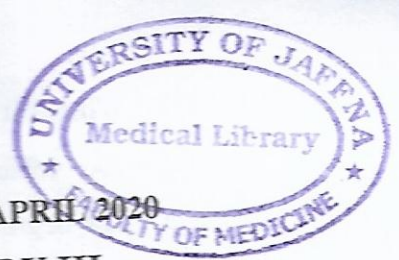


UNIVERSITY OF JAFFNA, SRI LANKA
BACHELOR OF PHARMACY
SECOND YEAR SECOND SEMESTER EXAMINATION – APRIL 2020
PHACH 2224-PHARMACEUTICAL CHEMISTRY III



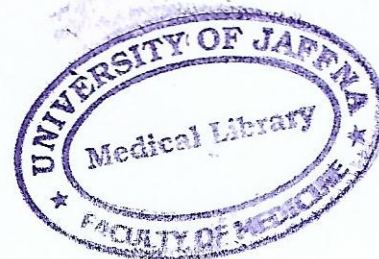
Date: 22.09.2020

Time: 3 Hours

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 ($\text{rate} = k[\text{HI}]^2$). The rate constant at 25 °C is $2.4 \times 10^{-11} \text{ Lmol}^{-1}\text{s}^{-1}$.
- 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 $[\text{HI}] = 0.01 \text{ molL}^{-1}$? (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 its 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 mol L^{-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 containing 1.00 g of I_2 in 100 mL of water was shaken with 10 mL of chloroform. The chloroform layer was titrated with 0.1 mol L^{-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 5 mL 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 ($R=8.314 \text{ JK}^{-1}\text{mol}^{-1}$) 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)

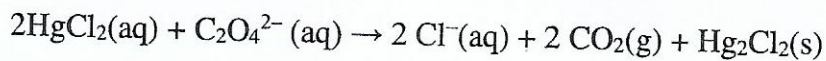


- 5 5.1 5.1.1 What is an electrochemical cell. (10 Marks)
- 5.1.2 The standard respective potentials of the Cu / Cu²⁺ and Zn / Zn²⁺ are E⁰_{Cu (Red)} = + 0.339 V and E⁰_{Zn (Red)} = -0.762 V.
- 5.1.2.1 Write the half-reactions for each process and identify the anode and the cathode. (20 Marks)
- 5.1.2.2 Write the balanced equation for the overall cell reaction. (10 Marks)
- 5.1.2.3 Write down the cell notation. (15 Marks)
- 5.1.2.4 Calculate the standard cell potential of a voltaic cell. (20 Marks)
- 5.1.3 Under standard conditions, [Cu²⁺] = [Zn²⁺] = 1.0 molL⁻¹ and T = 298 K. As the reaction proceeds, [Cu²⁺] decreases as [Zn²⁺] increases. After one minute, [Cu²⁺] = 0.05 molL⁻¹ while [Zn²⁺] = 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 Hg₂Cl₂.



The data obtained are listed in the table

No	[HgCl ₂] (molL ⁻¹)	[C ₂ O 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 HgCl₂, and C₂O₄²⁻, 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 [HgCl₂] = 0.094 molL⁻¹ and [C₂O₄²⁻] = 0.19 molL⁻¹? (10 Marks)