Column Chromatography Chemistry Questions with Solutions

Q-1: Define the terms

a) Stationary phase
b) Mobile phase
c) Elution

Answer:

a) **Stationary phase:** In analytical chemistry, the stationary phase is a solid. through which the mobile phase passes.The most common stationary phase for column chromatography is silica gel, followed by alumina.
b) **Mobile phase:**The mobile phase, also known as eluent, is a solvent or a mixture of solvents that is used to move compounds through the column.Solvents used as mobile phases based on their polarity include ethanol, acetone, water and others.
c) **Elution :** The process of extracting one material from another in analytical and organic chemistry by washing with a solvent is said to be elution.

Q-2: What are the two different types of solvent systems used in column chromatography?

Answer: In column chromatography, two types of solvent systems are used:
Isocratic:. In an isocratic system, only one solvent passes through the stationary phase,

Gradient: In a gradient system,two solvents in predetermined ratios pass through the stationary phase to separate the components.

Q-3: The process of elution is based on the
a) Electrostatic force
b) Capillary action
c) Differential adsorption of a substance by the adsorbent
d) Differential adsorption of a substance by the eluent.

Answer: c) Differential adsorption of a substance by the adsorbent

Explanation: When the mobile phase and the mixture to be separated are introduced from the top of the column, the individual components of the mixture move at different rates. When compared to components with higher adsorption and affinity to the stationary phase(adsorbent), those with lower adsorption and affinity travel faster. The components that move quickly are eluted first, followed by the components that move slowly.

Q-4: What is the retardation factor? How it is calculated?

Answer: In chromatographic separation, the retardation factor (R_f) is the ratio of the distance travelled by the substance of interest to the distance travelled simultaneously by the mobile phase.

It can be calculated using the formula below:

R_f =The substance's distance(cm) from the reference line/ the mobile phase's distance(cm) from the reference line

The value of R_f is always less than 1.

Q-5: Fill in the blanks

   a) The less adsorbed components are found at the _____ of the column chromatograph.
   b) _____ chromatography is also called medium pressure column chromatography.
   c) _____ _ chromatography separates according to the different molecular weights.
   d) Compounds are adsorbed at different regions due to _____ differences.
   e) Chromatography is derived from the greek word " kroma" which means _____

Answers:

   a) Bottom
   b) Flash
   c) Gel permeation
   d) Polarity
   e) Colour

Q-6: Chromatography is a

   a) Chemical method
   b) Biochemical method
   c) Physical method
   d) Novel Method

Answer: c) Physical method

Explanation: Chromatography is a laboratory technique for separating a mixture by passing it through a medium in which the mixture's components move at different rates and thus separate.

As we can see, no chemical reactions are taking place; instead, their separation is caused by differences in rates and mobility. As a result, a physical process.

Q-7: Which physical property is used in column chromatography?

Answer: Solubility

Explanation: The speed of the various constituents of the mixture is the most important factor influencing the column chromatography technique. This speed is determined by the amount of time the constituents spent in the solvent. If they are drawn to the stationary phase, they move slowly out. They will move out faster if they are highly soluble in the mobile phase.

Hence it can be concluded that,

The greater the attraction to the stationary phase, the slower the movement of the desired particles. This is referred to as adsorption.The higher the constituent solubility in the mobile phase, the faster the mobility rate and elution.

Q-8: How will you account for the R_f value always being less than one?

Answer: R_f value is always less than 1 can be understood by taking the following example:

If the substance moves, it can only move in the direction of the solvent flow and cannot move faster than the solvent. If a specific substance in an unknown mixture travels 3 cm and the solvent front(mobile phase) travels 6 cm, the retardation factor is 0.5.

The R_f value comes out to be less than 1 because the distance travelled by the substance can never exceed that travelled by the solvent front.

Q-9: Which of the following is not a type of column chromatography?

   a) Size-exclusion chromatography
   b) Ion-exchange chromatography
   c) Paper chromatography
   d) Gas chromatography

Answer: c) Paper chromatography

Q-10: Give three uses of column chromatography?

Answer: The three uses of Column chromatography are:

1. It is the most effective technique for separating plant extracts into their constituents in pure form.

2. It is used to separate drugs from the blood, colours from the dye etc.

3. Column chromatography is widely used for sample purification and cleanup, especially in synthetic organic laboratories.

Q-11: What do you mean by wet loading in column chromatography?

