Math 10

Section 4.2

Exponent Laws and Negative Exponents

Focus:

1. To be able to apply exponent laws to expressions using rational numbers or variables as bases and integers as exponents.
2. To be able to convert a power with a negative exponent to an equivalent power with a positive exponent.

Curricular Competency

B4: I can apply flexible and strategic approaches to problems

What patterns can you see?

What is happening to the value in each table? What is happening to the exponent? Leave answers as fractions rather than decimals.

Power	Value
2^4	16
2^3	8
2^2	4
2^1	2
2^0	1
2^{-1}	$\frac{1}{2}$ 0.5
2^{-2}	$\frac{1}{4}$

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

Power	Value
3^4	81
3^3	27
3^2	9
3^1	3
3^0	1
3^{-1}	$\frac{1}{3}$
3^{-2}	$\frac{1}{9} = \frac{1}{3^2}$

Power	Value
10^4	10 000
10^3	1000
10^2	100
10^1	10
10^0	1
10^{-1}	$\frac{1}{10}$
10^{-2}	$\frac{1}{10^2} = \frac{1}{100}$

What patterns do you observe?

- calculating powers + putting answer under 1

What does a negative exponent appear to do?

→ changes to a fraction

$\frac{1}{3^{-2}} = \frac{3^2}{1}$ $3^{-2} = \frac{1}{3^2}$

$= 9$

$\frac{1}{9}$

$\frac{1}{3} \cdot \frac{1}{3}$

Rewrite the following with positive exponents:

3^{-4} $\frac{1}{3^4}$	5^{-2} $\frac{1}{5^2}$	$\frac{1}{7^{-1}}$ $\frac{7^1}{1} = 7^1$	$\frac{1}{2^{-8}}$ $\frac{2^8}{1}$

$\frac{2^{-3}}{3^{-4}} = \frac{3^4}{2^3}$

Exponent Laws

Rule	Symbols	Example
Product of Powers	$(x^m)(x^n) = x^{m+n}$	$(8^6)(8^5) = 8^{11}$
Quotient of Powers	$\frac{x^m}{x^n} = x^{m-n}$	$7^8 \div 7^5 = 7^3$
Power of a Power	$(x^m)^n = x^{m \times n}$	$(4^6)^5 = 4^{30}$
Power of a Product	$(xy)^m = x^m y^m$	$(6x)^2 = 6^2x^2 \rightarrow 36x^2$
Power of a Quotient	$\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$	$\left(\frac{3}{9}\right)^2 = \frac{3^2}{9^2} = \frac{9}{81} = \frac{1}{9}$
Zero Exponent	$x^0 = 1$	$10\,396^0 = 1$
★ Negative Exponent	$x^{-m} = \frac{1}{x^m}$ $\frac{1}{x^{-m}} = x^m$	$3^{-2} = \frac{1}{3^2}$ $\frac{1}{4^{-6}} = 4^6$

Simplified answers should contain _____ exponents only.

Note also that … $\left(\frac{2}{5}\right)^{-3} = \frac{1}{\left(\frac{2}{5}\right)^3} = 1 \div \left(\frac{2}{5}\right)^3 = 1 \times \left(\frac{5}{2}\right)^3 = \left(\frac{5}{2}\right)^3$

$\left(\frac{4}{7}\right)^{-6} =$ Or, to change the sign of an exponent, reciprocate the base … $\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$

Rewrite the following using only positive exponents.

8^{-3}	$a^{-2}b^{-3}c^{-1}$	$-2x^{-3}y^{4}$
$\frac{1}{5^{-7}}$	$\left(\frac{9}{13}\right)^{-2}$	$\frac{x^{-3}}{y^{-4}}$

Exponent Laws

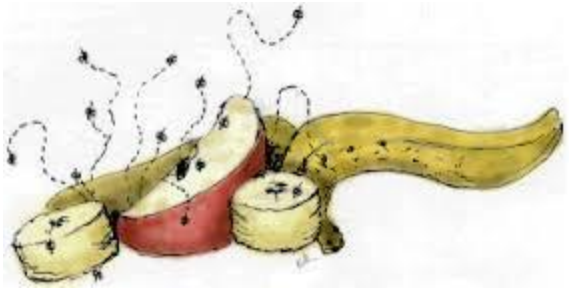
Using exponent laws, rewrite the following with a single, positive exponent. Evaluate where possible.

$(3^{9})(3^{-5})$	$\frac{x^{-6}}{x^{-2}}$	$\frac{5^{-2}\times 5^{3}}{5^{-4}}$
$[(x^{-3})(x^{-6})]^{-2}$	$\left(\frac{a^{-5}}{a^{2}}\right)^{-2}$	$\frac{(-3.5)^{4}}{(-3.5)^{-3}}$
$\frac{(3y)^{2}}{(3y)^{-6}}$	$\left(\frac{x^{6}}{x^{4}}\right)^{-2}$	$\left[\left(\frac{3}{4}\right)^{-2}\left(\frac{3}{4}\right)^{-2}\right]^{-2}$

A certain bacterium has a width of 10^{-3} mm. If your fingernail is about 1 cm across, how many bacterium can fit across your fingernail?

A population of fruit flies increases by a factor of 8 each week. Currently there are 2000 fruit flies in a garden. The number of fruit flies can be modeled using the equation $N = 2000(8)^w$ where N is the number of fruit flies and w is the number of weeks.

a. How many fruit flies will there be in 3 weeks?



b. How many fruit flies were there 3 weeks ago?

c. What does w = 0 represent?

assignment: p 169 2-8, 10, 13, 20