

**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**

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