GCSE Maths – Algebra

Straight Line Graphs

Worksheet

NOTES

SOLUTIONS

This worksheet will show you how to work out different types of questions involving straight line graphs. Each section contains a worked example, a question with hints and then questions for you to work through on your own.

Section A

Worked Example

Plot point $(3, -2)$ on a graph.

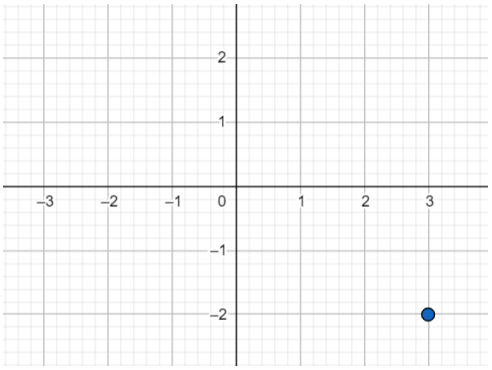
Step 1: Work out the x and y values of the point

The x value is 3.
The y value is -2.

Step 2: Locate where these points will be placed

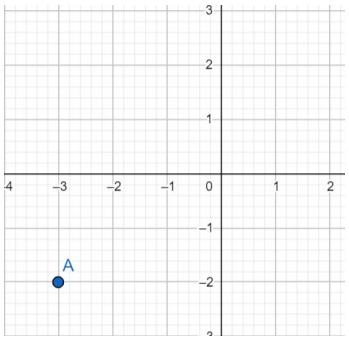
From the x-coordinate we know the point will be 3 units right from the origin and from the y-coordinate we know the point will be 2 units down from the origin.

Step 3: Plot the point on a graph.



Guided Example

State the coordinates of Point A given in the graph below.

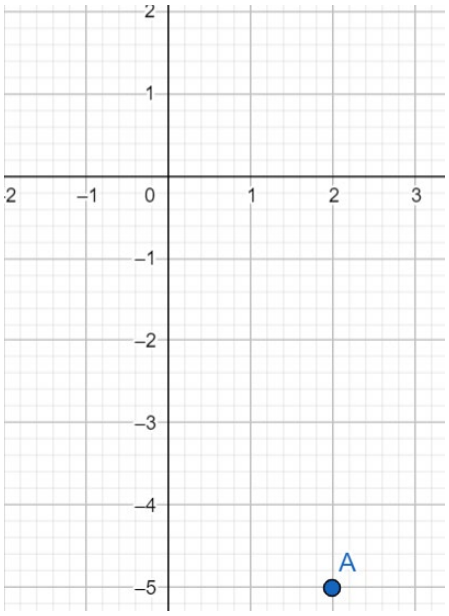


Step 1: Locate the values of x and y of the point A.

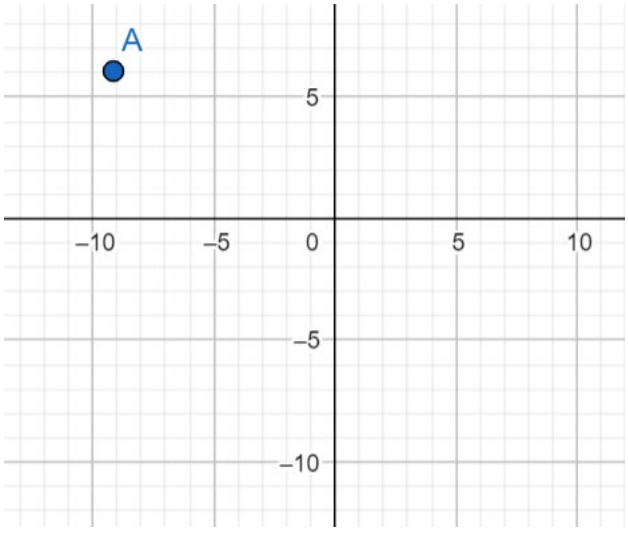
Step 2: Write the point A in coordinate form.

