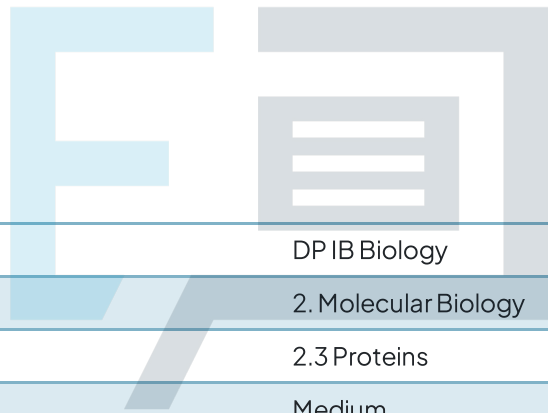




2.3 Proteins

Mark Schemes



Course	DP IB Biology
Section	2. Molecular Biology
Topic	2.3 Proteins
Difficulty	Medium

Exam Papers Practice

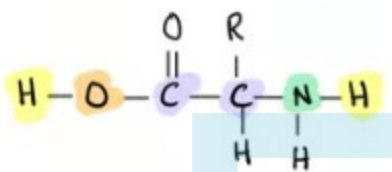
To be used by all students preparing for DP IB Biology HL
Students of other boards may also find this useful

1

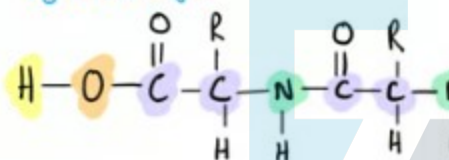
The correct answer is **B**.

Below is shown how the length of one amino acid is calculated from the data in the table:-

$$0.06 + 0.13 + 0.154 + 0.154 + 0.14 + 0.06 = 0.698 \text{ nm (0.70 nm approx.)}$$



So if we condense two of these together, we get



$$= 1.146 \text{ nm}$$

To make the maths easier without a calculator, we can say that during condensation, we have 'lost' 2 hydrogens and one oxygen.

Length of dipeptide =

$$2 \times \text{length of one amino acid} - (2 \text{ hydrogens} + 1 \text{ oxygen})$$

$$= 2 \times 0.7 - (2 \times 0.06 + 0.13)$$

$$= 1.4 - 0.25$$

$$= 1.15 \text{ nm}$$

$$= 1.2 \text{ nm (to 2sf) [1 mark]}$$

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2

The correct answer is **A** because this is a hydroxyl group. Hydroxyl groups are present in some R groups (e.g. in serine) but are never bonded directly to the central carbon.

The four groups that bond to the central carbon atom are: $-\text{NH}_2$, $-\text{COOH}$, $-\text{H}$ and the variable group $-\text{R}$.



3

The correct answer is **C** because polypeptides joining together e.g. α - and β -chains of haemoglobin, does not explain why the same 20 amino acid are used in all of life. The joining together of polypeptides could still happen with a different range of amino acids, were they to exist.

The reason why only 20 amino acids are used throughout all of life has been the subject of many differing hypotheses; **A**, **B** and **D** are all examples of these hypotheses.

4

The correct answer is **B** because, to be **soluble** in water, a polypeptide (or any molecule) must have amino acids with **polar side chains** on its surface that can **hydrogen bond** with water.

A is incorrect because very large (long) polypeptides are able to dissolve if they have polar amino acids on their surface.

C is incorrect because being insoluble makes fibrous polypeptides good for structural roles but being structural does not cause a polypeptide to be insoluble.

D is incorrect because the number of polypeptide chains in a protein does not affect its solubility.

5

The correct answer is **B**.

Haemoglobin does not feature in the correct answer because it is made up of four polypeptide chains.



6

The correct answer is **D**. The 'conformation' of a protein (for example) is its final 3-D shape, which ultimately determines the function of the protein.

The confirmation of a protein is determined by its amino acid sequence and its constituent polypeptides. Think of it as how the amino acids and constituent polypeptides 'form' themselves around each other (from the middle part of the word 'conformation').

