Date: ________________

4.3 Mixed and Entire Radicals

$\sqrt{4 \cdot 9} = \sqrt{4} \cdot \sqrt{9} = 2 \cdot 3 = 6$

$\sqrt{36} = \sqrt{4 \cdot 9} = 6$

A. Entire → Mixed Radicals

Multiplication Property of Radicals $\sqrt[n]{ab} = \sqrt[n]{a} \bullet \sqrt[n]{b}$

This property can be used to simplify square and cube roots that are **not** perfect, but have *factors* that are perfect.

$\sqrt{24}$ ← entire radical

The factors of 24 are: 1, 2, 3, 4, 6, 8, 12, 24 (4 ← perfect square)

$= \sqrt{4} \cdot \sqrt{6} = 2 \cdot \sqrt{6} = 2\sqrt{6}$ ← mixed radical

Examples:

a) $\sqrt{80}$

$= \sqrt{8 \cdot 10}$ * look for factors that appear twice

$= \sqrt{2 \cdot 2 \cdot 2 \cdot 10} = \sqrt{2 \cdot 2 \cdot 2 \cdot 2 \cdot 5}$

$= \sqrt{2 \cdot 2} \cdot \sqrt{2 \cdot 2} \cdot \sqrt{5} = 2 \cdot 2 \cdot \sqrt{5}$

$= 4\sqrt{5}$

d) $\sqrt[3]{144}$

$\sqrt[3]{12 \cdot 12}$

$\sqrt[3]{2 \cdot 2 \cdot 3 \cdot 2 \cdot 2 \cdot 3}$

$2\sqrt[3]{3 \cdot 2 \cdot 3}$

$2\sqrt[3]{18}$

b) $\sqrt{72}$

$= \sqrt{8 \cdot 9} = \sqrt{2 \cdot 2 \cdot 2 \cdot 3 \cdot 3}$

$= 2 \cdot 3\sqrt{2}$

$= 6\sqrt{2}$

e) $\sqrt[4]{32}$

$\sqrt[4]{16 \cdot 2}$

$\sqrt[4]{8 \cdot 2 \cdot 2} = \sqrt[4]{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}$

$2\sqrt[4]{2}$

c) $\sqrt[3]{128}$

$= \sqrt[3]{4 \cdot 32}$

$= \sqrt[3]{2 \cdot 2 \cdot 8 \cdot 4}$

$= \sqrt[3]{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}$

$= 2 \cdot 2\sqrt[3]{2} = 4\sqrt[3]{2}$

f) $\sqrt[4]{162}$

$\sqrt[4]{81 \cdot 2}$

$= \sqrt[4]{9 \cdot 9 \cdot 2}$

$= \sqrt[4]{3 \cdot 3 \cdot 3 \cdot 3 \cdot 2}$

$= 3\sqrt[4]{2}$

g) $\sqrt{x^4}$ $= \sqrt{x^2 \cdot x^2}$

$= \sqrt{x \cdot x \, x \cdot x}$

$= x \cdot x = x^2$

h) $\sqrt[3]{16x^2y^4}$

$= \sqrt[3]{2 \cdot 2 \cdot 2 \cdot 2 \cdot x \cdot x \cdot y \cdot y \cdot y \cdot y}$

$2y\sqrt[3]{2x^2y}$

B. Mixed $\rightarrow$ Entire Radicals

Examples:

a) $4\sqrt{3}$

$\sqrt{4 \cdot 4 \cdot 3}$

$= \sqrt{48}$

b) $2\sqrt{7}$

$\sqrt{2 \cdot 2 \cdot 7}$

$= \sqrt{4 \cdot 7} = \sqrt{28}$

c) $3\sqrt{10}$

$\sqrt{3 \cdot 3 \cdot 10}$

$= \sqrt{9 \cdot 10} = \sqrt{90}$

3times

d) $3\sqrt[3]{2}$

$\sqrt[3]{3 \cdot 3 \cdot 3 \cdot 2}$

$= \sqrt[3]{27 \cdot 2} = \sqrt[3]{54}$

e) $2\sqrt[3]{12}$

$\sqrt[3]{2 \cdot 2 \cdot 2 \cdot 12}$

$= \sqrt[3]{8 \cdot 12} = \sqrt[3]{96}$

5 times

f) $2\sqrt[5]{2}$

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

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

$= \sqrt[5]{64}$

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