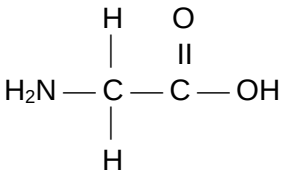
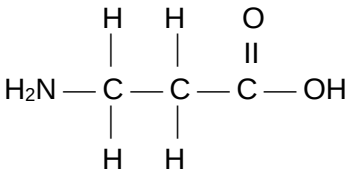
PROTEINS – TOPIC TEST 1

QUESTION 1
Which of the following structures is NOT that of an α-amino acid? (1 mark)

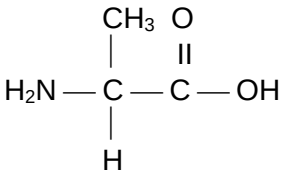
(a)



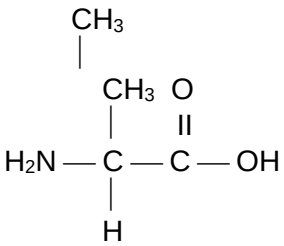
(b)



(c)



(d)



QUESTION 2
The formula of the amino acid serine, $H_2NCHCH_2OHCOOH$, at a pH of 11 is

A $H_2NCHCH_2OHCOOH$
B $H_2NCHCH_2OHCOO^-$
C $^+H_3NCHCH_2OHCOOH$
D $^+H_3NCHCH_2OHCOO^-$

(1 mark)

QUESTION 3
Which of the following molecules is produced when a peptide link is formed?

A CO_2
B NHCO
C H_2O
D $CO(NH_2)_2$

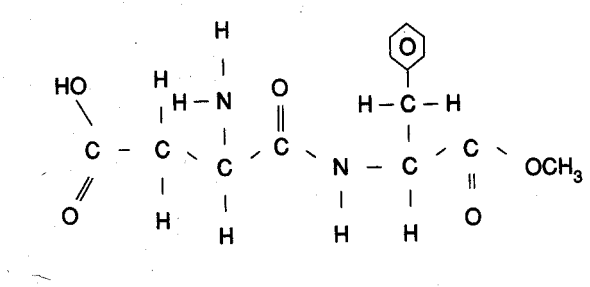
(1 mark)

QUESTION 4
The body gets rid of excess nitrogen by discharging the compound urea. The formula of this compound is

A NH_2CO
B $(NH_2)CO_2$
C NHCO
D $CO(NH_2)_2$

(1 mark)

QUESTION 5
The molecule below is best described as:



A An amino acid
B A polypeptide
C A di-peptide
D A tri-peptide

(1 mark)

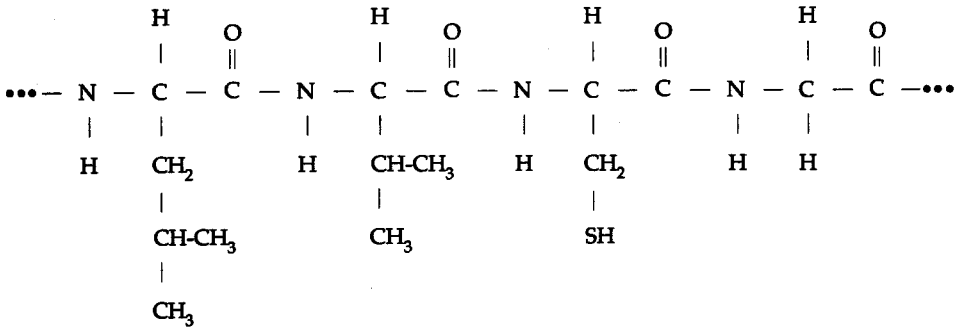
QUESTION 6
Which of the following variables will NOT affect the biological functioning of an enzyme?

A Type of substrate
B pH
C Temperature
D Quantity of substrate

(1 mark)

QUESTION 7

Proteins are a very important group of compounds that have many different functions in the human body. The structural formula below shows part of the polypeptide chain of a protein.



