AP Chemistry Summer Enrichment

Welcome to AP Chemistry! There will be a lot of differences between AP Chemistry and Regular Chemistry such as the need to memorize various information that was given to you previously. The summer assignment is to help with some of the memorization, math skills, and basic topics that have been covered in chemistry with some additional topics that your class may or may not have covered that are important in AP. AP Chemistry will require a decent amount of time and dedication to study on your own time, much like a college course. If you are ever stuck on any topic, your textbook and online videos will be your best friend to see more examples. It is highly encouraged to make friends and form study groups/networks you can rely on!

For questions, comments, concerns feel free to email me at:

HOJ@esuhsd.org

Replies may take some time as we are on Summer break
I look forward to meeting you all in the coming school year and be prepared to be challenged as soon as school starts!

Supplies recommended for AP Chemistry:

- Scientific Calculator (AP classroom also allows the usage of DESMOS)
- Binder/Lined Paper
- Small Lab Notebook: – for recording lab data.
- Pencil/Pen/Highlighters etc.

Student expectations going into AP Chemistry from General Chemistry
(YOU WILL BE TESTED ON THIS IMMEDIATELY so Review before school starts!)

- Unit conversion calculations: (Milliliters = ? Liters)
- The AP Chem periodic table is provided and note it does not give names
- The concept of Coulombic attraction/(Z_{eff}) and how it explains atomic radius & Ionization Energy
    - Trends: Atomic Radius, Ionization Energy, Electronegativity
- What are Isotopes
- The # of valence electrons for Main Group elements (Groups 1,2,13,14,16,17,18)
- Know the ionic charges for groups: 1(+1), 2 (+2), 13 (+3), 15 (-3), 16(-2), 17 (-1)
- Read and Write Chemical Formulas for both Ionic & Covalent Bonding
- Naming for Ionic Compounds (including the usage of polyatomic & transition metals)
- Naming for Binary covalent compounds
- 7 Diatomic Elements: H_2, N_2 O_2 F_2 I_2 Cl_2 Br_2 (memorize)
- How to balance a Chemical Equation
- Moles
- Stoichiometry
- Limiting Reactant & Percent Yield

Supplemental Content You will need to learn that you may or may not have covered in your General chemistry class.
(You will be tested on this the following week after school starts)

- Significant Figures:
    - **o** How to read how many there are in a number/measurement
    - **o** How to add/subtract & Multiple/divide using significant figures
- How to write and read Electron configurations for ground state elements
- How to draw Lewis Dot Structures for ground state elements
- Molarity

Supplemental content that you may or may not have covered in your

A word on the Usage of AI

While we are not particularly against the usage of AI as a whole, it should only be used as a tool to help facilitate your learning. Use it to help check your answers on problems but never use it to give you the answers. You want to help your brain actually train and practice these skills! A student who has only ever been fed the answers and cannot think for themselves will not be successful in the class. Additionally keep in mind that AI is currently not 100% accurate on all answers. A brain trained on learning the skills and knowledge will be more flexible and adaptable to the multitude of challenges that this course and future higher learning will offer. So do not rob yourself of that!

Summer Enrichment

- **Work on committing the Memorize list to memory**
- **Complete the Worksheet problems below (Print and complete or write the answers on a separate sheet of paper)**
  The worksheets also represent concepts you are expected to know going into AP Chemistry.

MEMORIZE List:

- **How to convert between units in the Metric system and memorize their prefixes & factors**
  - Kilo- (10^{3}), Hecto- (10^{2}), Deca- (10), Deci- (10^{-1}), Centi- (10^{-2}), Milli- (10^{-3}),
    (**K**ing **H**enry **D**ied **D**rinking **C**hocolate **M**ilk)
  - Mega- (10^{5}), Micro- (10^{-5}), Nano- (10^{-9}), pico- (10^{-12})

- **The Ion Charges for the Main Group Elements**
  - Group 1 = 1+ Group 2 = 2+ Group 13 = 3+
  - Group 15 = 3- Group 16 = 2- Group 17 = 1-

- The following Common Polyatomic ions: Both their names and their ion formulas

+1		-1		-2		-3	
Ammonium	NH_4^+	**Acetate**	$C_2H_3O_2^-$	**Biphosphate**	HPO_4^{-2}	**Phosphate**	PO_4^{-3}
Hydronium	H_3O^+	**Bicarbonate**	HCO_3^-	**Carbonate**	CO_3^{-2}		
		Bisulfate	HSO_4^-	**Chromate**	CrO_4^{-2}		
		Bromate	BrO_3^{-1}	**Dichromate**	$Cr_2O_7^{-2}$		
		Chlorate	ClO_3^-	**Oxalate**	$C_2O_4^{-2}$		
		Cyanide	CN^-	**Peroxide**	O_2^{-2}		
		Hydroxide	OH^{-1}	**Sulfate**	SO_4^{-2}		
		Hypobromite	BrO^-				
		Iodate	IO_3^-				
		Nitrate	NO_3^-				
		Perchlorate	ClO_4^-				
		Permanganate	MnO_4^-				

- The names and Formulas for the **6 Strong Acids**
  - Hydrochloric Acid HCl
  - Hydrobromic Acid HBr
  - Hydroiodic Acid HI
  - Nitric Acid HNO_3
  - Perchloric Acid $HClO_4$
  - Sulfuric Acid H_2SO_4
- What the **Strong Bases** are
  - All Group 1 Hydroxides & Group 2 Hydroxides are considered Strong Bases
  - Ie: NaOH, KOH, $Ba(OH)_2$, $Mg(OH)_2$, etc.

