CLPhys1 28.P.063. (381946)

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A Cell Membrane The inner and outer surfaces of a cell membrane carry excess negative and positive charge, respectively. Because of these charges, a potential difference of about 70 mV exists across the membrane. The thickness of the membrane is about 8 nm.

(a) If the membrane were empty (filled with air), what would be the magnitude of the electric field inside the membrane?

(b) If the dielectric constant of the membrane were $\kappa = 3$, what would the field be inside the membrane?

(c) Cells can carry ions across a membrane against the field ("uphill") using a variety of active transport mechanisms. One mechanism does so by using up some of the cell's stored energy converting ATP to ADP. How much work does it take to carry one sodium ion (charge = +e) across the membrane against the field? Calculate your answer in eV, joules, and kcal/mole (the last for one mole of sodium ions).

Question Details

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Textbook
Cummings, Laws, Redish, and Cooney, "Understanding Physics", ed.1

Chapter
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