CHE 201

HW 3

Q1. The following data are taken for the concentration of A, C_A (mol/L), as a function of time, t (min), from the start of the reaction.

t (min)	C_A (mol/L)
0	$C_{A0} = 1$
20	0.87
70	0.646
130	0.44
180	0.33
250	0.21
∞	$C_{Ae} = 0.1$

If the following equation is used to fit the above data

$C_A = C_{Ae} + (C_{A0} - C_{Ae})\, e^{-kt}$

a) What is the value of k as well as its units (use a rectangular paper as well as a semi-log paper in your solution of this part of the problem.)
b) Determine the value of k using the method of least squares.
c) What will be the mass concentration of A (g/L) after 2 hours from the start? (Molecular weight of A is 20.)

(d) Find the value of k using Excel.

Q2. For laminar flow in pipes, the following equation is used:

$$Q = c\frac{\Delta P \times r^4}{\mu \times L}$$

Where,

Q = volumetric flow rate (volume/time)

ΔP = pressure drop [pressure = (force/area)]

R = radius of the pipe

L = length of the pipe

μ = viscosity

c = dimensionless constant

a) What are the base dimensions of viscosity?

b) What are the units of μ in SI, CGS, and American system?

Q3. The specific gravity of gasoline is approximately 0.70.

a) Determine the mass (kg) of 60 liters of gasoline.

b) The mass flow rate of gasoline exiting a refinery tank is 1370 kg/min. Estimate the volumetric flow rate in liters/s.

c) Estimate the average mass flow rate (Ib_m/min) delivered by a gasoline pump.

d) Gasoline and kerosene (specific gravity = 0.79) are blended to obtain a mixture with a specific gravity of 0.75. Calculate the volumetric ratio (volume of gasoline/volume of kerosene) of the two compounds in the mixture, assuming $V_{blend} = V_{gasoline} + V_{kerosene}$.

Q4. A mixture is 15.0 mole% ethyl alcohol, 65.0 mole % ethyl acetate ($C_4H_8O_2$), and 20.0 mole % acetic acid. Calculate the mass fractions of each compound. What is the average molecular weight of the mixture? What would be the mass (kg) of a sample containing 30.0 kmol of ethyl acetate?