選擇題 (請注意每題均有兩個正確選項，請於"選擇題作答區"作答，須完全正確才給分，每題 5 分，不倒扣，選擇題共 40 分)

1. 關於蒸餾(distillation)塔下列敘述何者正確【A】蒸餾塔進料位置以下的可稱為 stripping(氣提) section，【B】蒸餾塔進料位置以上的可稱為 rectifying (精餾) section，【C】所謂的 q-line 其截距代表著進料的狀態，【D】迴流比(reflux ratio)與建塔硬體成本呈正向關係，【E】迴流比與建塔硬體成本呈反向關係
2. 關於氣提(stripping)下列敘述何者正確【A】是指物質由液相傳遞至氣相，【B】與吸收(absorption)物質傳遞方向相反，【C】與蒸發(evaporation)是指同一單元操作，【D】是指以氣動(pneumatic)方式傳遞顆粒之設計，【E】特別適合奈米(nanometer)顆粒之物質傳送
3. 關於蒸發罐(evaporator)下列敘述何者正確【A】多效(multi-effect) 蒸發罐是指將蒸發罐串聯，【B】多效蒸發罐目的是提高蒸汽使用效率，【C】多效(multi-effect)蒸發罐是指具有多功能設計的蒸發罐，【D】正向進料（forward-feed）多效蒸發罐具有較高的蒸汽使用效率，【E】反向進料（backward-feed）多效蒸發罐具有較高的蒸汽使用效率
4. 關於以氣液逆流進行質傳的填充塔(packed tower)的下列敘述何者正確【A】氣體流量大於溢流點(flooding point)會使液體溢出塔頂，【B】氣體流量大於負載點(loading point)會使塔內液體滯留量(liquid holdup)增加，【C】相較於負載點，溢流點發生於壓力降(pressure drop)較低時，【D】相較於負載點，溢流點通常發生在較低之氣體流速，【E】相較於負載點，溢流點附近壓力降受氣體流量之影响較不顯著
5. 關於質傳係數(mass transfer coefficient)與擴散係數(diffusivity)下列敘述何者正確【A】薄層理論(film theory)指出質傳係數與擴散係數一次方成正比，【B】由滲透理論(penetration theory)指出質傳係數與擴散係數 0.5 次方成正比，【C】由表面更新(surface renewal)理論指出質傳係數與擴散係數的平方成正比，【D】由邊界層(boundary layer)理論指出質傳係數與擴散係數的一次方成正比，【E】由邊界層理論指出質傳係數與擴散係數的平方成正比
6. 關於平板上邊界層的厚度下列敘述何者正確【A】層流(laminar flow)時，速度(velocity)邊界層厚度與熱傳(thermal)邊界層厚度的相對大小與 Prandtl number 無因次群有關，【B】紊流(turbulent flow)時速度邊界層厚度約等於熱傳邊界層厚度，【C】速度邊界層厚度總是比熱傳邊界層厚度大，【D】速度邊界層厚度總是比熱傳邊界層厚度小，【E】速度邊界層厚度與熱傳邊界層厚度的相對大小與雷諾數(Reynolds number)無因次群有關
7. 在單元操作及輸送現象中，下略何者類比是恰當的【A】熱傳中的 thermal diffusivity 類似於流體力學中的 kinematic viscosity，【B】熱傳中的 thermal diffusivity 類似於質傳中的 diffusion coefficient ，【C】熱傳中的 Stanton number 與質傳中的 Stanton number 是相同的東西，【D】熱傳中的 Colburn j factor 與質傳中的 Colburn j factor 是相同的東西，【E】熱傳中 Schmidt number 類似於質傳中的 Sherwood number
8. 下列何者流量計是利用壓降(pressure drop)變化為量測流量大小的基礎【A】ultrasonic

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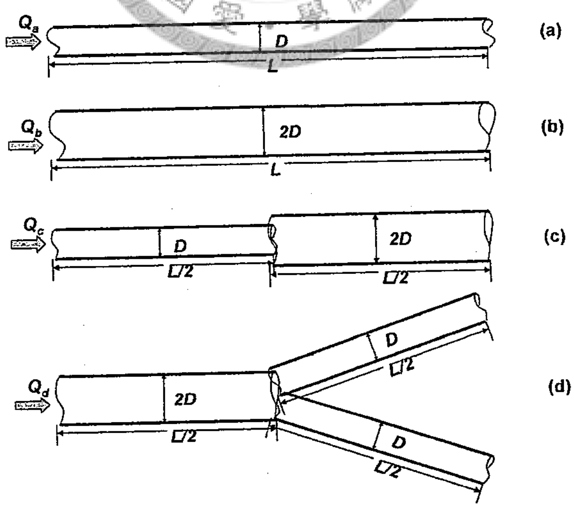
meter，【B】turbine meter，【C】rotameter，【D】pitot tube，【E】Venturi meter

