February 7 Recitation Notes
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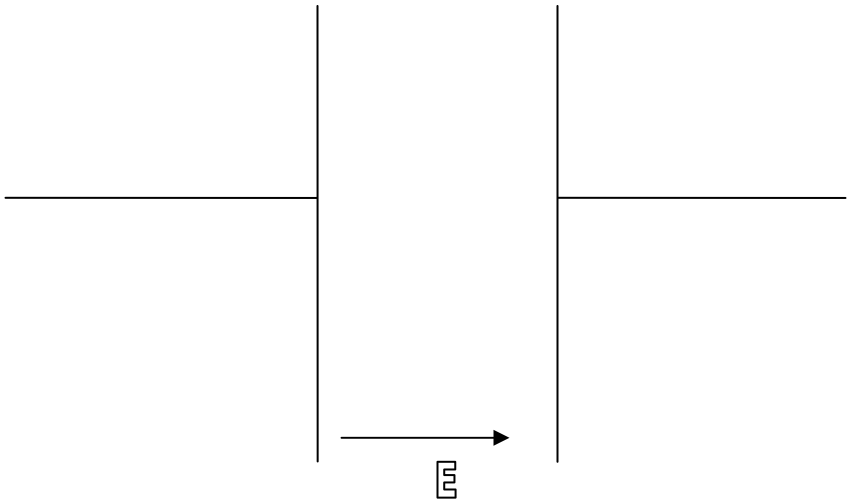
Today we reviewed capacitors, keeping emphasis off of potential energy.

In the picture of capacitors you're given, one assumption key:



Consider the realism of this picture, where charge has evenly distributed itself across these plates. The book has claimed that the electric field between these plates is uniform, but what charge distributions have we seen that provide a uniform field?

This is where the assumption comes in: we have seen on page 590 that for a very large plate at very small separations, $E = \frac{\frac{Q}{A}}{2\varepsilon_0}$, which is a constant and not a function of distance. Thus, we assume that the plate is enormous compared to the distance between them.

In this case, then, integrating our new potential energy formula becomes easy:

$$\Delta V\left(\frac{J}{C}\right) = \int \vec{E}\left(\frac{N}{C}\right) \cdot d\vec{l}\,(m)$$

where V is the potential in volts, and the units for each are given. This is essentially the same as your usual formula for work $Work = Force \cdot Distance$, but divided by Coulombs. Note that in all cases $d\vec{l} = \langle dx, dy, dz \rangle$ and the dot product allows me to simply integrate each component separately along the path.

The final point, then, is that the potential energy will be path-independent. In other words, regardless of how you choose to integrate, as long as your path of integration starts and ends at the same position, you will get the same potential energy. This is essential to prevent an "infinite energy cycle".