Gaseous Equilibrium (GE) Part I

1. At 25 °C, Kc = 2.2 * 10^{-3} for the reaction
   $ICl\,(g) \leftrightarrow \frac{1}{2} I_2\,(g) + \frac{1}{2} Cl_2\,(g)$

   a. Calculate Kc at 25 °C for $2\ ICl\,(g) \leftrightarrow I_2\,(g) + Cl_2\,(g)$
   b. Calculate Kc at 25 °C for $2\ I_2\,(g) + 2\ Cl_2\,(g) \leftrightarrow 4\ ICl\,(g)$

2. Given the following data at 25 °C
   $2\ NO\,(g) + Br_2\,(g) \leftrightarrow 2NOBr\,(g)$ Kc = 2.0 * 10^3
   $2\ NO\,(g) \leftrightarrow N_2\,(g) + O_2\,(g)$ Kc = 1.0 * 10^{30}

   Calculate Kc for the following reaction:
   $\frac{1}{2} N_2\,(g) + \frac{1}{2} O_2\,(g) + \frac{1}{2} Br_2\,(g) \leftrightarrow NOBr\,(g)$

3. Write the equilibrium constant expressions (Kc and Kp) for the following reactions:
   a. $IF\,(g) \leftrightarrow \frac{1}{2} I_2\,(g) + \frac{1}{2} F_2\,(g)$
   b. $2\ C_5H_6\,(g) \leftrightarrow C_{10}H_{12}\,(g)$
   c. $P_4O_{10}\,(g) + 6\ PCl_5\,(g) \leftrightarrow 10\ POCl_3\,(g)$

4. Write a balanced chemical equation for an equilibrium system that would lead to the following expressions for Kc:
   a. $\frac{[H_2]\,[Br_2]}{[HBr]^2}$ b. $\frac{[CH_3OH]}{[CO]\,[H_2]^2}$ c. $\frac{[C_2H_4]\,[H_2]}{[C_2H_6]}$

5. For the system $CO\,(g) + 3\ H_2\,(g) \leftrightarrow CH_4\,(g) + H_2O\,(g)$ analysis shows that at a certain temperature, the concentrations of methane, steam, hydrogen gas and carbon monoxide gas are 0.150 M, 0.233 M, 0.259 M, and 0.513 M respectively. Calculate Kc at that temperature.

6. At 227 °C carbon monoxide gas reacts with hydrogen gas to form one mole of methanol. *At equilibrium* and 227 °C, a 10.0 L flask contains 0.114 moles of methanol gas, 0.718 moles of carbon monoxide, and 1.23 moles of hydrogen gas.
   a. Write a balanced equation for the reaction
   b. Calculate Kc for the reaction at 227 °C.