West Bengal University
B.A./B.Sc./B.Com. (Honours, Major, General) Examinations, 2012
PART–III

CHEMISTRY — Honours

Paper–VI

Duration : 4 Hours   Full Marks : 100

Candidates are required to give their answers in their own words as far as practicable.

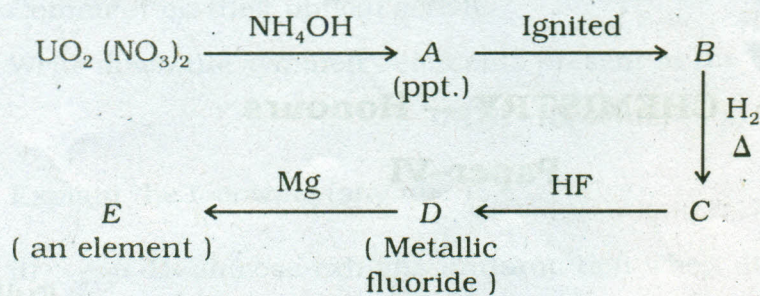*The figures in the margin indicate full marks.*

GROUP - A

Answer any *three* questions taking one from each Unit.

UNIT - I

1. a) Name one important ore of titanium along with its composition. Discuss the principle of extraction of the metal from the ore. Give the balanced equations of the reactions involved. Mention two uses of the metal.   1 + 4 + 2 + 1

   b) Discuss briefly the ion exchange method of separation of lanthanide elements. 6

   c) How would you prepare $K_2Cr_2O_7$ from $FeCr_2O_4$ (chromite) ?   2

2. a) Give the preparation of any two of the following compounds with appropriate chemical equations and mention their uses.   3 + 3

   i) $K_4\left[Fe\,(CN)_6\right]$

   ii) $AgNO_3$

   iii) $Hg\left[Co\,(NCS)_4\right]$.

b)   In aqueous solution Mn^{+3} is more oxidising than Fe^{+3}. Explain.

c)   Identify A to E in the following transformations :

$$UO_2(NO_3)_2 \xrightarrow{NH_4OH} \underset{(ppt.)}{A} \xrightarrow{Ignited} B \xrightarrow[\Delta]{H_2} C$$

$$\underset{(\text{an element})}{E} \xleftarrow{Mg} \underset{\substack{(\text{Metallic} \\ \text{fluoride})}}{D} \xleftarrow{HF} C$$

d)   Give the chemical formula of one important ore of vanadium.

UNIT - II

3.   a)   Give the d-orbital splitting diagram of the central metal ion in the follow complex ions :

i) $NiCl_4^{2-}$

ii) $\left[Cr(H_2O)_6 \right]^{3+}$.

b)   Find out the geometrical isomers for the chemical formula $\left[Co(en)_2 F_2 \right]$ Which one of these will be optically active ?

c)   Explain why CuCl is colourless but Cu_2O is intense red.

d)   Calculate spin–only μ_{eff} values in B.M. of the following compou (any *two*) :

i) $K_3 \left[Co F_6 \right]$

ii) $K_2 \left[CoCl_4 \right]$

iii) $K_2 \left[Ni(CN)_4 \right]$.

e)   Write down the products when the *cis*- and *trans*- isomers of $\left[Pt(NH_3)_2 C \right.$ react with excess of thiourea. Explain the reaction with the help of trans effe

4.   a)   Calculate CFSE values in terms of Dq and pairing energy of the following systems.   6

     i) d^6 (both H.S. and L.S.)

     ii) d^5 (both H.S. and L.S.)

     iii) d^7 (both H.S. and L.S.).

  b)   Predict whether the following compounds will adopt normal or inverse Spienel structures. Give reason for your answer.   2 + 2

     i) Mn_3O_4

     ii) Co_3O_4 .

  c)   Arrange the following ligands in the increasing order of 10 Dq values :   6

     Cl^-, NH_3, CN^-. Give reason.

  d) $HgCl_2$ is colourless but HgI_2 is highly coloured. Explain.   2

UNIT - III

5.   a)   Name one zinc containing metalloenzyme and state its biofunction.   1 + 3

  b)   Write a brief account on Na^+ and K^+ transport across the biological membrane.   4

  c)   Write down the products in the following transformations :   3 + 2

     i) $Mn_2 (CO)_{10} + Br_2 \rightarrow A$

     ii) $Fe_2 (CO)_9 + 4NO \rightarrow B + C$

     Explain your answer with the help of 18-electron rule.