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

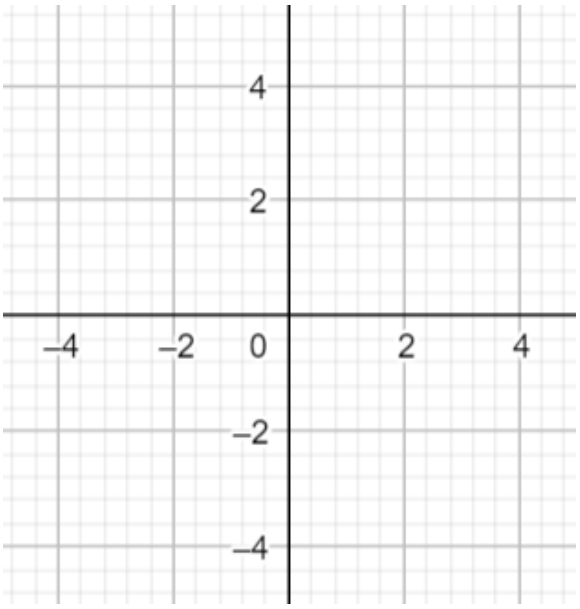
1. State the coordinates of Point A given in the graph below.



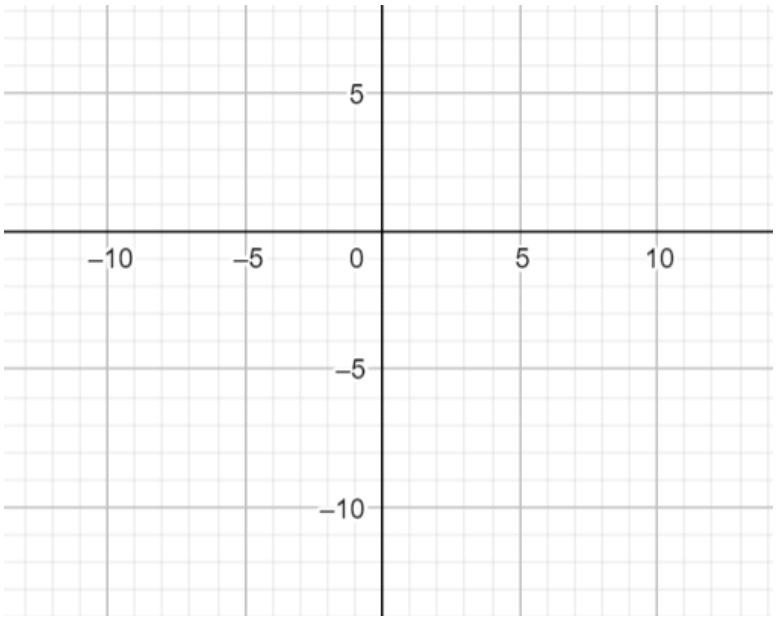
2. State the coordinates of Point A given in the graph below.



3. Plot point $(-4, 3)$ in the graph below.



4. Plot point $(-10, -11)$ in the graph below.



Section B

Worked Example

Draw the graph $y = -2x + 1$ between $-5 \leq x \leq -1$.

Step 1: Create a table with x values between -5 and -1.

x	-5	-4	-3	-2	-1
y					

Step 2: Calculate the y values by substituting in the x values to the given equation.

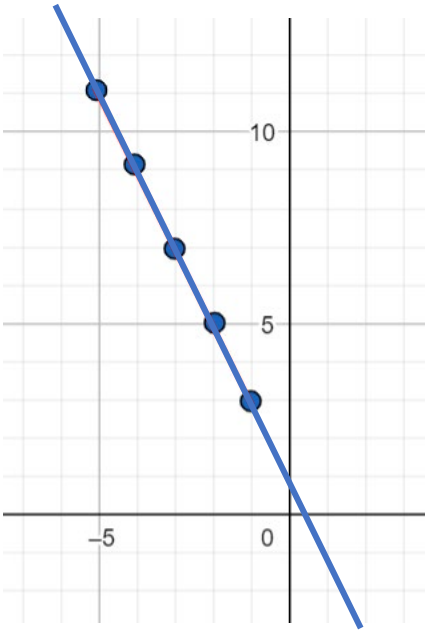
x	-5	-4	-3	-2	-1
y	11	9	7	5	3

For example, for $x = -5$:

$$y = -2x + 1$$
$$y = -2(-5) + 1$$
$$y = 10 + 1$$
$$y = 11$$

Step 3: Form coordinate points out of the table of values. Plot these points on the graphs and join this up with a ruler.

