K_{eq} & LeChâtelier's Principle Practice

1. Write the expression for the equilibrium constant for each of the following reactions:

a. $4NH_3(g) + 5O_2(g) \leftrightarrow 6H_2O(g) + 4NO(g)$

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

b. $4H_2(g) + CS_2(s) \leftrightarrow CH_4(g) + 2H_2S(g)$

$K_{eq} = \frac{[CH_4][H_2S]^2}{[H_2]^4}$

2. At a high temperature the following system reaches equilibrium: **$N_2(g) + O_2(g) \leftrightarrow 2NO(g)$**

a.) An analysis of the equilibrium mixture in a 1 L flask gives the following results: nitrogen 0.05 mol; oxygen 0.50 mol; nitrogen monoxide 0.020 mol. Calculate K_{eq} for the reaction. Show all of your work!

$K_{eq} = \frac{[NO]^2}{[N_2][O_2]} = \frac{(0.020)^2}{(0.050)(0.50)} = \frac{4 \times 10^{-4}}{0.025} = 0.016$

b.) Will the products or reactants be favored in the above reaction? Explain your answer.

reactants because K_{eq} is less than 1

3. Assuming that the reaction is at equilibrium, what effect do the following changes have on the equilibrium position (shifts left, right or no change)? **$2SO_3(g) + CO_2(g) + heat \leftrightarrow CS_2(g) + 4O_2(g)$**

a. Addition of CO_2 — Shift right

b. Addition of heat — Shift right

c. Increasing the volume — Shift right

d. Removal of O_2 — Shift right

e. Addition of a catalyst — no change

f. Addition of O_2 — Shift left

4. The industrial production of ammonia is described by this reversible reaction:

$N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g) + 92kJ$

What would be the result of the following stresses to the system? ***Be specific: increase or decrease in reactants or product.***

a. Removal of heat → products $[NH_3]$ would increase & reactants $[N_2]$ & $[H_2]$ would decrease

b. Removal of NH_3 → products $[NH_3]$ would increase & reactants $[N_2]$ & $[H_2]$ would decrease

c. Addition of H_2 → products $[NH_3]$ would increase & reactants $[N_2]$ & $[H_2]$ would decrease

d. Removal of N_2 ← products $[NH_3]$ would decrease & reactants $[N_2]$ & $[H_2]$ would increase

What stress(es) could you apply to the system to get the following results? List 2 for each result.

e. Increase in $[NH_3]$ → remove heat, add $[N_2]$, add $[H_2]$, decrease volume, remove $[NH_3]$

f. Increase in $[H_2]$ ← add $[NH_3]$, add heat, remove $[N_2]$, remove $[H_2]$, increase volume

g. Decrease in $[N_2]$ → add $[H_2]$, add $[N_2]$, decrease volume, remove heat, remove $[NH_3]$