# Unit 13 - Week 11



# Assignment 11

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

**Due on 2020-12-02, 23:59 IST.**

1) An enzyme following Michaelis-Menten kinetics is immobilised on a non- porous surface. The substrate in the liquid phase with concentration $S_0$ flows and reaches the solid liquid interface (here its concentration is S) where the reaction occurs. Which of the following best represents the steady state condition with respect to the substrate? ***1 point***

- $k_s(So - S) = \frac{Vmax\ S}{Km + S}$
- $k_s(So - S) > \frac{Vmax\ S}{Km + S}$
- $k_s(So - S) = K_m S$
- $k_s(So - S) < \frac{Vmax\ S}{Km + S}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$k_s(So - S) = \frac{Vmax\ S}{Km + S}$

2) The above system had a Dahmkohler number of 5. Which of the following inferences is/are correct regarding the immobilised enzyme system with this information? ***1 point***

- Mass transfer rates are higher than the reaction rates
- Reaction rates are higher than the mass transfer rates
- The process is reaction limited
- The process is mass transfer limited

No, the answer is incorrect.
Score: 0

Accepted Answers:
*Reaction rates are higher than the mass transfer rates*
*The process is mass transfer limited*

3) If the Dahmkohler number $Da \to 0$, in the above immobilised enzyme system following MM kinetics, what would be the apparent velocity of the process? ***1 point***

- $k_s\ So$
- $\frac{Vmax\ S}{Km + S}$
- zero
- $K_m\ S$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{Vmax\ S}{Km + S}$

4) Define Prandtl number ***1 point***

- $\frac{\mu C_p}{k}$
- $\frac{k}{\mu C_p}$
- $\frac{D\rho\vartheta}{\mu}$
- $\frac{\mu C_v}{D\rho\vartheta}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{\mu C_p}{k}$

5) Consider a submerged culture of *Aspergillus niger* where the mold exists in a pelleted form. The aeration and agitation rates enable the formation of almost uniform spherical pellets. At a particular time 't', the aeration is stopped and the culture is supplied with oxygen in liquid phase through $H_2O_2$ addition. A steady state is reached. The only source of oxygen now is the LPOS. The $H_2O_2$ supplied enters the pellet through diffusion. Here it is used up by the cell through a first order reaction. If a steady-state material balance of $H_2O_2$ is done on the pellet, which among the following do we get as the governing equation? ***2 points***

- $\frac{D_{eff}}{r^2}\frac{d}{dr}\left(r^2\frac{dC_{H_2O_2}}{dr}\right) = kC_{H_2O_2}$
- $\frac{D_{eff}}{r^2}\frac{d}{dr}\left(r^2\frac{dC_{H_2O_2}}{dr}\right) = o$
- $\frac{d}{dr}\left(r^2\frac{dC_{H_2O_2}}{dr}\right) = 0$
- $\frac{dC_{H_2O_2}}{dt} + D_{eff}\frac{d}{dr}\left(r^2\frac{dC_{H_2O_2}}{dr}\right) = kC_{H_2O_2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{D_{eff}}{r^2}\frac{d}{dr}\left(r^2\frac{dC_{H_2O_2}}{dr}\right) = kC_{H_2O_2}$

6) In the above example of LPOS in a submerged culture of *Aspergillus niger*, which is under steady state, which among the following do we get as the boundary condition, given the radius(r) of the pellet to be 'R'? ***1 point***

- At r=0, $\frac{\partial C_{H_2O_2}}{\partial r} = 0$
- At r=R, $\frac{\partial C_{H_2O_2}}{\partial r} = 0$
- At r=R,$C_{H_2O_2} = 0$
- At r=R, $C_{o_2} = 0$

No, the answer is incorrect.
Score: 0

Accepted Answers:
*At r=0,* $\frac{\partial C_{H_2O_2}}{\partial r} = 0$
*At r=R,* $C_{o_2} = 0$

7) In a couette- flow bioreactor, the velocity profile of the fluid is given by: given: k- ratio of inner and outer radius, $\Omega_0$- angular velocity, R- outer radius ***2 points***

- $v_\theta = \frac{\Omega_0 R(\frac{kR}{r} - \frac{r}{kR})}{k - \frac{1}{k}}$
- $v_\theta = \Omega_0 R(\frac{kR}{r} - \frac{r}{kR})$
- $v_\theta = \Omega_0 R$
- $v_\theta = \Omega_0\frac{kR}{r}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$v_\theta = \frac{\Omega_0 R(\frac{kR}{r} - \frac{r}{kR})}{k - \frac{1}{k}}$

8) A horizontal metal pipe with internal radius R is involved in handling the products of bioprocess. It is heated and maintained at a temperature (T) at the walls of the pipe. The pipe handles liquid and it carries the heat along its flow through the pipe. Assume the flow to be laminar. Consider the velocity component along the axial 'z' direction alone. Applying the steady state balance, find from below the governing equation for variation of temperature with flow. Neglect viscous dissipation. ***2 points***

- $\rho C_v v_{z,max}\left[1 - \left(\frac{r}{R}\right)^2\right]\frac{\partial T}{\partial z} = 0$
- $\rho C_v v_{z,max}\left[1 - \left(\frac{r}{R}\right)^2\right]\frac{\partial T}{\partial z} = k\frac{1}{r}\frac{\partial}{\partial r}(r\frac{\partial T}{\partial r})$
- $k\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T}{\partial r}\right) = C_v$
- $\rho C_v v_{z,max} = \frac{\partial T}{\partial z}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\rho C_v v_{z,max}\left[1 - \left(\frac{r}{R}\right)^2\right]\frac{\partial T}{\partial z} = k\frac{1}{r}\frac{\partial}{\partial r}(r\frac{\partial T}{\partial r})$