Dear PAP Chemistry Students,

Welcome to Pre-AP Chemistry. We hope you are as excited to take this course as we are excited to teach it. You have chosen to study one of the building blocks of science. Chemistry defines matter and identifies the properties of how matter behaves. This course is structured to prepare you to take the AP chemistry course the following year. It is a rigorous one, but doable if you study. In order to prepare you for the class, there are a few math rules that you need to remember. This packet covers those rules.

You are expected to turn in this packet on August 21st which is the Monday after you start school. This assignment will be GRADED. You are also given a list of elements from the periodic table. You are responsible for the correct spelling of each element name and the correct symbol that goes with each element. A test on this material will be given to you the second week after you start.

Just a reminder that students who take any Pre-AP course have to be mature, dedicated, humble and inquisitive. They have to be organized, communicative and energetic. Utilize your summer time wisely. Good Luck and we can't wait to meet you in the fall.

Measurement: Metric System and Conversions

In science, it is very important to make measurements to describe the observations that you make. Quantitative observations help us make use of our observations by making sense out of the patterns that we see. It is also very important to have a common system of measurement for the collaboration of people from around the world. The metric system is an internationally agreed decimal system of measurement that was originally based on the mètre des archives and the kilogramme des archives introduced by France in 1799. Over the years, the definitions of the meter and kilogram have been refined and the metric system has been extended to incorporate many more units. Although a number of variants of the metric system emerged in the late nineteenth and early twentieth centuries, the term is now often used as a synonym for "SI" or the "International System of Units"—the official system of measurement in almost every country in the world.

The variation of the metric system we use:

- m; the meter for length
- kg; the kilogram for mass
- s; the second for time
- L; the liter for volume
- A; the ampere for electric current
- K; the Kelvin for temperature
- mol; the mole for amount of substance
- cd; the candela for luminous intensity

Watch https://www.youtube.com/watch?v=5tHpDzXP-lg

Convert the following measurements: *Show ALL work*

1. 36.52 mg = _____ g
2. 14.72 kg = _____ mg
3. 0.0035 hm = _____ dm
4. 134 m = _____ km
5. 25 mm = _____ cm
6. 2.5 cm^3 = _____ mL
7. 243 daL = _____ L
8. 45.23 L = _____ mL
9. 0.035 hL = _____ cL
10. 27.32 mm = _____ m
11. 15 m = _____ dm
12. 0.023 cc = _____ L
13. 0.0049 km = _____ mm
14. 0.025 kg = _____ g

Scientific Notation

Scientific notation is a way of writing numbers that are too big or too small to be conveniently written in decimal form. Scientific notation has a number of useful properties and is commonly used in calculators and by scientists, mathematicians and engineers. In scientific notation all numbers are written in the form of $a \times 10^b$ (a times ten raised to the power of b), where the exponent "b" is an integer, and the coefficient "a" is any real number. Correct scientific notation has only one number to the left of the decimal and retains the proper number of significant figures.

Standard decimal notation	Normalized scientific notation
2.0	2.0×10^{0}
0.2	2×10^{-1}
300	3×10^{2}
6,720,000,000	6.72×10^{9}
0.000 000 007 51	7.51×10^{-9}

Prefixes

Along with the basic units of measurement in the metric system we use prefixes to express very large or very small numbers in science. Some commonly used prefixes in the sciences are listed below. ***PAP Students: Please memorize prefixes and their numbers***

- tera- (T-) 10^{12} 1 trillion
- giga- (G-) 10^{9} 1 billion
- mega- (M-) 10^{6} 1 million
- kilo- (k-) 10^{3} 1 thousand
- deci- (d-) 10^{-1} 1 tenth
- centi- (c-) 10^{-2} 1 hundredth
- milli- (m-) 10^{-3} 1 thousandth
- micro- (μ-) 10^{-6} 1 millionth
- nano- (n-) 10^{-9} 1 billionth
- pico- (p-) 10-12 1 trillionth

Watch https://www.youtube.com/watch?v=Q_klLmTSyyw

Convert normal notation to scientific notation: *Show ALL Work*

1. 7300 mL = _____
2. 6,000,000 m = _____
6. 0.16 mL = _____
7. 0.060 mg = _____

3. 261 g = _____

4. 42.3 mm = _____

5. 21000 cm = _____

8. 0.023 m = _____

9. 0.0000623 g = _____

10. 0.00035 kg = _____

Convert scientific notation to normal notation: *Show ALL Work*

1. 2.6×10^3 = _____

2. 5.1×10^6 = _____

3. 4.20×10^{-2} = _____

4. 6.10×10^{-3} = _____

5. 9.26×10^{-1} = _____

6. 7.6×10^0 = _____

7. 3.80×10^{-3} = _____

8. 2.11×10^6 = _____

9. 0.00765×10^{-2} = _____

10. 54.08×10^3 = _____

Scientific/Exponential Notation Arithmetic

- To *multiply* numbers written in scientific notation, multiply the coefficients (M&N) and add the exponents (A&B).

$$M^A \times N^B = (MxN)^{A+B}$$

For example, $(3x10^4) \times (2x10^2) =$

$(3x2)x10^{(4+2)} = 6 \times 10^6$.

- To *divide* numbers written in scientific notation, divide the coefficients (M&N) and subtract the exponent in the denominator from the exponent in the numerator.

$$\frac{M^A}{N^B} = \left(\frac{M}{N}\right) x\ 10^{(A-B)}$$

For example,

$\frac{3.0 x10^5}{6.0 x 10^2} = \left(\frac{3.0}{6.0}\right) \times 10^{(5-2)} = 0.5x10^3 = 5.0x10^2$

Watch https://www.youtube.com/watch?v=UADVIDjdaVg

- If you want to *add* or *subtract* numbers expressed in scientific notation and you are not using a calculator, then the exponents must be the same.

