

2022

(February)

CHEMISTRY

(Honours)

(Part-A : Inorganic Chemistry—I)

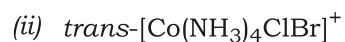
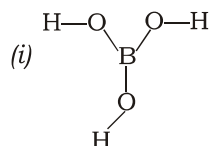
[Chem-H-501]

Marks : 38

Time : 2 hours

The figures in the margin indicate full marks
for the questions

1. (a) Explain improper axis of rotation with the help of a suitable example. How many symmetry operations can be generated about an S_5 axis? 4
- (b) Determine the symmetry point group of the following molecules. How many and which symmetry operations are possible in each case? 3



OR

- 2 (a) Determine the various symmetry elements and symmetry operations in a regular tetrahedral molecule having T_d point group. 3
- (b) Write down the symmetry point group of the following molecules. How many symmetry operations that can be carried out on the geometry of each molecule? 3
- (i) H_2O
- (ii) B_2H_6
- (c) Define significant figures. How many significant figures are present in 1000? 1
3. (a) What are the advantages of using organic precipitants? 2
- (b) Write down the structure of the complex containing α -nitroso- β -naphthol with Cu^{2+} ions and dimethylglyoxime with Ni^{2+} ions. 2
- (c) Write short notes on the following : 4
- (i) Coprecipitation
- (ii) Digestion of the precipitate

(3)

OR

4. (a) Discuss the principles of argentometric titrations. How is it different from precipitation titrations? 3
- (b) What do you mean by masking agents? Explain with an example. 3
- (c) Discuss the role of metal ion indicators in a complexometric reaction. 2
5. (a) Derive the expression for the disintegration of a radioactive substance. What is meant by disintegration constant? 3
- (b) Calculate the binding energy per nucleon in helium atom which has a mass of 4.00260 a.m.u.
(Mass of neutron = 1.008665 a.m.u.
Mass of hydrogen atom = 1.007875 a.m.u.)
Express the result in joule. (1 MeV = 1.602×10^{-13} J) 2
- (c) Give a brief account of basic principles and types of nuclear reactors. 3

OR

6. (a) What are the differences between chemical and nuclear reactions? Write down the Bethe notation for a nuclear reaction. 3

(4)

- (b) What are tracers? Mention at least two applications of radioactive isotopes used as a tracer element. 3
- (c) Discuss the nature of forces which hold the nucleons together in a small nucleus. 2
7. (a) What are the differences between an inner orbital and an outer complexes? Discuss with an example of each. 2
- (b) How do the *d*-orbitals split when a transition metal ion is placed in tetrahedral crystal field of ligands? 2
- (c) Draw the relative energy molecular orbital diagram in an octahedral complex. 3

OR

8. (a) State and explain Jahn-Teller effect. Discuss the consequences of Jahn-Teller effect on the electron spectra of an octahedral complex. 3
- (b) Define crystal field stabilizing energy. How can crystal field stabilizing energy be calculated from heat of hydration data of bivalent metal ions of the first transition series? 3

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- (c) Why do the ionic radii of Ca^{2+} , Mn^{2+} and Zn^{2+} show a steady decrease whereas the ionic radii of the other bivalent metal ions of the first transition series show an irregular pattern? 1

9. (a) Explain magnetic susceptibility of a paramagnetic substance. Describe Faraday's method of determination of measuring magnetic susceptibility of a paramagnetic substance. 3

- (b) State Curie and Curie-Weiss law. Write down the temperature-dependent magnetic susceptibility equation corrected for diamagnetic behaviour. 3

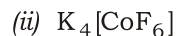
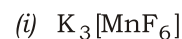
- (c) Explain the magnetic behaviour of the following compounds : 2
- (i) $\text{K}_3[\text{Fe}(\text{CN})_6]$
- (ii) $\text{K}_2[\text{Ni}(\text{CN})_4]$

OR

10. (a) Define the following terms : 3
- (i) Magnetic induction
- (ii) Magnetic permeability
- (iii) Intensity of magnetization

(6)

- (b) Determine the magnetic moments of the following compounds : 2



- (c) Explain the temperature-dependent behaviour of a paramagnetic behaviour with respect to magnetic susceptibility. 3

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