

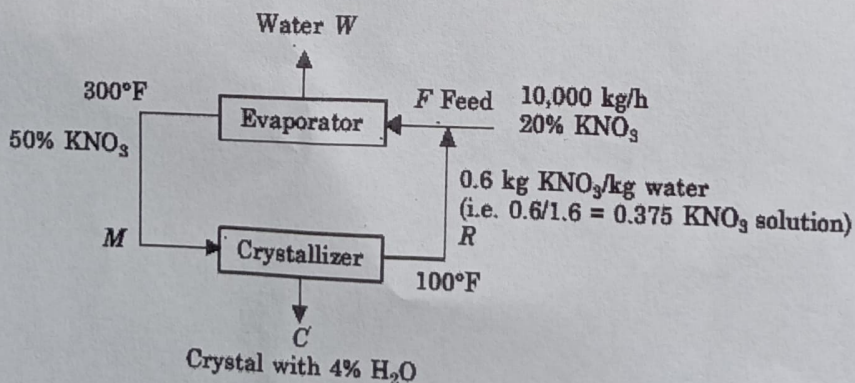


KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS TREATED AS EXAM MALPRACTICE

Answer any TEN Questions

(10 X 10 = 100 Marks)

1. A solution of sodium chloride in water contains 230 g/L of NaCl at 293 K. The density of the solution at that temperature is 1.148 g/cm³. Calculate the following composition by weight percent, composition by mole percent, composition by atomic percent and volume percent of water. The density of water at 298 K is 0.998 g/cm³.
2. a) The latent heat of vaporisation of saturated steam at 250 psi is 1201.1 Btu/lb. Convert the pressure and enthalpy values into SI units. (1 psi = 6.895 kN/m²; 1 Btu = 1055 J ; 1 lb = 0.454 kg) [5]
b) Write a short note on specific gravity measurement in API and Baume scales. [5]
3. 10,000 kg of mixture of benzene and toluene containing 50 mole % benzene is distilled to get an overhead product containing 95 mole % benzene and a residue containing 90 mole % toluene. Calculate the weights of benzene and toluene in the feed, distillate and residue.
4. Saturated steam at 1 atm is discharged from a turbine at a rate of 1150 kg/h and its specific enthalpy was 2676 kJ/kg. Superheated steam at 300°C and 1 atm with specific enthalpy 3074 kJ/kg is needed as a feed to a heat exchanger; to produce it, the turbine discharge stream is mixed with superheated steam available from a second source at 400°C and 1 atm with specific enthalpy 3278 kJ/kg. The mixing unit operates adiabatically. Calculate the amount of superheated steam at 300°C produced.
5. What is the flow rate in recycle stream in figure shown below?



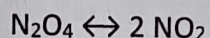
6. Derive the relationship between enthalpy, internal energy and heat added to the system.

7. 30,000 m³ of coal gas measured at 289 K and 1 atm is saturated with water vapour. This is compressed to 340 kN/m² pressure and cooled to 289 K and the condensed water is drained off. Subsequently, the pressure is reduced to 170 kN/m² and gas is distributed at this pressure and 289 K. What is the % humidity after treatment? The vapour pressure of water at 289 K is 1.8 kN/m².
8. Use Buckingham's theorem and show that the discharge of a centrifugal pump is given by

$$Q = ND^2 f\left(\frac{gH}{N^2 C}, \frac{\mu}{N \rho D^2 \rho}\right)$$

Where (N) is the speed of the pump in r.p.m., (D) the diameter of impeller, (g) gravitational acceleration, (H) manometric head, (μ), (ρ) are the dynamic viscosity and the density of fluid.

9. When nitrogen tetroxide is heated to 673 K, 50% of it dissociates. If 30 kg of nitrogen tetroxide is heated to 673 K and 740 mm Hg, calculate the volume occupied by the resulting gases. (use $R = 0.08205 \text{ m}^3 \text{ atm/kmol K}$)



10. Discuss in detail about the different types of manometer and their applications with the neat labelled sketches.
11. Explain about the classification of pumps in detail with neat labelled sketches.
12. A straight, horizontal water pipe changes diameter from 6 in. at the inlet to 3 in. at the outlet. If the pressures are 7.5 psi at the inlet and 5.0 psi at the outlet, find the flow rate at 70°F. At 70°F $\gamma_{\text{water}} = 62.3 \text{ lbs/ft}^3$. Ignore friction. ($g = 32.17 \text{ ft/s}^2$)

