

Finding the equation of a line

About 75 minutes No calculator 61 marks



Hints online, answers free with an account:
mathswariz.uk/worksheets/further-maths-finding-the-equation-of-a-line/

Date _____

A Do Now

The first two questions are what today's lesson needs. The others bring back earlier topics.

- A1** Needed today [2 marks]

Write $y - 5 = -3(x + 2)$ in the form $y = mx + c$.

A2 Needed today [2 marks]

Work out the gradient of the line through $(-1, 8)$ and $(5, -4)$.

Answer $y = \dots\dots$

Answer $\dots\dots$

- A3** Last lesson [2 marks]

Work out where the line $4x - 3y = 24$ meets each axis.

A4 From chapter 2 [2 marks]

Write $x^2 + 10x + 18$ in the form $(x + a)^2 + b$.

Answer $(\dots, \dots)$ and $(\dots, \dots)$

Answer $\dots\dots$

B Example, then your turn

Level 2

Your teacher works through each example with you. Then try the one beside it.

EXAMPLE 1

Work out the equation of the line with gradient -4 that passes through $(4, -3)$. Give your answer in the form $y = mx + c$.

Hint A line with gradient m through (x_1, y_1) is $y - y_1 = m(x - x_1)$.

- B1** [2 marks]
- Work out the equation of the line with gradient 5 that passes through $(-2, -1)$. Give your answer in the form $y = mx + c$.

Answer $y = \dots\dots$

EXAMPLE 2

Work out the equation of the line with gradient $-\frac{2}{3}$ that passes through $(6, -1)$. Give your answer in the form $px + qy + r = 0$, where p , q and r are integers.

Hint Write $y - y_1 = m(x - x_1)$, then multiply every term by 3 to clear the fraction.

B2 Work out the equation of the [3 marks]

line with gradient $\frac{3}{4}$ that passes through $(-2, 5)$. Give your answer in the form $px + qy + r = 0$, where p , q and r are integers.

Answer ... = 0

EXAMPLE 3

Work out the equation of the line through $(-3, 8)$ and $(5, -4)$. Give your answer in the form $px + qy + r = 0$, where p , q and r are integers.

Hint Work out the gradient first. Then use either point in $y - y_1 = m(x - x_1)$, and check with the other.

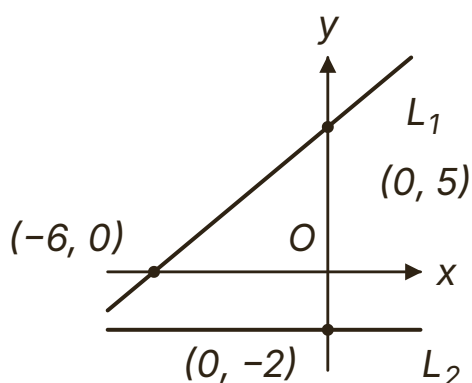
B3 Work out the equation of the [3 marks]

line through $(-4, -3)$ and $(2, 1)$. Give your answer in the form $px + qy + r = 0$, where p , q and r are integers.

Answer ... = 0

EXAMPLE 4

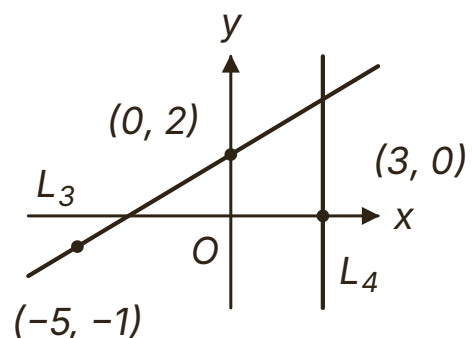
The diagram shows the lines L_1 and L_2 . Work out the equation of each line.



Hint L_1 meets the axes at two points you can read: use them for the gradient. L_2 is horizontal.

B4 The diagram shows the lines [3 marks]

L_3 and L_4 . Work out the equation of each line. Give the equation of L_3 in the form $px + qy + r = 0$, where p , q and r are integers.



Answer $L_3 : \dots = 0$ $L_4 : \dots$

EXAMPLE 5

The length, L cm, of a spring is a linear function of the mass, m grams, hanging from it. With 20 g hanging, $L = 13$; with 50 g hanging, $L = 17.5$. Work out a formula for L in terms of m . Write down the length with no mass, and work out the mass that makes the spring 22 cm long.

Hint The two readings are two points (m, L) . Find the gradient, then use one point.

