8th Grade Math: ExPWN it! 3

Key

Powers and Products Raised to a Power

Wednesday, August $(3^3 + 2^2)$, 2016

AIMS:

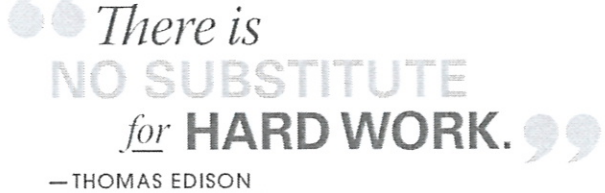
- ✓ SWBAT take powers of powers.
- ✓ SWBAT raise products to a power using the rule that each factor of the product is raised to that power.
- ✓ SWBAT write simplified, equivalent numeric, and symbolic expressions using this new knowledge of powers.

AGENDA:

I. Do Now (2 min)
II. Open/Do Now Review (3 min)
III. Class Notes: Powers and Products Raised to a Power
IV. Guided Practice
V. Independent Practice
'I. Class Notes: Products Raised to a Power
VII. Guided Practice
VIII. Independent Practice
IX. Sprint (IF TIME!)
X. Practicing our AIMS:
   - ✓ Exit Ticket (5 min)
   - ✓ Homework: ExPWN it! 3

XI. Close (2 min)

Will your choices help us STRIVE?



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AIM CHECK:

✓ How do you take the power of a power? What is the rule?

✓ When taking a product to a power, what happens to each factor?

8th Grade Math Powers and Products Raised to a Power	Name: Key #: Date: Homeroom: Cleveland State University KENTUCKY STATE UNIVERSITY	 ExPWN It! 3

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- ✓ SWBAT take powers of powers.
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DO NOW

Directions: Complete the following questions.

Let a, b be nonzero numbers. What is the following number?

$$\frac{\left(\frac{a}{b}\right)^9}{\left(\frac{a}{b}\right)^2} = \left(\frac{a}{b}\right)^7$$

Let x be a nonzero number. What is the following number?

$$\frac{x^5}{x^4} = x$$

$$6^5 \times 4^9 \times 4^3 \times 6^{14} = 6^{19}4^{12}$$

$$9^4 \times 9^6 \times 9^{13} = 9^{23}$$

Class Notes: Powers Raised to a Power

Directions: Board Equals Paper!

Discussion: What is a power raised to a power?

What is $(x^m)^n$? Is it x^{m+n}? Is it $x^{m \cdot n}$? Is it even able to be simplified?

$x^m \cdot x^m \cdot x^m$ (n times)

Recall and Remember

You can always use concrete numbers for x, m, and n to explore this.

$(3^2)^4 =$ $3 \cdot 3^2 \cdot 3^2 \cdot 3^2$ $= 3^{2+2+2+2}$ so this is the same as 3^8

$(3^3)^2 =$ $3^3 \cdot 3^3$ $= 3^{3+3}$ so this is the same as 3^6

Simplify the following expression by showing it in expanded form: $(5^3)^5$

$5^3 \cdot 5^3 \cdot 5^3 \cdot 5^3 \cdot 5^3$

$(5 \cdot 5 \cdot 5) \cdot (5 \cdot 5 \cdot 5) \cdot (5 \cdot 5 \cdot 5) \cdot (5 \cdot 5 \cdot 5) \cdot (5 \cdot 5 \cdot 5)$

5^{15}

For any number x and any positive integers m and n,

$$(x^m)^n = x^{nm}$$

because

$$(x^m)^n = \underbrace{(x \cdot x \cdots x)^n}_{m \text{ times}}$$

$$= \underbrace{\underbrace{(x \cdot x \cdots x)}_{m \text{ times}} \times \cdots \times \underbrace{(x \cdot x \cdots x)}_{m \text{ times}}}_{n \text{ times}}$$

$$= x^{nm}.$$

Guided Practice

Directions: Board=Paper!

1) Show the law of raising exponentials to a power is true by expanding the below expressions.

a) $(7^2)^6$

$7^2 \cdot 7^2 \cdot 7^2 \cdot 7^2 \cdot 7^2 \cdot 7^2$

7^{12}

b) $(1.3^3)^{10}$

$1.3^3 \cdot 1.3^3 \cdot 1.3^3 \cdot 1.3^3 \cdot 1.3^3 \cdot 1.3^3 \cdot 1.3^3 \cdot 1.3^3 \cdot 1.3^3 \cdot 1.3^3$

1.3^{30}

Discussion

Students have a **common misconception** when working with exponentials raised to a power: they add the powers rather than multiply! Explain, in your own words, why the powers are multiplied rather than added. Be ready to share out! Use the sentence starter "we multiply the exponent and the power it's raised to because…"

My Explanation	A Classmate's Excellent Explanation
	Ex: We multiply the exponent & power because we are repeatedly adding the exponent, which is multiplication.

