CHAPTER 9

Brainstorming 1

In groups

Aim: To determine the relationship between equation $y = mx + c$ with gradient and y-intercept.

Materials: Graph paper, linear function cards

Steps:

1. Get into four groups.
2. Each group is given a card written with two linear functions.

Group 1	*Group 2*	*Group 3*	*Group 4*
$y = 3x + 6$ $y = -2x - 4$	$y = 2x + 6$ $y = -4x + 8$	$y = 5x - 10$ $y = -3x + 9$	$y = 4x - 8$ $y = -2x + 2$

3. Complete the table of values below for each given function.

x	–3	–2	–1	0	1	2	3
y							

4. Based on the table of values draw the graphs of the functions.
5. From the graph of the function, calculate the gradient and state the y-intercept.
6. Compare the values of gradient and y-intercept from the graph with the values in the function card.

Discussion:

1. Compare your findings in step 6 with linear function $y = mx + c$. What is your conclusion?
2. Present your findings. Are your findings the same as the other groups' findings?

From Brainstorming 1, it is found that:

(a) For a linear function, $y = mx + c$, m is the gradient and c is the y-intercept of the straight line.

(b) The graph of linear function, $y = mx + c$ is a straight line.

In general,

Equation of straight line

$y = mx + c$

Gradient — y-intercept

Brainstorming 2

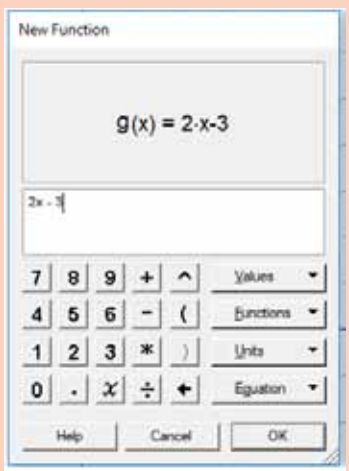
In pairs

Aim: To produce a graph of linear function.

Materials: Dynamic software

Steps:

1. Start with *New sketch.*
2. Select *graph* icon.
3. Select *plot new function* and enter the required equation of straight line (Diagram 1).



The first graph of straight line: $y = 2x - 3$

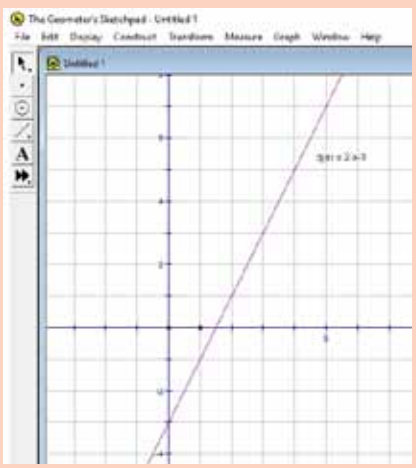


Diagram 1

4. Click *straightedge tool* and mark two points on the constructed graph of straight line.
5. Click *measure* and then click *slope* (Diagram 2).
   The gradient value will be displayed (Diagram 3).

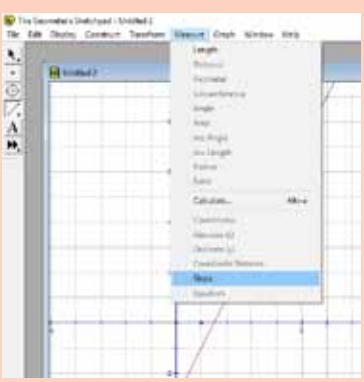


Diagram 2

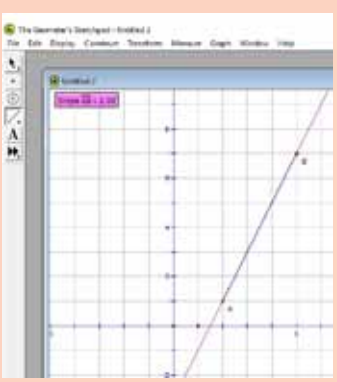


Diagram 3

6. Repeat steps 2 to 5 to draw and determine the gradient of the graph of straight line for function $y = -2x + 8$. (Diagram 4)