  d)   Give one method for the preparation of $Fe \left(\eta^5 - C_5 H_5 \right)_2$. What is its magnetic moment value ?   2 + 1

6. a) Using 18-electron rule, establish the possible structures of the f
        compounds :

        i) $Fe_3 (CO)_{12}$

        ii) $Mn_2 CO_{10}$

        iii) $Co_4 (CO)_{12}$.

    b) γ_{CO} values in cm^{-1} for the following species, given below in increasing or

        $$\left[Ti (CO)_6\right]^{2-} \langle \left[V (CO)_6\right]^- \langle \left[Cr (CO)_6\right] \langle \left[Mn (CO)_6\right]^+.$$

        Explain the sequence.

    c) Name the enzyme responsible for biological nitrogen fixation and descr
        role.

    d) Explain the function of $Na_2 \left[Ca (EDTA)\right]$ for the removal of Pb^{2+} from
        body.

GROUP - B

Answer any *three* questions taking one from each Unit.

UNIT - I

7. a) What are systematic and random errors in chemical analysis ? Conve
        decimal number 36 to binary number.

    b) State Nernst equation. How is it used in potentiometric titrations ?

    c) Write a short account of neutron activation analysis.

    d) What is the common source of radiation in atomic absorption spectrosc
        Discuss its working priciple.

    e) State the principle of estimation of potassium in water sample by at
        emission spectroscopy.   (3 + 1) + 3 + 4 +

8. a) Define 'accuracy' and 'precision' in quantitative analysis. Zinc content of an alloy was determined by three analysts as 33·27%, 33·37% and 33·34%. Find the co-efficient of variation.

    b) How would you measure the pH of a solution ? State the principle during the potentiometric titration of $K_2Cr_2O_7$ vs $FeSO_4$. Give the change in oxidation number of chromium stating equation.

    c) Discuss the nature of curve for the conductometric titration of a mixture of acetic acid and hydrochloric acid by sodium hydroxide.

    d) Differentiate between hardware and software. What are the input and output devices of a computer ?

    e) Describe the principle of the spectrophotometric estimation of phosphorous.

$$(2 + 2) + 4 + 3 + (1\frac{1}{2} + 1\frac{1}{2}) + 4$$

UNIT - II

9. a) What are co-precipitation and post-precipitation ? How is post precipitation avoided during gravimetric analysis ? Discuss with an example.

    b) Describe the principle of gravimetric estimation of chloride explaining gravimetric factor.

    c) What are the major constituents in basic slag ? State the principle of estimation of mercury in a water sample.

    d) Briefly discuss the principle of estimation of Fe^{3+} and Al^{3+} in a mixture by EDTA.

$4 + 4 + 4 + 4$

10. a) Give a scheme for the estimation of the following :

    i)   Lead in type metal

    ii) Zinc in brass.

b) Mention the functions of the components of Zimmerman-Reinhardt solu

quantitative analysis.

c) Describe the estimation of the following :

  i) NH_4^+ ion in soil

  ii) NO_2^- in water.

d) Formal potential of Fe^{+3}/Fe^{+2} system becomes lower than its standard va

presence of F^-, whereas the opposite phenomenon occurs in prese

1, 10-phenanthroline. Explain.

e) Explain the behaviour of potassium hydrogen iodate as an oxidant

example. $(2 + 2) + 3 + (2 + 2)$

UNIT - III

11. a) What is R_f value ? Discuss its significance in chromatographic separatio

b) State the principle of ion-exchange chromatography. Give one application

c) Define the terms 'BOD', 'COD', 'TDS' for water sample.

d) In solvent extraction, the extracting solvent is used in a number of

instead of using the whole liquid in one portion. Explain deriving the re

equations.

e) State the principle for the estimation of urea. $(1 + 2) + (3 + 1) + 3$

12.   a)   State the principle for the estimation of the following :

i)   CO in air sample.

ii) H_2S in air sample

iii)   Vitamin C (reduced).

b)   Distinguish between partition coefficient and distribution ratio.

c)   Give the scheme for recovery of coal-tar based chemicals by fractional distillation method.

d)   What are the differences between cation and anion exchange resins. State the principles for the separation of Mg^{2+} and Zn^{2+} in a mixture by anion exchange resin.   (2 + 2 + 2) + 2 + 5 + (1 + 2)

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