

Level 3 Algebra - Surds - Answers

June 2013 - Question 13

Question	Working	Answer	Mark	Notes
13 (a)	$3\sqrt{5} \times 3\sqrt{5}$	45	1	B1 for 45
(b)	$7\sqrt{2} + 3\sqrt{2}$	$10\sqrt{2}$	2	M1 for correct method to write $\sqrt{98}$ or $\sqrt{18}$ in the form $a\sqrt{2}$ or sight of $7\sqrt{2}$ or $3\sqrt{2}$ A1 cao
(c)	$\frac{1}{5-\sqrt{2}} \times \frac{5+\sqrt{2}}{5+\sqrt{2}}$	$\frac{5+\sqrt{2}}{23}$	2	M1 for multiplying both numerator and denominator by a suitable expression, eg $5 + \sqrt{2}$ A1 cao

Jan 2014 - Question 15

15 (a)	$\sqrt{36 \times 3}$	$6\sqrt{3}$	1	B1 cao
(b)	$(2 - \sqrt{3})(2 + \sqrt{3}) = 4 - 3$	1	2	M1 for correct method to expand A1 cao
(c)	$\frac{1}{2\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$	$\frac{\sqrt{3}}{6}$	2	M1 for multiplying both numerator and denominator by a suitable expression, eg $\sqrt{3}$ or a multiple of $\sqrt{3}$ A1 $\frac{\sqrt{3}}{6}$ oe where a and b are both integers

Jan 2015 - Question 19

19		$\frac{3+\sqrt{5}}{2}$	4	M1 for multiplying both numerator and denominator by a suitable expression, eg $(5 + \sqrt{5})$ M1(dep) for eg $(5 + \sqrt{5})(5 + \sqrt{5}) = 30 + 10\sqrt{5}$ or $(5 - \sqrt{5})(5 + \sqrt{5}) = 20$ A1 $\frac{30 + 10\sqrt{5}}{20}$ A1 cao
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June 2015 - Question 17

17 (a)	$2 \times 3 + 1$	7	2	M1 for one term correctly evaluated A1 cao
(b)		$\frac{25+5\sqrt{7}}{6}$ or $\frac{5(5+\sqrt{7})}{6}$	3	M1 for multiplying by $\frac{5+\sqrt{7}}{5+\sqrt{7}}$ M1 for $15(5 + \sqrt{7})$ or $75 + 15\sqrt{7}$ and $25 - 7 (= 18)$ A1 $\frac{25+5\sqrt{7}}{6}$ or $\frac{5(5+\sqrt{7})}{6}$

Jan 2016 - Question 20

20 (a)		$\frac{\sqrt{3}}{15}$	2	M1 for correct method to rationalise, eg multiplying by $\frac{\sqrt{3}}{\sqrt{3}}$ oe A1 $\frac{\sqrt{3}}{15}$ oe
(b)(i)		$3\sqrt{2}$	4	B1 cao
(ii)	$\frac{\frac{1}{2\sqrt{2}} + \frac{1}{3\sqrt{2}}}{\frac{3+2}{6\sqrt{2}}}$	$\frac{5}{6\sqrt{2}}$		M1 for $\frac{1}{2\sqrt{2}} + \frac{1}{3\sqrt{2}}$ or $\frac{\sqrt{8}}{8} + \frac{\sqrt{18}}{18}$ M1 for use of a correct common denominator, eg $6\sqrt{2}$, 72 A1 for $\frac{5}{6\sqrt{2}}$ or equivalent answer in correct form. SC B2 for equivalent rationalised answer.

June 2016 - Question 12

12	(a)		28	1	B1 cao
	(b)		$9\sqrt{3}$	2	M1 for correct first step, eg $12\sqrt{3}$, $3\sqrt{3}$ A1 cao
	(c)		$\frac{7 - \sqrt{3}}{23}$	3	M1 for multiplying by $\frac{7-\sqrt{3}}{7-\sqrt{3}}$ M1 for $14 - 2\sqrt{3}$ and $49 - 3$ A1 cao

Jan 2017 - Question 15

Question	Working	Answer	Mark	Notes
15 (a)		$\frac{3 - \sqrt{7}}{2}$	2	M1 for multiplying by $\frac{3-\sqrt{7}}{3-\sqrt{7}}$ oe A1 for $\frac{3-\sqrt{7}}{2}$
b(i)		$4\sqrt{10}$	4	M1 for correct expansion of $(\sqrt{5} + \sqrt{2})^2$ or $(\sqrt{5} - \sqrt{2})^2$ or $\{(\sqrt{5} + \sqrt{2}) - (\sqrt{5} - \sqrt{2})\}\{(\sqrt{5} + \sqrt{2}) + (\sqrt{5} - \sqrt{2})\}$ A1 for $(5 + 2\sqrt{2}\sqrt{5} + 2) - (5 - 2\sqrt{2}\sqrt{5} + 2)$ oe or $2\sqrt{2} \times 2\sqrt{5}$ A1
(ii)		160		B1 ft in $a\sqrt{b}$

June 2017 - Question 19

19		$3 + \sqrt{5}$	3	M1 for multiplying by $\frac{3+\sqrt{5}}{3+\sqrt{5}}$ M1 for $12 + 4\sqrt{5}$ and $9 - 3\sqrt{5} + 3\sqrt{5} - 5$ or $\frac{4(3+\sqrt{5})}{4}$ A1 $3 + \sqrt{5}$
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Jan 2018 - Question 7

Question	Working	Answer	Mark	Notes
7		$4\sqrt{10}$	3	M1 for a correct expansion eg $\sqrt{125} \times \sqrt{8} - \sqrt{5} \times \sqrt{8} - \sqrt{125} \times \sqrt{2} + \sqrt{5} \times \sqrt{2}$ or $\sqrt{1000} - \sqrt{40} - \sqrt{250} + \sqrt{10}$ allow one sign error M1 for simplifying one term correctly to the form $a\sqrt{10}$ or $a\sqrt{5}\sqrt{2}$ where $a \neq 1$ A1 for $4\sqrt{10}$ (accept $2\sqrt{40}$) OR M1 for $\sqrt{125} = 5\sqrt{5}$ or $\sqrt{8} = 2\sqrt{2}$ M1 for $4\sqrt{5} \times \sqrt{2}$ A1 for $4\sqrt{10}$ (accept $2\sqrt{40}$)

June 2018 - Question 16

Question	Working	Answer	Mark	Notes
16 (a)		$\frac{3x - 8y}{5(x-y)(x+y)}$	4	M1 for correct factorisation of $x^2 - y^2$, eg $(x - y)(x + y)$ M1 for finding a common denominator, eg $5(x - y)(x + y)$ or $(5x + 5y)(x^2 - y^2)$ M1 (dep M1) for correct method to combine fractions A1 for $\frac{3x - 8y}{5(x-y)(x+y)}$ or $\frac{3x - 8y}{(5x - 5y)(x + y)}$ or $\frac{3x - 8y}{(x - y)(5x + 5y)}$ or $\frac{3x - 8y}{5(x^2 - y^2)}$ or $\frac{3x - 8y}{5x^2 - 5y^2}$
(b)		$\frac{3\sqrt{p} - 1}{2}$	3	M1 for correct method to rationalise, eg multiplying by $\frac{\sqrt{p}}{\sqrt{p}}$ oe M1 for $3p\sqrt{p} - p$ and $2p$ or $6p\sqrt{p} - 2p$ and $4p$ oe A1 $\frac{3\sqrt{p} - 1}{2}$ or $\frac{3\sqrt{p}}{2} - \frac{1}{2}$

Jan 2019 - Question 8

8 (a)		25	2	M1 for $(2\sqrt{5})^2 + (-\sqrt{5})^2$ or $(2\sqrt{5})^2 = 20$ or $(-\sqrt{5})^2 = 5$ A1 cao
(b)		$-4 + 4\sqrt{5}$	2	M1 for expanding $(2\sqrt{5} + 2)(-\sqrt{5} + 3)$ to obtain 4 terms with all 4 correct without considering signs or for 3 terms out of 4 correct with correct signs A1 for $-4 + 4\sqrt{5}$
(c)		$\frac{1}{3}$	2	M1 for simplifying to $\sqrt{5} \div 3\sqrt{5}$ oe or rationalising to $\frac{20 - 10 - 10 + 5}{20 - 5}$ oe A1 for $\frac{1}{3}$ oe

