

Biological Molecules

Question Paper 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Biological Molecules
Sub Topic	
Booklet	Multiple Choice
Paper Type	Question Paper 1

Time Allowed : 60 minutes

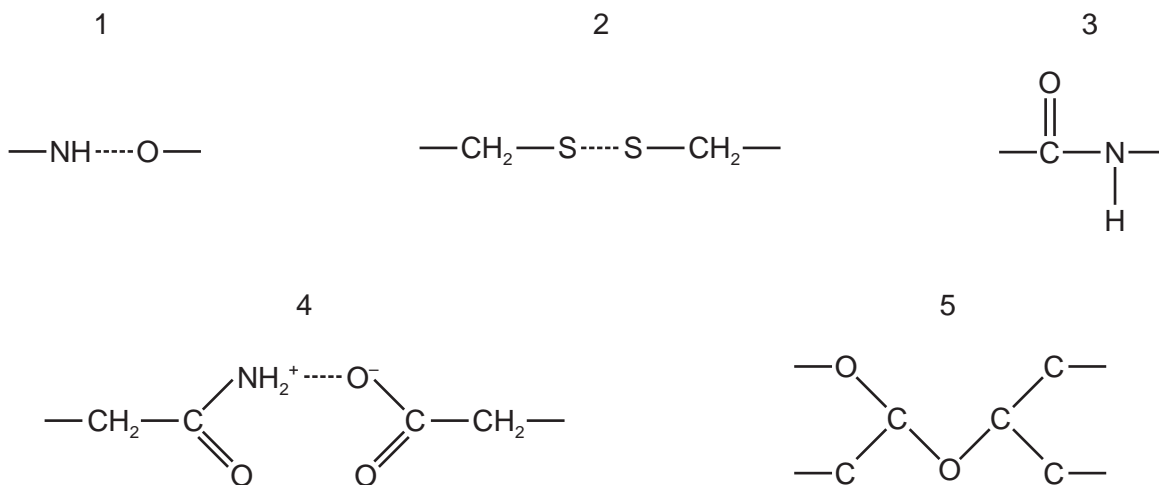
Score : / 50

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 The diagrams show different types of bond found in biological molecules.



Which combination of bonds could **not** be found in a protein with a tertiary structure?

- A** 1, 2, 3 and 4 **B** 1, 2 and 4 only **C** 3 and 5 **D** 5 only

2 Which description is correct?

- A** A collagen molecule has a high proportion of the amino acid glycine, which has a very small side chain.
- B** A group of three collagen fibres forms a strong, insoluble coiled structure termed a triple helix.
- C** Each of the collagen polypeptides in a collagen molecule has a regular spiral arrangement of many alpha helices.
- D** Peptide bonds are present between amino acids of the same polypeptide and between the different polypeptides forming the collagen molecule.

3 Polar molecules form hydrogen bonds with each other.

Which properties of water result from its molecules being polar?

- 1 good solvent
- 2 high specific heat capacity
- 3 high surface tension
- 4 cohesive

- A** 1, 2 and 3
- B** 1, 2 and 4
- C** 1, 2 and 4
- D** 3 and 4 only

- 4 Which type of bond holds together an α -helix or β -pleated sheet of a protein?
- A disulfide
 - B hydrogen
 - C ionic
 - D peptide

- 5 What describes only the quaternary structure of haemoglobin?

- 1 α -helix
- 2 a dipeptide
- 3 a globular structure
- 4 the specific order of amino acids
- 5 four polypeptide chains joined together

- A 1, 2 and 3 B 2, 4 and 5 C 1 and 4 D 5 only

- 6 The statements are about the properties of water.

