Worksheet 5-1: 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 → $2^4 = 2\times2\times2\times2$ ← Product Form (Expanded form)
$= 16$ ← Standard Form (Evaluated form)

exponent 4, base 2

Investigation 1: Multiplying Powers with the Same Base

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

Fraction means division

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
$(-7)^4\div(-7)^1$	$\frac{(-7)(-7)(-7)(-7)}{(-7)}$	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	$\left(\frac{2}{3}\right)^1 = \frac{2}{3}$

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

$-7^2 \neq (-7)^2$

$-49 \neq 49$

Investigation 3: Power of a Power Base is 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
$((-7)^2)^3$	$[(-7)^2][(-7)^2][(-7)^2]=(-7\times-7)(-7\times-7)(-7\times-7)$	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	$\left(\frac{1}{2}\right)^{12}$

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

x^y y^x $\wedge$ $x^{\square}$

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) $\left(\frac{1}{2^3}\right)^2$
$=\left(\frac{1}{8}\right)^2$
$=\frac{1}{64}$

$\frac{1^2}{8^2}$

2. **Evaluate** $\left(\frac{1}{81}\right)^3$ **and** $\left(\frac{1}{9}\right)^6$**. Use the exponent rule to explain why the answers are the same.**

$\left(\frac{1}{81}\right)^3=\frac{1^3}{81^3}=\frac{1}{531441}$
$\left(\frac{1}{9}\right)^6=\frac{1^6}{9^6}=\frac{1}{531441}$

$\because 9^2=81$
$\left(\frac{1}{81}\right)^3=\left(\frac{1}{9^2}\right)^3=\left(\frac{1^2}{9^2}\right)^3=\left(\left(\frac{1}{9}\right)^2\right)^3$
$=\left(\frac{1}{9}\right)^6$

3. **Mac evaluated the problem** $2^3\times2^2$**. His solution is** 2^6**. Is his solution correct? If not, explain where he went wrong and correct his work.**

No, he is not correct. He multiplied 2 and 3 instead of adding them when he is supposed to be multiplying powers with the same base.

P.361 $3^8 = 3^4 \times 3^4 = 3^3 \times 3^5 = 3^1 \times 3^7$

9. You can write 3^8 as $3^2 \times 3^6$ using the exponent rules. $\Rightarrow 3 \times 3^7$

a) Write 3^8 as the product of two powers in three other ways.

b) Write 2^5 as the quotient of two powers in three ways.

c) Write 7^{12} as a power of a power in three ways.

(a) $3^8 = 3^4 \times 3^4$ Product (Multiply)

$= 3^3 \times 3^5$

$= 3^1 \times 3^7$

(b) $2^5 = 2^7 \div 2^2$ Quotient (Divide)

$= 2^{10} \div 2^5$

$= 2^6 \div 2^1$

(c) $7^{12} = (7^3)^4$ $(7^{-3})^{-4}$

$= (7^2)^6$ $(7^{-2})^{-6}$

$= (7^1)^{12}$

10. Consider the powers 64^2 and 16^3.

a) Are these powers equivalent? Use the exponent rules to explain.

b) Write a power with a different base that is equivalent to 64^2.

(a) $64 = 4^3$

$64^2 = (4^3)^2$

$= 4^6$

$16 = 4^2$

$16^3 = (4^2)^3$

$= 4^6$

(b)

$64^2 = (2^2)^6$

$= 2^{12}$

$64^2 = (8^2)^2$

$= 8^4$

14. Copy and complete the table.

Use π key

Measurement to be Calculated	Formula	Dimensions Given	Calculated Measurement
Area of a Circle	$A = \pi r^2$	$r = \pi$ cm	$\pi(\pi)^2 = \pi^3$
Volume of a Cube	$V = s^3$	$s = \frac{1}{2}$ in.	
Volume of a Sphere	$V = \frac{4}{3}\pi r^3$	$r = \frac{1}{8}$ in.	
Volume of a Cylinder	$V = \pi r^2 h$	$r = h = 5$ cm	