

## **Exponents and Radicals Lesson #3: Entire Radicals and Mixed Radicals - Part One**

Recall the following from Lesson #2.

- i) The product (quotient) of the roots of two numbers is equal to the root of the product (quotient) of the two numbers.
- ii) The sum (difference) of the roots of two numbers is NOT equal to the root of the sum (difference) of the two numbers.

In general  $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$  where  $a, b \geq 0$  and  $\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}$  where  $a \geq 0, b > 0$ .

In this lesson we use the above rules in reverse:

$$\sqrt{ab} = \sqrt{a} \times \sqrt{b} \text{ where } a, b \geq 0 \text{ and } \sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}} \text{ where } a \geq 0, b > 0.$$



Write the following as a product or quotient of radicals.

- a)  $\sqrt{24} = \sqrt{4 \times 6} = \sqrt{4} \times \sqrt{6} = 2\sqrt{6}$       b)  $\sqrt{18} = \sqrt{9 \times 2} = \sqrt{9} \times \sqrt{2} = 3\sqrt{2}$
- c)  $\sqrt{\frac{11}{4}} = \frac{\sqrt{11}}{\sqrt{4}} = \frac{\sqrt{11}}{2}$

### Entire Radicals and Mixed Radicals

Use a calculator to approximate the value of each radical to 5 decimal places.

i)  $\sqrt{80} = 8.94427$     ii)  $2\sqrt{20} = 8.94427$     iii)  $4\sqrt{5} = 8.94427$

What do you notice about the answers? same

Complete the following to explain why the three radicals are equivalent.

$\sqrt{80} = \sqrt{4 \times 20} = \sqrt{4} \times \sqrt{20} = 2\sqrt{20}$        $\frac{8}{16} = \frac{4}{8} = \frac{1}{2}$

$\sqrt{80} = \sqrt{16 \times 5} = \sqrt{16} \times \sqrt{5} = 4\sqrt{5}$        $\frac{3}{2} = 1\frac{1}{2}$

\*mixed radical  
\*lowest term

$\sqrt{80}$  is an example of an **entire radical**; the number is entirely under the root symbol.

$2\sqrt{20}$  and  $4\sqrt{5}$  are examples of **mixed radicals**.

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#### 16 Exponents and Radicals Lesson #3: Entire Radicals and Mixed Radicals- Part One

- |   |  |
|---|--|
| <p><b>Entire/Pure Radicals</b></p> <ul style="list-style-type: none"> <li>• Radicals expressed in the form <math>\sqrt[n]{b}</math> are called entire (or pure) radicals.</li> <li>• For example, <math>\sqrt{25}</math>, <math>\sqrt{80}</math>, <math>\sqrt[3]{17}</math>.</li> </ul> | <p><b>Mixed Radicals</b></p> <ul style="list-style-type: none"> <li>• Radicals expressed in the form <math>a\sqrt[n]{b}</math> are called mixed radicals.</li> <li>• For example <math>\frac{2}{3}\sqrt{5}</math>, <math>8\sqrt{7}</math>, <math>-9\sqrt[3]{17}</math>.</li> </ul> |
|---|--|

Every mixed radical can be expressed as an entire radical.

Every mixed radical can be expressed as an entire radical.

To determine if an entire radical (with an index of 2) can be expressed as a mixed radical, we need to check if the number has a factor which is a perfect square.

**Converting Entire Radicals (with an index of 2) to Mixed Radicals**

An entire radical of index 2 may be expressed as a mixed radical when the highest perfect square has been factored out of the entire radical.

Complete the following to convert  $\sqrt{108}$  to a mixed radical.

