

Gradients, equations of lines and real-life graphs

Grades 4–9 About 80 minutes No calculator 91 marks

Hints online, answers free with an account:
mathswariz.uk/worksheets/linear-graphs/

Name _____

Class _____

Date _____

A Before you start

Grades 4–5

You will need these in every question below.

A1 Work out the value of $2x - 7$ when $x = -3$.

[1 mark]

Answer

A2 Write down the coordinates of the point where the line $y = 5x - 8$ crosses the y -axis.

[1 mark]

Answer

A3 Rearrange $4x + 2y = 18$ to make y the subject.

[2 marks]

Answer

A4 The point $(3, k)$ lies on the line $y = 2x - 9$. Work out the value of k .

[1 mark]

Answer

A5 A line goes up 6 squares for every 4 squares it goes across. Work out its gradient. Give your answer as a fraction in its simplest form.

[1 mark]

Answer

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

EXAMPLE 1

Work out the gradient of the line through (2, 3) and (5, 12).

Hint Gradient is the change in y divided by the change in x .

B1 Work out the gradient of the line [2 marks]
through (−1, 7) and (3, −5).

Answer

EXAMPLE 2

Write down the gradient and the y -intercept of the line $3y = 6x - 12$.

Hint Divide every term by 3 to get the equation in the form $y = mx + c$.

B2 Write down the gradient and the [2 marks]
 y -intercept of the line
 $2y + 5x = 8$.

Answer gradient, y -intercept

EXAMPLE 3

A line has gradient 5 and passes through (2, 3). Work out its equation.

Hint Put $x = 2$ and $y = 3$ into $y = 5x + c$ to find c .

B3 Work out the equation of the line [3 marks]
through (1, 10) and (4, 1).

Answer

EXAMPLE 4

Work out the equation of the line that is perpendicular to $y = 2x + 1$ and passes through $(4, 3)$.

Hint The gradients of perpendicular lines multiply to -1 , so the new gradient is $-\frac{1}{2}$.

B4 Work out the equation of the line [3 marks]
that is perpendicular to
 $y = 3x - 2$ and passes through
 $(6, 1)$.

Answer

c Practice

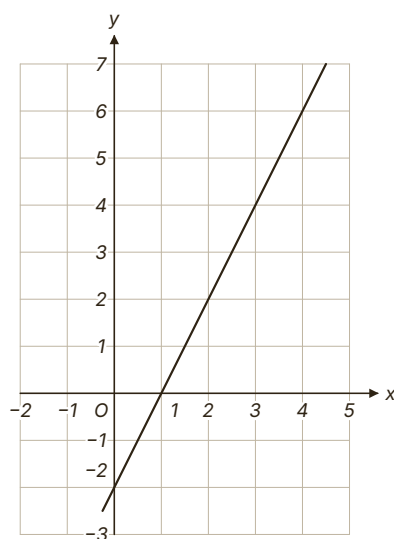
Grades 5–7

Each question asks for something different. Show your working.

C1 For the line $y = 3 - 2x$, work out the value of y when $x = -2$, when $x = 0$ and when $x = 3$. [2 marks]

Answer

C2 Work out the equation of the line shown on the grid. [3 marks]



Answer

- C3** The line $4x + 5y = 20$ crosses the x -axis at A and the y -axis at B . Write down the coordinates of A and of B . [2 marks]

Answer A , B

- C4** A line is parallel to $3y = 15x + 2$ and passes through $(2, 1)$. Work out its equation. [3 marks]

Answer

- C5** A is the point $(-2, 1)$ and B is the point $(4, 4)$.

- (a) Work out the gradient of AB . [2 marks]

Answer

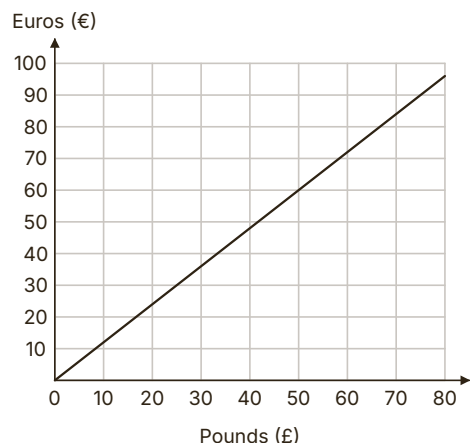
- (b) Work out the equation of the line through A and B . [2 marks]

Answer

- (c) Show that the point $(10, 7)$ lies on the same line. [2 marks]

Total for C5: 6 marks

C6 The graph is used to change between pounds (£) and euros (€).