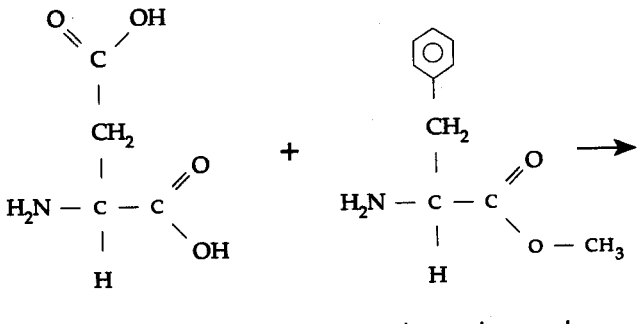
(a) Circle all the peptide links on the diagram. (1 mark)

(b) Name the reaction responsible for converting this protein into its constituent amino acids. Suggest the conditions that are necessary. (2 marks)

(c) Draw the structural formulae of the amino acids that make up this protein. (3 marks)

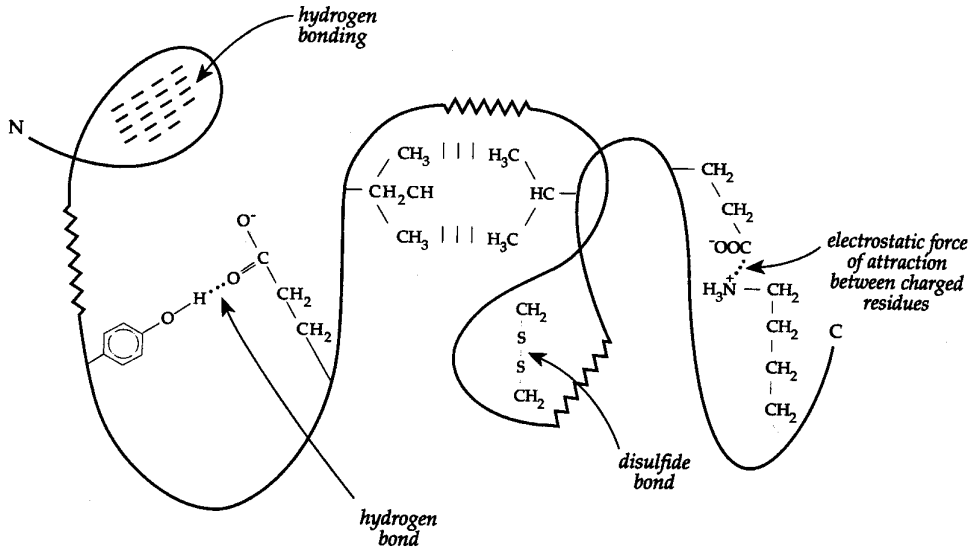
QUESTION 8
The artificial sweetener Aspartame is about 200 times sweeter than sucrose. It is produced by reacting two amino acids to produce a di-peptide.

(a) Draw the structure of the di-peptide by completing this reaction: (2 marks)



(b) Aspartame does produce some energy. Suggest a reason why aspartame is considered to be a low calorie/joule artificial sweetener. (2 marks)

QUESTION 9
The complex structure below is a representation of a protein molecule.



Use this diagram to help you explain what is meant by the terms primary, secondary and tertiary structure of a protein. Explain how the tertiary structure of a protein determines the functioning of enzymes? (4 marks)

Solution

QUESTION 10
Consider the molecules labelled A to H:

A $C_3H_8O_3$
B $C_6H_{12}O_6$
C $H_2NCH(CH_3)_2COOH$
D $C_{18}H_{34}O_2$
E H_2O
F CO_2

Identify the molecule or group of molecules that could have been produced by the hydrolysis of

Starch	A	B	C	D	E	F
Saturated fat	A	B	C	D	E	F
Unsaturated fat	A	B	C	D	E	F
Protein	A	B	C	D	E	F

In each case circle your answer.

