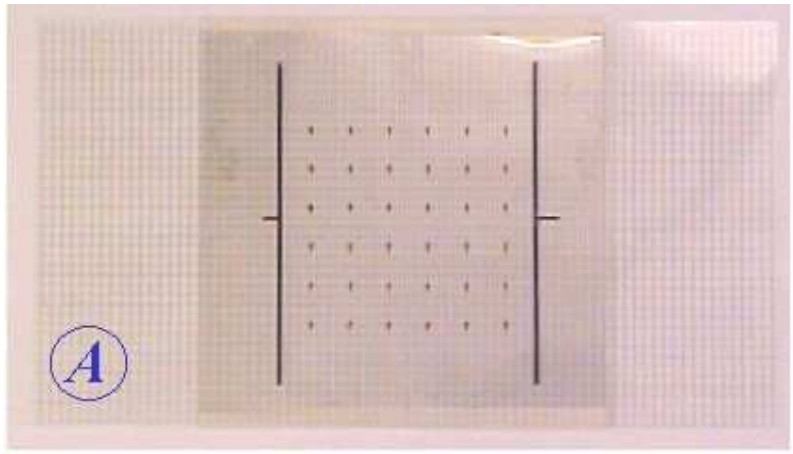
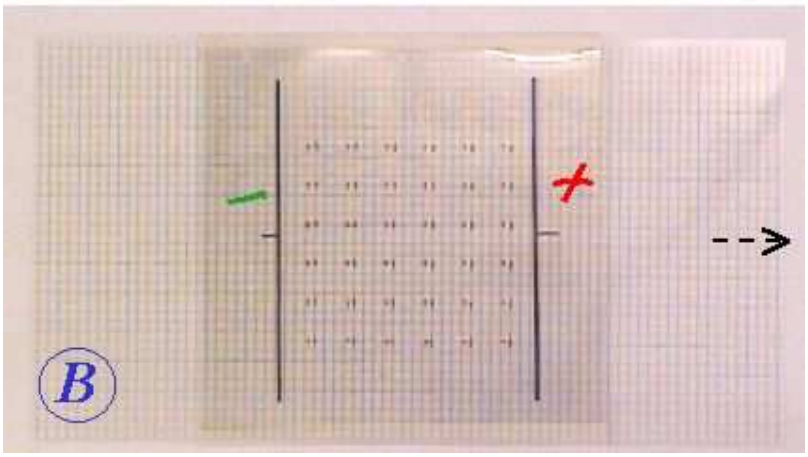
Polarizing a dielectric

Aim: To show what happens inside a material that is placed in an electric field (and in which the molecules have no dipole moment).

Subjects: 5A40 (Induced Charge)
5C20 (Dielectric)

Diagram:





Equipment: An assembly of overheadsheets:

- Overheadsheet with capacitor drawn on it.
- Overheadsheet with six rows of six negative charges (green colored).
- Overheadsheet with six rows of six positive charges (red colored).

The overheadsheet with the capacitorplates drawn on it is actually a sleeve, in which the two sheets with the opposite charges just fit and can be shifted.

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Presentation: The assembly of overheadsheets is projected: The two sheets with the opposite charges are placed between the capacitor plates such that the plus - and minus signs cover each other (the molecules are no dipoles) (See Diagram A and Figure 1).

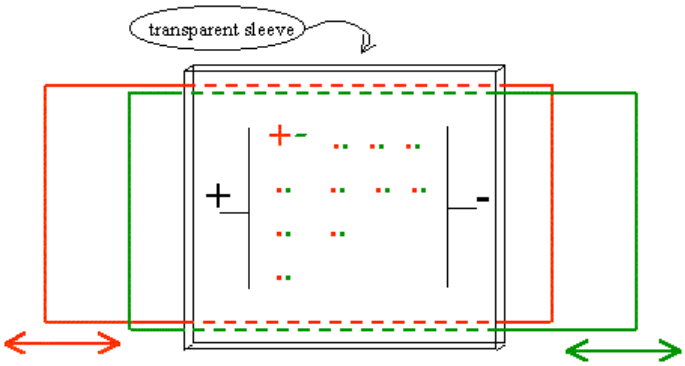

Figure 1

Using a non-permanent marker we apply (write) a clear PLUS- and MINUS-sign to the capacitor plates and by hand the two sheets with the charges are shifted a little, thus showing that the "molecular charges" are seperated a little (see DiagramB). The net effect is clearly visible: There is a net negative charge on the outer edge of the material facing the positive plate and a net positive charge on the opposite side.
We can also draw the vectors to indicate the original electric field (E_0) and the induced, opposing field (E_{ind}), showing that now $E_{Dielectric}=E_0-E_{ind}$.

Explanation: When an outside electric field is applied to the material (for instance by placing it between the plates of a capacitor) there is some seperation of charge induced in the molecules. In the demonstration this is shown by slightly displacing the "negative"-overheadsheet towards the positive plate (opposite to the direction of E_0).

Remarks:

- The model is static; there is no thermal motion.

Sources:

- Giancoli, D.G., Physics for scientists and engineers with modern physics, pag. 624-625