

國立成功大學

111學年度碩士班招生考試試題

編 號： 154

系 所： 生物醫學工程學系

科 目： 流體力學

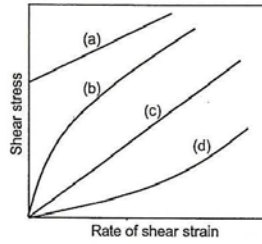
日 期： 0219

節 次： 第 2 節

備 註： 可使用計算機

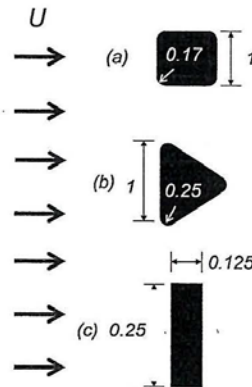
※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. ____ Which line in the following figure represents the **Newtonian fluid**? A) a B) b C) d E) a & c. F) None. (5%)



2. ____ According to the Bernoulli's Equation, with no energy loss, what will happen to the blood flow rate and pressure when a **vessel diameter shrinks**? (5%) A) velocity decreases but pressure increases; B) both velocity and pressure increase; C) both velocity and pressure decrease; D) velocity increases but pressure decreases.
3. ____ Which description of Reynolds number is **incorrect**? (5%) A) $Re \ll 1$ Creeping flow B) $Re < 2100$ Laminar flow C) $Re > 4000$ Turbine flow D) $2100 < Re < 4000$ Transient flow
4. ____ In the Hagen Poiseuille flow, what factor may alter the flow rate? (5%) A) pressure difference B) tube diameter C) tube length D) All of the above.
5. Given that drag coefficients for the following geometries are under same flow velocity (U), fluid density (ρ), and Reynolds number ($Re = 10^5$). Determine their drags in an order from high to low. ($b=1$) (8%)

Shape	Reference area A ($b = \text{length}$)	Drag coefficient $C_D = \frac{g}{\frac{1}{2} \rho U^2 A}$	Reynolds number $Re = \rho U D / \mu$														
 Square rod with rounded corners.	$A = bD$	<table border="1"> <thead> <tr> <th>R/D</th> <th>C_D</th> </tr> </thead> <tbody> <tr><td>0</td><td>2.2</td></tr> <tr><td>0.02</td><td>2.0</td></tr> <tr><td>0.17</td><td>1.2</td></tr> <tr><td>0.33</td><td>1.0</td></tr> </tbody> </table>	R/D	C_D	0	2.2	0.02	2.0	0.17	1.2	0.33	1.0	$Re = 10^5$				
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 Rounded equilateral triangle	$A = bD$	<table border="1"> <thead> <tr> <th>R/D</th> <th>C_D</th> </tr> </thead> <tbody> <tr><td>0</td><td>1.4</td></tr> <tr><td>0.02</td><td>1.2</td></tr> <tr><td>0.08</td><td>1.3</td></tr> <tr><td>0.25</td><td>1.1</td></tr> <tr><td>1.3</td><td>1.3</td></tr> </tbody> </table>	R/D	C_D	0	1.4	0.02	1.2	0.08	1.3	0.25	1.1	1.3	1.3	$Re = 10^5$		
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6. The uniform swamp gate has a mass of 4 Mg and a width of 1.5 m (Fig. 1). Determine the angle θ for equilibrium if the water rises to a depth of $d = 1.5$ m. (Assume all pressures are gage pressures and ρ_w is

1000 kg/m³. (25%)

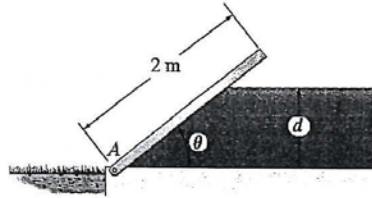


Fig. 1

7. The horizontal flow confined by the walls is defined by the stream function $\psi = \left[4r^{4/3} \sin\left(\frac{4}{3}\theta\right) \right] \text{ m}^2/\text{s}$,

where r is in meters (Fig. 2). (A) Express the velocity in terms of r and θ . (Hint: $u_r = \frac{1}{r} \frac{\partial \psi}{\partial \theta}$; $u_\theta = \frac{1}{r} \frac{\partial \psi}{\partial r}$) (B)

Is the flow continuous or discontinuous? Prove it. (Hint: continuity $\frac{1}{r} \frac{\partial(ru_r)}{\partial r} + \frac{1}{r} \frac{\partial u_\theta}{\partial \theta} = 0$) (C) Determine the difference in pressure between the two points A and B (Hint: Bernoulli equation). (27%)

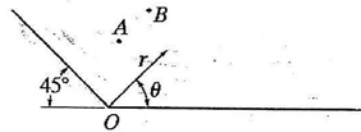


Fig. 2

8. The barge is being loaded with an industrial waste liquid having a density of ρ over a time period of Δt (Fig. 3). If the average velocity of flow out of the pipe (radius is r) is V_A , determine (A) the force in the tie rope needed to hold the barge stationary and (B) the buoyancy needed to support the barge before it sinks. (Notice: A Free Body Diagram and a Control Volume must be drawn.) (20%)

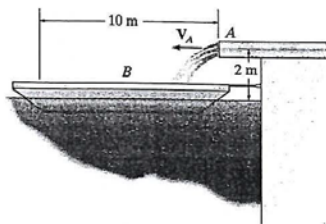


Fig.3