Independent Practice

Directions: Complete every question below! Do your best! When done, you may work on the ADVANCED WORK ONLY (not homework ☺)

1) Rewrite the following expressions without parentheses

a) $(15^3)^9$

$(15)^{27}$

b) $(3.4^{17})^4$

$(3.4)^{68}$

$17 \times 4 = 68$

c) $((-2)^5)^8$

$(-2)^{13}$

d) $(s^{17})^4$

s^{68}

KEEP GOING!

2) Sarah wrote $(3^5)^8 = 3^{12}$. Correct her mistake. Write an exponential equation using a base of 3 and exponents of 5, 7, and 12 that would make her answer correct.

$(3^5)^8 = 3^{40}$ because we multiply the power & it's power.

$3^5 \times 3^8 = 3^{12}$.

3) A number y satisfies $y^{24} - 256 = 0$. You know that $x = y^4$. Replace y^{24} with it's equivalent x power.

$(y^4)^6 - 256 = 0$, so $4x\_ = 24$, so the exponent is 6. $x^6 - 256 = 0$

4) Simplify the following expression by showing it in expanded form: $(6^4)^5$

$6^4 \times 6^4 \times 6^4 \times 6^4 \times 6^4 = 6^{4+4+4+4+4} = 6^{20}$

Turn and Talk: Sums, Products, Quotients, Differences

Consider the four below questions. Which of the below are true? Which are not?

1) $(4 \times 2)^2 = 4^2 \times 2^2$

$8^2 = 64$ $\quad 4^2 \times 2^2$ $\quad 16 \times 4 = 64$ ✓

2) $\left(\frac{4}{2}\right)^2 = \frac{4^2}{2^2} \rightarrow$ $\frac{16}{4} = 4$ ✓

$2^2 = 4$

True Multiplication & division ones are true.

3) $(4 + 2)^2 = 4^2 + 2^2$

$6^2 = 36$ $\quad 16 + 4 = 20$ ✗

4) $(4 - 2)^2 = 4^2 - 2^2$

2^2 $\quad 16 - 4$

4 $\quad 12$ ✗

Class Notes: Products Raised to a Power

Directions: Board Equals Paper!

Show that $(5 \times 8)^{17}$ is equivalent to $5^{17} \times 8^{17}$ by expanding the expression.

$(5\times8)^{17} = \underbrace{(5\times8)\times(5\times8)\times\cdots\times(5\times8)}_{17\text{ times}} = \underbrace{5\times5\cdots\times5}_{17\text{ times}} \times \underbrace{8\times8\times\cdots\times8}_{17\text{ times}}$

$= 5^{17} \times 8^{17}$

Show that $\left(\frac{5}{8}\right)^{17}$ is equivalent to $\frac{5^{17}}{8^{17}}$ by expanding the expression.

$\underbrace{\frac{5}{8}\times\frac{5}{8}\times\cdots\times\frac{5}{8}}_{17\text{ times}} = \underbrace{5\times5\times\cdots\times5}_{17\text{ times}} \times \underbrace{\frac{1}{8}\times\frac{1}{8}\times\frac{1}{8}\times\cdots\times\frac{1}{8}}_{17\text{ times}} = \frac{5^{17}}{8^{17}}$

$$(xy)^n = x^n y^n$$

because

$$(xy)^n = \underbrace{(xy)\cdots(xy)}_{n \text{ times}}$$ By definition of raising a number to the n^{th} power

$$= \underbrace{(x\cdot x\cdots x)}_{n \text{ times}} \cdot \underbrace{(y\cdot y\cdots y)}_{n \text{ times}}$$ By commutative and associative properties

$$= x^n y^n$$ By definition of x^n

Similarly,

$$\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}$$

Because

$$\left(\frac{x}{y}\right)^n = \underbrace{\frac{x}{y}\times\cdots\times\frac{x}{y}}_{n \text{ times}}$$ ***By definition***

$$= \frac{\overbrace{x\cdot x\cdots x}^{n \text{ times}}}{\underbrace{y\cdot y\cdots y}_{n \text{ times}}}$$ ***By the product formula***

$$= \frac{x^n}{y^n}$$ ***By definition***

Guided Practice

Directions: Board=Paper!

