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# MATHS METHODS

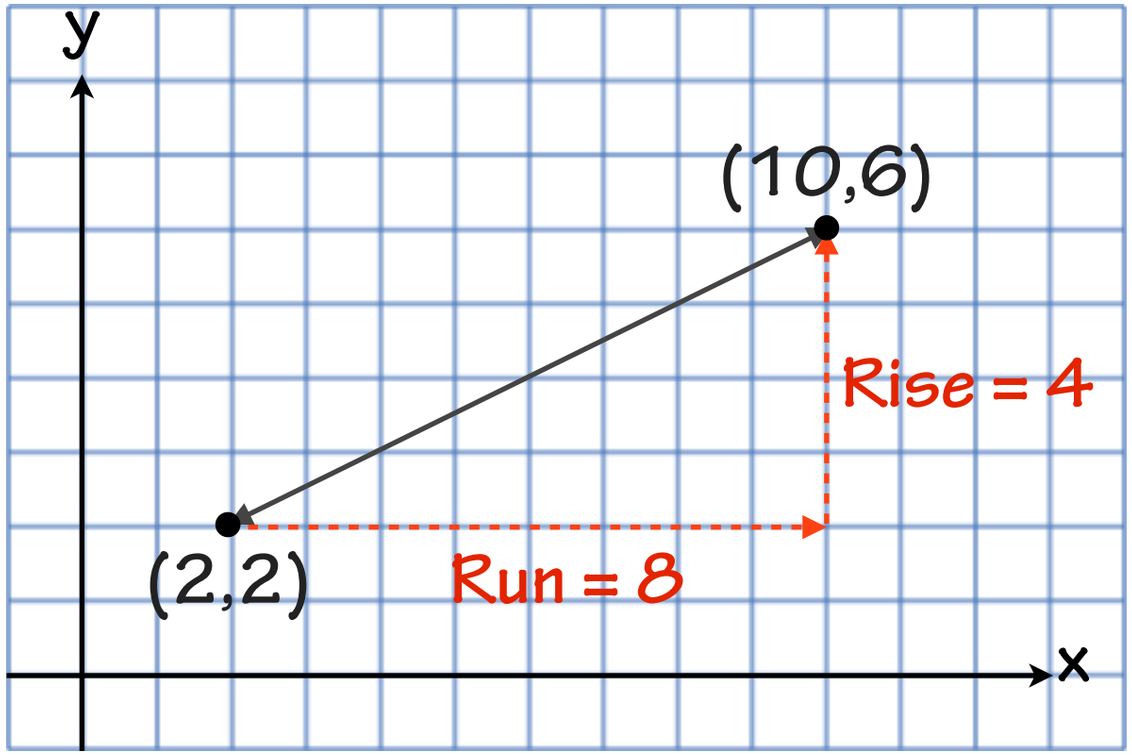
PODCAST

# Linear Graphs

- Gradient of lines
- Graphing linear equations
- Finding the equation of a line
- Perpendicular lines
- Distance between points
- Midpoint of a line

# Gradient of lines

The gradient is the measure of how far up a line rises, as it it runs across.




Gradient of 4/8:
Same as 1/2.

$$gradient = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1} \qquad gradient = \frac{6-2}{10-2} = \frac{4}{8} = \frac{1}{2}$$

