

CHEMISTRY

PROTEINS – WORKSHEET 1

QUESTION 1

Which two functional groups react to form the peptide link found in proteins?

- A $-NH_2$ and $-OH$
- B $-NH_2$ and $-NH_2$
- C $-OH$ and $-COOH$
- D $-COOH$ and $-NH_2$

QUESTION 2

The elements present in proteins are

- A C, H, O, N only
- B C, H, O, N, S only
- C C, H, O, N, S, P only
- D C, H, O, N, P only

QUESTION 3

Which one of the following substances is most likely to be involved in the production of a protein?

- A $CH_3(CH_2)_{14}COOH$
- B $NH_2CH_2CH_2COOH$
- C $HOCH_2CH(OH)CH_2OH$
- D $H_2NCH(CH_3)COOH$

QUESTION 4

An α - amino acid must contain two functional groups. Which alternative lists these groups correctly?

- A an amino group and a hydroxyl group
- B an amide group and a hydroxyl group
- C an amino group and a carboxylic acid group
- D an amide group and a carboxylic acid group

QUESTION 5

Why are amino acids soluble in water?

Solution

QUESTION 6

Describe how proteins maintain the pH in biological systems.

Solution

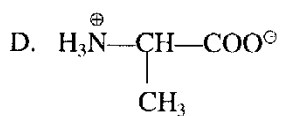
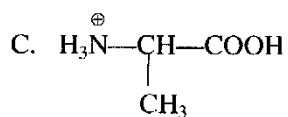
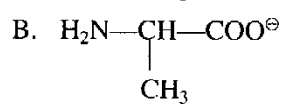
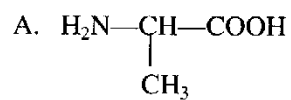
QUESTION 7

Why does the addition of small amounts of acid or alkali cause little change to the pH in blood?

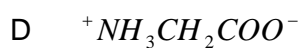
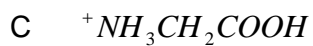
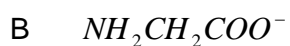
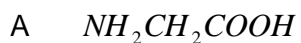
Solution

QUESTION 8

In a solution of alanine at pH approximately 7, the alanine exists mainly as

**QUESTION 9**

Which of the following represents an amino acid in a solution in which the pH is 1?



QUESTION 10

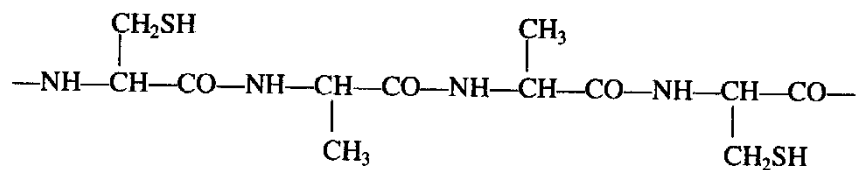
Consider the amino acids serine, leucine and cysteine.

- (a) What part of the serine molecule makes it behave as a base?
- (b) What part of the serine molecule makes it behave as an acid?
- (c) Show how a serine molecule may join with a molecule of leucine and one of cysteine to form a tripeptide.

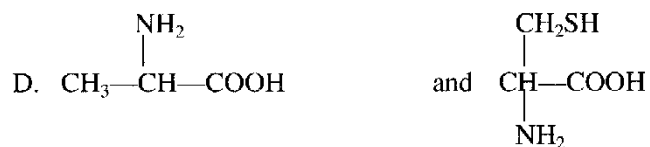
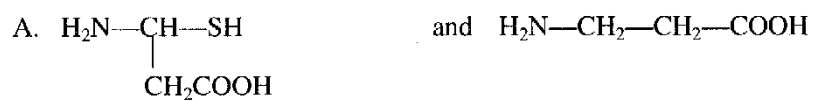
- (d) How many different peptides consisting of two molecules of serine, one of leucine and one of cysteine can be formed?

