AP Chemistry Summer Assignment

Directions: You must do all of the problems. This assignment is worth 100 points. **THIS ASSIGNMENT IS DUE ON THE FIRST DAY OF SCHOOL IN SEPTEMBER.**

For mathematical problems, you must show how the problem is set up.

NO WORK = NO CREDIT!

CIRCLE ALL MATHEMATICAL ANSWERS!

AP Chemistry can be considered as the second year of a two year program. The topics covered at the beginning of the year are mostly review from first year chemistry so we will move **very quickly** through this material. The purpose of this assignment is to review some of the material you learned last year to help you with these units. You may help each other but do not copy someone else's work. If you do not know how to do a problem, ask a friend to explain it to you. You will be doing him/her a favor because the ability to explain a concept to someone else is a test of that person's true understanding.

I look forward to working with you next year.

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1. How many significant figures are there in each of the following values?

a. 0.01334520 _____
b. 12.0000 _____
c. 133.45 _____
d. 120.3 _____
e. 0.000200 _____
f. 2200 _____
g. 0.04 _____

2. Perform the indicated calculations on the following measured values, giving the final answer with the correct number of significant figures.

a. 16.82 + 3.2257 _____
b. 324.6 x 815.991 _____
c. 7.442 - 7.429 _____
d. 27 / 4.148 _____
g. [(3.901 - 3.887) / 3.901] x 1.00 _____

3. Using conversion factors, convert 4.1 liters to:

a. kiloliters _____
b. milliliters _____
c. microliters _____
d. cubic centimeters _____

4. A velocity is 9.21×10^4 cm per minute. Calculate the velocity in meters per second.

5. Which of the following is greater:

a. 43 kg or 4300 g? _____
b. 90000 mL or 9000 L _____

6. Perform the following temperature conversions:

a. 450. Kelvin to Celsius _____
b. 200. Celsius to Kelvin _____
d. -230. Celsius to Kelvin _____

7. An object weighing 5.4 kg occupies 1650 mL. What is the density of the object in g/mL?

8. The density of the earth is about 5.5 g/cm^3. If the earth has a diameter of 12750 km, what is its mass?

9. A sample of uranium weighing 41.237 g was dropped in a graduated cylinder containing 23.20 mL of water. The volume of the water plus the sample was 25.27 mL. What is the density of uranium?

10. Which of the following is the smallest mass?
a. 0.001197 g
b. 0.0174 mg
c. 973.1 micrograms
d. 43000 cg

11. 3.0 g of an element was isolated from 777 kg of the ore molybdenite. The percent by mass of this element in the ore was?

12. Express the length 5.91 mm in centimeters.

13. A truck contains a cargo of uranium hexafluoride. The cargo of the uranium hexafluoride weighed 472000000 kg and was contained in 30 drums, each having a volume of 2000000 L. What is the density of uranium hexafluoride in g/mL? (use 2 sig. fig.)

14. How many protons, neutrons and electrons are in each of the following ions?

a. mass # 56 atomic # 26 Fe 3+ charge	____p ____n ____e
b. mass # 40 atomic # 20 Ca 2+ charge	____p ____n ____e
c. mass # 19 atomic # 9 F 1- charge	____p ____n ____e
d. mass # 31 atomic # 15 P 3- charge	____p ____n ____e
e. mass # 127 atomic # 53 I 1- charge	____p ____n ____e
f. mass # 133 atomic # 53 I no charge	____p ____n ____e

15. Name the family or group of the Periodic Table to which each of the following elements belong:

a. Ar _____
b. Sr _____
c. Fe _____
d. Cl _____
e. Nd _____
f. Rb _____

16. Name each of the following compounds:

a. PbI_2 _____
b. NH_4Cl _____
c. Fe_2O_3 _____
d. LiH _____
e. CsCl _____
f. NaH _____
g. $Cr(OH)_3$ _____
h. $NaC_2H_3O_2$ _____
i. $K_2Cr_2O_7$ _____
j. Na_2SO_4 _____
k. KH_2PO_4 _____

