AP Chemistry Summer Assignment 2018-19

Part I: (correct numerical answers must show correct significant figures)

1. An element has two naturally occurring isotopes with the following masses and abundances:

| Isotopic Mass (amu) | Fractional Abundance |
|---|---|
| 68.9256 | 0.611 |
| 70.9247 | 0.3989 |

What is the average atomic mass of this element? _____

What is the identity of this element? _____

2. An element has three naturally occurring isotopes with the following masses and abundance.

| Isotopic Mass (amu) | Fractional Abundance |
|---|---|
| 27.977 | 0.9221 |
| 28.976 | 0.0470 |
| 29.974 | 0.0309 |

What is the average atomic mass of this element? _____

What is the identity of the element? _____

3. A sample of ethanol (ethyl alcohol) $C_5H_5OH$, contains 3.1 x 10 $^{23}$ hydrogen atoms. How many C2H5OH molecules are in this sample?

_____

4. For each of the following pairs of ions, write the formula for the corresponding compound.

$Co^{+2}$ and $Br^{-}$ _____

$K^{+}$ and $O^{-2}$ _____

$Ni^{+2}$ and $OH^{-}$ _____

$Na^{+}$ and $PO_4^{-3}$ _____

5. Name the following compounds correctly

$N_2O_4$ _____

$Fe_2O_3$ _____

$Cu(NO_3)_2$ _____

$P_4O_6$ _____

6. For each of the following binary compounds, decide whether the compound is expected to be ionic or molecular.

CuCl _____

$N_2O_4$ _____

CsI _____

$Fr_2O$ _____

7. Give systematic names to the following binary compounds.

$As_4O_6$ _____

$CCl_4$ _____

$SF_4$ _____

$ClO_2$ _____

8. Write formulas for the following compounds.
   Chlorine trifluoride _____
   Dichlorine monoxide _____
   Dinitrogen tetrafluoride _____
   Phosphorous pentafluoride _____
9. Give the name and formula for the acid associated with the following oxyanions:
   $ClO_4^-$ _____ _____
   $SO_4^{-2}$ _____ _____
   $SeO_4^{-2}$ _____ _____
   $Cr_2O_7^{-2}$ _____ _____
10. Give the name and formula for the acid associated with the following oxyanions:
    $SeO_3^{-2}$ _____ _____
    $SO_3^{-2}$ _____ _____
    $IO^-$ _____ _____
    $P_2O_7^{-4}$ _____ _____
11. Cobalt (II) hexahydrate has a pink color. It loses water on heating and changes to a blue-colored compound. What is the formula of Cobalt (II) chloride hexahydrate? _____
12. Balance the following equations using the smallest possible coefficients.
    $\_\_Sn + \_\_NaOH \rightarrow \_\_Na_2SnO_2 + \_\_H_2$
    $\_\_Al + \_\_Fe_3O_4 \rightarrow \_\_Al_2O_3 + \_\_Fe$
    $\_\_CH_3OH + \_\_O_2 \rightarrow \_\_CO_2 + \_\_H_2O$
    $\_\_P_4O_{10} + \_\_H_2O \rightarrow \_\_H_3PO_4$
    $\_\_PCl_5 + \_\_H_2O \rightarrow \_\_H_3PO_4 + \_\_HCl$
13. Balance the following equations using the smallest possible coefficients.
    $\_\_Cl_2O_7 + \_\_H_2O \rightarrow \_\_HClO_4$
    $\_\_Na_2S_2O_3 + \_\_I_2 \rightarrow \_\_NaI + \_\_Na_2S_4O_6$
    $\_\_MnO_2 + \_\_HCl \rightarrow \_\_MnCl_2 + \_\_Cl_2 + \_\_H_2O$
14. Solid potassium metal reacts with water, giving a solution of potassium hydroxide and releasing hydrogen gas. Write a balanced equation for the reaction using complete formulas for the compounds with phase labels indicating the states of matter under standard conditions.

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15. Lead metal is produced by heating solid lead (II) sulfide with solid lead (II) sulfate, resulting in liquid lead and sulfur dioxide gas. Write a balanced equation for the reaction using complete formulas for the compounds with phase labels indicating the states of matter under standard conditions.

