Chemical Equilibrium Worksheet Pt. 1

Determine whether each of the following statements are true or false:

1. As a system approaches equilibrium, only the forward reaction is occurring.
   F
2. Once equilibrium is achieved, the amount of each reactant and product remains constant.
   T
3. In a system in dynamic equilibrium, products are being made, but reactants are being made at the same rate.
   T
4. You have to begin your reaction with reactants for equilibrium to be reached.
   F

Balance the following reactions (if they are unbalanced) and then write the equilibrium constant expressions for the following reactions (note, all of the reactants and products are in a gaseous phase because solids and pure liquids do not appear in the equilibrium constant expression):

$PCl_5 \longleftrightarrow PCl_3 + Cl_2$

$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$

$H_2 + I_2 \longleftrightarrow 2HI$

$K_c = \frac{[HI]^2}{[H_2][I_2]}$

$4NH_3 + 5O_2 \longleftrightarrow 4NO + 6H_2O$

$K_c = \frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5}$

Quick Properties of Solutions Review:

Calculate the molarity of the following solution:

2.3 moles of NaCl in 0.56 L of solution:

$M = mol/L$

$$\frac{2.3 \text{ mol NaCl}}{0.56 \text{ L}} = 4.1 \text{ M NaCl}$$

Calculate the molality of a solution when 20.0 g of sodium hydroxide are dissolved in 500.0 mL of water:

$$20.0 \text{ g NaOH} \left| \frac{1 \text{ mol NaOH}}{40.0 \text{ g/mol}} \right. = 0.500 \text{ mol NaOH}$$

$$m = \frac{\text{mol solute}}{\text{kg solvent}}$$

$$m = \frac{0.500 \text{ mol}}{0.500 \text{ kg}}$$

$$m = 1.00 \text{ mol/kg}$$

Quick Colligative Property Review:

Calculate the freezing point and boiling point of a solution prepared by mixing 6.00 g of $C_6H_{12}O_6$ with 35.0 g of H_2O (hint: calculate the molality first):

$K_f = 1.86$ C/m

$K_b = 0.51$ C/m

mol $C_6H_{12}O_6$

$$6.00 \text{ g } C_6H_{12}O_6 \left| \frac{1 \text{ mol } C_6H_{12}O_6}{180 \text{ g}} \right. = 0.0333 \text{ mol } C_6H_{12}O_6$$

$$\text{Molality} = \frac{\text{mol } C_6H_{12}O_6}{1 \text{ kg } H_2O}$$

$$\frac{0.0333 \text{ mol } C_6H_{12}O_6}{0.035 \text{ kg } H_2O} = 0.952 \text{ m}$$

$\Delta T_{fp} = K_f m$

$1.86 \text{ °C/m} \; (0.952 \text{ m}) = 1.77 \text{ °C}$

$0 - 1.77 \text{ °C} = -1.77 \text{ °C}$

$\Delta T_{bp} = K_b m$

$0.51 \text{ °C/m} \; (0.952 \text{ m}) = 0.486 \text{ °C}$

$100 \text{ °C} + 0.486 \text{ °C} = 100.486 \text{ °C}$