

國立中正大學

113 學年度碩士班招生考試

試題

[第 2 節]

科目名稱	流體力學
系所組別	機械工程學系-丙組

—作答注意事項—

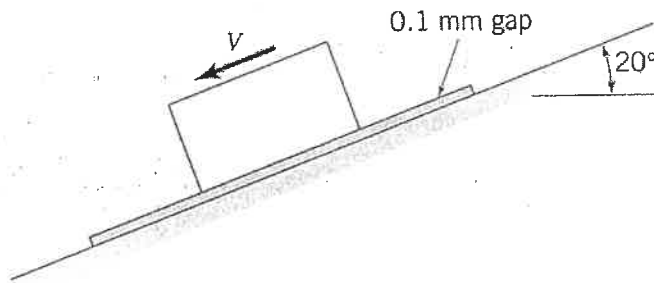
※作答前請先核對「試題」、「試卷」與「准考證」之系所組別、科目名稱是否相符。

1. 預備鈴響時即可入場，但至考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。
2. 考試開始鈴響時，即可開始作答；考試結束鈴響畢，應即停止作答。
3. 入場後於考試開始 40 分鐘內不得離場。
4. 全部答題均須在試卷（答案卷）作答區內完成。
5. 試卷作答限用藍色或黑色筆（含鉛筆）書寫。
6. 試題須隨試卷繳還。

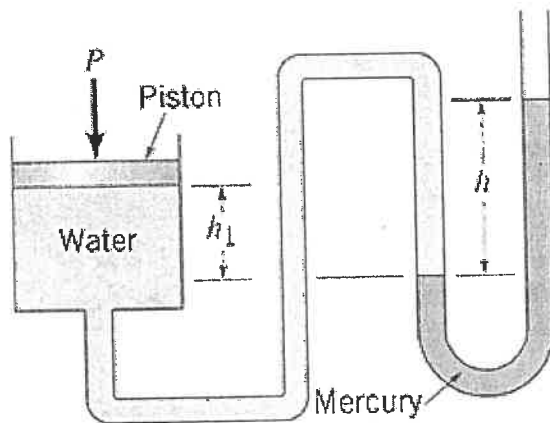
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1. A 10-kg block slides down a smooth inclined surface as shown below. Determine the terminal velocity of the block if the 0.1-mm gap between the block and the surface contains an oil with a dynamic viscosity of $0.35 \text{ N}\cdot\text{s}/\text{m}^2$. Assume the velocity distribution in the gap is linear, and the area of the block in contact with the oil is 0.1 m^2 . (20%)



2. A piston having a cross-sectional area of 0.06 m^2 is located in a cylinder containing water as shown in the following figure. An open U-tube manometer is connected to the cylinder as shown. For $h_1 = 60 \text{ mm}$ and $h = 100 \text{ mm}$, what is the value of the applied force, P , acting on the piston? The weight of the piston is negligible. The densities of mercury and water are $13,600 \text{ kg}/\text{m}^3$ and $1,000 \text{ kg}/\text{m}^3$, respectively. (15%)



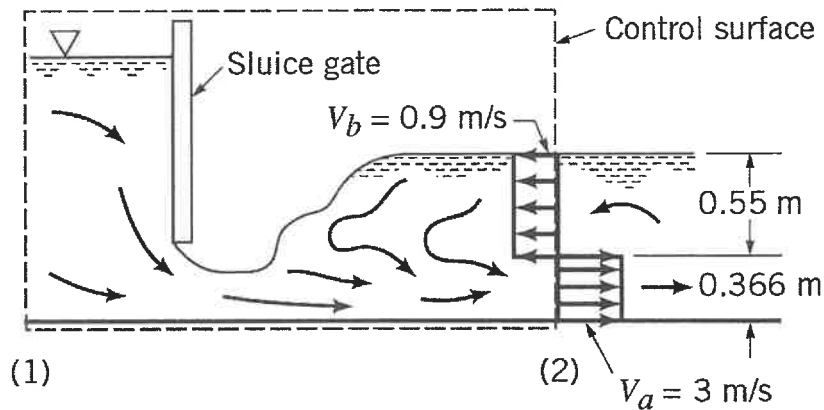
3. The velocity components of u and v of a two-dimensional flow are given by: $u = ax$ and $v = by$, where a and b are constants. Please calculate the acceleration. (8%)
4. In the region just downstream of a sluice gate, the water may develop a reverse flow region as shown in the following figure. The velocity profile is assumed to consist of two uniform regions, one with velocity $V_a = 3 \text{ m/s}$ and the other with $V_b = 0.9 \text{ m/s}$. Determine the net flowrate of water across the portion of the control surface at section (2) if the channel is 5 m wide. (7%)

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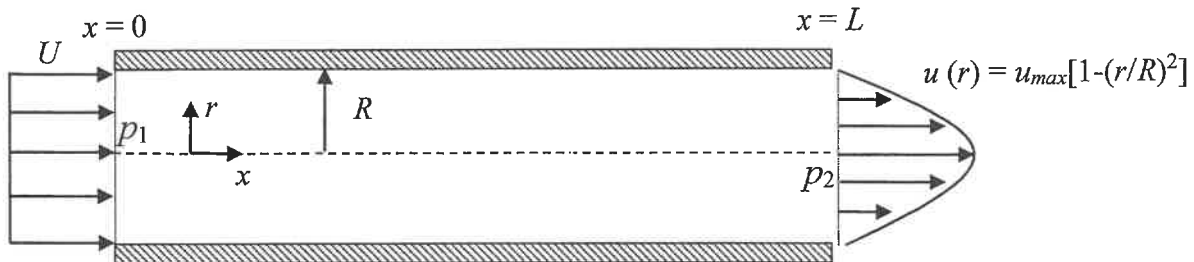
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5. The drag D on a washer-shaped plate placed normally to a stream of fluid can be expressed as $D = f(d_1, d_2, V, \mu, \rho)$, where d_1 is the outer diameter, d_2 is the inner diameter, V is the fluid velocity, μ is the fluid viscosity, and ρ is the fluid density. What dimensionless parameters would you use to organize these data? (20 %) (Use Buckingham Pi theorem)
6. Water flows steadily through a pipe of length L and radius $R = 3$ m. Calculate the uniform inlet velocity, U , if the velocity distribution across the outlet is given by $u(r) = u_{max}[1 - (r/R)^2]$ and $u_{max} = 10$ m/s. (15 %)



7. Show that whether the following sets of three-dimensional flow cases is incompressible and irrotational or not? (15 %)
- (a) $u = x + y + z^2$; $v = x - y + z$; $w = 2xy + y^2 + 4$ (5 %)
- (b) $u = xyz$; $v = -xyzt^2$; $w = (z^2 / 2)(xt^2 - yt)$ (5 %)
- (c) $u = y^2 + 2xz$; $v = -2yz + x^2yz$; $w = \frac{1}{2}x^2z^2 + x^3y^4$ (5 %)