Proteins
Question Paper 2

Level	A Level
Subject	Biology
Exam Board	Edexcel
Topic	Biological Molecules
Sub Topic	Proteins
Booklet	Question Paper 2

Time Allowed: **56 minutes**

Score: **/ 46**

Percentage: **/100**

Grade Boundaries:

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

1 There is evidence for a causal relationship between blood cholesterol levels and cardiovascular disease (CVD).

(a) Explain the meaning of the term **causal relationship**.

(1)

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(b) Lipoproteins are composed of phospholipids, cholesterol and proteins.

  (i) Proteins are made up of amino acids.

  Describe how amino acids join together to form the three-dimensional structure of a protein.

(4)

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(ii) The diagrams below show part of the structure of the surface of high-density lipoprotein (HDL) and low-density lipoprotein (LDL).

Phospholipid

Protein

Cholesterol

HDL   LDL
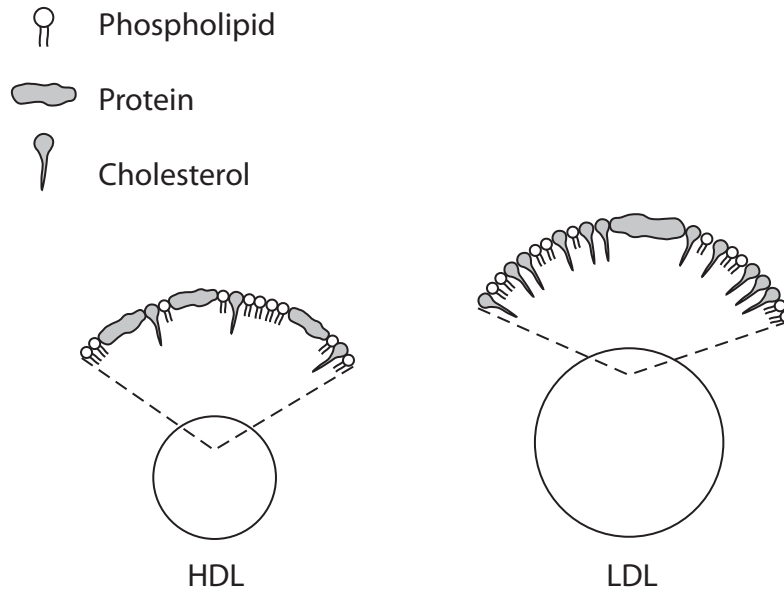
Using the information in the diagram, describe the differences between the structure of HDL and the structure of LDL.

(2)

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(c) Obesity and high blood pressure are also factors that increase the risk of CVD.

The graph below shows the percentage of people with CVD who have high blood pressure or have high blood cholesterol or are obese for the period 1960 to 1990.

(i) Using the information in the graph, describe the overall changes that have occurred in these risk factors during this period.

(3)

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(ii) Suggest **two** reasons for the overall change in high blood cholesterol as a risk factor.

(2)

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2 ....

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(iii) State **two** factors, other than obesity, high blood pressure and high blood cholesterol, that increase the risk of CVD.

(1)

1 ....

2 ....

(Total for Question 1 = 13 marks)

2 Caffeine is a drug frequently consumed in a number of drinks such as coffee, cola, hot chocolate and tea.

Caffeine is broken down in the liver by a group of enzymes called cytochrome P450 oxidase.

