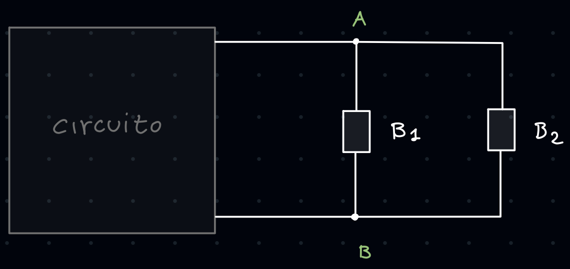
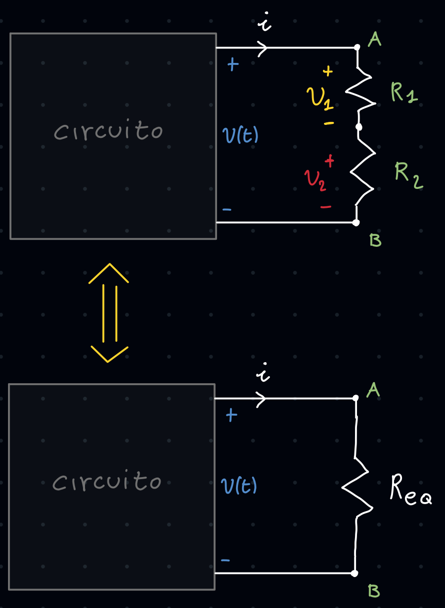


SERIE

Se hanno UN SOLO Morsetto in comune IN ESCLUSIVA
Inoltre Sono attraversati dalla stessa corrente

PARALLELO

se hanno i morsetti connessi "a due a due"
Inoltre la differenza di Potenz. é la stessa



LKC : $i = i_1 = i_2$ (SERIE)

LKT : $-v + v_1 + v_2 = 0 \Rightarrow v = v_1 + v_2$ (1)

R.C. $\begin{cases} v_1 = R_1 i \\ v_2 = R_2 i \end{cases} \Rightarrow v = R_1 i + R_2 i = i(R_1 + R_2)$

Chiamo $R_{eq} = R_1 + R_2 \rightarrow v = R_{EQ} \cdot i$

$\Rightarrow$ $\boxed{R_{EQ} = \sum_i R_i}$

Partitore di tensione

Siccome $v = v_1 + v_2$

RIPARTITA

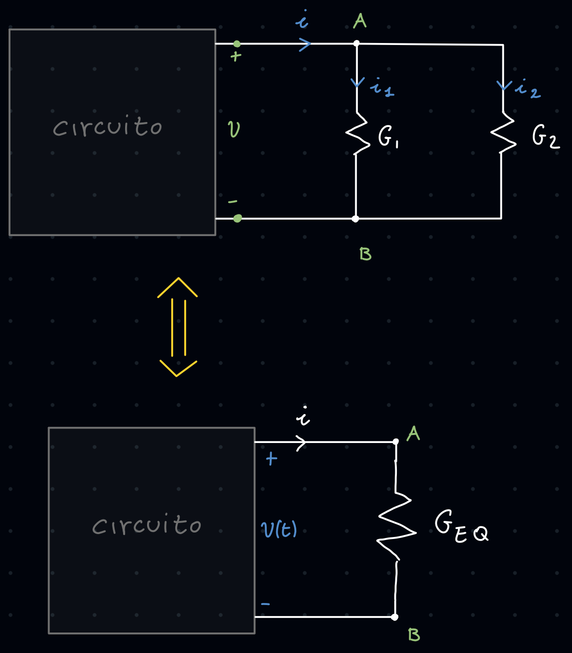
inoltre $\begin{cases} v_1 = R_1 i \\ i = \dfrac{v}{R_1 + R_2} \end{cases} \Rightarrow v_1 = \dfrac{R_1}{R_1 + R_2} v$

C.U.

con $v_1 \leq v$

CADUTA DI TENSIONE

$$\boxed{v_n = v \cdot \frac{R_n}{\sum_{k=1}^{n} R_i}}$$



LKT: $v = v_1 = v_2$ (PARALLELO)