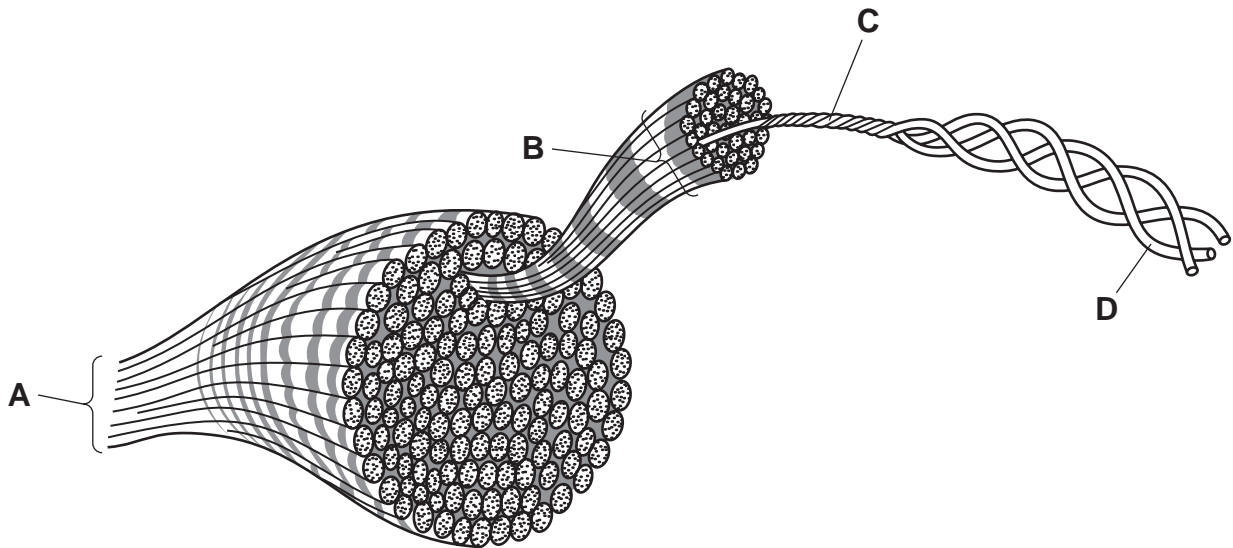
- 1 ability to form hydrogen bonds with other molecules
- 2 less dense when frozen
- 3 able to hold a lot of heat

What allows a small insect to rest on the surface of a pond?

- A 1 and 2 B 2 and 3 C 1 only D 2 only

7 The diagram shows the three dimensional structure of collagen.

Which labelled part represents a molecule of collagen?



8 Which type of bond does **not** hold together the tertiary structure of a protein?

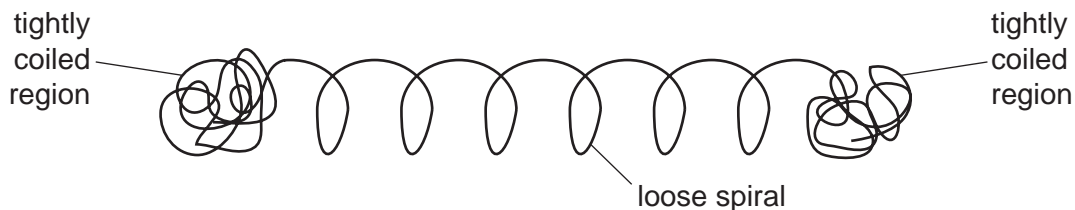
- A disulfide
- B hydrogen
- C hydrophobic interactions
- D peptide

9 Which properties of water are a result of only cohesion?

- 1 The water has a high surface tension.
- 2 Water moves up xylem vessels.
- 3 Water is an excellent solvent.

- A 1, 2 and 3 B 1 and 2 only C 1 only D 3 only

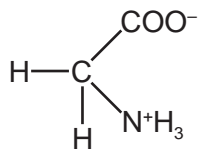
- 10 The protein glutenin gives bread dough its elasticity. The diagram represents a polypeptide of glutenin.



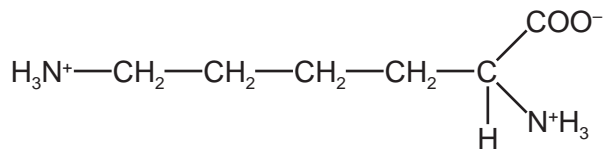
What describes the structure of glutenin?

- A quaternary structure because there are both globular and fibrous regions
 - B quaternary structure because there are both spiral and tightly coiled regions
 - C secondary structure because the loose spiral is an α -helix
 - D tertiary structure because the different regions form a 3D shape
- 11 Which force holds water molecules on the surface of cell walls?
- A adhesion
 - B capillarity
 - C cohesion
 - D surface tension

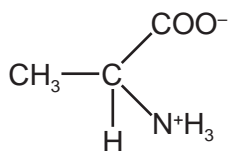
12 The diagram shows the structure of four amino acids in solution.



