

2013-XE-27-39

EE24BTECH11003 - Akshara Sarma Chennubhatla

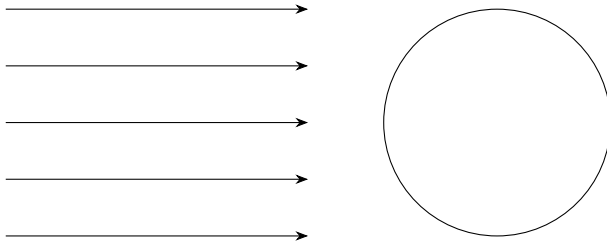
- 27) Flow past a circular cylinder can be produced by superposition of the following elementary potential flows: (2013)
- Uniform flow, doublet
 - Uniform flow, vortex
 - Source, vortex
 - Sink, vortex
- 28) Let δ , δ_1 and δ_2 denote respectively the boundary-layer thickness, displacement thickness and the momentum thickness for laminar boundary layer flow of an incompressible fluid over a flat plate. The correct relation among these quantities is (2013)
- $\delta < \delta_1 < \delta_2$
 - $\delta > \delta_1 > \delta_2$
 - $\delta > \delta_1 < \delta_2$
 - $\delta < \delta_1 > \delta_2$
- 29) In the hydrodynamic entry region of a circular duct, the pressure forces balance the sum of (2013)
- viscous and buoyancy forces
 - inertia and buoyancy forces
 - inertia and surface tension forces
 - inertia and viscous forces
- 30) Bodies with various cross-sectional shapes subjected to cross-flow of air are shown in the following figures. The characteristic dimension of all the shapes is the same. The cross-sectional shape with the largest coefficient of drag (i.e. sum of the pressure and skin-friction drags), at any moderately large Reynolds number, is (2013)

a) 

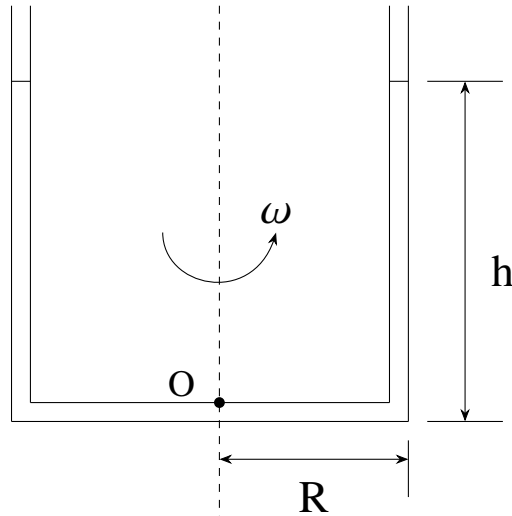
b) 

c) 

d) 



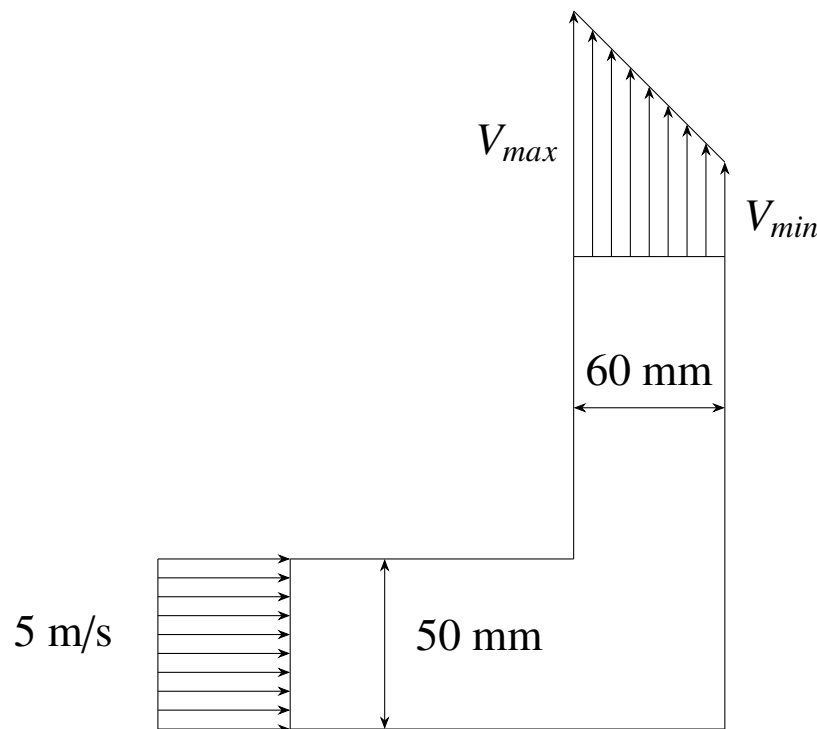
- 31) A U-tube of a very small bore, with its limbs in a vertical plane and filled with a liquid of density ρ , up to a height of h , is rotated about a vertical axis, with an angular velocity of ω , as shown in the Figure. The radius of each limb from the axis of rotation is R . Let p_a be the atmospheric pressure and g , the gravitational acceleration. The angular velocity at which the pressure at the point O becomes half of the atmospheric pressure is given by



