Name _____
Date _____
Prof. Abel

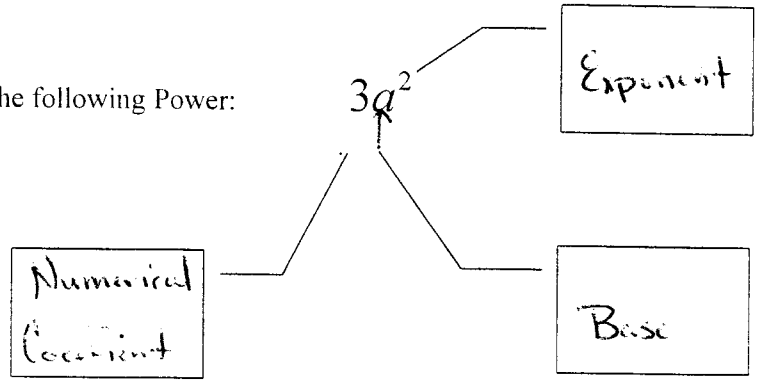
Elementary Algebra
Class #18

Section 5.1 – Rules of Exponents.

Quality – Accuracy – Transfer – 100%

Section 1. The Meaning of a "Power".

1. Name the Parts of the following Power:



2. Write the following using exponents:

a. $x \cdot x \cdot x \cdot x \cdot x \cdot y \cdot y \cdot y$ a. x^5y^3

b. $a \cdot a \cdot a \cdot b \cdot b \cdot b \cdot b$ b. a^3b^4

c. $2 \cdot m \cdot m \cdot m \cdot m \cdot n \cdot n \cdot n$ c. $2m^4n^3$

3. Write the following WITHOUT Using Exponents.

a. x^2y^4 $XXYYYY$ a. _____

b. a^4bc^3 b. $aaaa\,b\,ccc$

c. $4^3 \cdot 3^2$ c. $4 \cdot 4 \cdot 4 \cdot 3 \cdot 3$

Section 2. The Product Rule for Exponents: $x^a \cdot x^b = x^{a+b}$

Different Powers, Same base

4. Multiply Each Expression Using the Product Rule:

a. $x^5 \cdot x^2$ a. x^7

b. $3^2 \cdot 3$ b. 3^3

c. $2^2 \cdot 2^4$ c. 2^6

d. $x^2 \cdot x^6$ d. x^8

e. $y^4 \cdot y^7$ e. y^{11}

Section 3. The Quotient Rule for Exponents: $x^a \div x^b = x^{a-b}$

Divide different power, same base

5. Perform each Division:

a.	$x^8 \div x^5$	a. x^3
b.	x^5 / x^3	b. x^2
c.	$\frac{3^5}{3^2}$	c. 3^3
d.	$\frac{6^4}{6^1}$	d. 6^3
e.	$\frac{x^{12}}{x^5}$	e. x^7
f.	$\frac{z^8}{z}$	f. z^7

6. Special Cases – Division:

a.	$\frac{c^4}{c^7}$	a. c^{-3} $\frac{1}{c^3}$
b.	$\frac{y^5}{y^9}$	b. y^{-4} $\frac{1}{y^4}$
c.	$\frac{x^3}{x^4}$	c. x^{-1} $\frac{1}{x}$

Section 4. The Zero-Exponent Rule: Any number (expression) raised to 0 = 1

7. Simplify the Following Expressions:

a.	3^0	a. 1
b.	x^0 → $x \neq 0$	b. 1
c.	$3x^0 = 3 \cdot 1$, $x \neq 0$	c. 3
d.	$(3x)^0$ $x \neq 0$	d. 1
e.	$4x^4y^2z^0$ $4x^4y^2 \cdot 1$	e. $4x^4y^2$

NOTE: 0^0 Undefined

Section 5. The Power Rule for Exponents: $(x^a)^b = x^{ab}$ Raise Power to Power

8. Apply the Power Rule for the Following Expressions:

a. $(x^5)^3$ $x^5 \cdot x^5 \cdot x^5$ x^{15}

b. $(3^4)^2$ 3^8

c. $(y^5)^7$ y^{35}

9. The Extended Power Rule: $(a^x b^y)^z = a^{xz} b^{yz}$

a. $\left(\frac{ax}{by}\right)^4$ $\frac{a^4x^4}{b^4y^4}$

b. $(4x)^2$ $(4x)(4x)$ $16x^2$

c. $(-x)^3$ $-x^3$

d. $(5xy^3)^3$ $125x^3y^6$

e. $\left(\frac{-3y}{2z}\right)^2$ $+\frac{9y^2}{4z^2}$

10. Order of Operations and the Extended Power Rule:

a. $\left(\frac{9x^3y^2}{3xy^2}\right)^3$ $\left(\frac{\overset{3}{9}\ \overset{x^2}{x^3}\ \overset{}{y^2}}{\underset{}{3}\ \underset{}{x}\ \underset{}{y^2}}\right)^3 = (3x^2)^3$ $27x^6$

b. $\left(\frac{25x^4y^3}{5x^2y^7}\right)^4$ $\left(\frac{\overset{5}{25}\ \overset{x^2}{x^4}\ \overset{}{y^3}}{\underset{}{5}\ \underset{}{x^2}\ \underset{y^4}{y^7}}\right)^4 = \left(\frac{5x^2}{y^4}\right)^4$ $\frac{625x^8}{y^{16}}$

c. $(3y^3z^4)^2(2y^4z)$ $(9y^6z^8)(2y^4z)$ $18y^{10}z^9$

d. $(5x^4z^{10})^2(2x^2y^8)$ $(25x^8z^{20})(2x^2y^8)$ $50x^{10}y^8z^{20}$

Section 5.2: Negative Exponents – What Are They:

