

Write each radical as simplified mixed radical:

$\sqrt[3]{625}$        $\sqrt{98}$        $\sqrt[4]{324}$   
 $\sqrt[3]{125 \cdot 5}$        $\sqrt{49 \cdot 2}$        $\sqrt[4]{81 \cdot 4}$   
 $\sqrt[3]{125} \cdot \sqrt[3]{5}$        $\sqrt{49} \cdot \sqrt{2}$        $\sqrt[4]{81} \cdot \sqrt[4]{4}$   
 $5\sqrt[3]{5}$        $7\sqrt{2}$        $3\sqrt[4]{4}$

Write each radical as a power:

$\sqrt{3}$        $5\sqrt[3]{2}$        $2\sqrt[4]{7}$   
 $\sqrt{7 \cdot 3}$        $\sqrt[3]{5^3 \cdot 2}$        $\sqrt[4]{2^4 \cdot 7}$   
 $\sqrt{49 \cdot 3}$        $\sqrt[3]{125 \cdot 2}$        $\sqrt[4]{16 \cdot 7}$   
 $\sqrt{49} \sqrt{3}$        $\sqrt[3]{125} \sqrt[3]{2}$        $\sqrt[4]{16} \sqrt[4]{7}$   
 $(\sqrt{7})^2$        $(\sqrt[3]{3})^7$        $(\sqrt[4]{32})^4$

Express as a radical:

$a^{-2/3}$        $(56)^{1/2}$        $(81)^{6/4}$

Evaluate:

$64^{1/3}$        $5^{-3}$        $(\frac{1}{4})^{-2}$

## Number systems.

- N** → natural #s      1, 2, 3, ...
- W** → whole #s      0, 1, 2, 3, ...
- I** → integers      -3, -2, -1, 0, 1, 2, 3, ...
- Q** → rational → all of the above, fractions, decimals that stop or repeat
- Q̄** → irrational → decimals that do not stop or repeat (π)
- R** → real # → all #s in this course

$$\sqrt{16} \rightarrow 4$$

$$\sqrt{18} \rightarrow \sim 4.2$$

$$\sqrt{25} \rightarrow 5$$

Express as a power

$$\left(\sqrt[3]{7}\right)^2$$

$$7^{\frac{2}{3}}$$

$$\left(\sqrt[4]{3}\right)^{-7}$$

$$3^{-\frac{7}{4}}$$

$$\left(\frac{1}{3}\right)^{\frac{7}{4}}$$

$$\left(\sqrt[5]{32}\right)^4$$

$$32^{\frac{4}{5}}$$

Express as a radical

$$a^{-\frac{2}{3}}$$

$$\left(\frac{1}{a}\right)^{\frac{2}{3}}$$

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

$$(56)^{\frac{1}{2}}$$

$$\sqrt{56}$$

$$(81)^{\frac{6}{4}}$$

$$\left(\sqrt[4]{81}\right)^6$$

$$\left(\frac{64}{1}\right)^{\frac{1}{3}}$$

Evaluate:

$$64^{\frac{1}{3}}$$

$$\left(\frac{1}{64}\right)^{\frac{1}{3}}$$

$$\sqrt[3]{\frac{1}{64}} = \frac{\sqrt[3]{1}}{\sqrt[3]{64}}$$

$$= \frac{1}{4}$$

$$5^{-3}$$

$$\left(\frac{1}{5}\right)^3 = \frac{1^3}{5^3}$$

$$= \frac{1}{125}$$

$$\left(\frac{1}{4}\right)^{-2}$$

$$4^2$$

$$16$$

$$\left(-\frac{1}{2}\right)^{-3}$$

$$(-2)^3$$

$$-8$$

$$-\frac{1}{2} \rightarrow -\frac{2}{1} \rightarrow -2$$

$$\left(\frac{81}{16}\right)^{-\frac{3}{4}}$$

$$\left(\frac{16}{81}\right)^{\frac{3}{4}} = \left(\sqrt[4]{\frac{16}{81}}\right)^3 = \left(\frac{2}{3}\right)^3 = \frac{2^3}{3^3} = \frac{8}{27}$$

$$\left(\sqrt[4]{\frac{81}{16}}\right)^{-3} = \left(\frac{3}{2}\right)^{-3} = \left(\frac{2}{3}\right)^3 = \frac{8}{27}$$

#1.

#3.

