Assignment 8

The due date for submitting this assignment has passed. Due on 2019-03-27, 23:59 IST.
As per our records you have not submitted this assignment.

1) Water comes out of a tank through a nozzle, as an open jet. As a result, the level of water in the tank continuously falls (see figure). A streamline in the tank conceptually identifies the figure spanning from point 1 to point 2, the curvilinear length of which (assuming zero velocity along the streamline) is approximately $kh$, where $k = 1.5$. For mathematical analysis, the following assumptions can be made: (i) the velocity along the streamlines approximately $V_1$, and (ii) viscous effects are negligible. The ratio of area of cross section of the tank to that of the nozzle is 2:1. At a given instant of time, $h = 5$ m and $V_2 = 1$ m/s. The local component of acceleration of flow at the point 2, at that instant will be

![Diagram of water flow through nozzle](image)

(a) $3.49$ m/s²
(b) $6.49$ m/s²
(c) $9.49$ m/s²
(d) $12.49$ m/s²

No, the answer is incorrect.
The radial variation of velocity at the midsection of the 180° bend shown is given by \( rV_r = \) constant as shown in figure. The cross section of the bend is square. Assume that the velocity is not a function of \( z \). The expression for the pressure difference between the outside and the inside of the bend can be expressed in terms of the mass flow rate, the fluid density, the geometric parameters, \( R_1, R_2 \) and the depth of the bend \( b = R_2 - R_1 \), as:

\[
\begin{align*}
(a) \quad p_2 - p_1 &= \frac{\dot{m}^2}{2\rho b^2 (\ln(R_2/R_1))^2} \frac{R_1^3 - R_2^3}{R_2^3 R_1^3} \\
(b) \quad p_2 - p_1 &= \frac{\dot{m}^2}{2\rho b^2 (\ln(R_1/R_2))^2} \frac{R_1^3 - R_2^3}{R_1^3 R_2^3} \\
(c) \quad p_2 - p_1 &= \frac{\dot{m}^2}{2\rho b^2 (\ln(R_2/R_1))^2} \frac{R_1^3 - R_2^3}{R_2^3 R_1^3} \\
(d) \quad p_2 - p_1 &= \frac{\dot{m}^2}{2\rho b^2 (\ln(R_1/R_2))^2} \frac{R_1^3 - R_2^3}{R_1^3 R_2^3}
\end{align*}
\]

No, the answer is incorrect.
Score: 0
Accepted Answers:
(c)
The velocity components in an inviscid, constant density \((=1000 \text{ kg/m}^3)\), steady flow field are given as follows: \(u = \frac{A}{2}(x+y+z)\), \(v = \frac{A}{2}(x+y+z)\), \(w = -A(x+y+z)\) where \(A\) is a dimensional constant, with a numerical value of 1 unit. Consider a directed line segment in the flow field, connecting the points \(P_1(0,0,0)\) and \(P_2(-3,3,0)\). In order to find the change in pressure experienced on moving from the point \(P_1\) to the point \(P_2\) along the direction \(\overrightarrow{P_1P_2}\)

(a) Bernoulli’s equation cannot be applied.

(b) Bernoulli’s equation can be applied as \(\overrightarrow{P_1P_2}\) is a streamline.

(c) Bernoulli’s equation can be applied as the flow is irrotational.

(d) Bernoulli’s equation can be applied as \(\mathbf{V} \times \mathbf{z}\) is perpendicular to \(\overrightarrow{P_1P_2}\), where \(\mathbf{z}\) is the vorticity.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(d)

4) Water flows through a 300 mm x 150 mm horizontal venturimeter at the rate of \(=0.065 \text{ m}^3/\text{s}\) and the differential gauge is deflected 1.2 m, as shown in the figure below.

