Unit 11 - Week 9

Course outline
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Assignment 9

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-04-01, 23:59 IST.

1) *1 point*

In the figure a shaded area is shown in the velocity field where the velocity is given by $\vec{V} = axi + byj$; $a = b = 25$ and the coordinates are measured in meters. The volume flow rate through the shaded area is

(a) $35\,m^3/s$
(b) $750\,m^3/s$
(c) $500\,m^3/s$
(d) $30\,m^3/s$

a.
b.
c.
d.

No, the answer is incorrect.
Score: 0
Accepted Answers:
b.

2) *1 point*

Mathematical statement of Reynolds transport theorem in its most general form is given by

(a) $\left.\frac{dN}{dt}\right|_{System} = \frac{\partial}{\partial t}\int_{CV}\eta\rho\vec{V}_r\,d\vec{A} + \int_{CV}\eta\rho\vec{V}d\forall$

(b) $\left.\frac{dN}{dt}\right|_{System} = \frac{\partial}{\partial t}\int_{CV}\eta\rho\vec{V}_r\cdot d\vec{A} + \int_{CV}\eta\rho\vec{V}d\forall$

(c) $\left.\frac{dN}{dt}\right|_{System} = \frac{\partial}{\partial t}\int_{CV}\eta\rho\vec{V}d\forall + \int_{CS}\eta(\rho\vec{V}_r\cdot\hat{n})dA$

(d) $\left.\frac{dN}{dt}\right|_{System} = \frac{\partial}{\partial t}\int_{CV}\eta\rho\vec{V}d\forall - \int_{CS}\eta(\rho\vec{V}_r\cdot\hat{n})dA$

where N is an extensive property, η is the property per unit mass, $\vec{V}_r$ is the velocity of fluid relative to the control volume and $d\vec{A}$ is the elemental area vector on the control surface.

a.
b.
c.
d.

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

3) *1 point*

The conservation of mass equation can be derived from the Reynolds Transport Theorem. If it is given that there is no generation or consumption of mass in the system, then which among the below statements is true in this context: (symbols have their usual meanings)

(a) The equation $\int_{System}\frac{\partial\rho(\vec{x},t)}{\partial t}d\tau + \int_{RSC}\rho(\vec{x},t)\vec{u}(\vec{x},t)\cdot\vec{n}\,dA = 0$ is applicable when the control volume moves with velocity of fluid. The control volume can be deformable in this case.

(b) The equation $\frac{d}{dt}\int_{System}\rho(\vec{x},t)\,d\tau' + \int_{RSC}\rho(\vec{x},t)(\vec{u}(\vec{x},t) - \vec{b}(\vec{x},t))\cdot\vec{n}\,dA = 0$ is applicable only when the control volume and fluid both move with a velocity $\vec{b}$.

(c) Both (a) and (b) are correct.

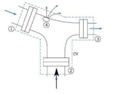
(d) Both (a) and (b) are wrong.

a.
b.
c.
d.

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

4) *1 point*

Consider the steady flow in a water pipe joint shown in figure. The areas are: $A_1 = 0.2\,m^2$, $A_2 = 0.2\,m^2$, and $A_3 = 0.15\,m^2$. In addition, fluid is lost out of a hole at 4, estimated at a rate of $0.3\,m^3/s$. The average speeds at sections 1 and 3 are $V_1 = 15\,m/s$ and $V_3 = 12\,m/s$, respectively. The velocity at section 2 is



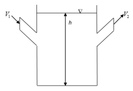
(a) $V_2 = 1.5\,m/s$
(b) $V_2 = 4.5\,m/s$
(c) $V_2 = -4.5\,m/s$
(d) $V_2 = 0.5\,m/s$

a.
b.
c.
d.

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

5) *1 point*

Fluid flows through a variable head tank with cross-sectional area A as shown in the figure. Fluid is entering the tank with a uniform velocity V_1 through a pipe of cross-sectional area A_1 and it leaves with a uniform velocity V_2 through a pipe of cross-sectional area A_2. At a particular time instant, height of the tank from the bottom is h. For constant density flow, the change in fluid height can be expressed as



(a) $\frac{dh}{dt} = \frac{A_1V_1 - A_2V_2}{A}$

(b) $\frac{dh}{dt} = \frac{A_1V_1 + A_2V_2}{A}$

(c) $\frac{dh}{dt} = \frac{V_1 + V_2}{2}$

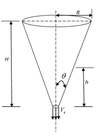
(d) $\frac{dh}{dt} = \frac{V_1 - V_2}{2}$

a.
b.
c.
d.

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

6) *1 point*

A conical tank of with radius 1.73 m and height 1 m, drains though a hole of radius 10 mm in its bottom as shown in the figure. The speed of the liquid leaving the tank is approximately $V_e = \sqrt{2gh}$, where h is the instantaneous height of the liquid free surface above the hole at a time t and g=9.81 m/s^2. The rate of change of surface level in the tank at the instant when $h = 0.5$ m will be



(a) $\frac{dh}{dt} = -0.00042$ m/s

(b) $\frac{dh}{dt} = -0.042$ m/s

(c) $\frac{dh}{dt} = -0.02$ m/s

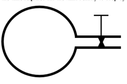
(d) $\frac{dh}{dt} = -0.002$ m/s

a.
b.
c.
d.

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

7) *1 point*

Compressed air exhausts from a small hole in a rigid spherical tank of diameter 60 cm as shown in the figure. The initial pressure and temperature of compressed air in the tank are 400 kPa and 400 K, respectively. The mass flow rate of $\dot{m}_e$ through the hole is proportional to the density (ρ) of air in the tank. Initial exhaust rate of air through the hole is 0.02 kg/s. Assuming uniform density within the tank, the time required for the tank density to drop by 80 % will be



(a) 8 s

(b) 18 s

(c) 28 s

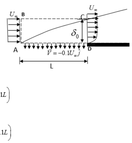
(d) 32 s

a.
b.
c.
d.

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

8) *1 point*

A fluid of constant density ρ flows steadily past a porous plate with a uniform free stream velocity U_∞ as shown in the figure. Constant suction is applied along the porous section. The velocity distribution at section CD is given by $\frac{u}{U_\infty} = \frac{3}{2}\frac{y}{\delta} - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$. The mass flow rate per unit width of the plate perpendicular to the plane of the figure across the section BC is



(a) $\rho U_\infty\left(\frac{3\delta}{8} - 0.1L\right)$

(b) $\rho U_\infty\frac{3\delta}{8}$

(c) $\rho U_\infty\left(\frac{3\delta}{8} + 0.1L\right)$

(d) $\rho U_\infty\left(\frac{3\delta}{2} - 0.1L\right)$

a.
b.
c.
d.

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