II.10 Biopolymers

Civil Services 2016–2026: **14** parts, **155** marks · IFoS 2016–2025: **16** parts, **90** marks

Syllabus. Basic properties of proteins and nucleic acids: amino acids, peptide bond, primary, secondary and tertiary structure of proteins; nucleosides, nucleotides, DNA and RNA (asked in both papers though listed only in the IFoS syllabus).

Marks	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
CSE	10	10	20	10	15	15	25	15	10	15	10
IFoS	15	15	0	5	0	15	15	10	5	10	

How to use this chapter. Read every question once and mark the ones that repeat. Pick three, write them by hand against the clock (about 7 minutes for 10 marks), then compare with the model answers on vkcscience.com.

2026

CSE 2026 · Q5(a) Proteins as dynamic molecules: haemoglobin [10 marks]

Proteins are dynamic molecules rather than static structures. Explain this phenomenon using hemoglobin as an example.

2025

CSE 2025 · Q1(e) Permanent and temporary denaturation of a protein [10 marks]

With example, elucidate the permanent and temporary denaturation of a protein.

CSE 2025 · Q4(b)(iii) Salient features of the α-helix [5 marks]

(iii) What are the salient features of alpha helix in regards to handedness, residues per turn and elongation per residue? What are the principal stabilizing factors for an alpha helix? [5]

IFoS 2025 · Q5(a) Edman degradation [5 marks]

Derive the structure of the monomeric product that is identifiable by HPLC in Edman degradation of a peptide.

IFoS 2025 · Q5(b) Complementary base pairs in RNA [5 marks]

Write the complementary base pairs in RNA and show their H-bondings by drawing the structure of the bases.

2024

CSE 2024 · Q5(a) Bases of DNA and RNA; stability of DNA and RNA [10 marks]

Write the structures of the bases present in DNA and RNA. Compare the stability of DNA and RNA.

IFoS 2024 · Q5(d) Geometry of a peptide bond [5 marks]

Draw the structure of a peptide bond giving the values of bond angles and bond lengths.

2023

CSE 2023 · Q7(a) 2′-Deoxycytidine-3′-monophosphate; acidity; duplex stability; G≡C pairing [15 marks]

(i) Draw the structure of 2′-deoxycytidine-3′-monophosphate.
(ii) Why nucleotides and nucleic acids are acidic? Mention the factor(s) that stabilize the DNA duplex.
(iii) Show the hydrogen bonding in between cytosine and guanine base pair.

IFoS 2023 · Q5(h) Complementary DNA base pairs [5 marks]

Write the structure of the complementary base pairs of DNA and show their bonding interactions.

IFoS 2023 · Q7(f) Sanger determination of the N terminus [5 marks]

Give the mechanism for detection of N-terminal amino acid in a protein with Sanger's reagent.

2022

CSE 2022 · Q5(a) Nucleosides, nucleotides and the primary structure of DNA and RNA [10 marks]

Write the structures of nucleosides and nucleotides, and discuss the primary structures of DNA and RNA.

CSE 2022 · Q7(a) Secondary structures of proteins compared with tertiary structure [15 marks]

Discuss the different types of secondary structures of proteins and compare these structures with tertiary structure of proteins.

IFoS 2022 · Q5(a) Hydrophobic effect in biomolecules [5 marks]

What are hydrophobic attractions? How do such attractions alter the conformation of proteins and nucleic acids?

IFoS 2022 · Q5(c) Complementary DNA and RNA sequence [5 marks]

In a strand of DNA, a sequence 5′-CGCATC-3′ is found. Suggest sequence of its complementary strand and also predict the sequence of RNA strand synthesized from the above complementary strand.

IFoS 2022 · Q6(c) Hydrogen bonds in protein secondary structure [5 marks]

Hydrogen bonding plays an important role in explaining the structure of biomolecules. Can you predict, which type of hydrogen bonding is responsible for the formation of α-helix and β-pleated sheets of proteins? If yes, draw the structures and represent hydrogen bonds.

2021

CSE 2021 · Q6(b) Interactions that stabilise a protein, with the residues involved [15 marks]

Show salt bridge, hydrogen bond, van der Waals' interaction and disulfide bridge for stabilization of protein by choosing appropriate amino acid residues in the protein chain.

IFoS 2021 · Q4(d)(ii) Nucleoside and nucleotide structures [5 marks]

(ii) Draw the structure of a nucleoside and nucleotide clearly by drawing the structure of each individual component. 5

IFoS 2021 · Q5(b) DNA bases and pairing [5 marks]

Write the structure of the four bases of DNA and show the H-bonding between the base pairs.

IFoS 2021 · Q6(b)(i) Tertiary protein structure [5 marks]

(i) Write the role of various bonding and non-bonding interactions present in tertiary structure of proteins. 5

2020

CSE 2020 · Q7(b) Length of an α-helix and of B-DNA; effect of denaturation [15 marks]

Compare the length of an α-helix that contains 74 amino acids with that of a B-DNA having same number of base pairs. Also mention if the lengths of these biopolymers increase or decrease on denaturation.

2019

CSE 2019 · Q5(a) DNA bases and Watson–Crick pairing [10 marks]

Write the structure of purine and pyrimidine bases present in DNA and show their pairing.

IFoS 2019 · Q5(b) Structural and functional differences between DNA and RNA [5 marks]

Write the important structural and functional differences between DNA and RNA.

2018

CSE 2018 · Q2(b) Secondary structure of proteins: α-helix and β-pleated sheet [10 marks]

What do you mean by secondary structure of proteins? Explain α-helix and β-pleated sheet structures of proteins.

CSE 2018 · Q5(e) DNA and RNA: nucleotides, location, functions [10 marks]

Distinguish between DNA and RNA with regard to their nucleotide structures, location in the cells and functions.

2017

CSE 2017 · Q6(e) Nucleosides, nucleotides; primary structure of DNA and RNA [10 marks]

Give the structures of nucleosides and nucleotides and discuss the primary structures of DNA and RNA.

IFoS 2017 · Q5(c) Purines and pyrimidines of RNA and DNA [5 marks]

Write the names and draw the structures of two purins and three pyrimidines that occur in RNA and/or DNA.

IFoS 2017 · Q6(c) Peptide bond; peptide, oligopeptide and protein [10 marks]

What is a peptide bond? What is the difference between a peptide, oligopeptide and protein?

2016

CSE 2016 · Q6(d) Forces that hold the DNA double helix [10 marks]

Discuss the forces responsible for the stability of double helical structure of DNA.

IFoS 2016 · Q5(b) Products of complete hydrolysis of DNA [5 marks]

Name the products obtained on complete hydrolysis of DNA and give their structures.

IFoS 2016 · Q6(d) Oligopeptide, polypeptide; secondary structure of proteins [10 marks]

What is an oligopeptide ? How is it different from a polypeptide ? What is the secondary structure of protein ?