CH 3030 Tutorial 7

1. The following equilibrium data for phenol adsorption on a special clay has been obtained at 30°C. Here, c is the concentration in equilibrium in the liquid in mg/l and q is the uptake in mg/g of adsorbent. Which isotherm model among Freundlich and Langmuir best fits the data and what are the isotherm parameters.

c (mg/L)	q (mg/g)
3.9	9.6
6.8	11.6
9.9	14.9
12.0	17.6
16.0	21.0
23.0	25.6
35.7	32.1
61.8	38.2
80.2	40.1

2. 10 litres of water containing 3.5 mg/L of an organic compound is to be treated with charcoal to reduce the final concentration to 0.1 mg/L. The average particle diameter of the charcoal used is 2 mm and the specific surface area is $5m^2/kg$. The adsorption equilibrium at 25°C is represented by $q=50c^{0.32}$ where q is mg of the organic compound per gram of charcoal and c is mg of organic compound per litre of solution. The adsorption is mass transfer controlled with the Sherwood number determined to be 30 and the binary diffusivity estimated to be $1.5x10^{-5}$ cm^2/s.

a) What is the minimum amount of adsorbent required?
b) Using twice the minimum amount of adsorbent required, estimate the batch time required for the desired final concentration of the solution to be attained.

3. Adsorption breakthrough of methyl ethyl ketone (MEK) from air on a zeolite based packed bed adsorber was studied at 20°C and atmospheric pressure. The length of the bed for this experiment was 0.2 m and the superficial gas velocity was 0.29 m/s and the bed density was 700 kg/m^3. The concentration in the feed ci was 0.11 $gmol/m^3$. The following breakthrough data was obtained.

Time (min)	9.5	19	21	25.7	34.3	39	42	46.7	51.4	56.2
c/ci	0	0.018	0.037	0.083	0.287	0.435	0.491	0.62	0.713	0.768

64.7	68.6	72.4	77.1	84.8	97.1	104.7	108.6
0.852	0.935	0.952	0.963	0.97	0.981	0.991	1

a) If the maximum permissible concentration of MEK in the effluent gas is specified as c/ci=0.03, determine the breakthrough time and the length of the mass transfer zone.
b) Using the above data, design a bed for treating 3000 m^3/h of the same gas if an adsorption cycle of 8 hours is allowed. What is the average loading of the bed at the breakthrough time? Calculate the maximum solute loading at the given inlet concentration of MEK in the gas.