

2019

(October.)

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) What are meant by symmetry element and symmetry operation? 2
- (b) Determine all the symmetry elements in the following molecules : 2
 - (i) PF_5
 - (ii) Cyclohexane (chair form)
- (c) What 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 for one set of 10 determinations, $S = 0.210$ and for

(Turn Over)

(2)

8 determinations by another method is 0.441. Is there any significant difference between the precision of two sets of results? (F value for 9 and 7 degrees of freedom at 95% confidence limit is 3.68)

3

OR

2. (a) Draw the flowchart diagram relating to the determination of symmetry point group of molecules.

2

(b) In terms of symmetry operation, explain the following terms :

2

(i) Equivalent configuration

(ii) Equivalent atoms

(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

3. (a) What is an adsorption indicator? Give an example. Mention the use of adsorption indicator in argentometric titrations.

2½

(b) Write down three points of differences between co-precipitation and post-precipitation.

1½

(3)

(c) What are the advantages of using organic precipitants?

2½

(d) Write down the chemical and structural formulae of cupferron. Write one important application of cupferron in quantitative analysis.

1½

OR

4. (a) Draw the structure of EDTA-metal complex. In what manner, the stability of EDTA-metal complex varies with (i) the change of the metal cation, (ii) the pH of the medium?

3

(b) Write down the structure of the complex containing dimethyl glyoxime with Ni^{2+} ion and cupferron with Cu^{2+} ion.

2

(c) Discuss the role of metal ion indicator in a complexometric titration reaction.

1½

(d) What do you mean by masking agents? Explain with an example.

1½

5. (a) Discuss the separation of isotopes by electrolytic method.

3

(b) Write short notes on the following :

$1\frac{1}{2} + 1\frac{1}{2} = 3$

(i) Spontaneous fission

(ii) Radioactive equilibrium

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(4)

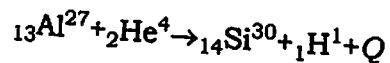
- (c) What are tracers? Mention at least two applications of radioactive isotopes used as tracers.

2

OR

6. (a) Calculate the Q-value of the following nuclear reaction :

4



Given the masses of

$${}_{13}\text{Al}^{27} = 26.9815 \text{ amu}$$

$${}_{14}\text{Si}^{30} = 29.9738 \text{ amu}$$

- (b) Write notes on the following : $1\frac{1}{2} \times 2 = 3$

(i) Positron decay

(ii) Electron capture

- (c) Write down the Bethe notation for a nuclear reaction.

1

7. (a) Define crystal field stabilising energy. What is the relationship between crystal field stabilising energy and pairing energy in determining high or low spin complexes?

3

- (b) Draw a figure to show the splitting of degenerate d-orbitals in an octahedral crystal field.

2

(5)

- (c) Draw a plot of hydration energies of M^{2+} ions of the first-row transition metals and explain the important features of it.

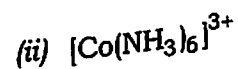
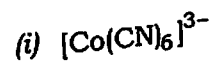
2

OR

8. (a) Account for the fact that $[\text{Cr}(\text{NH}_3)_6]^{3+}$ is paramagnetic while $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic.

3

- (b) Which of the following complexes has higher crystal field splitting energy?



2

Give reason for your answer.

- (c) Calculate the CFSE value for a d^4 and d^6 tetrahedral complex.

2

9. (a) Discuss the variation of magnetic susceptibilities of ferromagnetic and anti-ferromagnetic compounds as a function of temperature.

4

- (b) How is the paramagnetic moment of a substance related to the number of unpaired electrons? Calculate the 'spin only' magnetic moment for $[\text{MnCl}_4]^{2-}$ and $[\text{CoF}_6]^{4-}$ complexes.

4

OR

10. (a) State Curie law. What is the significance of Curie point? 1½
- (b) Explain the following : 2
 CO^{3+} complexes may be paramagnetic as well as diamagnetic while Cr^{3+} complexes are paramagnetic only.
- (c) Explain Faraday's method of determining magnetic susceptibility of compounds. 2
- (d) Which among the following complexes will exhibit the highest paramagnetic behaviour and why? 2½
 $\text{K}_4[\text{Fe}(\text{CN})_6]$, $\text{K}_2[\text{Ni}(\text{CN})_4]$, $[\text{Ni}(\text{CO})_4]$ and $\text{K}_3[\text{MnF}_6]$
[Fe = 26, Ni = 28, Mn = 25]

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