Entire Radical  $\Rightarrow$  Mixed Radical

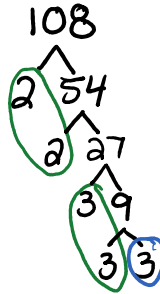
$$\sqrt{108} = \sqrt{\quad 36}$$

divide it by perfect squares  $\Rightarrow$

$$\sqrt{\quad 36} \sqrt{3}$$

$$= 6 \times \sqrt{3}$$

$$\sqrt{108} = 6\sqrt{3}$$



$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$
$10^2 = 100$
$11^2 = 121$
$12^2 = 144$
$13^2 = 169$
$14^2 = 196$
$15^2 = 225$

$$\sqrt{108} = \sqrt{2 \cdot 2 \cdot 3 \cdot 3 \cdot 3}$$

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

$$= 6\sqrt{3}$$

$$\sqrt[3]{108} = \sqrt[3]{2 \cdot 2 \cdot 3 \cdot 3 \cdot 3}$$

$$\sqrt[3]{108} = 3\sqrt[3]{4}$$



If the perfect square which is factored out is not the highest perfect square, then the process will require more than one step to obtain the mixed radical in simplest form. When converting an entire radical to a mixed radical, it is expected that the answer will be in simplest form.



Convert the following entire radicals to mixed radicals in simplest form.

a)  $\sqrt{50} = \sqrt{25 \cdot 2} = \sqrt{25} \cdot \sqrt{2} = 5\sqrt{2}$

b)  $\sqrt{45} = \sqrt{9 \cdot 5} = \sqrt{9} \sqrt{5} = 3\sqrt{5}$

c)  $\sqrt{320} = \sqrt{64 \cdot 5} = \sqrt{64} \sqrt{5} = 8\sqrt{5}$

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Convert the following radicals to mixed radicals in simplest form.

a)  $2\sqrt{192} = 2\sqrt{64 \cdot 3} = 2(8\sqrt{3}) = 16\sqrt{3}$

b)  $\frac{3}{4}\sqrt{160} = \frac{3}{4}(2\sqrt{10}) = \frac{3 \cdot 2}{4} \sqrt{10} = \frac{3 \cdot 4}{4} \sqrt{10} = 3\sqrt{10}$

$\frac{\sqrt{7}}{\sqrt{9}} = \frac{\sqrt{7}}{3} \text{ or } \frac{1}{3}\sqrt{7}$

Complete Assignment Questions #1 - #5

**Converting Entire Radicals (with an index of 3 or greater) to Mixed Radicals**

An entire radical of index 3 may be expressed as a mixed radical when the highest perfect cube has been factored out of the entire radical.

$1^3 = 1$
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An entire radical of index 3 may be expressed as a mixed radical when the highest perfect cube has been factored out of the entire radical.

$1^3 = 1$
$2^3 = 8$
$3^3 = 27$
$4^3 = 64$
$5^3 = 125$
$6^3 = 216$
$7^3 = 343$
$8^3 = 512$
$9^3 = 729$
$10^3 = 1000$

Complete the following to convert  $\sqrt[3]{54}$  to a mixed radical.

Entire Radical  $\Rightarrow$  Mixed Radical

$$\begin{aligned} \sqrt[3]{54} &= \sqrt[3]{27 \cdot 2} \\ &= \sqrt[3]{27} \cdot \sqrt[3]{2} \\ &= 3 \times \sqrt[3]{2} \\ \sqrt[3]{54} &= 3\sqrt[3]{2} \end{aligned}$$



A similar process is involved for indices greater than 3.



Convert the following radicals to mixed radicals in simplest form.

a)  $\sqrt[3]{6000}$

Diagram: 6000 is factored into 6 and 1000. 6 is factored into 3 and 2. 1000 is factored into 100 and 10. 100 is factored into 10 and 10. The final result is  $10\sqrt[3]{6}$ .

b)  $\sqrt[5]{320}$

Diagram: 320 is factored into 32 and 10. 32 is factored into 16 and 2. 16 is factored into 4 and 4. 4 is factored into 2 and 2. The final result is  $2\sqrt[5]{10}$ .

c)  $\sqrt[3]{-16}$

Diagram: -16 is factored into -1 and 16. 16 is factored into 8 and 2. 8 is factored into 4 and 2. 4 is factored into 2 and 2. The final result is  $-2\sqrt[3]{2}$ .

