Worksheet 6-1: Powers and Exponent Rules

Exponent Review:

2^4 is a power, where **2** is the base of the power
and **4** is the exponent of the power

Exponential Form → $2^4 = 2 \times 2 \times 2 \times 2$ ← Expanded Product Form
$= 16$ ← Standard Form

1×2^4

1×2^0

Investigation 1: Multiplying Powers with the Same Base

Product	Expanded Form	Number of Factors	Single Power
$5^2 \times 5^4$	$(5\times5)\times(5\times5\times5\times5)$	6	5^6
$3^5 \times 3^2$	$(3\times3\times3\times3\times3)\times(3\times3)$	7	3^7
$(-2)^5 \times (-2)^3$	$(-2\times-2\times-2\times-2\times-2)\times(-2\times-2\times-2)$	8	$(-2)^8$
$\left(\frac{1}{2}\right)^5 \times \left(\frac{1}{2}\right)^1$	$\left(\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\right)\times\left(\frac{1}{2}\right)$	6	$\left(\frac{1}{2}\right)^6$

Exponent Rule 1: $(x^m)(x^n) = x^{m+n}$

Investigation 2: Dividing Powers with the Same Base

Quotient	Expanded Form	Number of Factors	Single Power
$\frac{5^6}{5^2}$	$\frac{5\times5\times5\times5\times5\times5}{5\times5}$	4	5^4
$\frac{3^5}{3^3}$	$\frac{3\times3\times3\times3\times3}{3\times3\times3}$	2	3^2
$(-7)^4 \div (-7)$	$\frac{-7\times-7\times-7\times-7}{-7}$	3	$(-7)^3$
$\left(\frac{2}{3}\right)^4 \div \left(\frac{2}{3}\right)^3$	$\frac{\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)}{\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)}$	1	$\left(\frac{2}{3}\right)$

Exponent Rule 2: $x^m \div x^n = x^{m-n}$

Investigation 3: Power of a Power

Power	Expanded Form	Number of Factors	Single Power
$(5^3)^2$	$(5^3)\times(5^3)=(5\times5\times5)\times(5\times5\times5)$	6	5^6
$(3^2)^4$	$(3^2)(3^2)(3^2)(3^2)=(3\times3)(3\times3)(3\times3)(3\times3)$	8	3^8
$((-7)^2)^3$	$(-7)^2\times(-7)^2\times(-7)^2=(-7\times-7)(-7\times-7)(-7\times-7)$	6	$(-7)^6$
$\left(\left(\frac{1}{2}\right)^4\right)^3$	$\left(\frac{1}{2}\right)^4\left(\frac{1}{2}\right)^4\left(\frac{1}{2}\right)^4=\left(\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\right)\left(\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\right)\left(\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\right)$	12	$\left(\frac{1}{2}\right)^{12}$

y^x x^y $\wedge$

Exponent Rule 3: $(x^m)^n = x^{mn}$

1st 2nd

Practice:

1. **Write each expression as a single power, then evaluate.** You need a scientific calculator!

(a) $6^2\times6^3$
$=6^{2+3}$
$=6^5$
$=7776$

(b) $\frac{(-7)^6}{(-7)^4}$
$=(-7)^{6-4}$
$=(-7)^2$
$=49$

(c) $(3^4)^3$
$=3^{4\times3}$
$=3^{12}$
$=531441$

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

2. **Simplify each expression as a single power.**

(a) $\frac{3^2\times3^4}{3^3}$
$=3^{2+4-3}$
$=3^3$
$=\frac{3^{2+4}}{3^3}$
$=\frac{3^6}{3^3}$
$=3^{6-3}=3^3$

(b) $\frac{5^6\times5^7}{(5^3)^3}$
$=5^{(6+7)-(3\times3)}$
$=5^{13-9}=5^4$
$=\frac{5^{6+7}}{5^{3\times3}}$
$=\frac{5^{13}}{5^9}$
$=5^{13-9}=5^4$

(c) $\frac{(2^3)^5}{(2^4)^2}$
$=2^{3\times5-4\times2}$
$=2^7$
$=\frac{2^{3\times5}}{2^{4\times2}}$
$=\frac{2^{15}}{2^8}$
$=2^{15-8}=2^7$

(d) $\left(\left(\frac{1}{3}\right)^2\right)^3$
$=\left(\frac{1}{3}\right)^{2\times3}$
$=\left(\frac{1}{3}\right)^6$

3. **Evaluate 81^3 and 9^6. Use the exponent rule to explain why the answers are the same.**

$81^3=531441 \rightarrow (9^2)^3=9^6$
$9^6=531441$

81^3 can be written as a power of power $(9^2)^3$. Using the multiplying rule for a power of power, $81^3=(9^2)^3=9^6$.

7. Use the exponent rules to simplify each algebraic expression.

a) $(s^3)^4$

b) $(\pi r^2)^3$

c) $(2x^2y^3)(3xy^4)$

d) $\dfrac{45x^7y^4}{9xy^3}$

e) $\dfrac{(4x^4y^5)^2}{8xy^8}$

$= \dfrac{(4)^2(x^4)^2(y^5)^2}{8xy^8}$

$= \dfrac{16x^8y^{10}}{8xy^8}$

$= 2x^7y^2$

13. a) Determine two positive integers x and y such that $8^x = 4^y$. $x=2$ $y=3$ $(8^2=64)=(4^3=64)$

b) Are these the only values of x and y that will work? If so, explain why. If not, find another set of values that will work.

yes

$8^4 = 4096$ $4^6 = 4096$

Power of a Power

$8^6 =$ $4^9 =$

$\therefore$