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16. How many protons, neutrons and electrons are in $^{119}Sn^{+4}$?
    Protons _____ Neutrons _____ Electrons _____
17. You have a mythical element, X, that can exist as $X^+$, $X^{2+}$ or $X^{5+}$ ions.
    What would be the chemical formulas for compounds fromed from the combination of X ions with sulfate ions?

_____ _____ and _____

If the name of element X is "exy", name each of the compounds created above.

_____ _____ and _____

18. A chunk of an unidentified element (let's call it X) is reacted with sulfur to form an ionic compound with the chemical formula $X_2S$. Which of the following elements is the most likely identity of X? Indicate your answer by circling the correct element.

    C Br Ca K Al

19. Write formulas and names for all the ionic compounds that can form by combinations of the following ions: $Mg^{+2}$, $Pb^{+4}$, carbonate anion and phosphide anion:

    _____ _____

    _____ _____

    _____ _____

    _____ _____

20. The IO3- anion is called iodate. There are three related anions, IO-, IO2- and IO4-.Using what you have learned about similar groups of anions, write the name for each of the following compounds.

    $Sn(IO_3)_2$ _____

    $Al(IO_2)_3$ _____

    $KIO_4$ _____

    $LiIO_4$ _____

Part II: (correct numerical answers must show correct significant figures)

21. Find the formula masses of the following substances to three significant figures.

    Phosphorous pentachloride _____

    Sulfuric acid _____

    Potassium sulfite _____

22. Calculate the mass in grams of the following.

    0.225 mol Fe _____

    0.783 mol F _____

    6.10 mol $CO_2$ _____

    37.0 mol $K_2CrO_4$ _____

23. Find the moles in each of the following.

    2.58 g As _____

    7.93 g $S_8$ _____

    38.0 g $N_2H_4$ _____

    238 g $Al_2(SO_4)_3$ _____

24. Calcium sulfate is a white, crystalline powder. Gypsum is a mineral that is a hydrate of calcium sulfate. A 0.799 g smaple of gypsum contains 0.632 g $CaSO_4$. How many moles of $CaSO_4$ are there in this sample? _____

Assuming that the rest of the sample is water, how many moles of water are there in the sample? _____

Use this information to write a chemical formula for the mineral called gypsum. _____

25. Calculate the following.

    Number of atoms in 22.6 g Al _____

    Number of atoms in 85.1 g $I_2$ _____

    Number of molecules in 12.0 g $N_2O_5$ _____

    Number of furmula units in 3.35 g $NaClO_4$ _____

    Number of Ca+2 ions in 4.98 g $Ca_3(PO_4)_2$ _____

26. Chlorine trifluoride is a colorless, reactive gas used in nuclear fuel reprocessing. How many molecules are there in a 5.84 mg sample of chlorine trifluoride? _____

27. A 1.733 g sample of coal contains 1.404 g C. Calculate the mass percentage of C in the coal sample. _____

28. Calculate the percent composition for each of the follwong compounds to three significant figures.

    $H_2O_2$ _____% H _____% O

    $KClO_4$ _____%K _____%Cl _____%O

29. Calculate the amss percentarge to three significant figures of each element in propanol ($C_3H_7OH$)

    _____% C _____% H _____% O

30. An oxide of osmium is a pale yellow solid. If 2.76 g of the compound contains 2.07 g of Os, what is its empirical formula? _____

31. Putrescine, a substance produced by decaying animals, has the empirical formula C2H6N. Several determinations of molecular mass give values in the range of 87-90 amu. Find the molecular formula for putrescine. _____

32. Butane, $C_4H_{10}$, burns with the oxygen in air to give carbon dioxide and water.

    $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$

    What is the amount (in moles) of carbon dioxide produced from 0.23 mol $C_4H_{10}$?

    _____

33. Nickel (II) chloride reacts with sodium phosphate to precipitate nickel (II) phosphate.

    $3\ NiCl_2 + 2\ Na_3PO_4 \rightarrow Ni_3(PO_4)_2 + 6\ NaCl$

    How many moles of nickel (II) chloride are needed to produce 0.523 mol nickel (II) phosphate?

    _____

34. Tungsten metal, W, is used to make incandescent bulb filaments. The metal is produced fro the yellow tungsten (VI) oxide, WO3, by reaction with hydrogen.