From the table, the graph passes through coordinate points $(-5,11)$, $(-4,9)$, $(-3,7)$, $(-2,5)$ and $(-1,3)$. We plot these points and then draw a line passing through the points. Extend the line beyond the points in both directions.



Guided Example

Draw the graph $y = 5x - 1$ between $2 \leq x \leq 10$

Step 1: Create a table with x values between 2 and 10.

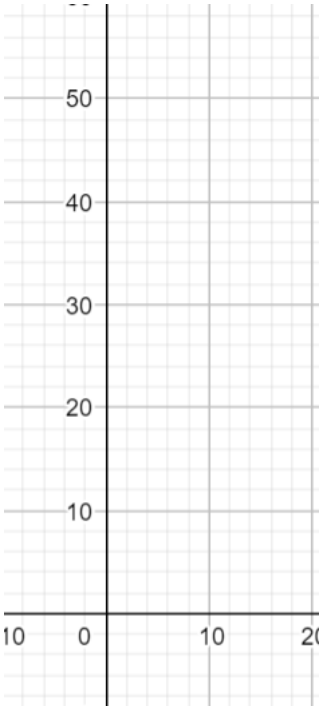
x					
y					

Step 2: Calculate the y values by substituting in the x values to the given equation.

$$y = 5x - 1$$

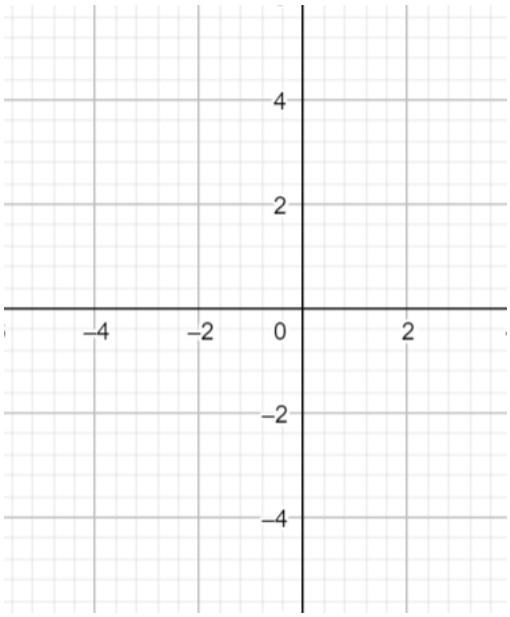
x					
y					

Step 3: Form coordinate points out of the table of values. Plot these points on the graphs and join this up with a ruler.

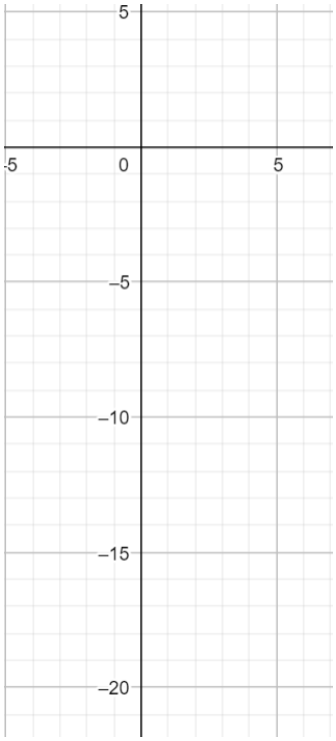


Now it's your turn!
If you get stuck, look back at the worked and guided examples.