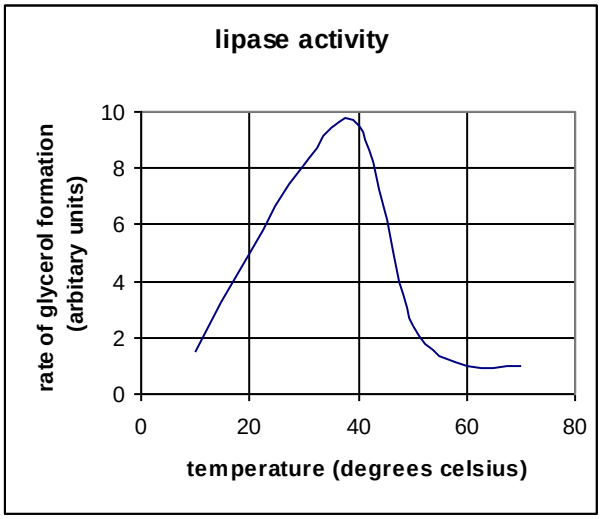
(4 marks)

QUESTION 11
An amino acid has the molecular formula $C_3H_7O_2$. Deduce and draw 2 possible structural formulae for this amino acid. Hint: One of the structures must be that of an α-amino acid. (2 marks)

Solution

QUESTION 12

Lipases are a group of enzymes that catalyse the hydrolysis of fats. During a laboratory experiment the effect of temperature on the functioning of a lipase is studied by observing the rate of glycerol formation as fats are hydrolysed at different temperatures. A graph of the results of this experiment is shown below:



(a) At what temperature does the enzyme function at its optimum? (1 mark)

(b) Explain why the rate of glycerol formation is used as an indicator of the enzyme's activity. (1 mark)

(c) Explain why the rate of glycerol formation increases as the temperature increases from 10^0C to 40^0C. (2 marks)

(d) Explain why the rate of glycerol formation has virtually ceased after the temperature 60^0C. (1 mark)