- The following **Solubility rules**: Group 1 Cations, Ammonium (NH_4^+), and Nitrate (NO_3^{-1}) are ALWAYS soluble in water

Review Videos to help :

- **Conversions: https://bit.ly/2dIhiCD**
- **Converting Squared and cubed units: https://youtu.be/6fN5cZ5gdrQ**
- **Density: https://youtu.be/74jU3B-2bAE and https://youtu.be/7tVebi3TSsg**
- **Scientific Notation: https://youtu.be/i6lfVUp5RW8**
- **Moles & Gram conversion: https://youtu.be/CMnkSb2YsXI**
- **Limiting Reactant: https://youtu.be/nZOVR8EMwRU and https://youtu.be/Mlu_v8rE1TY**
- **Theoretical and Percent Yield: https://www.youtube.com/watch?v=jtAj0s203CI**
- **Percent Composition by mass: https://www.youtube.com/watch?v=lywmGCfIUIA**

Section 1: Significant Figures

1. Write out a set of rules in your own words for determining the Significant figures of a number

2. Write out a set of rules your own words for determining the number of significant figures in the final answer of an addition/subtraction problem

3. Write out a set of rules your own words for determining the number of significant figures in the final answer of a multiplcation/division problem

Significant Figures Practice Problems

4. How many significant figures are in the following numbers?

a. 0.0450 _____

b. 790 _____

c. 32.10 _____

d. 520 ml _____

e. 0.0105 ms _____

f. 0.140 kg _____

g. 33,700 _____

h. 20.0005 ns _____

i. 0.123 Pa _____

j. 0.005 cm _____

k. 2.006 _____

l. 80000 _____

m. 67600 _____

n. 0.000040 _____

o. 110000000.00 _____

5. How many significant figures should the final answer have?

a. Bob measures out 15.33 grams of Sodium Chloride at first, then he adds 5.54 grams more of NaCl. How many significant figures will he record if he added these two quantities?

_____

b. Bob adds, 13.3 ml of water to 12.005 ml, how many significant figures will he record if he added these two?

_____

c. Bob Calculates the Grams of Product expected if he mixed 20.156 grams of NaCl & 5.55 grams of $AgNO_3$, How many significant figures should his final answer have?

_____

6. **Significant Figure Math**

a. 0.3287 g x 45.2 g = _____

b. 0.258 mL / 0.36105 mL = _____

c. 2.1 x 0.47000 = _____

d. 6000 x 0.144 = _____

e. 40.0 g + 0.7631 g + 5000.112 g + 610.70 g =_____

f. 0.067 cm + 0.104 cm + 3 cm + 7.0002 cm =_____

g. $(2.1 \times 10^{3})(4.0 \times 10^{-4}) =$ _____

h. $\frac{1.6 \times 10^{-8}}{8.0 \times 10^{-3}} =$ _____

i. $4.0 \times 10^{4} + 6 \times 10^{3} =$ _____

j. $8.0 \times 10^{-4} - 9 \times 10^{-5} =$ _____

Section 2: Unit Conversions

Prefixes

1. **What prefix does the following multiplication factors correspond to**

a. 10^{-6} _____

b. 10^{-3} _____

c. 10^{3} _____

d. 10^{6} _____

Conversions

2. **Make the following conversions (Round the answers according to sigfigs and show work with units)**

a. 16.2 m to km

b. 5.44 nL to mL

c. 200.00 mL to L

d. 4.00 L to mL

e. 45.7 mL/s to kL/hr

f. How many cm^2 are in an area of 4.21 in^2 ?

g. 400 cm^3 to m^3

h. Convert 100 ^{o}F to C^{o} then to Kelvin (K)

Section 3: Math Review

In Chemistry there are many mathematical calculations you will have to do. While it is given in the context of chemistry these are the underlying math skills you will need.

Below are actual equations you will need to solve in AP Chemistry eventually but without the units present to keep things simple.

Algebraically solve for the missing Variable.

Solving for an unknown Variable: Show your work

1. **Given the equation: PV = nRT solve the following:**

   a. P = ? V = 0.25 n = 3.25 R = 0.08206 T = 355.22

   b. P = 0.89 V = ? n = 4.43 R = 0.08206 T = 298

   c. P = 1.25 V = 5.45 n = ? R = 0.08206 T = 298

   d. P = 2.00 V = 2.25 n = 5 R = 0.08206 T = ?

