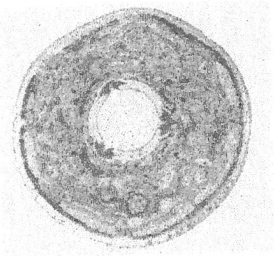
Mathematics 172

Quiz 3

Name: Key

You must show your work to get full credit.



A cell has volume $V = 7 \times 10^{-6}$ mm^3 and surface $A = 4.1 \times 10^{-3}$ mm^2. Assume that oxygen, O_2, passes through the cell membrane at a rate of .5(mg/mm^2)/hr.

1. What is the total amount of O_2 that is coming into the cell per hour?

Total amount is 2.05×10^{-3} mg/hr

This is (Area) x (rate)

$= (4.1 \times 10^{-3}) \times (.5)$

$= 2.05 \times 10^{-3}$ mg/hr

2. What is the amount of O_2 per volume coming into the cell per hour?

Amount per volume is 292.86 (mg/mm^3)/hr

$$\frac{\text{Amount}}{\text{volume}} = \frac{2.05 \times 10^{-3}}{7 \times 10^{-6}} = 292.86 \text{ (mg/mm}^3\text{)/hr}$$

3. If the cell needs 50(mg/mm^2)/hr to survive, then how much can it be maginified before it dies from lack of O_2?

Critical magnificiation factor is $\lambda =$ 5.856

For a magnified cell

$$\frac{\text{Amount}}{\text{vol}} = \frac{2.05 \times 10^{-3} \lambda^2}{7 \times 10^{-6} \lambda^3} = \frac{292.86}{\lambda} = 50 \quad \text{(50 is critical point)}$$

$$\lambda = \frac{292.86}{50} = 5.857$$