

Ramakrishna Mission Residential College (Autonomous)

Narendrapur, Kolkata-700103

B.A./B.Sc. Examinations 2019

Subject: Chemistry (Inorganic)

Semester-III

Course Code: HCHEIICC05LTH

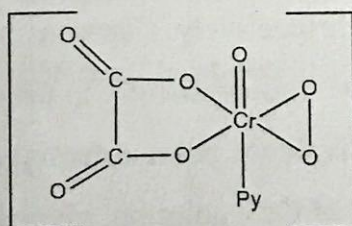
Time: 2 hrs

Full Marks:50

1. Answer any four questions:

[3X4 = 12]

- Give examples of complexes with coordination number 7, 8 and 9.
- Give an example of a carbon free optically active complex isolated by Werner. Predict the number of stereo-isomers of a $[M(a-a)_2X_2]$ type complex.
- The stepwise stability constants of the mercury cyanide complex are $\log K_1, 18.0$; $\log K_2, 16.7$; $\log K_3, 3.8$ and $\log K_4, 3.0$. Explain the trend.
- A chelate is more stable than the corresponding non-chelate. Explain with an example.
- The binding modes of L in $[Pd(NH_3)_2L_2]$ and $[Pd(PPh_3)_2L_2]$ when $L = SCN^-$ are different. Explain.
- Write the IUPAC names of the ligands, the complex and coordination number of the given complex.



2. Answer the following questions:

[3]

- Explain magic numbers of nuclei and produce evidences in support of extra-stability of such nuclei.

OR

A piece of wood recovered in an excavation is found to have the activity 15% compared to that of a fresh sample. Find the dead time of the wood. Given, Half life of $^{14}C = 5578$ year.

- Define Spallation with an example.

[2]

OR

How will you establish by Tracer method that oxidation of H_2O_2 does not involve cleavage of peroxo bond.

- (c) Calculate the maximum K.E. of the β^- particle emitted in the radioactive decay of He^6 . Assume that the β^- has its maximum energy when no other emission accompanies the process. Given, the mass of $\text{He}^6 = 6.01889$, $\text{Li}^6 = 6.01512$ amu respectively. [2]

OR

- (i) In ^{189}F , $\frac{n}{p}$ ratio = 1 still it is radioactive. Explain.

3.

- a) Answer any three: [3x3]

- (i) Copper displaces zinc from a solution of zinc(ii) salt in presence of excess KCN. Explain.
- (ii) Find out the standard electrode potential for $\text{MnO}_4^-/\text{MnO}_2$ redox couple in 1(M) acid medium, given E^0 for $\text{MnO}_4^-/\text{Mn}^{2+}$ & $\text{MnO}_2/\text{Mn}^{2+}$ are 1.51V & 1.2V, respectively.
- (iii) Explain the role of phosphoric acid in the titration of Fe^{2+} by $\text{Cr}_2\text{O}_7^{2-}$ in presence of BDS indicator.
- (iv) The E^0 values of the redox couples Cu^{2+} , I^-/CuI , $\text{Fe}^{3+}/\text{Fe}^{2+}$ & $\frac{1}{2} \text{I}_2/\text{I}^-$ are 0.85V, 0.77V & 0.54V, respectively. Can you suggest any condition that will enable estimation of Cu^{2+} iodometrically in presence of Fe^{3+} ? Justify your answer.
- (v) Find out the equivalence point potential during the titration of 0.1M Fe^{2+} solution with 0.1M Ce^{4+} solution, given E^0 values for $\text{Fe}^{3+}/\text{Fe}^{2+}$ & $\text{Ce}^{4+}/\text{Ce}^{3+}$ are 0.77V & 1.57V. Name one suitable indicator for this titration.

- b) Answer any one: [3x1]

- i) Calculate the solubility of AgCl in 0.1 KCl solution at 25°C (Given K_{sp} of $\text{AgCl} = 1.0 \times 10^{-10}$ at 25°). Compare this value with that in pure water at the same temperature.
- ii) Explain the role of NH_4Cl in qualitative analysis of Group-III A basic radicals in ammoniacal medium. Do you think that the same purpose will be served if NaOH is used instead of NH_4OH ?

4.

