2025

(May–June)

FYUP : 4th Semester Examination

CHEMISTRY

(Inorganic Chemistry—I)

(CHE–250)

(Theory)

Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. *(a)* Write the expression for solubility product (k_{sp}) of sparingly soluble salt CaF_2 and calculate its k_{sp}. Given the solubility of CaF_2 is 2×10^{-4} mole/L. 3

(b) Define primary and secondary standard solutions. Give one example of each. 3

(c) What are complexometric titrations? What types of indicator and titrant are used in the above titration? Give example. 3

(d) Write the chemical equation involved in the standardization of hypo ($Na_2S_2O_3 \cdot 5H_2O$) using $K_2Cr_2O_7$ (iodometric method) as well as iodometric method of determination of Cu^{2+}. 3

(e) What is co-precipitation? How does it differ from post-precipitation? 3

(f) Draw the structure of metal-EDTA complex. In what manner, the stability of the metal-EDTA complex varies with

(i) the charge of the metal cation;

(ii) the pH of the medium? 4

OR

2. (a) How does iodometry differ from iodimetry? Explain with the help of equations. 3

(b) What are acid-base indicators? Explain why phenolphthalein cannot be used as an indicator in the titration of aqueous NH_3 against dil. HCl. 3

(c) Calculate the equivalent mass of $KMnO_4$ in acidic medium (mass of $KMnO_4 = 158$) and also calculate the amount required to prepare 0·1 *N* of $KMnO_4$ in 250 cc volumetric flask. 3

(d) H_2S is used as group reagent in group II and group III B in the analysis of cations in qualitative inorganic analysis. Why are group III B cations not precipitated in group II, all precipitates being in form of their sulphides? 2

(e) What do you understand by the terms 'permanganometry' and 'dichromatometry'? Give examples. 1½×2=3

(f) 25 ml of 0·0020 *M* potassium chromate are mixed with 75 ml of 0·000125 *M* lead nitrate. Will a precipitate of lead (II) chromate form? (k_{sp} of lead (II) chromate is $1 \cdot 8 \times 10^{-14}$) 2

(g) The colour changes of acid and base indicator are explained on the basis of which theory? Outline the theory. 3

3. *(a)* What is meant by effective atomic number? Calculate the effective atomic number of cobalt in $[Co(NH_3)_6]^{3+}$ and Fe in $[Fe(CO)_5]$. (atomic number of Co = 27, Fe = 26) 3

(b) What is a chelating ligand? Write down the two applications of chelate formation. 3

(c) Draw the geometrical isomers of $Cr(NH_3)_3Cl_3$ and name them as per IUPAC nomenclature. 3

(d) Write down the important postulate of Werner's coordination theory. Why is the complex of $CoCl_3 \cdot 3NH_3$ non-ionic according to this theory? 3

(e) Identify the kind of isomerism inhibit by the following isomers : 2

(i) $[Cr(NH_3)_6][Co(CN)_6]$ and $[Co(NH_3)_6][Cr(CN)_6]$

(ii) $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5SO_4]Cl$

(Continued)

(f) What is ambidentate ligand? Giving example, show how it differs from bidentate ligand. 2

(g) Explain the following with suitable examples : 1½×2=3

(i) Hydrate isomerism

(ii) Linkage isomerism

OR

4. *(a)* Define double salts and coordination compound with the help of suitable examples. 1½×2=3

(b) Write the IUPAC name of $[Co(en)_2Cl_2]Cl$ and draw the structure of all isomers. Why does the transgeometry not exhibit optical isomerism? 3

(c) Draw all the possible isomers $[Ma_2b_2c_2]$. 3

(d) Define the following terms : 1×3=3

(i) Coordination complex

(ii) Ligand

(iii) Coordination number

(Turn Over)

(e) Give the IUPAC name of the following complexes : 1×3=3

(i) $K_4[Fe(CN)_6]$

(ii) $\left[(C_2H_5)(CO)Fe\begin{matrix}Co\\Co\end{matrix}Fe(CO)(C_2H_5)\right]$

(iii) $[Fe(H_2O)_6]SO_4$

(f) What are facial and meridional isomers? Explain with example and draw the isomers. 3

(g) What are the criteria for a molecule to be optically active? 1

5. (a) Explain with example, what are—

(i) ionic organometallic compounds;

(ii) sigma bonded organometallic compounds.

