CW: 4.2.3 **Name:** _____

Exploring Powers that have exponents that are zero and negative.

Without using a calculator, complete the table below:

$\frac{1}{27}$	$\frac{1}{9}$	$\frac{1}{3}$	1	3	9	27
3^{-3}	3^{-2}	3^{-1}	3^{0}	3^{1}	3^{2}	3^{3}

(×3 over 3 and 9; ÷3 over 3^{-2}, 3^{-1}, 3^{0}, 3^{2}, 3^{3})

$\frac{1}{3} \div \frac{3}{1} = \frac{1}{3} \cdot \frac{1}{3} = \frac{1}{9}$

Using a base of your choice, complete the table below.

$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4	8
2^{-3}	2^{-2}	2^{-1}	2^{0}	2^{1}	2^{2}	2^{3}

(×2 over 4 and 8; ÷2 over 2^{1}, 2^{2}, 2^{3})

Definition of Zero and Negative Exponents:

* A non zero number to the 0 power is 1.

$a^0 = 1$ $\quad 5^0 = 1$

* a^{-n} is the reciprocal of a^n: $\frac{1}{a^n}$

$a^{-n} = \frac{1}{a^n}$ $\quad 5^{-3} = \frac{1}{5^3} = \frac{1}{125}$

Examples: Simplify the following expressions. Evaluate, if possible.

a. $(-5)^0 = 1$ $\quad -5^0 = -1$

b. $x^0 = 1$

c. $2^0 \bullet 2^3 = 1 \cdot 8 = 8$

d. $a^0 \bullet (b^2)^3 = 1 \cdot b^6 = b^6$

e. 3^{-4} $\quad \frac{1}{3^4} = \frac{1}{81}$

f. 2^{-3} $\quad \frac{1}{2^3} = \frac{1}{8}$

g. $(-2)^{-4}$ $\quad \frac{1}{(-2)^4} = \frac{1}{16}$

h. -2^{-4} $\quad \frac{1}{1} = \frac{1}{-2^4} = \frac{1}{-16} = -\frac{1}{16}$

$\frac{-1}{16}$

i. $(5^{-2})^{-3} = 5^{6}$

j. $(5^{2})^{-3} = 5^{-6} = \frac{1}{5^{6}}$

k. $\left(\frac{3}{5}\right)^{-1} = \left(\frac{5}{3}\right)^{1} = \frac{5}{3}$

l. $2^{-4} \cdot 2^{4} = 2^{-4+4} = 2^{0} = 1$

$\frac{2^{4}}{2^{4}} = \frac{16}{16} = 1$

Simplify the following expressions. (Rewrite with positive exponents. Evaluate, if possible.)

a. $\frac{4}{(2)^{-3}} = 4 \cdot 2^{3} = 4 \cdot 8 = 32$

b. $3(5)^{-2}$ $\frac{3}{5^{2}} = \frac{3}{25}$

c. $(4y)^{-3}$ $\frac{1}{(4y)^{3}} = \frac{1}{4^{3}y^{3}} = \frac{1}{64y^{3}}$

d. $5g^{-3}h^{-4}$ $\frac{5}{g^{3}h^{4}}$

e. $\frac{1}{x^{-2}}$ x^{2}

f. $\frac{x^{-2}y}{z^{-3}}$ $\frac{yz^{3}}{x^{2}}$