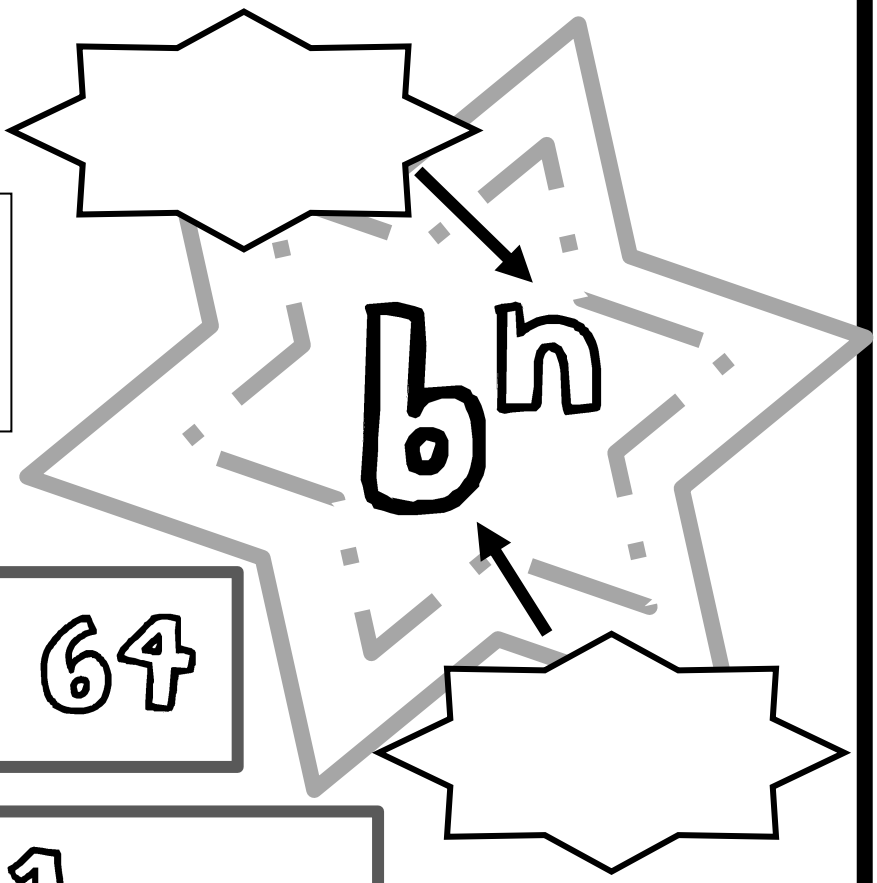
ALGEBRA

UNIT 8

EXPONENT RULES

Exponents



This means "b" multiplied by _____ "n" times.

$4^3 = 4 \cdot 4 \cdot 4 = 64$

$1^5 = 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 =$

$3^4 =$

BE CAREFUL!

The base is only what is directly in front of the power. In order for a negative symbol to be included in the base, it must be grouped with parentheses.

The negative symbol is NOT part of the base.

$-4^3 = -[4 \cdot 4 \cdot 4] = -64$

The negative symbol IS part of the base.

$(-4)^3 = (-4) \cdot (-4) \cdot (-4) = 64$

EXPONENTS OF ONE AND ZERO

Any term raised to a power of <u>zero</u> is...

EXAMPLE:

Any term raised to a power of <u>one</u> is...

EXAMPLE:

ADDING & SUBTRACTING

ADDING EXAMPLES:

We must

_____

in order to add and subtract with exponents.

SUBTRACTING EXAMPLES:

Multiplying bases

When we multiply the bases of terms with exponents...

Power to a Power

When we raise a power to a power...

DIVISION WITH EXPONENTS

When we divide the same bases with exponents...

NEGATIVE EXPONENTS

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

- NEGATIVE EXPONENTS MAKE _____ NUMBERS AND NOT _____ NUMBERS.
- NEGATIVE EXPONENTS MUST BECOME _____ BY _____ OR _____.

$$ad^{-4} = \frac{a}{d^4}$$

Scientific Notation: Basics

Positive Exponents =

$7{,}500{,}000 = \_\_ \cdot 10^{-}$

$0.00000479 = \_\_\_ \cdot 10^{-}$

Negative Exponents =

Operations with Scientific Notation

MULTIPLYING

Steps:
1. Multiply first terms
2. Add Exponents

DIVIDING

Steps:
1. Divide first terms
2. Subtract Exponents

ADDING

Steps:
1. Add first terms
2. Exponent stays the same

SUBTRACTING

Steps:
1. Subtract first terms
2. Exponent stays the same

For adding & subtracting, the exponents must be the same! If they are not, make them the same!

