In this section we will discuss

* Adding and Subtracting Radical Expressions (Combining Like Terms)
* Products and Quotients of Two of Tow or More Radical Terms
* Rationalizing Denominators or numerators with two terms
* Simplifying Terms with Differing Indices

## Adding and Subtracting Radical Expressions (Combining Like Terms)

Def: When two radical expressions have the same indicies and radicands, they are called **like radicals**.

Like radicals are very much the same thing as like terms, in order to combine or add/subtract them, they must be alike.

Ex: Simplify

a)$14\sqrt[5]{2}-8\sqrt[5]{2}$ b) $7\sqrt[3]{2}-5\sqrt[3]{16}$ c)$\sqrt{4x-4}-\sqrt{x^{3}-x^{2}}$ d)$\sqrt[3]{4}+\sqrt[5]{4}+\sqrt[3]{32}+\sqrt[5]{128}$

## Products and Quotients of Two or More Radical Terms

Fortunately multiplying and dividing radicals is very much the same as multiplying and dividing with polynomials.

Ex: Simplify

a) $\sqrt{3}\left(6-\sqrt{3}\right)$ b)$\sqrt[3]{x}\left(\sqrt[2]{3x^{2}}-\sqrt[3]{81x^{2}}\right)$ c)$ \left(\sqrt{1}+\sqrt{2}\right)\left(\sqrt{2}-\sqrt{4}\right)$ d)$ \left(\sqrt{3}+\sqrt{5}\right)\left(\sqrt{3}-\sqrt{5}\right)$ e)$\left(3+\sqrt{2}\right)^{2}$

## Rationalizing the Denominators or Numerators

To rationalize the denominator means to make the denominator a rational number, which means to say

 “Get rid of all radicals in the denominator”.

Recall what we had to do to Rationalize the Denominator/numerator if it consisted of only one term.

$\frac{2\sqrt{5}}{7\sqrt{3}}$

Now consider what we might do if the denominator or numerator had two terms.

Ex:

$$\frac{3}{1+\sqrt{2}}$$

Recall this fact: $\left(x+y\right)\left(x-y\right)=x^{2}-y^{2}$ or specifically, if $x=1 and y=\sqrt{2}$ then $\left(1+\sqrt{2}\right)\left(1-\sqrt{2}\right)=1-\left(\sqrt{2}\right)^{2}$

Pairs of radical expressions of the form $\left(\sqrt{a}+\sqrt{b}\right)\&\left(\sqrt{a}-\sqrt{b}\right)$ are called conjugates.

Ex: Find the conjugate of the following:

a) $\left(\sqrt{2}+\sqrt{3}\right)$ b) $\left(1-\sqrt{b}\right)$ c) $\sqrt{3}$ d) $2$

Ex: Rationalize the part of the fraction that already has a radical.

a) $\frac{6}{3-\sqrt{2}}$ b)$ \frac{\sqrt{15}-3}{6}$ c)$\frac{\sqrt{7}-\sqrt{3}}{\sqrt{3}-\sqrt{7}}$ d)Den:$ \frac{5\sqrt{3}-\sqrt{11}}{2\sqrt{3}-5\sqrt{11}}$ e)$\frac{\sqrt{z}}{\sqrt{x}-\sqrt{z}}$

Ex: Find $f\left(3-\sqrt{2}\right);if f\left(x\right)=x^{2}$

## Simplifying Terms with Differing Indices

If the terms you are multiplying have different indices, then just convert the expression to a base with a rational exponent.

Ex: Simplify

a) $\sqrt[10]{a}\sqrt[5]{a^{2}}$ b) $\sqrt{2x^{3}y^{3}}∙\sqrt[3]{4xy^{2}}$ c) $\frac{\sqrt[3]{x^{2}}}{\sqrt[5]{x}}$

 Ex Find $(f∙g)(x)$ if $f\left(x\right)=\sqrt[4]{2x}+5\sqrt{2x} \& g\left(x\right)=\sqrt[3]{2x}$