    $WO_3 + 3\ H_2 \rightarrow W + 3\ H_2O$

    How many grams of tungsten can be obtained from 4.15 kg of hydrogen with excess tungsten (VI) oxide? _____

35. Using the following reaction , large quantities of ammonia are burned in the presence of a platinum catalyst to give nitric oxide, as the first step in preparation of nitric acid.

$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

Suppose a vessel contains 4.30 g of $NH_3$, how many grams of $O_2$ are needed for a complete reaction? _____

36. Solutions of sodium hypochlorite, NaClO, are sold as a bleach. They are prepared by the reaction of chlorine with sodium hydroxide.

$2\ NaOH + Cl_2 \rightarrow NaCl + NaClO + H_2O$

If you have 1.87 mol of NaOH in solution and 1.84 mol of $Cl_2$ gas available to react, which is the limiting reactant? _____

How many moles of NaClO could be obtained? _____

37. Methanol ($CH_3OH$) is prepared industrially from the gas phase catalytic balanced reaction below.

$CO + 2\ H_2 \rightarrow CH_3OH$

In a laboratory test, a reaction vessel was filled with 52.7 g CO and 11.4 g $H_2$.

How many grams of methanol would be produced in a complete reaction? _____

Which reactant remains unconsumed at the end? _____

How many grams of it remain? _____

38. Carbon disulfide, $CS_2$, burned in oxygen. Complete combustion gives the balanced reaction below.

$CS_2 + 3\ O_2 \rightarrow CO_2 + 2\ SO_2$

Calculate the grams of sulfur dioxide, $SO_2$, produced when a mixture of 35.4 g of carbon disulfide and 31.3 g of oxygen reacts. _____

Which reactant remains unconsumed at the end of the combustion? _____

How many grams remain? _____

39. Methyl salicylate is prepared by heating salicylic acid, $C_7H_6O_3$, with methanol, $CH_3OH$.

$C_7H_6O_3 + CH_3OH \rightarrow C_8H_8O_3 + H_2O$

In an experiment, 1.40 g of salicylic acid is reacted with 11.20 g of methanol. The yield of methyl salicylate, $C_8H_8O_3$ is 1.19 g. What is the percent yield? _____

40. Sorbic acid is added to food as a mold inhibitor. Its composition is 64.3% C, 7.2% H, 28.5% O and its molecular mass is 112 amu. What is its formula? _____

41. A titanium ore contains rutile ($TiO_2$) plus some iron oxide and silica. When it is heated with carbon in the presence of chlorine, titanium tetrachloride, $TiCl_4$, is formed.

    $TiO_2 + C + 2\ Cl_2 \rightarrow TiCl_4 + CO_2$

    Titanium tetrachloride, a liquid, can be distilled from the mixture. If 36.3 g of titanium tetrachloride is recovered from 20.8 g of crude ore, what is the mass percentage of $TiO_2$ in the ore (assuming all $TiO_2$ reacts)?

42. Nitrobenzene, $C_6H_5NO_2$, an important raw material for the dye industry, is prepared from benzene, $C_6H_6$, and nitric acid, $HNO_3$.

    $C_6H_6 + HNO_3 \rightarrow C_6H_5NO_2 + H_2O$

    When 22.3 g of benzene and an excess of $HNO_3$ are used, what is the theoretical yield of nitrobenzene? _____

    If 30.1 g of nitrobenzene is recovered, what is the percentage yield? _____

43. A sample of sandstone consists of silica, $SiO_2$, and calcite, $CaCO_3$. When the sandstone is heated, calcium carbonate, $CaCO_3$, decomposes into calcium oxide, CaO and carbon dioxide.

    $CaCO_3 \rightarrow CaO + CO_2$

    What is the percentage of silica in the sandstone if 18.4 mg of the rock yields 4.85 mg of carbon dioxide?

44. A 3.6 L sample of paint that has a density of 4.65 g/ml is found to contain 26.7 g $Pb_3N_2$. How many grams of lead were in the paint sample?

Part III: (correct numerical answers must show correct significant figures)

45. Using solubility rules, decide whether the following ionic solids are soluble or insoluble in water. If they are soluble, write the net ionic equation for dissolving in water (enter NONE if the solid is insoluble)

    $Ag_3PO_4$ _____

    $BaI_2$ _____

    NaCl _____

    $CaBr_2$ _____

46. Write net ionic equations for the following molecular equation. HBr is a stron electrolyte. Include states of matter in your answer.

