AP Chemistry Summer Assignment ekent@mail.seaford.k12.ny.us

You are to complete the following problem set prior to the first day of class in September. I will collect your answers (with work).

The difficulty of the problems varies, so don't be surprised if you are challenged by several of them. Do give them all a good try, though. I would estimate that this problem set should take 10 to 20 hours, so please do not leave it for the last day before the start of school.

You should use the text book, regents review book, yahoo answers (chemistry), mychemistrytutor.com, my website (kentchemistry.com) or any other resources you find helpful. Please also feel free to contact me at the email above if you have any questions.

1. Memorize the names, formulas and charges for the common anions. Aside from the following table, you can use Table E from the NYS reference table.

Formula	Ion Name	Formula	Ion Name	Formula	Ion Name
		1- Charge			
H^-	Hydride	N_3^-	Azide	ClO^-	Hypochlorite
F^-	Fluoride	CN^-	Cyanide	ClO_2^-	Chlorite
Cl^-	Chloride	OH^-	Hydroxide	ClO_3^-	Chlorate
Br^-	Bromide	$C_2H_3O_2^-$	Acetate	ClO_4^-	Perchlorate
I^-	Iodide	$H_2PO_4^-$	Dihydrogen Phosphate	SCN^-	Thiocyanate
NO_2^-	Nitrite			HSO_4^-	Hydrogen Sulfate
NO_3^-	Nitrate	HCO_3^-	Hydrogen Carbonate		
MnO_4^-	Permanganate				
		2- Charge			
O^{2-}	Oxide	CO_3^{2-}	Carbonate	SO_4^{2-}	Sulfate
O_2^{2-}	Peroxide	CrO_4^{2-}	Chromate	$C_2O_4^{2-}$	Oxalate
S^{2-}	Sulfide	$Cr_2O_7^{2-}$	Dichromate	HPO_4^{2-}	Hydrogen Phosphate
$S_2O_3^{2-}$	Thiosulfate	SO_3^{2-}	Sulfite		
		3- Charge			
N^{3-}	Nitride	P^{3-}	Phosphide	PO_4^{3-}	Phosphate

2. Memorize the names, formulas and charges for the common cations. Aside from the following table, you can use Table E from the NYS reference table.

Formula	Ion Name	Formula	Ion Name	Formula	Ion Name
		1+ Charge			
H^+	Hydrogen	K^+	Potassium	NH_4^+	Ammonium
Li^+	Lithium	Cs^+	Cesium	H_3O^+	Hydronium
Na^+	Sodium	Ag^+	Silver	Cu^+	Copper(I)
		2+ Charge			
Mg^{2+}	Magnesium	Zn^{2+}	Zinc	Fe^{2+}	Iron(II)
Ca^{2+}	Calcium	Cd^{2+}	Cadmium	Co^{2+}	Cobalt(II)
Sr^{2+}	Strontium	Sn^{2+}	Tin(II)	Ni^{2+}	Nickel(II)
Ba^{2+}	Barium	Mn^{2+}	Manganese(II)		
Pb^{2+}	Lead(II)	Hg_2^{2+}	Mercury(I)	Hg^{2+}	Mercury(II)
		3+ Charge			
Al^{3+}	Aluminum	Fe^{3+}	Iron(III)		

3. Memorize the solubility rules for compounds that are <u>soluble</u> in water. You can also use reference table F in the NYS reference tables.

Soluble Compounds contain:	Exceptions
Most common acids	-
Group 1 Metals	None
Ammonium	None
Nitrates	None
Acetate	Silver Acetate is slightly soluble
Chlorate	None
Perchlorate	None
Hydrogen Carbonate	None
Halides	Ag^{+}, Pb^{2+}, Hg_2^{2+}, and CaF_2
Sulfates	Ag^{+}, Pb^{2+}, Hg_2^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+}

4. Memorize the solubility rules for compounds that are <u>insoluble</u> in water. You can also use reference table F in the NYS reference tables.

