Unit 14 - Week 12

Assignment 12

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

Due on 2020-04-22, 23:59 IST.

1) *1 point*

Linked Question (1-6)

Oxygen diffuses through the walls of drug containers and oxidizes many drugs rendering them inactive. It is the oxygen diffusion/reaction scenario that limits the shelf life of many pharmaceutical products. To limit the oxidation of drugs, Oxygen scavengers, like sodium bisulfate, are often added to the drugs. The reaction to remove oxygen is:

$$2HSO_3^- + O_2 \rightarrow SO_4^{2-} + H_2O$$

Consider a liquid drug stored in a cylindrical polyethylene container. The container is 15 cm high, and has an inner radius of 6 cm. The initial concentration of $NaHSO_3$ in the drug formulation is 1 gm/lt. Neglect diffusion through the top and bottom of the container and assume that the $NaHSO_3$ reacts instantly with O_2. The oxygen concentration in air is always 21% and this may be approximated as the concentration at the outer end of the container. The effective diffusivity of O_2 through polyethylene is $9\times10^{-13}\ m^2/s$. Assume P=1 atm, T= 25°C, and it operates at steady state.

Choose the correct governing equation for the diffusion of O_2 through the walls of cylindrical solid?

a) $\frac{d}{dr}\left(r^2\frac{dC_A}{dr}\right)=0$

b) $\frac{d}{dr}\left(r\frac{dC_A}{dr}\right)=0$

c) $\frac{d}{dr}\left(-r^2\frac{dC_A}{dr}\right)=0$

d) $\frac{d}{dr}\left(\frac{dC_A}{dr}\right)=0$

- a
- b
- c
- d

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

2) *1 point*

Choose the correct the boundary conditions?

a) $at\ r=r_i,\quad C_A=0$
$at\ r=r_o,\quad C_A=1\ mol/m^3$

b) $at\ r=r_i,\quad C_A=2\ mol/m^3$
$at\ r=r_o,\quad C_A=0$

c) $at\ r=r_i,\quad C_A=0$
$at\ r=r_o,\quad C_A=8.588\ mol/m^3$

d) $at\ r=r_i,\quad C_A=7\ mol/m^3$
$at\ r=r_o,\quad C_A=0$

- a
- b
- c
- d

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

3) *2 points*

Select the correct concentration profile of O_2 in the container material.

a) $C_A=\frac{C_{A0}}{\ln\frac{r_0}{r_i}}.\ln\frac{r}{r_i}$

b) $C_A=C_{A0}.\ln\frac{r_0 r}{r_i}$

c) $C_A=r\frac{C_{A0}}{\ln\frac{r_0}{r_i}}$

d) $C_A=C_{A0}r\left[\frac{1}{r_i}-\frac{1}{r_0}\right]$

- a
- b
- c
- d

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

4) *2 points*

Molar amount of $NaHSO_3$ in the container

a) 0.227 moles
b) 0.145 moles
c) 2.57×10−2 moles
d) 1.63×10^{-2} moles

- a
- b
- c
- d

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

5) *2 points*

Diffusion rate of O_2 **(Given : 10% of Sodium bisulphate is consumed in 1 year)**

a) $2.585\times10^{-11}\ moles/s$
b) $8.94\times10^{-8}\ moles/s$
c) $7.932\times10^{-10}\ moles/s$
d) $8.94\times10^{-5}\ moles/s$

- a
- b
- c
- d

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

6) *2 points*

Relation between inner (r_i) and outer (r_o) radius of the cylinder

a) r_0=0.543r_i
b) r_0=1.325r_i
c) r_0=1.012r_i
d) r_0=0.442r_i

- a
- b
- c
- d

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