Square-root operations: factor, multiply and combine — Teacher answers

Year 8, lower volume • text pp. 5–12 • textbook lessons 3–6

Use the two prerequisite checks to choose support. Project the worked and guided tasks, then collect the eight paper core questions. Follow-ups and extensions are optional; accept other complete valid methods. This page does not save learners' paper answers.

Ordinary route: prerequisites 4, short inquiry 5, worked/guided 8, independent 15, correction 5, exit 3 minutes. Advanced route: inquiry 18, organise 4, selected practice 13, exit 5 minutes.

Prerequisites: Root meaning, signed fractions and the distributive law.

Ordinary route: use the first fixed case for the five-minute demonstration. Advanced route: complete the full investigation.

1. 3′ Predict whether adding square roots obeys the same rule as multiplying them. Give one test case.
2. 8′ On paper compare $\sqrt{8}\sqrt{2}=4$ with $\sqrt{8}+\sqrt{2}=3\sqrt{2}$. Draw rectangles with sides $\sqrt{\ }8$ and $\sqrt{\ }2$ to interpret the product. Test $\sqrt{9}+\sqrt{16}$ against $\sqrt{9+16}$.
3. 5′ Explain why $7\neq5$ refutes the proposed addition rule. State a,b≥0 for $\sqrt{\ }\sqrt{\ }=\sqrt{\ }$; combine only like radical terms after simplification.
4. 2′ Individually simplify $\sqrt{18}+\sqrt{8}$ and explain each transformation.

Worked example 1

Simplify exactly. State any restriction that is needed.

$$\sqrt{12}+\sqrt{27}$$

Reference answer

$5\sqrt{3}$

$$5\sqrt{3}$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $2\sqrt{3}+3\sqrt{3}$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Guided attempt 2

Simplify exactly. State any restriction that is needed.

$$\sqrt{18}\times\sqrt{8}$$

1. Both radicands are nonnegative, so $\sqrt{18}\sqrt{8}=\sqrt{18\times8}=\sqrt{\square}$.
2. Find the nonnegative number satisfying $\square^2=144$.
3. Check the product by simplifying both original roots separately.

Reference answer

12

$$12$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $\sqrt{144}=12$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Prerequisite 3

Simplify exactly. State any restriction that is needed.

$$\sqrt{16}$$

Reference answer

4

$$4$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. The simplified form is 4.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Prerequisite 4

Simplify exactly. State any restriction that is needed.

$$\sqrt{3} \times \sqrt{3}$$

Reference answer

3

$$3$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. The simplified form is 3.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Independent practice 5

Simplify exactly. State any restriction that is needed.

$$\sqrt{75} - \sqrt{12}$$

Reference answer

$3\sqrt{3}$

$$3\sqrt{3}$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $5\sqrt{3} - 2\sqrt{3}$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Independent practice 6

Simplify exactly. State any restriction that is needed.

$$\frac{\sqrt{48}}{\sqrt{3}}$$

Reference answer

4

$$4$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $\sqrt{16} = 4$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Independent practice 7

Simplify exactly. State any restriction that is needed.

$$\sqrt{2}(\sqrt{8} + \sqrt{18})$$

Reference answer

10

$$10$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $4 + 6 = 10$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Independent practice 8

Simplify exactly. State any restriction that is needed.

$$\frac{3}{\sqrt{3}}$$

Reference answer

$\sqrt{3}$

$$\sqrt{3}$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $\frac{3\sqrt{3}}{3}$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Exit question 9

Simplify exactly. State any restriction that is needed.

$$\sqrt{20}+\sqrt{5}$$

Reference answer

$3\sqrt{5}$

$$3\sqrt{5}$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $2\sqrt{5}+\sqrt{5}$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Exit question 10

Simplify exactly. State any restriction that is needed.

$$\frac{\sqrt{54}}{\sqrt{6}}$$

Reference answer

3

$$3$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $\sqrt{9}=3$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Further practice 11

Simplify exactly. State any restriction that is needed.

$$2\sqrt{18}-\sqrt{8}$$

Reference answer

$4\sqrt{2}$

$$4\sqrt{2}$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $6\sqrt{2}-2\sqrt{2}$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Further practice 12

Simplify exactly. State any restriction that is needed.

$$\sqrt{\frac{3}{4}}$$

Reference answer

$\frac{\sqrt{3}}{2}$

$$\frac{\sqrt{3}}{2}$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. The simplified form is $\frac{\sqrt{3}}{2}$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Further practice 13

Simplify exactly. State any restriction that is needed.

$$(-2\sqrt{3})(3\sqrt{12})$$

Reference answer

-36

$$-36$$

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $-6\sqrt{36} = -36$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Further practice 14

Simplify exactly. State any restriction that is needed.

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

Reference answer

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

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

1. The squarefree radical parts differ, so the two terms cannot be combined into one like-radical term.
2. The simplified form is $\sqrt{2} + \sqrt{3}$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Extension 15

Simplify exactly. State any restriction that is needed.

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

Reference answer

$5+2\sqrt{6}$

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

1. Extract square factors first. The square-root symbol denotes the nonnegative root.
2. An intermediate form is $3+2\sqrt{6}+2$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Extension 16

Compare this value with $\sqrt{9}+\sqrt{16}$ to test whether square roots distribute over addition.

$$\sqrt{9+16}$$

Reference answer

$5 \neq 7$

$$5 \neq 7$$

1. The left value is 5; the proposed right value is 3+4=7, so the proposed rule fails.
2. The simplified form is $5 \neq 7$.
3. Check the original expression and the sign of the square-root value.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.