Insoluble	Exceptions
Carbonates	Group 1 metals, ammonium and dilute acids
Oxides	Group 1 metals, ammonium and dilute acids
Phosphates	Group 1 metals, ammonium and dilute acids
Sulfides	Group 1 metals, ammonium
Hydroxides	Group 1 metals, ammonium, dilute acids, Ca^{2+}, Ba^{2+}, and Sr^{2+}
Chromates	Group 1 metals, ammonium, dilute acids, Ca^{2+},Mg^{2+}

5. Use **factor labeling** method to convert the following:
   a. 50.0mL = ___ liters.

$$? \text{ L} = 50.0 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 0.0500 \text{ L (to 3 significant figures)}$$

   b. 650 in = ____ meters

   c. 4 years= _____ seconds.

   d. 200 liters = _____ ml

6. Classify each of the following as units of mass, volume, length, density, energy, or pressure.
   a.Kg b. Liter c. m^3 d. mm e. kg/m^3

   f. Joule g. atm h. cal i.Torr J. g/ml

7. Most laboratory experiments are performed at room temperature at 25˚C. Express this temperature in:

   a. ˚F

   b. K

8. How many **significant figures** are in each of the following?
   a. 1.9200 mm b. 0.0301001 kJ c. 6.022×10^{23} atoms

   d. 460.000 L e. 0.000036 cm^3 f. 10000

   g. 1001 h. 0.001345 i. i.0.0101

   J. 3.02×10^4 k. 3.21×10^{-2}

9. Write the number 1200 three ways: to 2, 3, and 4 significant figures

10. Record the following in correct **scientific notation**:
    a. 4,050,000,000 cal 4.05×10^9 cal

    b. 0.000123 mol

    c. 0.00345 Å

    d. 700,000,000 atoms

11. Calculate the following to the **correct number** of significant figures (assume measurements). (google→ "rules for sig figs KENT")
    a. 1.270 g / 5.296 cm^3

    b. 12.235 g / 1.010 L

    c. 12 g + 0.38 g

    d. 170g + 2.785 g

    e. 2.1 x 3.2102

    f. 200.1 x 120

    g. 17.6 + 2.838 + 2.3 + 200.

12. A cylinder rod formed from silicon is 46.0 cm long and has a mass of 3.00 kg. The density of silicon is 2.33 g/cm^3. What is the diameter of the cylinder? (the volume of cylinder is given by $V=\prod r^2h$, where r is the radius and h is the length)

13. Give the **chemical symbols** for the following elements:
    a. Carbon b. sulfur c. Titanium d. Nitrogen e. Helium

    f. Krypton g. Fluorine h. Scandium I. Arsenic J. Potassium

    k. Sodium l. chlorine m. Iron n. Zinc

14. Write **the Latin** names for each of the elements symbols:

a. Na

b. Au

c. Ag

d. Sn

e. Fe

f. Hg

g. K

h. Pb

15. A container has a volume of 1.05×10^3 cm^3. When filled with gas, the mass of the container + gas is 837.6 g. The mass of the container alone is 836.2 g. To the correct number of significant figures, what is the density of the gas? D=m/v

16. Classify each of the following as to pure substances or mixtures. If an item is a mixture, specify if it is heterogeneous or homogeneous.

(a) concrete

(b) seawater

(c) magnesium

(d) gasoline

(e) air

(f) tomato juice

(g) iodine crystals

(h) a nickel

17. How would you separate a mixture of granulated sugar and beach sand of comparable grain size?

18. Label each of the following as either a **physical process** or a **chemical process**.

a. Corrosion of aluminum metal.

b. Melting of ice.

c. Pulverizing an aspirin.

d. Digesting a candy bar.

e. Explosion of nitroglycerin.

f. Milk turning sour.

g. Burning of paper.

h. Forming of frost on a cold night.

i. Bleaching of hair with H_2O_2.

j. A copper wire is hammered flat.

