



KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE

**Answer any TEN Questions
(10 X 10 = 100 Marks)**

1.

The sugar solution is prepared by dissolving 30 kg of sucrose in 70 kg of water and density of the solution is 1129 kg/m^3 . Determine.

- ☒ a) concentration, weight per unit weight
- ☒ b) concentration, weight per unit volume
- ☒ c) molarity
- ☒ d) mole fraction
- ☒ e) molality

9-10

8-9

2.

A gas mixture contains 0.28 kmol of HCl, 0.34 kmol of N_2 and 0.09 kmol of O_2 .

Calculate:

- ☒ a) Average molecular weight of gas
- ☒ b) Volume occupied by this mixture in m^3 at 4 atm and 303 K. Take $R = 0.083 \text{ m}^3 \text{ atm/kmol K}$

3. A paint mixture containing 25% of pigment and the balance of water sells for \$18/kg, and a mixture containing 12% pigment sells for \$10/kg. If a paint retailer produces a blend containing 17% pigment, for how much (\$/kg) should it be sold to yield a 10% profit?

4. Strawberries contain about 15 wt% solids and 85 wt% water. To make strawberry jam, crushed strawberries and sugar are mixed in a 45:55 mass ratio and the mixture is heated to evaporate water until the residue contains one-third of water by mass. Draw and label a flowchart of this process and calculate how many pounds of strawberries are needed to make a pound of jam.

5.

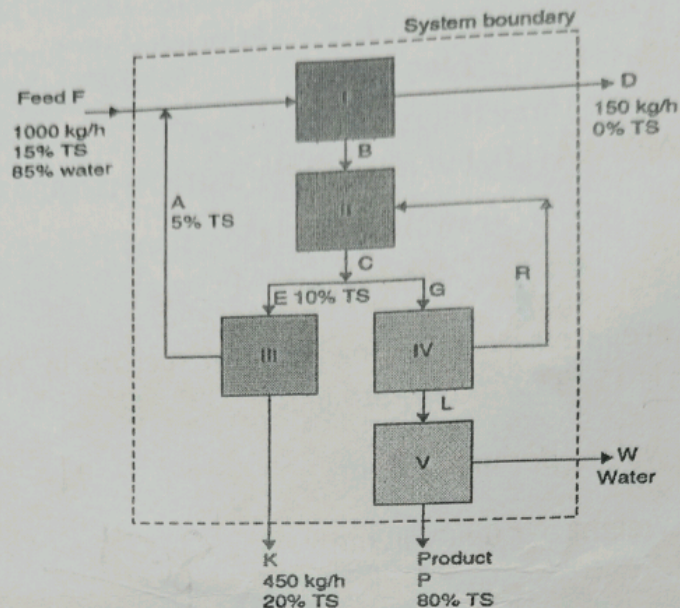
Discuss the concepts of conversion, yield and selectivity with the help of simple stoichiometry.

10

6.

An experimental engineered food is being manufactured using five stages, as shown in Figure. The feed is 1000 kg/h. Various streams have been labelled along with the known composition values on the diagram. Note that the composition of each stream is in terms of solids and water only. Stream C is divided equally into streams E and G. Product P, with 80% solids, is the desired final product. Stream K produces a by-product at the rate of 450 kg/h with 20% solids. Calculate the following:

- a) Calculate the mass flow rate of product (P) and water (W).
- b) Calculate the mass flow rate of recycle stream A.
- c) Calculate the mass flow rate of recycle stream R.



7. Air containing 21% (mole) O_2 and 79% (mole) N_2 is to be heated from 300 K to 450K. Calculate the heat required to be added if the air flow rate is 5 m^3 per minute using data given below.

$$C_{p, O_2} = 26.01 + 11.76 \times 10^{-3}T - 2.35 \times 10^{-6}T^2, \text{ kJ/kgmol K}$$

$$C_{p, N_2} = 29.60 - 5.15 \times 10^{-3}T + 13.19 \times 10^{-6}T^2, \text{ kJ/kgmol K}$$

8. Write a note on the following

- a) Dimensional homogeneity
- b) Model analysis and Similitude

9. The pressure difference Δp in a pipe of diameter D and length ℓ due to turbulent flow depends on velocity V , density ρ , viscosity μ , and roughness k . Using Buckingham's π -theorem obtain an expression for Δp . (Select D , V and μ as repeating variable)

10. Describe in detail the concepts of pressure and its measurement using u-tube differential manometer with its points are at the same level.

11. A 30 cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s. Find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s.

12. Explain the venturimeter cross section with a neat sketch and mention its application with appropriate equations.

