



**LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034**

**M.Sc. DEGREE EXAMINATION – CHEMISTRY**

THIRD SEMESTER – APRIL 2018

**16PCH3ES02- PHYSICAL CONCEPTS IN INORGANIC CHEMISTRY**

Date: 05-05-2018  
Time: 09:00-12:00

Dept. No.

Max. : 100 Marks

**Part-A**

*Answer ALL questions.*

**(10 x 2= 20)**

1. What are Laporte allowed and Laporte forbidden transitions?
2. Calculate the number of microstates possible for the term  $^3P$ .
3. How is the Lande splitting factor calculated for a free electron?
4. Obtain the stretching and bending vibrational modes for the ligand  $SO_4^{2-}$ .
5. What are chemical shift reagents? Give an example.
6. How is migration current eliminated in cyclic voltammetry?
7. What are the different types of electrodes used in voltammetry? Mention their specific applications.
8. What are the roles of sensitizers and quenchers in the photochemical reactions? Cite an example.
9. Highlight the significances of photosplitting reaction of  $CO_2$ .
10. What are the important components of polarogram?

**Part-B**

*Answer any EIGHT questions.*

**(8 x 5= 40)**

11. How will you distinguish between cis and trans isomers of  $[Co(NH_3)_4(NO_2)_2]^+$  using IR spectroscopy? Explain.
12. Why is the molar extinction coefficient of tetrahedral complexes higher than that of octahedral complexes? Explain.
13. Explain isotropic and anisotropic hyperfine coupling with examples.
14. Determine the spin multiplicities for the ground states of the following octahedral complexes i) low spin –  $[Fe(CN)_6]^{3-}$  ii) high spin –  $[Cr(H_2O)_6]^{3+}$ .
15. What are fluxional molecules? Discuss the use of NMR in the study of fluxional molecules.
16. Discuss the Orgel diagram of  $d^9$  metal ion in an octahedral environment.
17. Explain Adamson's rule in explaining the photosubstitution of chromium complexes.
18. Derive the relation between diffusion current and applied voltage in polarography.
19. Illustrate the working principle of dye sensitized solar cell using ruthenium complex as a photosensitizer.
20. Describe the role of metal complexes as catalyst for the photocarbonylation of a hydrocarbon.
- 21a. What are inert and labile complexes?
  - b. State whether the following complexes are inert or labile:
    - i)  $[Co(NH_3)_6]^{3+}$
    - ii)  $[Cr(CN)_6]^{3-}$

22. Discuss the different types of coupled chemical reactions with suitable examples.

### Part-C

*Answer any FOUR questions.*

**(4 x 10= 40)**

- 23a. How are the various possible modes of coordination exhibited by  $\text{NO}_2^-$  ion determined?
- b. Discuss the effect of bidentate and unidentate mode of coordination of  $\text{CO}_3^{2-}$  on the frequency of asymmetric stretching in IR spectra. (5+5)
24. Explain with an example the use of EPR in the determination of covalency in metal-ligand bonding.
25. Highlight the relevance of electric field gradient in Mossbauer spectroscopy. How does the field gradient affect the spectra of  $[\text{Fe}(\text{CN})_6]^{4-}$  and  $[\text{Fe}(\text{CN})_6]^{3-}$  complexes?
- 26a. Highlight the significance of Ilkovich equation to discuss the factors influencing diffusion current.
- b. Highlight the significance of Nernst equation in the interpretation of polarographic waves for qualitative and quantitative analysis. (3+7)
27. Illustrate the mechanistic pathway of photosplitting of water using any two metal complexes as catalyst.
28. Describe the mechanism of any two rhodium complexes as catalyst for the photochemical generation of hydrogen from alcohol.

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