非選擇題(配分列於各子題，共 60 分)

1. Please draw an illustrative diagram of the following unit operations.
   (a) 2-4 shell-and-tube heat exchanger **(5%)** (2) Cross flow filtration **(5%)**
2. (a) What is the physical meaning of Reynolds number? **(2 %)** Estimate the Reynolds number for the following systems: (b) tap water flowing though a 10-in pipe **(1 %)**; (c) air blowing onto a CPU in your notebook to remove produced heat **(1 %)**; (d) a polypropylene melt coating on a glass fiber at 1 mm thickness **(1 %)**.
3. (a) What is the physical meaning of Prandtl number? **(2 %)** Estimate the Prandtl number for (b) water **(1 %)**; (c) air **(1 %)**; (d) supercritical water **(1 %)**.
4. (a) What is the physical meaning of view factor? **(2 %)** (b) Estimate the view factor between two infinitely large, parallel plates with black-body surfaces **(1 %)**; (c) Estimate the view factor between two concentric, black-body surfaces with inner diameter (D_i) being half of outer diameter (D_o) (D_i=D_o/2) **(1 %)**; (d) the same as (c), but the inner surface is grey body with emmisivity of 0.5 **(1 %)**.
5. The liquid flowing through the four pipelines (L>>D) noted below is subjected to the same pressure drop, with the total volumetric flow rate for pipeline (a) as Q_a. Please estimate Q_b-Q_d in terms of Q_a for pipelines (b)-(d) in the attached figure in case the fluid is water and D=10 cm, or the fluid is glycerol and D=1 mm. **(4 % for pipeline (b), 4 % for pipeline (c), and 7 % for pipeline (d))**.



6. Membrane transport is a major application of mass transport theory in the pharmaceutical sciences. Since convection is generally not involved, we can use Fick's first and second laws to determine the flux and concentration across membranes. Consider a membrane of thickness h_m, diffusivity of solute molecules across membrane D_m, and partition coefficient of at membrane surface K, describe

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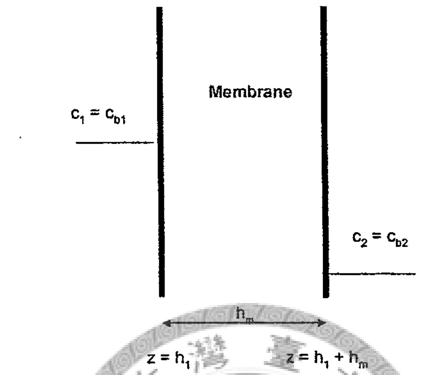
the flux of solute molecules across the membrane and the concentration profile (sketch) for:

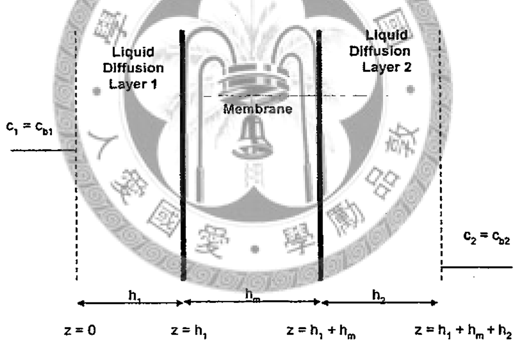
(a) well-stirred and mixed solutions on both sides **(5 %)**

(b) almost stationary liquid film on both sides of the membrane **(5 %)**.

State clearly all the assumptions made in the derivation



(a) well-stirred and mixed solutions on both sides



(b) stationary films on both sides

7. Water flows through 3.6 kg of glass particles of density 2590 kg/m^3 forming a packed bed of depth 0.475 m (L) and diameter 0.0757 m. The variation in frictional pressure drop across the bed with water flowrate in the range 200–1200 cm^3/min is shown in the following Table. Estimate the mean surface-volume diameter of the particles (D) **(10 %)**

Water flowrate (cm^3/min)	**Pressure drop (ΔP, mmHg)**
200	5.5
400	12.0
500	14.5
700	20.5
1000	29.5
1200	36.5

The Ergun equation is: $$\frac{-\Delta P}{L} = 150\frac{(1-\varepsilon)^2}{\varepsilon^3}\cdot\frac{\mu\cdot u}{D^2} + 1.75\frac{1-\varepsilon}{\varepsilon}\cdot\frac{\rho\cdot u^2}{D}$$

where u is the superficial velocity, μ is the water viscosity, and ρ is the water density.

試題隨卷繳回