

PLANT PHYSIOLOGY PROBLEMS #1

These problems should help you to become more familiar with doing calculations relating to bioenergetics and water potential. These are the same types of problems that will appear on exams.

1. An open beaker sitting on the lab bench contains a solution of 0.060 molal NaCl. What is the Ψ of this solution.

$$\Psi = -0.3 \text{ MPa}$$

2. The sap from a single cell of a maple leaf was extracted using a microcapillary tube and was determined to have a melting point of -0.7° . What is the Ψ_s of this cell?

$$\Psi_s = -0.91 \text{ MPa}$$

3. A leaf cell in a well - watered plant was determined to have the following characteristics:
 $\Psi = -0.8 \text{ MPa}$, $\Psi_s = -1.2 \text{ MPa}$, $\Psi_p = 0.4 \text{ MPa}$, $\epsilon = 12 \text{ MPa}$. If there is a drought and the volume of water in the cell is reduced by 10%, what will be the effect on Ψ , Ψ_s , and Ψ_p ?

$$\Psi_p \text{ will be } 0$$

$$\Psi_s = -1.32 \text{ MPa}$$

$$\Psi = -1.32 \text{ MPa}$$

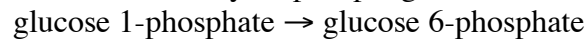
4. A leaf at the very top of an oak tree is 14 m above the ground. Insertion of a pressure probe into a mesophyll cell in this leaf indicated that the turgor pressure of the cell was 0.5 MPa. Further analysis of the cell showed that the total solute concentration was 0.72 molal ($0.72 \text{ moles kg}^{-1}$). What is the water potential of this mesophyll cell?

$$\Psi_s = -1.8 \text{ MPa}$$

$$\Psi_g = 0.14 \text{ MPa}$$

$$\Psi = -1.16 \text{ MPa}$$

5. The important metabolic enzyme phosphoglucomutase catalyzes the following reaction:



The K_{eq} for this reaction is 19.0. In the cytosol of a plant cell where [glucose 1-phosphate] = 7 mM and [glucose 6-phosphate] = 10 mM, how much energy is released by the conversion of G1P into G6P? Will the cell be able to capture this energy?

$$\Delta G = -6.4 \text{ kJ mol}^{-1}$$