M. Chromatography and Band Broadening

1. Define:
   (a) Stationary phase - does not move
   (b) Mobile phase - moves
2. What do you know about the composition of each phase above for
   (a) Normal phase chromatography - polar stationary, nonpolar mobile
   (b) Reverse phase chromatography - nonpolar stationary, polar mobile
3. What characteristics define a good separation for a chromatography experiment? resolution, narrow bandwidth, resemble natural form
4. What is the minimum resolution required for two peaks to be baseline resolved? 1.5
5. What factors affect the width of a peak on a chromatogram? Write an equation relating the effects of these factors to the flow rate and the breadth of the band. Multiple paths, diffusion, mass transfer

$$H = A + \frac{B}{u_x} + C u_x$$

6. Identify the terms associate with the symbols k', R_s, and D for chromatographic separations. Explain the importance of these terms. k' - retention factor $\rightarrow k' = \frac{t_r - t_m}{t_m}$; R_s - resolution; D - distribution constant

$$k_D = \frac{[S_s]}{[S_m]}$$

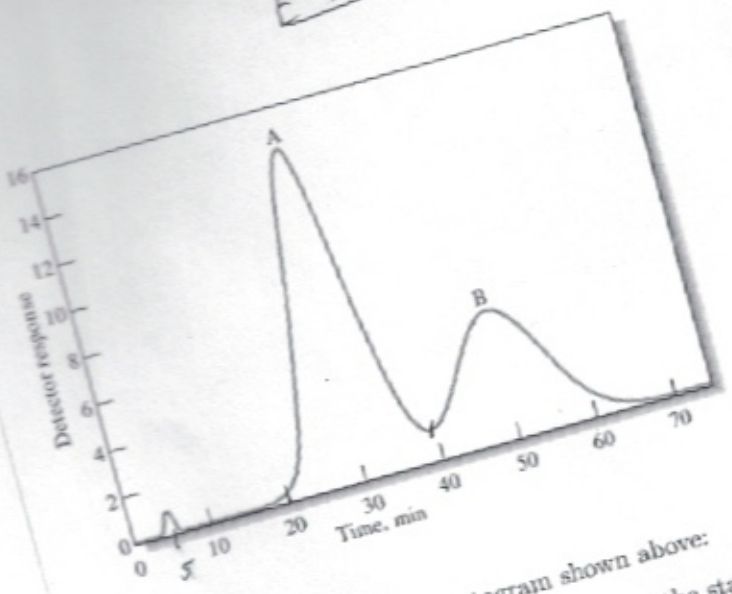
$$\frac{t_{r_2} - t_{r_1}}{\left(\frac{w_1 + w_2}{2}\right)}$$

7. How is the resolution of a chromatogram calculated?
8. How do the relative polarities of the stationary and mobile phase affect the retention time for a solute? greater retention with, depends on polarity of solute
9. What effect do the following have on bandwidth?
   (a) Multiple paths – broadens
   (b) Diffusion – broadens
   (c) Mass transfer – broadens

Where do the three terms in the van Deemter equation come from? What do they represent?

3 terms in H

11. On a single set of axes, sketch the relationship between band broadening and flow rate for each of the factors in the van Deemter equation and the van Deemter equation itself.



12. For the packed liquid chromatogram shown above:

(a) How long did each component spend in the stationary phase?

$t_s = t_r - t_m$ $\quad t_m = 5$

$t_{s,A} = 30 - 5 = 25$ $\quad t_{s,B} = 50 - 5 = 45$

(b) Find the retention time for each component.

$t_{r,A} = 30$ $\quad t_{r,B} = 50$

(c) Determine the retention factor for each component.

$k'_A = \frac{25}{5} = 5$ $\quad k'_B = \frac{45}{5} = 9$

(d) What is the resolution for the two peaks?

$R_s = \frac{50 - 30}{\frac{1}{2}(40)} = \frac{20}{20} = 1$ 28

13. Assuming A is isopropanol and B is hexane, is this an example of normal or reverse phase chromatography?

reverse

14. If the other phase were used how would this affect the elution order?

reverse

15. If B were instead propylene glycol, how would this effect the elution order?

reverse

16. For the van Deemter plot below, identify the optimum linear flow rate and the relative contributions of the factors in the van Deemter equation.