intercept with the given equation
  (by substituting $\boldsymbol{x = 0}$)
- ***x***-intercept: This is where the line cuts the *x*-axis
  Find the *x*-intercept by substituting $\boldsymbol{y = 0}$ into the equation

Step 2: In the space, draw the *x*- and *y*-axes.
Label the 2 axes and the origin, *O*.

Step 3: Mark out *x*- and *y*-intercepts on the *x*- and *y*-axes respectively.
We now have 2 points *x*-intercept $(x_1, 0)$
y-intercept $(0, y_1)$

Step 4: Join the 2 points $(x_1, 0)$ and $(0, y_1)$ with a straight line.

Step 5: Label the line with the given equation (if given)

When sketching the graph

DO NOT .....

DO mark the .....,

..... and .....

The difference between PLOTTING and SKETCHING

With reference p12 and p26, compare the plotting and sketching.
Complete the table below

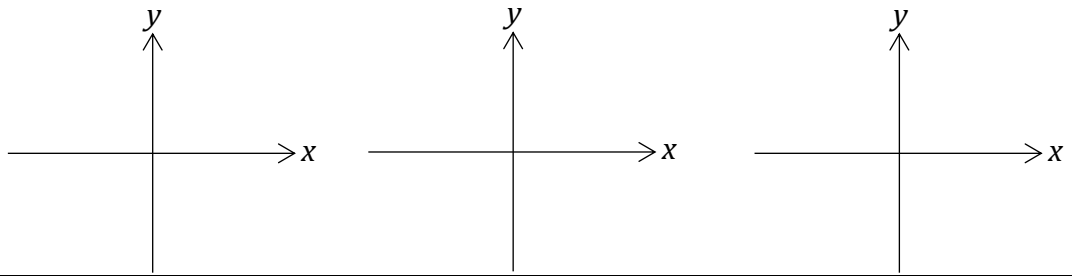
Plotting	Sketching
A **g**_____ **p**_____ is required.	A sketch can be done on foolscap paper or plain paper.
Every unit has to be marked on the axes.	Only the **i**_____ need to be marked
The scale used is **e**_____.	The scale used is an **e**_____.
A table of values is needed.	Only the **g**_____ and the **i**_____ are needed.
Questions that come along with plotting graphs will include reading off values from the graphs.	Graph sketching focuses on the sketch itself.

(II) Special Cases

What happens to the gradient in this case?

(a) Graph of $y = c$

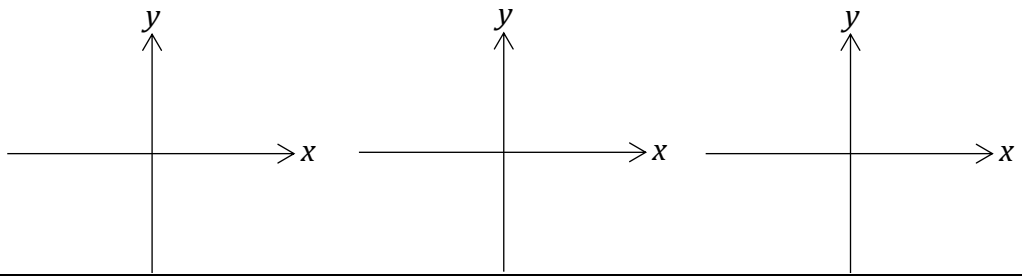
(i) $y = 4$ (ii) $y = -2$ (iii) $y = 0$



What happens to the gradient in this case?

(b) Graph of $x = a$

(i) $x = 2$ (ii) $x = -8$ (iii) $x = 0$



Class work 1 (Tier B)

Sketch the following

Find the necessary information required to sketch the graph	Sketch the graph in the space below
(a) $y = 2x + 3$	
(b) $y = -2x + 9$	
(c) $y = 0.5x - 2.5$	

Lesson 6 Determining Equation of a Linear Graph

At the end of the lesson, you should be able to

- determine the equation of a linear graph through application of concepts of gradient and intercepts

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Discussion 1 (Tier B)

Question 1 Determine the equation of the straight line with a gradient of 5 that intersects the *y*-axis at 8.
Question 2 Determine the equation of the straight line with a gradient of –2 and passes through the origin.
Question 3 Determine the equation of the straight line that is parallel to the line $y = 2x$ and has the *y*-intercept = 5.
Question 4 Determine the equation of the straight line that passes through the point (0, 10) and has the gradient of 0.

Discussion 2 (Tier C)

Question 1 The gradients of the lines AB and AC are 0 and undefined respectively. What can be deduced about AB and AC?
Question 2 Describe the various ways that we can use to find out if 3 given points lie on the same straight line? For example: Determine if the three points, N(–2, –1), P(0, 2) and Q(2, 5) lie on the same straight line.

Lesson 7 Application in Real World Situations

At the end of the lesson, you should be able to

- apply the concepts of gradient and intercepts to solve problems involving linear graphs in real world

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Linear graphs are used in many daily situations. For example, we can use a graph to 'convert' between different currencies, and to show the journey of a moving vehicle.

Class Work 1 (Tier B)

An electrician charges an initial fee of \$35 for attending a house call.

(a) If he charges \$15 for every hour spent on the job, find the amount of money the house owner needs to pay if he spent
(i) 1 hour (ii) 2 hours (iii) 3 hours (iv) 4 hours
on the job. [4]

Ans: (i) (ii) (iii) (iv)

(b) Given that \$$y$ represents the charges the house owner has to pay and x is the number of hours the electrician spent on the job, complete the following table. [1]

x	0	1	2	3	4
y	35				

Hence, write an equation (in terms of x and y) to illustrate the relationship between the charges the house owner has to pay and the number of hours the electrician spent on the job. [1]

(c) On a sheet of graph paper, using a scale of 2 cm to represent 1 hour on the horizontal axis and 1 cm to represent \$10 on the vertical axis, plot the pairs of value of (x, y). [3]

Note: Attach the graph paper to the back of this set of notes.