QUESTION 11

The following represents part of a polypeptide chain:



The amino acids from which this part of the polypeptide chain is composed are:

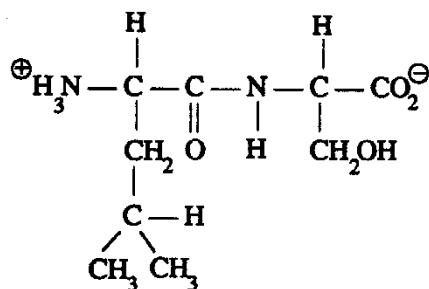


QUESTION 12

(a) Draw the structural formula of the product formed when leucine reacts with a dilute solution of sodium hydroxide.

(b) Draw the structural formula of the product formed when leucine reacts with a dilute solution of hydrochloric acid.

(c) When leucine is bonded to serine (ser) the following dipeptide (leu-ser) is formed.

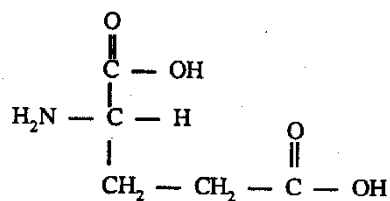


Draw the structural formula of another dipeptide formed between leucine and serine.

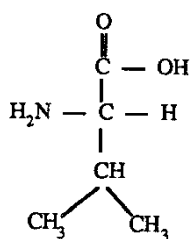
(d) Hot 6 mol L⁻¹ hydrochloric acid is used to break the peptide bond that joins the two amino acids together. Draw the structural formulae of the products formed when the dipeptide in (c) is reacted with hot 6M hydrochloric acid.

QUESTION 13

Monosodium glutamate (M.S.G.) is a food additive that enhances taste. It is made from glutamic acid, which has a structural formula of



- (a) To which group of compounds does glutamic acid belong?
- (b) Glutamic acid could be bonded to valine, which has a structural formula of

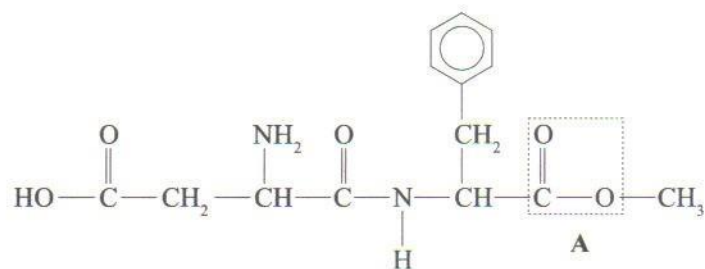


Show how this bonding can arise.

- (c) Name the type of bond between glutamic acid and the valine molecule.
- (d) In the disease, sickle cell anaemia, glutamic acid is replaced by one valine molecule on the haemoglobin molecule. One effect of this is to lower the polarity of the molecule.
- Explain why the polarity is reduced.
 - How would this change in polarity affect the solubility of haemoglobin in water?

QUESTION 14

Aspartame is an artificial sweetener that's prepared from two amino acids and an alcohol. The structural formula of aspartame is shown in the diagram below:



- (a) Name functional group **A**.
- (b) (i) On the diagram above, circle the functional group that links the two amino acids.
- (ii) Name this functional group.
- (c) Draw the structural formula of the original amino acid that contains the benzene ring.

SOLUTIONS

QUESTION 1 Answer is D

QUESTION 2 Answer is B

QUESTION 3 Answer is D (must be an α amino acid)

QUESTION 4 Answer is C

QUESTION 5

Due to the presence of 2 polar groups: NH_3^+ and COO^- and that can form H bonds with water.

QUESTION 6

The COOH group can donate H^+ to lower pH, the NH_2 gp can gain $\text{H}^+ \rightarrow (\text{NH}_3^+)$ to raise the pH of solution.