A. Answer any two:

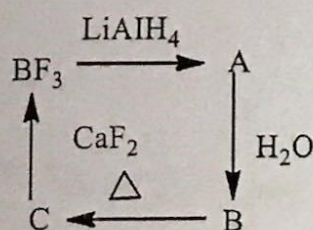
[3×2]

- a) Discuss the structure and bonding of diborane (B_2H_6) in the light of VB theory and MO theory.
- b) What are polythiazyl? How are they prepared? What is the special electrical property associated with polythiazyl? Draw the structure of polythiazyl.
- c) Draw the structures (according to VBT), mentioning the hybridisation of the central xenon atom;
- i) XeO_4^{2-} ii) XeF_5^- iii) XeO_2F_2
- d) Interhalogen compounds are always diamagnetic, covalent and generally more reactive than the elemental halogens. Explain.

B. Answer any four

[4×2]

- a) NO_2 but not ClO_2 readily forms dimer. Explain.
- b) Elucidate "clathrate" compound citing at least one example.
- c) Give examples of two basic halogen compounds.
- d) Beryllium chloride exhibits different structures in solid and gaseous states. Explain.
- e) Identify A, B and C of the following transformations.



- (f) Draw the structures of basic beryllium nitrate and basic beryllium acetate.

5. Answer any two:

[2.5×2]

- (i) "Borazine is called inorganic benzene, but this is a misnomer (wrong or inaccurate name)". Justify or criticize this comment citing at least two reactions.
- (ii) Write down the structure of the product formed in reaction of 1 mole of $[\text{NPCl}_2]_3$ with 3 moles of Me_2NH . Explain the course of the reaction.
- (iii) Comment on the structure of 'Zeolite' and explain its cation exchange property.
- (iv) Compare the common properties between organic and inorganic polymers.

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B.A./B.Sc. Semester-III Examination, 2018

Subject: Chemistry (Honours)

Paper-V

Time: 2 Hrs

F.M.- 50

Write Group-A or Group-B on the top of the separate answer scripts.

Group-A

Unit-I

1. Answer *any three* questions: 3×3=9
- Define primary and secondary valencies with examples.
 - Predict the number of stereo-isomers of $[\text{Co}(\text{NH}_2\text{CH}_2\text{CO}_2)_3]$.
 - What is the role of ethylenediamine in the chemical distinction of isomers of $[\text{PtCl}_2(\text{NH}_3)_2]$.
 - Compare the overall stability constants of $[\text{Ni}(\text{en})_3]^{2+}$ and $[\text{Ni}(\text{NH}_3)_6]^{2+}$ complex ions.
 - Name the following compounds according to IUPAC system.
 - $[(\text{NH}_3)_4\text{Cr}(\text{OH})(\text{NH}_2)\text{Cr}(\text{NH}_3)_4](\text{SO}_4)_2$
 - $[(\text{CO})_3\text{Fe}(\text{CO})_3\text{Fe}(\text{CO})_3]$

Unit--2

2. Answer question (a) and any three from the rest: 4×2=8
- Write down the structures of the products (X) and (Y) in the following scheme of reaction and indicate the states of hybridization of B and N in them.
$$\text{B}_2\text{H}_6 + \text{NH}_3 \xrightarrow{\text{heat}} \text{X} + \text{Y}$$
 - On burning in oxygen, lithium forms Li_2O while sodium forms Na_2O_2 . Explain.
 - As we go down group 2, the hydroxides become more soluble in water, while their carbonates become gradually less soluble. Explain.
 - Account for the magnetic property of KO_2 , and GaCl_2 .
 - $\text{K}_2\text{Cr}_2\text{O}_7$ can be used as a primary standard for oxidometric titration, while $\text{Na}_2\text{Cr}_2\text{O}_7$ is not preferred. Explain.

- f. When TiI_3 which is isomorphous with alkali metal triiodides, is treated with aqueous sodium hydroxide, hydrated Ti_2O_3 is quantitatively precipitated. Comment on the above observation.

Unit-3

3. Answer **any four** questions:

4×2=8

- a. How will you identify nitrite in presence of nitrate in wet test in the laboratory? Give relevant chemical equation?
- b. What is Nessler's reagent? How it is prepared? Mention its analytical use with equations.
- c. 'Fluorine is a superhalogen'. Discuss
- d. In O_2F_2 the O-O bond is abnormally short while O-F bonds are larger than expected. Explain.
- e. What are thionic acids? How does dithionate differ from polythionates?
- f. Oxygen is O_2 gas while sulphur is S_8 solid. Explain.
- g. Interhalogen compounds have even number of halogen atoms while polyhalide ions have odd number of halogen atoms. Explain.

