AP Chemistry Summer Assignment

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To be completed on separate sheets of paper - all work must be shown for credit

Part 1: Atomic Structure and the Periodic Table

Video Resources

https://www.youtube.com/watch?v=5PyVoMnRTlQ Professor Dave Explains Nuclide Symbols (Nuclide Symbols: Atomic Number, Mass Number, Ions, and Isotopes)

https://www.youtube.com/watch?v=zUT3Ubk2JOM Crash Course Chemistry (Electron Configurations Using Periodic Table, Explained in Easy Tutorial)

https://www.youtube.com/watch?v=hePb00CqvP0 Professor Dave Explains The Periodic Table (Atomic Radius, Ionization Energy, and Electronegativity)

https://www.youtube.com/watch?v=QdajjpfwZEM Metals, nonmetals, and metalloids

Questions

1. Fill in the gaps in the following table:

Symbol	$^{31}P^{3-}$			
Protons		34	50	
Neutrons		45	69	118
Electrons			46	76
Net Charge		2-		3+

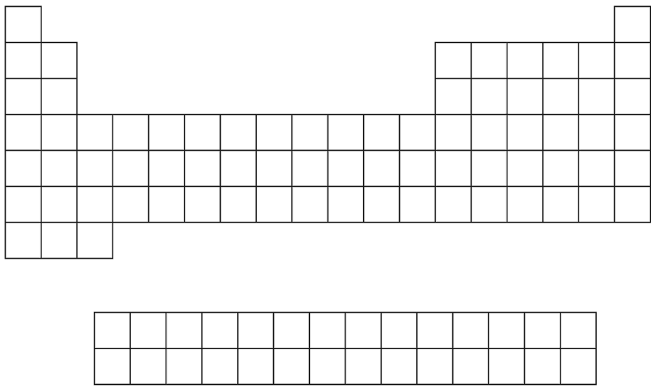
2. Write the orbital-filling diagram, electron configuration, noble gas configuration and draw the lewis dot structure for each of the following elements:
   a. Magnesium
   b. Fluorine
   c. Potassium
   d. Sulfur
   e. Krypton

3. Using the periodic table, arrange each of the following sets of elements in terms of **increasing** atomic radius
   a. K, Li, Cs
   b. Pb, Sn, Si
   c. F, O, N
   d. Ba, Ca, Na
   e. Sn, Sb, As
   f. Al, Be, Si

4. Based on their position in the periodic table - predict which element will have the smaller first ionization energy:
    a. Ti, Ba
    b. Ag, Cu
    c. Ge, Cl
    d. Pb, Sb
    e. Cl, Ar
    f. Be, Ca
    g. S, Ge
    h. Sn, Te

5. Using the periodic table select the most electronegative atom out of each group:
    a. Na, Mg, K, Ca
    b. P, S, As, Se
    c. Be, B, C, Si
    d. Zn, Ge, Ga, As

6. On an outline of the periodic table like the one below, use arrows to label the general trends in which **atomic radius, 1st ionization energy, and electronegativity** each **increase**



7. How is the metallic character of an element related to its first ionization energy?
    a. What type of ion charges do metals typically have as a result of this relationship?
    b. What type of ion charges do nonmetals typically have? Explain in terms of their general values for 1st ionization energy and electronegativity

8. Create a table that categorizes metals, nonmetals, and metalloids in terms of the following general properties: **melting point, state of matter at room temperature, conductivity as a solid, appearance, malleability / ductility as a solid**

Part 2: Bonding and Properties of Matter

Video Resources

https://www.youtube.com/watch?v=S_k0kr2eZSQ Ionic and Covalent Bonding

https://www.youtube.com/watch?v=7x6Mwqi2QLo Properties of Ionic vs. Covalent Bonds

https://www.youtube.com/watch?v=cluXl7o6mAw Lewis Dot Diagrams Made Easy

https://www.youtube.com/watch?v=bzr-byiSXlA Crash Course Chemistry Doing Solids (Solids, Liquids and Gases)

Questions

1. Complete the table by writing the correct ionic formula and name for the compound

Ion	Na^+	Ca^{2+}	NH_4^+	Fe^{3+}
O^{2-}				
NO_3^-				
SO_4^{2-}				
PO_4^{3-}				

2. Answer the following questions regarding covalent and ionic bonding.
   a. What is meant by the term **covalent bond**?
   b. Give three examples of combinations of elements that form covalent bonds
   c. A substance **XY**, formed by two different elements, boils at -33°C. Is XY likely to be a covalent or an ionic substance? Explain.

3. Draw Lewis Dot Structures for the following compounds:
   a. SiH_4
   b. SF_2
   c. CO_2
   e. H_2O
   f. C_2H_4
   g. C_3H_8

d. NH_3 h. HBr

4. How do the average kinetic energy of molecules compare in solids, liquids, and gases?

5. How do the forces of attraction between molecules compare in solids, liquids, and gases?

6. Why does increasing the temperature of a solid substance often cause the substance to change in succession from liquid to gas?

