NAME:_____ Date:_____

Mr. Rogove Math _____ , Period _____

Study Guide: Exponents and Scientific Notation

EXPONENT RULES

	Description	Example
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.	$4^0 = 1$ $(3x)^0 = 1$

NAME:_____ Date:_____

Mr. Rogove Math _____ , Period _____

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.

Converting to Scientific Notation		
Standard Notation	Scientific Notation	Explanation
45,000,000 (big number)	4.5×10^{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)	3.25×10^{-6}	Move the decimal 6 places to the RIGHT to make the coefficient between 1 and 10. Raise 10 to a negative power.
Converting to Standard Notation		
Scientific Notation	Standard Notation	Explanation
1.55×10^{6} (big number)	1,550,000	Move the decimal 6 places to the RIGHT. A positive exponent means your number is greater than 10.
2×10^{-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: $(3 \times 10^{7}) + (5 \times 10^{9}) = (3 \times 10^{7}) + (5 \times \mathbf{10^{2}} \times \mathbf{10^{7}})$

$= (3 \times 10^{7}) + (500 \times 10^{7}) = 503 \times 10^{7} = 5.03 \times 10^{9}$

NAME:_____ Date:_____

Mr. Rogove Math _____ , Period _____

Review Questions: Due when you take the test!

Simplify

$7^9 \cdot 7^3$ 7^{12}	$5^2 \cdot 5^{-3}$ $5^{-1} = \frac{1}{5}$
$2x^5 \cdot 5x^7$ $10x^{12}$	$-6y^6 \cdot 7y^{-3}$ $-42y^3$
$(x^{-3})^4$ $x^{-12} = \frac{1}{x^{12}}$	$(x^2y^3)^4$ x^8y^{12}
$(5x^4)^3$ $125x^{12}$	$(3x^4)^{-3}$ $\frac{1}{27x^{12}}$
$(3x^{15}y^{109})^0$ 1	$(3x^0y^3)^2$ $9y^6$

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

	Scientific Notation	**Order (1=least, 7=greatest)**
0.3×10^5	3×10^4	2
$401{,}054\times10^{-2}$	4.01054×10^3	4
5^3	1.25×10^2	5
3,546,000	3.546×10^6	1
0.0045×10^{-3}	4.5×10^{-6}	6
435×10^{-8}	4.35×10^{-6}	7
2400×10^1	2.4×10^4	3

NAME:_____ Date:_____

Mr. Rogove Math _____ , Period _____

Simplify and put into proper scientific notation

$(3\times10^{-4})(5\times10^{8})$ $15 \times 10^{4} =$ 1.5×10^{5}	$(2.5\times10^{-2})(4\times10^{-12})$ 10×10^{-14} $= 1 \times 10^{-13}$
$\frac{5.2\times10^{7}}{1.3\times10^{2}}$ 4×10^{5}	$\frac{3.6\times10^{8}}{7.2\times10^{9}}$ 0.5×10^{-1} $= 5 \times 10^{-2}$
$(3.8\times10^{8}) + (2.1 \times 10^{8}) + (4.7 \times 10^{9})$ 3.8×10^{8} 2.1×10^{8} 47×10^{8} $= 52.9 \times 10^{8}$ $= 5.29 \times 10^{9}$	$(4.65 \times 10^{7}) + (5.56\times10^{8})$ 4.65×10^{7} 55.6×10^{7} $= 60.25 \times 10^{7}$ $= 6.025 \times 10^{8}$

NAME:_____ Date:_____

Mr. Rogove Math _____ , Period _____

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!

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

a. Name the countries in order from largest GDP to smallest GDP.
USA, Brazil, Mexico, Venezuela, Puerto Rico, Ecuador, Guatemala, Haiti, Grenada

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

$$\frac{1.624 \times 10^{13}}{5.038 \times 10^{10}}$$

$$\approx \frac{16 \times 10^{12}}{5 \times 10^{10}}$$

$$= 3.2 \times 10^{2} = 320 \; times \; larger.$$

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

$$\frac{1.183 \times 10^{12}}{7.187 \times 10^{9}}$$

$$\approx \frac{(12 \times 10^{11})}{7.2 \times 10^{9}}$$

$$= 1.66 \times 10^{2} = about \; 166 \; times \; larger$$

d. Is the GDP of the largest nation larger than all the rest of the nations' GDP combined? Show your work.
US GDP: 1.624×10^{13}. All others: (written with a magnitude 8 to add):
$(22500 \times 10^{8}) + (875 \times 10^{8}) + (7.28 \times 10^{8}) + (503.8 \times 10^{8}) + (71.87 \times 10^{8}) + (11830 \times 10^{8}) + (1035 \times 10^{8}) + (3824 \times 10^{8}) = 40646.95 \times 10^{8} =$ **4.064695×10^{12} USA about 4 times larger!!**

NAME:_____ Date:_____

Mr. Rogove Math _____ , Period _____

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 7.43×10^{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.

$$175 \times 10^{-12} = 1.75 \times 10^{-10} cu.\ km$$

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

Multiply:

$$(1.75 \times 10^{-10}) \times (7.43 \times 10^{18})$$
$$= 13.0025 \times 10^{8}\ cu\ km.$$
$$= \mathbf{1.30025 \times 10^{9}\ cu\ km.}$$
$$\mathbf{OR}\ 1{,}300{,}250{,}000\ cu\ km$$

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.

Jessica's fishtank is 250 liters, or $2.5 \times 10^{-10} cu\ km$. Divide the volumes to find out the number of fish tank refills needed to fill up the Pacific.

$$\frac{660{,}000{,}000}{2.5 \times 10^{-10}} = \frac{6.6 \times 10^{8}}{2.5 \times 10^{-10}}$$
$$= 2.64 \times 10^{18}\ \text{tanks}$$
$$OR\ 2{,}640{,}000{,}000{,}000{,}000{,}000\ \text{fish tanks to fill the Pacific Ocean}$$