

# 國立臺北科技大學九十五學年度碩士班招生考試

系所組別：1422 能源與冷凍空調工程系碩士班乙組

## 第二節 流體力學（選考）試題

填 准 考 證 號 碼

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第一頁 共二頁

### 注意事項：

1. 本試題共五題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
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. Assume the temperature of the exhaust in an exhaust pipe can be approximated by  $T = T_0(1 + ae^{-bx})[1 + c \cos(\omega t)]$ , where  $T_0 = 100^\circ\text{C}$ ,  $a = 3$ ,  $b = 0.03 \text{ m}^{-1}$ ,  $c = 0.05$ , and  $\omega = 100 \text{ rad/s}$ . If the exhaust speed is a constant  $2 \text{ m/s}$ , determine the time rate of change of temperature ( $DT/Dt$ ) of the fluid particles at  $x = 0$  and  $x = 4$  when  $t = 0$ . (20分)
2. Two water jets of equal size and speed strike each other as shown in Fig. 1. Determine the speed,  $V$ , and direction,  $\theta$ , of the resulting combined jet. Gravity is negligible. (20分)

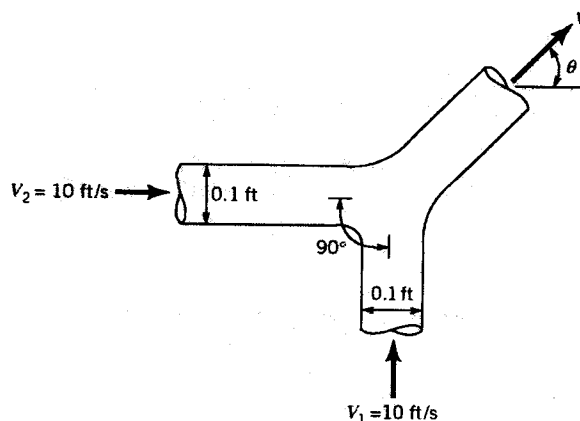


Figure 1

3. A 12-in.-diameter circular plate is placed over a fixed bottom plate with a 0.1-in. gap between the two plates filled with glycerin as shown in Fig. 2. Determine the torque required to rotate the circular plate slowly at 2 rpm. Assume that the velocity distribution in the gap is linear and that the shear stress on the edge of the rotating plate is negligible. (20 分)

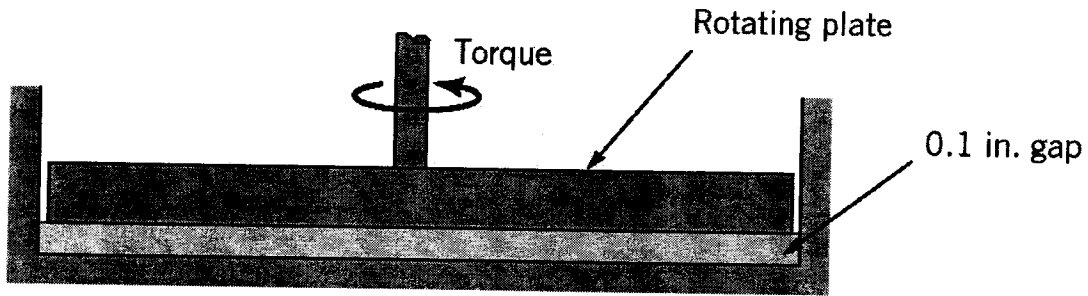


Figure 2

4. The velocity potential for a certain inviscid flow field is  $\phi = -(3x^2y - y^3)$  where  $\phi$  has the units of  $\text{ft}^2/\text{s}$  when  $x$  and  $y$  are in feet. Determine the pressure difference (in psi) between the points (1, 2) and (4, 4), where the coordinates are in feet, if the fluid is water and elevation changes are negligible. The specific weight of water  $\gamma_w = 62.4 \text{ lb}/\text{ft}^3$ , and the gravity  $g = 32.2 \text{ ft}/\text{s}^2$ . (20 分)

注意：背面尚有試題

5. Flow of a viscous fluid over a flat plate surface results in the development of a region of reduced velocity adjacent to the wetted surface as depicted in Fig. 3. This region of reduced flow is called a boundary layer. At the leading edge of the plate, the velocity profile may be considered uniformly distributed with a value  $U$ . All along the outer edge of the boundary layer, the fluid velocity component parallel to the plate surface is also  $U$ . If the  $x$  direction velocity ( $u$ ) profile at section (2) is

$$\frac{u}{U} = \left(\frac{y}{\delta}\right)^{\frac{1}{7}}$$

please develop an expression for the volume flowrate  $Q$  (in  $U$ ,  $\delta$  and  $\ell$ ) through the edge of the boundary layer from the leading edge to a location downstream at  $x$  where the boundary layer thickness is  $\delta$ . The width of the plate is  $\ell$ , and  $y$  is the vertical distance perpendicular to the plate. (20分)

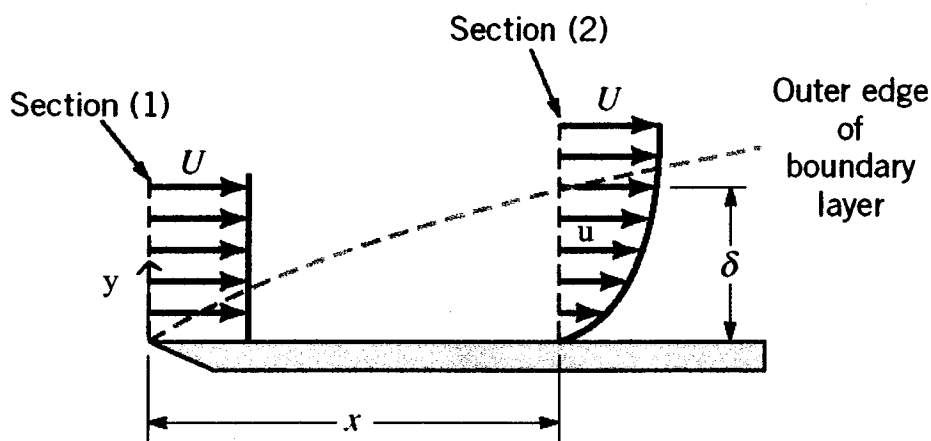


Figure 3