Chapter 19: Capacitance and Dielectrics

- Capacitance $Q = C\Delta V$ $\quad C = \dfrac{Q}{\Delta V}$
- Parallel plate capacitor $C = \dfrac{\varepsilon_0 A}{d}$
- Equivalent capacitance for capacitors in parallel $\quad C_{eq} = \sum_{i=1}^{n} C_i$
- Capacitors in series $\dfrac{1}{C_{eq}} = \sum_{i=1}^{n} \dfrac{1}{C_i}$
- For a dielectric

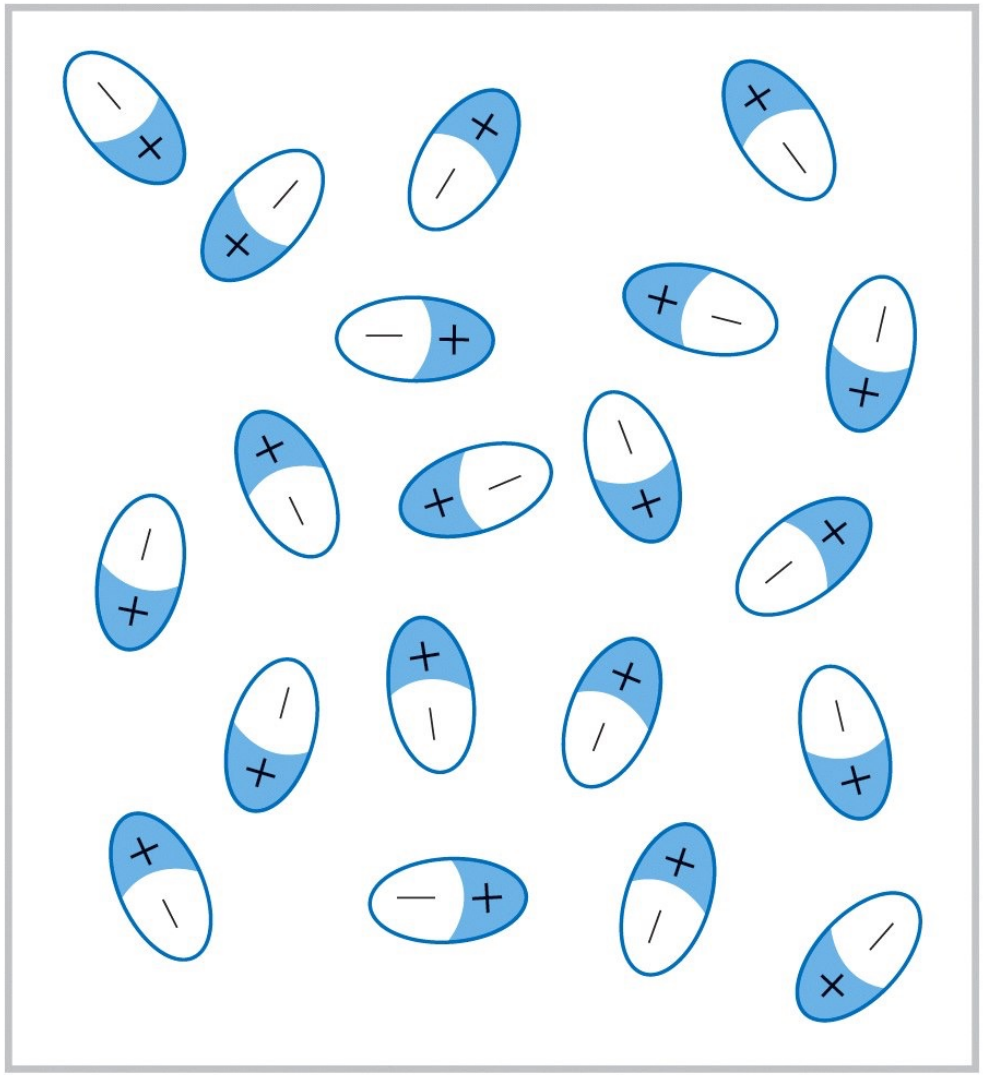
$$C = \kappa C_0$$

$$C = \kappa \frac{\varepsilon_0 A}{d} = \frac{\varepsilon A}{d} \qquad \varepsilon = \kappa \varepsilon_0$$

