

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**

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

$$(6^7)^8 = 6^{56}$$

$$(1738^{17})^{38}$$

*Examples:*

$$(21^7)^{20} = 21^{140}$$

$$(17^{21})^{13} = 17^{21 \cdot 13}$$

$$(3^2)^3 = \boxed{3^2 \cdot 3^2 \cdot 3^2} = 3^{2 \cdot 3}$$

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

**Raising Products to Powers**

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

*Examples*

$$(12 \cdot 2)^3 = 12^3 \cdot 2^3$$
  
$$24^3 = \underbrace{24 \cdot 24 \cdot 24}_{12 \cdot 2 \cdot 12 \cdot 2 \cdot 12 \cdot 2} = 12^3 \cdot 2^3$$

$$(3z)^8 = 3^8 \cdot z^8$$
  
$$\underbrace{3z \cdot 3z \cdot \dots \cdot 3z}_{8 \text{ times}}$$

$$(3a^4)^3 = 3^3 \cdot a^{4 \cdot 3}$$
  
a  $9a^{12}$   
b  $27a^7$   
c  $27a^{12}$

**Raising Quotients to Powers**

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

*Examples:*

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

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

$$\frac{2^6 x^6}{5^6}$$

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**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.

$\frac{(11^6)^9}{11^{54}}$	$\frac{(5^4)^7}{5^{28}}$
$\frac{(-7abc)^5}{(-7)^5 a^5 b^5 c^5}$ <p><i>Handwritten: -7abc · -7abc · -7abc (5 times)</i></p>	$\frac{(4xy)^3}{64x^3y^3}$
$\frac{(3s \cdot 12t)^3}{27s^3 \cdot 12^3 t^3}$ <p><i>Handwritten: 36^3 s^3 t^3</i></p>	$\frac{(4 \cdot 5x)^3}{(4 \cdot 5x)^3}$
$(3ab^3c^7)^8$	<del> <math display="block">\frac{(13x^4y^3z^2)^5}{13^5 x^{20} y^{15} z^{10}}</math> </del>

**Steps for Evaluating Powers of Quotients**

1. Raise the numerator and denominator to the power.
2. Simplify if possible.

$\frac{\left(\frac{3}{4}\right)^4}{25b}$ <p><i>Handwritten: 81 / 25b</i></p>	$\frac{81}{256} \left(\frac{9}{16}\right)^2$
$\left(\frac{3x^2}{7y}\right)^3$	$\frac{4s^{12}}{169t^6} \left(\frac{2s^6}{13t^3}\right)^2$

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**INDEPENDENT PRACTICE: Simplify**

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

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**ACTIVATING PRIOR KNOWLEDGE:**

We know how to multiply exponents with the same base

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

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

$$x^{mq} y^{nq} z^{pq}$$

**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.