Combining Unlike Radicals

Example 1: Simplify $\sqrt{32} + \sqrt{8}$

As they are, these radicals cannot be combined because they do not have the same radicand. (The radicand of the first is 32 and the radicand of the second is 8.) In other words, these are not ***like*** radicals.

To see if they can be combined, we need to simplify each radical separately from each other. Then, if they are like radicals, they can be combined.

Let's simplify them separately: $\sqrt{32}$ can be simplified by first using prime factorization:

$32 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$; paired up, it looks like this

$32 = \mathbf{2 \cdot 2} \cdot \mathbf{2 \cdot 2} \cdot 2$

$32 = \mathbf{4} \cdot \mathbf{4} \cdot 2$, so ... $\sqrt{32} = \sqrt{\mathbf{4} \cdot \mathbf{4} \cdot 2} = \sqrt{\mathbf{4}} \cdot \sqrt{\mathbf{4}} \cdot \sqrt{2}$

$= \mathbf{2} \cdot \mathbf{2} \cdot \sqrt{2}$

$= 4\sqrt{2}$

Likewise, $\sqrt{8} = \sqrt{4 \cdot 2} = \sqrt{4} \cdot \sqrt{2} = 2\sqrt{2}$

So, the original expression $\sqrt{32} + \sqrt{8}$ becomes $4\sqrt{2} + 2\sqrt{2}$ and these are like radicals, so they can be combined:

$\sqrt{32} + \sqrt{8} = 4\sqrt{2} + 2\sqrt{2} = 6\sqrt{2}$ Done!

Example 2: Simplify $5\sqrt{12} - 6\sqrt{6}$

Let's first simplify $5\sqrt{12}$:

$5\sqrt{12} = \sqrt{\mathbf{4} \cdot 3} = 5 \cdot \mathbf{2} \cdot \sqrt{3} = 10\sqrt{3}$

$6\sqrt{6}$ cannot be simplified since 6 has no perfect square factors.

So, the original expression $5\sqrt{12} - 6\sqrt{6}$ becomes $10\sqrt{3} - 6\sqrt{6}$ but these are ***not*** like radicals, so they can't be combined. All we could say is that

$5\sqrt{12} - 6\sqrt{6} = 10\sqrt{3} - 6\sqrt{6}$ Done!