Unit 2 4.6 Negative and Zero Exponent Rules Notes   Name: __Key__

Using the exponent rules you have already learned simplify the following problems...

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

$x^{3-5} = x^{-2}$ or

$\frac{\cancel{x}\cdot\cancel{x}\cdot\cancel{x}}{\cancel{x}\cdot\cancel{x}\cdot\cancel{x}\cdot x\cdot x} = \frac{1}{x^2}$

$$\frac{b^3 c^7}{b^6 c^2}$$

$b^{-3} c^5$ or

$\frac{c^5}{b^3}$

$$\frac{18 f^3 g^4}{27 f g^5}$$

$\frac{2}{3} f^2 g^{-1}$ or

$\frac{2 f^2}{3 g}$

Can you generalize what has happened?

exponents can be positive or negative depending where you locate the factor.

Negative Exponents Rule:

$$a^{-n} = \frac{1}{a^n} \quad \text{or} \quad \frac{1}{a^{-n}} = a^n$$

Using the exponent rules you have already learned simplify the following problems...

4^x	
Power	Answer
4^5	1024
4^4	256
4^3	64
4^2	16
4^1	4
4^0	1

Two ways of looking at it...	
$\frac{x^5}{x^5}$	1
$\frac{x^5}{x^5}$	$x^{5-5} = x^0$

x^0 must equal 1

Can you generalize what has happened?

Zero as the Exponent Rule:

$$a^0 = 1$$

Exponential Expression	Exponential Expression (positive exponents)
k^{-3}	$\dfrac{1}{k^3}$
$6f^{-7}$	$\dfrac{6}{f^7}$
$12g^3f^{-2}$	$12g^3/f^2$
$\dfrac{-37x^3}{y^{-7}}$	$-37x^3y^7$
$a^{-1}b^{-2}c^{-3}$	$\dfrac{1}{ab^2c^3}$

Operations with exponents that are negative and zero:

1. $x^3 \cdot x^{-2}$

X

or

$\dfrac{14}{x^9}$

2. $\dfrac{14x^{-6}}{x^3}$

$14x^{-9}$

or

$\dfrac{14}{x^9}$

3. $\dfrac{a^{-5}}{a^4}$

a^{-9}

or

$\dfrac{1}{a^9}$

4. $\dfrac{10m^3n^4}{-25n^9}$

$-\dfrac{2}{5}m^3n^{-5}$

or

$\dfrac{-2m^3}{5n^5}$

5. $(k^5)^{-3}$

k^{-15}

or

$\dfrac{1}{k^{15}}$

6. $(16z^{-5})^2$

$256z^{-10}$

or

$\dfrac{256}{z^{10}}$

7. $\left(\dfrac{42x^{-3}}{20y^{-5}}\right)^2$

$\left(\dfrac{21x^{-3}}{10y^{-5}}\right)^2$

$\dfrac{441x^{-6}}{100y^{-10}}$ or $\boxed{\dfrac{441y^{10}}{100x^6}}$

8. $\left(\dfrac{14x^7z^4}{21x^3z^{10}}\right)(9x^{-8}y^{-2})^0$

$\dfrac{2x^4}{3z^6}(1)$

$\boxed{\dfrac{2x^4}{3z^6}}$

9. $\left(\dfrac{-9d^3e}{2d^3e^7}\right)^3$

$\left(\dfrac{-9d^0e^{-6}}{2}\right)^3$

$\boxed{\dfrac{-729}{8e^{18}}}$

Simplify each expression so your answer does not contain negative exponents.

1. $\dfrac{x^4 y^{-5}}{z^{-2}}$

$$\dfrac{x^4 z^2}{y^5}$$

2. $\dfrac{x^{-7}}{x^4}$

x^{-11}

$$\boxed{\dfrac{1}{x^{11}}}$$

3. $\dfrac{x^3}{x^{-6}}$

x^9

4. $x^{-2} \cdot x \cdot x^{-8}$

x^{-9}

$$\boxed{\dfrac{1}{x^9}}$$

5. $(x^{-2})^3$

x^{-6}

$$\boxed{\dfrac{1}{x^6}}$$

6. $\dfrac{x^4}{x^8}$

x^{-4}

$$\boxed{\dfrac{1}{x^4}}$$

7. $(10x^{-2}y^4)^0$

1

8. $(x^{-3})^{-9}$

x^{27}

9. $\dfrac{12x^7}{36x^9}$

$$\dfrac{1}{3x^2}$$

10. $\dfrac{48x^6 y^7 z^5}{-6xy^7 z^6}$

$$\dfrac{-8x^5}{z}$$

11. $\left(\dfrac{3x^{-5}}{-24y^2}\right)$

$$\dfrac{-1}{8x^5 y^2}$$

12. $\left(\dfrac{4x^3}{7x^{-2}}\right)^2$

$$\dfrac{16x^{10}}{49}$$

*13. $\left(\dfrac{6x^{-4}y}{9xy^{-3}}\right)^3$

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

$$\boxed{\dfrac{8y^4}{27x^5}}$$

*14. $\left(\dfrac{2x^3y^2z}{3x^{-4}yz^{-2}}\right)^{-2}$

$$\left(\dfrac{3x^{-4}yz^{-2}}{2x^3y^2z}\right)^2$$

$$\boxed{\dfrac{9}{4x^{14}y^2z^6}}$$

*15. $\dfrac{(12xz^{-2})(3x^{-3}yz^{-4})}{(2x^5yz^{-7})^2}$

$$\dfrac{36x^{-2}yz^{-6}}{4x^{10}y^2z^{-14}}$$

$$\boxed{\dfrac{9z^8}{x^{12}y}}$$

*16. $\dfrac{(3x^{-5}y^2)^0(-4x^7y)^2}{(2x^6)(-6y)^{-1}}$

$$\dfrac{1(16x^{14}y^2)(-6y)^1}{2x^6}$$

$$\boxed{-48x^8y^3}$$