19. A solid white substance A is heated strongly in the absence of air. It decomposes to form a new white solid substance B and a gas C. The gas has exactly the same properties as the product obtained when carbon is burned with excess oxygen. What can you say about whether solids A and B and the gas C are elements or compounds?

20. In the process of attempting to characterize a substance, a chemist makes the following observation: The substance is a silvery white, lustrous metal. It burns in air, producing an intense white light. It reacts with chlorine to give a brittle white solid. The substance can be pounded into thin sheets or down into wires. It is a good conductor of electricity. Which of these characteristics are physical and which are chemical properties?

21. Why do we call $Ba(NO_3)_2$ barium nitrate, but we call $Fe(NO_3)_2$ iron(II) nitrate?

22. Write the formula of the following compounds? (google ➔ "formula writing")
    a. Calcium sulfate. b. Ammonium Phosphate c. Lithium Nitrite

    d. potassium perchlorate. e. Barium Oxide f. Zinc sulfide.

    g. Sodium Perbromate I. Calcium Iodide J. Aluminum Carbonate

23. Convert **6.75 atm** to: (Using **factor-labeling** method) (google ➔"pressure conversions Kent")

a.torr

b. kilopascals

c. mm of Hg

24. Define the words:

atomic number

atomic mass

mass number

molecular formula

structural formula

empirical formula

isotopes

cation

anion

metalloid

allotrope

25. Fill in all the gaps in the table assuming all the atoms are neutral
(google➔"isotopic notation kent")

Symbol	^{39}K				
Protons		25			82
Neutrons		30	64		
Electron			48	56	
Mass #				137	207

26. Fill in the gaps of the table

Symbol	$^{52}Cr^{3+}$	$^{131}I^{-}$			
Protons			47		33
Neutrons			60	69	42
Electron			46	48	
Net Charge				2+	3-

27. List the following has diatomic molecule, molecular compound, ionic compound, atomic element.

a. F_2	f. CO_2	k. O_2
b. Cl_2	g. H_2	l. I_2
c. C	h. Ag	m.CO
d. NaCl	i. Rust (Fe_2O_3)	n. K_2CO_3
e. KF	j. MgO	

28. White gold is an alloy that typically contains 45.0% by mass gold and the remainder is platinum. If **154 g** of gold are available, how many grams of platinum are required to combine with the gold to form this alloy?

29. What is the empirical formula of a compound that contains 53.73% Fe and 46.27% of S ? (Google ➔"empirical formula percent kent")

30. Determine the number of molecules present in 4.56 mol of nitrogen (N_2). (Google➔"mole conversions kent")

Atoms?

30. State the contribution of the following chemist in one line.

a. Democritus

b. Mendeleev

c. Henry Becquerel

d. Roentgen

e. J.J Thomson

f. Faraday

g. Chadwick

h. Millikan

i. Proust

j. Cavendish

k. Madam Curie

31. What is the difference between
    a. Chlorine and Chloride?

    b. Sodium atom and sodium ion.

32. How many grams of methane (CH_4) are present in 5.60 moles of methane gas? (USE factor labeling method)

33. Calculate the **mass in grams** of each of the following: (Google➔"mole conversions kent")

a. 6.02×10^{23} atoms of Mg.

b. 3.01×10^{23} Formula units of $CaCl_2$

c. 12.4×10^{15} atoms of neon

34. In an experiment, a student gently heated a hydrated copper compound to remove the water of hydration. The following data was recorded:

    1. Mass of crucible, cover, and contents before heating 23.4 g.
    2. Mass of empty crucible and cover 18.82 g.
    3. Mass of crucible, cover, and contents after heating to constant mass 20.94 g.

Calculate the experimental percent of water in the compound.

