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Courses » Fluid dynamics and turbomachines

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# Week #2. INTEGRAL ANALYSIS

Course outline

How to access the portal

Pre-requisite Assignment

Course Content

Week #1. INTRODUCTION TO FLUID FLOWS

Week #2. INTEGRAL ANALYSIS

- Lec 01 - Integral analysis, Control volume, Generalised conservation equation
- Lec 02 - Mass and linear momentum conservation in CV
- Lec 03 - Angular momentum conservation, Non-inertial frame of reference

## Assignment 2

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

**Due on 2018-09-05, 23:59 IST.**

1) The volume of the 'Control Volume' *1 point*

- is fixed and should not change with time
- may be fixed or may change with time
- is never fixed and should change with time
- None

**No, the answer is incorrect.**
**Score: 0**

**Accepted Answers:**
*may be fixed or may change with time*

2) Mass inside a control volume *1 point*

- is fixed
- should always change with time
- may or may not change with time
- None

**No, the answer is incorrect.**
**Score: 0**

**Accepted Answers:**
*may or may not change with time*

3) In an inertial reference frame, ($V_f$ refers to the frame velocity, t refers to time, $x$ refers to spatial co-ordinate, and e refers to the mathematical constant). Which of the following can be true. *1 point*

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$V_f = e$

**No, the answer is incorrect.**
**Score: 0**

**Accepted Answers:**
$V_f = e$

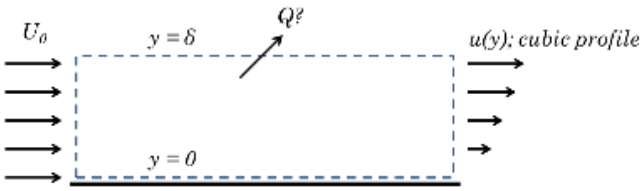
4) In a control volume **1 point**

- The mass is strictly constant at all the times
- The momentum is strictly constant at all the times
- The angular momentum is strictly constant at all the times
- None

**No, the answer is incorrect.**
**Score: 0**

**Accepted Answers:**
*None*

5) An incompressible fluid flows past an impermeable flat plate, with a uniform inlet profile $u = U_0$ m/s and a cubic polynomial exit profile $u \sim U_0 \frac{(3\eta - \eta^3)}{2}\, m/s$ where $\eta = \frac{y}{\delta}$ . Compute the ratio of volume flow per unit length $Q$ to $\delta$ (take $Q$ and $\delta$ also in SI units) across the top surface of the control volume if $U_0 = 1m/s$.

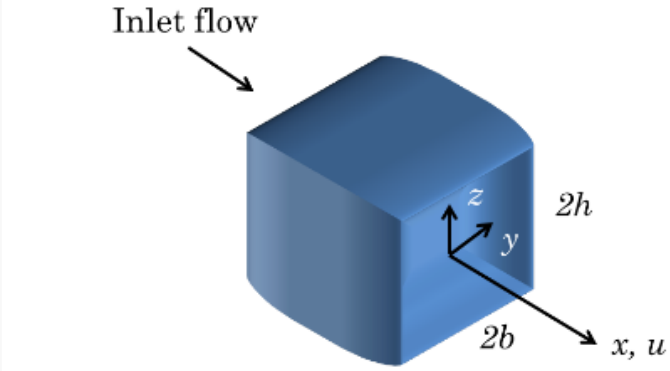



**No, the answer is incorrect.**
**Score: 0**

**Accepted Answers:**
*(Type: Range) 0.35,0.4*

**2 points**

6) An incompressible fluid flows steadily through the rectangular duct. The exit velocity profile is given approximately by $u = u_{max}\ (1 - \frac{y^2}{b^2})(1 - \frac{z^2}{h^2})$. If the inlet flow is 0.1416 $m^3$ /s, estimate $u_{max}$ (which is a constant) in m/s for $b = h$ = 10 cm.

