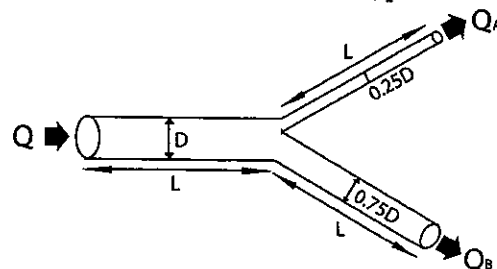


多重選擇題：(總共三題，請務必在“選擇題作答區”作答，正確答案有兩或三個，必須全對才給分)

1. With regard to “heat and mass transfer,” which of the following statements are correct? (5%)
  - (A) The Sherwood number in turbulent-flow mass transfer to pipe walls is a function of the Reynolds number and the Prandtl number.
  - (B) A high value of Prandtl number indicates rapid diffusion of momentum by viscous action compared to diffusion of mass.
  - (C) The Nusselt number is the ratio of diffusion to convection resistance.
  - (D) A high value of Schmidt number indicates rapid diffusion of momentum by viscous action compared to diffusion of mass.
  - (E) In the two-film theory, it is assumed that turbulence dies out at the interface and that a laminar layer exists in each of the two fluids.
  
2. Considering a packed column for distillation, which of the following statements are correct? (5%)
  - (A) If the equilibrium curve can be considered linear, the height equivalent of a theoretical plate is equal to the height of a transfer unit in all circumstances.
  - (B) The values of the height equivalent of a theoretical plate for full-scale plants are generally in the range of 0.3 to 0.9 m.
  - (C) The pressure drop in a packed column depends on the gas and liquid flow rates, as well as the packing size, shape and height.
  - (D) For distillation operating at low reflux ratios, the establishment of good distribution of the liquid is more difficult than operating at high reflux ratios.
  - (E) The process of enrichment is stagewise.
  
3. With regard to “drying,” which of the following statements are correct? (5%)
  - (A) For heat-labile materials, the use of freeze drying is preferable to the use of regular drying.
  - (B) In a porous material, diffusion of internal moisture to the material surface may limit the rate of drying.
  - (C) Drying can be achieved only by vaporization.
  - (D) The critical moisture content does not vary with the rate of drying and the thickness of the material.
  - (E) The rate of drying does not change appreciably if a continuous liquid film exists over the entire material surface.

非選擇題：(總共五題，請務必寫明題號)

4. We consider a liquid flowing through the pipeline depicted below. The pipe with inner diameter  $D$  connects to two smaller pipes with inner diameters  $0.25D$  and  $0.75D$ . All three pipes have length  $L$ , and  $L$  is much larger than  $D$ .  $Q$ ,  $Q_A$  and  $Q_B$  are the volumetric flow rates in three pipes. Please answer the following questions:
  - (a) If the liquid is a Newtonian fluid, please determine the ratio of  $Q_A$  to  $Q_B$ . (4%)
  - (b) If the liquid is a power-law fluid with  $n=0.5$ , please determine the ratio of  $Q_A$  to  $Q_B$ . (12%)



見背面

5. The pressure rise across a pump P is affected by the fluid density  $\rho$ , the angular velocity  $\omega$ , the impeller diameter D, the volumetric flow rate Q, and the fluid viscosity  $\mu$ .
- To perform dimensional analysis, we need to know the dimension of each variable (P,  $\rho$ ,  $\omega$ , D, Q, and  $\mu$ ) in terms of M (mass), L (length) and t (time). For example, the dimension of  $\rho$  is  $ML^{-3}$ . Please give the dimension of the rest five variables. (10 %)
  - How many independent dimensionless groups are necessary to characterize this problem? (2 %)
  - Find appropriate dimensionless groups, choosing them so P, Q and  $\mu$  appear only once. (9 %)
6. We consider heat transfer in the following solid construct that has thermal conductivity  $k_s=400$  W/mK. The length of the construct L is 10 cm, and the radii of the ends are 2 cm ( $r_1$ ) and 2.5 cm ( $r_2$ ), respectively. Except both ends, the surface of the construct is perfectly insulated, and we can assume that conduction is one dimensional (in x direction). If the ends of the construct are maintained at constant temperatures,  $T_1=400$  K and  $T_2=300$  K, please determine the steady-state rate of heat transfer through this construct. (15 %)



7. Assuming that gas F diffuses through a stagnant film of gas surrounding a spherical catalyst particle. An instantaneous reaction  $2F \rightarrow G$  occurs at the surface of the catalyst particle. Gas G diffuses back through the stagnant film into the bulk. Assuming constant temperature and pressure conditions, the thickness of the stagnant film is  $\delta$ ; The radius of the catalyst particle is R; The mole fraction of F outside the stagnant film is  $Y_{FO}$ ; The mole fraction of G outside the stagnant film is  $Y_{GO}$ ; The total molar concentration is C; The diffusivity of gas F is D.
- If this is a steady-state process, please write the governing mass-transfer equation and the associated boundary conditions. (6%)
  - Please determine the distribution of mole fraction of F in the stagnant film. (6%)
  - Please also find out the reaction rate at the surface of the catalyst particle. (6%)
8. A binary mixture containing 40 mol% A and 60 mol% B at the rate of 200 mol/h is to be separated in a fractionating column. The top product contains 90 mol% A, and the bottom product contains 10 mol% A. If the feed contains 50% liquid and 50% vapor and the relative volatility is 3, please determine: (請直接計算求解，或在答案卷上作圖求解)
- The flow rates of the top and bottom products (5%)
  - The minimum reflux ratio (5%)
  - The bottom operating line if a reflux ratio of 4 is to be used. (5%)

試題隨卷繳回