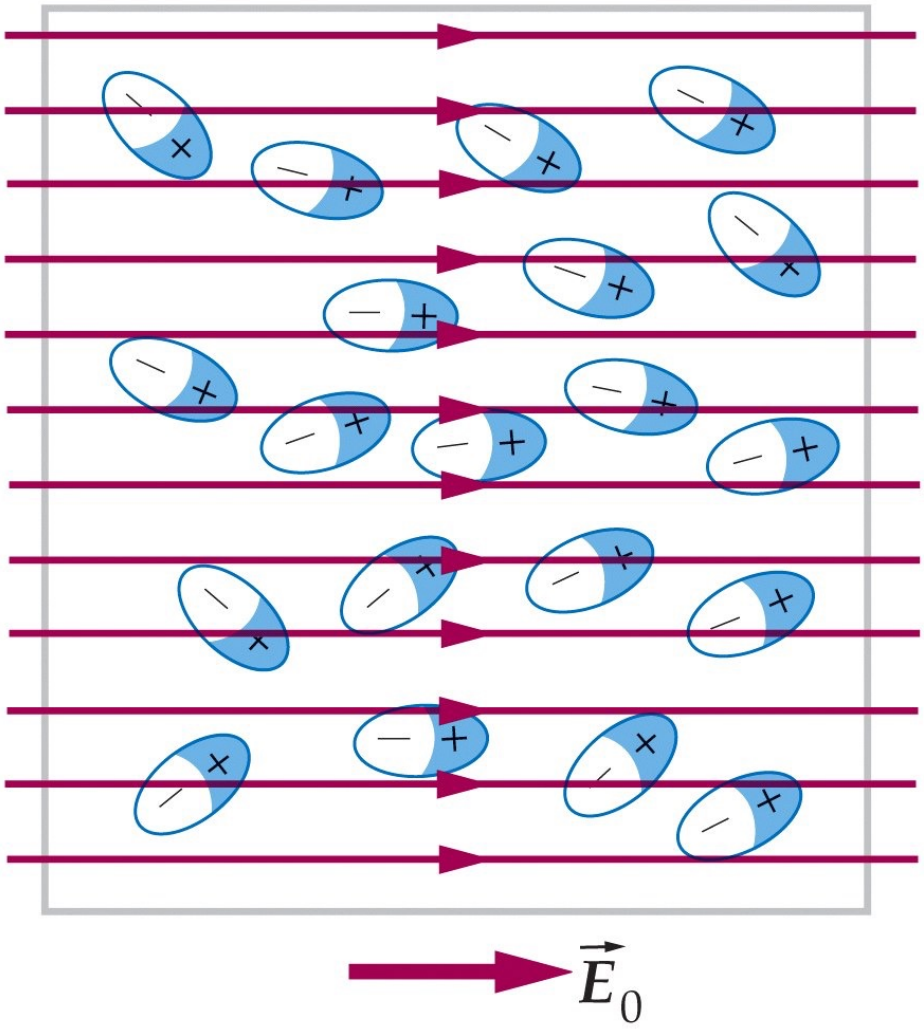
Example problem

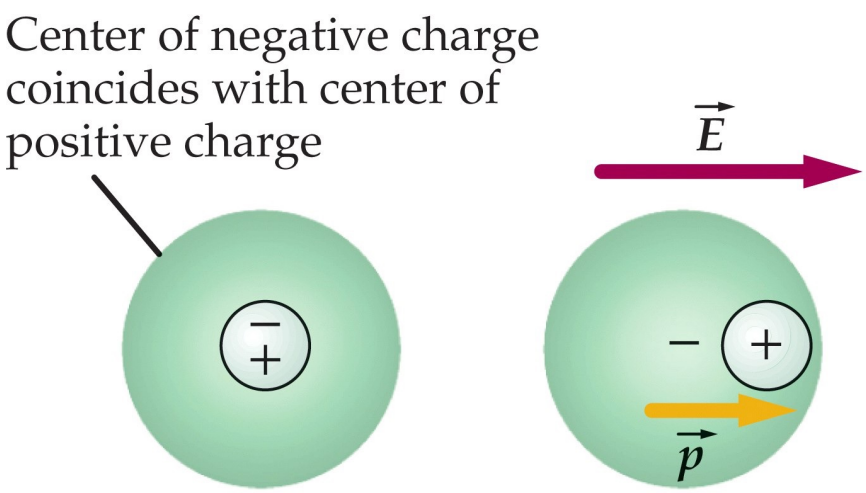
- When a potential difference of 150 V is applied to the plates of a parallel-plate capacitor, the plates carry a surface charge density of 30.0 nC/cm^2 (after coming to steady-state). What is the spacing between plates? If the surface area of a plate is 7.60 cm^2, what is the capacitance and charge?