1) Rewrite the below expressions without parentheses

a) $(2m)^4 =$

$2^4 m^4$

b) $\left(\frac{w^2}{k}\right)^5 =$

$\frac{w^{10}}{k^5}$

c) $(a^6b^3)^{14} =$

$14 \times 6 = 84$

$a^{6\cdot14}\ b^{14\cdot3} = a^{84}\ b^{42}$

d) $(54 \times 23)^9 =$

$54^9 \times 23^9$

Independent Practice

Directions: Complete every question below! Do your best! When done, you may work on the ADVANCED WORK ONLY (not homework ☺)

1) Rewrite the below expressions without parentheses

a) $(11 \times 4)^9 =$

$11^9 \times 4^9$

b) $(5x)^7 =$

$5^7 x^7$

c) $(3^2 7^4)^5 =$

$3^{10} 7^{20}$

d) $(5xy^2)^7 =$

$5^7 x^7 y^{14}$

e) Let a, b, and c be numbers.

$(3^2a^4)^5 = 3^{10}a^{20}$

f) Let a, b, and c be numbers.

$(a^2bc^3)^4 = a^8b^4c^{12}$

KEEP GOING!

g) $\left(\frac{4}{13}\right)^{43} =$ $\frac{4^{43}}{13^{43}}$

h) Let a, b, and c be numbers, where $b, c \neq 0$

$\left(\frac{a^2}{b^5 c}\right)^{43} =$ $\frac{a^{86}}{b^{215} c^{43}}$

$43 \times 5 = 215$

2) Write the following **with** parentheses.

a) Let b and f be numbers, where $f \neq 0$

$\frac{b^4}{f^4} =$ $\left(\frac{b}{f}\right)^4$

b) $5^3 \times 43^3 \times 6.1^9$

$(5 \times 43 \times 6.1^3)^3$

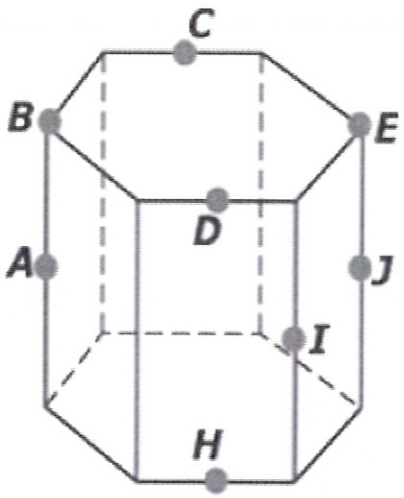
8th Grade Math Advanced Work (Due 9/1/16)

Directions: Complete this for dollars! Turn in advanced work with your homework.

Name:_____ #:_____ HR:_____

1)

A hexagonal prism is shown.



Select the shape that is formed by each cross section.

	Hexagon	Rectangle
Cross section through points *C*, *D*, and *H*	☐	☐
Cross section through points *A*, *I*, and *J*	☐	☐
Cross section through points *A*, *B*, *E*, and *J*	☐	☐

2)

The table shows the number of songs and the length of each music playlist on an MP3 player. Each song is the same length.

Number of Songs	Length of Playlist (minutes)
4	16
9	36
16	64

How long, in minutes, is each song on the playlists?

Name and Number: _____

Date: _____

Class: _____

Is this a re-submit?_____

HOMEWORK
8th Grade Math

ExPWN it! 3
Powers and Products Raised to a Power

Ms. Huber
614-859-0019
Mshubersmath.weebly.com

_____/ 5 = _____% DNG
A B C D F

STRIVE Due Date:	Accepted Until:
9/1/16	9/8/16

Directions: Complete all of the below problems (FRONT AND BACK). If you have questions, first check the examples in your packet. Then, check the class website or ask a classmate or guardian for help. Then, you can call your teacher if you still have questions.

1) Simplify the following expression by showing it in expanded form: $(3 \times 4 \times 7)^3$

2) Simplify the following expression by showing it in expanded form: $(xyz)^4$

3) Simplify the following expression by showing it in expanded form: $\left(\frac{d^2}{3}\right)^4$

FLIP OVER!

