

Gradients and $y = mx + c$

Solutions

For AQA GCSE Mathematics (8300) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (3 marks)

- (a) Write down the gradient of the line $y = 4x - 7$

A straight line $y = mx + c$ has gradient m .

Here m is the number in front of x , which is 4.

Answer: 4

- (b) Write down the coordinates of the y -intercept of the line $y = 5x + 9$

The y -intercept is where the line crosses the y -axis, so $x = 0$.

When $x = 0$: $y = 5 \times 0 + 9 = 9$

So the y -intercept is $(0, 9)$.

Answer: $(0, 9)$

Tip: The y -intercept is on the y -axis, so its x -coordinate is 0. Answers like $(5, 9)$ or $(9, 0)$ are wrong.

- (c) Work out the gradient of the line $3y = 12x$

First rearrange into the form $y = mx + c$.

Divide both sides by 3: $y = 4x$

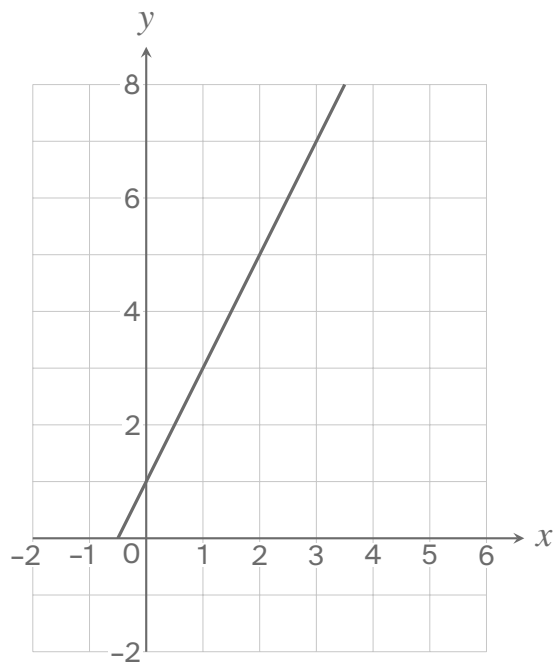
So the gradient is 4.

Answer: 4

Tip: Always get y on its own first. The gradient is not 12.

2 (1 mark)

Here is a straight line.



Circle the gradient of the line.

Options: -2 , $\frac{1}{2}$, 2 , 3

Pick two points on the line where it crosses grid lines, e.g. $(0, 1)$ and $(2, 5)$.

From $(0, 1)$ to $(2, 5)$ the line goes up 4 and across 2.

$$\text{Gradient} = \frac{\text{up}}{\text{across}} = \frac{4}{2} = 2$$

Answer: 2

3 (2 marks)

Work out the gradient of the straight line through $(-3, 2)$ and $(1, 14)$

$$\text{Gradient} = \frac{\text{change in } y}{\text{change in } x}$$

$$\text{Change in } y: 14 - 2 = 12$$

$$\text{Change in } x: 1 - (-3) = 4$$

$$\text{Gradient} = \frac{12}{4} = 3$$

Answer: 3

Tip: Put the change in y on **top**. Working out $\frac{4}{12}$ (change in x over change in y) is a common mistake.

Marks: 1 mark for $\frac{12}{4}$. 1 mark for 3.

4 (2 marks)

The graph of a straight line crosses the y -axis at $(0, -3)$.

The gradient of the line is 5

Write down the equation of the line.

Give your answer in the form $y = mx + c$

In $y = mx + c$, m is the gradient, so $m = 5$.

The line crosses the y -axis at $(0, -3)$, so the y -intercept is -3 and $c = -3$.

The equation is $y = 5x - 3$.

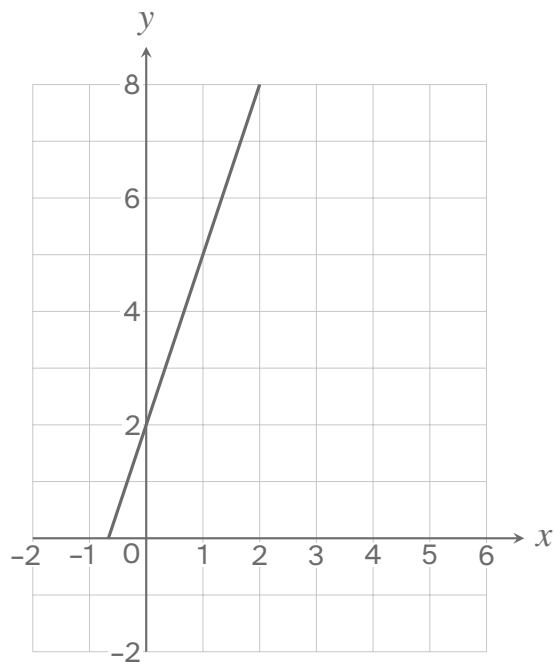
Answer: $y = 5x - 3$

Tip: Keep the sign: the line crosses the y -axis below the origin, so c is -3 , not 3.

Marks: 2 marks for $y = 5x - 3$. 1 mark for $y = 5x + k$ or $y = mx - 3$.

5 (3 marks)

Here is a straight line.



Work out the equation of the line.

Give your answer in the form $y = mx + c$

The line crosses the y -axis at $(0, 2)$, so $c = 2$.

Find the gradient using two points on the line, e.g. $(0, 2)$ and $(2, 8)$.

From $(0, 2)$ to $(2, 8)$ the line goes up 6 and across 2.

Gradient = $\frac{6}{2} = 3$, so $m = 3$.

The equation is $y = 3x + 2$.

