AP Chemistry Summer Packet

Dear Future AP Chemistry Students,

Welcome to AP Chemistry! We look forward to our journey together in chemistry next year. We have prepared a packet of practice material to help you get into chemistry mode so we can hit the ground running in AP Chem. This is a good opportunity to review topics you studied in Phys-Chem, so they will be fresh in your minds as we begin AP Chem. The packet contains practice problems and links to videos that will help you review. A key is also available at this link. Use it to help you, but know that you are responsible for knowing how to solve these problems!

The practice problems are due on the first day of class, and these topics will be included on our first quiz, during the second week of school. Good luck and have a great summer break!

Sincerely,
Mr. Bernthal, Ms. Kralik, and Ms. Remack
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Part I. Mathematics in Chemistry:

Rules for Significant Figures

1. *Zeroes*
   a. Leading zeros NEVER count as SF.
   b. Captive Zeroes ALWAYS count as SF.
   c. Trailing zeroes only count IF THEY FOLLOW A DECIMAL POINT.
2. *All nonzero digits count as SF.*
3. *Exact Numbers* have unlimited sig figs: Determined by counting and not by using a measuring device
   a. Assumed to have an infinite number of significant figures
   b. Can arise from definitions
   c. Example - 2 in 2πr

● Example - 1.008 has four sig. figs.

Scientific Notation : Know how to convert any number to scientific notation.

- Generic format for scientific notation: #.## x $10^{\#}$
- ALWAYS INCLUDE UNITS IN YOUR ANSWER AND USE CORRECT SIG FIGS!!!
- Know how to use scientific notation in your calculator.

Metric Prefixes:

- Nano (n)= 10^{-9}
- Micro (μ)= $10^{-6.}$
- Milli (m) = 10^{-3}
- Centi (c)= 10^{-2}
- Deci =(d) 10^{-1}
- Kilo (k)= 10^{3}
- Mega (M)= 10^{6}

Unit Conversions: Know how to convert between units

- Mass Units: g and kg
- Length Units: m, mm, cm
- Volume: mL and L
- Density : Density = mass/volume, units: g/cm^3 , g/mL, kg/L,
- Temperature: Kelvin (K), Celsius (°C) T(K) = T(°C) +273

Video Links: Check out Tyler DeWitt on Youtube.

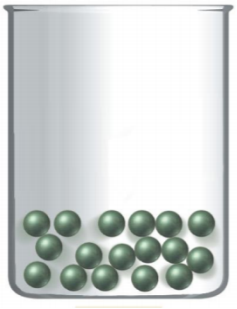
- Significant Figures: https://www.youtube.com/watch?v=5UjwJ9PIUvE
- More Sig Figs: https://www.youtube.com/watch?v=PNH7_nDE6SQ
- Converting Units, simple: https://www.youtube.com/watch?v=7N0IRJLwpPI
- Converting Units, more complex: https://www.youtube.com/watch?v=LdZ00OFAfaQ

Practice Problems

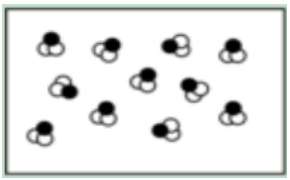
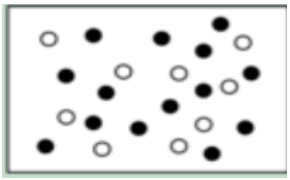
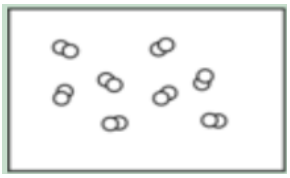
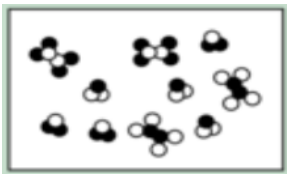
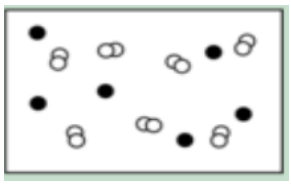
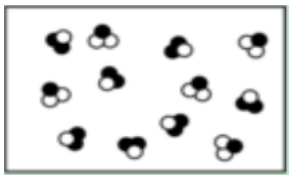
1. Indicate the number of significant figures in each of the following measurements.
    a. 23.500 g _____
    b. 100.35 mL _____
    c. 1.0043×10^{-7} m _____
    d. 0.00230 kg _____
2. Round the following numbers to the indicated number of significant figures.
    a. 0.0089346 kg (3 sig figs) _____
    b. 96515 mL (3 sig figs) _____
    c. 3.50492 m (3 sig figs) _____
3. Perform the following conversions. Show all work.
    a. 100. km to cm (use at least 2 conversion factors)
    b. A liquid has a critical temperature of 154.4 K; calculate the temperature °C.
    c. The thickness of a human hair is approximately 70,000 nm; calculate the thickness in millimeters.
    d. A typical soft drink container is 355 mL; determine the mass of the drink if the density is 1.03 g/cm^3.

