



AQA GCSE Maths: Higher



Your notes

Coordinate Geometry

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Your notes

2D Coordinates

2D Coordinates

What is the Cartesian plane?

- The **Cartesian plane** is a **two-dimensional** grid that has
 - a **horizontal** scale, called the **x-axis**
 - a **vertical** scale, called the **y-axis**
- The two axes **meet** at the **origin**
 - where **x** and **y** are both 0

What are coordinates?

- **Coordinates** are a **pair of numbers**, **x** and **y**, that describe the **location** of a **point** on the grid
 - They are written in **brackets** as **(x , y)**
 - The point is
 - **x units** on the **horizontal** scale
 - **y units** on the **vertical** scale
- The **origin** is **(0, 0)**
 - **Positive** values of **x** are to the **right** of the origin
 - **Negative** values are to the **left**
 - **Positive** values of **y** are **above** the origin
 - **Negative** values are **below**
- For example, from the origin:
 - (2, 5) is the point 2 units to the **right** and 5 units **up**
 - (-1, -4) is the point 1 unit to the **left** and 4 units **down**
- "Along the corridor, up the stairs" helps to remember **horizontal** then **vertical**, **(x , y)**





Your notes

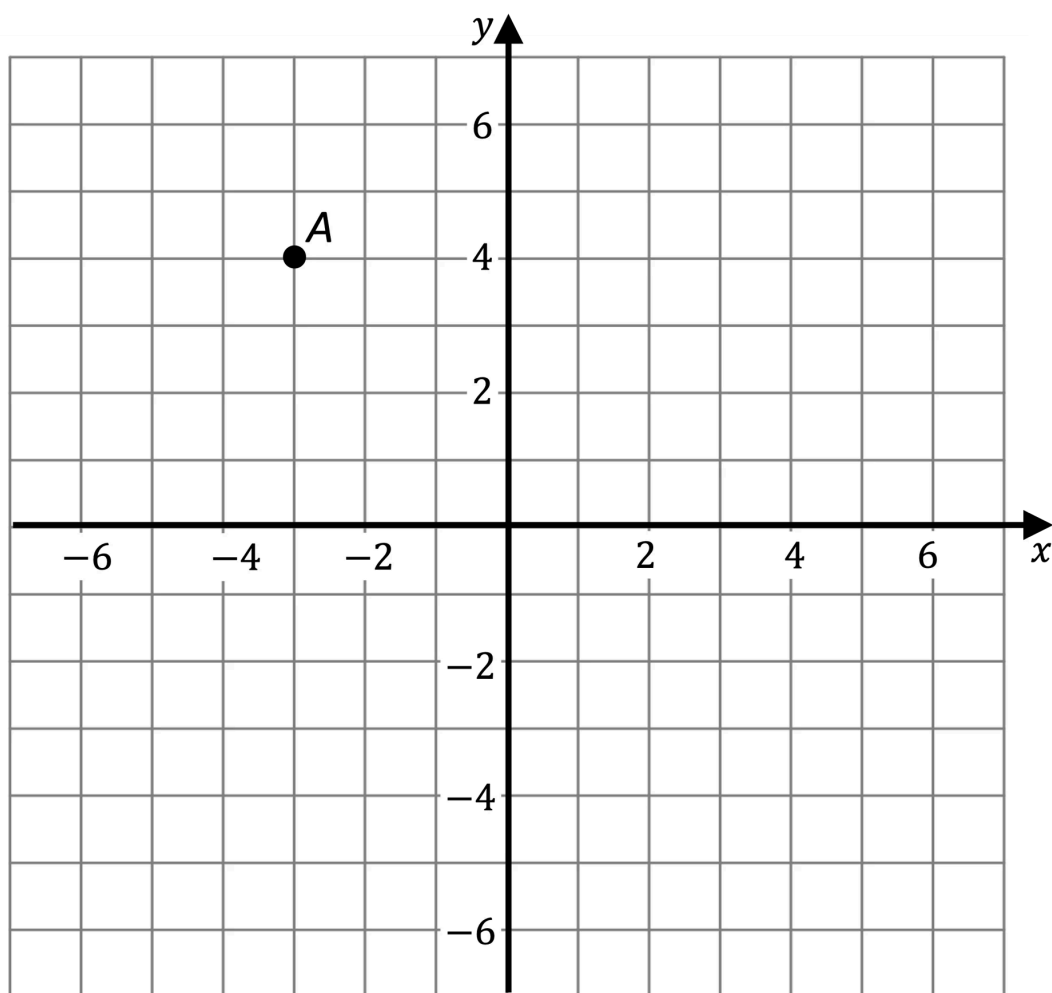
Examiner Tips and Tricks

- Check the scale on the coordinate grid!
 - 1 square might not be 1 unit



Worked Example

(a) Write down the coordinates of the point A shown on the axes below.





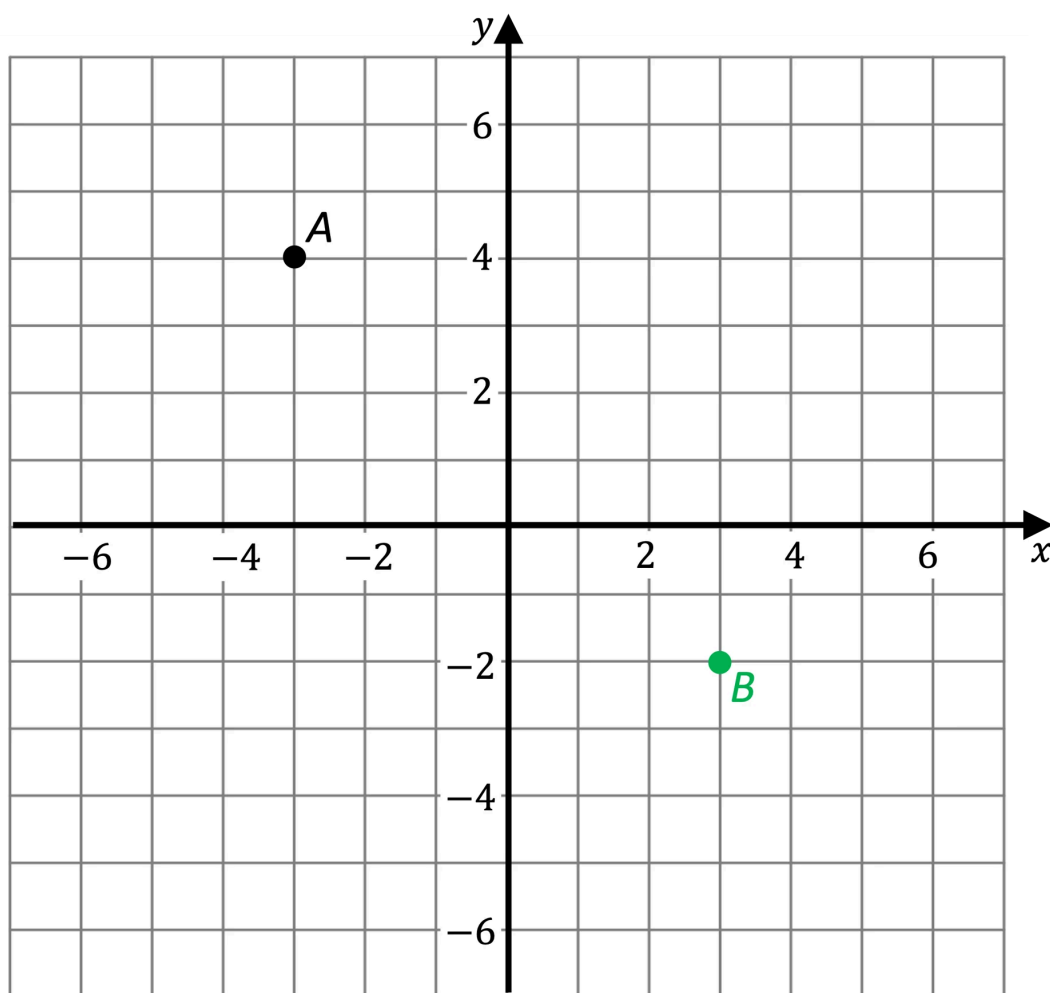
Your notes

A is 3 units to left, so x is -3
A is 4 units up, so y is 4
Give your answer in brackets

 $(-3, 4)$

(b) Mark the point B with coordinates $(3, -2)$ on the same set of axes.

