

# **4/CHE-250 (Th) Syllabus-2023**

**2 0 2 5**

( 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  $\text{CaF}_2$  and calculate its  $k_{sp}$ . Given the solubility of  $\text{CaF}_2$  is  $2 \times 10^{-4}$  mole/L. 3
- (b) Define primary and secondary standard solutions. Give one example of each. 3

( 2 )

- (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 ( $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ ) using  $\text{K}_2\text{Cr}_2\text{O}_7$  (iodometric method) as well as iodometric method of determination of  $\text{Cu}^{2+}$ . 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  $\text{NH}_3$  against dil.  $\text{HCl}$ . 3

D25/1287

( Continued )

( 3 )

- (c) Calculate the equivalent mass of  $\text{KMnO}_4$  in acidic medium (mass of  $\text{KMnO}_4 = 158$ ) and also calculate the amount required to prepare 0.1 N of  $\text{KMnO}_4$  in 250 cc volumetric flask. 3
- (d)  $\text{H}_2\text{S}$  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.  $1\frac{1}{2} \times 2 = 3$
- (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  $1.8 \times 10^{-14}$ ) 2
- (g) The colour changes of acid and base indicator are explained on the basis of which theory? Outline the theory. 3

D25/1287

( Turn Over )

( 4 )

3. (a) What is meant by effective atomic number? Calculate the effective atomic number of cobalt in  $[\text{Co}(\text{NH}_3)_6]^{3+}$  and Fe in  $[\text{Fe}(\text{CO})_5]$ . (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  $\text{Cr}(\text{NH}_3)_3\text{Cl}_3$  and name them as per IUPAC nomenclature. 3
- (d) Write down the important postulate of Werner's coordination theory. Why is the complex of  $\text{CoCl}_3 \cdot 3\text{NH}_3$  non-ionic according to this theory? 3
- (e) Identify the kind of isomerism inhibit by the following isomers : 2
- (i)  $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$  and  $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$
- (ii)  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$  and  $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$

( 5 )

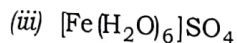
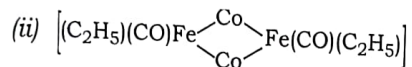
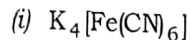
- (f) What is ambidentate ligand? Giving example, show how it differs from bidentate ligand. 2
- (g) Explain the following with suitable examples :  $1\frac{1}{2} \times 2 = 3$
- (i) Hydrate isomerism
- (ii) Linkage isomerism

OR

4. (a) Define double salts and coordination compound with the help of suitable examples.  $1\frac{1}{2} \times 2 = 3$
- (b) Write the IUPAC name of  $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$  and draw the structure of all isomers. Why does the transgeometry not exhibit optical isomerism? 3
- (c) Draw all the possible isomers  $[\text{Ma}_2\text{b}_2\text{c}_2]$ . 3
- (d) Define the following terms :  $1 \times 3 = 3$
- (i) Coordination complex
- (ii) Ligand
- (iii) Coordination number

( 6 )

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



- (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.

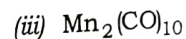
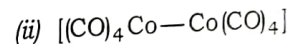
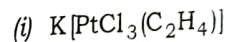
Name them. Give one method of preparation of organolithium compound. 4

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

( 7 )

- (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

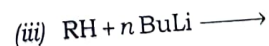
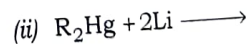
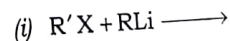


- (e) Draw the structure and mention one application of each of the following compounds as precipitant : 1½×2=3

(i)  $\alpha$ -Nitroso- $\beta$ -naphthol

(ii) Cupron

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



OR

6. (a) Why is alkyllithium compound known as super Grignard reagent? How does methylithium 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

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
- $(15.02 \pm 0.02) \text{ ml} \times (0.2000 \pm 0.0001) \text{ mmol ml}^{-1}$
- (f) Discuss the propagation of determinate errors when it transmits through addition and subtraction in the final results through calculation. 3

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,  $S=0.210$  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

$$\frac{0.02856 \times 298.15 \times 0.112}{0.5785}$$

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

- (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

\*\*\*