CH01

國立臺北科技大學 108 學年度碩士班招生考試

系所組別：3510 化學工程與生物科技系化學工程碩士班甲組

第一節　單元操作與輸送現象　試題

注意事項：

1. 本試題共五題，第一題 15 分，第二題 20 分，第三題 20 分，第四題 15 分，第五題 30 分，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. A furnace cavity as shown in Figure 1, which is in the form of a cylinder of 75 mm diameter (D) and 150 mm length (L), is open at one end to surroundings that are at 27 °C. The side and bottom may be approximated as black bodies, are heated electrically, are well insulated, and are maintained at temperature of 1350 °C (T_1) and 1650 °C (T_2), respectively. View factor and interchange factor, radiation between opposed parallel disks, rectangles, and squares are shown in Figure 2. How much power is required to maintain the furnace conditions? (15 分)

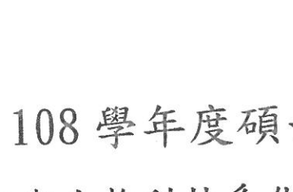

Figure 1

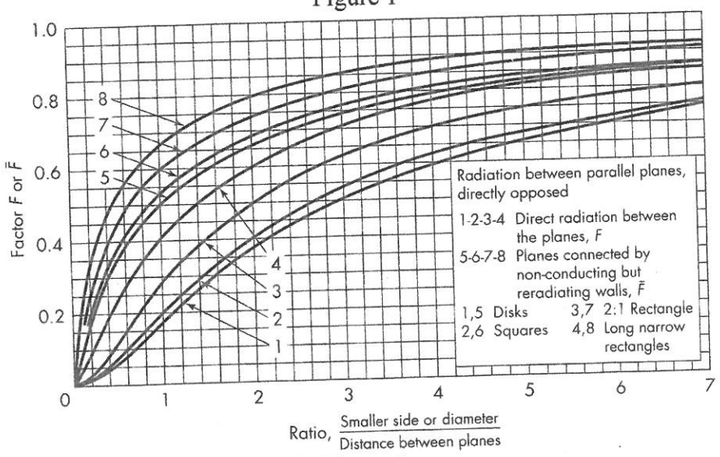

Figure 2

2. Oil with density of 0.8 g/cm^3 flows smoothly through the circular reducing section at 0.085 m^3/s as shown in Figure 3. The pressures (P) at entering and leaving streams, and diameters (D) at entering and leaving sections are also indicated in Figure 3. If the entering and leaving velocity profiles are uniform, estimate the force which must be applied to the reducer to hold it in place. Assume the flow is steady state. (20 分)

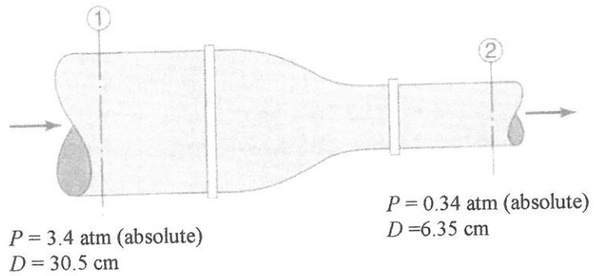

Figure 3

3. A pump takes water from a river to a reservoir 150 m above the river. The water is then returned from the reservoir to the river through a turbine to provide power. Diameter of the pipe connected to the turbine is 75 cm and the friction losses in the entire piping system are 45.1 J/kg. The volumetric flowrate through the turbine is 75 m^3/min. Please calculate the maximum power generated by the turbines if water density is 1 g/cm^3 and neglecting the kinetic energy correction. (20 分)

4. A sphere of radius of 5 cm is initially in equilibrium at 400 °C in a furnace. It is suddenly removed from the furnace and cooled in air at 20 °C for a period of time t_a until the average temperature of the sphere reaches 335 °C. In this cooling step, the convective heat transfer coefficient of air is 10 W/m^{2}K. The density, thermal conductivity and specific heat capacity of the sphere are 3 g/cm^3, 20 W/mK and 1000 J/kgK, respectively. Please calculate the cooling times t_a. (15 分)

5. Ammonia in air stream is removed by a pilot-scale counter-current absorption tower. The air stream containing 3 mol% ammonia is entering the absorption tower at a molar flowrate of 200 mole/min. An ammonia-free water is used as the absorbent. From the phase equilibrium study, the distribution coefficient of ammonia in air and water stream is 0.8 (molar basis). In a preliminary study, 95 % of ammonia is removed when operating at the minimum water molar flowrate. If the water molar flowrate is two times the minimum water molar flowrate, what is the removal percentage of ammonia in air stream if the concentration of ammonia in the exit water stream is designed as 1.78 mol%? (30 分)