Chapter 7 Section 3
Multiplying and Simplifying Radical Expressions

Product Rule for Radicals
If $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are real numbers, then $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$

If the root indexes are the same, then multiply the radicand and write as one radical, leaving the root index the same.

Example:

a) $\sqrt{3} \cdot \sqrt{7}$

b) $\sqrt[8]{10x} \cdot \sqrt[8]{8x^4}$

Solution

a) $\sqrt{3} \cdot \sqrt{7}$

$\sqrt{3 \cdot 7}$

$\sqrt{21}$

b) $\sqrt[8]{10x} \cdot \sqrt[8]{8x^4}$

$\sqrt[8]{10x} \cdot \sqrt[8]{8x^4}$

$\sqrt[8]{10x \cdot 8x^4}$

$\sqrt[8]{80x^5}$

Try:

a) $\sqrt[3]{6} \cdot \sqrt[3]{10}$

b) $\sqrt[5]{2x} \cdot \sqrt[5]{6x^3}$

c) $\sqrt{5} \cdot \sqrt{11}$

d) $\sqrt[3]{7} \cdot \sqrt[3]{9}$

Simplifying Radical Expressions by Factoring

A radical expression whose index is n is **simplified** when its radicand has no factors that are perfect nth powers. To simplify, use the following procedure:

1. Write the radicand as the product of two factors, one of which is the greatest perfect nth power.
2. Use the product rule to take the nth root of each factor.
3. Find the nth root of the perfect nth power.

Example:

Simplify: $\sqrt{28}$

Solution:

$\sqrt{28}$

$\sqrt{4 \cdot 7}$

$\sqrt{4} \cdot \sqrt{7}$

$2\sqrt{7}$

Always write the whole number in front of the radical.

Simplify: $\sqrt[5]{64}$

Solution

$\sqrt[5]{64}$

$\sqrt[5]{32 \cdot 2}$

$2\sqrt[5]{2}$

What about:

F(x) = $\sqrt{2x^2+4x+2}$

Solution:

F(x) = $\sqrt{2x^2+4x+2}$

$\sqrt{2\left(x^2+2x+1\right)}$ factor out the GCF

$\sqrt{2\left(x+1\right)^2}$ factor

$\left|x+1\right|\sqrt{2}$ take square root

Note: When the exponent inside the radical and the root index are the same, then the simplification is the base

Example:

$\sqrt{x^6}$

$\sqrt{\left(x^3\right)^2}$

x^3

Example:

$\sqrt{x^5 y^{13}}$

Solution:

$\sqrt{x^5 y^{13}}$

Since the root index is even, write the radicand with the largest even exponent

$\sqrt{x^4 \cdot x \cdot y^{12} \cdot y}$

$\sqrt{\left(x^2\right)^2 \cdot \left(y^6\right)^2 \cdot x \cdot y}$

$x^2 y^6 \sqrt{x \cdot y}$

Simplify

a) $\sqrt{75}$

b) $\sqrt[5]{64}$

Solution:

a) $\sqrt{75}$

$\sqrt{25} \cdot \sqrt{3}$

$5\sqrt{3}$

b) $\sqrt[5]{64}$

$\sqrt[5]{32 \cdot 2}$

$\sqrt[5]{32} \cdot \sqrt[5]{2}$

$2\sqrt[5]{2}$

Try:

- $\sqrt{80}$
- $\sqrt[3]{40}$

Multiplying and Simplifying Radicals

a) $\sqrt{15} \cdot \sqrt{3}$

b) $7\sqrt[3]{4} \cdot 5\sqrt[3]{6}$

Try these: Simplify completely

1) $\sqrt{5} \cdot \sqrt{7}$

2) $\sqrt[4]{6x^2} \cdot \sqrt[4]{3x}$

3) $\sqrt{28}$

4) $\sqrt{x^8 y^7}$

5) $\sqrt{40x^3}$

6) $\sqrt{5x^3} \cdot \sqrt{3}$

7) $\sqrt[3]{25x^4 y^3} \cdot \sqrt[3]{5xy^{12}}$

8) $\sqrt[3]{y^{11}}$