Unit 12 - Week 10

Assignment 10

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

Due on 2020-04-08, 23:59 IST.

1) Which of the following is the correct expression for equation of continuity for a binary mixture? The symbols have the usual meaning unless otherwise stated. *1 point*

a. $\frac{\partial \rho}{\partial t} + \nabla.\rho v = r_A + r_B$

b. $\frac{\partial \rho}{\partial t} + \nabla \cdot \rho v = 0$

c. $\frac{\partial C}{\partial t} + \nabla g C v = 0$

d. $\frac{\partial C}{\partial t} + \nabla \cdot C v \neq 0$

- a
- b
- c
- d

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

2) Molecular diffusion can occur because of a difference in which of the following *1 point*

a. Temperature

b. Concentration

c. Pressure

d. All of the above.

- a
- b
- c
- d

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

3) **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*

While dealing with problems involving the transfer of species in a system, the molar flux of a given species, say A, could involve contributions from both molecular flux and convective flux.

When chemical reactions occur, we distinguish between two reaction types: homogeneous, in which the chemical change occurs in the entire volume of the fluid, and heterogeneous, in which the chemical change takes place only in a restricted region, such as the surface of a catalyst.

a. True
b. False

- a
- b

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

4) Linked Question (4-5) *2 points*

Gas 'A' diffuses from point 1 (x_{A1}) to a catalyst surface at point 2 (X_{A2}), where it reacts as follows:

2A ⟹ B

Gas 'B' diffuses back through a distance 'δ' to point 1.

Choose the correct expression for N_A for a very fast reaction using mole fraction units

a. $N_A = 2D_{AB}C \ln\left|\frac{1-\frac{1}{2}x_{A2}}{1-\frac{1}{2}x_{A1}}\right|$

b. $N_A = \frac{2D_{AB}C}{\delta}\ln\left|1-\frac{1}{2}x_{A2}\right|$

c. $N_A = \frac{D_{AB}C}{\delta}\ln\left|\frac{1-\frac{1}{2}x_{A2}}{1-\frac{1}{2}x_{A1}}\right|$

d. $N_A = \frac{2D_{AB}C}{\delta}\ln\left|\frac{1-\frac{1}{2}x_{A2}}{1-\frac{1}{2}x_{A1}}\right|$

- a
- b
- c
- d

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

5) Determine the correct value of N_A in the above problem (choose the closest value) *1 point*

$$D_{AB} = 0.2\times10^{-4} m^2/s\ ;\ x_{A1} = 0.97\ ;\ T = 298K\ ;$$
$$R = 8.314 J/K.mol;\ P = 101.32 KPa\ ;\ \delta = 1.3mm.$$

a. 0.82 mol/m^2s

b. 83.71 mol/m^2s

c. 0.56 mol/m^2s

d. 4 mol/m^2s

- a
- b
- c
- d

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

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*

The Schmidt number is the ratio of momentum diffusivity to mass diffusivity and represents the relative ease of molecular momentum and mass transfer, and it is analogous to the Nusselt number, which represents the ratio of the momentum diffusivity to the thermal diffusivity.

The diffusional Grashof number arises because of the buoyant force caused by the concentration inhomogeneities.

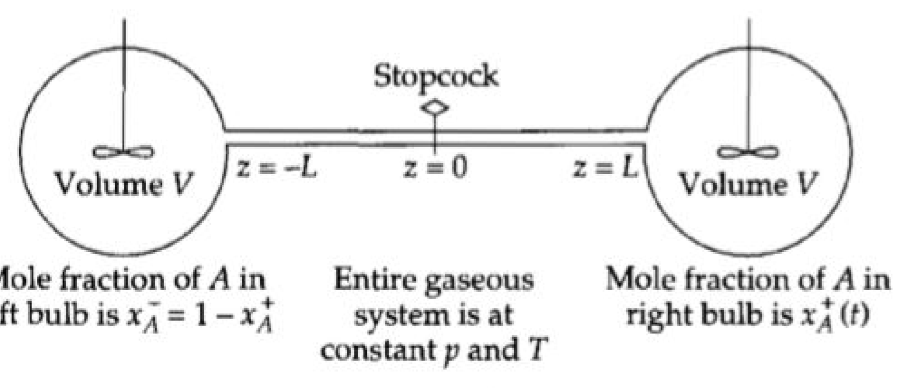
a. True
b. False

- a
- b

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

7) Linked Questions (7-8) *1 point*

One way of measuring gas diffusivities is by means of a two-bulb experiment. The left bulb and the tube from z = -L to z = 0 are filled with gas A. The right bulb and the tube from z = 0 to z = +L are filled with gas B (as shown in figure). At time t = 0, the stopcock is opened, and diffusion begins; then the concentrations of A in the two well-stirred bulbs change. One measures x_A^+ as a function of time, and from this deduces D_{AB}.



Since the bulbs are large compared to the tube, x_A^+ and x_A^- change very slowly with time.

Hence the diffusion in the tube can be treated as a quasi-steady-state problem with the boundary conditions that $x_A = x_A^-$ and z = -L, and that $x_A = x_A^-$ at z = +L.

What will be the combined flux (N_{Az}) for this system?

a. $N_{Az} = -D_{AB}\left(\frac{dx_A}{dz}\right)$

b. $N_{Az} = -(c/x)D_{AB}\left(\frac{dx_A}{dz}\right)$

c. $N_{Az} = -cD_{AB}\left(\frac{dx_A}{dz}\right)$

d. None of the above

- a
- b
- c
- d

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

8) What will be the value of N_{Az} after putting the boundary conditions? *2 points*

a. $N_{Az} = \left(\frac{1}{2} - x_A^+\right)\frac{D_{AB}}{L}$

b. $N_{Az} = \left(\frac{1}{2} - x_A^+\right)\frac{cD_{AB}}{L}$

c. $N_{Az} = \left(\frac{1}{2} - x_A^-\right)\frac{cD_{AB}}{L}$

d. None of the above

- a
- b
- c
- d

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