



# Warm Up

Simplify:

$$1. \frac{14x}{(2x^0)^2}$$

$$2. \frac{10x^3 y^3 x^{-2}}{4x^5 y}$$

$$3. (Ilovemath)^0$$

$$4. -6(2fd^2)^3$$

$$5. (3x^5)^3 (2x^7)^2$$

$$6. \frac{12x^3 y^4}{36x^7 y^2}$$

$$1. \frac{7x}{2}$$

$$2. \frac{5y^2}{2x^4}$$

$$3. 1$$

$$4. -48f^3 d^6$$

$$5. 108x^{29}$$

$$6. \frac{y^2}{3x^4}$$

# P3A Radicals & Rational Exponents

- Evaluate square roots
- Simplify expressions of the form  $\sqrt{a^2}$
- Use the product rule and the quotient rule to simplify square roots
- Add and subtract square roots
- Rationalize denominators
- Evaluate and perform operations with higher roots

Square root of a number is one of its two equal factors.  $\sqrt{n}$

○ Principal square root  $5 = \sqrt{25}$

○ Negative square root  $-5 = -\sqrt{25}$

○ Square root of a negative number is **not** a real number.  $\sqrt{-25} = \textit{not real}$

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Example 1:

$$\sqrt{64} \\ = 8$$

$$-\sqrt{49} \\ = -7$$

$$\sqrt{\frac{1}{4}} \\ = \frac{1}{2}$$

$$\sqrt{9 + 16} \\ = \sqrt{25} \\ = 5$$

$$\sqrt{9} + \sqrt{16} \\ = 3 + 4 \\ = 7$$

# Simplifying Expressions of the Form $\sqrt{a^2}$

- $\sqrt{a^2} = |a|$

- $\sqrt{6^2} = |6| = 6$  and  $\sqrt{(-6)^2} = |-6| = 6$

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## Product Rule for Square Roots

- $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$  and  $\sqrt{a} \cdot \sqrt{b} = \sqrt{ab}$

- $\sqrt{25 \cdot 4} = \sqrt{100} = 10$  and  $\sqrt{25} \cdot \sqrt{4} = 5 \cdot 2 = 10$

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Example 2:

$$\begin{aligned}\sqrt{500} \\ &= \sqrt{100} \cdot \sqrt{5} \\ &= 10\sqrt{5}\end{aligned}$$

$$\begin{aligned}\sqrt{6x}\sqrt{3x} \\ &= \sqrt{6x \cdot 3x} \\ &= \sqrt{18x^2} \\ &= 3x\sqrt{2}\end{aligned}$$

# Quotient Rule for Square Roots

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}} \quad \text{and} \quad \frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}$$

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Example 3:

$$\begin{aligned} & \sqrt{\frac{100}{9}} \\ &= \frac{\sqrt{100}}{\sqrt{9}} \\ &= \frac{10}{3} \end{aligned}$$

$$\begin{aligned} & \frac{\sqrt{48x^3}}{\sqrt{6x}} \\ &= \sqrt{\frac{48x^3}{6x}} \\ &= \sqrt{8x^2} \\ &= 2x\sqrt{2} \end{aligned}$$

# Adding & Subtracting Like Radicals

$$\begin{aligned}7x + 6x &= (7 + 6)x \\ &= 13x\end{aligned}$$

$$\begin{aligned}7\sqrt{11} + 6\sqrt{11} &= (7 + 6)\sqrt{11} \\ &= 13\sqrt{11}\end{aligned}$$

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Example 4

$$\begin{aligned}7\sqrt{2} + 5\sqrt{2} \\ &= (7 + 5)\sqrt{2} \\ &= 12\sqrt{2}\end{aligned}$$

$$\begin{aligned}\sqrt{5x} - 7\sqrt{5x} \\ &= (1 - 7)\sqrt{5x} \\ &= -6\sqrt{5x}\end{aligned}$$

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Example 5

Simplify Radicals before combining

$$\begin{aligned}7\sqrt{3} + \sqrt{12} \\ &= 7\sqrt{3} + \sqrt{4 \cdot 3} \\ &= 7\sqrt{3} + 2\sqrt{3} \\ &= 9\sqrt{3}\end{aligned}$$

$$\begin{aligned}4\sqrt{50x} - 6\sqrt{32x} \\ &= 4\sqrt{25 \cdot 2x} - 6\sqrt{16 \cdot 2x} \\ &= 4 \cdot 5\sqrt{2x} - 6 \cdot 4\sqrt{2x} \\ &= 20\sqrt{2x} - 24\sqrt{2x} \\ &= -4\sqrt{2x}\end{aligned}$$

# Rationalizing Denominators

Example 6:

$$\frac{15}{\sqrt{6}}$$

$$= \frac{15}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}}$$

$$= \frac{15\sqrt{6}}{6}$$

$$= \frac{5\sqrt{6}}{2}$$

$$\frac{12}{\sqrt{8}}$$

$$= \frac{12}{2\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}}$$

$$= \frac{12\sqrt{2}}{4}$$

$$= 3\sqrt{2}$$

# Multiplying Conjugates

$$(\sqrt{a} + \sqrt{b})(\sqrt{a} - \sqrt{b}) = (\sqrt{a})^2 - (\sqrt{b})^2 = a - b$$

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Example 7:

$$\frac{7}{5 + \sqrt{3}} = \frac{7}{5 + \sqrt{3}} \cdot \frac{5 - \sqrt{3}}{5 - \sqrt{3}}$$

$$= \frac{7(5 - \sqrt{3})}{25 - 3}$$

$$= \frac{7(5 - \sqrt{3})}{22}$$

OR

$$= \frac{35 - 7\sqrt{3}}{22}$$



## Example 8:

$$\sqrt[3]{24}$$

$$= \sqrt[3]{8 \cdot 3}$$

$$= 2\sqrt[3]{3}$$

$$\sqrt[4]{8} \cdot \sqrt[4]{4}$$

$$= \sqrt[4]{8 \cdot 4}$$

$$= \sqrt[4]{32}$$

$$= \sqrt[4]{16 \cdot 2}$$

$$= 2\sqrt[4]{2}$$

$$\sqrt[4]{\frac{81}{16}}$$

$$= \frac{\sqrt[4]{81}}{\sqrt[4]{16}}$$

$$= \frac{3}{2}$$

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## Example 9:

$$5\sqrt[3]{16} - 11\sqrt[3]{2}$$

$$= 5\sqrt[3]{8 \cdot 2} - 11\sqrt[3]{2}$$

$$= 5 \cdot 2\sqrt[3]{2} - 11\sqrt[3]{2}$$

$$= 10\sqrt[3]{2} - 11\sqrt[3]{2}$$

$$= -\sqrt[3]{2}$$