Assignment 5

The due date for submitting this assignment has passed. Due on 2019-03-06, 23:59 IST.

As per our records you have not submitted this assignment.

1) Conservation equation is written as

   a) \( \text{net rate of change in quantity} = \{\text{flow out through shell boundary}\} - \{\text{flow in through shell boundary}\} +\{\text{net generation}\} - \{\text{net consumption}\} \)

   b) \( \text{net rate of change in quantity} = \{\text{flow in through shell boundary}\} - \{\text{flow out through shell boundary}\} +\{\text{net generation}\} - \{\text{net consumption}\} \)

   c) \( \text{net rate of change in quantity} = \{\text{flow in through shell boundary}\} - \{\text{flow out through shell boundary}\} +\{\text{net generation}\} - \{\text{net consumption}\} \)

   d) \( \text{net rate of change in quantity} = \{\text{flow in through shell boundary}\} + \{\text{net generation}\} - \{\text{net consumption}\} \)

   **No, the answer is incorrect.**

   **Score:** 0

   **Accepted Answers:**

   c) \( \text{net rate of change in quantity} = \{\text{flow in through shell boundary}\} - \{\text{flow out through shell boundary}\} +\{\text{net generation}\} - \{\text{net consumption}\} \)

2) Boundary conditions are specified

   a) At the domain boundary at some specified time

   b) Throughout the domain at all times

   c) Throughout the domain at some specified time

   d) At the domain boundary at all times

   **No, the answer is incorrect.**

   **Score:** 0

   **Accepted Answers:**

   d) At the domain boundary at all times

3) Which of the given equation specifies the Dirichlet boundary condition with respect to the variable \( \Phi \) that is a function of \( x \) and \( y \)?

   a) \( \frac{\partial \Phi}{\partial n} = f(x,y) \)

   b) \( \Phi = f(x,y) \)

   c) \( \alpha(x,y)\Phi + \beta(x,y) \frac{\partial \Phi}{\partial n} = f(x,y) \)

   **No, the answer is incorrect.**

   **Score:** 0

   **Accepted Answers:**

   d) At the domain boundary at all times
4) Initial conditions are specified

- a) For a time-dependent variable, throughout the region of interest at all time
- b) For a time-independent variable, throughout the region of interest at some specified time
- c) For a time-independent variable, throughout the region of interest at all time
- d) For a time-dependent variable, throughout the region of interest at the start of the process

No, the answer is incorrect.
Score: 0
Accepted Answers:
d) For a time-dependent variable, throughout the region of interest at the start of the process

5) Which of the given boundary condition is also known as Type II boundary condition?

- a) Robbins
- b) Dirichlet
- c) Neumann
- d) Newton

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

6) **Problem Statement for Questions 6 - 10:**

Consider a rectangular fin solid material (as shown in the figure) occupying the space from \( y = 0 \) to \( y = \infty \) to be at an initial temperature of \( T_0 \). At time \( t = 0 \), the surface at \( y = 0 \) is suddenly raised temperature \( T_i \) and maintained at that temperature for \( t > 0 \).

The assumption(s) for writing the energy equation as

\[
\frac{d^2T}{dx^2} - \frac{hP}{kA}(T - T_\infty) = 0
\]

is/are

- a) Thermal conductivity is a constant
- b) Specific heat is a constant
- c) Density is a constant
- d) Spatial distribution of temperature is linear

No, the answer is incorrect.
7) The assumption(s) for further simplifying the energy equation as
\[ \frac{\partial T}{\partial t} = k \left( \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2} \right) \]
is/are:
   a) The process is at steady state
   b) Diffusive heat transfer is absent
   c) Convective heat transfer is absent
   d) The material of construction is non-homogeneous

No, the answer is incorrect.

Score: 0

Accepted Answers:
   a, b, c, d

8) The model equation may now be written as
\[ \frac{\partial T}{\partial t} = \frac{k}{\rho C_p} \frac{\partial^2 T}{\partial y^2} \]
by assuming
   a) Steady state
   b) Thermal gradient only in one direction
   c) Temperature is function of only time
   d) Temperature is function of only space

No, the answer is incorrect.

Score: 0

Accepted Answers:
   a, b, c, d

9) If the non-dimensional temperature is defined as \( \Theta = \frac{T-T_a}{T_l-T_a} \), the initial condition for the model equation is:
   a) \( \Theta = 0 \) at \( t = 0 \) \( \forall y \)
   b) \( \Theta = 1 \) at \( t = 0 \) \( \forall y \)
   c) \( \Theta = 0 \) at \( t = 0 \) \( \forall x \)
   d) \( \Theta = 1 \) at \( t = 0 \) \( \forall x \)

No, the answer is incorrect.

