Simplifying Radicals

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A. Definitions

1. **radical:** a mathematical symbol representing a root. *Ex.* $3\sqrt{3}$, $5\sqrt[3]{7}$, $\sqrt[4]{6}$, $-\sqrt[5]{13}$

2. **mixed radical:** the product of a monomial and a radical. *Ex.* $2\sqrt{5}$, $-6\sqrt[3]{2}$, $3\sqrt[4]{15}$

3. **entire radical:** a radical with a coefficient of 1 or -1. *Ex.* $\sqrt{50}$, $-\sqrt[3]{18}$, $\sqrt[4]{96}$

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

B. Simplifying Radicals

Radicals, like fractions you have learned in previous grades, can be simplified (reduced to lowest terms). In most cases you will always be expected to leave your answer in its lowest form, regardless of what else you may be asked to do in the question.

1. Simplify the following radicals.

   a) $\sqrt{108}$

   $\sqrt{36} \cdot \sqrt{3}$ $= 6\sqrt{3}$

   $\sqrt{9} \cdot \sqrt{12}$
   $= 3\sqrt{12}$
   $= 3\sqrt{4} \cdot \sqrt{3}$
   $= 6\sqrt{3}$

   To Solve
   a) Remember the list of perfect squares.
   $\sqrt{4}, \sqrt{9}, \sqrt{16}, \sqrt{25}, \sqrt{36}, \sqrt{49}, \sqrt{64}, \sqrt{81}, \sqrt{100}, \sqrt{121}, \sqrt{144} \ldots$

   b) Find the largest perfect square that divides evenly into the root.

   c) Square root the perfect square.

   b) $\sqrt{24}$

   $\sqrt{4} \cdot \sqrt{6}$ $= 2\sqrt{6}$
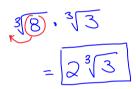
c) $\sqrt{13}$

If there no perfect square that divides in evenly then leave root alone.

$$\boxed{\sqrt{13}}$$

d) $\sqrt{25}$

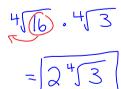If the root is a perfect square the answer is a whole number.

$$\boxed{5}$$

e) $\sqrt[3]{24}$

Remember the list of perfect cubes.
$\sqrt[3]{8}$, $\sqrt[3]{27}$, $\sqrt[3]{64}$, $\sqrt[3]{125}$, $\sqrt[3]{216}$ ...

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

f) $\sqrt[3]{250}$

$$\sqrt[3]{25} \cdot \sqrt[3]{2}$$
$$= \boxed{5\sqrt[3]{2}}$$

g) $\sqrt[4]{48}$

Remember the list of perfect fourths.
$\sqrt[4]{16}$, $\sqrt[4]{81}$, $\sqrt[4]{256}$, $\sqrt[4]{625}$ ...

$$\sqrt[4]{16} \cdot \sqrt[4]{3}$$
$$= \boxed{2\sqrt[4]{3}}$$

2. Write the following mixed radicals as entire radicals.

a) $3\sqrt{7}$

$$\sqrt{3^2 \cdot 7}$$

$$= \boxed{\sqrt{63}}$$

b) $4\sqrt{5}$

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

$$= \boxed{\sqrt{80}}$$

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

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

$$= \boxed{\sqrt[3]{54}}$$

d) $2\sqrt[4]{6}$

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

$$= \boxed{\sqrt[4]{96}}$$

Assignment: Simplifying Radicals Assignment

A. Simplify each of the following radicals.

1) $\sqrt{32}$

2) $\sqrt{20}$

3) $\sqrt{35}$

4) $\sqrt{63}$

5) $\sqrt{8}$

6) $\sqrt{125}$

7) $\sqrt[3]{108}$

8) $\sqrt[4]{48}$

9) $\sqrt{16}$

10) $\sqrt[3]{40}$

11) $\sqrt{54}$

12) $\sqrt{162}$

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

14) $\sqrt{80}$

15) $\sqrt[3]{320}$

16) $\sqrt{42}$

17) $\sqrt[3]{64}$

18) $\sqrt[4]{96}$

19) $\sqrt{108}$

20) $\sqrt[3]{56}$

21) $\sqrt[3]{18}$

22) $\sqrt{144}$

23) $\sqrt{75}$

24) $\sqrt[4]{80}$

25) $\sqrt[3]{81}$

26) $\sqrt{72}$

B. Write each of the following as an entire radical.

1) $2\sqrt{5}$

2) $7\sqrt{2}$

3) $3\sqrt{10}$

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

5) $3\sqrt[4]{2}$

6) $4\sqrt{6}$

7) $3\sqrt[3]{4}$

8) $6\sqrt{3}$

9) $2\sqrt[4]{7}$

10) $7\sqrt{5}$

11) $11\sqrt{2}$

12) $5\sqrt[3]{2}$