1. Solve by The Quotient Rule: Show all work…

$\frac{x^3}{x^5}$ Solve by the Quotient Rule: x^{-2}

$\frac{x^3}{x^5}$ Solve by Showing the Structural Work: $\frac{\cancel{x}\cancel{x}\cancel{x}\ 1}{\cancel{x}\cancel{x}\cancel{x}\ x\,x} = \frac{1}{x^2}$

2. Simply Stated: the Negative Exponent Rule: $x^{-n} = \frac{1}{x^n}$

3. Simplify the Following Expressions: Write each answer with positive exponents only. Simplify.

a. x^{-6} $\frac{1}{x^6}$

b. x^{-7} $\frac{1}{x^7}$

c. 4^{-2} $\frac{1}{4^2} = \frac{1}{16}$

d. 5^{-3} $\frac{1}{5^3} = \frac{1}{125}$

4. Consider Negative Exponents Presented Another Way:

a. $\frac{x^2}{x^4}$ $\frac{x^2}{1}$ or x^2

b. $\frac{5}{5^1}$ $\frac{5}{1}$ or 5

5. Practice Using the Power Rule:

a. $\left(x^{-5}\right)^4$ $x^{-20} = \frac{1}{x^{20}}$

b. $\left(4^2\right)^{-3}$ $4^{-6} = \frac{1}{4^6}$

6. Practice Using Product Rule:

a. $x^{3} \cdot x^{-5} = x^{-2} \quad \frac{1}{x^{2}}$

b. $3^{-4} \cdot 3^{-7} = 3^{-11} = \frac{1}{3^{11}}$

7. Practice Using the Quotient Rule:

a. $\frac{x^{-5}}{x^{13}} = x^{-18} = \frac{1}{x^{18}}$ $\qquad \frac{x^{-5}}{x^{13}x^{5}} = \frac{1}{x^{18}}$

b. $\frac{6}{6^{-5}6^{+7}} = \frac{1}{6^{2}} = \frac{1}{36}$ $\qquad \frac{6^{-7}}{6^{-5}} \quad -7-(-5) \quad 6^{-2} = \frac{1}{6^{2}} = \frac{1}{36}$

8. Negative Product and Power Rule:

a. $\frac{8z^{-4}}{32x^{-2}}$

$\frac{8 \; x^{2} \; z^{-4}}{32 \; x^{2} \; z^{4}}$

$\frac{x^{2}}{4z^{4}}$

b. $\frac{18m^{-3}n^{0}}{6m^{5}n^{9}}$

$\frac{18^{3} \; m^{-3} \; n^{0}}{6 \; m^{5}m^{3} \; n^{9}}$

$\frac{3}{m^{8}n^{9}}$

c. $\left(\frac{b^{4}c^{-2}}{2d^{-3}}\right)^{-1}$

$\left(\frac{b^{4} \; c^{-2}}{2 \; d^{-3}}\right)^{-1}$

$\left(\frac{2 \; b^{-4} \; c^{+2}}{2^{1} \; b^{4} \; d^{+3}}\right)$

$\frac{2c^{2}}{b^{4}d^{3}}$

d. $\left(\frac{5m^{-1}n^{-3}}{p^{2}}\right)^{-3}$ $\left(\frac{5^{1} \; m^{-1} \; n^{-3}}{p^{2}}\right)^{-3}$

$\left(\frac{5^{-3} \; m^{+3} \; n^{+9} \; p^{6}}{125 \; p^{6}}\right)$

$= \frac{m^{3}n^{9}p^{6}}{125}$

9. CONCEPT: "MIGRATION".

a. $7x^4\left(6x^{-9}\right)$

$42x^{-5}$

$= \frac{42}{x^5}$

b. $\frac{16r^3s^{-3}}{8rs^2}$

$\frac{2}{1}\cdot\frac{r^2}{r}\cdot\frac{1}{s^2s^3}$ $\quad \frac{2}{s^5}$

c. $\frac{2x^2y^5}{8x^7y^{-4}}$

$\frac{1}{4}\cdot\frac{x^2}{x^7}\cdot\frac{y^5y^4}{1}$ $\quad \frac{y^9}{4x^5}$

d. $\left(\frac{2}{3}\right)^{-2} = \left(\frac{2^{-2}}{3^{-2}}\right) = \frac{9}{4}$

*Square of Reciprocal

e. $\left(\frac{x^5}{y^7}\right)^{-4} = \left(\frac{x^{-20}}{y^{-28}}\right)$

$\frac{y^{28}}{x^{20}}$

f. $\left(\frac{x^2y^{-3}}{z^4}\right)^{-5}$ $\left(\frac{x^{10}y^{+15}z^{20}}{x^{10}z^{20}}\right)$

$\frac{y^{15}z^{20}}{x^{10}}$

g. $\left(\frac{2x^{-3}y^2z}{x^2}\right)^2$

$\frac{2^2}{1}\cdot\frac{x^{-6}}{x^4x^2}\cdot\frac{y^4}{1}\cdot\frac{z^2}{1}$

$\frac{4y^4z^2}{x^{10}}$

h. $\left(\frac{x^3y^{-4}z}{y^{-2}}\right)^{-6}$

$\left(\frac{x^{-18}}{x^{18}}\cdot\frac{y^{12}}{y^{+24}}\cdot\frac{z^{-6}}{z^6}\right)$

$\frac{y^{12}}{x^{18}z^6}$

Homework Section:

Section(2)	*Page(s)*	*Problem(s)*
5.1	289 → 291	11 → 131 EOO*
5.2	300 → 301	11 → 129 EOO*

*Every Other Odd