Start at the origin
Count 3 units right and two units down
Mark the point with a solid circle or cross and label it B





Your notes

Midpoint of a Line

Midpoint of a Line

How do I find the midpoint of a line?

- The **midpoint** of a line will be the **same distance from both endpoints**
- You can think of a midpoint as being the average (**mean**) of two coordinates
- The **midpoint** of (x_1, y_1) and (x_2, y_2) is

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$



Worked Example

The coordinates of A are $(-4, 3)$ and the coordinates of B are $(8, -12)$.

Find the coordinates of the midpoint of AB.

The midpoint can be found using $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

Substitute in the values of x and y from each point into their correct positions

$$\left(\frac{-4 + 8}{2}, \frac{3 + -12}{2} \right) = \left(\frac{4}{2}, \frac{-9}{2} \right)$$

Simplify

$(2, -4.5)$



Your notes

Gradient of a Line

Gradient of a Line

What is the gradient of a line?

- The **gradient** is a measure of how **steep** a straight line is
- A gradient of 3 means:
 - For every **1 unit** to the right, go **up** by 3
- A gradient of -4 means:
 - For every **1 unit** to the right, go **down** by 4
- A gradient of 3 is **steeper** than 2
 - A gradient of -5 is **steeper** than -4
- A **positive** gradient means the line goes **upwards** (uphill)
 - Bottom left to top right
- A **negative** gradient means the line goes **downwards** (downhill)
 - Top left to bottom right

How do I find the gradient of a line?

- Find **two points** on the line and draw a **right-angled triangle**
 - Then $\text{gradient} = \frac{\text{change in } y}{\text{change in } x}$
 - Or, in short, $\frac{\text{rise}}{\text{run}}$
 - The **rise** is the vertical length of the triangle
 - The **run** is the horizontal length of the triangle
- Put the correct **sign** on your answer
 - **Positive** for uphill lines
 - **Negative** for downhill lines



Your notes

- You can also find gradient of a line between two points, (x_1, y_1) and (x_2, y_2)

- Use the formula $\frac{y_2 - y_1}{x_2 - x_1}$

How do I draw a line with a given gradient?

- To draw the gradient $\frac{2}{3}$
 - The **rise** is 2
 - The **run** is 3
 - It is **positive** (uphill)
 - Move 3 units to the **right** and 2 units **up**
- To draw the gradient -5 make it a fraction, $-\frac{5}{1}$
 - The **rise** is 5
 - The **run** is 1
 - It is **negative** (downhill)
 - Move 1 unit to the **right** and 5 units **down**



Examiner Tips and Tricks

- A lot of students forget to make their gradients negative for downhill lines!

