MATHEMATICS · GRADES 10-12

Simplifying radicals

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you tidy up a square root into its shortest form, so two roots that look different can be recognised as the same size or combined. A messy root hides what it is really worth, and two messy roots cannot be added together until they are tidied. Once each root is in its simplest form, you can see at a glance which ones match and which ones do not. That is what lets you add, subtract, or compare them without guessing.



Rule

Simplifying radicals: to simplify a square root, write the number as a perfect square times another number, then take the square root of the perfect square.

The number left inside the root has no perfect square factor but 1.

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Worked examples

EXAMPLE 1

Q Simplify $\sqrt{50}$

SOLUTION

$50 = 25 \times 2$

$25 = 5 \times 5$

So the largest perfect square factor is 25.

Split the root: $\sqrt{50} = \sqrt{25 \times 2} = \sqrt{25} \times \sqrt{2}$

Simplify: $5 \times \sqrt{2}$, so $\sqrt{50} = 5\sqrt{2}$

EXAMPLE 2

Q Simplify $\sqrt{72}$

SOLUTION

$72 = 36 \times 2$

$36 = 6 \times 6$

So the largest perfect square factor is 36.

Split the root: $\sqrt{72} = \sqrt{36 \times 2} = 6 \times \sqrt{2}$

So $\sqrt{72} = 6\sqrt{2}$

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Practice questions

1 Simplify $\sqrt{20}$.

- **A** $2\sqrt{10}$
- **B** $2\sqrt{5}$
- **C** $5\sqrt{2}$
- **D** $\sqrt{20}$

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2 Simplify $2\sqrt{18}$.

- **A** $6\sqrt{2}$
- **B** $3\sqrt{2}$
- **C** $2\sqrt{2}$
- **D** $6\sqrt{18}$

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3 Which radical equals $3\sqrt{5}$?

- A $\sqrt{45}$
- B $\sqrt{15}$
- C $\sqrt{75}$
- D $\sqrt{35}$

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4 Simplify $\sqrt{12} + \sqrt{27}$.

- A $5\sqrt{3}$
- B $\sqrt{39}$
- C $2\sqrt{3}$
- D $5\sqrt{6}$

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5 Which is larger, $\sqrt{50}$ or 7?

- **A** $\sqrt{50}$
- **B** 7
- **C** They are equal
- **D** Cannot tell

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6 A square tile has area 98 cm². Write its side length as a simplified radical.

- **A** $7\sqrt{2}$
- **B** $2\sqrt{7}$
- **C** $14\sqrt{2}$
- **D** $\sqrt{98}$

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7 A student simplifies a radical to $3\sqrt{5}$. Which radical was it?

- **A** $\sqrt{75}$
- **B** $\sqrt{45}$
- **C** $\sqrt{15}$
- **D** $\sqrt{27}$

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8 Ivy simplifies $\sqrt{48}$ as $4\sqrt{3}$. Then she simplifies $\sqrt{72}$ as $6\sqrt{3}$. What is Ivy's mistake in the second one?

- **A** She divided 72 by 6 instead of by 36
- **B** The second one has 2 under the root, not 3; $\sqrt{72}$ is $6\sqrt{2}$
- **C** $\sqrt{72}$ cannot be simplified
- **D** The first one is wrong too: $\sqrt{48}$ is $4\sqrt{2}$

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9 A square has side length $3\sqrt{2}$ cm. What is its area?

- **A** $18\ \text{cm}^2$
- **B** $6\sqrt{2}\ \text{cm}^2$
- **C** $9\sqrt{2}\ \text{cm}^2$
- **D** $36\ \text{cm}^2$

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10 Which one is already in simplest form?

- **A** $\sqrt{12}$
- **B** $\sqrt{18}$
- **C** $\sqrt{27}$
- **D** $\sqrt{30}$

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ANSWER KEY

1. $2\sqrt{5}$

2. $6\sqrt{2}$

3. $\sqrt{45}$

4. $5\sqrt{3}$

5. $\sqrt{50}$

6. $7\sqrt{2}$

7. $\sqrt{45}$

8. The second one has 2 under the root, not 3; $\sqrt{72}$ is $6\sqrt{2}$

9. 18 cm^2

10. $\sqrt{30}$

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