(2013)

- a) $\sqrt{\frac{p_a + 2\rho gh}{\rho R^2}}$
- b) $\sqrt{\frac{2(p_a + \rho gh)}{\rho R^2}}$
- c) $\sqrt{\frac{p_a + 2\rho gh}{2\rho R^2}}$
- d) $\sqrt{\frac{p_a + \rho gh}{2\rho R^2}}$

- 32) An incompressible fluid at a pressure of 150 kPa (absolute) flows steadily through a two-dimensional channel with a velocity of 5 m/s as shown in the Figure. The channel has a 90° bend. The fluid leaves the channel with a pressure of 100 kPa (absolute) and linearly-varying velocity profile. v_{max} is four times v_{min} . The density of the fluid is 914.3 kg/m^3 . The velocity v_{min} , in m/s, is



(2013)

- a) 25
- b) 2.5
- c) 2.0
- d) 0.2

33) The velocity vector corresponding to a flow field is given, with usual notation, by $\mathbf{V} = 3x\mathbf{i} + 4xy\mathbf{j}$. The magnitude of rotation at the point (2, 2) in rad/s is (2013)

- a) 0.75
- b) 1.33
- c) 2
- d) 4

34) The stream function for a potential flow field is given by $\psi = x^2 - y^2$. The corresponding potential function, assuming zero potential at the origin, is (2013)

- a) $x^2 + y^2$
- b) $2xy$
- c) $x^2 - y^2$
- d) $x - y$

35) Fully developed flow of an oil takes place in a pipe of inner diameter 50 mm. The pressure drop per metre length of the pipe is 2 kPa. Determine the shear stress, in Pa, at the pipe wall. (2013)

36) The Darcy friction factor f for a smooth pipe is given by $f = \frac{64}{Re}$ for laminar flow and by $f = \frac{0.3}{Re^{0.25}}$ for turbulent flow, where Re is the Reynolds number based on the diameter. For fully developed flow of a fluid of density 1000 kg/m^3 and dynamic viscosity $0.001 \text{ Pa}\cdot\text{s}$ through a smooth pipe of diameter 10 mm with a velocity of 1 m/s, determine the Darcy friction factor. (2013)

37) Air flows steadily through a channel. The stagnation and static pressures at a point in the flow are measured by a Pitot tube and a wall pressure tap, respectively. The pressure difference is found to be 20 mm Hg. The densities of air, water and mercury, in kg/m^3 , are 1.18, 1000 and 13600, respectively. The gravitational acceleration is 9.81 m/s^2 . Determine the air speed in m/s. (2013)

Common Data for Questions 12 and 13:

The velocity field within a laminar boundary layer is given by the expression:

$$\mathbf{V} = \frac{Bu_{\infty}y}{x^{\frac{3}{2}}}\mathbf{i} + \frac{Bu_{\infty}y^2}{4x^{\frac{5}{2}}}\mathbf{j}$$

where $B = 100m^{\frac{1}{2}}$ and the free stream velocity $u_{\infty} = 0.1$ m/s.

- 38) Calculate the x-direction component of the acceleration in m/s^2 at the point $x = 0.5$ m and $y = 50$ mm. _____ (2013)
- 39) Find the slope of the streamline passing through the point $x = 0.5$ m and $y = 50$ mm. _____ (2013)