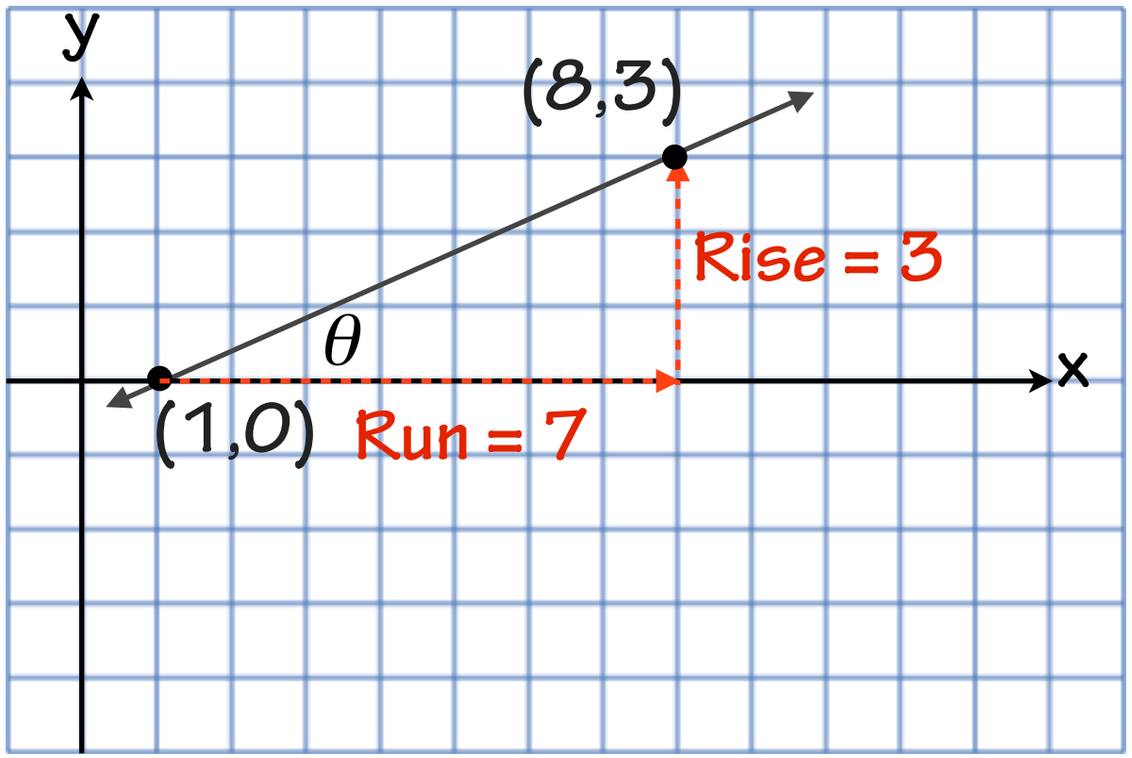
Positive gradient

Negative gradient

# Angles & gradients

The gradient of the line can be used to find the angle between the line and the axis.

$$gradient = \frac{rise}{run} = \frac{opposite}{adjacent} = \tan\theta$$




$$\tan\theta = \frac{3}{7}$$

$$\theta = \tan^{-1}\left(\frac{3}{7}\right)$$

$$\theta \approx 23.2°$$

- Negative gradient: use a negative angle (Clockwise, below the axis) or the supplementary angle ($180° - \theta$)

# Angles & gradients

Find the acute angle between the two lines:

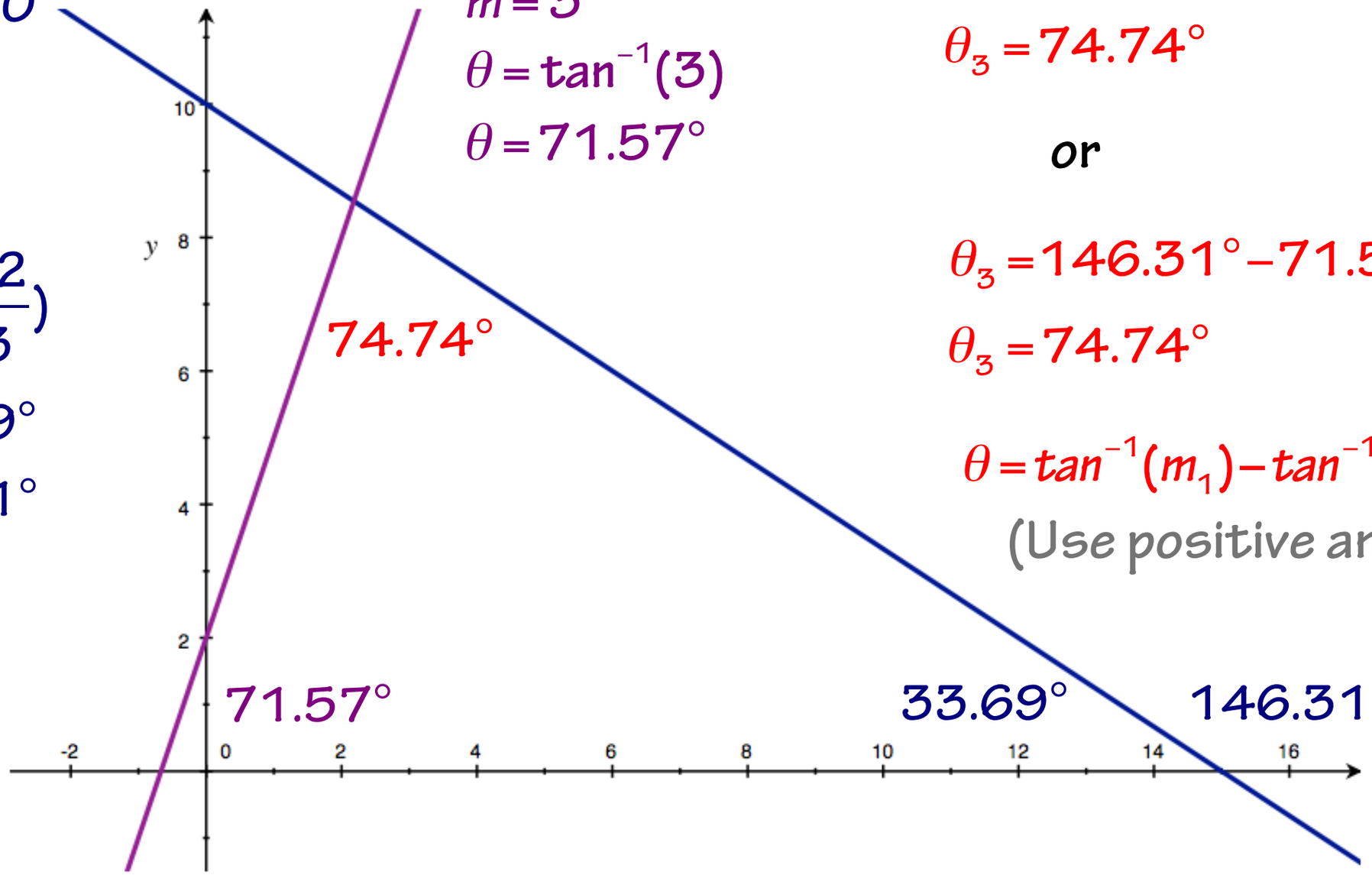
$$y = \frac{-2x}{3} + 10$$

$$m = -\frac{2}{3}$$

$$\theta = \tan^{-1}\left(\frac{-2}{3}\right)$$

$$\theta = -33.69°$$

$$\theta = 146.31°$$




$$y = 3x + 2$$

$$m = 3$$

$$\theta = \tan^{-1}(3)$$

$$\theta = 71.57°$$

$$\theta_3 = 180° - 33.69° - 71.57°$$

$$\theta_3 = 74.74°$$

or

$$\theta_3 = 146.31° - 71.57°$$

$$\theta_3 = 74.74°$$

$$\theta = \tan^{-1}(m_1) - \tan^{-1}(m_2)$$

(Use positive angles)

