B.Sc. First Semester Examination (ESE)-2024

(CCFUP : NEP)

[4 Years UG Programme]

CHEMISTRY

PAPER: UG/I/CHEM/4/MJ-IT

[Basic Chemistry - I]

Full Marks: 40 ***Time: 02 Hrs.***

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Group A

Answer any four questions of the following: 4x2= 8

1. State Hund's rule and find out the most stable electronic configuration of Cr – atom.
2. Explain the sequence of ionization energies KJ/mol: Cu(746), Zn(906), and Ga(579).
3. Calculate the Aldred-Rochow electronegativity of Zn taking its covalent radius as 125 pm.
4. The atomic radii of Zr and Hf are almost same- Explain.
5. Why Ga is smaller in size than Al?
6. Find out the 'Ground state term' for a free ion with $3d^7$ configuration.

7. Why electron affinity of fluorine is less than of chlorine?
8. Ionization potential and Electron affinity are inherent properties of an atom, where as electronegetivity is not the inherent property of an atom, Explain.

Answer any one questions of the following **1x5= 5**

9. a) Calculate Z* for the following electron in a Scandium atom

   (i) 3p (ii) 3d

   b) What is Aufbau principle? Explain any two of its exceptions with respect to the electron filling in Lanthanoids. 2+3

10. a) $PbCl_4$ is very unstable where as $SnCl_4$ is stable - Explain

    b) Calculate the principle quantum number where the electron is revolving in a H-atom when the kinetic energy is 217.945×10^{-20} J.

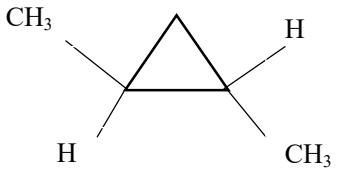
    [Given E for H= -871.78×10^{-20} J] 3+2

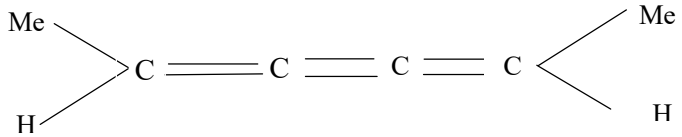
Group B

Answer any four questions of the following: **4x2=8**

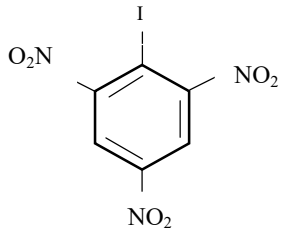
1. Compare the dipole moment of $CH_3CH_2-Cl, CH_2=CH-Cl, H-C\equiv C-Cl$

2. Comment on the chirality of the following compound

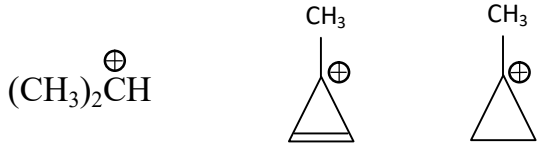




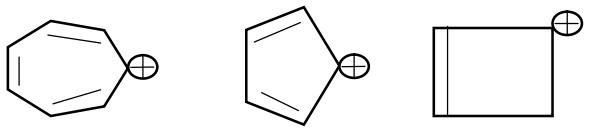
3. Compare the bond length a/b of the following structure



4. Arrange the following ions in order of increasing stability. Give reason.



5. Classify the following molecules as aromatic, anti aromatic and homo aromatic with reason (any two)



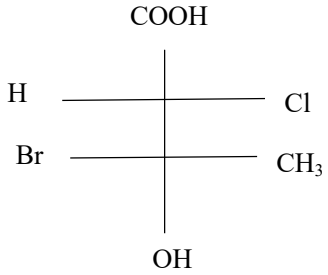
6. Allyl cation is more stable than a secondary carbocation. Explain the observation on the basis of resonance.

7. Draw the Π-MO diagram of allyl radical. Indicate the HOMO and LUMO in the diagram.

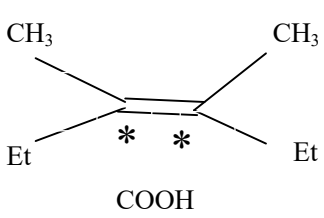
8. Write a short note on racemisation.

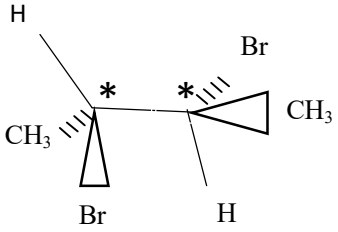
Answer any one question of the following **1x6= 6**

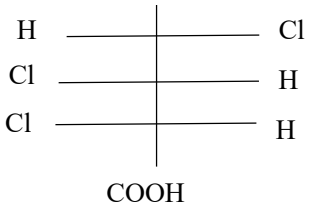
9. a) Convert the given Fischer projection into Newman and corresponding sawhorse projection formula. (Only staggered conformation)

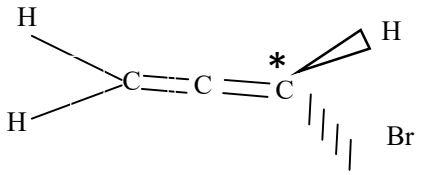


b) Designate Marked (*) centres of the following compound as stereogenic / Non-stereogenic, chirotopic/achirotopic. Give reason. 2+4









10. a) The m.p of a dicarbeoylic acid having even number of carbon atom is always higher than that of acids having odd number of carbon atoms lying immediately below or above the series. Justify and comments.

b) Calculate the specific rotation of an optically active compound in solution containing 0.75g/10ml, when measured inb a 1dm tube of a polarimeter at 25^0C shows a rotation $+1.2^0$.

3+3

Group C

Answer any four question of the following: 4x2 = 8

1. Identify the extensive and intensive properties from among the following.

Free energy, molar enthalphy, heat capacity and temperature.

2. Derive the integrated form of kirchoff's equation to show the variation of ΔH^0 of a reaction with temperature.

3. Prove thermodynamically that $C_P > C_V$.

4. State the Zeroth low of Thermodynamic.

5. Show for an ideal gas $Cp - Cv = R$.

6. For a zero order reaction plot the variation of concentration of reactants and products with time.

7. Calculate the ratio of $t_{3/4}$ and $t_{1/2}$ for a first order reaction.

8. Write the rate equation for the reaction $2A + B \rightarrow C + D$ if the reaction is first order in A and also first order in B.

Answer any one questions of the following **1x5= 5**

9. a) How does the time required for first order reaction to go to 99% completion relate to the half-life of the reaction?

b) For the equation

$$C_p - C_V = \left[P + \left(\frac{\partial u}{\partial v} \right)_T \right] \left(\frac{\partial v}{\partial T} \right)_P$$

Show that for a gas obeying the equation of state $P(v-b) = nRT$, Cp exceeds Cv by the Quanting nR. 3+2

10. a) 2 litres of CO_2 (behaving ideally) at 0^0C temperature and 5 atm pressure are expanded isothermally until the pressure is 1 atmosphere. Calculate w,q, ΔU and ΔH. Also find out the values if the process were adiabatic ($\gamma = 1.3$).

b) On doubling the initial concentration of the reactant the half life period of the reaction is doubled. What is the order of the reaction? 3+2
