Name: **Enrolment No:**	

UPES

End Semester Examination, December 2024

Course: Physical Chemistry — **Semester : III**

Program: Elective BSc(H) Maths/Physics/Geology — **Time : 03 hrs.**

Course Code: CHEM 2038 — **Max. Marks: 100**

Instructions: Answer all the questions. Internal choice is given in Q9 and Q11.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	The rise of water level in a capillary of radius 0.2 mm at 20 ^{0}C is 7.4 cm. Calculate the surface tension of water taking its density as 1 g cm^{-3} at 20 ^{0}C.	**4**	**CO1**
Q 2	A first order reaction takes 40 minutes for 30% decomposition. Calculate $t_{1/2}$ for this reaction.	**4**	**CO1**
Q 3	Oxygen at 1 atm Pressure and 0 ^{o}C has a density of 1.4290 gm per lit. Find the root mean square velocity of oxygen molecules (P=76 x 13.6 x981 dynes cm^{-2}).	**4**	**CO1**
Q 4	If a solution has a pH of 7.41, determine its H^+ concentration.	**4**	**CO1**
Q 5	Calculate the activation energy of a reaction whose reaction rate at 27 ^{o}C gets doubled for 10 ^{o}C rise in temperature.	**4**	**CO1**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Write short notes on the following: (a) Order of a reaction (b) Molecularity of a reaction (c) Collision theory of reaction rate	**10**	**CO2**
Q 7	Derive the expression for the rate constant of parallel reaction.	**10**	**CO3**
Q 8	Derive the relation between average velocity, RMS velocity and most probable velocity.	**10**	**CO1**
Q 9	Calculate for oxygen gas at 25 ^{o}C and 1 atm pressure (a) mean free path, (b) number of collisions per second per molecule. The collision diameter of the oxygen molecule is 361 picometers. (P= 1.01325 x 10^5 Nm^{-2}) ***Or*** A litre solution containing 0.1 mole of CH_3COOH and 0.1 mole of CH_3COONa provides a buffer of pH 4.74. Calculate the pH of solution after the addition of 0.02 mole NaOH. K_a = 1.8 x 10^{-5}	**10** **10**	**CO3** **CO3**

SECTION-C (2Qx20M=40 Marks)			
Q 10	(a) Calculate the root mean square velocity of chlorine molecules at 17 ^{0}C and 800 mm pressure. (b) A second order reaction in which the initial concentration of both the reactants are same is 25% complete in 600 seconds. How long will it take for the reaction to go to 75% completion?	**10 + 10**	**CO3**
Q 11	(a) Deduce the expression for the rate constant of a second order reaction of the type 2A→ P. ***Or*** Calculate the pH of 0.1 M NH_3 solution. The ionized constant K_b for NH_3 is 1.8 x 10^{-5}. (b) Calculate from the van der Waals equation the temperature at which 3 moles of SO_2 would occupy a volume of 0.01 m^3 at 1519875 Nm^{-2} pressure (a= 0.679 Nm^4 mol^{-2}, b = 5.64 x 10^{-5} m^3 mol^{-1}, R= 8.314 J K^{-1} mol^{-1}). ***Or*** Define the following terms; (i) Axis of symmetry (ii) Inversion centre (iii) Mirror plane (iv) Improper rotation	**10 + 10**	**CO2**