RAMAKRISHNA MISSION VIDYAMANDIRA
(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SIXTH SEMESTER EXAMINATION, MAY 2016
THIRD YEAR [BATCH 2013-16]

Date : 07/05/2016   **CHEMISTRY (Honours)**

Time : 11 am – 1 pm   **Paper :** VIII   Full Marks : 50

[Use a separate Answer Book for each group]

Group – C

[*Attempt <u>one question</u> from each Unit*]

Unit – I

1. a) If the single electron spin-orbit coupling constant of $4f^6$ species is $1415 cm^{-1}$, calculate the energy difference between J-th and (J+1)-th level and hence suggest with explanation the μ_J relation which can be used for the magnetic moment. [2+2]

    b) Why is it difficult to separate compounds of lanthanide elements? What methods have been used and which of these is still used? [1+2+1]

    c) Describe the selection rules for electronic transition. [2]

    d) Calculate the percent of transmission of incident light from a test solution if absorbance of that solution is 0·30. What is molar extinction co-efficient? [2]

    e) Give two examples of metal carbonyl clusters with structural formula. [1]

2. a) Calculate the magnetic moment of $Er^{+3}(4f^{11})$. [3]

    b) 'Lanthanides and actinides show significant difference in their oxidation states' —Justify or contradict. [2]

    c) What is the lanthanide contraction and what are its consequences? [1+1]

    d) Counting cluster electrons, predict the expected structures of the following :
    $Fe_5C(CO)_{15}$, $Os_5(CO)_{16}$, $Rh_7(CO)_{16}^{3-}$ [3]

    e) The colour of transition metal complexes with tetrahedral geometry is more intense than octahedral geometry. —Explain [2]

    f) Mention an important use of f-block elements in chemistry. [1]

Unit – II

3. a) What is supramolecular chemistry? Give a brief outline of a the various types of chemical forces which are present in supramolecules. [1+3]

    b) Mention and briefly explain two applications of nanoparticles. [1+1]

    c) Why small molecule sensors are important in biological systems for monitoring the metal ions at low concentrations? [2]

    d) How will you prepare nanoparticles by the sol-gel method? [2]

    e) What type of potential energies are stored in an explosive material? [2]

4. a) 'The explosion reactions are generally redox reactions with $E_{cell}^o \geq 1·0\, volt$ '—Justify the statement giving two examples and the relevant explosion reactions. [3]

    b) What is RDX? What is its structure? [1]

    c) Why are nanoparticles generally found to be more reactive in comparison to their bulk analogue? [2]

    d) Mention the names of four reducing agents commonly used for the synthesis of noble metal (Ag, Au, Pt etc) nanoparticles. [2]

    e) 'Lead azide is an explosive but sodium azide is not' —explain. [2]

    f) Define 'high explosive' and 'low explosives'. [1+1]

Group - D

Unit – III

5. a) Give outlines of the analytical procedures for estimation of the following materials.   [3+3]
    i) As in water sample
    ii) CO in air sample

   b) State the principle of least-square. Apply this principle to obtain the best straight line of slope m and intercept c.   [4]

   c) The "differential migration phenomenon" is responsible for the separation of components from their mixtures in different types of chromatography —Explain.   [2]

   d) What are the major constituents of SPM in urban air?   [1]

6. a) What do you mean by DO of a water sample? Describe the method of determination of DO of a water sample.   [1+3]

   b) A sample is known to contain $49 \cdot 06 \pm 0 \cdot 02\%$ of a given constituent X. The results obtained by two observers using the same substance and the same general technique are :
   Observer 1 : 49·01, 49·21, 49·08
   Observer 2 : 49·40, 49·44, 49·42
   Compare the precision of the set of results obtained by each observer.   [4]

   c) Discuss the principle for the spectrophotometric estimation of lead in a sample of water.   [3]

   d) Mention an advantage and a disadvantage of TLC over paper chromatography.   [2]

Unit – IV

7. a) What do you mean by masking and de-masking agent in connection with complexometric titration? Discuss with suitable example.   [3]

   b) Calculate the percentage of iron in sample, when 0·2010gm of iron sample was dissolved and iron was precipitated as hydroxide on farther ignition and weighing gave 0·11069gm as ferric oxide.   [3]

   c) The permanganate end point is not permanent in permanganometric titrations —Explain with reaction.   [3]

   d) Calculate the ratio of the equivalent weights for $KH(IO_3)_2$ when it participates in both acid-base and redoc reactions.   [2]

   e) Name a hexadentate ligand to be used in complexometric titrations as an alternative for EDTA.   [1]

8. a) How does metal-ion indicator act in complexometric titration. Outline the procedure for estimation of Cu and Zn in a mixture complexometrically.   [3+3]

   b) 0·20gm of an ore containing MnO_2 was treated with excess hydrochloric acid. The Cl_2 formed was distilled off and absorbed in KI solution. Titration of the liberated iodine consumed 42·5ml of 0·052N sodium thiosulphate solution. Calculate the percentage of MnO_2 in the ore.   [3]

   c) Which one of the common mineral acids is used for the dissolution of a sample of brass for chemical analysis? Give reason for your answer.   [3]

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