\*odd index can be negative

$(-1)(2)\sqrt[3]{2} = -2\sqrt[3]{2}$

**Complete Assignment Questions #6 - #9**

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(2,3,4)aceg, (5,6)ac, 7  
tomorrow L4, Friday QUIZ on L1-4

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**Extension: Radicals involving Variables (Entire to Mixed)**

Since  $x^3 \times x^3 = x^6$ , then  $\sqrt{x^6} = \underline{\hspace{2cm}}$ . Also, since  $x^5 \times x^5 \times x^5 = x^{15}$  then  $\sqrt[3]{x^{15}} = \underline{\hspace{2cm}}$ .

So  $\sqrt{x^4} = \underline{\hspace{2cm}}$ .  $\sqrt{y^{10}} = \underline{\hspace{2cm}}$ .  $\sqrt{a^8b^6} = \underline{\hspace{2cm}}$ .  $\sqrt[3]{x^{24}} = \underline{\hspace{2cm}}$ .  $\sqrt[3]{y^6} = \underline{\hspace{2cm}}$ .

Complete the following to convert  $\sqrt{x^5}$  to a mixed radical.

Entire Radical  $\Rightarrow$  Mixed Radical

$$\begin{aligned} \sqrt{x^5} &= \sqrt{x^4 \times x} \\ &= \sqrt{\hspace{2cm}} \times \sqrt{x} \\ &= \underline{\hspace{2cm}} \times \sqrt{x} \\ \sqrt{x^5} &= \end{aligned}$$



Convert the following entire radicals to mixed radicals in simplest form.

- a)  $\sqrt{a^7}$       b)  $\sqrt{t^9}$       c)  $\sqrt[3]{x^5}$       d)  $\sqrt[3]{x^7}$



Convert the following entire radicals to mixed radicals in simplest form.

- a)  $\sqrt{x^6y^5}$       b)  $\sqrt{18x^3}$       c)  $\sqrt{32y^7z^8}$       d)  $\sqrt[3]{40x^4y^9}$

**Complete Assignment Questions #10 - #12**

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Exponents and Radicals Lesson #3: *Entire Radicals and Mixed Radicals- Part One* **19**

## Assignment

1. Identify whether each radical is written as a mixed radical or an entire radical.

- a)  $\sqrt{35}$       b)  $2\sqrt{7}$       c)  $\sqrt{81}$       d)  $0.3\sqrt{6}$

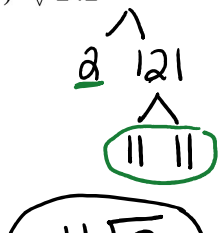
2. Convert the following radicals to mixed radicals in simplest form.

- a)  $\sqrt{8}$       b)  $\sqrt{20}$       c)  $\sqrt{75}$       d)  $\sqrt{98}$

- e)  $3\sqrt{32}$       f)  $-5\sqrt{45}$       g)  $2\sqrt{54}$       h)  $-4\sqrt{48}$

3. Convert the following radicals to mixed radicals in simplest form.

- a)  $\sqrt{96}$       b)  $\sqrt{242}$       c)  $-\frac{2}{3}\sqrt{180}$       d)  $\frac{1}{8}\sqrt{320}$



$$\begin{array}{c} \textcircled{11 \ 11} \\ = 11\sqrt{2} \end{array}$$

e)  $\sqrt{245}$

f)  $4\sqrt{338}$

g)  $\sqrt{1\ 250}$

h)  $\sqrt{980}$

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4. Convert the following radicals to mixed radicals in simplest form. There are two which cannot be converted. Identify them and explain why they cannot be converted to mixed radicals.

