

GATE - 2009 - XE

EE1030 : Matrix Theory

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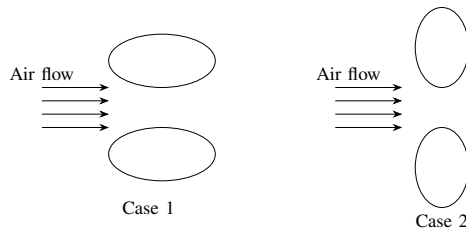
- 1) Under what conditions is the equation $\Delta \cdot \rho \vec{V} = 0$ valid ?
 - P : Steady incompressible flow
 - Q : Unsteady incompressible flow
 - R : Steady compressible flow
 - S : Unsteady compressible flow
 - a) P,Q,R
 - b) Q,R,S
 - c) P,R,S
 - d) P,Q,S

- 2) Stream function CANNOT be defined for
 - a) two dimensional incompressible flow
 - b) two dimensional compressible flow
 - c) three dimensional incompressible flow
 - d) axisymmetric incompressible flow

- 3) Which one of the following is an irrotational flow ?
 - a) Free vortex flow
 - b) Forced vortex flow
 - c) Couette flow
 - d) Wake flow

- 4) Under strong wind conditions, electrical cables can be subjected to wind-induced oscillations. Which one of the following non-dimensional numbers is relevant to this problem ?
 - a) Froude number
 - b) Weber number
 - c) Faraday number
 - d) Strouhal number

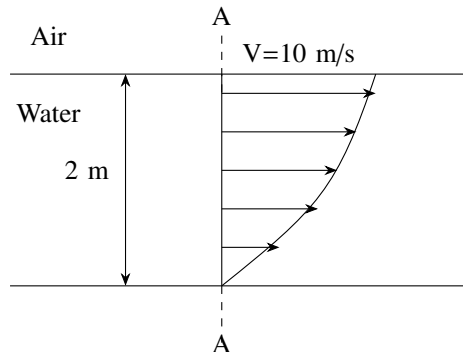
- 5) Dimples are made on golf balls for which of the following reasons ?
 P : to make the ball travel a longer distance
 Q : to make the flow over the ball turbulent
 R : to make the flow over the ball laminar
 S : to create a separated boundary layer flow over the ball
- P, Q
 - Q, S
 - R, S
 - P, R
- 6) In a 2-D boundary layer flow, x and y are the streamwise and wall-normal coordinates, respectively. If u denotes the velocity along x direction, which one of the following represents the condition at the point of flow separation ?
- $\frac{\partial u}{\partial x} = 0$
 - $\frac{\partial u}{\partial y} = 0$
 - $\frac{\partial^2 u}{\partial x^2} = 0$
 - $\frac{\partial^2 u}{\partial y^2} = 0$
- 7) Which one among the following boundary layer flows is the LEAST susceptible to flow separation ?
- turbulent boundary layer in a favourable pressure gradient
 - laminar boundary layer in a favourable pressure gradient
 - turbulent boundary layer in an adverse pressure gradient
 - laminar boundary layer in an adverse pressure gradient
- 8) Air from the blower of a hairdryer flows between two identical elliptical cylinders suspended freely, for two cases shown in the figure. The cylinders would move



- away from each other for Case 1 and towards each other for Case 2
 - towards each other for Case 1 and away from each other for Case 2
 - away from each other for Case 1 and away from each other for Case 2
 - towards each other for Case 1 and towards each other for Case 2
- 9) A 40 cm cubical block slides on oil (viscosity = 0.80 Pa.s), over a large plane horizontal surface. If the oil film between the block and the surface has a uniform

thickness of 0.4 mm, what will be the force required to drag the block at 4 m/s ? Ignore the end effects and treat the flow as two dimensional.

- a) 1280 N
 - b) 1640 N
 - c) 1920 N
 - d) 2560 N
- 10) For a floating body, G, B, and M represent centre of gravity, centre of buoyancy, and the metacentre, respectively. The body will be stable if
- a) G is located above B
 - b) B is located above M
 - c) M is located above B
 - d) M is located above G
- 11) A nozzle has inlet and outlet diameters of 10 cm and 5 cm, respectively. If it discharges air at a steady rate of $0.1 \text{ m}^3/\text{s}$ into atmosphere, the gauge pressure (static) at the nozzle inlet will be
- a) 1.26 kPa
 - b) 1.46 kPa
 - c) 3.52 kPa
 - d) 3.92 kPa
- 12) Consider incompressible flow through a two-dimensional open channel. At a certain section A-A, the velocity profile is parabolic. Neglecting air resistance at the free surface, find the volume flow rate per unit width of the channel.



- a) $10 \text{ m}^3/\text{s}$
- b) $13.33 \text{ m}^3/\text{s}$
- c) $20 \text{ m}^3/\text{s}$
- d) $33.33 \text{ m}^3/\text{s}$