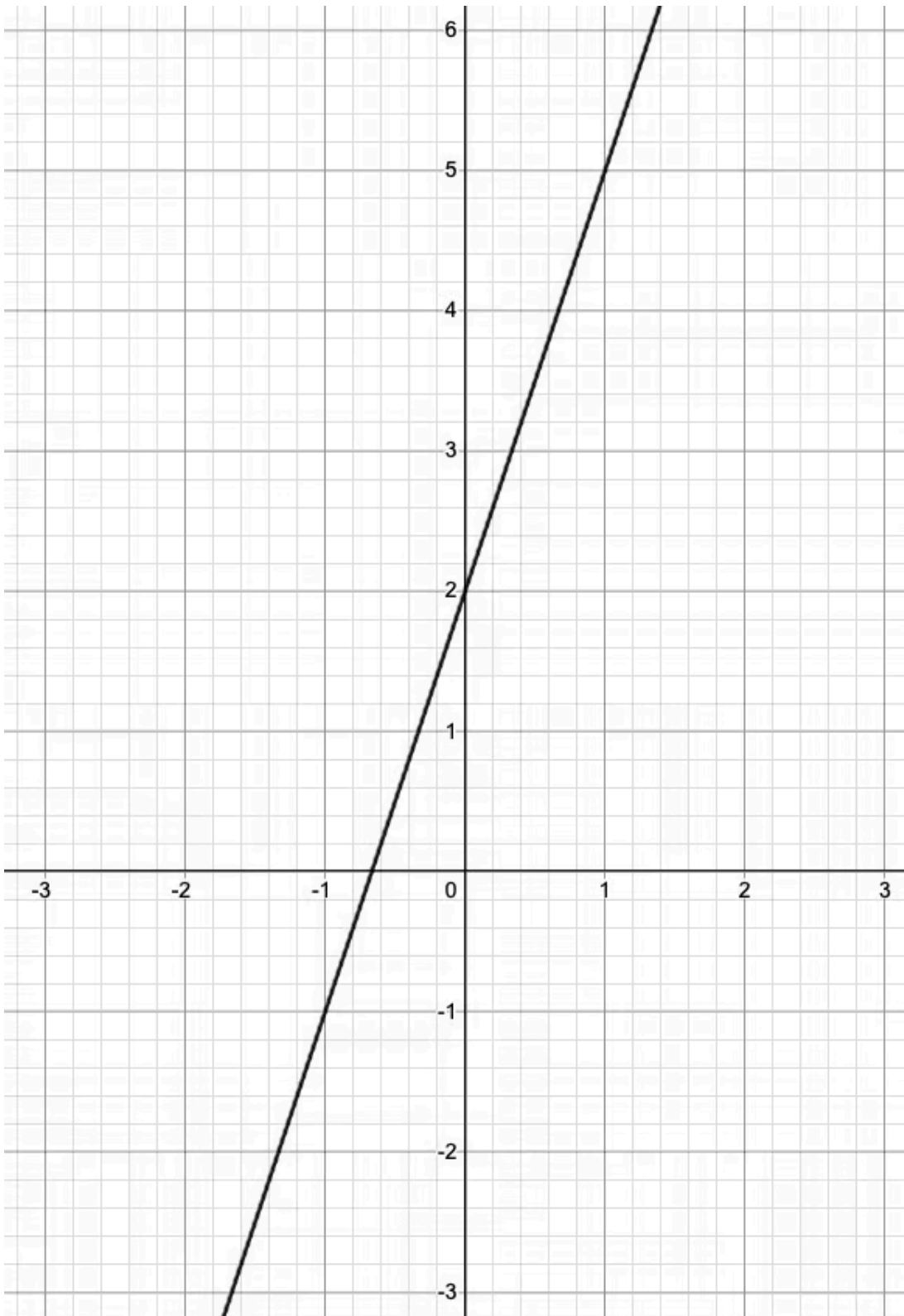


Worked Example

(a) Find the gradient of the line shown in the diagram below.