LKC: $i = i_1 + i_2$ (NODO A)

R.C: $\begin{cases} i_1 = G_1 \cdot v_1 = G_1 \cdot v \\ i_2 = G_2 \cdot v_2 = G_2 \cdot v \end{cases}$

$\Rightarrow \quad i = G_1 v + G_2 v = v(G_1 + G_2)$

$\Rightarrow \quad G_{EQ} = G_1 + G_2 \quad \Leftrightarrow \quad \dfrac{1}{R_{EQ}} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$

CONDUTTANZA RESISTENZA

Inoltre $\forall R_1, R_2 > 0 \rightarrow R_{EQ} < R_1, R_2$

proof: $\dfrac{R_1 \cdot R_2}{R_1 + R_2} < R_1$ DISEQUAZIONE

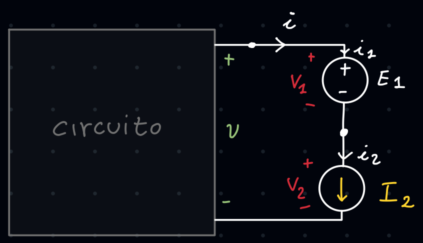
Partitore di Corrente

$$\begin{cases} i = G_1 \cdot v \\ v = \dfrac{i}{G_1 + G_2} \end{cases} \Rightarrow \quad i_1 = i \, \dfrac{G_1}{G_1 + G_2} \quad \text{C.U.}$$

LKC: $i = i_1 = i_2$

LKT: $v - v_1 - v_2 = 0 \Rightarrow v = v_1 + v_2$

$$\begin{cases} v_1 = E_1 \\ v_2 = E_2 \end{cases} \forall i \Rightarrow \underbrace{v = E_1 + E_2}_{\text{UN SINGOLO GENERATORE}} \quad \forall i$$

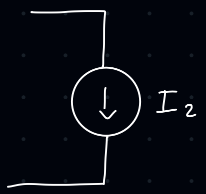


LKC: $i = i_1 = i_2 \overset{\text{IMPOSTA!}}{=} I_2$

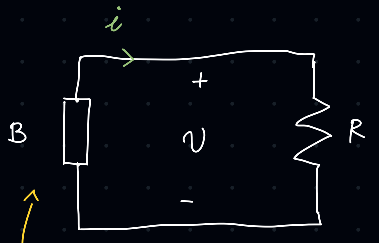
LKT: $v = v_1 + v_2$

R.C. $\begin{cases} v_1 = E_1 \\ v_2 = \text{Dipende dal circuito} \end{cases}$

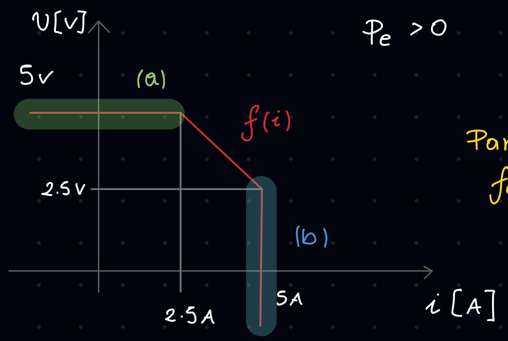
$\Rightarrow$ Equivale ad un singolo generatore di corrente



Risolvere il circuito in figura costituito da un bipolo attivo con la caratteristica indicata in basso e un resistore R

