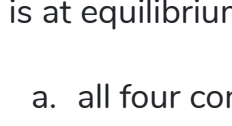


HW03 - Chemical Equilibria

Question 1

1.5 pts

When the chemical reaction



is at equilibrium, which of the following is true?

- all four concentrations are equal
- neither the forward nor the reverse reactions have stopped
- the sum of the concentrations of A and B equals the sum of the concentrations of C and D
- both the forward and reverse reactions have stopped

Question 2

1.5 pts

Explain why equilibrium constants are dimensionless.

- They are dimensionless because the pressures or concentrations we put in are all for the substances in their standard states.
- This is a trick question. Equilibrium constants have units that involve some multiple of atmospheres or moles per liter.
- They are not really dimensionless, but we must treat them as such in order to be able to take $\ln(K)$ in the expression:

$$\Delta G^\circ = -RT \ln K$$

- Every concentration or pressure that enters into K_c or K_p is really divided by the corresponding concentration or pressure of the substance in its standard state.

Question 3

1.5 pts

The expression for K_p for the reaction



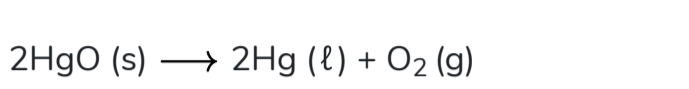
at equilibrium is:

- $\frac{P_{\text{H}_2\text{O}}^6 P_{\text{NO}}^4}{P_{\text{O}_2}^5 P_{\text{NH}_3}^4}$
- $\frac{P_{\text{NH}_3}^4 P_{\text{O}_2}^5}{P_{\text{NO}}^4 P_{\text{H}_2\text{O}}^6}$
- No answer text provided.
- $\frac{P_{\text{NH}_3}^4 P_{\text{O}_2}^5}{P_{\text{NO}}^4 P_{\text{H}_2\text{O}}^6}$
- $\frac{P_{\text{NO}} P_{\text{H}_2\text{O}}}{P_{\text{NH}_3} P_{\text{O}_2}}$

Question 4

1.5 pts

Consider the following reactions at 25°C:



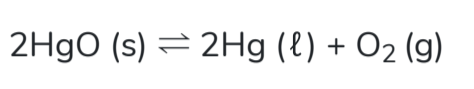
Which compound is most likely to dissociate and give $\text{O}_2(\text{g})$ at 25°C?

- CO_2
- NO
- $\frac{P_{\text{NO}} P_{\text{H}_2\text{O}}}{P_{\text{NH}_3} P_{\text{O}_2}}$
- H_2O

Question 5

1.5 pts

At 600°C, the equilibrium constant for the reaction



is 2.8. Calculate the equilibrium constant for the reaction

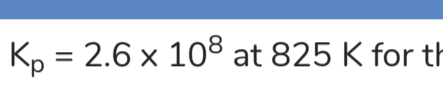


- 0.60
- CO
- 1.1
- 1.7

Question 6

1.5 pts

Consider the reaction



What is the form of the equilibrium constant K_p for this reaction?

- $\frac{P_{\text{O}_2}}{P_{\text{HgO}}^2}$
- $\frac{P_{\text{Hg}}^2 P_{\text{O}_2}}{P_{\text{HgO}}^2}$
- P_{O_2}
- $P_{\text{Hg}}^2 P_{\text{O}_2}$

Question 7

1.5 pts

$K_p = 2.6 \times 10^8$ at 825 K for the reaction



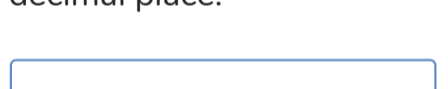
The equilibrium pressure of H_2 is 0.0020 atm and S_2 is 0.0010 atm. What is the equilibrium pressure of H_2S ?

- 0.10 atm
- 1.0 atm
- 0.0010 atm
- 0.36

Question 8

1.5 pts

Consider the reaction below



At 1000 K the equilibrium pressures of the three gases in one mixture were found to be 0.562 atm SO_2 , 0.101 atm O_2 , and 0.332 atm SO_3 . Calculate the value of K_p for the reaction.

- 2.64
- 0.298
- 0.171
- 3.46

Question 9

1.5 pts

Consider the following reaction:



Calculate K_c for this reaction at 100 °C.