17. Name each of the following compounds:

a. NI_3 _____
b. PCl_5 _____
c. CO _____
d. P_4O_{10} _____
e. N_2O_4 _____
f. NH_3 _____

18. Write formulas for each of the following compounds:

a. iron(III) oxide _____
b. sulfur hexafluoride _____
c. tin(II) fluoride _____
d. calcium phosphate _____
e. lead(II) nitrate _____
f. sodium cyanide _____
g. sodium hydrogen sulfate _____
h. sodium iodate _____
i. tin(IV) oxide _____
j. potassium carbonate _____
k. iron(III) chloride _____
l. magnesium hydroxide _____
m. carbon tetrachloride _____
n. potassium hydrogen phosphate _____
o. potassium permanganate _____
p. potassium perchlorate _____
q. cesium bromate _____
r. ammonium acetate _____
s. calcium chlorite _____
t. ammonium dichromate _____

19. Give the names of the following acids:

a. H_2SO_3 _____

b. HI _____

c. HBr _____

d. HNO_2 _____

e. H_3PO_4 _____

f. HCl _____

20. Give formulas for the following acids:

a. hypochlorous acid _____

b. hydrofluoric acid _____

c. acetic acid _____

d. sulfuric acid _____

e. nitric acid _____

f. hydrosulfuric acid _____

21. Give the names of seven diatomic elements.

22. Define the word isotope.

23. Give three examples of alkaline earth elements.

24. What does the law of definite composition say?

25. What does the law of multiple proportions say?

26. An element "E" is present as ^{10}E with a mass value of 10.01 amu, and as ^{11}E with a mass value of 11.01 amu. The natural abundances of ^{10}E and ^{11}E are 19.78% and 80.22% respectively. What is the average atomic mass of the element? What is the element?

27. Chlorine has two stable isotopes. The mass of one isotope is 34.97 amu. It's relative abundance is 75.53%. What is the mass of the other stable isotope?

28. How many moles are in a sample of 300 atoms of Neon (Ne)? How many grams?

29. How many atoms of gold (Au) does it take to make 1.00 gram of gold?

30. How many grams of zinc are in 1.16×10^{22} atoms of zinc (Zn)?

31. How many milligrams of Br_2 are in 4.80×10^{20} molecules of Br_2?

32. How many grams are there in 0.36 moles of cobalt (III) acetate ($Co(C_2H_3O_2)_3$)? How many grams of cobalt are in this sample? How many atoms of cobalt?

33. Calculate the mass percent of Cl in each of the following compounds:

a. ClF

c. $CuCl_2$

34. Chlorophyll a is essential for photosynthesis. It contains 2.72% magnesium (Mg) by mass. What is the molar mass of chlorophyll a assuming there is one atom of magnesium in every molecule of chlorophyll a?

35. Which of the following formulas can be empirical? Circle them, and justify your answers.

a. CH_4
b. CH_2
c. $KMnO_4$
d. N_2O_5
e. B_2H_6
f. NH_4Cl
g. N_2O_4
h. C_3H_6O
i. $C_4H_8O_2$

36. A compound is found, by mass spectral analysis, to contain the following percentages of elements by mass:

C = 49.67%, Cl = 48.92%, H = 1.39%

The molar mass of the compound is 289.9 g/mole. Determine the empirical and molecular formulas of the compound.

37. The following reaction was performed:

$Fe_2O_3(s) + 2X(s) \text{ ----> } 2Fe(s) + X_2O_3(s)$

It was found that 79.847 g of Fe_2O_3 reacted with "X" to form 55.847 g of Fe and 50.982 g of X_2O_3. Identify element X.

38. 54.2 g of Tin (II) nitrate was heated to remove the water of hydration, producing 21.8 g of the anhydrate. What is the formula of the hydrate?

