

SURDS

Note Title

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Numbers such as $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$ etc are IRRATIONAL - they cannot be written exactly as decimals because they never stop and never repeat. So it is often better to leave them written as roots. A number written as a root is called a surd.

Rules for handling surds.

$$\begin{aligned}\sqrt{a} \times \sqrt{b} &= \sqrt{ab} \\ \frac{\sqrt{a}}{\sqrt{b}} &= \sqrt{\frac{a}{b}}\end{aligned}$$

(BUT $\sqrt{a} + \sqrt{b} \neq \sqrt{a+b}$ and $\sqrt{a} - \sqrt{b} \neq \sqrt{a-b}$)

Examples

$$\begin{aligned}\textcircled{1} \quad \sqrt{18} \times \sqrt{2} &= \sqrt{18 \times 2} \\ &= \sqrt{36} \\ &= \underline{\underline{6}}\end{aligned}$$

$$\begin{aligned}\textcircled{2} \quad \frac{\sqrt{80}}{\sqrt{20}} &= \sqrt{\frac{80}{20}} \\ &= \sqrt{4} \\ &= \underline{\underline{2}}\end{aligned}$$

$$\begin{aligned}\textcircled{3} \quad \frac{\sqrt{50}}{\sqrt{10}} &= \sqrt{\frac{50}{10}} = \underline{\underline{\sqrt{5}}}\end{aligned}$$

④ Simplify $\sqrt{72}$

To do this we make the number under the root as small as possible.

look for a square number which is a factor of 72.

$$\begin{aligned}\sqrt{72} &= \sqrt{9 \times 8} \\ &= \sqrt{9 \times 4 \times 2} \\ &= \sqrt{9} \times \sqrt{4} \times \sqrt{2} \\ &= 3 \times 2 \times \sqrt{2} \\ &= 6\sqrt{2}\end{aligned}$$

⑤ Simplify $\sqrt{72} + \sqrt{50}$

$$\begin{aligned}\sqrt{72} + \sqrt{50} &= 6\sqrt{2} + \sqrt{25 \times 2} \\ &= 6\sqrt{2} + \sqrt{25} \times \sqrt{2} \\ &= 6\sqrt{2} + 5\sqrt{2} \\ &= 11\sqrt{2}\end{aligned}$$

⑥ $(3 + 2\sqrt{7})(5 - \sqrt{7})$

$$\begin{aligned}&= 15 - 3\sqrt{7} + 10\sqrt{7} - 2(\sqrt{7})^2 \\ &= 15 + 7\sqrt{7} - 14 \\ &= 1 + 7\sqrt{7}\end{aligned}$$

⑦ Simplify $\frac{6}{\sqrt{3}}$

It is undesirable to have a surd on the bottom of a fraction

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

$$\begin{aligned}\frac{6}{\sqrt{3}} &= \frac{6 \times \sqrt{3}}{\sqrt{3} \times \sqrt{3}} \\ &= \frac{6\sqrt{3}}{3} \\ &= \underline{\underline{2\sqrt{3}}}\end{aligned}$$

⑧

Simplify $\frac{10\sqrt{7}}{3\sqrt{2}}$

$$\begin{aligned}\frac{10\sqrt{7}}{3\sqrt{2}} &= \frac{10\sqrt{7} \times \sqrt{2}}{3\sqrt{2} \times \sqrt{2}} \\ &= \frac{10\sqrt{14}}{3 \times 2} \\ &= \frac{5\sqrt{14}}{3} \\ &= \underline{\underline{\frac{5\sqrt{14}}{3}}}\end{aligned}$$

$$= \frac{10\sqrt{14}}{6}$$