Assignment 10

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

Due on 2019-04-10, 23:59 IST.

1) A fluid of constant density $\rho$ flows over a stationary flat plate as shown in the figure. The relative velocity between the solid boundary and the fluid in contact with that is zero. Incip its free stream velocity on the plate is $U_w$. The velocity distribution within the boundary layer region adhering to the plate in which viscous effects are important is approxim by $\frac{u}{U_w} = 2y - \left(\frac{y}{\delta}\right)^2$, where $y$ is the distance measured from the plate perpendicular to the direction of flow and $\delta$ is the local boundary layer thickness. The boundary layer thickness at location $B$ is $\delta_B$. The plate width perpendicular to the plane of the figure is $w$. The net drag force exerted by the plate on the fluid over the length $L$ will be

![Diagram of fluid flow over a flat plate with boundary layer and velocity distribution](image)

(a) $\frac{1}{5} \rho w U_w^2 \delta_B$
(b) $\frac{1}{15} \rho w U_w^2 \delta_B$
(c) $\frac{4}{5} \rho w U_w^2 \delta_B$
(d) $\frac{2}{15} \rho w U_w^2 \delta_B$

No, the answer is incorrect.

Score: 0
When a jet strikes an inclined fixed plate, as in above figure, it breaks into two jets at 2 and equal velocity \( V = \frac{V_j}{2} \) but unequal fluxes \( \alpha Q \) at 2 and \( (1-\alpha)Q \) at section 3. \( \alpha \) be fraction. Assuming a frictionless surface the angle \( \alpha \) can be expressed as a function of the angle \( \theta \) as:

(a) \( \alpha = \frac{1}{2} (1 - 2\cos(\theta)) \).

(b) \( \alpha = \frac{1}{2} (1 + \cos(\theta)) \).

(c) \( \alpha = \frac{1}{2} (1 + 2\cos(\theta)) \).

(d) \( \alpha = \frac{1}{2} (1 - \cos(\theta)) \).

No, the answer is incorrect.
Score: 0
Accepted Answers:
(b)
1 point
A jet of water issuing having density $\rho$ from a stationary nozzle with a uniform velocity $V$ strikes a frictionless turning vane mounted on a cart as shown in the figure. The vane turns through an angle $\theta$. The area corresponding to jet velocity $V$ is $A$. An external mass $M$ connected to the cart through a frictionless pulley. Assuming that the ground to be frictionless, the magnitude of $M$ required to hold the cart stationary will be

\[ M = \frac{\rho AV^2 (1 - \cos \theta)}{g} \]  

(a) $M = \frac{\rho AV^2 (1 - \cos \theta)}{g}$

(b) $M = \frac{\rho AV^2 (1 + \cos \theta)}{g}$

(c) $M = \frac{\rho AV^2 (1 - \cos \theta)}{2g}$

(d) $M = \frac{\rho AV^2 (1 + \cos \theta)}{2g}$

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No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)
4)
A vane is attached to a block as shown in the figure. The block moves with a speed of \( V_j \) and the influence of a liquid jet of velocity \( V_j \), cross-sectional area \( A \) and density \( \rho \). The mass of the block is \( M \). The coefficient of kinetic friction for motion of the block along the surface is \( \mu_k \). The terminal speed of the block will be

\[
U_w = V_j - \sqrt{\frac{\mu_k M g}{\rho A}}
\]

(b) \( U_w = V_j - \frac{\mu_k M g}{\rho A} \)

(c) \( U_w = V_j + \frac{\mu_k M g}{\rho A} \)

(d) \( U_w = V_j + \sqrt{\frac{\mu_k M g}{\rho A}} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)
A cart is propelled by a liquid jet (density $\rho$) issuing horizontally from a tank as shown in the figure. The initial mass of the block is $M_0$. The tank is pressurized so that the jet speed may be considered to be a constant. Assuming that the jet issues with a velocity $V$ in the leftward direction, relative to the cart and the track to be frictionless, the expression for the speed of the block as it accelerates from rest will be

\[ U = V \ln \left( \frac{M_0}{M_0 - \rho A V t} \right) \]

(a)

\[ U = V \ln \left( \frac{M_0}{M_0 - \rho t} \right) \]

(b)

\[ U = V \ln \left( \frac{M_0}{M_0 - \rho AV t} \right) \]

(c)

\[ U = \ln \left( \frac{M_0}{M_0 - \rho AV t} \right) \]

(d)

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

1 point
A tank and trough are placed on a trolley as shown in figure. Water issues from the tank through a 50 mm diameter nozzle at 5 m/s and strikes the trough which turns through which turn through it by 45° as shown. The compression of the spring of stiffness 2 kN/m is:

(a) 176.39 mm
(b) 27.36 mm
(c) 34.72 mm
(d) 17.36 mm

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

A rocket is attached to a rigid horizontal rod hinged at the origin as in figure. Its initial mass is $M_0$, and its exit properties are $\dot{m}$ and $V_0$ relative to the rocket. Neglect gravity, air drag, and rod mass.

The time evolution of the mass of fuel in the rocket is

(a) $M = M_0 e^{-\dot{m}t}$
(b) $M = M_0 e^{-\dot{m}t}$
(c) $M = M_0 - \dot{m}t$
(d) $M = M_0 - \frac{1}{2} \dot{m} t$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(d)
If one neglects the time dependencies of fluid velocities relative to the rocket within the rocket itself as well as the time dependence of density within the rocket, then the differential equation for rocket motion is given by:

\[ \frac{d\omega}{dt} = \frac{V_e}{R} \frac{m}{R(\dot{m} t - M_0)} \]

(a) \[ \frac{d\omega}{dt} = \frac{V_e}{R} \frac{m}{\dot{m} t - M_0} \]

(b) \[ \frac{d\omega}{dt} = -\frac{V_e}{R} \frac{m}{2\dot{m} t - M_0} \]

(c) \[ \frac{d\omega}{dt} = \frac{V_e}{R} \frac{m}{\dot{m} t - M_0} \]

(d) \[ \frac{d\omega}{dt} = -\frac{V_e}{R} \ln(\dot{m} t - M_0) \]

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

If the rocket starts from an initial rest condition then the time evolution of angular velocity can be expressed as

(a) \[ \omega = -\frac{V_e}{R} \ln \left( \frac{\dot{m} t - M_0}{\dot{m} t} \right) \]

(b) \[ \omega = \frac{V_e}{R} e^{\dot{m} t / M_0} \]

(c) \[ \omega = \frac{V_e}{R} e^{-\dot{m} t / M_0} \]

(d) \[ \omega = -\frac{V_e}{2R} \ln \left( \frac{\dot{m} t - M_0}{\dot{m} t} \right) \]

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)
The force required to hold the plug of circular cross section in place at the exit of the water pipe of circular cross-section when the flow rate is 1.5 m³/s, and the upstream pressure is 3.5 MPa.

(a) F=100.4 MN
(b) F=107.04 MN
(c) F=190.4 MN
(d) F=200.4 MN

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