

2014

CHEMISTRY

( Major )

Paper : 6.4

( Inorganic Chemistry )

Full Marks : 60

Time : 3 hours

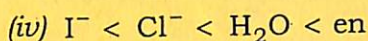
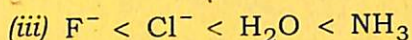
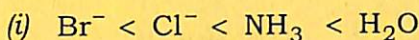
*The figures in the margin indicate full marks  
for the questions*

1. Choose the correct options : 1×7=7

(a) The molar absorptivity ( $\epsilon$ ) of an absorption band observed for a metal complex is  $73 \text{ L mol}^{-1} \text{ cm}^{-1}$ . The type of electronic transition involved is

- (i) spin allowed, Laporte allowed
- (ii) spin allowed, Laporte forbidden
- (iii) spin forbidden, Laporte forbidden
- (iv) charge transfer transition

(b) Which of the following options correctly places the ligands as per spectrochemical series?



(c) The incorrect one among the following statements about ligand substitution reactions is

(i) the stepwise formation constants lie in the order  $K_n > K_{n+1}$

(ii) for a complex of type  $\text{ML}_6$ , the stepwise ( $\beta$ ) and overall ( $K$ ) stability constants have the relation  $\beta_6 = K_1 K_2 K_3 K_4 K_5 K_6$

(iii) the complex  $[\text{Co}(\text{phen})_3]^{3+}$  is more labile compared to  $[\text{Co}(\text{NH}_3)_6]^{3+}$

(iv) complexes of  $d$ -block  $\text{M}(\text{III})$  ions are distinctly less labile than those of  $d$ -block  $\text{M}(\text{II})$  ions

(d) The approximate quantity of the  $O_2$  transport protein haemoglobin found in a litre of human blood is

(i) 15 mg

(ii) 150 mg

(iii) 15 g

(iv) 150 g

(e) Which of the following elements is not a member of actinides?

(i) Pa

(ii) Th

(iii) Tl

(iv) Pu

(f) The rest mass is the lowest for which of the following 'elementary' particles?

(i) Electron

(ii) Neutrino

(iii) Neutron

(iv) Photon

(g) The volatile chemical compound  $\text{UF}_6$  finds large scale use in gaseous diffusion plants for the separation of uranium isotopes, because

(i) natural uranium consists of  $^{235}\text{U}$  only

(ii) fluorine consists only of  $^{19}\text{F}$  isotope

(iii) this compound is not corrosive

(iv) this compound is found in many uranium ores

2. Answer the following :

$2 \times 4 = 8$

(a) Why are dilute aqueous solutions of  $\text{Mn(II)}$  salts nearly colourless?

(b) State and explain briefly how colorimetry is same with or different from spectrophotometry.

(c)  $\text{CO}_2$  is not toxic, yet a build-up of its concentration in the atmosphere is considered to affect our environment adversely. Explain briefly.

(d) Why does europium ( $Z = 63$ ), unlike most other lanthanide elements, form a number of stable compounds in its +2 oxidation state?

3. Answer any *three* from the following :  $5 \times 3 = 15$

(a) State the Laporte selection rule governing electronic transitions in transition metal complexes. Is this rule applicable for transitions involving tetrahedral complexes? 4+1

(b) Discuss how the measurement of electrical conductivity may be useful in the determination of composition of ionic compounds comprised of positively and/or negatively charged complex ions. 5

(c) What is the reaction involved in 'nitrogen fixation'? What is the enzyme that catalyzes this reaction? Compare and contrast this reaction with Haber's process of ammonia synthesis. 2+1+2

(d) Write a resume on environmental toxicity of mercury. 5

(e) What is the shell model for the description of nuclear structure? Show how the numbers 2, 8, 20, 82 and 126, called magic numbers, are important in this model. 5

4. Answer the following :

(a) In the iodometric determination of copper using starch solution as

indicator, the end point is detected by observing the disappearance of blue colour to give a solution containing a precipitate of pale pink colour. Explain these facts regarding this method for the titrimetric estimation of copper by writing appropriate equation. 10

Or

Aqueous solutions of salts such as  $\text{CoCl}_2$  and  $\text{Co}(\text{NO}_3)_2$  are light pink in colour. On the other hand, these solutions turn deep blue upon addition of ammonium thiocyanate. Explain these facts with help of an appropriate Orgel diagram and also by utilizing selection rules that may be useful in explaining colour of transition metal complexes.

- (b) "One compound that is currently being used for the treatment of certain cancers is *cis*-diammine-dichloro-platinum(II), or cisplatin." While this coordination compound is active, its *trans*-isomer is inactive as an anticancer drug. Explain the mechanism of therapeutic action of cisplatin and discuss the reason behind the inactivity of the *trans*-isomer. What are the requirements for a compound to act as an effective mutagenic agent? 8+2

Or

Explain in detail how nitrogen oxides are harmful to the environment. 10

- (c) Give reasons why all the lanthanide elements closely resemble one another. What is lanthanide contraction? Discuss consequences of lanthanide contraction. 4+3+3

Or

- (i) What are nuclear reactions and the  $Q$ -values associated with them? How do nuclear reactions differ from chemical reactions? 3+2
- (ii) A freshly cut piece of wood gives 16100 counts of  $\beta$ -emissions per minute per kg and an old wooden bowl gives 13200 counts per minute per kg. Calculate the age of the wooden bowl. The half-life period of  $^{14}\text{C}$  is 5568 years. 5

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