2. **Given the equation** $\mathbf{K = \frac{[C]^c[D]^d}{[A]^a[B]^b}}$ **Solve the following:**

   a. a = 1 A = 1
   b = 2 B = 2
   c = 3 C = 3
   d = 4 D = 4
   K = ?

   b. a = 1 A = 5.5
   b = 0 B = 2
   c = 1 C = ??
   d = 1 D = 2.5
   $K = 5.5 \times 10^{8}$

   c. a = 2 A = 0.125
   b = 3 B = ??
   c = 1 C = 0.22
   d = 0 D = 1.0
   $K = 1.0 \times 10^{-14}$

   d. a = 2 A = 0.125
   b = 1 B = 0.115
   c = ? C = 0.22
   d = 2 D = 0.225
   $K = 1.0 \times 10^{14}$

3. **Given the equation:** $q = mc(T_f - T_i)$

a. q = 2000 m = 50 c = 8.314 T_f = 295.15 T_i = ?

b. q = 30000 m = 25 c = 4.184 T_f = ? T_i = 298.15

c. q = 2000 m = 100 c = ? T_f = 500.00 T_i = 293.15

d. q = 2000 m = ? c = 2.00 T_f = 295.15 T_i = 295.15

e. q = ? m = 50 c = 3.93 T_f = 295.15 T_i = 298.15

4. **Solve the following given:**

$pH = - \log [H^+]$

a. What is **pH** if **$[H^+]$** = 0.025

b. What is **pH** if **$[H^+]$** = 0.125

c. What is **pH** if **$[H^+]$** = 1.25×10^{-8}

d. What is **pH** if **$[H^+]$** = 2.05×10^{-13}

5. **Solve the following given:**

$pOH = - \log [OH^-]$

a. What is **pOH** if **$[OH^-]$** = 0.050

b. What is **pOH** if **$[OH^-]$** = 0.450

c. What is **pOH** if **$[OH^-]$** = 2.05×10^{-11}

d. What is **pOH** if **$[OH^-]$** = 4.25×10^{-12}

6. **Solve the following given:**

pH + pOH = 14

a. What is **pH** if **pOH** = 8.0

b. What is **pH** if **pOH** = 11.54

c. What is **pOH** if **pH** = 3.00

d. What is **pOH** if **pH** = 2.22

7. **Solve the following given:**

$[H^+] = 10^{-pH}$

a. What is **$[H^+]$** if **pH** = 3.0

b. What is **$[H^+]$** if **pH** = 4.45

8. **Solve the following given:**

$[OH^-] = 10^{-pOH}$

a. What is **$[OH^-]$** if **pOH** = 9.00

b. What is **$[OH^-]$** if **pOH** = 13.11

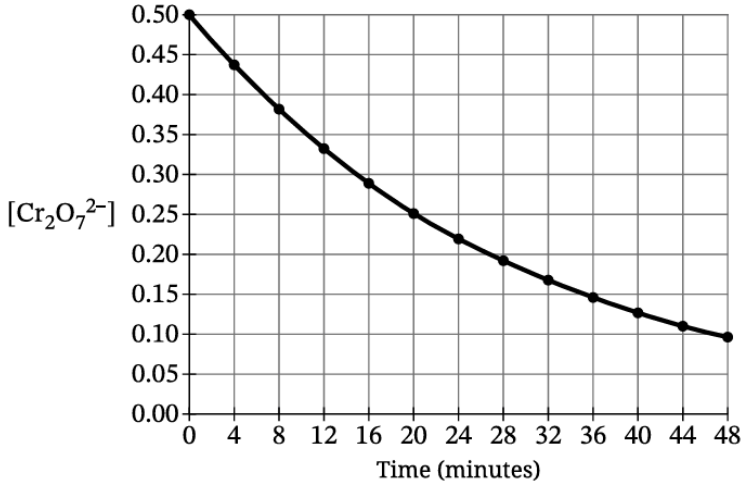
9. Using a combination of the given equations earlier, solve the following.

a. If $[OH^-]$ = 0.125, then what is pH = ?

b. If $[H^+] = 1.25 \times 10^{-5}$, then what is pOH = ?

Graphing:

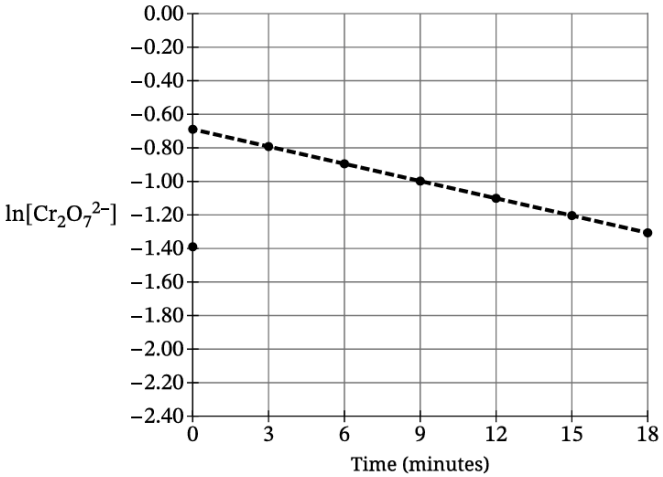
1. A graph of the concentration (M) of $[Cr_2O_7^{2-}]$ in a chemical reaction over time is given below.



a. Complete the table below based on the graph

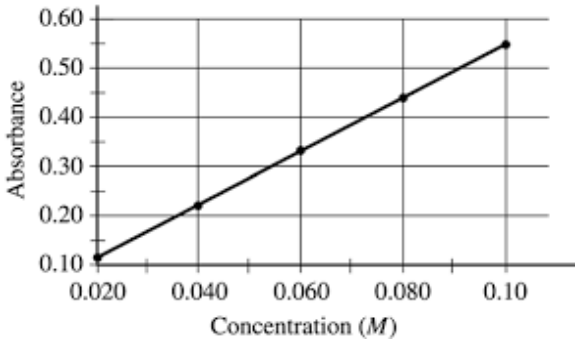
time	$[Cr_2O_7^{2-}]$
0	
8	
	0.25
36	
	0.10

The graph below is obtained by taking the ln of $[Cr_2O_7^{2-}]$ data points from the previous graph



b. What is the slope of the graph of ln of $[Cr_2O_7^{2-}]$ vs. time?

c. A student wanted to sketch a new graph for where $\ln[Cr_2O_7^{2-}]$ at time 0 is -1.40. Assuming the same slope calculated in part (b), sketch what the graph would look like.



