UNIVERSITY OF JAFFNA, SRILANKA
BACHELOR OF PHARMACY
SECOND YEAR SECOND SEMESTER EXAMINATION – February 2017
PHACH 2224 PHARMACEUTICAL CHEMISTRY III

DATE: 23.02.2017 **TIME: 3 Hours.**

Answer to all six questions.

1.

1.1.

1.1.1. Find out the pH of a mixture which contains 0.45M in HNO_2 and 0.25M in HCN (Ka of HNO_2 is $7.1X10^{-4}$ and Ka of HCN is $6.2X10^{-10}$) at 25^0C. (20 Marks)

1.1.2. Find out the concentration of $(CN)^-$ of this solution. (10 Marks)

1.2.

1.2.1. Derive the Henderson-Hasselbalch equation by considering a weak base B. (20 Marks)

1.2.2. Calculate the number of moles of NH_4Cl that should be added to 3L of 0.125M NH_3 solution to produce a buffer solution with a pH of 8.75 (Kb of NH_3 is $1.8X10^{-5}$ and assume that addition of NH_4Cl does not change the volume of solution). (30 Marks)

1.2.3. Calculate the pH of this solution after adding 0.02moles of HCl (Neglect any volume change). (20 Marks)

2.

2.1. State the phase rule and define the terms involved in it. (20 Marks)

2.2. Draw the labeled diagram for vapour pressure versus composition for ideal solution, solution with positive deviation and solution with negative deviation. (15 Marks)

2.3. Briefly describe the fractional distillation of an ideal solution containing mixture of A and B liquids as its composition and $P^0_A > P^0_B$. (30 Marks)

2.4.

2.4.1. Mole fraction of benzene in vapour state of an ideal solution containing benzene and toluene as its components is 0.4. Total vapour pressure of this solution is 50cmHg. Pure vapour pressure of toluene is 45cmHg at that particular temperature. Calculate the percentage of mass of benzene in initial solution. (Molecular weight of benzene and toluene are $78gmol^{-1}$ and $92gmol^{-1}$ respectively). (25 Marks)

2.4.2. Calculate the pure vapour pressure of benzene at this temperature. (10 Marks)

3.

3.1.

3.1.1. State the rate law. (10 Marks)

3.1.2. Derive the integrated rate law for first order reaction and second order reaction. (30 Marks)

3.2. Derive the equation for calculating half-life of a second order reaction. (10 Marks)

3.3. A second order reaction has a rate constant 2.4 $M^{-1}min^{-1}$ at 25^0C.

3.3.1. If initial concentration of the reactant is 0.075M, calculate the concentration after 3 minutes. (10 Marks)

3.3.2. Calculate the half- life of the reaction in minutes, if the initial concentration of the reactant is 0.5M (10 Marks)

3.4. A chemical substance decomposes at certain elevated temperature. 50% of the reaction was completed in 216 seconds when the initial pressure was 673mmHg and in 294 seconds when the initial pressure was 577mmHg. Find out the order of the reaction. (30 Marks)

4.

4.1. Write the Arrhenius Equation and explain each component. (20 Marks)

4.2. The rate constants of a first order reaction of an organic compound were measured at different temperature and the results are given below.

Temperature (K)	250	260	270
Rate constant K(s^{-1})	$1.5X10^{-6}$	$3.25X10^{-6}$	$6.6495X10^{-6}$

Calculate the activation energy of this reaction. (30 Marks)

4.3. Calculate the solubility of AE_2 (Ksp of AE_2 is $6.2X10^{-8}$ at 25^0C) in

4.3.1. Pure water (10 Marks)

4.3.2. 0.125M DE (15 Marks)

(Assume that AE_2 is a sparingly soluble ionic compound and DE is a freely soluble ionic salt)

4.4. At 25^0C, the solubility product of MI and YI_2 are $8X10^{-16}M^2$ and $7.75X10^{-8}M^3$ respectively. Find out the $[M^+]$, $[Y^{2+}]$ and $[I^-]$ in a solution at equilibrium with both substances. [Assume that both MI and YI_2 are sparingly soluble ionic substances.] (25 Marks)

5.

5.1. Define isothermal process. (10 Marks)

5.2. 5 moles of an ideal gas at 28^0C and 10 atm pressure undergoes reversible isothermal expansion to quarter of its initial pressure. Calculate the work done on the gas by the surroundings. ($R = 8.314\ Jmol^{-1}K^{-1}$) (15 Marks)

5.3.

5.3.1. State the first law of thermo dynamics. (15 Marks)

5.3.2. Give the definition for entropy, enthalpy and molar specific heat. (15 Marks)

5.4.

5.4.1. 7.5 moles of a solid metal is heated from 450K to 600K keeping its volume as constant. Calculate the internal energy change of this metal ($C_{v,m} = 60Jmol^{-1}K^{-1}$). (15 Marks)

5.4.2. Calculate the amount of heat energy that is required to convert 3 moles of liquid $H_2O_{(l)}$ at 75^0C to vapour at 125^0C under standard atmospheric pressure. [Molar heat capacity of liquid water at constant pressure $C_{p,m}$(liquid water) is $75.4Jmol^{-1}K^{-1}$,Heat of vaporization Lv is $40.7KJmol^{-1}$ at 373K and molar heat capacity of water vapour at constant pressure $C_{p,m}$ (water vapour) is $36.3Jmol^{-1}K^{-1}$]. (30 Marks)

6.

6.1. Briefly describe the standard voltaic cell constructed with Cu and Zn as electrodes, $Cu(NO_3)_2$ and $Zn(NO_3)_2$ as electrolytes and with NaCl salt bridge. (30 Marks)

6.2. A galvanic cell was constructed by using standard cadmium and standard hydrogen electrodes.

$E^0(Cd^{2+}/Cd) = -0.40V$

6.2.1. Write the balanced equations for half- cell reactions and overall reaction. (15 Marks)

6.2.2. Write the standard shorthand cell notation for this galvanic cell. (10 Marks)

6.2.3. Find out the E^0 of the cell at 25^0C and Gibbs free energy change of this cell. ($F= 96500Cmol^{-1}$) (10 Marks)

6.2.4. Write down the Nernst equation and identify its components (20 Marks)

6.3. Calculate the mass of the chromium which can be plated by the passage of 2.8A for $2^1/_2$ hours through a Cr^{6+} solution. (Molecular Weight of Cr = $52gmol^{-1}$). (15 Marks)