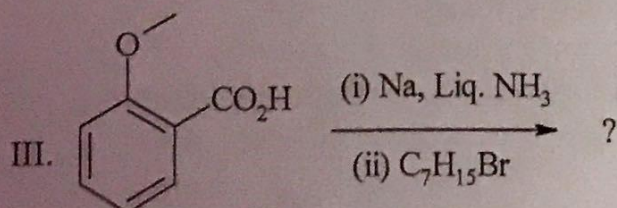
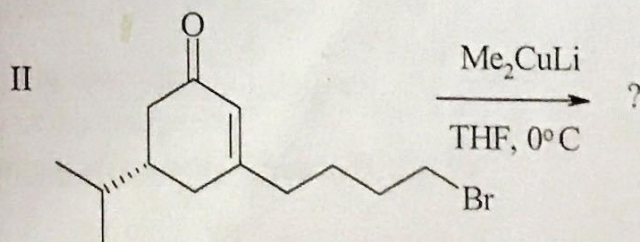
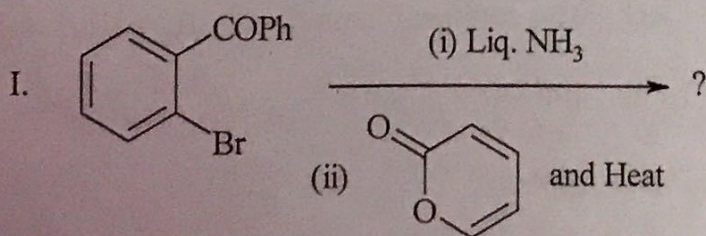
Group-B

(Use separate Answer script)

Unit-4

4. Answer the following questions:

- a. Predict the product/s in the following reactions with explanation: (**any two**). $2 \times 2\frac{1}{2} = 5$



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B.Sc. Semester-V Examinations, 2019

Subject: Chemistry Honours

Paper: IX

Time: 2 hrs.

Full Marks: 50

Unit-1

1. Answer question (a) and any three from the rest: 1 + (3 x 3) = 10
- Give d- orbital splitting pattern in square pyramidal crystal field.
 - Δ_0 Value for a given set of ligands in case of Fe^{III} complexes is more than that for Fe^{II} complexes. Explain.
 - Calculate respective OSSE values and hence comment on Spinel type of NiCr_2O_4 .
 - An octahedral $\text{Au}(\text{II})$ complex is unstable and disproportionates to $\text{Au}(0)$ and $\text{Au}(\text{III})$. Explain.
 - Negatively charged OH^- is a weaker field ligand than neutral H_2O . Explain why?
 - Aqueous $\text{Co}(\text{II})$ is neither oxidizing nor reducing. It becomes strongly reducing on addition of KCN . Explain the observation in terms of CFT.

Unit-2

- 2.
- Answer **any two** questions: (2 x 3) = 10
 - How does electronic transition of a d^3 metal ion differ from a d^4 (high spin) metal ion? Explain.
 - An equimolar mixture of aqueous Ni^{2+} and Co^{2+} is colourless. Explain.
 - The experimental magnetic moment of CsCoCl_4 is higher than the spin only value. Explain.
 - Answer **any two** of the following questions: (2 x 2) = 4
 - VO_4^{3-} is white, while MnO_4^- is purple. Explain.
 - What is spin isomerism? Explain with an example.
 - Lanthanide ions give sharp spectral band while those by d block metal ions broad. Discuss.

Unit-3

3. Answer **any five** (2 x 5) = 10
- Compare the O_2 binding nature of hemocyanin and hemerythrin.
 - What are the role of proximal and distal Histidine of Haemoglobin.
 - What is Vaska's complex? Mention its importance in context of bio-inorganic chemistry.
 - Write a note on 2Fe-2S ferredoxin.
 - Write down the biological role of cytochrome C.
 - Why does nature choose Zn^{2+} over Cu^{2+} in Carboxypeptidase A?
 - Which metal involved in Wilson's disease? What is the antidote for this metal?
 - Write a note on *cis*-platin.