Properties of Exponents

There are many properties of exponents that we will study. Below, we will investigate many properties and practice using those properties.

Exponents of Zero and One

$(-2)^0 =$ $4^1 =$ $(\frac{1}{2})^0 =$ $(\frac{1}{3})^1$

Any term raised to the zero power is _____

Any term raised to the power of one is _____

Adding/Subtracting with exponents

$6y^2 + 4y^2 =$ $10w^2 - 5w^3 =$ $z^3 + z^2 =$

What rule can you generalize when adding and subtracting terms with exponents? _____

Multiplying with exponents

$x^2 \cdot x^4 = \boxed{x \cdot x} \cdot \boxed{x \cdot x \cdot x \cdot x} = x^{2+4} = x^6$

$3x^2 \cdot 4x^3 = \boxed{3 \cdot x \cdot x} \cdot \boxed{4 \cdot x \cdot x \cdot x} = 12x^{2+3} = 12x^5$

$6y^2 \cdot 4y^3 =$ $2c^4 \cdot 3c^6 =$ $3k^{-2} \cdot 8k^4 =$

$a^2c^4 \cdot 3a^3c^9 =$

Raising a Power to a Power

$(x^2)^3 = \boxed{x \cdot x} \cdot \boxed{x \cdot x} \cdot \boxed{x \cdot x} = x^{2 \cdot 3} = x^6$
$(2m^2)^3 = \boxed{2m \cdot m} \cdot \boxed{2m \cdot m} \cdot \boxed{2m \cdot m} = 16m^{2 \cdot 3} = 16m^6$

$(y^4)^{-2} =$ $(b^2)^3 \cdot (b^4)^5 =$ $(m^2k^3)^4 =$

Division with exponents

$\frac{a^4}{a^2} = \frac{a \cdot a \cdot a \cdot a}{a \cdot a} = \frac{\cancel{a} \cdot \cancel{a} \cdot a \cdot a}{\cancel{a} \cdot \cancel{a}} = a \cdot a = a^2$
$\frac{6m^4}{2m^2} = \frac{6}{2} m^{4-2} = 3m^{4-2} = 3m^2$

$\frac{3x^2y^7}{x^5y^3} =$ $\frac{w^4}{w^9m^5} =$

Negative Exponents with Numbers

$3^{-1} = \frac{1}{3^1} = \frac{1}{3}$	$3^{-4} =$
$3^{-2} = \frac{1}{3^2} = \frac{1}{9}$	$3^{-5} =$
$3^{-3} =$	$x^{-6} =$

Negative Exponents with Variables

Rules in math request for there to be no negative exponents in a final answer, therefore there is a property that allows us to remove the negative sign in exponents. Fill in the chart with the appropriate solution.

$a^{-3} = \frac{1}{a^3}$	$\frac{a^2x^4}{n^{-7}} =$
$\frac{3a^{-4}}{2} = \frac{3 \cdot a^{-4}}{2} = \frac{3}{2a^4}$	$a^2g^{-7} =$
$\frac{7x}{5a^{-9}} = \frac{7 \cdot x}{5 \cdot a^{-9}} = \frac{7xa^9}{5}$	$\frac{e^{-8}}{p^{-2}} =$

$ab^{-2} =$

$\frac{x^{-2}}{x^2y^2} =$

Putting It All Together!

Now, we are going to take all of these rules and simplify expressions using many of them at one time.

