# Radical Exponents and Square Roots

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**Learning Objectives**

- Convert between fractional exponents and radical notation
- Evaluate perfect square roots using the multiplication table
- Simplify irregular square roots using a factor tree
- Simplify radical expressions with variables

*Simplify each expression completely, showing your work and writing answers in simplest radical form.*

**1. Evaluate the square root.**

$\sqrt{81}$

Answer: _____

**2. Evaluate the square root using the multiplication table.**

$\sqrt{144}$

Answer: _____

**3. Rewrite the fractional exponent as a radical and evaluate.**

$25^{\frac{1}{2}}$

Answer: _____

**4. Rewrite the fractional exponent as a radical and evaluate.**

$64^{\frac{1}{3}}$

Answer: _____

**5. Convert the radical to a fractional exponent.**

$\sqrt[4]{x^3}$

Answer: _____

**6. Simplify the radical using a factor tree.**

$\sqrt{72}$

Answer: _____

**7. Simplify the irregular square root.**

$\sqrt{50}$

Answer: _____



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**8. Simplify the irregular square root.**

$\sqrt{98}$

Answer: _____

**9. Simplify the radical expression with a variable.**

$\sqrt{75x^2}$

Answer: _____

**10. Simplify the radical expression completely.**

$\sqrt{200}$

Answer: _____

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**ANSWER KEY & SOLUTIONS**

*This worksheet covers the full lesson on radicals: warm-up review of perfect squares from the multiplication table, converting fractional exponents to radicals, evaluating square roots of perfect squares, using a factor tree to simplify irregular square roots, and simplifying radical expressions with variable factors.*

## Solutions

**1.** Evaluate the square root.

$\sqrt{81}$

→ *Look for a number that multiplies by itself to give 81.*
→ *Since 9 times 9 equals 81, the square root of 81 is 9.*

**Answer:** 9

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**2.** Evaluate the square root using the multiplication table.

$\sqrt{144}$

→ *Recall that 12 times 12 equals 144.*
→ *Therefore the square root of 144 is 12.*

**Answer:** 12

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**3.** Rewrite the fractional exponent as a radical and evaluate.

$25^{\frac{1}{2}}$

→ *A fractional exponent of one-half means the square root.*
→ *Rewrite as the square root of 25.*
→ *Since 5 times 5 equals 25, the answer is 5.*

**Answer:** 5

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**4.** Rewrite the fractional exponent as a radical and evaluate.

$64^{\frac{1}{3}}$

→ *A fractional exponent of one-third means the cube root.*
→ *Rewrite as the cube root of 64.*
→ *Since 4 times 4 times 4 equals 64, the answer is 4.*

**Answer:** 4

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**5.** Convert the radical to a fractional exponent.

$\sqrt[4]{x^3}$

→ *The index of the root becomes the denominator of the fractional exponent.*
→ *The exponent on the radicand becomes the numerator.*
→ *Write the expression as x raised to the three-fourths power.*

**Answer:** $x^{\frac{3}{4}}$

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**6.** Simplify the radical using a factor tree.

$\sqrt{72}$

→ *Build a factor tree for 72 to get the prime factorization 2 times 2 times 2 times 3 times 3.*
→ *Group the primes into pairs: one pair of 2s and one pair of 3s, with a single 2 left over.*
→ *Each pair comes out of the radical as one factor, giving 2 times 3 outside and 2 inside.*
→ *Multiply the outside numbers to get 6 times the square root of 2.*

**Answer:** $6\sqrt{2}$

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**7.** Simplify the irregular square root.

$\sqrt{50}$

→ *Factor 50 as 25 times 2, where 25 is a perfect square.*
→ *Take the square root of 25 to get 5 outside the radical.*
→ *The 2 remains inside, giving 5 times the square root of 2.*

**Answer:** $5\sqrt{2}$

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**8.** Simplify the irregular square root.

$\sqrt{98}$

→ *Factor 98 as 49 times 2, where 49 is a perfect square.*
→ *Take the square root of 49 to get 7 outside the radical.*
→ *The 2 remains inside, giving 7 times the square root of 2.*

**Answer:** $7\sqrt{2}$

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**9.** Simplify the radical expression with a variable.

$\sqrt{75x^2}$

→ *Factor 75 as 25 times 3, where 25 is a perfect square.*
→ *The square root of 25 is 5 and the square root of x squared is x.*
→ *Write 5x outside the radical with 3 remaining inside.*

**Answer:** $5x\sqrt{3}$

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**10.** Simplify the radical expression completely.

$\sqrt{200}$

→ *Use a factor tree to find the prime factorization of 200 as 2 times 2 times 2 times 5 times 5.*
→ *Group the primes into pairs: one pair of 2s and one pair of 5s, with a single 2 left over.*
→ *Each pair contributes one factor outside the radical, giving 2 times 5 outside and 2 inside.*
→ *Multiply to get 10 times the square root of 2.*

**Answer:** $10\sqrt{2}$