# Worksheet 6-2: Zero and Negative Exponents

## Investigation: Zero and Negative Exponents

| Quotient | Expanded Form | Number of Factors | Single Power | Evaluated |
|---|---|---|---|---|
| $\frac{5^4}{5^4}$ | $\frac{5\times5\times5\times5}{5\times5\times5\times5}$ | 0 | $5^0$ | 1 |
| $\frac{(-3)^5}{(-3)^5}$ | $\frac{(-3)(-3)(-3)(-3)(-3)}{(-3)(-3)(-3)(-3)(-3)}$ | 0 | $(-3)^0$ | 1 |
| $\frac{2^3}{2^3}$ | $\frac{2\times2\times2}{2\times2\times2}$ | 0 | $2^0$ | 1 |
| $\frac{4^2}{4^3}$ | $\frac{\cancel{4}\times\cancel{4}}{\cancel{4}\times\cancel{4}\times4}$ 1 | $-1$ | $4^{-1}$ | $\frac{1}{4} = \frac{1}{4^1}$ |
| $\frac{2^3}{2^5}$ | $\frac{\cancel{2}\times\cancel{2}\times\cancel{2}}{\cancel{2}\times\cancel{2}\times\cancel{2}\times2\times2}$ 1 | $-2$ | $2^{-2}$ | $\frac{1}{4} = \frac{1}{2^2}$ |
| $\frac{(-10)^3}{(-10)^6}$ | $\frac{(\cancel{-10})(\cancel{-10})(\cancel{-10})}{(\cancel{-10})(\cancel{-10})(\cancel{-10})(-10)(-10)(-10)}$ 1 | $-3$ | $(-10)^{-3}$ | $-\frac{1}{1000} = \frac{1}{(-10)^3}$ |

| Zero Exponent: $x^0 =$ 1 , $x \neq 0$ | Negative Exponent: $x^{-n} = \frac{1}{x^n}$ |
|---|---|
| Amina$^0 = 1$ | $\left(\frac{x}{y}\right)^{-n} = \left(\frac{y}{x}\right)^n$ |

$(-2)^2 = (-2)(-2) = 4$ $(-2)^3 = -2\times-2\times-2 = -8$

$\left(\frac{x}{y}\right)^{-n} = \frac{1}{\left(\frac{x}{y}\right)^n}$

$1 \div \left(\frac{x}{y}\right)^n = 1 \div \frac{x^n}{y^n}$

$= 1 \times \frac{y^n}{x^n}$

$= \frac{y^n}{x^n}$

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

**Practice:**

**1. Write each as a single power with positive exponents, then evaluate as integers or fractions.**

(a) $8^{-2} = \frac{1}{8^2}$
$= \frac{1}{64}$

(b) $100^0 = 1$

(c) $(-4)^{-1} = \frac{1}{(-4)^1}$
$= -\frac{1}{4}$

(d) $\frac{1}{3^{-2}} = \left(\frac{1}{3}\right)^{-2}$
$= 3^2$
$= 9$

(e) $\left(\frac{1}{2}\right)^{-5} = 2^5$
$= 32$

(f) $\left(\frac{3}{4}\right)^{-2} = \left(\frac{4}{3}\right)^2$
$= \frac{16}{9}$

(g) $\left(\frac{1}{4}\right)^{-3} = 4^3$
$= 64$

(h) $\left(\frac{2}{3}\right)^{-4} = \left(\frac{3}{2}\right)^4$
$= \frac{81}{16}$

**2. Use exponent rules to simplify each expression then evaluate as integers or fractions.**

(a) $4^3 \times 4^{-5}$
$= 4^{3+(-5)}$
$= 4^{-2}$ ✓ ✓
$= \frac{1}{4^2} = \frac{1}{16}$

(b) $\frac{(-2)^2}{(-2)^{-5}}$
$= (-2)^{2-(-5)}$
$= (-2)^7 = -128$ ✓ ✓

(c) $\left(\frac{4^2}{4^5}\right)^2$
$= (4^{2-5})^2$
$= (4^{-3})^2$
$= 4^{-3\times 2}$
$= 4^{-6}$
$= \frac{1}{4^6} = \frac{1}{4096}$ ✓ ✓

(d) $\left(\frac{5^3 \times 5^4}{5^7}\right)^{105}$
$= \left(\frac{5^7}{5^7}\right)^{105}$
$= (5^0)^{105}$
$= 5^0 = 1$ ✓ ✓

**3. Evaluate the power in each statement. Express your answers as integers or fractions.**

(a) One kilobyte is $2^{10}$ bytes.

1024 bytes

(b) One byte is $2^{-10}$ kilobytes.

$2^{-10} = \frac{1}{2^{10}}$

$= \frac{1}{1024}$ kilobytes

(c) One megabyte is $(2^{10})^2$ bytes.

$(2^{10})^2 = 2^{20}$

$= 1048576$

(d) One byte is $(2^{-10})^3$ gigabytes.

$(2^{-10})^3 = 2^{-30}$

$= \frac{1}{2^{30}} = \frac{1}{1073741824}$

**4. Represent each as a power with a negative exponent using the smallest positive base integer.**

(a) $\frac{1}{125}$ $= \frac{1}{5^3}$

$= 5^{-3}$

(b) 0.00001 $= 10^{-5}$

5 jumps