大葉大學九十學年度研究所碩士班招生考試試題紙			
系　所　組　別	考　試　科　目 （中 文 名 稱）	考　試　日　期	備　　註
食品工程學系 碩士班甲組	單元操作	4 月 22 日 第 1 節	可攜計算機

註：計算題需詳列算式，否則一律不予計分。

1. 簡答下列各題：
   a. (5%) 試以雷諾數(Reynolds number)說明：流體中有那些性質會影響流動時的層流(laminar flow)或亂流(turbulent flow)型態？其物理意義何在？
   b. (5%) 熱傳共有哪三種機制？其原理為何？又，哪些機制在真空時不會發生？
   c. (5%) 說明 Pitot tube 與 Venturi meter 的應用及其差異處？
   d. (5%) 說明熱傳中的 Biot 數與 Nusselt 數的物理意義。
   e. (5%) 說明 momentum diffusivity, thermal diffusivity 與 molecular diffusivity 三者為何與它們的類似性。
   f. (5%) 氣體在管中擴散，當壓力變低時有所謂 Knudsen 擴散會發生。試說明在何種情況下必須考慮 Knudsen 擴散。

2. (20%) Consider a double-pipe heat exchanger where the overall heat-transfer coefficient U is constant throughout the equipment and the heat capacity of each fluid is constant, the proper temperature driving force to use over the entire apparatus is the log mean temperature, *i.e.*,

$$\Delta T_{lm} = \frac{\Delta T_2 - \Delta T_1}{\ln(\Delta T_2 / \Delta T_1)}.$$

When crude oil flows at the rate of 2000 lb/hr through the inside pipe of the double-pipe heat exchanger and is heated from 90 to 200°F. The heat is supplied by kerosene, initially at 450°F, flowing through the annular space. If the temperature of approach (minimum temperature difference between fluids) is 20°F, **determine** the heat-transfer area **and** the required kerosene flow rate for (a) concurrent flow (*i.e.*, same direction when crude oil and kerosene through the heat exchanger) and (b) countercurrent flow.

Data: Overall coefficient U = 80 Btu/(hr)(ft^2)(°F)

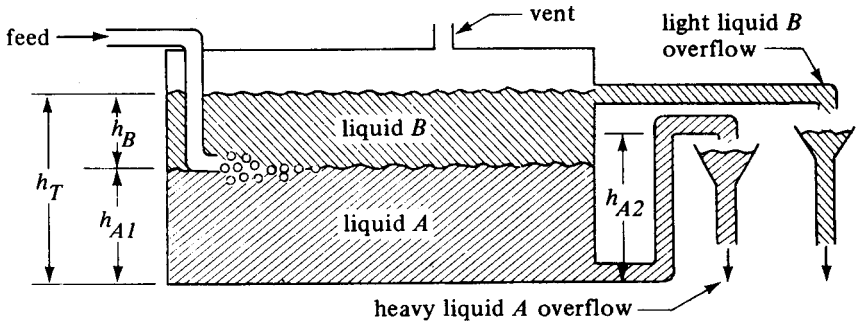
Specific heat of crude oil = 0.56 Btu/(hr)(°F)

Specific heat of kerosene = 0.60 Btu/(hr)(°F)

本試卷僅供參考

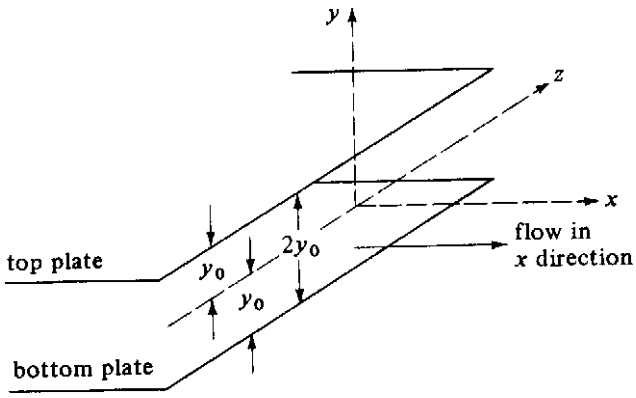
3. (15%) In a process producting KNO_3 salt, 1000 kg/h of a feed solution containing 20 wt% KNO_3 is fed to an evaporator, which evaporates some water at 422 K to produce a 50 wt% KNO_3 solution. This is then fed to a crystallizer at 311 K, where crystals containing 96 wt% KNO_3 are removed. The saturated solution containing 37.5 wt% KNO_3 is recycled to the evaporator. **Calculate** the amount of recycle stream R in kg/h **and** product stream of crystals P in kg/h.

4. (15%) For continuous atmospheric gravity separator (see Figure), it has the depth h_{A1} and density ρ_A for heavy liquid A and depth h_B and density ρ_B for light liquid B. **Show** h_{A1} by h_{A2}, h_T, ρ_A and ρ_B.



5. (20%) Velocity profile (v_x) for a Newtonian fluid flowing in laminar flow in the x direction between two parallel plates at point far from the inlet or outlet of the channel as following.

$$v_x = v_{x\,\max}\left[1-\left(\frac{y}{y_0}\right)^2\right]$$



Derive the average velocity ($v_{x\,av}$) with $v_{x\,\max}$ **as well as** the locations which v_x equals v_{av}.

Note: $2y_0$ is the width between the plates, y is the distance from the center line.