

Remember the definitions of negative and rational exponents you learned earlier, as well as the properties of exponents (summarized below).

Properties of n th Roots



For positive real numbers a and b :

WORDS	NUMBERS
Product Property of Roots The n th root of a product is equal to the product of the n th roots.	$\sqrt[4]{32} = \sqrt[4]{16} \cdot \sqrt[4]{2} = 2\sqrt[4]{2}$



Properties of Rational Exponents

For all nonzero real numbers a and b and rational r

WORDS	NUMBERS
Product of Powers Property To multiply powers with the same base, add the exponents.	$7^{\frac{1}{2}} \cdot 7^{\frac{3}{2}} = 7^{\frac{1}{2} + \frac{3}{2}}$
Quotient of Powers Property To divide powers with the same base, subtract the exponents.	$\frac{8^{\frac{2}{3}}}{8^{\frac{1}{3}}} = 8^{\frac{2}{3} - \frac{1}{3}}$
Power of a Power Property To raise one power to another, multiply the exponents.	$\left(6^{\frac{3}{4}}\right)^4 = 6^{\frac{3}{4} \cdot 4}$

Rewrite the following expressions using rational exponent notation.

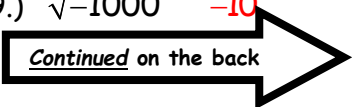
- 1.) $\sqrt[3]{7}$ $7^{\frac{1}{3}}$ 2.) $(\sqrt[3]{6})^2$ $6^{\frac{2}{3}}$ 3.) $\frac{\sqrt{10}}{\sqrt{2}} = \sqrt{\frac{10}{2}} = \sqrt{5} = 5^{\frac{1}{2}}$

Rewrite the following expressions using radical notation in simplest form.

- 4.) $17^{\frac{1}{3}}$ $\sqrt[3]{17}$ 5.) $8^{\frac{1}{2}}$ $-2\sqrt{2}$ 6.) $(-32)^{\frac{3}{5}}$ -8

Evaluate without using a calculator.

- 7.) $\sqrt[4]{1}$ 1 8.) $\sqrt[3]{125}$ 5 9.) $\sqrt[3]{-1000}$ -10



Evaluate without using a calculator.

$$10.) \sqrt[6]{64} \quad -2$$

$$11.) \left(\sqrt[3]{-27}\right)^2 \quad 9$$

$$12.) (-8)^{\frac{5}{3}} \quad -32$$

$$13.) 81^{\frac{3}{2}} \quad 729$$

$$14.) 64^{\frac{2}{3}} \quad 16$$

$$15.) (81)^{\frac{3}{2}} \quad 729$$

$$16.) (25)^{-\frac{3}{2}} \quad \frac{1}{125}$$

$$17.) (100)^{-\frac{5}{2}} \quad \frac{1}{100,000}$$

$$18.) (27)^{-\frac{4}{3}} \quad \frac{1}{81}$$

$$9.) \left(\frac{8}{27}\right)^{\frac{1}{3}} = \frac{8^{\frac{1}{3}}}{27^{\frac{1}{3}}} = \frac{2}{3}$$

$$20.) \left(\frac{4}{25}\right)^{-\frac{3}{2}} = \frac{4^{\frac{3}{2}}}{25^{\frac{3}{2}}} = \frac{25^{\frac{3}{2}}}{4^{\frac{3}{2}}} = \frac{125}{8}$$

$$21.) \left(\frac{49}{64}\right)^{\frac{1}{2}} \quad \frac{7}{8}$$

Simplify the following expressions using properties of exponents:

$$22.) (4x^3y^5)(-2xy^{-3})$$

$$-8x^4y^2$$

$$23.) (-3x^2y^{-2})^3$$

$$-\frac{27x^6}{y^6}$$

$$24.) -3(2x)^2(-x)^3$$

$$12x^5$$

$$25.) \frac{(-4x^3y^{-1})^2}{5x^3y}$$

$$\frac{16x^3}{5y^3}$$

$$26.) \frac{10x^3z}{(5xz^2)^2}$$

$$\frac{2x}{5z^3}$$

$$27.) \frac{-x^3y(-xy)^4}{(x^3y^2)^2}$$

$$-xy$$

$$28.) y^{3n} \cdot y^{1-n}$$

$$y^{2n+1}$$

$$29.) (a^{n+1})^3 \cdot a^{n-3}$$

$$a^{4n}$$

$$30.) (x^{2n}y^0)^2 \cdot (x^{-3}y^2)^n$$

$$x^n y^{2n}$$

$$31.) \frac{k^{x+2}}{k^{2-x}} \quad k^{2x}$$

$$32.) \left(\frac{x^{2n-1}}{x^{n-3}}\right)^2 \quad k^{2n+4}$$

$$33.) \left(\frac{(a^{4x})(a^x)}{(a^{x-2})^2}\right)^2 a^{6x+8}$$

Express in **simplest radical form**: (Hint: you may want to convert to rational exponents first)

$$34.) \sqrt[3]{-56a^7b^9}$$

$$-2a^2b^3\sqrt[3]{7a}$$

$$35.) \sqrt[4]{16a^3b^8}$$

$$2b^2\sqrt[4]{a^3}$$

$$36.) \sqrt[3]{5^3x^4y^2z^{15}}$$

$$5xz^5\sqrt[3]{xy^2}$$

Evaluate/simplify without using a calculator:

$$37.) 36^{\frac{3}{4}} \div 36^{\frac{1}{4}} \quad 6$$

$$38.) a^{\frac{2}{3}} \cdot a^{\frac{1}{4}} \quad a^{\frac{11}{12}} \text{ or } \sqrt[12]{a^{11}}$$

$$39.) \frac{a^{\frac{4}{3}}}{(125a)^{\frac{2}{3}}} \quad \frac{\sqrt[3]{a^2}}{25}$$