IB Math Studies 2 --- BELL WORK

Use midpoints to find the fourth vertex of the given parallelogram:

M of AC = (-1.5, 1)

$\frac{1+x}{2} = -1.5$

$1+x = -3$

$x = -4$

$\frac{3+y}{2} = 1$

$3+y = 2$

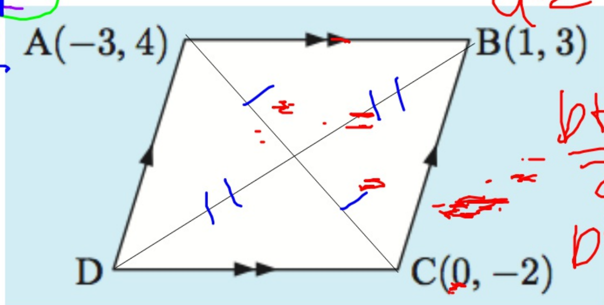
$y = -1$

$(-4, -1)$

$\frac{a+1}{2} = \frac{-3+0}{2}$

$a+1 = -3$

$a = -4$




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

$b+3 = 2$

$b = -1$

$(-4, -1)$

# Chapter 13

## Coordinate geometry

- **C** Gradient
- **D** Parallel and perpendicular lines
- **E** Applications of gradient
- **F** Vertical and horizontal lines

## C GRADIENT

The **gradient** of a line is a measure of its steepness.

The **gradient** of a line $= \dfrac{\text{vertical step}}{\text{horizontal step}}$ or $\dfrac{y\textbf{-step}}{x\textbf{-step}}$.

$\dfrac{\text{rise}}{\text{run}}$

- the gradient of **horizontal** lines is **0**
- the gradient of **vertical** lines is **undefined**.

The **gradient** $m$ of the line passing through $(x_1, y_1)$ and $(x_2, y_2)$ is $\boxed{\boldsymbol{m = \dfrac{y_2 - y_1}{x_2 - x_1}}}$.

Find $a$ given that the line joining:

A$(a, 8)$ to B$(-3, -4)$ has gradient $\frac{2}{3}$.

$$\frac{-4-8}{-3-a} = \frac{2}{3}$$

$$\frac{-12}{-3-a} = \frac{2}{3}$$

$$\frac{-36}{2} = \frac{2(-3-a)}{2}$$

$$-18 = -3 - a$$

$$-15 = -a$$

$$a = 15$$

# D PARALLEL AND PERPENDICULAR LINES

## PARALLEL LINES

For lines $l_1$ and $l_2$ with gradients $m_1$ and $m_2$ respectively,
$l_1$ is parallel to $l_2 \Leftrightarrow m_1 = m_2$.

$\Leftrightarrow$ means if and only if

## PERPENDICULAR LINES

For non-vertical and non-horizontal lines $l_1$ and $l_2$ with gradients $m_1$ and $m_2$ respectively,
$l_1$ is perpendicular to $l_2 \Leftrightarrow m_1 \times m_2 = -1$.

Consider the points A(1, 2), B(−3, 0), C(5, 3), and D(3, $k$). Find $k$ if:

**a** AB is parallel to CD

$$\frac{0-2}{-3-1} = \frac{-2}{-4} = \frac{1}{2}$$

$$\frac{K-3}{3-5} = \frac{1}{2}$$

$$\frac{-2}{2} = \frac{2(K-3)}{2}$$

$$-1 = K-3$$

$$K=2$$

**c** AB is perpendicular to CD

$$\frac{K-3}{3-5} = -2$$

$$K-3=4$$

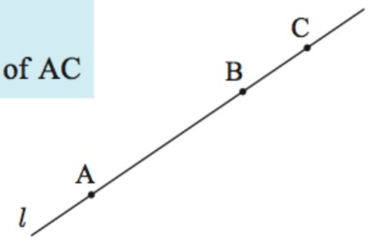
$$K=7$$

## COLLINEAR POINTS

Three or more points are **collinear** if they lie on the same straight line.

Three points A, B, and C are **collinear** if:

gradient of AB = gradient of BC = gradient of AC



Determine whether the following sets of three points are collinear:

A(−1, 7), B(1, 1), C(4, −8)

AB $\frac{1-7}{1+1} = \frac{-6}{2} = -3$

BC $\frac{-8-1}{4-1} = \frac{-9}{3} = -3$

AC $\frac{-8-7}{4+1} = \frac{-15}{5} = -3$

## E APPLICATIONS OF GRADIENT

We see gradients every day in the real world when we consider the slope of a hill or ramp.

Gradients are also important when we consider how quantities are related. If we draw the graph relating two quantities, the gradient of the line describes the **rate** at which one quantity changes relative to the other.

One of the most common examples of a rate is **speed**, which is the rate at which something is travelling.