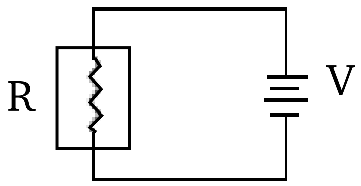
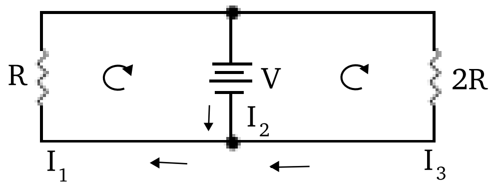
8.022 Lecture Notes Class 31 - 11/13/2006



$V = IR$ Macroscopic Ohm's Law

$\Sigma \Delta V$ Kirchoff's I

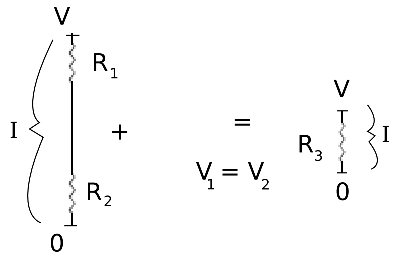
$$\Longleftrightarrow \oint \vec{E} \cdot d\vec{l} = 0$$



Three loops but only two interesting ones.
Charge is conserved at junctions.

$\Sigma I = 0$ Kirchoff's II

Resistors in Series

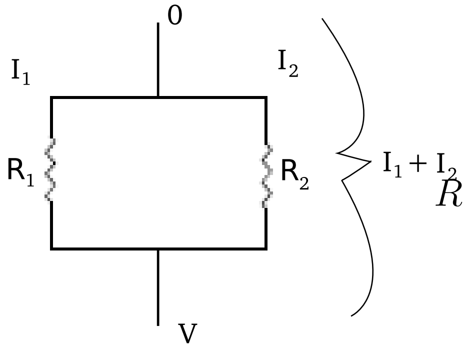


Use $\Sigma V = 0$

$$V_1 + V_2 = V$$

$$R = \frac{V}{I} = \frac{V_1 + V_2}{I} = \frac{V_1}{I} + \frac{V_2}{I} = R_1 + R_2$$

Resistors in Parallel

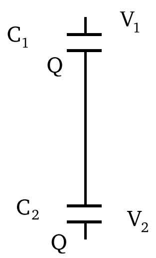


$$= \frac{V}{I} = \frac{V}{I_1+I_2} = \frac{1}{\frac{I_1+I_2}{V}} = \frac{1}{\frac{I_1}{V}+\frac{I_2}{V}}$$

$R = \frac{1}{\frac{1}{R_1}+\frac{1}{R_2}}$ Harmonic Sum!

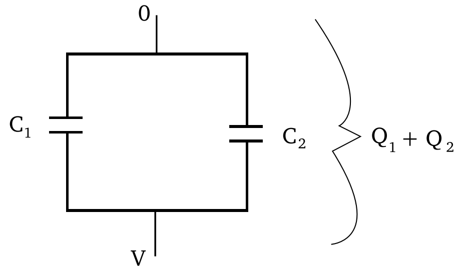
(or $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$)

Capacitors in Series



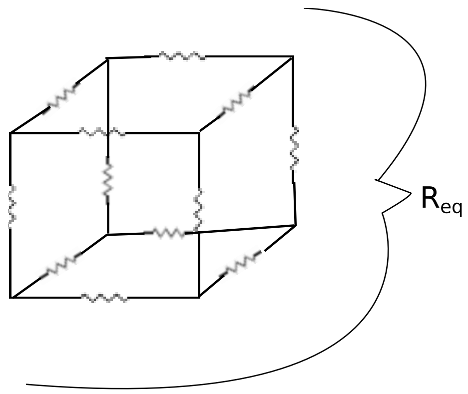
$$C = \frac{Q}{V} = \frac{Q}{V_1 + V_2} = \frac{1}{\frac{V_1}{Q} + \frac{V_2}{Q}} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2}}$$

Capacitors in Parallel



$$C = \frac{Q_1 + Q_2}{V} = \frac{Q_1}{V} + \frac{Q_2}{V} = C_1 + C_2$$

Resistor Cube



$$\begin{aligned}
\frac{1}{R_{\text{eq}}} &= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \\
&= \frac{1}{R+\frac{1}{\frac{1}{2R}+\frac{1}{2R}}} + \frac{1}{R+\frac{1}{\frac{1}{2R}+\frac{1}{2R}}} + \frac{1}{R+\frac{1}{\frac{1}{2R}+\frac{1}{2R}}} \\
&= \frac{3}{R+R} \\
&= \frac{3}{2R} \\
R_{\text{eq}} &= \frac{2}{3}R
\end{aligned}$$