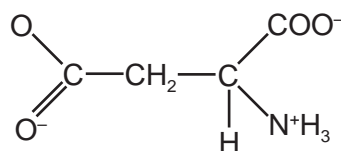
glycine



lysine



alanine

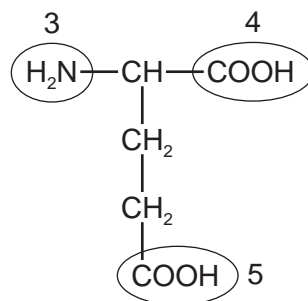
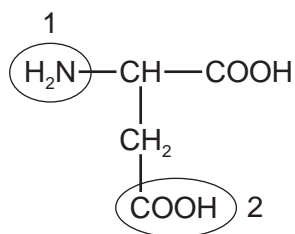


aspartate

Which of these four amino acids have an overall charge?

- A alanine and aspartate
- B alanine and glycine
- C aspartate and lysine
- D glycine and lysine

13 The diagrams show the structures of two amino acids, each of which has two carboxylic acid ($-\text{COOH}$) groups.

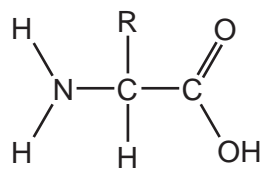


A peptide bond is formed between the two amino acids.

Which groups form the peptide bond?

- A 1 and 4
- B 1 and 5
- C 2 and 3
- D 2 and 5

14 The diagram represents an amino acid.



R represents a variable side chain.

Which is **not** a possible side chain?

- A CH₃
- B CH₂CH₂SCH₃
- C CH₂CONH₂
- D HOCH₂CH(OH)CH₂OH

15 Which molecules have properties that are dependent on hydrogen bonds?

- 1 cellulose
- 2 glycogen
- 3 haemoglobin
- 4 water

A 1, 2 and 3 only B 1, 2 and 4 only C 1, 3 and 4 only D 2, 3 and 4 only

16 Features of four proteins, W, X, Y and Z, are described below.

W consists of two polypeptides held together by disulfide bonds

X consists of three polypeptides tightly coiled together

Y consists of four polypeptides each with a prosthetic group

Z consists of four polypeptides held together by disulfide bonds

Which row correctly identifies the named proteins?

	antibody	collagen	haemoglobin
A	W	X	Y
B	W	Y	X
C	Z	X	Y
D	Z	Y	X

17 Why may fish living in ponds survive temperatures below 0°C in winter?

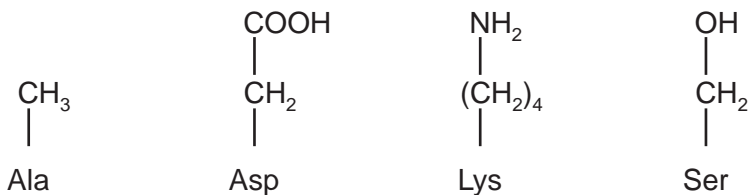
A Fish body tissues produce an enzyme which prevents blood from freezing.

B The ice on the pond surface insulates the water in the pond.

C The plants in the pond help to keep the water temperature above 0°C.

D The rocks in the pond warm up during the day and heat the water.

- 18 The R groups (side chains) of amino acids can be hydrophobic, hydrophilic, acidic or basic. The diagram shows four different amino acid R groups.



Which row is correct for these amino acid R groups?

	hydrophobic	hydrophilic	acidic	basic
A	Ala	Ser	Asp	Lys
B	Ala	Ser	Lys	Asp
C	Asp	Lys	Ser	Ala
D	Asp	Ser	Lys	Ala

- 19 Which molecules contain a carboxyl group?

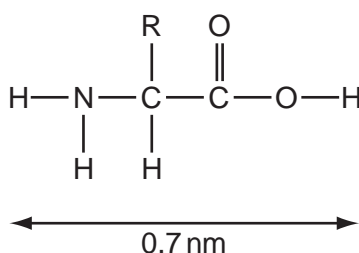
- 1 amino acid
- 2 glycerol
- 3 saturated fatty acid
- 4 unsaturated fatty acid

A 1 and 2 only **B** 3 and 4 only **C** 1, 3 and 4 only **D** 2, 3 and 4 only

20 The diameter of some atoms when they form bonds are given in the table.

atom	single bond / nm	double bond / nm
H	0.06	–
O	0.13	0.110
N	0.14	0.120
C	0.154	0.134

The approximate length of the amino acid shown below was estimated using the figures in the table.