Part II. Properties

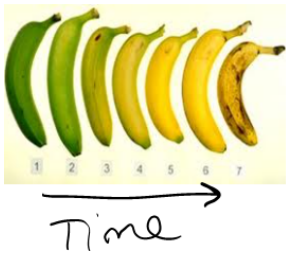
1. Look at the particle picture below. Draw corresponding models for solid and gas.

Solid	Liquid	Gas
		

2. Classify the following as…
    a. Pure element
    b. Pure compound
    c. Mixture of elements only
    d. Mixture of compounds only
    e. Mixture of elements and compounds

3. Classify the following events as chemical or physical changes.

4. Classify the following characteristics as chemical or physical properties.

	chem/phys?		**chem/phys?**
Boiling point of 100°C		Brittle	
Able to react with acid		Good conductor of electricity and heat	
Flammable		Ductile	

5. Consider a sample of sandy salt water. How can you separate the components of the mixture so you end up with pure sand, pure salt, and pure water in separate containers?

Part III. Balancing Equations

Youtube Videos: Tyler Dewitt Channel on Balancing Equations in Chemistry
Intro to Balancing: https://www.youtube.com/watch?v=yA3TZJ2em6g
More Balancing: https://www.youtube.com/watch?v=eNsVaUCzvLA
Reaction types: https://youtu.be/aMU1RaRulSo?si=rJCwwdxD_fWDG3hv

Practice Problems: Balance the following equations and identify the reaction type.

Single Replacement (SR) | Double Replacement (DR) | Combustion (C) | Synthesis (S) | Decomposition (D)

1. _____ $Ca(OH)_2(aq)$ + _____ $H_3PO_4(aq)$ → _____ $H_2O(l)$ + _____ $Ca_3(PO_4)_2(s)$ type:_____

2. _____ $Al(OH)_3(s)$ + _____ $HCl(aq)$ → _____ $AlCl_3(aq)$ + _____ $H_2O(l)$ type:_____

3. _____ $AgNO_3(aq)$ + _____ $H_2SO_4(aq)$ → _____ $Ag_2SO_4(s)$ + _____ $HNO_3(aq)$ type:_____

4. _____ $KO_2(s)$ + ____ $H_2O(l)$ → _____ $KOH(aq)$ + _____ $O_2(g)$ + _____ $H_2O_2(aq)$ type:_____

5. _____ $Fe_2O_3(s)$ + _____ $HNO_3(aq)$ → _____ $Fe(NO_3)_3(aq)$ + _____ $H_2O(l)$ type:_____

6. _____ $C_{12}H_{22}O_{11}(s)$ + _____ $O_2(g)$ → _____ $CO_2(g)$ + _____ $H_2O(g)$ type:_____

7. _____ $Fe(s)$ + _____ $O_2(g)$ → _____ $Fe_2O_3(s)$ type:_____

8. _____ $FeO(s)$ + _____ O_2 → _____ $Fe_2O_3(s)$ type:_____

9. _____ $SiO_2(s)$ + _____ $C(s)$ → _____ $Si(s)$ + _____ $CO(g)$ type:_____

10. _____ $C_{12}H_{22}O_{11}(aq)$ + _____ $H_2O(l)$ → _____ $C_2H_5OH(aq)$ + _____ $CO_2(g)$ type:_____

Part IV. Nomenclature : Compound Names and Formulas

Ionic Compounds: https://www.youtube.com/watch?v=URc75hoKGLY
Molecular Compounds: https://youtu.be/DejkvR4pvRw?si=DtmTn4J6nNOEHsl-

- Know the element symbols, names and charges for atomic numbers 1-30.
- Know the diatomic elements: HONClBrF: H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2
- Know the following polyatomic ion symbols, names and charges:

Acetate	$C_2H_3O_2^{1-}$	Carbonate	CO_3^{2-}
Hydroxide	OH^{1-}	Sulfite	SO_3^{2-}
Bicarbonate	HCO_3^{1-}	Sulfate	SO_4^{2-}
Nitrite	NO_2^{1-}	Chromate	CrO_4^{2-}
Nitrate	NO_3^{1-}	Phosphate	PO_4^{3-}
Chlorate	ClO_3^{1-}	Ammonium	NH_4^{1+}
Chlorite	ClO_2^{1-}		

*There's actually not *that* much memorizing in AP Chemistry! It's just easier if you know these basics, since it will save you tons of time looking them up. After you've got this down, it's all about finding patterns and relationships instead of memorizing. :)

Practice Problems: Practice writing the chemical formulas for the following compounds.

