Unit 11 - Week 9

Course outline

Assignment 9

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

Due on 2019-10-02, 23:59 IST.

1) Which among the following is the MOST GENERAL form of the kinematic boundary condition applicable at a fluid-fluid interface where $F(x, y, t) = 0$ describes the interface shape? *1 point*

(A) $\frac{\partial F}{\partial t} = 0$

(B) $\frac{\partial F}{\partial t} + \vec{V} \cdot \nabla F = 0$

(C) $\vec{V} \cdot \nabla F = 0$

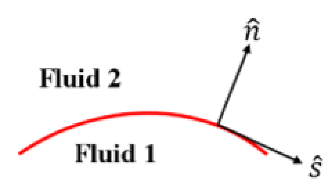
(D) $\frac{\partial F}{\partial t} + \nabla \cdot \left(F \vec{V}\right) = 0$

- a
- b
- c
- d

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

2) Which among the following is the MOST GENERAL mathematical form of the balance of tangential forces at a fluid-fluid interface (in the absence of electric/magnetic effects)? *1 point*

$\vec{T}^n$ denotes the traction vector, σ denotes the surface tension, $\hat{n}$ and $\hat{s}$ are the unit vectors normal and tangential to the interface respectively as shown in the figure below.



(A) $\vec{T_1}^n \cdot \hat{s} = \vec{T_2}^n \cdot \hat{s}$

(B) $\vec{T_1}^n \cdot \hat{n} = \vec{T_2}^n \cdot \hat{n}$

(C) $\vec{T_1}^n \cdot \hat{s} - \vec{T_2}^n \cdot \hat{s} = \nabla_s \sigma \cdot \hat{s}$

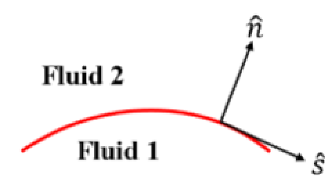
(D) $\vec{T_1}^n \cdot \hat{n} - \vec{T_2}^n \cdot \hat{n} = -\sigma \left(\nabla \cdot \hat{n}\right)$

- a
- b
- c
- d

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

3) Which among the following is the MOST GENERAL mathematical form of the balance of normal forces at a fluid-fluid interface (in the absence of electric/magnetic effects)? *1 point*

$\vec{T}^n$ denotes the traction vector, σ denotes the surface tension, $\hat{n}$ and $\hat{s}$ are the unit vectors normal and tangential to the interface respectively as shown in the figure below.



(A) $\vec{T_1}^n \cdot \hat{s} = \vec{T_2}^n \cdot \hat{s}$

(B) $\vec{T_1}^n \cdot \hat{n} = \vec{T_2}^n \cdot \hat{n}$

(C) $\vec{T_1}^n \cdot \hat{s} - \vec{T_2}^n \cdot \hat{s} = (\nabla_s \sigma) \cdot \hat{s}$

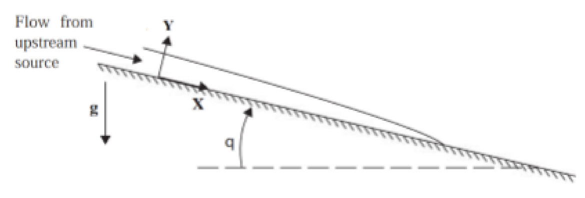
(D) $\vec{T_1}^n \cdot \hat{n} - \vec{T_2}^n \cdot \hat{n} = -\sigma \left(\nabla \cdot \hat{n}\right)$

- a
- b
- c
- d

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

4) **Common Data for Questions 4 to 10:** *1 point*

Gravity-Driven Flow of a Thin Film: Consider the two-dimensional gravity-driven flow of a thin layer of Newtonian fluid on an inclined plane of angle θ to the horizontal.



The pressure of the atmosphere above the film is p_{atm}. Assume the thickness of the film, $h(x,t)$ to be small compared to the characteristic length scale, L in the x-direction. Also assume the Reynolds number, $Re_L = \frac{\rho u_c L}{\mu} << 1$, where u_c is the characteristic velocity scale in the x-direction. The atmosphere produces no shear stress at the outer surface of the film.

