UNIVERSITY OF JAFFNA, SRILANKA
BACHELOR OF PHARMACY
SECOND YEAR SECOND SEMESTER EXAMINATION – MARCH 2019
PHACH 2224 PHARMACEUTICAL CHEMISTRY III

DATE: 21.03.2019 **TIME: 3 Hours**

Answer to all six questions

1.

1.1. Calculate the concentration of a diprotic acid which has pH of 3. (10 Marks)

1.2. A mixture contains 0.275M HF and 0.125M HCN at 25°C.
(Ka of HF = $3.5X10^{-4}$ and Ka of HCN = $6.2X10^{-10}$ at 25°C.)

1.2.1. Find out the pH of the above mentioned mixture. (20 Marks)

1.2.2. Calculate the concentration of $(CN)^-$ of this mixture. (10 Marks)

1.3. Calculate the pKb of a 0.2M weakbase (B) having the pH of 9.25. (10 Marks)

1.4. Derive the Henderson Hassel Bach equation for a weak base. (10 Marks)

1.5. 25ml of 0.125M CH_3NH_2 was titrated with 0.175M of HCl. (Ka of CH_3NH_2 is $2X10^{-8}$ and $K_w = 1X10^{-14}$ at 25°C) Calculate the followings.

1.5.1. Initial pH of CH_3NH_2 (10 Marks)

1.5.2. pH of resultant mixture after the addition of 10ml of HCl (20 Marks)

1.5.3. pH of resultant mixture at equivalent point (10 Marks)

2.

2.1. Define "rate law". (10 Marks)

2.2. Derive the integrated rate law for first order and second order of chemical reactions. (15 Marks)

2.3.

2.3.1. Derive the equation that is used for determination of half-life of first order reaction. (10 Marks)

2.3.2. Rate constant of a second order reaction was $2.75M^{-1}\ min^{-1}$ at 25°C and the initial concentration of reactant was 7.5M. Determine the half-life of the reaction. (15 Marks)

2.4. List and explain the factors that affect the rate of the chemical reaction. (25 Marks)

2.5.

2.5.1. Write the Arrhenius equation. (10 Marks)

2.5.2. The rate constant of a chemical reaction was determined as a function of temperature and the results are given below. Find out the activation energy of that chemical reaction. (15 Marks)

Temperature (^{0}C)	57	67	77
K (min^{-1})	$2.5X10^{-8}$	$5.42X10^{-8}$	$11.25X10^{-8}$

3.

3.1. $XY_{(aq)} + Y_{2\,(s)} \longrightarrow XY_{3(aq)}$

XY reacts with Y_2 and form XY_3 as mentioned in above equation

3.1.1 0.26 moles of Y_2 was added to a two phase system containing 50ml of water and 25ml of chloroform and shaken well at 25°C. Then it was allowed to reach equilibrium for 10 minutes. 48ml of 4M of titrant, 'T' was needed to titrate the Y_2 present in the 10ml of chloroform layer. Determine the partition coefficient of Y_2 between organic and aqueous phases.
(Y_2 can dissolve in both organic and aqueous phases while XY and the product, XY_3 can dissolve only in aqueous phase. Stoichiometric ratio between Y_2 and 'T' is 1: 2) (15 Marks)

3.1.2 1.5 moles of XY was added to the above mentioned water and chloroform system and shaken well until equilibrium was reached. 36ml of 4M of 'T' was needed to titrate Y_2 present in 10ml of chloroform layer. Determine the equilibrium constant of the above mentioned reaction. (35 Marks)

3.2. Define the terms solubility and solubility product. (10 Marks)

3.3. Calculate the solubility of a sparingly soluble ionic compound MY_2 in a solution containing 0.25M of Y^+ at 30°C.
(Ksp of $MY_2 = 1.75X10^{-5}$ at 30°C) (25 Marks)

3.4. ACl and ECl_2 are sparingly soluble ionic substances. Find out the concentrations of A^+, E^{2+} and Cl^- in a solution of ACl and ECl_2 after equilibrium.
(The solubility product of ACl and ECl_2 are $9.5X10^{-16}M^2$ and $6.75X10^{-8}M^3$ respectively at 35°C.) (15 Marks)

4.

