# RAMAKRISHNA MISSION VIDYAMANDIRA

**(Residential Autonomous College affiliated to University of Calcutta)**

**B.A./B.Sc. FIRST SEMESTER EXAMINATION, MARCH 2022**

**FIRST YEAR [BATCH 2021-24]**

Date : 08/03/2022

Time : 11 am – 1 pm

**INDUSTRIAL CHEMISTRY (HONOURS)**

**PAPER : I [CC1]**

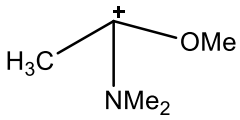
Full Marks : 50

## Unit-I

Answer **any five** questions of the following: [5×5]

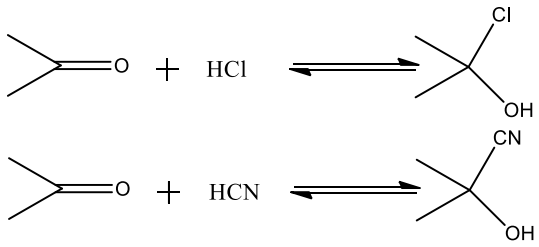
1. a) Draw the orbital picture of nitromethane indicating the states of hybridisation of atom.

   b) Draw the all possible resonating structure of molecule-A and arrange them with increasing order of stability (2+3)




Molecule-A

2. a) Identify with reasoning which one is preferred thermodynamically-

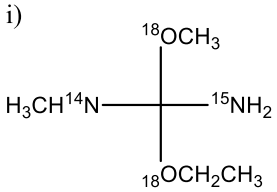



Given bond dissociation energy (BDE) in Kcal/mole: H-Cl=103 H-CN= 130 C-Cl= 84 C-CN=122.

   b) Draw the energy profile diagram for sulfonation of naphthalene indicating kinetic and thermodynamic control product. (2+3)

3. a) Assign R/S descriptors of the following compounds and also show the priority order of the groups:

i)

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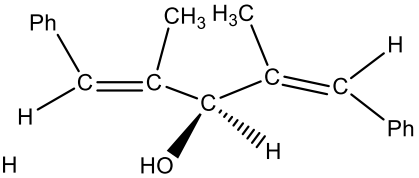


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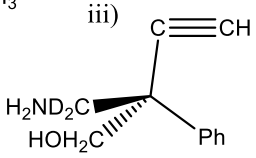
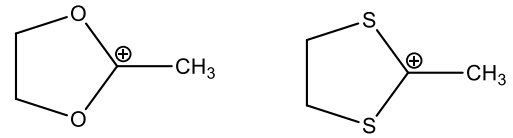
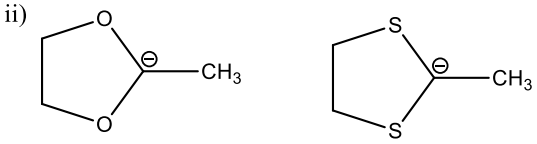



   b) Write the Fischer projection formula of erythro-3-phenyl-2-butanol and represent it also in Newman projection formula. (3+2)

4. a) Compare the stabilities of each pair in the following with reasons

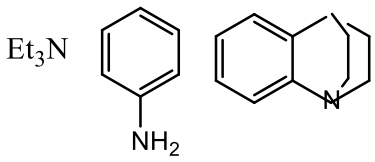
i) 

ii) 

b) Draw orbital picture of singlet and triplet carbine.

c) Why dimethoxycarbene fails to add to an alkene? (2+2+1)

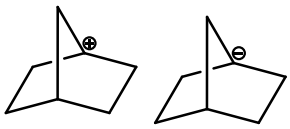
5. a) Arrange the following molecules in order of increasing basicity towards $BF_3$ molecule with justification.



b) Which one is the stronger acid among acetic acid and peroxyacetic acid? Explain why? (3+2)

6. a) What is mean by 'enantiomeric excess' (ee)? The pure (+) enantiomer of a compound shows a specific rotation of $+80^o$. Calculate the percentage of the (-) enantiomer of the same compound in a partially resolved sample showing a specific rotation of $-20^o$.

b) Which is more stable and why?

