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淡江大學八十九學年度碩士班招生考試試題

系別：化學工程學系　　科目：輸送現象與單元操作

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本試題雙面印製

1. (20%)

Water having a density of 998 kg/m^3 is flowing at the rate of 1.6 m/s in a 0.15-m-diameter horizontal pipe at a pressure of 65.5 kPa abs. It then passes to a pipe having an inside diameter of 0.05 m. Calculate the pressure in the 0.05-m pipe. Assume no friction losses.

2. (20%)

A small copper ball with a diameter of 20.8 mm and initially at 370 K is suddenly immersed into a liquid held constant at 310 K. The convection coefficient h = 15.5 W/m^2-K. The physical properties of the wire can be assumed constant and are thermal conductivity k = 375 W/m-K, heat capacity c_p = 0.389 kJ/kg-K, and density ρ = 8890 kg/m^3.

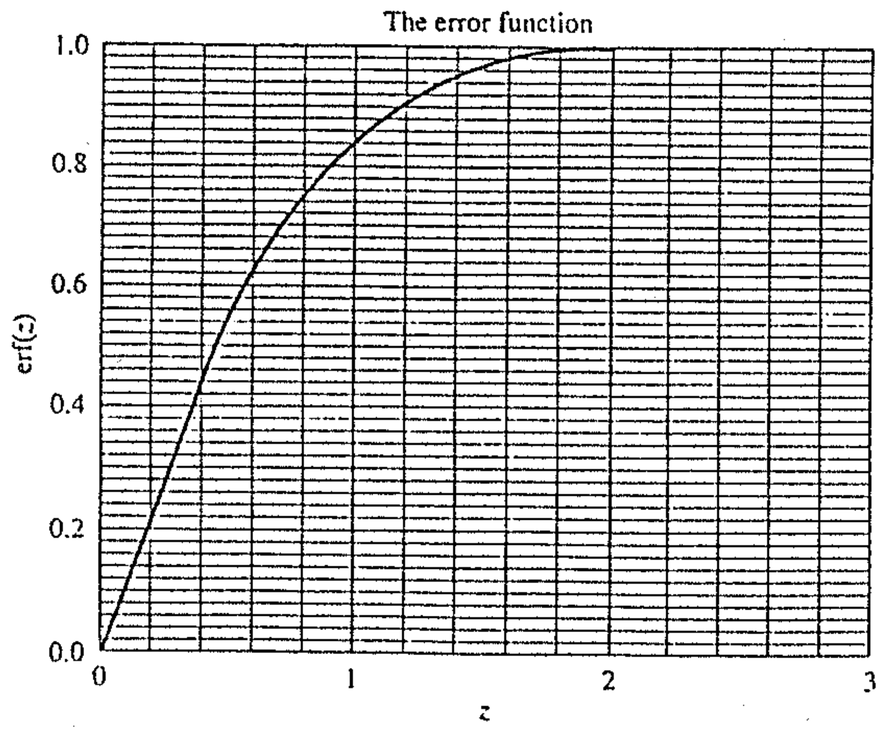
(a) Determine the time for the average temperature of the wire to drop to 340 K.

(b) For part (a), calculate the total amount of the heat removed.

3. (20%)

A very thick slab has a uniform concentration of solute A of c_0 = 0.01 mole A/m^3. Suddenly, the concentration of the front face of the slab is changed to 0.1 mole A/m^3. The diffusivity of A in the slab is $D_{AB} = 5\times10^{-9}$ m^2/s. Assuming that the slab is a semiinfinite solid, calculate the concentration in the solid at 0.01 m from the front face after 1 hour.

The value of the error function *erf*(z) vs. z is shown in following figure.



◀注意背面尚有試題▶

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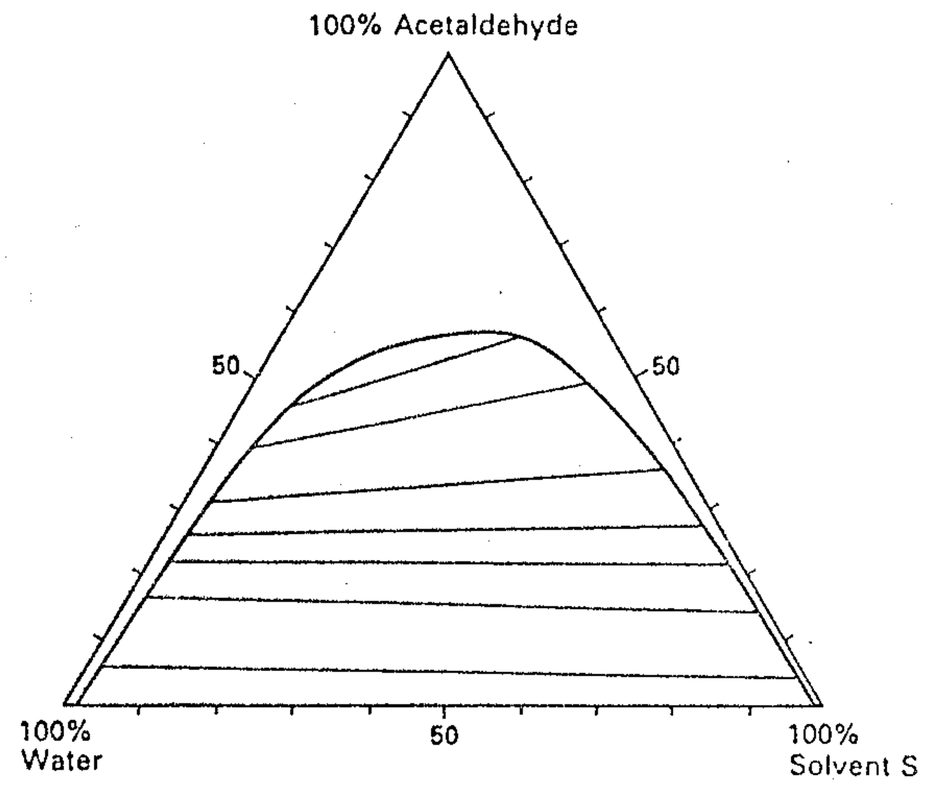
4. (20%)

A 100 kg aqueous solution with 45 wt% acetaldehyde is extracted by a total amount of 100 kg pure solvent S in a two theoretical-stages cocurrent process. The solvent used in each stage was 50 kg, what fraction of the acetaldehyde could be extracted? The equilibrium relationship for this system is given in the following diagram:



5. (20%)

A single-effect evaporator is concentrating a feed organic solution from 10 to 50 wt%. The solution has a negligible boiling-point rise. The heat capacity of the feed is c_p = 4.06 kJ/kg-K and the feed enters at 15.6°C. Saturated steam at 101.32 kPa is available for heating, and the pressure in the vapor space of the evaporator is 15.3 kPa. A total of 4536 kg/h of water is to be evaporated. The overall heat-transfer coefficient is 1950 W/m²-K. What is the required heat transfer area in the evaporator and the steam consumption?

[From steam tables: water at 15.3 kPa, the boiling-point is 54.3°C, and the latent heat is 2372.4 kJ/kg; saturated steam at 101.32 kPa, the temperature is 100°C, and the latent heat is 2257.1 kJ/kg. The conversion factor, 1 J/s = 1 W]

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