Score: 0

Accepted Answers:
   a, b, c, d
10. The boundary conditions for the model equation are

a) \[ \theta = 1 \text{ at } y = 0 \text{ & } \infty \text{ for all } \tau > 0 \]

b) \[ \theta = 1 \text{ at } y = \infty \text{ & } \forall \tau > 0 \text{ and } \theta = 0 \text{ at } y = 0 \text{ & } \forall \tau > 0 \]

c) \[ \theta = 0 \text{ at } y = 0 \text{ & } \forall \tau > 0 \text{ and } \theta = 1 \text{ at } y = \infty \text{ & } \forall \tau > 0 \]

d) \[ \theta = 1 \text{ at } y = 0 \text{ & } \forall \tau > 0 \text{ and } \theta = 0 \text{ at } y = \infty \text{ & } \forall \tau > 0 \]

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

11) Consider the unsteady-state operation in packed bed reactor as shown in Figure 1. Component undergoes a second-order reaction as it passes through the reactor. Its concentration \(c\) varies from the inlet to outlet.

![Figure 1. Packed bed reactor](https://onlinecourses.nptel.ac.in/noc19_ce15/un...)

Assume plug flow and only axial diffusion of the A. Species mass balance for A in this system given by:
Which of the following statement(s) is/are correct regarding non-dimensionalization of equation for modeling a system?

- a) It provides scaling of the variables in the equations that increases the numerical solution more efficient
- b) It helps in establishing a unified method of solution of different processes if they all have the same non-dimensional form of equation
- c) With the help of this, different physical problems become identical mathematical problems
- d) It provides scaling of the variables in the equations that increases the numerical solution more inefficient

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

12) Which of the following statement(s) is/are correct regarding non-dimensionalization of equation for modeling a system? 1 point

- a) It provides scaling of the variables in the equations that increases the numerical solution more efficient
- b) It helps in establishing a unified method of solution of different processes if they all have the same non-dimensional form of equation
- c) With the help of this, different physical problems become identical mathematical problems
- d) It provides scaling of the variables in the equations that increases the numerical solution more inefficient

No, the answer is incorrect.
Score: 0
Accepted Answers:
a) It provides scaling of the variables in the equations that increases the numerical solution more efficient
b) It helps in establishing a unified method of solution of different processes if they all have the same non-dimensional form of equation
c) With the help of this, different physical problems become identical mathematical problems

13) Problem Statement for Questions 13 - 18:

Consider a piston-cylinder apparatus enclosing a gas as shown in Figure 2. The piston is free to move inside the cylinder. The frictional resistance is considered to be zero. At some instant, the piston is at a distance of 15 cm from the closed end of the cylinder. At this moment, the gas density is uniform at 18 kg/m³ and the piston begins to move away from the closed end with a velocity of 12 m/s. The gas velocity is taken to be one-dimensional and proportional to distance from the closed end, that is, it varies linearly from zero at the closed end to V at the piston surface.

Figure 2: Piston-cylinder apparatus
14. The change in gas density with distance from the closed end of the cylinder is
   a) 18
   b) 0
   c) 7
   d) 9

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

15. The velocity \( u \) at any point between the closed end and the piston is
   a) \( u = \frac{V_x}{b} \)
   b) \( u = 0 \)
   c) \( u = V \frac{x}{c} \)
   d) \( u = V \frac{x}{d} \)

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

16. The density varies with time as
   a) \( \frac{\partial \rho}{\partial t} = \frac{\partial u}{\partial x} \)
   b) \( \frac{\partial \rho}{\partial t} = -\frac{du}{dx} \)
   c) \( \frac{\partial \rho}{\partial t} = \rho \frac{du}{dx} \)
   d) \( \frac{\partial \rho}{\partial t} = -\rho \frac{du}{dx} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
b) 0
17. Find the rate of change of gas density at any instant of time

\[ \rho(t) = \rho_0 \frac{1}{1 + \frac{V}{L_0}} \]

Where \( L = L_0 + Vt \)

a) \[ \rho(t) = \rho_0 \frac{1}{1 + \frac{V}{L_0}} \]

b) \[ \rho(t) = \rho_0 \frac{1}{1 + \frac{V}{L_0}} \]

c) \[ \rho(t) = \rho_0 \frac{1}{1 + \frac{V}{L_0}} \]

d) \[ \rho(t) = \rho_0 \frac{1}{1 + \frac{V}{L_0}} \]

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

18. The rate of change of density of the gas at \( t = 0 \) is

a) 0
b) -1440 kg/m³/s

c) -1100 kg/m³/s

d) -720 kg/m³/s

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