MIDTERM REVIEW

Scientific Method - steps, scientific laws

Matter - physical & chemical properties
- physical and chemical change
- pure substances: elements & compounds
- mixtures

Reactants & Products:
- Law of Conservation of Mass

Metric Measurements:
- Scientific notation, Significant figures
- Add, subtract, multiply, divide

Atomic Structure & Periodic Table:
- Atomic mass, atomic number
- # protons, # electrons, # neutrons
- isotopes, average atomic mass
- families, periods
- periodic trends
- group trends

Types of reactions:
- Decomposition, Synthesis,
- Single-Displacement, Double-Displacement,

Name each compound and identify as Molecular or Ionic:

Cu_3N	S_3O_5
MnS	P_2F_3
PbO_2	CO_2
$HgCl_2$	N_4I_2

What ions make up and name:

$MgBr_2$	Cu_2CO_3
$Ba(NO_3)_2$	NH_4Cl
$Sn_3(PO_4)_2$	FeI_2
$Al_2(SO_4)_3$	$Pb(OH)_2$

Properties of metals, nonmetals, metalloids:
- Laws of Definite & Multiple Proportions

Know these scientist and their work: *J.J. Thompson, John Dalton, Democritus, Ernest Rutherford, Demitri Mendeleev, James Chadwick*

Density of solids and liquids: d = m/v

Empirical or Molecular Formulas or both?

$C_5H_{10}O_5$ $C_6H_{12}O_6$ H_2O_2 $C_{12}H_{17}ON$ Na_3N

Find Molecular Mass:

K_3PO_4 $Ca(NO_3)_2$ $Al_2(SO_4)_3$ $(NH_4)_2CO_3$

How many molecules/formula units are there of each of the compounds above (assume 10.0 g of each compound)?

Balance:

$PbO_2 \longrightarrow PbO + O_2$

$MnO_2 + HCl \longrightarrow MnCl_2 + Cl_2 + H_2O$

$KOH + H_3PO_4 \longrightarrow K_3PO_4 + H_2O$

$Al(NO_3)_3 + H_2SO_4 \longrightarrow Al_2(SO_4)_3 + HNO_3$

Complete and Balance:

$Ca(NO_3)_2 + HCl \longrightarrow$

$BaCl_2 + Na_2SO_4 \longrightarrow$

% Composition:

a) $Na_2S_2O_3$ b) NH_4NO_3 c) calcium chloride d) sodium phosphate

Write the compound formulas and balance each equation:

1) aluminum nitrate + sodium hydroxide ------> aluminum hydroxide + sodium nitrate
2) copper (II) chloride + potassium sulfate ------> potassium chloride + copper (II) sulfate
3) hydrogen carbonate + magnesium hydroxide ------> magnesium carbonate + water

Balance the following equations:

1) $NaOH\ (aq) + HCl\ (aq) \longrightarrow H_20\ (l) + NaCl\ (aq)$
2) $Pb(NO_3)_2\ (aq) + NaCl\ (aq) \longrightarrow PbCl_2\ (s) + NaNO_3\ (aq)$
3) $Na_3PO_4\ (aq) + CaCl_2\ (aq) \longrightarrow NaCl\ (aq) + Ca_3(PO_4)_2\ (s)$

Calculate the number of moles of the following:

1) 560.0 g of bromine, Br_2
2) 73.2 g of magnesium
3) 814 g of $Ba(OH)_2$
4) 472 g of water
5) 86.6 g of methane, CH_4
6) 8.25 g of $CaCO_3$
7) 200.0 g of Al_2O_3

Calculate the mass in grams of each of the following:

1) 5.25 mol ZnO How many total atoms are there?
2) 12.4 mol HCl How many total atoms are there?
5) 205 mol Al_2O_3 How many molecules?
6) 42.7 mol Na_2CO_3 How many molecules?

3) 6.68 mol H_2SO_4 How many oxygen atoms are there?
4) 7.5 mol sugar, $C_6H_{12}O_6$ How many molecules are there?
7) 80.3 mol CH_4 How many total atoms?
8) 8.273 mol $CaCO_3$ How many molecules?

