

Unit 11 - Week 9

Course outline

How does an NPTEL online course work?

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Week 9

- Lecture 41: Free Convection
- Lecture 42: Thermal Boundary Layer
- Lecture 43: Mass Transfer
- Lecture 44: Mass Transfer (Contd.)
- Lecture 45: Mass Transfer (Contd.)

Quiz : Assignment 9

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Assignment 9

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

Due on 2020-04-01, 23:59 IST.

1) Fick's law of diffusion is analogous to which of the following

1 point

- a. Fourier's law of conduction.
- b. Newton's law of cooling.
- c. Newton's law of viscosity
- d. Both a. and c.

No, the answer is incorrect.

Score: 0

Accepted Answers:

d. Both a. and c.

2) Which of the following statements is true?

1 point

- a. Buoyancy forces are negligible in natural convection
- b. Solution to energy equation, requires knowledge of velocity profile.
- c. Both a. and b.
- d. None of the above.

No, the answer is incorrect.

Score: 0

Accepted Answers:

b. Solution to energy equation, requires knowledge of velocity profile.

3)

1 point

Linked Question (3-5)

Engine oil at 100°C and a velocity of 0.1m/s flows over both surfaces of a 1 m long flat plate maintained at 20°C. The properties of the oil are as under (all abbreviations have their usual meanings):

$$\rho = 864 \text{ kg/m}^3, \nu = 86.1 \times 10^{-6} \text{ m}^2/\text{s}, k = 0.140 \text{ W/m.K}, Pr = 1081$$

Determine the thermal boundary layer thickness at the trailing edge (choose the closest value)

- a. 0.234 m
- b. 0.008 m
- c. 0.147 m
- d. 0.322 m

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

c

4) Determine the local heat flux, for the same conditions mentioned in problem 3 (choose the closest value)

1 point

[Hint: Use $h_L = k/L \cdot 0.332 \text{ Re}_L^{1/2} \text{ Pr}^{1/3}$]

- a. -1300 W/m²
- b. -1000 W/m²
- c. -1200 W/m²
- d. -575 W/m²

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

a

5) Determine the total heat transfer rate per unit width of the plate (choose the closest value)

1 point

- a. -4000 W/m
- b. -5200 W/m
- c. -3400 W/m
- d. -6500 W/m

No, the answer is incorrect.

Score: 0

Accepted Answers:

b. -5200 W/m

6) True or False: Consider both the statements, and even if one of them is false then mark the entire answer as false, else mark the answer as true.

1 point

For heat transfer situations involving forced convection, the Nusselt number is a function of Reynolds and Prandtl numbers; whereas for situations involving natural convection heat transfer, the Nusselt number is a function of Grashof and Prandtl numbers.

One critical observation that could be made while comparing the natural and forced convection heat transfer correlations is that the Stanton number can only be used in correlating forced-convection data.

- a. True
- b. False

No, the answer is incorrect.

Score: 0

Accepted Answers:

a. True

7) True or False: Consider both the paragraphs, and even if one of them is false then mark the entire answer as false, else mark the answer as true.

1 point

In many mass-transfer operations, one of the boundaries may move with time. If the length of the diffusion path changes a small amount over a long period of time, a pseudo-steady-state diffusion model may be used.

When the reaction rate is slow relative to the rate of diffusion, the process is diffusion controlled. On the other hand, when the reaction rate of the transferring species at the surface does not limit the mass-transfer, then the process is reaction controlled.

- a. True
- b. False

No, the answer is incorrect.

Score: 0

Accepted Answers:

b. False

8) Linked Question (8-9)

1 point

A droplet of liquid A, of radius r_1 , is suspended in a stream of gas B. There is a stagnant gas film of radius r_2 surrounding the droplet. The concentration of A in the gas phase is x_{A1} at $r=r_1$ and x_{A2} at the outer edge of the film ($r=r_2$).

Starting from shell balance, choose the correct governing equation in terms of molar flux by shell balance (N_A)

- a. $\frac{d}{dr}(r^2 N_{Ar}) = 0$
- b. $\frac{d}{dr}(r N_{Ar}) = 0$
- c. $\frac{d}{dr}(r^2 N_{Ar1}) = 0$
- d. Cannot be determined

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

a

9) Select the correct expression for x_A

1 point

- a. $r^2 N_{Ar} = -\frac{cD_{AB}}{1-x_A} r^2 \frac{dx_A}{dr}$
- b. $r_1^2 N_{Ar1} = -\frac{cD_{AB}}{1-x_A} r^2 \frac{dx_A}{dr}$
- c. $r_1^2 N_{Ar1} = -\frac{cD_{AB}}{1-x_A} r^2 \frac{dx_A}{dr}$
- d. None of the above

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

c

10) Rate of production of a species in heterogeneous reactions

1 point

- a. Appears as a boundary condition at the surface at which chemical reaction occurs.
- b. Appears as a source term in the shell momentum balance.
- c. Does not appear in the shell momentum balance.
- d. None of the above

No, the answer is incorrect.

Score: 0

Accepted Answers:

a. Appears as a boundary condition at the surface at which chemical reaction occurs.