

**19.** The membrane surrounding a living cell consists of an inner and an outer wall that are separated by a small space. Assume that the membrane acts like a parallel plate capacitor in which the effective charge density on the inner and outer walls has a magnitude of  $7.1 \times 10^{-6} \text{ C/m}^2$ . **(a)** What is the magnitude of the electric field within the cell membrane? **(b)** Find the magnitude of the electric force that would be exerted on a potassium ion ( $\text{K}^+$ ; charge =  $+e$ ) placed inside the membrane.

For a parallel plate capacitor or a set of parallel charges the electric field is found from the expression

$$E = \frac{\sigma}{\epsilon_0} = \frac{7.1 \times 10^{-6} \text{ C/m}^2}{8.85 \times 10^{-12} \text{ C}^2/(\text{Nm}^2)} = 8.023 \times 10^5 \text{ N/C}$$

Force comes from

$$F = qE = (1.6 \times 10^{-19} \text{ C})(8.023 \times 10^5 \text{ N/C}) = 1.284 \times 10^{-13} \text{ N}$$

$E = 8.0 \times 10^5 \text{ N/C}$ $F = 1.3 \times 10^{-13} \text{ N}$
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