

Practice Problems – Osmosis and Water potential

Use this key to answer all the problems below. If you choose B or C, rewrite the statement so that it is complete and true.

T = TRUE F = FALSE N = NOT ENOUGH INFORMATION

PROBLEM ONE: The initial molar concentration of the cytoplasm inside a cell is 2M and the cell is placed in a solution with a concentration of 2.5M.

1. It is possible that this cell is already in equilibrium with its surroundings.
F The cell must lose water to reach equilibrium. There is no way pressure can build up to bring the cell to equilibrium.
2. Initially, solute concentration is greater outside the cell than inside.
T
3. Water will enter the cell because solute potential is lower inside the cell than outside.
F Water will leave the cell because solute potential is higher inside the cell than outside.
4. The cell will become flaccid because the pressure potential is greater outside the cell than inside.
F The cell will become more flaccid because the solute potential is greater inside the cell than outside.
5. The cell is already in equilibrium with its surroundings because of the combination of pressure potential and solute potential inside and outside the cell.
F The cell is not in equilibrium because there is no pressure potential inside the cell and none will build up when water leaves the cell.
6. Initially, the cytoplasm is hypertonic to the surrounding solution.
F cell is hypotonic to the surrounding solution.
7. Initially, the numerical value of the solute potential is more negative inside the cell than outside.
F more negative outside the cell than inside.
8. Net diffusion of water will be from inside the cell to outside the cell.
T
9. At equilibrium, the molarity of the cytoplasm will have increased.
T
10. At equilibrium, the pressure potential inside the cell will have increased.
F pressure potential inside the cell will remain zero.

PROBLEM TWO: The initial molar concentration of the cytoplasm inside a cell is 1.3 M and the surrounding solution is .3M.

1. The cell could already be in equilibrium with the surrounding solution.
T

2. If the cell is already in equilibrium with its surroundings, there must be pressure potential inside the cell.
T
3. If the cell is initially flaccid, there will be a net gain of turgor during osmosis.
T
4. If the cell is initially flaccid, diffusion will proceed until solute potential inside the cell equals solute potential outside the cell.
N Probably false, but it depends on how much room there is inside the cell for water to enter before pressure begins to build. Most likely, pressure will bring the cell to equilibrium before the cytoplasm and the solution become isotonic.
5. At equilibrium, the cytoplasm and the surrounding solution will be isotonic.
N Same as above
6. At equilibrium, water potential inside and outside the cell will be equal.
T
7. If the cell is initially flaccid, the molarity of the cytoplasm will increase during osmosis.
F will DECREASE...
8. If the cell is initially flaccid, then both solute potential and pressure potential inside the cell will increase during osmosis.
N Probably true, but it depends on how much room there is inside the cell for water to enter before pressure begins to build. As soon as pressure begins to build, the statement is true.

PROBLEM 3: A cell is in equilibrium with its environment. The solute potential of the cell's cytoplasm is -0.45MPa . The water potential of the surrounding solution is -0.32Mpa . When the cell was first put into the solution, it was flaccid.

1. Since the cell was put into this solution, its solute potential and pressure potential have both risen.
T
2. The pressure potential of the cell is now $+0.32\text{MPa}$.
F = +0.13
3. The cell has a higher solute potential than the surrounding solution
F.... LOWER
4. The cell's water potential is now lower than that of the surrounding solution.
F ... EQUAL
5. Initially, the cell's solute potential was lower than that outside.
T
6. Initially, the cell's water potential was lower than that outside.
T
7. There is still a concentration gradient that tends to draw water into the cell.
T

8. The pressure potential of the cell is equal to that outside the cell
F GREATER
9. There is lower molarity inside the cell than outside.
F.....HIGHER
10. The cell is isotonic to its surroundings.
F HYPERTONIC

PROBLEM 4: A cell is in equilibrium with its surroundings. The molarity of the surrounding solution is 0.5M. To convert molarity to solute potential in MPa, use the formula: $\Psi_S = - (i$

CRT) where

i = ionization constant (assume that is 1)

C=molar concentration (given above)

R = pressure constant (R=0.00831 liter MPa/mole $^{\circ}\text{K}$)

T = temperature in $^{\circ}\text{K}$ (room temp is about 293 $^{\circ}\text{K}$)

1. Calculate the solute potential of the surrounding solution.
 $\Psi_S = - 1.22 \text{ MPa}$
2. Find the water potential of the surrounding solution.
 $\Psi = - 1.22 \text{ MPa}$
3. What is the water potential of the cytoplasm of the cell?
 $\Psi = - 1.22 \text{ MPa}$
4. **True, false, or not enough information:** The cell's molar concentration is equal to the molar concentration of the surrounding solution.

N We would need to know the pressure potential of the cell. IF the cell is flaccid, then molarity is equal to the molarity outside (and so is solute potential). IF the cell is turgid, the molarity inside is greater than that outside (and the solute potential is lower).

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Contributors

Courtney Ricca (Montclair High School, Montclair, NJ), Primary Author

Howard Kimmel, Levelle Burr-Alexander, John Carpinelli - Center for pre-College Programs, NJIT.

Dr. Bilgili/Anagha Bhakay, Dr. Yueyang Shen, Dr. Boris Khusid, Rajesh Dave - C-SOPS, NJIT