# SURDS

## EXAM-TYPE QUESTIONS

## NO CALCULATOR



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|---|---|---|---|
| **A1**<br>Express $\sqrt{48}$ in the form $a\sqrt{b}$ where $b$ is a prime number. | **A2**<br>Express $4\sqrt{5}$ in the form $\sqrt{a}$ where $a$ is an integer. | **A3**<br>Express $\sqrt{175}-\sqrt{63}$ in the form $a\sqrt{7}$ where $a$ is an integer. | **A4**<br>Express $\sqrt{75}+\sqrt{27}$ in the form $a\sqrt{b}$ where $a$ and $b$ are integers |
| **B1**<br>Expand $(3+\sqrt{5})(2+\sqrt{5})$<br>Give your answer in the form $a+b\sqrt{5}$ where $a$ and $b$ are integers | **B2**<br>Expand $(2+3\sqrt{7})^2$<br>Give your answer in the form $a+b\sqrt{7}$ where $a$ and $b$ are integers | **B3**<br>Show that<br>$(4+2\sqrt{3})(5-\sqrt{3})=14+6\sqrt{3}$<br>Show clear working out. | **B4**<br>Show that<br>$(2+\sqrt{8})(9-3\sqrt{2})=6+12\sqrt{2}$<br>Show clear working out. |
| **C1**<br>Show that<br>$\frac{12}{\sqrt{45}}=\frac{4\sqrt{5}}{5}$<br>Show clear working out. | **C2**<br>Rationalise the denominator and simplify fully<br>$\frac{9+2\sqrt{3}}{\sqrt{3}}$ | **C3**<br>Simplify $\frac{2+\sqrt{20}}{\sqrt{5}-1}$ giving your answer in the form $a+b\sqrt{5}$ | **C4** A rectangle has an area of $\sqrt{80}$ cm$^2$ and a width of $1+\sqrt{5}$ cm.<br>Calculate the exact height of the rectangle, leaving your answer as a simplified surd. |
| **D1** Given that<br>$(a+\sqrt{b})^2=49+12\sqrt{b}$<br>Find the value of $a$ and the value of $b$. | **D2** Given that<br>$(1+\sqrt{e})(3+\sqrt{e})=f+4\sqrt{5}$<br>Find the value of $e$ and the value of $f$. | **D3** Given that<br>$(5+3\sqrt{2})^2=p+\frac{q}{\sqrt{8}}$<br>Find the value of $p$ and the value of $q$. | **D4** Given that<br>$(\sqrt{x}+\sqrt{8x})^2=54+y\sqrt{2}$<br>Find the value of $x$ and the value of $y$. |

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Ref: G188. 1R1

**A1**

Express $\sqrt{48}$ in the form $a\sqrt{b}$ where $b$ is a prime number.

$\sqrt{48} = \sqrt{16} \times \sqrt{3}$

$= 4\sqrt{3}$

**A2**

Express $4\sqrt{5}$ in the form $\sqrt{a}$ where $a$ is an integer.

$4\sqrt{5} = \sqrt{16} \times \sqrt{5}$

$= \sqrt{80}$

**A3**

Express $\sqrt{175} - \sqrt{63}$ in the form $a\sqrt{7}$ where $a$ is an integer.

$\sqrt{175} - \sqrt{63} = 5\sqrt{7} - 3\sqrt{7}$

$= 2\sqrt{7}$

**A4**

Express $\sqrt{75} + \sqrt{27}$ in the form $a\sqrt{b}$ where $a$ and $b$ are integers

$\sqrt{75} + \sqrt{27} = 5\sqrt{3} + 3\sqrt{3}$

$= 8\sqrt{3}$

**B1**

Expand $(3+\sqrt{5})(2+\sqrt{5})$

$= 6 + 3\sqrt{5} + 2\sqrt{5} + 5$

$= 11 + 5\sqrt{5}$

**B2**

Expand $(2+3\sqrt{7})^2$

$= 4 + 6\sqrt{7} + 6\sqrt{7} + 9 \times 7$

$= 67 + 12\sqrt{7}$

**B3**

$(4+2\sqrt{3})(5-\sqrt{3})$

$= 20 - 4\sqrt{3} + 10\sqrt{3} - 2 \times 3$

$= 14 + 6\sqrt{3}$

**B4**

$(2+\sqrt{8})(9-3\sqrt{2})$

$= 18 - 6\sqrt{2} + 9\sqrt{8} - 3 \times \sqrt{16}$

$= 18 - 6\sqrt{2} + 18\sqrt{2} - 3 \times 4$

$= 6 + 12\sqrt{2}$

$\frac{12}{\sqrt{45}} \times \frac{\sqrt{45}}{\sqrt{45}} = \frac{12\sqrt{45}}{45}$

$= \frac{12 \times 3\sqrt{5}}{45}$

$= \frac{4\sqrt{5}}{5}$

$\frac{9+2\sqrt{3}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{9\sqrt{3} + 2 \times 3}{3}$

$= 3\sqrt{3} + 2$

$(= 2 + 3\sqrt{3})$

$\frac{2+\sqrt{20}}{\sqrt{5}-1} \times \frac{\sqrt{5}+1}{\sqrt{5}+1} = \frac{2\sqrt{5} + 2 + \sqrt{100} + \sqrt{20}}{5-1}$

$= \frac{2\sqrt{5} + 2 + 10 + 2\sqrt{5}}{4}$

$= \frac{12 + 4\sqrt{5}}{4} = 3 + \sqrt{5}$

$\text{height} = \frac{\sqrt{80}}{1+\sqrt{5}} = \frac{\sqrt{80}}{1+\sqrt{5}} \times \frac{1-\sqrt{5}}{1-\sqrt{5}}$

$= \frac{\sqrt{80} - \sqrt{400}}{1-5}$

$= \frac{4\sqrt{5} - 20}{-4} = 5 - \sqrt{5}$

$(a+\sqrt{b})^2 = a^2 + 2a\sqrt{b} + b$

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

If $a^2 + b + 2a\sqrt{b} = 49 + 12\sqrt{b}$

$2a\sqrt{b} = 12\sqrt{b}$ $\quad a^2 + b = 49$

$a = 6$ $\quad b = 13$

$(1+\sqrt{e})(3+\sqrt{e}) = 3 + 4\sqrt{e} + e$

$= 3 + e + 4\sqrt{e}$

If $3 + e + 4\sqrt{e} = f + 4\sqrt{5}$

$4\sqrt{e} = 4\sqrt{5}$ $\quad f = 3 + e$

$e = 5$ $\quad = 8$

$(5+3\sqrt{2})^2 = 25 + 30\sqrt{2} + 18$

$= 43 + 30\sqrt{2}$

If $43 + 30\sqrt{2} = p + \frac{q}{\sqrt{8}}$

$p = 43$ $\quad \frac{q}{\sqrt{8}} = 30\sqrt{2}$

$q = 30 \times \sqrt{16} = 120$

$(\sqrt{x} + \sqrt{8x})^2 = x + 2x\sqrt{8} + 8x$

$= 9x + 2x\sqrt{8}$

If $9x + 2x\sqrt{8} = 54 + y\sqrt{2}$

$9x = 54$ $\quad y\sqrt{2} = 2x\sqrt{8}$

$x = 6$ $\quad y = \frac{2 \times 6\sqrt{8}}{\sqrt{2}} = 24$