39. Complete the following reactions: (Make sure they are balanced.)

a. $HNO_3 + \_\_\_\_ \text{ ---> } H_2O + KNO_3$

b. $\_\_\_\_ + Na_3PO_4 \text{ ---> } Ca_3(PO_4)_2 + NaCl$

c. $Mg(OH)_2 + HCl \text{ ---> } MgCl_2 + \_\_\_\_$

d. $\_\_\_\_ + Cl_2 \text{ ---> } NaCl + Br_2$

e. $C_3H_6O + O_2 \text{ ---> } \_\_\_\_\_ + \_\_\_\_\_$

f. $MgCO_3 \text{ ---> } \_\_\_\_\_ + \_\_\_\_\_$

g. $H_2O_2 \text{ ---> } \_\_\_\_\_ + \_\_\_\_\_$

40. How many grams of sodium hydroxide are required to form 51.63 g of lead hydroxide?

$Pb(NO_3)_2(aq) + NaOH(aq) \text{ ----> } Pb(OH)_2(s) + NaNO_3(aq)$ (unbalanced)

41. You have 6 moles of silver ions and 150 g of copper (Cu). How many grams of silver (Ag) can you recover? Is this enough copper to react with all 6 moles of silver ions?

$2Ag^+ + Cu \text{ ---> } 2Ag + Cu^{2+}$

42. A reaction combines 113.484 g of lead (II) nitrate with 45.010 g of sodium hydroxide.

a. How much lead (II) hydroxide can be formed?

b. Which reactant is limiting? Which is in excess?

c. How much of the excess reactant is left over?

d. If the actual yield of lead (II) hydroxide were 80.02 g, what was the percent yield?

43. $NaHCO_3$ is the active ingredient in baking soda. How many grams of oxygen are in 0.35 g of $NaHCO_3$?

44. What mass of lead chromate is produced when 100.0 ml of 0.4100 M sodium chromate is mixed with 100.0 ml of 0.3200 M lead (II) nitrate?

45. A given sample of a xenon fluoride contains molecules of a single type XeF_n, where n is some whole number. Given that 9.03×10^{20} molecules of XeF_n weigh 0.311 g, calculate n.

46. The Claus reactions, shown below, are used to generate elemental sulfur from hydrogen sulfide.

$2H_2S + 3O_2 \text{ ---> } 2SO_2 + 2H_2O$
$SO_2 + 2H_2S \text{ ---> } 3S + 2H_2O$

a. How many grams of sulfur can be produced from 48.0 grams of O_2?

b. How many grams of H_2S are required?

47. When the following equation is balanced

$Al_2(CO_3)_3 + HCl \rightarrow AlCl_3 + CO_2 + H_2O$

the sum of the coefficients is:

48. Consider the fermentation reaction of glucose:

$$C_6H_{12}O_6 \xrightarrow{\text{yeast}} 2C_2H_5OH + 2CO_2$$

A 1.00-mole sample of $C_6H_{12}O_6$ was placed in a vat with 100g of yeast. If 46 grams of C_2H_5OH was obtained, what was the percent yield of C_2H_5OH?

49. Reaction of methane with oxygen really proceeds in two steps:

$CH_4 + (3/2)O_2 \rightarrow CO + 2H_2O$
$CO + (1/2)O_2 \rightarrow CO_2$

A sample of CH_4 is burned in an excess of O_2 to give 2.2 moles of H_2O. Assuming a 100% yield, how many moles of CH_4 were in the original sample?

50. One commercial system removes SO_2 emissions from smoke by the following set of balanced reactions:

$SO_2 + Cl_2 \rightarrow SO_2Cl_2$
$SO_2Cl_2 + 2H_2O \rightarrow H_2SO_4 + 2HCl$
$H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + 2H_2O$

Assuming the process is 95.0% efficient, how many grams of $CaSO_4$ may be produced from 1.00×10^2 grams of SO_2?

51. Iron is biologically important in the transport of oxygen by red blood cells from the lungs to the various organs of the body. In the blood of an adult human, there are approximately 2.60×10^{13} red blood cells with a total of 2.90 g of iron. On the average, how many iron atoms are present in each red blood cell? (A.W. (Fe) = 55.85 amu)

52. Water is added to 4.267 grams of UF_6. The only products are 3.730 grams of a solid containing only uranium, oxygen and fluorine and 0.970 gram of a gas. The gas is 95.0% fluorine, and the remainder is hydrogen.

