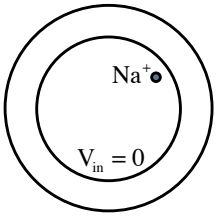
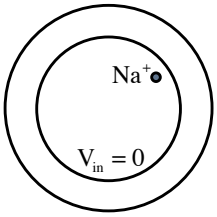
16.3) How much work is required to eject a Na^+ ion from cell?



$V_{outside} = 90\ x10^{-3}$ volts

How much work is required to eject a Na ion from cell?

It's best to start by drawing a picture and defining voltages at different points on the sketch. Once done, come up with a relationship between work and potential differences. In this case, that would be:



$V_{outside} = 90\ x10^{-3}$ volts

$$\frac{W}{q} = -\Delta V$$

$$\Rightarrow \quad W = -q\left(V_{final} - V_{initial}\right)$$

$$\Rightarrow \quad W = -(1.6x10^{-19}\,C)\left(90x10^{-3}\ V - 0\right)$$

$$\Rightarrow \quad W = -1.45x10^{-20}\,J$$

Notice that a positive charge is being made to move from lower voltage to higher voltage. The field will take energy away from the proton to do that, hence the negative sign. Put a little differently, you would have to put energy INTO the system to make this work. That is, the amount of energy lost by the proton is equal to the amount of energy you would have to provide to execute the maneuver.