Name: Enrolment No:	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Course: Physical Chemistry
Semester: I
Program: B.Sc (H) Chemistry   **Time : 03 hrs.**
Course Code: CHEM 1004   **Max. Marks: 100**

Instructions:
1. Write your enrolment number on the top left of the question paper
2. Do not write any thing else on the question paper except your enrolment number
3. Attempt all part of a question at one place only
4. Internal choice is given for question number 4 of Section B and question number 2 of Section C only

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Discuss capillary tube method for determination of surface tension	4	CO1
Q 2	Calculate the pH of 0.10 M solution of NH_4Cl. The dissociation constant (K_b) of NH_3 is 1.6×10^{-5}	4	CO3
Q 3	(i) Why falling liquid drops are spherical? (ii) A liquid is transferred from a smaller vessel to a bigger vessel at the same temperature. What will be the effect on the vapour pressure?	4	CO1
Q 4	Calculate the Miller indices of crystal planes which cut through the crystal axes at (i) (a, b, c) (ii) (-2a, -3b, -3c)	4	CO1
Q 5	What would be the pH of a solution obtained by mixing 100 mL of 0.1 N HCl and 9.9 mL of 1.0 N NaOH solution?	4	CO3

SECTION B
(4Qx10M= 40 Marks)
(Question No. 1, 2 and 3 are Compulsory); attempt any one from question no 4

Q 1	State and explain the principle of corresponding states. Derive an expression Inter connecting critical pressure, critical volume and critical temperature.	10	CO2

Q 2	(i) Derive an expression of hydrolysis constant for salt of strong acid and weak base. Consider degree of hydrolysis to be "h". (ii) The solubility of AgCl in water at 25^oC is found to be 1.06×10^{-5} moles per litre. Calculate the solubility product of AgCl at this temperature	**6+4**	**CO3**
Q 3	(i) Calculate the total and average kinetic energy of 32 g methane molecules at 27^oC (ii) Calculate the pH on addition of 1 mL of 1 M NaOH of a buffer which is 0.1 M in acetic acid and 0.15 m in sodium acetate. K_a of acetic acid is 1.75×10^{-5}	**5+5**	**CO3**
Q 4	(i) An element exists in the body-centered cubic structure whose cell edge is 2.88 A^o. The density of the element is 7.20 g/cc. Calculate the number of atoms in 104 g of the element (ii) Calculate the packing efficiency in the Body centered cubic unit cell. **OR** (i) The first-order reflection of a beam of X-rays of wavelength 1.54 A^o from the (1 0 0) plane of a crystal of the simple cubic type occurs at an angle of 11.29^o. Calculate the length of the unit cell. (ii) Discuss the structure of CsCl	**6+4**	**CO1**
SECTION-C **(2Qx20M=40 Marks)** **(Question No. 1 Compulsory); attempt any one from question no 2**		

Q 1	(i) Explain the pH titration curve for weak acid and strong base
	
	 (ii) Derive the equation for solubility product in terms of solubility of the corresponding ions for the following:
	
	     (a) $Pb(NO_3)_2$
	
	     (b) $Ca_3(PO_4)_2$
	
	     (c) Ag_2S
	
	     (d) Ag_2SO_4
		4+8+8	**CO3**

	(iii) Calculate H^+ concentration in the following solutions
	
	  (a) a mixture of 5 mL of N/10 CH3COOH and 5 mL of N/10 NaOH
	  (b) a mixture of 5 mL of N/10 ammonia and 5 mL of N/10 HCl		

Q 2	(i) Equal volume of 2×10^{-3} M $BaCl_2$ solution and 2×10^{-4} M Na_2SO_4 are mixed. Will precipitation occur? (K_{sp} of $BaSO_4 = 1 \times 10^{-10}$)
	
	(ii) Explain:
	  (a) Solubility Product
	  (b) common Ion Effect
	
	 OR
	(i) Lead chloride has a solubility product of 1.7×10^{-5} at 298K. calculate its solubility at this temperature
	
	(ii) Establish relation between pK_a, pK_b and pK_w
		10+10	**CO3**