

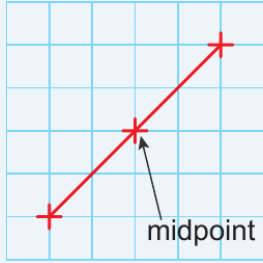
# Unit 9—Graphs

## Key point 1

On the line with equation  $y = 1$  the  $y$ -coordinate is always 1. The line is **parallel** to the  $x$ -axis. On the line with equation  $x = 3$  the  $x$ -coordinate is always 3. The line is parallel to the  $y$ -axis.

## Key point 2

The **midpoint** of a line segment is the point exactly in the middle.



## Example 1

Find the midpoint of a line segment with start point (3, 2) and end point (7, 9).

$$\frac{(3 + 7)}{2} = 5$$

Add the  $x$ -coordinates and divide by 2.

$$\frac{(2 + 9)}{2} = 5.5$$

Add the  $y$ -coordinates and divide by 2.

$$\text{Midpoint} = (5, 5.5)$$

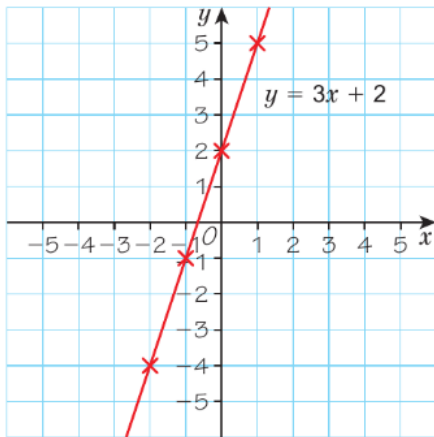
## Example 2

a Complete this table of values for the equation  $y = 3x + 2$

$x$	-2	-1	0	1
$y = 3x + 2$	-4	-1	2	5

When  $x = -2$ ,  $y = 3 \times -2 + 2 = -4$   
When  $x = -1$ ,  $y = 3 \times -1 + 2 = -1$   
and so on...

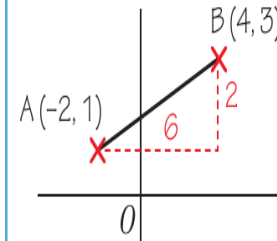
b Draw the graph of  $y = 3x + 2$



Plot the coordinate pairs from the table with crosses  $(-2, -4)$ ,  $(-1, -1)$ ,  $(0, 2)$ ,  $(1, 5)$ . Join them with a straight line and extend it to the edge of the grid.

## Example 3

Find the gradient of the line joining the points A  $(-2, 1)$  and B  $(4, 3)$ .



Sketch a diagram. Draw in lines across and up. Work out the distances across and up.

$$\text{Gradient} = \frac{\text{total distance up}}{\text{total distance across}} = \frac{2}{6} = \frac{1}{3}$$

## Key point 3

The steepness of a graph is called the **gradient**.

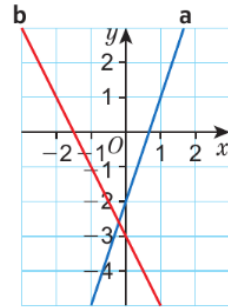
To find the gradient work out how many units the graph goes up for each unit it goes across.

## Key point 5

A **linear equation** produces a straight line graph. The equation of a straight line is  $y = mx + c$ , where  $m$  is the gradient and  $c$  is the  $y$ -intercept.

### Example 4

Write the equation of each line.



a  $y = mx + c$

$m = 3$

Work out the gradient,  $m$ .

$c = -2$

The line crosses the  $y$ -axis at  $-2$ .

Equation of line is  $y = 3x - 2$

Substitute  $m = 3$  and  $c = -2$  into  $y = mx + c$

b  $y = mx + c$

$m = -2$

This line slopes down so its gradient is negative.

$c = -3$

Equation of line is  $y = -2x - 3$

## Key point 8

A **rate of change graph** shows how a quantity changes over time. On a **velocity–time graph** the gradient represents the acceleration.

### communication hint

**Velocity** means speed in a particular direction.

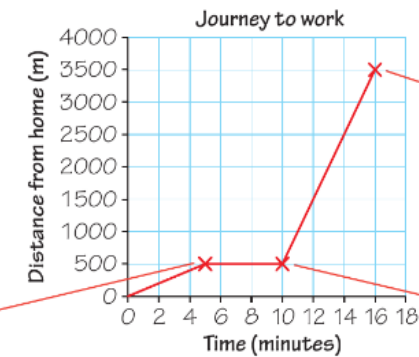
### Example 5

Jenny walks 500 metres in 5 minutes, then arrives at the bus stop. She waits 5 minutes for the bus. She travels 3000 metres on the bus and gets off 16 minutes after she left home.

a Draw a distance–time graph for her journey.

b Work out the average speed in km/h of Jenny's walk.

a



After 5 minutes she has travelled 500 m. Plot the point (5, 500).

After 16 minutes she has travelled 500 + 3000 m. Plot the point (16, 3500) and join your points with straight lines.

After 10 minutes she has still only travelled 500 m. Plot the point (10, 500).

b Jenny walks 500 m in 5 minutes.

$$\begin{array}{l} \times 12 \quad \begin{array}{l} 5 \text{ min} \quad 500 \text{ m} \\ \hline 60 \text{ min} \quad 6000 \text{ m} \end{array} \quad \times 12 \end{array}$$

$$6000 \text{ m} = 6 \text{ km}$$

Average walking speed = 6 km/h

## Key point 6

A **distance–time graph** represents a journey. The vertical axis represents the distance from the starting point. The horizontal axis represents the time taken.

$$\text{Average speed} = \frac{\text{distance travelled}}{\text{time taken}}$$