Secondary 2 Honors Quad Prep Day 3 Notes

Exploring Laws of Exponents

What does an exponent tell you about the number?

Product of Powers Property

Complete the table below.

Expression	E·X·P·A·N·D·E·D Form	Exponential Form
$3^2 \cdot 3^5$	$3\cdot3\cdot3\cdot3\cdot3\cdot3\cdot3$	3^7
$2 \cdot 2^6$	$2\cdot2\cdot2\cdot2\cdot2\cdot2\cdot2$	2^7
$b^5 \cdot b^8$	$b\cdot b\cdot b\cdot b\cdot b\cdot b\cdot b\cdot b\cdot b\cdot b\cdot b\cdot b\cdot b$	b^{13}

1. Look at the table above. Compare the first and third column. Describe, using words, the relationship that you see between them.

2. Use your observations from above to fill in a generalized form:

$$a^m \cdot a^n = a^{m+n}$$

$-4^2 \stackrel{?}{=} (-4)^2$

$-16 \neq +16$

3. The rule you discovered is called the "**product of powers**." Use it to simplify the expressions below.

a. $2^6 \cdot 2^8$

2^{6+8}

2^{14}

b. $(-7)^3 \cdot (-7)^1 \cdot (-7)^5$

$(-7)^{3+1+5}$

$(-7)^9$

c. $m^7 \cdot m^4 \cdot m^6$

m^{7+4+6}

m^{17}

Power of a Power Property

Complete the table below.

Expression	E·X·P·A·N·D·E·D Form	Exponential Form
$(5^2)^3$	$5^2 \cdot 5^2 \cdot 5^2$	5^6
$(8^5)^2$	$8^5 \cdot 8^5$	8^{10}
$(x^3)^4$	$x^3 \cdot x^3 \cdot x^3 \cdot x^3$	x^{12}

1. Look at the table above. Compare the first and third column. Describe, using words, the relationship that you see between them.

2. Use your observations from above to fill in a generalized form:

$$(a^m)^n = a^{m \cdot n}$$

3. The rule you discovered is called the "**power of a power**." Use it to simplify the expressions below.

a. $(7^4)^9$

$7^{4\cdot9}$

7^{36}

b. $(k^{17})^2$

$k^{17\cdot2}$

k^{34}

c. $(w^{100})^5$

$w^{100\cdot5}$

w^{500}

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Quotient of Powers Property

Complete the table below.

Expression	E·X·P·A·N·D·E·D Form	Exponential Form
$\frac{6^9}{6^4}$	$\frac{6\cdot6\cdot6\cdot6\cdot6\cdot6\cdot6\cdot6\cdot6}{6\cdot6\cdot6\cdot6}$ $1\cdot1\cdot1\cdot1\cdot6\cdot6\cdot6\cdot6\cdot6$	6^5
$\frac{100^5}{100^2}$	$\frac{100\cdot100\cdot100\cdot100\cdot100}{100\cdot100}$	100^3
$\frac{t^{15}}{t^8}$		t^7

1. Look at the table above. Compare the first and third column. Describe, using words, the relationship that you see between them.

2. Use your observations from above to fill in a generalized form:

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

3. The rule you discovered is called the "**quotient of powers**." Use it to simplify the expressions below.

a. $\frac{16^7}{16^3} = 16^{7-3} = 16^4$

b. $\frac{w^{25}}{w^{10}} = w^{25-10} = w^{15}$

c. $\frac{4^3\cdot4^7}{4^5} = \frac{4^{10}}{4^5} = 4^{10-5} = 4^5 = 256$

4. Using the Quotient of Powers Property what is $\frac{5^3}{5^3}$? $5^{3-3} = 5^0 = 1$

5. What do you get when you divide a number by itself (for instance $\frac{5^3}{5^3}$) ? 1

Zero Powers Property

Complete the table below.

Expression	E·X·P·A·N·D·E·D Form	Answer
5^4	$5\cdot5\cdot5\cdot5$	625 ÷5
5^3	$5\cdot5\cdot5$	125 ÷5
5^2	$5\cdot5$	25 ÷5
5^1	5	5 ÷5
5^0		1

1. Look at the table above. What is the pattern in the third column? Describe, using words, how that pattern helps you find 5^0?

