

Level 3 Algebra – Quadratic Equations - Answers

June 2013 - Question 4

Question	Working	Answer	Mark	Notes
4	(a) $(x-4)^2 - 16$	-4, -16	2	M1 for $(x-4)^2 \pm c$ A1 cao
	(b) $4\{(x-4)^2 - 16\} + 63 = 0$ $4(x-4)^2 = 1$ $x-4 = \pm \frac{1}{2}$ OR $4x^2 - 32x + 63 = 0$ $(2x-7)(2x-9) = 0$ OR $a = 4, b = -32, c = 63$ $\frac{-32 \pm \sqrt{(-32)^2 - 4 \times 4 \times 63}}{2 \times 4}$ $= \frac{32 \pm \sqrt{1024 - 1008}}{8}$ $= \frac{32 \pm \sqrt{16}}{8}$ $= \frac{9}{2} \text{ or } \frac{7}{2}$	$\frac{7}{2}, \frac{9}{2}$	3	M1 for correct use of completing the square, eg $4\{(x-4)^2 - 16\} + 63 = 0$ or $(2x-8)^2 - 64 + 63 = 0$ M1 for $(x-4) = \pm \sqrt{\frac{1}{4}}$ or $(2x-8) = \pm 1$ A1 for $\frac{7}{2}, \frac{9}{2}$ oe OR M1 for $4x^2 - 32x + 63 = 0$ M1 for factorisation of $4x^2 - 32x + 63$ A1 for $\frac{7}{2}, \frac{9}{2}$ oe OR M1 for correct substitution into the formula M1 for $\frac{32 \pm \sqrt{16}}{8}$ or $\frac{16 \pm \sqrt{4}}{4}$ or $\frac{8 \pm 1}{2}$ A1 for $\frac{7}{2}, \frac{9}{2}$ oe

Jan 2014 - Question 5

5	$a = 4, b = -6, c = 1$ $\frac{-6 \pm \sqrt{(-6)^2 - 4 \times 4 \times 1}}{2 \times 4}$ $= \frac{6 \pm \sqrt{36 - 16}}{8} = \frac{6 \pm \sqrt{20}}{8}$ $= \frac{3 \pm \sqrt{5}}{4}$	$\frac{3 \pm \sqrt{5}}{4}$	3	M1 for correct formula or $\frac{-6 \pm \sqrt{(-6)^2 - 4 \times 4 \times 1}}{2 \times 4}$ oe M1 for $\frac{6 \pm \sqrt{36 - 16}}{8}$ A1 for $\frac{3 \pm \sqrt{5}}{4}$ oe
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Jan 2014 - Question 21

21		$\neq 8$	4	M1 for intention to multiply all terms by $(10-x)$ or $(10+x)$ or correct method to add $\frac{9}{10-x}$ and $\frac{9}{10+x}$ M1 for multiplying all terms by $(10-x)(10+x)$ oe M1 for correct method to clear brackets A1 cao
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Jan 2015 - Question 15

15	$\frac{x+1-x}{x(x+1)} = 2$ $1 = 2x(x+1)$ $2x^2 + 2x - 1 = 0$ $x = \frac{-2 \pm \sqrt{12}}{4}$	$-\frac{1}{2} \pm \frac{1}{2} \sqrt{3}$	5	M1 for multiplying all terms by x or $(x+1)$ or method to subtract $\frac{1}{x+1}$ from $\frac{1}{x}$ M1 for a method to clear the fractions M1 (dep M2) for correct method to solve the quadratic equation A1 for correct, unsimplified solutions A1 for $-\frac{1}{2} \pm \frac{1}{2} \sqrt{3}$
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June 2015 - Question 12

Question	Working	Answer	Mark	Notes
12 (a)(i)		$(x + 3)^2 - 2$	4	B1 for $(x + 3)^2$ or $a = 3$ B1 for $(x + 3)^2 - 2$ or $a = 3, b = -2$
(ii)		$-3 \pm \sqrt{2}$		B1 ft $-3 - \sqrt{2}$ B1 ft $-3 + \sqrt{2}$
(b)		Graph drawn	3	B3 ft fully correct graph sketched with labels at points where the graph intersects the axes and at the turning point. (B2 correct graph sketched without labels) (B1 correct shape of graph in any position)