7

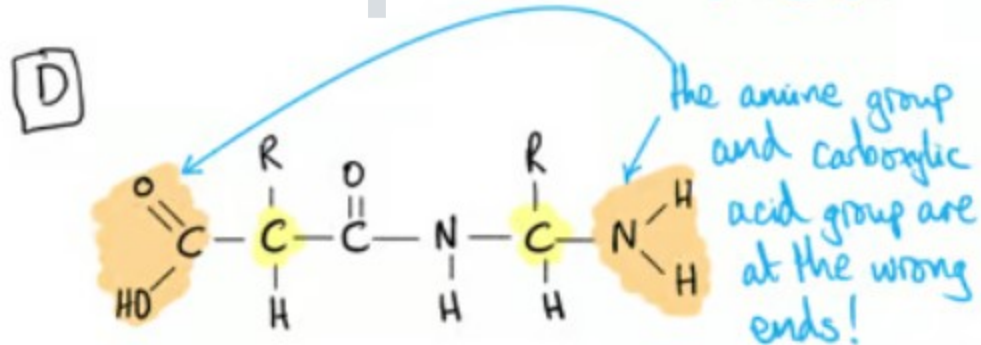
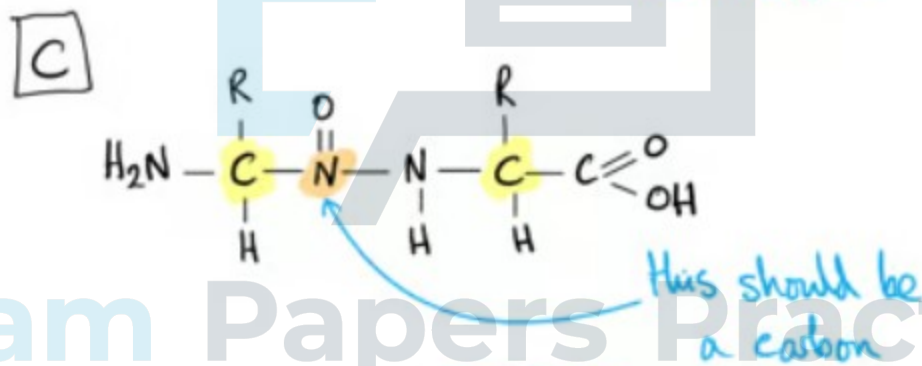
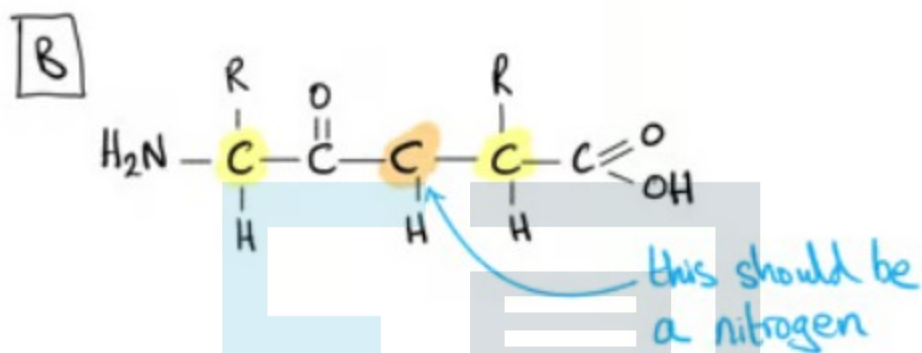
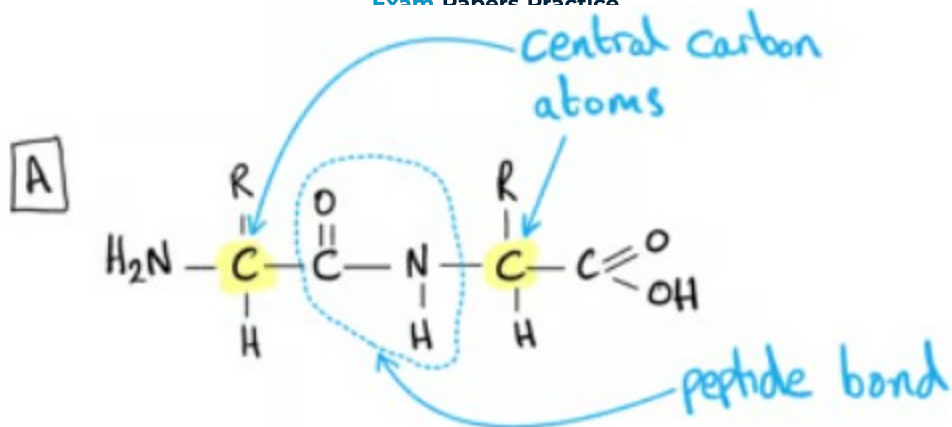
The correct answer is **D** because the proteins expressed can vary according to the needs of the individual at different stages of life. A proteome is all of the proteins produced by a cell, a tissue or an organism. Whereas the genome of an organism is fixed, the proteome is variable.

A is incorrect because not all genes in an organism's genome are expressed (i.e. translated into proteins) at the same time. For example, different cells in an organism make different proteins, so they have different proteomes. **B** is incorrect because every organism has a different proteome due to small differences in amino acid sequences. **C** is incorrect because any one gene can be expressed fully or partially in many different ways, and that gives rise to many different combinations of polypeptides.

8

The correct answer is **A**.

Identify the central carbon of each amino acid (highlighted below in yellow); this will allow you to spot errors (highlighted below in orange) in the surrounding atoms/bonds.

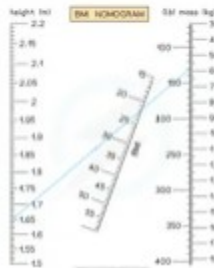


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9

The correct answer is **B**

Using a ruler, draw a line from 1.65 on the height axis to 130 (lbs) on the mass axis:



Step 1: read off the mass scale to convert 130 lbs into kg:

$$130 \text{ lbs} = 59 \text{ kg}$$

Step 2: apply the formula:

$$\text{Body Mass Index} = \frac{\text{Body mass (kg)}}{\text{Height}^2 \text{ (metres)}}$$

$$\text{BMI} = \frac{59}{1.65^2} = 21.7$$

Step 3: round to the nearest whole number:

$$\text{BMI} = 22$$



10

The correct answer is **C** because molecular visualisation software tends to produce static models. Many molecules change conformation when in aqueous solution (glucose is a good example). Most biological reactions take place in aqueous solution, so a 3-D model might not capture a molecule's shape *in vivo*.

A, **B** and **D** are all observable using molecular visualisation software and can be very informative in understanding molecular function in biology.



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