(a) From these data, determine the empirical formula of the gas.

(b) What percent of the fluorine of the original compound is in the solid, and what percent is in the gas after the reaction?

(c) What is the formula of the solid product?

(d) Write a balanced equation for the reaction between UF_6 and H_2O. Assume that the empirical formula of the gas is the true formula.

53. A sample of dolomitic limestone containing only $CaCO_3$ and $MgCO_3$ was analyzed.

(a) When a 0.2800 gram sample of this limestone was decomposed by heating, 0.00308 moles of CO_2 were evolved. How many grams of CO_2 were produced?

(b) Write equations for the decomposition of both carbonates described above.

(c) It was also determined that the initial sample contained 0.0448 gram of calcium. What percent of the limestone by mass was $CaCO_3$?

(d) How many grams of the magnesium containing product were present in the sample in (a) after it had been heated?

54. 16.0 g of sodium carbonate was dissolved in water to produce 725 mL of solution. What is the molarity?

55. What mass of sulfuric acid is contained in 181 mL of a 2.50 M solution?

56. 125 mL of water is added to 250 mL of a 1.40 M solution of ammonia. What is the molarity?

57. Which of the following ionic compounds are soluble in water? Circle the soluble compounds.

a. Calcium carbonate
b. Ammonium sulfate
c. Magnesium bromide
d. Silver chloride
e. Calcium nitrate
f. Sodium phosphate
g. Ammonium sulfide
h. Lead iodide

58. Write the half reactions for each of the following redox reactions.

a. $Al + CuCl_2 \longrightarrow AlCl_3 + Cu$

b. $Na + Cl_2 \longrightarrow NaCl$

c. $LiCl + F_2 \longrightarrow LiF + Cl_2$

59. 15.7 mL of 0.155 M NaOH was required to neutralize 3.50 mL of HBr solution. What is the concentration of the acid solution?

60. How many mL of 0.20 M NaOH are required to neutralize 5.4 mL of 1.75 M acetic acid?

61. 0.800 g of an unknown monoprotic acid was dissolved in 25.0 mL of water and neutralized with 52.5 mL of 0.125 M KOH. What is the molar mass of the acid?

62. Predict the products of each reaction and write them in net ionic form:

(a) Zinc reacts with hydrochloric acid.

(b) Lead reacts with copper(II)nitrate.

(c) Magnesium bromide reacts with silver chlorate.

63. What volume will a sample of 240 mL of argon occupy if its pressure is increased from 0.10 atm to 6.0 atm?

64. The temperature of 150 ml of a gas at constant pressure is increased from 20°C to 40°C. What is the new volume of the gas?

65. The gas in a partially filled balloon occupies 0.75 liters at a temperature of 21°C and a pressure of 99.0 kPa. At what temperature will it be if its volume has increased to 2.0 liters and its pressure is 850 torr?

66. A container has 16 g of oxygen, 32 g of CH_4, and 4.0 g of H_2. The total pressure is 78 kPa. What is the partial pressure of the methane gas?

67. A sample of carbon dioxide occupies 2.30 L at 825 mm Hg an 70°C. What is its density at these conditions?

68. How many grams of SO_3 (g) are present in a sample if it occupies 4.60 L at 20.0°C and 1.3 atm?

69. What is the molar mass of a gas if 372 cm^3 has a mass of 0.800 g at 100°C and 106.7 kPa?

70. The density of a certain gas at 27.0°C and 740.0 torr is 2.53 g/L. What is the molar mass of the gas?

71. A compound contains only nitrogen and hydrogen and is 87.4% N by mass. A gaseous sample of the compound has a density of 0.977 g/L at 710 torr and 100°C. What is the molecular formula of the gas?

72. What volume of oxygen gas, measured at 30.°C and 725 torr, can be produced from the complete decomposition of 4.1 g of mercury (II) oxide?