1. $\frac{15a^5b^2c^4}{25a^3b^{-3}(c^2)^3} =$

2. $\frac{3x^6}{(x^1)^3} =$

3. $(-3x^{-1}y^2)^4 =$

4. $(-5x^{-2}y)(-2x^{-3}y^2)$

Properties of Exponents

1) $2m^2 \cdot 2m^3$

2) $m^4 \cdot 2m^{-3}$

3) $4r^{-3} \cdot 2r^2$

4) $4n^4 \cdot 2n^{-3}$

5) $2k^4 \cdot 4k$

6) $2x^3y^{-3} \cdot 2x^{-1}y^3$

7) $2y^2 \cdot 3x$

8) $4v^3 \cdot vu^2$

9) $4a^3b^2 \cdot 3a^{-4}b^{-3}$

10) $x^2y^{-4} \cdot x^3y^2$

11) $(x^2)^0$

12) $(2x^2)^{-4}$

13) $(4r^0)^4$

14) $(4a^3)^2$

15) $(3k^4)^4$

16) $(4xy)^{-1}$

17) $(2b^4)^{-1}$

18) $(x^2y^{-1})^2$

19) $(2x^4y^{-3})^{-1}$

20) $(3m)^{-2}$

21) $\frac{r^2}{2r^3}$

22) $\frac{x^{-1}}{4x^4}$

23) $\frac{3n^4}{3n^3}$

24) $\frac{m^4}{2m^4}$

25) $\frac{3m^{-4}}{m^3}$

26) $\frac{2x^4y^{-4}z^{-3}}{3x^2y^{-3}z^4}$

27) $\frac{4x^0y^{-2}z^3}{4x}$

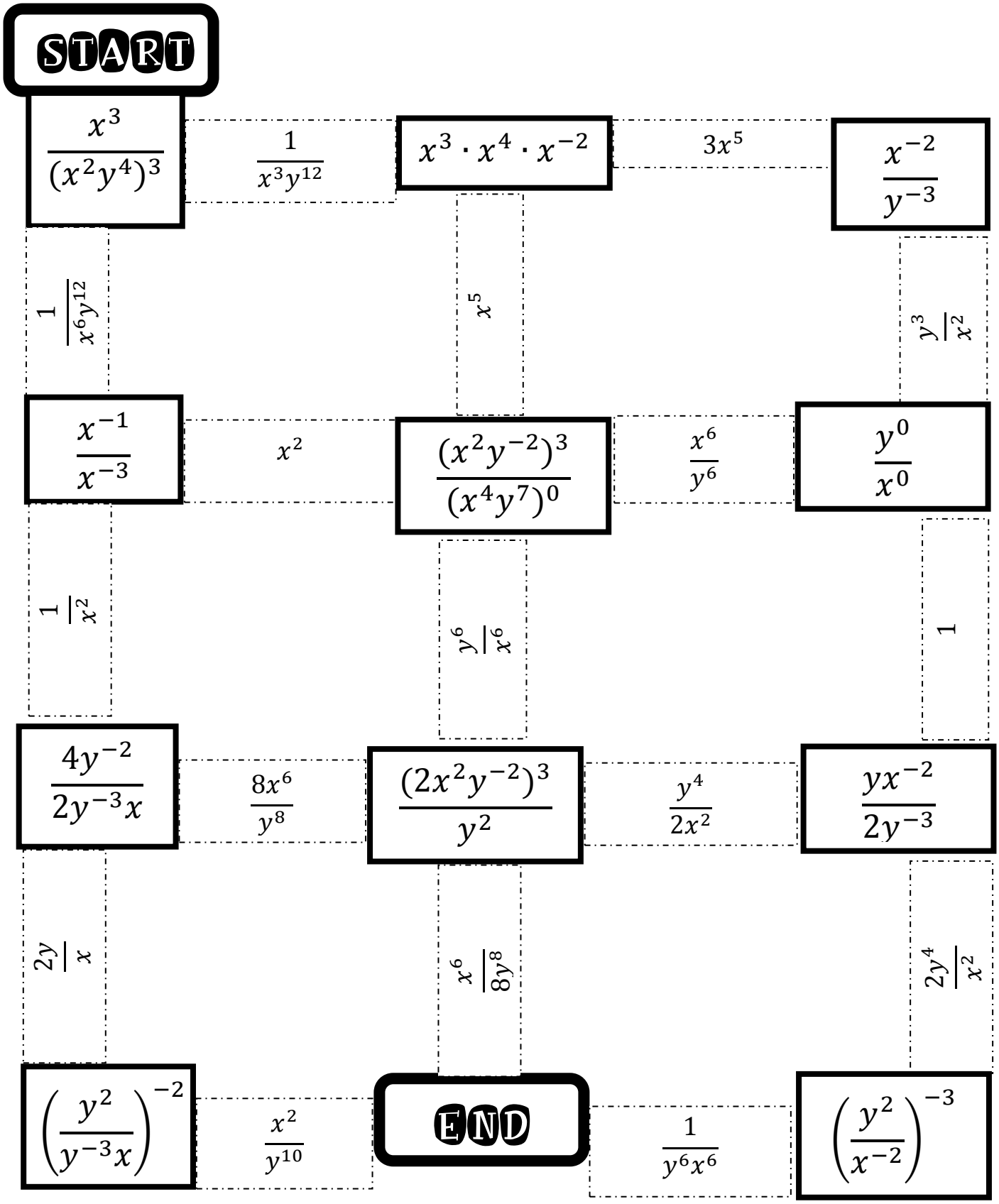
28) $\frac{2h^3j^{-3}k^4}{3jk}$

29) $\frac{4m^4n^3p^3}{3m^2n^2p^4}$

30) $\frac{3x^3y^{-1}z^{-1}}{x^{-4}y^0z^0}$

EXPONENT PROPERTIES MAZE

DIRECTIONS: SOLVE THE PROBLEMS IN THE BOLD BOXES. FIND THE SOLUTION IN THE DOTTED BOXES AND CONTINUE THROUGH THE MAZE.