(d) **Use the graph to find**
(i) the amount of money he charge a house owner if he spent 2.5 hours on the job.

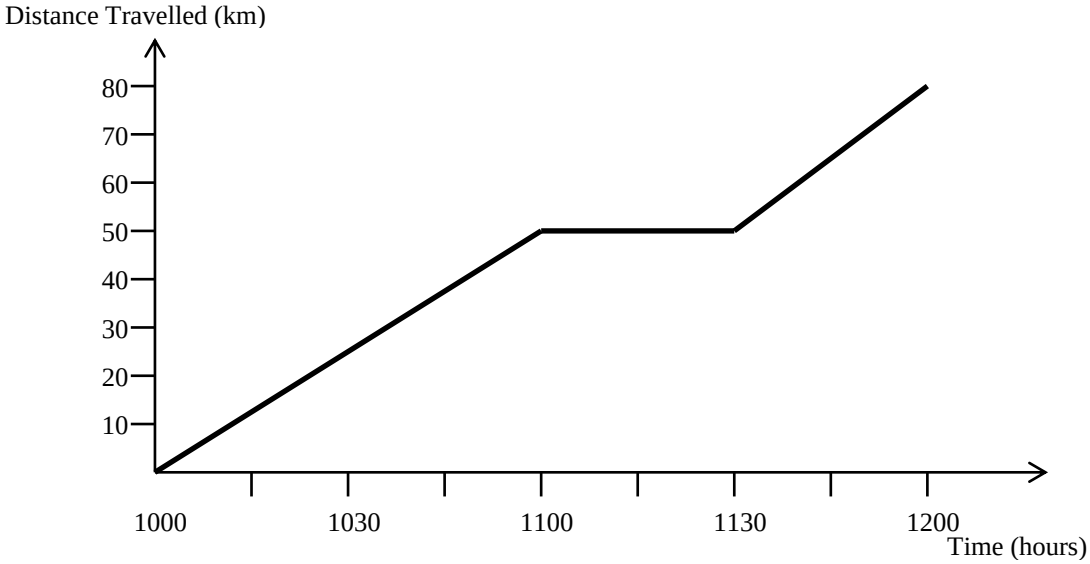
Ans: \$_____ [1]

(ii) the number of hours the electrician spent on the job if he charges \$90 on the job.

Ans: _____ hours [1]

Class Work 2 (Tier B)
Source: Textbook (p171) Exercise 6C Q4

The graph shows Khairul's journey when he visited a friend in Town C. During the journey, he stopped for breakfast at a cafeteria, after which he continued to drive to Town C.



(b) At what time did he leave home?

Ans: _____[1]

(c) How far did he travel before he reached the cafeteria?

Ans: _____[1]

(d) Find the gradient of each of the following line segments, state~~ly~~ clearly what each gradient represents:

(i) Gradient of OA [2]

(ii) Gradient of AB [2]

(iii) Gradient of BC [2]

Class Work 3 (Tier B)

A tank contains 12 500 litres of water. When the tap is fully turned on, water flows from the tank at the rate of 150 litres per minute.

(a) Write a linear equation in the form of $V = mt + c$ to represent the volume of water remaining in the tank after t minutes if the tap is fully turned on.

(b) Determine the volume of water remaining in the tank after 15 minutes.

(c) How long will it take for the volume of water remaining in the tank to reach 2 000 litres?

Class Work 4 (Tier C)

Two candles A and B have different heights and different diameters. Candle A is 30 cm long and it burns out in 3 hours. Candle B is 25 cm long and it burns out in 5 hours. The two candles start to burn at the same time $t = 0$. Let y cm be the remaining height of a candle after burning for t hours.

(a) Using a scale of 2 cm representing 1 hour on the t-axis and 2 cm representing 5 cm on the y-axis, draw the graph of y against t for each candle on the same diagram.

(b) Find the gradient of the graph for each candle. Interpret the physical meaning of the gradient.

(c) From the graph, find the time that both candles have the same remaining height.

ASSIGNMENT 4 (Lesson 7)

Textbook 1A (p170-p171) Exercise 6C Q3, Q5*

Lesson Sequence in unit (tick ✓ where applicable)

Sub-Topics	BIG IDEAS							
	Functions	Invariance	Notations	Diagrams	Measures	Equivalence	Proportionality	Model
	F	**I**	**N**	**D**	**M**	**E**	**P**	**M**
Cartesian Coordinate System								
Linear Functions								
Drawing Linear Graphs								
Concepts of Gradient and Vertical Intercepts								
Sketching Linear Graphs								
Determining Equation of a Linear Graph								
Application in Real World Situations								

Unit Checklist

Cognitive Level	**Know, Understand, Demonstrate**	**Checklist**
Level 0: Memorisation	1. Read, write and plot coordinates of a given point	
	2. Understand a function is a relationship between an independent variable (input) and a dependent variable (output)	
	3. Describe gradient of a straight line	
	4. State gradient and vertical intercepts in a linear function	
Level 1: Procedural tasks without connection	5. Describe a linear relationship using an equation with 2 variables	
	6. Plot a straight line (linear) graph	
	7. Describe the behaviour of a linear graph when the gradient changes	
Level 2: Procedural tasks with connections	8. Sketch a linear graph	
	9. Determine Equation of a linear graph	
Level 3: Problem Solving	10. Application in Real World Situations	