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AP Chemistry- 2020 Summer Assignment

- **Answer the questions, Label chapter and question number, show work for all calculations, Box final answers with units, rounded to correct number of sig figs.**
- **Do the assignment in a one subject spiral notebook, label with your name.**
- **Your work should be neat and legible, written with dark pencil or pen. Keep space between answers. Start a new page for each Chapter.**
- **Work is due the first day of class, following about a week of review, you will be tested on the materials in this assignment.**

Chapter 1: The Foundations of Chemistry

58. The specific heat of aluminum is 0.895 J/g · °C. Calculate the amount of heat required to raise the temperature of 35.1 g of aluminum from 27.0 °C to 62.5 °C.

59. How much heat must be removed from 19.5 g of water at 90.0 °C to cool it to 34.2 °C?

60. In some solar-heated homes, heat from the sun is stored in rocks during the day and then released during the cooler night. a. Calculate the amount of heat required to raise the temperature of 69.7 kg of rocks from 25.0 °C to 41.0 °C. Assume that the rocks are limestone, which is essentially pure calcium carbonate. The specific heat of calcium carbonate is 0.818 J/g · °C. b. Suppose that when the rocks in part (a) cool to 30.0 °C, all the heat released goes to warm the 10,000 ft3 (2.83 x 105 L) of air in the house, originally at 10.0 °C. To what final temperature would the air be heated? The specific heat of air is 1.004 J/g · °C, and it's density is 1.20 x 10^{-3} g/mL.

62. When 50.0 grams of metal at 75.0 °C is added to 100. grams of water at 15.0 °C, the temperature of the water rises to 18.3 °C. Assume that no heat is lost to the surroundings. What is the specific heat of the metal?

65. The radius of a hydrogen atom is about 0.37 Å, and the average radius of the earth's orbit around the sun is about 1.5 x 10^8 km. Find the ratio of the average radius of the earth's orbit to the radius of the hydrogen atom.

68. The lethal dose of a specific drug taken orally is 1.5 mg/kg of body weight. Calculate the lethal dose of the drug taken orally by a 165-lb person.

70. Household ammonia is 5% ammonia by mass and has a density of 1.006 g/mL. What volume of this solution must a person purchase to obtain 25.8 g of ammonia?

80. Cesium atoms are the largest naturally occurring atoms. The radius of a cesium atom is 2.65 Å. How many cesium atoms would have to be laid side by side to give a row of cesium atoms 1.00 in. long? Assume that the atoms are spherical.

Chapter 2: Chemical Formulas and Composition Stoichiometry

12. Name the following compounds:
 a. HNO_3 b. C_5H_{12} c. NH_3 d. CH_3OH

 18. Write the chemical formula for the ionic compound formed between each of the following pairs of ions. Name each compound.
 a. Cu^{2+} and CO_3^{2-} b. Sr^{2+} and Br^- c. NH_4^+ and CO_3^{2-} d. Zn^{2+} and O^{2-}
 e. Fe^{3+} and SO_4^{2-}

  22. Write the formula of the compound produced by the combination of each of the following pairs of elements. Name each compound.
 a. Sodium and Chlorine   b. Magnesium and Bromine   c. Sulfur and Oxygen
 d. Calcium and Oxygen   e. Potassium and Sulfur   f. Aluminum and Bromine

30. Determine the formula weight (molecular mass) of each of the following compounds:
 a. Hydrogen Sulfide   b. Phosphorous Trichloride   c. Hypochlorous Acid
 d. Hydrogen Iodide

38. How many molecules are in 15.5 g of each of the following substances?
 a. CO2   b. N2   c. P_4 d. P_2 e. Do parts c. and d. contain the same number of atoms of phosphorous?

 44. What is the mass of 8.00 million methane, CH_4, molecules?

 52. The beta-blocker drug, timolol, is expected to reduce the need for heart bypass surgery. Its composition by mass is 49.4% C, 7.64% H, 17.7% N, 15.2% O, and 10.1% S. The mass of 0.0100 mol of timolol is 3.16 g. a. What is the simplest(empirical) formula of timolol?
 b. What is the molecular formula of timolol?

56. A common product found in nearly every kitchen contains 27.37% sodium, 1.20% hydrogen, 14.30% carbon, and 57.14% oxygen. The simplest formula is the same as the formula of the compound. Find the formula of this compound.

60. A compound with the molecular weight of 56.0 g was found as a component of photochemical smog. The compound is composed of carbon and oxygen, 42.9% and 57.1%, respectively. What is the formula of this compound?

62. Calculate the percent composition of the following compound:
vitamin E - $C_{29}H_{50}O_2$

66. A 0.1153 gram sample of pure hydrocarbon was burned in a C-H combustion train to produce 0.3986 grams of CO_2 and 0.0578 grams of H_2O. Determine the masses of C and H in the sample and the percentage of these elements in this hydrocarbon.

70. A 1.000 gram sample of an alcohol was burned in oxygen to produce 1.913 g of CO_2 and 1.174 g of H_2O. The alcohol contained only C, H, and O. What is the simplest formula of the alcohol?

