

Adding, Subtracting, and Multiplying Radical expressions

Product Property of Radicals

If $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are real numbers, and $n \geq 2$ is an integer, then

$$\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$$

We can prove this using rational exponents.

Note: $\sqrt{a+b} \neq \sqrt{a} + \sqrt{b}$

Simplify

$$\sqrt{5} \cdot \sqrt{3} = \sqrt{15}$$

$$\sqrt[3]{2} \cdot \sqrt[3]{13} = \sqrt[3]{2 \cdot 13}$$

$$\sqrt{4} + \sqrt{36} = \sqrt{40}$$

xy

$$2 + 6 = 8$$

$$\boxed{\sqrt{3} + \sqrt{5}}$$

$x + y$

Multiply

$$\sqrt[5]{6c} \cdot \sqrt[5]{7c^2} = \sqrt[5]{42c^3}$$

You try

$$\sqrt{11} \cdot \sqrt{7} = \sqrt{77} \quad \sqrt[4]{6} \cdot \sqrt[4]{7} = \sqrt[4]{42}$$

$$\sqrt[3]{5p} \cdot \sqrt[3]{4p^3} = \sqrt[3]{20p^4}$$

Multiply and Simplify Assuming all variables are greater than or equal to zero.

$$\sqrt{3} \cdot \sqrt{15} \cdot \sqrt{45} \quad 3\sqrt[3]{4x} \cdot \sqrt[3]{2x^4}$$

$\sqrt{3} \cdot \sqrt{15} \cdot \sqrt{45}$ is simplified to $3\sqrt{5}$ by prime factorizing 15 (3 and 5) and 45 (3, 3, and 5), then combining the 3s.

$3\sqrt[3]{4x} \cdot \sqrt[3]{2x^4}$ is simplified to $3\sqrt[3]{8x^5}$ by multiplying the radicands (4x and 2x^4) and then simplifying the cube root of 8 to 2.

$$\sqrt[4]{27a^2b^5} \cdot \sqrt[4]{6a^3b^6}$$

$\sqrt[4]{27a^2b^5} \cdot \sqrt[4]{6a^3b^6}$ is simplified to $3ab^2\sqrt[4]{2ab^3}$ by multiplying the radicands (27a^2b^5 and 6a^3b^6) and then simplifying the fourth root of 27 to 3, and the exponents of a and b to 5 and 11 respectively.

You try

$$\sqrt{6} \cdot \sqrt{8}$$

$$4\sqrt[3]{8a^2b^5} \cdot \sqrt[3]{6a^2b^4}$$

What is inside radical DOES NOT
 Add the following CHANGE (+ & -)

$$5\sqrt{2x} + 9\sqrt{2x} = 14\sqrt{2x}$$

$$3\sqrt[3]{10} + 7\sqrt[3]{10} - 5\sqrt[3]{10} = 5\sqrt[3]{10}$$

You Try

$$9\sqrt{13y} + 4\sqrt{13y} = 13\sqrt{13y}$$

$$4\sqrt[4]{5} + 9\sqrt[4]{5} - 3\sqrt[4]{5} = 7\sqrt[4]{5}$$

Add or subtract as indicated.

$$3\sqrt{12} + 7\sqrt{3}$$

Handwritten annotations: A blue arrow points from the 3 to the 4 in the simplified radical below. A blue 'x' is written over the 3 in the simplified radical.

$$6\sqrt{3} + 7\sqrt{3} = 13\sqrt{3}$$

Add or subtract as indicated.

$$3x\sqrt{20x} - 7\sqrt{5x^3}$$

Handwritten annotations: A blue arrow points from the 3 to the 4 in the simplified radical below. A blue 'x' is written over the 3 in the simplified radical. A blue arrow points from the 5 in the second radical to the 5 in the simplified radical below.

$$6x\sqrt{5x} - 7x\sqrt{5x} = -x\sqrt{5x}$$

$$3\sqrt{5} + 7\sqrt{13}$$

You try

$$7\sqrt{10} - 6\sqrt{3}$$

$$4\sqrt{14} - 3\sqrt{8}$$

$$-5x\sqrt[3]{54x} + 7\sqrt[3]{2x^4}$$

Add or subtract as indicated.

$$\sqrt[3]{16x^4} - 7x\sqrt[3]{-2x} + \sqrt[3]{54x}$$

You try

$$\sqrt[3]{8z^4} - 2z\sqrt[3]{-27z} + \sqrt[3]{125z}$$

Multiply and simplify

$$\sqrt{5}(3 - 4\sqrt{5})$$

$$\sqrt[3]{2}(3 + \sqrt[3]{4})$$

You try

$$\sqrt{6}(3 - 5\sqrt{6})$$

$$\sqrt[3]{12}(3 - \sqrt[3]{2})$$