#6

#7 ←

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$$\frac{23 \text{ cm}^2}{4.8}$$

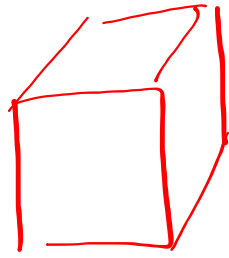
$$A = l \times w$$

$$A = l^2$$

$$23 = l$$

$$\sqrt{23} = l$$

$$4.8 = l$$



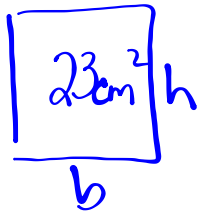
$$V = l \times w \times h$$

$$V = x^3$$

$$1000 = x^3$$

$$x = 10$$

7.



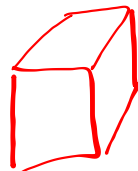
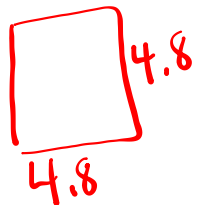
$$A = b \times h$$

$$A = b^2$$

$$\sqrt{23} = \sqrt{b^2}$$

$$b = \sqrt{23}$$

$$= 4.8$$



$$V = l \times w \times h$$

$$V = l^3$$

$$1000 = l^3$$

$$\sqrt[3]{1000} = 10$$

→ Evaluate  $\sqrt{25}$   $\sqrt[3]{27}$   $\sqrt[4]{81}$

→ Estimate  $\sqrt{23}$   $\sqrt[3]{25}$   $\sqrt[4]{60}$

→ Order

\* Mixed  $\leftrightarrow$  entire  
 $2\sqrt{2}$   $\sqrt{2^2 \cdot 2} = \sqrt{8}$   
 $\sqrt{4 \cdot 2} = 2\sqrt{2}$

\* Radical  $\leftrightarrow$  power  
 $\sqrt{4} \rightarrow 4^{\frac{1}{2}}$

\* Laws of exponents  
 $\rightarrow$  positive exponents.

switch to positive exponents.

$$\left(\frac{4}{9}\right)^{-\frac{1}{2}} \Rightarrow \left(\frac{9}{4}\right)^{\frac{1}{2}} \quad \sqrt{\frac{9}{4}} \Rightarrow \boxed{\frac{3}{2}}$$

1.  $\sqrt{25} = 5$   
 $\sqrt{121} = 11$

$\sqrt[3]{27} = 3$   
 $\sqrt[4]{16} = 2$

2.  $\sqrt[3]{105}$   
 $\sqrt[3]{64} = 4$   
 $\sim 4.8$   
 $\sqrt[3]{125} = 5$

3.

$\sqrt{49} = 7$	$\overbrace{N \ W \ I}$	Q	R
-3		Q	R
1.7		Q	R
$-3/4 = 0.75$		Q	R
$0.\overline{8888}$		Q	R
$\sqrt{60}$		$\overline{Q}$	R
$\pi$		$\overline{Q}$	R

Q

4. a)

$\sqrt{40}$	1
$\sqrt{4 \cdot 10}$	4 *
$\sqrt{4} \sqrt{10}$	9
$2\sqrt{10}$	16
	25
	36
	49

b)

$\sqrt[3]{80}$	1, 8, 27, 64, 125
$\sqrt[3]{8 \cdot 10}$	
$\sqrt[3]{8} \cdot \sqrt[3]{10}$	
$2\sqrt[3]{10}$	

$$5. \quad 2\sqrt{13}$$

$$\sqrt{2^2 \cdot 13}$$

$$\sqrt{4 \cdot 13}$$

$$\sqrt{52}$$

$$b) \quad 10\sqrt[3]{7}$$

$$\sqrt[3]{10^3 \cdot 7}$$

$$\sqrt[3]{1000 \cdot 7}$$

$$\sqrt[3]{7000}$$

$$6. \quad m^{n/p}$$

$$(\sqrt[p]{m})^n$$

$$5^{3/4}$$

$$(\sqrt[4]{5})^3$$

$$16^{1/2}$$

$$\sqrt{16} = 4$$

$$125^{-2/3}$$

$$(\sqrt[3]{125})^{-2}$$

$$\left(\frac{8}{27}\right)^{1/3}$$

$$\sqrt[3]{\frac{8}{27}} = \boxed{\frac{2}{3}}$$

$$\left(\frac{1}{\sqrt[3]{125}}\right)^2 = \left(\frac{1}{5}\right)^2 = \frac{1}{25}$$



$$7. a) (2x^2y^5)^3 = 2^3 x^6 y^{15} \\ = 8x^6 y^{15}$$

$$b) \frac{8xy^7}{2xy} \cdot 4x^5y^{-3} \\ = 4y^6 \cdot 4x^5y^{-3} \\ = \boxed{16x^5y^3}$$

$$c) \left( \frac{4a^6b^{-2}}{5c^3} \right)^{-3} = \frac{4^{-3} a^{-18} b^6}{5^{-3} c^{-9}} \\ = \frac{5^3 b^6 c^9}{4^3 a^{18}} \\ = \frac{125b^6c^9}{64a^{18}}$$

