Section 3.3a – Exponent Laws

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Part 1: Exponent Laws Investigation

Product of Powers Rule: Complete the following table

Product	Expanded Form	Single Power
$3^2 \cdot 3^4$	(3 x 3) x (3 x 3 x 3 x 3) = 3 x 3 x 3 x 3 x 3 x 3	3^6
$4^3 \cdot 4^3$		
$2^3 \cdot 2^4 \cdot 2^2$		
$k^3 \cdot k^5$		
create your own example		

Describe any trends you see:

Quotient of Powers Rule: Complete the following table

Quotient	Expanded Form	Single Power
$5^5 \div 5^3$	$\frac{5 \times 5 \times 5 \times 5 \times 5}{5 \times 5 \times 5}$	5^2
$7^4 \div 7^1$		
$10^6 \div 10^4$		
$x^8 \div x^5$		
create your own example		

Describe any trends you see:

Power of a Power Rule: Complete the following table

Power of a Power	Expanded Form	Single Power
$(2^2)^3$	$(2^2) \times (2^2) \times (2^2)$ $= (2 \times 2) \times (2 \times 2) \times (2 \times 2)$ $= 2 \times 2 \times 2 \times 2 \times 2 \times 2$	2^6
$(5^3)^4$		
$(10^4)^2$		
Create your own example		

Describe any trends you see:

Summary of Exponent Laws:

Product Rule	$x^a \cdot x^b =$
Quoutient Rule	$x^a \div x^b =$
Power of a Power Rule	$(x^a)^b =$
Zero Exponent Rule	$x^0 =$

Part 2: Summary of Exponent Laws

Product of Powers Rule

When multiplying powers with the **same base,** keep the same _____and _____ the exponents.

General Rule:

$$x^a \cdot x^b =$$

Quotient of Powers Rule

When dividing powers with the **same base,** keep the same _____and _____ the exponents.

General Rule:

$$x^a \div x^b =$$

Power of a Power Rule

A power of a power can be written as a single power by _____ the exponents.

General Rule:

$$(x^a)^b =$$

Power of a Quotient

When you have a single power with a rational base, you can evaluate it by applying the exponent to the _____ and the _____.

Rule:

$$\left(\frac{a}{b}\right)^x =$$

Power of a Product

When you have a single power with a base that is a product, the exponent gets put on to each _____ in the brackets. Please notice that this only works when inside the brackets is a single term (no + or – signs separating terms)

Rule:

$(ab)^x =$

$$x^a \cdot x^b = x^{a+b}$$

Part 3: Apply the Product Rule

Write each product as a single power. Then, evaluate the power where possible.

1) $3^2 \times 3^3$

2) $5^2 \times 5 \times 5^2$

3) $(x^2)(x^7)$

4) $(a^4)(a^4)(a^5)$

5) $(-2)^4 \times (-2)^3$

6) $\left(\frac{1}{2}\right)^3 \times \left(\frac{1}{2}\right)^2$

Part 4: Apply the Quotient Rule

$$x^a \div x^b = x^{a-b}$$

Write each quotient as a single power. Then, evaluate the power where possible.

7) $8^7 \div 8^5$

8) $4^7 \div 4 \div 4^3$

9) $x^{70} \div x^{40} \div x^{29}$

10) $\frac{x^7}{x^3}$

11) $\frac{(-0.5)^6}{(-0.5)^3}$

12) $\frac{\left(\frac{3}{4}\right)^3 \times \left(\frac{3}{4}\right)^2}{\left(\frac{3}{4}\right)^5}$

13) $\frac{a^5 a^2}{a^6 a^1}$

Note: An exponent of zero always gives the answer of _____

Part 5: Apply the Power of a Power Rule

$$(x^a)^b = x^{a \times b}$$

Write each power of a power as a single power. Then, evaluate the power where possible.

14) $(3^2)^4$

15) $[(-2)^3]^4$

16) $\left[\left(\frac{2}{3}\right)^2\right]^2$

17) $(3ab^7)^2$

Note: *for #16 you will need the power of a quotient rule and #17 you will need the power of a product rule.*

Product of Powers Rule	$x^a \cdot x^b = x^{a+b}$
Quotient of Powers Rule	$x^a \div x^b = x^{a-b}$
Power of a Power Rule	$(x^a)^b = x^{a \times b}$
Power of a Quotient	$\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$
Power of a Product	$(ab)^x = a^x \cdot b^x$
Zero Exponent Rule	$x^0 = 1$
Negative Exponent Rule	$x^{-a} = \frac{1}{x^a}$