



eClassroom

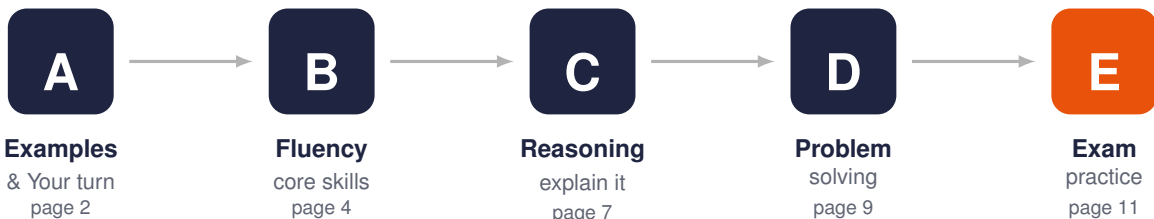
GCSE MATHEMATICS • ALGEBRA

Quadratics

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator allowed

Free Quadratics worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: solve quadratic equations by factorising, rearranging first when needed • plot quadratic graphs and read roots, intercepts and turning points • form quadratic equations from problems and choose the valid answer • *Higher:* $ax^2 + bx + c = 0$, the quadratic formula and completing the square.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER Higher only: $ax^2 + bx + c = 0$, the quadratic formula and completing the square. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	13	15
Higher marks	16	14	17	15
My score				

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Name

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Date



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A

Worked examples & Your turn

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION

Everyone starts here

Worked example A1

Solve $x^2 + x - 12 = 0$

Factorise, then set each bracket equal to 0

$$(x + 4)(x - 3) = 0$$

$$x = -4 \text{ or } x = 3$$

Your turn A1

Solve $x^2 - 8x + 15 = 0$

Worked example A2

Solve $x^2 + 6 = 5x$

Rearrange so one side is 0 first.

$$x^2 - 5x + 6 = 0 \quad (x - 2)(x - 3) = 0$$

$$x = 2 \text{ or } x = 3$$

Your turn A2

Solve $x^2 = 4x + 21$

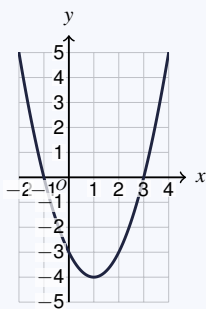
Worked example A3

The graph of $y = x^2 - 2x - 3$ is drawn.

Write down the roots and the turning point.

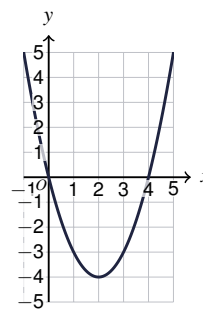
Roots: where the curve crosses the x -axis.

$$-1, 3; (1, -4)$$



Your turn A3

The graph of $y = x^2 - 4x$ is drawn. Write down the roots and the turning point.



HIGHERHigher only: $ax^2 + bx + c = 0$, the formula and completing the square**Worked example A4:** $ax^2 + bx + c = 0$

Solve $2x^2 - 5x - 3 = 0$

Factorise: $2 \times (-3) = -6$; the numbers are -6 and 1

$$(2x + 1)(x - 3) = 0$$

$$x = -\frac{1}{2} \text{ or } x = 3$$

Your turn A4

Solve $3x^2 + 10x - 8 = 0$

Worked example A5: the quadratic formulaSolve $x^2 + 4x - 3 = 0$. Give your answers to 2 decimal places.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \text{ with } a = 1, b = 4, c = -3$$

$$x = \frac{-4 \pm \sqrt{28}}{2}$$

$$x = 0.65 \text{ or } x = -4.65$$

Your turn A5Solve $2x^2 - 3x - 4 = 0$. Give your answers to 2 decimal places.**Worked example A6: completing the square**Write $x^2 + 8x + 5$ in the form $(x + p)^2 + q$, and solve $x^2 + 8x + 5 = 0$ exactly.*Halve the 8: $(x + 4)^2 - 16 + 5$*

$$(x + 4)^2 = 11$$

$$(x + 4)^2 - 11; x = -4 \pm \sqrt{11}$$

Your turn A6Write $x^2 - 10x + 18$ in the form $(x + p)^2 + q$, and solve $x^2 - 10x + 18 = 0$ exactly.**Worked example A7: completing the square with $a \neq 1$** Write $2x^2 + 12x + 7$ in the form $a(x + b)^2 + c$ *Take out the 2: $2(x^2 + 6x) + 7 = 2((x + 3)^2 - 9) + 7$*

$$2(x + 3)^2 - 11$$

Your turn A7Write $3x^2 - 12x + 5$ in the form $a(x + b)^2 + c$ 

B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION*Everyone starts here***B1** Solve