Jan 2016 - Question 2

Question	Working	Answer	Mark	Notes
2 (a)	$a = 4, b = -1, c = -2$ $\frac{- -1 \pm \sqrt{(-1)^2 - 4 \times 4 \times -2}}{2 \times 4}$ $= \frac{1 \pm \sqrt{1 + 32}}{8}$ $= \frac{1 \pm \sqrt{33}}{8}$	$\frac{1 \pm \sqrt{33}}{8}$	2	M1 for stating the quadratic formula or correct substitution into formula A1 cao
(b)		$\frac{1 \pm \sqrt{33}}{8}$	1	B1 for $\frac{1 \pm \sqrt{33}}{8}$ oe, ft 2 solutions from (a)

June 2016 - Question 9

9		$\frac{-4 \pm \sqrt{76}}{6}$	2	M1 Stating the quadratic formula or substitution into formula A1 $\frac{-4 \pm \sqrt{76}}{6}$ oe
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June 2016 - Question 17

17 (a)		2 -3	2	M1 for $(x + 2)^2$ or $p = 2$ A1 for $p = 2$ and $q = -3$
(b)		$-\frac{1}{2}$ and 3	2	M1 for a complete method A1 cao

Jan 2017 - Question 4

Question	Working	Answer	Mark	Notes
4 (a)	$4x^2 - 12x - 7 = 0$ $(2x - 7)(2x + 1) = 0$	$-\frac{1}{2}, \frac{7}{2}$	3	M1 for writing in the form $ax^2 + bx + c (= 0)$ or correctly completing the square to the form $(dx + e)^2 + f = 7$ M1 (dep) for factorisation or $x = \frac{p \pm \sqrt{q}}{r}$ A1 for $-\frac{1}{2}, \frac{7}{2}$ oe
(b)	$a = 3, b = 8, c = -1$ $\frac{-8 \pm \sqrt{8^2 - 4 \times 3 \times -1}}{2 \times 3}$ $= \frac{-8 \pm \sqrt{76}}{6} = \frac{-4 \pm \sqrt{19}}{3}$	$\frac{-4 \pm \sqrt{19}}{3}$	3	M1 for $3x^2 + 8x - 1 (= 0)$ or $-3x^2 - 8x + 1 (= 0)$ or $a = 3, b = 8, c = -1$ or $a = -3, b = -8, c = 1$ M1 for stating the quadratic formula or correct substitution into formula A1 cao

June 2017 - Question 10

10	(a)(i)		2, 2, -43	5	M1 for recognising a as 2, maybe seen in appropriate working M1 for $2(x+2)^2+k$ A1 for 2, 2, -43
	(ii)		$-2 \pm \sqrt{\frac{43}{2}}$		M1 for " $(x+2)^2 = \frac{43}{2}$," A1 ft for " $-2 \pm \sqrt{\frac{43}{2}}$," (If M0 scored, SCB1 for correct solution in the form $p \pm \sqrt{\frac{q}{r}}$)
	(b)		(-2, -43)	1	B1 for (-2, -43) or ft from (a)

Jan 2018 - Question 4

4	$a=5, b=2, c=-1$ $\frac{-2 \pm \sqrt{2^2 - 4 \times 5 \times -1}}{2 \times 5}$ $= \frac{-2 \pm \sqrt{24}}{10} = \frac{-1 \pm \sqrt{6}}{5}$	$\frac{-1 \pm \sqrt{6}}{5}$	3	M1 for correct substitution into formula M1 for simplifying to $\frac{-2 \pm \sqrt{24}}{10}$ or $\frac{-2 \pm \sqrt{4} \sqrt{6}}{10}$ or $\frac{-1 \pm \sqrt{1+5}}{5}$ A1 cao
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June 2019 - Question 5

Question	Working	Answer	Mark	Notes
5 (a)		$2p^{-\frac{1}{2}}$	2	B2 for $2p^{-\frac{1}{2}}$ oe (B1 for $2p^n$ where $n \neq -\frac{1}{2}$ or $ap^{-\frac{1}{2}}$ oe where $a \neq 2$)
(b)		$u^{\frac{3}{2}} m^{\frac{5}{2}}$	2	M1 for correct first step, eg $\frac{u^2}{m^{\frac{1}{2}}} \times \frac{m^3}{u^{\frac{1}{2}}}$ A1 for $u^{\frac{3}{2}} m^{\frac{5}{2}}$
(c)		$\frac{-7x+3}{(x+3)(x-3)}$	3	M1 for using a correct common denominator A1 for $\frac{(x-1)(x-3)-x(x+3)}{(x+3)(x-3)}$ oe A1 for $\frac{-7x+3}{(x+3)(x-3)}$ or equivalent simplest form

