gate 2

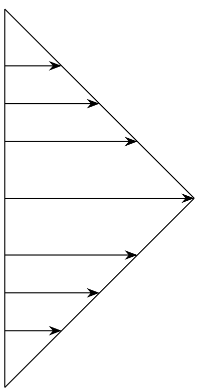
EE24Btech11041 - Mohit

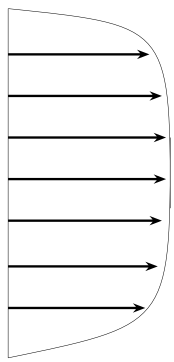
1) Flow around a Rankine half-body is represented by the superposition of (XE 2014)

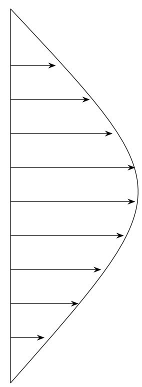
    a) source and vortex flows.
    b) source and uniform flows.
    c) vortex and uniform flows.
    d) source, vortex and uniform flows.

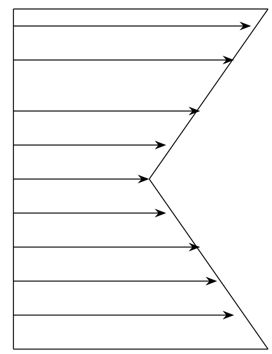
2) It is required to carry out model studies on a boat having a characteristic length of $3.6m$ and travelling at a speed of $3m/s$. Assume the acceleration due to gravity as $10m/s^2$ and neglect the effects due to viscous and surface tension forces. The value of appropriate non-dimensional number is ________.
3) Which one of the following velocity profiles typically represents a fully developed incompressible, turbulent flow in a pipe?

(XE 2014)

a) 

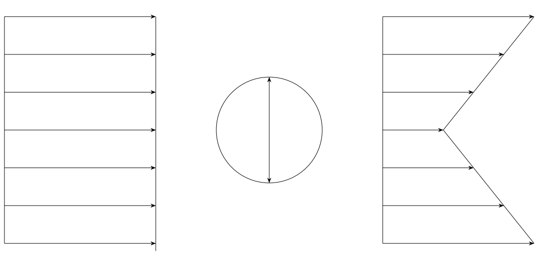
b) 

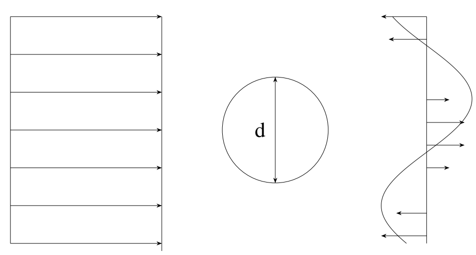
c) 

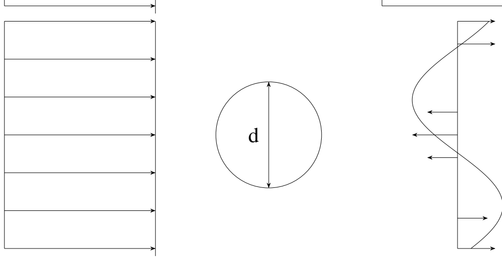
d) 

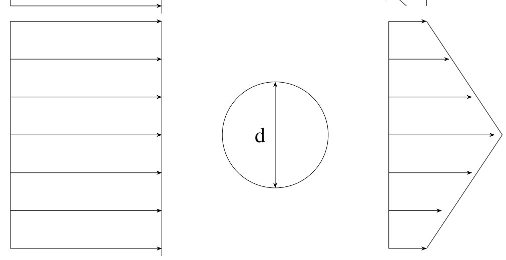
4) Consider an incompressible, laminar flow past a circular cylinder of diameter d. The flow is uniform at the far upstream. Which one of the following figures typically represents the wake velocity profile just downstream of the cylinder?

(XE 2014)

a) 

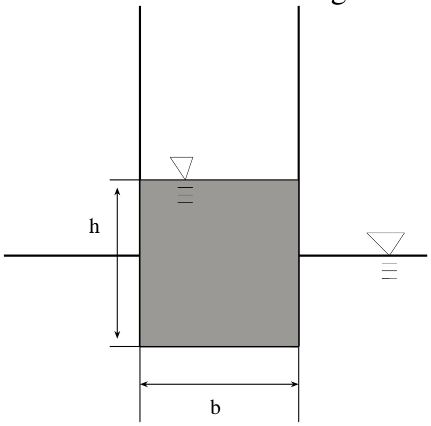
c) 

b) 

d) 

5) A container of square cross-section is partially filled with a liquid of density ρ_1. The cylinder is intended to float in another liquid of density ρ_2, as shown in the figure. The distance between

metacentre and centre of buoyancy is $\frac{1}{V_{sub}}$, where I and V_{sub} are area moment of inertia of the cross-section and submerged volume, respectively. Neglect the weight of the container.



Which one of the following is the correct condition for stability?

