

NAME: \_\_\_\_\_

Date: \_\_\_\_\_

Mr. Rogove

Math \_\_\_\_\_, Period \_\_\_\_\_

## Study Guide: Exponents and Scientific Notation

### EXPONENT RULES

	<b>Description</b>	<b>Example</b>
Multiplying Exponents	Add exponents with the same base	$x^8 \cdot x^6 = x^{14}$  $3^2 \cdot 3^5 = 3^7$ (3 is the base)
	Multiply any coefficient terms	$3x^4 \cdot 5x^9 = 15x^{13}$
Raising a Power to a Power	Multiply the exponents	$(x^3)^5 = x^{15}$  $(2x^4)^3 = 2^3 \cdot x^{3 \cdot 4} = 8x^{12}$
Dividing Exponents	Subtract the exponents with the same base	$\frac{x^{11}}{x^7} = x^4$
	Divide any coefficient terms	$\frac{18x^8}{3x^2} = 6x^6$
Raising a factor to a Power	Raise the numerator and the denominator to the power	$\left(\frac{3x}{5}\right)^3 = \frac{(3x)^3}{5^3} = \frac{27x^3}{125}$
Negative Exponents	When a number is raised to a negative exponent, change the sign of the exponent and use the reciprocal.	$x^{-4} = \frac{1}{x^4}$  $\frac{1}{x^{-5}} = x^5$
Zero as an Exponent	Any number raised to the 0 power equals 1.	$4^0 = 1$  $(3x)^0 = 1$

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## SCIENTIFIC NOTATION

A way to write numbers that are really big or really small. Numbers written as the product of two factors, where one factor is greater than or equal to 1 and less than 10, and the other factor is 10 raised to a power.

<b>Converting to Scientific Notation</b>		
Standard Notation	Scientific Notation	Explanation
45,000,000 (big number)	$4.5 \times 10^7$	Move the decimal 7 places to the LEFT to make the coefficient between 1 and 10. Raise 10 to a positive power.
0.00000325 (small number)	$3.25 \times 10^{-6}$	Move the decimal 6 places to the RIGHT to make the coefficient between 1 and 10. Raise 10 to a negative power.
<b>Converting to Standard Notation</b>		
Scientific Notation	Standard Notation	Explanation
$1.55 \times 10^6$ (big number)	1,550,000	Move the decimal 6 places to the RIGHT. A positive exponent means your number is greater than 10.
$2 \times 10^{-5}$ (small number)	0.00002	Move the decimal 5 places to the LEFT. A negative exponent means your number is between 0 and 1.

### Multiplying and Dividing Scientific Notation

→→ **Multiplying:** Multiply the coefficients, add the exponents, and simplify to proper scientific notation.

Example:  $(4 \times 10^5)(7 \times 10^2) = 28 \times 10^7 = 2.8 \times 10^8$

→→ **Dividing:** Divide the coefficients, subtract the exponents, and simplify to proper scientific notation.

Example:  $\frac{3 \times 10^9}{6 \times 10^4} = \frac{3}{6} \cdot \frac{10^9}{10^4} = \frac{1}{2} \times 10^5 = 0.5 \times 10^5 = 5 \times 10^4$

### Adding and Subtracting Scientific Notation

Make sure your numbers are the same **order of magnitude** (raised to the same power of ten)

Example:  $(3 \times 10^7) + (5 \times 10^9) = (3 \times 10^7) + (5 \times 10^2 \times 10^7)$   
 $= (3 \times 10^7) + (500 \times 10^7) = 503 \times 10^7 = 5.03 \times 10^9$

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**Review Questions: Due when you take the test!**

Simplify

$7^9 \cdot 7^3$	$5^2 \cdot 5^{-3}$
$2x^5 \cdot 5x^7$	$-6y^6 \cdot 7y^{-3}$
$(x^{-3})^4$	$(x^2y^3)^4$
$(5x^4)^3$	$(3x^4)^{-3}$
$(3x^{15}y^{109})^0$	$(3x^0y^3)^2$

Convert the following terms to proper scientific notation, and then place order them from least to greatest:

	<b>Scientific Notation</b>	<b>Order (1=least, 7=greatest)</b>
$0.3 \times 10^5$		
$401,054 \times 10^{-2}$		
$5^3$		
3,546,000		
$0.0045 \times 10^{-3}$		
$435 \times 10^{-8}$		
$2400 \times 10^1$		

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Simplify and put into proper scientific notation

$(3 \times 10^{-4})(5 \times 10^8)$	$(2.5 \times 10^{-2})(4 \times 10^{-12})$
$\frac{5.2 \times 10^7}{1.3 \times 10^2}$	$\frac{3.6 \times 10^8}{7.2 \times 10^9}$
$(3.8 \times 10^8) + (2.1 \times 10^8) + (4.7 \times 10^9)$	$(4.65 \times 10^7) + (5.56 \times 10^8)$

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Below are the gross domestic product (GDP) for select countries in the Western Hemisphere. Answer all questions below based on this table. Use calculator to perform your calculations, but show all your work!

<b>Country</b>	<b>2012 GDP (in dollars)</b>
Brazil	$2.25 \times 10^{12}$
Ecuador	$8.75 \times 10^{10}$
Grenada	$7.28 \times 10^8$
Guatemala	$5.038 \times 10^{10}$
Haiti	$7.187 \times 10^9$
Mexico	$1.183 \times 10^{12}$
Puerto Rico	$1.035 \times 10^{11}$
United States	$1.624 \times 10^{13}$
Venezuela	$3.824 \times 10^{11}$

a. Name the countries in order from largest GDP to smallest GDP.

b. Comparing only GDP, about how many times larger is the United States than Guatemala?

c. Again comparing only GDP, about how many times larger is Mexico compared to Haiti?

d. Is the GDP of the largest nation larger than all the rest of the nations' GDP combined? Show your work.

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Gem and Sydney bought a fish tank that has a volume of 175 liters. The brochure for their tank lists a “fun fact” that it would take  $7.43 \times 10^{18}$  tanks of that size to fill all the oceans in the world. Gem and Syd think they can quickly calculate the volume of the oceans using the fun fact and the size of their tank.

a. Given that 1 *liter* =  $1.0 \times 10^{-12}$  cubic kilometers (measurement of volume), rewrite the size of the tank in cubic kilometers using scientific notation.

b. Determine the volume of all the oceans in the world in cubic kilometers using the “fun fact.”

c. Jessica liked Gem and Syd’s tank so much she bought her own fish tank that holds an additional 75 liters. Syd asked you to find how many tanks it would take to fill the Pacific Ocean. The Pacific Ocean has a volume of 660,000,000 cubic kilometers.