a)  $-\frac{5}{6}\sqrt{304}$

b)  $\sqrt{66}$

c)  $4\sqrt{272}$

d)  $-3\sqrt{288}$

e)  $2\sqrt{369}$

f)  $\sqrt{364}$

g)  $\frac{2}{5}\sqrt{450}$

h)  $\frac{7}{11}\sqrt{341}$

5. Convert the following radicals to mixed radicals where the radicand is a whole number.

a)  $\sqrt{\frac{2}{9}}$

b)  $\sqrt{\frac{5}{4}}$

c)  $\sqrt{\frac{18}{25}}$

d)  $7\sqrt{\frac{20}{49}}$

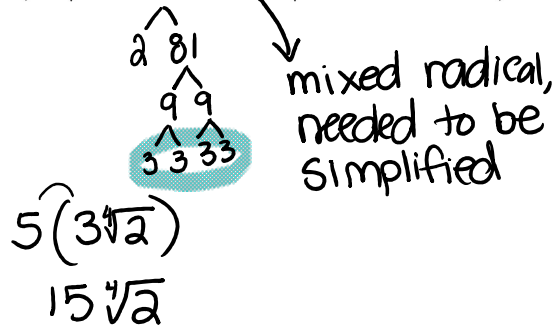
6. Convert the following radicals to mixed radicals in simplest form.

- a)  $\sqrt[3]{48}$       b)  $\sqrt[3]{128}$       c)  $\sqrt[3]{2000}$       d)  $5\sqrt[3]{-81}$

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7. Convert the following radicals to mixed radicals in simplest form.

- a)  $\frac{5}{6}\sqrt[3]{108}$       b)  $5\sqrt[4]{162}$       c)  $\sqrt[5]{-192}$       d)  $-2\sqrt[3]{625}$



**Multiple Choice**

8.  $\sqrt[3]{240}$  is equivalent to

- A.  $2\sqrt[3]{40}$       B.  $4\sqrt[3]{15}$   
 C.  $2\sqrt[3]{30}$       D.  $8\sqrt[3]{30}$

**Numerical Response**

9. When  $\sqrt[4]{891}$  is converted to the form  $3\sqrt[4]{x}$ , the value of  $x$  is \_\_\_\_\_.

(Record your answer in the numerical response box from left to right)

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**Extension Assignment**

10. Express each as a mixed radical in simplest form.

- a)  $\sqrt{a^5}$       b)  $\sqrt{t^3}$       c)  $\sqrt{x^{11}}$       d)  $\sqrt[3]{x^4}$       e)  $\sqrt[3]{b^8}$       f)  $\sqrt[4]{x^6}$

a)  $\sqrt{a^5}$     b)  $\sqrt{t^3}$     c)  $\sqrt{x^{11}}$     d)  $\sqrt[3]{x^4}$     e)  $\sqrt[3]{b^8}$     f)  $\sqrt[4]{x^6}$

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**11.** Express each as a mixed radical in simplest form.

a)  $\sqrt{8y^2}$                       b)  $\sqrt{16p^3}$                       c)  $\sqrt{75y^3z^4}$

d)  $\sqrt[3]{2000x^7}$                       e)  $5\sqrt{28c^4d^3}$                       f)  $-6\sqrt{29a^4b^8}$

**Multiple Choice**

**12.**  $\sqrt{3x} \sqrt{2x}$  is equivalent to

- A.  $\sqrt{6x}$                       B.  $\sqrt{36x^2}$   
 C.  $6\sqrt{x}$                       D.  $x\sqrt{6}$

**Answer Key**

1. a) entire    b) mixed    c) entire    d) mixed  
 2. a)  $2\sqrt{2}$     b)  $2\sqrt{5}$     c)  $5\sqrt{3}$     d)  $7\sqrt{2}$     e)  $12\sqrt{2}$     f)  $-15\sqrt{5}$     g)  $6\sqrt{6}$     h)  $-16\sqrt{3}$   
 3. a)  $4\sqrt{6}$     b)  $11\sqrt{2}$     c)  $-4\sqrt{5}$     d)  $\sqrt{5}$     e)  $7\sqrt{5}$     f)  $52\sqrt{2}$     g)  $25\sqrt{2}$     h)  $14\sqrt{5}$   
 4. a)  $-\frac{10}{3}\sqrt{19}$     b) cannot be converted because 66 does not have a factor which is a perfect square.  
 c)  $16\sqrt{17}$     d)  $-36\sqrt{2}$     e)  $6\sqrt{41}$     f)  $2\sqrt{91}$     g)  $6\sqrt{2}$   
 h) cannot be converted because 341 does not have a factor which is a perfect square.  
 5. a)  $\frac{1}{3}\sqrt{2}$     b)  $\frac{1}{2}\sqrt{5}$     c)  $\frac{3}{5}\sqrt{2}$     d)  $2\sqrt{5}$   
 6. a)  $2\sqrt[3]{6}$     b)  $4\sqrt[3]{2}$     c)  $10\sqrt[3]{2}$     d)  $-15\sqrt[3]{3}$   
 7. a)  $\frac{5}{2}\sqrt[3]{4}$     b)  $15\sqrt[4]{2}$     c)  $-2\sqrt[5]{6}$     d)  $-10\sqrt[3]{5}$   
 8. C    9. 

