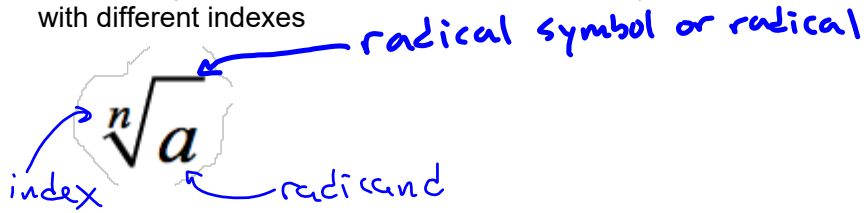


## 6-1b Notes: Roots and Radical Expressions

Lesson Objective: To understand how to simplify radical expressions with different indexes



	Perfect Squares	Perfect Cubes	Perfect Fourths
2	4	8	16
3	9	27	81
4	16	64	256
5	25	125	625
6	36	216	1296
7	49	343	2401
8	64	512	4096
9	81	729	6561
10	100	1000	10,000

Simplifying with radicals  
Even and odd indexes

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

odd index, so negative radicand is cool

$$\sqrt[3]{-27} = -3$$

$$-3(-3)(-3)$$

$$\sqrt{9(-3)}$$

$$\sqrt{-27}$$

$$-\sqrt[4]{16} = -1(2)$$

$$= -2$$

$$-\sqrt[3]{-27} = -1(-3)$$

$$= \textcircled{3}$$

$$\sqrt{49} = 7$$

$$\begin{aligned} & \sqrt[3]{0.008} \\ &= \sqrt[3]{\frac{8}{1000}} \\ &= \frac{2}{10} \\ &= \frac{1}{5} \end{aligned}$$

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

$$\sqrt[3]{\frac{1}{27}} = \frac{1}{3}$$

$$\sqrt[4]{1} = 1$$

With even indexes, negative radicands are bad

$$\begin{aligned} \sqrt[4]{-0.0001} &= \sqrt[4]{\frac{-1}{10,000}} \\ &= \frac{1}{10}i \end{aligned}$$

$$\sqrt[4]{\frac{16}{81}} = \frac{2}{3}$$

Find all the real square roots of each number.

1. 225

$$15$$

2. 0.0049

$$\sqrt{\frac{49}{10,000}}$$

$$\frac{7}{100}$$

3.  $-\frac{1}{121}$

$$\frac{1}{11}i$$

4.  $\frac{64}{169}$

$$\frac{8}{13}$$

Find all the real cube roots of each number.

5. -64

$$-4$$

6. 0.125

$$\sqrt[3]{\frac{125}{1000}}$$

$$\frac{5}{10}$$

$$\frac{1}{2}$$

7.  $-\frac{27}{216}$

$$-\frac{3}{6}$$

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

8. 0.000343

$$\sqrt[3]{\frac{343}{1,000,000}}$$

$$\frac{7}{100}$$

Find all the real fourth roots of each number.

9. 16

2

10. -16

2i

11. 0.0081

$$\sqrt[4]{\frac{81}{10000}}$$

$$\left(\frac{3}{10}\right)$$

12.  $\frac{10,000}{81}$

$\frac{10}{3}$

Find each real-number root.

13.  $\sqrt{36}$

6

14.  $-\sqrt{36}$

-6

15.  $\sqrt{-36}$

6i

16.  $\sqrt{0.36}$

$$\frac{36}{100}$$

$$\frac{6}{10}$$

$$\left(\frac{3}{5}\right)$$

17.  $-\sqrt[3]{64}$

-4

18.  $\sqrt[3]{-64}$

-4

19.  $-\sqrt[4]{81}$

-3

20.  $\sqrt[4]{-81}$

3i

**Academics** Some teachers adjust test scores when a test is difficult. One teacher's formula for adjusting scores is  $A = 10\sqrt{R}$ , where  $A$  is the adjusted score and  $R$  is the raw score. If the raw scores on one test range from 36 to 90, what is the range of the adjusted scores?

## Simplifying Radicals with Variables

$$\sqrt{4x^6} = 2x^3$$

Why?  $2x^3 \cdot 2x^3 = 4x^6$

$$\sqrt[3]{a^3b^6} = ab^2$$

$$\sqrt[4]{x^4y^5}$$

$$\sqrt[4]{x^4y^4y}$$

$$xy\sqrt[4]{y}$$

$$\sqrt[3]{x^6} = x^2$$

$$\sqrt[4]{162x^9} =$$

$$81 \cdot 2 \cdot x^8 \cdot x^1$$

$$\sqrt[4]{81 \cdot 2 \cdot x^8 \cdot x}$$

$$3x^2\sqrt[4]{2x}$$

$$\sqrt{x^{12}y^7} = x^6y^3\sqrt[4]{y}$$

Simplify each radical expression.