- B5** A print shop charges $\pounds C$ for n posters, where C is a linear function of n . 40 posters cost $\pounds 26$ and 100 posters cost $\pounds 50$. Work out a formula for C in terms of n . Write down the fixed set-up charge, and work out how many posters cost $\pounds 70$. [4 marks]

Answer $C = \dots\dots \pounds \dots\dots \dots$ posters

c Practice

Level 2

- C1** Work out the equation of the line that is parallel to $4x + 2y = 7$ and passes through $(-2, 7)$. Give your answer in the form $y = mx + c$. [3 marks]

Answer $y = \dots\dots$

- C2** Work out the equation of the line through the origin and the point $(-6, 4)$. Give your answer in the form $px + qy = 0$, where p and q are integers. [2 marks]

Answer $\dots\dots = 0$

- C3** A line meets the y -axis at $(0, -4)$ and passes through $(6, 5)$. Work out its equation in the form $px + qy + r = 0$, where p, q and r are integers. [2 marks]

Answer $\dots\dots = 0$

- C4** A line has gradient 4 and passes through $(-1, -5)$. Does the point $(3, 12)$ lie on the line? Show how you decide. [2 marks]

- C5** Work out the equation of the line through $(\frac{1}{2}, 3)$ and $(2, 0)$. Give your answer in the form $y = mx + c$. [2 marks]

Answer $y = \dots\dots$

- D1** A line has gradient -2 and passes through $(-3, 4)$. Which is its equation? Circle [1 mark]
your answer. $y = -2x - 2$ $y = -2x + 10$ $y = 4x - 2$ $y = -2x + 5$

- D2** Tom wants the equation of the line through $A(4, -1)$ and $B(-2, 8)$. He writes: "Gradient
 $= \frac{-2 - 4}{8 - (-1)} = -\frac{2}{3}$, so the line is $y + 1 = -\frac{2}{3}(x - 4)$."

Tom is wrong.

- (a) Explain Tom's mistake, and work out the correct gradient. [2 marks]

Answer gradient

- (b) Work out the equation of the line AB . Give your answer in the form [2 marks]
 $px + qy + r = 0$, where p, q and r are integers.

Answer = 0

Total for D2: 4 marks

- D3** The line through the points $(2, 9)$ and $(6, k)$ is parallel to the line $3x + 2y = 5$.

- (a) Work out the value of k . [3 marks]

Answer $k = \dots\dots$

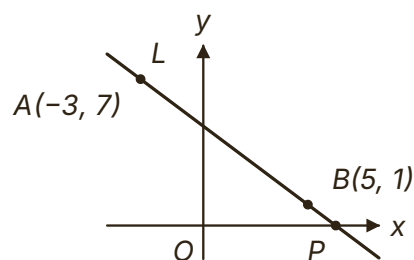
- (b) Work out the equation of the line through $(2, 9)$ and $(6, k)$. Give your answer in [2 marks]
the form $px + qy + r = 0$, where p, q and r are integers.

Answer = 0

Total for D3: 5 marks

D4 The line L passes through the points $A(-3, 7)$ and $B(5, 1)$. L meets the x -axis at P .

- (a) Work out the equation of L . Give your answer in the form $px + qy + r = 0$, where p, q and r are integers. [3 marks]



Answer = 0

- (b) Work out the coordinates of P . [1 mark]

Answer (.....,.....)

- (c) The point $C(k, -2)$ lies on L . Work out the value of k . [2 marks]

Answer $k = \dots\dots$

Total for D4: 6 marks

D5 An oven is switched on. For the first 15 minutes its temperature, $T^\circ\text{C}$, is a linear function of the time, t minutes. When $t = 4$, $T = 74$. When $t = 10$, $T = 146$.

- (a) Show that $T = 12t + 26$. [3 marks]

- (b) Write down the temperature of the oven when it was switched on. [1 mark]

Answer $^\circ\text{C}$

- (c) Work out the time at which the temperature reaches 200°C . [2 marks]

Answer minutes

Total for D5: 6 marks

No route is given. The hints are at the end of the sheet. Use one at a time.

- E1** A straight line passes through the point (3, 2). It meets the positive x -axis and the positive y -axis. The sum of the two intercepts is 12. Work out the two possible equations of the line, each in the form $px + qy = r$, where p , q and r are integers. [5 marks]

Answer and

Extension hints

Cover these with paper. Uncover one at a time.

- E1 Hint 1** Call the intercepts a and $12 - a$, and write the line as $\frac{x}{a} + \frac{y}{12 - a} = 1$.
- Hint 2** The point (3, 2) is on the line, so $\frac{3}{a} + \frac{2}{12 - a} = 1$.
- Hint 3** Multiply by $a(12 - a)$: $3(12 - a) + 2a = a(12 - a)$, so $a^2 - 13a + 36 = 0$ and $a = 4$ or $a = 9$. The intercepts are 4 and 8, giving $2x + y = 8$, or 9 and 3, giving $x + 3y = 9$.

How did it go?

Colour one circle on each line: not yet, nearly, yes.

- I can write the equation of a line from its gradient and one point, using $y - y_1 = m(x - x_1)$. ☐ ☐ ☐
- I can find the equation of the line through two points, or read it from a diagram. ☐ ☐ ☐
- I can give an equation in the form $px + qy + r = 0$ with integer coefficients. ☐ ☐ ☐
- I can build a linear model from two readings and use it. ☐ ☐ ☐