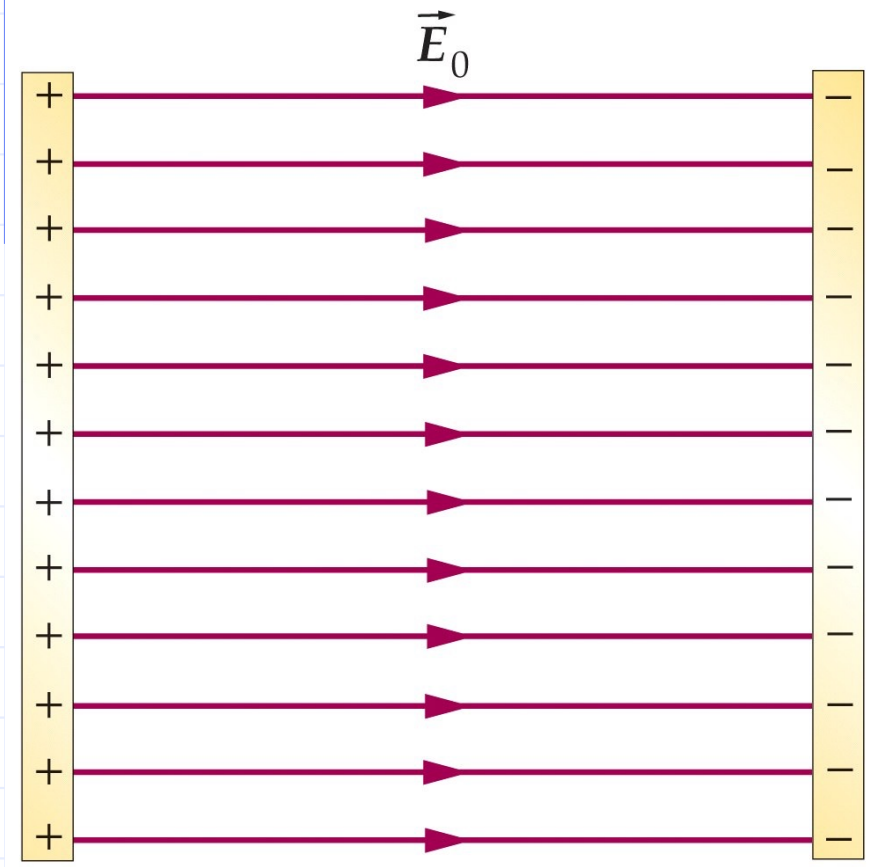
- Polar molecules
- With E=0

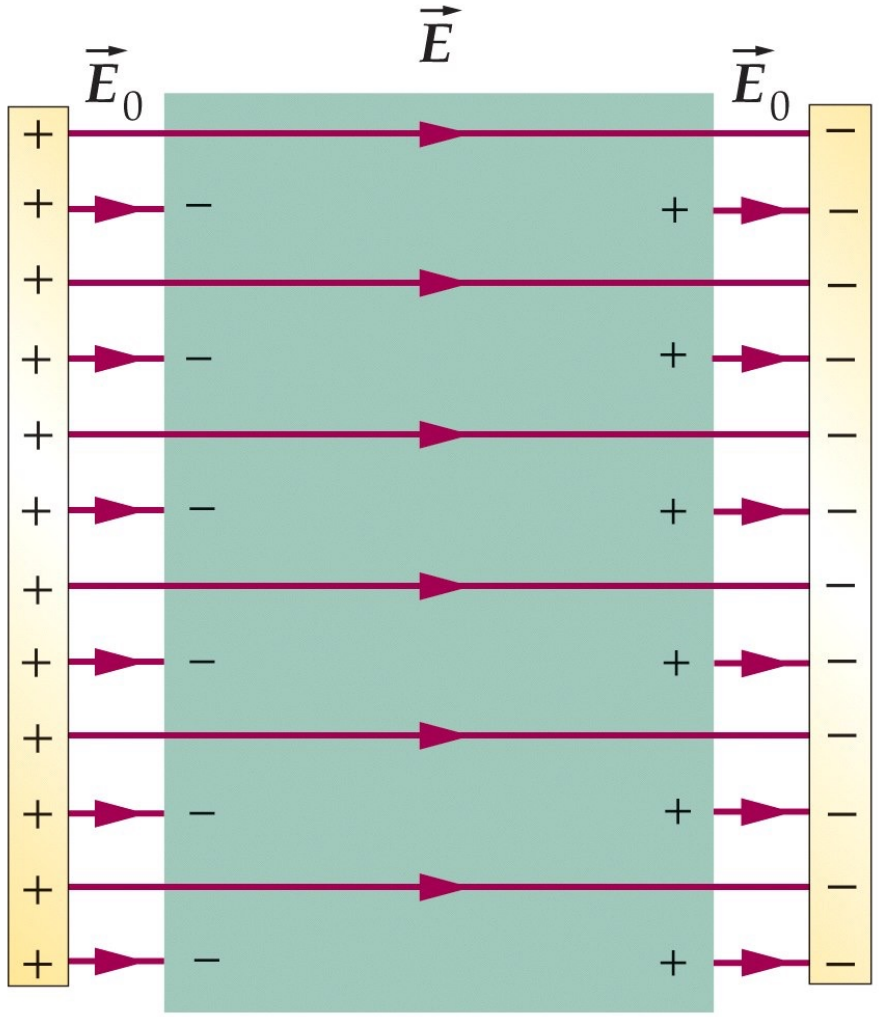


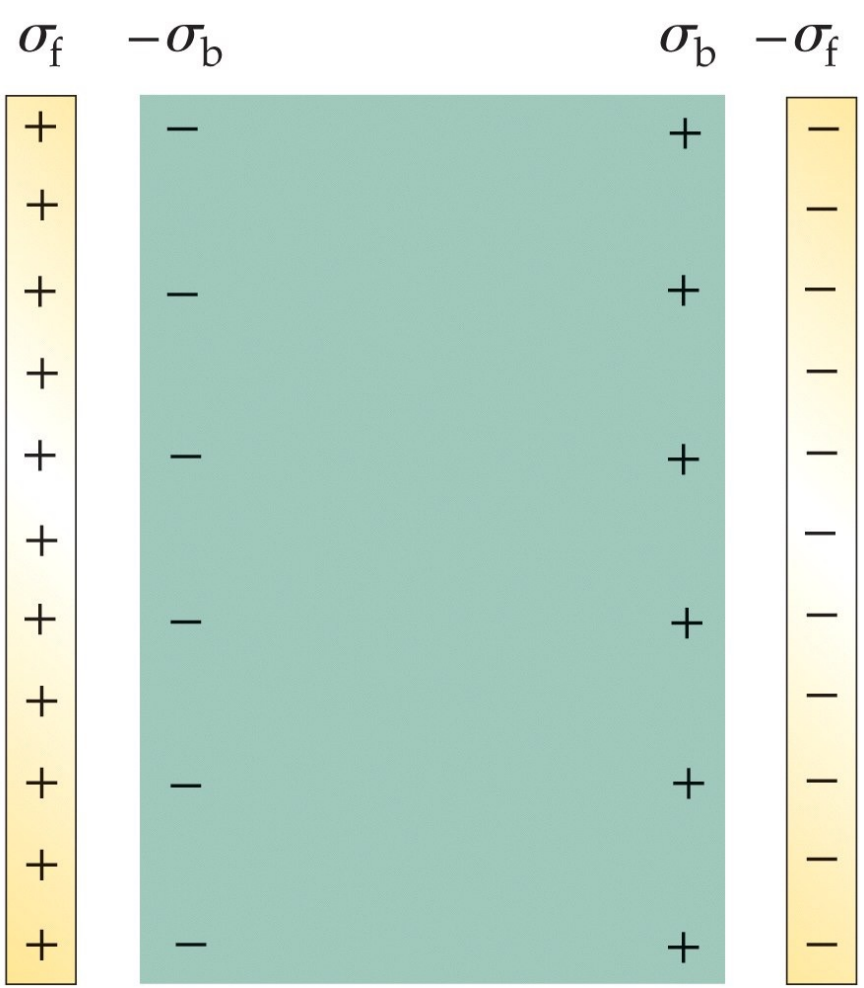
- With applied E