What would be the approximate length of a dipeptide formed using this amino acid?

- A** 0.9 nm **B** 1.2 nm **C** 1.4 nm **D** 1.7 nm

21 A naturally occurring polysaccharide is a branched chain of α -glucose.

The straight parts of the molecule are linked by α -1, 6 glycosidic bonds with a small number of branches which are linked by either an α -1, 3 glycosidic bond or an α -1, 4 glycosidic bond.

Which polysaccharide has a structure **most** similar to that described?

- A** amylopectin
B amylose
C cellulose
D glycogen

22 Which molecule has properties that are **not** dependent on hydrogen bonds?

- A** cellulose
B glycogen
C haemoglobin
D water

- 23 What occurs during protein denaturation by extremes of pH?
- 1 breakage of peptide bonds leading to loss of shape of active site
 - 2 disruption of existing ionic bonds between amino acid R-groups
 - 3 loss of α -helical regular arrangement of amino acids
 - 4 loss of protein tertiary structure resulting in loss of function
- A** 1, 2 and 3
B 2, 3 and 4
C 1 and 3 only
D 2 and 4 only
- 24 When the ice on the surface of a pond melts, which changes benefit the ecosystem in the pond?
- 1 The melted water sinks to the bottom of the pond.
 - 2 The water from the bottom of the pond brings dissolved minerals to the surface.
 - 3 Warmer water dissolves more oxygen for the aerobic organisms.
- A** 1, 2 and 3
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only
- 25 Which level of protein structure maintains the globular shapes of enzymes?
- A** primary
B secondary
C tertiary
D quaternary

26 Which substances contain carbon, hydrogen, oxygen and nitrogen?

- 1 collagen
- 2 amylopectin
- 3 deoxyribonucleic acid

- A** 2 only
- B** 1 and 3 only
- C** 2 and 3 only
- D** 1, 2 and 3

27 Which set of statements correctly describes haemoglobin?

A	four polypeptide chains, each containing a prosthetic group	iron ions can associate with oxygen forming oxyhaemoglobin	in each chain, hydrophobic R groups of amino acids point towards the centre of the molecule	at 50% saturation, two oxygen molecules are transported by the molecule
B	polypeptide chains interact to produce a globular chain	each chain contains a prosthetic group of amino acids surrounding an iron ion	two identical alpha chains and two identical beta chains	each chain can transport an oxygen molecule
C	polypeptide chains interact to produce an almost spherical molecule	an iron ion is present within each haem group	quaternary structure of two alpha chains and two beta chains	each molecule can transport a total of four oxygen atoms
D	polypeptide chains produce a loose helical shape, which curls to form a spherical molecule	iron ions in the molecule can bind reversibly with oxygen	in each chain, hydrophobic R groups of amino acids surround the iron ion	each molecule can transport a total of eight oxygen atoms

28 A human aorta has a lumen width of 2 cm.

A human red blood cell has a diameter of 7 μm .

How many red blood cells could be laid end to end across the diameter of the aorta lumen?

- A** 2.9×10^{-3} **B** 2.9×10^{-2} **C** 2.9×10^2 **D** 2.9×10^3

29 At which levels of protein structure do ionic bonds occur?

1 secondary

2 tertiary

3 quaternary

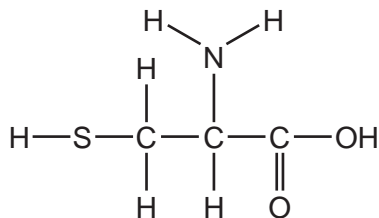
- A** 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

30 Myoglobin is a protein with a similar function to haemoglobin. However, myoglobin does not have a quaternary structure.

Why does myoglobin **not** have a quaternary structure?

- A** Myoglobin does not contain a haem group.
B Myoglobin does not contain any alpha helices.
C Myoglobin has a fibrous rather than a globular structure.
D Myoglobin has only one polypeptide chain.

- 31 The diagram shows the structure of the amino acid cysteine.



When two of these amino acids join together what bond(s) are formed?

- A** disulfide bonds only
B disulfide and peptide bonds
C hydrogen, disulfide and peptide bonds
D peptide bonds only
- 32 As a frozen lake warms after a cold winter, mineral nutrients are brought to the surface.