35. An **extensive property** is one that depends on the amount of the sample. Which of the following properties are extensive?

a. volume b. density c. temperature

d. energy e. melting point. f. pressure

36. A hydrated compound has an analysis of 18.29% Ca, 32.37% Cl, and 49.34% water. What is its formula? (Google➔ “percent empirical formula kent”)

37. Name the 4 types of **general inorganic reactions** with example of each?

38. Define Acid, base and salt? Give two examples of each.

Acid-

Base-

Salt-

39. What mass of copper is required to replace silver from 4.00g of silver nitrate dissolved in water?

(Google➔"stoichiometry kent")

$$___Cu(s) + ___AgNO_3 \rightarrow ___Cu(NO_3)_2 + ___Ag$$

40. Write the chemical formulas for the following compounds:
    a. Calcium Carbonate
    b. Ammonium Phosphate
    c. Sodium Chloride
    d. Sodium Oxide
    e. Calcium Sulfate
    f. Sodium Nitrite
    g. Magnesium Acetate
    h. Potassium cyanide
    i. Zinc Nitrate
    j. Iron (III) Phosphate
    k. Nickel (II) Fluoride

41. Define
    a. Law of conservation of mass

    b. Law of multiple proportion

42. Strontium consists of four isotopes with masses and their percent abundance of 83.9134 amu (0.5%), 85.9094 amu (9.9%) , 86.9089 amu (7.0 %) , and 87.9056 amu (82.6 %). Calculate the atomic mass of Sr ? (Google➔ "atomic mass calculation kent")

43. Nitrogen (atomic mass=14.00674) has two isotopes, N-14 and N-15, with atomic masses of 14.00031 amu and 15.001 amu, respectively. What is the percent abundance of N-15?
    (google➔ "atomic mass isotope abundance kent")

44. Write the number of protons and electrons?

	Protons	Electrons
a P_4 molecule		
b. a PCl_5 molecule		
c. a P^{3-} Ion		
d. P^{5+} ion		

45. Mercury has an atomic mass of 200.59 g/mol. Calculate the
    a. Mass of 3.0×10^{10} atoms

    b. Number of atoms in one nanogram of Mercury

46. Calculate the molar masses (g/mol) of
    a. Ammonia (NH_3)

    b. Baking soda ($NaHCO_3$)

    c. Osmium Metal (Os)

47. Convert the following to moles

a. 3.86 grams of Carbon dioxide.

b. 6.0 x 10^{5}g of Hydrazine (N_2H_4), a rocket propellant.

48. The molecular formula of morphine, a pain-killing narcotic, is $C_{17}H_{19}NO_3$.

a.What is the molar mass?

b.What fraction of atoms in morphine is accounted for by carbon?

c.Which element contributes least to the molar mass?

49. Complete the list ionic compounds (name or formula)

a. Copper(II) Hydroxide

b. Strontium Chromate

c. Ammonium Perchlorate

d. $NaHCO_3$

e. $Fe_2(CO_3)_3$

f. Sodium Hydroxide.

50. The hormone, thyroxine is secreted by the thyroid gland, and has the formula: $C_{15}H_{17}NO_4I_4$. How many milligrams of Iodine can be extracted from 15.0 Grams of thyroxine? (hint…mass% I)

51. Determine the **formula weight** (aka molar mass) for the following:
    a. N_2O_5
    b. $CuSO_4$
    c. $Ca(HCO_3)_2$
    d. $CaSO_4 \bullet 2H_2O$

52. Determine the empirical formula of the compounds with the following compositions by mass:
    a. 10.4 % C, 27.8% S , 61.7 % Cl
    b. 21.7 % C, 9.6 % O, and 68.7 % F

53. Arsenic reacts with chlorine to form a chloride. If 1.587 g of arsenic reacts with 3.755 g of chlorine, what is the simplest formula of the chloride?

(google➔moles to empirical formula kent)

54. Washing soda is a hydrate of sodium carbonate. Its formula is $Na_2CO_3 \bullet x\ H_2O$. A 2.714 g Sample of washing soda is heated until a constant mass of 1.006 g of Na_2CO_3 is reached. What is x ?

