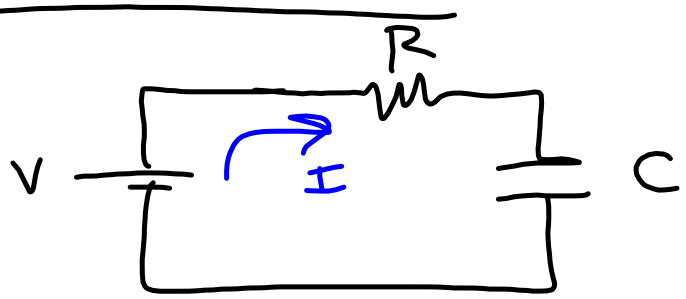
RC CIRCUITS



$$V_{round\ trip} = V - IR - \frac{Q}{C} = \emptyset$$

- final state: $I = \emptyset\ A$

$$Q = VC$$

- initial state: $I = \dfrac{V - Q/C}{R}$

$$\frac{dQ}{dt} = \frac{V - Q/C}{R}$$

$$\int_{\emptyset}^{Q} dQ = \int_{\emptyset}^{t} \left(\frac{V - Q/C}{R}\right) dt$$

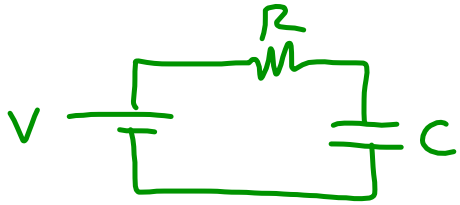
$$Q = CV\left[1 - e^{-t/RC}\right]$$

$$\tau = RC$$

↳ time constant

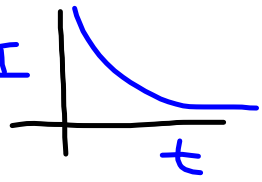
Equations

- Charging:

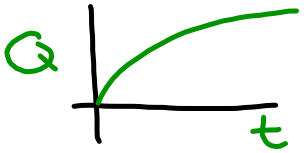


- Current

$$I = \frac{V}{R} e^{-\frac{t}{Rc}}$$

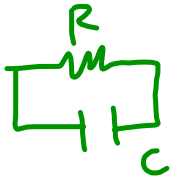


- Charge



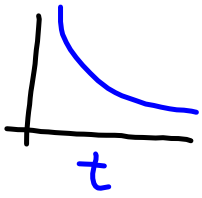
$$Q(t) = CV\left[1 - e^{-t/Rc}\right]$$

- Discharge:



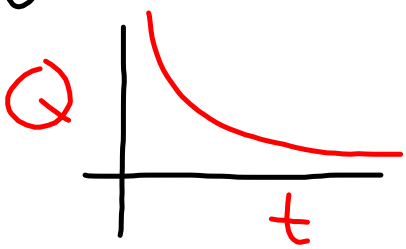
- Current

$$I(t) = \frac{V}{R} e^{-t/Rc}$$



- Charge

$$Q(t) = CV e^{-t/Rc}$$



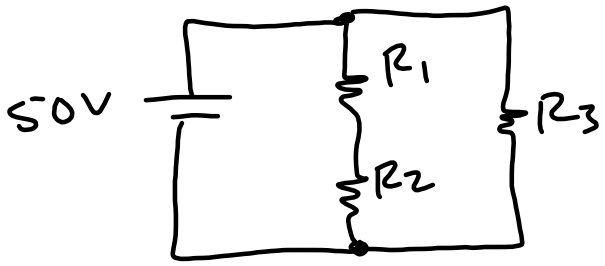
emf → electromotive force

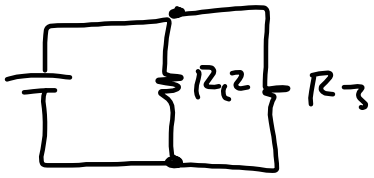
$\mathcal{E}$ (V)

Practice

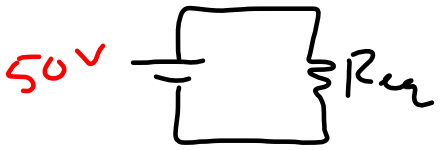
$R_1 = 5\Omega$ $R_3 = 20\Omega$
$R_2 = 10\Omega$

Find: V, I, P for each R.





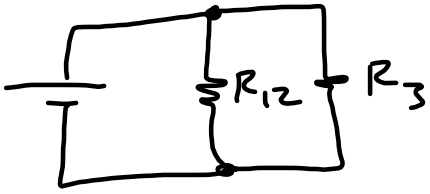
$R_{12} = R_1 + R_2 = 15\Omega$



$$\frac{1}{R_{eq}} = \frac{1}{R_{12}} + \frac{1}{R_3}$$

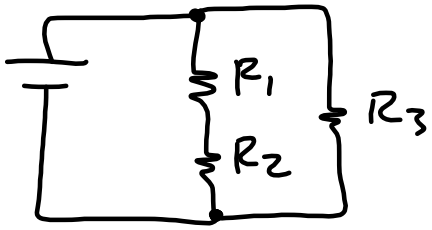
$R_{eq} = 8.57\Omega$

$$I = \frac{V}{R_{eq}} = \frac{50V}{8.57\Omega} = 5.83A$$



$$I_{12} = \frac{V}{R_{12}} = 3.33A$$

$$I_3 = \frac{V}{R_3} = 2.5A$$



$V_1 = I_{12} R_1 = 16.67V$

$V_2 = I_{12} R_2 = 33.3V$

$P_1 = I_{12} V_1 = 55.1W$

$P_2 = I_{12} V_2 = 110.2W$

$P_3 = I_3 V_3 = 125W$