Your notes



Find two points that the line passes through

$(0, 2)$ and $(1, 5)$

Use the grid to draw a right-angled triangle

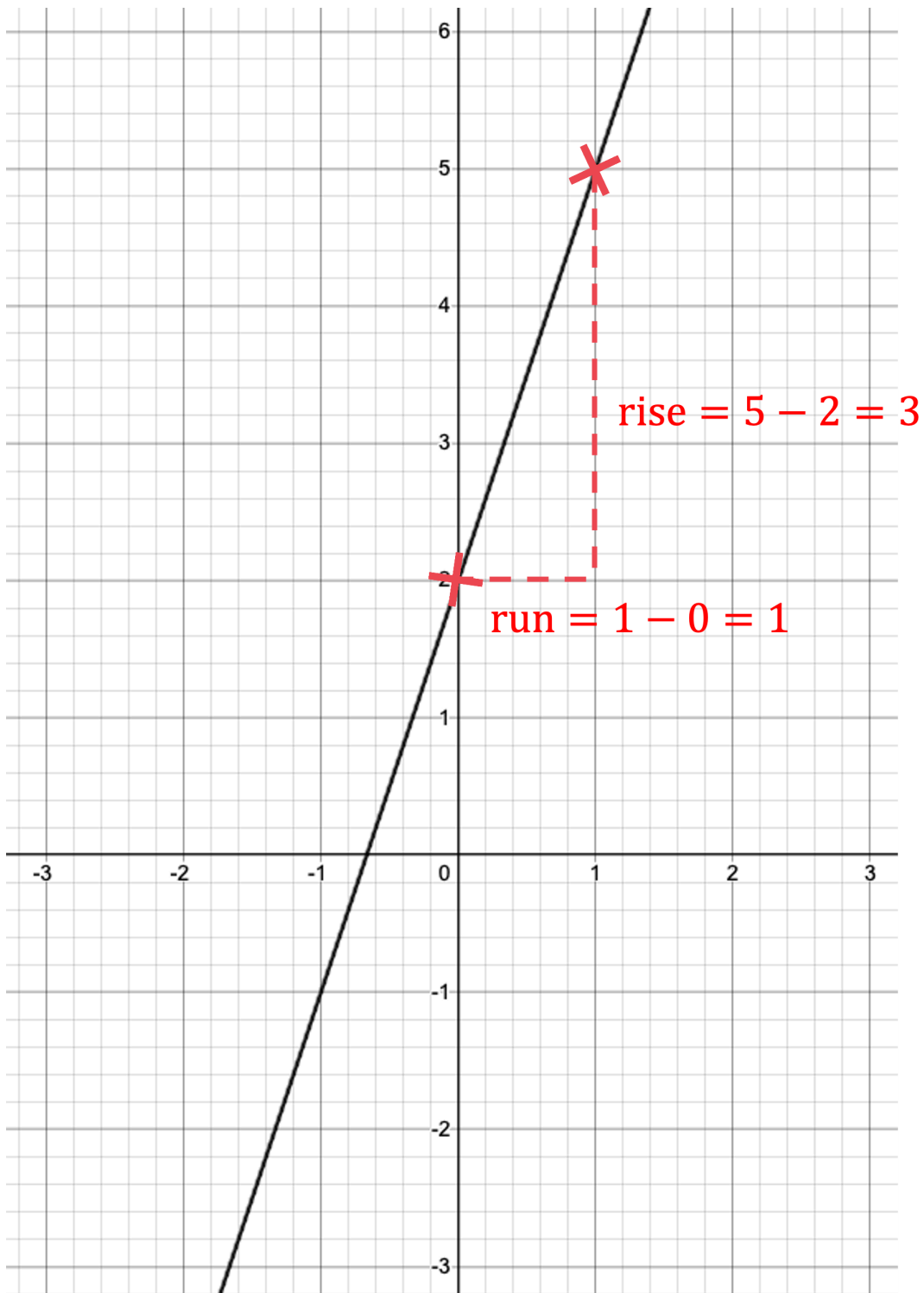
Find the 'rise' (vertical length) and 'run' (horizontal length)



