Multiplying and Dividing Radicals

This is very similar to how you would treat x and y. x^2 and x^3.
We look for things the same…

$\underbrace{2x + x = 3x}$ but $\underbrace{2x + y} = 2x + y$

$x^2(x) = x^3$ but $x^2(y) = x^2y$

Let's do this but with radicals instead of x,y.

$\underbrace{2\sqrt{3}} \bullet \underbrace{4\sqrt{6}}$ $\quad 2(4)\sqrt{3(6)}$
$8\sqrt{18}$
$= 8\sqrt{3^2 \cdot 2}$
$= 8(3)\sqrt{2}$
$\boxed{= 24\sqrt{2}}$

Here are the steps that we always want to follow:

1. Simplify
2. Multiply
   - ➢ $a\sqrt{b} \bullet c\sqrt{d} = ac\sqrt{bd}$
3. Simplify
   - ➢ Nothing can come out of the radical.
   - ➢ No radicals in the denominator.

72
9 8
3 3 2 2 2

$3\sqrt{5} \bullet 2\sqrt{72}$

$= 3\sqrt{5} \cdot 2(3)(2)\sqrt{2}$

$= 3(2)(3)(2)\sqrt{5 \cdot 2}$

$= 36\sqrt{10}$

$3\sqrt[3]{2x} \bullet 7\sqrt[3]{5x^2}$

$= 3(7)\sqrt[3]{2x \cdot 5x^2}$

$= 21\sqrt[3]{10x^3}$

$= 21x\sqrt[3]{10}$

$x(x-4)$

$x^2 - 4x$

$x(x+1)$

$x^2 + x$

$$\begin{array}{c} 30 \\ 15 \quad 2 \\ 5 \quad 3 \end{array}$$

$\sqrt{30} = \sqrt{2 \cdot 3 \cdot 5}$

$\sqrt{60} = \sqrt{4 \cdot 15}$

$= \sqrt{2^2 \cdot 15}$

$2\sqrt{6}(\sqrt{5} - 2\sqrt{10})$

$= 2\sqrt{6} \cdot \sqrt{5} - 2\sqrt{6} \cdot 2\sqrt{10}$

$= 2\sqrt{30} - 4\sqrt{60}$

$= 2\sqrt{30} - 4(2)\sqrt{15}$

$= 2\sqrt{30} - 8\sqrt{15}$

2

$(\sqrt{3} - 4\sqrt{5})(2 + \sqrt{5})$

$\sqrt{3}(2) + \sqrt{3}\sqrt{5} - 4\sqrt{5}(2) - 4\sqrt{5}\sqrt{5}$

$2\sqrt{3} + \sqrt{15} - 8\sqrt{5} - 4\sqrt{25}$

$2\sqrt{3} + \sqrt{15} - 8\sqrt{5} - 4(5)$

Dividing radicals works the same way. We can follow the same steps as above. Just divide instead.

$\sqrt{2} \cdot \sqrt{3}$

$= \sqrt{2 \cdot 3}$

$$\frac{8\sqrt{15}}{2\sqrt{3}} = \frac{8}{2}\sqrt{\frac{15}{3}}$$

$$= 4\sqrt{5}$$

$$\frac{2\sqrt{20}}{8\sqrt{5}} = \frac{2}{8} \cdot \sqrt{\frac{20}{5}}$$

$$= \frac{1}{4} \cdot \sqrt{4}$$

$$= \frac{2}{4} = \frac{1}{2}$$

$$\frac{\sqrt{24x^2}}{\sqrt{3x}} = \sqrt{\frac{24x^2}{3x}}$$

$$= \sqrt{8x}$$

$$= 2\sqrt{2x}$$

If we get a radical in the denominator, we have to ditch that .... Rationalize the denominator:

$$\frac{2\sqrt{5}}{\sqrt{10}} = 2\sqrt{\frac{5}{10}}$$

$$= 2\frac{\sqrt{1}}{\sqrt{2}} = \frac{2}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}}$$

$$= \frac{\cancel{2}\sqrt{2}}{\cancel{2}}$$

$$= \sqrt{2}$$

$$\frac{5}{2\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}}$$

$$= \frac{5\sqrt{3}}{2(3)} = \frac{5\sqrt{3}}{6}$$

If there is more than just one term in the denominator, we need to bring out the conjugate!

Example:

$(x+1)(x+2)$

$$\frac{5\sqrt{3}}{4-\sqrt{6}} \cdot \frac{4+\sqrt{6}}{4+\sqrt{6}}$$

$$= \frac{5(4)\sqrt{3} + 5\sqrt{3\cdot 6}}{4(4) + 4\sqrt{6} - 4\sqrt{6} - \sqrt{6\cdot 6}}$$

$$= \frac{20\sqrt{3} + 5\sqrt{18}}{16 - 6} = \frac{20\sqrt{3} + 5\sqrt{18}}{10}$$

$$= \frac{4\sqrt{3} + 3\sqrt{2}}{2}$$

$$\frac{6}{\sqrt{5}+2\sqrt{2}}$$

HW: pg 289

#1abcd,2,3,4,5ab,6,8ab,9ab,10