



Lines through two points, double brackets, algebraic fractions, quadratic graphs and simultaneous equations

Year 9 About 85 minutes No calculator
89 marks

Name _____

Class _____

Date _____

A Before you start

Recall

You will need these in every question below.

A1 Expand $3(2x - 5)$.

[1 mark]

Answer

A2 Factorise $8x + 12$ fully.

[1 mark]

Answer

A3 Solve $5x - 7 = 2x + 8$.

[2 marks]

Answer

A4 Write down the gradient and the y -intercept of the line $y = 2x - 9$.

[2 marks]

Answer gradient y -intercept

A5 Work out the value of $x^2 - 3x$ when $x = -2$.

[1 mark]

Answer

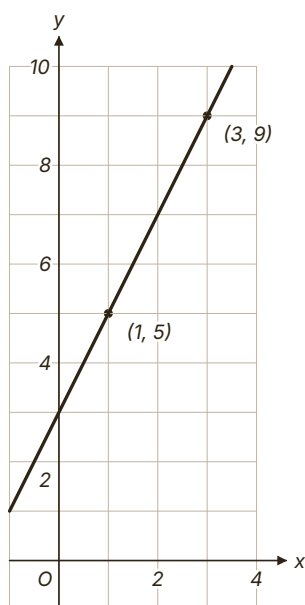
B Examples, then your turn

Core

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

EXAMPLE 1

A straight line passes through the points $(1, 5)$ and $(3, 9)$. Find the equation of the line.



Hint The gradient is the change in y divided by the change in x . Then put one of the points into $y = mx + c$ to find c .

B1 A straight line passes through the points $(1, 7)$ and $(4, -2)$. Find the equation of the line. [3 marks]

Answer

EXAMPLE 2

Expand and simplify $(x + 8)(x - 3)$.

Hint Multiply each term in the first bracket by each term in the second. There are four products. Then collect the two x terms.

B2 Expand and simplify
 $(x - 3)(x + 9)$.

[2 marks]

Answer

EXAMPLE 3

Factorise $x^2 + 5x - 14$.

Hint Find two numbers that multiply to -14 and add to 5 .

B3 Factorise $x^2 - 4x - 45$.

[2 marks]

Answer

EXAMPLE 4

Simplify $\frac{x^2 + 8x + 15}{x^2 - 25}$.

Hint Factorise the top and the bottom first. You can only cancel a whole bracket that is a factor of both.

B4 Simplify $\frac{x^2 - 5x - 6}{x^2 - 36}$.

[3 marks]

Answer

C Practice

Core

Each question asks for something different. Show your working.

C1 Factorise $x^2 - 81$.

[1 mark]

Answer

C2 The graph of $y = (x - 3)(x + 5)$ is a curve.

(a) Write down the two values of x where the curve crosses the x -axis.

[2 marks]

Answer

(b) Work out where the curve crosses the y -axis.

[1 mark]

Answer

(c) Work out the coordinates of the turning point of the curve.

[2 marks]

Answer

Total for C2: 5 marks

C3 Simplify $\frac{x^2 + 4x - 32}{x - 4}$.

[2 marks]

Answer

C4 Write $\frac{3}{x + 1} - \frac{2}{x + 4}$ as a single fraction. Simplify the top.

[3 marks]

Answer

C5 The lines $y = 4x - 3$ and $y = 2x + 7$ cross at one point. Work out the coordinates of that point.

[3 marks]

Answer

- C6** How many solutions do the simultaneous equations $y = 2x + 3$ and $4y = 8x - 5$ have? [2 marks]
Give a reason for your answer.

Answer solutions, because

- C7** A straight line passes through $(1, 1)$ and $(4, 10)$. The point $(6, k)$ is also on the line. Work out the value of k . [2 marks]

Answer

- C8** The graph of $y = (x + 2)(x - 1)(x - 5)$ is a cubic curve.

- (a) Write down the values of x where the curve crosses the x -axis. [2 marks]

Answer

- (b) Work out where the curve crosses the y -axis. [1 mark]

Answer

Total for C8: 3 marks

- C9** Expand and simplify $(x + 4)^2 - (x - 2)(x + 3)$. [3 marks]

Answer

D Test-style questions

Stretch

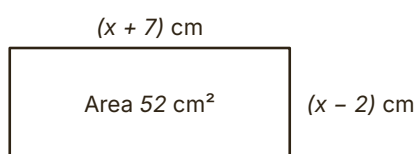
Answer every question in the space given. Show your working: most of the marks are for method.

- D1** Mia says, " $(x + 5)^2$ is the same as $x^2 + 25$." [2 marks]

Mia is wrong. Show that she is wrong, and write down the correct expansion of $(x + 5)^2$.

Answer correct expansion

- D2** A rectangle is $(x + 7)$ cm long and $(x - 2)$ cm wide. Its area is 52 cm^2 .



