Mathematics 172

Quiz #2   Name: _____Key_____

You must show your work to get full credit.

A cell has volume $V = 5.2 \times 10^{-6}$ mm^3 and surface area $A = 7.5 \times 10^{-3}$ mm^2. Assume that oxygen, O_2, passes through the cell membrane at a rate of $.38$(mg/mm^2)/hr.

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

Amount of O_2/hour is __$.00285$ mg/hr__

$$= (\text{rate}) \times (\text{Area}) = (.38)(7.5 \times 10^{-3}) = .00285 \text{ mg/hr}$$

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

Amount of O_2 per volume per hour is __548.1 (mg/hr)/mm^3__

Divide answer to 1 by volume

$$= \frac{.00285}{5.2 \times 10^{-6}} = 548.1 \text{ (mg/hr)/mm}^3$$

3. If the cell needs 58(mg/mm^3)/hr of O_2 to survive, then how much can it be magnified before it dies from lack of oxygen?

Let a = magnification factor. Computing as above   __by a factor of 9.45.__

$V_{mag} = 5.2 \times 10^{-6} a^3$ mm^3

$A_{mag} = 7.5 \times 10^{-3} a^2$ mm^2

$(\text{Amount } O_2)_{mag} = .00285 a^2$ mg/hr.

$(\text{Amount of } O_2/\text{vol})_{mag} = \frac{.00285 a^2}{5.2 \times 10^{-6} a^3} = \frac{548.1}{a}$ (mg/mm^3)/hr

The cut off is

$$\frac{548.1}{a} = 58 \quad \text{so} \quad a = \frac{548.1}{58} = 9.45$$