FMP10 Name: _____

Date: _____

2.3 Integral Exponents

Exponent Law Summary

Exponent Law	
Note that a and b are rational or variable bases and m and n are integral exponents.	
Product of Powers	$(a^m)(a^n) = a^{m+n}$
Quotient of Powers	$\frac{a^m}{a^n} = a^{m-n}, a \neq 0$
Power of a Power	$(a^m)^n = a^{mn}$
Power of a Product	$(ab)^m = (a^m)(b^m)$
Power of a Quotient	$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0$
Zero Exponent	$a^0 = 1, a \neq 0$

$\frac{5^3}{5^3} = 1$

$5^0 = 1$

Exploring Negative Exponents:

Continue the pattern:

$2^4 = 16$ $2^4 = 16$

$2^3 = 8$ ÷2 $3^4 = 81$

$2^2 = 4$ ÷2 $3^3 = 27$

$2^1 = \boxed{2}$ ÷2 $3^2 = 9$

$2^0 = \boxed{1}$ ÷2 $3^1 = \boxed{\quad}$

$2^{-1} = \boxed{1/2}$ $3^0 = \boxed{\quad}$

$2^{-2} = \boxed{1/4} = 1/2^2$ $3^{-1} = \boxed{\quad}$

$2^{-3} = \boxed{1/8} = 1/2^3$ $3^{-2} = \boxed{\quad}$

$2^{-4} = \boxed{1/16} = 1/2^4$ $3^{-3} = \boxed{\quad}$

$3^{-4} = \boxed{\quad}$

$5^{-2} = \frac{1}{5^2} = \frac{1}{25}$

Simplify using expansion and cancellation, then simplify by exponent laws:

$10^{-3} = \frac{1}{10^3} = \frac{1}{1000}$

$\frac{4^2}{4^5} = \frac{\cancel{4}^1 \cdot \cancel{4}^1}{4 \cdot \cancel{4} \cdot 4 \cdot \cancel{4} \cdot \cancel{4}} = \frac{1}{4^3} = \frac{1}{64}$

$4^{2-5} = 4^{-3}$

$\frac{(-2)^3}{(-2)^7} = (-2)^{3-7}$

$= (-2)^{-4}$

$= \frac{1}{(-2)^4} = \frac{1}{16}$

$\neq \frac{1}{-2^4}$

$= -\frac{1}{16}$

Summary:

$a^{-n} = \frac{1}{a^n}$

$\frac{1}{a^{-n}} = a^n$

$\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$

Ex. Write each expression with positive exponents.

$5^{-2} = \frac{1}{5^2}$

$x^{-5} = \frac{1}{x^5}$

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

$\frac{1}{6^{-3}} = 6^3$

$\frac{1}{z^{-5}} = z^5$

$(4y)^{-3} = \frac{1}{(4y)^3} = \frac{1}{64y^3}$

$4y^{-3} = \frac{4}{y^3}$

$(xy)^{-2} = \frac{1}{(xy)^2} = \frac{1}{x^2y^2}$

$xy^{-2} = x \cdot \frac{1}{y^2} = \frac{x}{y^2}$

$x^3y^{-1}z^{-7} = \frac{x^3}{yz^7}$

Ex. Write each product or quotient as a power with a single exponent.

$(5^8)(5^{-3})$

$= 5^{8+(-3)}$

$= 5^5$

$(0.8^{-2})(0.8^{-4})$

$= (0.8)^{-2+-4}$

$= 0.8^{-6} = \left(\frac{8}{10}\right)^{-6} = \left(\frac{4}{5}\right)^{-6}$

$= \frac{1}{0.8^6} = \left(\frac{5}{4}\right)^{+6}$

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

$= (2x)^{3-(-2)}$

$= (2x)^5$

$(-4)^3(-4)^{-8}$

$= (-4)^{3+(-8)}$

$= (-4)^{-5}$

$= \frac{1}{(-4)^5}$

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

$= x^8$

$\frac{q^{-1}}{q^7}$

$= q^{-8}$

$= \frac{1}{q^8}$

Ex. Write each expression as a power with a single, positive exponent. Then, evaluate where possible.

$(4^3)^{-2}$

$= 4^{-6}$

$= \frac{1}{4^6}$

$= \boxed{\frac{1}{4096}}$

$\left(\frac{2^4}{2^6}\right)^{-3} = \frac{2^{-12}}{2^{-18}}$

$= \left(2^{-2}\right)^{-3}$

$= 2^6$

$= \boxed{64}$

$2^{-12-(-18)}$

$= \left(\frac{2^6}{2^4}\right)^3$

$\left[\frac{(y^2)^0}{(y^{-4})^2}\right]^{-3}$

$\left[\frac{y^0}{y^{-8}}\right]^{-3}$

$\left[\frac{1}{y^{-8}}\right]^{-3}$

$= \boxed{\frac{1}{y^{24}}}$

$= [y^8]^{-3}$

$= y^{-24}$

$= \frac{1}{y^{24}}$

$[(a^{-2})(a^3)]^{-1}$

$= [a]^{-1}$

$= a^{-1}$

$= \boxed{\frac{1}{a}}$

$\left[\left(\frac{3}{4}\right)^{-2} \cdot \left(\frac{3}{4}\right)^4\right]^{-2}$

$= \left[(3/4)^2\right]^{-2}$

$= (3/4)^{-4}$

$= (4/3)^4 = \boxed{256/81}$

Ex. It is estimated that there are 117 billion grasshoppers in an area of 39 000 km^2 of Saskatchewan. Approximately how many grasshoppers are there per square kilometre? Solve using exponents without a calculator.

$$\frac{117\,000\,000\,000}{39\,000} = \frac{(117)(10^9)}{(39)(10^3)}$$

$$= (3)(10^6)$$

$$= \boxed{3{,}000{,}000 \text{ grasshoppers/km}^2}$$

Practice: pg. 169/ # 2, 4–7, 10, 11, 20, 21

#6 both decimals + fractions

solve using exponents