Which properties of water contribute to this process?

- 1 Its greatest density is at 4 °C.
- 2 It has high specific heat capacity.
- 3 It is a solvent.
- 4 Its molecules form hydrogen bonds.

- A** 1 and 3 only **B** 1 and 4 only **C** 2 and 3 only **D** 2 and 4 only
- 33 Which feature of haemoglobin makes it a globular protein?
- A** It has four cross-linked polypeptide chains forming a quaternary structure.
B It has hydrophobic groups on the inside and hydrophilic groups on the outside.
C It has hydrophobic interactions and is insoluble in water.
D It has polypeptide chains which are cross-linked to form sheets.

34 Which types of bonds maintain the tertiary structure of a protein molecule?

	disulfide	hydrogen	ionic	peptide
A	✓	✓	✓	✗
B	✗	✓	✓	✗
C	✗	✓	✗	✓
D	✓	✗	✗	✓

35 When a peptide bond is formed, which statement is correct?

- A** One amino acid loses a hydroxyl group from its amine group.
- B** One amino acid loses a hydroxyl group from its carboxyl group.
- C** Both amino acids lose a hydrogen atom from their amine group.
- D** Both amino acids lose a hydrogen atom from their carboxyl group.

36 When one molecule of oxygen combines with haemoglobin it makes it easier for the next oxygen molecule to bind, which makes it easier for the next molecule of oxygen to bind.

Which orders of protein structure change to allow this to happen?

- A** primary and quaternary
- B** primary and secondary
- C** secondary and tertiary
- D** tertiary and quaternary

37 How is the shape of a polypeptide chain maintained when it is coiled into an α helix?

- A** disulphide bonds
- B** hydrogen bonds
- C** hydrophobic interactions
- D** ionic bonds

38 What will break an ionic bond between amino acids?

- A condensation
- B hydrolysis
- C low temperature
- D pH change

39 High concentrations of urea break all bonds, except covalent bonds, in protein molecules.

Which level of protein structure would remain unchanged when a protein is treated with urea?

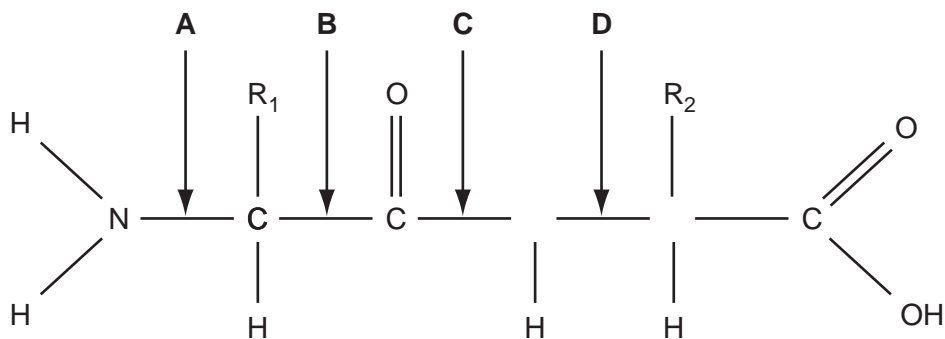
- A primary
- B secondary
- C tertiary
- D quaternary

40 At which levels of protein structure do hydrophobic interactions occur?

- A primary, secondary and tertiary
- B primary, secondary, tertiary and quaternary
- C tertiary and quaternary
- D quaternary only

41 The diagram shows a dipeptide.

Which bond is the peptide bond?



42 The movement of water through the vascular tissue in plants relies on which property of water?

- A changes in density with temperature
- B good solvent for ions and polar molecules
- C high specific heat capacity
- D strong cohesive forces between molecules

