2024

CHEMISTRY

(Honours)

B.Sc. First Semester End Examination - 2024

PAPER - MJ-101T

[Use seperate answer script for Unit-I, Unit-II and Unit-III]

Full Marks : 40 *Time : 2 hours*

The figures in the right-hand margin indicate marks.
Candidates are required to give their answers in their own words as far as practicable.
Illustrate the answers wherever necessary.

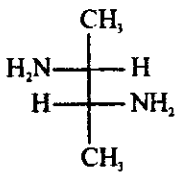
(Organic)

Unit-I

Group - A

Answer any two questions. **2×2=4**

1. Label the following pairs of molcule as homomers, enatimors and disastereoisomers. Justify your answer.



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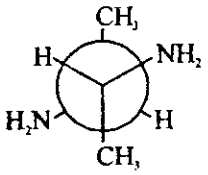

2. Calculate double bond equivalent of the following compounds.
   (i) $C_{12}H_{16}N_2O_4$ (ii) $C_{24}H_{18}F_2N_2O_5$

3. Define centre of inversion with an example.

Group-B

Answer any two questions : 5×2=10

4. (a) Determine the symmetry elements and assign the point of group of the follwing elements (any two)

   (I) HCN, (II) NH_3 (III) trans-CHCl=CHCl

   (b) Arrange the following carbocations in order of increasing stability and explain.

I II III

3+2

5. (a) Draw the π-molecular orbital diagram for 1,3,5-hexatraine according to their enerty levels in ascending order. Identify HOMO and LUMO in ground state.

   (b) Write down the Fischer projection formula of Erytho-2,3-butandiol and draw its most stable conformer in

Newman projection formula. 3+2

6. (a) Both meso-tartaric acid and recemic-tartaric acid are optically inactive. State reason for the optical inactivity in each case.

   (b) The <H-C-H bond angle in methane is 109°28' but <F-C-F bond angle in difluoromethane is much smaller. Explain. 3+2

7. (a) Draw the orbital picture for the following compound indicating the state of hybridization in each carbon and oxygen atom : CH_3–CH=C=O

   (b) What do you mean by stereogenic centre? Are centres of stereonicity always centres of chirality? Explain with suitable examples. 3+2

(Inorganic)

Unit-2

Group-A

Answer any two of the following questions. **1½×2=3**

8. Describe two limitation of Bohr theory of atom.

9. What are normalized and orthogonal wave functions?

10. The sixe of an anion is larger than its parent atom. Explain

Group - B

Answer any two of the following questions. 5×2=10

11. (a) Give Staler rules for calculating shielding constant for Z effective.

    (b) Calculate effective nuclear charge for an electron in ^{19}K.

    (c) Write the ground state electronic configuration of Cr^{3+} (Z=24) and I (Z=53) 2+2+1

12. (a) Discuss the significance of ψ and ψ^2.

    (b) What do you understand by Hund's rule of maximum multiplicity? Discuss this rule by taking two examples.

    2+3

13. (a) Ground state electronic configuration of 'Cr' ia $3d^54s^1$, not $3d^44s^2$. Justify with proper reason.

    (b) Defind electronegativity.

    (c) Which element has smaller size, O or F? Explain with reason. 2+1+2

14. (a) Find the values of n, l, m and s of an electron if 4f orbital of an atom.

    (b) What is inert pair effect? Explain that the rate of tharmac decomposition of $PbCl_4$ is relatively higher than that of $SnCl_4$. 2+(1+2)

Unit-3

Group-A

Answer any two from the following : **1½×2=3**

15. Show that isothermal reversible work is greater than isothermal irrevesible gas.

16. Laws of thermochemistry are the consequence of first law of thermodynaics. Explain.

17. Does a zero-order reaction complete – Justify or criticize.

(Group-B)

Answer any two from the following : **5×2=10**

18. (a) Two moles of an idal monatomic gas initially at 100°C and 5 atm pressure expands adiabatically and reversible at 2 atm pressure. Calculate the (i) work done by the gas (ii) final molar volume, and change in enthalpy.

(b) For the reaction, $H_2O(g) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$; ΔH^0=242 kJ mol at 290 K. Find ΔH^0 at 310 K. Assume that, oever the temperature range C_p values are effectively constant are given by $C_p(H_2O, g)$=35.5; $C_p(H_2g)$=28.8; and $C_p(O_2,g)$=29.1, all are in units of J K^{-1} mol^{-1}.

3+2=5

19. (a) For the reaction, $2NO+Cl_2 \rightarrow 2NOCl$, it was found that on doubling the conc. of both reactants, the rate increases by eight-fold. But on doubling the conc. of Cl_2 alone, the rate only doubles. What is the order of the reaction with respect of NO and Cl_2?

(b) The specific rate constant (k) for a reaction depends on T as $k=B\sqrt{T}\ 10^{-C/T}$. Express the energy of activation in terms of C.

$2+2\frac{1}{2}=5$

(Continued)

20. (a) For every proecess is an isolates system, $\Delta U=0$, Justify or criticize the statement.

(b) Calculate the heat of formation of ethanol at 25°C from the given ΔH values at this temperature for the following processes :

(i) $C_2H_5OH(l)+3O_2(g)=2CO_2(g)+3H_2O(l)$; $\Delta H=-327.0$ Kcal

(ii) $C(s) + O_2 = CO_2(g)$; $\Delta H = -94.0$ Kcal

(iii) $H_2(g) + \frac{1}{2}O_2(g) = H_2O(l)$; $\Delta H=-68.4$ Kcal 2+3=5

21. (a) While it is expected that a larger amount of subtance would take a longer time to decompse, the dependence of half-life on the initial conc. does not indicate so, in general. Explain.

(b) The decomposition of agas at an initial pressure of 600 mm Hg was studied in a closed vessel at a certain temperature. The gas is found to be 50% decomposed in 30 min and 75% decomposed in 90 min. Nhow that the reaction is 2nd order and calculate the rate constant (clearly stating unit) (1+2)=3