(a) Use the graph to change £50 into euros.

[1 mark]

Answer €

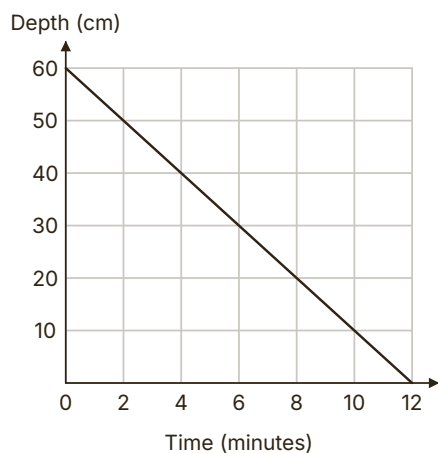
(b) Lena changes €150 into pounds. Work out how many pounds she gets.

[2 marks]

Answer £

Total for C6: 3 marks

C7 Water drains out of a tank. The graph shows the depth of water in the tank.



(a) Work out the gradient of the line.

[2 marks]

Answer

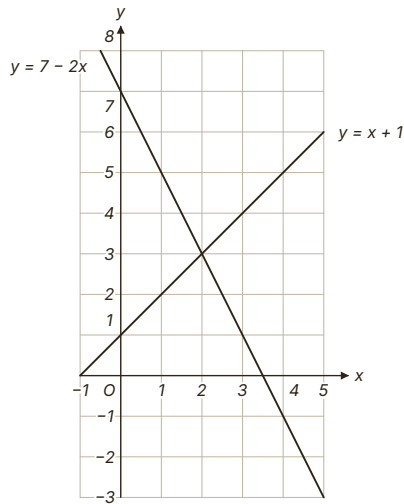
(b) Explain what the gradient tells you about the water.

[1 mark]

Total for C7: 3 marks

C8 Use the graph to solve the simultaneous equations $y = x + 1$ and $y = 7 - 2x$.

[2 marks]



Answer $x = \dots\dots$, $y = \dots\dots$

C9 Work out the coordinates of the point where the line $y = 3x - 4$ meets the line $y = 8$.

[2 marks]

Answer

D Exam-style questions

Grades 6–9

Answer every question in the space given. Show your working: most of the marks are for method.

D1 A is the point $(1, 2)$ and B is the point $(7, 10)$. Work out the equation of the perpendicular bisector of AB .

[5 marks]

Answer

- D2** Amir says, "The lines $2y = 6x + 5$ and $y = 3x - 2$ cross at exactly one point." [2 marks]
- Show that Amir is wrong.

- D3** An energy company has two tariffs. Tariff A costs a fixed £18 each month plus 20p for each unit used. Tariff B costs 28p for each unit used and has no fixed charge. The cost for a month in which u units are used is £ C .

- (a) Write down an equation for C in terms of u for each tariff. [2 marks]

Answer A : , B :

- (b) For how many units do the two tariffs cost the same? [2 marks]

Answer

- (c) In one month Kim pays £84 on tariff B . How much less would she have paid that month on tariff A ? [2 marks]

Answer £

Total for D3: 6 marks

- D4** The line $3x + 4y = 24$ crosses the x -axis at P and the y -axis at Q . O is the origin. Work out the area of triangle OPQ . [3 marks]

Answer

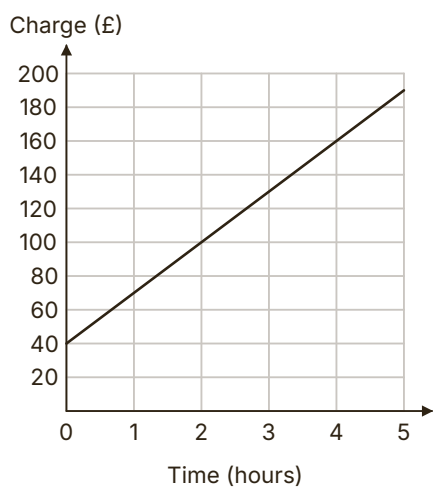
D5 The points $(2, 5)$, $(6, 13)$ and $(k, 21)$ lie on a straight line. Work out the value of k . [3 marks]

