RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

FIRST YEAR [2018-21]

B.A./B.Sc. FIRST SEMESTER (July – December) 2018

Mid-Semester Examination, September 2018

Date : 24/09/2018 **CHEMISTRY (Honours)**

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

[Use a separate Answer Book for each group]

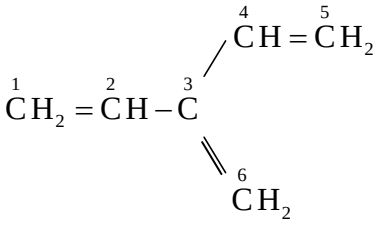
Group – A

[***Answer two questions***]

Unit - I [2×8]

1. a) Draw the orbital picture for $CH_3CH=CH-CN$ (trans) [2]

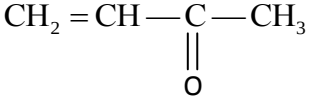
   b) Give all the possible canonical forms of the following compound and also predict the relative double bond character of the three double bonds $(C_1-C_2, C_4-C_5, C_3-C_6)$ [3]



   c) Compare the C=O bond distance in CH_3COCH_3 and CH_3CO_2H. [1]

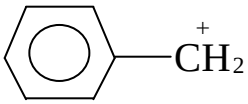
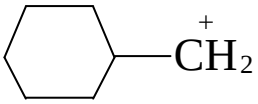
   d) What is meant by DBE ? Calculate DBE for the compound with molecular formula C_4H_8ONCl [2]

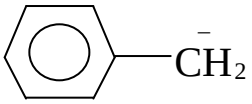
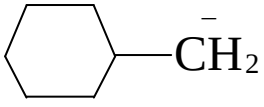
OR

2. a) Show the orbital picture of the enone  and mention the hybridisation state of each carbon atom. [2]

   b) Draw the all possible π molecular orbitals for 1,3 – butadiene and also indicate HOMO. [3]

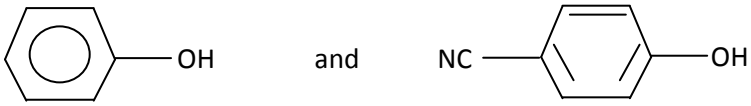
   c) Which species of the following pairs is more stable and why ?

   i)  and 

   ii)  and 

   [2]

   d) Which of the following molecule has higher dipole moment and why ? [1]

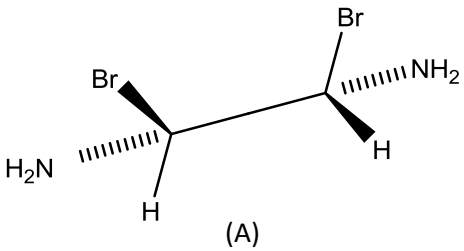


Unit - II

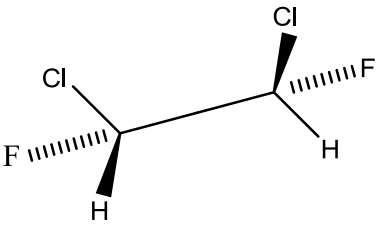
3. a) Draw the Fischer Projection formule of (2S,3S) – 3- bromo-2-butanol and represent it in Newman projection formula. [2]

   b) Justify or Criticise : Meso tartaric acid is optically inactive due to presence of σ. [2]

   c) Determine whether each of the following molecules is chiral or achiral. [2]



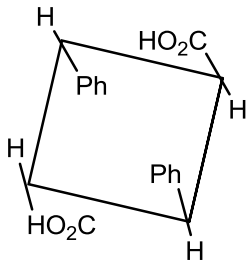
(A)



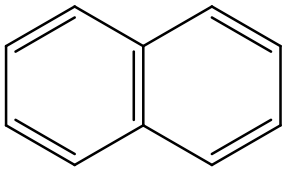
(B)

   d) Indicate the Symmetry elements present in the following compounds: [2]

i)



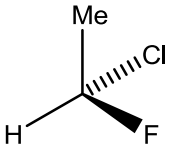
ii)



OR

4. a) Label the following molecules as homomers, enantiomers or diastereomers. [2]

i)



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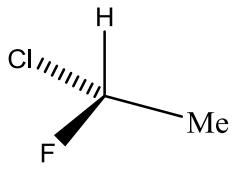

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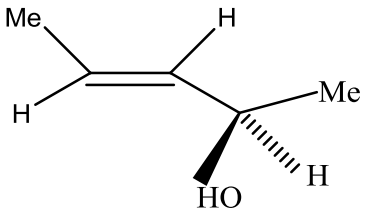

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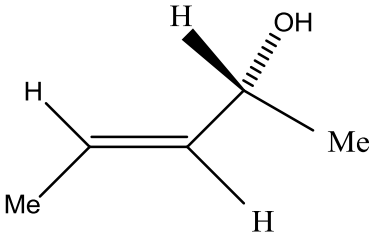
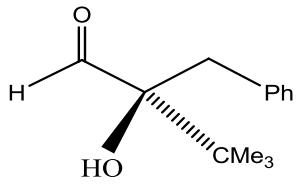
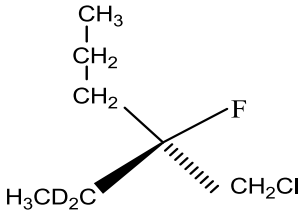


b) Give R/S designation at the chiral centres of the following compounds showing the priority sequence order. [4×1.5]