Your notes



Your notes





Your notes

Work out the fraction $\frac{\text{rise}}{\text{run}}$

$$\frac{3}{1} = 3$$

Look to see if the line is uphill or downhill

uphill, so the gradient is positive

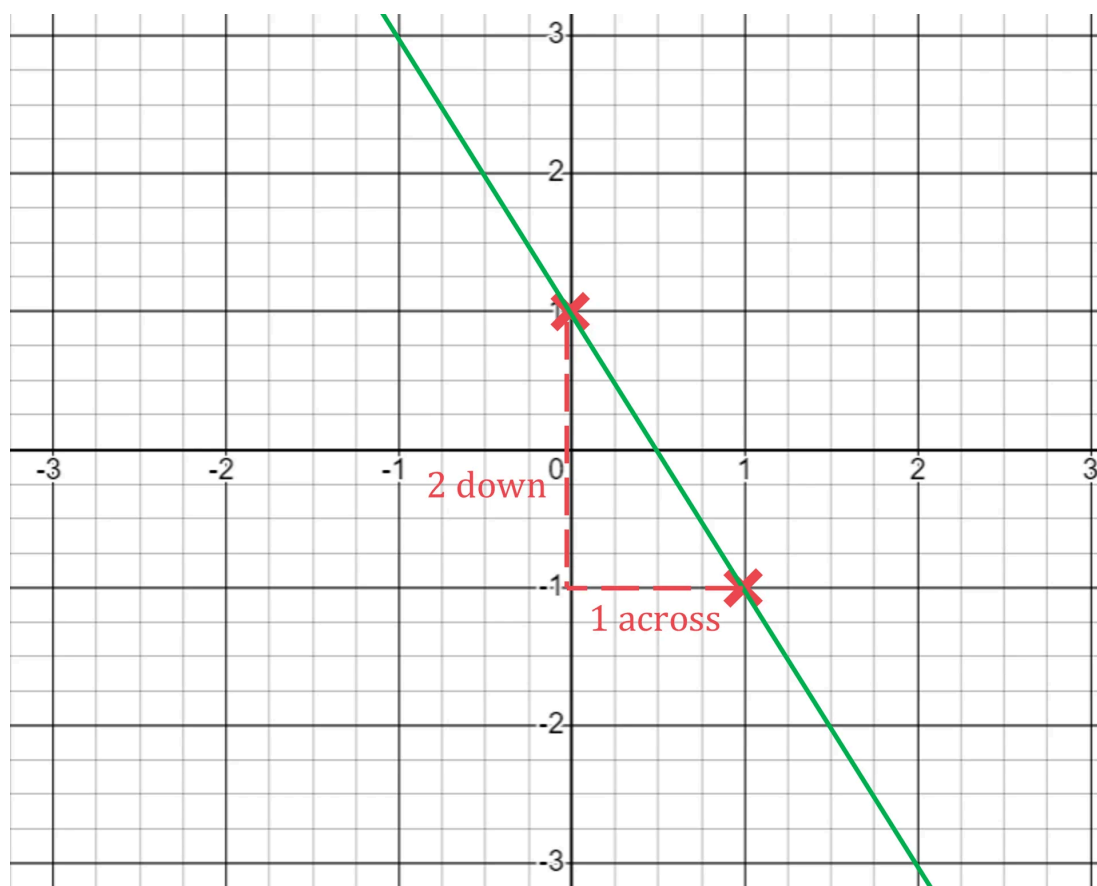
The gradient is 3

(b) On the grid below, draw the line with a gradient of -2 that passes through $(0,1)$.

Mark on the point $(0,1)$

-2 is the fraction $-\frac{2}{1}$

The rise is 2, the run is 1, the line goes downhill (so 1 across, 2 down)



