Example Assignment 1

CHEM 312

Q1) The following data is collected from two experiments. What is the critical level of confidence where the results from A become significantly different than B? (Hint use Excel's TDIST function with a two-tail distribution. This function will calculate the probability α, to convert to a confidence level: C.L. = 100(1-α), e.g. $\alpha = 0.05$, C.L. = 95%)

Experiment A		Experiment B
10.5410		10.3764
10.7206		12.4323
10.0470		11.4020
10.2696		11.9898
10.0684		10.3764

	Experiment A		B
Avg	10.3293		11.5501
S_Dev	0.2955		0.8890
%RSD	2.8607		7.6969
Spool	0.6234		
Tcalc	2.9193		
Critical level of confidence %			97.7639

To answer this question:

1- Calculate the averages from A & B
2- Calculate the standard deviations from A & B
3- Pool the standard deviations (see formula sheets)
4- Calculate the value of t
5- Use Excel to calculate the probability associated with the value of t. The formula is of general form TDIST(tcalc,dof,2-tail) and would be entered as =TDIST(value of Tcalc,7,2). In an Exam you may use the t-table and interpolate the value of t.
6- With Excel the C.L. in % is 100 x (1-the probability)

Q2) The following data was collected from a CG experiment. Calculate the retention index for the unknown.

		retention time (s)
unretained marker		100.7
butane		134.9
pentane		159.2
hexane		200.7
heptane		271.6
octane		392.7
nonane		599.6
unknown		163.9

Carbon number		tr (s)		log(tr-tm)
4		134.92		1.535
5		159.21		1.767
6		200.70		2.000
7		271.58		2.232
8		392.68		2.465
9		599.57		2.698
slope				0.232
intercept				0.604
equivalent carbon number of unknown				5.145
retention index				514.5

To answer this question:

1- Calculate the adjusted retention time (tr-tm)
2- Take the log of the adjusted retention time
3- Plot log(adj. time) vs. carbon number (you can also plot against retention index)
4- Calculate the equation of the line and use it to calculate the equivalent carbon number of the unknown. If you plotted against retention index your answer will be the unknown's retention index.
5- Calculate the retention index by multiplying by 100

Q3) Calculate the plate height (in cm) given the following information.

particle diameter			30.366	microns
MP velocity			2.004	cm/s
SP film thickness			1.347	microns
tortuosity factor			0.732	
diffusion constant in MP			2.0938E-04	cm^2/s
diffusion constant in SP			2.6000E-06	cm^2/s
fm(k')			4.630	
fs(k')			3.666	
obstructive factor			0.602	

				common units			in cm	
particle diameter			30.366	microns			0.0030366	
MP velocity			2.004	cm/s			2.00350785	
SP film thickness			1.347	microns			0.00013474	
tortuosity factor			0.732				0.73207163	
diffusion constant in MP			2.0938E-04	cm2/s			0.00020938	
diffusion constant in SP			2.6000E-06	cm2/s			0.0000026	
fm(k')			4.630				4.62964971	
fs(k')			3.666				3.66606438	
obstructive factor			0.602				0.60212763	
terms								
multipath		long diffn		resist in SP		resist in MP		H total
(cm)		(cm)		(cm)		(cm)		(cm)
0.0044		0.0001		0.0513		0.4085		0.4644

To answer this question:

1- Convert all of the values into the same units, in this case I chose cm. You could have alternatively used microns or meters.
2- Use the formulas for the Van Deempter equation to calculate the contributions of each component.
3- Sum the various contributions for the total
4- In this example the resistance to mass transfer in the MP is the dominant source of bandbroadening