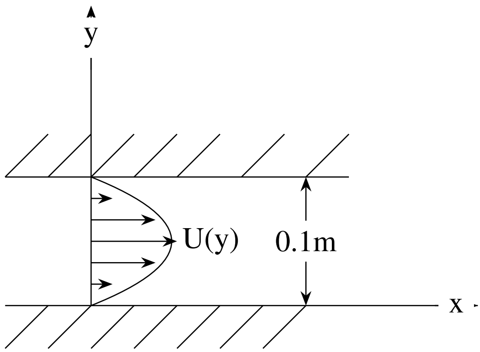
XE - 2019

EE24BTECH11064 - Harshil Rathan

1) The power input P to a centrifugal pump is a function of the volume flow rate Q, impeller diameter D, rotational speed Ω, fluid density ρ, dynamic viscosity μ, and surface roughness ϵ. To carry out a dimensional analysis using Buckingham's π theorem, which one of the following sets can be taken as the set of repeating variables?

a) Q, Ω, D
b) Q, ϵ, D
c) ϵ, D, ρ
d) D, ρ, Ω

2) Consider the two-dimentional laminar flow of wtaer ($\mu = 0.001 Ns/m^2$)between two infinitely long parallel plates $0.1m$ apart as shown in the figure below. The velocity profile at any location is given by $u(y) = 100(0.1y - y^2)m/s$ where y is in m. The magnitude if shear stress(in N/m^2, rounded off to 2 decimal places) acting on the bottom plate is ______



3) The maximum velocity in a fully developed laminar incompressible flow through a circular pipe of constant cross-sectional area is $6m/s$. The average velocity (in m/s) of the flow is ______

4) The theoretical discharge for the flow through an orifice-meter is $40m^3/s$. If the measured discharge in an experiment is $32m^3/s$, then the discharge coefficient (rounded off to one decimal place) is ______

5) Consider the flow between two infinitely long parallel plates of large iwdth separated by a distance $2H$. The upper plate is moving with a constant velocity U while the lower plate is stationary. The volumetric flow rate per unit width of the plate is

a) 0.25 UH
b) 0.5 UH
c) UH
d) 2 UH

6) The velocity field in Cartesian coordinates in a two-dimensional steady incompressible flow of a fluid with density ρ is $\mathbf{V}$=$x\hat{i} - y\hat{j}$. Assuming no body and line forces, the magnitude of pressure gradient Δp at the point (1,1) is

a) $\sqrt{2}\rho$
b) ρ
c) $\frac{\rho}{\sqrt{2}}$
d) $\frac{\rho}{2}$

7) A two-dimentional velocity field in cartesian coordinates is defined by $\mathbf{V}$=$y\hat{i} - x\hat{j}$. This flow is

a) compressible and rotational
b) compressible and irrotational
c) incompressible and rotational
d) incompressible and irrotational

8) Assertion[a]:The streamlines in a free vortex flow are concentric circles.
Reasoning[r]: There exists only radial component for the velocity field in a free vortex flow.

a) Both [a] and [r] are true and [r] is the correct reason for [a]
b) Both [a] and [r] are true but [r] is nor the correct reason for [a]
c) [a] is true but [r] is false
d) [a] is false but [r] is true

9) The velocity components in Cartesian coordinates in a two-dimensional incompressible flow are $u = e^y \cos x$ and $v = e^y \sin x$. The magnitude of total acceleration at the point(-1,1) is

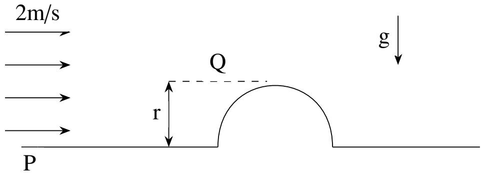
a) 0
b) 1
c) e
d) e^2

10) For steady laminar flow at zero incidence over a flat plate, the component of velocity parallel to the plate in the boundary layer is given by $u(y) = a + by + cy^2$, where y is the distance measured normal to the flat plane. If μ is the coefficient of dynamic viscosity, U is the velocity parallel to the wall at the edge of the boundary layer thickness, the wall shear stress is given by

a) $\frac{\mu U}{\delta}$
b) $\frac{2\mu U}{\delta}$
c) $2\mu(\frac{U}{\delta})^2$
d) $\frac{3\mu U}{\delta}$

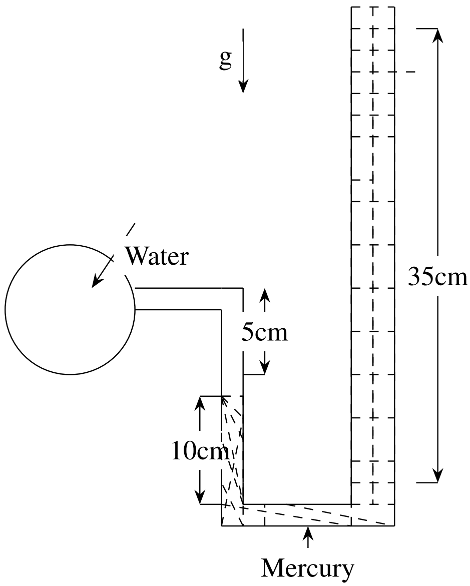
11) A fluid with constant density of $1kg/m^3$ flows past a semi-cylindrical structure witha freestream velocity of $2m/s$ as shown in the figure below. The difference in static pressure between points P and Q is $10N/m^2$. If the gravitational acceleration g is

$10m/s^2$ and the flow is assumed to be potential, what is the radius r (in m) of te semi-cylindrical structure?



a) 1
b) 0.8
c) 0.6
d) 0.4

12) The mercury manometer shown in the figure below is connected to a water pipe at one end while the other end is open to atmosphere. The density of wate ris $1000kg/m^3$, the specific gravity of mercury is 13.6 and the gravitational acceleration g is $10m/s^2$. The gauge pressure p_w((in kN/m^2, rounded off to 2 decimal places) in the water pipe is ______



13) Water ($\rho = 1000kg/m^3$, $\mu = 0.001Ns/m^2$) flows through a smooth circular pipe of radius 0.05m. If the flow Reynolds number is 1000, then the pressure drop (in N/m^2, rounded off to 2 decimal places) over a length of 5m will be ______