

## Lesson 7.4: Adding, Subtracting, and Multiplying Rational Expressions

### Objectives:

- Add and Subtract Radical Expressions.
- Multiply Radical Expressions.

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### Definition:

Two radicals are called “like radicals” if each radical has the same index and the same radicand (term inside of the radical).

### Example:

$\sqrt[4]{x-2}$  and  $5\sqrt[4]{x-2}$  are “like radicals” with different coefficients.

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### *To Add or Subtract Radical Expressions:*

- Step 1: Simplify all of your radicals (pull out perfect squares, or cubes, etc.), if necessary.
- Step 2: Add or subtract the COEFFICIENTS ONLY of the like radicals. The values inside the radicals will not change. This is just like adding or subtracting polynomials with like terms.

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Examples:

a.)  $3\sqrt{5x} + 7\sqrt{5x}$

$= 10\sqrt{5x}$

b.)  $5\sqrt[3]{11} - 8\sqrt[3]{11} + \sqrt[3]{11}$

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

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Examples:

$$c.) \quad 3\sqrt{20} + 8\sqrt{45}$$

4 · 5      9 · 5  
↑      ↑  
2 2      3 3

$$= 3 \cdot 2\sqrt{5} + 8 \cdot 3\sqrt{5}$$

$$= 6\sqrt{5} + 24\sqrt{5}$$

$$= \boxed{30\sqrt{5}}$$

$$d.) \quad 6x\sqrt{12x} - 5\sqrt{3x^3}$$

4 · 3      x · x  
↑      ↑  
2 2

$$= 12x\sqrt{3x} - 5x\sqrt{3x}$$

$$= \boxed{7x\sqrt{3x}}$$

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Examples:

e.)  $2\sqrt{11} + 8\sqrt{6}$

Simplified...

so

$$\boxed{2\sqrt{11} + 8\sqrt{6}}$$

f.)  $\sqrt[3]{-54x^4} + 5x\sqrt[3]{2x} + x\sqrt[3]{16x}$

$-27 \hat{\phantom{2}} 2 \hat{\phantom{x}} x$

$\textcircled{8} \hat{\phantom{2}}$



$$= -3x\sqrt[3]{2x} + 5x\sqrt[3]{2x} + 2x\sqrt[3]{2x}$$

$$= \boxed{4x\sqrt[3]{2x}}$$

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Examples:

g.)  $2\sqrt{a^2b} - 5a\sqrt[6]{b^3}$

$2a\sqrt{b} - 5a\sqrt[6]{b^3}$

$= 2a\sqrt{b} - 5a\sqrt{b}$

$= -3a\sqrt{b}$

$b^{\frac{3}{6}} = b^{\frac{1}{2}}$   
 $= \sqrt{b}$

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### Multiplying Radical Expressions:

- Key Idea: You *must* have the same index on the radicals in order to combine the radicands!
- Multiply outside coefficients, and multiply radicands (outsides stay outside, insides stay inside).
- When multiplying radical expressions, we use the Distributive Property.



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Examples:

$$\begin{aligned} \text{h.) } & \sqrt{6}(3 - 2\sqrt{6}) \\ & = 3\sqrt{6} - 2\sqrt{36} \\ & = 3\sqrt{6} - 2(6) \\ & = \boxed{3\sqrt{6} - 12} \end{aligned}$$

$$\begin{aligned} \text{i.) } & (8 - 3\sqrt{2})(5 + 7\sqrt{2}) \\ & = 40 + 56\sqrt{2} - 15\sqrt{2} - 21\sqrt{4} \\ & = 40 + 4(\sqrt{2}) - 21(2) \\ & = 40 + 4\sqrt{2} - 42 \\ & = \boxed{-2 + 4\sqrt{2}} \end{aligned}$$

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Examples:

$$\begin{aligned} \text{j.) } & (5\sqrt{7} + \sqrt{2})^2 \\ & = (5\sqrt{7} + \sqrt{2})(5\sqrt{7} + \sqrt{2}) \\ & = 25(7) + 5\sqrt{14} + 5\sqrt{14} + 2 \\ & = 175 + 10\sqrt{14} + 2 \\ & = \boxed{177 + 10\sqrt{14}} \end{aligned}$$

$$\begin{aligned} \text{k.) } & (8 + \sqrt{5})(8 - \sqrt{5}) \\ & = 64 - \cancel{8\sqrt{5}} + \cancel{8\sqrt{5}} - \sqrt{25} \\ & = 64 - 5 \\ & = \boxed{59} \end{aligned}$$

# Homework:

Pg. 564: # 7-33 odds, 37, 41,  
43, 47, 51, 55, 57, 63, 65, 69, 71,  
75, 83, 89, 91, 95  
(30 problems)