NAME:_____ Math ____, Period_____

Mr. Rogove Date:_____

LEARNING OBJECTIVE: We will take powers of powers and raise products to powers. (G8M1L3)

CONCEPT DEVELOPMENT:

Taking Powers of Powers

$(x^6)^4$ BASE x^6

$x^6 \cdot x^6 \cdot x^6 \cdot x^6$ (4 times)

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

Examples:

$(3^2)^3 = 3^2 \cdot 3^2 \cdot 3^2 = 3^{2 \cdot 3}$ $((-4)^3)^4 = (-4)^3 \cdot (-4)^3 \cdot (-4)^3 \cdot (-4)^3 = (-4)^{3 \cdot 4}$

Raising Products to Powers

Base = $6a$ $(6a)^4 = 6^4 a^4$

$6a \cdot 6a \cdot 6a \cdot 6a$

$6 \cdot a \cdot 6 \cdot a \cdot 6 \cdot a \cdot 6 \cdot a$

$\underbrace{6 \cdot 6 \cdot 6 \cdot 6}_{4} \cdot \underbrace{a \cdot a \cdot a \cdot a}_{4}$ $6^4 a^4$

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

Examples

$(12 \cdot 2)^3 = 12^3 \cdot 2^3$ $(3z)^8 = 3^8 \cdot z^8$

Raising Quotients to Powers

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

Examples:

$\left(\frac{3}{2}\right)^4 = \frac{3^4}{2^4}$

$\frac{3}{2} \cdot \frac{3}{2} \cdot \frac{3}{2} \cdot \frac{3}{2} = \frac{3 \cdot 3 \cdot 3 \cdot 3}{2 \cdot 2 \cdot 2 \cdot 2} = \frac{3^4}{2^4}$

$\left(\frac{2x}{5}\right)^6 = \frac{(2x)^6}{5^6}$

NAME:_____ Math ____, Period_____

Mr. Rogove Date:_____

GUIDED PRACTICE:

Steps for Evaluating Powers of Powers
1. Raise each factor to the power outside of the parentheses.
2. Multiply the exponents for each factor.

BASE: 11^6 $(11^6)^9$ $11^{6\cdot9} = 11^{54}$ $\underbrace{11^6\times11^6\times\dots\times11^6}_{9\text{ times}}$	BASE : 5^4 $(5^4)^7$ $5^{4\cdot7}$ 5^{28}
BASE: $-7abc$ $(-7^1a^1b^1c^1)^5$ $-7abc\cdot-7abc\cdot-7abc\cdot-7abc\cdot-7abc$ $-7^5a^5b^5c^5$	$(4xy)^3$ $4xy\cdot4xy\cdot4xy$ $4^3x^3y^3$
BASE: $3s\cdot12t$ $(3s\cdot12t)^3$ $36st$ $(36st)^3$ $36^3s^3t^3$	BASE: $20x$ $(4\cdot5x)^3$ $(20x)^3$ 20^3x^3
BASE: $3ab^3c^7$ $(3ab^3c^7)^8$ $\underbrace{3ab^3c^7\cdot3ab^3c^7\cdot\dots\cdot3ab^3c^7}_{8}$ $3^8a^8(b^3)^8(c^7)^8$ $3^8a^8b^{24}c^{56}$	BASE $13x^4y^3z^2$ $(13x^4y^3z^2)^5$ $13^5x^{20}y^{15}z^{10}$

Steps for Evaluating Powers of Quotients
1. Raise the numerator and denominator to the power.
2. Simplify if possible.

$\frac{9}{16} = \left(\frac{3}{4}\right)^2$

$\left(\left(\frac{3}{4}\right)^2\right)^2$

$\left(\frac{3}{4}\right)^4 = \frac{3^4}{4^4} = \frac{81}{256}$	$\left(\frac{9}{16}\right)^2$ $\frac{9^2}{16^2} = \frac{81}{256}$
$\left(\frac{3x^2}{7y}\right)^3 = \frac{3^3x^6}{7^3y^3}$	$\left(\frac{2s^6}{13t^3}\right)^2$ $\frac{2^2s^{12}}{13^2t^6}$

NAME:_____ Math ____, Period_____

Mr. Rogove Date:_____

INDEPENDENT PRACTICE: Simplify

$(3x^3)^4$	$\left(\frac{6}{7}\right)^4$
$(q^3r)^4$	$(10h^7)^3$
$(2x \cdot y^5)^4$	$\left(\frac{2a^4b^5}{ab^4}\right)^3$
Challenge: $(12x^2y^3)^2(2x^3y^{13})^3$	Solve for *x*. $(5^8)^{3x} = 5^{48}$
Challenge: $\frac{5y^3}{(5y)^3}$	$\left(\frac{(-3)^2}{(-2)^4}\right)^2$

NAME:_____ Math ____, Period_____

Mr. Rogove Date:_____

Activating Prior Knowledge:

We know how to multiply exponents with the same base

$5^3 \cdot 5^4$	$(2x)^6 \cdot (2x)^5$

Closure:

1. Simplify: $(x^m y^n z^p)^q$

Teacher Notes:

Students are ready to complete the In the Cloud activity after this lesson.

Have students log on to Khan and complete the "positive exponents with positive and negative bases"

Homework: Problem #1192 from Math Forum.