國立高雄應用科技大學
107 學年度研究所碩士班招生考試
化學工程與材料工程系碩士班
單元操作及輸送現象

注意：a. 本試題共 6 題，共 100 分
b. 作答時不必抄題，**務必依序作答**。
c. 考生作答前請詳閱答案卷之考生注意事項

1. A binary mixture containing the vapor and liquid of A and B in equilibrium at room temperature. The relative volatility of A and B is α_{AB}. Please answer the following questions.
   (a) Explain the definition of α_{AB}. (in partial pressure & molar fraction of composition). (5%)
   (b) Write $\alpha_{AB} = \alpha_{AB}$ (x_A, x_B, y_A, y_B), where x and y is the molar fraction of vapor and liquid phase, respectively. (5%)
   (c) If vapor-liquid equilibrium system, the Raoult's law is applicable. Please derive the relationship between relative volatility and vapor pressure of pure component. (5%)

2. (a) Explain the penetration theory. (5%)
   (b) What is the two-film theory? Derive the molar flux N_A by the mass transfer model. (5%)
   (c) Explain the surface-renewal theory. (5%)

3. In the system of flow past immersed bodies, please explain the follows.
   (a) Write the definition of drag coefficient. (5%)
   (b) What is Stoke's law? (5%)
   (c) Derive the relationship between drag coefficient and Reynold's number of particle. (5%)

4. Benzene at 100 °F is pumped through the system of Figure 1 at the rate of 40 gal/min. The reservoir is at atmospheric pressure. The gauge pressure at the end of the discharge line is 50 lb_f/in^2. The discharge is 10 ft and the pump suction 4 ft above the level in the reservoir. The discharge line is 1.5-in. Schedule 40 pipe, and the discharge velocity of the pipe is 6.31 ft/s.

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The friction in the suction line is known to be 0.5 lb_f/in^2, and that in the discharge line is 5.5 lb_f/in^2. The mechanical efficiency of the pump is 60 %. The density of benzene is 54 lb_m/ft^3, and its vapor pressure at 100 °F is 3.8 lb_f/in^2.

Calculate (a) the total power input in hp, (10%) (b) the net positive suction head in ft. (10%)

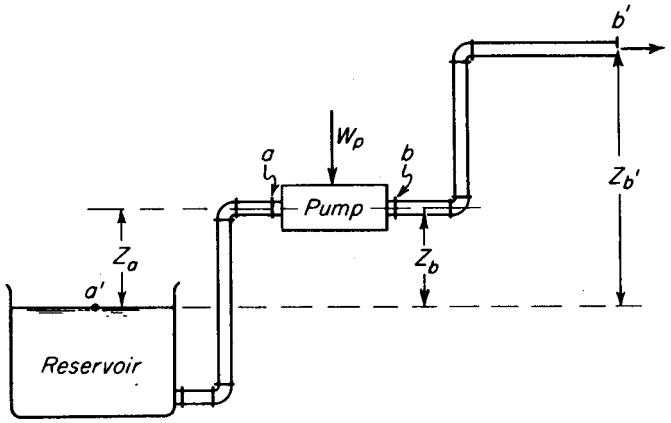

Figure 1

5. Application of heat conduction is in the calculation of the efficiency of a cooling fin. Such fins are used to increase the area available for heat transfer between metal walls and poorly conducting fluids such as gases. A simple rectangular fin is sketched in Figure 2 as shown below. It is known that no heat is loss from the end, and the heat flux at the surface is given by $q = h (T-T_a)$, in which h is constant and $T = T_{(z)}$. **Please derive** the temperature distribution equation of $T_{(z)}$. (20%)

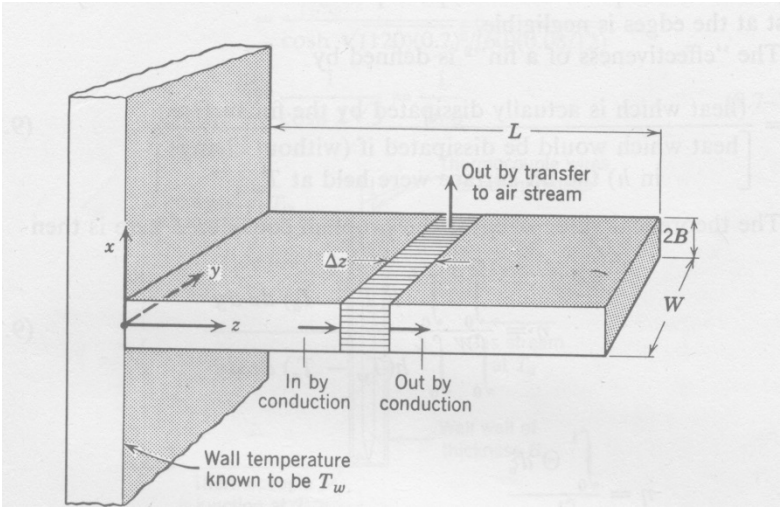

Figure 2 A simple cooling fin with B << L

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6. The liquid-liquid phase diagram is shown in Figure 3. Please explain the physical meaning of (a), (b) and (c) noted in this figure, respectively. (each 5%)

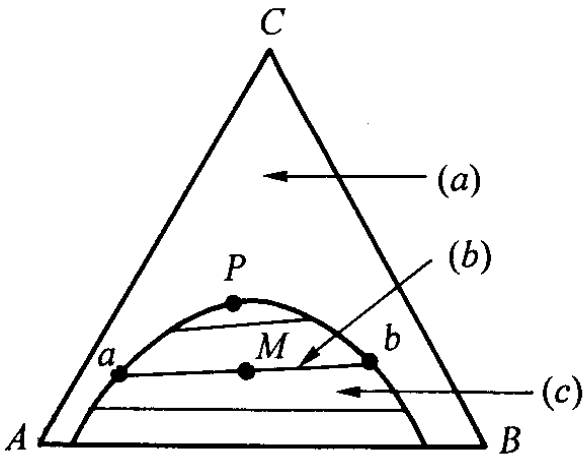

Figure 3

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