Answer

D6 Line L_1 passes through $(0, 3)$ and $(6, 0)$. Line L_2 is perpendicular to L_1 and passes through the origin. Work out the coordinates of the point where L_1 and L_2 cross. [4 marks]

Answer

D7 The graph shows the charge made by a plumber for a job. The charge is a fixed call-out fee plus an amount for each hour. Work out the call-out fee and the amount charged for each hour. [3 marks]



Answer call-out fee £ , each hour £

- D8** Work out the equation of the line that passes through $(-2, 7)$ and is parallel to the line through $(1, 1)$ and $(4, -5)$. [3 marks]

Answer

- D9** A is $(0, 0)$, B is $(4, 2)$ and C is $(1, 8)$. Show that angle ABC is a right angle. [3 marks]

- D10** The line $y = 4x + c$ passes through the point where the lines $y = 3x - 1$ and $y = 9 - 2x$ cross. Work out the value of c . [3 marks]

Answer

E Extension

Grade 9 and beyond

No route is given. Spend five minutes on a problem before you look at a hint. The hints are on the last page of the worksheet, and you can use one at a time.

- E1** The lines $y = 2x + 1$ and $y = 7 - x$ and the y -axis make a triangle. Work out the area of the triangle. [3 marks]

Answer

E2 The lines $kx + 2y = 7$ and $3x - 6y = 4$ are perpendicular. Work out the value of k . [3 marks]

Answer

E3 $A(1, 1)$ and $B(5, 3)$ are two corners of a square $ABCD$, next to each other. The letters go anticlockwise round the square. Work out the coordinates of C and of D . [4 marks]

Answer C , D

E4 A straight line passes through $(2, 9)$. It makes a triangle with the positive x -axis and the positive y -axis, and the area of the triangle is 36. Work out the equation of the line. [4 marks]

Answer

F How did it go?

Colour one circle on each line.

	Not yet	Nearly	Yes
I can draw a line from a table or from its equation, and find its gradient and y -intercept.	☐	☐	☐
I can find the equation of a line from a graph or two points, and use parallel and perpendicular gradients.	☐	☐	☐
I can read conversion and rate graphs, and solve simultaneous equations from where two lines cross.	☐	☐	☐

Extension hints

Use one hint at a time. Cover the ones below it with a sheet of paper.

-
- E1**
- Hint 1** Find the three corners of the triangle. Two of them are on the y -axis.
- Hint 2** The lines cross where $2x + 1 = 7 - x$, so at $(2, 5)$. They meet the y -axis at $(0, 1)$ and $(0, 7)$.
- Hint 3** Use the side on the y -axis as the base: it has length 6, and the height is the distance from the y -axis to $(2, 5)$.
-
- E2**
- Hint 1** Write each line in the form $y = mx + c$.
- Hint 2** The gradients are $-\frac{k}{2}$ and $\frac{1}{2}$.
- Hint 3** Perpendicular gradients multiply to -1 , so $-\frac{k}{2} \times \frac{1}{2} = -1$.
-
- E3**
- Hint 1** To get from A to B you go 4 across and 2 up.
- Hint 2** BC is perpendicular to AB and the same length. Going anticlockwise, you go 2 back and 4 up.
- Hint 3** C is 2 left and 4 up from B . D is 2 left and 4 up from A .
-
- E4**
- Hint 1** Call the gradient $-t$, with t positive. Write down where the line meets each axis in terms of t .
- Hint 2** It meets the y -axis at $9 + 2t$ and the x -axis at $2 + \frac{9}{t}$. So $\frac{1}{2}(9 + 2t)(2 + \frac{9}{t}) = 36$.
- Hint 3** This gives $4t + \frac{81}{t} = 36$, so $4t^2 - 36t + 81 = 0$, which is $(2t - 9)^2 = 0$.