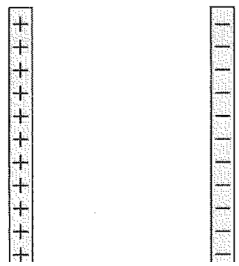
In-class problems, Fri Feb 23, 2018

23.5 23.6 parallel plate capacitors, motion of charges in E

1. (from Wednesday) Consider the parallel plate capacitor, modeled as two infinite charged sheets with surface charge density η spaced d apart.



(a) Write the equation for the $\vec{E}$ of an infinite plane of charge.
(b) Draw $\vec{E}$ from the + plate, and $\vec{E}$ from the - plate. Find $\vec{E}_{\text{total}}$ to the left of the plates. Use superposition.
(b) Repeat to find $\vec{E}_{\text{total}}$ to the right of the plates.
(c) Repeat to find $\vec{E}_{\text{total}}$ between the plates.

The parallel plate capacitor is an often used system. It's the configuration that gives a *uniform* $\vec{E}$. That is, one where $\vec{E}$ is the same everywhere (as long as you're between the plates).

2. An electron and a proton are each placed at rest in a uniform electric field, $\vec{E} = (520\hat{z})\text{N/C}$.

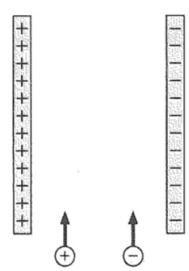
Calculate the *velocity* of each particle 50ns after being released.

3. 23.26 and 23.27 from the workbook:

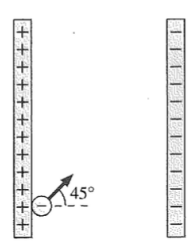
Positively and negatively charged objects, with equal masses and equal quantities of charge, enter the capacitor in the directions shown.

a. Use solid lines to draw their trajectories on the figure if their initial velocities are fast.

b. Use dashed lines to draw their trajectories on the figure if their initial velocities are slow.



An electron is launched from the positive plate at a 45° angle. It does not have sufficient speed to make it to the negative plate. Draw its trajectory on the figure.



4. A proton enters a uniform horizontal electric field of $9.6\text{kN/C}\hat{\imath}$ with an initial velocity of $450\text{km/s}(-\hat{\jmath})$. Ignore any gravitational effects.

(a) Sketch this situation. Sketch the trajectory.

Determine the
(b) time required for the proton to travel 5cm vertically.
(c) horizontal displacement after it travelled 5cm vertically.
(d) its velocity after it travelled 5cm vertically. Give this in component form.

(answers: 111ns, 5.68mm, $(102\hat{\imath} - 450\hat{\jmath})$*km/s)*

Due Mon Feb 26, 2018, beginning of class

Electric charge, force and field

We'll take Monday to revisit what we've covered in the first two chapters. Monday is an opportunity to work on 1 or 2 ideas that you'd like to be more confident with.

1. Write down one problem based on Ch 22 and 23 that you'd like to work on. Include a diagram if possible. Choose anything from in class or the text.

2. Repeat (1).