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CHEMISTRY

ORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	CHROMATOGRAPHY
PAPER TYPE:	SOLUTION - 3
TOTAL QUESTIONS	10
TOTAL MARKS	/26

Chromatography - 3

1.

GCMS (Gas chromatography/Mass spectrometry) working:

- **Sample Injection:** Sample is injected and vaporized in the GC.
- **Separation in GC:** Compounds separate in the column based on retention times.
- **Transfer to MS:** Compounds enter the mass spectrometer.
- **Ionization:** Compounds are ionized, creating charged fragments.
- **Mass Analysis:** Ions are separated by their mass-to-charge ratio (m/z).
- **Detection:** Detector records ion abundance at each m/z value.
- **Data Analysis:** Retention times and fragmentation patterns, including molecular ion peaks, confirm compound identities.

(4)

2.

The basic principle of all kinds of chromatography is the separation of a mixture dissolved in a mobile phase (solvent) as it passes over a solid stationary phase.

(2)

3.

In chromatography, the R_f value is the ratio of the distance travelled by a compound to the distance travelled by the solvent front.
It is calculated as:

$$Rf = \frac{\text{Distance travelled by the spot}}{\text{Distance travelled by the solvent fron}}$$

I am Sorry !!!!!

Distance moved by the spot:

Measure the distance from the initial line (where the mixture was spotted) to the center of the spot.

Distance moved by the solvent front:
Measure the distance from the initial line to the point where the solvent front has reached.

(2)

4.

(a)

$$Rf = \frac{\text{Distance travelled by the spot}}{\text{Distance travelled by the solvent fron}}$$

$$Rf = \frac{27}{80} = 0.34$$

Amino acid:

Glycine

(2)

(b)

UV Lamp:

Place the chromatogram under a UV lamp. Amino acids will appear as dark spots against a bright background.

Ninhydrin:

Spray the chromatogram with ninhydrin solution. Amino acids will appear as purple or blue spots.

(1)

(c)

Each amino acid has a different Rf value because each one has a different relative affinity or attraction to the stationary phase and different solubility in the mobile phase.

This causes them to travel varying distances during chromatography.

(1)

5.

Aldehydes have the shortest retention time in column chromatography. This is because aldehydes have less polar bonds compared to alcohols, resulting in weaker interactions with the stationary phase.

As a result, aldehydes move more quickly down the column compared to alcohols.
The force of attraction between the stationary phase and aldehydes is less pronounced due to their weaker polarity.

(2)

6.

Advantages:

- **High Sensitivity:**

  GLC is very sensitive, capable of detecting minute traces of substances in foodstuffs and linking oil pollution on beaches to the specific tanker the oil came from.

- **Quantitative Analysis:**

  It allows for precise quantification of compounds present in the sample.

Uses:

- **Food Analysis:**

  GLC is employed to detect traces of substances in foodstuffs, ensuring safety and quality.

- **Environmental Analysis:**

  It is used to identify and quantify pollutants in environmental samples, aiding in pollution control and monitoring.

- **Forensic Analysis:**

  GLC is utilized to test athletes' and horses' blood and urine for drugs, ensuring fairness in sports and racing competitions.

(3)

7.

In gas-liquid chromatography (GLC), the mobile phase is a inert gas, such as helium or nitrogen.

This gas carries the sample vapor through the chromatographic column, interacting with the stationary phase and facilitating the separation of compounds based on their differential interactions with the stationary phase.

(1)

8.

In gas-liquid chromatography (GLC), the stationary phase consists of a fine powder coated with oil.

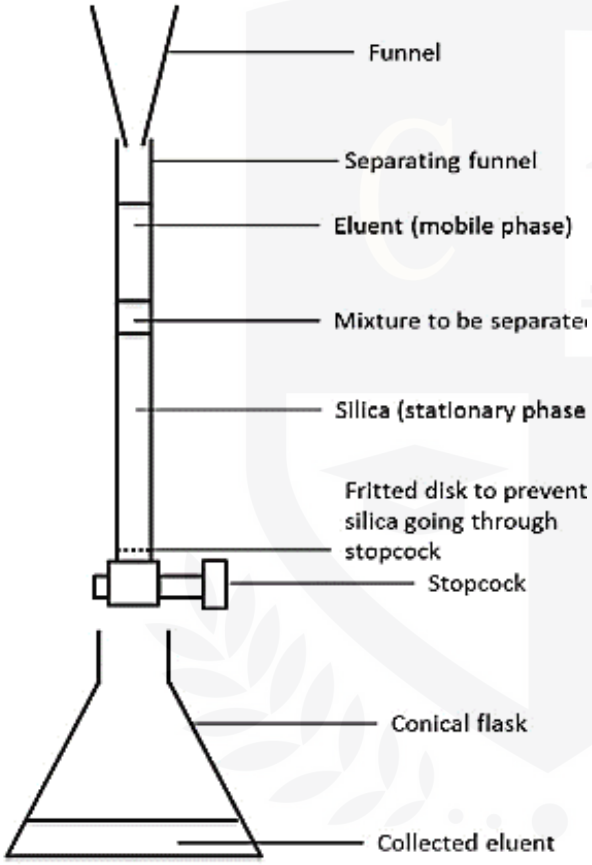
This stationary phase is packed into a long, thin, capillary tube, typically around 100 meters long with a diameter of 0.5 millimeters.

The packed column is then coiled and placed in an oven, where the temperature can be varied.

(1)

9.

Diagram of column chromatography:



(4)

10.

Advantages of column chromatography:

Multiple Eluents:

Column chromatography allows for the use of more than one eluent, enhancing separation capabilities and leading to better resolution.

Scalable for Large Amounts:

It is suitable for separating and collecting fairly large amounts of compounds after separation, making it practical for preparative and purification purposes.

(3)

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