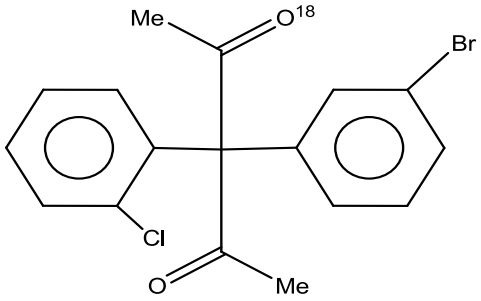
(i)



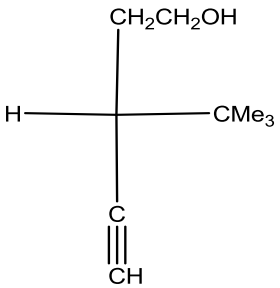
(ii)



(iii)



(iv)



Group – B

[***Answer two questions***]

Unit - III

[2×8]

5. a) Consider a gas molecule AB_2, which can be either linear or nonlinear. How can you conclude about the geometry of the molecule from the kinetic theory approach? Also state the principle, used to analyse this. [3+2]

   b) Calculate the mean speed and the root mean square speed for the following set of molecules. 10 molecules moving at 5×10^2 mS^{-1}, 20 molecules moving 10×10^2 mS^{-1} and 5 molecules moving with 15×10^2 mS^{-1}. [3]

OR

6. a) Assume same no. of CO and N_2 molecules in two different containers of same volume. Compare the 3D speed distribution curves (no. of molecules vs speed) in the same speed distribution plot w.r.t. the most probable speed and area under the curve. Explain the equation also. [3+2]

   b) Justify the Dalton's law of partial pressure from kinetic theory of gas. [3]

Unit – IV

[8 marks]

7. A gas is made to undergo the following isothermal changes in state—
   i) (P_i, V_i) to (P_f, V_f) in infinite number of steps (isothermally)
   ii) (P_f, V_f) to (P_i, V_i) in infinite number of steps (isothermally)

   a) Show graphically the amount of work done in both case (i) and (ii). [2]

   b) Calculate the net work done, internal energy and heat withdrawn by the system for the overall process. [3]

   c) Which of the above quantities would change if the expansion and compression were carried out infinite number of steps? [3]

OR

8. a) Starting with the mathematical definition of the First Law of thermodynamics show that:
   (i) The energy of the universe is constant.
   (ii) Work done is independent of path under adiabatic condition. [2+2]

b) One mole of an ideal gas with molar $C_v = (3/2)R$, intially at 293K and 1.0 MPa pressure undergoes a two stage transformation.

(i) Stage I : Isothermal, reversible expansion to double the initial volume.

(ii) Stage II: Beginning at the final state of Stage I, keeping the volume constant, the temperature is raised to 353 K.

For each stage I, II and for the overall change calculate Q, W, ΔU and ΔH. [4×1]

Group – C

[***Answer two questions***]

Unit – V

[2×9]

9. a) Distinguish between electron affinity and electronegativity. [2]

b) Write down Slater's rules and its limitations. The F-F distance is 1.43 $\overset{o}{A}$, using Slater's rule, calculate the electronegativity of fluorine. [$1\frac{1}{2}+1\frac{1}{2}$]

c) What is inert pair effect ? $PbCl_4$ is unstable but PbF_4 is stable, explain with reason. [2+2]

OR

10. a) Separation of Zr and Hf is very difficult task , explain. [2]

b) Explain the advantages of Mulliken scale of electronegativity over Pauling's scale. [2]

c) Rationalize the trends in the specific atomic properties in the following atoms. [3]

	C	N	O
First electron affinity (eV) :	1.263	-0.070	1.461

d) Sodium bismuthate is a strong oxidising agent ; Explain in terms of inert pair effect. [2]

Unit – VI

[9 marks]

11. a) Applying Bohr atomic model, calculate the ratio of velocities of an electron at first and second Bohr orbits of He^+ ion. [2]

b) Calculate the minimum uncertainty in locating

(i) A 1-g mass moving with a speed of 1.5 ms^{-1}

(ii) An electron moving with a speed of 2.2×10^6 ms^{-1}. In each case the uncertainty $\Delta p = p \times 0.1\%$. Comment on the results obtained in the two cases.

[Mass of an electron = 9.1×10^{-31} kg, h = 6.624×10^{-34} Js] [3]

c) Establish Bohr's assumption of quantized angular momentum from de Broglie's hypothesis. [2]

d) Explain why s orbits are spherical but P orbits aren't. [2]

OR

12. a) Plot the probability vs r for the following radial wave function for H atom. Show how many nodes are there, identify the actual orbital this radial wave function represent. [3]

$$R(r) = \frac{4}{81\sqrt{30}}\left(\frac{1}{a_0}\right)^{\frac{3}{2}}\left(\frac{r}{a_0}\right)^2 e^{-\frac{r}{3a_0}}$$

b) What is the meaning of nodes in a wave function? Do the signs on the two sides of a node make any difference in the electronic charge distribution? [1+1]

c) Calculate the longest wavelength of light needed to remove an electron from the third orbit of H atom. [3]

d) State the significance of azimuthal (l) and magnetic (m_l) quantum number. [1]

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