1	1	1
4	8	16
9	27	81
16	64	
25	125	
36		
49		
64		
↓		

1. a)  $\sqrt{25} = 5$   
 c)  $\sqrt[3]{27} = 3$   
 d)  $\sqrt[4]{16} = 2$

2.  $\sqrt[3]{105}$   
 $\sqrt[3]{64} \rightarrow 4$   
 $\sqrt[3]{125} \rightarrow 5$   
 $\sim 4.8$

3.  $\sqrt{49} = 7$  N, W, I, Q, R  
 $-3$  I, Q, R  
 $1.7$  Q, R  
 $-\frac{3}{4} = 0.75$  Q, R  
 $0.888\bar{8}$  Q, R

$\sqrt{26}$   
 $\pi$   
 $3.14159\dots$

4. a)  $\sqrt{40}$   
 $\sqrt{4 \cdot 10}$   
 $\sqrt{4} \cdot \sqrt{10}$   
 $2\sqrt{10}$

b)  $\sqrt{12}$   
 $\sqrt{4 \cdot 3}$   
 $\sqrt{4} \cdot \sqrt{3}$   
 $2\sqrt{3}$

$\textcircled{4}$   
 9  
 16  
 25  
 36  
 $\downarrow$

d)  $\sqrt[3]{80}$   
 $\sqrt[3]{8 \cdot 10}$   
 $\sqrt[3]{8} \cdot \sqrt[3]{10}$   
 $2\sqrt[3]{10}$

1  
 8  
 27  
 64  
 125

$$5. \quad \begin{aligned} & 2\sqrt{13} \\ & \sqrt{2^2 \cdot 13} \\ & \sqrt{4 \cdot 13} \\ & \sqrt{52} \end{aligned}$$

$$b) \quad \begin{aligned} & 10\sqrt[3]{7} \\ & \sqrt[3]{10^3 \cdot 7} \\ & \sqrt[3]{1000 \cdot 7} \\ & \sqrt[3]{7000} \end{aligned}$$

$$6. \quad \begin{aligned} & m^{n/p} \\ & (\sqrt[p]{m})^n \end{aligned}$$

$$b) \quad \begin{aligned} & 5^{3/4} \\ & (\sqrt[4]{5})^3 \end{aligned}$$

$$c) \quad \begin{aligned} & 16^{1/2} \\ & \sqrt{16} = 4 \end{aligned}$$

$$d) \quad \begin{aligned} & 125^{-2/3} \\ & (\sqrt[3]{125})^{-2} = (5)^{-2} = \left(\frac{1}{5}\right)^2 = \frac{1}{25} \\ & \left(\frac{1}{\sqrt[3]{125}}\right)^2 = \left(\frac{1}{5}\right)^2 = \frac{1}{25} \end{aligned}$$

7. c)

$$\frac{4^{-3} a^{-18} b^6}{5^{-3} c^{-9}} = \frac{5^3 b^6 c^9}{4^3 a^{18}} = \frac{125 b^6 c^9}{64 a^{18}}$$

## 4.2

6. Tell whether each number is rational or irrational. Justify your answers.

- |                |                       |                      |
|----------------|-----------------------|----------------------|
| a) $-2$        | b) $17$               | c) $\sqrt{16}$       |
| d) $\sqrt{32}$ | e) $0.75\overline{6}$ | f) $12.\overline{3}$ |
| g) $0$         | h) $\sqrt[3]{81}$     | i) $\pi$             |

