All kinds of Equilibria Practice

Answer the following questions showing <u>all</u> your work!
Use https://www.chem.purdue.edu/gchelp/howtosolveit/Equilibrium/ICEchart.htm and http://users.stlcc.edu/gkrishnan/solubilityproduct.html

Part I. ICE diagrams and other Equilibrium Practice besides Ksp

1. Given the following reaction at equilibrium: $N_2O_{4(g)} \leftrightarrow 2NO_{2(g)}$

Initially, 0.0400 mol $N_2O_{4(g)}$ are placed in a previously evacuated flask and heated to 100ºC. When equilibrium is established at 100ºC, the equilibrium concentration of $N_2O_{4(g)}$ is found to be 0.0134 M. The volume of the flask is 1.00 L.

(A) Calculate the equilibrium concentration of $NO_{2(g)}$.

(B) Calculate the equilibrium constant, K_c, for the reaction at 100ºC.

(C) In another experiment, equilibrium was approached from the other direction by injecting a quantity of $NO_{2(g)}$ into a previously evacuated flask. After equilibrium is established in this system at 100 ºC, the equilibrium concentration of NO_2 is found to be 0.0243 M. Find the equilibrium concentration of N_2O_4 in the system.

2. K_c for the reaction: $2ICl_{(g)} \leftrightarrow I_{2(g)} + Cl_{2(g)}$

is 0.11 at a certain temperature. Suppose the initial concentrations (mol/L) of ICl, I_2, and Cl_2 are 0.20 M, 0.00 M, and 0.00 M, respectively. Some of the ICl decomposes and the system reaches equilibrium. What is the equilibrium concentration of each species?

3. The following reaction has an equilibrium constant K_c equal to 3.07×10^{-4} at 24ºC.

$2NOBr(g) \rightarrow 2NO(g) + Br_2(g)$

For each of the following compositions, decide whether the reaction mixture is at equilibrium. If it is not, decide which direction the reaction should go.

A) [NOBr]=0.0610M, [NO]=0.0151M, [Br_2]=0.0108M
B) [NOBr]=0.115M, [NO]=0.0169M, [Br_2]=0.0142M
C) [NOBr]=0.181M, [NO]=0.0123M, [Br_2]=0.0201M

Part II. Ksp

1. Write an equation that describes the equilibrium present in a saturated solution of Cu_3PO_4.

2. 53 g of Na_2CO_3 are dissolved in sufficient water to make 5.0 L of solution.

a) Write the equation for the dissolution of Na_2CO_3 into its aqueous ions.

b) Calculate the concentration of each ion in solution.

c) Describe the change in entropy as the Na_2CO_3 dissolves.

3. Write an equilibrium equation and a Ksp expression for only those salts that have low solubility:

a) Cu_2S

b) PbI_2

c) $Al_2(SO_4)_3$

4. A 1.0 M solution of sodium sulphide is added to a 1.0 M solution of copper (II) chloride resulting in the formation of a precipitate.

a) Write the formula of the precipitate.

b) Write the formula equation for the reaction.

c) Write the net ionic equation for the reaction.

5. Calculate the concentration of each ion in the following saturated solutions:

a) $Al(OH)_3$ Ksp = 3.0×10^{-33}

b) $Pb(IO_3)_2$ Ksp = 3.7×10^{-13}

6. A suspension of barium sulphate is used to improve the quality of X-rays in the digestive system. If the patient is required to drink 0.400 L of this suspension, calculate the actual mass in grams of the dissolved $BaSO_4$.

7. What maximum $[F^-]$ exists in a solution in which the $[Sr^{2+}] = 4.4 \times 10^{-3}$ M?

8. Show by calculation if a precipitate forms when 10.0 mL of 0.010 M $AgNO_3$ are mixed with an equal volume of 0.10 M Na_2CO_3.