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 L·atm·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?

- 1.49×10^5 g/mol
- 1.69×10^5 g/mol
- 2.81×10^5 g/mol
- 1.81×10^5 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

$A + B \rightleftharpoons C + D$

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

$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$

at equilibrium is:

- $\frac{[NH_3]^4[O_2]^5}{[NO]^4[H_2O]^6}$
- $\frac{[NO][H_2O]}{[NH_3][O_2]}$
- $[NH_3]^4[O_2]^5$
- $\frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5}$

Question 8
1.2 pts

Consider the following reactions at 25°C:

$2NO(g) \rightleftharpoons N_2(g) + O_2(g)$ $K_c = 1 \times 10^{30}$

$2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g)$ $K_c = 5 \times 10^{-82}$

$2CO(g) + O_2(g) \rightleftharpoons 2CO_2(g)$ $K_c = 3 \times 10^{91}$

Which compound is most likely to dissociate and give $O_2(g)$ at 25°C?

- H_2O
- NO
- CO
- CO_2

Question 9
1.2 pts

At 600°C, the equilibrium constant for the reaction

$2HgO(s) \longrightarrow 2Hg(l) + O_2(g)$

is 2.8. Calculate the equilibrium constant for the reaction

$0.5O_2(g) + Hg(l) \longrightarrow HgO(s)$.

- 1.1
- 0.36
- 0.60
- 1.7

Question 10
1.2 pts

Consider the reaction

$2HgO(s) \rightleftharpoons 2Hg(l) + O_2(g)$

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

- $\frac{[O_2]}{[HgO]^2}$
- $\frac{[Hg]^2[O_2]}{[HgO]^2}$
- $[O_2]$
- $[Hg]^2[O_2]$

Question 11
1.2 pts

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

$2H_2(g) + S_2(g) \rightleftharpoons 2H_2S(g)$

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

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

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:

$2NO(g) + Br_2(g) \rightleftharpoons 2NOBr(g)$ $K_p = 2.40$ @ 373 K

Calculate K_c for this reaction at 100°C.

- 0.0784
- 7440
- 19.7
- 73.5

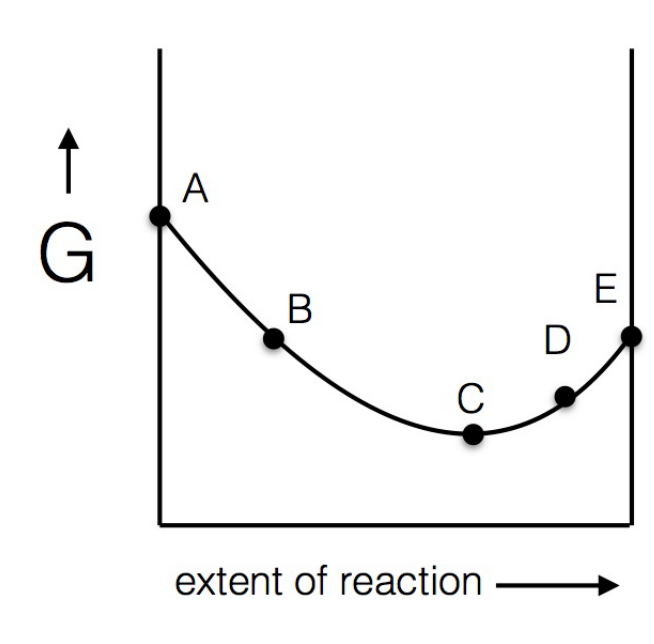
Question 14
1.2 pts

Calculate the equilibrium constant at 25°C for a reaction for which $\Delta G^\circ = -4.22$ 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:

$C_{graphite}(s) + O_2(g) \rightleftharpoons CO_2(g)$ $\Delta G^\circ = -400$ kJ

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

$A + B \rightleftharpoons C + 2D$

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

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

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

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

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

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

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:

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

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

Question 21
1.2 pts

Consider the following reaction:

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

where $\Delta H_{rxn} = -198$ kJ. The amount of $SO_2(g)$ 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

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

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 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:

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

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
- 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?

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta H^\circ = -92.22$ kJ/mol

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