

# 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!

1. Change to a *mixed radical*:  $\sqrt{80}$

$$\begin{aligned} &\sqrt{16 \cdot 5} \\ &4\sqrt{5} \end{aligned}$$

2. Change to an *entire radical*:  $4\sqrt[3]{5}$

$$\begin{aligned} &\sqrt[3]{4^3 \cdot 5} \\ &\sqrt[3]{320} \end{aligned}$$

3. Simplify:

$$\begin{aligned} \text{a) } (x^4 x^{-9})^{-3} &= x^{-12} x^{27} \\ &= x^{15} \end{aligned}$$

$$\begin{aligned} \text{b) } \left(\frac{x^{-5} y^3}{x^{-8} y}\right)^2 &= (x^3 y^2)^2 \\ &= x^6 y^4 \end{aligned}$$

4. Evaluate:

$$\begin{aligned} \text{a) } 3^{-4} &= \frac{1}{81} \end{aligned}$$

$$\begin{aligned} \text{b) } \frac{1}{4^{-2}} &= 16 \end{aligned}$$

5. Simplify:

$$\begin{aligned} \text{a) } \left(\frac{4x}{6y}\right)^{-2} &= \left(\frac{6y}{4x}\right)^2 \\ &= \frac{36y^2}{16x^2} \\ &= \frac{9y^2}{4x^2} \end{aligned}$$

$$\begin{aligned} \text{b) } (2x^2 y^{-4})^{-3} &= \left(\frac{1}{2x^2 y^4}\right)^3 \\ &= \frac{1}{8x^6 y^{12}} \\ &= \frac{y^{12}}{8x^6} \end{aligned}$$

6. Evaluate:

$$\begin{aligned} \text{a) } 4^{\frac{1}{2}} &= 2 \end{aligned}$$

$$\begin{aligned} \text{b) } 64^{\frac{5}{6}} &= 32 \end{aligned}$$

$$\begin{aligned} \text{c) } \left(\frac{8}{27}\right)^{\frac{1}{3}} &= \sqrt[3]{\frac{8}{27}} \\ &= \frac{2}{3} \end{aligned}$$

$$\begin{aligned} \text{d) } (25x^3 y^6)^{\frac{1}{2}} &= 5x^{\frac{3}{2}} y^3 \end{aligned}$$

7. 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)  $(3x^{-4}y^2)^{-2}$

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

$$\frac{1}{9x^{-8}y^4}$$

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

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

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

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

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

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

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

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

$$\frac{16y^2}{x^4} \cdot \frac{1}{8x^9y^{-6}}$$

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