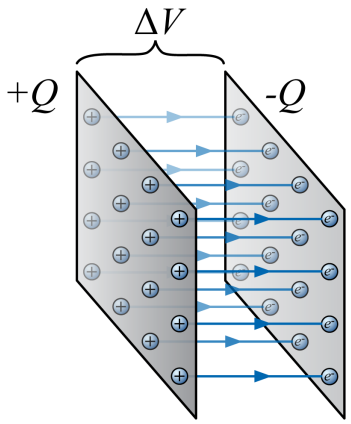
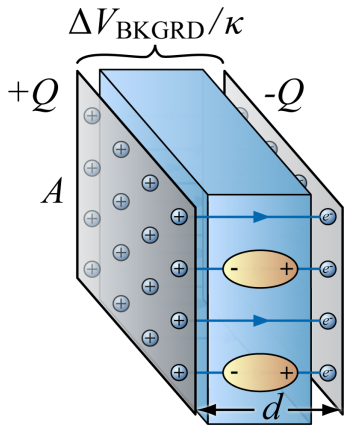
Capacitors



Capacitance

$$C := \frac{Q}{\Delta V}$$

$$[C] = \frac{\mathrm{C}}{\mathrm{V}} = \mathrm{F}$$



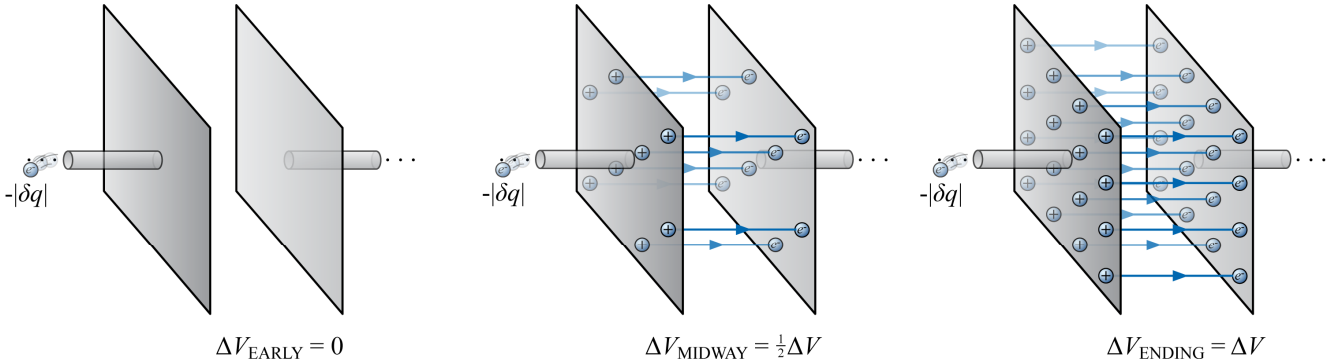
Parallel-plate capacitor

$$C_{\parallel\ \mathrm{PLATES}} = \kappa\epsilon_0 \frac{A}{d}$$

$$\left|\vec{\mathbf{E}}_{\parallel,\mathrm{BKGRD}}\right| = \frac{Q}{\epsilon_0 A}$$

$$\left|\vec{\mathbf{E}}\right| = \frac{\left|\vec{\mathbf{E}}_{\mathrm{BKGRD}}\right|}{\kappa}$$

Storing energy in a capacitor



$$\Delta W_{\mathrm{HAND}} = |\delta q|0 + \cdots + |\delta q|\left|\frac{1}{2}\Delta V\right| + \cdots + |\delta q||\Delta V|$$

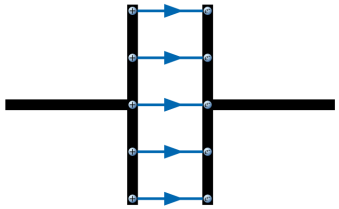
$$= Q\left[\frac{|\delta q|}{Q}0 + \cdots + \frac{|\delta q|}{Q}\left|\frac{1}{2}\Delta V\right| + \cdots + \frac{|\delta q|}{Q}|\Delta V|\right]$$

$$\Delta U_{\mathrm{C}} = Q\left(\frac{1}{2}\Delta V\right) = \frac{1}{2}C(\Delta V)^2 = \frac{Q^2}{2C}$$

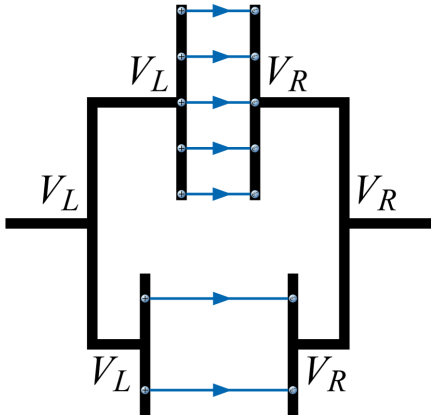
Capacitors

Capacitors in circuits

Single capacitor



Capacitors in parallel

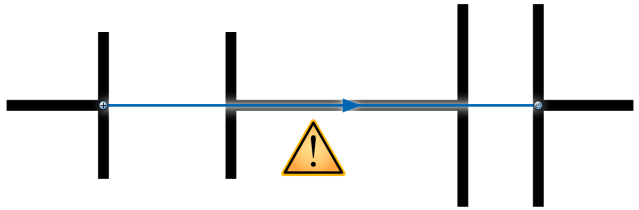


Each capacitor has same ΔV

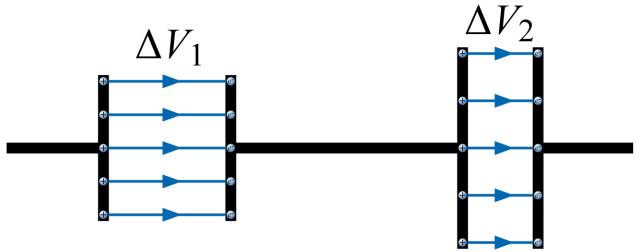
$$C_{\text{EQ},\parallel} = C_1 + C_2 + \cdots$$

Q_{EQ} divides so that $Q_i \propto C_i$

Capacitors in series



$|\vec{\mathbf{E}}|$ should quickly approach 0 in conductor
(quickly achieves electrostatic equilibrium)



Each capacitor has same Q

$$\frac{1}{C_{\text{EQ,SER}}} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots$$

ΔV_{EQ} divides so that $\Delta V_i \propto \frac{1}{C_i}$