SKKK1113
Assignment 01 - Introduction to Engineering Calculations
Instruction : Write down the basis of calculation and assumptions (if any) clearly. BOX the final answer(s)

1. Toyota Prius is one of the best cars for environmental performance that you can buy on earth. The car generally gets 40.6 miles per gallon of gasoline when driving with the air conditioner on, but gets 59.2 miles per gallon when the air conditioner is off. How much gasoline (in gallons) would you use if you drove 457 miles and only had the air conditioner on for 65% of the miles that you drove? (*Ans: 10.02 gallon*)

2. A supersonic aircraft consumes 6364 gallons of kerosene per hour of flight and flies an average of 14 hours per day. It takes roughly seven tons of crude oil to produce one ton of kerosene. The density of kerosene is 965 kg/m^3. How many planes would it take to consume the entire annual world production of 4.02 X 10^9 metric tons of crude oil? (*Ans: 4833 planes*)

3. A mixing container holds a solution containing 5000 mol of water and 5 lb-mole of NaOH. (Assume: average density of solution=$\Sigma(X_i \rho_i)$)

   a. Calculate the total mass of a solution in (a) kg and (b) lb_m (*Ans: 180.7 kg; 398.4 ib_m*)
   b. Calculate the mass fraction and mole fraction of water and NaOH. (*Ans: X_W=0.498 kg H_2O/kg solution; Y_W= 0.688 mol H_2O/mol solution*)
   c. Calculate the average molecular weight of the solution. (*Ans: MW_{ave}= 24.86 g/mol*)
   d. Calculate the molarity of NaOH in the solution. (*Ans: M=19.7 mol NaOH/L solution*)
   e. Calculate the specific gravity of the solution. (*Ans: SG=1.567*)

4. 100 kilograms of a water and ethanol mixture that has 50 mass percent water is mixed with 80 liters of pure water.

   a. What is the mass (kilogram) of the final mixture? (*Ans: 180 kg mixture*)
   b. What is the final mass percent of ethanol? (*Ans: 0.278 kg EtOH/kg mixture*)
   c. What is the final mole percent of ethanol? (*Ans: 0.131 kmol EtOH/kmol mixture*)

5. Gasoline (SG = 0.70) and kerosene (SG = 0.82) are blended in a 15 m^3 tank to obtain a mixture with a specific gravity of 0.78. Calculate the mass ratio (mass of gasoline/mass of kerosene) of the two compounds in the mixture. (*Ans: 0.427 kg gasoline/kg kerosene*)

6. A liquid stream contains 25 vol % ethanol and the rest is water. What would the molar flowrate (mol/hr) be if the mass flowrate is 100 g/hour? In this problem, assume that volumes are additive; i.e., $V_{total} = V_{water} + V_{ethanol}$. (*Ans: 4.85 mol/hr*)

7. The 1993 Environmental Protection Agency (EPA) regulation contains standards for 84 chemicals and minerals in drinking water. According to the EPA one of the most prevalent of the listed contaminants is naturally occurring antimony. The maximum contaminant level for antimony and nickel has been set at 0.006 mg/L and 0.1 mg/L, respectively.

   A laboratory analysis of a drinking water sample from brand Q shows the antimony concentration to be 4 ppb and that of nickel to be 60 ppb. Is brand Q water is safe for drinking with respect to the antimony and nickel levels? (Assume: the drinking water density to be 1.0 g/mL)