

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. 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 4.02×10^9 metric tons of crude oil? (Ans: 4833 planes)
2. A mixing container holds a solution containing 5000 mol of water and 5 lb-mole of NaOH. (Assume: average density of solution = $\sum(X_i \rho_i)$)
 - a. Calculate the total mass of a solution in (a) kg and (b) lb_m (Ans: 180.7 kg; 398.4 lb_m)
 - b. Calculate the mass fraction and mole fraction of water and NaOH. (Ans: $X_w=0.498 \text{ kg H}_2\text{O/kg solution}$; $Y_w=0.688 \text{ mol H}_2\text{O/mol solution}$)
 - c. Calculate the average molecular weight of the solution. (Ans: $MW_{ave}=24.86 \text{ g/mol}$)
 - d. Calculate the molarity of NaOH in the solution. (Ans: $M=19.7 \text{ mol NaOH/L solution}$)
 - e. Calculate the specific gravity of the solution. (Ans: $SG=1.567$)
3. 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)
4. 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)
5. 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 safe for drinking with respect to the antimony and nickel levels? (Assume: the drinking water density to be 1.0 g/mL) (Ans: Safe)

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