Week 9 Assessment

The due date for submitting this assignment has passed. **Due on 2020-04-01, 23:59 IST.**
As per our records you have not submitted this assignment.

1) What is the diffusion equation for mass transport when the diffusion coefficient $D$ is dependent on the concentration $c$ of the solute? In the expression below, $v$ is the flow velocity.

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

$$\frac{dc}{dt} + \nabla \cdot (vc) = D\nabla^2 c$$

2)
The incompressible Navier-Stokes equations for a Newtonian Fluid of density $\rho$ and viscosity $\mu$ are,

$$\nabla \cdot \mathbf{v} = 0$$

$$\rho \left( \frac{\partial \mathbf{v}}{\partial t} + \mathbf{v} \cdot \nabla \mathbf{v} \right) = -\nabla p + \mu \nabla^2 \mathbf{v}$$

What are the assumptions in the derivation of these equations?

- Constant density and pressure.
- Constant density and temperature.
- Constant pressure and viscosity.
- Constant density and viscosity.

No, the answer is incorrect.
Score: 0
Accepted Answers:
Constant density and viscosity.

3) Consider the flow of a incompressible Newtonian fluid of density $\rho$ and viscosity $\mu$ in two dimensions, where the co-ordinates are $x$ and $y$ and the velocities in the two directions are $v_x$ and $v_y$. In relating to this two questions are as followed.

The stress $\tau_{xy}$ is given by,

$$\mu \frac{\partial v_x}{\partial y}$$

$$\mu \left( \frac{\partial v_x}{\partial y} + \frac{\partial v_y}{\partial x} \right)$$

$$-p + \mu \left( \frac{\partial v_x}{\partial y} + \frac{\partial v_y}{\partial x} \right)$$

$$-p + \mu \left( \frac{\partial v_x}{\partial x} + \frac{\partial v_y}{\partial y} \right)$$

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

4) The momentum conservation equation in the $x$-direction is,

$$\rho \left( \frac{\partial v_x}{\partial t} + v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_y}{\partial y} \right) = -\frac{\partial p}{\partial x} + \mu \left( \frac{\partial^2 v_x}{\partial x^2} + \frac{\partial^2 v_y}{\partial x^2} \right)$$
10/07/2020
Transport processes I- Heat and Mass Transfer - Unit 10 - Forced convection.

\[ \rho \left( \frac{\partial v_x}{\partial t} + v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_x}{\partial y} \right) = -\frac{\partial p}{\partial x} + \mu \left( \frac{\partial^2 v_x}{\partial x^2} + \frac{\partial^2 v_x}{\partial y^2} \right) \]

\[ \rho \left( \frac{\partial v_x}{\partial t} + v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_y}{\partial y} \right) = -\frac{\partial p}{\partial x} + \mu \left( \frac{\partial^2 v_x}{\partial x^2} + \frac{\partial^2 v_y}{\partial y^2} \right) \]

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

\[ \rho \left( \frac{\partial v_x}{\partial t} + v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_x}{\partial y} \right) = -\frac{\partial p}{\partial x} + \mu \left( \frac{\partial^2 v_x}{\partial x^2} + \frac{\partial^2 v_y}{\partial y^2} \right) \]

5) Consider a rectangular solid block extending from \( x = 0 \) to \( x = L_x \) in the x direction, and \( y = 0 \) to \( y = L_y \) in the y direction, as shown in the figure below. The left and right faces at \( x = 0 \) to \( x = L_x \) are insulated, the top face at \( y = L_y \) is at temperature \( T_1 \) and bottom at \( y = 0 \) is at temperature \( T_2 \). If the temperature field at steady state is expressed as

\[ \frac{T - T_0}{T_1 - T_0} = \sum_{n=1}^{\infty} F_n(x, y) \]

Based on the above description two questions are as followed,

If \( A_n \) and \( B_n \) are constant coefficients, what are the appropriate spatial eigenfunctions \( F_n(x, y) \)?

- \( \sin(n\pi x/L_x)(A_n \exp(n\pi y/L_y) + B_n \exp(-n\pi y/L_y)) \)
- \( \cos(n\pi x/L_x)(A_n \exp(n\pi y/L_y) + B_n \exp(-n\pi y/L_y)) \)
- \( \sin(n\pi x/L_x)(A_n \exp(n\pi y/L_y)) + B_n \exp(-n\pi y/L_y) \)
\[ \cos(n\pi x/L_x)(A_n \exp(n\pi y/L_x) + B_n \exp(-n\pi y/L_x)) \]

No, the answer is incorrect.
Score: 0
Accepted Answers:
\[ \cos(n\pi x/L_x)(A_n \exp(n\pi y/L_x) + B_n \exp(-n\pi y/L_x)) \]

6) How are the coefficients \( A_n \) and \( B_n \) determined?  

- Using the orthogonality relation in \( x \) co-ordinate at \( x = 0 \) and \( x = L_x \).
- Using the orthogonality relation in \( y \) co-ordinate at \( y = 0 \) and \( y = L_y \).
- Using the orthogonality relation in \( x \) co-ordinate at \( y = 0 \) and \( y = L_y \).
- Using the orthogonality relation in \( y \) co-ordinate at \( x = 0 \) and \( x = L_x \).

No, the answer is incorrect.
Score: 0
Accepted Answers:
Using the orthogonality relation in \( x \) co-ordinate at \( y = 0 \) and \( y = L_y \).

7) Determines the eigenfunctions for heat conduction in a two-dimensional polar co-ordinate system,

\[ \nabla^2 T = \frac{1}{r} \frac{\partial}{\partial r} \left( r \frac{\partial T}{\partial r} \right) + \frac{1}{r^2} \frac{\partial^2 T}{\partial \phi^2} = 0 \]

with co-ordinates \( r \) which is the distance from the center and \( \phi \) which is the angle made by the position vector with the x-axis.

Based on the following three questions are as followed,

The temperature \( T \) is written as a product \( R(r)F(\phi) \), where \( R \) is only a function of \( r \) and \( F \) is only a function of \( \phi \). This is substituted into the conduction equation and the resulting equation is divided by \( R(r)F(\phi) \). Of the two terms in the equation, what is the solution that satisfies the equation of \( F(\phi) \) which the condition that \( F(\phi + 2\pi) = F(\phi) \). In the following, \( n \) is an integer.

- \( A \sin(\phi)^n + B \cos(\phi)^n \)
- \( A \sin(n\phi) + B \cos(n\phi) \)
- \( A \exp(n\phi) + B \exp(-n\phi) \)
- \( A \sin^n(\phi) + B \cos^n(\phi) \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
\( A \sin(n\phi) + B \cos(n\phi) \)

8) What is the solution for \( R(r) \)?  

- \( C_r^n + D_r^{-(n+1)} \)
- \( C_r^n + D_r^{-n} \)
9) What is the solution for \( n = 0? \)

- \( T(r, \phi) = Cr + D \)

- \( T(r, \phi) = \frac{C}{r} + Dr \)

- \( T(r, \phi) = \frac{C}{r^2} + D \)

- \( T(r, \phi) = C\log(r) + D \)

No, the answer is incorrect. Score: 0
Accepted Answers:
\( T(r, \phi) = C\log(r) + D \)