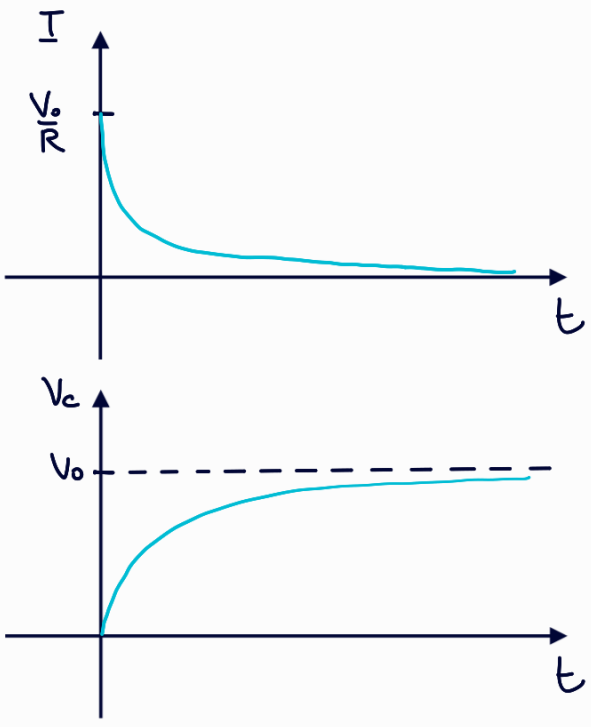
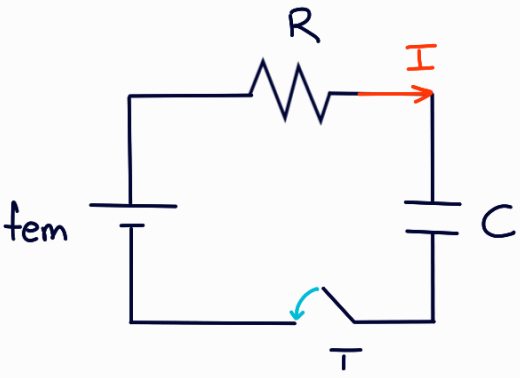
## Carica del condensatore:



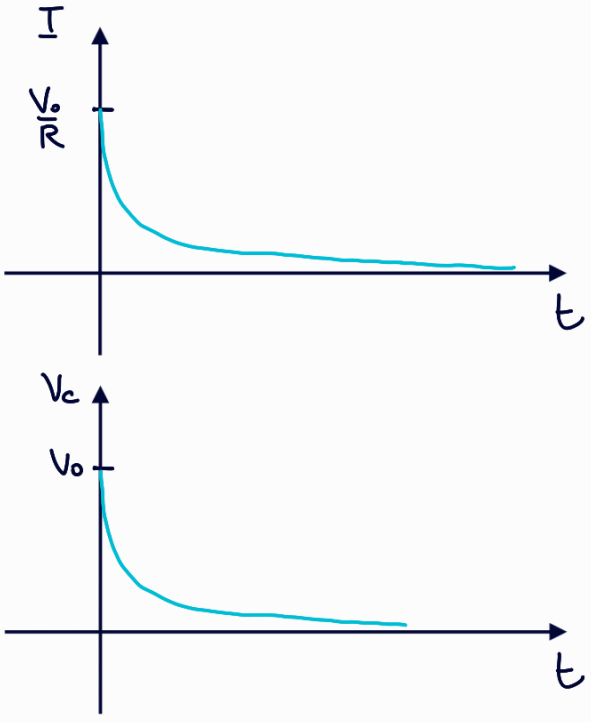

$$I(t) = \frac{fem}{R} e^{-\frac{t}{RC}}$$

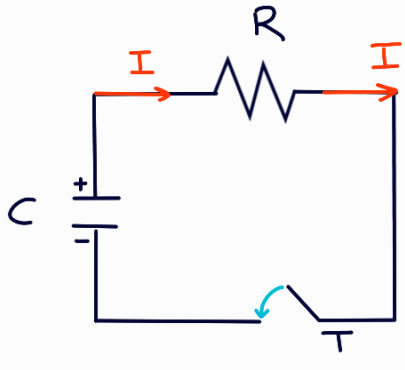
$$\Delta V_c(t) = fem\left(1 - e^{-\frac{t}{RC}}\right)$$

per $t \approx 0$: $I \approx \frac{fem}{R}$, $\Delta V_c \approx 0$ — C si comporta come un corto circuito

per $t \to +\infty$: $I \to 0$, $\Delta V_c \to fem$ — C si comporta come un circuito aperto