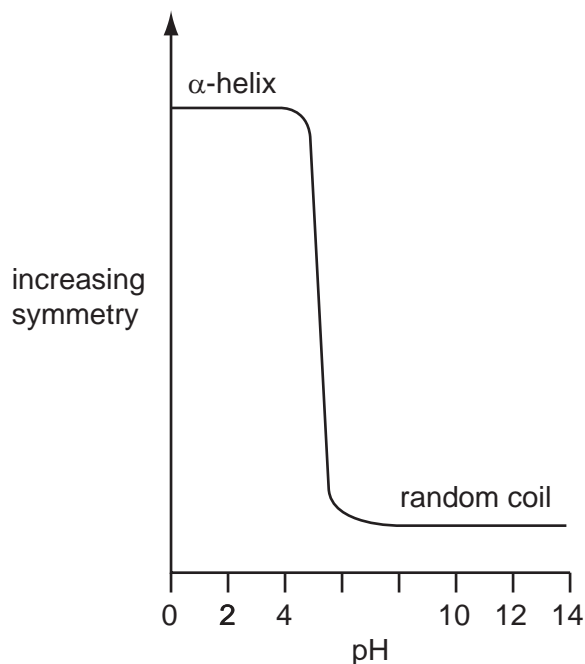
43 Which levels of protein structure are demonstrated by a haemoglobin molecule?

	primary	secondary	tertiary	quaternary
A	✓	x	x	x
B	✓	✓	x	x
C	✓	✓	✓	x
D	✓	✓	✓	✓

44 Which property of water minimises temperature changes in cells and organisms?

- A cohesion
- B heat of vaporisation
- C maximum density at 4 °C
- D specific heat capacity

- 45 The graph shows the effect of pH on the structure of a protein which consists entirely of repeating residues of one amino acid.



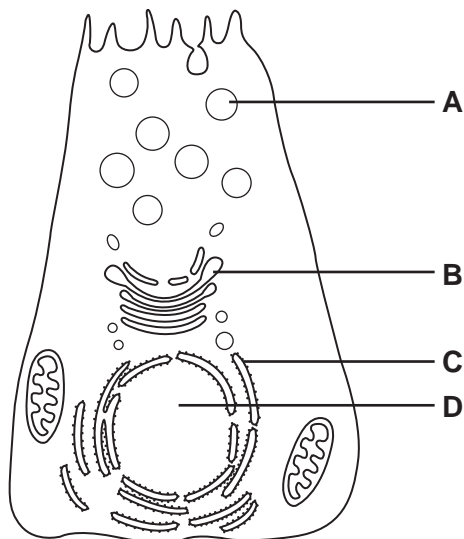
Which statement is true?

- A At pH2 the protein has lost its secondary structure.
 - B At pH2 the protein has lost its tertiary structure.
 - C At pH10 the protein has lost its primary structure.
 - D At pH10 the protein has lost its secondary structure.
- 46 Which types of bonds hold the tertiary structure of a protein molecule?

	disulphide	glycosidic	hydrogen	ionic	peptide
A	x	✓	x	x	✓
B	x	x	✓	x	✓
C	✓	✓	x	✓	x
D	✓	x	✓	✓	x

47 Radioactively-labelled amino acids are introduced into a cell.

In which cell structure will the radioactivity first become concentrated?

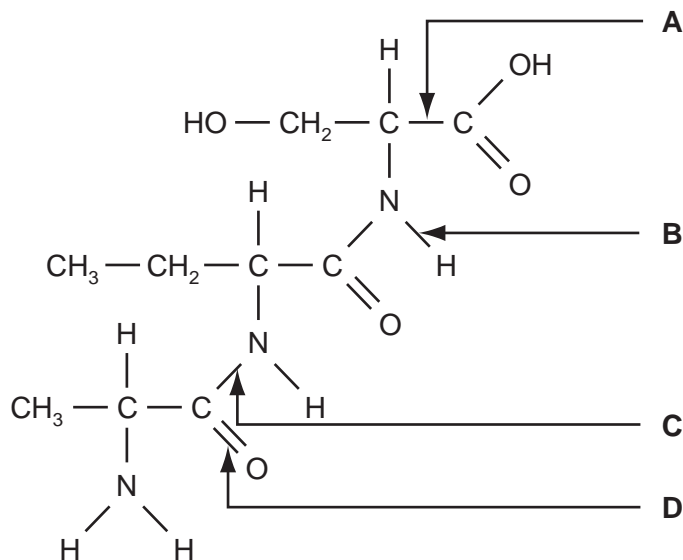


48 What is the theoretical number of chemically different dipeptides that may be assembled from 12 different types of amino acids?

- A** 24 **B** 72 **C** 144 **D** 400

49 The diagram shows a molecule.

Which arrow labels a peptide bond?



50 How many haem groups are there in one molecule of human haemoglobin?

A 1

B 2

C 3

D 4