# Graphing equations - gradient form

Linear equations are defined by a gradient and y-intercept

$$y = mx + c$$

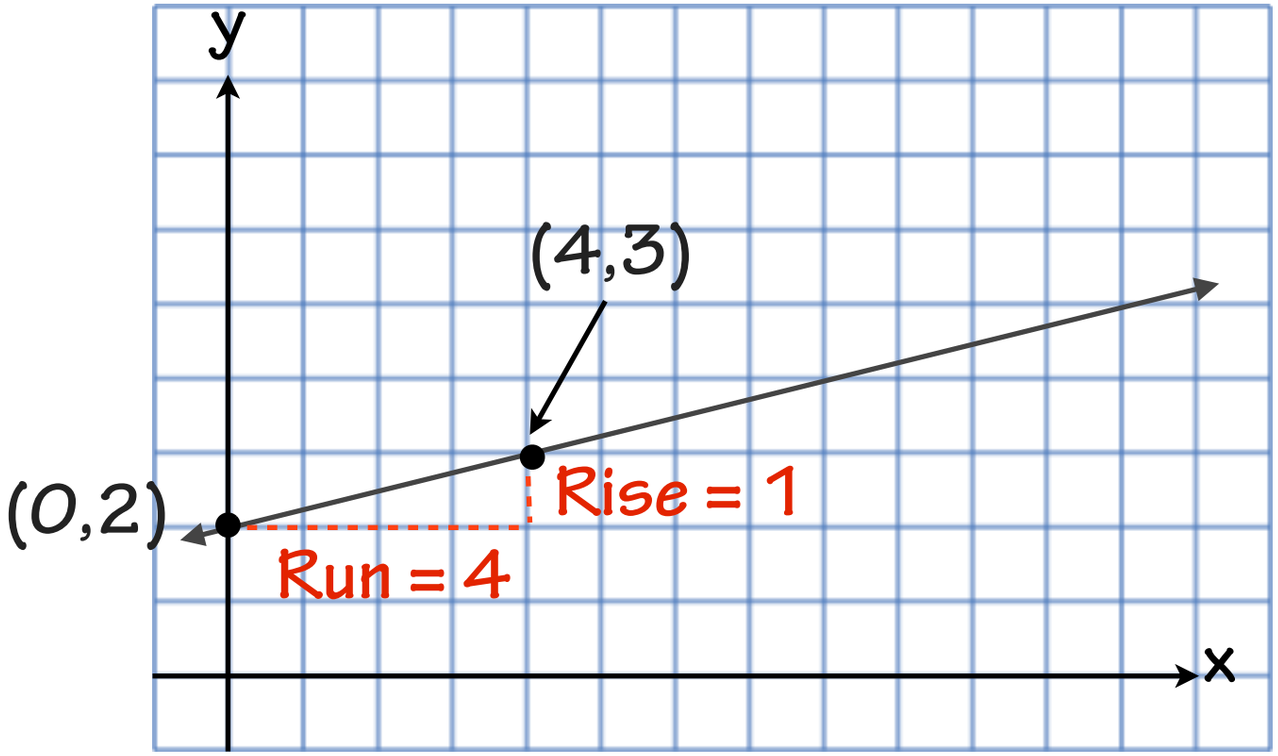
$c$ = y intercept

$m$ = gradient

$$y = \frac{x}{4} + 2$$

$$x = 4$$

$$y = \frac{4}{4} + 2 = 3$$



# Graphing equations - intercept form

- Linear equations can also be written in an intercept form.
- The gradient form (y = mx + c) can be re-arranged.

$$\frac{x}{a}+\frac{y}{b}=1 \qquad bx+ay=ab$$

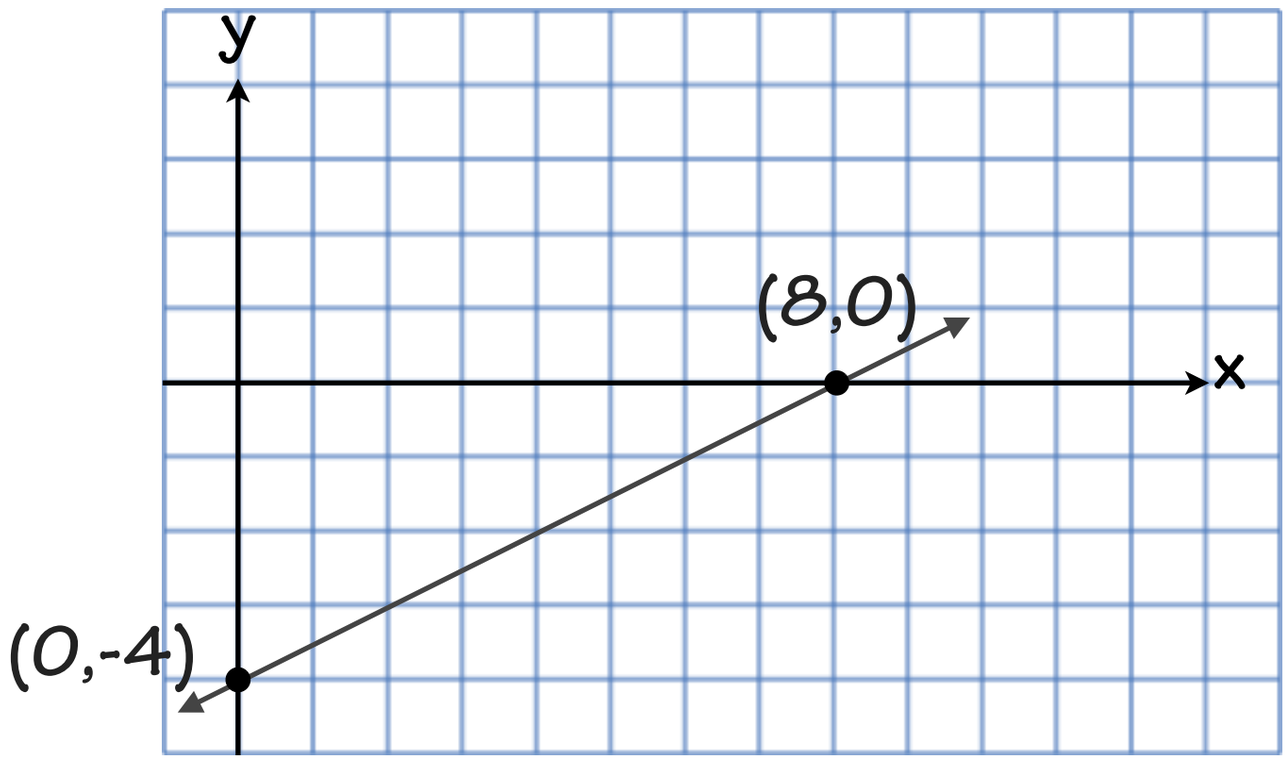
$$y=\frac{x}{2}-4 \longrightarrow 4=\frac{x}{2}-y \longrightarrow \frac{x}{8}-\frac{y}{4}=1 \longrightarrow x-2y=8$$

