RAMAKRISHNA MISSION VIDYAMANDIRA
(Residential Autonomous College under University of Calcutta)

FIRST YEAR
B.A./B.SC. FIRST SEMESTER (July – December), 2012
Mid-Semester Examination, September 2012

Date : 10/09/2012 **CHEMISTRY (Honours)**
Time : 11 am – 1 pm Paper : I Full Marks : 50

[Use Separate Answer Script for each Group]

Group – A

1. a) Compare and contrast between— [1½+1½]
   i) Boron and Silicon
   ii) Lithium and Magnesium

   b) Write down the I.U.P.A.C name with symbol of the elements 107 and 109. [1+1]

   c) What do you mean by Lanthanide contraction? Write down the causes and consequences of Lanthanide contraction. [1+1½+1½]

OR

   a) Fluorine is some times referred to as super-Halogen, —Justify. [2]

   b) Electron affinity of chlorine is much higher than that of Fluorine. —Justify. [1½]

   c) Justify Electron affinity of Beryllium-Boron and carbon atom. [1½]

   d) It is hard to separate Zirconium from Haufmium —Jusify [2]

   e) Calculate the effective nuclear change of 3d electron of, Manganese using Slater's rule. [2]

2. a) Determine the ground state term symbol for Cu atom. [2]

   b) Calculate the Wave length of the lowest energy transition in Balmer Series of the hydrogen spectrum. [2]

   c) What is Radial Wave function and Radial probability function? Draw the Radial wave function curve for 3s, 3p and 3d orbit. [2+2]

   d) Explain the significance of magnetic quantum number. [1]

OR

2. a) The Balmer series in spectrum of hydrogen originates from transitions between states of n = 2 and n > 2 compare the wavelengths for the first three lines in the Balmer series with those expected for similar transition in Li^{2+}. [3]

   b) The correct electronic configuration of Cr in $[Ar]3d^5 4s^1$ but not $[Ar]3d^4 4s^2$. —Explain. [2]

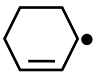
   c) Calculate the ground state energy of $1s^1$ electron and the radius of the find Bohr orbit of hydrogen atom. [3]

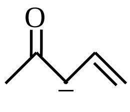
   d) Explain the meaning of the Heisenberg equation in the form of $\Delta x.\Delta p \simeq \frac{h}{2\pi}$. [1]

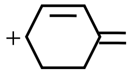
Group – B

(*Answer **<u>any one</u>** question*)

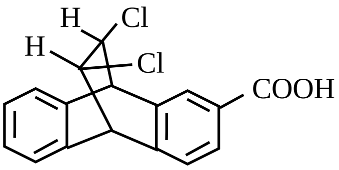
3. a) Derive the major resonance structures for each of the following species and determine which structure is most important in each case. [3]

(i) 

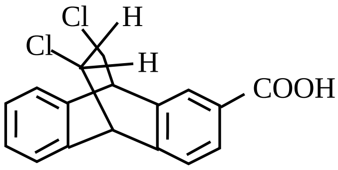
(ii) 

(iii) 

b) The pK_a values of following acid 1 and 2 are 6·07 and 5·67 respectively. Account the fact. [3]



1 (pk_a= 6·07)

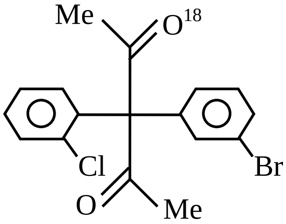


2 (pk_a= 5·67)

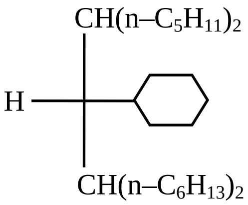
c) Arrange the following C-H bonds in order of decreasing bond energy with reasons : [2]
and CH_3CH_2-H, $\equiv C-H$, $= C-H$

d) Assign R/S configurational designation at the chiral centre of the following molecules showing the priority sequence. [2]

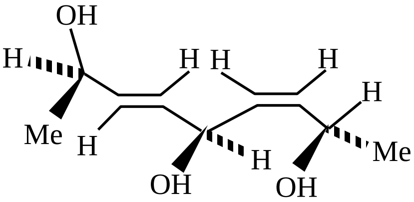
(i)



(ii)



e) Assign E/Z and R/S designation at the appropriate centres. [3]

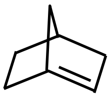


f) Write the structure of all the stereoisomers of hepta – 2, 5 – dien – 4 – ol. Assign R/S and E/Z designation at the appropriate centres. [3]

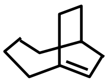
4. a) Draw the orbital pictures of the following compounds indicating the state of hybridization of C, N, and O atoms. [3]

(i) $CH_3 - CH = CH - CN$ (trans) (ii) (E)- $HC \equiv C - CH = NMe$

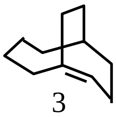
b) Compound I does not exist but other exist. —Explain. [3]



1



2



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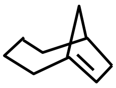

4

c) Predict the relative order of C-C bond lengths in propane, propene and propyne with explanation. [2]

d) Write the structure of the following compounds : [3]

i) Butanone – (E) – oxime

ii) (2E,4Z) – 2, 4 – Hexadienoic acid

iii) Meso – butane – 2, 3 – diol (Newman projection)

e) Cite examples through their structures according to the instructions given [3]

i) A molecule having S_2-axis showing the axis.

ii) A molecule having C_3-axis showing the axis.

f) Justify or criticise : L-alanine must be laevorotatory. [2]

Group – C

(*Answer* ***any one*** *from each unit*)

Unit - I

5. a) For 1·00 mol CH_4(g) at 0°C and 1 atm, find the number of molecules whose speed lies in the range 90·000m/s to 90·002 m/s. [3]

   b) Write down the expression of $g(v_x)$ and find out $<v_x>$ and $<v_x^2>$. Plot $g(v_x)$ vs v_x at two different temperatures. [3+2]

6. a) Find out expressions of $<v^2>$ for a 2D-gas. And $<v>$ for 3D-gas. [4]

   b) Starting from the expression of Maxwell's distribution of molecular speeds in 3D, find out an expression of the most probable speed. [2]

   c) Draw G(v) vs. v for He and CH_4 using the same pair of axes and explain the curves. [2]

Unit - II

7. a) Show that for ideal gas $C_P – C_V = R$. [3]

   b) Derive a relation that shows how enthalpy change of a process like the conversion of A to B varies with temperature. [2]

   c) Infinitesimally small change of a function f(x,y) is given as df(x,y) = xdx + ydy (x, y are independent variables). Show whether or not f(x, y) is a state function. [2]

   d) Compare (graphically) the works done in an isothermal and an adiabatic expansion process (the initial state and the final volumes being the same). [1]

8. a) Starting with the mathematical definition of the first law of thermodynamics show that—

      i) Under adiabatic condition work done is independent of path.

      ii) Energy of the universe is constant. [3]

   b) Compare (graphically) the works done in a single step versus a multistep process in an expansion process (initial and final state being the same). [2]

   c) Show that for a constant pressure process dH = q + w (non-mechanical). [2]

   d) An ideal gas is expanded against vacuum from a pressure, volume (P, V) to (P´,V´) under adiabatic condition. Calculate the works done by the system and change of internal energy of the system for the process.