

B.Sc. Part III Honors Examination, 2021**Subject: Chemistry****Paper: IX****(New syllabus)****Full Marks: 50****Time: 2 h**

Candidates are required to answer in their own words as far as practicable

Group A1. Answer *any three* questions

3 × 5 = 15

- (a) Note down the differences between ionic solid and hydrogen bonded solid. "Lattice energy of sodium chloride is 778 kJ mole⁻¹." – what does it mean? Can you measure lattice energy experimentally?
- (b) What is Na⁺-K⁺ ion pump? Which metal is responsible for *minamata* disease? Name one naturally occurring organometallic compound.
- (c) What is *trans* effect? Briefly discuss the role of *trans* effect in synthesizing *cis*-platin.
- (d) What do you mean by homogeneous hydrogenation of alkenes? Name one suitable catalyst for this. Cite one example in each of oxidative addition and reductive elimination.
- (e) What are pre-organization and complementarity in supramolecular chemistry? Give one example in each of 0 D, 1 D, 2 D and 3 D nanomaterials.

2. Answer *any one* question

1 × 10 = 10

- (a) Derive the limiting radius ratio of a body centered type cubic (*bcc*) lattice. What are the different coordination modes of nitrosyls? Give at least one example in each. Cite the role of Cu(II) on human body. "CN⁻ is poisonous to human." - why?
- (b) Draw the coordination mode(s) of carbonyl. Give an example of a complex where molecular nitrogen behaves like a ligand. Assuming 18 electron rule to be valid find the number of Os-

Os bonds in $\text{Os}_4(\text{CO})_{14}$. What are sandwich compounds? Give example. Explain macrocyclic effect in supramolecular chemistry.

Group B

3. Answer *any three* questions

$3 \times 5 = 15$

(a) Define binding energy per nucleon of a nucleus in terms of mass number and atomic number. The binding energy per nucleon of ^{16}O is 7.97 MeV and for ^{17}O is 7.75 MeV. Calculate the amount of energy needed to remove a neutron from ^{17}O .

(b) Define accuracy and precision? Mention different cases of distribution of the observed data in terms of accuracy and precision.

(c) Narrate the reaction conditions required for reduction of Fe(III) using SnCl_2 ? Why saturated Hg_2Cl_2 solution is added at a time to remove slight excess of SnCl_2 ? What is the role of Z-R solution in the estimation of iron in HCl medium using KMnO_4 ?

(d) EDTA is a suitable reagent for complexometric titration- explain. How will you estimate total hardness of water?

(e) What do you mean by solvent extraction? Illustrate the role of pH on extraction of aniline and benzoic acid using appropriate combination of solvents.

4. Answer *any one* question

$1 \times 10 = 10$

(a) State Lambert-Beer's law. What do you mean by spectrophotometric titration? Aqueous solution of a drug (0.10 milimolar) shows 50% transmission in 1.0 cm cell at 250 nm. Calculate the molar absorptivity. Give examples one each of a masking and demasking agents in the context of complexometric titration.

(b) The color change of an indicator requires over titration of one drop of titrant having volume 0.05 mL. Titre values for two samples 'A' and 'B' are 4.0 mL and 10.0 mL respectively using this indicator. Which sample will you prefer that will result less error? Justify. Why TLC is

essential before performing column chromatography. State the principle of high frequency titration.

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1. Answer *any three* questions 3 × 5 = 15
- (a) Write down the selection rule(s) for electronic transitions. "d-d transitions are forbidden."—why? Give an example of a MLCT transition.
- (b) What is σ donor and π acceptor ligand? Give example. Also exemplify the π donor ligand. Note down several oxidation states of nitrosyl.
- (c) What is *trans* effect? Briefly discuss the role of *trans* effect in synthesizing *cis*-platin.
- (d) State hazardous effect of Hg on human health. Also state few of its remedies.
- (e) " $\text{Cr}(\text{CO})_6$ is diamagnetic."— why? Comment on the magnetic behavior of ferrocene.
2. Answer *any one* question 1 × 10 = 10
- (a) " T_d complexes are always high spin." – why? " CoF_6^{3-} is a high spin complex." – Justify or criticize. Find out ground term symbol for Mn(II). "The spin-only magnetic moment of $\text{K}_3[\text{Mn}^{\text{III}}(\text{C}_2\text{O}_4)_3] \cdot 3\text{H}_2\text{O}$ is found to be 4.80-5.00 BM, whereas $\text{K}_2[\text{Mn}^{\text{III}}\text{F}_5] \cdot \text{H}_2\text{O}$ shows lower value." – why? State the preparation of $\text{Fe}(\text{CO})_5$.
- (b) Write down the name of the metal (with its oxidation state) present in the active site of hemoglobin. Briefly state the mechanism of oxygen transport by hemoglobin. Explain why square planar complexes prefer an associative mode of activation. Outline the preparatory procedures and suggest the structural formulae of Millon's base and sodium nitroprusside. "Among the coinage metals only gold forms Au(-I), not copper and silver." - why?

Group B

1. Answer *any three* questions

3 × 5 = 15

- a) Define R_f value in relation to thin layer chromatography? Write short note on electrogravimetry.
- b) EDTA is a suitable reagent for complexometric titration- explain. How will you estimate total hardness of water?
- c) The color change of an indicator requires over titration of one drop of titrant having volume 0.05 mL. Titre values for two samples 'A' and 'B' are 4.0 mL and 10.0 mL respectively using this indicator. Which sample will you prefer that will result less error? Justify.
- d) Define accuracy and precision? Mention different cases of distribution of the observed data in terms of accuracy and precision.
- e) Define binding energy per nucleon of a nucleus in terms of mass number and atomic number. The binding energy per nucleon of ^{16}O is 7.97 MeV and for ^{17}O is 7.75 MeV. Calculate the amount of energy needed to remove a neutron from ^{17}O .

2. Answer *any one* question

1 × 10 = 10

- a) What do you mean by solvent extraction? Calculate the amount of Fe (III) that remain unextracted from 100 mL of a solution having 400 mg of Fe(III) in 6M HCl after two extractions with 25 mL of diethyl ether. [Given: Distribution ratio of Fe(III) species = 150]. Define column resolution in chromatography. In iodometric titration, at which moment starch indicator is usually added and why?
- b) State Lambert-Beer's law. What do you mean by spectrophotometric titration? Define molar extinction coefficient? Mention its unit. An aqueous solution of a drug (0.10 milimolar) shows 50% transmission in 1.0 cm cell at 250 nm. Calculate the molar absorptivity.