Name them. Give one method of preparation of organolithium compound. 4

(b) Mention the advantage of organic precipitants to inorganic reagent. Which reagent is used in the precipitation of nickel? Draw the precipitated complex. 3

(Continued)

(c) What are Grignard reagents? Give one method of its preparation. Write one chemical reaction to show its use in organic chemistry. 3

(d) Give the IUPAC names of the following : 3

(i) $K[PtCl_3(C_2H_4)]$

(ii) $[(CO)_4Co—Co(CO)_4]$

(iii) $Mn_2(CO)_{10}$

(e) Draw the structure and mention one application of each of the following compounds as precipitant : 1½×2=3

(i) α-Nitroso-β-naphthol

(ii) Cupron

(f) Complete the following reactions : 1×3=3

(i) $R'X + RLi \longrightarrow$

(ii) $R_2Hg + 2Li \longrightarrow$

(iii) $RH + n\,BuLi \longrightarrow$

(Turn Over)

OR

6. *(a)* Why is alkyllithium compound known as super Grignard reagent? How does methyllithium react with the following? 1+3=4

(i) Dry ice

(ii) $(C_5H_5)_2Zn$

(iii) HCHO

(b) On the basis of composition, define simple and mixed organometallic compounds, with one example of each. 3

(c) Give the structural formula of cupferron. Discuss the important application of cupferron in quantitative analysis. 3

(d) How are solvents classified into protic and non-protic solvents? Give example. 3

(e) Write the molecular formula of rhodamine B. Draw its structure and discuss how it is used in inorganic analysis. 3

(f) Give one method for the preparation of magnesium diphenyl. Write one property of magnesium diphenyl and draw its structure. 3

(Continued)

7. *(a)* Define significant figures. Give the answer of the following problems to the maximum number of significant figures : 3½

(i) $50.00 \times 27.8 \times 0.1167$

(ii) $(2.776 \times 0.0050) - (6.7 \times 10^{-3})$

(b) On replicate analysis of brass sample, the zinc content was found to be 33·27%, 33·34% and 33·09%. Calculate the standard deviation and standard deviation of mean for the analysis. 3

(c) Explain the significance of *F*-test in developing a new method in comparison to the accepted method of determination of analytical results. 3

(d) Mention the factors that are responsible for error in experimental measurements. 2½

(e) Calculate the absolute error in the following : 3

(15.02 ± 0.02) ml $\times (0.2000 \pm 0.0001)$ mmol ml^{-1}

(f) Discuss the propagation of determinate errors when it transmits through addition and subtraction in the final results through calculation. 3

(Turn Over)

OR

8. *(a)* Distinguish between accuracy and precision with an example. 4

(b) Which test would you perform to compare the precision of two sets of data obtained for a sample by two different analytical methods? The standard deviation from one set of 10 determination, $S = 0 \cdot 210$ and for 8 determination by another method is 0·441. Is there any significant difference between the precision of two sets of results? (Corresponding F value for 9 and 7 degrees of freedom at 95% confidence limit is 3·68.) 3

(c) Find the value of

$$\frac{0 \cdot 02856 \times 298 \cdot 15 \times 0 \cdot 112}{0 \cdot 5785}$$

How many significant figures should be present in the answer and why? 3

(d) The following sets of weight were obtained :

28·7 mg, 30·2 mg, 29·6 mg, 28·6 mg

Calculate the standard deviation of the individual values. 3

(Continued)

(e) The following replicate molarities were obtained when standardizing a solution :

0·1057, 0·1081, 0·1055, 0·1066

Can one of the results be discarded as due to accidental error? (*Q* value for four observations is 0·76.) 3

(f) What type of error would you expect to occur while taking weight of a hygroscopic compound? What precaution may be taken to minimize such an error? 2

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