Operations on Radicals Lesson #2:
Multiplying Radicals

Investigation | *Investigating Multiplication Properties of Radicals*

Use a calculator to determine whether the following statements are true or false.

✓ **a)** $\sqrt{2} \times \sqrt{3} = \sqrt{6}$ **b)** $(2\sqrt{5})(-4\sqrt{3}) = -8\sqrt{15}$ **c)** $\sqrt{2} \cdot \sqrt[3]{4} = \sqrt[3]{8}$ ✗

✓ **d)** $2\sqrt[3]{10} \times 3\sqrt[3]{7} = 6\sqrt[3]{70}$ **e)** $(4\sqrt[3]{5})(7\sqrt{6}) = 28\sqrt[6]{30}$ ✗

Based on the results from a) - e), write a rule which describes the process of multiplying radicals.

must have the same index

Multiplying Radicals

To multiply radicals, the index must be the same in each radical.

- Multiply numerical coefficients by numerical coefficients.
- Multiply radicand by radicand.
- Simplify into mixed radical form if possible.

Note It is usually easier to convert each radical to its simplest mixed form before multiplying.

Class Ex. #1 Multiply and simplify where possible.

a) $\sqrt{8} \cdot \sqrt{8}$ **b)** $(4\sqrt{5})(3\sqrt{6})$ **c)** $(4\sqrt{x})(3\sqrt{y})$ **d)** $-2\sqrt{8} \times 5\sqrt{12}$

$\to 5 \cdot \sqrt{4} \cdot \sqrt{3}$

$-2 \sqrt{4} \cdot \sqrt{2}$

$\sqrt{64}$

$= 8$ $= 12\sqrt{30}$ $= 12\sqrt{xy}$ $(-4\sqrt{2})(10\sqrt{3})$

$= -40\sqrt{6}$

Class Ex. #2

Expand and simplify.

a) $\sqrt{5}\left(2\sqrt{10} - \sqrt{5}\right)$

$2\sqrt{50} - 5$

$2 \cdot \sqrt{25}\sqrt{2}$

$\cdot 5$

$= \boxed{10\sqrt{2} - 5}$

b) $2\sqrt{5}\left(3\sqrt{45} - 8\sqrt{5} + 3\sqrt{20}\right)$

$2\sqrt{5}\left(9\sqrt{5} - 8\sqrt{5} + 6\sqrt{5}\right)$

$\left(2\sqrt{5}\right)\left(7\sqrt{5}\right)$

$= \boxed{70}$

c) $2\left(\sqrt{3} - \sqrt{5}\right) - \sqrt{2}\left(\sqrt{6} + \sqrt{10}\right)$

$= 2\sqrt{3} - 2\sqrt{5} - \sqrt{12} - \sqrt{20}$
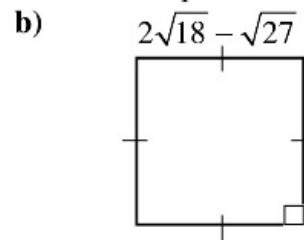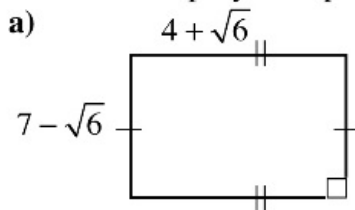
$= 2\sqrt{3} - 2\sqrt{5} - 2\sqrt{3} - 2\sqrt{5}$

$= \boxed{-4\sqrt{5}}$

d) $-4\sqrt{a}\left(\sqrt{a} - 9\sqrt{b}\right)$

$\boxed{-4a + 36\sqrt{ab}}$

Class Ex. #3

Write and simplify an expression for the area of each shape.

a)

$4 + \sqrt{6}$

$7 - \sqrt{6}$

b)

$2\sqrt{18} - \sqrt{27}$

Complete Assignment Questions #1 - #10

Multiplying Conjugate Binomials

Expand the following expressions:

i) $\left(\sqrt{5} - \sqrt{2}\right)\left(\sqrt{5} + \sqrt{2}\right)$ **ii)** $\left(2\sqrt{7} + 8\right)\left(2\sqrt{7} - 8\right)$

The pairs of binomials above are called **conjugates** of each other.
What do you notice about the product of two conjugate binomials?

Note

• Conjugate binomials are pairs of binomials in the form $a\sqrt{b} + c\sqrt{d}$ and $a\sqrt{b} - c\sqrt{d}$.

• The product of conjugate binomials is always a rational number of the form $a^2b - c^2d$.

Class Ex. #4
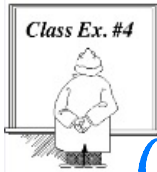
Write the conjugate of each, then multiply each pair.

a) $4\sqrt{6} + 3$

$(4\sqrt{6} + 3)(4\sqrt{6} - 3)$

$96 + 12\sqrt{6} - 12\sqrt{6} - 9$

$= \boxed{87}$

b) $-3\sqrt{11} + \sqrt{2}$

$(-3\sqrt{11} + \sqrt{2})(-3\sqrt{11} - \sqrt{2})$

$= 99 - 2$

$= \boxed{97}$

c) $5\sqrt{x} - \sqrt{y}$

$(5\sqrt{x} - \sqrt{y})(5\sqrt{x} + \sqrt{y})$

$= \boxed{25x - y}$

Complete Assignment Questions #11 - #17

Assignment

#1-4, 6-13
(a, c, e, --) for all

1. Multiply and simplify where possible. Do not use a calculator.

a) $(\sqrt{7})(\sqrt{3})$

b) $4\sqrt{3} \times 2\sqrt{5}$

c) $-3\sqrt{5} \times 2\sqrt{2}$

d) $6\sqrt{p} \times 8\sqrt{q}$

e) $(\sqrt{15})(\sqrt{3})$

f) $10\sqrt{5} \times 9\sqrt{5}$

g) $3\sqrt{6} \cdot 5\sqrt{10}$

h) $\sqrt{a} \times 10\sqrt{a}$

i) $7\sqrt{54} \cdot 2\sqrt{6}$

j) $(\sqrt{32})(\sqrt{6})$

k) $\sqrt{15} \times 3\sqrt{27}$