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Expression	E·X·P·A·N·D·E·D Form	Answer
3^4		
3^3		
3^2		
3^1		
3^0		

1. Use your observations from above to fill in a generalized form:

$$a^0 = 1$$

2. The rule you discovered is called the "**zero power property**." Use it to simplify the expressions below.

a. $(x^1 \cdot x^2 \cdot x^9)^0$ $(x^{12})^0 = 1$ b. $\left(\frac{3^4}{3^0}\right)^2 = \left(\frac{3^4}{1}\right)^2 = (3^4)^2 = 3^8$ c. $(128{,}917{,}654^5)^0 = 1$

What is $\frac{x^3}{x^7}$ expanded? $\frac{x \cdot x \cdot x}{x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x} = \frac{1}{x^4}$

What is $\frac{x^3}{x^7}$ using the quotient of powers rule? $x^{3-7} = x^{-4}$

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

Negative Powers Property

Complete the table below.

Expression	E·X·P·A·N·D·E·D Form	Answer
4^2	$4 \cdot 4$	16
4^1	4	4
4^0		1
4^{-1}	$\frac{4^{-1}}{1} \rightarrow \frac{1}{4^1}$	$\frac{1}{4}$
4^{-2}	$\frac{4^{-2}}{1} \rightarrow \frac{1}{4 \cdot 4}$	$\frac{1}{16}$

1. In order to work up in exponents, you are increasing the number of times that you are _____ the number (or variable).
   If you are decreasing the exponent (the exponent is getting more negative) then you are _____ by the number (or variable).

2. Use your observations from above to fill in a generalized form:

$$\frac{a^{-m}}{1} = \frac{1}{a^m} \qquad \frac{1}{a^{-m}} = \frac{a^m}{1} = a^m$$

3. The rule you discovered is called the "**negative power property**." Use it to simplify the expressions below.

a. $\frac{y^{-5}}{1} = \frac{1}{y^5}$ b. $(x^2)^{-5} = x^{2 \cdot -5} = x^{-10} = \frac{1}{x^{10}}$ c. $\left(\frac{z^0}{z^2 \cdot z^4}\right)^{-2} = \left(\frac{1}{z^6}\right)^{-2} = \frac{1^{-2}}{z^{-12}} = \frac{z^{12}}{1} = z^{12}$

Secondary 2 Honors -- Quad Prep Unit

Day 3 Notes -- Properties of Exponents

Simplify. Your answer should only contain positive exponents.

1) $6^4 \cdot 6^6$

$= 6^{10}$

2) $(3^2 \cdot 3^2)^3$ $= (3^4)^3$

$= 3^{12}$

3) $n^2 \cdot 2n$ $= n^2 \cdot 2 \cdot n = 2 \cdot n^2 \cdot n$

$= 2n \cdot n^2$

$= 2n^3$

4) $m^3 \cdot 3m$ $= 3 \cdot m^3 \cdot m^1$

$= 3m^4$

5) $(2p^2)^3$ $= 2p^2 \cdot 2 \cdot p^2 \cdot 2 \cdot p^2$

$2^3 p^6$

$8p^6$

6) $(x^{-3})^{-2}$ $= x^{-3 \cdot -2}$

$= x^6$

7) $3x^0 \cdot (yx^{-2})^{-2}$

$3 \cdot y^{-2} \cdot x^4 = \frac{3x^4}{y^2}$

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

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

$2^3 \cdot a^9 b^{12}$ $= 8a^9b^{12}$

9) $\frac{6^{-4}}{6^{-6}}$ $= 6^{-4} \cdot 6^6$

$= 6^2$

$= 36$

10) $\frac{2^{-3}}{2^4}$ $= \frac{1}{2^4 2^3} = \frac{1}{2^7}$

11) $\frac{2n^{-2}}{n^{-3}}$ $= 2n^{-2}n^3$

$= 2n$

12) $\frac{3v}{2v}$ $= \frac{3}{2}$

13) $\frac{2v^3}{2v \cdot (3v^3)^2} = \frac{2v^3}{2v \cdot 3^2 \cdot v^6} = \frac{2v^3}{2 \cdot 3^2 v^7}$

$= \frac{1}{3^2 \cdot v^7 v^{-3}}$

$\frac{1}{9v^4}$

14) $\frac{(3x^3)^2 \cdot x^3}{x}$ $= \frac{3^2 x^6 \cdot x^3}{x}$

$= \frac{9x^9}{x}$ $= 9x^8$

15) $\frac{(3a^{-3})^2}{3a^0} = \frac{3^2 a^{-6}}{3a} = \frac{3}{a^1 a^6} = \frac{3}{a^7}$

16) $\frac{2a^2 \cdot b^{-3}}{(a^3 b^1)^3} = \frac{2a^2 b^{-3}}{a^9} = \frac{2}{a^7 b^3}$