

## Week #4. VISCOUS FLOW

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### Assignment 4

The due date for submitting this assignment has passed. Due on 2018-09-12, 23:59 IST.  
 As per our records you have not submitted this assignment.

1) 1 point

If  $u = U\left(\frac{2y}{\delta} - \frac{2y^3}{\delta^3} + \frac{y^4}{\delta^4}\right)$  where  $U, \delta$  represent the free stream velocity and boundary layer thickness respectively for a flow over a flat plate, find the displacement thickness approximately at  $x = 0.05$  m if  $U = 1$  m/s,  $\rho = 1000$  kg/m<sup>3</sup>,  $\mu = 10^{-3}$  Pa.s. The boundary layer thickness can be estimated from Blasius solution.

- 1.118 mm
- 0.409 mm
- 0.335 mm
- 0.216 mm

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
0.335 mm

2) 1 point

In the analysis of 2D boundary layer flow over a flat plate, it is assumed that  $v \ll u$ . Building on this, which of the following is true?

- $\frac{\partial u}{\partial x}$  in the continuity equation can be neglected
- $\frac{\partial v}{\partial y}$  in the continuity equation can be neglected
- $\frac{\partial v}{\partial y}$  in the continuity equation cannot be neglected
- None

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
 $\frac{\partial v}{\partial y}$  in the continuity equation cannot be neglected

3) In question 1, find the momentum thickness ( $\theta$  in mm)

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
(Type: Range) 0.12,0.14

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 1.7,1.8

1 point

5)

1 point

For a 2D flow over a flat plate, if  $\eta = \frac{y}{\delta}$  and  $f'(\eta) = \frac{u}{U}$  then the value of  $f'(0)$ , and  $f'(\infty)$  are

- 0,0
- 1,0
- 0,1
- None

No, the answer is incorrect.

Score: 0

Accepted Answers:

0,1

6)

1 point

The relation between the drag forces ( $F$ ) experienced by a cylinder (radius  $R$  and height  $h$ ) and cube (side length  $R$  and having same volume as the cylinder) in a similar flow is (Note: the flow is perpendicular to the axis of cylinder and a face of the cube)

- $F_{cyl} = F_{cube}$
- $F_{cyl} > F_{cube}$
- $F_{cyl} < F_{cube}$
- None

No, the answer is incorrect.

Score: 0

Accepted Answers:

$F_{cyl} < F_{cube}$

7)

1 point

Which of the following can be true with respect to pressure profile in the fully developed laminar flow in a pipe?

- $P = -6x^3 - 5x^2 - 3x - 4$
- $P = -5x^2 - 3x - 4$
- $P = -3x - 4$
- None

No, the answer is incorrect.

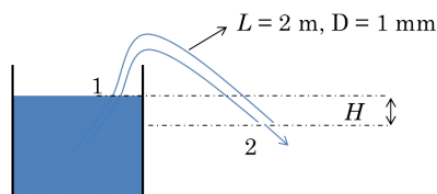
Score: 0

Accepted Answers:

$P = -3x - 4$

8)

Water is to be siphoned through a tube 2 m long and 1 mm in diameter. What is the flow rate (in  $\text{cm}^3/\text{s}$ ) if  $H = 25 \text{ cm}$ ? Neglect the tube curvature and minor losses. Take  $\rho = 1000$ ,  $g = 9.81$ ,  $\mu = 10^{-3}$  in SI units. The cross sectional area of the tank is very large compared to the tube.




No, the answer is incorrect.

Score: 0

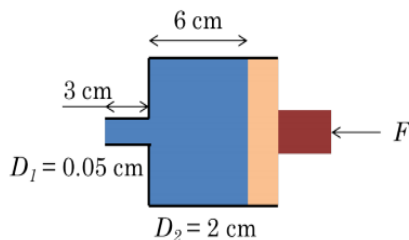
Accepted Answers:

(Type: Range) 0.028,0.031

2 points

9)

A steady push on the piston causes a flow rate  $Q = 0.3 \text{ cm}^3/\text{s}$  through the syringe. The fluid has  $\rho = 900 \text{ kg/m}^3$  and  $\mu = 0.002 \text{ kg}/(\text{m s})$ . What force  $F$  (in N) is required to maintain the flow? Neglect entrance losses and assume laminar flow.




No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 0.35,0.4

2 points

10)

A fluid (density,  $\rho = 900 \text{ kg/m}^3$  and viscosity,  $\mu = 0.002 \text{ kg}/(\text{m s})$ ) is fl in a pipe (1 m long and 1 cm radius) with an average velocity of  $0.2 \text{ m/s}$  the shear stress (in Pa) on the pipe assuming fully developed flow.

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 0.15,0.2

2 points

11)

1 point

The ratio of friction factors ( $\frac{f_1}{f_2}$ ) in two different pipes with same fluid is 0.5. The average flow velocity in pipe-1 is 0.15 m/s and the pipe diameter is 0.1 cm. The flow in the pipes can be assumed to be laminar. The radius of pipe-2 is 0.2 cm. The average velocity in pipe-2 is

- 0.0375 m/s  
 0.019 m/s  
 0.075 m/s  
 None

No, the answer is incorrect.

Score: 0

Accepted Answers:

0.019 m/s

12)

1 point

If the maximum velocity in a fully developed region of a pipe (radius  $R = 1$  mm) flow is 0.5 m/s, the entrance length (in m) is approximately (take  $\rho = 1000$  and  $\mu = 10^{-3}$  both in SI units)

- 0.02  
 0.04  
 0.06  
 0.08

No, the answer is incorrect.

Score: 0

Accepted Answers:

0.06

13)

1 point

At what distance (in mm) from the leading edge (approximately), the boundary layer thickness will be 0.1 mm for a 2D fluid flow over a flat plate. (Use Von-Karman approximation. Take kinematic viscosity  $\nu = 0.5$  cSt and free stream velocity  $U = 1$  m/s)

- 0.66  
 0.76  
 0.86  
 0.96

No, the answer is incorrect.

Score: 0

Accepted Answers:

0.66

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