**AP Chemistry Semester 1 Practice Problems**

1. Adipic Acid contains 49.32% C, 43.84% O, and 6.85% H by mass. What is the empirical formula?
   a) $C_3H_5O_2$ b) $C_3H_3O_4$ c) $C_2HO_3$ d) $C_2H_5O_4$ e) $C_3HO_3$

2. How many of the following salts are expected to be insoluble in water?
   Sodium sulfide, Barium nitrate, Ammonium sulfate, Potassium phosphate, Barium Sulfate
   a) 1 b) 2 c) 3 d) 4 e) none

3. Consider three 1.0 Liter flasks at STP. Flask A contains $NH_3$ gas, flask B contains $NO_2$ gas, and flask C contains $N_2$ gas. Which contains the largest number of molecules?
   a) Flask A b) Flask B c) Flask C d) All are the same e) None

4. Consider the same three 1.0 Liter flasks at STP. Again, flask A contains $NH_3$ gas, flask B contains $NO_2$ gas, and flask C contains $N_2$ gas. In which flask do the molecules have the highest average velocity?
   a) Flask A b) Flask B c) Flask C d) All are the same e) None

5. The net ionic equation for the reaction of calcium bromide and sodium phosphate contains which of the following species?
   a) $2Ca_3(PO_4)_2(s)$ b) $Ca^{2+}(aq)$ c) $PO_4^{3-}(aq)$ d) $3Ca^{2+}(aq)$ e) 6NaBr(aq)

6. If all of the chloride in a 5.000 gram sample of an unknown metal chloride is precipitated as AgCl with exactly 70.90 mL of 0.2010 M $AgNO_3$, what is the percentage of chloride in the sample?
   a) 50.55% b) 10.10% c) 1.425% d) 20.22% e) none of these

7. At 25ºC the following heats of reaction are known:
   $2ClF + O_2 \rightarrow Cl_2O + F_2O$ $\Delta H = 167.4$ kJ
   $2ClF_3 + 2O_2 \rightarrow Cl_2O + 3\ F_2O$ $\Delta H = 341.4$ kJ
   $2F_2 + O_2 \rightarrow 2F_2O$ $\Delta H = -43.4$ kJ

   Calculate $\Delta H$ for $ClF + F_2 \rightarrow ClF_3$

   a) –217.5 kJ b) –130.2 kJ c) +217.5 kJ d) –108.7 kJ e) none of these

8. If the equilibrium constant for $A + B \rightleftharpoons C$ is .123, the equilibrium constant for $2C \rightleftharpoons 2A + 2B$ will be
   a) 1.00 – 2(0.123)  b) 8.13  c) 0.123  d) 66.1  e) 16.3

9. A mixture contained no fluorine compound except methyl fluoroacetate, $FCH_2COOCH_3$ (molar mass = 92.1 g/mol). When chemically treated, all the fluorine was converted to $CaF_2$ (molar mass = 78.1 g/mol). The mass of $CaF_2$ obtained was 12.1 grams. Find the mass of methyl fluoroacetate in the original mixture.
   a) 92.0g  b) 28.5g  c) 24.2g  d) 14.3g  e) 12.1g

10. The reaction $H_2\ (g) + I_2\ (g) \rightleftharpoons 2HI\ (g)$ has $K_p = 45.9$ at 763 K. A particular equilibrium mixture at that temperature contains gaseous HI at a partial pressure of 4.00 atm and hydrogen gas at a partial pressure of 0.200 atm. What is the partial pressure of $I_2$?
   a) 0.200 atm  b) 0.436 atm  c) 1.74 atm  d) 0.574 atm  e) 14.3 atm

11. Equal masses of 3 different ideal gases, X, Y, and Z are mixed in a sealed rigid container. If the temperature of the system remains constant, which of the following statements about the partial pressure of gas X is correct?

    a) It is equal to 1/3 of the total pressure
    b) It depends on the intermolecular forces of X, Y, and Z
    c) It depends on the relative molecular masses of X, Y, and Z
    d) It depends on the average distance traveled between molecular collisions
    e) It can be calculated with knowledge only of the volume of the container

12. When 70. mL of 3.0 molar $Na_2CO_3$ is added to 30. mL of 1.0 molar $NaHCO_3$, the resulting concentration of $Na^+$ is
    a) 2.0M  b) 2.4M  c) 4.0M  d) 4.5M  e) 7.0M

13. A 20.0 ml sample of 0.200 molar $K_2CO_3$ solution is added to 30.0 ml of 0.400 molar $Ba(NO_3)_2$ solution. Barium carbonate precipitates. The concentration of barium ion, $Ba^{2+}$, in solution **after** the reaction is
    a) 0.150M  b) 0.160M  c) 0.200M  d) 0.240M  e) 0.267M

14. A sample of 9.00grams of aluminum metal is added to an excess of hydrochloric acid. The volume of hydrogen gas produced at standard temperature and pressure is
    a) 22.4 L  b) 11.2 L  c) 7.47 L  d) 5.60 L  e) 3.74 L

15. In which of the following systems would the number of moles of the substances present at equilibrium NOT be shifted by a change in the volume of the system? Assume constant temperature.
    a) $CO(g) + NO(g) \rightleftharpoons CO_2(g) + N_2(g)$
    b) $N_2(g) + H_2(g) \rightleftharpoons NH_3(g)$
    c) $N_2(g) + O_2(g) \rightleftharpoons NO_2(g)$
    d) $N_2O_4(g) \rightleftharpoons NO_2(g)$
    e) $NO(g) + O_3(g) \rightleftharpoons NO_2(g) + O_2(g)$

16. What volume of 0.150 molar HCl is required to neutralize 25.0 ml of 0.120 molar $Ba(OH)_2$?
    a) 20.0ml  b) 30.0ml  c) 40.0ml  d) 60.0ml  e) 80.0ml

17. For the reaction: $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
    When 0.40 mole of $SO_2$ and 0.60 mole of $O_2$ are placed in an evacuated 1.00L flask, the reaction represented above occurs. After the reactants and the product reach equilibrium and the initial temperature is restored, the flask is found to contain 0.30 mol of $SO_3$. Based on these results, the equilibrium constant, Kc, for the reaction is
    a) 20.  b)10.  c) 6.7  d) 2.0  e) 1.2

Key: 1) a
2) a
3) d
4) a
5) d
6) b
7) d
8) d
9) b
10) c
11) c
12) d
13) b
14) b
15) e
16) c
17) a

Redox Reactions Review: Balance each of the following redox reactions using the oxidation states method. Be sure to show electrons gained and lost like we did in class.

1) $AlF_3(aq) + Mg(s) \rightarrow MgF_2(aq) + Al(s)$

2) $Zn(s) + AgNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + Ag(s)$

3) $HNO_3(aq) + H_3AsO_3(aq) \rightarrow NO(g) + H_3AsO_4(aq) + H_2O(l)$

4) $H_2SO_3(aq) + I_2(s) + H_2O(l) \rightarrow H_2SO_4(aq) + HI(aq)$

5) Acidic: $Cr_2O_7^{2-}(aq) + Fe^{2+}(aq) \rightarrow Cr^{3+}(aq) + Fe^{+3}(aq)$

6)Basic: $MnO_4^{1-}(aq) + C_2O_4^{-2}(aq) \rightarrow MnO_2(aq) + CO_3^{2-}(aq)$

Final answer for 6) $MnO_4^{1-}(aq) + C_2O_4^{-2}(aq) \rightarrow MnO_2(aq) + CO_3^{2-}(aq)$