Radical expressions

When we work with radicals, we'll run into all different kinds of radical expressions, and we'll want to use the rules we've learned for working with radicals in order to simplify them. This could include any combination of addition, subtraction, multiplication, and division of radicals.

Just so we remember, here are some rules for radicals that we'll use:

$$\sqrt{ab} = \sqrt{a}\sqrt{b}$$

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$$

$$\sqrt{a}\sqrt{a} = a$$

Let's do an example where we have to simplify a radical expression.

Example

Simplify the radical expression.

$$3\sqrt{2} + 6\sqrt{8} - \sqrt{18}$$

In order to add or subtract terms containing square roots, the radicands have to be the same. Otherwise, those terms aren't like terms, and we can't simplify the sum or difference.

Even though the radicands in the square roots in this expression aren't the same, we may be able to simplify some of them in order to get identical radicands. Since 8 and 18 can be factored as $4 \cdot 2$ and $9 \cdot 2$, respectively, we could rewrite the expression as

$$3\sqrt{2} + 6\sqrt{4 \cdot 2} - \sqrt{9 \cdot 2}$$

We know that the square root of a product is equal to the product of the square roots with the individual factors as the radicands. So we can rewrite $\sqrt{4 \cdot 2}$ and $\sqrt{9 \cdot 2}$ as $\sqrt{4}\sqrt{2}$ and $\sqrt{9}\sqrt{2}$, respectively. Also, 4 and 9 are perfect squares, so we can take their square roots.

$$3\sqrt{2} + 6\sqrt{4}\sqrt{2} - \sqrt{9}\sqrt{2}$$

$$3\sqrt{2} + 6(2)\sqrt{2} - 3\sqrt{2}$$

$$3\sqrt{2} + 12\sqrt{2} - 3\sqrt{2}$$

Now the radicands in all three terms are the same, so all three terms are like terms, and can be combined.

$$(3 + 12 - 3)\sqrt{2}$$

$$12\sqrt{2}$$