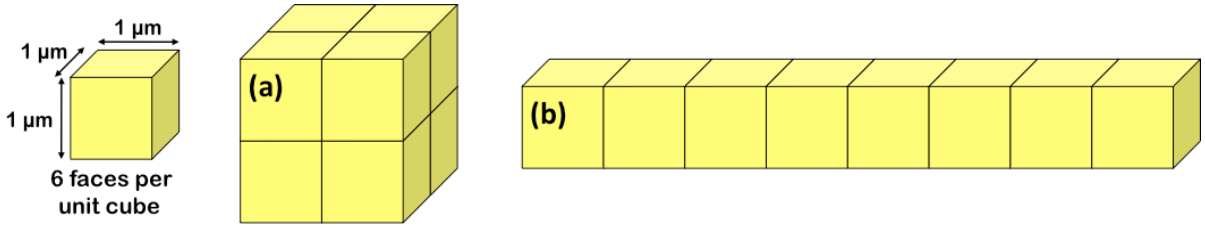
MICROBIOLOGY EXERCISES (WEEK 1)

Your Name : _____ Grade : _____

Your Partner: _____ Grade : _____

QUESTION 1 "LIVING AT MICRO SCALE" :

Imagine two microorganisms with equal mass and volume but different shapes, (a) and (b):



1. Which shape has the lower ratio of surface area to volume (S/V ratio)?
☐ A. Shape (a).
☐ B. Shape (b).
☐ C. Shapes (a) and (b) have the same S/V ratio.
Explain your answer:

2. Which shape is better optimized to conserve internal heat (for example, heat generated by metabolic processes)?
☐ A. Shape (a).
☐ B. Shape (b).
☐ C. Shapes (a) and (b) are equivalent with respect to conservation of internal heat.
Explain your answer:

3. Which shape is better optimized to promote rapid exchange of diffusible materials (for example, nutrients) between the outside and inside?
☐ A. Shape (a).
☐ B. Shape (b).
☐ C. Shapes (a) and (b) are equivalent with respect to exchange of diffusible materials.
Explain your answer:

4. If cell (a) grows larger *while keeping the same shape*, how does the S/V ratio change?
☐ A. As the cell grows larger the S/V ratio increases.
☐ B. As the cell grows larger the S/V ratio decreases.
☐ C. As the cell grows larger the S/V ratio stays the same.
Explain your answer:

5. If cell (b) “stretches” to get longer and thinner *while keeping the same volume*, how would the S/V ratio change?
☐ A. As the cell stretches the S/V ratio increases.
☐ B. As the cell stretches the S/V ratio decreases.
☐ C. As the cell stretches the S/V ratio stays the same.
Explain your answer:

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QUESTION 2 "LIVING AT MICRO SCALE" :

1. Write the exponential growth rate equation: _____ and define each term below.
Do not peek at the slides until you've made your best effort to write everything from memory!

N =
N_0 =
e =
k =
t =
t_d =

2. Imagine a cell culture growing exponentially with a doubling time of 2.00 hours.
The culture's growth rate constant is: _____
Show your work:

3. Imagine a cell culture growing exponentially with a growth rate constant of 1.40 per hour.
The culture's doubling time is: _____
Show your work:

4. Imagine a cell culture growing exponentially with a doubling time of 2.00 hours.
Starting from one cell, how long would it take the culture to reach one million cells: _____
Show your work:

5. Imagine a cell culture growing exponentially with a growth rate constant of 1.40 per hour.
Starting from one cell, how long would it take the culture to reach one million cells: _____
Show your work:

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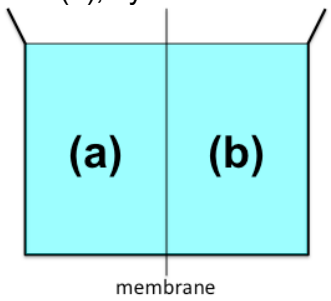
EXERCISE 3 "LIVING AT MICRO SCALE" :

Imagine a container filled with water and separated into two equal-volume compartments, (a) and (b), by a membrane that is permeable to water but impermeable to solutes.



1. Write the equation for the van't Hoff relation: _____ and define each term below. Do not peek at the slides until you've made your best effort to write everything from memory!

n =
P =
R =
T =
V =

2. If you add some solute to compartment (a), what happens?
☐ A. The volume of water increases in compartment (a) and decreases in compartment (b).
☐ B. The volume of water increases in compartment (b) and decreases in compartment (a).
☐ C. The volume of water remains the same in both compartments.
Explain your answer:

3. If you add 0.2 moles (mol) of solute to compartment (a) with a volume (V) of one liter (0.001 m^3) at 27°C (300°K), the resulting osmotic pressure (*P*) would be: _____
Show your work:

4. Imagine a bacterium surrounded by a rigid (non-elastic) cell wall that is water-permeable. If you put the bacterium in a container filled with pure distilled water:
☐ A. The bacterium's internal pressure increases.
☐ B. The bacterium's internal pressure decreases.
☐ C. The bacterium's internal pressure stays the same.
Explain your answer:

5. If you change the shape of a bacterium from sphere-shaped to cube-shaped while maintaining the same size (volume), what happens?
☐ A. The bacterium's internal pressure increases.
☐ B. The bacterium's internal pressure decreases.
☐ C. The bacterium's internal pressure stays the same.
Explain your answer: