Surds: exam questions

10 questions · 28 marks · mark schemes at the end

Name _____ Date _____ Score / 28

- Calculators are allowed on both 4MA1 Higher papers (1H and 2H). Show your working: most marks are for method.
- Mark schemes start after the questions. M marks are for a correct method, A marks for an accurate answer that follows a correct method, and B marks for a correct result on its own.
- Online, with more practice: igcsemathrevision.com/igcse-frontend/4ma1/exam-questions/surds

1. **3 marks**

(a) Simplify $\sqrt{72}$. **(1)**

(b) Simplify $\sqrt{50} + \sqrt{18}$. **(2)**

2. **2 marks**

Expand and simplify $(3 + \sqrt{5})(2 - \sqrt{5})$.

3. **2 marks**

Rationalise the denominator of $\dfrac{12}{\sqrt{3}}$. Simplify your answer.

4. **3 marks**

Rationalise the denominator of $\frac{6}{3-\sqrt{7}}$. Give your answer in the form $a+b\sqrt{7}$.

5. **2 marks**

Expand and simplify $(2\sqrt{3}+1)^2$.

6. **2 marks**

Show that $\sqrt{45}-\sqrt{20}=\sqrt{5}$.

7. **5 marks**

A rectangle has length $(4+\sqrt{2})$ cm and width $(4-\sqrt{2})$ cm.

(a) Work out the area of the rectangle. **(2)**

(b) Show that the diagonal of the rectangle is 6 cm. **(3)**

8. 3 marks

Write $\dfrac{5+\sqrt{3}}{2-\sqrt{3}}$ in the form $a+b\sqrt{3}$, where a and b are integers.

9. 3 marks

Solve $x\sqrt{2}+3=5\sqrt{2}$. Give your answer in the form $a+b\sqrt{2}$, where a and b are rational.

10. 3 marks

$(a+\sqrt{b})^2=19+6\sqrt{2}$, where a and b are positive integers.

Find the values of a and b.

Answers and worked solutions

Question 1 — 3 marks

(a)

B1 $6\sqrt{2}$

(b)

M1 $5\sqrt{2}$ or $3\sqrt{2}$

A1 $8\sqrt{2}$

Answer: (a) $6\sqrt{2}$; (b) $8\sqrt{2}$

Question 2 — 2 marks

M1 $6 - 3\sqrt{5} + 2\sqrt{5} - 5$ (three of the four terms correct)

A1 $1 - \sqrt{5}$

Answer: $1 - \sqrt{5}$

Question 3 — 2 marks

M1 $\dfrac{12}{\sqrt{3}} \times \dfrac{\sqrt{3}}{\sqrt{3}} = \dfrac{12\sqrt{3}}{3}$

A1 $4\sqrt{3}$

Answer: $4\sqrt{3}$

Question 4 — 3 marks

M1 multiply top and bottom by $3 + \sqrt{7}$

M1 denominator $9 - 7 = 2$

A1 $9 + 3\sqrt{7}$

Answer: $9 + 3\sqrt{7}$

Question 5 — 2 marks

M1 $12 + 2\sqrt{3} + 2\sqrt{3} + 1$

A1 $13 + 4\sqrt{3}$

Answer: $13 + 4\sqrt{3}$

Question 6 — 2 marks

M1 $\sqrt{45} = 3\sqrt{5}$ and $\sqrt{20} = 2\sqrt{5}$

A1 $3\sqrt{5} - 2\sqrt{5} = \sqrt{5}$ shown

Answer: shown

Question 7 — 5 marks

(a)

M1 $16 - 4\sqrt{2} + 4\sqrt{2} - 2$

A1 $14\,\text{cm}^2$

(b)

M1 $(4 + \sqrt{2})^2 = 18 + 8\sqrt{2}$ or $(4 - \sqrt{2})^2 = 18 - 8\sqrt{2}$

M1 $d^2 = 18 + 8\sqrt{2} + 18 - 8\sqrt{2} = 36$

A1 $d = 6$ shown

Answer: (a) $14\,\text{cm}^2$; (b) shown

Question 8 — 3 marks

M1 multiply top and bottom by $2 + \sqrt{3}$

M1 $\dfrac{10 + 5\sqrt{3} + 2\sqrt{3} + 3}{4 - 3}$

A1 $13 + 7\sqrt{3}$

Answer: $13 + 7\sqrt{3}$

Question 9 — 3 marks

M1 $x = \dfrac{5\sqrt{2} - 3}{\sqrt{2}}$

M1 $\dfrac{(5\sqrt{2} - 3)\sqrt{2}}{2} = \dfrac{10 - 3\sqrt{2}}{2}$

A1 $5 - \frac{3}{2}\sqrt{2}$

Answer: $x = 5 - \frac{3}{2}\sqrt{2}$

Question 10 — 3 marks

M1 $a^2 + b + 2a\sqrt{b}$

M1 $a^2 + b = 19$ and $a\sqrt{b} = 3\sqrt{2}$, so $a^2 b = 18$

A1 $a = 1$, $b = 18$ ($a = 3$, $b = 2$ gives $a^2 + b = 11$)

Answer: $a = 1$, $b = 18$

Online, with every solution: igcsemathrevision.com/igcse-frontend/4ma1/exam-questions/surds
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