



eClassroom

GCSE MATHEMATICS • ALGEBRA

Quadratics

Worked Solutions

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

Full worked solutions for the free Quadratics worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Quadratics worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. In the exam, method marks are given for correct working even when the final answer is wrong. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **P** = process mark, **A** = accuracy mark, **B** = independent mark, **C** = communication mark.

Question sheet

Algebra revision engine

Free courses

More worksheets



Join students already acing their exams.

Book your FREE lesson at www.eclassroom.org.uk

A**Your turn answers**

Compare each line of your working with the solution.

FOUNDATION

A1 $(x-3)(x-5) = 0$ $x = 3$ or $x = 5$

A2 $x^2 - 4x - 21 = 0$ $(x-7)(x+3) = 0$ $x = 7$ or $x = -3$

A3 Roots: **0 and 4** Turning point: **(2, -4)**

HIGHER

A4 $3 \times (-8) = -24$: the numbers are 12 and -2 $(3x-2)(x+4) = 0$ $x = \frac{2}{3}$ or $x = -4$

A5 $x = \frac{3 \pm \sqrt{9+32}}{4} = \frac{3 \pm \sqrt{41}}{4}$ $x = 2.35$ or $x = -0.85$

A6 $x^2 - 10x + 18 = (x-5)^2 - 25 + 18 = (x-5)^2 - 7$ $(x-5)^2 = 7$ $x = 5 \pm \sqrt{7}$

A7 $3(x^2 - 4x) + 5 = 3((x-2)^2 - 4) + 5 = 3(x-2)^2 - 7$

B**Fluency solutions**One mark for each correct part. The notes in *italics* explain why each sequence was chosen.**FOUNDATION**

B1 (a) $x = 3$ or $x = -5$ (b) $x = 0$ or $x = 4$ (c) $x = \frac{1}{2}$ or $x = -3$ (d) $x = 6$

Each bracket equals 0, so the solution has the opposite sign to the number in the bracket.

B2 (a) $(x+2)(x+5) = 0$: $x = -2$ or $x = -5$ (b) $(x-3)(x-4) = 0$: $x = 3$ or $x = 4$
 (c) $(x+5)(x-3) = 0$: $x = 3$ or $x = -5$ (d) $(x-5)(x+3) = 0$: $x = 5$ or $x = -3$



- B3** (a) $x^2 - 6x = 0$, $x(x - 6) = 0$: $x = 0$ or $x = 6$ (b) $x = 7$ or $x = -7$
 (c) $x^2 + 4x - 12 = 0$, $(x + 6)(x - 2) = 0$: $x = 2$ or $x = -6$ (d) $x^2 + x - 20 = 0$, $(x + 5)(x - 4) = 0$: $x = 4$ or $x = -5$

In (a), dividing by x would lose the solution $x = 0$

- B4** (a) -2 and 3 (b) -6 (c) about $(0.5, -6.25)$ (d) where the curve meets $y = 4$: about -2.7 and 3.7

- B5** (a) $6, -3, 6$ (b) $0, -1, 3$ (c) $1, 5, 1$

- B6** (a) $x^2 = 49$: 7 cm (-7 is not a length) (b) $x^2 + 2x - 35 = 0$, $(x + 7)(x - 5) = 0$: $x = 5$ (-7 rejected)
 (c) $x^2 + x - 56 = 0$, $(x + 8)(x - 7) = 0$: 7 and 8 (d) $x^2 - x - 30 = 0$, $(x - 6)(x + 5) = 0$: 6 or -5 , and both work

HIGHER

- B7** (a) $(2x + 1)(x + 3) = 0$: $x = -\frac{1}{2}$ or $x = -3$ (b) $(3x + 1)(x - 2) = 0$: $x = -\frac{1}{3}$ or $x = 2$
 (c) $(2x + 3)(2x - 3) = 0$: $x = \pm \frac{3}{2}$ (d) $(3x + 2)(2x - 1) = 0$: $x = -\frac{2}{3}$ or $x = \frac{1}{2}$

- B8** (a) $0.30, -3.30$ (b) $4.56, 0.44$ (c) $1.35, -1.85$ (d) $2.18, 0.15$ Use $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

- B9** (a) $(x + 3)^2 - 8$ (b) $(x - 2)^2 + 3$ (c) $\left(x + \frac{3}{2}\right)^2 - \frac{9}{4}$ (d) $2(x^2 - 4x) + 3 = 2(x - 2)^2 - 5$

Halve the coefficient of x , then subtract the square of that half.

- B10** (a) $(-3, -8)$ (b) $(x + 3)^2 = 8$: $x = -3 \pm 2\sqrt{2}$ (c) $(2, -5)$ (d) $(x - 2)^2 = \frac{5}{2}$: $x = 2 \pm \sqrt{\frac{5}{2}}$



C

Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

FOUNDATION

- C1** Tom used the signs in the brackets. $x - 3 = 0$ gives $x = 3$ and $x + 4 = 0$ gives $x = -4$ $x = 3$ or $x = -4$
- C2** $4^2 - 3 \times 4 - 4 = 16 - 12 - 4 = 0$, so $x = 4$ is a solution. $(x - 4)(x + 1) = 0$: the other is $x = -1$
- C3** x^2 is never negative, so $x^2 + 4$ is at least 4 and can never be 0. There are no solutions: the graph of $y = x^2 + 4$ never crosses the x -axis.
- C4** Area = $x(x + 2) = 48$, so $x^2 + 2x - 48 = 0$ $(x + 8)(x - 6) = 0$ $x = 6$
A width cannot be -8 , so only $x = 6$ is valid.

