# 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

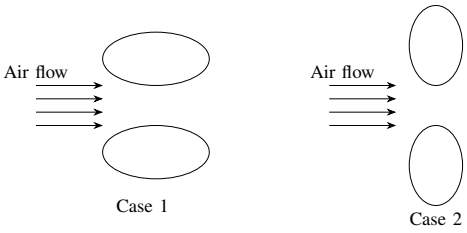
4) Under strong wind conditions, electrical cables can be subjected to wind-induced oscillations. Which one of the following non-dimensional numbersis relevant to this problem ?
a) Froude number
b) Weber number
c) Faraday number
d) Strouhal number

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
a) P, Q
b) Q, S
c) R, S
d) 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 ?
a) $\frac{\partial u}{\partial x} = 0$
b) $\frac{\partial u}{\partial y} = 0$
c) $\frac{\partial^2 u}{\partial x^2} = 0$
d) $\frac{\partial^2 u}{\partial y^2} = 0$

7) Which one among the following boundary layer flows is the LEAST susceptible to flow separation ?
a) turbulent boundary layer in a favourable pressure gradient
b) laminar boundary layer in a favourable pressure gradient
c) turbulent boundary layer in an adverse pressure gradient
d) 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




a) away from each other for Case 1 and towards each other for Case 2
b) towards each other for Case 1 and away from each other for Case 2
c) away from each other for Case 1 and away from each other for Case 2
d) 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

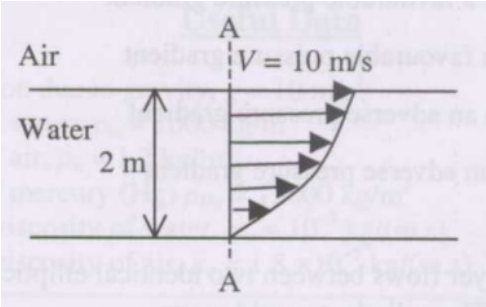
10) For a floating body, G, B, and M represent centre of gravity, centre of buoyancy, and the metacentre, respectively. The body will be stable if

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 $m^3/s$ 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 $m^3/s$
b) 13.33 $m^3/s$
c) 20 $m^3/s$
d) 33.33 $m^3/s$