Name:

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UPES
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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Course: Physical Chemistry I **Semester: I**
Program: B.Sc. (H) Chemistry **Time 03 hrs.**
Course Code: CHEM1004 **Max. Marks: 100**
Number of pages: 2

Instructions: Attempt all the questions. Internal choice is given in Q 9, Q 10 and Q 12.

SECTION A

S. No.		Marks	CO
Q 1	Calculate the total kinetic energy of 0.5 mol of an idea gas at 273 K (R= 8.314 $JK^{-1}mol^{-1}$) (Avagadro's number 6.023 x 10^{-23}/mol).	**4**	**CO1**
Q 2	Benzene has a density of 0.879 g cm^{-3} and has a surface tension of 0.028 N m^{-1}. What will be the difference of its heights in two capillaries of diameter 0.10 mm and 0.15 mm, respectively?	**4**	**CO2**
Q 3	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**	**CO3**
Q 4	Calculate the pH of a 3.2 x 10^{-3} M solution of $Ba(OH)_2$ in water at 25 ^{0}C.	**4**	**CO1**
Q 5	Explain plane of symmetry, axis of symmetry and centre of symmetry in crystal with relevant example.	**4**	**CO1**
	SECTION B		
Q 6	Define buffer solution. Explain buffer action by taking example of basic buffer solution.	**8**	**CO1**
Q 7	Derive the relation between K_h, K_w and K_b for the hydrolysis of salt of weak base and strong acid. Calculate the value of K_h if the dissociation constant for NH_4OH at 25 ^{o}C is 2.0 x 10^{-5} mol/litre. (K_w = 1.0 x 10^{-14} $mol^2/litre^2$).	**8**	**CO3**
Q 8	Calculate the pressure exerted by 22 g of carbon dioxide in 0.5 dm^3 at 298.15 K using (a) the ideal gas law (b) *van der Waals* equation. Given (a= 363.76 kPa dm^6 mol^{-2}, and b= 42.67 cm^3mol^{-1}, R= 8.314 kPa dm^3 $K^{-1}mol^{-1}$).	**8**	**CO3**
Q 9	The enthalpy of vaporization of cyclohexane (C_6H_{12}) at its boiling point 80.75 ^{0}C is 385.15 J g^{-1}. The density of liquid and vapor at this temperature are 0.719 g cm^{-3} and 0.002 g cm^{-3}. (a) Calculate the value of d*p*/dT. (b) Estimate the boiling point at 740 mm Hg. **OR**	**8**	**CO2**

	What do you understand by root mean square velocity and molecular velocity of a gas? Also what is the relation between them.		
Q 10	If one litre of 0.05 M $Pb(NO_3)_2$ and one litre of 0.05 M KCl are mixed, will precipitation occur? Support your answer with suitable reason. (Ksp of $PbCl_2$ = 1.7 x 10^{-5} $mol^3/liter^3$) **OR** (a) Discuss the effects of nonvolatile impurities on vapor pressure and boiling point of a liquid. (b) What is Trouton's rule?	**8**	**CO2** **CO3**
	SECTION-C		
Q 11	**a)** Calcium carbonate, $CaCO_3$, has solubility in water of 0.018 g/litre at 25 ^oC. Calculate the K_{sp} for $CaCO_3$. (M.W. of $CaCO_3$ = 100 g/mol). **b)** The first order diffraction pattern of Cu was obtained at an angle of 25^0. Calculate the d-spacing between the diffraction of Cu-metal. (wavelength of X-ray = 1.54 A^0) **c)** Calculate the pressure exerted by 10^{23} gas particles each of mass 10^{-22} g in a container of volume 1 dm^3. The root mean square speed is 10^5 cm s^{-1}. **d)** The refractive index of carbon tetrachloride for D-line of sodium has been found to be 1.4573. Calculate its molar refraction if the density is 1.595 g/cm^3.	**5 + 5 + 5 + 5**	**CO1** **CO2** **CO3**
Q 12	**a)** Derive the Bragg's equation for diffraction of X-rays by crystal. **b)** Barium has a radius of 224 pm and crystallizes in a body-centred cubic structure. Calculate the edge length of the unit cell ? **c)** Calculate the root mean square velocity of hydrogen at 27 ^0C and 500 mm pressure. **d)** The boiling point of n-heptane is 36 ^0C. Estimate its molar heat of vaporization assuming that it obeys Trouton's rule. **OR** **a)** Polonium exist as a simple cube. The edge of its unit cell is 334.7 pm. Calculate its density. (Atomic mass of Polonium = 210 g/mol and Avagadro's number = 6.023 x 10^{-23}/mol). **b)** Explain Frenkel and Schottky defects in ionic solids with appropriate examples. **c)** A steel ball with radius 0.1 cm and density 7.87 g cm^{-3} falls through a liquid of density 1.26 g cm^{-3} at a constant velocity of 10 cm s^{-1}. Calculate the coefficient of viscosity of the liquid. **d)** A liquid rises to 1 cm in a glass capillary of radius r_1. How much will it rise if the cross-sectional area of the tube is (i) halved, (ii) doubled?	**5 + 5 + 5 + 5**	**CO1** **CO2** **CO3**