HIGHER

- C5** The formula starts with $-b$, and $b = -3$, so $-b = +3$ $x = \frac{3 \pm \sqrt{49}}{4} = \frac{3 \pm 7}{4}$ $x = 2.5$ or $x = -1$
- C6** Leo should halve the 6: $(x + 3)^2 = x^2 + 6x + 9$, so $x^2 + 6x + 2 = (x + 3)^2 - 7$
- C7** Turning point $(3, -2)$ means $y = (x - 3)^2 - 2 = x^2 - 6x + 7$ $b = -6$, $c = 7$
- C8** (a) $x^2 - 2x + 3 = (x - 1)^2 + 2$. $(x - 1)^2 \geq 0$, so $x^2 - 2x + 3 \geq 2 > 0$. The least value is 2 , when $x = 1$
(b) The denominator is always at least 2, so the fraction is always at most $\frac{1}{2}$

D

Problem solving solutions

There is often more than one correct method. Any complete, correct method scores full marks.

FOUNDATION

- D1** $30t - 5t^2 = 40$ $5t^2 - 30t + 40 = 0$ $t^2 - 6t + 8 = 0$ $(t - 2)(t - 4) = 0$ $t = 2$ and $t = 4$ seconds
- D2** The side of the whole square is $x + 4$ $(x + 4)^2 = 100$, so $x + 4 = 10$ $x = 6$



D3 $n(n+2) = 168$ $n^2 + 2n - 168 = 0$ $(n+14)(n-12) = 0$ **12 and 14** (or -14 and -12)

D4 Draw the line $y = 2$. It meets the curve at about $x = -0.2$ and $x = 4.2$ **$x \approx -0.2$ or 4.2**

HIGHER

D5 $x + \frac{1}{x} = \frac{10}{3}$ $3x^2 + 3 = 10x$, so $3x^2 - 10x + 3 = 0$ $(3x-1)(x-3) = 0$ **$x = 3$** or **$x = \frac{1}{3}$**

D6 $2x^2 + 4x(x+3) = 90$ $6x^2 + 12x - 90 = 0$ $x^2 + 2x - 15 = 0$ $(x+5)(x-3) = 0$, so $x = 3$
Volume = $3 \times 3 \times 6 =$ **54** cm^3

D7 y -axis: $(0, 5)$ x -axis: $(x-1)(x-5) = 0$, so **$(1, 0)$** and **$(5, 0)$** $y = (x-3)^2 - 4$: turning point **$(3, -4)$**
A U-shaped curve through these points, lowest at $(3, -4)$.

D8 Let $u = (x+2)^2$: $u^2 - 5u + 4 = 0$, so $(u-1)(u-4) = 0$ and $u = 1$ or $u = 4$
 $(x+2)^2 = 1$: $x+2 = \pm 1$ $(x+2)^2 = 4$: $x+2 = \pm 2$ **$x = -1$** , **$x = -3$** , **$x = 0$** , **$x = -4$**

E

Exam practice solutions

Marks are shown on the right of each line.

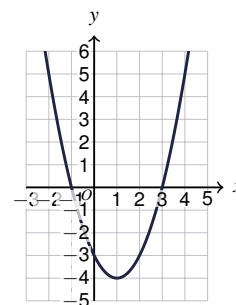
FOUNDATION *Foundation and Higher crossover*

E1 (a) **$(x-2)(x-5)$** B2
(b) **$x = 2$** or **$x = 5$** B1

E2 $x^2 - 5x = 0$, so $x(x-5) = 0$: **$x = 0$** or **$x = 5$** M1 A1



- E3** (a) y : 5, $\boxed{0}$, -3 , $\boxed{-4}$, $\boxed{-3}$, 0 , $\boxed{5}$
 (b) A smooth U-shaped curve
 (c) $\boxed{x = -1}$ or $\boxed{x = 3}$



B2 B1 B1

- E4** (a) $\boxed{(-1, -3)}$

B1

- (b) Where the curve crosses the x -axis: about $\boxed{0.7 \text{ and } -2.7}$

M1 A1

- E5** $x(x+3) = 40$, so $x^2 + 3x - 40 = 0$

M1

$$(x+8)(x-5) = 0, \text{ so } x = 5$$

A1

$$\text{Length} = 5 + 3 = \boxed{8} \text{ cm}$$

A1

HIGHER

- E6** $(2x-1)(x+4) = 0$

M1 M1

$$\boxed{x = \frac{1}{2}} \text{ or } \boxed{x = -4}$$

A1

- E7** $x = \frac{5 \pm \sqrt{25+12}}{6} = \frac{5 \pm \sqrt{37}}{6}$

M1 M1

$$\boxed{x = 1.85} \text{ or } \boxed{x = -0.18}$$

A1

- E8** (a) $(x-3)^2 - 9 + 11$

M1

$$\boxed{(x-3)^2 + 2}$$

A1

- (b) $\boxed{(3, 2)}$

B1

- (c) $(x-3)^2 + 2 \geq 2$, so it is never 0: the curve's lowest point is above the x -axis

C1

- E9** $x^2 + (x+7)^2 = (x+8)^2$

M1

$$2x^2 + 14x + 49 = x^2 + 16x + 64$$

M1

$$x^2 - 2x - 15 = 0, (x-5)(x+3) = 0, \text{ so } x = 5$$

A1

Sides 5, 12 and 13 cm

M1

$$\text{Area} = \frac{1}{2} \times 5 \times 12 = \boxed{30} \text{ cm}^2$$

A1