The second graph of straight line: $y = -2x + 8$

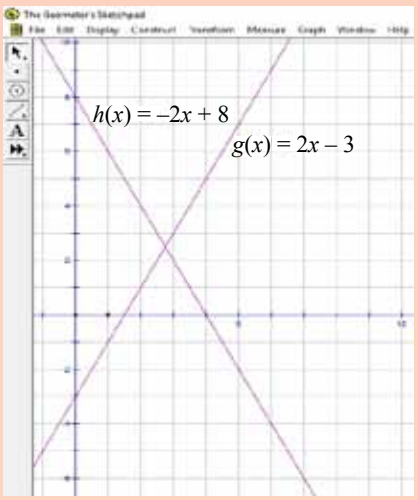
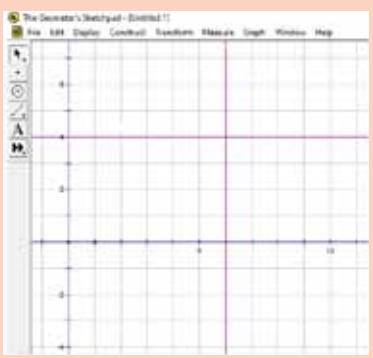


Diagram 4

7. Straight lines that are parallel to the *x*-axis and *y*-axis.

A displayed example of straight lines such as

(a) $y = 4$ (b) $x = 6$



$y = 4$

$x = 6$

Discussion:

1. Compare the forms of graph resulting from dynamic software with the forms of graph from Brainstorming 1.

2. Make a conclusion for the values of m and c of the equation of straight line in the form $y = mx + c$. Discuss the shape of the graph when

(a) m is positive. (b) m is negative.

(c) parallel to x-axis. (d) parallel to y-axis.

From Brainstorming 2, it is found that:

(a) The graph of linear function $y = mx + c$ is a straight line.
(b) The graph of function $y = h$ is a straight line parallel to x-axis.
(c) The graph of function $x = h$ is a straight line parallel to y-axis.

Brainstorming 3

In groups

Aim: To determine the relationship between the equations of straight lines in the form of $ax + by = c$, $\frac{x}{a} + \frac{y}{b} = 1$ and $y = mx + c$.

Materials: Graph paper, straight line equation cards

Steps:

1. Get into four groups.
2. Each group is given a card with three equations of a straight line written on it.

Group 1	*Group 2*	*Group 3*	*Group 4*
$2x + 3y = 6$	$4x - 2y = -8$	$-3x + 4y = -12$	$-x - 4y = 4$
$\frac{x}{3} + \frac{y}{2} = 1$	$\frac{x}{(-2)} + \frac{y}{4} = 1$	$\frac{x}{4} + \frac{y}{(-3)} = 1$	$\frac{x}{(-4)} + \frac{y}{(-1)} = 1$
$y = -\frac{2}{3}x + 2$	$y = 2x + 4$	$y = \frac{3}{4}x - 3$	$y = -\frac{1}{4}x - 1$

3. Determine the corresponding value of y when $x = 0$ and the corresponding value of x when $y = 0$ for each equation.

Example:

x	0	3
y	2	0

$2x + 3y = 6$

When $x = 0$:
$2(0) + 3y = 6$
$3y = 6$
$y = 2$

When $y = 0$:
$2x + 3(0) = 6$
$2x = 6$
$x = 3$

4. Draw a straight line graph for each equation.
5. From the graph, state the x-intercept and y-intercept and determine the gradient of the graph.

Discussion:

1. What is your conclusion about the relationship between the x-intercept with the y- intercept and the gradients of the three straight line graphs?
2. What is your conclusion about the relationship between the equations of straight line in different forms?

From Brainstorming 3, it is found that:

(a) The values of x-intercept and y-intercept and the gradient for these three straight lines are the same.

(b) Equations of straight line in the forms of $ax + by = c$, $\frac{x}{a} + \frac{y}{b} = 1$ and $y = mx + c$ produce the same straight line graph if the values of x-intercept and y-intercept are the same.

In general,

Straight line equation can also be written in the form of $\boldsymbol{ax + by = c}$ and $\boldsymbol{\frac{x}{a} + \frac{y}{b} = 1}$, $a \neq 0$ and $b \neq 0$

Brainstorming 4

In pairs

Aim: To determine the relationship between gradients of straight lines with parallel lines.