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 10. a)  $a^2\sqrt{a}$     b)  $t\sqrt{t}$     c)  $x^5\sqrt{x}$     d)  $x\sqrt[3]{x}$     e)  $b^2\sqrt[3]{b^2}$     f)  $x\sqrt[4]{x^2}$   
 11. a)  $2y\sqrt{2}$     b)  $4p\sqrt{p}$     c)  $5yz^2\sqrt{3y}$     d)  $10x^2\sqrt[3]{2x}$   
 e)  $10c^2d\sqrt{7d}$     f)  $-6a^2b^4\sqrt{29}$

10. a)  $a^2\sqrt{a}$       b)  $t\sqrt{t}$       c)  $x^2\sqrt{x}$       d)  $x\sqrt{x}$       e)  $b^2\sqrt{b^2}$       f)  $x\sqrt{x^2}$   
11. a)  $2y\sqrt{2}$       b)  $4p\sqrt{p}$       c)  $5yz^2\sqrt{3y}$       d)  $10x^2\sqrt[3]{2x}$   
    e)  $10c^2d\sqrt{7d}$       f)  $-6a^2b^4\sqrt{29}$   
12. D

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## **Exponents and Radicals Lesson #4: Entire Radicals and Mixed Radicals - Part Two**

**Converting Mixed Radicals (with an index of 2) to Entire Radicals**

A mixed radical of index 2 may be expressed as an entire radical. This is done by i) converting the number outside the radical symbol into a radical and then 2) multiplying it by the radicand. The number outside the radical symbol can be converted into a radical by raising it to the power of 2.

Complete the following to convert  $3\sqrt{14}$  to an entire radical.

*Mixed Radical*  $\Rightarrow$  *Entire Radical*

$$3\sqrt{14} = \sqrt{\quad} \times \cancel{3}^2 14$$

$$= \sqrt{\quad} \times 914$$

$$3\sqrt{14} = \sqrt{126}$$

**Class Ex. #1**



Convert the following mixed radicals to entire radicals.

a)  $2\sqrt{5}$

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

$$= \sqrt{4 \cdot 5}$$

$$= \sqrt{20}$$

b)  $4\sqrt{7}$

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

$$= \sqrt{16 \cdot 7}$$

$$= \sqrt{112}$$

$$= \sqrt{112}$$

c)  $10\sqrt{6}$

$$= \sqrt{100 \cdot 6}$$

$$= \sqrt{600}$$

**Class Ex. #2**



Convert the following mixed radicals to entire radicals.

a)  $\frac{3}{2}\sqrt{8}$

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

$$= \sqrt{\frac{9}{4} \cdot 8} = \sqrt{\frac{9 \cdot 8}{4}}$$

$$= \sqrt{\frac{9 \cdot 8}{4}} = \sqrt{18}$$

b)  $0.4\sqrt{50}$

$$= \sqrt{0.4 \cdot 0.4 \cdot 50}$$

$$= \sqrt{8}$$

c)  $-5\sqrt{7}$

$$= -1 \sqrt{5 \cdot 5 \cdot 7}$$

$$= -\sqrt{25 \cdot 7}$$

$$= -\sqrt{175}$$

↑  
leave the negative out

**Complete Assignment Questions #1 - #2**

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**Converting Mixed Radicals (with an index of 3 or greater) to Entire Radicals**

**Converting Mixed Radicals (with an index of 3 or greater) to Entire Radicals**

A mixed radical of index 3 may be expressed as an entire radical by 1) converting the number outside the radical symbol into a radical and then 2) multiplying it by the radicand. The number outside the radical symbol can be converted into a radical by raising it to the power of 3.

