Multiplying Radical Expressions (7.3) **Math 098**

Example 1: Examine

a.) $\sqrt{9\cdot 16}$ vs. $\sqrt{9}\cdot\sqrt{16}$

b.) $\sqrt{9+16}$ vs. $\sqrt{9}+\sqrt{16}$

Definition: (The product rule for radicals) For any real numbers $\sqrt[n]{a}$ and $\sqrt[n]{b}$, we have $\sqrt[n]{a}\cdot\sqrt[n]{b}=\sqrt[n]{a\cdot b}$
That is, the product of two *n*th roots is the *n*th root of the product of the two radicands.

Example 2: Multiply

a.) $\sqrt{5}\cdot\sqrt{6}$

b.) $\sqrt{x-4}\cdot\sqrt{x+4}$

c.) $\sqrt{2}\cdot\sqrt{8}$

d.) $\sqrt[3]{9}\cdot\sqrt[3]{3}$

Method: Using the product rule to simplify

$\sqrt[n]{a \cdot b} = \sqrt[n]{a} \cdot \sqrt[n]{b}$ where $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are both real numbers

Example 3: Simplify $\sqrt{50}$ (The Jail Story)

Method: To simplify a radical expression with index *n* by factoring

1.) Express the radicand as a product in which one factor is the largest perfect *n*th power possible.
2.) Take the *n*th root of each factor.
3.) Simplification is complete when no radicand has a factor that is a perfect *n*th power.

Example 4: Simplify

a.) $\sqrt{27}$

b.) $\sqrt[3]{40}$

c.) $\sqrt[4]{162}$

d.) $\sqrt{169p^4r^6}$

e.) $\sqrt{81y^5}$

f.) $\sqrt{32xy^2}$

g.) $\sqrt[4]{32z^7}$

h.) $\sqrt[3]{24a^9b^4}$

Example 5: You try to simplify $\sqrt[3]{108x^{14}y^{27}z^{34}}$

Example 6: Simplify $f\left(x\right)=\sqrt{2x^2-8x+8}$

Example 7: Multiply and simplify

a.) $\sqrt{10} \cdot \sqrt{14}$

b.) $\sqrt[3]{4} \cdot \sqrt[3]{20}$

c.) $\sqrt[4]{4a^3b^5} \cdot \sqrt[4]{20a^2b^7}$