x intercept: y = 0  y intercept: x = 0

$$x-2y=8 \qquad 0-2y=8$$

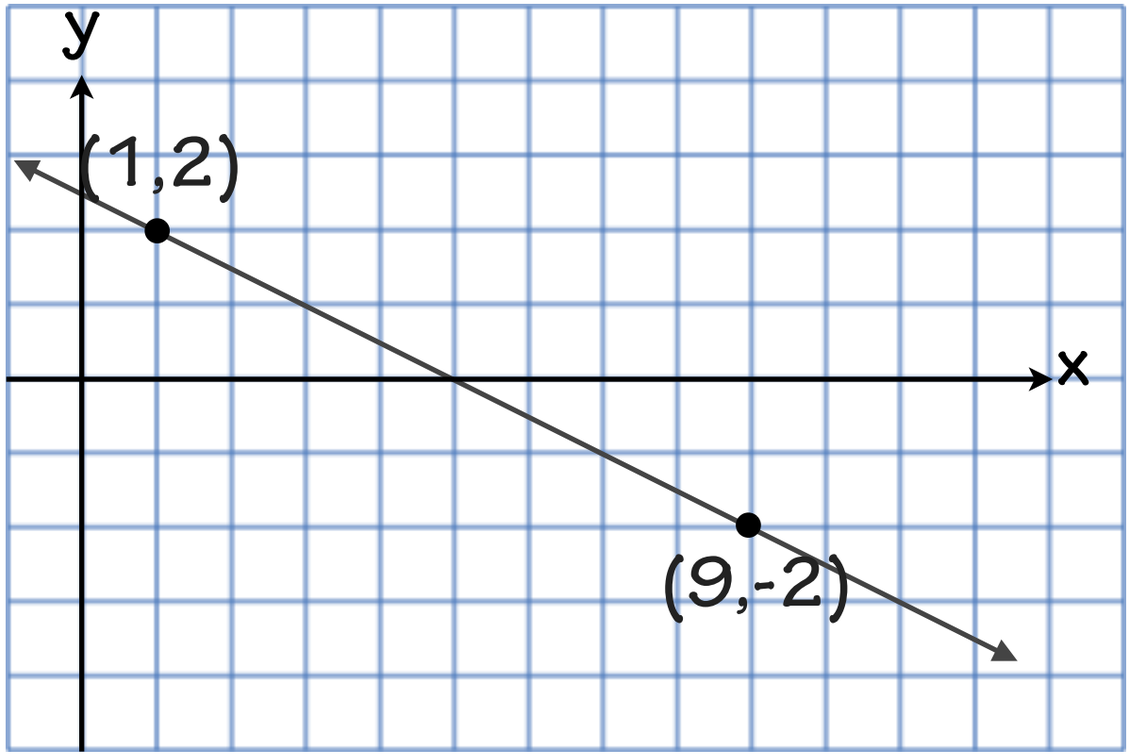
$$x-2\times 0=8 \qquad y=\frac{8}{-2}$$

$$x=8 \qquad y=-4$$



# Finding the equation of a line - two points

- To find the equation of a line, a point and a gradient are needed.
- If two points are given, the gradient must be found first.
- The rule $y - y_1 = m(x - x_1)$ is used to find the linear equation.




