1. The feed water to the reverse osmosis plant has dissolved solids to the extent of 5000 mg/L[14]. The feed-to-product ratio (on mass basis) is 4:3. The treated water (product) from the plant contains 600 mg/L of solids. Fine the dissolved solids in the reject stream.

2. A multiple-effect evaporator system has a capacity of processing one tonne per day of solid caustic soda when it concentrates weak liquor from 4 to 25% (both on mass basis). When the plant is fed with 5% weak liquor and if it is concentrated to 50% (both on mass basis), find the capacity of the plant in terms of solid caustic soda, assuming the water evaporating capacity to be the same in both cases.

3. A sample of coal from Andrew Yules colliery, West Bengal, is found to contain 67.2% carbon and 22.3% ash (mass basis). The refuse obtained at the end of combustion is analyzed to contain 7.1% carbon and the rest ash. Compute the % of the original carbon remaining unburnt in the refuse.

4. Soybean seeds are extracted with n-hexane in batch extractors. The flaked seeds contain 18.6% oil, 69.0% solids and 12.4% moisture. At the end of the extraction process, de-oiled cake (DOC) is separated from the n-hexane-oil moisture. DOC analysis yields 0.8% oil, 87.7% solids and 11.5% moisture. Find the percentage recovery of oil. All percentage are by mass.

5. A vent stream from an ethylbenzene plant has a composition: 66% H_2, 33% CH_4 and 1% other components (CO + C_2H_6 + C_2H_4 etc.). It is passed through a PSA Unit where hydrogen is recovered as 98% pure stream with 2% CH_4 as an impurity. Recovery of hydrogen is 85% at feed pressure of 50 bar. Calculate the composition of reject stream.

6. Composition of soybean oil deodorizer distillate[4] is C_{16}-fatty acids 19.8%, C_{16}-fatty acids 56.1%, monoglycerides 9.2%, squalene 12.0%, mixed tocopherols 11.5%, sterols 14.8%, diglycerides 1.7%, and triglycerides 1.7%. High vacuum distillation is short path distillation unit is carried out at 5 mbar a and 463 K(190°C) to recover a stream consisting of 95% fatty acids, .025% mixed tocopherols and balance other components. Bottom residue is found to contain 10% fatty acids. All percentages are by mass. Calculate the ratio of overhead product to bottom residue.

7. Crystals of $MgCl_2.6H_2O$ have a solubility[15] of 190 g per 100 g ethanol at 298.15 K(25°C). It is desired to make 1000 kg of saturated solution. Calculate the quantities of the crystals and ethanol required to make the above solution. Also, find the composition of the saturated solution by mass.

8. A spent solution of chloroacetic acid in ether contains 20 mole % chloroacetic acid. It is desired to make 500 kg of a saturated solution at acid required to make the above solution.
   Data: The solubility of chloroacetic acid in ether[15] is 190 g/100 g ether at 298.15 K(25°C).

9. A mixture of $CuSO_4.5H_2O$ and $FeSO_4.4H_2O$ weighs 100 g. It is heated in an oven at 378 K(105°C) to evaporate the water of hydration. The mass of mixture after removal of water is 59.78 g. Calculate the mass ratio of $CuSO_4$ and $FeSO_4$ in the mixture.

10. The average molar mass of a flue gas sample is calculated by two different engineers. One engineer uses the correct molar mass of 28 for N_2 and determines the average molar mass to be 30.08, the other engineer, using an incorrect value of 14, calculates the average molar mass to be 18.74.
    (a) Calculate the volme % of N_2 in the fule gases.
    (b) If the remaining components of the fle gases are CO_2 and O_2, Calculate the volume % of each of them

11. A spent lye sample obtained from a soap-making unit contains 9.6% glycerol and 10.3% salt (NaCl). It is concentrated at the rate of 50,000 kg/h in double-effect evaporator until the final solution contains 80% glycerol and 6% salt. Assume that about 4.5% glycerol is lost by entrainment. All percentages are by mass.
    Find: (a) The evaporation taken place in the system: and (b) the amount of salt crystallized out in the salt box of the evaporator.

12. A mixed fertilizer, having the NPK composition 10:26:26 as % N, % P_2O_5 and % K_2O by mass respectively, is to be formulated by mixing ammonia, phosphoric acid, potassium chloride and/or urea.
    (a) If anhydrous ammonia, anhydrous phosphoric acid and 100% pure potassium chloride are used for mixing, calculate the amount of each of them required of formulating 100 kg mixed fertilizer.
    (b) If 100% pure urea is used in place of anhydrous ammonia calculate the amount of urea required for formulating 100 kg mixed fertilizer.
    (c) If anhydrous ammonia 98% potassium chloride (mass %) are available, calculate the strength H_3PO_4 required for making the required mixed fertilizer.

13. For carrying out nitration reaction, it is desired to have a mixed acid containing 39% HNO_3, 42% H_2SO_4 (mass). Nitric acid of 68.3% (mass) is readily available (azeotropic composition). Calculate: (a) the required strength of sulphuric acid to obtain the above mixed. Also solve the problem using triangular chart.