Name: _____ Date: _____

Learning Goal 5.2	Use exponent laws to evaluate expression with positive and negative rational exponents.

Recall the Product of Powers rule to simplify the following expressions.

a. $3^6 3^2$

$= 3^{6+2}$

$= 3^8$

b. $6^7 6^2$

$= 6^{7+2}$

$= 6^9$

c. $7^6 7^1$

$= 7^{6+1}$

$= 7^7$

And the Quotient of Powers rule:

d. $3^6 \div 3^2$

$= 3^{6-2}$

$= 3^4$

e. $\frac{6^2}{6^7} = 6^{2-7}$

$= 6^{-5}$

f. $7^1 \div 7^6 = 7^{1-6}$

$= 7^{-5}$

Take a (silent) minute. What do you think the negative exponents represent?

$$= \frac{1 \quad 1}{6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6} = \frac{1}{6^5}$$

Negative exponents are related to reciprocals

* if the -ve exponent is in the numerator, it moves to the denominator
* if the -ve exponent is in the denominator, it moves to the numerator.

$1.5 = \frac{15}{10} \div 5 = \frac{3}{2}$

Example Evaluate the following expressions **without a calculator.** Leave your answers as fractions.

a. $\frac{7^{-2}}{1} = \frac{1}{7^2}$ ✓

$= \frac{1}{49}$

b. $\frac{(-1.5)^{-3}}{1} = \frac{1}{(-1.5)^3}$

$= \left(-\frac{3}{2}\right)^{-3} = \left(-\frac{2}{3}\right)^3 = \frac{(-2)^3}{(3)^3} = \frac{-8}{27}$

c. $\left(-\frac{3}{4}\right)^{-3}$

$= \left(-\frac{4}{3}\right)^3 = -\frac{4^3}{3^3} = -\frac{64}{27}$

d. $\left(\frac{10}{3}\right)^{-2}$

$= \left(\frac{3}{10}\right)^2 = \frac{3^2}{10^2} = \frac{9}{100}$

Example Simplify the following expressions to a single power with only positive exponents. Do not evaluate. Show all your work.

B
E
D
M
A
S

a. $-((3^2 \times 3^{-7})^{-2})^2$

$= -((3^{-5})^{-2})^2$

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

$= -3^{20}$

b. $(-(q^{-5} \times q^{-4})^2)^{-4}$

$-3 \neq \frac{1}{3}$

$= (-(q^{-9})^2)^{-4}$

$= \left(-\left(\frac{1}{q^9}\right)^2\right)^{-4}$

$= \left(-\frac{1}{q^{18}}\right)^{-4}$

$= \frac{1}{q^{-72}}$

$= q^{72}$

c. $\left(-\frac{x^{-5}}{x^2}\right)^{-4}$

$= \left(-\frac{1}{x^5 x^2}\right)^{-4}$

$= \left(-\frac{1}{x^7}\right)^{-4}$

$= (-x^7)^4$

$= x^{28}$

d. $\left(\frac{64}{32^{-2}}\right)^{-4}$

$= \left(\frac{2^6}{(2^5)^{-2}}\right)^{-4}$

$= \left(\frac{2^6}{2^{-10}}\right)^{-4}$

$= (2^6 \times 2^{10})^{-4}$

$= (2^{16})^{-4}$

$= \left(\frac{1}{2^{16}}\right)^4$

$= \frac{1}{2^{64}}$