(a) $(x - 3)(x + 5) = 0$

(b) $x(x - 4) = 0$

(c) $(2x - 1)(x + 3) = 0$

(d) $(x - 6)^2 = 0$

[4 marks]**B2** Solve

(a) $x^2 + 7x + 10 = 0$

(b) $x^2 - 7x + 12 = 0$

(c) $x^2 + 2x - 15 = 0$

(d) $x^2 - 2x - 15 = 0$

[4 marks]**B3** Solve

(a) $x^2 = 6x$

(b) $x^2 = 49$

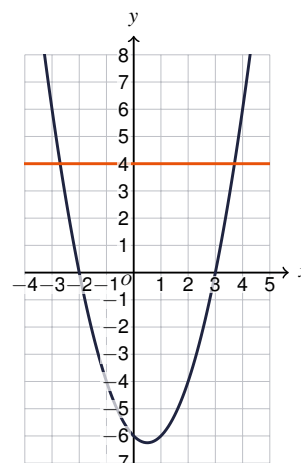
(c) $x^2 + 4x = 12$

(d) $x(x + 1) = 20$

[4 marks]**B4** The graph of $y = x^2 - x - 6$ is drawn.(a) Write down the roots of $x^2 - x - 6 = 0$

(b) Write down the y-intercept.

(c) Estimate the coordinates of the turning point.

(d) Use the graph to estimate the solutions of $x^2 - x - 6 = 4$ **[4 marks]**

FOUNDATION*continued: tables of values and forming equations***B5** Find the missing values of y .

(a) $y = x^2 - 3$ at $x = -3, 0, 3$

(b) $y = x^2 + 2x$ at $x = -2, -1, 1$

(c) $y = 5 - x^2$ at $x = -2, 0, 2$

[3 marks]**B6** Form an equation and solve it. Say whether a negative answer makes sense.**(a)** A square has area 49 cm^2 . Find its side length.**(b)** A rectangle is $x \text{ cm}$ wide and $(x + 2) \text{ cm}$ long. Its area is 35 cm^2 . Find x .**(c)** The product of two consecutive whole numbers is 56. Find the numbers.**(d)** When a number is squared and the number is then subtracted, the answer is 30. Find the number.**[4 marks]****HIGHER***Higher tier only***B7** Solve

(a) $2x^2 + 7x + 3 = 0$

(b) $3x^2 - 5x - 2 = 0$

(c) $4x^2 - 9 = 0$

(d) $6x^2 + x - 2 = 0$

[4 marks]**B8** Solve, giving your answers to 2 decimal places.

(a) $x^2 + 3x - 1 = 0$

(b) $x^2 - 5x + 2 = 0$

(c) $2x^2 + x - 5 = 0$

(d) $3x^2 - 7x + 1 = 0$

[4 marks]

HIGHER*continued: completing the square*

B9 Write in the form $(x + p)^2 + q$, or $a(x + p)^2 + q$ in part (d).

(a) $x^2 + 6x + 1$

(b) $x^2 - 4x + 7$

(c) $x^2 + 3x$

(d) $2x^2 - 8x + 3$

[4 marks]

B10 (a) Find the turning point of $y = x^2 + 6x + 1$ (b) Solve $x^2 + 6x + 1 = 0$ exactly.

(c) Find the turning point of $y = 2x^2 - 8x + 3$ (d) Solve $2x^2 - 8x + 3 = 0$ exactly.

[4 marks]



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C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Tom solves $(x - 3)(x + 4) = 0$ and writes $x = -3$ or $x = 4$
Explain Tom's mistake, and give the correct solutions. [2 marks]
- C2** Show that $x = 4$ is a solution of $x^2 - 3x - 4 = 0$, and find the other solution. [2 marks]
- C3** Sam solves $x^2 + 4 = 0$ and writes $x = 2$ or $x = -2$
Explain why Sam is wrong. What does this tell you about the graph of $y = x^2 + 4$? [3 marks]
- C4** A rectangle is x cm wide and $(x + 2)$ cm long. Its area is 48 cm^2
Show that $x^2 + 2x - 48 = 0$, solve it, and explain why only one solution gives the width. [3 marks]



HIGHER*Higher tier only*

- C5** Jo uses the quadratic formula to solve $2x^2 - 3x - 5 = 0$. She writes $x = \frac{-3 \pm \sqrt{9+40}}{4}$

Explain Jo's mistake, and find the correct solutions.

[3 marks]

- C6** Leo writes $x^2 + 6x + 2 = (x+6)^2 - 34$

Explain Leo's mistake, and write $x^2 + 6x + 2$ correctly in the form $(x+p)^2 + q$

[3 marks]

- C7** The graph of $y = x^2 + bx + c$ has its turning point at $(3, -2)$. Find b and c .

[3 marks]

- C8** (a) Show that $x^2 - 2x + 3$ is positive for every value of x , and find its least value.