Not drawn accurately

- (a)** Show that $x^2 + 5x - 66 = 0$. [2 marks]

- (b)** Solve $x^2 + 5x - 66 = 0$ to find the value of x . You must show your working. [3 marks]

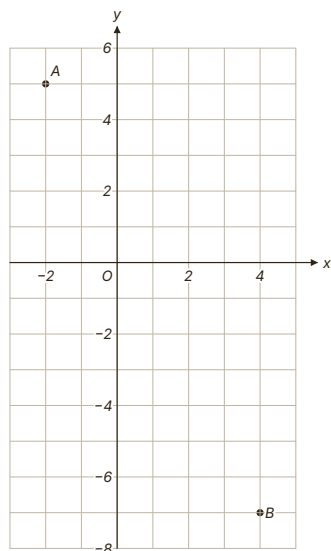
Answer

- (c)** Work out the perimeter of the rectangle. [1 mark]

Answer

Total for D2: 6 marks

D3 The points $A(-2, 5)$ and $B(4, -7)$ are shown on the grid.



(a) Find the equation of the straight line through A and B .

[3 marks]

Answer

(b) Show that the point $C(10, -19)$ is on the same line.

[2 marks]

Total for D3: 5 marks

D4 Gym A charges a joining fee of £20 and then £6 for each visit. Gym B has no joining fee and charges £8 for each visit.

(a) For how many visits do the two gyms cost the same? What is that cost? You must show your working.

[3 marks]

Answer visits £

(b) Sana plans to make 15 visits. Which gym is cheaper for her, and by how much? [2 marks]

Answer Gym by £

Total for D4: 5 marks

D5 The curve $y = x^2 + bx + c$ crosses the x -axis at $x = -2$ and $x = 8$.

(a) Work out the values of b and c . [2 marks]

Answer $b = \dots\dots$ $c = \dots\dots$

(b) Work out the coordinates of the turning point of the curve. [2 marks]

Answer

Total for D5: 4 marks

D6 Simplify fully $\frac{x^2 + 6x + 9}{x - 1} \div \frac{x + 3}{x^2 - 1}$. [4 marks]

Answer

D7 The line $y = x + 7$ and the curve $y = (x + 1)^2$ cross at two points. Work out the coordinates of both points. You must show your working. [4 marks]

Answer

- D8** Use the difference of two squares to work out $85^2 - 15^2$ without a calculator. You must show your working. [2 marks]

Answer

- D9** The curve $y = (x - a)(x + 2)(x - 4)$ crosses the y -axis at $(0, 24)$. Work out the value of a . [2 marks]

Answer

E Challenge

UKMT level

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 expression $x^2 + bx + c$ factorises into two brackets $(x + p)(x + q)$, where p and q are positive whole numbers. Also $b + c = 20$. [4 marks]

Work out the values of b and c .

Answer $b = \dots\dots$ $c = \dots\dots$

- E2** The line $y = mx + 12$ has a negative gradient m . The line, the x -axis and the y -axis make a triangle with an area of 36 square units. [3 marks]

Work out the value of m .

Answer

E3 The curve $y = x^2 - 6x + k$ touches the x -axis at exactly one point.

[3 marks]

Work out the value of k .

Answer

E4 The lines $y = 2x + 3$ and $y = 15 - x$ and the y -axis make a triangle.

[4 marks]

Work out the area of the triangle.

Answer

F How did it go?

Colour one circle on each line.

	Not yet	Nearly	Yes
I can find the equation of a straight line from two points on it, and check whether a third point is on the same line.	☐	☐	☐
I can expand two brackets, factorise a quadratic expression, and use the difference of two squares.	☐	☐	☐
I can simplify an algebraic fraction by factorising, and add, subtract, multiply and divide algebraic fractions.	☐	☐	☐
I can find the roots, the y -intercept and the turning point of a quadratic graph, and the roots of a cubic graph.	☐	☐	☐
I can solve two simultaneous equations by finding where their graphs meet, and say when there is no solution.	☐	☐	☐

Extension hints

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

E1	Hint 1	Expand $(x + p)(x + q)$. What are b and c in terms of p and q ?
	Hint 2	$b = p + q$ and $c = pq$, so $p + q + pq = 20$. Add 1 to both sides.
	Hint 3	$pq + p + q + 1 = (p + 1)(q + 1) = 21$. The only way with p and q positive is 3×7 , so $p = 2$ and $q = 6$.

E2	Hint 1	The line crosses the y -axis at 12. Where does it cross the x -axis?
	Hint 2	It crosses the x -axis where $mx + 12 = 0$. The triangle has height 12, so its base must be 6.
	Hint 3	The line meets the x -axis at $(6, 0)$, so $0 = 6m + 12$ and $m = -2$.

E3	Hint 1	If the curve touches the x -axis once, the turning point is on the x -axis.
	Hint 2	The curve is symmetrical about the line $x = 3$, so the turning point is where $x = 3$.
	Hint 3	At $x = 3$, $y = 9 - 18 + k$. This must be 0, so $k = 9$.

E4	Hint 1	Find the three corners. Two of them are on the y -axis.
	Hint 2	The lines meet the y -axis at $(0, 3)$ and $(0, 15)$. They meet each other where $2x + 3 = 15 - x$.
	Hint 3	They meet at $(4, 11)$. Take the side on the y -axis, of length 12, as the base. The height is 4, so the area is $\frac{1}{2} \times 12 \times 4$.