Answer: $y = 3x + 2$

Marks: 1 mark for $c = 2$. 1 mark for a correct method for the gradient. 1 mark for $y = 3x + 2$.

6 (1 mark)

Circle the equation of a line parallel to $y = 4x - 3$

Options: $y = x + 4$, $y = 4x + 7$, $y = -4x - 3$, $y = \frac{1}{4}x - 3$

Parallel lines have the same gradient.

$y = 4x - 3$ has gradient 4.

The only other line with gradient 4 is $y = 4x + 7$.

Answer: $y = 4x + 7$

7 (2 marks)

Write down the equation of a line parallel to $y = 5 - 2x$ that passes through $(0, 4)$.

$y = 5 - 2x$ is the same as $y = -2x + 5$, so its gradient is -2 .

A parallel line also has gradient -2 , so $m = -2$.

$(0, 4)$ is on the y -axis, so $c = 4$.

The equation is $y = -2x + 4$.

Answer: $y = 4 - 2x$ (or $y = -2x + 4$)

Marks: 2 marks for the correct equation. 1 mark for a line with gradient -2 .

8 (2 marks)

Tick **one** box for each statement.

	True	False
$y = 2x + 3$ has gradient 3		✓
$y = 7 - x$ has gradient -1	✓	
$y = 4x$ passes through $(0, 0)$	✓	
$y = 5$ has gradient 5		✓

$y = 2x + 3$ has gradient 2 (the 3 is the y-intercept). False

$y = 7 - x$ is $y = -1x + 7$, so the gradient is -1 . True

$y = 4x$: when $x = 0$, $y = 0$. True

$y = 5$ is a horizontal line, so its gradient is 0. False

Marks: 2 marks for all four correct. 1 mark for two or three correct.

9 (2 marks)

Does the point $(3, 10)$ lie on the line $y = 4x - 2$?

Tick a box.

Show working to support your answer.

Substitute $x = 3$ into $y = 4x - 2$.

$$y = 4 \times 3 - 2 = 12 - 2 = 10$$

This is the y-coordinate of the point, so it lies on the line.

Answer: Yes

Marks: 1 mark for substituting $x = 3$. 1 mark for Yes with 10 shown.

10 (3 marks)

Line L passes through the points (2, 5) and (4, 11).

Work out the equation of line L .

Give your answer in the form $y = mx + c$

First find the gradient.

$$\text{Gradient} = \frac{\text{change in } y}{\text{change in } x} = \frac{11 - 5}{4 - 2} = \frac{6}{2} = 3$$

So the line is $y = 3x + c$.

Substitute the point (2, 5): $5 = 3 \times 2 + c$

$$5 = 6 + c, \text{ so } c = -1$$

The equation is $y = 3x - 1$.

Check with (4, 11): $3 \times 4 - 1 = 11$ ✓

Answer: $y = 3x - 1$

Marks: 1 mark for a gradient of 3. 1 mark for substituting a point to find c . 1 mark for $y = 3x - 1$.

11 (2 marks)

Line L has gradient -3

C and D are points on line L .

The y -coordinate of C is 8

The x -coordinate of D is 5 more than the x -coordinate of C .

Work out the y -coordinate of D .

$$\text{Gradient} = \frac{\text{change in } y}{\text{change in } x}$$

So change in $y = \text{gradient} \times \text{change in } x$

From C to D , the change in x is $+5$.

$$\text{Change in } y = -3 \times 5 = -15$$

y-coordinate of $D = 8 - 15 = -7$

Answer: -7

Tip: A negative gradient means the line goes down as x increases. Moving 5 to the right on this line takes you 15 **down**, so subtract 15. $8 + 15 = 23$ is a common wrong answer.

Marks: 1 mark for -3×5 or -15 (or 15 less). 1 mark for -7 .

12 (2 marks)

(a) Here are the equations of four straight lines.

A $y = 3x + 2$ **B** $y = 2x + 3$

C $y + 3x = 2$ **D** $y - 3x = 7$

Which **two** lines are parallel?

Parallel lines have the same gradient. Write each line as $y = mx + c$.

A: $y = 3x + 2$, gradient 3

B: $y = 2x + 3$, gradient 2

C: $y = -3x + 2$, gradient -3

D: $y = 3x + 7$, gradient 3

So **A** and **D** are parallel.

Answer: **A** and **D**

Tip: Rearrange before reading the gradient. $y + 3x = 2$ becomes $y = -3x + 2$, so its gradient is -3 , not 3.

(b) The line $y = 2x + c$ passes through the point $(5, 4)$.

Work out the value of c .

Substitute $x = 5$ and $y = 4$ into $y = 2x + c$.

$$4 = 2 \times 5 + c$$

$$4 = 10 + c$$

$$c = -6$$

Answer: $c = -6$

13 (3 marks)

Line A has equation $y = -2x + 9$

Line B is parallel to line A .

Line B goes through the point $(3, 1)$.

Work out the equation of line B .

Give your answer in the form $y = mx + c$

Parallel lines have the same gradient.

Line A has gradient -2 , so line B also has gradient -2 .

So line B is $y = -2x + c$.

Substitute the point $(3, 1)$: $1 = -2 \times 3 + c$

$$1 = -6 + c$$

$$c = 7$$

The equation of line B is $y = -2x + 7$.

Check: $-2 \times 3 + 7 = 1$ ✓

Answer: $y = -2x + 7$

Tip: Line B does not go through $(0, 9)$. Keep the gradient -2 from line A , but find a new value of c using the point $(3, 1)$.

Marks: 1 mark for a gradient of -2 . 1 mark for substituting $(3, 1)$ to find c . 1 mark for $y = -2x + 7$.
