淡江大學 105 學年度碩士班招生考試試題

系別：化學工程與材料工程學系 A 組　　科目：輸送現象與單元操作

考試日期：3 月 5 日(星期六) 第 2 節　　本試題共 四 大題， 二 頁

本試題雙面印刷

1. Derive the following Hagen-Poiseuille law in fluid mechanics:

$$Q = \frac{\pi R^4 (P_0 - P_L)}{8\mu L}$$

where Q is the volume flow rate, μ the viscosity, P_0, P_L the end pressures for the Newtonian fluid flowing through a horizontal circular tube with a radius R and L in length. (30 points)
[*Hint*: Make a shell momentum balance in a horizontal circular tube]

2. A steel ball having a radius of 1.0 in. is at a uniform temperature of 800°F. It is suddenly plunged into a medium whose temperature is held constant at 250°F. Assuming a convective coefficient of $h = 2.0$ $\mathrm{btu/h \cdot ft^2 \cdot °F}$, calculate the temperature of the ball after 1 h (3600 s). The average physical properties are $k = 25$ $\mathrm{btu/h \cdot ft \cdot °F}$, $\rho = 490 lb_m/ft^3$, and c_p=$0.11 \mathrm{btu}/lb_m \cdot °F$.
(30 points)

[*Hint*: Assume that the lumped capacity method can be used. You must make a heat balance on the steel ball for a small time interval of time dt, and the heat transfer from the media to the ball is equal to the change in internal energy of the ball $c_p \rho V dT$.]

3. It is desired to absorb 90% of the acetone in a gas containing 1.0 mol % acetone in air in a countercurrent stage tower. The total inlet gas flow to the tower is 30 kg mol/h, and the total inlet pure water flow to be used to absorb the acetone is 90 kg mol H_2O/h. The process is to operate isothermally at 300 K and a total pressure of 101.3kPa. The equilibrium relation for the acetone in the gas-liquid is y = 2.53x. Determine the number of theoretical stages required for this separation.
(30 points)

4. Explain briefly (not just only translation) the following technical terms:
(10 points)

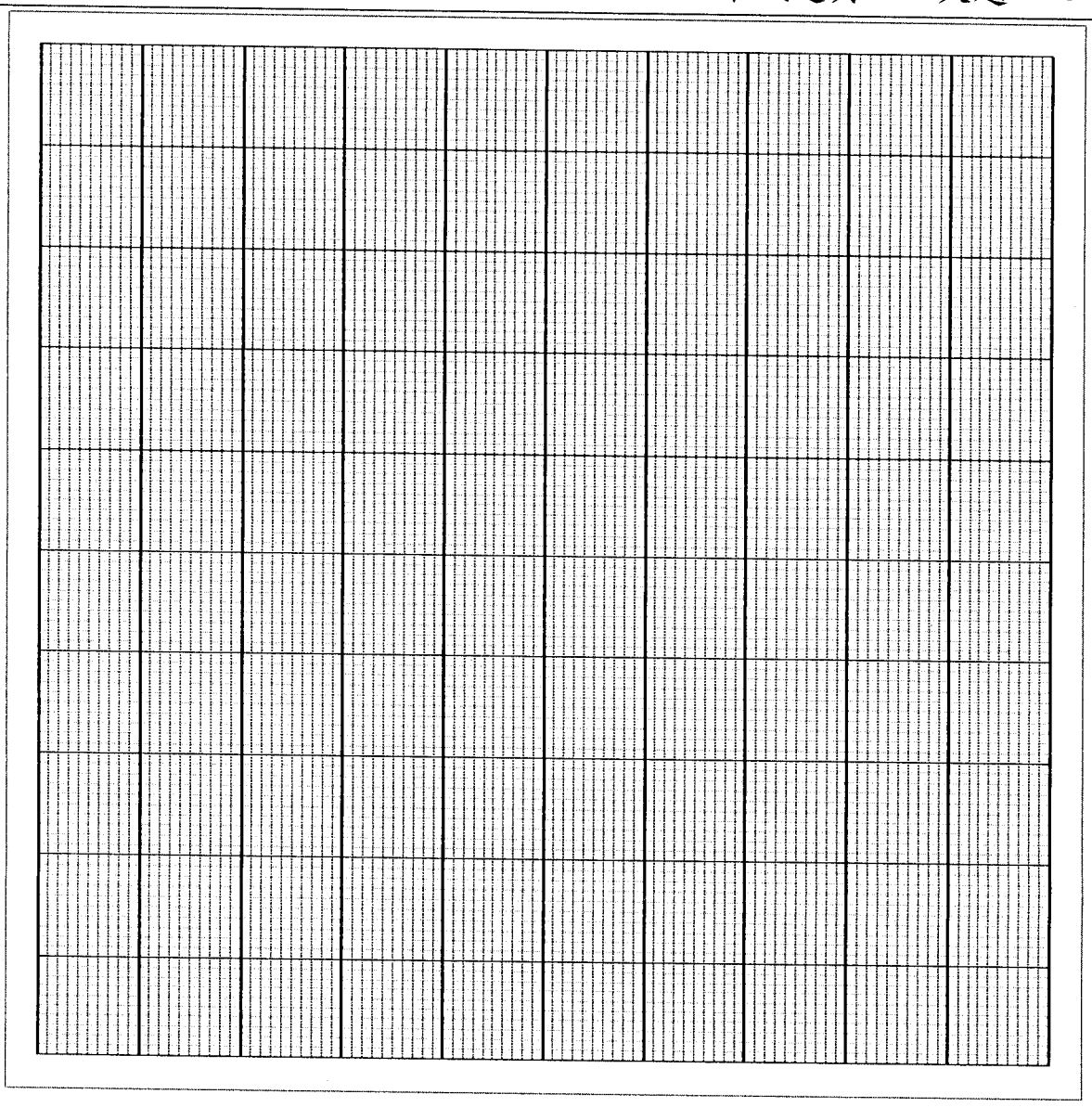
(A) Prandtl number
(B) Liquid-liquid extraction

背面尚有試題

淡江大學 105 學年度碩士班招生考試試題

系別：化學工程與材料工程學系 A 組　　科目：輸送現象與單元操作

考試日期：3 月 5 日(星期六) 第 2 節　　本試題共 四 大題， 二 頁



註：1. 此方格紙為第 3 題作答繪圖使用，需與答案紙*夾在一起*繳交評分。
2. 可以鉛筆繪圖，以方便塗改。
3. 請在以下表格填寫清楚 准考證號碼與姓名。

准考證號碼	姓名