Name: **Enrolment No:**	

UPES

End Semester Examination, December 2024

Course: States of Matter and Ionic Equilibria **Semester: I**

Program: BSc. (H) Chemistry by Research **Time : 03 hrs.**

Course Code: CHEM 1029 **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	25.8 litre of a gas has a pressure of 690 torr and temperature of 17 ^{o}C. What will be the volume if pressure is changed to 1.85 atm and the temperature to 345 K.	**4**	**CO1**
Q 2	Calculate the total kinetic energy of 0.5 mol of an idea gas at 273 K (R= 8.314 J K^{-1} mol^{-1}) (Avagadro's number 6.023 x 10^{-23}/mol).	**4**	**CO1**
Q 3	Calculate the volume of 10 moles of methane at 100 atm pressure and 0 ^{o}C. At this temperature and pressure, Z = 0.75.	**4**	**CO1**
Q 4	What do you mean by Miller indices and how is it determined?	**4**	**CO1**
Q 5	The dissociation constant of formic acid and acetic acid are 1.77 x 10^{-4} mol/dm^3 and 1.75 x 10^{-5} mol/dm^3. Calculate the relative strengths of two acid and point out which one is stronger?	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Derive the expression for pH of a solution obtained after hydrolysis of salt of weak acid and strong base.	**10**	**CO1**
Q 7	(a) Calculate the average kinetic energy of a hydrogen molecule at 0^{o}C. (R= 8.314 x 10^{7} erg K^{-1} mol^{-1}). (b) Calculate the kinetic energy of two moles of nitrogen at 27 ^{o}C. (R=8.314 J K^{-1} mol^{-1})	**5 + 5**	**CO2**
Q 8	Calculate the RMS velocity of chlorine molecules at 12 ^{0}C and 78 cm pressure.	**10**	**CO2**
Q 9	What pressure is exerted by a mixture of 2.0 gm of H_2 and 8.0 gm of N_2 at 273 K in a 10 litre vessel?	**10**	**CO3**

	Or The first-order reflections from the 100, 110 and 111 planes of a given cubic crystal (NaCl crystal) were found to occur at angles 5.9°, 8.4° and 5.2° respectively. Determine the type of cubic lattice to which the crystal belongs.		
SECTION-C (2Qx20M=40 Marks)			
Q 10	(a) One 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 $10^{-5.}$ (b) At 0 ^oC and 1 atm pressure the molecular diameter of gas is 4A^o. Calculate the mean free path of its molecules.	**10 + 10**	**CO2**
Q 11	(a) Derive the mathematical expression of kinetic molecular theory of gases. ***Or*** The RMS velocity of hydrogen at STP is 1.85 x 10^5 cm s^{-1} and its mean free path is 1.75 x 10^{-5} cm. Calculate the collision number. (b) Calculate the root mean square velocity, average velocity and most probable velocity of sulphur dioxide molecules at 427 °C. ***Or*** In what way does knowledge of surface tension help in deciding the chemical constitution of the liquid?	**10 + 10**	**CO3**