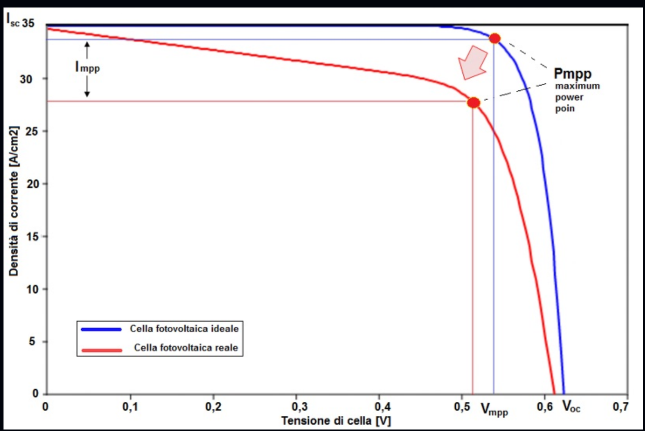


Convenzione generatore (per il Bipolo B



$P_e > 0$

Pannello fotovoltaico



Immaginiamo di risolvere il circuito con 3 valori di resistenza

$$\begin{cases} R = 3\,\Omega & (1) \\ R = 0.8\,\Omega & (2) \\ R = 0.1\,\Omega & (3) \end{cases}$$

Cosa conosciamo del circuito

$$\begin{cases} LKC: & i = i_R \\ LKT: & v = v_R \\ R.C.: & \begin{cases} v_R = R\cdot i \\ v = f(i) \end{cases} \end{cases} \Rightarrow \begin{cases} v = R\cdot i & \text{C.U.} & \text{A} \\ v = f(i) & \text{C.G.} & \text{B} \end{cases}$$

Possiamo scrivere la piecewise funct.:

$$\begin{cases} v = 5\,V & \text{if} & i < 2.5\,A & (a) \\ i = 5A & \text{if} & v < 2.5\,V & (b) \\ v = (7.5 - 1i)_V & \text{if} & 5A < i < 2.5A & (c) \end{cases}$$

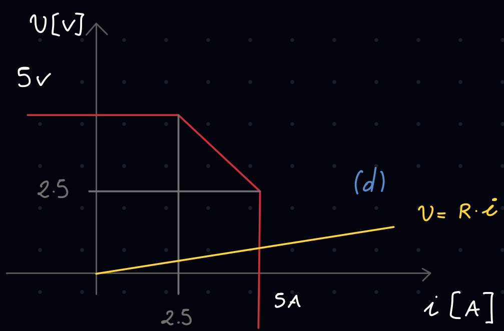
(c) $\dfrac{x - x_0}{x_1 - x_0} = \dfrac{y - y_0}{y_1 - y_0}$ $\quad \begin{array}{c} x_0 \quad y_0 \\ (7.5, 0) \\ x_1 \quad y_1 \\ (0, 7.5) \end{array}$

$\Rightarrow \dfrac{x - 7.5}{-\cancel{7.5}} = \dfrac{y - 0}{\cancel{7.5}} \Rightarrow \underset{v}{y} = -\underset{i}{x} + 7.5$

$\Rightarrow$ La soluzione del problema è quella che soddisfa A e B contemporaneamente!

$\Rightarrow f(i) = R\cdot i$

$\Rightarrow$ PUNTO DI INTERSEZIONE



(d) se $v = R\cdot i$ e siamo in (3) $\Rightarrow R = 0.1$

$\Rightarrow v = 0.1\cdot i \qquad v(5) = 0.1\cdot 5 = 0.5 = \frac{1}{2} < 2.5$

$v(5)$ è sicuramente minore del punto (5; 2.5)

Caso (1) $R = 0.1\ \Omega \Rightarrow v = 0.1 \cdot i$

Sezione (a) $i < 2.5\ A \Rightarrow$ Resistore : $v = 0.1 \cdot 2.5 = 0.25\ V$

ma $v = 5\ V \Rightarrow$ NO

Sezione (b) $i = 5\ A \rightarrow$ Resistore $v = 0.1 \cdot 5 = 0.5\ V$

DA AGGIUSTARE!