June 2019 - Question 18

18 (a)		2.3	2	M1 for correct substitution, eg $\frac{4 \times 4 + 7}{16 - 3\sqrt{4}}$ A1 oe
(b)		$\frac{65 + 6\sqrt{7}}{29}$	3	M1 for multiplying by $\frac{6 + \sqrt{7}}{6 + \sqrt{7}}$ oe M1 (dep M1) for $72 - 6\sqrt{7} + 12\sqrt{7} - 7 (= 65 + 6\sqrt{7})$ used as the numerator A1 for $\frac{65 + 6\sqrt{7}}{29}$

Jan 2020 - Question 9

9 (a)		$\frac{1}{8}$	1	B1 for $\frac{1}{8}$ or 0.125
(b)		$2 + \sqrt{5}$	4	M1 for substitution, eg $\frac{\sqrt{5}}{5 - 2\sqrt{5}}$ M1 for multiplying by $\frac{5 + 2\sqrt{5}}{5 + 2\sqrt{5}}$ or a multiple of $\frac{5 + 2\sqrt{5}}{5 + 2\sqrt{5}}$ A1 for a single fraction with surds resolved eg $\frac{5\sqrt{5} + 10}{25 - 20}$ or $\frac{5(\sqrt{5} + 2)}{5}$ A1 for $2 + \sqrt{5}$
(c)		$n = \frac{5t}{2t + 1}$	3	M1 for correct first step, eg $t(5 - 2n) = n$ M1 for isolating terms in n on one side of the equation eg $2nt + n = 5t$ A1 for $n = \frac{5t}{2t + 1}$ oe

Jan 2020 - Question 14

Question	Working	Answer	Mark	Notes
14 (a)		$\frac{7}{4\sqrt{2}}$	3	M1 for $\frac{1}{(\sqrt{2})^3} = \frac{1}{2\sqrt{2}}$ or $\frac{1}{(\sqrt{2})^5} = \frac{1}{4\sqrt{2}}$ M1 for $\frac{4+2+1}{4\sqrt{2}}$ A1 for $\frac{7}{4\sqrt{2}}$ OR M1 for $\frac{(\sqrt{2})^4 + (\sqrt{2})^2 + 1}{(\sqrt{2})^5}$ or $\frac{\sqrt{16} + \sqrt{4} + \sqrt{1}}{\sqrt{32}}$ M1 for $(\sqrt{2})^4 = 4$ or $(\sqrt{2})^2 = 2$ or $(\sqrt{2})^5 = 4\sqrt{2}$ A1 for $\frac{7}{4\sqrt{2}}$
(b)		3	3	M1 for multiplying by $\frac{\sqrt{20+\sqrt{5}}}{\sqrt{20+\sqrt{5}}}$ or a multiple of $\frac{\sqrt{20+\sqrt{5}}}{\sqrt{20+\sqrt{5}}}$ A1 for $\frac{20+10+10+5}{20-5}$ A1 cao OR M1 for $\frac{2\sqrt{5}+\sqrt{5}}{2\sqrt{5}-\sqrt{5}}$ M1 for $\frac{3\sqrt{5}}{\sqrt{5}}$ A1 cao

Jan 2021 - Question 19

19		$\frac{-21 + 14\sqrt{5}}{11}$	3	M1 for multiplying by $\frac{3-2\sqrt{5}}{3-2\sqrt{5}}$ oe M1 (dep M1) for correct expansion of the denominator, eg $\frac{-21+14\sqrt{5}}{3^2-(2\sqrt{5})^2}$ or $\frac{7(3-2\sqrt{5})}{3^2-6\sqrt{5}+6\sqrt{5}-(2\sqrt{5})^2}$ A1 for $\frac{-21+14\sqrt{5}}{11}$ oe
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Jan 2022 - Question 17

17 (a)		$12 + 4\sqrt{3}$	2	M1 for at least one of $(\sqrt{3})^2 = 3$, $(\sqrt{3})^3 = 3\sqrt{3}$, $(\sqrt{3})^4 = 9$ A1 oe
(b)		-4	3	M1 for multiplying $\frac{1}{2-\sqrt{5}}$ by $\frac{2+\sqrt{5}}{2+\sqrt{5}}$ oe or for multiplying $\frac{1}{2+\sqrt{5}}$ by $\frac{2-\sqrt{5}}{2-\sqrt{5}}$ oe or for combining fractions, eg: $\frac{2+\sqrt{5}+2-\sqrt{5}}{(2+\sqrt{5})(2-\sqrt{5})}$ A1 for $-2 - \sqrt{5}$ or $-2 + \sqrt{5}$ or $\frac{4}{4-5}$ A1 cao

