

**Passage VI**

*Polarity* is a measure of the separation of charge in a molecule. Molecules are attracted to other molecules based on polarity. In *liquid column chromatography*, a mixture is carried by the flow of solvent through a glass column containing an adsorbent material. If the components of the mixture have different polarities, they will interact differently with the solvent and adsorbent, causing the mixture to separate into its components. When the components *elute* (exit) from the column, they pass through a detector (see Figure 1).

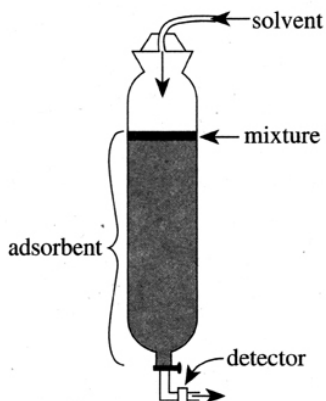


Figure 1

The following experiments were done to study how using solvents and adsorbents of differing polarities affects the separation of a mixture. A component's *elution time* is the time it takes (from the start of the flow) for 100% of the component to be eluted. Table 1 shows the relative polarities (0 being nonpolar and 10 being extremely polar) of the components of the mixture and of the solvents used.

Table 1	
Substance	Polarity
Component	
A	5.6
B	4.2
C	1.1
D	0.4
Solvent	
I	8.2
II	4.1
III	0.2

**Experiment 1**

A glass column 50 cm tall and 7 cm in diameter was packed with 3 kg of a *normal-phase* (highly polar) adsorbent. A mixture containing 0.2 g each of Components A–D was dissolved and then added to the top layer of the adsorbent. Solvent I was then allowed to flow through the column at a constant rate. The % *eluted* of each component was measured for 50 min. The procedure was repeated using Solvents II and III (see Figure 2).

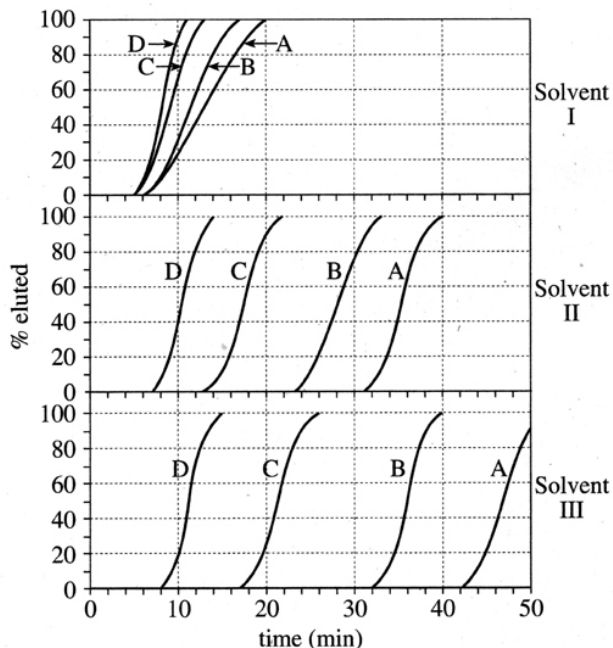


Figure 2

**Experiment 2**

Experiment 1 was repeated, but a *reverse-phase* (non-polar) adsorbent was used in each trial (see Figure 3).

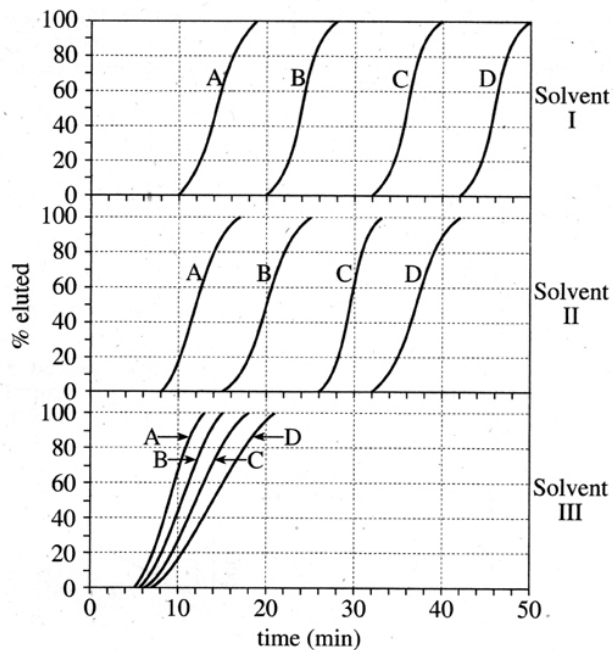


Figure 3

28. In Experiment 1, when Solvent III was used, exactly half the amount of Component B had eluted from the column at a time closest to:
- F. 10 min.
  - G. 15 min.
  - H. 35 min.
  - J. 40 min.

29. Component X has a polarity of 3.9. The results of Experiments 1 and 2 would have been most similar to those shown in Figures 2 and 3 if, in each trial, Component X had been substituted in the mixture for:

- A. Component A.
- B. Component B.
- C. Component C.
- D. Component D.

30. Suppose that Experiment 1 will be repeated using Solvent I, but 0.2 g of Component Z (polarity = 0.7) will be part of the mixture. Which of the following best predicts the order of the elution times of the 5 components, from shortest to longest?

- F. A, B, C, Z, D
- G. A, Z, B, C, D
- H. D, Z, C, B, A
- J. D, C, B, Z, A

31. The *resolution* of a chromatographic separation increases as the amount of time between the elutions of each of the components increases. Based on the results of Experiments 1 and 2, which of the following sets of conditions had the greatest resolution for the separation of the mixture?

	Normal-phase	Reverse-phase
A.	Solvent I	Solvent II
B.	Solvent I	Solvent III
C.	Solvent II	Solvent I
D.	Solvent III	Solvent I

32. In Experiment 1, for Solvent I, at the time when exactly 50% of the amount of Component B had eluted from the column, the percent of Component D that had eluted from the column was closest to:

- F. 10%.
- G. 20%.
- H. 90%.
- J. 100%.

33. Suppose that Experiment 2 was repeated using a solvent with a polarity of 9.3. The elution time of Component D would most likely be:

- A. less than 20 min.
- B. between 20 min and 40 min.
- C. between 40 min and 50 min.
- D. greater than 50 min.