Answer: Column chromatography requires a series of steps to be completed. The loading of the column is the most important consideration here.

In chromatography, loading refers to the amount of substance introduced into a column.

Wet loading involves directly placing a liquid sample onto the top of the column with a pipet and allowing it to seep through the top of the sorbent bed.

Q-12: The R_f values of X and Y in a mixture determined by TLC in a solvent are 0.75 and 0.52, respectively. Which of the two compounds, X or Y, will be adsorbed at the top if the mixture is separated by column chromatography with the same solvent mixture as a mobile phase? Explain.

Answer: Y

Explanation: The large value of R_f is due to the less adsorption of components. The components with the large R_f are found to be adsorbed at the bottom of the column and the components with the less R_f are found to be adsorbed at the top of the column.
This shows that Y will be found to be adsorbed at the top as it has less R_f value than X.

Q-13: Which substances elute first? Is it polar or nonpolar?

Answer: Non polar

Explanation: With less adsorption, the component elutes first.

Because the adsorbents are polar, the more polar compounds are strongly adsorbed and will elute last. Non-polar compounds are thus eluted first.

Q-14: Eluting power is related to the

   a) Solvent

b) Solute
c) Both solute and solvent
d) Solution

Answer: a) Solvent

Explanation: A solvent's eluting power is largely a measure of how well it can pull an analyte off the sorbents to which it is attached.
The polarity of a solvent, the polarity of the stationary phase, and the nature of the sample components all influence its elution power.

Q-15: What is a chromatogram?

Answer: A chromatogram is a visible record (such as a graph) demonstrating the outcome of separating the components of a mixture using chromatography.

Practise Questions on Column Chromatography

Q-1: In column chromatography, the mobile phase is _____ and the stationary phase is _____.

a) Solid, solid
b) Liquid, solid
c) Solid, liquid
d) Liquid, solid

Answer: d) Liquid, solid

Q-2: Which of the following cannot be used as the adsorbent material in column chromatography?

a) Calcium phosphate
b) Alumina
c) Calcium carbonate
d) Potassium dichromate

Answer: d) Potassium dichromate

Explanation: An adsorbent material is a stationary phase.Column chromatography employs a variety of stationary phases, including silica, alumina, calcium phosphate, calcium carbonate, starch, and magnesia.

Q-3: The column chromatography elutes two compounds, A and B. (adsorption of B>A).

Which of the following is the correct statement?

a) B will elute first with high R_F value
b) A will elute first with high R_F value
c) B will elute first with low R_F value
d) A will elute first with low R_F value

Answer: b) A will elute first with high R_F value

Explanation: Higher adsorption of the compound results in a lower R_F value with slower speed. As a result, they elute later than those with low adsorption capacity.

Because compound A has a low adsorption capacity, it will be eluted first with a higher R_F value than compound B.

Q-4: Complete separation occurs in column chromatography depending on the degree of adsorption.Three coloured bands l, m, and n are formed in the given column.
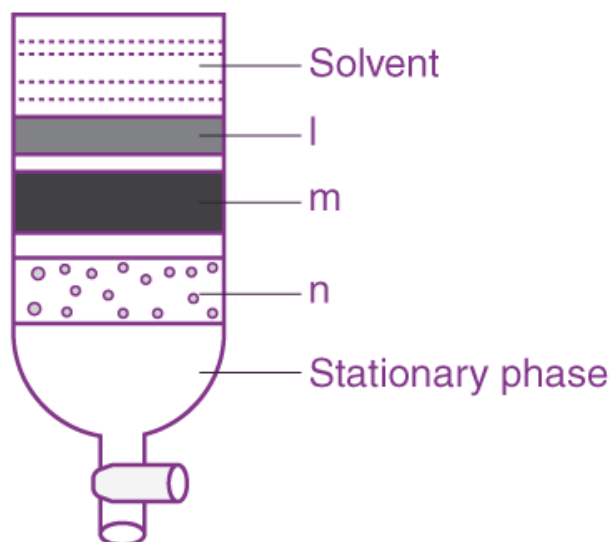
Answer the following questions:

a) The component with higher speed is _____
b) The most readily adsorbed component is _____
c) Arrange the components in the order in which they will elute.

Answer:

a) n

b) l

c) n>m>l

Q-5: How is elution time different from elution volume?

Answer:

Elution Time	Elution volume
A solute's elution time is the time between when the solute enters the column and when the solute elutes.	The volume of eluent required to cause elution is referred to as the elution volume.