



Proteins: practice questions

8 questions • 24 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 24

1 PAPER 1A STYLE [1 mark]

Between which groups does a peptide bond form when two amino acids are joined?

- A. ☐ The R-group of one amino acid and the R-group of the other
- B. ☐ The carboxyl group of one amino acid and the amine group of the other
- C. ☐ The amine groups of both amino acids
- D. ☐ The alpha carbon of one amino acid and the hydrogen of the other

2 PAPER 1A STYLE [1 mark]

How many different tripeptides could be made from the 20 amino acids coded for in the genetic code?

- A. ☐ 60
- B. ☐ 400
- C. ☐ 1140
- D. ☐ 8000

3 PAPER 1A STYLE [1 mark]

HL only

Which bond holds an alpha helix in shape?

- A. ☐ Disulfide bonds between pairs of cysteines
- B. ☐ Ionic bonds between charged R-groups
- C. ☐ Hydrogen bonds between C=O and N-H groups of the polypeptide backbone
- D. ☐ Hydrophobic interactions between non-polar R-groups

4 PAPER 1A STYLE [1 mark]

HL only

Which protein is conjugated?

- A. ☐ Collagen
- B. ☐ Insulin
- C. ☐ Haemoglobin
- D. ☐ A single alpha helix

Samples of an enzyme from a mammal were kept at different temperatures for 10 minutes, then cooled to 37 °C. The activity of each sample was then measured at 37 °C and given as a percentage of the activity of an unheated sample. The data are for practice. (a) Describe the effect of pre-incubation temperature on enzyme activity. [2] (b) Calculate the percentage decrease in activity between 50 °C and 60 °C. [1] (c) Explain why the activity of the samples kept at 70 °C and 80 °C did not recover when cooled. [2] (d) Suggest why activity was measured at 37 °C for every sample. [1]

Activity after 10 minutes at each temperature (practice data)	
Pre-incubation temperature / °C	Activity / % of unheated sample
20	100
40	98
50	80
60	35
70	6
80	0

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Distinguish between essential and non-essential amino acids and outline why people following a vegan diet need to pay attention to protein sources.

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PAPER 2A STYLE

HL only

[illegible]

PAPER 2B STYLE

HL only

[illegible]

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B [1]

2. [1]

D D [1]

3. [1] HL only

C C [1]

4. [1] HL only

C C [1]

5. [6]

- (a) little / no loss of activity up to 40 °C [1]
- (a) above 40 °C activity falls, steeply between 50 °C and 70 °C / no activity at 80 °C [1]
- (b) $(80 - 35) \div 80 \times 100 = 56 \%$ [1] Accept 56.25 %
- (c) the enzyme was denatured / its three-dimensional shape / active site changed [1]
- (c) hydrogen bonds / weak bonds broken by increased vibration; denaturation is (usually) permanent so cooling does not restore the shape [1]
- (d) so that any difference in activity is due only to the effect of the pre-incubation / irreversible change / to control temperature during the assay [1]

6. [3]

- essential amino acids cannot be synthesised by the body / must be obtained from food [1]
- non-essential amino acids can be made from other amino acids [1]
- some plant proteins contain little of certain essential amino acids [1]
- so vegans need a variety of plant protein sources / combine e.g. legumes and cereals [1]
- max 3

7. [4] HL only

- hydrogen bonds form between polar R-groups [1]
- ionic bonds form between positively charged ($-\text{NH}_3^+$) and negatively charged ($-\text{COO}^-$) R-groups [1]
- R-groups become charged by gaining / losing hydrogen ions [1]
- disulfide (covalent) bonds form between pairs of cysteines [1]
- hydrophobic / non-polar R-groups cluster together in the core, away from water [1]
- polar / charged R-groups on the surface keep the protein soluble [1]
- max 4

8. [7] HL only

- primary structure / amino acid sequence determines how each protein folds [1]
- insulin is a globular protein / compact rounded shape [1]
- insulin has two polypeptide chains linked by disulfide bonds / non-conjugated quaternary structure [1]
- hydrophilic R-groups on the surface make insulin soluble, so it is transported in blood plasma [1]
- precise shape binds a specific insulin receptor on target cells [1]
- binding triggers uptake of glucose by target cells / lowers blood glucose [1]
- collagen is a fibrous protein / long, narrow and insoluble [1]
- three polypeptides wound into a triple helix / non-conjugated quaternary structure [1]
- hydrogen bonds between the chains / every third amino acid is glycine, allowing tight packing [1]
- molecules cross-linked side by side into fibrils [1]
- high tensile strength, so it resists pulling forces in tendons / ligaments / skin [1]
- max 7