For example, suppose you want to calculate the sum of $5.4 \times 10^3 + 8.0 \times 10^2$.

First, rewrite the second number so that the exponent is a 3.

$(5.4 \times 10^3) + (8.0 \times 10^2 \rightarrow 0.80 \times 10^3)$

Now add the numbers.

$(5.4 + 0.80) \times 10^3 = 6.2 \times 10^3$

Follow the same rule when you subtract numbers expressed in scientific notation.

$(3.42 \times 10^{-5}) - (2.5 \times 10^{-6}) =$

$(3.42 \times 10^{-5}) - (2.5 \times 10^{-6} \rightarrow 0.25 \times 10^{-5}) =$

$(3.42-0.25) \times 10^{-5} = 3.17 \times 10^{-5}$

Watch https://www.youtube.com/watch?v=p0zVNTko7z4

Solve the following problems. The answer should be in scientific notation: *Show ALL Work*

1. $(1 \times 10^3) \times (3 \times 10^1) =$ _____
2. $(5 \times 10^{-5}) \times (11 \times 10^4) =$ _____
3. $(4 \times 10^3) / (8 \times 10^5) =$ _____
4. $(4 \times 10^3) + (3 \times 10^2) =$ _____
5. $(8 \times 10^6) + (3.2 \times 10^7) =$ _____
6. $(2 \times 10^2) - (4 \times 10^1) =$ _____
7. $(9 \times 10^{12}) - (8.1 \times 10^9) =$ _____
8. $(3 \times 10^4) \times (2 \times 10^3) =$ _____
9. $(2 \times 10^{-4}) \times (4 \times 10^3) =$ _____
10. $(9 \times 10^{21}) / (3 \times 10^{19}) =$ _____
11. $(9 \times 10^2) + (1 \times 10^4) =$ _____
12. $(1.32 \times 10^{-3}) + (3.44 \times 10^{-4}) =$ _____
13. $(3 \times 10^{-6}) - (5 \times 10^{-7}) =$ _____
14. $(2.2 \times 10^{-4}) - (3 \times 10^2) =$ _____

Equations/Solving for Variables

Many relationships in chemistry can be expressed by simple algebraic equations. However, the equation given is always in the form that is most useful in figuring out a particular problem. In such a case, you must first solve the equation for the unknown quantity; this is done by rearranging the equation so that the unknown is on one side of the equation, and all the known quantities are on the other side.

An equation is solved using the laws of equality. The laws of equality are summarized as follows: If equals are added to, subtracted from, multiplied by, or divided by equals, the results are equal. In other words, you can perform any of these mathematical operations on an equation and not destroy the equality, as long as you do the same thing to both sides of the equation. The laws of equality apply to any legitimate mathematical operation, including squaring, taking square roots, and taking the logarithm.

Consider the following equation relating the Kelvin and Celsius temperature scales:

$$K = °C + 273$$

If we need to solve this equation for °C we need to get °C by itself on one side of the equation. This means we need to move 273 to the other side. To do this we need to do the opposite of the operation that is attaching °C and 273, the opposite of addition is subtraction.

So we need to subtract both sides by 273:

$$K - 273 = °C + 273 - 273.$$

The 273 will cancel on the right side of the equation.

$$K - 273 = °C + 273 - 273$$

Leaving: $K - 273 = °C$

If they were attached by subtraction you would need to use addition to separate them.

The same thing goes for if the numbers are attached by multiplication.

$$°F = (1.8 \times °C) + 32$$

You would need to subtract both sides by 32 and then divide both sides by 1.8.

$$\frac{°F-32}{1.8}=°C$$

There is one slight change for division, you need to first move your unknown to the numerator if it is in the denominator.

Solve the following equations for x: *Show ALL Work*

1. $14x + 12=40$
2. $2y - 2x = 38$
3. $5x + 8 = 11$
4. $5x - 2 = 8$
5. $kx = a + by$

Solve the following for x_1: *Show ALL Work*

1. $3x_1 + 5y_1 = 2x_2 + 8y_2$
2. $y_1x_1 - k_2 x_2 = 0$

Solve the following equation PV = nRT: *Show ALL Work*

1. For P:
2. For V:
3. For n:
4. For R:
5. For T:

Elements of the Periodic Table

(Please memorize element, Name and Symbol)

Element Name	Element Symbol	Element Name	Element Symbol
Hydrogen	H	Krypton	Kr
Helium	He	Rubidium	Rb
Lithium	Li	Strontium	Sr
Beryllium	Be	Zirconium	Zr
Boron	B	Silver	Ag
Carbon	C	Cadmium	Cd
Nitrogen	N	Tin	Sn
Oxygen	O	Antimony	Sb
Fluorine	F	Iodine	I
Neon	Ne	Xenon	Xe
Sodium	Na	Cesium	Cs
Magnesium	Mg	Barium	Ba
Aluminum	Al	Tungsten	W
Silicon	Si	Gold	Au
Phosphorus	P	Mercury	Hg
Sulfur	S	Lead	Pb
Chlorine	Cl	Bismuth	Bi
Argon	Ar	Polonium	Po
Potassium	K	Astatine	At
Calcium	Ca	Radon	Rn
Scandium	Sc	Francium	Fr
Titanium	Ti	Radium	Ra
Vanadium	V	Lawrencium	Lr
Chromium	Cr	Thorium	Th
Manganese	Mn	Protactinuim	Pa
Iron	Fe	Uranium	U
Cobalt	Co	Neptunium	Np
Nickel	Ni	Plutonium	Pu
Copper	Cu	Bromine	Br
Zinc	Zn	Arsenic	As
Gallium	Ga	Selenium	Se
Germanium		Ge	