3.2 Exponent Laws

Recall: Exponent Laws

Multiplying Powers $x^9 \cdot x^4 = x^{9+4} = x^{13}$

Dividing $x^5 \div x^2$ or $\frac{x^5}{x^2} = x^{5-2} = x^3$

Power Law $(x^9)^2 = x^{9 \cdot 2} = x^{18}$

Power of a Product $(x^3y^4)^3 = x^{3 \cdot 3}y^{4 \cdot 3} = x^9y^{12}$

Power of a Quotient $\left(\frac{x^3}{y^4}\right)^3 = \frac{x^{3 \cdot 3}}{y^{4 \cdot 3}} = \frac{x^9}{y^{12}}$ where $y \neq 0$

Zero Exponent $x^0 = 1$ where $x \neq 0$ since 0^0 is undefined

Negative Exponent $x^{-5} = \frac{1}{x^5}$ where $x \neq 0$

Reminders...

EVALUATE - answers should be a #, without exponents; if a fraction, reduced

SIMPLIFY - answer will have variables in it, like bases should be combined, should be no negative exponents, in lowest terms

BEDMAS applies!

Let's try.....

1. Evaluate.

a) 2^4

$= 2 \cdot 2 \cdot 2 \cdot 2$

$= 16$

b) $(-2)^3$

$= (-2)(-2)(-2)$

$= -8$

c) $(-2)^4$

$= 16$

d) -2^4

$= -16$

e) 3^{-4}

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

$= \frac{1}{81}$

f) 7^{-1}

$= \frac{1}{7}$

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

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

$= \frac{16}{9}$

h) $2^{-1} + 2^3$

$= \frac{1}{2} + 8$

$= \frac{17}{2}$

i) $(-5)^0$

$= 1$

j) -5^0

$= -5^0$

$= -1$

k) $(-3^3)^2$

$= \left[(-1)(3^3)\right]^2$

$= (-1)^2(3^3)^2$

$= 3^6$

$= 729$

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

$= 3^{-8}$

$= \frac{1}{3^8}$

$= \frac{1}{6561}$

m) $\frac{5^{10}}{5^{12}}$

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

$= \frac{1}{25}$

n) $\frac{1}{7^{-2}}$

$= 7^2$

$= 49$

o) $(5^3)(5^{-2})$

$= 5^{3+(-2)}$

$= 5^1$

$= 5$

$= \frac{5^3}{5^2}$

$= 5$

p) $\frac{3^{-2} + 2^{-3}}{4^{-2}}$

$= \frac{\frac{1}{3^2} + \frac{1}{2^3}}{\frac{1}{4^2}}$

$= \frac{\frac{1}{9} + \frac{1}{8}}{\frac{1}{16}}$

$= \frac{\frac{8}{72} + \frac{9}{72}}{\frac{1}{16}}$

$= \frac{\frac{17}{72}}{\frac{1}{16}}$

$= \frac{17}{72} \div \frac{1}{16}$

$= \frac{17}{\cancel{72}_{9}} \times \frac{\cancel{16}^{2}}{1}$

$= \frac{34}{9}$

$= \left(\frac{1}{3^2} + \frac{1}{2^3}\right)(4^2)$

$= \left(\frac{1}{9} + \frac{1}{8}\right)(16)$

$= \left(\frac{17}{\cancel{72}_{9}}\right)(\cancel{16}^{2})$

$= \frac{34}{9}$

2. Simplify. Express with positive exponents only.

a) $-3x\left(5x^3y^2z\right)\left(-2x^{-1}y^4z^3\right)$

$= (-3)(5)(-2)(x)(x^3)(x^{-1})(y^2)(y^4)(z)(z^3)$

$= 30x^3y^6z^4$

b) $(3a^4)^2$

$= (3a^4)(3a^4)$

$= 9a^8$

$= 3^2a^8$

$= 9a^8$

c) $(3a^{-3}b)^{-2}$

$= \frac{1}{(3a^{-3}b)^2}$

$= \frac{1}{3^2a^{-6}b^2}$

$= \frac{a^6}{9b^2}$

$= 3^{-2}a^6b^{-2}$

$= \frac{a^6}{3^2b^2}$

$= \frac{a^6}{9b^2}$

d) $\left(\frac{4m^3n}{6m^2n^4}\right)^2$

$= \frac{4^2m^6n^2}{6^2m^4n^8}$

$= \frac{16m^2}{36n^6}$

$= \frac{4m^2}{9n^6}$

e) $\left(\frac{8a^3b^4}{4a^{-2}b^3}\right)^{-3}$

$= \frac{8^{-3}a^{-9}b^{-12}}{4^{-3}a^6b^{-9}}$

$= \frac{4^3b^9}{8^3a^9a^6b^{12}}$

$= \frac{64}{512a^{15}b^3}$

$= \frac{1}{8a^{15}b^3}$

OR SIMPLIFY FIRST:

$= \left(\frac{2a^5b}{1}\right)^{-3}$

$= \left(\frac{1}{2a^5b}\right)^3$

$= \frac{1}{8a^{15}b^3}$

f) $\frac{\left(4x^3y^4\right)\left(-3x^{-4}y^3\right)^2}{\left(2x^4y^{-3}\right)\left(3x^{-5}y^{-1}\right)^3}$

$= \frac{4x^3y^4(-3)^2x^{-8}y^6}{2x^4y^{-3}(3)^3x^{-15}y^{-3}}$

$= \frac{2y^7(9)x^7y^9}{x(27)^3}$

$= \frac{2y^{16}x^6}{3}$

$= \frac{2}{3}x^6y^{16}$

Homework:
Exponents Practice Handout 3.2