Chemical Equilibrium

$$N_2(g) + 3\ H_2(g) \rightleftharpoons 2\ NH_3(g)$$

1)For the reaction represented above, the value of the equilibrium constant, K_p is 3.1 at 700 K in a 5.0L container

a. Write the expression for the equilibrium constant, K_p, for the reaction.

b. Assume that the initial partial pressures of the gases are as follows:

$P(N_2) = 0.411$ atm, $P(H_2) = 0.903$ atm, and $P(NH_3) = 0.224$ atm

i) Predict the direction in which the reaction will proceed at 700. K if the initial partial pressures are those given above. Justify your answer.

c. Calculate the value of the equilibrium constant, K_c, given that the value of K_p for the reaction at 700. K is 3.1×10^{-4}.

d. Calculate the new equilibrium pressures for N_2, H_2, and NH_3 if 0.012 moles of N_2 gas are added to the system.

d. The value of Kc for the reaction represented below is 1.44×10^{-4} at 700. K.

$$4NH_3(g) + 4H_2S(g) \rightleftharpoons 4NH_4HS(g)$$

Calculate the value of K_p at 700. K for each of the reactions represented below.

$2NH_4HS(g) \rightleftharpoons 2NH_3(g) + 2H_2S(g)$

$3H_2S(g) + 3NH_3(g) \rightleftharpoons 3NH_4HS(g)$

Chemistry 232 Quiz 7

$C_{(s)} + 2NO_{2(g)} \rightleftharpoons 2NO_{(g)} + CO_{2(g)}$ $\Delta H^{o} = 62kJ$

2)Predict the shift in equilibrium if:

1. Some NO_2 is added 2. Some CO_2 is added 3. Some CO_2 is removed

4. Some C is added 5. Temperature is increased 6.Temperature is decreased

7. Increasing the pressure by adding argon gas to the reactants

8. Volume decreases 9. Increasing the pressure by adding fluorine gas to the reactants

10. Q > K 11. Q < K 12. adding a catalyst 13. Volume of container increases

$H_2(g) + I_2(g) \square 2\ HI(g)$ $\Delta H > 0$

Which of the following changes to the equilibrium system represented above will increase the quantity of HI(g) in the equilibrium mixture?

I. Adding $H_2(g)$
II. Increasing the temperature
III. Decreasing the pressure

3) If for a chemical system, the reaction quotient is larger than the equilibrium constant, which way will the reaction proceed?

4) If K>1, are the rates of the forward or the reverse reaction greater?

5) In a certain exothermic chemical equilibrium, the temperature is increased. was the K_c of reaction larger before or after the temperature increase?

6)Initially, 0.25 moles of CH_3OH are placed into a 5.0-L container and allowed to decompose at 609K. Without using an equation solver, what are the equilibrium partial pressures of all three chemicals? What is the total pressure at equilibrium? Make the x is small assumption to simplify calculations.

$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$ $K = 2.5 \times 10^4$ 609 K

Chemistry 232 Quiz 7

Conceptual Questions to Kindle Joy 😊

For the following, determine if a final answer can be made, otherwise, write needs more info

(NOTE: memorization will <u>not</u> help you. Actually think about it!)

Smaller boiling point elevation: 2.0 m NaOH or 1.0 m $Ca(SO_4)$

Smallest velocity: NO_2 or O_2 with the same kinetic energy

Largest final temperature: Same number of joules added to 10 grams of substance A that has a smaller specific heat capacity than 15 grams of substance B.

Largest final temperature: where same amounts of joules is removed from 10 grams of substance A which has a greater specific heat capacity than 15 grams of B.

Smallest volume occupied: equal grams of Argon and Xenon at STP

Largest kinetic energy: Oxygen with larger velocity than Nitrogen

Largest volume occupied: equal grams of CO vs CO_2 where pressure of CO is less than the pressure of CO_2

Largest volume occupied: equal grams of Carbon vs Fluorine where the temperature of carbon is larger than that of Fluorine

Largest volume occupied: equal grams of CO vs CO_2 where the pressures are the same, but CO is at 298K and CO_2 is at 350K.

Largest volume occupied: Neon or Krypton where there is a larger amount of Krypton present.

Largest volume occupied: equal amounts of Bromine vs Hydrogen, where the temperature of Br is larger.

Largest kinetic energy: N_2 or O_2 where nitrogen has a larger temperature

Largest velocity: N_2 or Cl_2 where the average kinetic energy of Cl_2 is greater than N_2

Largest volume occupied: Helium and Neon, where the temperatures and pressures are the same, but there is more helium present.

Largest final temperature: higher amount of substance A with more energy added but a higher specific heat capacity compared to substance B with lesser energy added, lower specific heat, and lower amount of grams

Largest volume occupied: O_2 or Cl_2 where there is a larger amount of Cl_2 and Cl_2 has a greater temperature

Largest volume occupied: O_2 or Cl_2 where there is twice the amount of Cl_2 than O_2 and Cl_2 is at 350K and O_2 is at 300K

Largest volume occupied: C or O_2 where there is 10 grams of C, 30 grams of O_2 at the same temperature and pressure.

Largest volume occupied: equal grams and temperature of Hydrogen and Carbon, where H has a larger velocity, but carbon has lower pressure.

Largest kinetic energy: Cl or F where fluorine has a larger temperature

Largest final temperature: equal grams of Substance A and B where A has a larger specific heat capacity than B, but more energy is added onto A.

Largest final temperature: higher amount of substance A with lesser energy added but a higher specific heat capacity compared to substance B with more energy added, lower specific heat, and lower amount

Largest Band gap: substance A with a smaller atomic radius in group 3A or B with a larger atomic radius in group 7A?