ES 1: Carica elettrone : $e = -1.6 \times 10^{-19}$ C

(a) $Q = -1.6\,\mu C \rightarrow 1\,\mu C = 1 \times 10^{-6}$ C $\Rightarrow Q = -1.6 \times 10^{-6}$ C
MICRO

$\Rightarrow \dfrac{Q_{TOT}}{e} = \dfrac{\cancel{-1.6} \times 10^{-6}}{\cancel{-1.6} \times 10^{-19}} = \dfrac{10^{-6}}{10^{-19}} \rightarrow \dfrac{10^{19}}{10^{6}} = 10^{13}$ elettroni Ans

(b) $Q = -4.8 \times 10^{-15}$ C $\rightarrow N = \dfrac{Q_{TOT}}{e} = \dfrac{-4.8}{-1.6} \cdot \dfrac{10^{-15}}{10^{-19}} = 3 \times 10^{4}$ Ans

(c) $Q = -10$ pC $= -10 \times 10^{-12}$ C

$N = \dfrac{-10}{-1.6} \cdot \dfrac{10^{-12}}{10^{-19}} = 6.25 \times 10^{7}$ Ans

ES 2: $i = 1$ mA $= 1 \times 10^{-3}$ A Cariche che attraversano S generica
milli Ampere

In generale $dq = \int \vec{J} \cdot \hat{n}\, ds \cdot dt \rightarrow q = \int_{t_0}^{t_f} \int \vec{J} \cdot \hat{n}\, ds \cdot dt$

ma $\int J \cdot \hat{n}\, ds = i \Rightarrow Q = \int_{t_0}^{t_f} i(\tau)\, d\tau = \int_{t_0}^{t_f} 1\,mA \cdot dt$

Formule derivate dagli integrali

(a) $t = 1$ s $\rightarrow Q = \int_0^1 10^{-3} \cdot dt = 10^{-3}A \cdot [t]_0^1 = 10^{-3}$ C

Ci serve il numero di cariche elementari ($e = -1.6 \times 10^{-19}$ c)

$\rightarrow N = \dfrac{A}{e} \dfrac{[c]}{[c]} = \dfrac{10^{-3}}{1.6 \times 10^{-19}} = 6.25 \times 10^{15}$ ANS$_1$

(b) 3 ms $= 3 \times 10^{-3}$ s

$\rightarrow \boxed{Q_{TOT} = [\text{Corrente}] \cdot [\text{Tempo}]} \Rightarrow \boxed{N_{TOT} = \dfrac{Q_{TOT}}{e}}$

$\Rightarrow N = \dfrac{10^{-3} A \cdot 3 \times 10^{-3} s}{e} \dfrac{[A \cdot s = C]}{[C]} = 1.875 \times 10^{13}$ Ans$_2$

(c) $8\,\mu s = 8 \times 10^{-6}$ s

$\rightarrow N = \dfrac{10^{-3} \cdot 8 \times 10^{-6}}{1.6 \times 10^{-19}} = 5 \times 10^{10}$ Ans 3

ES 3: Sup chiusa Σ $\quad i = ?$ $\quad \hat{n}$ uscente

(a) $\boxed{i(t) = \frac{dq}{dt}}$ $\rightarrow$ $i_1(t) = \frac{d}{dt}\left[10 \cdot 10^{-15} t\right] = 10 \times 10^{-15} = 10^{-14}\,A$ Ans1

Formula usata

(b) $i_2(t) = \frac{d}{dt}\left(-25 \times 10^{-10} t\right) = -25 \times 10^{-10} = -2.5 \times 10^{-9}\,A$ Ans2

(c) $i_3 = \frac{d}{dt}\left(5 \times 10^{-10} \cdot \sin(314 t)\right) = 314 \cdot 5 \times 10^{-10} \cos(314 t) = 157 \times 10^{-7} \cdot \cos(314 t)$ Ans

ES 4 Conv. U.

