SEMESTER END EXAMINATION, APRIL-MAY 2023

Sem. IV of S.Y.B.Sc

Paper: Physical Chemistry and Inorganic Chemistry Code: CHC -104

Maximum marks: 80 Date:28/04/2023 Duration: 02 Hours Total No of pages: 03

Instructions: *1. All questions are compulsory*

2. Figures to the right indicate marks

3. Use of scientific calculators is allowed

4. Answer both the sections separately

Section A (PHYSICAL CHEMISTRY) Marks:40

Q1. Answer any 5 of the following: **(2x5 =10 marks)**

i) State any 2 postulates of kinetic theory of gases.

ii) At 20°C, toluene rises 1.5cm in a capillary tube of radius 0.41mm. Calculate the surface tension of toluene. The density of toluene at 20°C is 0.866 g per cc.

iii) Identify the crystal system to which the following data of unit cells belong:

1) $a \neq b \neq c,\ \alpha \neq \beta \neq \gamma \neq 90^{o}$

2) $a = b = c,\ \alpha = \beta = \gamma = 90^{o}$

iv) How is the rate constant (k) for first order reactions calculated graphically.

v) The van der Waals constants for HCl gas are a = 0.367 Nm^4mol^{-2} and b= 0.0408 x $10^{-8}\ m^3mol^{-1}$. Calculate Tc and Vc.

vi) Define axis of symmetry and draw a diagram showing three-fold axis of symmetry.

vii) What is the effect of a catalyst on the rate of a reaction?

Q2.A.i) Draw isotherms of CO_2 below and above its critical temperature. Write briefly how these isotherms are used to understand the principle of liquefaction of gases. **(4)**

ii) How is surface tension determined using Stalagnometer. **(3)**

OR

Q2.A iii) a)Calculate the root mean square velocity and most probable velocity of SO_2 molecules at 427°C (R= 0.082 L/atm/degree/mol) **(2)**

b)Answer the following: **(2)**

1) Write the equation for compressibility factor

2) What is the value of compressibility factor for an ideal gas.

iv) Explain 3 factors affecting viscosity of a liquid. **(3)**

Q2. B. i) Derive the rate equation for second order reaction with equal concentration of the reactants (4)

ii) The second order reflection of x-rays from (100) planes of NaCl occurs at 29.3°.If the wavelength used is 1.5A°, Calculate the distance between two successive (100) planes in NaCl. (4)

Q3.A i) Calculate the activation energy of a reaction whose reaction rate at 27°C gets doubled for 10°C rise in temperature. (4)

ii) Explain the powder method for determination of crystal structure of a solid (3)

OR

Q3.A.iii) Answer the following:

a) Write a note on collision theory. (2)

b) What are zero order reactions? Give an example. (2)

iv) KCl and NaCl are isomorphous compounds but NaCl shows a face centered cubic structure and KCl shows simple cubic structure. Why? (3)

Q3.B.i) Answer the following:

a) Write van der Waals equation of state and explain the terms involved. (2)

b) What is Boyle temperature? Write the equation for the same. (2)

ii) The water flow time for an viscometer is 53.1 sec at 25°C. If 46.2 sec are required for the same volume of ethyl alcohol (density= 0.789 g/cm3) to flow through the capillary, calculate its viscosity at 25°C, that of water being 0.00895poise at the same temperature. (4)

SECTION B: INORGANIC CHEMISTRY 40 Marks

Q1. Answer **any five** from the following **(2×5 = 10 marks)**

i) Give the name of any one transition element. Give the name and chemical formula of two of its compounds and calculate the oxidation state of the transition element in each of the compounds.

ii) The atomic radii of Cr, Mn, Fe, Co and Ni are close to one another. Give reasons.

iii) $CuSO_4.xH_2O$ is blue but $ZnSO_4.xH_2O$ is colourless. Explain

iv) Define with examples i) ligand and ii) Coordination number.

v) What is the coordination number and oxidation state of the metal in the following

ethyl alcohol (density= 0.789 g/cm3) to flow through the capillary, calculate its viscosity at 25°C, that of water being 0.00895poise at the same temperature. (4)

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v) What is the coordination number and oxidation state of the metal in the following complexes

a) $K[Fe(SCN)_4(en)]$

b) $Na_3[Co(CN)_4(Cl)_2]$

vi) What is meant by crystal field splitting energy and electron pairing energy?

vii) List only the factors that affect the splitting of the d-orbitals.

Q2. A. Answer the following

i) What are lanthanides? Describe the ion exchange method for the separation of lanthanides. **(4)**

ii) Give the IUPAC name of the following complexes **(3)**

a) $[Al(OH)(H_2O)_5]Cl_2$

b) $K[Co(NH_3)_3Cl_3]$

c) $[Ni(CO)_4]$

OR

i) Write a short note on the colour of lanthanide compounds. **(4)**

ii) Draw the geometric isomers and optical isomers of the metal complex $[Cr(en)_2Cl_2]^+$ **(3)**

Q2. B. i) Give the splitting of the d-orbitals in the complex $[Ni(CN)_6]^{3-}$. Is this a high spin or low spin complex? **(4)**

ii) Using the VBT, explain why $[CoF_6]^{3-}$ is paramagnetic while $[Co(NH_3)_6]^{3+}$ is diamagnetic. **(4)**

Q3. A) Answer the following

i) Among the pairs of complexes given below, select the complex in which the d-d transition will occur at a longer wavelength. Give reasons for your choice. **(4)**

a) $[CrCl_6]^{3-}$ or $[Cr(CO)_6]^{3+}$

b) $[Ti(NH_3)_6]^{3+}$ or $[Ti(NH_3)_6]^{2+}$

ii) Write a short note on the colour of transition metal compounds. **(3)**

OR

iii) Give the splitting of the d-orbitals in an octahedral ligand field. Show the occupancy of the electron in these orbitals for a low spin d^6 configuration. **(4)**

iv) Transition elements show variable oxidation states. Explain **(3)**

Q3. B. i) Describe the bonding in the complex $[Fe(H_2O)_6]^{3+}$ on the basis of valence bond

b) $[Ti(NH_3)_6]^{3+}$ or $[Ti(NH_3)_6]^{2+}$

ii) Write a short note on the colour of transition metal compounds. (3)

OR

iii) Give the splitting of the d-orbitals in an octahedral ligand field. Show the occupancy of the electron in these orbitals for a low spin d^6 configuration. (4)

iv) Transition elements show variable oxidation states. Explain (3)

Q3. B. i) Describe the bonding in the complex $[Fe(H_2O)_6]^{3+}$ on the basis of valence bond theory. Comment on its magnetic properties. (4)

ii) Calculate the CFSE for the following coordination compounds (4)

a) $K_3[CoF_6]$
b) $Na_3[Fe(CN)_6]$

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