Steps:

1. Examine the straight lines below that were drawn based on the equation of a straight line with the same gradient of $m = 2$.

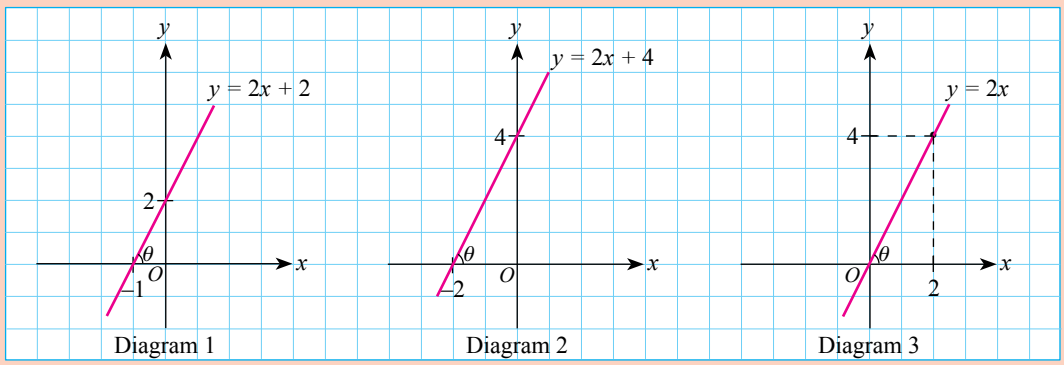


Diagram 1

Diagram 2

Diagram 3

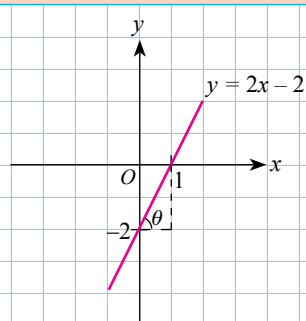


Diagram 4

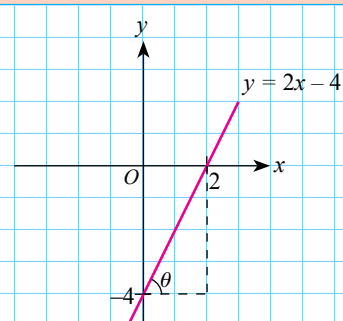
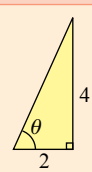
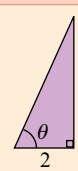
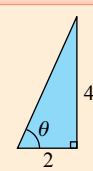


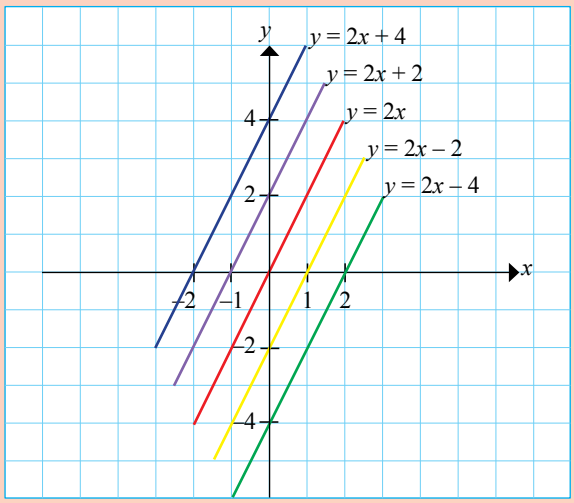
Diagram 5

2. Based on Diagram 1 to Diagram 5, calculate the value θ.

				
Diagram 1	Diagram 2	Diagram 3	Diagram 4	Diagram 5
$\tan\theta = \frac{2}{1}$ $\theta = 63.43°$				

3. Are the values of θ for the five diagrams the same?

4. The graphs in Diagram 1 to Diagram 5 are combined as below.



Discussion:

1. What is the connection between the values of θ with the five straight lines above?

2. Are the straight lines $y = 2x + 4$, $y = 2x + 2$, $y = 2x$, $y = 2x - 2$ and $y = 2x - 4$ parallel? Why?

3. What are the connections between the gradients and the parallel lines?

4. Are your findings the same as those of the other groups?

From Brainstorming 4, it is found that:

The straight lines $y = 2x + 4$, $y = 2x + 2$, $y = 2x$, $y = 2x - 2$ and $y = 2x - 4$ are parallel because they have the same gradient, that is $m = 2$ and the same corresponding angle, that is 63.43°.