(hint…find the mole ratio of the anhydrate to the water)

55 .What is the molecular formula of each of the following compounds?

a.Empirical formula CH_2 , molar mass =84g/mol.

b.Empirical formula NH_2Cl, Molar mass = 51.5 g/mol

56. Determine the empirical and molecular formula of each of the following substances:

a.Ibufuren, a headache remedy contains 75.6 % C, 8.80 % H , and 15.5 % O by mass and has a molar mass about 206 g/mol. (google➔ “molecular formula from percent kent”)

b.Epinerphine (adrenaline) a hormone secreted into the bloodstream in times of danger or stress contains 59% C, 7.1% H, 26.2% O, and 7.7% N by mass, its MW is about 180 amu.

57.Write a **balanced equation** for the following: (google ➔"formula writing")

a.Reaction of boron trifluoride gas with water to give liquid hydrogen fluoride and solid boric acid,(H_3BO_3).

b.Reaction of magnesium Oxide with Iron to form Iron (III) Oxide and Magnesium.

c.The decomposition of dinitrogen Oxide gas to its elements.

d.The reaction of Calcium Carbide solid with water to form calcium hydroxide and acetylene (C_2H_2) gas.

e.The reaction of solid calcium cyan amide ($CaCN_2$) with water to from calcium carbonate and ammonia gas.

f.Ethane burns in air (Oxygen).

g.Hydrogen reacts with oxygen to from Water.

h.Nitrogen gas reacts with Hydrogen to form Ammonia.

j.Hydrogen reacts with Iodine gas to form Hydrogen Iodide.

k. Sodium reacts with Iodine gas to form Sodium Iodide.

l. Potassium metal reacts with water to form potassium hydroxide and hydrogen.

58. DEFINE

limiting reagent

theoretical yield

actual yield

59.Sodium hydroxide reacts with carbon dioxide as follows:

$2\ NaOH(s) + CO_2(g) \rightarrow Na_2CO_3(s) + H_2O(l)$

Which reagent is the limiting reactant when 1.85 mol of sodium hydroxide and 1.00 mol carbon dioxide are allowed to react? How many moles of sodium carbonate can be produced? How many moles of the excess reactant remain after the completion of the reaction?

(google➔"ICE box kent")

$2\ NaOH(s) \quad + \quad CO_2(g) \rightarrow \quad Na_2CO_3(s) + \quad H_2O(l)$

I

C

_____

E

60. ICE BOX…..When benzene (C_6H_6) reacts with bromine (Br_2) bromobenzene(C_6H_5Br) is obtained:

$$C_6H_6 + Br_2 \rightarrow C_6H_5Br + HBr$$

a.What is the theoretical yield of bromobenzene in this reaction when 30.0g of benzene reacts with 65.0g of bromine?

b. If the actual yield of bromobenzene was 56.7 g what was the percentage yield?

(google➔ "percent yield Kent")

<u>moles</u>

$C_6H_6 + Br_2 \rightarrow C_6H_5Br + HBr$

I

C

E

61.One way to remove Nitrogen Oxide (NO) from smokestack emissions is to react it with ammonia:

$$4\ NH_3\ (g) + 6\ NO\ (g) \text{ --------> } 5\ N_2\ (g) + 6\ H_2O\ (l)$$

a. 12.3 mol of NO reacts with _____ mol of ammonia

b. 5.87 mol NO yields _____ mol nitrogen.

62. Name the following covalent compounds:

a. CO_2

b. P_4S_{10}

c. NI_3

d. PCl_5

e. CCl_4

f. SF_6

g. CH_4

h. C_2H_6

i. C_3H_8

62.Define **Oxidation number**.

