Trouble-shooting guide

Last time:

\[ E = \frac{E_0}{\varepsilon} \]

\( \varepsilon \) = dielectric constant

or can use \( E = \) Permittivity rather than \( E_0 \)

\( E = \varepsilon \varepsilon_0 \)
$K, \varepsilon$ are material dependent

Resistance $\rightarrow$ obstacles to particles looking for

Charges flow $i = \frac{d q}{d t}$ in Amperes

1 Ampere = \frac{1 \text{ coul}}{1 \text{ second}}
André Marie Ampère
(1775 - 1836)

French Mathematician
Chemist
Physicist

The inspiration for
Elvis' Collar
\[ V = IR \]

Ohm's Law

Resistance measured in Ohms

Ohm = \( \frac{1 \text{ volt}}{\text{Ampere}} \)

1789–1854

Georg Ohm

German
Power spent in resistor \rightarrow heat

\[ P = iV \]

\[ v = iR \]

\[ P = i^2R \]

\[ i = \frac{v}{R} \]

Use the one that works.
\[ V = V_1 + V_2 + V_3 = iR_1 + iR_2 + iR_3 = i(R_1 + R_2 + R_3) \]

\[ = iR \]

\[ R = R_1 + R_2 + R_3 = \sum R_i \]
\[ V = IR \quad V = i_1 R_1 \quad V = i_2 R_2 \]

\[ I = i_1 + i_2 \]

\[ \frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} \]

\[ \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \]

\[ \frac{1}{R} = \frac{1}{\Delta} \cdot \frac{1}{R_1} \]
Battery $\rightarrow$ V constant

one direction

Direct Current $\rightarrow$ DC

Alternating Current $\rightarrow$ AC

\[ i_v = i_2 + i_3 \]
Kirchhoff's Rules:

1. \( \Sigma V = 0 \) around closed loop in circuit

2. \( \Sigma i = 0 \) at any junction

Current is conserved at any branch point

Use rules and independent loops and conventions

To get \( N \) eqns

\( \rightarrow \) solve for \( N \) unknowns
Solve a problem → convention

Choose currents in each branch of circuit (arbitrary)

Imaginary loops about circuit

Sum $\Delta V$ as go around each independent imaginary loop

$\Delta V - \text{if} \rightarrow \text{loop}$

$\Delta V + \text{if} \rightarrow \text{loop}$
$E + i f \quad \text{loop}$

$E - i f \quad \text{loop}$

Each indep loop $\Delta V = 0$

$\rightarrow N$ eqns

Solve $N$ unk
\[ \sum V = 0 \text{ around each loop} \]

A \[ \sum V = -i_1 R - \varepsilon_1 + i_2 R_2 + \varepsilon_2 = 0 \]

B \[ \sum V = -\varepsilon_3 + i_3 R_3 + i_2 R_2 = 0 \]

gives 3 eqns \rightarrow can solve for up to 3 unknowns