RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

FIRST YEAR [2016-19]

B.A./B.Sc. FIRST SEMESTER (July – December) 2016

Mid-Semester Examination, September 2016

Date : 10/09/2016 **CHEMISTRY (Honours)**

Time : 11 am – 1 pm Paper : I Full Marks : 50

[Use a separate Answer Book for each group]

Group – A

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

Unit - I

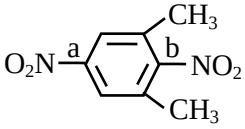
1. a) Draw the orbital picture of MeCH = C = CHMe indicating the state of hybridisation of each 'C'. [2]

   b) Draw the resonating structures of CH_2N_2. Which Cannonical form is least contributing and why? [2]

   c) $(CH_3)_3\overset{+}{C}$ is more stable than $(CH_3)_2\overset{+}{C}H$. Explain. [2]

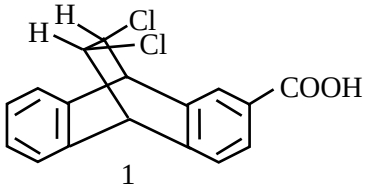
   d) Sum of Dipole moments of NN-dimethylaminobenzene and nitrobenzene is less than the dipole moment of p-nitro-N, N-dimethylaniline. Explain. [2]

2. a) Predict the relative stability of Carbon Carbon bonds in propane, propene and propyne with explanation. [2]

   b)  The two C-N bonds a & b are with different bond length. Explain. [2]

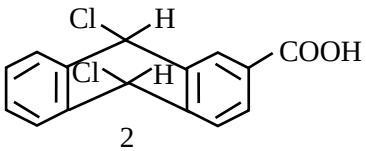
   c) Draw the M.O's of $CH_2 = CH - CH = CH - \overset{\oplus}{C}H_2$ mentioning the HOMO and LUMO. [2]

   d) The pka values of following acid 1 and 2 are given below. Account the fact [2]



1

pKa = 6·07



2

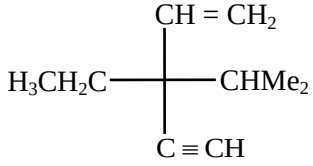
pKa = 5·67

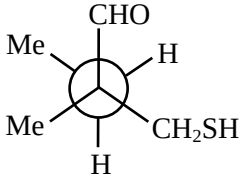
Unit - II

3. a) Centre of symmetry 'i' $\equiv S_2$. Explain with suitable example. [2]

   b) Write the structure of Threo-butane-2, 3-diol in Fischer Projection formula. Represent the most stable ion formed in Newmann projection and justify. [2]

   c) Assign R/S designation at the chiral centres of the following molecules. [2]

   i) 

   ii) 

   d) Draw the possible configurational isomers of the compounds $OHC.\underset{OH}{CH}.\underset{OH}{CH}.CHO$. Comment on their optical activities. [2]

4. a) Identify whether the following pair is identical, enantiomer or diastereomer after assigning R/S designation. [2]

b) Write the structure of the following compounds. [2]

i) Butanone- (E) – oxime

ii) Erythro – 2,3 dibromobutane

c) Justify or criticise : (**any <u>one</u>**) [2]

i) A molecule having R-configuraiton or D-configuration must be dextrorotatory.

ii) Mesotartaric acid is optically inactive due to presence of S_1 symmetry.

d) Draw the π_v M.O diagram of $H-CH=CH-\underset{\underset{H}{|}}{C}=O$ mentioning HOMO & LUMO. [2]

<u>Group – B</u>

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

<u>Unit - I</u>

5. a) Plot the 1D probability density, of NH_3 and N_2 against velocity at 25°C. Comment on the nature of graphs. [3]

b) AB_2 type of molecule can have either linear or non-linear structure. From the principle of equipartition theory, how does one justify the structure. [3]

c) Find the probability that v_x for an Ar atom in a system at 273·15K be in the range $650\,ms^{-1} < v_x < 651 ms^{-1}$. [2]

6. a) Calculate the amount of momentum transfer per unit time for He atom on the wall of container along x axis. Mention two important assumptions towards this collision. [4]

b) Show that the total probability of finding molecules within speed range 0 to ∞ is unity. [2]

c) The Maxwell distribution of energy (3D) is independent to molar mass. Justify or criticize. [2]

<u>Unit - II</u>

7. a) A system consists of n number of subsystems. x_i is the value of a certain variable 'X' for the i^{th} subsystem. X is the same for the whole system. State how X and x_is are related if the variable is (i) extensive (ii) intensive. [3]

b) Starting with the mathematical definition of first law of thermodynamics prove that under adiabatic condition work done is independent of path. [2]

c) Consider the differential $dg = 2x^2y^3dx + 3x^3y^2dy$. Explain whether 'dg' is an exact differential. [3]

8. a) Calculate graphically the amount of work done when 1 mole of an ideal gas is expanded from initial state (P_i, V_i) to a final state (P_f, V_f), [$P_f < P_i$] isothermally.
(i) in a single step (ii) reversibly. [3]

b) Find the same of the reverse process (P_f, V_f) to (P_i, V_i), under both the conditions (i) single step (ii) reversible. [3]

c) Finally calculate the net work done in the above two processes when both the expansion and the reverse process are carried out (i) in single steps (ii) reversibly. [2]

<u>Group – C</u>

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

<u>Unit - I</u>

9. a) Zr and Hf are similar in their chemical behaviour; explain with reason. [2]

b) Ga is liquid at room temperature, comment. [2]

c) Arrange the following ions in increasing order of their ionic radii, give reasons : [2]
H^-, I^-, Br^-, Cl^-, F^-

d) Calculate the effective nuclear charge of the hydrogen atom and comment. [2]

e) Mention the limitations of Slater's rule. [1]

10. a) What is inert pair effect? Give example. [2]

b) What happen when $MnSO_4$ in acid medium treated with sodium bismuthate, give reason. [2+1]

c) It is very difficult to define the absolute size of an atom, comment. [2]

d) Define with example (i) covalent radius (ii) Vander Waals radius. [2]

Unit - II

11. a) Write down Rydberg equation. Explain the terms present. Give its importance in the light of hydrogen like species. [1+2+2]

b) Calculate the shortest wavelength of deuterium (R = 109737 cm^{-1}) and compare that with hydrogen. [2+2]

12. a) Show that Balmer spectral lines of hydrogen atom falls in visible range. [3]

b) Neglecting reduced mass effect, what optical transition in the He^+-spectrum will have same wave length as the first line of Lyman spectral series of hydrogen. [3]

c) What is fine structure of hydrogen spectral lines? How is it justified? [1+2]

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