Find the **Oxidation number** of

a.Carbon in CO_2

b.Sulfur in H_2SO_4

c.Phosphorus in PO_4^{3-}

d.Manganese in MnO_4^-

63. Which of the following statements are always true? False? Not always true?

a._____A compound with the molecular formula C_6H_6 has the same simplest formula.

b._____The mass percent of copper in CuO is less than in Cu_2O.

c._____The limiting reactant is the one present in the smallest number of grams.

d._____Since $C_3H_6O_3$ and $C_6H_{12}O_6$ reduce to the same formula, they represent the same compound.

64. (BOYLES LAW) A sample of carbon dioxide gas, CO_2 (g), occupies a volume of 5.75 L at 0.890 atm. If the temperature and the number of moles remain constant, calculate the volume when the pressure

a. increased to 1.25 atm

b. decrease to 0.350 atm

65. CHARLES LAW- A nitrogen sample at 30.0˚C has a volume of 1.75L. If the pressure and the amount of gas remain unchanged, determine the volume when the Celsius temperature is doubled.

66. Calculate the densities of the following gases at STP: (Google➔ "Gas density at STP kent")

a. Carbon Monoxide

b. Chlorine Gas

67. A volatile liquid (one that evaporates) is put into a jar and the jar is then sealed. Does the mass of the sealed jar and its contents change upon the vaporization of the liquid? Why?

68. Define the terms:

Exothermic

Endothermic

69. How much heat is required to raise the temperature of 100.0 grams of water from 25.0^{o}C to 82.0^{o}C?

(google➔ "kent specific heat")

70. A piece of unknown metal with mass 14.9 g is heated to 100.0^{o}C and dropped into 75.0 g of water at 20.0^{0}C. The final temperature of the system is 28.0 degree Celsius. What is the specific heat of the metal?

71. What is a solute and solvent?

Solute-

Solvent-

72. Define:

Molarity-

Molality-

Mole-fraction-

Mass percent-

72. Calculate the molarity of a solution that contains 0.0345 mol NH_4Cl in exactly 400 ml of solution? (Google➔ "kent molarity")

73. Calculate the molarity of a solution that contains 20.0 grams of sodium hydroxide in 200. Ml of solution?

74. What volume of 0.100 M HCl solution is needed to neutralize 50.0 ml of 0.350 M KOH in a titration experiment? (google ➔ "titration kent")

75. Ion Name Symbol with charge

a) Sodium
b) Potassium
c) Cesium
d) Beryllium
e) Calcium
f) Strontium
g) Barium
h) Gallium
i) Aluminum
j) Nitride
k) Arsenide
l) Bismuth
m) Oxide
n) Fluoride
o) Chloride
p) Bromide
q) Iodide

Common ions of transition elements

Ion Name Ion

a) Chromium(III)

b) Manganese(II)

c) Iron(II) or Ferrous

d) Iron(III) or Ferric

e) Cobalt(II)

f) Nickel(II) or nickel

g) Copper(II) or Cupric

h) Zinc

i) Silver

j) Cadmium

k) Mercury(II) or mercuric

Common Polyatomic Ions

Name	Formula with charge	Name	Formula with charge
a) Acetate		b) Ammonium	
c) Carbonate		d) Chlorate	
e) Chlorite		f) Chromate	
g) Cyanide		h) Dichromate	
i) Dihydrogen Phosphate		j) Dihydrogen Phosphate	
k) Hydrogen Carbonate		l) Hydrogen Sulfate	
m) Hydrogen Sulfite		n) Hypochlorite	
o) Hydroxide		p) Nitrate	
q) Nitrite		r) Oxalate	
s) Perchlorate		t) Permanganate	
u) Perioxide		v) Phosphate	
w) Sulfate		x) Sulfite	
y) Thiosulfate			

Common Acids	Formula	Common Acids	Formula
Hydrochloric Acid		Phosphoric acid	
Perchloric acid		Periodic Acid	
Carbonic acid		Sulfurous Acid	
Nitrous acid		Sulfuric Acid	
Nitric Acid		Hypochlorous Acid	
Chlorous Acid		Chloric Acid	