Surds

GCSE Mathematics • **Higher Tier** • Grades 8–9 • Non-calculator

WORKED SOLUTIONS

Name: worked example Class: _____ Total: 55 / 55

Show all your working. Marks are given for correct method as well as the final answer.

1. Simplify $\sqrt{50}$. **[2 marks]**

$50 = 25 \times 2$
$\sqrt{25} = 5$
look for a square factor

Answer: $5\sqrt{2}$

2. Simplify $\sqrt{72}$. **[2 marks]**

$72 = 36 \times 2$
$= 6\sqrt{2}$

Answer: $6\sqrt{2}$

3. Simplify $\sqrt{200}$. **[2 marks]**

$200 = 100 \times 2$

Answer: $10\sqrt{2}$

4. Simplify $\sqrt{3} \times \sqrt{12}$. **[2 marks]**

$\sqrt{36}$
$= 6$
this one is a whole number

Answer: 6

5. Simplify $\sqrt{8} \times \sqrt{2}$. **[2 marks]**

$\sqrt{16} = 4$

Answer: 4

6. Simplify $\dfrac{\sqrt{48}}{\sqrt{3}}$. **[2 marks]**

$\sqrt{16} = 4$

Answer: 4

7. Simplify $3\sqrt{5} \times 2\sqrt{5}$. **[3 marks]**

numbers: $3 \times 2 = 6$
surds: $\sqrt{5} \times \sqrt{5} = 5$
$6 \times 5 = 30$

Answer: 30

8. Simplify $5\sqrt{7} + 2\sqrt{7}$. **[1 mark]**

like surds -- just add the numbers

Answer: $7\sqrt{7}$

9. Simplify $\sqrt{18} + \sqrt{8}$. **[3 marks]**

$\sqrt{18} = 3\sqrt{2}$
$\sqrt{8} = 2\sqrt{2}$
$3\sqrt{2} + 2\sqrt{2} = 5\sqrt{2}$
simplify BEFORE adding

Answer: $5\sqrt{2}$

10. Simplify $\sqrt{75} - \sqrt{27}$. **[3 marks]**

$5\sqrt{3} - 3\sqrt{3}$

Answer: $2\sqrt{3}$

11. Explain why $\sqrt{2} + \sqrt{3}$ cannot be simplified. **[2 marks]**

different numbers under the root
NOT $\sqrt{5}$

Answer: unlike surds

12. Expand $\sqrt{2}(3 + \sqrt{2})$. **[3 marks]**

$\sqrt{2} \times 3 = 3\sqrt{2}$
$\sqrt{2} \times \sqrt{2} = 2$

Answer: $3\sqrt{2} + 2$

13. Expand and simplify $(1 + \sqrt{3})(2 + \sqrt{3})$. **[4 marks]**

$1 \times 2 = 2$
$1 \times \sqrt{3} = \sqrt{3}$
$\sqrt{3} \times 2 = 2\sqrt{3}$
$\sqrt{3} \times \sqrt{3} = 3$
$2 + 3 = 5$, $\sqrt{3} + 2\sqrt{3} = 3\sqrt{3}$

Answer: $5 + 3\sqrt{3}$

14. Expand and simplify $(2 + \sqrt{5})(2 - \sqrt{5})$. **[3 marks]**

difference of two squares
$4 - 5 = -1$
the surds cancel -- this is the conjugate trick

Answer: -1

15. Expand and simplify $(\sqrt{7} + 1)^2$. **[4 marks]**

$(\sqrt{7} + 1)(\sqrt{7} + 1)$
$7 + \sqrt{7} + \sqrt{7} + 1$
$= 8 + 2\sqrt{7}$

Answer: $8 + 2\sqrt{7}$

16. Rationalise the denominator of $\frac{1}{\sqrt{3}}$. **[2 marks]**

multiply top and bottom by $\sqrt{3}$

Answer: $\frac{\sqrt{3}}{3}$

17. Rationalise the denominator of $\frac{6}{\sqrt{2}}$. **[3 marks]**

$\times \frac{\sqrt{2}}{\sqrt{2}}$: $\frac{6\sqrt{2}}{2}$

$= 3\sqrt{2}$

Answer: $3\sqrt{2}$

18. Rationalise the denominator of $\frac{10}{\sqrt{5}}$. **[3 marks]**

$\frac{10\sqrt{5}}{5} = 2\sqrt{5}$

Answer: $2\sqrt{5}$

19. Rationalise the denominator of $\frac{1}{3+\sqrt{2}}$. **[4 marks]**

multiply by the conjugate $\frac{3-\sqrt{2}}{3-\sqrt{2}}$

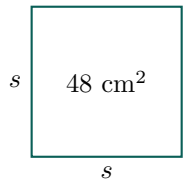
bottom: $9 - 2 = 7$

difference of two squares kills the surd

$= \frac{3-\sqrt{2}}{7}$

Answer: $\frac{3-\sqrt{2}}{7}$

20. A square has area 48 cm^2.



(a) Work out its side length in simplified surd form. **[3 marks]**

side $= \sqrt{48}$

$48 = 16 \times 3$

$= 4\sqrt{3}$ cm

(b) Work out its perimeter in simplified surd form. **[2 marks]**

$4 \times 4\sqrt{3}$

$= 16\sqrt{3}$ cm

Answer: $4\sqrt{3}$ cm ; $16\sqrt{3}$ cm

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