2. A Student tested five solutions of different known concentrations (M) and plotted the amount of light each solution absorbed.
Then the plot depicting the amount of light absorbed by each solution is graphed against the concentration (M).

a. Complete the table below by filling in the amount of light absorbed at each concentration

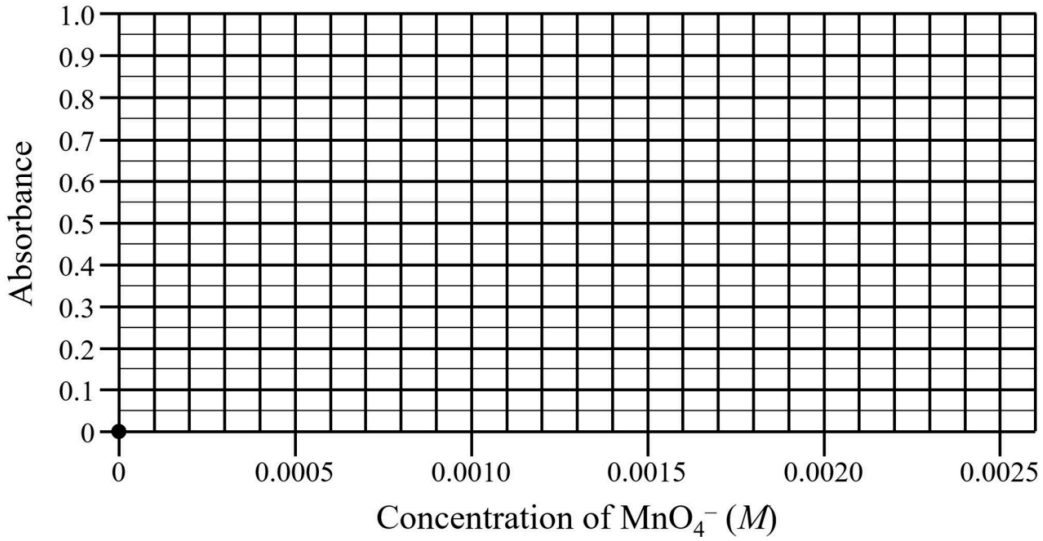
Solution #	Concentration (M)	Amount of light absorbed (Absorbance)
1	0.20	
2	0.040	
3	0.060	
4	0.080	
5	0.10	

b. A student is asked to predict the concentration of four random solutions.
They tested the absorbance of each solution. Use the graph above to estimate the concentrations (M) of each solution the student tested.

Unknown Solution	Estimated Concentration (M) of the unknown solution	Amount of light absorbed (Absorbance)
A		0.25
B		0.50
C		0.70
D		0.85

3. Graph the following data set on the graph provided.

Sample #	Conc. of MnO_4^- (M)	Absorbance
0	0	0
1	0.0005	0.11
2	0.0010	0.35
3	0.0015	0.53
4	0.0020	0.71
5	0.0025	0.89



Section 4: Properties of Substances

Chemical & Physical Properties & Changes

1. Define in your own words
    a. Physical Property & Physical Change (give at least 3 examples of each)
    b. Chemical Property & Chemical Change (Give at least 3 examples of each)

2. Explain why melting a piece of Ice is not considered a chemical change

3. A student takes a large piece of salt and puts it in water. They claim it is a chemical change? Do you agree or disagree? Justify your answer.

Mixtures

1. Define in your own words **heterogeneous mixture** and give a few examples

2. Define in your own words **homogenous mixture** and give a few examples

Density

4. Define **Density** in your own words.

5. Density Practice Problems
    a. What is the density of an object if it has a mass of 10.00 grams and takes up a volume of 35.55 mL?
    b. A mysterious liquid has a density of 1.48 g/cm^3. What volume is the liquid if it has a mass of 5.00 grams?
    c. The density of aluminum is 2.70 g/cm^3.
        i. If a cube of aluminum weighs 13.5 grams, what is the volume of this cube?
        ii. What is the length of the edge of the cube in cm?
    d. Look up the Density of the following Elements
        i. Copper
        ii. Lead
        iii. Iron
        iv. Zinc
        v. A student is trying to identify the type of metal used in a piece of pipe. Assuming the pipe is a singular metal and not a mixture, the student measures the mass of the piece of pipe as 200.00 Gram. To get the volume they decided to use water displacement where they then placed the piece of pipe in a container of water. The water rose by 17.64 mL. What is the density of this object and what metal is it most likely to be? (*note that 1 mL of water has the same volume as 1 cm^3)