![Diagram of venturimeter](image)

Specific gravity of the manometric liquid is 1.6. The coefficient of discharge of the venturimeter will be

(a) \(C_d = 0.99\)

(b) \(C_d = 0.98\)

(c) \(C_d = 0.95\)

(d) \(C_d = 0.92\)
5) A vertical venturi meter is fitted with a circular pipe of diameter 30 cm. Diameter of the throat of the venturi meter is 15 cm. The loss of head from the entrance to the throat is \( \frac{1}{6} \) times the throat velocity head. The difference in reading of the two limbs of the differential mercury (specific gravity =13.6)-manometer is 30 cm. The quantity of water flowing through the pipe will be

(a) 0.0064 m\(^3\)/s

(b) 0.064 m\(^3\)/s

(c) 0.64 m\(^3\)/s

(d) 6.4 m\(^3\)/s

No, the answer is incorrect.
Score: 0
Accepted Answers:
(c)

6) A Pitot tube is inserted in an air flow (at STP) to measure the flow speed. The tube is inserted so that it points upstream into the flow and the pressure sensed by the tube is the stagnation pressure. The static pressure is measured at the same location in the flow, using a wall pressure tap. The specific gravity of mercury is 13.6, the density of water is 1000 kg/m\(^3\) and the density of the air at STP is 1.23 kg/m\(^3\). If the pressure difference is 20 mm of mercury, the flow speed will be

(a) 6.58 m/s

(b) 65.86 m/s

(c) 80.8 m/s

(d) 95.26 m/s

No, the answer is incorrect.
Score: 0
Accepted Answers:
7) A cylindrical tank of diameter \( D \) contains liquid to an initial height of \( h_0 \), as shown in figure below.

At time \( t = 0 \), a small stopper of diameter \( d \) is removed from the bottom. For constant density, inviscid flow with no losses, the differential equation describing the free-surface height \( h(t) \) during draining can be obtained as:

(a) \( \frac{dh}{dt} = -C\sqrt{2gd} \)
(b) \( \frac{dh}{dt} = -C\sqrt{2gDh/d} \)
(c) \( \frac{dh}{dt} = -C\sqrt{2gD} \)
(d) \( \frac{dh}{dt} = -C\sqrt{2gDd/h} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(c)

8) In the previous physical set-up, the expression for the time \( t_e \) to drain the entire tank

(a) \( t_e = \left(\frac{2h_0}{g} \right) / C \)
(b) \( t_e = \sqrt{h_0D} / (Cgd) \)
(c) \( t_e = \sqrt{h_0d} / (CgD) \)
(d) \( t_e = h_0\sqrt{1/(2CgD)} \)
A necked-down or venturi section of a pipe flow develops a low pressure which can be used to aspirate liquid upward from a reservoir as shown in figure below.

Consider the liquids to be the same and neglecting frictional losses the exit velocity $V_2$ which is just sufficient to cause the reservoir liquid to rise in the tube up to Section 1 is:

(a) $V_2 \geq \frac{\sqrt{2gh}}{\left(D_2 / D_1 \right)^2 - 1}^{1/2}$

(b) $V_2 \geq \frac{\sqrt{2gh}}{\left(D_2 / D_1 \right)^3 - 1}^{1/3}$

(c) $V_2 \geq \frac{\sqrt{gh}}{\left(D_2 / D_1 \right)^2 - 1}^{1/2}$

(d) $V_2 \geq \frac{\sqrt{gh}}{\left(D_2 / D_1 \right)^4 - 1}^{1/2}$

No, the answer is incorrect.

Score: 0

Accepted Answers:
(a)
11) A closed cylinder of 0.4 m in diameter and 0.4 m in height is filled with oil of specific gravity 0.80.

If the cylinder is rotated about its vertical axis at a speed of 200 rpm, the thrust of oil on top ($F_T$) and bottom ($F_B$) covers of the cylinder are:

(a) $F_T = 440.81 \, N, F_B = 835.29 \, N$

(b) $F_T = 835.29 \, N, F_B = 440.81 \, N$

(c) $F_T = 40.81 \, N, F_B = 830.29 \, N$

(d) $F_T = 81 \, N, F_B = 235.29 \, N$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)

11) The angle of diffuser angle of a venturimeter is less than the converging cone

(a) to minimize the loss of energy due to flow separation
(b) to increase to velocity of flow in the direction of flow at diverging part
(c) to decrease to pressure in the direction of flow at diverging part
(d) to avoid the situation where flow may become compressible

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)

12)
A student makes the following statement regarding the stagnation pressure: "It is the total pressure at a point in a flow where the flow is brought to rest." What do you think about his statement?

(a) Since the point denotes the stagnation point, it is evident that the total pressure at that location is the stagnation pressure.

(b) Even if the flow is brought to rest the point may not be a stagnation point and thus the statement is wrong.

(c) The stagnation pressure is equal to total pressure only if the fluid entering the stagnation point is brought to rest isentropically. Thus the student's statement is wrong.

(d) None of the above.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(c)