

# 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...

$$\underline{2x + x = 3x} \text{ but } \underline{2x + y = 2x + y}$$

$$x^2(x) = x^3 \text{ but } x^2(y) = x^2 y$$

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

$$2\sqrt{3} \cdot 4\sqrt{6}$$

Here are the steps that we always want to follow:

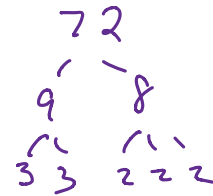
1. Simplify
- 2. Multiply

$$\text{➤ } a\sqrt{b} \cdot c\sqrt{d} = ac\sqrt{bd}$$

3. Simplify

- Nothing can come out of the radical.
- No radicals in the denominator.

$$\begin{aligned} & 2(4) \sqrt{3(6)} \\ & 8 \sqrt{18} \\ & = 8 \sqrt{3^2 \cdot 2} \\ & = 8(3) \sqrt{2} \\ & = 24\sqrt{2} \end{aligned}$$



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

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

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

$$= 36\sqrt{10}$$

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

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

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

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

$$\begin{array}{l} x(x+1) \\ x^2 + x \end{array}$$

$$\begin{array}{l} x(x-4) \\ x^2 - 4x \end{array}$$

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

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

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

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

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

$$\begin{array}{r} 30 \\ / \quad \backslash \\ 15 \quad 2 \\ / \quad \backslash \\ 5 \quad 3 \\ \sqrt{30} = \sqrt{2 \cdot 3 \cdot 5} \end{array}$$

$$\begin{array}{l} \sqrt{60} = \sqrt{4 \cdot 15} \\ = \sqrt{2^2 \cdot 15} \end{array}$$

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

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

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

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

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

$$\begin{aligned} \sqrt{2} \cdot \sqrt{3} \\ = \sqrt{2 \cdot 3} \end{aligned}$$

$$\begin{aligned} \frac{8\sqrt{15}}{2\sqrt{3}} &= \frac{8}{2} \sqrt{\frac{15}{3}} \\ &= 4\sqrt{5} \end{aligned}$$

$$\begin{aligned} \frac{2\sqrt{20}}{8\sqrt{5}} &= \frac{2}{8} \sqrt{\frac{20}{5}} \\ &= \frac{1}{4} \sqrt{4} \\ &= \frac{2}{4} = \frac{1}{2} \end{aligned}$$

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

$$= \sqrt{8x}$$

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

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

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

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

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

$$= \sqrt{2}$$

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

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

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