1.2 Rationalising Denominators and Surd Equations: Test Pack

Total Marks

AQA 8365 · Calculator allowed · about 65 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Simplify each surd, giving your answer in the form $a\sqrt{b}$ where b has no square factors.

(a) Simplify $\sqrt{20}$. **(1)**

(b) Simplify $\sqrt{63}$. **(1)**

(c) Simplify $\sqrt{8} \times \sqrt{18}$, giving your answer as an integer. **(2)**

(Total for Question 1 is 4 marks)

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2 Rationalise the denominator in each expression, simplifying fully.

(a) $1 / \sqrt{3}$ **(2)**

(b) $5 / \sqrt{5}$ **(2)**

(c) $12 / \sqrt{6}$ **(2)**

(Total for Question 2 is 6 marks)

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3 Expand and simplify each expression.

(a) $(2 + \sqrt{3})(2 - \sqrt{3})$ **(2)**

(b) $(\sqrt{5} + 1)^2$ **(2)**

(c) $\sqrt{7}\,(3 - \sqrt{7})$ **(2)**

(Total for Question 3 is 6 marks)

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4 Solve each equation.

(a) $\sqrt{x} = 7$ **(1)**

.....

(b) $\sqrt{x + 3} = 5$ **(2)**

.....

(c) $\sqrt{2x - 1} = 3$ **(2)**

.....

(Total for Question 4 is 5 marks)

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5 Solve each equation. Check that your answer satisfies the original equation.

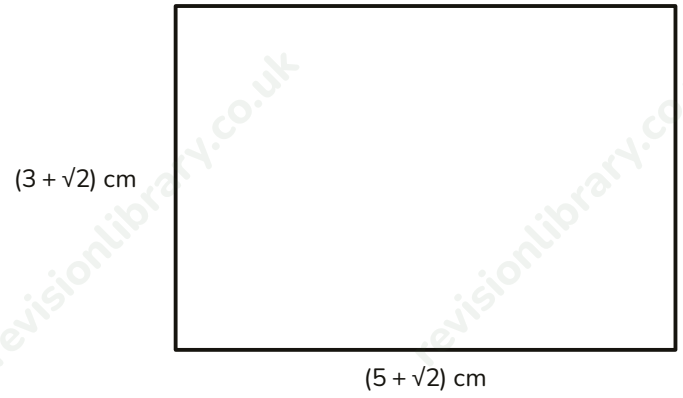
(a) $\sqrt{3x + 4} - 2 = 3$ **(3)**

(b) $\sqrt{5x + 1} + 2 = 7$ **(3)**

(Total for Question 5 is 6 marks)

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6 A rectangle has length $(5 + \sqrt{2})$ cm and width $(3 + \sqrt{2})$ cm.



(a) Find the perimeter of the rectangle, giving your answer in the form $a + b\sqrt{2}$. **(2)**

(b) Find the area of the rectangle, giving your answer in the form $p + q\sqrt{2}$. **(3)**

(Total for Question 6 is 5 marks)

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7 Simplify fully: $(3 + \sqrt{2})/(2 - \sqrt{2}) + (3 - \sqrt{2})/(2 + \sqrt{2})$.

(Total for Question 7 is 5 marks)

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8 Prove that $1 / (\sqrt{n+1} - \sqrt{n}) = \sqrt{n+1} + \sqrt{n}$ for all positive integers n.

(Total for Question 8 is 5 marks)

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9 Solve $\sqrt{x + 38} = x - 4$. You must show how you reject any invalid solution.

(Total for Question 9 is 4 marks)

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10 Rationalise the denominator of $1/(\sqrt{10} + \sqrt{2})$. Give your answer in its simplest form.

(Total for Question 10 is 3 marks)

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11 Simplify $(-9 + 6\sqrt{6})/\sqrt{6}$, writing your answer in the form $a + b\sqrt{6}$ with a and b in their simplest form.

(Total for Question 11 is 3 marks)

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12 $x = 3 + \sqrt{8}$. Show that $1/x = 3 - \sqrt{8}$ and hence find the exact value of $x^2 + 1/x^2$.

