

Separate answer booklet to be used
for each **Module**.

2026

CHEMISTRY — HONOURS

Paper : DSCC-14

(Fundamentals of Chemistry - III)

Full Marks : 75

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Module - I

(Chemistry of Biomolecules)

Answer **any five** questions.

- (a) The mutarotation of D-glucose in an aprotic solvent doesnot occur in presence of pyridine or cresol alone, but takes place when both pyridine and cresol are present together. Explain the observation with mechanism.

(b) Give the structures of C-3 epimer and C-4 epimer of D-glucose. 3+2
- (a) How can you determine the N-terminal residue of a peptide following Edman's degradation method? What advantage does this method offer over Sanger's method?

(b) Write the structure of BOC derivative of alanine. Mention any one reagent for its deprotection. 3+2
- (a) Predict the product(s) of the following reaction indicating the mechanistic pathway.

$$\alpha\text{-D-glucose} \xrightarrow[\text{heat}]{\text{aq. NaOH}} ?$$

(b) What happens when α -D-glucopyranose is treated with methanol and HCl? Is the product a reducing / non-reducing sugar? Explain. 3+2
- (a) Using solid phase peptide synthesis, prepare the dipeptide Ala-Gly.

(b) Write down the structures of the nucleosides of —

 - Deoxyribose with cytosine.
 - Ribose with guanine. 3+2
- (a) Write a brief account on the double helical structure of DNA proposed by Watson and Crick.

(b) Write down the reaction of proline with ninhydrin. 3+2

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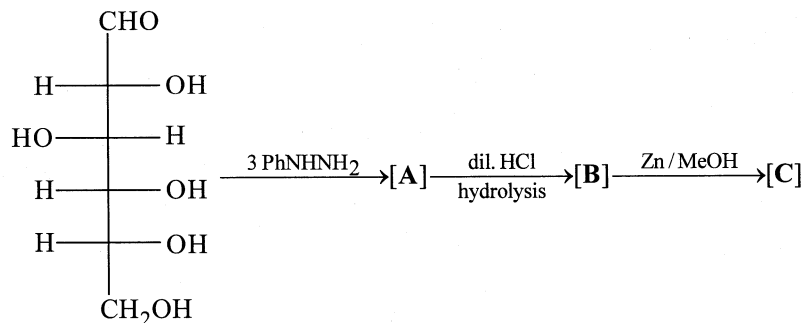
6. (a) Carry out following conversions :

(i) D-Arabinose $\rightarrow$ D-Glucose

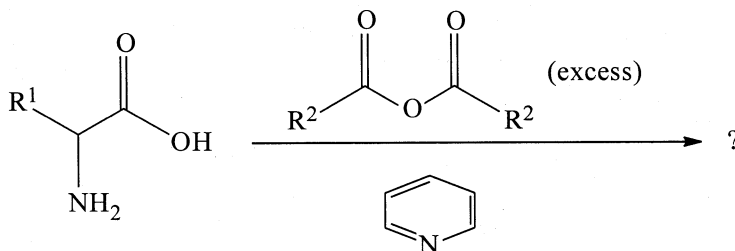
(ii) D-Arabinose $\rightarrow$ D-Erythrose.

(b) Identify [A], [B] and [C] in the following sequence of reactions :

3+2



7. (a) Predict the product in the following reaction with suitable mechanism :



(b) In an electric field, towards which electrode would an amino acid migrate at a

(i) $\text{pH} < \text{pI}$ (ii) $\text{pH} > \text{pI}$? Explain.

3+2

Module - II

(Statistical Thermodynamics)

Answer *any five* questions.

8. Derive Boltzmann distribution law

q = molecular partition function

ϵ_i = energy of i -th level.

$$\frac{N_i}{N} = \frac{e^{-\beta \epsilon_i}}{q}$$

N_i = number of molecules in the i -th level

N = total number of molecules

β = constant.

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9. (a) For a two-level system with energy gap ' ϵ ', write down the molecular partition function.

(b) (i) What will be the expression for the population of the two levels?

(ii) What will be the values of the populations for $T \rightarrow 0$ and $T \rightarrow \infty$?

1+(2+2)

10. (a) What do you understand by ensemble?
 (b) State the criteria of the following ensembles :
 (i) Micro-canonical (ii) Canonical (iii) Grand-canonical. 2+3
11. (a) Show that the internal energy of a system containing 'N' non-interacting particles can be expressed in terms of its molecular partition function q :

$$U = NkT^2 \left[\frac{\partial \ln q}{\partial T} \right]_{N,V}$$

The terms have their usual significance.

- (b) Derive the expression for Helmholtz free energy (A) in terms of molecular partition function. 3+2
12. (a) What do you understand by Gibbs paradox?
 (b) State and explain Nernst heat theorem. 2+3
13. (a) List the two main requirements for a paramagnetic salt to be effective in reaching $T \rightarrow 0$, via adiabatic demagnetization.
 (b) Explain with S - T diagram, the principle of cooling by adiabatic demagnetization of paramagnetic substances. 2+3
14. (a) Discuss the postulates of Einstein's theory of specific heat of solids.
 (b) Draw the experimental plot of C_V of solids vs T and hence, explain why Einstein's model fails at low temperature. 2+3

Module - III

(Silicate Materials of Industrial Importance)

Answer *any five* questions.

15. (a) What are ceramics? Distinguish between traditional and high technology ceramics.
 (b) What is RDX? Mention its chemical name. 3+2
16. (a) Discuss the chemical changes that occur during the setting of cement.
 (b) What is annealing of glass? 3+2
17. (a) Distinguish between coloured glass and photochromatic glass. Which specific metal oxide is used to give green colour to glass?
 (b) What is rocket propellant? Mention the types of rocket propellant. 3+2
18. (a) What is glazing? Mention the steps involved in the production of glazed porcelain.
 (b) What is the function of gypsum in cement? 3+2

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19. (a) What is PETN? How is it prepared?
(b) Differentiate clay with feldspar. 3+2
20. (a) What is borosilicate glass? Mention its properties.
(b) What are superconducting oxides? Give an example. 3+2
21. (a) What is quick setting cement? Mention the key components.
(b) What is soda-lime glass? Mention any one of its properties. 3+2
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