



বিদ্যাসাগর বিশ্ববিদ্যালয়
VIDYASAGAR UNIVERSITY

Question Paper

B.Sc. Honours Examinations 2021

(Under CBCS Pattern)

Semester - II

Subject: CHEMISTRY

Paper: C 3-T & P

Inorganic Chemistry - I

Full Marks : 60

Time : 3 Hours (Theory-40 + Practical-20)

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

THEORY (Marks : 40)

Group A

Answer any *two* from the following :

2×15=30

- (a) What is exchange energy? From the concept of exchange energy how ground state electronic configuration of chromium can be determined? 4
- (b) The amino acid glycine exists predominantly in the form $\text{NH}_3^+\text{CH}_2\text{COO}^-$. Write down the formula for conjugate base and conjugate acid of glycine. 2

- (c) Using Slater's rules calculate the effective nuclear charge for the following electrons :
 (i) a 4s electron in Cu atom ($Z=29$), (ii) a 3d electron in Cu atom. 3
- (d) A solution of potassium ferricyanide cannot oxidise iodide to iodine but it can do so in presence of zinc ion — Explain. [Given E^0 (volts) : $\text{Fe}(\text{CN})_6^{3-} / \text{Fe}(\text{CN})_6^{4-} = +0.36\text{V}$ and $1/2 \text{I}_2 / \text{I}^- = +0.54\text{V}$] 4
- (e) State Heisenberg's uncertainty principle and discuss its significance. 2
2. (a) Draw the vector orientation of the m_l values corresponding to $l=3$ in magnetic field. 3
- (b) Arrange BF_3 , BCl_3 and BBr_3 in the increasing order of their acidity with justification. 2
- (c) The interionic distance in RbBr is 342 pm. Use Pauling's method to calculate the radii of Rb^+ and Br^- (Atomic no of Rb is 37). 4
- (d) Construct the Frost diagram from the following Latimer diagram for 'Hg' in acid solution.

$$\text{Hg}^{2+} \xrightarrow{0.911\text{V}} \text{Hg}_2^{2+} \xrightarrow{0.796\text{V}} \text{Hg}$$
 Comment on the tendency of any of the species to undergo disproportionation. 4
- (e) Deduce the ground state term symbol for Ni^{2+} ion (atomic no. of Ni is 28). 2
3. (a) Calculate the equilibrium constant for the reaction of KMnO_4 and Fe^{2+} in acid medium.
 [Given E^0 (volts) : $\text{Fe}^{3+} / \text{Fe}^{2+} = +0.77\text{V}$ & $\text{MnO}_4^- / \text{Mn}^{2+} = +1.51\text{V}$] 3
- (b) Electron affinity of Mn^{3+} is greater than that of Fe^{3+} — explain. 2
- (c) Sketch the radial distribution function for the 3s, 3p and 3d hydrogenic orbitals. Which orbital electron has the greater probability to be closer to the nucleus ? 4
- (d) How many radial nodes and nodal planes do 3p, 3d and 4f orbitals each have ? 3
- (e) Draw the structures of chloric acid (HClO_3) and chlorous acid (HClO_2) and predict their pK_a values using Pauling's rules. 3

4. (a) The solubility product (K_{sp}) of MgF_2 is 7×10^{-4} . Find its solubility in water and in 0.01(M) NaF solution. 4
- (b) What are superacids ? Indicate the parameter used to have a quantitative measure of superacid strength. 4
- (c) Account for the decrease in first ionisation energy between P and S. 2
- (d) Show that Bohr's postulates of quantisation of angular momentum for an electron can be derived by the application of de-Broglie's hypothesis. 3
- (e) Balance the equation by ion electron method : 2
- $$NaNO_3 + Zn + NaOH \rightarrow NH_3 + Na_2ZnO_2 + H_2O$$

Group - B

Answer any *one* question : 1×10=10

5. (a) Predict the wavelengths of the first two lines in the Paschen series. 3
- (b) Draw the acid base titration curve of weak acid by strong base. Name the suitable indicator used in this titration. 2
- (c) 'SnCl₂ is reducing while PbCl₂ is neither reducing nor oxidizing' — explain. 3
- (d) Define comproportionation reaction with example. 2
6. (a) Draw the Sommerfeld's orbit for n = 4. 2
- (b) Predict the direction of the following reaction (left or right) in gas phase with explanation.
- (i) $TiF_4 + 2TiI_2 \rightarrow TiI_4 + 2TiF_2$
- (ii) $HI + NaF \rightarrow HF + NaI$ 3
- (c) Establish the working potential of BDS indicator ($E^0 = 0.83V$ at 1(M)H⁺) 2.5
- (d) Explain the basis of electronegativity as described by Allred-Rockhow scale. 2.5

PRACTICAL (Marks : 20)

Paper : C 3P

Answer any *one* question :

1×20=20

1. Discuss the principle, methodology and calculation for the quantitative estimation of Fe(III) - Mn(II) mixture using potassium permanganate giving all the chemical reactions involved. 20
 2. (a) Describe titrimetric method for estimation of iron(III) using potassium dichromate.
(b) What is the role of H_3PO_4 and NH_4HF_2 in the above titration. 15+5
 3. Discuss the principle, methodology and calculation for the estimation of free alkali present in different soaps/detergents. 20
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