82. When a mole of $CuSO_4 \cdot 5H_2O$ is heated to 110°C, it loses four moles of H_2O to form $CuSO_4 \cdot H_2O$. When it is heated to temperatures above 150°C, the other mole of H_2O is lost.
a. How many grams of $CuSO_4 \cdot H_2O$ could be obtained by heating 675 g of $CuSO_4 \cdot 5H_2O$ to 110°C? b. How many grams of anhydrous $CuSO_4$ could be obtained by heating 584 g of $CuSO_4 \cdot 5H_2O$ to 180°C?

86. a. What weight of magnesium carbonate is contained in 562 pounds of an ore that is 26.7% magnesium carbonate by weight?
b. What weight of impurities is contained in the sample?
c. What weight of magnesium is contained in the same? (Assume that no magnesium is present in the impurities.)
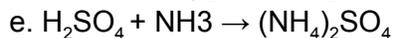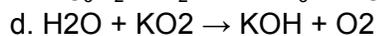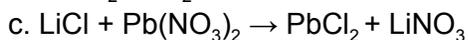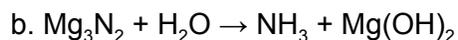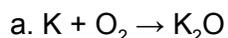
88. a. What is the percent by mass of copper sulfate, $CuSO_4$, in a sample of copper sulfate pentahydrate, $CuSO_4 \cdot 5H_2O$?
b. What is the percent by mass of $CuSO_4$ in a sample that is 74.4% $CuSO_4 \cdot 5H_2O$ by mass?

92. Vitamin E is an antioxidant that plays an especially important role protecting cellular structures in the lungs. Combustion of a 0.497 g sample of vitamin E produced 1.47 g of carbon dioxide and 0.518 g of water. Determine the empirical formula of vitamin E.

Chapter 3: Chemical Equations and Reaction Stoichiometry

8. Balance each "equation" by inspection.

a. $K + O_2 \rightarrow K_2O$

b. $Mg_3N_2 + H_2O \rightarrow NH_3 + Mg(OH)_2$

c. $LiCl + Pb(NO_3)_2 \rightarrow PbCl_2 + LiNO_3$

d. $H2O + KO2 \rightarrow KOH + O2$

e. $H_2SO_4 + NH3 \rightarrow (NH_4)_2SO_4$

14. a. Limestone, CaCO3, dissolves in muriatic acid, HCl, to form calcium chloride, CaCl2, carbon dioxide, and water. b. How many moles of HCl are required to dissolve 5.4 mol of $CaCO_3$? c. How many moles of water are formed in part b?

30. Carbon monoxide and oxygen react to give carbon dioxide. $2CO + O2 \rightarrow 2CO2$ Imagine that we mix six CO molecules and six O_2 molecules and allow them to react as completely as possible.

 a. Draw a molecular representation of the mixture and reactants.

 b. Draw a molecular representation of the product mixture, including any remaining reactant molecules.

c. How many grams of CO_2 can be prepared from 134.67 g of CO and 77.25 g of O_2?

36. What is the maximum amount of $Ca_3(PO_4)_2$ that can be prepared from 12.9 g of $Ca(OH)_2$ and 18.37 g of H_3PO_4? $3Ca(OH)_2 + 2H_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6H_2O$

42. When heated, potassium chlorate. $KClO_3$, melts and decomposes to potassium chloride and diatomic oxygen.

 a. What is the theoretical yield of O_2 from 3.75 g $KClO_3$?

b. If 1.05 g of O_2 is obtained, what is the percent yield?

48. The reaction of finely divided aluminum and iron(III) oxide, Fe_2O_3, is called the thermite reaction. It produces a tremendous amount of heat, making the welding of railroad track possible. The reaction of 500.0 grams of aluminum and 500.0 grams of iron(III) oxide produces 166.5 grams of iron. $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3 + Heat$

 a. Calculate the mass of iron that should be released by this reaction.

b. What is the percent yield of iron?

  66. A solution made by dissolving 16.0 g of $CaCl_2$ in 64.0 g of water has a density of 1.180 g/mL at 20°C.

a. What is the percent by mass of $CaCl_2$ in the solution?

b. What is the molarity of $CaCl_2$ in the solution?

72. Commercial concentrated hydrochloric acid is 12.0 M HCl. What volume of concentrated hydrochloric acid is required to prepare 2.50 L of 1.50 M HCl solution?

76. Calculate the final volume of solution obtained if 100. mL of 12.0 M NaOH are diluted to 5.20 M.

82. An excess of $AgNO_3$ reacts with 110.5 mL of an $AlCl_3$ solution to give 0.215 g of AgCl. What is the concentration, in moles per liter, of the $AlCl_3$ solution?
$AlCl_3 + 3AgNO_3 \rightarrow 3AgCl + Al(NO_3)_3$
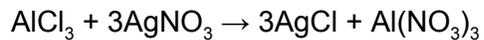
100. What is the molarity of a solution prepared by mixing 35.0 mL of 0.375 M NaCl solution with a 47.5 mL of a 0.632 M NaCl solution?