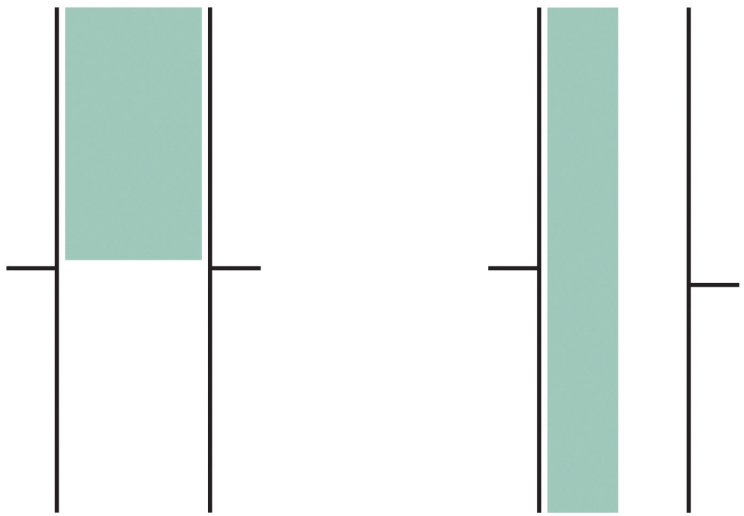


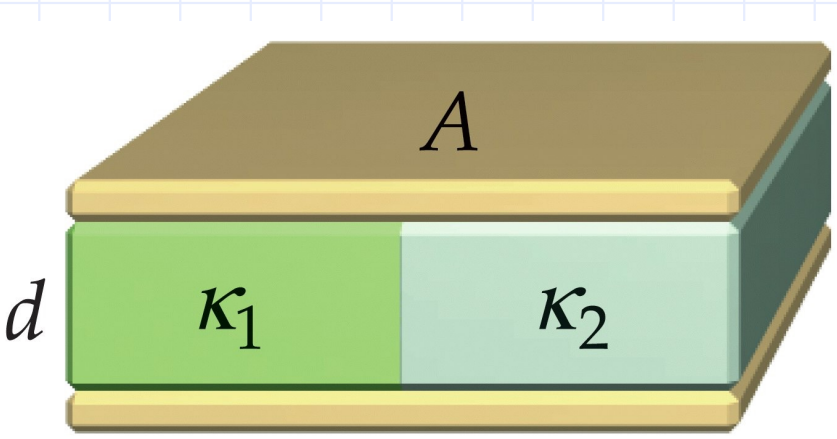

Center of negative charge coincides with center of positive charge
$\vec{E}$
