

Surds

Simplify, multiply, divide, add, and subtract surds.



Name _____

Date _____

Show your method

Find the largest perfect-square factor to simplify a surd. To multiply or divide, combine both surds under one root first, then simplify.

Worked example Simplify $\sqrt{72}$.

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

largest square factor split the root $\sqrt{36} = 6$

$$\begin{aligned}\sqrt{72} &= \sqrt{36 \times 2} \\ &= \sqrt{36} \times \sqrt{2} \\ &= 6\sqrt{2}\end{aligned}$$

1. Simplify $\sqrt{80}$.

$$\boxed{\sqrt{80}} = \boxed{\sqrt{16 \times 5}} = \boxed{\sqrt{16} \times \sqrt{5}} = \boxed{4\sqrt{5}}$$

largest square factor split the root $\sqrt{16} = 4$

Solution

$$\begin{aligned}\sqrt{80} &= \sqrt{16 \times 5} \\ &= 4\sqrt{5}\end{aligned}$$

2. Simplify $\sqrt{54}$.

$$\boxed{\sqrt{54}} = \boxed{\sqrt{9 \times 6}} = \boxed{\sqrt{9} \times \sqrt{6}} = \boxed{3\sqrt{6}}$$

largest square factor split the root $\sqrt{9} = 3$

Solution

$$\begin{aligned}\sqrt{54} &= \sqrt{9 \times 6} \\ &= 3\sqrt{6}\end{aligned}$$

3. Simplify $\sqrt{28}$.

$$\boxed{\sqrt{28}} = \boxed{\sqrt{4 \times 7}} = \boxed{\sqrt{4} \times \sqrt{7}} = \boxed{2\sqrt{7}}$$

largest square factor split the root $\sqrt{4} = 2$

Solution

$$\begin{aligned}\sqrt{28} &= \sqrt{4 \times 7} \\ &= 2\sqrt{7}\end{aligned}$$

4. Simplify $\sqrt{2} \times \sqrt{18}$.

$$\boxed{\sqrt{2} \times \sqrt{18}} = \boxed{\sqrt{2 \times 18}} = \boxed{\sqrt{36}} = \boxed{6}$$

one root multiply simplify

Solution

$$\begin{aligned}\sqrt{2} \times \sqrt{18} &= \sqrt{36} \\ &= 6\end{aligned}$$

5. Simplify $\sqrt{32} \div \sqrt{2}$.

$$\boxed{\sqrt{32} \div \sqrt{2}} = \boxed{\sqrt{\frac{32}{2}}} = \boxed{\sqrt{16}} = \boxed{4}$$

one root divide simplify

Solution

$$\begin{aligned}\sqrt{32} \div \sqrt{2} &= \sqrt{16} \\ &= 4\end{aligned}$$

6. Simplify $\sqrt{7} \times \sqrt{7}$.

$$\boxed{\sqrt{7} \times \sqrt{7}} = \boxed{\sqrt{7 \times 7}} = \boxed{\sqrt{49}} = \boxed{7}$$

one root multiply simplify

Solution

$$\begin{aligned}\sqrt{7} \times \sqrt{7} &= \sqrt{49} \\ &= 7\end{aligned}$$

7. Simplify $5\sqrt{6} + 3\sqrt{6}$.

Solution

$$\begin{aligned}5 + 3 &= 8 \\ &= 8\sqrt{6}\end{aligned}$$

8. Simplify $9\sqrt{2} - 5\sqrt{2}$.

Solution

$$\begin{aligned}9 - 5 &= 4 \\ &= 4\sqrt{2}\end{aligned}$$

9. Is $\sqrt{24}$ fully simplified as $2\sqrt{6}$? Explain.

Solution

Yes: $24 = 4 \times 6$, and 4 is the largest square factor of 24, with 6 square-free.

Surds (continued)

Combining like surds, harder simplifying, and rationalising a denominator.



Name _____

Date _____

10. Simplify $4\sqrt{3} + 6\sqrt{3}$.

$$\begin{array}{c} \boxed{\sqrt{3}} \boxed{\sqrt{3}} \boxed{\sqrt{3}} \boxed{\sqrt{3}} + \boxed{\sqrt{3}} \boxed{\sqrt{3}} \boxed{\sqrt{3}} \boxed{\sqrt{3}} \boxed{\sqrt{3}} \boxed{\sqrt{3}} = \boxed{10\sqrt{3}} \\ 4 \qquad \qquad \qquad 6 \\ \text{count the } \sqrt{3} \text{ tiles: } 4 + 6 = 10 \end{array}$$

Solution

$$\begin{aligned} 4 + 6 &= 10 \\ &= 10\sqrt{3} \end{aligned}$$

11. Simplify $8\sqrt{5} - 3\sqrt{5}$.

$$\begin{array}{c} \boxed{\sqrt{5}} \boxed{\sqrt{5}} \boxed{\sqrt{5}} \boxed{\sqrt{5}} \boxed{\sqrt{5}} \boxed{\sqrt{5}} \boxed{\sqrt{5}} \boxed{\sqrt{5}} - \boxed{\sqrt{5}} \boxed{\sqrt{5}} \boxed{\sqrt{5}} = \boxed{5\sqrt{5}} \\ 8 \qquad \qquad \qquad 3 \\ \text{count the } \sqrt{5} \text{ tiles: } 8 - 3 = 5 \end{array}$$

Solution

$$\begin{aligned} 8 - 3 &= 5 \\ &= 5\sqrt{5} \end{aligned}$$

12. Simplify $\sqrt{98} \div \sqrt{2}$.

$$\sqrt{98} \div \sqrt{2} = \sqrt{\frac{98}{2}} = \sqrt{49} = 7$$

one root divide simplify

Solution

$$\begin{aligned} \sqrt{98} \div \sqrt{2} &= \sqrt{49} \\ &= 7 \end{aligned}$$

13. Simplify $\sqrt{3} \times \sqrt{48}$.

Solution

$$\begin{aligned} \sqrt{3} \times \sqrt{48} &= \sqrt{144} \\ &= 12 \end{aligned}$$

14. Simplify $\sqrt{72} \div \sqrt{8}$.

Solution

$$\begin{aligned} \sqrt{72} \div \sqrt{8} &= \sqrt{9} \\ &= 3 \end{aligned}$$

15. A square has side length $\sqrt{18}$ cm. Find its area.

Solution

$$\begin{aligned} \text{Area} &= (\sqrt{18})^2 \\ &= 18 \text{ cm}^2 \end{aligned}$$

16. Rationalise the denominator of $\frac{7}{\sqrt{7}}$.

Solution

$$\begin{aligned} \frac{7}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} &= \frac{7\sqrt{7}}{7} \\ &= \sqrt{7} \end{aligned}$$

17. Rationalise the denominator of $\frac{20}{\sqrt{5}}$.

Solution

$$\begin{aligned} \frac{20}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} &= \frac{20\sqrt{5}}{5} \\ &= 4\sqrt{5} \end{aligned}$$

18. Simplify $\sqrt{50} + \sqrt{8} - \sqrt{2}$.

Solution

$$\begin{aligned} 5\sqrt{2} + 2\sqrt{2} - \sqrt{2} \\ &= 6\sqrt{2} \end{aligned}$$