Review! Directions: Choose the correct answer choice for each question.

4) $8^4 \cdot 8^7$

Ⓐ 8^3
Ⓑ 8^{28}
Ⓒ 8^{11}
Ⓓ 64^{11}

5) $p^4 \cdot p^6$

Ⓐ p^2
Ⓑ p^{24}
Ⓒ p^{10}
Ⓓ $2p^{24}$

6) $6^4 \cdot 6^8$

Ⓐ 6^{48}
Ⓑ 6^4
Ⓒ 36^{48}
Ⓓ 6^{12}

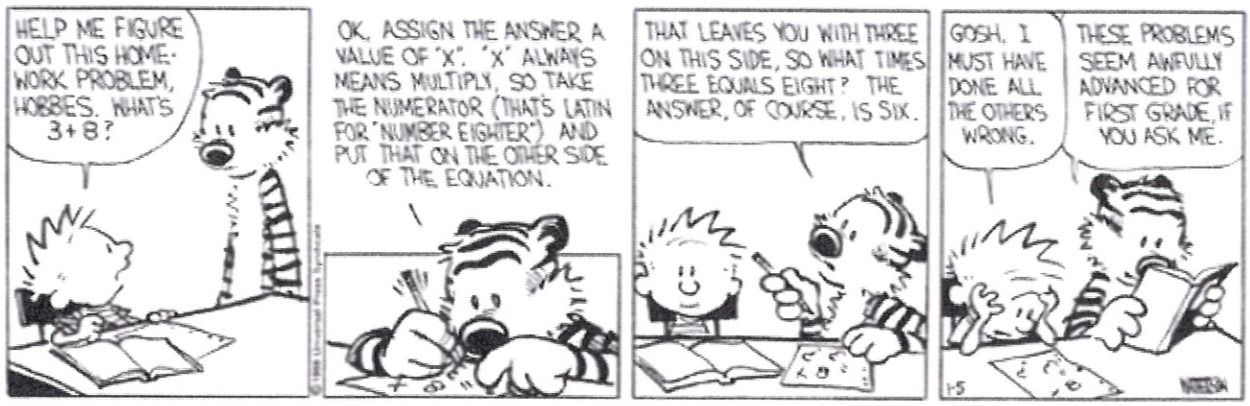
7) $\dfrac{13^{10}}{13^3}$

Ⓐ 13^{13}
Ⓑ 13^7
Ⓒ 13^3
Ⓓ 7

8) If *n and m* are positive integers , then $x^n x^m$ = _____.

Ⓐ $n^x m^x$
Ⓑ x^{m+n}
Ⓒ there is no answer
Ⓓ $2x$

9) Read this Calvin and Hobbes strip, just for fun!



Name and Number: _____		**Exit Ticket** **8th Grade Math** **ExPWN it! 3** Powers and Products Raised to a Power	**Ms. Huber**	
Date: _____ Class: _____			_____/ 5 = _____% DNG A B C D F	

Directions: Complete all of the below problems. Do not use notes. This is an independent task, so you may not get help from your teacher either. Try your best! Work on Advanced work when done.

Write each expression as a base raised to a power or as the product of bases raised to powers that is equivalent to the given expression.

1) $(9^3)^6 =$

2) $(113^2 \times 37 \times 51^4)^3 =$

3) Let x, y, z be numbers. $(x^2yz^4)^3 =$

4) Let x, y, z be numbers and let m, n, p, q be positive integers. $(x^m y^n z^p)^q =$

Reflect on your **understanding** of **TODAY'S LESSON**, and circle the most true statement			
I don't get it at all	I just need some help	I understand	I could teach it!
Reflect on your **effort** in **TODAY'S CLASS**, and circle the most true statement			
I wasn't working hard today	I was trying but off-task a little	I was on task	I was laser-focused on learning

SPRINT! (IF TIME!)

Directions: On a sprint, we practice our math facts for one minute. Then, we STOP, even if we're not done, so we can track our progress!

$1^3 =$ _____	$2^3 =$ _____
$15^2 =$ _____	$5^3 =$ _____
$0^3 =$ _____	$5^3 =$ _____
$11^2 =$ _____	$7^2 =$ _____
$4^3 =$ _____	$11^2 =$ _____
$2^3 =$ _____	$8^2 =$ _____
$14^2 =$ _____	$4^3 =$ _____
$15^2 =$ _____	$0^3 =$ _____