(XE 2014)

a) $\frac{\rho_2}{6\rho_1}\frac{b}{h} - \frac{h}{b}\left(1 - \frac{\rho_1}{\rho_2}\right) > 0$
b) $\frac{\rho_2}{6\rho_1}\frac{b}{h} - \frac{h}{b}\left(1 + \frac{\rho_1}{\rho_2}\right) > 0$
c) $\frac{\rho_2}{6\rho_1}\frac{b}{h} + \frac{h}{b}\left(1 - \frac{\rho_1}{\rho_2}\right) > 0$
d) $\frac{\rho_2}{6\rho_1}\frac{b}{h} + \frac{h}{b}\left(1 + \frac{\rho_1}{\rho_2}\right) > 0$

6) In a steady state two-dimensional potential flow field due to a point source, the acceleration of a particle at a distance r from the point source is

(XE 2014)

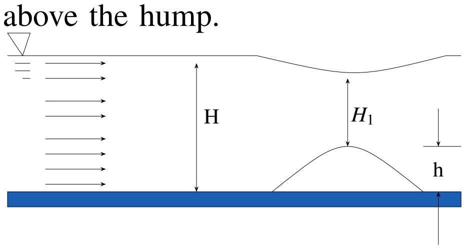
a) proportional to r^{-1} .
b) proportional to r .
c) a constant
d) proportional to r^{-3} .

7) Velocity in a two-dimensional flow at time t and location (x, y) is described as: $\mathbf{V} = 3t^2\hat{i} + (x-1)\hat{j}$. The equation for the path line of a particle passing through the point $(1, 0)$ at

(XE 2014)

a) x^4-$4y^3$
b) $(x-1)^3$-$2y^4$
c) $(x-1)^4$-$64y^3$
d) $(x+1)^4$-$16y^3$

8) The gravity driven flow over a hump of height h n a canal is shown in the figure. The height of the free surface from the canal bed at upstream of the hump is H.The free surface height reduces to H_1 above the hump.

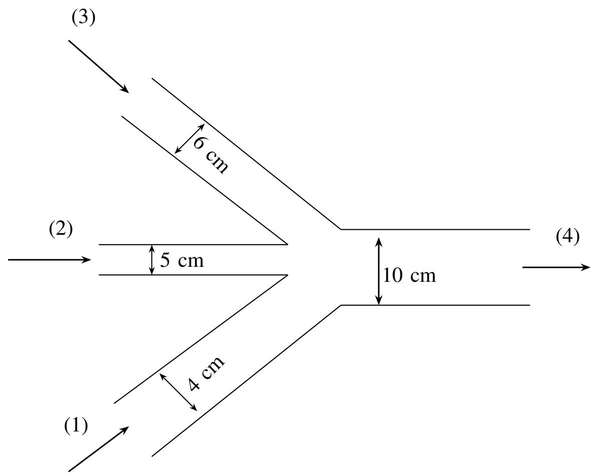


Assuming the canal bed to be horizontal, the discharge per unit width is given by

(XE 2014)

a) $\sqrt{\frac{2g(H-H_1-h)}{\frac{1}{H_1^2}-\frac{1}{H^2}}}$
b) $\sqrt{\frac{2gh}{\frac{1}{(H_1+h)^2}-\frac{1}{H^2}}}$
c) $\sqrt{\frac{2g(H-H_1)}{\frac{1}{(H_1+h)^2}-\frac{1}{H^2}}}$
d) $\sqrt{\frac{2g(H-H_1)}{\frac{1}{H_1^2}-\frac{1}{H^2}}}$

9) Steady state incompressible flow through a pipe network is shown in the figure. Inlets marked as (1),(2), and (3) and exit marked as (4) are shown with their respective diameters. The exit flow rate at (4) is $0.1m^3/s$. A 20% increase in flow rate through (1) results in a 10% increase in flow rate through (4). The original velocity through inlet (3) is ________ m/s. (XE 2014)



10) A reducing elbow is used to deflect water upward by 30° as shown in the figure. The mass flow rate at the inlet is $14kg/s$. Water is entering at a gauge pressure of $200kPa$ and exits to the atmosphere. The cross-sectional area is $113cm^2$ at the inlet and $7cm^2$ at the exit. Density of water and acceleration due to gravity are $1000kg/m^3$ and $10m/s^2$, respectively. Magnitude of x - component of the water force on the elbow is ____ N. (XE 2014)
11) A source with a strength of k_1 and a vortex with a strength of k_2 are located at the origin.The resultant velocity at a radial distance r rom the origin due to the superpositon of the source and vortex is expressed as (XE 2014)

   a) $\frac{k_1+k_2}{r}$ b) $\frac{\sqrt{{k_1}^2+{k_2}^2}}{r}$ c) a constant d) proportional to r^{-3} .

12) Velocity potential for an incompressible fluid flow is given as: $\phi = 2(x^2+2y-y^2)$.Assume the value of stream function at the origin to be zero .The value of stream function at $[(x, y) \equiv (2, 2)]$ is ________ . (XE 2014)
13) The model of a conduit is scaled to $\frac{1}{100}$ of the actual size. Seawater is used in the prototype and fresh water is used in the model. Velocity in the prototype is $0.5m/s$. Density and dynamic viscosity of the seawater are $1025kg/m^3$ and $1.07\times10^{-3}kg/m-s$, respectively. Density and dynamic viscosity of fresh water are $1000kg/m^3$ and $1\times10^{-3}kg/m-s$, respectively. Assume the viscous forces to be dominant. The velocity to be maintained in the model to ensure dynamic similarity is ________ m/s. (XE 2014)