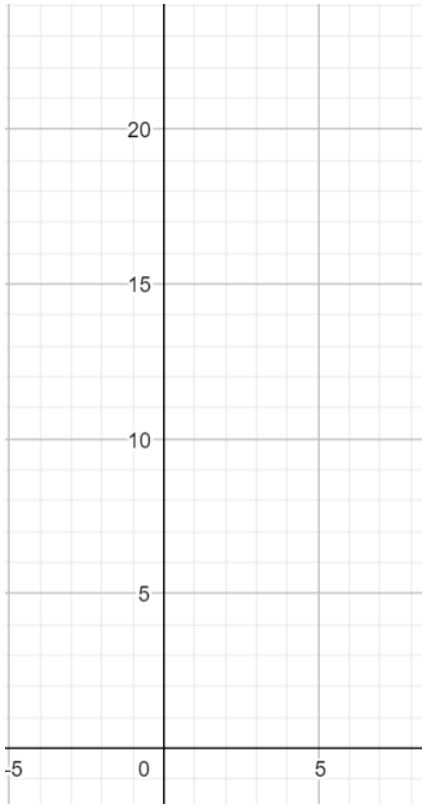
5. Draw the graph $y = x + 3$ between $-2 \leq x \leq 2$



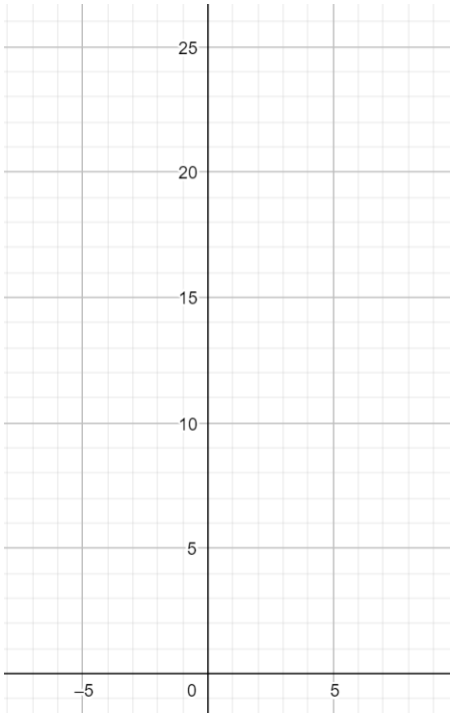
6. Draw the graph $y = 4x - 10$ between $-2 \leq x \leq 2$



7. Draw the graph $y = -3x + 7$ between $-1 \leq x \leq 5$



8. Draw the graph $2y = -8x + 10$ between $-5 \leq x \leq -1$



Section C

Worked Example

Line M passes through the points $(4, 15)$ and $(2, 7)$. Find the equation of Line M in the from $y = mx + c$.

Step 1: Using the coordinates of the two points given, calculate the gradient of Line M.

We are given $(x_1, y_1) = (4,15)$ *and* $(x_2, y_2) = (2,7)$.

Gradient $\boldsymbol{m}$ *of the Line M:*

$$m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{15 - 7}{4 - 2} = \frac{8}{2} = 4$$

The gradient of Line M is 4.

Step 2: Find the value of c (the y-intercept) by substituting known values into the form $y = mx + c$.

We know $m = 4$ *and we also know the line passes through the point* $(x, y) = (4,15)$.
Substitute these known values into the form $y = mx + c$ *and solve for* c*:*

$$y = mx + c$$
$$15 = 4(4) + c$$
$$15 = 16 + c \quad \Rightarrow \quad c = -1$$

Step 3: Substitute m and c values into the general form $y = mx + c$ to find the equation of the line.

We found $m = 4$ *and* $c = -1$*:*

$$\boldsymbol{y = 4x - 1}$$

Guided Example

Line L passes through the point $(-3, 11)$ and $(1, -9)$. Find the equation of Line L in the from $y = mx + c$.

Step 1: Using the coordinates of the two points given, calculate the gradient of Line M.

Step 2: Find the value of c (the y-intercept) by substituting known values into the form $y = mx + c$.

