

Day 4: Exponent Rules I

Investigation: Exponent Rules

Complete the following table, using what you know about exponents and the example provided.

Question	Repeated Multiplication	Answer in Exponential Form	Exponent of Answer	Exponents in Original Question
Multiplication Rule				
$2^3 \times 2^5$	$\underbrace{2 \times 2 \times 2}_{2^3} \times \underbrace{2 \times 2 \times 2 \times 2 \times 2}_{2^5}$	2^8	8	3, 5
$5^5 \times 5^5$	$5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$	5^{10}	10	5, 5
$x^3 \times x^2$	$x \cdot x \cdot x \cdot x \cdot x$	x^5	5	3, 2
$\left(\frac{3}{4}\right)^2 \times \left(\frac{3}{4}\right)^5$	$\left(\frac{3}{4}\right)\left(\frac{3}{4}\right)\left(\frac{3}{4}\right)\left(\frac{3}{4}\right)\left(\frac{3}{4}\right)\left(\frac{3}{4}\right)\left(\frac{3}{4}\right)$	$\left(\frac{3}{4}\right)^7$	7	2, 5
Compare the exponents in the answer and in the original question. To multiply powers, you <u>ADD</u> the exponents, if the base is the same.				
Division Rule				
$\frac{10^5}{10^3}$	$\frac{10 \times 10 \times 10 \times 10 \times 10}{10 \times 10 \times 10}$	10^2	2	5, 3
$\frac{7^8}{7^5}$	$\frac{\cancel{7} \times \cancel{7} \times \cancel{7} \times \cancel{7} \times \cancel{7} \times \cancel{7} \times 7 \times 7}{7 \times 7 \times 7 \times 7 \times 7}$	7^3	3	8, 5
$\frac{x^6}{x^5}$	$\frac{\cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot x}{\cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x}}$	x^1	1	6, 5
Compare the exponents in the answer and in the original question. To divide powers, you <u>SUBTRACT</u> the exponents, if the base is the same. $\frac{x^6}{x^5} = x^{6-5} = x^1$				

TAKE-AWAY

Lesson: Multiplication and Division Exponent Rules

like exponents

Example 1:
 $= 2^2 \times 2^5$
 $= 2^{2+5}$
 $= 2^7$

Example 2:
 $= y^{11} \div y^7$
 $= y^{11-7}$
 $= y^4$

Example 3:
 $= \frac{(-2)^3 (8)^5 (-2)^8 (8)^1}{(-2)^4 (8)^3}$
 $= \frac{(-2)^{3+8} (8)^{5+1}}{(-2)^4 (8)^3}$
 $= \frac{(-2)^{11} (8)^6}{(-2)^4 (8)^3}$
 $= (-2)^{11-4} \cdot (8)^{6-3}$
 $= (-2)^7 \cdot (8)^3$
 $= -65536$

Example 4:
 $\frac{(-2)^8 \cdot (-2)^{-1} \cdot (-3)^2}{(-2)^2 \cdot (-3)^{-1}} = \frac{(-2)^{8-1} \cdot (-3)^2}{(-2)^2 \cdot (-3)^{-1}}$
 $= \frac{(-2)^7 \cdot (-3)^2}{(-2)^2 \cdot (-3)^{-1}}$
 $= (-2)^{7-2} \cdot (-3)^{2-(-1)}$
 $= (-2)^5 \cdot (-3)^{2+1}$
 $= (-2)^5 \cdot (-3)^3$

Day 4: Exponent Rules I

Investigation: Exponent Rule III

none #7 ✓

Complete the following table, using what you know about exponents, the multiplication rule, and the example provided.

Power of a Power Rule				
$(2^3)^4$	$2^3 \times 2^3 \times 2^3 \times 2^3$	2^{12} (from multiplication rule)	12	3, 4
$(3^6)^2$	$3^6 \times 3^6$	$3^{6+6} = 3^{12}$	12	6, 2
$(x^5)^3$	$x^5 \cdot x^5 \cdot x^5$	$x^{5+5+5} = x^{15}$	15	5, 3

Compare the exponents in the answer and in the original question.
To raise a power to a power, you MULTIPLY the exponents, if the base is the same.

