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CHEMISTRY

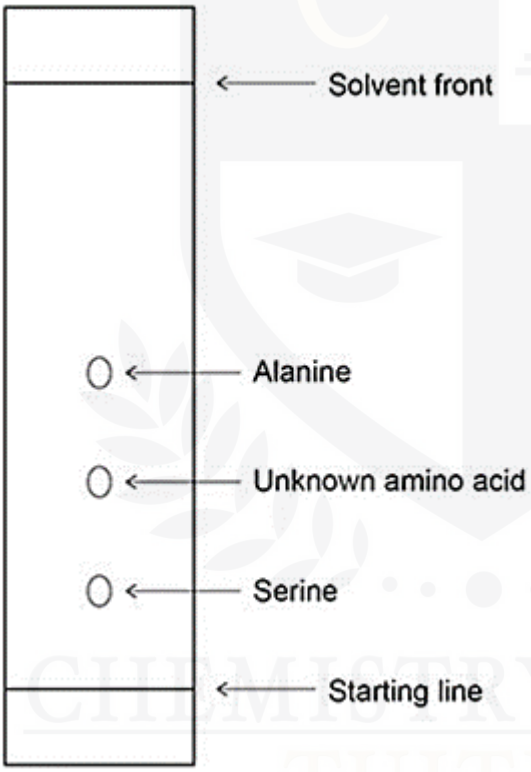
INORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	AMINO ACIDS, PROTEIN AND DNA
PAPER TYPE:	QUESTION PAPER - 4
TOTAL QUESTIONS	10
TOTAL MARKS	35

Amino Acids, Protein and DNA

1. The protein fibroin can be broken down into amino acids using an enzyme.

(a) A student uses thin-layer chromatography (TLC) to identify these amino acids.
The student identifies two of the amino acids as alanine and serine.
Use the figure below to calculate the Rf value of the unknown amino acid. Show your working.
Use your Rf value and the table below to identify the unknown amino acid.



Amino acid	Rf value
tyrosine	0.25
glycine	0.34
valine	0.64
leucine	0.73

(2)

(b) The amino acids cannot be seen as they move during the experiment.

State how the amino acids can be made visible at the end of the experiment.

(1)

(c) State why each amino acid has a different Rf value.

(1)

2. A single strand of DNA is made from many nucleotides linked together.

Draw the structure of the nucleotide that contains guanine, showing clearly the bonding between the components.

(3)

3. The compound $H_2C=CHCN$ is used in the formation of acrylic polymers.

(a) Draw the repeating unit of the polymer formed from this compound.

(1)

(b) Name the type of polymerisation involved in the formation of this polymer.

(1)

4. Draw the structures of the two dipeptides which can form when one of the amino acids shown below reacts with the other.

(2)

5. Propylamine, $CH_3CH_2CH_2NH_2$, can be formed either by nucleophilic substitution or by reduction.

(a) Draw the structure of a compound which can undergo nucleophilic substitution to form propylamine.

(1)

(b) Draw the structure of the nitrile which can be reduced to form propylamine.

(1)

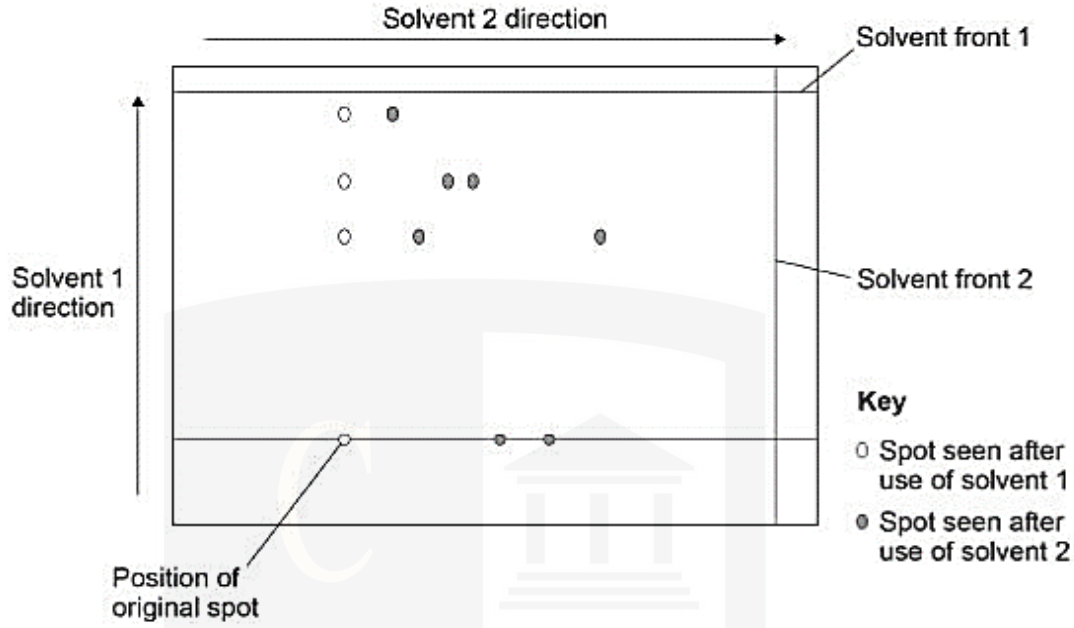
(c) State and explain which of the two routes to propylamine, by nucleophilic substitution or by reduction, gives the less pure product.

