

Key

# Roots and Powers

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## Key Ideas:

1. Estimating roots / Irrational numbers
2. Mixed / Entire radicals
  - (squares and cubes)
3. Gr. 9 Exponent Laws:
  - when **multiplying common** bases, **ADD** exponents
  - when **dividing common** bases, **SUBTRACT** exponents
  - when you have a power of a power, **MULTIPLY** exponents
  - anything to the power of zero is "1"
4. Negative Exponent Law
  - "flip and fly"
5. Fractional Exponent Law
  - change to a radical

**\*Note: Watch your positive and negative signs!! Always simplify!**

## Irrational Numbers/Mixed and Entire Radicals

1. Estimate the value of each radical below.

a)  $\sqrt[3]{90}$

$2^3 = 8$   
 $3^3 = 27$   
 $4^3 = 64$   
 $5^3 = 125$

90 is closer to 64

$\sqrt[3]{64} = 4$   
 $\sqrt[3]{90} = 4.4$   
 $\sqrt[3]{125} = 5$

b)  $\sqrt{30}$

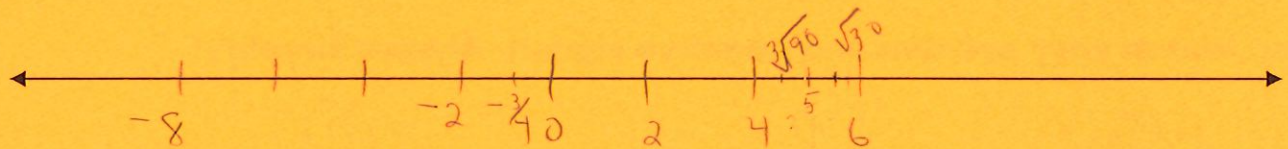
$2^2 = 4$   
 $3^2 = 9$   
 $4^2 = 16$   
 $5^2 = 25$   
 $6^2 = 36$

30 is closer to 25

$\sqrt{25} = 5$   
 $\sqrt{30} = 5.4$   
 $\sqrt{36} = 6$

c) Order the following numbers from least to greatest.

$\sqrt[3]{90}$        $\sqrt{30}$        $-8$        $-\frac{3}{4}$



2. Change to a **mixed radical**:

a)  $\sqrt{80}$

$\sqrt{16 \cdot 5}$   
 $\sqrt{16} \sqrt{5}$   
 $4\sqrt{5}$

b)  $2\sqrt[3]{54}$

$2\sqrt[3]{27 \cdot 2}$   
 $2\sqrt[3]{27} \sqrt[3]{2}$   
 $2(3)\sqrt[3]{2}$   
 $6\sqrt[3]{2}$

c)  $\sqrt[4]{32x^6y^9}$

$\sqrt[4]{16 \cdot 2x^4 \cdot x^2y^8y}$   
 $\sqrt[4]{16x^4y^8} \sqrt[4]{2x^2y}$   
 $2xy^2 \sqrt[4]{2x^2y}$

3. Change to an **entire radical**:

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

$$\sqrt[3]{4^3 \cdot 5}$$

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

b)  $2\sqrt{5}$

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

$$\sqrt{20}$$

4. Determine whether each number is rational or irrational. Then determine the smallest number family each number belongs to.

a)  $-12$

Q

b)  $0$

Q

c)  $\pi$

$\overline{Q}$

d)  $150$

Q

e)  $\frac{4}{5}$

Q

f)  $13.\overline{23}$

Q

### Exponent Laws

5. Simplify:

a)  $(x^4 x^{-9})^{-3} x^0$

$$x^{-12} x^{27}$$

$$x^{15}$$

b)  $\left(\frac{x^{-5} y^3}{x^{-8} y}\right)^2$

$$(x^3 y^2)^2$$

$$x^6 y^4$$

6. Evaluate:

a)  $3^{-4}$

$$\frac{1}{3^4}$$

$$\frac{1}{81}$$

b)  $\frac{1}{4^{-2}}$

$$4^2$$

$$16$$

7. Simplify:

a)  $\left(\frac{4x}{6y}\right)^{-2}$

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

$$\left(\frac{3y}{2x}\right)^2$$

$$\frac{9y^2}{4x^2}$$

b)  $(2x^2y^{-4})^{-3}$

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

$$\left(\frac{y^4}{2x^2}\right)^3$$

$$\frac{y^{12}}{8x^6}$$

8. Evaluate:

a)  $4^{\frac{1}{2}}$

$$\sqrt{4}$$

$$2$$

b)  $64^{\frac{5}{6}}$

$$\sqrt[6]{64}^5$$

$$2^5$$

$$32$$

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

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

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

$$\frac{2}{3}$$

d)  $(25x^3y^6)^{\frac{1}{2}}$

$$\sqrt{25x^3y^6}$$

$$\sqrt{25x^2 \cdot xy^6}$$

$$5xy^3\sqrt{x}$$

9. Evaluate:

a)  $\left(\frac{4x^6}{6x^{-2}}\right)^{-3}$

$$\left(\frac{2x^8}{3}\right)^{-3}$$

$$\left(\frac{3}{2x^8}\right)^3$$

$$\frac{27}{8x^{24}}$$

b)  $(3x^{-4}y^2)^{-2}$

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

$$\left(\frac{x^4}{3y^2}\right)^2$$

$$\frac{x^8}{9y^4}$$

c)  $\left(\frac{25x^{-2}y^3}{16x^{-4}y^{-1}}\right)^{-\frac{3}{2}}$

$$\left(\frac{25x^2y^4}{16}\right)^{-\frac{3}{2}}$$

$$\left(\frac{16}{25x^2y^4}\right)^{\frac{3}{2}}$$

$$\left(\frac{\sqrt{16}}{\sqrt{25x^2y^4}}\right)^3$$

$$\left(\frac{4}{5xy^2}\right)^3$$

$$\frac{64}{125x^3y^6}$$

d)  $(4x^{-2}y)^2(2x^3y^{-2})^{-3}$

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

$$\frac{16y^2}{x^4} \left(\frac{y^2}{2x^3}\right)^3$$

$$\frac{16y^2}{x^4} \cdot \frac{y^6}{8x^9}$$

$$\frac{16y^8}{8x^{13}}$$

$$\frac{2y^8}{x^{13}}$$