Simplifying Radicals Part 2

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PRE-CALCULUS 11
RADICALS
SIMPLIFYING RADICALS PART 2

A. Definitions

1. **radical:** a mathematical symbol representing a root. *Ex.* $3\sqrt{3}$, $\sqrt[3]{10}$, $2\sqrt[4]{18}$, $-5\sqrt[5]{45}$

2. **perfect root:** a root that can be completely simplified. *Ex.* $\sqrt{25}$, $\sqrt[3]{-8}$, $\sqrt[4]{81}$

B. Comparing Radicals

Arrange the following in order from least to greatest.

a) $9\sqrt{2}$, $2\sqrt{6}$, $8\sqrt{3}$

$\sqrt{9^2 \cdot 2}$ $\sqrt{2^2 \cdot 6}$ $\sqrt{8^2 \cdot 3}$

$\sqrt{162}$ $\sqrt{24}$ $\sqrt{192}$

$2\sqrt{6}$, $9\sqrt{2}$, $8\sqrt{3}$

b) $7\sqrt[3]{2}$, $6\sqrt[4]{5}$, $4\sqrt{5}$

8.819 8.972 8.944

$7\sqrt[3]{2}$, $4\sqrt{5}$, $6\sqrt[4]{5}$

C. Simplifying Radicals with Variables

1. For which values of the variable is each radical defined?

a) $\sqrt{54x^3}$

Negative: $\sqrt{54(-1)^3}$ → $\sqrt{-54}$ ✗

Zero: $\sqrt{54(0)^3}$ → $\sqrt{0}$ ✓

Positive: $\sqrt{54(1)^3}$ → $\sqrt{54}$ ✓

$x \geq 0$

b) $\sqrt[3]{12x^5}$

$x \in R$

Negative: $\sqrt[3]{12(-1)^5}$ → $\sqrt[3]{-12}$ ✓

Zero: $\sqrt[3]{12(0)^5}$ → $\sqrt[3]{0}$ ✓

Positive: $\sqrt[3]{12(1)^5}$ → $\sqrt[3]{12}$ ✓

2. Simplify the following radicals if possible.

a) $\sqrt{75a^2}$ $a \in R$

pairs: $a \cdot a$

$\sqrt{25} \cdot \sqrt{a^2} \cdot \sqrt{3}$

$5a\sqrt{3}$

b) $\sqrt{18m^5}$ $m \geq 0$

2 pairs: $m \cdot m$ $m \cdot m \cdot m$

$\sqrt{9} \cdot \sqrt{m^4} \cdot \sqrt{2m}$

$= 3m^2\sqrt{2m}$

c) $\sqrt[3]{-12x^2}$ $x \in R$

no groups of 3: $x \cdot x$

$= \sqrt[3]{-12x^2}$

d) $\sqrt[4]{80y^7}$ $y \geq 0$

one group of 4: $y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y$

$\sqrt[4]{16} \cdot \sqrt[4]{y^4} \cdot \sqrt[4]{5y^3}$

$= 2y\sqrt[4]{5y^3}$

D. Division Property of Radicals

$$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}, \text{ where } a \text{ \& } b \in R,\ b \neq 0$$

$\frac{5}{0}$ Undefined

1. Write the following as a mixed radical.

a) $\sqrt{\frac{27}{4}}$

$\frac{\sqrt{27}}{\sqrt{4}} = \frac{\sqrt{9}\cdot\sqrt{3}}{\sqrt{4}}$

$= \frac{3}{2}\sqrt{3}$ or $\frac{3\sqrt{3}}{2}$

b) $\sqrt{\frac{81m^4}{28}}$ $m \in R$

$= \frac{\sqrt{9m^4}}{\sqrt{28}} = \frac{\sqrt{81}\cdot\sqrt{m^4}}{\sqrt{4}\cdot\sqrt{7}}$

$= \frac{9m^2}{2\sqrt{7}}$ or $\frac{9m^2}{2}\sqrt{\frac{1}{7}}$

c) $\sqrt[3]{\frac{-40}{7}}$

$\frac{\sqrt[3]{-40}}{\sqrt[3]{7}} = \frac{\sqrt[3]{-8}\cdot\sqrt[3]{5}}{\sqrt[3]{7}}$

$= \frac{-2\sqrt[3]{5}}{\sqrt[3]{7}}$ or $-2\sqrt[3]{\frac{5}{7}}$

d) $\sqrt[3]{\frac{81x^3}{40y^6}}$ $x \in R,\ y \neq 0$

$\frac{\sqrt[3]{81x^3}}{\sqrt[3]{40y^6}} = \frac{\sqrt[3]{27}\cdot\sqrt[3]{x^3}\cdot\sqrt[3]{3}}{\sqrt[3]{8}\cdot\sqrt[3]{y^6}\cdot\sqrt[3]{5}}$

$= \frac{3x\sqrt[3]{3}}{2y^2\sqrt[3]{5}}$ or $\frac{3x}{2y^2}\sqrt[3]{\frac{3}{5}}$

2. Write the following as an entire radical.

a) $-3\sqrt{\frac{2}{3}}$

$-\sqrt{3^2\cdot\frac{2}{3}}$

$= -\sqrt{6}$

b) $\frac{2}{3}\sqrt[3]{\frac{1}{2}}$

$\sqrt[3]{\left(\frac{2}{3}\right)^3\cdot\frac{1}{2}}$

$= \sqrt[3]{\frac{4}{27}}$

Assignment: Pg. 100 #3 - 11