★ KEEP THE BASE, MULTIPLY THE POWERS

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Lesson: Power of a Power Exponent Rule

Example 1:

★ $(x^4)^5$
 $= x^{4 \times 5}$
 $= x^{20}$

Example 2:

$(2^3)^2$
 $= 2^{3 \times 2}$
 $= 2^6 = \underline{\underline{64}}$

Example 3:

★ $(x^5 y)^2 = (x^5 y)(x^5 y)$
 $= x^{5+5} \cdot y^{1+1}$
 $= x^{10} \cdot y^2$
 (OR)

METHOD 1

METHOD 2 } Multiply each exponent by 2
 $= x^{5 \times 2} \cdot y^{1 \times 2}$
 $= x^{10} \cdot y^2$

Example 4:

$(xy^2)^2 = (xy^2)(xy^2)$
 $= \underline{\underline{x^2 y^4}}$

Day 4: Exponent Rules I

Practice: Exponent Rules

Simplify, but do not evaluate

<p>a. $8^3 \times 8^6$ $= 8^{3+6}$ $= 8^9$</p>	<p>b. $y^3 \times y^4 \times y$ $= y^{3+4+1}$ $= y^8$</p>	<p>c. $(-6)^2 \times (-6)^4$ $= (-6)^{2+4}$ $= (-6)^6$</p>	<p>d. $2^3 \times 4^2 \times 4 \times 2^5$ $= 2^{3+5} \times 4^{2+1}$ $= 2^8 \times (4^3)$ $= 2^8 \times (2^2)^3$ $= 2^8 \times 2^6 = \boxed{2^{14}}$</p>
<p>e. $5^3 \div 5^2 \times 5^8$ $= 5^{3-2} \times 5^8$ $= 5^1 \times 5^8$ $= 5^{1+8}$ $= 5^9$ <u> </u></p>	<p>f. $8^4 \times 8^3 \div 8^5$ $= 8^{4+3} \div 8^5$ $= 8^7 \div 8^5$ $= 8^{7-5}$ $= \boxed{8^2}$</p>	<p>g. $\left(\frac{3}{2}\right)^2 \times \left(\frac{3}{2}\right)^5$ $= \left(\frac{3}{2}\right)^{2+5}$ $= \left(\frac{3}{2}\right)^7$</p>	<p>h. $\frac{2^2 \times 3^2 \times 2^4 \times 3}{2^5 \times 3}$ $= \frac{2^{2+4} \times 3^{2+1}}{2^5 \times 3}$ $= \frac{2^6 \times 3^3}{2^5 \times 3}$ $= 2^{6-5} \times 3^{3-1} = 2 \times 3^2$</p>
<p>i. $(5^2)^3$ $= (5^2)(5^2)(5^2)$ $= 5^{2+2+2}$ $= 5^6$</p>	<p>j. $(a^3b)^2$ $= a^{3 \times 2} \cdot b^{1 \times 2}$ $= a^6 b^2$</p>	<p>k. $\frac{a^3 b^6}{ab^2} = a^{3-1} \cdot b^{6-2}$ $= a^2 \cdot b^4$</p>	<p>l. $(m^2 n)^2 = m^{2 \times 2} \cdot n^{1 \times 2}$ $= m^4 n^2$</p>

Find the missing exponent:

<p>m. $10^6 \times 10^x = 10^{10}$ $6+x = 10$ $x = 10-6$ $x = 4$</p>	<p>n. $\frac{5^x}{5^3} = 5^2$ $5^{x-3} = 5^2$ $x-3 = 2$ $x = 2+3$ $x = 5$</p>	<p>o. $3^x \times 3^3 = 3^7$ $3^{x+3} = 3^7$ $x+3 = 7$ $x = 7-3$ $x = 4$</p>	<p>p. $\frac{(-2)^8}{(-2)^x} = (-2)$ $(-2)^{8-x} = (-2)^1$ $8-x = 1$ $-x = 1-8$ $-x = -7$ $x = 7$</p>
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ANSWERS: a) 8^9 , b) y^8 , c) $(-6)^6$, d) $2^8 \times 4^3$, e) 5^9 , f) 8^2 , g) $(3/2)^7$, h) 2×3^2 , i) 5^6 , j) $a^6 b^2$, k) $a^2 b^4$, l) $m^4 n^2$, m) $x = 4$, n) $x = 5$, o) $x = 4$, p) $x = 7$