Section 5: Atomic Structure & Coulombic Attraction

1. **Define the following terms**
   a. Element

   b. Atom

   c. Molecule

   d. Proton

   e. Neutron

   f. Electron

   g. Valence Electrons

   h. Isotope

2. **Coulomb's Law**
   a. Define Coulomb's Law

   b. In your own words, explain how can Coulomb's law relate to the Structure of an Atom

3. **How many Protons, Neutrons, & electrons are found in the following Isotope Symbols or Isotope Names ?**

a. $^{12}_{6}C$
p^+:___ n^0:_____ e^-:_____

b. $^{25}_{11}Na$
p^+:___ n^0:_____ e^-:___

c. $^{15}_{8}O$
p^+:___ n^0:_____ e^-:___

d. $^{25}_{12}Mg^{2+}$
p^+:___ n^0:_____ e^-:___

e. $^{53}_{26}Fe^{3+}$
p^+:___ n^0:_____ e^-:___

f. $^{109}_{47}Ag^{+}$
p^+:___ n^0:_____ e^-:___

g. $^{35}_{17}Cl^{-}$
p^+:___ n^0:_____ e^-:___

h. $^{32}_{15}P^{3-}$
p^+:___ n^0:_____ e^-:___

i. $^{124}_{53}I^{-}$
p^+:___ n^0:_____ e^-:___

Lewis Dot Diagrams

4. Define what is a Lewis Dot Diagram

5. **Draw the Lewis Dot Diagrams for the following Elements by adding in their valence electrons**

a.	**H**	**f.**	**C**
b.	**K**	**g.**	**O**
c.	**Ca**	**h.**	**Cl**
d.	**Al**	**i.**	**Ne**
e.	**N**	**j.**	**He**

Electron Configurations

6. **Define/Describe Electron Configurations**

7. **Write out directions in your own words on how to write Electron configurations**

8. **Write out the Electron configurations for the following Ground state elements**

a.	**H**	**g.**	**N**
b.	**He**	**h.**	**O**
c.	**Li**	**i.**	**F**
d.	**Be**	**j.**	**Ne**
e.	**B**	**k.**	**K**
f.	**C**	**l.**	**Fe**

Section 6: Periodic Trends

Periodic Trends:

1. Definitions
   a. Define in your own words **Atomic Radius** and what is the trend of atomic radius going up & down and across the periodic table

   b. Define in your own words **Ionization Energy** and what is the trend of ionization energy going up & down and across the periodic table

   c. Define in your own words **Electronegativity** and what is the trend of electronegativity going up & down and across the periodic table

2. Between *each pair* of elements, circle/box/underline the one with the ***Largest*** atomic radius

   I or Sr Sulfur or oxygen F or Cesium

3. Between *each pair* of elements, circle/box/underline the one with the ***Smallest*** atomic radius

   Ba or Ca Sulfur or Argon Chlorine or Oxygen

4. Out of the entire list, circle/box/underline the element with: The **Smallest** atomic radius

   Al Helium B Chlorine Carbon O

5. Place the elements from Largest to Smallest Atomic Radii: K Na Cs H Li

6. Place the elements from Smallest to Largest Atomic Radii: Cesium Tungsten Radon Hafnium Lead

7. Organize the elements by Smallest to Largest Ionization Energy: S Mg Na Cl K P Ne

8. Organize the elements by Highest to Lowest Ionization energy: : Bromine, Indium, Tantalum, Gold, Thallium, Oxygen

9. Put in order from: Largest to Smallest Electronegativity: O, As, C, Br, Fe, Sr, Cs,

10. Organize the elements by Low to high Electronegativity: Fluorine, Technetium, Cobalt, Germanium Manganese, Oxygen

Section 7 Bonding

1. **Define the Octet Rule**

2. **Ionic Bonding**

    a. **Define and describe how an atom becomes a Cation**

    b. **Define and describe how an atom becomes an Anion**

    c. **Define Ionic Bonding & Ionic Compounds**

        i. **Describe how to write and name a Binary Ionic chemical Formula**

        ii. **Describe how to write and name a ternary Ionic chemical Formula**

3. **Define Covalent Bonding & Covalent compounds, & explain how these compounds achieve the octet rule.**

    a. **Describe how to write and name a Binary Covalent Chemical formula**

    b. **What are Homonuclear Diatomic molecules? What are the 7 homonuclear diatomic molecules**

4. **Define Metallic Bonding & describe how these atoms are kept bonded together.**

5. Provide the names for the following ionic compounds:

a. AlF_3
b. $Fe(OH)_2$
c. $Cu(NO_3)_2$
d. $Ba(ClO_4)_2$
e. Li_3PO_4
f. Hg_2S
g. $Cr_2(CO_3)_3$
h. $(NH_4)_2SO_4$
i. $Ca(NO_3)_2$
j. Li_3PO_4
k. $Cr(C_2H_3O_2)_3$
l. $NiCl_2$
m. $Co(NO_3)_3$
n. HgCl
o. Zn_3N_2
p. AlN
q. $Fe_2(SO_3)_3$
r. TiP
s. $CaBr_2$
t. $Ni_2(SO_4)_3$
u. $V(CN)_5$
v. SrO
w. BaS