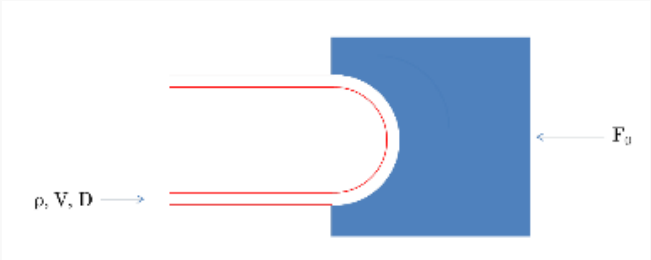



**No, the answer is incorrect.**
**Score: 0**

**Accepted Answers:**
*(Type: Range) 7.9,8*

***2 points***

7) If a vane turns a water jet completely as shown in the figure, find the maximum jet velocity in m/s for which a force $F_0$ of value 100 N will prevent the vane from moving. Take $\rho$ = 1000, $D$ = 0.05 (all in SI units)

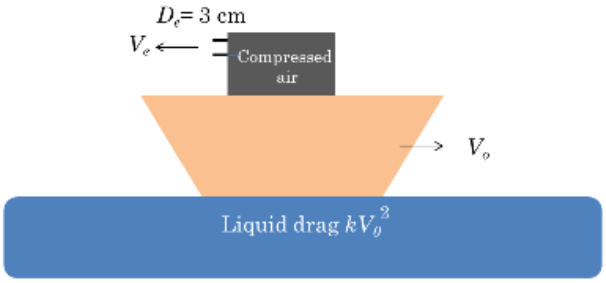



**No, the answer is incorrect.**
**Score: 0**

**Accepted Answers:**
*(Type: Range) 5,5.1*

***2 points***

8) The small boat is driven at steady speed $V_o$ by compressed air issuing from a 3 cm diameter hole at $V_e = 343 m/s$ with respect to the compressor and $P_e = 1$ atm, $T_e = 30^o C$. Neglect air drag on the boat. The liquid drag on boat is $kV_o^2$ , where $k = 19 Ns^2/m^2$ . Estimate the boat speed $V_o$ (in m/s). Use $P = \rho RT$ equation for air where $R = 287$ (in SI units).

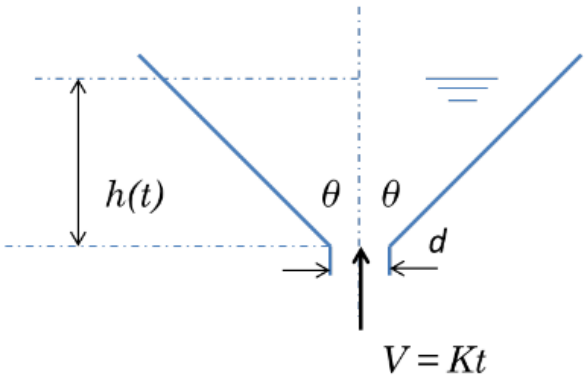



No, the answer is incorrect.
Score: 0

**Accepted Answers:**
*(Type: Range) 2.2,2.3*

***2 points***

9) Water enters the bottom of the cone in the figure at a uniformly increasing average velocity $V = Kt$. If $d$ is very small, find the water surface rise (in mm) at $t$ = 5 s, assuming $h$ = 0 at $t$ = 0 and $d$ = 1 mm, $K$ = 2 $m/s^2$ , $\theta = 60^o$

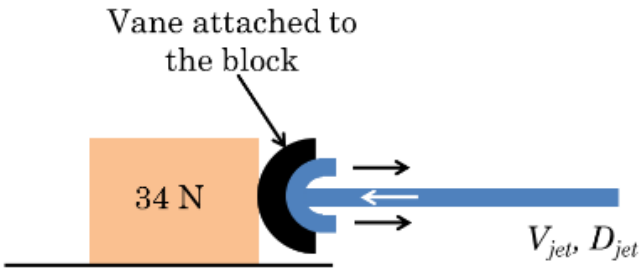



No, the answer is incorrect.
Score: 0

**Accepted Answers:**
*(Type: Range) 18.3,18.5*

***2 points***

10) A block weighs 34 N and is to be accelerated from rest by a 2 cm diameter water jet with a velocity of 30 m/s. The water jet is turned through $180^o$ by a vane (attached to the block) on which the jet impinges. The water exits the vane with same velocity as the inlet. Neglecting air drag and friction on the block, estimate the distance travelled by the block after 0.07 s. Take density of water = 1000 $kg/m^3$ and g = 9.81 $m/s^2$ .




No, the answer is incorrect.
Score: 0

**Accepted Answers:**
*(Type: Range) 0.28,0.35*

***2 points***

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