## 4.3

11. Write each radical in simplest form.

a)  $\sqrt{150}$

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

12. Write each mixed radical as an entire radical.

a)  $6\sqrt{5}$

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

17. Express each power as a radical.

a)  $12^{\frac{1}{4}}$

b)  $(-50)^{\frac{5}{3}}$

c)  $1.2^{0.5}$

d)  $\left(\frac{3}{8}\right)^{\frac{1}{3}}$

18. Express each radical as a power.

a)  $\sqrt{1.4}$

b)  $\sqrt[3]{13^2}$

c)  $(\sqrt[5]{2.5})^4$

d)  $\left(\sqrt[4]{\frac{2}{5}}\right)^3$

19. Evaluate each power without using a calculator.

a)  $16^{0.25}$

b)  $1.44^{\frac{1}{2}}$

c)  $(-8)^{\frac{5}{3}}$

d)  $\left(\frac{9}{16}\right)^{\frac{3}{2}}$

#### 4.6

28. Simplify. Explain your reasoning.

a)  $(3m^4n)^2$

b)  $\left(\frac{x^2y}{y^{-2}}\right)^{-2}$

c)  $(16a^2b^6)^{-\frac{1}{2}}$

d)  $\left(\frac{r^3s^{-1}}{s^{-2}r^{-2}}\right)^{-\frac{2}{3}}$

29. Simplify. Show your work.

a)  $(a^3b)(a^{-1}b^4)$     b)  $\left(x^{\frac{1}{2}}y\right)\left(x^{\frac{3}{2}}y^{-2}\right)$

c)  $\frac{a^3}{a^5} \cdot a^{-3}$     d)  $\frac{x^2y}{x^{\frac{1}{2}}y^{-2}}$

30. Evaluate.

a)  $\left(\frac{3}{2}\right)^{\frac{3}{2}} \cdot \left(\frac{3}{2}\right)^{\frac{1}{2}}$     b)  $\frac{(-5.5)^{\frac{2}{3}}}{(-5.5)^{-\frac{4}{3}}}$

c)  $\left[\left(-\frac{12}{5}\right)^{\frac{1}{3}}\right]^6$     d)  $\frac{0.16^{\frac{3}{4}}}{0.16^{\frac{1}{4}}}$



32. Identify any errors in each solution, then write a correct solution.

$$\begin{aligned} \text{a) } \left(s^{-1}t^{\frac{1}{3}}\right)(s^4t^3) &= s^{-1} \cdot s^4 \cdot t^{\frac{1}{3}} \cdot t^3 \\ &= s^{-4}t \end{aligned}$$

$$\begin{aligned} \text{b) } \left(\frac{4c^{\frac{1}{3}}}{d^3}\right)^{-3} &= \frac{-12c^{-1}}{d^0} \\ &= -12c^{-1} \\ &= \frac{1}{12c} \end{aligned}$$

# Homework

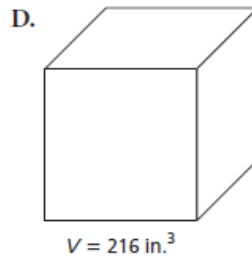
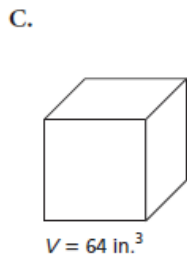
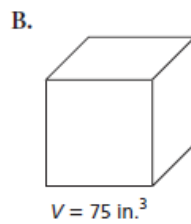
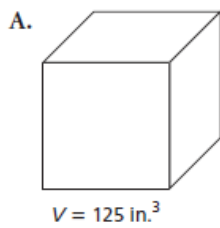
Study for Tomorrows test  
-Chapter 4 material

**PRACTICE TEST**

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ALL QUESTIONS

For questions 1 and 2, choose the correct answer: A, B, C, or D

1. The volume  $V$  cubic inches of each cube is given. For which cube is the edge length an irrational number?



2. Which number is rational?

A.  $\sqrt{0.09}$     B.  $\sqrt{50}$     C.  $\sqrt[3]{-\frac{64}{121}}$     D.  $\pi$

3. a) Which is greater,  $\sqrt{70}$  or  $5\sqrt{3}$ ? Justify your answer.  
 b) Sketch a number line to illustrate the numbers in part a.

4. Evaluate without using a calculator.

a)  $\sqrt[4]{\frac{256}{81}}$     b)  $(-4)^{-2}$     c)  $0.81^{\frac{3}{2}}$     d)  $16^{-\frac{1}{2}}$

5. Write  $44^{\frac{1}{2}}$  as a radical in simplest form.

6. A student simplified  $\frac{x^{-1}y^3}{xy^{-2}}$  as follows:

$$\begin{aligned} \frac{x^{-1}y^3}{xy^{-2}} &= x^{-1+1} \cdot y^{3-2} \\ &= x^0y^1 \\ &= y \end{aligned}$$

Is the student correct? If not, describe any errors and write a correct solution.

7. Simplify each expression. Write your answers using positive exponents.

a)  $(p^{-2}q^{-1})^2(pq^{\frac{1}{2}})^2$

b)  $\left(\frac{c^6d^5}{c^3d^4}\right)^{\frac{1}{3}}$

8. Scientists use the formula  $d = 0.099m^{\frac{9}{10}}$  to calculate the volume of water,  $d$  litres, that a mammal with mass  $m$  kilograms should drink in 1 day. Calculate how much water a 550-kg moose should drink in one day.