2016

CHEMISTRY

(Major)

Paper : 6·4

(Inorganic Chemistry)

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer : 1×7=7

(a) The visible spectra of salts of the following complexes are measured in aqueous solution. For which complex would the spectrum contain absorptions with the highest ε_{max} values?

(i) $[CoCl_4]^{2-}$

(ii) $[Co(OH_2)_6]^{2+}$

(iii) $[MnO_4]^-$

(iv) $[Mn(OH_2)_6]^{2+}$

(b) The total degeneracy of the terms ^1G, ^3F, ^1D, ^3P are

(i) 9, 21, 5, 9 respectively

(ii) 21, 9, 9, 5 respectively

(iii) 5, 9, 21, 9 respectively

(iv) 9, 21, 9, 5 respectively

(c) The correct one among the following statements about ligand substitution reaction is

(i) complexes of the M(III) ions of *f*-block are inert

(ii) lability is common among the complexes of 4*d* and 5*d* series

(iii) all complexes of *s*-block ions except the smallest Be^{2+} and Mg^{2+} are inert

(iv) complexes of d^{10} ions (Zn^{2+}, Cd^{2+}, Hg^{2+}) are normally very labile

(d) Which of the following gases on inhalation dissolves in the blood hemoglobin more rapidly than oxygen?

(i) SO_2

(ii) NO

(iii) CO

(iv) NO_2

(e) The rate of radioactive decay can be increased by increasing the

(i) temperature

(ii) pressure

(iii) size of the particle

(iv) None of the above

(f) Which reaction is likely to result in successful conversion of $La_2O_3(s)$ to $LaCl_3(s)$?

(i) $La_2O_3(s) + 6Cl_2(g) \rightarrow 2LaCl_3(s) + 3Cl_2O(g)$

(ii) $La_2O_3(s) + 3COCl_2(g) \rightarrow 2LaCl_3(s) + 3CO_2(g)$

(iii) $La_2O_3(s) + 6NaCl(s) \rightarrow 2LaCl_3(s) + 6Na_2O$

(iv) $La_2O_3(s) + 6HCl(aq) \rightarrow 2LaCl_3(s) + 3H_2O(l)$

(g) Radioisotope useful in the treatment of cancer, tumors and cells is

(i) phosphorus-32

(ii) carbon-14

(iii) iron-55

(iv) cobalt-60

2. Answer the following : 2×4=8

(a) Explain why the absorption bands in electronic spectra of transition metal complexes are usually broad.

(b) What is ligand-bridged mechanism in redox reactions? Illustrate with suitable examples.

(c) What are metalloproteins? Name the two metalloproteins which comprise nitrogenase.

(d) Why do lighter elements generally undergo nuclear fusion while heavier elements show nuclear fission?

3. Answer any *three* of the following : 5×3=15

(a) What is lanthanide contraction? Explain the cause and effects of lanthanide contraction. 2+3=5

(b) What is radioactive waste? Discuss the disposal of radioactive waste from nuclear reactors. 2+3=5

(c) What are microstates in relation to an electronic configuration? Determine the possible spectroscopic term symbols for the p^2-configuration from its micro-states. 5

(d) Explain the mechanism of Na^+-K^+ pump. 5

(e) What are successive and cumulative formation constants? The successive formation constants for complexes of cadmium with Br^- are $K_{11} = 36{\cdot}3$, $K_{12} = 3{\cdot}42$, $K_{13} = 1{\cdot}15$, $K_{14} = 2{\cdot}34$. Suggest an explanation of why $K_{14} > K_{13}$. 2+3=5

4. Answer any *three* of the following : 10×3=30

(a) (i) Write the basic principle of colorimetric titrations. Discuss how the amount of copper can be estimated in a given sample by colorimetric method. 2+3=5

(ii) What is cisplatin? Explain the mechanism of therapeutic action of cisplatin against cancer and also discuss the reason behind the inactivity of its *trans*-isomer. 1+2+2=5

(b) (i) Explain nuclear fission. Using laws of radioactive disintegration, show that

$$N = N_0 e^{-\lambda t}$$ 2+3=5

(ii) What is *trans*-effect? Discuss the π-bonding theory of *trans*-effect. 2+3=5

(c) (i) Explain the terms mass defect and binding energy of a nucleus. Calculate the mass defect and binding energy of the helium nucleus having a mass of 4·0039 a.m.u., given that masses of proton and neutron are 1·00758 a.m.u. and 1·00893 a.m.u. respectively. 2+3=5

(ii) Write a note on importance of metal ions in diagnostic medical imaging. 5

(d) (i) State the Laporte selection rule governing electronic transitions in transition metal complexes. Under what conditions are these rules relaxed? Explain. 2+3=5

(ii) Discuss the paramagnetic behaviour of lanthanides and also account for the colour exhibited by them. 3+2=5

(e) (i) What are fissile materials? How are they different from fissionable materials? Discuss with suitable examples. 1+4=5

(ii) Write notes on the following : 2½×2=5

(1) Eigen-Wilkins mechanism

(2) Chelate effect

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