

Elementary Algebra
Skill-BUILDER # SQRT – 1C
Simplifying Square Root Radicals: Radicand Consists of Numbers and Variables

Now we can consider the case when the radicand is a product of a positive number and powers of variables. We will again assume that the variables represent positive real numbers.

Examples Find the following.

1. $\sqrt{8x^8}$

Solution: Recall there are several ways we can deal with the numeric factor. We'll show each but pick your favorite and stick to it. For the variables, let's do the division by the index 2. Perfect square factors will be enclosed by \square . So:

$$\sqrt{8x^8} = \sqrt{\square{4} \cdot 2 \cdot \square{x^8}} = 2x^4\sqrt{2}$$

$$\text{OR } \sqrt{8x^8} = \sqrt{\square{2} \cdot \square{2} \cdot 2 \cdot \square{x^8}} = 2x^4\sqrt{2}$$

$$\text{OR } \sqrt{8x^8} = \sqrt{\square{2^2} \cdot 2 \cdot \square{x^8}} = 2x^4\sqrt{2}$$

2. $\sqrt{20a^7b^{10}c^3}$

Solution: Let's show the three ways.

$$\sqrt{20a^7b^{10}c^3} = \sqrt{\square{4} \cdot 5 \cdot \square{a^6} \cdot a \cdot \square{b^{10}} \cdot \square{c^2} \cdot c} = 2a^3b^5c\sqrt{5ac}$$

$$\text{OR } \sqrt{20a^7b^{10}c^3} = \sqrt{\square{2} \cdot \square{2} \cdot 5 \cdot \square{a^6} \cdot a \cdot \square{b^{10}} \cdot \square{c^2} \cdot c} = 2a^3b^5c\sqrt{5ac}$$

$$\text{OR } \sqrt{20a^7b^{10}c^3} = \sqrt{\square{2^2} \cdot 5 \cdot \square{a^6} \cdot a \cdot \square{b^{10}} \cdot \square{c^2} \cdot c} = 2a^3b^5c\sqrt{5ac}$$

Now, what happens when there are factors sitting outside the radical expression? The answer is we multiply to these factors whatever square roots we extract.

3. $3x\sqrt{50x^7}$

Solution:

$$3x\sqrt{50x^7} = 3x\sqrt{\square{5} \cdot \square{5} \cdot 2 \cdot \square{x^6}} \cdot x = 3x \cdot 5x^3\sqrt{2x} = 15x^4\sqrt{2x}$$

4. $\frac{a}{3b^2} \sqrt{\frac{27a^2b^5}{16}}$

Solution:

$$\frac{a}{3b^2} \sqrt{\frac{27a^2b^5}{16}} = \frac{a}{3b^2} \sqrt{\frac{\square{3} \cdot \square{3} \cdot 3 \cdot \square{a^2} \cdot \square{b^4} \cdot b}{\square{4} \cdot \square{4}}} = \frac{a}{\cancel{3}b^{\cancel{2}}} \cdot \frac{\cancel{3}a\cancel{b^4}\sqrt{3b}}{4} = \frac{a^2\sqrt{3b}}{4}$$

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Find the following. Assume all variables represent positive real numbers.

1. $\sqrt{18y^{18}}$	2. $\sqrt{12x^9}$
3. $3\sqrt{80y^8z^5}$	4. $-4\sqrt{32a^3b^6c}$
5. $2ab^2\sqrt{36a^5b^{13}}$	6. $2x^2y\sqrt{45x^7y^{14}z^{21}}$
7. $\frac{6x}{5y}\sqrt{\frac{25x^3y^8}{4z^4}}$	8. $-\frac{1}{12ab^2}\sqrt{\frac{27a^5b^9}{4c^8}}$

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Answers

1. $3y^9\sqrt{2}$	2. $2x^4\sqrt{3x}$
3. $12y^4z^2\sqrt{5z}$	4. $-16ab^3\sqrt{2ac}$
5. $12a^3b^8\sqrt{ab}$	6. $6x^5y^8z^{10}\sqrt{5xz}$
7. $\frac{3x^2y^3}{z^2}$	8. $-\frac{ab^2\sqrt{3ab}}{8c^4}$

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