(Total for Question 12 is 3 marks)

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Mark scheme · 1.2 Rationalising Denominators and Surd Equations: Test Pack

Question 1

(a) $2\sqrt{5}$ oe **B1**

(a) Answer: $2\sqrt{5}$

(b) $3\sqrt{7}$ oe **B1**

(b) Answer: $3\sqrt{7}$

(c) combines to $\sqrt{8 \times 18} = \sqrt{144}$ oe (e.g. $2\sqrt{2} \times 3\sqrt{2}$) **M1**

(c) 12 cao **A1**

(c) Answer: 12

Question 2

(a) multiplies numerator and denominator by $\sqrt{3}$ **M1**

(a) $\sqrt{3}/3$ oe cao **A1**

(a) Answer: $\sqrt{3}/3$

(b) multiplies numerator and denominator by $\sqrt{5}$ **M1**

(b) $\sqrt{5}$ cao **A1**

(b) Answer: $\sqrt{5}$

(c) multiplies numerator and denominator by $\sqrt{6}$ **M1**

(c) $2\sqrt{6}$ cao **A1**

(c) Answer: $2\sqrt{6}$

Question 3

(a) attempts full expansion, e.g. $4 - 2\sqrt{3} + 2\sqrt{3} - 3$ **M1**

(a) 1 cao **A1**

(a) Answer: 1

(b) attempts full expansion $5 + \sqrt{5} + \sqrt{5} + 1$ oe **M1**

(b) $6 + 2\sqrt{5}$ oe cao **A1**

(b) Answer: $6 + 2\sqrt{5}$

(c) multiplies out to $3\sqrt{7} - 7$ oe (unsimplified acceptable) **M1**

(c) $3\sqrt{7} - 7$ oe cao **A1**

(c) Answer: $3\sqrt{7} - 7$

Question 4

(a) $x = 49$ cao **B1**

(a) Answer: $x = 49$

(b) squares both sides: $x + 3 = 25$ **M1**

(b) $x = 22$ cao **A1**

(b) Answer: $x = 22$

(c) squares both sides: $2x - 1 = 9$ **M1**

(c) $x = 5$ cao **A1**

(c) Answer: $x = 5$

Question 5

(a) rearranges to $\sqrt{3x+4} = 5$ **M1**

(a) squares both sides to $3x + 4 = 25$ (dependent on previous M1) **M1**

(a) $x = 7$ cao **A1**

(a) Answer: $x = 7$

(b) rearranges to $\sqrt{5x+1} = 5$ **M1**

(b) squares both sides to $5x + 1 = 25$ (dependent on previous M1) **M1**

(b) $x = 4.8$ oe $(24/5)$ cao **A1**

(b) Answer: $x = 4.8$ (24/5)

Question 6

(a) $P = 2[(5+\sqrt{2})+(3+\sqrt{2})]$ oe **M1**

(a) $16 + 4\sqrt{2}$ cao **A1**

(a) Answer: $16 + 4\sqrt{2}$ cm

(b) attempts full expansion $(5+\sqrt{2})(3+\sqrt{2})$ **M1**

(b) simplifies $\sqrt{2} \times \sqrt{2} = 2$ within the expansion **M1**

(b) $17 + 8\sqrt{2}$ cao **A1**

(b) Answer: $17 + 8\sqrt{2}$ cm^2

Question 7

identifies common denominator $(2-\sqrt{2})(2+\sqrt{2}) = 2$ **M1**

expands first numerator $(3+\sqrt{2})(2+\sqrt{2}) = 8 + 5\sqrt{2}$ **M1**

expands second numerator $(3-\sqrt{2})(2-\sqrt{2}) = 8 - 5\sqrt{2}$ **M1**

combines numerators: surd terms cancel to give 16 **A1**

8 cao **A1**

Answer: 8

Question 8

multiplies numerator and denominator by the conjugate $(\sqrt{n+1} + \sqrt{n})$ **M1**

correctly expands denominator $(\sqrt{n+1} - \sqrt{n})(\sqrt{n+1} + \sqrt{n}) = (n+1) - n$ **M1**

denominator simplifies to 1 **A1**

reaches $\sqrt{n+1} + \sqrt{n}$ cso, printed result obtained **A1**

recognises the simplification holds regardless of the value of n, so the identity is true for all positive integers n **B1**

Answer: $\sqrt{n+1} + \sqrt{n}$ (proven for all positive integers n)

Question 9

squares both sides: $x + 38 = (x - 4)^2$ **M1**

rearranges to $x^2 - 9x - 22 = 0$ **M1**

factorises or solves correctly (two roots found) **A1**

$x = 11$ only, with the other root rejected cao **A1**

Answer: $x = 11$

Question 10

multiplies top and bottom by $\sqrt{10} - \sqrt{2}$ **M1**

denominator $10 - 2 = 8$ **M1**

$(\sqrt{10} - \sqrt{2})/8$ cao **A1**

Answer: $(\sqrt{10} - \sqrt{2})/8$

Question 11

multiplies top and bottom by $\sqrt{6}$ **M1**

$-9\sqrt{6} + 36$ over 6 **M1**

$6 - 3\sqrt{6}/2$ cao **A1**

Answer: $6 - 3\sqrt{6}/2$

Question 12

multiplies by $3 - \sqrt{8}$ over itself **M1**

denominator $9 - 8 = 1$ shown **A1**

34 cao **A1**

Answer: 34

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