B. Sc. Part-III (Honours) Examination, 2020

Subject: Chemistry

Paper: IX

(New Syllabus)

Candidates are requested to answer Group A and Group B in separate answer scripts

Full Marks: 50 **Time: 2 h**

Group A

1. Answer *any three* questions: $3 \times 5 = 15$

(a) What is spectator ligand? Give example. Briefly state and exemplify *cis* effect.

(b) What are the differences between haemoglobin and myoglobin? Give an example of phorphyrin complex in nature.

(c) "Grignard reagent is a good nucleophile." - why? What do you mean by double decker compound? Give example.

(d) What is crystal defect? Note down its classification briefly stating each of them. Give an example of a hydrogen-bonded solid.

(e) What is π back-bonding? "As a ligand carbonyl can stabilize lower oxidation state of metals." - why?

2. Answer *any one* question: $1 \times 10 = 10$

(a) "Metals are good conductors of electricity." - explain in the light of band theory of metals. What is adenosine triphosphate? Make a line-drawing of its structure. Briefly state its activity in biological system. What is (are) difference(s) between clathrate and cavitate compounds? Draw (line-drawing) the structure of a cryptand

(b) What is effective atomic number (EAN)? Calculate EAN for $[Pt(NH_3)_6]^{4+}$. What is carbon nanotube? What is the heptacity of cyclopentadienyl? "The bridging and terminal carbonyls in $Fe_3(CO)_{12}$ can be distinguished by IR measurements." - explain.

Group B

3. Answer *any three* questions: $3 \times 5 = 15$

a) Derive the relationship between half-life ($t_{½}$) and average life (t_{av}) of the radioactive disintegration process.

b) What do you mean by precision and accuracy? "It is possible to have 'high precision low accuracy' but not 'low precision high accuracy' in a measurement" – Explain. Choose the better result of the following with reasons:

(A) 0.80 g was reported as 0.79 g.

(B) 1.70 g was reported as 1.68 g.

c) What are the main sources of error in titration involving I_2? How can these errors be minimised? Starch should be added towards the end point – why?

d) What do you mean by solvent extraction? Illustrate the variation of extraction of aniline and benzoic acid with pH with reasons.

e) A 0.25 g sample of mixture of CaO and MgO was dissolved in dil HNO_3 and made a solution of 1.0 L by adding water. A 50.0 mL of this solution was buffered and titrated against 0.01 M EDTA solution after addition of EBT indicator. In this titration 25.8 mL of the titrant were required. Find the percentage by mass of CaO and MgO in the mixture.

4. Answer *any one* question: $1 \times 10 = 10$

a) 'Fission of Uranium nucleus is energetically more favorable than fission of oxygen.'- Justify the statement from binding energy curve. By What mechanism nucleons in a nucleus are kept together?

b) 50 mL of 0.1 M NaCl is treated with 0.1 M $AgNO_3$ solution. Calculate the Cl^- concentration during titrations at (i) start, (ii) after adding 10 mL, (iii) after adding 49.9 mL, (iv) at equivalence point, (v) 60 mL of 0.1 M $AgNO_3$ solution.[Given, K_{sp} of AgCl= 1.56×10^{-10}]

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Group A

1. Answer *any three* questions: $3 \times 5 = 15$

(a) Write down the spin-only magnetic moment equation. "$[Co(OH_2)_6]^{2+}$ has orbital contribution to its magnetic moment." - Justify or criticize.

(b) Briefly state and exemplify *cis* effect. What is associative mechanism in transition metal complexes?

(c) What is π back-bonding? "As a ligand carbonyl can stabilize lower oxidation state of metals." - why?

(d) "Charge transfer transition spectra are more intense than the d-d transitions." -Explain. Provide one example each of charge transfer and d-d transitions.

(e) List out the hazardous effect of Pb on human health. Name the metal ions present in haemoglobin and chlorophyll.

2. Answer *any one* question: $1 \times 10 = 10$

(a) Draw a schematic diagram for crystal field splitting of d orbitals in a square planar ligand field. "Square planar complexes of Ni(II) are diamagnetic." - explain why? Calculate CFSE for a d^4 system (both high and low spin) in octahedral ligand field. "Geometry of Zn(II) complexes solely depend on steric factor." - why?

(b) "Carbonyl is a π-acid ligand." - What does that 'π-acid' mean? "The briding and terminal carbonyls in $Fe_2(CO)_9$ can be distinguished by IR measurements." - explain. "NO^+ is an electrophile." - Justify or criticize. 'Lability sequence in Group 8 metals are $Ni^{2+} > Pd^{2+} > Pt^{2+}$.' - explain why.

Group B

3. Answer *any three* questions: $3 \times 5 = 15$

a) Derive the relationship between half-life ($t_{1/2}$) and average life (t_{av}) of the radioactive disintegration process.

b) What are the main sources of error in titration involving I_2? How can these errors be minimized? Starch should be added towards the end point – why?

c) 1.0 g Radium -226 is placed in a sealed tube. How much Helium (in mL) will be accumulated in 60 days at NTP? [Given $t_{½}$ = 1590 years]. How long this element (1.0 g Ra) will take to become 0.1 g?

d) Define Chromatography. How it is classified? Discuss briefly.

e) Write two important characteristics of a good ion exchanger. Define detection limit. Write the structural formula and use of a gravimetric reagent.

4. Answer *any one* question: $1 \times 10 = 10$

a) The three aliquots of 25.00 mL of a chloride containing sample were titrated with standard $AgNO_3$ solution. The titre values are 26.78, 26.82 and 26.75 mL.

(i) Calculate the mean volume of the titration and (ii) Calculate absolute uncertainty in number of millimoles of chloride ions contained in 100.0 mL of this stock solution. [Given: The molarity of $AgNO_3$ solution = 0.1265± 0.0002 M]

A 0.25 g sample of mixture of CaO and MgO was dissolved in dil HNO_3 and made a solution of 1.0 L by adding water. A 50.0 mL of this solution was buffered and titrated against 0.01 M EDTA solution after addition of EBT indicator. In this titration 25.8 mL of the titrant were required. Find the percentage by mass of CaO and MgO in the mixture.

b) State Lambert-Beer's law. Mention the important variables to be controlled to obtain reproducible absorbance data. Mention the difference between the end point and the equivalence point in a titration. Why fusion of hydrogen into helium nuclides is energetically favorable but not of Rhodium into Uranium nucleus?