

HW02 - Osmosis & Chemical Equilibria

Question 1

1.5 pts

A semi-permeable membrane can withstand an osmotic pressure of 0.75 atm. What molarity of aqueous magnesium bromide solution would reach the limit for this membrane? (Assume $RT = 25 \text{ L}\cdot\text{atm}\cdot\text{mol}^{-1}$)

- 0.01 M
- 0.03 mM
- 0.03 M
- 0.01 mM

Question 2

1.5 pts

Catalase (a liver enzyme) dissolves in water. A 14mL solution containing 0.166g of catalase exhibits an osmotic pressure of 1.2 Torr at 20°C. What is the molar mass of catalase?

- $1.49 \times 10^5 \text{ g/mol}$
- $1.69 \times 10^5 \text{ g/mol}$
- $2.81 \times 10^5 \text{ g/mol}$
- $1.81 \times 10^5 \text{ g/mol}$

Question 3

1.5 pts

Two aqueous solutions are separated by a semi-permeable membrane:

Solution A = 0.34 M KCl

Solution B = 0.34 M MgCl_2

Which of the following statements is TRUE?

- There is no net flow of H_2O molecules from one solution to another.
- There is a net flow of H_2O molecules from solution B to solution A.
- There is a net flow of H_2O molecules from solution A to solution B.
- There is a net flow of Cl^- ions from solution B to solution A.

Question 4

1.5 pts

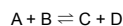
Red blood cells contain Na^+ ions, K^+ ions, and water. If we place some red blood cells into a beaker full of pure water, what will happen to them?

- they will shrivel and collapse
- nothing
- they will wiggle around rapidly
- they will swell and burst

Question 5

1.2 pts

When the chemical reaction



is at equilibrium, which of the following is true?

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

Question 6

1.2 pts

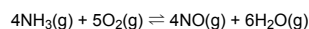
Explain why equilibrium constants are dimensionless.

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

Question 7

1.2 pts

The expression for K_c for the reaction



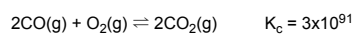
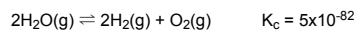
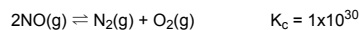
at equilibrium is:

- $\frac{[\text{NH}_3]^4[\text{O}_2]^5}{[\text{NO}]^4[\text{H}_2\text{O}]^6}$
- $\frac{[\text{NO}][\text{H}_2\text{O}]}{[\text{NH}_3][\text{O}_2]}$
- $[\text{NH}_3]^4[\text{O}_2]^5$
- $\frac{[\text{NO}]^4[\text{H}_2\text{O}]^6}{[\text{NH}_3]^4[\text{O}_2]^5}$

Question 8

1.2 pts

Consider the following reactions at 25°C:



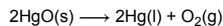
Which compound is most likely to dissociate and give $\text{O}_2(\text{g})$ at 25°C?

- H_2O
- NO
- CO
- CO_2

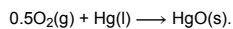
Question 9

1.2 pts

At 600°C, the equilibrium constant for the reaction



is 2.8. Calculate the equilibrium constant for the reaction

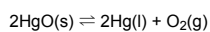


- _____
- 1.1
- 0.36
- 0.60
- 1.7

Question 10

1.2 pts

Consider the reaction



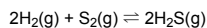
What is the form of the equilibrium constant K_c for this reaction?

- _____
- $\frac{[\text{O}_2]}{[\text{HgO}]^2}$
- $\frac{[\text{Hg}]^2[\text{O}_2]}{[\text{HgO}]^2}$
- $[\text{O}_2]$
- $[\text{Hg}]^2 [\text{O}_2]$

Question 11

1.2 pts

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



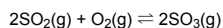
The equilibrium concentration of H_2 is 0.0020 M and S_2 is 0.0010 M. What is the equilibrium concentration of H_2S ?

- _____
- 1.0 M
- 10 M
- 0.0010 M
- 0.10 M

Question 12

1.2 pts

Consider the reaction below



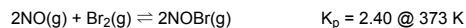
At 1000 K the equilibrium pressures of the three gases in one mixture were found to be 0.562 atm SO_2 , 0.101 atm O_2 , and 0.332 atm SO_3 . Calculate the value of K_p for the reaction.

- _____
- 2.64
- 0.171
- 0.289
- 3.46

Question 13

1.2 pts

Consider the following reaction:



Calculate K_c for this reaction at 100°C.

- _____
- 0.0784
- 7440
- 19.7
- 73.5

Question 14

1.2 pts

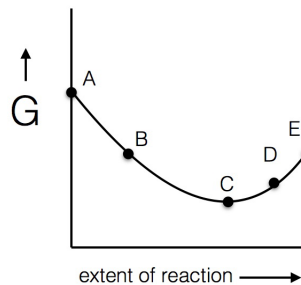
Calculate the equilibrium constant at 25°C for a reaction for which $\Delta G^\circ = -4.22 \text{ kcal/mol}$.

- _____
- 1240.51
- 1240.51
- 620.254
- 2481.02

Question 15

1.2 pts

The figure below represents a reaction at 298 K.



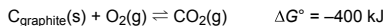
Based on the figure, which of the following statements (if any) are FALSE?

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

Question 16

1.2 pts

Consider the reaction:



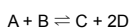
Which of the following is a possible value of K for this reaction?

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

Question 17

1.2 pts

The reaction



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

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

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

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

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

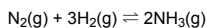
Which of the following statements is definitely true?

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

Question 18

1.2 pts

The reaction



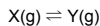
has an equilibrium constant of 4.0×10^8 at 25°C . What will eventually happen if 44.0 moles of NH_3 , 0.452 moles of N_2 , and 0.108 moles of H_2 are put in a 10.0 L container at 25°

- 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 19

1.2 pts

Given the hypothetical reaction:



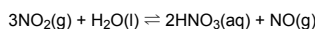
Predict what will happen when 1.0 mol Y is placed into an evacuated container.

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

Question 20

1.2 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?

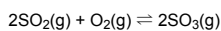


- it increases
- it is impossible to tell
- it remains the same
- it decreases

Question 21

1.2 pts

Consider the following reaction:



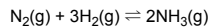
where $\Delta H_{\text{rxn}} = -198 \text{ kJ}$. The amount of $\text{SO}_2(\text{g})$ at equilibrium increases when...

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

Question 22

1.2 pts

Suppose the reaction mixture



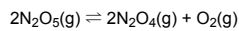
is at equilibrium at a given temperature and pressure. The pressure is then increased at constant temperature by compressing the reaction mixture, and the mixture is then allowed to reestablish equilibrium. At the new equilibrium...

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

Question 23

1.2 pts

Consider the system:



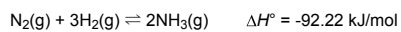
at equilibrium at 25°C. If this is an exothermic reaction and the temperature was raised, would the equilibrium be shifted to produce more N_2O_5 or more N_2O_4 ?

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

Question 24

1.2 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?



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