June 2022 - Question 17

Question	Working	Answer	Mark	Notes
17 (a)		$-3 + \sqrt{3}$	3	B1 for using $\sqrt{12} = 2\sqrt{3}$ or $\sqrt{3}\sqrt{12} = 6$ M1 for expanding bracket to obtain 4 terms with all 4 correct without considering signs or for 3 terms out of 4 correct with correct signs, eg $15 - 9\sqrt{3} + 5\sqrt{12} - 3\sqrt{3}\sqrt{12}$ A1 for $-3 + \sqrt{3}$
(b)		$\frac{11 - \sqrt{13}}{12}$	3	M1 for multiplying by $\frac{1+\sqrt{13}}{1+\sqrt{13}}$ oe M1 for rationalising to $\frac{2-13+2\sqrt{13}-\sqrt{13}}{1-13}$ oe A1 for $\frac{11-\sqrt{13}}{12}$

Jan 2023 - Question 14

Question	Working	Answer	Mark	Notes
14 (a)		$\frac{\sqrt{5}}{35}$	2	M1 for rationalising the denominator eg $\frac{7\sqrt{5}}{7\sqrt{5} \times 7\sqrt{5}}$ A1 oe
(b)		$2\sqrt{2}$	3	M1 for writing both fractions over a common denominator eg $\frac{-1+\sqrt{2}}{(1+\sqrt{2})(-1+\sqrt{2})} + \frac{1+\sqrt{2}}{(1+\sqrt{2})(-1+\sqrt{2})}$ or $\frac{-1+1+2\sqrt{2}}{(\sqrt{2}-1)(\sqrt{2}+1)}$ or for rationalising both fractions eg $\frac{1-\sqrt{2}}{(1+\sqrt{2})(1-\sqrt{2})} + \frac{-1-\sqrt{2}}{(-1+\sqrt{2})(-1-\sqrt{2})}$ M1 for simplifying to $\frac{2\sqrt{2}}{2-1}$ or $\frac{1-\sqrt{2}}{-1} + \frac{-1-\sqrt{2}}{-1}$ A1 cao

June 2023 - Question 7

Question	Working	Answer	Mark	Notes
7 (a)		3	2	M1 for correct substitution, eg $\frac{1+4\sqrt{25}}{12-\sqrt{25}}$ oe A1 cao
(b)		$4(6 - \sqrt{2})$	3	M1 for reduction of surd, eg $\sqrt{32} = 4\sqrt{2}$, $\sqrt{32} = 2\sqrt{8}$ or $\sqrt{8} = 2\sqrt{2}$ M1 for correct expansion of brackets, eg $40 - 5\sqrt{32} + 8\sqrt{8} - \sqrt{256}$ A1 for $4(6 - \sqrt{2})$ or $2(12 - \sqrt{8})$

Jan 2024 - Question 17

Question	Working	Answer	Mark	Notes
17 (a)		$-30 + 14\sqrt{5}$	3	<p>M1 for a partial expansion and a simplification of $\sqrt{5} \times \sqrt{5} = 5$ eg $9 - 3\sqrt{5} - 3\sqrt{5} + 5$ or $\sqrt{5}(3 - \sqrt{5}) = 3\sqrt{5} - 5$ or for a full expansion of the expression eg $9\sqrt{5} - 3\sqrt{5} \times \sqrt{5} - 3\sqrt{5} \times \sqrt{5} + \sqrt{5} \times \sqrt{5} \times \sqrt{5}$</p> <p>M1 for a full expansion and a simplification of $\sqrt{5} \times \sqrt{5} = 5$, eg $14\sqrt{5} - 6\sqrt{5} \times \sqrt{5}$ or $9\sqrt{5} - 15 - 3\sqrt{5} \times \sqrt{5} + 5\sqrt{5}$</p> <p>A1 for $-30 + 14\sqrt{5}$ or $2(-15 + 7\sqrt{5})$</p>
(b)		$\frac{13 + 5\sqrt{7}}{2}$	3	<p>M1 for multiplying by $\frac{3+\sqrt{7}}{3+\sqrt{7}}$ oe</p> <p>M1 for rationalising to $\frac{6+7+2\sqrt{7}+3\sqrt{7}}{9-7}$</p> <p>A1 for $\frac{13+5\sqrt{7}}{2}$</p>