

This question paper contains 4 printed pages.

3143

Your Roll No. _____

M. E.

J

POLYMER TECHNOLOGY

Paper – CH.503

(Unit Operation – I)

Time : 3 hours

Maximum Marks : 100

*(Write your Roll No. on the top immediately
on receipt of this question paper)*

*Attempt any five questions.
All questions carry equal marks.*

1. (a) Convert the following:
 - (i) 1000 kcal/hr m °C to W/mK 2
 - (ii) 100 Btu/hr ft²°F to cal/s cm²°C 2
 - (iii) 0.8 Btu/lb_m °F to cal/g °C 2
- (b) In an evaporator a dilute solution of 4% NaOH is concentrated to 25% NaOH. Calculate the water evaporated per kg of feed. 5
- (c) When heated to 100 °C and 720 mm Hg, 17.2 g of N₂O₄ gas occupies a volume of 11,450 cc. Assuming that the ideal gas law applies, calculate the percentage dissociation of N₂O₄ to NO₂. 9

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2. (a) Compare laminar and turbulent flow in regard to:
- (i) Velocity profile 2
 - (ii) Ratio of average to maximum velocity 2
 - (iii) Dependence of flow rate on pressure drop. 2
- (b) An oil is being pumped inside a 10.0 mm diameter pipe at a Reynolds number of 2100. The oil density is 855 kg/m^3 and the viscosity is $2.1 \times 10^{-2} \text{ Pa.s}$.
- (i) What is the velocity in the pipe?
 - (ii) It is desired to maintain the same Reynolds number of 2100 and the same velocity as in part (i) using a second fluid with a density of 925 kg/m^3 and a viscosity of $1.5 \times 10^{-2} \text{ Pa.s}$. What pipe diameter should be used? 8
- (c) What is meant by the term "non-Newtonian"? What types of substance exhibit this behavior? 6
3. Discuss the importance of unit operations in chemical and other processing industries. Mention the different unit operations occurring in these industries and describe them in brief. 20
4. (a) A continuous fractionating column is designed to separate 5000 kg/hr of a solution of benzene and toluene containing 30 wt percent benzene into an overhead product containing 95 wt percent benzene and a bottom product containing 95%

- toluene by weight. Determine the quantity of top and bottom products. 10
- (b) A venturimeter having a throat diameter of 38.9 mm is installed in a line having an inside diameter of 102.3 mm. It meters water having a density of 999 kg/m³. The measured pressure drop across the venturi is 156.9 kPa. The venturi coefficient C_v is 0.98. Calculate the flow rate. 10
5. (a) Explain the different modes of heat transfer. 9
- (b) A thick-walled tube of stainless steel having a $k=21.63$ W/mK with a dimension of 0.0254 m ID and 0.0508 m OD is covered with a 0.0254 m layer of asbestos insulation, $k=0.2423$ W/mK. The inside wall temperature of the pipe is 811 K and the outside surface of the insulation is at 310.8 K. For a 0.305 m length of pipe, calculate the heat loss and also the temperature at the interface between the metal and insulation. 11
6. (a) Compare the reciprocating and centrifugal compressor. 10
- (b) Sketch the different types of agitators used in mixing of liquids. 7
- (c) Why are the baffles provided in mixing tanks? 3
7. Discuss the various types of equipments used in particle size reduction. 20