- 10 atm
- 73.5
- 19.7
- 0.0784

Question 10

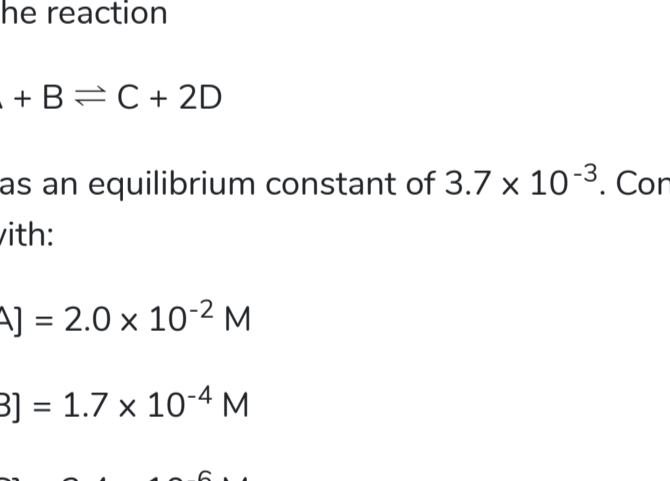
1.5 pts

Calculate the equilibrium constant at 25°C for a reaction for which $\Delta G^\circ = -4.22 \text{ kcal/mol}$. Include the sign if needed and round to the second decimal place.

Question 11

1.5 pts

The figure below represents a reaction at 298 K.



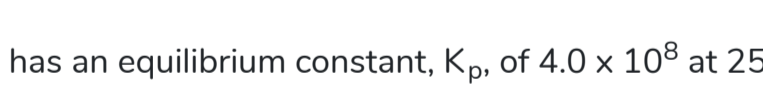
Based on the figure, which of the following statements (if any) are FALSE?

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

Question 12

1.5 pts

Consider the reaction:



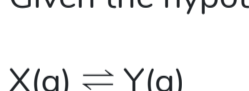
Which of the following is a possible value of K for this reaction?

- At point B, $Q < K$.
- 10^{-70}
- 10^{70}
- 0.56

Question 13

1.5 pts

The reaction



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

$$[\text{A}] = 2.0 \times 10^{-2} \text{ M}$$

$$[\text{B}] = 1.7 \times 10^{-4} \text{ M}$$

$$[\text{C}] = 2.4 \times 10^{-6} \text{ M}$$

$$[\text{D}] = 3.5 \times 10^{-3} \text{ M}$$

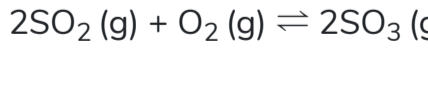
Which of the following statements is definitely true?

- 0.56
- The reverse reaction will occur to a greater extent than the forward reaction until equilibrium is established.
- The system is at equilibrium.
- The forward reaction will occur to a greater extent than the reverse reaction until equilibrium is established.

Question 14

1.5 pts

The reaction



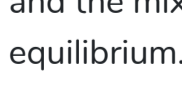
has an equilibrium constant, K_p , of 4.0×10^8 at 25°C. What will eventually happen if 44.0 moles of NH_3 , 0.452 moles of N_2 , and 0.108 moles of H_2 are put in a 10.0 L container at 25°C.

- More N_2 and H_2 will be formed.
- No conclusions about the system can be made without additional information.
- It is impossible to know what will happen unless we know what the equilibrium constant is at 298 K.
- Nothing. The system is at equilibrium.

Question 15

1.5 pts

Given the hypothetical reaction:



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

- Nothing. The products are already formed, so no reaction occurs.
- More NH_3 will be formed.
- As the reaction progresses, Q will increase until $Q = K$.
- As the reaction progresses, ΔG° will decrease until $\Delta G^\circ = 0$.

Question 16

1.5 pts

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

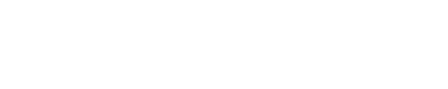


- it remains the same
- it is impossible to tell
- As the reaction progresses, Q will decrease until $Q = K$.
- it increases

Question 17

1.5 pts

Consider the following reaction:



where $\Delta H_{\text{rxn}} = -198 \text{ kJ}$. The amount of $\text{SO}_2(\text{g})$ at equilibrium increases when...

- the volume is increased.
- the temperature is decreased.
- SO_3 is removed.
- it decreases

Question 18

1.5 pts

Suppose the reaction mixture

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

Question 19

1.5 pts

Consider the system:

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 ?

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

Question 20

1.5 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?

- there is more ammonia present than there was originally.
- 1.42×10^9
- 326
- 6.85×10^5