Step 3: *Substitute* m *and* c *values into the general form* $y = mx + c$ *to find the equation of the line.*

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

9. The gradient of a line is equal to 2 and the line passes through the point $(-5,3)$. Find the equation of the line.

10. The gradient of a line is $-\frac{1}{3}$ and the line passes through the point $(-6,-2)$. Find the equation of the line.

11. A line passes through the points $(2,10)$ and $(1,3)$. Find the equation of the line in the from $y = mx + c$.

12. A line passes through the points $(-10,1,)$ and $(4,7)$. Find the equation of the line in the from $y = mx + c$.

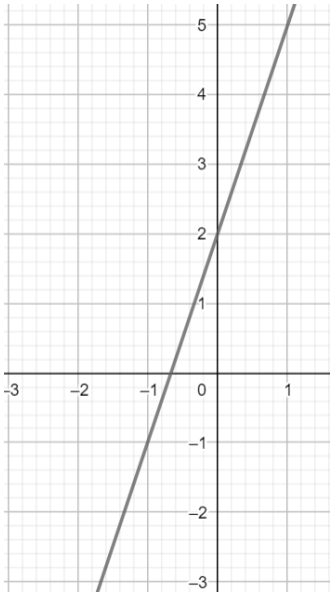
13. A line passes through the points $(6,-9)$ and $(4,2)$. Find the equation of the line in the from $y = mx + c$.

14. A line passing through the origin also passes through the point $(1,-7)$. Find the equation of the line in the from $y = mx + c$

Section D

Worked Example

Find the gradient of the line given in the following graph:



Step 1: Find the numerical value of the gradient by looking at how the y value changes as the x value increases by 1.

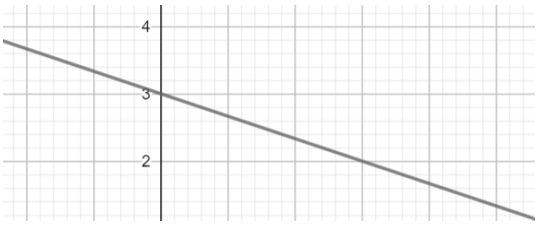
For every 1 *unit across in the x-direction, the y value of the graph increases by* 3*. This means the gradient of the line is* $m = 3$*.*

Step 2: Find the correct sign for the gradient.

The line slopes upwards towards the top right corner of the axis so the gradient is positive. The gradient of the line is 3*.*

Guided Example

Find the equation of the line given in the graph below:



Step 1: Find the numerical value of the gradient by looking at how the y value changes as the x value increases by 1.

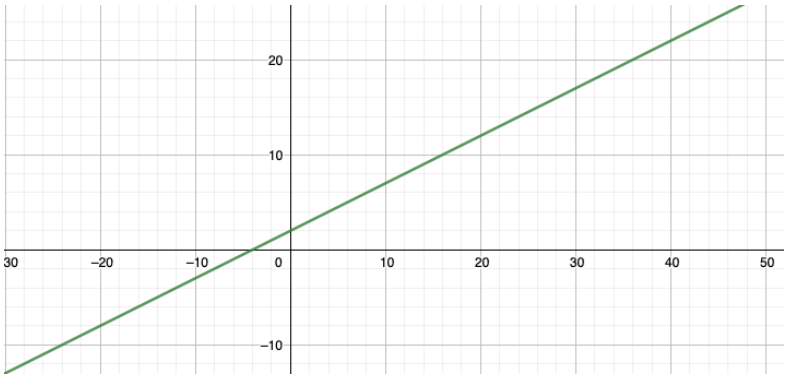
Step 2: Find the correct sign for the gradient.

Step 3: Identify the value of the y-intercept (the value of c).