6. Write the chemical formulas for the following compounds:

a. Potassium Phosphide
b. Lithium Oxide
c. Sodium Iodide
d. Calcium Bromide
e. Calcium Sulfide
f. Calcium Phosphide
g. Gallium Oxide
h. Indium Phosphide
i. Thallium Chloride
j. Copper (I) oxide
k. Potassium peroxide
l. Iron (III) carbonate
m. Zinc nitrate
n. Sodium hypobromite
o. Aluminum hydroxide
p. Aluminum Bromate
q. Potassium Chlorate
r. Calcium Carbonate
s. Ammonium Sulfide
t. Manganese (VI) Bromide
u. Vanadium (V) Carbonate
v. Manganese (II) carbonate
w. Uranium (II) Sulfide
x. Ammonium Phosphate
y. Californium (II) Fluoride
z. Ammonium Nitride

7. Give the name for each of the Binary covalent compounds / Diatomic molecules

a. SF_6
b. XeO_3
c. N_2O_4
d. HCN
e. IF_5
f. H_2O
g. P_4S_6
h. P_4O_{10}
i. SO_3
j. N_3O_5
k. F_2
l. CSe_2
m. N_2Cl
n. P_4O_6
o. I_2
p. H_2O
q. CO_2
r. N_2O_5
s. SiS_2
t. NO_2
u. C_4H_{10}

8. **Write the chemical formulas for the Binary covalent compounds / Diatomic molecules**

a. Dihydrogen Monoxide
b. Hydrogen
c. Nitrogen Monoxide
d. Disulfur Hexoxide:
e. Bromine
f. Tetraphosphorus Decoxide:
g. Trinitrogen Heptoxide:
h. Diphosphorus Pentoxide
i. Nitrogen Trihydride
j. Silicon Dioxide
k. Nitrogen
l. Tricarbon Octahydride
m. Pentacarbon decahydride
n. Sulfur dioxide
o. Chlorine
p. Dinitrogen Heptachloride:

9. Identify if the following molecules demonstrate Ionic or Covalent bonding

a. Aluminum Oxide
b. Diphosphorus Pentoxide
c. Manganese (IV) Phosphate
d. Iodine
e. Ammonium Sulfate
f. Dicarbon Dioxide
g. Cobalt (II) Sulfate
h. Tricarbon Octahydride
i. Calcium Phosphide
j. Dinitrogen Tetrachloride
k. K_3N
l. Fe_2O_3
m. $Ti(SO_3)_2$
n. C_2H_6
o. S_3O_5
p. O_2
q. $AlPO_4$
r. CO
s. CoO
t. Co_2O_3

10. Mixed bonding Practice: Write the chemical formulas for the given name of the compound

a. Sodium Nitride
b. Iodine
c. Carbon Monoxide
d. Iron (II) Phosphate
e. Ammonium Oxide
f. Dicarbon Tetroxide
g. Calcium Sulfite
h. Iron (II) dichromate
i. Barium Nitride
j. Chlorine
k. Sulfur Dibromide
l. Tungsten (VI) Iodate
m. Ammonium Chloride
n. Gold (I) Oxide
o. Ammonium Carbonate
p. Calcium Arsenate
q. Platinum (II) Sulfate
r. Gallium Bromide
s. Carbon tetrahydride
t. Dihydrogen monoxide
u. Sulfur Dioxide
v. Sulfur Hexafluoride
w. Sulfur Tetrafluoride
x. Xenon tetrabromide
y. Chlorine Trifluoride
z. Nitrogen Trihydride

Section 8: Chemical Reactions

1. **Define Chemical Reaction**

2. **Describe what is happening to atoms as a chemical reaction takes place**

Balance the following chemical equations

3. __Rb + __F_2 → ____RbF
4. ____Cu + ____O_2 → _____Cu_2O
5. __Mg + __O_2 → ___MgO
6. __Co + __O_2 →_____CoO
7. __Li + __N_2 → ____Li_3N
8. __Al + __I_2 → ____AlI_3
9. __Ti + __F_2 →_____TiF_4
10. __Ca + __N_2 → _____Ca_3N_2
11. __$Al_2(CO_3)_3$ → __Al_2O_3 + __CO_2
12. __N_2O_5 → ____N_2 + ____O_2
13. __CoO → ____Co + _____ O_2
14. _____ Al_2O_3 → ____Al + __ O_2
15. __W_2O_3 → ___W + _____ O_2
16. __CO → _____C + _____ O_2
17. __H_2O → ____H_2+ _____ O_2
18. __KF → ____K + _____ F_2
19. __Cu_2O → ____Cu + _____ O_2
20. ____CH_5 + ____ O_2 → ____CO_2 + ____H_2O
21. ____C_5H_{12} + ____O_2 → ____CO_2 + ____H_2O
22. ____ C_3H_8O + ____O_2 → ____CO_2 + ____H_2O
23. ___C_9H_{20} + ___O_2 → ____CO_2 + ____H_2O
24. ___$C_9H_{20}O$ + ___O_2 → ____CO_2 + ____H_2O
25. ___$C_{11}H_{22}$ + ___O_2 → ____CO_2 + ____H_2O
26. ___$C_{11}H_{22}O$ + ___O_2 → ____CO_2 + ____H_2O
27. ___$C_{13}H_{26}$ + ___O_2 → ____CO_2 + ____H_2O
28. ___$C_{13}H_{26}O$ + ___O_2 → ____CO_2 + ____H_2O
29. ___Na + ___$CoBr_3$ → _____Co + NaBr
30. _____ Li + _____ $Ca(NO_3)_2$ → _____ Ca + _____$LiNO_3$
31. ____K + ____$Al(NO_3)_3$ → ____Al + ____ KNO_3
32. _____ Ag + $Au(NO_3)_3$ → _____ Au + _____$AgNO_3$
33. _____ Al + ____$CuCl_2$ → _____ Cu + _____$AlCl_3$
34. __$BaCl_2$ + __Na_2SO_4 → _____NaCl + _____ $BaSO_4$
35. __$CuNO_3$ + ___Na_3PO_4 → ____$NaNO_3$ + ____ Cu_3PO_4
36. __$(NH_4)_2CO_3$ + __CaS→ _____$CaCO_3$ + _____ $(NH_4)_2S$
37. __KOH + __$MgBr_2$ → _____$Mg(OH)_2$ + ____ KBr
38. ___$Fe(NO_3)_3$ + ___KOH → ____KNO_3 + ____ $Fe(OH)_3$