Jan 2020 - Question 10

Question	Working	Answer	Mark	Notes
10 (a)(i)		$6x^2 - 4x - 3 = 0$	1	B1 for correct equation with integer coefficients
(ii)	$\frac{- -4 \pm \sqrt{(-4)^2 - 4 \times 6 \times -3}}{2 \times 6}$	$\frac{2 \pm \sqrt{22}}{6}$	3	M1 for stating the quadratic formula or correct substitution into formula ft from (a)(i) A1 ft for $\frac{4 \pm \sqrt{88}}{12}$ A1 for $\frac{2 \pm \sqrt{22}}{6}$
(b)		-3, -2	3	M1 for $(x+3)[(x+3)-1]=0$ M1 for $(x+3)(x+2)=0$ A1 for -3, -2 OR M1 for $x^2 + 6x + 9 - x - 3 = 0$ M1 for $(x+3)(x+2)=0$ or use of the quadratic formula as far as $\frac{-5 \pm \sqrt{1}}{2}$ A1 for -3, -2
(c)		$(x-4)^2 - 13$	2	M1 $(x-4)^2$ oe A1 $(x-4)^2 - 13$

Jan 2021 - Question 6

6	(a)		$2(x-3)^2 - 5$	3	M1 for a start to the process eg $2(x^2 - 6x) + 13$ or $2(x^2 - 6x + 6.5)$ M1 for $2(x-3)^2 + c$ or $2[(x-3)^2 + c]$ A1 cao
	(b)		$3 \pm \sqrt{\frac{5}{2}}$	2	M1 (dep M2) for isolating $(x-3)^2$ term A1 $3 \pm \sqrt{\frac{5}{2}}$

Jan 2022 - Question 5

5			$x = -8, x = 0$	3	M1 for dealing with fraction, eg $2x(x+2) = x(x-4)$ or for $\frac{2}{x-4} = \frac{1}{x+2}$ or for $2(x+2) = 1(x-4)$ M1 for writing equation in the form $ax^2 + bx + c (= 0)$, eg $x^2 + 8x (= 0)$ oe A1 for $x = -8, x = 0$
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Jan 2022 - Question 15

Question	Working	Answer	Mark	Notes
15 (a)(i)		$x^2 - 12x + 25 = 0$	2	M1 for correct expansion of $(x-5)^2 = x^2 - 5x - 5x + 25$ A1
(ii)	$\frac{- - 12 \pm \sqrt{(-12)^2 - 4 \times 1 \times 25}}{2 \times 1}$	$6 \pm \sqrt{11}$	3	M1 for stating the quadratic formula or correct substitution into formula ft from (a)(i) or correct completion of the square A1 ft for $\frac{12 \pm \sqrt{44}}{2}$ or $(x-6) = \pm \sqrt{11}$ A1 for $6 \pm \sqrt{11}$
(b)(i)		$(x-3)^2 - 25$	2	M1 for $(x-3)^2$ A1 for $(x-3)^2 - 25$
(ii)		-2, 8	2	M1 $(x-3) = (\pm)5$ A1 cao

June 2022 - Question 3

3	$\frac{- - 2 \pm \sqrt{(-2)^2 - 4 \times 3 \times -6}}{6}$	$\frac{2 \pm \sqrt{76}}{6}$	2	M1 for stating the quadratic formula, may be implied by correct substitution into formula A1 oe, eg $\frac{1 \pm \sqrt{19}}{3}$
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June 2022 - Question 21