    $HBr(aq) + NH_3(aq) \rightarrow NH_4Br(aq)$

    _____

    $2\ HBr(aq) + Ba(OH)_2(aq) \rightarrow 2\ H_2O(l) + BaBr_2(aq)$

    _____

    $Pb(NO_3)_2(aq) + 2\ NaBr(aq) \rightarrow PbBr_2(s) + 2\ NaNO_3(aq)$

_____

$MgCO_3(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2O(l) + CO_2(g)$

_____

47. Write molecular and net ionic equations for each of the following aqueous reactions. If no reaction occurs, write NONE in the answer blank. Include states of matter in your answers.

    $CaCl_2 + Al(NO_3)_3 \rightarrow$

    Molecular: _____

    Net ionic: _____

    $AgNO_3 + NaI \rightarrow$

    Molecular: _____

    Net ionic: _____

    $Al(OH)_3 + HCl \rightarrow$

    Molecular: _____

    Net ionic: _____

    $HBr + Sr(OH)_2 \rightarrow$

    Molecular: _____

    Net ionic: _____

    $Ba(OH)_2 + HC_2H_3O_2 \rightarrow$

    Molecular: _____

    Net ionic: _____

    $HNO_3 + KOH \rightarrow$

    Molecular: _____

    Net ionic: _____

48. An aqueous solution is made form 0.937 g of potassium m permanganate, $KMnO_4$. If the volume of the solution is 55.5 ml, what is the molarity of $KMnO_4$ in the solution? _____
49. What is the volume, in milliliters, of 0.209 M $H_2SO_4$ containing 0.981 g of $H_2SO_4$? _____
50. Insulin is a hormone that controls the use of glucose in the body. How many moles of insulin are required to make up 50. ml of 0.0074 M insulin solution? _____
51. You wish to prepare 0.11 M $HNO_3$ from a stock solution of nitric acid that is 17.6 M. How many milliliters of the stock solution do you require to make up 1.00 L of 0.11 M $HNO_3$? _____
52. Calculate the concentrations of each ion present in a solution that results from mixing 50.5 ml of 0.20 M $NaClO_3$ (aq) solution with 27.6 ml of a 0.20 M $Na_2SO_4$ (aq) solution. Assume that volumes are additive.

    $ClO_3^-$ _____

    $SO_4^{-2}$ _____

    $Na^+$ _____

53. How many milliliters of 0.272 M KMnO4 are needed to react with 3.45 g of iron (II) sulfate, $FeSO_4$? _____

    The reaction is as follows.

$10FeSO_4(aq) + 2KMnO_4(aq) + 8H_2SO_4(aq) \rightarrow 5Fe_2(SO_4)_3(aq) + 2MnSO_4(aq) + K_2SO_4)aq) + 8H_2O(l)$

54. Consider the reaction of all pairs of the following compounds in water solution: $Sr(OH)_2$, AgNO3, $H_3PO_4$, $CuSO_4$,$KNO_3$

    Which two pairs will form one insoluble compound and one soluble compound (not water)?

    _____

    _____

    Which pair will form two insoluble compounds?

    _____

    Which compound will form one insoluble compound and water?

    _____

55. An aqueous solution contains 3.80 g of iron (III) sulfate, $Fe_2(SO_4)_3$, per liter. What is the molarity of $Fe_2(SO_4)_3$? _____

    When the compound dissolved in water, the $Fe^{+3}$ ions and $SO_4^{-2}$ ions in the crystal go into the solution. What is the Molar concentration of each ion in the solution?

    _____M $Fe^{+3}$

    _____ M $SO_4^{-2}$

56. A 72.0 g sample of oxalic acid, $H_2C_2O_4$, was dissolved in 1.00 L of solution. How would you prepare 1.00 L of 0.155 M $H_2C_2O_4$ from this solution?

    Place _____ml of the _____ M solution in a 1 L volumetric flask and dilute to 1.00 L by adding _____.

57. An antacid tablet has calcium carbonate as the active ingredient. Other ingredients include a starch binder. You dissolve the tablet in hydrochloric acid and filter off insoluble material. You add potassium oxalate to the filtrate (containing calcium ion) to precipitate calcium oxalate. If a tablet weighing 0.680 g gave 0.6332 g of calcium oxalate, what is the mass percentage of active ingredient in the tablet? _____