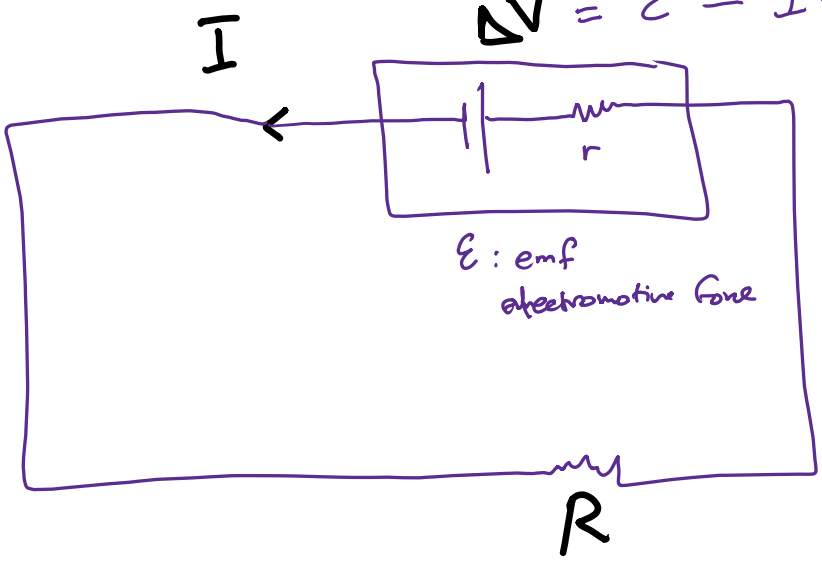
Chapter 28:



$\Delta V = \mathcal{E} - Ir$

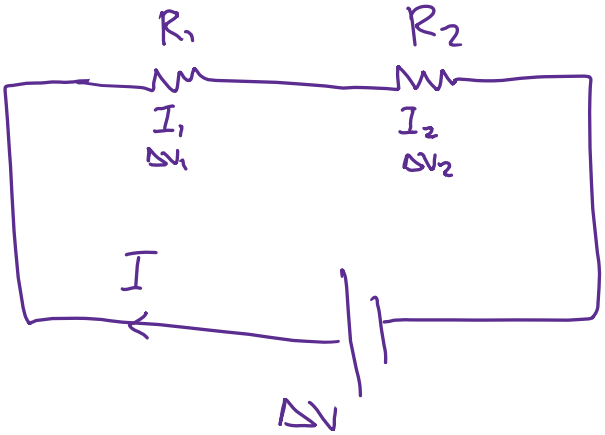
$\mathcal{E}$: emf
electromotive force

$$I = \frac{\Delta V}{R}$$

$$I = \frac{\mathcal{E}}{R + r}$$

$$P_{batt} = I\mathcal{E} = I^2 r + I^2 R$$

Resistors in Series



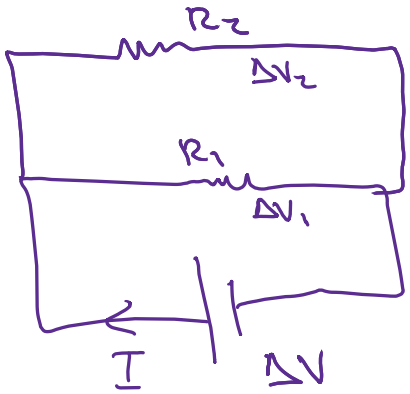
$$R_{eq} = R_1 + R_2$$

$$I = I_1 = I_2$$

$$\Delta V = \Delta V_1 + \Delta V_2$$

$$\Delta V_1 = I_1 R_1 \qquad \Delta V_2 = I_2 R_2$$

Resistors in Parallel



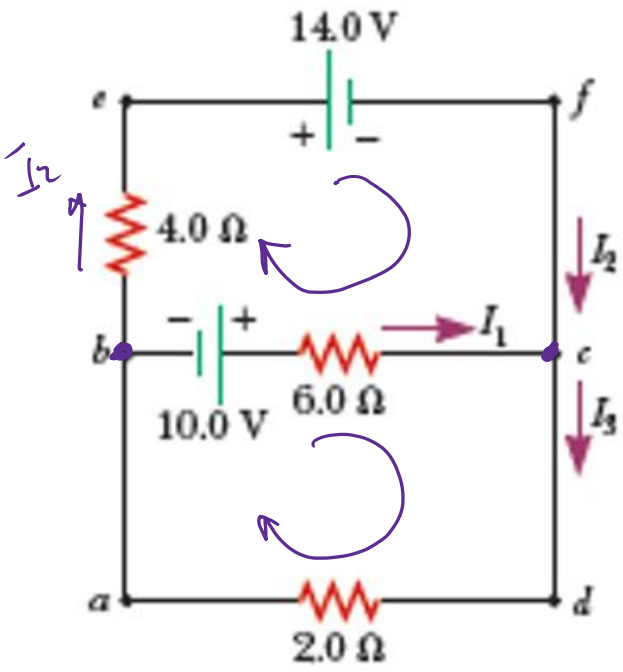
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\Delta V = \Delta V_1 = \Delta V_2$$