Unit-4

4. (3 × 2) = 6
- (i) Answer any three:
- Why transition elements exhibit variable oxidation states?
 - Would the f- block metal ions be expected to form strong field complex? Why or why not?
 - Why most of the heavier transition metals form LS complexes? Why the paramagnetic species of such metals rarely conform to μ_s values.
 - Give one example with formula & structure of entirely inorganic Rh complex that was resolved into optical isomer.
 - Compare the stability between Cu(III) and Au(III) ions.
- (ii) Answer any one: (1 × 4) = 4
- Give a brief outline of the separation of lanthanide elements by the ion-exchange method.
 - Outline the synthetic routes of the three isomers of $[\text{Pt}(\text{NH}_3)(\text{py})(\text{Br})(\text{Cl})]$ with the help of trans effect whose relative order being $\text{Br} > \text{Cl} > \text{py} > \text{NH}_3$.

Unit-5

1. Answer of the following questions (any five): (2 × 5) = 10
- What is the difference between 'Precision' and 'Accuracy'?
 - Distinguish between Random and Systematic errors with suitable examples.
 - What do you mean by retention time in Chromatography?
 - What are the most common sources of errors in the measurements in UV- visible spectrophotometric estimations?
 - Explain two factors on which one cation is preferably adsorbed over another by ion exchange resin.
 - A spectrophotometer cell when filled with liquid X transmits 50% and when filled with another liquid Y transmits only 25 % of the incident light. What would be the optical density when the same cell is filled with a mixture of equal volumes of two liquids?
 - What are the crucial differences between DTA and DSC techniques?
 - When and how hydride generation method is used for AAS analysis of an element?

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B.A./B.Sc. Semester-V Examination, 2018

Subject: Chemistry (Honours)

Paper-IX

Time: 2 Hrs

F.M.- 50

Unit-1

1. Question (a) is compulsory and attempt **any three** from the rest: 1+3× 3
- Show the d-orbital splitting pattern in a square pyramidal crystal field.
 - $[\text{Fe}(\text{CN})_6]^{4-}$ is more stable than $[\text{Fe}(\text{CN})_6]^{3-}$, while $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ is more stable than $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$. Explain.
 - Δ_0 values are larger than Δ_t values for a given metal ion with a given set of ligands. Justify or Contradict.
 - What is the trend of the Δ_0 values of $\text{Cr}(\text{CO})_6$, $\text{Mo}(\text{CO})_6$ and $\text{W}(\text{CO})_6$? Explain with proper reason(s).
 - The values of Δ_0 , for the high-spin cations $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Mn}(\text{H}_2\text{O})_6]^{3+}$ have been evaluated spectroscopically as 8400 and 21000 cm^{-1} respectively. On the assumption that these values hold also for the corresponding oxide lattices, predict whether $\text{Ni}^{\text{II}} \text{Mn}_2^{\text{III}} \text{O}_4$ should have the normal or inverse spinel structure. What other factors might make your prediction unreliable?
 - Aqueous $\text{Co}(\text{II})$ is neither oxidizing nor reducing. It becomes strongly reducing on addition of KCN . Explain the observation in terms of VBT.

Unit-2

- 2.
- Answer **any two** questions: 3×2
 - All the lanthanide ions are colored. Explain.
 - Compare the electronic spectra of $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{FeCl}_4]^-$ ions.
 - The color intensities of $[\text{NiCl}_4]^{2-}$ and $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ ions are notably different. Explain.
 - Answer **any two** questions from the followings: 2 × 2
 - Give important differences between ferromagnetic and anti-ferromagnetic substances.
 - The ligand to metal charge transfer band increase in energy in the sequence: $[\text{CoI}_4]^{2-} < [\text{CoBr}_4]^{2-} < [\text{CoCl}_4]^{2-}$. Explain.
 - Calculate the effective magnetic moment μ_{eff} of a f^2 ion.

Unit-3

3. Answer *any four* questions:

Answer (a) and any three from (b) – (f)

1+3 × 3

- What is Wilson's disease?
- Draw the active sites of oxy-hemerythrin and oxy-hemocyanine.
- Write a short note on [4Fe-4S] ferredoxin.
- Describe the role of Zn-metal in carbonic anhydrase.
- Describe the mechanism of action of carboxy-peptidase A.
- Write the structures of two gold and platinum containing drugs.