In general, **Straight lines** that have the same gradients are parallel.

Brainstorming 5

In pairs

Aim: To determine the coordinates of the intersection of two straight lines.

Materials: Dynamic software

Steps:

1. Start with *New Sketch* and click *Graph* next click *Show Grid.*
2. Click *Graph* again and select *Plot New Function* (Diagram 1).
3. Use *Plot New Function* to plot the intersection of the two straight lines.
4. Example: $y = x + 3$ and $y = -x + 5$.
5. Use *Arrow Tool* to select both straight line graphs. Click *Construct* and select *Intersection*.
6. Click *Measure* and select *Coordinates*. The intersection point A (1.00, 4.00) will be displayed (Diagram 2).
7. Repeat steps 1 to 6 for intersection of the other two straight lines.
   (a) $y = x + 2$ and $y = 2x + 4$ (Diagram 3)
   (b) $y = 4$ and $y = 3x - 2$ (Diagram 4)

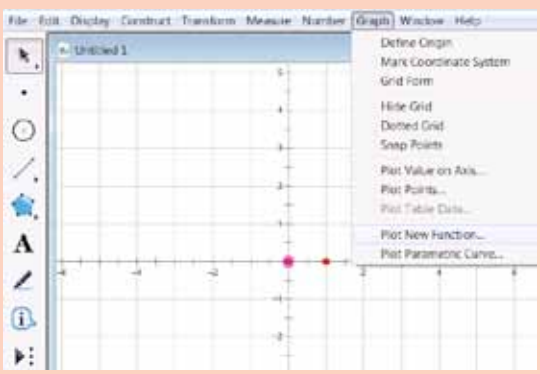


Diagram 1

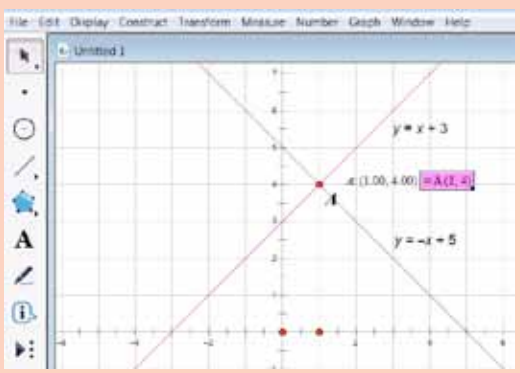


Diagram 2

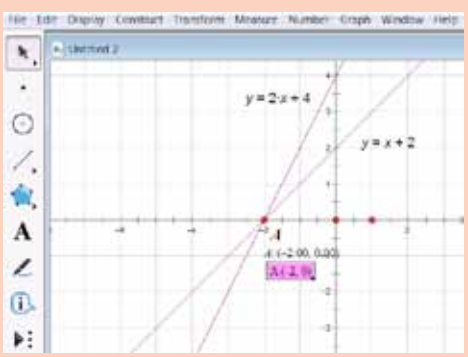


Diagram 3

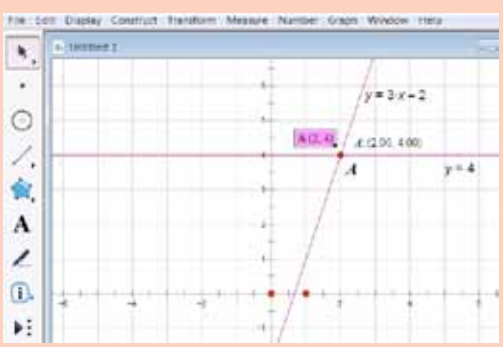


Diagram 4

Discussion:

What can you conclude from the results above?

From Brainstorming 5, it is found that:

(a) the point of intersection of two straight lines can be determined by plotting both straight lines on the Cartesian plane.

(b) two straight lines that are not parallel intersect at only one point.