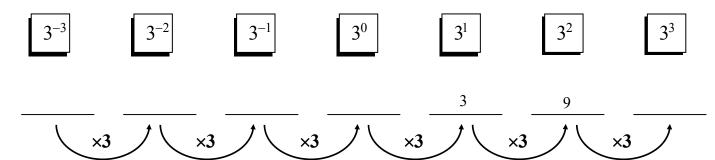
Name:	Date:
_	

INTEGER EXPONENTS COMMON CORE ALGEBRA II



We've finished our review of linear functions. Linear functions grow by equal differences for equal domain intervals (changes in x). In this unit we will concentrate on exponential functions which grow by equal **factors** for equal domain intervals. To understand exponential functions, we first need to understand exponents.

Exercise #1: The following sequence shows powers of 3 by repeatedly multiplying by 3. Fill in the missing blanks.



This pattern can be duplicated for any **base** raised to any **integer exponent**. Because of this we can now define positive, negative, and zero exponents in terms of multiplying the number 1 repeatedly or dividing the number 1 repeatedly.

INTEGER EXPONENT DEFINITIONS

If n is any positive integer then:

1.
$$b^n = 1 \cdot b \cdot b \cdot b \cdot \dots \cdot b \cdot b$$

n-times

2.
$$b^0 = 1$$

3.
$$b^{-n} = \frac{1}{b \cdot b \cdot b \cdot \dots \cdot b \cdot b} = \frac{1}{b^{n}}$$
n-times

Exercise #2: Given the exponential function $f(x) = 20(2)^x$ evaluate each of the following without using your calculator. Show the calculations that lead to your final answer.

(a) f(2)

(b) f(0)

(c) f(-2)

(d) When x increases by 3, by what **factor** does y increase? Explain your answer.





There are many basic **exponent properties or laws** that are critically important and that can be investigated using integer exponent examples. Two of the very important ones we will see next.

Exercise #3: For each of the following, write the product as a single exponential expression. Write (a) and (b) as extended products first (if necessary).

(a)
$$2^3 \cdot 2^4$$

(b)
$$2^6 \cdot 2^2$$

(c)
$$2^m \cdot 2^n$$

It's clear why the exponent law that you generalized in part (c) works for positive integer exponents. But, does it also make sense within the context of our negative exponents?

Exercise #4: Consider now the product $2^3 \cdot 2^{-1}$.

- (a) Use the exponent law found in Exercise 3(c) to write this as a single exponential expression.
- (b) Evaluate $2^3 \cdot 2^{-1}$ by first rewriting 2^3 and 2^{-1} and then simplifying.
- (c) Do your answers from (a) and (b) support the extension of the **Addition Property of Exponents** to negative powers as well? Explain.

Let's look at another important exponent property.

Exercise #5: For each of the following, write the exponential expression in the form 3^x . Write (a) and (b) as extended products first (if necessary).

(a)
$$(3^2)^3$$

(b)
$$(3^4)^2$$

(c)
$$\left(3^{m}\right)^{n}$$

Again, let's look at how the **Product Property of Exponents** still holds for negative exponents.

Exercise #6: Consider the expression $(3^{-2})^4$. Show this expression is equivalent to 3^{-8} by first rewriting 3^{-2} in fraction form.





Name:

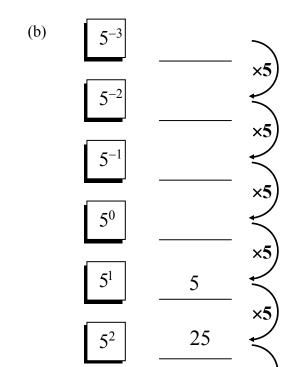
Date: _____

INTEGER EXPONENTS COMMON CORE ALGEBRA II HOMEWORK

FLUENCY

1. Write each of the following exponential expressions without the use of exponents such as we did in lesson Exercise #1.

(a)	$\boxed{2^{-3}}$	
	2^{-2}	×2
		 ×2



2. Now let's go the other way around. For each of the following, determine the integer value of n that satisfies the equation. The first is done for you.

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

(b)
$$4^n = 16$$
 (c) $3^n = \frac{1}{81}$

(c)
$$3^n = \frac{1}{81}$$

(d)
$$7^n = 1$$

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

$$n = -3$$

(e)
$$5^n = \frac{1}{25}$$

(f)
$$10^n = \frac{1}{10,000}$$
 (g) $13^n = 1$ (h) $2^n = \frac{1}{32}$

(g)
$$13^n = 1$$

(h)
$$2^n = \frac{1}{32}$$

3. Use the **Addition Property of Exponents** to simplify each expression. Then, find a final numerical answer *without* using your calculator.

(a)
$$2^{-5} \cdot 2^3 \cdot 2^4$$

(b)
$$5^3 \cdot 5^7 \cdot 5^{-10}$$

(c)
$$10^3 \cdot 10^{-7} \cdot 10^2$$

4. Use the **Product Property of Exponents** to simplify each exponential expression. You do not need to find a final numerical answer.

(a)
$$(2^3)^4$$

(b)
$$(3^{-2})^2$$

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

5. The exponential expression $\left(\frac{1}{8}\right)^4$ is equivalent to which of the following? Explain your choice.

$$(1) 4^{-8}$$

$$(3) 8^{-2}$$

$$(2) 2^{-12}$$

$$(4) 32^{-1}$$

REASONING

- 6. How can you use the fact that $25^2 = 625$ to show that $5^{-4} = \frac{1}{625}$? Explain your process of thinking.
- 7. We've extended the two fundamental exponent properties to negative as well as positive integers. What would happen if we extended the **Product Exponent Property** to a fractional exponent like $\frac{1}{2}$? Let's play around with that idea.
 - (a) Use the **Product Property of Exponents** to justify that $\left(9^{\frac{1}{2}}\right)^2 = 9$.
- (b) What other number can you square that results in 9? Hmm...