Complete the following to convert  $\frac{1}{2}\sqrt[3]{80}$  to an entire radical.

$$\sqrt[3]{\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \sqrt[3]{80}}$$

$$\begin{aligned} \text{Mixed Radical} &\Rightarrow \text{Entire Radical} \\ \frac{1}{2}\sqrt[3]{80} &= \sqrt[3]{\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \sqrt[3]{80}} \\ &= \sqrt[3]{\frac{1}{8} \times 80} \\ \frac{1}{2}\sqrt[3]{80} &= \sqrt[3]{10} \end{aligned}$$



Convert the following mixed radicals to entire radicals.

a)  $2\sqrt[4]{3}$       b)  $-4\sqrt[3]{7}$       c)  $\frac{2}{5}\sqrt[3]{100}$       d)  $-3\sqrt[4]{2}$

$2\sqrt[4]{3} = \sqrt[4]{2^4} \sqrt[4]{3} = \sqrt[4]{16 \cdot 3} = \sqrt[4]{48}$   
 $-4\sqrt[3]{7} = -\sqrt[3]{4^3} \sqrt[3]{7} = -\sqrt[3]{64 \cdot 7} = -\sqrt[3]{448}$  or  $\sqrt[3]{-448} = \sqrt[3]{\frac{800}{125}} = \sqrt[3]{\frac{32}{5}}$   
 $\frac{2}{5}\sqrt[3]{100} = \sqrt[3]{\left(\frac{2}{5}\right)\left(\frac{2}{5}\right)\left(\frac{2}{5}\right)\sqrt[3]{100}} = \sqrt[3]{\frac{8}{125} \cdot 100} = \sqrt[3]{\frac{800}{125}} = \sqrt[3]{\frac{32}{5}}$   
 $-3\sqrt[4]{2} = -\sqrt[4]{3^4} \sqrt[4]{2} = -\sqrt[4]{3 \cdot 3 \cdot 3 \cdot 3 \cdot 2} = -\sqrt[4]{162}$

can't go in, even index

(1-5)aceg, 6

Complete Assignment Questions #3 - #8

**Extension: Radicals involving Variables (Mixed to Entire)**



Convert the following mixed radicals to entire radicals.

a)  $2\sqrt{x^3}$       b)  $a^2\sqrt{a}$       c)  $x^5\sqrt{xy}$       d)  $3xy^3\sqrt[3]{2z^4}$

Complete Assignment Question #9

# Assignment

1. Convert the following to entire radical form.

# ASSIGNMENT

1. Convert the following to entire radical form.

a)  $2\sqrt{6}$       b)  $3\sqrt{7}$       c)  $5\sqrt{15}$       d)  $12\sqrt{2}$

e)  $3\sqrt{25}$       f)  $-8\sqrt{3}$       g)  $9\sqrt{10}$       h)  $-4\sqrt{5}$

2. Convert the following to entire radical form.

a)  $\frac{1}{3}\sqrt{27}$       b) 15      c)  $\frac{3}{2}\sqrt{8}$       d)  $3^2\sqrt{21}$

3. Convert the following mixed radicals to entire radicals.

a)  $2^3\sqrt{3}$       b)  $-4^3\sqrt{6}$       c)  $5^4\sqrt{2}$       d)  $\frac{4}{5}^3\sqrt{100}$

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4. Convert the following mixed radicals to entire radicals.

