8-1, 8-3, 8-5
Zero & Negative Exponents
Multiplication & Division with Exponents

Exponents:

$x^{n} =$ x * x * x * x .... ("x" times itself "n" times)

$ax^3 = a \cdot x \cdot x \cdot x$

$(ay)^{b}$ = ay * ay * ay . . . . ("ay" times itself "b" times)

"x" or "ay" is called the "base"

"n" or "b" is called the "exponent" or "power"

There are four kinds of exponents:

- positive: x^{2}
- negative: x^{-3}
- zero: x^{0}
- fractional: $x^{2/3}$

Simplifying Exponents

Goal: To reduce exponential terms to the lowest possible form by:
a) multiplying and dividing all exponential terms following the appropriate rules, resulting in the fewest possible terms
b) eliminating all zero exponents
c) eliminating all negative exponents

Multiplying Terms with Exponents:

$x^3 * x^5 = (x * x * x) * (x * x * x * x * x) = x^8 = x^{5+3}$

$x^2 * x^4 = (x * x) * (x * x * x * x) = x^6 = x^{2+4}$

RULE #1:

$x^a * x^b = x^{a+b}$

When multiplying terms with exponents, if your bases are the same you add your exponents

Apply Rule #1:

$x^7 * x^{23} = x^{30}$

$x^5 * x^{-5} = x^0$

$x^{-10} * x^7 = x^{-3}$

Dividing Terms with Exponents

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

$x^7 \div x^2 = \frac{x^7}{x^2} = \frac{x*x*x*x*x*x*x}{x*x} = x^5 = x^{7-2}$

Rule #2:

$x^a \div x^b = x^{a-b}$

When dividing terms with exponents, if the bases are the same you subtract the exponents

Apply Rule #2:

$x^{12} \div x^3 = x^9$

$\frac{x^9}{x^3} = x^6$

$x^5 \div x^8 = x^{-3}$

$x^4 \div x^4 = x^0$

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

$x^{-5} \div x^{-7} = x^2$

$x^4 \div x^{-8} = x^{12}$

Zero Exponents

$x^3 \div x^3 = \frac{x^3}{x^3} = \frac{x * x * x}{x * x * x} = 1 = x^{3-3} = x^0$

$x^3 \div x^3 = x^{3-3} = x^0 = 1$

$y^5 \div y^5 = \frac{y^5}{y^5} = \frac{y * y * y * y * y}{y * y * y * y * y} = y^0 = 1$

$y^5 \div y^5 = y^{5-5} =$

Rule #3:

$x^0 =$ 1

Any base raised to a power of zero (with an exponent of zero) is equal to one

Apply Rule #3:

$x^{-3} * x^3 =$ 1

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

$x^7 \div x^7 =$ 1

Negative Exponents

$x^3 \div x^5 = \frac{x^3}{x^5} = \frac{x * x * x}{x * x * x * x * x} = \frac{1}{x^2}$

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

$y^4 \div y^9 = \frac{y * y * y * y}{y * y * y * y * y * y * y * y * y} = \frac{1}{y^5}$

$y^4 \div y^9 = y^{4-9} = y^{-5}$

Rule #4:

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

Any base raised to a negative exponent is equivalent to its reciprocal ↑ pos power

Applying Rule #4:

$x^{-3} = x^{-3}$

$4y^{-2}x = 4 \cdot \frac{1}{y^2} \cdot x = \frac{4x}{y^2}$

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

$x^7 \div x^{12} = \frac{1}{x^5}$

$x^{-4} \div x^{-8} = \frac{1}{x^{-4}} = x^4$

$\frac{1}{w^{-4}} = w^4$

You try it Zero & Negative Exponents:

$\frac{1}{2^0}$ $= \frac{1}{1} = 1$ $\left(\frac{1}{2}\right)^0 = 1$

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

$4n^{?} = \frac{4}{n^2}$ $?=-2$

$\frac{a^{?}}{3b^{?}} = \frac{b^3}{3}$ $\frac{a^0}{3b^{-3}}$

$3ab^0 = 3a$

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

$\frac{6a^{-1}c^{-3}}{d^0} = \frac{1}{a^1} \cdot \frac{1}{c^3} \cdot \frac{6}{1} = \frac{6}{ac^3}$

$9^0 y^7 t^{-11} = 1 \cdot y^{7+11}$ y^{18}

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

$100{,}000 = 10^{?}$ 10^5

$10^{-6} = \frac{1}{10^6} = \frac{1}{1{,}000{,}000} = .000001$

$10^4 = 10{,}000$

$2^3(5^0 - 6m^2)$

$\frac{6}{m^2} + \frac{5m^{-2}}{3^{-3}}$

$\frac{2r^{-5}y^3}{n^2} + \frac{r^2y^5}{2n} =$

8-1 zero & negative exponents