

Name: Enrolment No:			
UPES End Semester Examination, December 2024			
Course: Physical Chemistry Program: Elective BSc(H) Maths/Physics/Geology Course Code: CHEM 2038		Semester : III Time : 03 hrs. 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 °C is 7.4 cm. Calculate the surface tension of water taking its density as 1 g cm ⁻³ at 20 °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 °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 °C gets doubled for 10 °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 °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 ₃ COOH and 0.1 mole of CH ₃ COONa 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	CO3

SECTION-C
(2Qx20M=40 Marks)

Q 10	(a) Calculate the root mean square velocity of chlorine molecules at 17 °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 $2A \rightarrow P$. <i>Or</i> Calculate the pH of 0.1 M NH_3 solution. The ionized constant K_b for NH_3 is 1.8×10^{-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 ($a = 0.679 \text{ Nm}^4 \text{ mol}^{-2}$, $b = 5.64 \times 10^{-5} \text{ m}^3 \text{ mol}^{-1}$, $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$). <i>Or</i> Define the following terms; (i) Axis of symmetry (ii) Inversion centre (iii) Mirror plane (iv) Improper rotation	10 + 10	CO2