Question	Working	Answer	Mark	Notes
21 (a)		$\frac{4x-8}{x^2-16}$	3	M1 for using a correct common denominator may be seen as $(x-4)(x+4)$ oe A1 for $\frac{3(x-4)+1(x+4)}{(x-4)(x+4)}$ oe A1 for $\frac{4x-8}{x^2-16}$ or $\frac{4x-8}{(x-4)(x+4)}$ or $\frac{2(2x-4)}{x^2-16}$ or $\frac{2(2x-4)}{(x-4)(x+4)}$ or $\frac{4(x-2)}{x^2-16}$ or $\frac{4(x-2)}{(x-4)(x+4)}$
(b)		-1, 6	3	M1 for clearing the fractions, eg $5(4x-8) = 4(x^2-16)$, ft from $\frac{ax+b}{x^2-c}$ in (a) A1 for writing equation in the form $ax^2 + bx + c = 0$, eg $x^2 - 5x - 6(= 0)$ or $4x^2 - 20x - 24(= 0)$ ft from $\frac{ax+b}{x^2-c}$ in (a) A1 cao

Jan 2023 - Question 13

Question	Working	Answer	Mark	Notes
13 (a)		$\frac{2 \pm \sqrt{10}}{3}$	3	M1 for stating the quadratic formula or correct substitution into formula A1 for $\frac{4 \pm \sqrt{40}}{6}$ or $\frac{4 \pm 2\sqrt{10}}{6}$ A1 cao
(b)(i)		$(2x-3)^2 + 1$	3	M1 for a correct first step eg $(2x-a)^2$ or $4(x^2-3x)+10$ or $4(x^2-3x+\frac{10}{4})$ M1 for $(2x-3)^2$ or $4(x-\frac{3}{2})^2 + 1$ or fully correct equivalent expression eg $4[(x-\frac{3}{2})^2 + \frac{1}{4}]$ A1 for $(2x-3)^2 + 1$
(ii)		Graph sketched with labels	3	M1 for a parabola in the correct orientation M1 for a parabola with (1.5, 1) labelled at turning point or (0, 10) labelled A1 fully correct graph drawn with all labels

June 2023 - Question 2

2	$\frac{-9 \pm \sqrt{9^2 - 4 \times 10 \times 2}}{2 \times 10}$	$\frac{2}{5}, -\frac{1}{2}$	2	M1 for factorising to $(5y+2)(2y+1)$ oe or correct substitution into the quadratic formula or correct completion of square. A1 for $\frac{2}{5}, -\frac{1}{2}$ oe
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June 2023 - Question 4

Question	Working	Answer	Mark	Notes
4 (a)	$\frac{- - 4 \pm \sqrt{(-4)^2 - 4 \times 3 \times -5}}{2 \times 3}$	$\frac{2 \pm \sqrt{19}}{3}$	3	M1 for stating the quadratic formula or correct substitution into formula M1 for simplification to $\frac{4 \pm \sqrt{76}}{6}$
(b)		$-\frac{3}{2}, \frac{1}{2}$	3	A1 cao M1 for start to method for finding values, eg correct expansion of $(x+p)^2$ or $4px = -6x$ or $2p^2 + q = 5$ or for $(x - \frac{3}{2})^2$ oe A1 for $p = -\frac{3}{2}$ or $-1\frac{1}{2}$ or -1.5 or for $2(x - \frac{3}{2})^2 + \frac{1}{2}$ oe A1 for $p = -\frac{3}{2}, q = \frac{1}{2}$ oe
(c)		-3	2	M1 for sum = $-\frac{b}{a}$ ($= -\frac{12}{4}$) or for $4x^2 + 12x - 5 (= 0)$ A1 cao

Jan 2024 - Question 3

3	$\frac{- - 3 \pm \sqrt{(-3)^2 - 4 \times 5 \times -2}}{10}$	$-\frac{2}{5}, 1$	2	M1 for stating the quadratic formula, may be implied by correct substitution into formula A1 for $-\frac{2}{5}, 1$ oe
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Jan 2024 - Question 22

Question	Working	Answer	Mark	Notes
22 (a)		$\frac{x}{x-2}$	2	M1 for factorisation, eg $x(x-3)$ or $(x-2)(x-3)$ A1 cao
(b)		$0, -\frac{3}{2}$	4	M1 for writing as a single fraction, eg $\frac{1(x+2)+2(x+1)}{(x+1)(x+2)}$ or deals with the fractions, eg $1(x+2) + 2(x+1) = 2(x+1)(x+2)$ M1 for dealing with the fractions and expanding brackets, eg $x+2+2x+2 = 2x^2+6x+4$ M1 for writing equation in the form $ax^2+bx+c=0$, eg $2x^2+3x(=0)$ A1 oe