Section 9: Moles

1. Define the following:

a. What is a Mole in Chemistry? How is this related to Avogadro's number?

b. What is the Molar Volume at STP? (What is STP?)

c. What is Molar Mass? Describe how you calculate the molar mass of a molecule

2. Moles: Calculate the number of moles of the following (show work & label your units):

a. 42.9 g of KNO_3

b. 1557.7 L of CO_2 at STP

c. 9.25×10^{26} molecules of $CaCl_2$

3. Make the following Mole Conversions

a. How many molecules of Ammonium sulfate are there in 55.21 grams?

How many molecules does a container of 300.00 liters of Carbon monoxide at STP have?

b. How many liters of Nitrogen Trihydride do we have if the container has 450.88 grams at STP ?

c. How many liters of Chlorine gas was produced if there were an estimated 5.10×10^{24} molecules at STP?

d. How many grams of Helium is found in a balloon that has a volume of 3.00 Liters?

e. How many grams of Potassium Sulfate is found in 1.53×10^{24} molecules?

Section 10: Molarity

1. Define Molarity

2. Describe how to calculate the Molarity of a Solution

3. Calculate the Molarity for the following:
    a. 1.0 moles of potassium fluoride is dissolved to make 0.10 L of solution.

    b. 1.0 g of potassium fluoride is dissolved to make 0.10 L of solution.

    c. 1.0 grams of potassium fluoride is dissolved to make 0.10 **mL** of solution.

    d. 952 grams of ammonium carbonate are dissolved to make 1750 **mL** of solution.

    e. 9.82 grams of lead (IV) nitrate are dissolved to make 465 **mL** of solution.

    f. What is the molarity of a 0.30-liter solution containing 0.50 moles of NaCl?

    g. Calculate the molarity of 0.289 moles of $FeCl_3$ dissolved in 120 **mL** of solution

    h. If a 0.075 liter solution contains 0.0877 moles of $CuCO_3$, what is the molarity?

Section 11: Stoichiometry

1. Using the following equation:
   $2\ NaOH + H_2SO4 \rightarrow\ 2\ H_2O + Na_2SO_4$
   How many grams of sodium sulfate will be formed if you start with 200 grams of sodium hydroxide, and you have excess sulfuric acid?

2. Using the following equation:
   $Pb(SO_4)_2 + 4\ LiNO_3 \rightarrow Pb(NO_3)_4 + 2Li_2SO_4$
   How many grams of lithium nitrate will be needed to make 250 grams of lithium sulfate, assuming that you have an adequate amount of lead (IV) sulfate to do the reaction?

3. Using the following equation:
   $Fe_2O_3 + 3\ H_2 \rightarrow 2\ Fe + 3\ H_2O$
   Calculate how many grams of iron can be made from 16.5 grams of Fe_2O_3.

4. How many liters of oxygen gas are produced when 6.23×10^{23} molecules of potassium chlorate break down?

   ____ $KClO_3 \rightarrow$ ____ KCl + ____ O_2

5. If 17.77 grams of Iron (III) are used in the reaction, then how many grams of the product will be produced? ?

   ____ Fe + ____ $I_2 \rightarrow$ ____ FeI_3

6. How many grams of the lead (II) sulfate are made when 1.51×10^{24} particles of Aluminum sulfate were used in the reaction?

   ____ $Pb(NO_3)_2$+ ____ $Al_2(SO_4)_3 \rightarrow$ ____ $PbSO_4$ + ____ $Al(NO_3)_3$

7. How many liters of oxygen was consumed if we burned 2.14×10^{25} particles of methanol (CH_4O)

   ____ CH_4O + ____ $O_2 \rightarrow$ ____ CO_2 + ____ H_2O

8. How many liters of oxygen gas are produced when 6.23×10^{23} molecules of potassium chlorate break down?

____ $KClO_3 \rightarrow$ ____ KCl + ____ O_2

9. If 17.77 grams of Iron (III) are used in the reaction, then how many grams of the expected product will be produced? ?

____ Fe + ____ $I_2 \rightarrow$ ____ FeI_3

10. How many grams of the solid product are made when 1.51×10^{24} particles of Aluminum sulfate was used in the reaction?

