MATHEMATICS · GRADES 10-12

Adding and subtracting radicals

Difficulty level: Advanced

Mathematics: Grades 10-12

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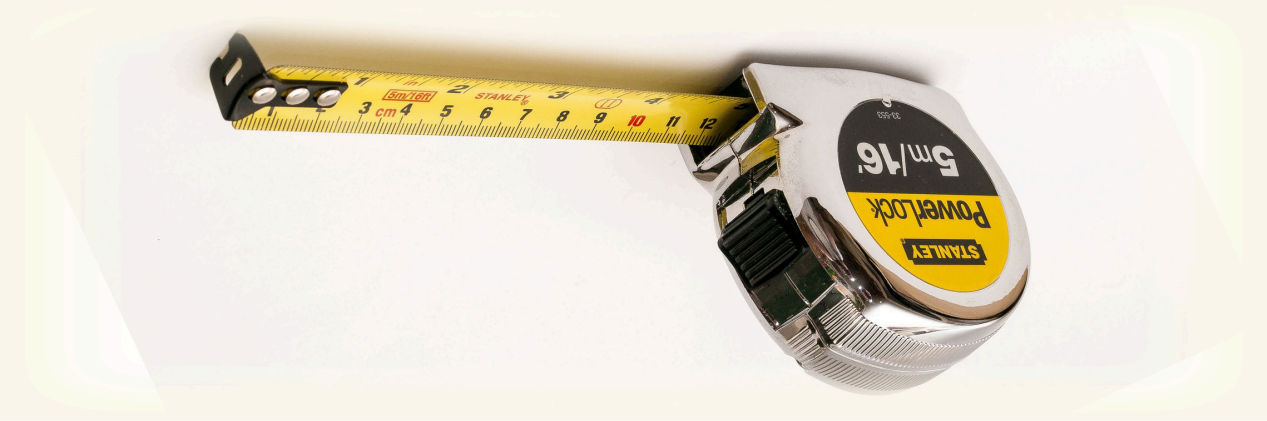
Overview of the concept

This is the skill engineers and builders use when exact lengths involving square roots have to be added together without rounding them away first. The diagonal of a square patio is a square root length, and if you round it early your measurements drift. Adding and subtracting radicals keeps the exact value until the very end, so the finished work actually fits.



Rule

Adding and subtracting radicals: only combine like radicals, by adding or subtracting the coefficients.

Simplify each root first so that like radicals can be combined, and keep the radical part unchanged.

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Worked examples

EXAMPLE 1

Q Simplify $3\sqrt{2} + 5\sqrt{2}$

SOLUTION

Check that both terms are like radicals: both are $\sqrt{2}$

Add the coefficients: $3 + 5 = 8$

Write the result: $8\sqrt{2}$

EXAMPLE 2

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

SOLUTION

Simplify each root first: $\sqrt{12} = 2\sqrt{3}$ and $\sqrt{27} = 3\sqrt{3}$

Now they are like radicals, so add the coefficients: $2 + 3 = 5$

Write the result: $5\sqrt{3}$

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Practice questions

1 Maya has two lengths of ribbon, $4\sqrt{3}$ m and $2\sqrt{3}$ m. She joins them end to end. How long is the joined ribbon?

- A $4\sqrt{3}$
- B $5\sqrt{3}$
- C $6\sqrt{3}$
- D $7\sqrt{3}$

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2 A gardener plants a row $7\sqrt{5}$ m long, then shortens it by $3\sqrt{5}$ m. How long is the row now?

- A $3\sqrt{5}$
- B $4\sqrt{5}$
- C $5\sqrt{5}$
- D $6\sqrt{5}$

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3 Two pieces of wire measure $\sqrt{8}$ m and $\sqrt{18}$ m. Write their total length as a single square root term.

- **A** $3\sqrt{2}$
- **B** $4\sqrt{2}$
- **C** $5\sqrt{2}$
- **D** $6\sqrt{2}$

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4 Simplify $\sqrt{72}$.

- **A** $6\sqrt{2}$
- **B** $4\sqrt{3}$
- **C** $8\sqrt{2}$
- **D** $9\sqrt{2}$

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5 Add $5\sqrt{6} + 3\sqrt{6} + 2\sqrt{6}$. What do you get?

- **A** $8\sqrt{6}$
- **B** $9\sqrt{6}$
- **C** $10\sqrt{6}$
- **D** $12\sqrt{6}$

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6 Which two terms are like radicals?

- **A** $2\sqrt{5}$ and $3\sqrt{7}$
- **B** $2\sqrt{5}$ and $4\sqrt{5}$
- **C** $3\sqrt{7}$ and $5\sqrt{3}$
- **D** $4\sqrt{5}$ and $5\sqrt{3}$

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7 A rope of length $\sqrt{50}$ m is shortened by $\sqrt{32}$ m. How long is the rope now?

- A $\sqrt{2}$
- B $2\sqrt{2}$
- C $3\sqrt{2}$
- D $4\sqrt{2}$

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8 Add $2\sqrt{3}$ and $4\sqrt{3}$, then take away $\sqrt{3}$. What do you get?

- A $4\sqrt{3}$
- B $5\sqrt{3}$
- C $6\sqrt{3}$
- D $7\sqrt{3}$

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9 Add $\sqrt{8} + \sqrt{2}$. What do you get?

- **A** $2\sqrt{2}$
- **B** $3\sqrt{2}$
- **C** $4\sqrt{2}$
- **D** $\sqrt{10}$

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10 Simplify $3\sqrt{20}$.

- **A** $3\sqrt{5}$
- **B** $6\sqrt{5}$
- **C** $6\sqrt{10}$
- **D** $12\sqrt{5}$

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ANSWER KEY

1. $6\sqrt{3}$

2. $4\sqrt{5}$

3. $5\sqrt{2}$

4. $6\sqrt{2}$

5. $10\sqrt{6}$

6. $2\sqrt{5}$ and $4\sqrt{5}$

7. $\sqrt{2}$

8. $5\sqrt{3}$

9. $3\sqrt{2}$

10. $6\sqrt{5}$

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