

Questions are of value as indicated in the margin

Group-A**(Answer any ten Questions)**

- 1 (a) What will be the energy separation between the ground state and the first excited state of f^3 system? 10 x 2
- (b) Comment on the magnetic behavior of triangular $[\text{Cu}_3(\text{cpse})_3(\text{H}_2\text{O})_3]$ (cpse = doubly deprotonated form of N-[2-hydroxyl-1(S)-methyl-2(S)-phenylethyl]-N-methyl glycine) compound.
- (c) The observed magnetic moment for an Os-complex at room temperature is ~ 1.50 B.M., apparently suggesting its +3 oxidation state. But this prediction is not correct. Explain.
- (d) Explain spin state isomerism in terms of Tanabe-Sugano diagram
- (e) What are the possible stereochemistries of the products for the addition reaction of bromine to *trans* -2-butene.
- (f) Give an example of regio-selective reaction. Can you say that it is also chemo-selective?
- (g) What is the intermediate in Curtius reaction? Give another reaction where you can find the same intermediate.
- (h) What is dynamic stereochemistry?
- (i) Write down the Poisson's equation and explain the terms in it.
- (j) What is streaming potential?
- (k) What are sols with suitable example?
- (l) Define the dynamic solvation number.

Group-B**(Answer any two Questions)**

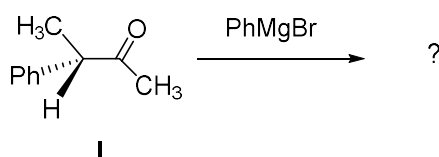
2. (a) $[\text{Cr}_2\text{Cl}_9]^{3-}$ is paramagnetic but $[\text{W}_2\text{Cl}_9]^{3-}$ is diamagnetic. Justify the observation. 3
- (b) Calculate the percentage of low-spin and high spin state of an octahedral $[\text{Fe}(\text{S}_2\text{CNR}_2)_3]$ complex at room temperature where $\mu_{\text{obs}} = 4.3$ B.M., $\mu_{\text{H.S.}} = 5.92$ B.M., $\mu_{\text{L.S.}} = 2.2$ B.M. 2
- (c) Explain which of the following complexes will have orbital contribution towards magnetic moment: 3
- (i) CoCl_4^{2-} , (ii) $\text{Co}(\text{H}_2\text{O})_6^{2+}$ and (iii) $\text{Co}(\text{CN})_6^{4-}$
- (d) How does the relation between multiplet width and thermal energy contribute toward the magnetic property of a species? 2
3. (a) Calculate the μ_{eff} for the complex ion, tetrachlorocobaltate (II). Given: $\lambda = -172$ cm^{-1} and $10 Dq = 3100$ cm^{-1} . 2
- (b) Write a brief note on the magnetic properties of manganous oxide emphasising the theory governing its observed magnetic behavior supported by an appropriate diagram. 3
- (c) Draw the spin state transition curve of $[\text{Fe}(\text{NCS})_2(\text{phen})_2]$. 1
- (d) What is the ground state term for f^9 system? Find out the μ_J and μ_S values for this electronic configuration. 4

4. (a) Calculate the diamagnetic correction for pyridine. 2
Given: Pascal's constant for H = -2.93×10^{-6} , C = -6.00×10^{-6} , N (open chain) = -5.57×10^{-6} , N (ring) = -4.61×10^{-6} and Pascal's constitutive corrections for C (in ring) = -0.24×10^{-6} , C (shared by two rings) = -3.07×10^{-6}
 (b) Predict the magnetic behavior of NiFe_2O_4 . 2
 (c) Justify that the diamagnetism originating from the spinning motion of the electron and nucleus is negligibly small compared to the orbital motions of the electron. 2
 (d) Why the magnetic moment of Eu^{3+} cannot be obtained from the equation used for the calculation of magnetic moment of Tb^{3+} ? 2
 (e) Explain the difference between paramagnetism and antiferromagnetism along with the laws governing them. 2

Group-C

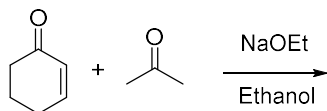
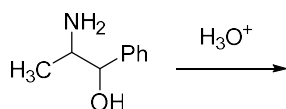
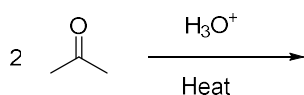
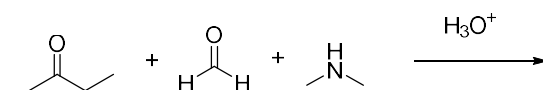
(Answer any two Questions)

5. Write the possible major product showing the proper mechanistic path for the following reaction using Cram's rule. 3+2+1+2+2



What are the two possible conformations of the above structure reactants (**I**) using Felkin-Anh model. Explain which structure is stable according to this model. Write the two possible products for the reaction also using Felkin-Anh model and suggest which one will be same according to the Cram's rule.

6. (a) Discuss the stereochemistry of E_2 and $\text{E}_{1\text{CB}}$ mechanism with specific example. 2.5 x 2
 (b) Discuss the following reactions in organic synthesis with special emphasis on their mechanistic details, applications and limitations. 2.5 x 2
 i) Beckmann rearrangement
 ii) Wittig reaction
7. Predict the product of the following reactions with possible mechanism. 2.5 x 4



Group-D

(Answer any two Questions)

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| 8. (a) | When a metal electrode is dipped in an electrolytic solution, a charge separation takes place and an electrode potential developed at the electrode/electrolytic interface. Explain the reason(s) behind this. Secondly discuss about the factors that govern the electrode potential at the interface. | 3+2 |
| (b) | When a planar metal electrode is dipped in an electrolytic solution, double layer is formed at the electrode/electrolytic interface. Discuss about the nature of the double layer with proper diagram. | 3 |
| (c) | Describe the factors that govern the interfacial surface tension between a metal and electrolytic solution. | 2 |
| 9. (a) | As per Bjerrum model, an ion-pair is formed in an electrolytic solution. Explain. Derive an expression for the fraction (θ) of ion pairs that is formed in an electrolytic solution using Bjerrum model. | 2+5 |
| (b) | What is zeta potential? How does this potential help to stabilize the colloidal suspension? | 2+1 |
| 10. (a) | What is sedimentation potential? How does it developed and help to separate out the colloid particles from their suspension? | 1+2 |
| (b) | What are the differences between “Coagulation” and “Flocculation”? Explain when coagulation takes place in the colloidal solution? | 2+3 |
| (c) | How can you measure the heat of solvation ($\Delta H_{s,salt}$) of an electrolytic salt experimentally?. | 2 |