Lesson 3-4

Simplifying Radicals

Warm Up: Simplify the following radicals.

(1) $\sqrt{75}$

$\sqrt{25 \cdot 3}$

$5\sqrt{3}$

(2) $\sqrt{20a^2}$

$\sqrt{4 \cdot 5 a^2}$

$2a\sqrt{5}$

(3) $\sqrt{121a^7b^4}$

$\sqrt{121 a^6 \cdot a \cdot b^4}$

$11a^3b^2\sqrt{a}$

Parts of a radical

Radicand → $\sqrt[n]{x}$ ← index

x, the radicand, is a real number
n, the index is a positive integer greater than zero

RADICALS THAT ARE SIMPLIFIED HAVE:

- No fractions left under the radical.
- No perfect power factors in the radicand, *x*.
- No exponents in the radicand, greater than the index, *n*.
- No radicals appearing in the denominator of a fractional answer.

Perfect Power Factors

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

perfect squares	perfect cubes ±
4, 9, 16, 25, 36, ...	8, 27, 64, 125, ...
$x^2, x^4, x^6, x^8, \ldots$	$x^3, x^6, x^9, x^{12}, \ldots$
$x^2y^2, x^2y^4, 16x^6y^8, \ldots$	$x^3y^3, x^3y^6, 27x^6y^9, \ldots$
powers are "even"	powers are "multiples of 3"

***Exercise* #1:** Simplify

(a) $\frac{1}{4}\sqrt{48x^2y^4z^6}$

$\frac{1}{4}\sqrt{16\cdot 3\cdot x^2\cdot y^4\cdot z^6}$

$\frac{1}{4}\cdot 16\,x\,y^2z^3\sqrt{3}$

$4xy^2z^3\sqrt{3}$

(b) $\sqrt{\frac{x^2}{9y^8}}$

$\frac{x}{3y^4}$

(c) $-\sqrt{xy^{10}z^5}$

$-\sqrt{x\,y^{10}\cdot z^4\cdot z}$

$-y^5z^2\sqrt{xz}$

(d) $\sqrt[3]{-8x^6}$

$x\cdot x\cdot x\;\; x\cdot x\cdot x$

$-2x^2$

(e) $\sqrt[3]{128a^{16}b^6}$

$\sqrt[3]{64\cdot 2\,a^{15}\cdot a\cdot b^6}$

$4a^5b^2\sqrt[3]{2a}$

Challenge Question: $\sqrt[5]{224r^7}$

$\sqrt[5]{32\cdot 7\cdot r^5\cdot r^2}$

Simplifying Radicals Practice

***Exercise* #1:** Find the value of each:

(a) $\sqrt{25}$

5

(b) $\sqrt[3]{8}$

2

(c) $3\sqrt{36}$

$3 \cdot 6$

18

(d) $\sqrt{\frac{9}{16}}$

$\frac{3}{4}$

(e) $\sqrt[3]{\frac{8}{27}}$

$\frac{2}{3}$

(f) $\sqrt{100x^2y^2}$

$10xy$

(g) $\sqrt{x^6y^{10}}$

x^3y^5

(h) $\sqrt[3]{-64}$

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***Exercise* #2:** Write each expression in simplest radical form.
Simplest Radical Form means that the radical is written so that no perfect power factor remains in the radicand.

(a) $\sqrt{24}$

$\sqrt{4 \cdot 6}$

$2\sqrt{6}$

(b) $\frac{1}{2}\sqrt{900x}$

$\frac{1}{2} \cdot 30\sqrt{x}$

$15\sqrt{x}$

(c) $\sqrt{z^3}$

$\sqrt{z^2 \cdot z}$

$z\sqrt{z}$

***Exercise* #3:** Write each expression in simplest radical form.

(a) $2\sqrt{45}$

$2\sqrt{9\cdot 5}$

$2\cdot 3\sqrt{5}$

$6\sqrt{5}$

(b) $\sqrt[3]{16}$

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

$2\sqrt[3]{2}$

(c) $\sqrt{75x^3y^2}$

$25\cdot 3\cdot x^2\cdot x\cdot y^2$

$5xy\sqrt{3x}$

(d) $\sqrt{98k}$

$\sqrt{49\cdot 2k}$

$7\sqrt{2k}$

(e) $3\sqrt{18a^3b^4}$

$3\sqrt{9\cdot 2\ a^2\cdot a\ b^4}$

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

$9ab^2\sqrt{2a}$

(f) $\sqrt[3]{-8y^4}$

$\sqrt[3]{-8y^3\cdot y}$

$-2y\sqrt[3]{y}$

(g) $\sqrt[3]{\dfrac{a^6b^9}{-64}}$

$\dfrac{\sqrt[3]{a^6\ b^9}}{\sqrt[3]{-64}}$

$\dfrac{a^2b^3}{-4}$

(h) Challenge: $\sqrt[5]{-243x^6y^{12}}$

$\sqrt[5]{-243\cdot x^5\cdot x\cdot y^{10}\cdot y^2}$

$-3xy^2\sqrt[5]{xy^2}$