Assignment 2

Q .1.

At 25°C, an aqueous solution containing 35.0 wt% H_2SO_4 has a specific gravity of 1.2563. A quantity of the 35% solution is needed that contains 195.5 kg of H_2SO_4.

(a) Calculate the required volume (L) of the solution using the given specific gravity.

(b) Estimate the percentage error that would have resulted if pure-component specific gravities of H_2SO_4 (SG = 1.8255) and water had been used for the calculation instead of the given specific gravity of the mixture.

Q .2.

A mixture of methane and air is capable of being ignited only if the mole percent of methane is between 5% and 15%. A mixture containing 9.0 mole% methane in air flowing at a rate of 700. kg/h is to be diluted with pure air to reduce the methane concentration to the lower flammability limit. Calculate the required flow rate of air in mol/h and the percent *by mass* of oxygen in the product gas. (*Note:* Air may be taken to consist of 21 mole% O_2 and 79% N_2 and to have an average molecular weight of 29.0.)

Q .3.

The reaction A → B is carried out in a laboratory reactor. According to a published article the concentration of A should vary with time as follows:

$$C_A = C_{AO} \exp(-kt)$$

where C_{AO} is the initial concentration of A in the reactor and k is a constant.

(a) If C_A and C_{AO} are in lb-moles/ft^3 and t is in minutes, what are the units of k?

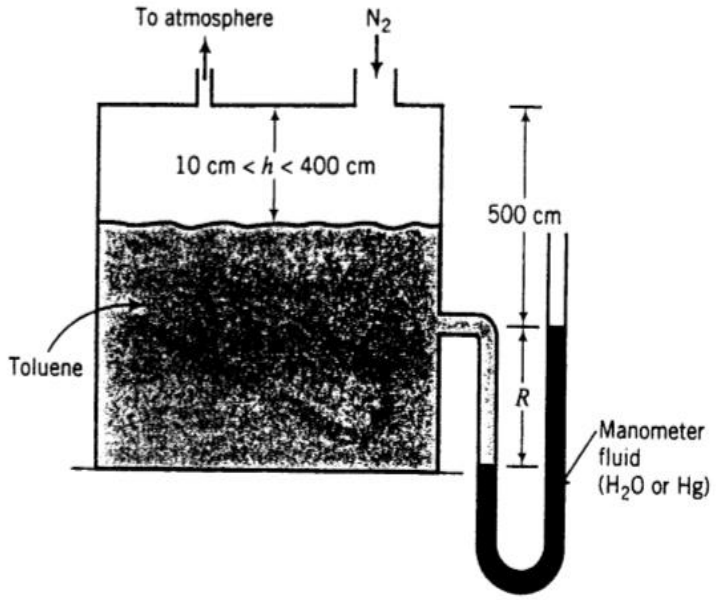
(b) The following data are taken for $C_A(t)$:

t(min)	C_A(lb-mole/ft^3)
0.5	1.02
1.0	0.84
1.5	0.69
2.0	0.56
3.0	0.38
5.0	0.17
10.0	0.02

Verify the proposed rate law graphically (first determine what plot should yield a straight line), and calculate C_{AO} and k.

Q .4.

The level of toluene (a flammable hydrocarbon) in a storage tank may fluctuate between 10 and 400 cm from the top of the tank. Since it is impossible to see inside the tank, an open-end manometer with water or mercury as the manometer fluid is to be used to determine the toluene level. One leg of the manometer is attached to the tank 500 cm from the top. A nitrogen blanket at atmospheric pressure is maintained over the tank contents.



(a) When the toluene level in the tank is 150 cm below the top (h = 150 cm), the manometer fluid level in the open arm is at the height of the point where the manometer connects to the tank. What manometer reading, R (cm), would be observed if the manometer fluid is (i) mercury, (ii) water? Which manometer fluid would you use, and why?

(b) Briefly describe how the system would work if the manometer were simply filled with toluene. Give several advantages of using the fluid you chose in part (a) over using toluene.

(c) What is the purpose of the nitrogen blanket?