Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Physical Chemistry-I, CHEM 1004 **Semester: I**

Programme: B.Sc. (H) Chemistry

Time: 03 hrs. **Max. Marks: 100**

Instructions: Attempt all the questions. The internal choice is given in Q9 and Q11. Attempt all part of the question at one place.

SECTION A

S. No.		Marks	CO
Q 1	Aluminium crystallizes in cubic close packed structure. Its metallic radius is 125 pm. What is the edge length of unit cell?	4	CO1
Q 2	If the solubility product of magnesium hydroxide is 2.00 x 10^{-11} mol^3 dm^{-9} at 298 K, calculate its solubility in mol dm^{-3} at that temperature.	4	CO3
Q 3	Explain the buffer action by taking example of basic buffer solution.	4	CO2
Q 4	Calculate the average velocity of nitrogen molecule at STP.	4	CO1
Q 5	What pressure is exerted by a mixture of 2.0 g of H_2 and 8.0 gm of N_2 at 273 K in a 10 litre vessel?	4	CO2
	SECTION B		
Q 6	Calculate the molar solubility of $Zn(OH)_2$ in 1M ammonia solution at room temperature. Given K_{sp} $[Zn(OH)_2]$ = 1.8 x 10^{-17} mol^3 dm^{-9}, K_{stab} $[Zn(NH_3)_4]^{2+}$ = 1.64 x 10^{10}.	10	CO2
Q 7	Derive the relation for pH when the salt of weak base and strong acid is hydrolysed.	10	CO1
Q 8	Derive kinetic gas equation in terms of kinetic energy. Calculate the average kinetic energy of a hydrogen molecule at 0 ^{0}C. [R= 8.314 X 10^7 erg $K^{-1}Mol^{-1}$].	10	CO2
Q 9	Molybdenum forms body-centred cubic crystals whose density is 10.3 g/cm^3. Calculate the edge length of the unit cell and distance between (111) planes. **OR** Two moles of NH_3 are enclosed in a five liter flask at 27 ^{0}C. Calculate its pressure using (i) van der Waal's equation; (ii) Ideal gas equation. [a = 5.464 L^2 atm mol^{-1}; b= 0.0305 L mol^{-1}; R= 0.0821 L atm. $Deg^{-1}mol^{-1}$).	10	CO3
	SECTION-C		
Q10(a) (b)	Explain the Schottky and Frenkel defects in solids. A buffer is prepared containing 1.00 M acetic acid and 1.00 M sodium acetate. What is its pH? (Given K_a = 1.77 x 10^{-5})	6+4 +10	CO1, CO2, CO3

(c)	The surface tension of water is 72.8 dynes cm^{-1}. Calculate the energy required to disperse one spherical drop of radius 3.0 mm into spherical drops of radius 3.0 X 10^{-3} mm.		
Q11(a)	K_{sp} for silver chromate, Ag_2CrO_4, is 1.1 × 10^{-12} mol^3 dm^{-9}. Calculate the molar concentration of silver chromate in a saturated solution.	**6+ 4 +10**	**CO1, CO2, CO3**
(b)	Calculate the pH of a 0.05 M solution of ammonium chloride, NH_4Cl. Given that $K_a = 5.65x10^{-10}$.		
(c)	Calculate the pressure exerted by 1.00 mole of CH_4 in a 250 mL container at 300K using van der Waals equation. What pressure will be predicted by ideal gas equation? [a= 2.253 L^2 atm mol^{-2}; b= 0.0428 L mol^{-1}; R= 0.0821 L atm mol^{-1} K].		
	OR		
(a)	Al crystallizes in FCC structure. Calculate the atomic mass of Al atom, if length of the unit cell is 404 pm and density of Al is 2.7 g/cm^3.		
(b)	$PbCl_2$ has K_{sp} = 1.7 × 10^{-5} mol^3 dm^{-9}. If equal volumes of 0.030 M $Pb(NO_3)_2$ and 0.030 M KCl are mixed, predict whether precipitation will occur or not. Assume 1 L of each solution.		
(c)	Derive the mean free path of one gas molecule and explain the effect of temperature and pressure on mean free path.		

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SECTION A

S. No.		Marks	CO
Q 1	Calculate the number of atoms present in FCC unit cell.	**4**	**CO1**
Q 2	$Ca(OH)_2$ has Ksp = 7.9×10^{-6} mol^3 dm^{-9}. What is the pH of a solution made by equilibrating solid $Ca(OH)_2$ with water?	**4**	**CO3**
Q 3	Explain why the pH of the buffer solution remains constant after adding little amount acid or base.	**4**	**CO1**
Q 4	50 mL of gas A effuse through a pin-hole in 160 seconds. The same volume of CO_2 under identical conditions effuses in 135 seconds. Calculate the molecular mass of A.	**4**	**CO2**
Q 5	Calculate the root mean square velocity of chlorine molecules at 12 ^{0}C and 78 cm pressure.	**4**	**CO2**
	SECTION B		
Q 6	Calculate the solubility of $Mg(OH)_2$ in (i) 0.01 M NaOH and (ii) 0.01 M $Ba(OH)_2$ solution and compare the results.	**10**	**CO1**
Q 7	Explain the titration curve of weak base vs strong acid and selection of suitable indicator.	**10**	**CO1**
Q 8	Describe the distribution of molecular velocities including root mean square velocity and the most probable velocity.	**10**	**CO2**
Q 9	Derive the Bragg's equation. Inter planar distance between two layers is 4.0A^0 in a crystal. Calculate the angle of reflection for first order reflection if X-rays of wavelength 1.54 A^0 are diffracted by the crystal. **OR** Derive the kinetic gas equation in terms of (i) the total change of momentum due to impact of all the molecules on all faces of the box (ii) calculation of pressure from change of momentum.	**10**	**CO3**

	SECTION-C		
Q10(a)	Explain the stoichiometric defects in the solids. Calculate the packing fraction of the BCC unit cell.	**5+5 +10**	**CO2, CO2, CO3**
(b)	Nickel crystallizes in a face-centred cubic lattice. If the density of the metal is 8.908 g/cm3, what is the unit cell edge length in pm? (Atomic mass of Ni 58.69).		
(c)	The average velocity of an ideal gas molecule at 27°C is 0.3 m sec^{-1}. Calculate average velocity at 927°C.		
Q11(a)	Calculate the pH of a solution obtained by mixing 5 g of acetic acid and 7.5 g of sodium acetate and making volume equal to 500 ml. Dissociation constant of acetic acid = 1.75 x 10^{-5}. MW of acetic acid = 60g and sodium acetate = 82g.	**7+3 +10**	**CO1, CO2, CO3**
(b)	If pH of the solution is 5.4, calculate the hydrogen ion concentration.		
(c)	Using kinetic theory of gases, deduce (i) Boyle's Law (ii) Graham's Law		
	OR		
(a)	Derive the relation of pH when salt of weak acid and strong base is hydrolysed.		
(b)	The dissociation constant of NH_4OH at 25 ^oC is 1.81 x 10^{-5}. Calculate the degree of hydrolysis of a 0.01 M solution of ammonium chloride. K_w= 1.0 x 10^{-14}		
(c)	What are Newtonian and non-Newtonian liquids? Discuss the effects of temperature on the viscosity of a liquid. "While the viscosity of a gas increases with increase in temperature, however, in liquid it decreases with increase in temperature". How would you account for it.		