$\vec{p}$

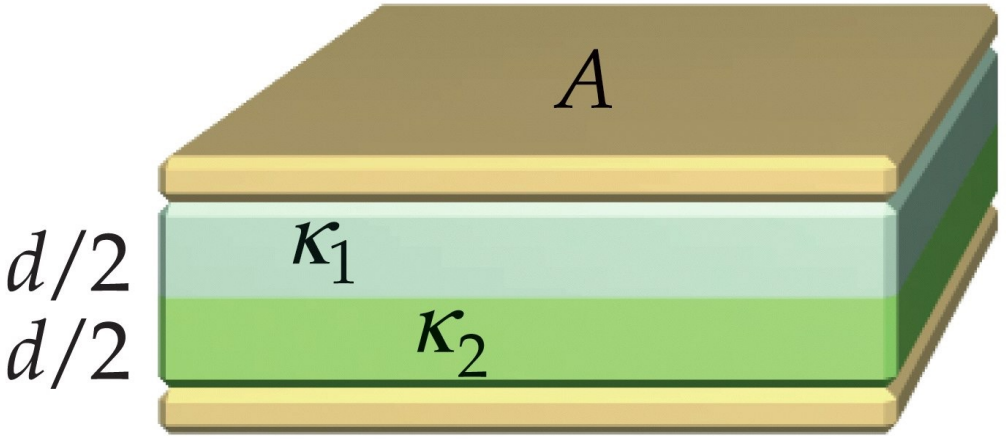

$\vec{E}_0$


$\vec{E}_0$
$\vec{E}$
$\vec{E}_0$


σ_f
$-\sigma_b$
σ_b
$-\sigma_f$




A
d
κ_1
κ_2


A
$d/2$
$d/2$
κ_1
κ_2