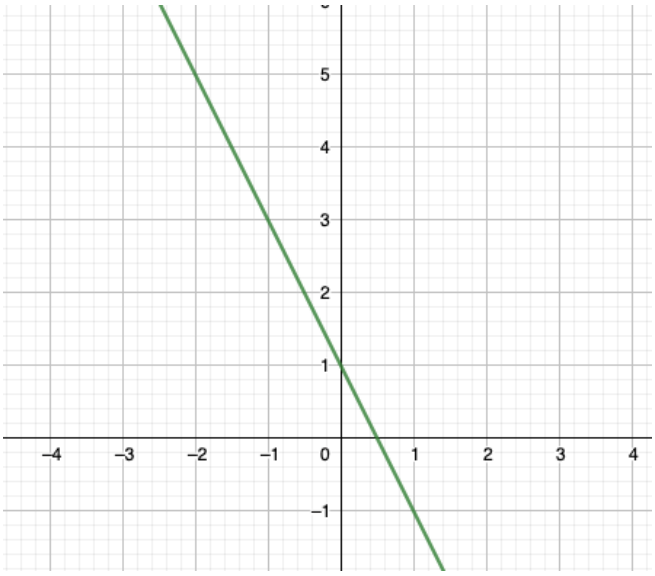
Step 4: Find the equation of the line by substituting the values of m and c into the form $y = mx + c$.

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

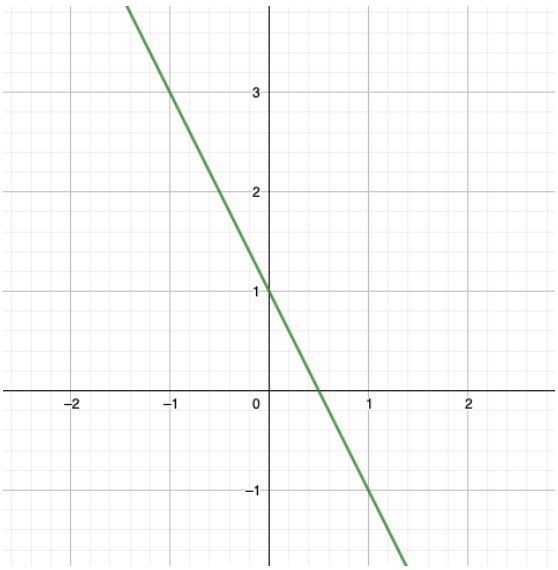
15. Find the gradient of the line given below:



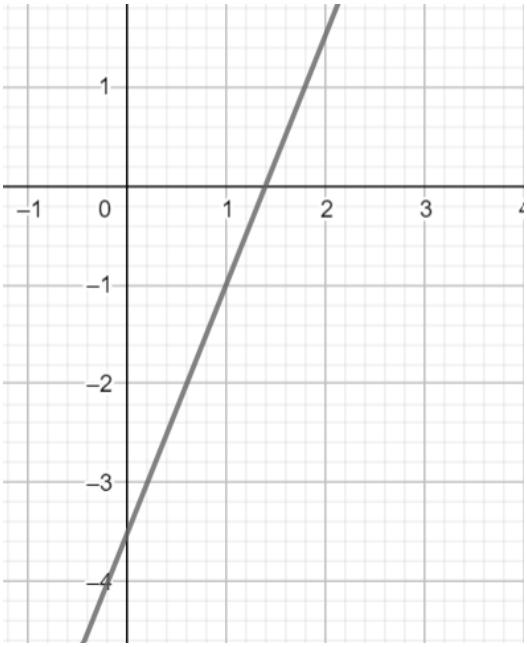
16. Find the gradient of the line given below:



17. Find the equation of the line given below:



18. Find the equation of the line given below:



Section E

Worked Example

Find the equation of the line that is parallel to $y = \frac{1}{2}x - 1$ and passes through the point $(2, 1)$.

Step 1: When two lines are parallel, the gradient m will be the same for both lines.

The gradient of $y = \frac{1}{2}x - 1$ can be found by comparing it to the general form $y = mx + c$.

So, the gradient is $m = \frac{1}{2}$. The gradient of the new line will be $\frac{1}{2}$ also.

