

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)  $C_2H_5OH$ , contains  $3.1 \times 10^{23}$  hydrogen atoms. How many  $C_2H_5OH$  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:

$\text{ClO}_4^-$  \_\_\_\_\_

$\text{SO}_4^{2-}$  \_\_\_\_\_

$\text{SeO}_4^{2-}$  \_\_\_\_\_

$\text{Cr}_2\text{O}_7^{2-}$  \_\_\_\_\_

10. Give the name and formula for the acid associated with the following oxyanions:

$\text{SeO}_3^{2-}$  \_\_\_\_\_

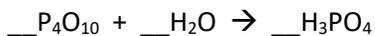
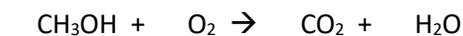
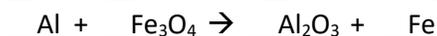
$\text{SO}_3^{2-}$  \_\_\_\_\_

$\text{IO}^-$  \_\_\_\_\_

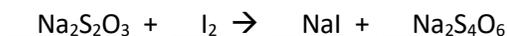
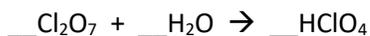
$\text{P}_2\text{O}_7^{4-}$  \_\_\_\_\_

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.



13. Balance the following equations using the smallest possible coefficients.



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  $^{119}\text{Sn}^{+4}$ ?

Protons \_\_\_\_\_ Neutrons \_\_\_\_\_ Electrons \_\_\_\_\_

17. You have a mythical element, X, that can exist as  $\text{X}^+$ ,  $\text{X}^{2+}$  or  $\text{X}^{5+}$  ions.

What would be the chemical formulas for compounds formed 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  $IO_3^-$  anion is called iodate. There are three related anions,  $IO^-$ ,  $IO_2^-$  and  $IO_4^-$ . 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 sample 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<sub>2</sub> \_\_\_\_\_

Number of molecules in 12.0 g N<sub>2</sub>O<sub>5</sub> \_\_\_\_\_

Number of formula units in 3.35 g NaClO<sub>4</sub> \_\_\_\_\_

Number of Ca<sup>2+</sup> ions in 4.98 g Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub> \_\_\_\_\_

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 following compounds to three significant figures.

H<sub>2</sub>O<sub>2</sub> \_\_\_\_\_ % H \_\_\_\_\_ % O

KClO<sub>4</sub> \_\_\_\_\_ % K \_\_\_\_\_ % Cl \_\_\_\_\_ % O

29. Calculate the mass percentage to three significant figures of each element in propanol (C<sub>3</sub>H<sub>7</sub>OH)

\_\_\_\_\_ % 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 C<sub>2</sub>H<sub>6</sub>N. Several determinations of molecular mass give values in the range of 87-90 amu. Find the molecular formula for putrescine. \_\_\_\_\_

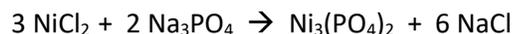
32. Butane, C<sub>4</sub>H<sub>10</sub>, burns with the oxygen in air to give carbon dioxide and water.



What is the amount (in moles) of carbon dioxide produced from 0.23 mol C<sub>4</sub>H<sub>10</sub>?

\_\_\_\_\_

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



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 from the yellow tungsten (VI) oxide, WO<sub>3</sub>, by reaction with hydrogen.



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.



Suppose a vessel contains 4.30 g of  $\text{NH}_3$ , how many grams of  $\text{O}_2$  are needed for a complete reaction? \_\_\_\_\_

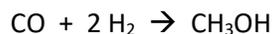
36. Solutions of sodium hypochlorite,  $\text{NaClO}$ , are sold as a bleach. They are prepared by the reaction of chlorine with sodium hydroxide.



If you have 1.87 mol of  $\text{NaOH}$  in solution and 1.84 mol of  $\text{Cl}_2$  gas available to react, which is the limiting reactant? \_\_\_\_\_

How many moles of  $\text{NaClO}$  could be obtained? \_\_\_\_\_

37. Methanol ( $\text{CH}_3\text{OH}$ ) is prepared industrially from the gas phase catalytic balanced reaction below.



In a laboratory test, a reaction vessel was filled with 52.7 g  $\text{CO}$  and 11.4 g  $\text{H}_2$ .

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,  $\text{CS}_2$ , burned in oxygen. Complete combustion gives the balanced reaction below.

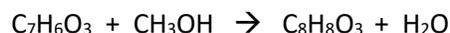


Calculate the grams of sulfur dioxide,  $\text{SO}_2$ , produced when a mixture of 35.4 g of carbon disulfide and 31.3 g of oxygen reacts. \_\_\_\_\_

Which reactant remains unconsumed at the end of the combustion? \_\_\_\_\_

How many grams remain? \_\_\_\_\_

39. Methyl salicylate is prepared by heating salicylic acid,  $\text{C}_7\text{H}_6\text{O}_3$ , with methanol,  $\text{CH}_3\text{OH}$ .



