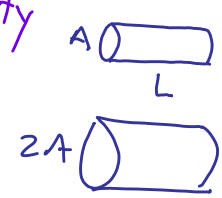
Circuits Review

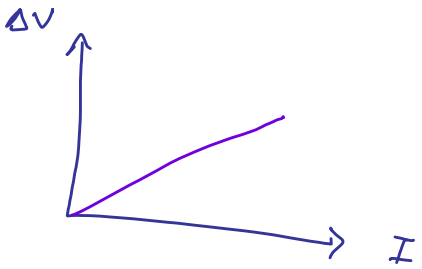
I. General

(A) $I = \frac{dQ}{dt}$ (A) flow rate, not speed

(B) $R = \frac{\rho L}{A}$ ρ - resistivity



$\rho(\alpha) \Rightarrow$ ohmic or non-ohmic



(C) Ohm's Law: $\Delta V = IR$

(D) Power = $I^2R = I\Delta V = \frac{\Delta V^2}{R} = \frac{dE}{dt}$

(E) $C = \frac{Q}{\Delta V}$; parallel plates $C = \frac{\varepsilon \cdot A}{d} K$

$U_c = \frac{1}{2} C \Delta V^2$

II. Resistor Circuits

(A) Series

i. $R_{eq} = \sum_i R_i$

ii. $\frac{1}{C_{eq}} = \sum_i \frac{1}{C_i}$

(B) Parallel

i. $\frac{1}{R_{eq}} = \sum_i \frac{1}{R_i}$

ii. $C_{eq} = \sum C_i$

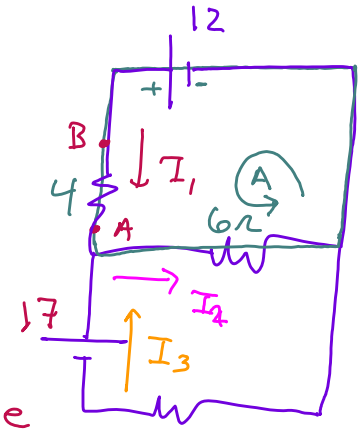
(C) Complex

i. Solve for R_{eq}

ii. Solve for I through battery

iii. Use $\Delta V = IR$

A: $12 - 4I_1 - 6I_2 = 0$



(D) Kirchhoff's Laws:

i. $I_{in} =$ I_{out}

ii. $\sum V =$ 0 loop $\quad (\pm \mathcal{E}, \pm IR)$

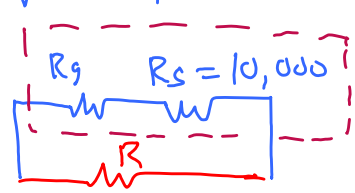
(E) Voltmeters & Ammeters

i. How to connect? voltmeter, //, R_V large

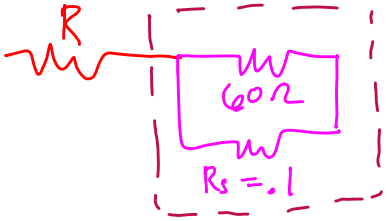
ammeter, series, R_a small

ii. How to make a galvanometer into each? $R_g \approx 60\Omega$

Voltmeter



ammeter



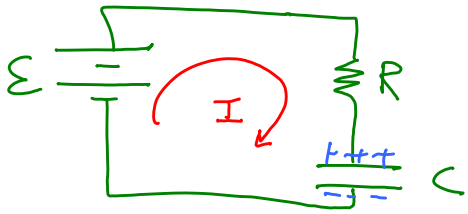
III. RC Circuits

(A) Differential equation

$$\mathcal{E} - IR - \frac{q}{C} = 0$$

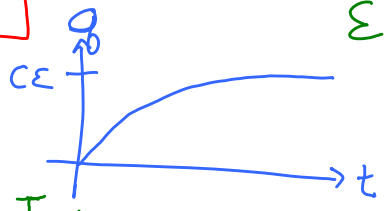
$$\frac{\mathcal{E}}{R} - \frac{q}{RC} = \frac{dq}{dt}$$

$Q_{MAX} = C\mathcal{E}$



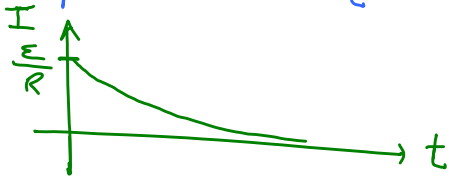
(B) $q(t) = Q_{MAX}\left(1 - e^{-\frac{t}{\tau}}\right)$

$q(t) = C\mathcal{E}\left(1 - e^{-\frac{t}{\tau}}\right)$



(C) $I(t) = I_{MAX} e^{-\frac{t}{\tau}}$

$I_{MAX} = \frac{\mathcal{E}}{R}$



(D) Time constant:

$\tau = RC$

$I = I_{MAX} e^{-\frac{t}{\tau}} = I_{MAX} \frac{1}{e}$

(E) ΔV across capacitor and resistor for charged & uncharged capacitor.

(F) Capacitor a t = 0 and t = ∞

i. An uncharged capacitor acts like a wire

ii. A charged capacitor acts like a opposing battery/open switch

$I_C = 0$

TEST - 1 period

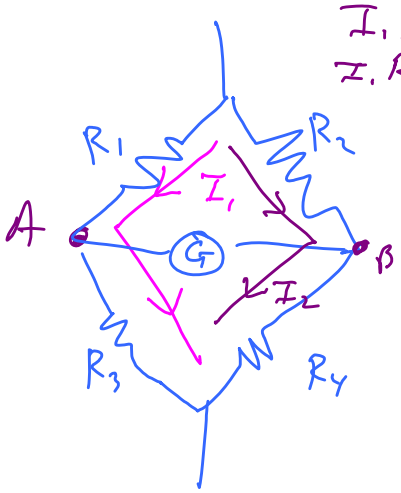
7 M.C.

- capacitor, C_{eq}, Q
- Complex, wheatstone
- Power
- RC graphs

1 F.R.

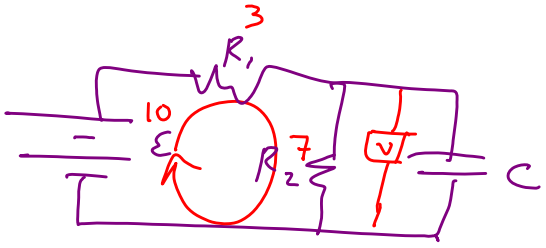
$I_1 R_1 = I_2 R_2$

$I_1 R_3 = I_2 R_4$



$I_G = 0$

Complex RC



when C is fully charged $I = 1A$

$V_{11} = 7V$