4.1. Define the following.

4.1.1. Phase (05 Marks)

4.1.2. Component (05 Marks)

4.1.3. Degree of freedom (05 Marks)

4.2. Briefly describe one component system by phase diagram. (30 Marks)

4.3. Briefly explain the fractional distillation of an ideal solution which contains toluene and benzene.
[Pure vapour pressure of benzene ($P^\circ_{Benzene}$) > pure vapour pressure of toluene ($P^\circ_{Toluene}$)] (25 Marks)

4.4.

4.4.1. State the Raoult's law. (10 Marks)

4.4.2. An ideal solution was prepared by mixing 40g of liquid A and 90g of liquid B at 80°C under 1atm. Find out the molecular weight of liquid B.
(Molecular weight of A is 20mg/mol, P^0_A is 1000mmHg and P^0 B is 600mmHg.) (20 Marks)

5.

5.1.

5.1.1. Define the zeroth and first law of thermodynamics. (20 Marks)

5.1.2. Two moles of liquid water is converted to equal moles of water vapor at its boiling point of 373K, under 1atm. Calculate the work done on the system during conversion liquid to vapour.
(Assume that water vapor can behave as an ideal gas at this condition.)
(Molar volume of liquid water is $1.8X\ 10^{-6}m^3mol^{-1}$ at the temperature of 373 K) (15 Marks)

5.1.3. If additionally $40.82kJmol^{-1}$ heat energy absorbed by the system, calculate the change in internal energy of this system. (10 Marks)

5.2. Proof that Cp = Cv+R (15 Marks)

5.3.

5.3.1. Define 'enthalpy' and 'entropy'. (10 Marks)

5.3.2. Calculate the enthalpy change that occurs when 6 moles of a solid substance is heated from 32^0C to 275^0C at constant volume.
($C_{v,m}= 23.08JK^{-1}mol^{-1}$) (10 Marks)

5.4. Calculate the amount of heat energy required to convert 4 moles of liquid medicinal substance into vapour under standard atmospheric pressure by heating it from 50^0C to150^0C.
(Its boiling point at this pressure is 120^0C, Molar heat capacity of liquid at constant pressure $C_{p,m}$(liquid) is 85.4 $Jmol^{-1}K^{-1}$, Heat of vaporization, Lv is $50.75kJmol^{-1}$ at 120^0C and molar heat capacity of liquid vapour at constant pressure $C_{p,m}$(vapour) is 48.35 $Jmol^{-1}K^{-1}$). (20 Marks)

6.

6.1. Define the following.

6.1.1. Adiabatic process (05 Marks)

6.1.2. Irreversible process (05 Marks)

6.1.3. Isolated System (05 Marks)

6.2.

6.2.1. Derive the Langmuir adsorption isotherm equation. (15 Marks)

6.2.2. List the assumptions that are used for the derivation of Langmuir adsorption isotherm equation. (10 Marks)

6.3. A galvanic cell was constructed using standard Nickel and standard zinc electrodes.

$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$, $E^\circ = -0.76$ V.

$Ni(s) - 2e^- \rightarrow Ni^{2+}(aq)$ $E^\circ = 0.25$ V

6.3.1. Write the standard cell notation for this cell. (10 Marks)

6.3.2. Find out the Gibbs free energy change and equilibrium constant, K of this cell at 25^0C ($F= 96500\ Cmol^{-1}$). (30 Marks)

6.4. An inorganic pharmaceutical substance, D was separated using electrolysis. Determine the time needed to separate 250g of D by passing 2.5Amp current through D_2^+ containing solution.
(Molecular Weight of D was $75.38gmol^{-1}$). (20 Marks)