

WORKSHEETS ARE DUE AT THE BEGINNING OF CLASS ON THE DATE GIVEN ON THE WORKSHEET. LATE WORKSHEETS WILL NOT BE ACCEPTED.

NAME \_\_\_\_\_ Panther ID \_\_\_\_\_

For problems involving calculations you must show your work for credit.

1) For each of the following reactions give the expression for  $K_C$  (the equilibrium constant in terms of concentrations). For cases where it is possible to do so, also given the expression for  $K_p$  (the equilibrium constant in terms of partial pressures). If it is not possible to give an expression for  $K_p$ , write n/a (not applicable).



$$K_C = \frac{[\text{PCl}_5]}{[\text{PCl}_3][\text{Cl}_2]}$$

$$K_p = \frac{(p_{\text{PCl}_5})}{(p_{\text{PCl}_3})(p_{\text{Cl}_2})}$$



$$K_C = \frac{[\text{H}_3\text{O}^+][\text{NO}_2^-]}{[\text{HNO}_2]}$$

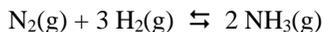
$$K_p \text{ n/a}$$



$$K_C = \frac{[\text{H}_2]^4}{[\text{H}_2\text{O}]^4}$$

$$K_p = \frac{(p_{\text{H}_2})^4}{(p_{\text{H}_2\text{O}})^4}$$

2) At high temperatures and in the presence of a catalyst ammonia ( $\text{NH}_3$ ) exists in equilibrium with nitrogen and hydrogen gas. The reaction can be written as



For a system at equilibrium at some temperature T the following partial pressures are observed

$$p_{\text{N}_2} = 0.85 \text{ atm}$$

$$p_{\text{H}_2} = 0.0031 \text{ atm}$$

$$p_{\text{NH}_3} = 0.031 \text{ atm}$$

Find the numerical value for  $K_p$  for the above reaction at temperature T.

$$K_p = \frac{(p_{\text{NH}_3})^2}{(p_{\text{N}_2})(p_{\text{H}_2})^3} = \frac{(0.031)^2}{(0.85)(0.0031)^3} = 3.8 \times 10^4$$

3) The equilibrium constant for the reaction



is  $K_C = 1.84$  at  $T = 425. \text{ }^\circ\text{C}$ .

a) A system at equilibrium at  $T = 425. \text{ }^\circ\text{C}$  has  $[\text{H}_2] = 3.2 \times 10^{-3} \text{ mol/L}$  and  $[\text{I}_2] = 4.1 \times 10^{-4} \text{ mol/L}$ .  
What is the concentration of HI in the system?

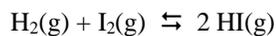
$$K_C = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2} \quad \text{So } [\text{HI}]^2 = \frac{[\text{H}_2][\text{I}_2]}{K_C} = \frac{(3.2 \times 10^{-3})(4.1 \times 10^{-4})}{1.84} = 7.13 \times 10^{-7}$$

$$\text{Therefore, } [\text{HI}] = (7.13 \times 10^{-7})^{1/2} = 8.4 \times 10^{-4} \text{ mol/L}$$

b) What is the numerical value for  $K_p$  for the above reaction at  $T = 425. \text{ }^\circ\text{C}$ ?

$$K_p = K_C (RT)^{\Delta n_g} \quad \text{Since } \Delta n_g = 0, K_p = K_C = 1.84$$

c) What is the numerical value for  $K_C$  for the reaction



at  $T = 425. \text{ }^\circ\text{C}$ ?

$$K_C = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = \frac{1}{([\text{H}_2][\text{I}_2] / [\text{HI}]^2)} = \frac{1}{1.84} = 0.543$$