4. Convert the following mixed radicals to entire radicals.

a)  $2\sqrt[4]{2}$       b)  $3\sqrt[3]{4}$       c)  $-3\sqrt[4]{3}$       d)  $-10\sqrt[3]{5}$

e)  $2\sqrt[5]{6}$       f)  $\frac{1}{2}\sqrt[3]{16}$       g)  $\frac{3}{10}\sqrt[4]{100\,000}$       h)  $-5\sqrt[3]{9}$

5. Convert the following mixed radicals to entire radicals.

a)  $7\sqrt{5}$       b)  $2\sqrt[3]{4}$       c)  $-2\sqrt[4]{3}$

d)  $-10\sqrt[3]{7}$       e)  $8\sqrt{10}$       f)  $\frac{1}{3}\sqrt[3]{9}$

**Multiple Choice** 6. Without using a calculator, determine which of the following radicals is not equal to the others.

A.  $12\sqrt{2}$

B.  $\sqrt{288}$

C.  $6\sqrt{8}$

D.  $4\sqrt{72}$

7. Consider the following two statements:

**Statement 1:**  $-3\sqrt[4]{8} = 3\sqrt[4]{-8}$ .

**Statement 2:**  $-2\sqrt[3]{7} = 2\sqrt[3]{-7}$ .

Which of the following is correct?

A. Both statements are true.

B. Both statements are false.

C. Statement 1 is true, and statement 2 is false.

D. Statement 1 is false, and statement 2 is true.

**Numerical Response** 8. The mixed radical  $\frac{1}{12}\sqrt[3]{128}$  can be converted to a mixed radical in simplest form  $a\sqrt[3]{b}$ .

The value of  $a + b$ , to the nearest tenth, is \_\_\_\_\_.

(Record your answer in the numerical response box from left to right)

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<b><i>Extension Assignment</i></b>
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9. Express as an entire radical.

- a)  $6\sqrt{y}$       b)  $8\sqrt{c^2}$       c)  $10\sqrt{2yz^3}$       d)  $-3\sqrt[3]{x^2}$   
 e)  $c\sqrt{c}$       f)  $x\sqrt{3y^3}$       g)  $11c^2\sqrt{c^2d}$       h)  $5a^3b\sqrt{3a^2b}$   
 i)  $4\sqrt{3} a^2b$       j)  $2p^2q\sqrt[3]{5pq^2}$       k)  $7p^8q^9\sqrt{p^2r}$       l)  $2xy^3\sqrt[4]{9x}$

**Answer Key**

1. a)  $\sqrt{24}$     b)  $\sqrt{63}$     c)  $\sqrt{375}$     d)  $\sqrt{288}$     e)  $\sqrt{225}$     f)  $-\sqrt{192}$     g)  $\sqrt{810}$     h)  $-\sqrt{80}$   
 2. a)  $\sqrt{3}$     b)  $\sqrt{225}$     c)  $\sqrt{18}$     d)  $\sqrt{1701}$   
 3. a)  $\sqrt[3]{24}$     b)  $\sqrt[3]{-384}$  or  $-\sqrt[3]{384}$     c)  $\sqrt[4]{1250}$     d)  $\sqrt[3]{\frac{256}{5}}$   
 4. a)  $\sqrt[4]{32}$     b)  $\sqrt[3]{108}$     c)  $-\sqrt[4]{243}$     d)  $-\sqrt[3]{5000}$  or  $\sqrt[3]{-5000}$     e)  $\sqrt[5]{192}$     f)  $\sqrt[3]{2}$     g)  $\sqrt[4]{810}$   
 h)  $-\sqrt[3]{1125}$  or  $\sqrt[3]{-1125}$   
 5. a)  $\sqrt{245}$     b)  $\sqrt[3]{32}$     c)  $-\sqrt[4]{48}$     d)  $-\sqrt[3]{7000}$  or  $\sqrt[3]{-7000}$     e)  $\sqrt{640}$     f)  $\sqrt[3]{\frac{1}{3}}$   
 6. D      7. D      8. 

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9. a)  $\sqrt{36y}$       b)  $\sqrt{64c^2}$       c)  $\sqrt{200yz^3}$       d)  $-\sqrt[3]{27x^2}$  or  $\sqrt[3]{-27x^2}$   
 e)  $\sqrt{c^3}$       f)  $\sqrt{3x^2y^3}$       g)  $\sqrt{121c^6d}$       h)  $\sqrt{75a^8b^3}$   
 i)  $\sqrt{48a^4b^2}$       j)  $\sqrt[3]{40p^7q^5}$       k)  $\sqrt{49p^{18}q^{18}r}$       l)  $\sqrt[4]{144x^5y^{12}}$