Gradient:

$$m = \frac{-2-2}{9-1} = \frac{-4}{8} = -\frac{1}{2}$$

Equation:

$$y - y_1 = m(x - x_1)$$

$$y - 2 = -\frac{1}{2}(x - 1)$$

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

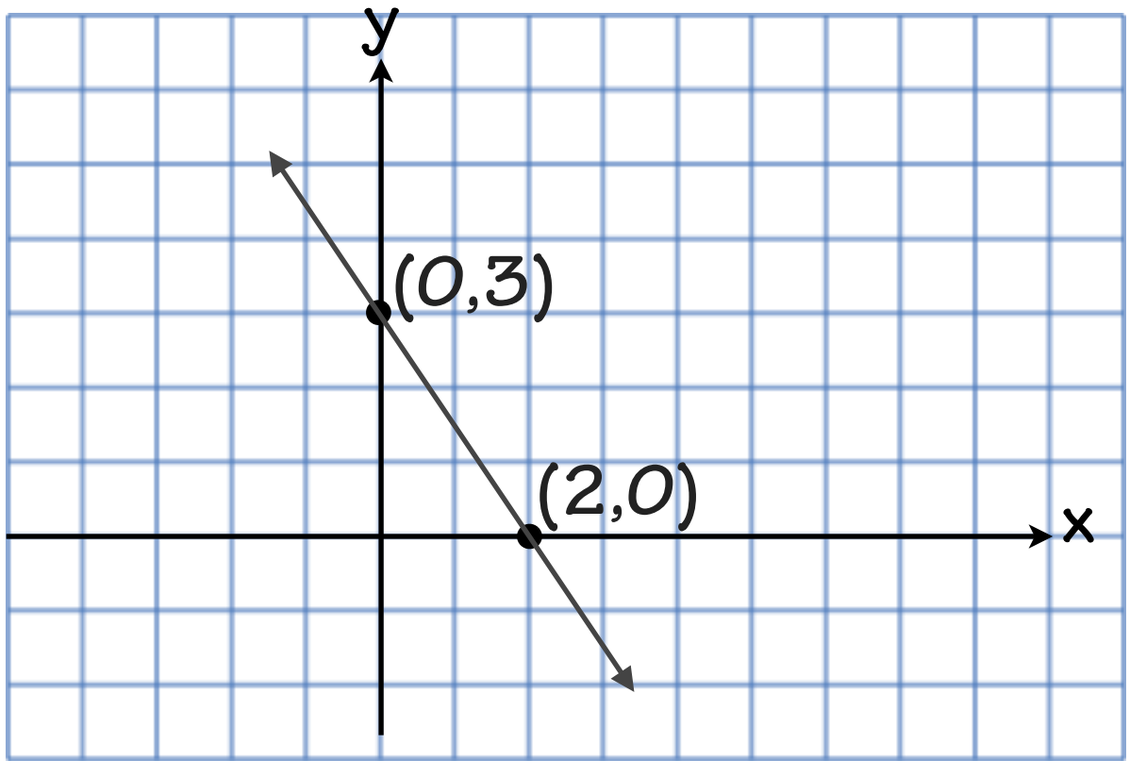
$$y = -\frac{1}{2}x + \left(\frac{1}{2} + 2\right)$$

$$y = -\frac{1}{2}x + \left(\frac{1}{2} + \frac{4}{2}\right)$$

$$y = -\frac{1}{2}x + \frac{5}{2}$$

# Finding the equation of a line - two intercepts

- To find the equation of a line, the two axis intercepts can be used.
- The graph of the function x + y = 1 can be transformed through dilations & reflections.