In an experiment, 1.40 g of salicylic acid is reacted with 11.20 g of methanol. The yield of methyl salicylate,  $\text{C}_8\text{H}_8\text{O}_3$  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<sub>2</sub>) plus some iron oxide and silica. When it is heated with carbon in the presence of chlorine, titanium tetrachloride, TiCl<sub>4</sub>, is formed.



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<sub>2</sub> in the ore (assuming all TiO<sub>2</sub> reacts)?

42. Nitrobenzene, C<sub>6</sub>H<sub>5</sub>NO<sub>2</sub>, an important raw material for the dye industry, is prepared from benzene, C<sub>6</sub>H<sub>6</sub>, and nitric acid, HNO<sub>3</sub>.



When 22.3 g of benzene and an excess of HNO<sub>3</sub> 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<sub>2</sub>, and calcite, CaCO<sub>3</sub>. When the sandstone is heated, calcium carbonate, CaCO<sub>3</sub>, decomposes into calcium oxide, CaO and carbon dioxide.



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<sub>3</sub>N<sub>2</sub>. 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)

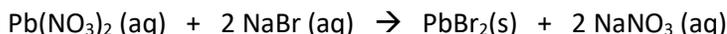
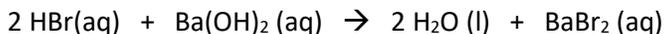
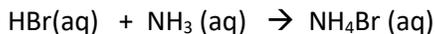
Ag<sub>3</sub>PO<sub>4</sub> \_\_\_\_\_

BaI<sub>2</sub> \_\_\_\_\_

NaCl \_\_\_\_\_

CaBr<sub>2</sub> \_\_\_\_\_

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



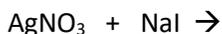


47. Write molecular and net ionic equations for each of the following aqueous reactions. If no reaction occurs, write NONE in the answer blank. Include states of matter in your answers.



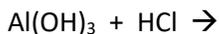
Molecular: \_\_\_\_\_

Net ionic: \_\_\_\_\_



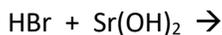
Molecular: \_\_\_\_\_

Net ionic: \_\_\_\_\_



Molecular: \_\_\_\_\_

Net ionic: \_\_\_\_\_



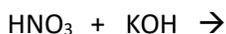
Molecular: \_\_\_\_\_

Net ionic: \_\_\_\_\_



Molecular: \_\_\_\_\_

Net ionic: \_\_\_\_\_



Molecular: \_\_\_\_\_

Net ionic: \_\_\_\_\_

48. An aqueous solution is made from 0.937 g of potassium permanganate,  $\text{KMnO}_4$ . If the volume of the solution is 55.5 ml, what is the molarity of  $\text{KMnO}_4$  in the solution? \_\_\_\_\_

49. What is the volume, in milliliters, of 0.209 M  $\text{H}_2\text{SO}_4$  containing 0.981 g of  $\text{H}_2\text{SO}_4$ ? \_\_\_\_\_

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  $\text{HNO}_3$  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  $\text{HNO}_3$ ? \_\_\_\_\_

52. Calculate the concentrations of each ion present in a solution that results from mixing 50.5 ml of 0.20 M  $\text{NaClO}_3$  (aq) solution with 27.6 ml of a 0.20 M  $\text{Na}_2\text{SO}_4$  (aq) solution. Assume that volumes are additive.

$\text{ClO}_3^-$  \_\_\_\_\_

$\text{SO}_4^{2-}$  \_\_\_\_\_

$\text{Na}^+$  \_\_\_\_\_

53. How many milliliters of 0.272 M  $\text{KMnO}_4$  are needed to react with 3.45 g of iron (II) sulfate,  $\text{FeSO}_4$ ? \_\_\_\_\_

The reaction is as follows.



54. Consider the reaction of all pairs of the following compounds in water solution:  $\text{Sr}(\text{OH})_2$ ,  $\text{AgNO}_3$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{CuSO}_4$ ,  $\text{KNO}_3$

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,  $\text{Fe}_2(\text{SO}_4)_3$ , per liter. What is the molarity of  $\text{Fe}_2(\text{SO}_4)_3$ ? \_\_\_\_\_

When the compound dissolved in water, the  $\text{Fe}^{+3}$  ions and  $\text{SO}_4^{-2}$  ions in the crystal go into the solution. What is the Molar concentration of each ion in the solution?

\_\_\_\_\_ M  $\text{Fe}^{+3}$

\_\_\_\_\_ M  $\text{SO}_4^{-2}$

56. A 72.0 g sample of oxalic acid,  $\text{H}_2\text{C}_2\text{O}_4$ , was dissolved in 1.00 L of solution. How would you prepare 1.00 L of 0.155 M  $\text{H}_2\text{C}_2\text{O}_4$  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? \_\_\_\_\_