

國立勤益技術學院九十四學年度研究所碩士班招生筆試試題卷

所別：材料與化學工程研究所

組別：化工科技組

身分別：一般生

科目：單元操作與輸送現象

准考證號碼：

(考生自填)

考生注意事項：

- 一、考試時間 100 分鐘。
- 二、請考生自填准考證號碼。
- 三、可以使用計算機。

試題一： 20 分

In the equipment shown in Fig. 1, a pump draws a solution, specific gravity= 1.84, from a storage tank through a 3-in. (75 mm) schedule 40 steel pipe. The efficiency of the pump is 60 percent. The velocity in the suction line is 3 ft/s (0.914 m/s). The pump discharge through a 2-in. (50 mm) schedule 40 pipe to an overhead tank. The end of the discharge pipe is 50 ft (15.2 m) above the level of the solution in the feed tank. Friction losses in the entire piping system are 10 ft-lb_f/lb (29.9 J/kg). What pressure must the pump develop? What is the power of the pump? (The cross sectional areas of the 3- and 2-in. pipes are 0.0513 and 0.0233 ft²)

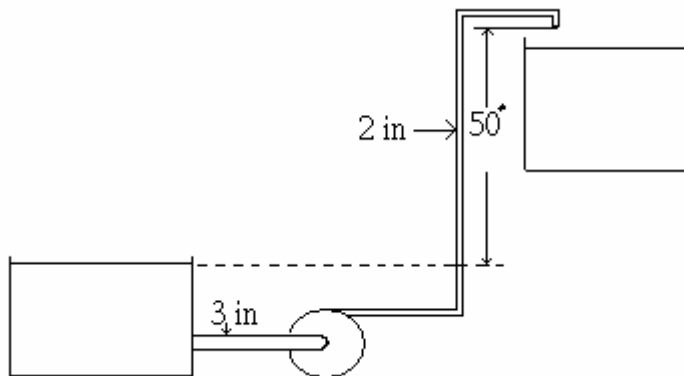
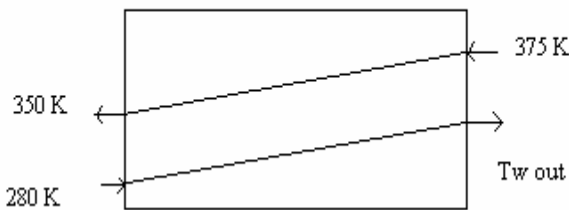


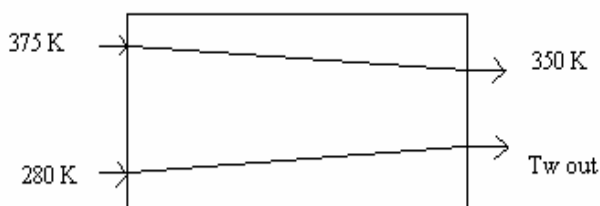
Fig. 1

試題二： 15 分

Light lubricating oil ($C_p=2090 \text{ J/kg}\cdot\text{K}$) is cooled by allowing it to exchange energy with water ($C_p=4177 \text{ J/kg}\cdot\text{K}$) in a small heat exchanger. The oil enters and leaves the heat exchanger at 375 K and 350 K , respectively, and flows at a rate of 0.5 kg/s . Water at 280 K is available in sufficient quantity to allow 0.201 kg/s to be used for cooling purposes. Determine the required heat transfer area for (a) counter flow, and (b) parallel flow operation (see Fig. 2). The overall heat transfer coefficient may be taken as $250 \text{ W/m}^2\cdot\text{K}$.



(a) Counter flow



(b) Parallel flow

Fig. 2 Single-path temperature profiles for counter flow and parallel flow.

試題三： 15 分

Determine the diffusivity of carbon monoxide through a gas mixture in which the mole fractions of each component are $y_{O_2} = 0.2$, $y_{N_2} = 0.7$, and $y_{CO} = 0.1$. The gas mixture is at 298 K and 2 atmosphere total pressure. From the literature, we find $D_{CO-O_2} = 0.185 \times 10^{-4} \text{ m}^2/\text{s}$ at 273 K , 1 atm and $D_{CO-N_2} = 0.192 \times 10^{-4} \text{ m}^2/\text{s}$ at 288 K , 1 atm.

試題四： 15 分

請說明納塞數(Nusselt Number)的無因次參數(Dimensionless Parameters)為何？並解釋納塞數在熱量傳送(Heat Transfer)的使用目的？

試題五： 10 分

內邊長為 L 的正方形管，若水流靜止時，水佔滿管子的一半，求水力半徑？

試題六： 25 分

地板積水 0.05 厘米厚，水溫恆為 24°C ，空氣溫度亦為 24°C ，壓力為 1 大氣壓，絕對溼度為每千克乾空氣含 0.002 千克之水蒸汽，水蒸發後擴散通過 0.5 厘米之氣體膜。 24°C 下，飽和溼度為每仟克乾空氣含 0.0189 千克之水蒸汽，問耗時多久，地板上之水始能蒸乾？假設空氣為理想氣體，且 24°C 下，水蒸發在空氣中之擴散度為 $0.093\text{ m}^2/\text{hr}$ 。