## Scarica del condensatore




$$\Delta V_c(t) = \Delta V_0 e^{-\frac{t}{RC}}$$

$$\Delta V_c(0) = \Delta V_0$$

$$I(t) = \frac{\Delta V_c(t)}{R} = \frac{\Delta V_0}{R} e^{-\frac{t}{RC}}$$

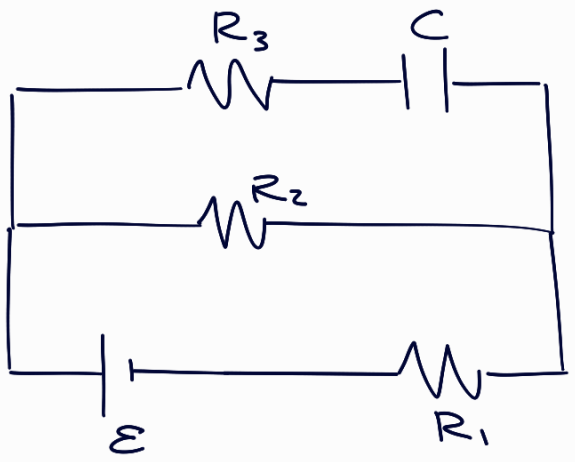
In entrambi i casi la differenza di potenziale ai capi del condensatore **non** varia istantaneamente ma rimane inizialmente la stessa che c'era prima dall'apertura/chiusura dell'interruttore.

---

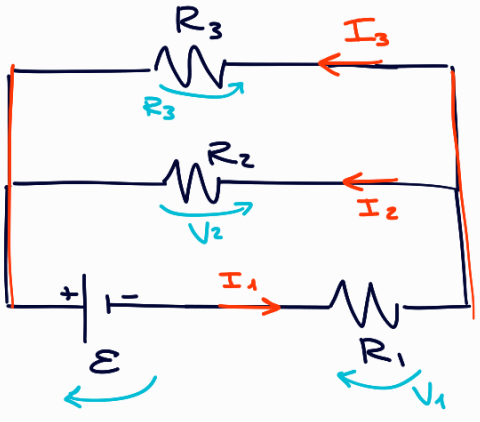
$R_1 = R_2 = R_3 = 730\ k\Omega$

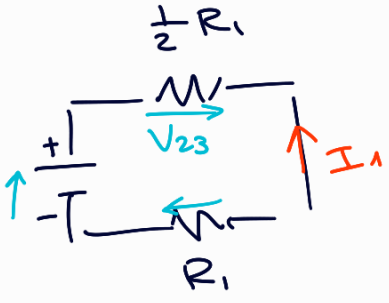
$\mathcal{E} = 1200\ V$

$C = 6{,}5\ \mu F$




Per $t = 0^+$ : C : cortocircuito




$V_2 = V_3 = V_{23}$

$$V_{23} + V_1 + \mathcal{E} = 0$$

$$I_1 \cdot \tfrac{1}{2} R_1 + I_1 R_1 + \mathcal{E} = 0$$

$$I_1 \left(\tfrac{1}{2} R_1 + R_1\right) + \mathcal{E} = 0$$

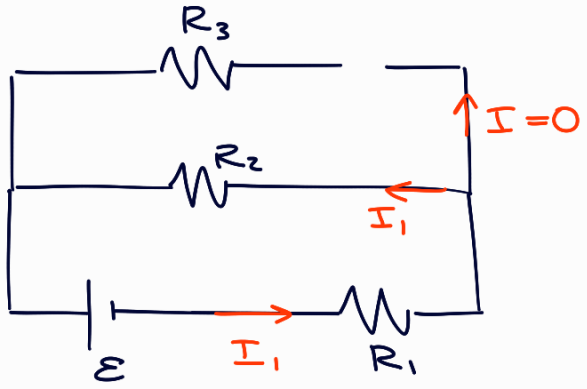
$$I_1 = -\frac{\mathcal{E}}{3/2\, R_1} = -\frac{2}{3}\frac{\mathcal{E}}{R_1} \cong 1.1\ mA$$

$$\rightarrow P_1 = R_1 I_1^2 \cong 0{,}88\ W$$

$$I_2 = \frac{V_{23}}{R_1} = \frac{\frac{1}{2} I_1 R_1}{R_1} = \frac{1}{2} I_1 = I_3 = 0{,}55\ mA$$