Which among the following is the MOST SIMPLIFIED form of the x-component of linear momentum equation governing this flow field under the above assumptions?

(A) $\rho\left(\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y}\right) = -\frac{\partial p}{\partial x} + \mu\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right) + \rho g \sin\theta$

(B) $0 = -\frac{\partial p}{\partial x} + \mu\frac{\partial^2 u}{\partial y^2} + \rho g \sin\theta$

(C) $0 = -\frac{\partial p}{\partial x} + \mu\frac{\partial^2 u}{\partial y^2}$

(D) $0 = \mu\frac{\partial^2 u}{\partial y^2}$

- a
- b
- c
- d

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

5) Which among the following is the MOST SIMPLIFIED form of the y-component of linear momentum equation governing this flow field under the above assumptions? *1 point*

(A) $\rho\left(\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y}\right) = -\frac{\partial p}{\partial y} + \mu\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right) - \rho g \cos\theta$

(B) $0 = -\frac{\partial p}{\partial y} + \mu\frac{\partial^2 v}{\partial y^2} - \rho g \cos\theta$

(C) $0 = -\frac{\partial p}{\partial y} + \mu\frac{\partial^2 v}{\partial y^2}$

(D) $0 = -\frac{\partial p}{\partial y} - \rho g \cos\theta$

- a
- b
- c
- d

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

6) Which among the following is the MOST SIMPLIFIED form of the kinematic boundary condition applicable at the liquid-gas interface under the above assumptions? *1 point*

(A) $v|_{y=h} = 0$

(B) $u|_{y=h} = 0$

(C) $v|_{y=h} = \frac{\partial h}{\partial t}$

(D) $v|_{y=h} = \frac{\partial h}{\partial t} + u|_{y=h}\frac{\partial h}{\partial x}$

- a
- b
- c
- d

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

7) Which among the following is the correct mathematical form of the kinematic boundary condition applicable at the solid surface, $y = 0$? *1 point*

(A) $v|_{y=0} = 0$

(B) $u|_{y=0} = 0$

(C) $v|_{y=0} = \frac{\partial h}{\partial t}$

(D) $v|_{y=0} = \frac{\partial h}{\partial t} + u\frac{\partial h}{\partial x}$

- a
- b
- c
- d

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

8) Which among the following is the correct mathematical form of no-slip condition applicable at the solid surface, $y = 0$? *1 point*

(A) $v|_{y=0} = 0$

(B) $u|_{y=0} = 0$

(C) $v|_{y=0} = \frac{\partial h}{\partial t}$

(D) $v|_{y=0} = \frac{\partial h}{\partial t} + u\frac{\partial h}{\partial x}$

- a
- b
- c
- d

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

9) Which among the following is the MOST SIMPLIFIED form of the balance of normal forces at the liquid-gas interface under the above assumptions? *1 point*

(A) $p|_{y=h} = p_{\text{atm}}$

(B) $\left.\frac{\partial u}{\partial y}\right|_{y=h} = 0$

(C) $p|_{y=h} = p_{\text{atm}} - \sigma\frac{\partial^2 h}{\partial x^2}$

(D) $\mu\left.\frac{\partial u}{\partial y}\right|_{y=h} = \frac{\partial \sigma}{\partial x} + \left(\frac{\partial h}{\partial x}\right)\frac{\partial \sigma}{\partial y}$

- a
- b
- c
- d

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

10) Which among the following is the MOST SIMPLIFIED form of the balance of tangential forces at the liquid-gas interface under the above assumptions? *1 point*

(A) $\mu\left.\frac{\partial u}{\partial y}\right|_{y=h} = \frac{\partial \sigma}{\partial x} + \left(\frac{\partial h}{\partial x}\right)\frac{\partial \sigma}{\partial y}$

(B) $p|_{y=h} = p_{\text{atm}} - \sigma\frac{\partial^2 h}{\partial x^2}$

(C) $p|_{y=h} = p_{\text{atm}}$

(D) $\left.\frac{\partial u}{\partial y}\right|_{y=h} = 0$

- a
- b
- c
- d

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