Draw the structure of a compound formed as an impurity.

(3)

6. This question is about thin-layer chromatography (TLC).

- A protein was hydrolysed to form a mixture of amino acids.
- A spot of this mixture was added to a TLC plate and the plate placed vertically in a small volume of solvent 1.
- When the solvent front reached nearly to the top of the plate, the plate was removed and allowed to dry.
- The plate was turned anticlockwise through 90° and placed vertically in a small volume of solvent 2.
- When the solvent front reached nearly to the top of the plate, the plate was again removed and allowed to dry.
- The diagram shows the final TLC plate.



(a) Suggest a suitable reagent for the hydrolysis of a protein.

(1)

(b) Suggest how the positions of the amino acids on the TLC plate were located.

(1)

(c) Deduce the minimum number of amino acids present in the original mixture.

(1)

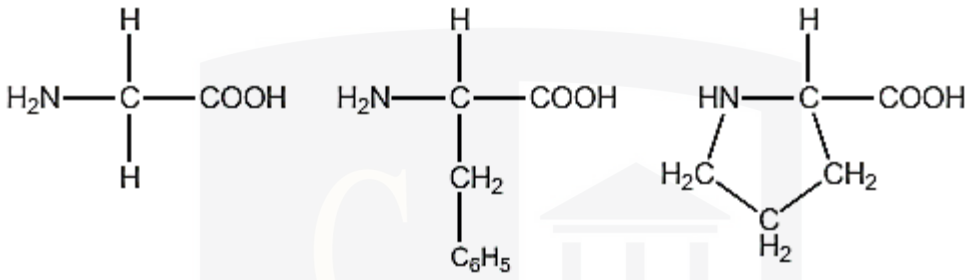
I am Sorry !!!!!

(d) Suggest why it was necessary to use two different solvents.

(1)

7. Amino acids can act as monomers in the formation of polypeptides and proteins.

The structures below show three amino acids, glycine, phenylalanine and proline.



Glycine, phenylalanine and proline can react together to form a mixture of tripeptides.

(a) Draw the structure of the tripeptide formed in the order glycine, phenylalanine and proline.

(3)

(b) How many different tripetides could have been formed containing glycine, phenylalanine and proline?

I am Sorry !!!!!

(1)

(c) The mixture of tripeptides can be analysed by using gas chromatography, coupled with mass spectrometry.

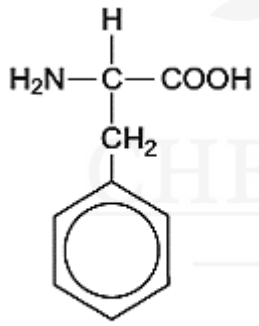
Summarise how each method contributes to the analysis.

(3)

8. State the general formula of an α-amino acid.

(2)

9. Phenylalanine exists as a pair of stereoisomers.



phenylalanine

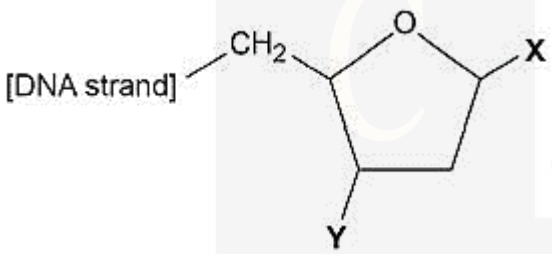
(a) State the meaning of the term stereoisomers.

(2)

(b) Explain how a pair of stereoisomers can be distinguished.

(2)

10. DNA exists as two strands of nucleotides in the form of a double helix with hydrogen bonding between the two strands.



A deoxyribose molecule in a strand of DNA is shown.

Name the types of group attached to 2-deoxyribose at positions X and Y.

(2)

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