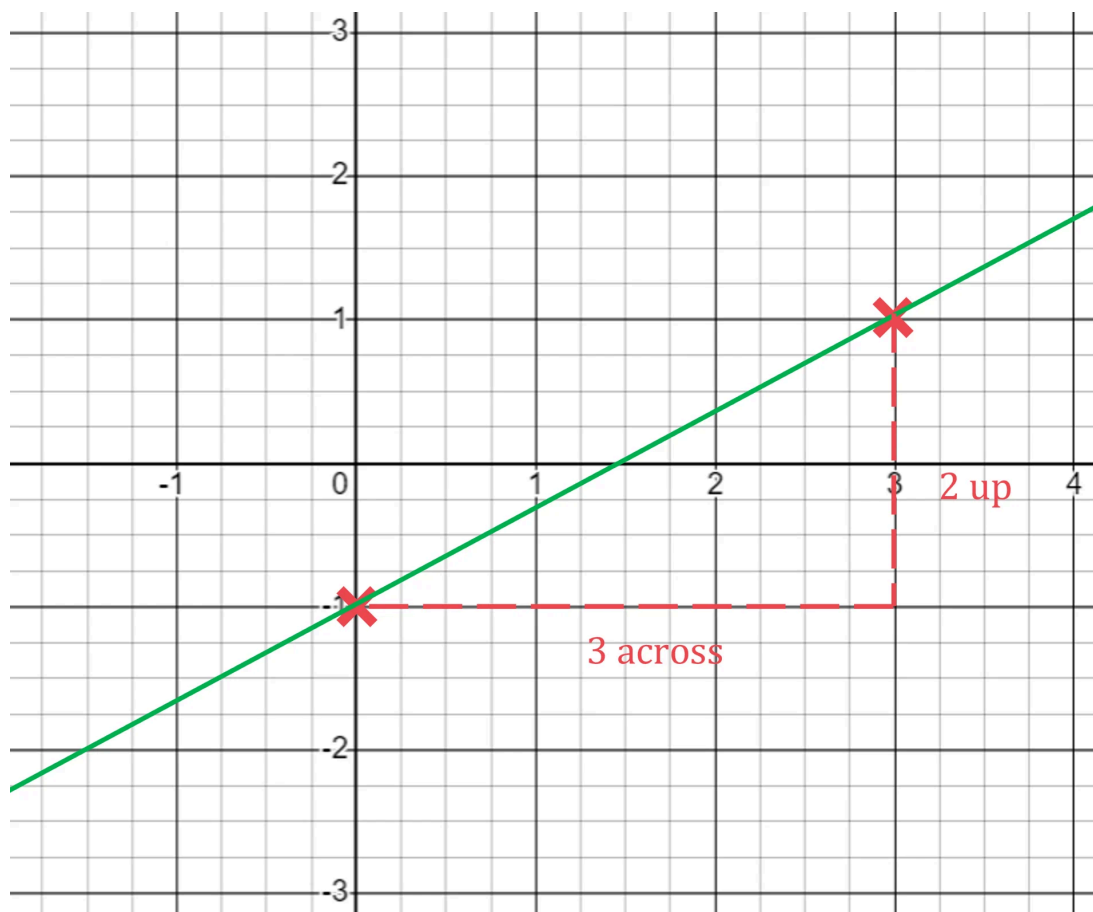


Your notes

(c) On the grid below, draw the line with a gradient of $\frac{2}{3}$ that passes through (0, -1).

Mark on the point (0, -1)

The rise is 2, the run is 3, the line goes uphill (so 3 across, 2 up)





Your notes

Length of a Line

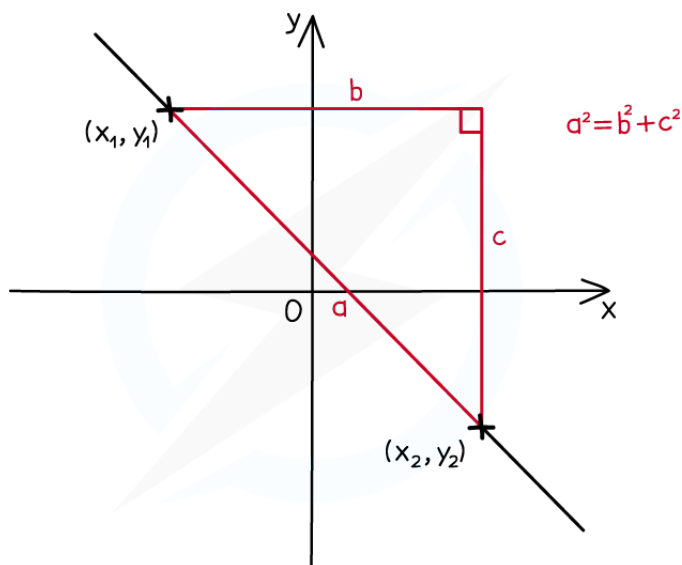
Length of a Line

How do I calculate the length of a line?

- The **distance between two points** with coordinates (x_1, y_1) and (x_2, y_2) can be found using the formula

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

- This formula uses **Pythagoras' theorem** $a^2 + b^2 = c^2$
 - It is applied to the difference in the x -coordinates and the difference in the y -coordinates



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Examiner Tips and Tricks

- Be extra careful when negative coordinates are involved



Your notes

- It can help to put negative numbers in brackets to make your working clearer
- E.g. $(-6) - (-8) = 2$



Worked Example

Point A has coordinates (3, -4) and point B has coordinates (-5, 2).

Calculate the distance of the line segment AB.

Using the formula for the distance between two points, $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$

Substitute in the two given coordinates

$$d = \sqrt{(3 - (-5))^2 + ((-4) - 2)^2}$$

Be careful with the negative numbers

$$3 - (-5) = 8 \text{ and } (-4) - 2 = -6$$

Simplify

$$d = \sqrt{(8)^2 + (-6)^2} = \sqrt{64 + 36} = \sqrt{100} = 10$$

10 units