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

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

$$\Rightarrow \frac{Q_{TOT}}{e} = \frac{1.6 \times 10^{-6}}{1.6 \times 10^{-19}} = \frac{10^{-6}}{10^{-19}} \to \frac{10^{13}}{10^{6}} = \boxed{10^{13}\ \text{elettroni}}$$ Ans

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

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

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

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

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

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

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

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

$$\to N = \frac{A}{e}\,\frac{[C]}{[C]} = \frac{10^{-3}}{1.6 \times 10^{-19}} = \boxed{6.25 \times 10^{15}}$$ Ans 1

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

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

$$\Rightarrow N = \frac{10^{-3}\,A \cdot 3 \times 10^{-3}\,S}{e}\ \frac{[A \cdot S = C]}{[C]} = \boxed{1.875 \times 10^{13}}$$ Ans 2

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

$$\to N = \frac{10^{-3} \cdot 8 \times 10^{-6}}{1.6 \times 10^{-19}} = \boxed{5 \times 10^{10}}$$ Ans 3

Formule derivate dagli integrali

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

ES 4 Conv. U.

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

$\Rightarrow dL = dq \cdot E \cdot d\ell$ $\Rightarrow$ In unità di tempo $\rightarrow$ $\frac{dL}{dt} = \frac{dq}{dt} \cdot E \cdot d\ell$

P_a $\quad i$ $\quad v$

Formula

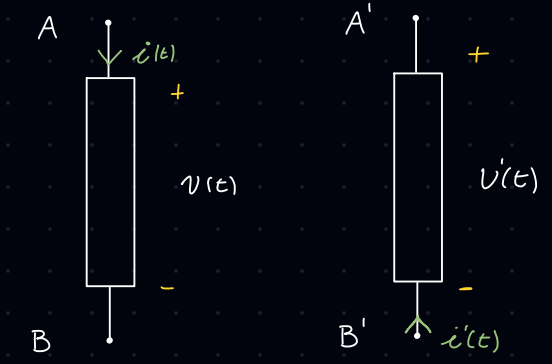
$\Rightarrow \boxed{P_a = i(t) \cdot v(t)}$

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

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

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

ES 5 Conv. Gen



UTILIZZATORE $\qquad$ GENERATORE

$\Rightarrow$ CAMBIA VERSO Di i

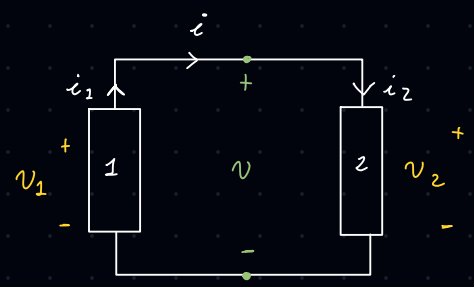
$\Rightarrow i'(t) = -i(t)$

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

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

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

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

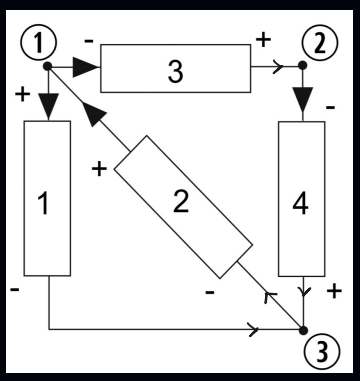
$V = 18\,V \qquad i = 300\,mA = 300 \times 10^{-3}\,A \qquad \Delta t = 3h = 10800\,s$

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

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

Ans

ES 8

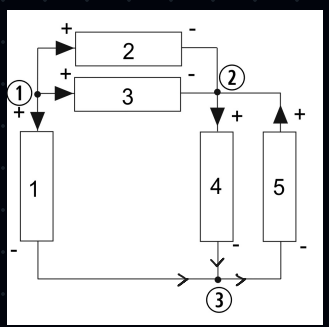


(a) LKC ENTRANTE = 0 (-) USCENTE = 0 (+)

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

LKT ORARIO

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

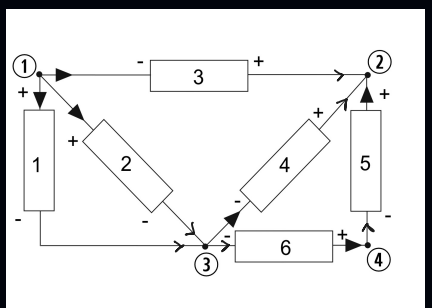


(b) LKC

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

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

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