Unit 4 - Week 2

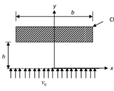
Assignment 2

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

Due on 2019-08-21, 23:59 IST.

1) 1 point

Common Data for Questions 1 to 3:
A heated rectangular electronic chip floats on the top of a thin layer of air, above a bottom plate as shown in figure below. Air is blown at a uniform velocity v_0 through holes in the bottom plate. Width of the chip perpendicular to the plane of the figure is L. Assume a steady, inviscid, constant density flow in the gap between the chip and the bottom plate.



The velocity field in the gap between the chip and the bottom plate is given by

(A) $u = \frac{v_0 x}{h}$; $v = v_0$

(B) $u = \frac{v_0 x}{h}$; $v = -\frac{v_0 y}{h}$

(C) $u = \frac{v_0 x}{h}$; $v = \frac{v_0 y}{h}$

(D) $u = \frac{v_0 x}{h}$; $v = v_0\left(1 - \frac{y}{h}\right)$

Hint: Since air cannot penetrate the chip, the component of velocity normal to the chip surface has to be zero.

a
b
c
d

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

2) 1 point

The acceleration of a fluid particle in the gap between the chip and the bottom plate is given by

(A) $\vec{a} = \frac{v_0^2 x}{h^2}\hat{i} + \frac{v_0^2 y}{h^2}\hat{j}$

(B) $\vec{a} = \frac{v_0^2 x}{h^2}\hat{i} - \frac{v_0^2 y}{h^2}\hat{j}$

(C) $\vec{a} = \frac{v_0^2 x}{h^2}\hat{i} - \frac{v_0^2}{h}\left(1 - \frac{y}{h}\right)\hat{j}$

(D) $\vec{a} = \frac{v_0^2 x}{h^2}\hat{i}$

a
b
c
d

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

3) 1 point

The weight of the chip that can be held in equilibrium by the injected air is

(A) $\frac{\rho v_0^2 b^2 L}{4h^2}$

(B) $\frac{\rho v_0^2 b^2 L}{12h^2}$

(C) $\frac{\rho v_0^2 b L}{24h^2}$

(D) $\frac{\rho v_0^2 b^2 L}{4h^2}$

a
b
c
d

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

4) 1 point

A steady, two-dimensional velocity field is represented by the stream function

$$\psi = Ax^2y$$

where A is a known dimensional constant. Consider two points P(1,4) and Q(2,1) in the flow field. Which among the following statements is/are correct?

(A) The flow field is irrotational.

(B) The flow field is rotational.

(C) Bernoulli equation can be used to evaluate the pressure difference between the points P and Q.

(D) Bernoulli equation cannot be used to evaluate the pressure difference between the points P and Q.

a
b
c
d

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

5) 1 point

Common Data for Questions 5 and 6:
A tornado may be modeled as a combination of vortices with $v_r = v_z = 0$ and $v_\theta = v_\theta(r)$, such that

$$v_\theta = \begin{cases} \frac{\omega r}{2} & \text{for } r < R \text{ (inner region)} \\ \frac{\omega R^2}{r} & \text{for } r \geq R \text{ (outer region)} \end{cases}$$

Assume the flow to be inviscid and the fluid density is constant. Also assume that $p \to p_\infty$ as $r \to \infty$.

Which among the following statements about this flow field is/are TRUE?

(A) The flow pattern is irrotational in the inner region

(B) The flow pattern is irrotational in the outer region

(C) The flow pattern is rotational in the inner region

(D) The flow pattern is rotational in the outer region

a
b
c
d

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

6) 1 point

Which among the following statements regarding the location and magnitude of lowest pressure in the tornado is/are correct?

(A) The lowest pressure occurs at $r = 0$.

(B) The lowest pressure occurs at $r = R$.

(C) The magnitude of lowest pressure is $p_\infty - \frac{\rho\omega^2 R^2}{2}$

(D) The magnitude of lowest pressure is $p_\infty - \rho\omega^2 R^2$

a
b
c
d

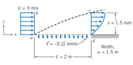
No, the answer is incorrect.
Score: 0
Accepted Answers:
a
d

7) 1 point

Water flows steadily past a porous flat plate. Constant suction is applied along the porous section. The velocity profile at section cd is

$$\frac{u}{U} = 3\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^{3/2}$$

The density of water is 1000 kg/m^3. Width of the porous plate perpendicular to the plane of the paper is 1.5 meters. The mass flow rate out of the control volume across the section bc (in kg/s) is



(A) 1.425

(B) 2.025

(C) 2.625

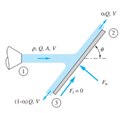
(D) 0

a
b
c
d

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

8) 1 point

When a jet strikes an inclined fixed plate, as shown in figure below, it breaks into two jets at 2 and 3 of equal velocity $V = V_{jet}$ but unequal flows αQ at 2 and $(1-\alpha)Q$ at section 3, α being a fraction. For a frictionless flow, the fluid can exert no tangential force F_t on the plate. The condition $F_t = 0$ enables us to solve for α. The value of α for $\theta = 60°$ is



(A) 0.5

(B) 0.625

(C) 0.75

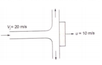
(D) 0.925

a
b
c
d

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

9) 1 point

42. A jet of water issues from a nozzle with a velocity 20 m/s and it impinges normally on a flat plate moving away from it at 10 m/s. The cross-sectional area of the jet is 0.02 m^2, and the density of water = 1000 kg/m^3. The force exerted by the jet on the plate is



(A) 1000 N

(B) 2000 N

(C) 4000 N

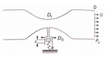
(D) 8000 N

a
b
c
d

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

10) 0 points

Air flows through a venture and into atmosphere. Air density is ρ ; atmospheric pressure is p_a ; throat diameter is D_t ; exit diameter is D and exit velocity is U. The throat is connected to a cylinder containing a frictionless piston of diameter D_p attached to a spring. The spring constant is k. The bottom surface of the piston is exposed to atmosphere. Due to the flow, the piston moves by distance x. Assuming a steady constant density inviscid flow, x is



(A) $\frac{\rho U^2}{2k}\pi D_p^2$

(B) $\frac{\rho U^2}{8k}\left(\frac{D_t^2}{D^2} - 1\right)\pi D_p^2$

(C) $\frac{\rho U^2}{2k}\left(\frac{D_t^2}{D^2} - 1\right)\pi D_p^2$

(D) $\frac{\rho U^2}{8k}\left(\frac{D_t^2}{D^2} - 1\right)\pi D_p^2$

a
b
c
d

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