Unit-4

4. Answer (a) and *any three* from (b) – (f):

1+3 × 3

- Give an example of an oxidizing agent containing a lanthanide element.
- Aqueous solution of Co (II) is pale pink, it turns intense blue on adding conc. HCl - explain.
- Give outline of the synthetic routes of the isomers of [Pt (NH₃) (py) (Br) (Cl)] from [Pt Cl₄]²⁻ using trans effect phenomenon, given the order of trans effect as NH₃ < py < Cl⁻ < Br⁻.
- Cupric acetate monohydrate exhibits subnormal magnetic moment. Explain.
- Lanthanides exhibit +3 oxidation state in general, while actinides show variable oxidation states. Explain.
- In comparison to Mo(VI) and W(VI), Cr(VI) does not show polyanion chemistry. Explain.

Unit-5

5. Answer of the following questions (*any five*):

2×5 = 10

- Briefly discuss the method of determination of total cation concentration in water by ion exchange method.
- What do you mean by diffusional titration error electroconometry?
- What do you mean by ion exchange capacity? How will you determine the exchange capacity of an anion exchanger?
- Write a note: Reverse phase chromatography.
- Write down the difference between thin layer chromatography and paper chromatography.
- At 460 nm a blue filter transmits 25% of the light and a yellow filter transmits 75% of the light. What is the transmittance at the same wave length of the two filters in combination?
- Draw a DSC curve for a typical organic polymer.
- When and how cold vapour technique is used for AAS analysis of an element?

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B.A./B.Sc. Semester-III Examination, 2017

Subject: Chemistry (Honours)

Paper-V

Time: 2 Hrs

F.M.- 50

Group-A

Unit-I

1. Answer *any three* questions:

3×3=10

- Give examples of complexes having coordination number six, seven and eight.
- Draw the possible isomers of $[\text{CoCl}_2(\text{NH}_3)_2(\text{H}_2\text{O})_2]$.
- What is a chelation effect? Explain with an example.
- The stepwise stability constants of the reaction of Hg^{2+} and CN^- are $\log K_1 = 18$, $\log K_2 = 16$, $\log K_3 = 3.8$ and $\log K_4 = 3.0$. Explain the features.
- Give examples showing flexideatate behaviour of sulphate and ambidentate behaviour of thiocyanate ion as ligands.

Unit--2

2. Answer *any two* questions:

3×2=6

- $(\text{SiH}_3)_3\text{N}$ is planar while $(\text{SiH}_3)_3\text{P}$ is pyramidal. Explain.
- What happens when excess NaOH solution is gradually added to BeCl_2 and MgCl_2 solutions separately?
- Amongst noble gases xenon is the most suitable to form chemical compounds. -
Explain

i. Answer *any one*:

2×1

- Give an example (with structure) of a cationic silicon compound.
- Cis dimerization of NO is favourable to trans dimerization. Explain.

Unit-3

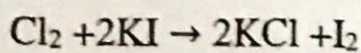
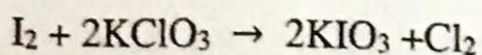
3. Answer *any four* questions:

4×2=8

- Phosphonium iodide is the most stable among the phosphonium halides – justify.
- Neither BrF_5 nor AsF_5 are good conductors of electricity. However, a mixture of these two is a better conductor than either of the pure substances – explain.

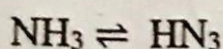
c. Nitrogen trichloride and phosphorus trichloride hydrolyze differently. Explain.

d. Rationalize the behaviour of halogens of the following reactions:



e. Compare the bond energies of "P - H" with "N - H" and "P - F" with "N - F" in binary compounds.

f. Show how will you interconvert the following:

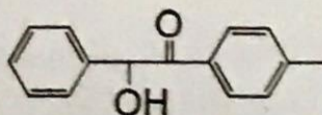


Group-B

Unit-4

4. Answer the following questions:

a. Explain the following:

Benzoin gives  when treated with p- methylbenzaldehyde in presence of KCN/ EtOH.

OR

Butanone on bromination in presence of sodium hydroxide produces $\text{CH}_3\text{CH}_2\text{COBr}$ whereas in case of bromination in acetic acid medium the major product is $\text{CH}_3\text{CHBrCOCH}_3$. Explain the observations with mechanistic details.

b. Predict the product/s in the following reactions with explanation: (*any two*). $2 \times 2\frac{1}{2} = 5$

