HW04 - Chemical Equilibria 2

Question 1 — 2 pts

Calculate the equilibrium constant at 25°C for a reaction for which $\Delta G°$ = -4.22 kcal/mol.

- 620.254
- 2481.02
- -1240.51
- 1240.51

Question 2 — 2 pts

The reaction

$A + B \rightleftharpoons C + 2D$

has an equilibrium constant of 3.7×10^{-3}. Consider a reaction mixture with:

[A] = 2.0×10^{-2} M

[B] = 1.7×10^{-4} M

[C] = 2.4×10^{-6} M

[D] = 3.5×10^{-3} M

Which of the following statements is definitely true?

- The reverse reaction will occur to a greater extent than the forward reaction until equilibrium is established.
- The forward reaction will occur to a greater extent than the reverse reaction until equilibrium is established.
- No conclusions about the system can be made without additional information.

Question 3 — 2 pts

The reaction

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

has an equilibrium constant (K_c) of 4.0×10^8 at 25°C. What will eventually happen if 44.0 moles of NH_3, 0.452 moles of N_2, and 0.108 moles of H_2 are put in a 10.0 L container at 25°

- It is impossible to know what will happen unless we know what the equilibrium constant is at 298 K.
- More N_2 and H_2 will be formed.
- More NH_3 will be formed.
- Nothing. The system is at equilibrium.

Question 4 — 2 pts

Consider the reaction:

$Ni(CO)_4(g) \rightleftharpoons Ni(s) + 4CO(g)$

If the initial concentration of $Ni(CO)_4(g)$ is 1.0 M and x is the equilibrium concentration of CO(g), what is the correct equilibrium relation?

- $K_c = \frac{256x^4}{(1.0 - 4x)}$
- $K_c = \frac{x^4}{\left(1.0 - \frac{x}{4}\right)}$
- $K_c = \frac{x^5}{\left(1.0 - \frac{x}{4}\right)}$
- $K_c = \frac{4x}{(1.0 - 4x)}$

Question 5 — 2 pts

Suppose the reaction

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

has an equilibrium constant K_c = 49 and the initial concentrations of H_2 and I_2 is 0.5 M and of HI is 0.0M. Which of the following is the correct value for the final concentration of HI(g)?

- 0.778 M
- 0.219 M
- 0.250 M
- 0.599 M

Question 6 — 2 pts

The system

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

is at equilibrium at a fixed temperature with a partial pressure of H_2 of 0.200 atm, a partial pressure of I_2 of 0.200 atm, and a partial pressure of HI of 0.100 atm. An additional 0.26 atm pressure of HI is admitted to the container, and it is allowed to come to equilibrium again. What is the new partial pressure of HI?

- 0.104 atm
- 0.464 atm
- 0.152 atm
- 0.360 atm

Question 7 — 2 pts

At 990°C, K_c = 1.6 for the reaction

$H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$

How many moles of $H_2O(g)$ are present in an equilibrium mixture resulting from the addition of 1.00 mole of H_2, 2.00 moles of CO_2, 0.75 moles of H_2O, and 1.00 mole of CO to a 5.00 liter container at 990°C?

- ○ 1.1 mol
- ○ 1.0 mol
- ○ 0.60 mol
- ○ 1.7 mol

Question 8 — 2 pts

What happens to the concentration of NO(g) when the total pressure on the reaction below is increased (by compression) when it is at equilibrium?

$3NO_2(g) + H_2O(l) \rightleftharpoons 2HNO_3(aq) + NO(g)$

- ○ it remains the same
- ○ it decreases
- ○ it increases
- ○ it is impossible to tell

Question 9 — 2 pts

Consider the following reaction:

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

where ΔH_{rxn} -198 kJ. The amount of $SO_2(g)$ at equilibrium increases when...

- ○ SO_3 is removed.
- ○ the volume is increased.
- ○ more oxygen is added.
- ○ the temperature is decreased.

Question 10 — 2 pts

Suppose the reaction mixture

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

is at equilibrium at a given temperature and pressure. The pressure is then increased at constant temperature by compressing the reaction mixture, and the mixture is then allowed to reestablish equilibrium. At the new equilibrium...

- ○ there is less ammonia present than there was originally.
- ○ there is the same amount of ammonia present as there was originally.
- ○ there is more ammonia present than there was originally.
- ○ the nitrogen is used up completely.

Question 11 — 2 pts

Consider the system:

$2N_2O_5(g) \rightleftharpoons 2N_2O_4(g) + O_2(g)$

at equilibrium at 25°C. If this is an exothermic reaction and the temperature was raised, would the equilibrium be shifted to produce more N_2O_5 or more N_2O_4?

- ○ more N_2O_5
- ○ there would be no change
- ○ more N_2O_4
- ○ it is impossible to tell

Question 12 — 2 pts

The system

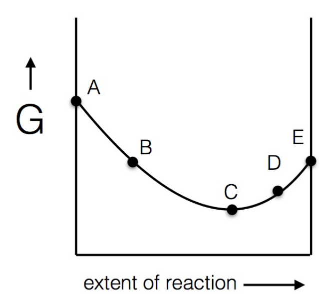
$CO_2(g) + H_2(g) \rightleftharpoons H_2O(g) + CO(g)$

is at equilibrium at some temperature. At equilibrium, a 4.00L vessel contains 1.00 mole CO_2, 1.00 mole H_2, 2.40 moles H_2O, and 2.40 moles CO. How many moles of CO_2 must be added to this system to bring the equilibrium CO concentration to 0.669 mol/L?

- ○ 0.429 moles
- ○ 0.498 moles
- ○ 0.069 moles
- ○ 0.993 moles

Question 13 — 1 pts

The figure below represents a reaction at 298 K.



Based on the figure, which of the following statements (if any) are FALSE?

- ○ At point D, the reaction will move toward the reactants to get to equilibrium.
- ○ For this reaction, $\Delta G°$ is negative.
- ○ At point C, the system is at equilibrium.
- ○ None of the other statements are false.
- ○ At point B, Q < K.

Question 14

1 pts

Given the hypothetical reaction:

$X(g) \rightleftharpoons Y(g)$

Predict what will happen when 1.0 mol Y is placed into an evacuated container.

- ◯ Q will increase until Q = K.
- ◯ Nothing. The products are already formed, so no reaction occurs.
- ◯ Q will decrease until Q = K.
- ◯ $\Delta G°$ will decrease until $\Delta G°$ = 0.

Question 15

2 pts

Consider the reaction:

$$\mathrm{C(s, graphite)} + \mathrm{O_2(g)} \rightleftharpoons \mathrm{CO_2(g)} \qquad \Delta G° = -400\ \mathrm{kJ\ mol^{-1}\ K^{-1}}$$

Which of the following is a possible value of *K* for this reaction?

- ◯ 0.56
- ◯ 10^{70}
- ◯ 10^{-70}
- ◯ -0.56

Question 16

2 pts

The equilibrium constant K for the synthesis of ammonia is 6.8×10^5 at 298 K. What will K be for the reaction at 375 K?

$$\mathrm{N_2(g)} + \mathrm{3H_2(g)} \rightleftharpoons \mathrm{2NH_3(g)} \qquad \Delta H° = -92.22\ \mathrm{kJ\ mol^{-1}}$$

- ◯ 326
- ◯ 1.42×10^9
- ◯ 6.75×10^5
- ◯ 6.85×10^5