7. What happens to a gas if you put it under extremely high pressure - why does this happen?

Part 3: Stoichiometry and Chemical Reactions

Video Resources

https://www.youtube.com/watch?v=42Mk1B2u0hk Determining the Mole Ratio in a Chemical Equation

https://www.youtube.com/watch?v=lcnliC8JZg0 Melissa Maribel Step By Step Stoichiometry

https://www.youtube.com/watch?v=ymCZ2ShhBAw Melissa Maribel How to Find Limiting Reactant

https://www.youtube.com/watch?v=_xeqkSQb0Pg Percent Yield Made Easy

Questions

1. Calculate the following quantities:
   a. Mass in grams of 0.105 mol of sucrose ($C_{12}H_{22}O_{11}$)
   b. Moles of $Zn(NO_3)_2$ in 143.50 g of this substance
   c. Number of molecules in 1.0×10^{-6} mol CH_3OH
   d. Number of N atoms in 0.410 mol NH_3

2. The reaction between potassium superoxide KO_2 and CO_2 is

$$4KO_2 + 2CO_2 \rightarrow 2K_2CO_3 + 3O_2$$

   a. How many moles of O_2 are produced when 0.400 mol of KO_2 reacts based on this reaction?
   b. How many grams of KO_2 are needed to form 7.50 g of O_2?
   c. How many grams of CO_2 are used when 7.50 g of O_2 are produced?

3. One of the steps in the commercial process for converting ammonia to nitric acid is the conversion of NH_3 to NO:

$$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$$

   In a certain experiment, 2.00 g of NH_3 reacts with 2.50 g O_2
   a. What is the limiting reactant?
   b. How many grams of NO and of H_2O form?
   c. How many grams of excess reactant remain after the limiting reactant is completely consumed?

Part 4: Empirical and Molecular Formulas

Video Resources

https://www.youtube.com/watch?v=lyWAGMEKzSY Empirical Formula from Percent Composition

https://www.youtube.com/watch?v=J_MtVs0aBdU&t=6s Tyler DeWitt Calculating Molecular Formula from Empirical Formula

https://www.youtube.com/watch?v=uvR7zNJ1KoI Introduction to Combustion Analysis, Empirical Formula & Molecular Formula Problems

Questions

1. Determine the empirical formula for the following compounds using the given information:
    a. 0.104 mol K, 0.052 mol C, and 0.156 mol O
    b. 5.28 g Sn and 3.37 g F
    c. 87.5% N and 12.5% H by mass

2. What is the molecular formula of each of the following compounds?
    a. Empirical formula HCO_2 and molar mass = 90.0 g/mol
    b. Empirical formula C_2H_4O and molar mass = 88.0 g/mol

3. Caffeine contains 49.5% C, 5.15% H, 28.9% N, and 16.5% O by mass and has a molar mass of 195 g/mol. Use the above information to solve for the empirical and molecular formula of caffeine.

4. Combustion analysis of toluene, a common organic solvent, gives 5.86 g of CO_2 and 1.37 g of H_2O. If the compound only contains carbon and hydrogen - what is its empirical formula?

5. The formula for epsom salts can be written as $MgSO_4 \bullet xH_2O$ wher x indicates the number of moles of H_2O per mole of $MgSO_4$ in its structure. When 5.061 grams of hydrated $MgSO_4$ is heated all of the water of hydration is lost, leaving 2.472 g of $MgSO_4$. What is the value of x?

Part 5: Solution Chemistry - Acids, Bases, and Molarity

Video Resources

https://www.youtube.com/watch?v=ph5lqm5fi8s Comparing Arrhenius and Bronsted-Lowry Acids and Bases

https://www.youtube.com/watch?v=AaYQ_ZiE7AY How to Memorize Strong Acids and Bases

https://www.youtube.com/watch?v=yb4FW6E1HKE Molarity - The Chemistry Tutorial

https://www.youtube.com/watch?v=v6dnEp58mVk Dilution Problems - The Chemistry Tutorial

Questions

1. What is the major difference between acids and bases in terms of ions produced in solution?
    a. Describe the similarities and differences between Arrhenius acids and Bronsted-Lowry acids
    b. Describe the similarities and differences between Arrhenius acids and Bronsted-Lowry bases

2. What is the definition of a **strong** acid or base (how do both act in aqueous solution?)

3. Make a table that lists all of the strong acids and strong bases - memorize this table

4. Solve the following problems as they relate to molarity
    a. Calculate the molarity of a solution that contains 0.175 mol $ZnCl_2$ in enough water to form exactly 150 ml of solution
    b. How many moles of HCl are present in 35.0 mL of a 4.50 M solution of HCl?
    c. How many milliliters of 6.00 M NaOH solution are needed to provide 0.325 mol of NaOH?

5. How many milliliters of a stock solution of 6.0 M HNO_3 would you have to use to prepare 110 mL of 0.500 M HNO_3?

    a. If you dilute 10.0 mL of the same stock solution to a final volume of 250 mL, what will the concentration of the diluted solution be?