Potenza Assorbita $\rightarrow$ $\quad L = \int \vec{F} \cdot d\ell \rightarrow dL = F \cdot d\ell$ ma $E = \frac{F}{q} \Rightarrow F = q \cdot E$

$\Rightarrow dL = dq \cdot E \cdot d\ell \Rightarrow$ In unita' di tempo $\rightarrow$ $\underbrace{\frac{dL}{dt}}_{P_a} = \underbrace{\frac{dq}{dt}}_{i} \cdot \underbrace{E \cdot d\ell}_{v}$

Formula

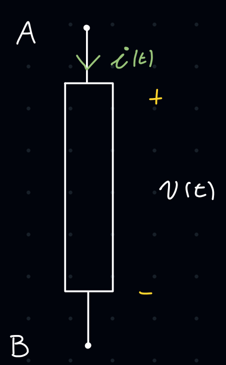
$\Rightarrow$ $\boxed{P_a = i(t) \cdot v(t)}$

(a) $v = 10V$; $i = -3\,A$ $\rightarrow$ $P_a = -3\,A \cdot 10\,V = -30\,W \Rightarrow$ Assorbita

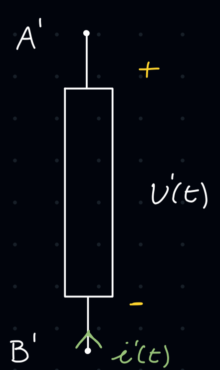
(b) $v = 30V$; $i = 0.5\,A$ $\rightarrow$ $P_a = 30V \cdot \frac{1}{2}\,A = 15\,W \Rightarrow$ EROGATA

(c) $v = -10\,V$; $i = -2\,A$ $\rightarrow$ $P_a = -10\,V \cdot (-2\,A) = 20\,W \Rightarrow$ Erogata

ES 5 Conv. gen



UTILIZZATORE



GENERATORE

$\Rightarrow$ CAMBIA VERSO DI i

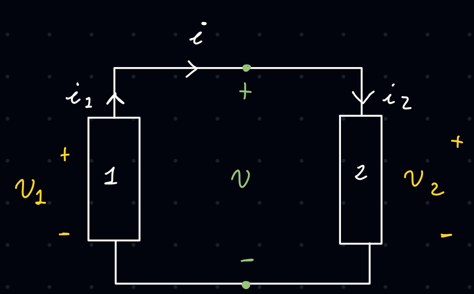
$\Rightarrow i'(t) = -i(t)$

(a) $P_a = 10V \cdot 3\,A = 30\,W$

(b) $P_a = 30V \cdot (-\frac{1}{2}\,A) = -15\,W$

(c) $P_a = -10V \cdot 2\,A = -20\,W$

ES 6



(a) $v = 10\,V \qquad i = -3\,A$

$i_1 = i_2 = i \quad ; \quad v_1 = v_2 = v$

BOH!

ES 7

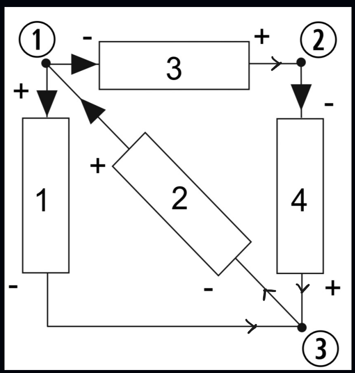
$v = 18\,V \qquad i = 300\,mA = 300 \times 10^{-3}\,A \qquad \Delta t = 3h = 10800\,s$

$\boxed{P_a = i \cdot v} = 18\,V \cdot 300 \times 10^{-3}\,A = 5.4\,W$

$\boxed{\mathcal{E} = \int_{t_0}^{t} P_a\, dt} = 5.4 \cdot [t_f - t_0] = 5.4 \cdot 10800 = 58320\,Joule = 58.3 \times 10^{3}\,J = 58.3\,kJ$

Ans

ES 8



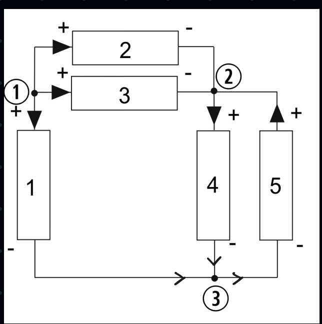
(a) LKC

ENTRANTE ⇒ (-) USCENTE ⇒ (+)

$$\begin{cases} (1) & i_3 + i_1 - i_2 = 0 \\ (2) & i_4 - i_3 = 0 \\ (3) & i_2 - i_4 - i_1 = 0 \end{cases}$$