21.  $\sqrt{16x^2}$

$$4x$$

22.  $\sqrt{0.25x^6}$

$$\sqrt{\frac{25}{100}x^6}$$

$$\frac{5}{10}x^3$$

$$.5x^3$$

$$\frac{1}{2}x^3$$

23.  $\sqrt{x^8y^{18}}$

$$x^4y^9$$

24.  $\sqrt{64b^{48}}$

$$8b^{24}$$

25.  $\sqrt[3]{-64a^3}$

$$-4a$$

26.  $\sqrt[3]{27y^6}$

$$3y^2$$

27.  $\sqrt[4]{x^8y^{12}}$

$$x^2y^3$$

28.  $\sqrt[5]{32y^{10}}$

$$2y^2$$

Simplify.

9.  $\sqrt{20x^3}$

10.  $\sqrt[3]{81x^2}$

11.  $\sqrt{50x^5}$

12.  $\sqrt[3]{32a^5}$

13.  $\sqrt[3]{54y^{10}}$

14.  $\sqrt{200a^6b^7}$

15.  $\sqrt[3]{-250x^6y^5}$

16.  $\sqrt[4]{64x^3y^6}$

⑨  $\sqrt{20x^3}$   
     $\swarrow$      $\searrow$   
    4 · 5     $x^2 \cdot x$   
 $2x\sqrt{5x}$

⑩  $\sqrt[3]{81x^2}$   
     $\swarrow$   
    27 · 3  
 $3\sqrt[3]{3x^2}$

⑮  $\sqrt[3]{-250x^6y^5}$   
     $\swarrow$      $\searrow$   
    -125 · 2     $y^3 \cdot y^2$   
 $-5x^2y\sqrt[3]{2y^2}$

### 6-2 Notes: Multiplying and Dividing Radical Expressions

Lesson Objective: To understand how to simplify radical expressions after multiplying or dividing two separate expressions.

**Product Property:**

$$\sqrt{4}\sqrt{25}$$

$$\sqrt[3]{-8}\sqrt[3]{27}$$

Simplify:

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

$$\sqrt{-2}\sqrt{8}$$

$$\sqrt[3]{-5x}\sqrt[3]{25x}$$

$$\sqrt[3]{54x^2y^3}\sqrt[3]{5x^3y^4}$$

**Multiply, if possible. Then simplify.**

1.  $\sqrt{8} \cdot \sqrt{32}$

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

3.  $\sqrt[3]{9} \cdot \sqrt[3]{-81}$

4.  $\sqrt[4]{8} \cdot \sqrt[4]{32}$

5.  $\sqrt{-5} \cdot \sqrt{5}$

6.  $\sqrt[3]{-5} \cdot \sqrt[3]{-25}$

7.  $\sqrt[3]{9} \cdot \sqrt[3]{-24}$

8.  $\sqrt[3]{-12} \cdot \sqrt[3]{-18}$

## Quotient Property

Simplify:

$$\frac{\sqrt{100}}{\sqrt{25}}$$

$$\frac{\sqrt[3]{64}}{\sqrt[3]{8}}$$

$$\frac{\sqrt[3]{32}}{\sqrt[3]{-4}}$$

$$\frac{\sqrt[3]{162x^5y^4}}{\sqrt[3]{3x^2y}}$$

An radical expression is simplified when:

1)

2)

Rationalizing the Denominator:

$$\frac{\sqrt{5}}{\sqrt{3}}$$

$$\frac{3}{\sqrt{7}}$$

Simplify first, then rationalize any denominators.

$$\frac{\sqrt{6}}{\sqrt{5xy}}$$

$$\frac{\sqrt[3]{2}}{\sqrt[3]{3x}}$$

$$\frac{2\sqrt[4]{2x^5y}}{\sqrt[4]{3xy^3}}$$

**Multiply and simplify. Assume that all variables are positive.**

17.  $\sqrt[3]{6} \cdot \sqrt[3]{16}$

18.  $\sqrt{8y^5} \cdot \sqrt{40y^2}$

19.  $\sqrt{7x^5} \cdot \sqrt{42xy^9}$

20.  $4\sqrt{2x} \cdot 5\sqrt{6xy^2}$

21.  $3\sqrt[3]{5y^3} \cdot 2\sqrt[3]{50y^4}$

22.  $-\sqrt[3]{2x^2y^2} \cdot 2\sqrt[3]{15x^5y}$



**Rationalize the denominator of each expression.**

27.  $\frac{\sqrt{x}}{\sqrt{2}}$

28.  $\frac{\sqrt{5}}{\sqrt{8x}}$

29.  $\frac{\sqrt[3]{x}}{\sqrt[3]{2}}$

30.  $\frac{\sqrt[3]{5}}{\sqrt{3x}}$

31.  $\frac{\sqrt[4]{2}}{\sqrt[4]{5}}$

32.  $\frac{15\sqrt{60x^5}}{3\sqrt{12x}}$

33.  $\frac{\sqrt{3xy^2}}{\sqrt{5xy^3}}$

34.  $\frac{\sqrt{5x^4y}}{\sqrt{2x^2y^3}}$