Quantum Mechanics:

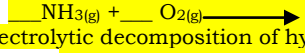
1) How is light produced?
2) Explain why flame tests produce different colors for different elements.
3) a. Calculate the frequency of a wave that is 450nm.
   B. Calculate the energy of a wave that has a frequency of 2.3×10^{14} hz
5) Rules for filling electron orbitals: Aufbau principle, Pauli exclusion principle, Hund's rule
6) What is the electron configuration for each of the following atoms?
   a) vanadium b) tellurium c) potassium

Chemical Bonding:

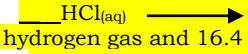
1) Define the following terms:
   a) valence electrons b) octet rule c) malleable d) ductile
2) Differentiate between ionic, covalent, and metallic bonding in terms of electron location and types of atoms combined.
3) How many valence electrons do each of the following atoms have?
   a) sodium b) argon c) carbon d) nitrogen
4) Draw the electron dot structure for each of the atoms above.
5) List three properties of ionic compounds.
6) How many electrons must each of the following atoms lose or gain in order to obtain a noble gas configuration? What is the resulting charge on each atom? Label each as anion or cation.
   a) cesium b) bromine c) phosphorus
7) Define the following terms:
   a) resonance structures b) dipole c) electronegativity d) London dispersion forces
8) Classify each of the following substances as having ionic bonds, covalent bonds, or metallic bonds.
   a) brass b) sodium bromide c) methane d) water e) calcium chloride
9) List all atoms that exist as diatomic molecules.
10) Draw the Lewis Structure, Identify the geometry, bond angles, polarity and hybridization for the following compounds.
   1) H_2O 2) N_2 3) XeF_4 4) CH_4 5) NH_3 6) NO_2^-
11) Describe the VSEPR theory and how it relates to shape.
12) Differentiate between single, double, and triple bonds in terms of strength, length, and electrons being shared.
13) What are the (1) molecular shapes and (2) bond angles for each of the following molecules? Label the molecules as polar, nonpolar, or ionic.
   a) ammonia b) water c) carbon dioxide d) carbon tetraiodide
14) Differentiate between the three main types of intermolecular forces described in your text.
15) Differentiate between the properties of ionically and covalently bonded compounds.
16) Describe each of the following and give three examples of each. Use electronegativities to support your answer.
   a) nonpolar covalent bond b) polar covalent bond c) ionic bond.
17) Explain each of the following observations on the basis of the forces of attraction that exist between the particles in matter.
   a) Water evaporates faster at 40°C than at 20°C.
   b) Propane (C_3H_8) boils at a lower temperature than water.
   c) Oil is not soluble in water

9 Stoichiometry DO NOT DO these problems. We did not cover STOICH!

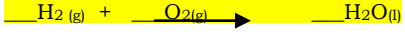
1. What is a limiting reagent? How do you find the mole ratio for reactants and products in a stoichiometry problem?
2. Calculate the mass of silver needed to react with chlorine to produce 84.0 g of silver (I) chloride. Write a balanced equation.
3. What mass of ammonia, NH_3, is necessary to react with 2.1×10^{24} molecules of oxygen in the following equation?



4. Calculate the percent yield in the electrolytic decomposition of hydrogen chloride if 25.8 g of HCl produce 13.6 g of chlorine gas.



5. Water can be made by cooling 16.2 g of hydrogen gas and 16.4 g of oxygen gas.



a) What is the limiting reagent?
b) What is the maximum amount of water that can be synthesized?

Nuclear Chemistry:

1) Differentiate between fission, fusion, and nuclear decay.
2) Show the symbols used for alpha, beta, and gamma radiation. Rank them according to their ability to penetrate substances.
3) Calculate the following:
   a) A radioactive compound had a half life of 2.6 years. If you started with 200. g of it, how much would you have left after 13 years?
   b) What is the half life for a substance that decayed from 100. g to 25g in 16 days?
4) Write the balanced nuclear equations for the following:
   a) alpha decay of thorium – 230 b) alpha decay of $^{235}_{92}U$
   c) beta decay of thorium – 234 d) beta decay of $^{66}_{29}Cu$