

**You must show all equations and all work to receive any credit**

1. Calculate the Nernst equilibrium potential, in mV, for the bicarbonate ion ( $\text{HCO}_3^-$ ) in a cell that has an extracellular concentration of 27 mM and an intracellular concentration of 8 mM. Draw a clearly labeled diagram showing the electric potential and concentration gradient across a bicarbonate ion channel at equilibrium. Do not account for any other ions that may be present.
  
2. For a cell with a resting membrane potential of -70 mV:
  - a. Explain why cells have this resting membrane potential; clearly outline the basis for this.
  
  - b. Neglect the resting membrane potential and calculate the change in Gibbs Free Energy required to move a mole of bicarbonate ions from the outside to the inside of a cell down the bicarbonate ion concentration gradient. Use the same intracellular and extracellular bicarbonate ion concentrations identified in the earlier question.
  
  - c. Now neglect the bicarbonate ion ( $\text{HCO}_3^-$ ) concentration gradient and calculate the change in Gibbs Free Energy required to move a mole of bicarbonate ions from the outside to the inside of a cell across the -70 mV electric resting potential.
  
  - d. If a bicarbonate ion channel were to open, explain what would spontaneously occur, why, and whether this would have an inhibitory or excitatory neural effect? Draw a diagram and clearly support your answer using the diagram.



