# 3055 BA SANGAM COLLEGE

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**WORKSHEET 18**

**School: Ba Sangam College**                    **Year / Level: 12**
**Subject: Mathematics**                          **Name of Student: _____**

| Strand | 4 – Coordinate Geometry |
|---|---|
| Sub strand | 4.1 – Applications Of Coordinate Geometry |
| Content Learning Outcome | ➢ Explore and apply the concepts of coordinate geometry |

**Coordinate Geometry**                    **(Ref: Year 12 Mathematics Pg 133 – 138)**

## PARALLEL LINES

**Note**: Parallel lines have the same slope/gradient. If $m_1$ is gradient of the first line and $m_2$ is the slope of the second line, then it is parallel lines if $\boxed{m_1 = m_2}$

**EXAMPLE 1:** Find the equation of the line parallel to $3x + 2y - 7 = 0$ and passing through the point (2, 4).

**Answers:**
Key words / sentences
- line parallel to $3x + 2y - 7 = 0$:

Make y the subject to find $m$

$$3x + 2y - 7 = 0$$

$$y = \frac{-3x+7}{2} = \frac{-3x}{2} + \frac{7}{2}$$

$$m_1 = \frac{-3}{2}$$

Note that **parallel** means **same gradient**.

Thus $m = \frac{-3}{2}$

- given a point $(2, 4) \Rightarrow (x_1, y_1)$ and $m = \frac{-3}{2}$,

  Equation of the line is: $y - y_1 = m(x - x_1)$ Substitute the values provided,

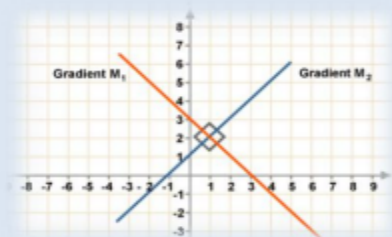  $y - 4 = \frac{-3}{2}(x - 2)$

- Make $y$ the subject

  $y - 4 = \frac{-3x}{2} + 3$

  $+4 \qquad +4$

  $\therefore y = \frac{-3x}{2} + 7$
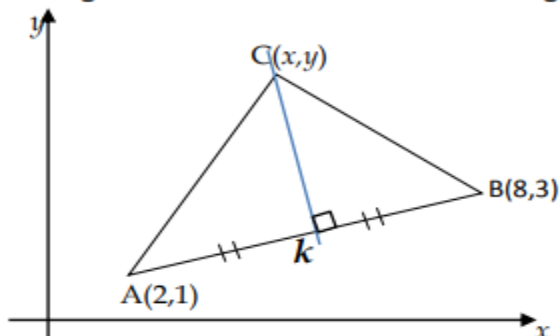
## PERPENDICULAR LINES

**Note:** Recall *Perpendicular* simply means **'at right angle'**. A *line* is *perpendicular* to another if they meet at **90 degrees**.
Graphically,



Moreover, two lines are perpendicular if the **product** of **gradient** is **negative one** that is $\boxed{m_1 m_2 = -1}$

**EXAMPLE 2:** The figure ABC below is an isosceles triangle.



a) Find the gradient of line segment AB.
b) Line $k$ is a perpendicular bisector of the line segment AB. Determine the coordinates of the midpoint of the line segment AB.
c) Write the equation of Line $k$.

**Answers:**

a) Gradient formula : $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$A(2,1) \rightarrow (x_1, y_1)$

and $B(8,3) \rightarrow (x_2, y_2)$

Substitute the values provided

$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{3-1}{8-2} = \dfrac{2}{6} = \dfrac{1}{3}$

$\therefore m = \dfrac{1}{3}$

b) Coordinates of the midpoint

$M(x_m, y_m) = \left( \dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2} \right)$

$M(x_m, y_m) = \left( \dfrac{2+8}{2}, \dfrac{3+1}{2} \right) = \left( \dfrac{10}{2}, \dfrac{4}{2} \right)$

