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Quiz 3 (10 pts)  
CEM 434  
Fall 2016

1 (2 pts). In designing a separation method, we use the theoretical plate ( $N$ ) as a measure of the separation efficiency of the column. So it might seem reasonable to assume that more theoretical plates is always better than fewer plates. Why do we not automatically increase the column length anytime we need to improve a separation?

$N = \text{efficiency or plate \#}$        $N = L/H$

Increasing  $L$  (column length) comes with a price. Remember,  $H$  has three terms: eddy diffusion, longitudinal diffusion, stationary phase mass transport. Increasing the column length increases the longitudinal diffusion term, which increases  $H$  and offsets any benefit from increasing  $L$ .

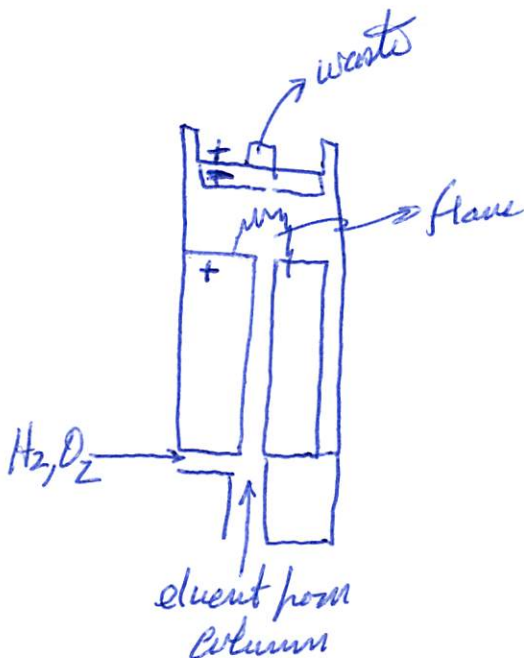
2 (2 pts). Rank the following compounds of the expected elution order for a GC separation under isothermal conditions. (a) ethanol, (b) n-propanol, (c) methanol, (d) n-pentanol and (e) n-butanol.

Separation in GC largely follows boiling point. Increased boiling point, longer retention time. Larger boiling point  $\Rightarrow$  higher molecular weight.

Predicted elution order:

methanol < ethanol < n-propanol < n-butanol < n-pentanol

3 (3 pts). Sketch a schematic of the flame ionization detector (FID) and describe how it functions.



(+) charged plate / burner head  
(-) charged plate near flame

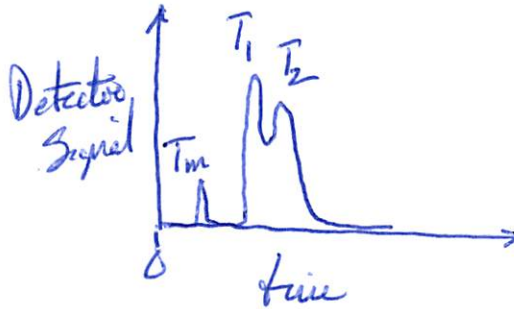
Molecules combusted to produce  
(organic molecules)

$C^+ + e^-$        $C^+$  ions collected at  
(-) biased plate.

ion current  $\propto C^+$  ions detected  
Mass sensitive detector

4 (3 pts). Imagine the following two peaks were observed in the chromatogram just after the peak for the dead volume (unretained mobile phase). Which of the following actions would be the "best" way to improve the resolution. Defend your answer.

- (A) use a longer column
- (B) use a faster carrier gas velocity
- (C) use a slower carrier gas velocity
- (D) use a higher column temperature
- (E) use a lower column temperature



poor resolution at short times.

Need more interaction with the stationary phase so must lower column temperature.

Remember, temperature is a key parameter affecting separations in GC !!