$$\frac{x}{a}+\frac{y}{b}=1$$

x intercept

y intercept

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

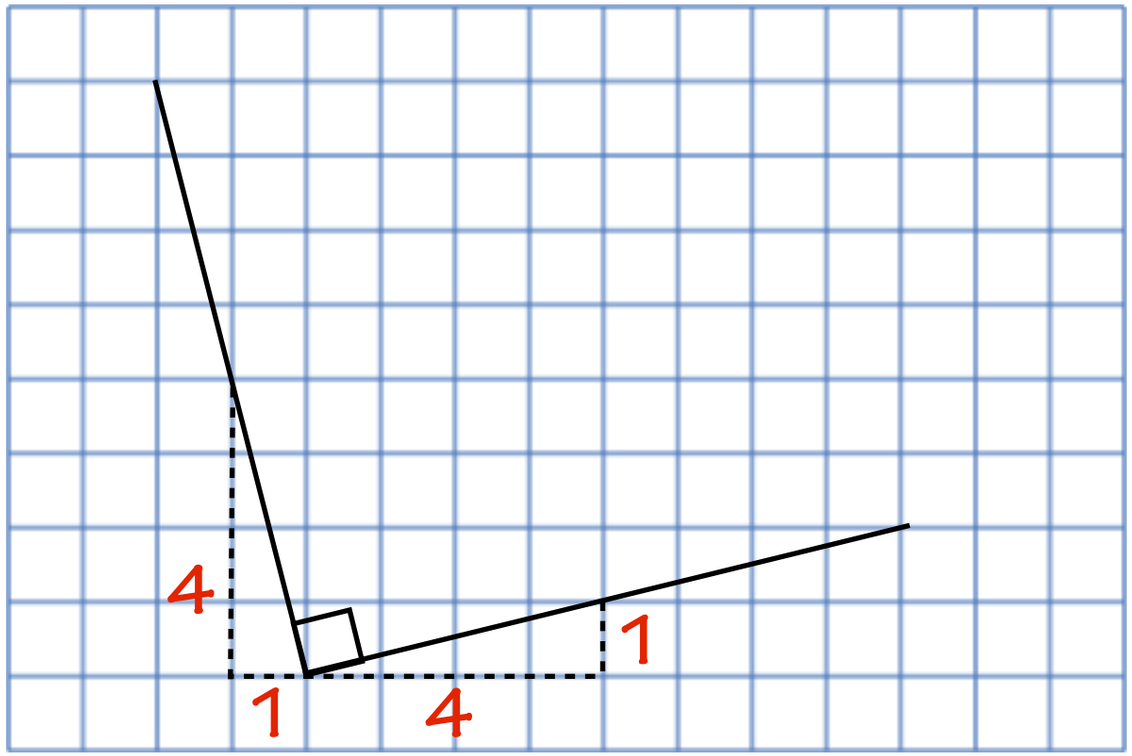
or

$$3x+2y=6$$

# Perpendicular lines

Two lines are perpendicular if they cross at a 90° angle.

Gradient of -4/1:



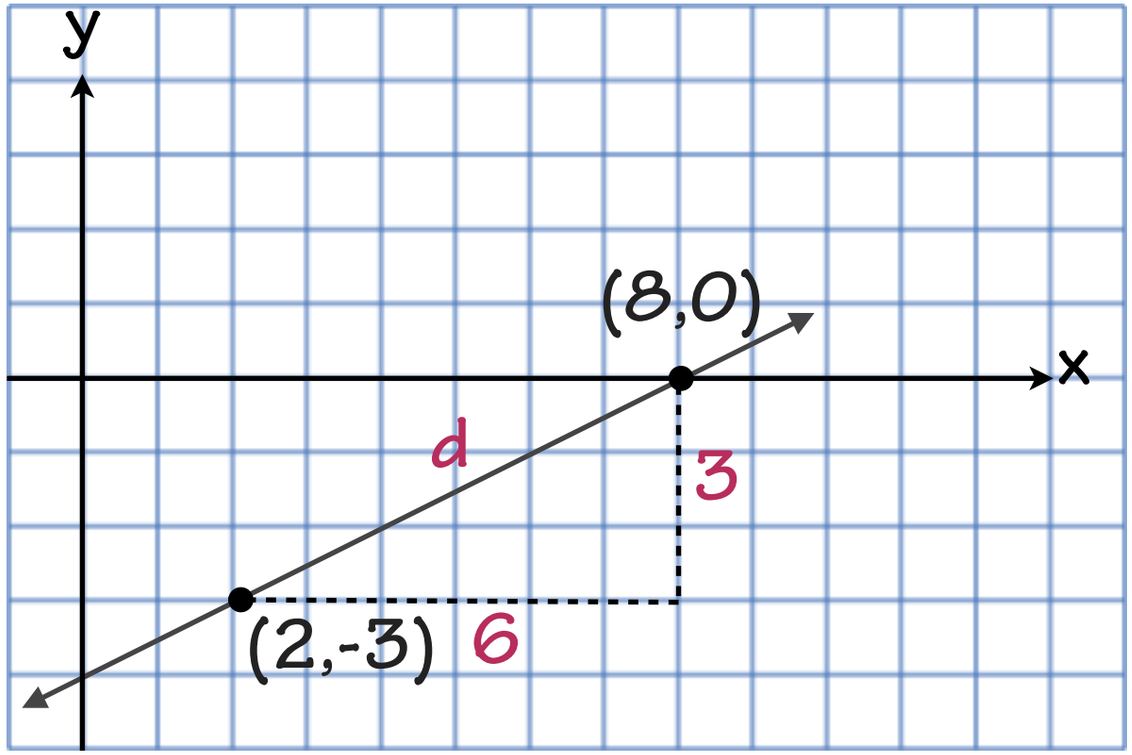

Gradient of 1/4:

Two lines are perpendicular if their gradients multiply to -1.

$$m_1 \times m_2 = -1 \qquad m_2 = -\frac{1}{m_1}$$

# Distance between points

The distance between two points can be found using Pythagoras' theorem:



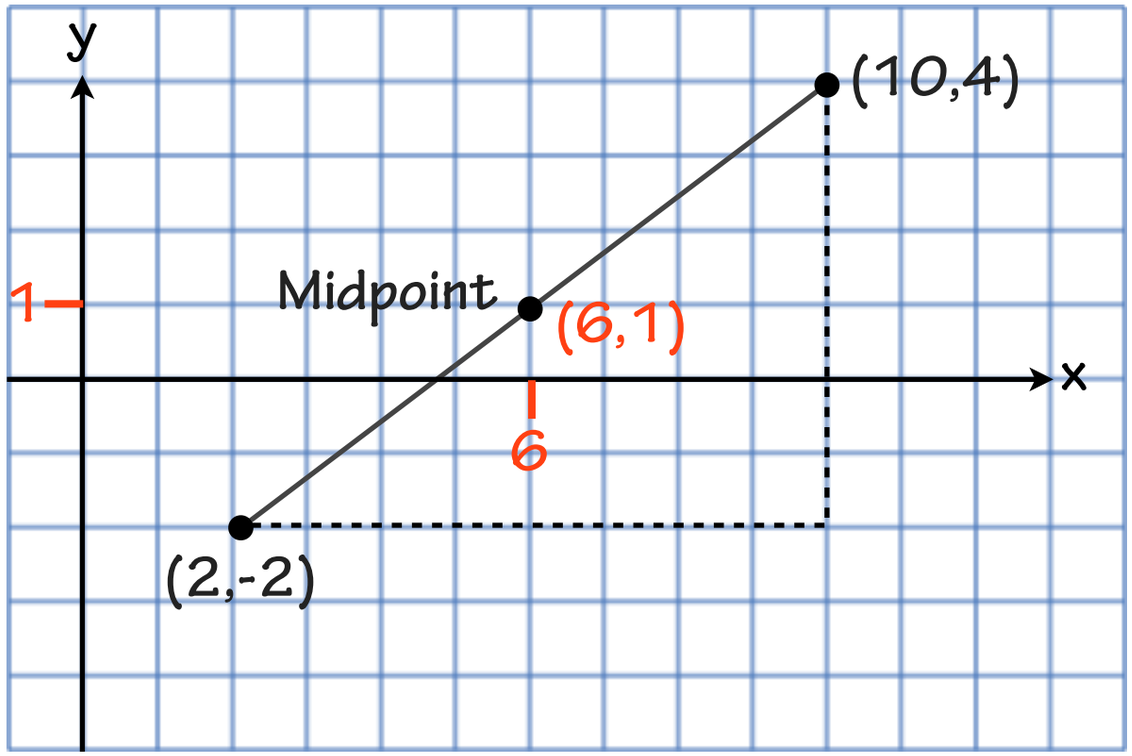

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$d^2 = 6^2 + 3^2$$
$$d^2 = 36 + 9$$
$$d^2 = 45$$

$$d = \sqrt{45} = 6.7$$

# Midpoint of a segment

The midpoint of a straight line segment is at the middle of the x & y values.




x value:

$$x_m = \frac{x_1 + x_2}{2}$$

$$x_m = \frac{2+10}{2} = \frac{12}{2} = 6$$

y value:

$$y_m = \frac{y_1 + y_2}{2}$$

$$y_m = \frac{-2+4}{2} = \frac{2}{2} = 1$$

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