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(February)

CHEMISTRY

(Honours)

[Chem-H-501]

(Part—A : Inorganic Chemistry—I)

Marks : 38

Time : 2 hours

*The figures in the margin indicate full marks
for the questions*

1. (a) Write all the symmetry operations of the following : $1\frac{1}{2} \times 2 = 3$
- (i) Octahedral point group molecules (O_h)
- (ii) Tetrahedral point group molecules (T_d)
- (b) Taking a suitable example, explain inversion centre of a molecule. $1\frac{1}{2}$

- (c) Assign molecular point group to the following molecules : $1 \times 2 = 2$



- (d) How many symmetry element does a molecule with C_1 point group have? $\frac{1}{2}$

OR

2. (a) Draw the flowchart diagram for determining the point group of the molecules. 2
- (b) Define the following : $1 \times 3 = 3$
- (i) Symmetry plane
- (ii) Improper rotation
- (iii) Molecular point group
- (c) Comment on the point group of linear molecules. 1
- (d) Write down all the symmetry operations of S_5 . 1
3. (a) What are EDTA titrations? What type of indicators are used in EDTA titrations? Explain clearly the working of these indicators. $1 + 1 + 2 = 4$

(3)

- (b) The amount of oxalic acid present in a given solution was determined by two methods, one is standard method and the other is new method, when the following results were obtained :

Sample No.	Amount of oxalic acid (g/L) obtained by	
	Standard method	New method
1	8.65	9.35
2	11.70	11.06
3	7.38	8.90
4	13.95	11.25
5	10.20	16.42
6	9.21	11.72

Show that there is no significant difference between the two methods. 2

- (c) Draw the structures and mention one application each of the following compounds as precipitants : 1+1=2
- (i) α -nitroso- β -naphthol
- (ii) Cupron

OR

4. (a) Explain how chloride is estimated using adsorption indicator. 1½
- (b) Using a suitable example, explain masking and de-masking agents in EDTA titrations. 1½

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(4)

- (c) Differentiate between post-precipitation and co-precipitation. 1
- (d) How many significant figures are present in 0.2341 and 2.300? Write a brief note on personal errors. ½+½+1=2
- (e) Mention the advantage of organic precipitants to inorganic reagents. Which reagent is used to precipitate nickel? Draw the precipitated complex. 1+½+½=2

5. (a) Write short notes on the following : 1×2=2
- (i) Alpha decay
- (ii) Electron capture
- (b) Differentiate between secular equilibrium and transient equilibrium. 1
- (c) Calculate the energy released in the following nuclear reaction involving the decay of ${}^{238}_{92}\text{U}$ by ${}^4_2\alpha$ particle emission : 2



The mass values are—

$${}^{238}_{92}\text{U} = 238.1249 \text{ a.m.u.}$$

$${}^{234}_{90}\text{Th} = 234.1165 \text{ a.m.u.}$$

$${}^4_2\alpha = 4.0039 \text{ a.m.u.}$$

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(Continued)

(5)

- (d) Mention three applications of radio-isotopes as tracers. $1\frac{1}{2}$
- (e) Write a note on the electrolytic separation of isotopes. $1\frac{1}{2}$

OR

6. (a) Discuss the principle of a thermal reactor. $1\frac{1}{2}$
- (b) Define Q-value and mention its significance. $1\frac{1}{2}$
- (c) Explain with a labelled diagram the working of a GM counter in the detection of radioactivity. $2\frac{1}{2}$
- (d) Why does a radioactive element emit gamma radiation? Comment on the penetrating and ionizing power of alpha particles, beta particles, gamma rays and neutrons. $\frac{1}{2}+2=2\frac{1}{2}$
7. (a) Explain on the basis of crystal field theory, $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic whereas $[\text{NiCl}_4]^{2-}$ is paramagnetic. 2
- (b) Draw the energy level splitting diagram of d^8 square planar geometry and show occupancy of the d-orbitals by electrons. 2

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(Turn Over)

(6)

- (c) State and explain Jahn-Teller effect. Discuss the spectral consequences of Jahn-Teller effect for octahedral complexes. 3

OR

8. (a) Which of the following complex ions of Co^{2+} has the weakest crystal field splitting (Δ_o)? 2
- $[\text{CoCl}_6]^{4-}$, $[\text{Co}(\text{CN})_6]^{4-}$, $[\text{Co}(\text{NH}_3)_6]^{2+}$
and $[\text{Co}(\text{en})_3]^{2+}$
- (b) Explain high-spin and low-spin states of coordination compounds with the help of crystal field theory. 2
- (c) Calculate the number of unpaired electrons in octahedral complexes for d^3 - and d^5 -systems when $\Delta_o > P$ and $\Delta_o < P$. 3
9. (a) Discuss the variation of magnetic susceptibilities of ferromagnetic and antiferromagnetic compounds as a function of temperature. 3
- (b) What is meant by the statement that "diamagnetism is an induced effect"? Why is a diamagnetic substance repelled by a magnet? $2+\frac{1}{2}=2\frac{1}{2}$

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(Continued)

(7)

- (c) Describe the Gouy method of measurement of magnetic susceptibility of a substance. $2\frac{1}{2}$

OR

10. (a) What are antiferromagnetism and Neel temperature? Comment on the magnetism of the following compounds :
 $1+1+1\frac{1}{2}=3\frac{1}{2}$



- (b) Write down the Curie-Weiss law. Write down the equation for calculation of spin magnetic moment. $1+\frac{1}{2}=1\frac{1}{2}$

- (c) What is the cause of magnetism in atoms? What is a Bohr magneton? What kind of magnetism will be exhibited by $[Ni(CO)_4]$? $1+1+1=3$

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