____ $Pb(NO_3)_{2\,(aq)}$ + ____ $Al_2(SO_4)_{3(aq)} \rightarrow$ ____ $PbSO_{4\,(s)}$ + ____ $Al(NO_3)_{3\,(aq)}$

11. How many grams of carbon dioxide are produced if we used 500 liters of oxygen gas?

____ $C_5H_{12}O$ + _____ $O_2 \rightarrow$ _____CO_2 + _____ H_2O

12. How many atoms of the aluminum are produced if we used 23.66 grams of magnesium?

____ Mg + ____ $Al(NO_3)_3 \rightarrow$ _____Al + ____ $Mg(NO_3)_2$

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13. ____ C_3H_8 + ____ $O_2 \rightarrow$ _____CO_2 + _____ H_2O

    a. How many Liters of water (H_2O) is produced when 20 liters of Oxygen gas (O_2) combust with propane (C_3H_8)

    b. How many liters of carbon dioxide (CO_2) is produced if we combust 500 liters of Propane (C_3H_8)

    c. How many liters of oxygen (O_2) is consumed to combust with 40 Liters of Propane (C_3H_8)

Section 12: Limiting Reactant and Percent Yield

1. $2\ Na + Cl_2 \rightarrow 2NaCl$
   10.0 g of sodium react with 10.0 g of chlorine gas according to the equation above
   a. What is the limiting reactant
   b. How many grams of Sodium chloride is produced?

2. $2\ Li + 2\ H_2O \rightarrow 2\ LiOH + H_2$
   50.0 g of lithium are reacted with 45.0 g of water according to the equation
   a. What is the limiting reactant
   b. How many grams of Lithium Hydroxide is expected?
   c. How many liters of Hydrogen gas is produced by the reaction?

3. $2\ H_2 + O_2 \rightarrow 2\ H_2O$
   68.3 g of hydrogen reacts with 85.4 g of oxygen according to the chemical equation above.
   a. What is the limiting reactant
   b. How many grams of water is produced?
   c. Determine the Percent yield if 86.4 g of water are collected.

4. Balance: _____Al + _____Cl_2 → _____$AlCl_3$
   114 grams of aluminum and 186 grams of chlorine gas react according to the equation above
   a. What is the limiting reactant?
   b. How many grams of aluminum chloride is produced?
   c. What is the percent yield if only 189.54 grams is made?

5. Balance: _____Fe +_____$AgNO_3$ → _____Ag + _____$Fe(NO_3)_3$
   5 grams of Iron reacts with 5 grams of Silver Nitrate
   a. What is the limiting reactant
   b. How many atoms of Silver are produced?
   c. What is the percent yield if 1.44×10^{22} of product was produced?

6. _____$C_7H_{16}O$ + _____O_2 → _____CO_2 + _____H_2O
   23 grams of $C_7H_{16}O$ reacts with 80 Liters of Oxygen gas in the atmosphere
   a. What is the limiting reactant
   b. How many grams of water vapour is produced?
   c. What is the percent yield if 22.11 grams was produced?

Section 13: Challenge problems (Optional)

1. magnesium (s) reacts with iron (III) nitrate (aq) to produce iron (s) & magnesium nitrate (aq).
In a lab 2.15 grams of magnesium is added to a 25.00 milliliters of 1.500 M iron (III) nitrate.

a. What is the balanced chemical equation?
b. What is the limiting reactant?
c. What is the excess reactant?
d. What is the theoretical yield of iron produced by the reaction?
e. What is the theoretical amount (in moles) of excess reactant left over after the reaction is complete?
f. What is the new molarity of the excess reactant left over in the beaker at the end?

g. A student ran the experiment; however, they left the Iron in the container too long, it reacted with excess oxygen in the atmosphere to produce Rust (aka. Iron (III) Oxide) before they could measure the original mass of the iron produced.
    i. The student measured the mass of the rust (aka. iron (III) oxide) at 2.70 grams.
    ii. How many grams was the Iron before it rusted?
    iii. What is their percent yield for the original experiment?
    iv. What is their percent Error for the original experiment?

2. Sodium sulfate reacts with Lead (II) Nitrate to produce a solid precipitate Lead (II) sulfate and soluble Sodium nitrate. In a beaker a student mixes 20.00 milliliters of a 0.250 M solution of sodium sulfate with a 15.00 milliliters solution of 0.500 M Lead (II) Nitrate.

a. What is the balanced chemical equation?
b. What is the limiting reactant?
c. What is the excess reactant?
d. What is the theoretical yield of solid precipitate?
e. What is the theoretical amount (in moles) of excess reactant left over after the reaction is complete?
f. What is the new molarity of the excess reactant left over in the beaker at the end?
g. If a student ran the experiment and in actuality they produced 1.28 grams of solid precipitate in the lab
    i. What is their percent yield for the experiment?
    ii. What is their percent Error for the experiment?

PERIODIC TABLE OF THE ELEMENTS

1																	18
1 H 1.008	2											13	14	15	16	17	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.30	3	4	5	6	7	8	9	10	11	12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.63	33 As 74.92	34 Se 78.97	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57-71 *	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103 †	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

*Lanthanoids	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.05	71 Lu 174.97
†Actinoids	89 Ac	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr