



Surds (Mixed)

Rules of Surds

A surd is an irrational square root of a whole number (e.g. $\sqrt{15}$). Irrational numbers cannot be expressed as fractions (e.g. 1.7325192). Since surds are irrational numbers, they are often left in their square root form. However, they can be simplified using two methods.

SURD RULES

$$\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$$

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$$

METHOD ONE: Find the Perfect Square

Identifying a perfect square only works for square root numbers that have perfect square factors. This method is very efficient.

STEP ONE: Identify the highest perfect square factor of the number

STEP TWO: Bring the perfect square out of the square root then simplify

EXAMPLE: Solve or simplify $\sqrt{18}$

$$\begin{aligned}\sqrt{18} &= \sqrt{9 \times 2} \\ \sqrt{18} &= \sqrt{9} \times \sqrt{2} \\ \sqrt{18} &= 3 \times \sqrt{2} \\ \sqrt{18} &= 3\sqrt{2}\end{aligned}$$

METHOD TWO: Find the Prime Factors

Prime factorisation can be used to breaking a square root down into its prime factors. This is less efficient but works for all square roots.

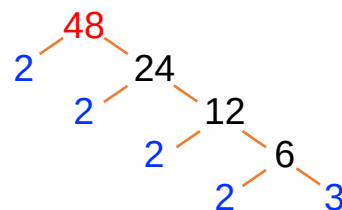
STEP ONE: Draw a tree diagram. Divide the number by the prime number 2. If it divides unevenly, use the next PM.

STEP TWO: Keep dividing downwards until you only have prime numbers left.

STEP THREE: Write the prime factors under the square root sign

STEP FOUR: Bring pairs of factors out of the square root then simplify

EXAMPLE: Solve or simplify $\sqrt{48}$



$$\begin{aligned}\sqrt{48} &= \sqrt{2 \times 2 \times 2 \times 2 \times 3} \\ \sqrt{48} &= \sqrt{2 \times 2} \times \sqrt{2 \times 2} \times \sqrt{3} \\ \sqrt{48} &= \sqrt{2^2} \times \sqrt{2^2} \times \sqrt{3} \\ \sqrt{48} &= 2 \times 2 \times \sqrt{3} \\ \sqrt{48} &= 4\sqrt{3}\end{aligned}$$



Instructions: Simplify the square roots below.

1	$\sqrt{20}$	2	$\sqrt{32}$
3	$\sqrt{24}$	4	$3\sqrt{18}$
5	$\sqrt{45}$	6	$\sqrt{80}$



7	$\frac{\sqrt{98}}{\sqrt{27}}$	8	$\sqrt{\frac{20}{96}}$
9	$4\sqrt{28}$	10	$9\sqrt{63}$
11	$\sqrt{200}$	12	$12\sqrt{108}$



$$\sqrt{324}$$

13

$$\sqrt{1008}$$

14

$$\sqrt{2025}$$

15



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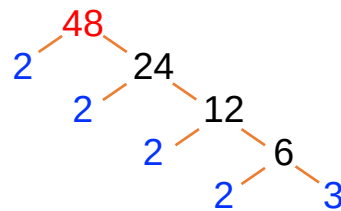
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Instructions: Simplify the square roots below.

1	$\sqrt{54}$	2	$\sqrt{75}$
3	$\sqrt{28}$	4	$3\sqrt{98}$
5	$5\sqrt{45}$	6	$10\sqrt{75}$



7	$\frac{7\sqrt{98}}{\sqrt{200}}$	8	$\sqrt{\frac{343}{20}}$
9	$12\sqrt{72}$	10	$8\sqrt{125}$
11	$3\sqrt{135}$	12	$13\sqrt{600}$



$$\sqrt{729}$$

13

$$\sqrt{1029}$$

14

$$\sqrt{4096}$$

15