

Essential Question: What are the division properties of exponents?

Do Now: Evaluate. You may use a calculator.

a. $\frac{3^9}{3^5}$

$$\frac{19683}{243} = 81$$

b. 3^4

81

c. $\left(\frac{4}{5}\right)^3$

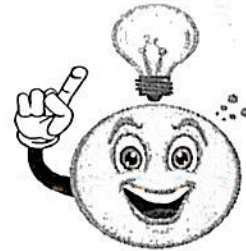
.512

d. $\frac{4^3}{5^3}$

$$\frac{64}{125} = .512$$

Rules We Know...

- Zero power and Negative Exponents:** $a^0 = 1, a \neq 0$
 $a^{-n} = \frac{1}{a^n}$ and $\frac{1}{a^{-n}} = a^n, a \neq 0$
- Product of Powers Property:** $a^m \cdot a^n = a^{m+n}$
- Power of a Power Property:** $(a^m)^n = a^{m \cdot n}$
- Power of a Product Property:** $(a \cdot b)^m = a^m \cdot b^m$



Division Properties of Exponents

Quotient of Powers Property	When dividing powers with the same base, <u>SUBTRACT</u> the exponents.	$\frac{a^m}{a^n} = a^{m-n}$
Power of a Quotient Property	When raising a fraction to a power, raise the <u>numerator</u> and <u>denominator</u> to the power.	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

Examples:

1. $\frac{(-6)^5}{(-6)^3}$

$$(-6)^2 = 36$$

2. $\frac{9^4 \cdot 9^2}{9^7}$

$$\frac{9^6}{9^7} = 9^{-1} \rightarrow \frac{1}{9}$$

3. $\frac{y^{-3}}{y^5}$

$$\frac{y^{-3-5}}{1} = \frac{1}{y^8}$$

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

$$\frac{2^2}{3^2} = \boxed{\frac{4}{9}}$$

$$5. \left(-\frac{3}{y}\right)^3$$

$$\boxed{\frac{-27}{y^3}}$$

$$6. \left(\frac{5}{4}\right)^{-3}$$

$$\frac{\left(\frac{4}{5}\right)^3}{4^3} = \boxed{\frac{64}{125}}$$

More Complicated Expressions

$$7. \frac{x^2 y^3}{x y^4}$$

$$x y^{-1}$$

$$\boxed{\frac{x}{y}}$$

$$8. \left(\frac{2x^2 y^4}{1xy}\right)^3$$

$$(2xy^3)^3$$

$$2^3 x^3 y^9$$

$$\boxed{8x^3 y^9}$$

$$9. \frac{2x^2 y}{3x} \cdot \frac{9xy^2}{y^4}$$

$$\frac{6x^3 y^3}{xy^4}$$

$$6x^2 y^{-1}$$

$$\boxed{\frac{6x^2}{y}}$$

$$(1) - (-5)$$

$$10. \left(\frac{3x^2 y}{x^8 y^{-5}}\right)^3$$

$$\frac{3^3 x^6 y^3}{x^{24} y^{-15}}$$

$$27 x^{-18} y^{18}$$

$$\boxed{\frac{27 y^{18}}{x^{18}}}$$

OR

$$(3x^{-6} y^6)^3$$

$$3^3 x^{-18} y^{18}$$

$$\boxed{\frac{27 y^{18}}{x^{18}}}$$

$$11. \frac{-6x^3 y^4}{4y} \cdot \frac{16x^2}{6xy}$$

$$\frac{-4x^5 y^4}{xy^2}$$

$$\boxed{-4x^4 y^2}$$

$$12. \frac{20x^3 y}{4xy^3} \cdot \frac{-6xy}{-x}$$

$$\frac{30x^4 y^2}{x^2 y^3}$$

$$30x^2 y^{-1}$$

$$\boxed{\frac{30x^2}{y}}$$

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

$$\left(\frac{2x^1 y^2}{2xy^{-2}y^4}\right)^2 \cdot 2^2 x^4 y^8$$

$$\frac{3^2 x^{-2} y^2}{2^2 x^2 y^4} \cdot 2^2 x^4 y^8$$

$$\rightarrow \frac{3^2 x^2 y^{10}}{x^2 y^4}$$

$$\rightarrow \boxed{9y^6}$$