$\therefore (x_m, y_m) = (5,2)$

c) Midpoint will be the first point $(x_1, y_1) \rightarrow (5,2)$

- Since perpendicular:

$m_1 m_2 = -1$

$m_2 = \dfrac{-1}{m_1} = -1 \div \dfrac{1}{3} = -3$

- The equation of a line:

$y - y_1 = m(x - x_1)$

$y - 2 = -3(x - 5)$

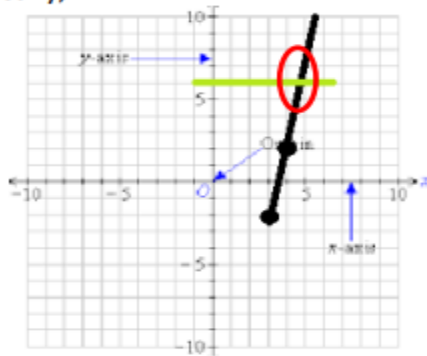$y = -3x + 15 + 2$

$\therefore y = -3x + 17$

# COLLINEAR POINTS

**Note**: Collinear points are points that lie on the same line.



Noncollinear points          Collinear points

The **gradient** between each pair of points will be the **same**. Consider the points Q, R, S and T. Since they are collinear, their **gradients** will be **same**.

**EXAMPLE 3:** If points P (3,-2), Q (4,2) and R (x,6) are collinear, then find the value of $x$.

Graphically,



- Find gradient of $\overline{PQ}$

$$P(3,-2) \rightarrow (x_1, y_1) \;\&\; Q(4,2) \rightarrow (x_2, y_2)$$

Use gradient formula:

$$m(\overline{PQ}) = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{2--2}{4-3}$$

$$\therefore m(\overline{PQ}) = \frac{4}{1} = 4$$

- **Collinear points** will lie on the same line, means **same gradient**.

  $\therefore m(\overline{PQ}) = m(\overline{QR}) = m(\overline{PR}) = 4$

- Consider points QR:

  $Q(4,2) \rightarrow (x_1, y_1)$

  and $R(x,6) \rightarrow (x_2, y_2)$          Substitute the given values

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

  $$4 = \frac{6-2}{x-4}$$

- Solve for $x$:   you may use distributive law

  $4(x - 4) = 4$

  $4x - 16 = 4$

  $4x = 20$

  $x = 5$

  Thus $x = 5$

## ACTIVITY

**1.**

The following equations represent four straight lines.

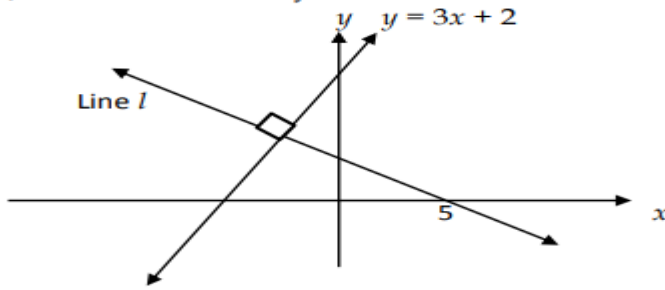| (i)   | $3y + 4x = 2$ | (ii)  | $4y = 3x + 2$ |
|-------|---------------|-------|---------------|
| (iii) | $3y + 4x = 2$ | (iv)  | $2 = -4x - 3y$ |

a) Find gradient of each line.
b) Which two lines are parallel? i.e. have same gradient
c) Which two lines are perpendicular?

**2.**

Line *l* is perpendicular to the line $y = 3x + 2$ and meets the $x$ axis at $x = 5$.



a) Calculate gradient of each line *l*.
b) Find the equation of line *l*.

**3.**

Test whether $(1, 2)$, $(2, 4)$ and $(3, 6)$ are collinear.

|  | (3 MARKS) |
| --- | --- |

**THE END**