2022

(November)

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)* Determine the point group for each element of the following molecules and write all the symmetry elements present in it : 1½×2=3

(i) H_2O

(ii) $XeOF_4$

(b) Write down all the symmetry elements of H_2O. 2

(c) What are significant figures? Calculate and give the answer with the correct number of significant numbers : 2

$1{\cdot}02 + 8{\cdot}2 + 3{\cdot}33 + 9{\cdot}781$

OR

2. *(a)* Distinguish between accuracy and precision with example. 3

(b) A molecule has the following symmetry elements/operations :

$8C_3(4C_3^1, 4C_3^2)$

$3C_2, E, 6S_4(3S_4^1, 3S_4^3)$

$6\sigma_d$

What point group would you assign to this molecule? Give an example of such molecule. 2

(c) In term of symmetry operation, explain the following terms : 1×2=2

(i) Equivalent configuration

(ii) Identical configuration

3. *(a)* Give the structural formulae of the following :

(i) Cupron

(ii) Dimethylglyoxime

Write some of the important applications of both in qualitative and quantitative analysis. 3

(b) What is co-precipitation? What are the factors responsible for co-precipitation? 1+2=3

(Continued)

(c) What is meant by EDTA titration? Mention the type of indicators used in this type of titration. 2

OR

4. *(a)* Discuss some of the advantages and disadvantages of organic reagent over inorganic reagent. 3

(b) Explain in what manner, the stability of metal-EDTA complex varies with—

(i) the change of the metal cation;

(ii) the pH of the medium. 1½×2=3

(c) Give one example of adsorption indicator. Mention its uses in argentometric titration. 2

5. *(a)* Describe nuclear chain reaction with reference to fission of ^{235}U and discuss the concept of critical mass. 3

(b) Discuss the seperation of isotopes by electrolytic method. 3

(c) Define *Q*-value. What is its significance? 2

(Turn Over)

OR

6. *(a)* Calculate the binding energy per nucleon of oxygen atom $_8O^{16}$, which has a mass of 15·994910 a.m.u.

Given :

Mass of neutron = 1·008665 a.m.u.

Mass of proton = 1·007277 a.m.u.

Mass of electron = 0·000548 a.m.u. 4

(b) Write short notes on (any *two*) : 1×2=2

(i) α–decay

(ii) Magic number

(iii) Positron decay

(c) Explain stability of atomic nuclei in terms of neutron to proton ratio. 2

7. *(a)* Draw a diagram to show how the ionic radii of a bivalent metal ion of the first transition series element vary in presence and absence of crystal field. Explain its important features. 3

(b) What are the factors that affect the magnitude of crystal field stabilization energy parameter (Δ_0) in complexes? 3

(c) Arrange the following complexes in increasing order of CFSE (Δ_0) value and give explanation for your answer : 1

$[Rh(NH_3)_6]^{3+}$, $[Ir(NH_3)_6]^{3+}$, $[Co(NH_3)_6]^{3+}$

OR

8. *(a)* Write the salient features of crystal field theory. 3

(b) Draw the crystal field diagram in tetrahedral field. 2

(c) Explain why $[Fe(H_2O)_6]^{3+}$ ion is more paramagnetic than $[Fe(CN)_6]^{3-}$ ion. 2

9. *(a)* Explain how the magnetic susceptibility is measured by Gouy's method. 3

(b) Calculate the spin only magnetic moment (μ_s) of the following : 1½×2=3

(i) $K_3[FeF_6]$

(ii) $K_3[Fe(CN)_6]$

(c) Explain and give examples of an anti-ferromagnetic substance and an ferromagnetic substance. 2

OR

10. *(a)* Write down the formula for calculation of spin magnetic moment and find out the spin only magnetic moment of the following complexes : 3

(i) $[MnCl_4]^{2-}$

(ii) $[CoF_6]^{4-}$

(b) What is meant by magnetic susceptibility χ_m^{corr} ? How is it related to magnetic moment μ_{eff} ? 2

(c) What is Curie's law? What is the significance of Curie point? 1½

(d) Draw a diagram to show magnetic susceptibility χ_m Vs. T (temperature) for anti-ferromagnetic substance. 1½

★★★