Investigation: Radicals

Part A) Evaluate without the use of a calculator:

$\sqrt{4 \times 9} = \sqrt{36}$ $\sqrt{4} \times \sqrt{9} = 2 \cdot 3$
    $= 6$ $= 6$

$\sqrt{4 \times 16} = \sqrt{64}$ $\sqrt{4} \times \sqrt{16} = 2 \cdot 4$
    $= 8$ $= 8$

$\sqrt{9 \times 16} =$ $\sqrt{9} \times \sqrt{16} =$

$\sqrt{4 \times 25} =$ $\sqrt{4} \times \sqrt{25} =$

What do you notice? Write a rule to explain your observations.

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Part B) Evaluate (round to 4 decimal places) with a calculator:

$\sqrt{5 \times 5} = \sqrt{25}$ $\sqrt{5} \times \sqrt{5} = 2.2361 \times 2.2361$
    $= 5$ $= 5$

$\sqrt{9 \times 3} =$ $\sqrt{9} \times \sqrt{3} =$

$\sqrt{2 \times 10} =$ $\sqrt{2} \times \sqrt{10} =$

$\sqrt{6 \times 3} =$ $\sqrt{6} \times \sqrt{3} =$
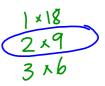
Does the rule you created in part A still work?

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Part C) Without a calculator, write each radical in a different way. (Notice the similarity to the numbers from part B)

$$\sqrt{27} = \sqrt{9 \cdot 3} = \sqrt{9} \cdot \sqrt{3} \quad \boxed{= 3\sqrt{3}}$$

$$\sqrt{20} = \sqrt{4 \cdot 5} = \sqrt{4} \cdot \sqrt{5} \quad \boxed{= 2\sqrt{5}}$$

$$\sqrt{18} = \sqrt{9 \cdot 2} = \sqrt{9} \cdot \sqrt{2} \; \boxed{= 3\sqrt{2}}$$

1×18
2×9
3×6

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Skill Builder: Operations with Radicals

The **product property** of radicals states:

$$\text{For} \quad a \geq 0, b \geq 0; \sqrt{a}\sqrt{b} = \sqrt{ab}$$

We can use this property to simplify & perform operations with radicals

Simplifying Radicals
1. Find **2** factors, one of which is a perfect square (highest perfect square possible).
2. Rewrite as two radicals. (First radical must be the perfect square.)
3. Evaluate the perfect square.

> If the number under your radical cannot be divided evenly by any of the perfect squares, your radical is already in simplest form and cannot be reduced further.

Practice: Simplify

a) $\sqrt{12}$ b) $2\sqrt{24}$ c) $\sqrt{32}$ d) $-\sqrt{8}$

a) $= \sqrt{4} \cdot \sqrt{3}$
$\boxed{= 2\sqrt{3}}$

b) $= 2 \cdot \sqrt{4} \cdot \sqrt{6}$
$= 2 \cdot 2 \cdot \sqrt{6}$
$\boxed{= 4\sqrt{6}}$

c) $= \sqrt{16} \cdot \sqrt{2}$
$\boxed{= 4\sqrt{2}}$

d) $\boxed{= -2\sqrt{2}}$

$= \sqrt{4} \cdot \sqrt{8}$
$= 2\sqrt{8}$
$= 2\sqrt{4}\sqrt{2}$
$= 2 \cdot 2\sqrt{2}$
$\boxed{= 4\sqrt{2}}$

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Multiplying Radicals

- Outside times outside, stays outside.
- Inside times inside, stays inside.
- Simplify radical

a) $2\sqrt{2} \times 3\sqrt{7}$

$$= 6\sqrt{14}$$

b) $5\sqrt{6} \times \sqrt{5}$

$$= 5\sqrt{30}$$

c) $-8\sqrt{10} \times 2\sqrt{2}$

$$= -16\sqrt{20}$$
$$= -16\sqrt{4} \cdot \sqrt{5}$$
$$= -16 \cdot 2 \cdot \sqrt{5}$$
$$= -32\sqrt{5}$$

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Dividing Radicals

- Outside divided by outside, stays outside.
- Inside divided by inside, stays inside.
- Simplify radical.

a) $\dfrac{2\sqrt{15}}{\sqrt{3}}$

$$= 2\sqrt{5}$$

b) $\dfrac{\sqrt{24}}{\sqrt{2}}$

$$= \sqrt{12}$$
$$= \sqrt{4} \cdot \sqrt{3}$$
$$= 2\sqrt{3}$$

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Adding/Subtracting Radicals

- You can only add or subtract like radicals (think algebra: like terms)
- Reduce if needed, then collect like radicals

Simplify any individual radical terms first.
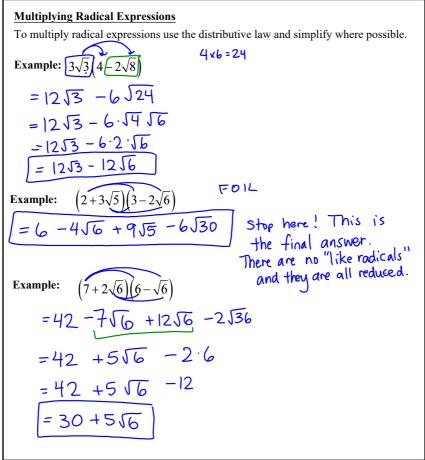
Example: $3\sqrt{7} + 2\sqrt{7} = 5\sqrt{7}$

Practice: Simplify

a) $3\sqrt{11} + 2\sqrt{11}$

$$= 5\sqrt{11}$$

b) $5\sqrt{8} - 3\sqrt{18}$

$$= 5 \cdot \sqrt{4}\sqrt{2} - 3\sqrt{9}\sqrt{2}$$

$$= 10\sqrt{2} - 9\sqrt{2}$$

$$= \sqrt{2}$$

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Multiplying Radical Expressions

To multiply radical expressions use the distributive law and simplify where possible.

Example: $3\sqrt{3} \left(4 - 2\sqrt{8}\right)$ $4 \times 6 = 24$

$$= 12\sqrt{3} - 6\sqrt{24}$$

$$= 12\sqrt{3} - 6 \cdot \sqrt{4}\sqrt{6}$$

$$= 12\sqrt{3} - 6 \cdot 2 \cdot \sqrt{6}$$

$$= 12\sqrt{3} - 12\sqrt{6}$$

Example: $\left(2 + 3\sqrt{5}\right)\left(3 - 2\sqrt{6}\right)$ FOIL

$$= 6 - 4\sqrt{6} + 9\sqrt{5} - 6\sqrt{30}$$

Stop here! This is the final answer. There are no "like radicals" and they are all reduced.

Example: $\left(7 + 2\sqrt{6}\right)\left(6 - \sqrt{6}\right)$

$$= 42 - 7\sqrt{6} + 12\sqrt{6} - 2\sqrt{36}$$

$$= 42 + 5\sqrt{6} - 2 \cdot 6$$

$$= 42 + 5\sqrt{6} - 12$$

$$= 30 + 5\sqrt{6}$$

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HW:

1. correct and sign quizzes

2. p. 167 #1-7ace, 15b, 17*hard!!!!