

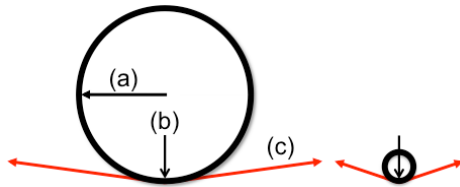
BIO-372 "MICROBIOLOGY" EXERCISES (WEEK 2)

Your Name : _____ Grade : _____

Your Partner: _____ Grade : _____

EXERCISE 1 "BIOMECHANICS OF THE BACTERIAL CELL ENVELOPE" :

Imagine two spherical cells, one large and one small.



1. Write the equation for Laplace's Law: _____ and define each term below, referring to the diagram above. Do not peek at the slides until you've made your best effort to write everything from memory!

(a) =

(b) =

(c) =

2. If the internal pressure is the same in both cells, then the cell wall tension:

☐ A. Will be higher in the small cell.

☐ B. Will be higher in the large cell.

☐ C. Will be the same in both cells.

Explain your answer:

3. If the cell wall tension is the same in both cells, then the internal pressure:

☐ A. Will be higher in the small cell.

☐ B. Will be higher in the large cell.

☐ C. Will be the same in both cells.

Explain your answer:

4. Starting from the same internal pressure, if the pressure is gradually increased then:

☐ A. The small cell will rupture first.

☐ B. The large cell will rupture first.

☐ C. Both cells will rupture at the same time.

Explain your answer:

5. Imagine two cells with equal size (volume), a sphere-shaped cell and a cube-shaped cell.

Starting from the same internal pressure, if the pressure is gradually increased then:

☐ A. The sphere-shaped cell will rupture first.

☐ B. The cube-shaped cell will rupture first.

☐ C. Both cells will rupture at the same time.

Explain your answer:

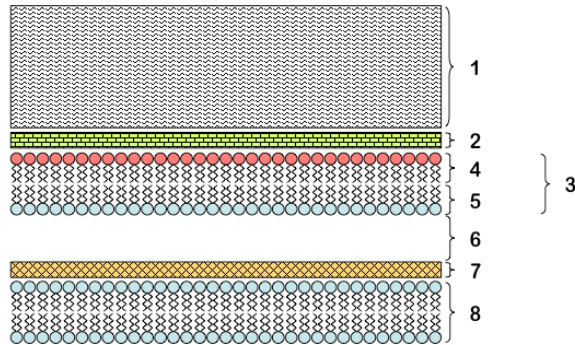
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EXERCISE 2 "BIOMECHANICS OF THE BACTERIAL CELL ENVELOPE" :

Here is a schematic diagram of a "generic" bacterial cell wall :



Identify each layer (1-8) and briefly state its biological function(s).

1. Name:
Function(s):

2. Name:
Function(s):

3. Name:
Function(s):

4. Name:
Function(s):

5. Name:
Function(s):

6. Name:
Function(s):

7. Name:
Function(s):

8. Name:
Function(s):

9. On the basis of the diagram, is this organism ☐ Gram-positive or ☐ Gram-negative?
Explain:

10. In class we discussed some mechanisms that layers #1 and #4 contribute to evasion of the host complement system.

Explain (layer #1):

Explain (layer #4):

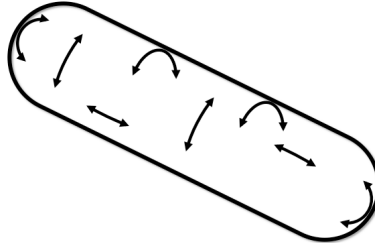
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Your Name : _____ Grade : _____

Your Partner: _____ Grade : _____

EXERCISE 3 "BIOMECHANICS OF THE BACTERIAL CELL ENVELOPE" :

The schematic depicts the distribution of stresses in the bacterial cell wall under positive internal osmotic pressure:



1. Write the equations that describe cell wall stress in the same direction as the long axis of the cell: _____ and in the same direction as the short axis of the cell: _____ and define each term below. Do not peek at the slides until you've made your best effort to write everything from memory!

$P =$

$r =$

$\sigma_H =$

$\sigma_L =$

$t =$

2. Imagine a rod-shaped cell with no peptidoglycan in which internal pressure increases until the cell ruptures. The cell would rupture along:

- ☐ A. Its short axis.
- ☐ B. Its long axis.
- ☐ C. Either axis with equal probability.

Explain:

3. In order to provide the best mechanical support against internal pressure, peptidoglycan cables should be oriented:

- ☐ A. In the same direction as the short axis of the cell.
- ☐ B. In the same direction as the long axis of the cell.
- ☐ C. In the same direction as both axes of the cell (long and short).
- ☐ D. Randomly.

Explain why:

4. If you increase the thickness of the cell wall while keeping the internal pressure the same, the tensile stress in the cell wall will:

- ☐ A. Increase.
- ☐ B. Decrease.
- ☐ C. Stay the same.

Explain:

5. If the width (i.e., the length of the short axis) of a cell increases by 2-fold, the resistance of the cell to rupture caused by osmotic pressure will:

- ☐ A. Increase by 2-fold.
- ☐ B. Increase by 4-fold.
- ☐ C. Decrease by 2-fold.
- ☐ D. Decrease by 4-fold.

Explain: