

Dielectric of parallel plate capacitor

$$\vec{E}_{induced} = \frac{\sigma_{induced}}{\epsilon}$$

$$\vec{E}_{net} = \vec{E}_{free} + \vec{E}_{induced}$$

Dielectric constant

$$\kappa = \frac{\vec{E}_{free}}{\vec{E}}$$

Gauss's law for dielectrics

$$\oint_S \vec{E} \cdot d\vec{A} = \frac{\sum Q_{enclosed, free}}{\kappa \epsilon}$$

Capacitor

A capacitor is a device for storing charge. Capacitors consist of two conductors separated by an insulator (dielectric).

Capacitance

Ratio of charge on either plate to the p.d. between the plates is called the capacitance, C of the capacitor.

$$C = \frac{Q}{V} \Rightarrow Q = CV$$

Parallel plate capacitors

$$C = \frac{Q}{V} = \frac{\epsilon A}{d}$$
$$E = \frac{V}{d} = \frac{\frac{Q}{A}}{\epsilon} = \frac{\sigma}{\epsilon}$$

Spherical capacitors

$$C = 4\pi\epsilon r$$

Energy of charged capacitor

$$U = \int_{all\ space} \frac{1}{2} \epsilon_0 E^2 dV = \frac{1}{2} \epsilon_0 \frac{\sigma}{\epsilon_0} Ah = \frac{1}{2} QV = \frac{1}{2} CV^2$$

Dielectric

Capacitor

Capacitance

Circuits

Capacitors in Series

$$C_{total}^{-1} = (\sum C^{-1})^{-1}$$

Capacitors in Parallel

$$C_{total} = \sum C$$