1. Lithium Sulfide _____
2. Silicon tetrahydride_____
3. Aluminum sulfide_____
4. Barium sulfide _____
5. Aluminum nitride _____
6. Calcium oxide _____
7. Gallium phosphide _____
8. Tetraphosphorus trisulfide _____
9. Nitrogen monoxide_____
10. Aluminum nitrate _____
11. Sodium phosphate _____
12. Potassium chlorate _____
13. Sulfur tetroxide _____
14. Lithium carbonate _____
15. Sodium bicarbonate _____
16. Iron (III) fluoride _____
17. Gold (II) nitride_____
18. Lead (II) nitrate _____

Practice Problems: Practice naming the following compounds.

1. N_2O_3_____
2. KBr_____
3. $MgCl_2$_____
4. $AlCl_3$_____
5. $AlBr_3$_____
6. $Fe(NO_3)_2$_____
7. $Fe(NO_3)_3$_____
8. KNO_3_____
9. PCl_3 _____
10. NH_4NO_3_____
11. As_2O_3_____
12. Li_3PO_4_____
13. Na_2CO_3_____
14. CsF_____
15. AgCl_____
16. CCl_4_____
17. BaF_2_____
18. $CuSO_4$_____

Part V. Periodic Table Review

Vocabulary: Define the following.

1. Element_____
2. Atomic Number _____
3. Atomic Mass_____
4. Compound _____
5. Cation _____
6. Anion _____
7. Molecule_____
8. Complete the table:

Element Symbol	Element name & mass #	Atom or ion?	Protons	Electrons	Neutrons
$^{90}_{?}Sr$					
	Cobalt-60	**atom**			
$^{?}_{13}Al^{+3}$					**14**
			9	**10**	**11**

9. Where are metals found on the periodic table? Name 3 examples of metals.

10. Where are the nonmetals found on the periodic table? Name 3 examples of nonmetals.

11. Complete the table with properties of metals and nonmetals from the list below.

Metal Properties	Nonmetal Properties
Conducts heat and electricity, Nonconductive, Malleable, Brittle, Dull, Shiny, Usually forms cations, Usually forms anions	

12. Metalloids are found on the “staircase line.” They are also called semi-metals because they have some metallic and some nonmetallic properties. Identify the following metalloids in the chart below.

Atomic #	Element Name	Atomic #	Element Name
5		14	
32		33	
51		52	
84		85	

Which element is missing from the list but is on the staircase line? (It’s a metal!)

Part VI. Mole Calculations

Mole Calculations and Conversions

To calculate molar mass of an element or compound

1. Element: Use the average atomic mass from periodic table but change unit to grams/mole.
2. Compound: Add atomic masses of all atoms in compound; use unit of grams/mole.

To convert from Grams to Moles

1. Determine the molar mass of the atom or molecular mass of the molecule

2. Divide the mass of the sample by the molar mass to get moles of sample Ex. Example:

Find the number of moles of $CaCl_2$in a 20.0 g sample.

Molar mass of $CaCl_2$ = (40.08 g Ca/mol) +2(35.45 g Cl/mol) = 110.98 g $CaCl_2$/mol

Moles of $CaCl_2$ = 20.0 g $CaCl_2$/ (110.98 g$CaCl_2$/mol) = 0.180 mol $CaCl_2$

To convert from moles to grams

1. Determine the molar mass of of the atom or molecular mass of the molecule

2. Multiply the moles of the sample by the molar mass to get grams of sample

Example: Find the mass of 20 moles of CO.

Molar mass of CO = (12 g C/mo + 16 g O/mol) = 28 g/mol CO

Mass CO = (20 mol CO)(28g CO/1mol CO) = 560 g CO

Tyler Dewitt Videos on YouTube

Converting between moles, atoms, molecules: https://www.youtube.com/watch?v=HMAOrGpkTsQ

Counting atoms: https://www.youtube.com/watch?v=hY7IzRBylSk

Practice Problems: Complete the following table and show your work in the space provided:

Formula	M, Molar Mass (g/mol)	m, Mass of Sample (g)	n, Moles of Sample (mol)
H_2O			3.50
CH_4		22.0	
KI		10.0	
$Mg(OH)_2$			5.50
H_2SO_4		123	
Si			12.5
PCl_5			6.00
C_2H_5OH		40.0	