

2.1 Proteins and protein structure

Name: _____ Class: _____ Date: _____

Total: 23 marks

KEY WORDS haemoglobin

Objective

Relate protein structure levels to function and compute oxygen capacity from first principles.

1 Key knowledge and worked examples

■ The four levels

Primary sequence → secondary helix/sheet → tertiary fold → quaternary assembly.
Haemoglobin: $\alpha_2\beta_2$, 64.5 kDa, 4 O₂; sigmoid binding from cooperativity (Hill $n_H \approx 2.8$).

■ Worked example: capacity from scratch

15 g Hb/dL ÷ 64 500 g/mol × 4 sites $\approx$ 930 μ mol O₂/dL $\approx$ 20.8 mL/dL ✓.

2 Practice

2.1 Order the four structure levels and name the bonds/forces dominant at each. [3]

2.2 Why does myoglobin bind O₂ hyperbolically but haemoglobin sigmoidally? [3]

2.3 A mutation swaps a surface glutamate for aspartate. Predict the structural impact and justify. [3]

3 Exam-style questions

3.1 Hb has 4 O₂ sites; p50 in tissues shifts with 2,3-BPG.

Explain the T $\leftrightarrow$ R transition and why binding is cooperative. Compute the O₂ content of blood (15 g/dL Hb) in mL/dL. State what happens to that number in anaemia (Hb 7.5 g/dL) and the compensatory mechanism. [7]

3.2 (Fictional) HbS: Glu6Val on the β chain.

Explain how a single primary-structure change produces sickling at the quaternary level. State the trigger state (oxy/deoxy) and why. Predict the effect on oxygen capacity per molecule and on blood viscosity. [7]