Writing Equivalent Expressions

For each expression given, please write 4 additional equivalent expressions using the method indicated.

Expression	Write using **Multiplication with Exponents**	Write using **Division with Exponents**	Write using **Raising a Power to a Power**	Write using **any method you chose**
10^5				
x^{-7}				
a^8				
y^9				
a^2b^5				
y^0				
$\frac{1}{a^5}$				
$a^{-5}b^4c^8$				
$\frac{a^{-5}}{b^7}$				

Name _____ Date_____

What do you get when you cross a piranha and a hyena?

Match each number in scientific notation with it's standard form to find out!
Place the letter associated with the correct answer, in the numbered box below.

1) 3.26×10^{4}	A) 8,350
2) 1.4×10^{6}	N) 0.00326
3) 1.2×10	A) 0.008
4) 3.2×10^{-2}	A) 0.0000014
5) 8.35×10^{3}	P) 1,400,000
6) 3.26×10^{-4}	H) 3,000
7) 3×10^{3}	A) 32,600
8) 1.2×10^{3}	A) 1,200
9) 8.35×10^{-3}	H) 0.00835
10) 1.4×10^{-6}	H) 0.102
11) 1.02×10^{-1}	I) 12
12) 8×10^{-4}	R) 0.032

									=			=		
1		2	3	4	5	6	7	8		9	10		11	12

SCIENTIFIC NOTATION

Directions: To write the number in scientific notation, first write how many places each decimal must be moved until there is only ONE NUMBER (not zero) in front of the decimal. Then write whether the decimal was moved LEFT or RIGHT. Finally, write the number in scientific notation.

NUMBER	PLACES MOVED	DIRECTION	SCIENTIFIC NOTATION
325,000	5	LEFT	3.25×10^5
89,300			
206,000,000			
0.456			
0.0712			
0.000000051			
75,000,000,000			

Directions: Write each number in Standard Form by moving the decimal according to the value of the exponent. Remember, think about a number line. The negative numbers are on the LEFT and the positive numbers are on the RIGHT.

5.3×10^3 = 5.3 = 5,300

3.7×10^{-6} = _____ = _____

2.15×10^2 = _____ = _____

9.03×10^4 = _____ = _____

7.67×10^{-1} = _____ = _____

3.99×10^{-5} = _____ = _____

Operations with Scientific Notation

Directions: Record your answers here as you work through the stations.

Station 1

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____

Station 2

1. _____
2. _____
3. _____
4. _____
5. _____

Station 3

1. _____
2. _____
3. _____
4. _____
5. _____

Station 4

1. _____
2. _____
3. _____
4. _____
5. _____

Station 5

1. _____
2. _____
3. _____
4. _____
5. _____

Station 6

1. _____
2. _____
3. _____
4. _____

Operations with Scientific Notation

1.) $(8.56 \times 10^5) + (3.2 \times 10^4)$

2.) $(4.67 \times 10^{-4}) + (5.9 \times 10^{-4})$

3.) $(4 \times 10^4) - (2.5 \times 10^2)$

4.) $(5.12 \times 10^{-6}) - (4.23 \times 10^{-6})$

5.) $(6 \times 10^3)(3 \times 10^2)$

6.) $(7.398 \times 10^{-1})(1 \times 10^{-1})$

7.) $\frac{(2.8 \times 10^7)}{(3.5 \times 10^3)}$

8.) $\frac{(4.77 \times 10^8)}{(3.5 \times 10^{-3})}$

8.EE.4 Operations with Scientific Notation

Situation: It is your job to figure out how many Americans eat at Gooeyburger every day. Use the following information to help you.

- There are about $8\ x\ 10^3$ Gooeyburger restaurants in America.
- Each restaurant serves an average of $2.5\ x\ 10^3$ people every day.

Explain your reasoning and show your work.

Situation: The world is consuming approximately 87 million barrels of oil per day. At this rate of consumption, how long will the known oil reserves of $1.653\ x\ 10^{12}$ barrels last?

Explain your reasoning and show your work.

Additional Practice: $p = 4\ x\ 10^{14}$ and $q = 8\ x\ 10^9$.

a.) What is the value of pq?

b.) What is the value of $\frac{p}{q}$?