SOLUTIONS

QUESTION 1 Answer is B

QUESTION 2 Answer is B

QUESTION 3 Answer is C

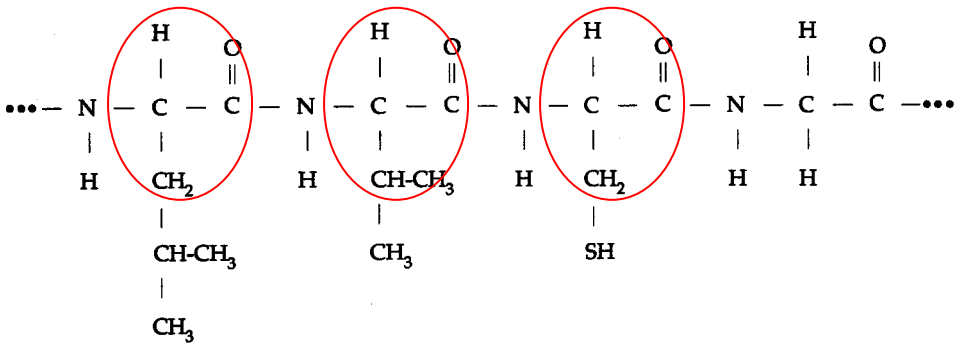
QUESTION 4 Answer is D

QUESTION 5 Answer is C

QUESTION 6 Answer is D

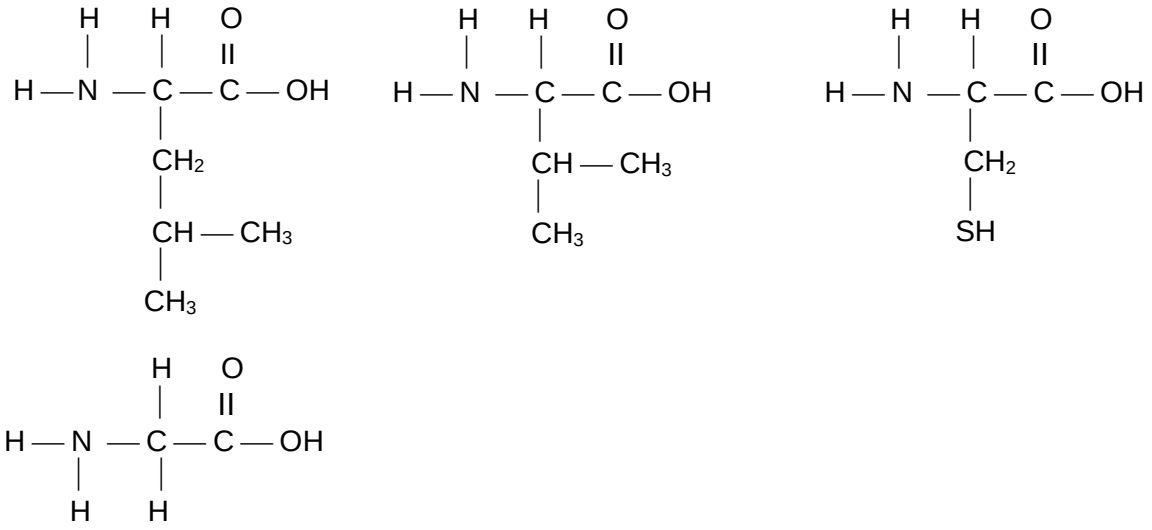
QUESTION 7

(a)



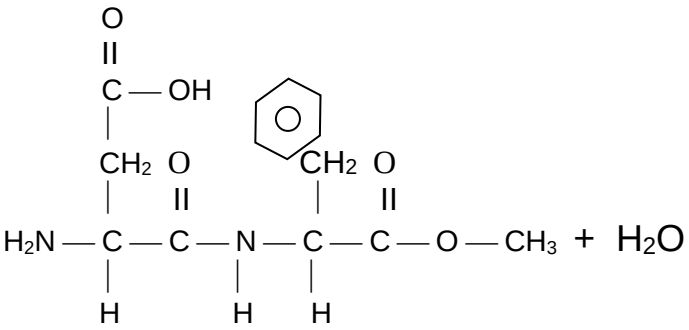
(b) Hydrolysis. The conditions necessary are an acidic environment with the appropriate enzymes present and water.

(c)



QUESTION 8

(a)



(b) Since aspartame is much sweeter than sucrose you would require a lot less of it to produce the same sweetness as an equivalent mass of sucrose. Aspartame is made from amino acids, which are not the body's preferred energy source.

QUESTION 9

The order of amino acids in a protein is known as the primary structure.

Parts of the protein chain will be attracted to each other. These forces are mainly dipole-dipole attractions and hydrogen bonding. These forces cause folding and coiling of the protein chain.

Further attractions result in more coiling and folding to produce the complete 3-D structure of the protein known as the tertiary structure.

The functioning of an enzyme is due to the active site of the molecule. The 3-D structure of this region determines which substrates will fit into it and hence controls the functioning of this molecule.

QUESTION 10

Starch	B
Saturated fat	A
Unsaturated fat	A and D
Protein	C

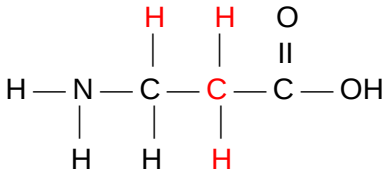
QUESTION 11

All amino acids have the general formula, $H_2N\text{-}CHZ\text{-}COOH$. If we take the number of carbon, hydrogen and nitrogen atoms in the general formula (C = 2, H = 4, O = 2) away from $C_3H_7O_2$, what we are left with will be the number of atoms that make up the rest of the molecule, which is the Z chain:

$C_{3-2}\,H_{7-4}\,O_{2-2} = CH_3$

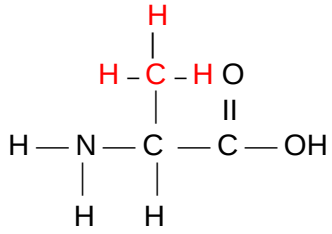
So the Z chain must contain 1 carbon and 3 hydrogens.

1st Structure:



Atoms that make up the Z chain are shown in red.

2nd Structure (α-amino acid)



QUESTION 12

(a) About 35^0C

(b) Glycerol is one of the products of fat hydrolysis so the rate of its formation is an indicator of the rate of the activity of the lipase enzyme.

(c) As the temperature increases the number of effective collisions between the reactant particles increases, therefore, the reaction rate increases until it reaches its optimum temperature.

(d) After 60^0C the enzyme has started to denature and lose its ability to catalyse the hydrolysis of fats.