(a) The diagram below shows the structure of caffeine and its three breakdown products, X, Y and Z.
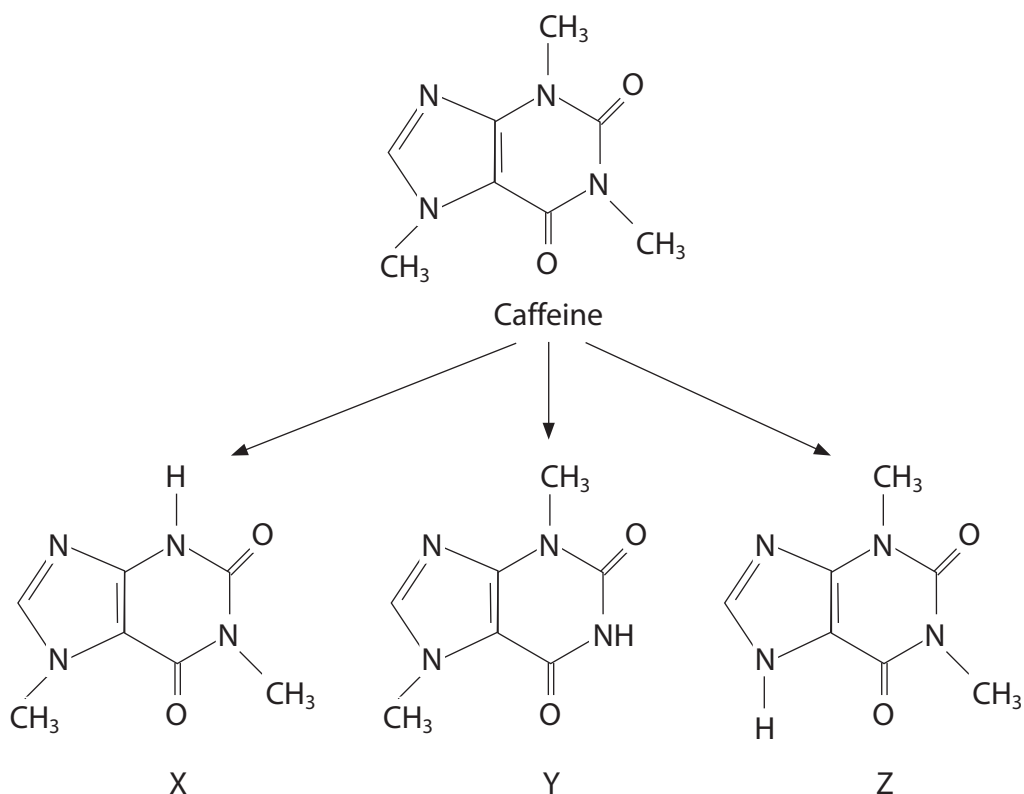
(i) Using the information in the diagram, give **two** reasons why caffeine is **not** an amino acid.

(2)

1 ....

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2 ....

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(ii) Using the information in the diagram, state **two** differences between the breakdown products.

(2)

1 ....

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2 ....

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(iii) Using the information in the diagram and your own knowledge of enzyme action, suggest why cytochrome P450 oxidase consists of more than one type of enzyme.

(3)

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(b) A student decided to investigate the concentration of caffeine in four drinks: coffee, cola, hot chocolate and tea.

The student's results are shown in the table below.

Drink	Volume of drink	Caffeine content / mg
coffee	200 cm^3	135
cola	1 can	80
hot chocolate	200 cm^3	10
tea	1 cup	50

The student made two conclusions from these results.

Conclusion 1 "Different drinks have different concentrations of caffeine."

Conclusion 2 "Coffee has the highest concentration of caffeine."

Comment on the validity of these conclusions. Give reasons for your answer.

(3)

Conclusion 1 ....

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Conclusion 2 ....

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(Total for Question 2 = 10 marks)

3 Proteins, such as enzymes, are important molecules found in all living organisms.

(a) Read through the following passage on the primary structure of proteins, then write on the dotted lines the most appropriate word or words to complete the passage.

(5)

Proteins are made of monomers called .... These monomers

are joined together by .... bonds, formed during

.... reactions.

Each monomer of a protein consists of a central carbon atom attached to a hydrogen

atom, an R group, an .... group and

a .... group. The sequence of monomers determines the primary

structure of the protein.

(b) (i) Describe the three-dimensional (tertiary) structure of an enzyme.

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(ii) Explain how the primary structure of an enzyme determines its three-dimensional (tertiary) structure and its properties.

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(Total for Question 3 = 11 marks)

4 Osteocalcin is a structural protein found in the bones of mammals.
The sequence of the amino acids in osteocalcin can be determined using mass spectrometry.

The sequences of the first 20 amino acids in the primary structure of osteocalcin from the bones of humans and some apes are shown in the table below.
Each amino acid is represented by a capital letter.

Mammal	Amino acid number																			
	1				**5**					**10**					**15**					**20**
Human	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	R	R
Chimpanzee	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	R	R
Orang utan	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	K	R
Gorilla		L	Y	Q	W	L	G	A	O	V	P	Y	P	D	P	L	E	P	K	R

(a) Place a cross ☒ next to the most appropriate answer that completes each of the following statements about these sequences of amino acids.

(i) The number of nucleotides in the gene for osteocalcin production used for each of these sequences is

(1)

☒ **A** 20

☒ **B** 40

☒ **C** 60

☒ **D** 80

(ii) The type of bond that links the amino acids in the primary structure of osteocalcin is

(1)

☒ **A** disulphide

☒ **B** hydrogen

☒ **C** ionic

☒ **D** peptide

(iii) The structure in which the amino acids in the primary structure of osteocalcin would be linked together is a

(1)

☐ **A** centriole

☐ **B** lysosome

☐ **C** nucleolus

☐ **D** ribosome

(b) (i)   Using the data in the table, suggest with reasons what conclusions scientists
might make about the ancestral relationships of humans and apes.

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(ii)   Suggest how DNA analysis could give further evidence for their conclusions.

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(iii) Describe how gel electrophoresis can be used to analyse DNA.

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(Total for Question 4 = 12 marks)