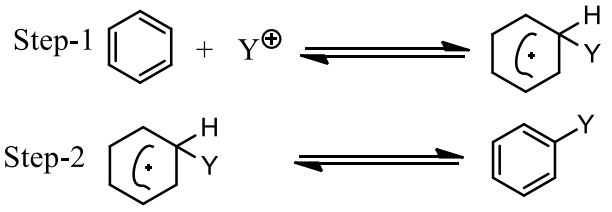


(3+2)

7. a) Draw the most stable conformations of 1,2-dibromoethane and ethylene glycol and justify your answer.

b) Compare the stabilities of radicals $CH_3$, $CH_2Cl$ and $CH_2NO_2$ (3+2)

8. a) A two steps reaction with $K_H/K_D = 7$ is given.




Draw and explain the energy profile diagram for the reaction showing the transition and intermediate states. Indicate the rate determining step as well.

b) Arrange the following compounds in increasing order of acid strength and explain:

4-nitrophenol, 2,6-dimethyl-4-nitrophenol and 3,5-dimethyl-4-nitrophenol. (3+2)

## Unit-II

Answer **any five** questions of the following: [5×5]

9. State Hund's rule in determining the ground state for a polyelectronic atom. Write down the values for all the quantum numbers for electrons in $Li^+$ ion in the ground state. (3+2)

10. a) Calculate the $r_c / r_a$ ratio in a tetrahedral and octahedral system; where $r_c$ = cationic radius, $r_a$ = anionic radius.

    b) If the radius of cation and anion are 116 pm and 181 pm respectively in a crystal lattice, determine the coordination number of the cation and structure of the crystal lattice. (3+2)

11. a) From de Broglie's concept derive the Bohr's postulate of quantisation of angular momentum for an electron.

    b) Calculate the change in de Broglie's wave length corresponding to $2^{nd}$ Balmer transition in terms of $a_0$ for H-atom. (3+2)

12. a) "Colour of AgCl is white while the colour of AgI is yellow— explains why?

    b) What is Lattice energy? Write down the expression of Lattice energy for an ionic solid.

    c) Using Born-Haber cycle, calculate the electron attachment enthalpy for chlorine from the following data given below. (in K.cal/mole)

    $\Delta H_f$ (RbCl) = -102.9; $\Delta H_l$ (Rb) = 95; $\Delta H_{sub}$ (Rb) = 20.5; $\Delta H_a(Cl_2)$=54 and $\Delta H_L$ (RbCl) = -166 [1+(1+1)+2]

13. a) Calculate ionization potential in volts of (a) $He^+$ and (b) $Li^{2+}$. What is the wavelength associated with 150 eV electron.

    b) Why does k (azimuthal number or sub-quantum number) only have integral values, less than or equal to principal quantum number (n)? [(2+1)+2]

14. a) Write ground state term symbols for some selected (configurations)atoms and ions

    (i) Nitrogen, $p^3$ (ii) $d^2$ – States ($V^{3+}$).

    b) Calculate the screening constant and effective nuclear charge for the valency electron of selenium (Atomic number of bromine is 35) [(1.5+1.5)+2]

15. a) Explain why cations are smaller and anions larger in radii than their parent atoms?

    b) Consider the following species: $N^{3-}$, $O^{2-}$, $F^-$, $Na^+$, $Mg^{2+}$, $Al^{3+}$

    i) What is common in them?

    ii) Arrange them in order of increasing ionic radii. [3+(1+1)]

16. a) How would you explain the fact that the first ionization enthalpy of sodium is lower than that of magnesium but its second ionization enthalpy is higher than that of magnesium?

    b) Explain the following:

    i) Electronegativity of elements increase on moving from left to right in the periodic table.

    ii) Ionisation enthalpy decrease in a group from top to bottom? (3+2)

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