Step 2: *Calculate the value of c (the y-intercept) of the new line by substituting the gradient and coordinates given into the general form $y = mx + c$ and solving for c.*

We have $m = \frac{1}{2}$ and we are given coordinates $(2,1)$:

$$y = mx + c$$
$$1 = \frac{1}{2}(2) + c$$
$$1 = 1 + c$$
$$0 = c$$

Step 3: Substitute values for m and c into the form $y = mx + c$ to find the equation of the line.

Since $m = \frac{1}{2}$ and $c = 0$, the equation of the new line is $\boldsymbol{y = \frac{1}{2}x}$.

Guided Example

Determine whether the line $y = 3x + 1$ and $x + 3y = 6$ are parallel.

Step 1: If the two the lines are parallel, the gradient m will be the same for both lines. Rearrange both equations so they are in the standard form $y = mx + c$.

Step 2: Compare the gradient m values and form a conclusion about whether the lines are parallel or not.

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

19. Determine whether the line $2y = 6x + 3$ and $4x + 6y = 1$ are parallel.

20. Write the equation of the line parallel to $y = -x + 2$ passing through point $(9,6)$.

21. Write the equation of the line parallel to $y = \frac{4}{5}x + 1$ passing through point $(10,7)$.

22. Line M passes through points $(0,5)$ and $(2,1)$. Line L is parallel to M and passes through the point $(6,7)$. Find the equation of Line L in the form $y = mx + c$.

23. Line A passes through points $(1,3)$ and $(2,6)$. Line B passes through the points $(-3,-8)$ and $(-5,-14)$. Are these lines parallel?

Section F

Worked Example

Line A passes through the points $(4, 12)$ and $(-1, -3)$. Given that line B is perpendicular to line A and passes through $(9, 2)$, find the equation of line B in the form $y = mx + c$.

Step 1: When lines are perpendicular, the product of their gradients m_1 and m_2 is $m_1 \times m_2 = -1$. Find the gradient m_1 for line A and use this to find the gradient m_2 for line B.

For line A, we are given $(x_1, y_1) = (4,12)$ and $(x_2, y_2) = (-1, -3)$. Gradient m_1 of A:

$$m_1 = \frac{y_1 - y_2}{x_1 - x_2} = \frac{12 - (-3)}{4 - (-1)} = \frac{15}{5}$$

Finding gradient of line B:

$$m_1 m_2 = -1$$
$$m_2 = \frac{-1}{3} = -\frac{1}{3}$$

The gradient of Line B is $m_2 = -\frac{1}{3}$.

Step 2: *Calculate the value of c (the y-intercept) of line B by substituting the gradient and coordinates given into the general form $y = mx + c$ and solving for c.*

We have $m = -\frac{1}{3}$ and we are given coordinates $(9,2)$:

$$y = mx + c$$
$$2 = -\frac{1}{3}(9) + c$$
$$2 = -3 + c$$
$$5 = c$$

Therefore, the equation of the Line B is $\boldsymbol{y = -\frac{1}{3}x + 5}$.

Guided Example

Determine whether the line $2y = 3x + 9$ and $2x - 3y = 1$ are perpendicular.

Step 1: Rearrange the equations so they are in the form $y = mx + c$. Identify the values of their gradients.

Step 2: Calculate the product of the gradients to form a conclusion about whether the lines are perpendicular.

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

24. Determine whether the lines $9y + 3x = -6$ and $6x - 8 = 2y$ are perpendicular.

25. Line A has equation $y = \frac{3}{5}x + 2$. Line B is perpendicular to A and passes through the point $(0, -2)$. Find the equation of line B.

26. Line A passes through the points $\left(-\frac{1}{2}, 4\right)$ and $(2,9)$. Given that line B is perpendicular to line A and passes through $(-4, -5)$, find the equation of line B in the form $y = mx + c$.

27. Line A and line B intersect at point $(0, -3)$.
Line A passes through the point $(-3, -2)$.
Given that line B is perpendicular to line A, find the equation of line B in the form $y = mx + c$.

28. Line M is perpendicular to the line below. Line M passes through $(6,8)$. Find the equation for line M and draw it on the graph below.