QUESTION 7

Bio amino acids can function as acids or bases and \therefore maintain pH at a constant level

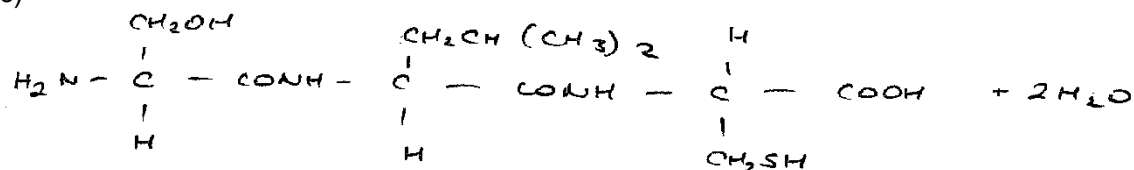
QUESTION 8 Answer is D

QUESTION 9 Answer is C

QUESTION 10

- (a) NH_2
 (b) COOH groups

(c)



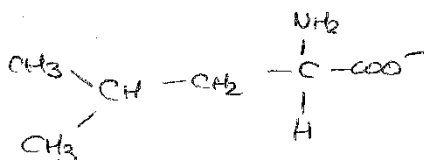
(d) 12

Ser – Ser – Leu – Cys
Ser – Ser – Cys – Leu
Cys – Ser – Ser – Leu
Leu – Ser – Ser – Cys
Leu – Cys – Ser – Ser
Cys – Leu – Ser – Ser
Ser – Leu – Ser – Cys
Ser – Cys – Ser – Leu
Leu – Ser – Cys – Ser
Cys – Ser – Leu – Ser
Ser – Cys – Leu – Ser
Ser – Leu – Cys – Ser

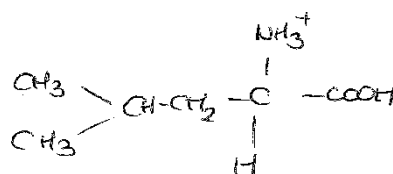
QUESTION 11 **Answer is D**

QUESTION 12

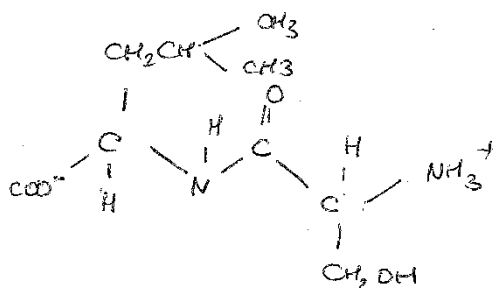
(a)



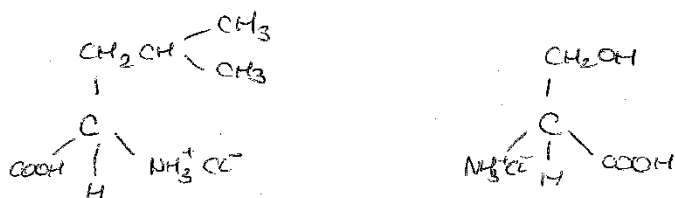
(b)



(c)



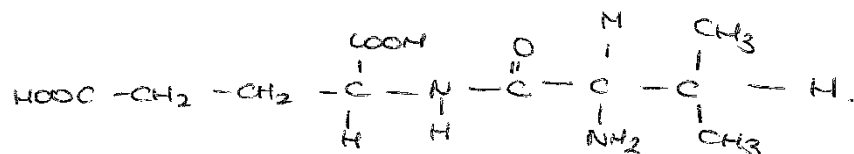
(d)



QUESTION 13

(a) Amino acids

(b)



(c) Peptide linkage

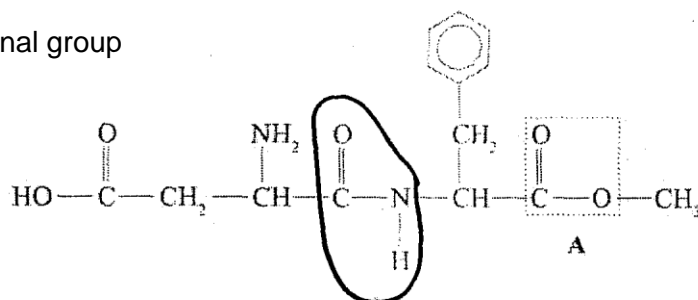
(d)

Polarity is reduced b/c the second -COOH group on glutamic acid has been replaced by the less polar group -CH(CH₃)₂. The lower polarity would reduce the solubility of haemoglobin & impair its transport in blood - which is an aqueous medium.

QUESTION 14

(a) Ester functional group

(b) (i)



(ii) Peptide linkage

(c)