LKT ORARIO

$$\begin{cases} v_2 - v_1 = 0 \\ -v_3 - v_4 - v_1 = 0 \\ -v_3 - v_4 - v_2 = 0 \end{cases}$$

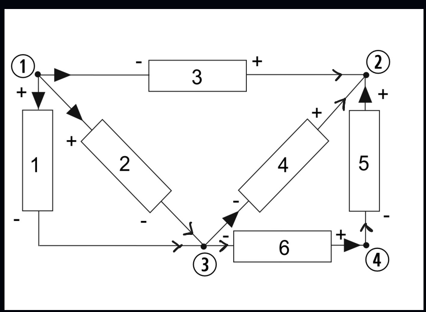


(b) LKC

$$\begin{cases} (1) & i_1 + i_3 + i_2 = 0 \\ (2) & i_4 - i_5 - i_2 - i_3 = 0 \\ (3) & i_5 - i_4 - i_1 = 0 \end{cases}$$

LKT ORARIO

$$\begin{cases} v_3 + v_4 - v_1 = 0 \\ v_3 + v_5 - v_1 = 0 \\ v_2 - v_3 = 0 \\ v_2 + v_5 - v_1 = 0 \\ v_5 - v_4 = 0 \\ -v_1 + v_2 + v_4 = 0 \end{cases}$$



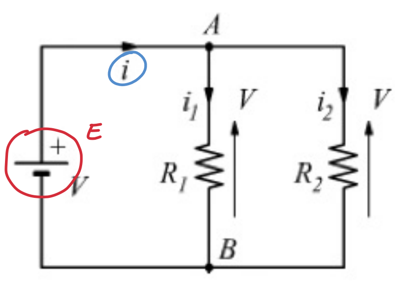
(c) LKC

$$\begin{cases} (1) & i_1 + i_3 + i_2 = 0 \\ (2) & -i_3 - i_4 - i_5 = 0 \\ (3) & i_4 + i_6 - i_2 - i_1 = 0 \\ (4) & i_5 - i_6 = 0 \end{cases}$$

LKT ORARIO

$$\begin{cases} -v_3 + v_5 + v_6 - v_1 = 0 \\ -v_3 + v_5 + v_6 - v_2 = 0 \\ -v_3 + v_4 - v_1 = 0 \\ -v_3 + v_4 - v_2 = 0 \\ v_2 - v_1 = 0 \\ v_2 - v_4 + v_3 = 0 \\ v_2 - v_6 - v_5 + v_3 = 0 \\ -v_6 - v_5 + v_4 = 0 \end{cases}$$

Esercizi Partitore di Corrente



$R_1 = 80\,\Omega$
$R_2 = 40\,\Omega$
$E = 220\,V$

Parallelo $\rightarrow$ la caduta di Tensione è la Stessa (220 V)

$$\frac{1}{R_{EQ}} = R_1 \parallel R_2 = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{40\,\Omega} + \frac{1}{80\,\Omega} = \frac{3}{80}$$

$$\rightarrow R_{EQ} = \frac{80}{3} \simeq \underline{27\,\Omega} \quad (1)$$

Siccome

$$v = R \cdot i \Rightarrow i = \frac{v}{R} = \frac{v}{R_{EQ}} = \frac{220 \cdot 3}{80} = \underline{8.25\,A} \quad (2)$$

CORRENTE DEL GENERATORE

Dalle leggi di Kirchhoff : $i = i_1 + i_2$

$$\rightarrow i_1 = \frac{v}{R_1} = \frac{220\,V}{40\,\Omega} = \underline{5.5\,A}$$

$$i_2 = \frac{v}{R_2} = \frac{220\,V}{80\,\Omega} = \underline{2.75\,A}$$

infatti $5.5\,A + 2.75\,A = 8.25\,A$