RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

FIRST YEAR

B.A./B.SC. FIRST SEMESTER (July – December), 2011

Mid-Semester Examination, September, 2011

Date : 12/09/2011

CHEMISTRY (Honours)

Time : 11 am – 1 pm

Paper : I

Full Marks : 50

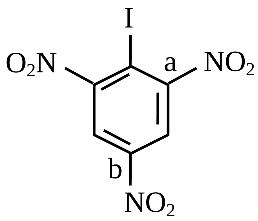
(Use separate answer scripts for each group)

Group – A

Answer **any two** questions :

1. a) Write the canonical forms of $Me_2N-\overset{+}{\underset{\underset{CH_3}{|}}{C}}-OMe$ and indicate which one is the most contributing. Give reasons.

   b) Explain which C–N bond ‘a’ or ‘b’ has a shorter bond length in the following compound.



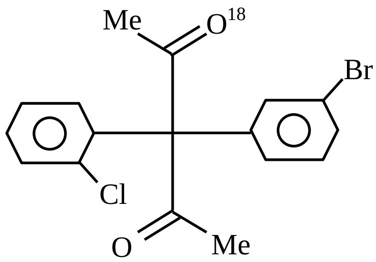
   c) The experimentally determined enthalpy of hydrogenation of cyclooctene and cycloocta-1, 3, 5, 7-tetraene to cyclooctane are –23 and –98 Kcalmol^{-1}, respectively. Calculate the resonance energy of the cyclooctatetraene and comment about the value.

   d) Using resonance arguments rank the radicals in order of increasing stability, least stable first. Explain

   $CH_2=CH-CH=CH-\dot{C}H_2$, (I) $\dot{C}H_2-\underset{\underset{CH_2}{||}}{C}-CH=CH_2$ (II) [2×4 = 8]

2. a) Assign R/S descriptors of the following molecules showing priority sequence of the groups attached. [3×1]

i)



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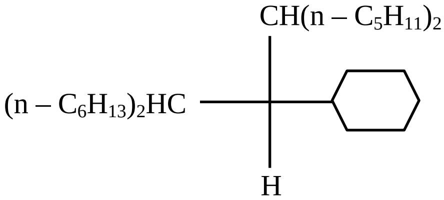
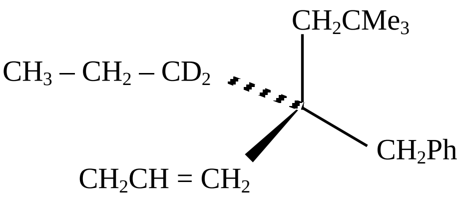


iii)



b) Write the structure of the following compounds. [3×1]

i) Butanone-(E)-Oxime

ii) (2E,4Z) – 2, 4-hexadienoic acid

iii) D-Glyceraldehyde

c) Cite examples through their structures according to the instructions given. [2×1]

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

ii) A molecule having S_4-axis showing the axis.

3. a) Justify or Criticise : [2×2]

i) Meso tartaric acid is optically inactive due to presence of plane of symmetry.

ii) A molecule having (R) configuration must be dextrorotatory.

b) Arrange the following C–H bonds in order of decreasing bond energy with reason. [2]

$$\equiv C-H, \quad > C-H, \quad = CH-H$$

c) Compare the dipole moments of o–, m– and p– dichlorobenzenes. [2]

Group – B

Answer **any two** questions :

4. a) What is magnetic Quantum Number? What are the informations provided by the principal Quantum number? [1+2]

b) Compare and contrast between— i) Lithium and Magnesium
ii) Beryllium and Aluminium [1·5×2 = 3]

c) What is exchange energy? Why $(n–1)d^9ns^2$ configuration is less stable than $(n–1)d^{10}ns^1$ configuration. [3]

5. a) Write down the I.U.P.A.C name with symbol of the elements with atomic number 104 and 109. [1]

b) What is lanthanide contraction? Write down the causes of Lanthanide contraction. Write down the consequences of Lanthanide contraction. 1+1·5+1·5]

c) It is very difficult to separate the Lanthanides from each other; comment and justify. [2]

d) Amongst $Ce(OH)_3$ and $Lu(OH)_3$ which one is more basic and why? [2]

6. a) Show the radial probability distribution function diagram of the orbitals of 3S, 3p, 3d in a hydrogen atom. Explain the above diagram. [3]

b) Calculate the velocity of an electron excited to the Third Bohr in a Hydrogen atom. [3]

c) "The orbital angular momentum of an electron does not give its total angular momentum" —Explain. Which Quantum number is used to supplement the orbital angular momentum. [3]

Group – C

Answer **any two** questions :

7. a) The vander-Waal's gas equation is given as $\left(P+\frac{a}{\bar{V}^2}\right)(\bar{V}-b)=RT$. Show that 'b' is a measure of the repulsive force present among gas molecules. Also show that this force is inversely proportional to the molar volume of gas. [2+1]

b) For a vander-waal's gas 1·0 atm L^2 mol^{-2} and b = 3×10^{-2} L mol^{-1}. Calculate $\bar{V}$ at a pressure of 1 atm and T = 300° K. [3]

c) Define state function using Euler's raciprocity relation. [2]

8. a) If α and β are coeff. of thermal expansion and compressibility coeff., respectively, then show that $\left(\frac{d\alpha}{dP}\right)_T + \left(\frac{d\beta}{dT}\right)_P = 0$ [2]

b) 1 mole of an ideal monatomic gas initially at P_1=2 atm, T_1 = 273 K is taken to a pressure of P_2 = 4atm by the reversible path defined by P/V = constant.

i) Calculate V_1, V_2 and T_2

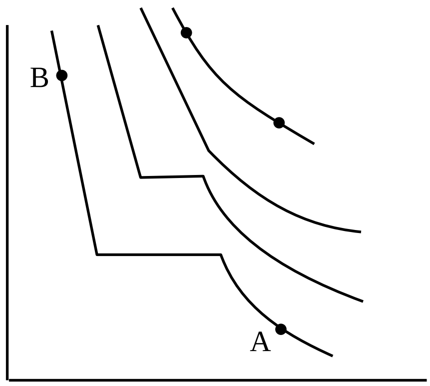
ii) Calculate q, w, Δu [4]

c) Is it possible to liquify a gas which obeys the equation of state $P(\bar{V}-b)=RT$, explain. [2]

9. a) We have the following P–V curves for a real gas. One needs to make a change of state from A to B. This can be done in two ways— i) passing through a 2-phase region

ii) by-passing the 2-phase region

Show schematically both the pathways in the above type P–V isothermal. [2]



b) Starting from the vander-Waals gas equation arrive at the reduced equation of state. [2]

c) A real gas has temperature change during free expansion. Justify the situation, considering it a isolated system. [2]

d) Using indicator diagram, show that work done in a reversible expansion is greater than that of irreversible one. [2]