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CHEMISTRY

ORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	CHROMATOGRAPHY
PAPER TYPE:	QUESTION PAPER - 1
TOTAL QUESTIONS	10
TOTAL MARKS	41

Chromatography - 1

1. Gas-liquid chromatography is used to separate and identify gases and liquids.

(a) State what quantitative value is normally used to identify the components in this type of chromatography.

(1)

(b) Sketch the chromatogram to show how the value is determined.

(1)

(c) State the physical process on which the separation used in gas-liquid chromatography depends.

(1)

2. Volatile organic compounds that enter soil via waste disposal sites affect the quality of the soil.

A preliminary step in analysing soil quality involves separation of these volatile components using gas/liquid chromatography.

(a) What name is given to the process by which components in a mixture are separated during gas/liquid chromatography?

(1)

(b) What are the roles of the gas and liquid in gas/liquid chromatography?

(2)

(c) Draw a diagram of a gas/liquid chromatogram for a mixture containing two components.

(1)

(d) Explain how the gas/liquid chromatogram could be used to determine the percentage composition of each component in the mixture.

(3)

3. α-Amino acids are found in human sweat.

A student had read that chromatography could be used to separate and identify the amino acids present in human sweat.

The student used Thin-Layer Chromatography (TLC) to separate the α-amino acids in a sample of human sweat and discovered that three different α-amino acids were present.

(a) Name the process by which TLC separates α-amino acids.

(1)

(b) The chromatogram was treated to show the positions of the separated α-amino acids.

Explain how the student could analyse the chromatogram to identify the three α-amino acids that were present.

(2)

(c) Several α-amino acids have structures that are very similar.

Suggest why this could cause problems when using TLC to analyse mixtures of α-amino acids.

(1)

4. A bottle was discovered labelled propan-2-ol.

The chemist showed, using infrared spectroscopy, that the propan-2-ol was contaminated with propanone.

The chemist separated the two compounds using column chromatography.

The column contained silica gel, a polar stationary phase.

The contaminated propan-2-ol was dissolved in hexane and poured into the column.

Pure hexane was added slowly to the top of the column.

Samples of the eluent (the solution leaving the bottom of the column) were collected.

- Suggest the chemical process that would cause a sample of propan-2-ol to become contaminated with propanone.
- State how the infrared spectrum showed the presence of propanone.
- Suggest why propanone was present in samples of the eluent collected first (those with shorter retention times), whereas samples containing propan-2-ol were collected later.

(4)

5. What relationship between a sample and the mobile phase makes the sample move faster?

(2)

6. A peptide is hydrolysed to form a solution containing a mixture of amino acids.

This mixture is then analysed by silica gel thin-layer chromatography (TLC) using a toxic solvent.

The individual amino acids are identified from their R_f values.

Part of the practical procedure is given below.

1. **Wearing plastic gloves to hold a TLC plate**, draw a pencil line 1.5 cm from the bottom of the plate.
2. Use a capillary tube to apply a very small drop of the solution of amino acids to the mid-point of the pencil line.
3. Allow the spot to dry completely.
4. In the developing tank, add the developing solvent to **a depth of not more than 1 cm.**
5. Place your TLC plate in the developing tank.
6. Allow the developing solvent to rise up the plate **to the top.**
7. Remove the plate and quickly mark the position of the solvent front with a pencil.
8. Allow the plate to dry **in a fume cupboard**.

(a) Parts of the procedure are in bold text.

For each of these parts, consider whether it is essential and justify your answer.

(4)

(b) Outline the steps needed to locate the positions of the amino acids on the TLC plate and to determine their R_f values.

(4)

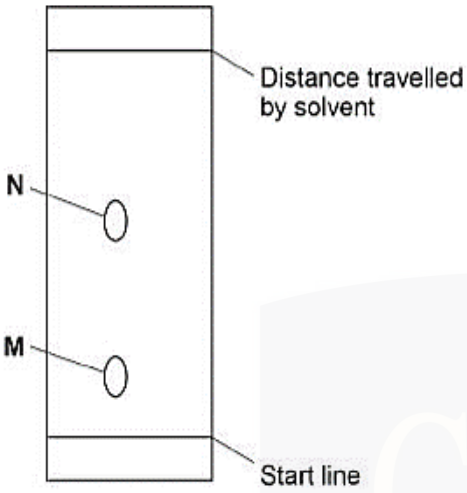
(c) Explain why different amino acids have different Rf values.

(2)

7. A tripeptide, L, is partially hydrolysed with concentrated hydrochloric acid to produce two dipeptides and the amino acids alanine (ala), lysine (lys) and serine (ser).

I am Sorry !!!!!

The two dipeptides are separated by chromatography.
The diagram below shows the chromatogram.



The table below contains the R_f values of some dipeptides.

Dipeptide	ala-lys	ala-ser	lys-ser	lys-ala	ser-ala	ser-lys
R_f value	0.55	0.85	0.10	0.20	0.15	0.45

Use the chromatogram in the diagram above and the R_f values in the table to identify the two dipeptides present in spots M and N.

Use your answers to deduce the order of the amino acids in the tripeptide L.

Dipeptide responsible for spot M

Dipeptide responsible for spot N

Order of amino acids in tripeptide L

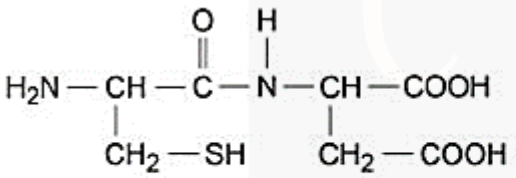
(3)

8. What is a mobile phase?

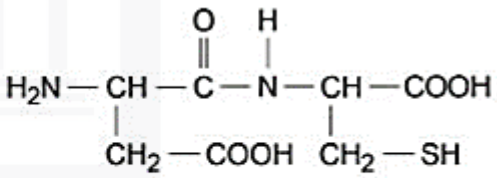
(2)

9. Chromatography is used to identify amino acid sequences in compounds.

The dipeptide cysteine-aspartic acid (cys-asp), J, and the dipeptide aspartic acid-cysteine (asp-cys), K, are shown.



J (cys–asp)



K (asp–cys)

A mixture of the two dipeptides J and K is analysed by gas chromatography followed by mass spectrometry (GC-MS).

Explain why J and K can be separated by gas chromatography and why mass spectrometry using electrospray ionisation does not enable you to identify them.

Gas chromatography explanation.

(4)

10. How are substances separated by chromatography?

(2)

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