UNIVERSITY OF JAFFNA, SRI LANKA

BACHELOR OF PHARMACY

SECOND YEAR SECOND SEMESTER EXAMINATION – APRIL 2020

PHACH 2224-PHARMACEUTICAL CHEMISTRY III

Time: 3 Hours

Date: 22.09.2020

ANSWER ALL THE SIX QUESTIONS

1. 1.1 Define "Chemical Kinetics". **(10 Marks)**

   1.2 Drive the integrated rate equation for a second order reaction, when a reactant 'A' is converted to a product 'P'. **(30 Marks)**

   1.3 At 25 °C, breakdown of HI to hydrogen and iodine is very slow (rate = $k[HI]^2$). The rate constant at 25 °C is 2.4×10^{-11} $Lmol^{-1}s^{-1}$.

   1.3.1 If 0.01 mol of HI(g) is placed in a 1.0 L container, how long will HI take to reduce its concentration to 0.009 $molL^{-1}$? **(20 Marks)**

   1.3.2 What is the half-life of this reaction at 0.01 $molL^{-1}$? **(25 Marks)**

   1.3.3 What is the concentration of the reactant after 1000 years, if [HI]=0.01 $molL^{-1}$? **(15 Marks)**

2 2.1 2.1.1 Define the "Phase diagram" of a substance. **(15 Marks)**

   2.1.2 Using the following data, draw and label the phase diagram: critical point at 373°C and 217 atm pressure; (b) triple point at 0.01°C and 0.006 atm pressure; (c) solid is less denser than liquid at triple point. **(20 Marks)**

   2.1.3 Explain why solid is less denser than liquid. **(15 Marks)**

   2.2 2.2.1 Briefly explain the pressure-composition phase diagram for an ideal solution. **(30 Marks)**

   2.2.2 Using the pressure-composition diagram, drive an expression for the lever rule. **(20 Marks)**

3 3.1 3.1.1 What is it degree of dissociation (α) of a weakly dissociable compound? **(10 Marks)**

3.1.2 Derive an equation for the degree of dissociation of a weak acid. **(15 Marks)**

3.1.3 The degree of dissociation of a 0.01 $molL^{-1}$ weak acid is 10^{-3}. Calculate the pOH of the weak acid. **(10 Marks)**

3.2 3.2.1 Define "Partition coefficient". **(10 Marks)**

3.2.2 A solution containing1.00 g of I_2 in 100 mL of water was shaken with 10 mL of chloroform. The chloroform layer was titrated with 0.1 $molL^{-1}$ of sodium thiosulphate and it required 63 mL of sodium thiosulphate to complete the reaction.

3.2.2.1 Calculate the partition coefficient of I_2 between chloroform and water (Molecular weight of I_2 -253.8 g/mol)? **(30 Marks)**

3.2.2.2 How much of I_2 would have been extracted into the chloroform layer if 1.00 g of I_2 in 100 mL of water is mixed with 5mL of chloroform? **(10 Marks)**

3.2.2.3 How much of I_2 would have been extracted in total, if it is carried in two separate steps with 5 mL, instead with 10 mL as one step extraction. **(10 Marks)**

3.2.2.4 Discuss the suitable method of extraction? **(05 Marks)**

4 4.1 4.1.1 Define "reversible" and "irreversible" processes. **(20 Marks)**

4.1.2 2 moles of an ideal gas at 300 K and 6 atm pressure underwent expansion isothermally to half the initial pressure. Calculate the work done by the gas on the surrounding (R-8.314 $JK^{-1}mol^{-1}$) for its expansion under the following conditions:

4.1.2.1 irreversibly against zero external pressure. **(20 Marks)**

4.1.2.2 irreversibly against the 3 atm external pressure. **(15 Marks)**

4.1.2.3 reversibly. **(15 Marks)**

4.2 4.2.2 If the molar isochoric thermal capacity of Argon gas is 3R/2 and is independent of temperature.

4.2.2.1 What would be the heat energy required to raise the temperature of 10 moles of argon from 295 to 305 K at constant volume. **(20 Marks)**

4.2.2.2 Calculate the internal energy change for the rise in temperature of argon gas. **(10 Marks)**

5 5.1 5.1.1 What is an electrochemical cell. **(10 Marks)**

5.1.2 The standard respective potentials of the Cu / Cu^{2+} and Zn / Zn^{2+} are $E^0_{Cu\ (Red)}$= + 0.339 V and $E^0_{Zn\ (Red)}$ = -0.762 V.

5.1.2.1 Write the half-reactions for each process and identify the anode and the cathode. **(20 Marks)**

5.1.2.2 Write the balanced equation for the overall cell reaction. **(10 Marks)**

5.1.2.3 Write down the cell notification. **(15 Marks)**

5.1.2.4 Calculate the standard cell potential of a voltaic cell. **(20 Marks)**

5.1.3 Under standard conditions, $[Cu^{2+}]$ =$[Zn^{2+}]$ =1.0 $molL^{-1}$ and T = 298 K. As the reaction proceeds, $[Cu^{2+}]$ decreases as $[Zn^{2+}]$ increases. After one minute, $[Cu^{2+}]$ = 0.05 $molL^{-1}$ while $[Zn^{2+}]$ = 1.95 $molL^{-1}$.

5.2.3.1 Calculate the cell potential after 1 minute. **(10 Marks)**

5.2.3.2 If the reaction has reached its equilibrium, calculate the equilibrium constant. **(15 Marks)**

6 6.1 Write short notes on 'Real time analysis'. **(30 Marks)**

6.2 6.2.1 Define "reaction order". **(10 Marks)**

6.2.2 The rate of the following reaction in aqueous solution is monitored by the precipitation of Hg_2Cl_2.

$$2HgCl_2(aq) + C_2O_4^{2-}(aq) \rightarrow 2\ Cl^-(aq) + 2\ CO_2(g) + Hg_2Cl_2(s)$$

The data obtained are listed in the table

No	$[HgCl_2]$ ($molL^{-1}$)	$[C_2O_4^{2-}]$ ($molL^{-1}$)	Initial rate ($molL^{-1}min^{-1}$)
1	0.105	0.15	1.8×10^{-5}
2	0.105	0.30	7.1×10^{-5}
3	0.052	0.30	3.5×10^{-5}
4	0.052	0.15	8.9×10^{-6}

6.2.2.1 Determine the order of reaction with respect to $HgCl_2$, and $C_2O_4^{2-}$, and overall. **(30 Marks)**

6.2.2.2 Calculate the rate constant of this reaction. **(20 Marks)**

6.2.2.3 What would be the initial rate of the reaction, if $[HgCl_2]$ = 0.094 $molL^{-1}$ and $[C_2O_4^{2-}]$ = 0.19 $molL^{-1}$? **(10 Marks)**