$$I = I_1 + I_2$$

$$I_1 = \Delta V_1 / R_1 \qquad I_2 = \Delta V_2 / R_2$$

KVL KCL



$$I_1 + I_2 = I_3 \quad \text{..... (1)}$$

$$-14 + 6I_1 - 10 - 4I_2 = 0 \quad \text{.... (2)}$$

$$10 - 6I_1 - 2I_3 = 0$$

$$10 - 6I_1 - 2(I_1 + I_2) = 0$$

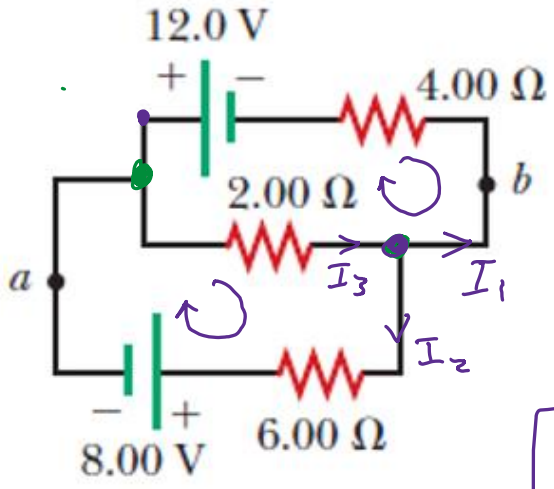
$(\times -2)$ $10 - 8I_1 - 2I_2 = 0$

$+$ $-24 + 6I_1 - 4I_2 = 0$

$-20 + 16I_1 + 4I_2 = 0$

$-44 + 22I_1 = 0 \Rightarrow I_1 = 2$ $\quad I_2 = -3$

$I_3 = -1$



$I_2 = I_3 - I_1$

$$I_3 = I_1 + I_2$$

$$-12 + 4I_1 + 2I_3 = 0$$

$$-6I_2 - 8 - 2I_3 = 0$$

$$-6(I_3 - I_1) - 8 - 2I_3 = 0$$

$$(\times -2) \quad -8I_3 + 6I_1 - 8 = 0$$

$$(\times 3) \quad 2I_3 + 4I_1 - 12 = 0$$

$$16I_3 - 12I_1 + 16 = 0$$

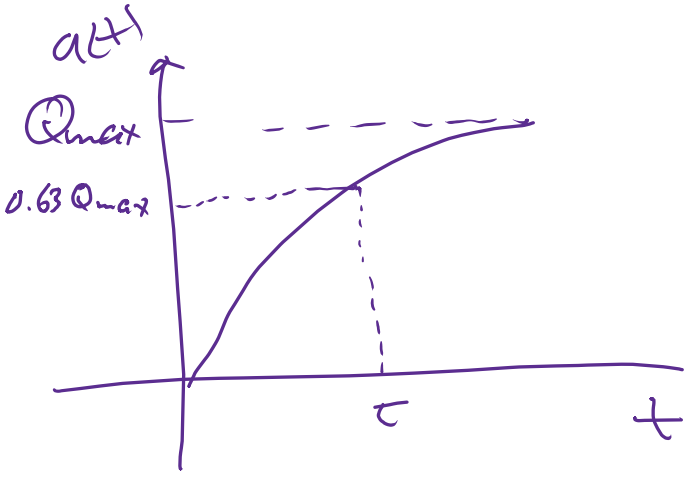
$$6I_3 + 12I_1 - 36 = 0$$

$$22I_3 - 20 = 0 \Rightarrow I_3 = \frac{20}{22}$$

$$= 0.91 \text{ A}$$

Charging:

$$q(t) = \frac{Q_{max}}{C\mathcal{E}}\left(1 - e^{-t/RC}\right)$$



$\tau = RC$ time constant

$$i(t) = \frac{\mathcal{E}}{R} e^{-t/RC}$$

$\frac{\mathcal{E}}{R} \rightarrow I_{max}$

Discharging:

$$q(t) = Q_i\, e^{-t/RC}$$

$$i(t) = -\frac{Q_i}{RC} e^{-t/RC}$$