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)** $\left(2\sqrt{5}\right)\left(-4\sqrt{3}\right) = -8\sqrt{15}$ **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)** $\left(4\sqrt[3]{5}\right)\left(7\sqrt{6}\right) = 28\sqrt[6]{30}$

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

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.

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

Multiply and simplify where possible.

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

$= \sqrt{64}$ $= 12\sqrt{30}$ $= 12\sqrt{xy}$ $= -2\sqrt{4 \cdot 2} \times 5\sqrt{4 \cdot 3}$

$= 8$ $= -4\sqrt{2} \times 10\sqrt{3}$

$= -40\sqrt{6}$

Class Ex. #2

Expand and simplify.

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

$=2\sqrt{50}-\sqrt{25}$

$=2\sqrt{25\cdot 2}-5$

$=10\sqrt{2}-5$

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

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

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

$=14\sqrt{25}=14(5)=70$

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

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

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

$=-4\sqrt{5}$

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

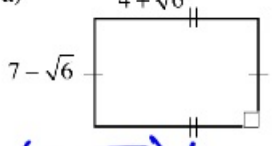
$=-4\sqrt{a^2}+36\sqrt{ab}$

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

Class Ex. #3

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

a)



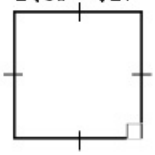
$A=(4+\sqrt{6})(7-\sqrt{6})$

$=28-4\sqrt{6}+7\sqrt{6}-\sqrt{36}$

$=28+3\sqrt{6}-6$

$=22+3\sqrt{6}$

b)



Complete Assignment Questions #1 - #10

Multiplying Conjugate Binomials

Expand the following expressions:

i) $\left(\sqrt{5}-\sqrt{2}\right)\left(\sqrt{5}+\sqrt{2}\right)$

$=\sqrt{25}+\sqrt{10}-\sqrt{10}-\sqrt{4}$

$=5-2=3$

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

$=4\sqrt{49}-16\sqrt{7}+16\sqrt{7}-64$

$=4(7)-64=28-64$

$=-36$

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

No radicals.

- 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.

Write the conjugate of each, then multiply each pair.

a) $4\sqrt{6}+3$ **b)** $-3\sqrt{11}+\sqrt{2}$ **c)** $5\sqrt{x}-\sqrt{y}$

$4\sqrt{6}-3$

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

$=16\sqrt{36}-12\sqrt{6}+12\sqrt{6}-9$

$=16(6)-9=96-9=87$

$5\sqrt{x}+\sqrt{y}$

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

$=25\sqrt{x^2}+5\sqrt{xy}-5\sqrt{xy}-\sqrt{y^2}$

$=25x-y$

Complete Assignment Questions #11 - #17

Assignment

Do # 1-13 (a, c, e...) (all of 5)

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