(b) Hence show that $\frac{1}{x^2 - 2x + 3} \leq \frac{1}{2}$ for every value of x

[5 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION *Everyone starts here*

D1 A ball is thrown upwards. Its height after t seconds is $h = 30t - 5t^2$ metres.

At what times is the ball 40 m above the ground?

[3 marks]

D2 A square garden has side x m. A path 2 m wide goes all the way around it. The garden and path together cover 100 m^2

Find x .

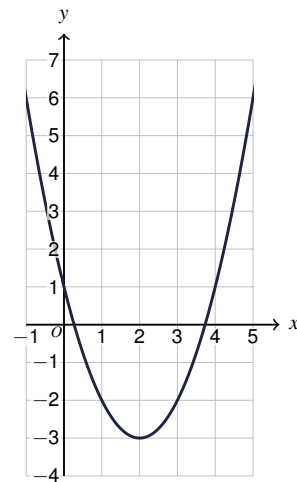
[4 marks]

D3 The product of two consecutive even numbers is 168. Find the two numbers.

[3 marks]

D4 The graph of $y = x^2 - 4x + 1$ is drawn.

Use the graph to estimate the solutions of $x^2 - 4x + 1 = 2$



[3 marks]



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HIGHER*Higher tier only*

- D5** The sum of a number and its reciprocal is $\frac{10}{3}$. Find the two possible numbers. [4 marks]
- D6** A cuboid has a square base of side x cm and a height of $(x+3)$ cm. Its total surface area is 90 cm^2 . Find the volume of the cuboid. [4 marks]
- D7** Find where the curve $y = x^2 - 6x + 5$ crosses the axes, find its turning point, and sketch the curve. [4 marks]
- D8** Solve $(x+2)^4 - 5(x+2)^2 + 4 = 0$
Hint: let $u = (x+2)^2$ [5 marks]



**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION*Foundation and Higher crossover***E1** (a) Factorise $x^2 - 7x + 10$

.....
(2)

(b) Hence solve $x^2 - 7x + 10 = 0$

.....
(1)

(Total for Question E1 is 3 marks)

E2 Solve $x^2 = 5x$

.....
(Total for Question E2 is 2 marks)

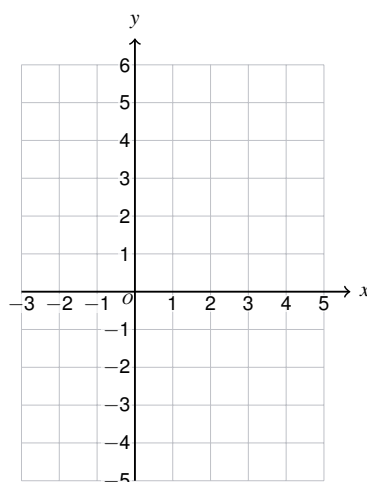


E3 (a) Complete the table of values for $y = x^2 - 2x - 3$

x	-2	-1	0	1	2	3	4
y	5		-3			0	

(2)

(b) On the grid, draw the graph of $y = x^2 - 2x - 3$ for values of x from -2 to 4



(1)

(c) Use your graph to write down the solutions of $x^2 - 2x - 3 = 0$

.....

(1)

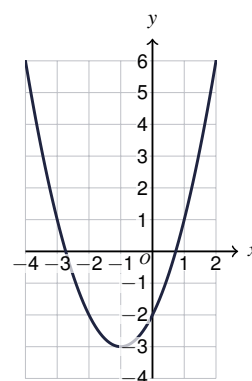
(Total for Question E3 is 4 marks)

E4 The graph of $y = x^2 + 2x - 2$ is drawn.

(a) Write down the coordinates of the turning point.

(1)

(b) Use the graph to estimate the solutions of $x^2 + 2x - 2 = 0$



.....

(2)

(Total for Question E4 is 3 marks)



- E5** A rectangle has length $(x+3)$ cm and width x cm. Its area is 40 cm^2
Find the length of the rectangle.

.....
(Total for Question E5 is 3 marks)

HIGHER*Higher tier only*

- E6** Solve $2x^2 + 7x - 4 = 0$

.....
(Total for Question E6 is 3 marks)

- E7** Solve $3x^2 - 5x - 1 = 0$. Give your solutions to 2 decimal places.

.....
(Total for Question E7 is 3 marks)

- E8** (a) Write $x^2 - 6x + 11$ in the form $(x+p)^2 + q$

.....
(2)

- (b) Write down the coordinates of the turning point of $y = x^2 - 6x + 11$

.....
(1)

- (c) Explain why $x^2 - 6x + 11 = 0$ has no real solutions.

(1)

(Total for Question E8 is 4 marks)



- E9** A right-angled triangle has sides x cm, $(x + 7)$ cm and $(x + 8)$ cm, where $(x + 8)$ cm is the hypotenuse. Find the area of the triangle.

.....
(Total for Question E9 is 5 marks)

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