$$\rightarrow \quad P_2 = P_3 = R_1 I_2^2 = 0{,}22\ W$$

Per $t \to \infty$ : C si comporta come un circuito aperto




$I_2 = I_1$

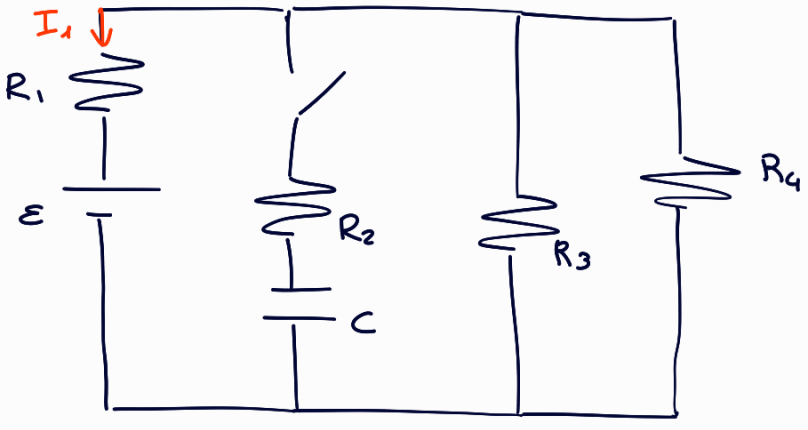
$I_3 = 0$ A

$P_3 = 0$ W

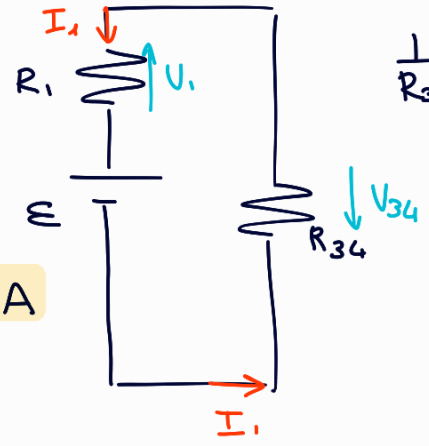
$$I_1 = I_2 = \frac{\mathcal{E}}{R_{eq}} = \frac{\mathcal{E}}{R_1 + R_2} = \frac{\mathcal{E}}{2R_1} = 0{,}82 \text{ mA}$$

$$P_1 = P_2 = I_1^2 R_1 = 0{,}49 \text{ W}$$

---




A interruttore aperto:



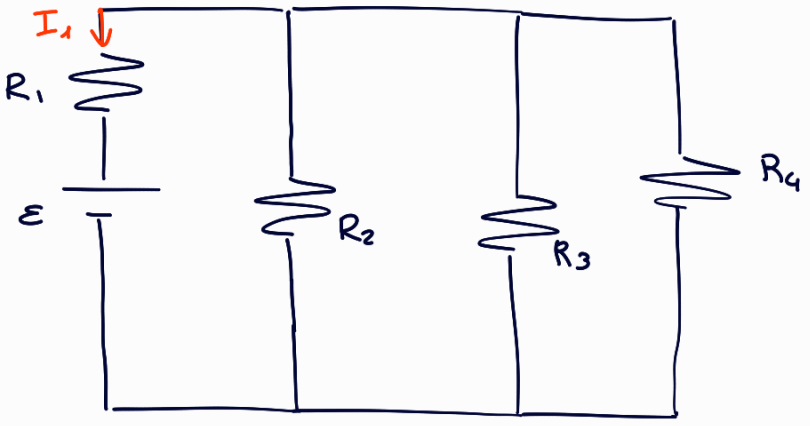

$$\mathcal{E} + I_1(R_1 + R_{34}) = 0$$

$$I_1 = -\frac{\mathcal{E}}{R_1 + R_{34}} = \frac{3\text{V}}{6\,\Omega} = 0{,}5\text{A}$$

$$\frac{1}{R_{34}} = \frac{1}{R_3} + \frac{1}{R_4} = \frac{R_4 + R_3}{R_3 R_4}$$

$$\Rightarrow R_{34} = \frac{18}{9} = 2\,\Omega$$

subito dopo la chiusura : C → corto circuito

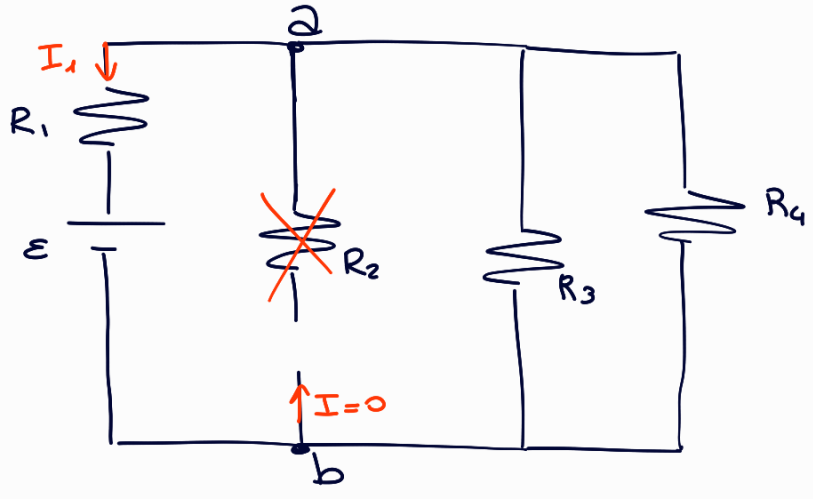



$$\Rightarrow I_1 = -\frac{\mathcal{E}}{R_1 + (R_2 \| R_3 \| R_4)}$$

dove $R_2 \| R_3 \| R_4 = \frac{R_2 R_3 R_4}{R_2 + R_3 + R_4}$

$$P = \mathcal{E} \cdot I \cong -1{,}9 \text{ W}$$

In condiz. di stazionarietà: C → circuito aperto




$$R_{34} = \frac{R_3 R_4}{R_3 + R_4} = 2\,\Omega$$

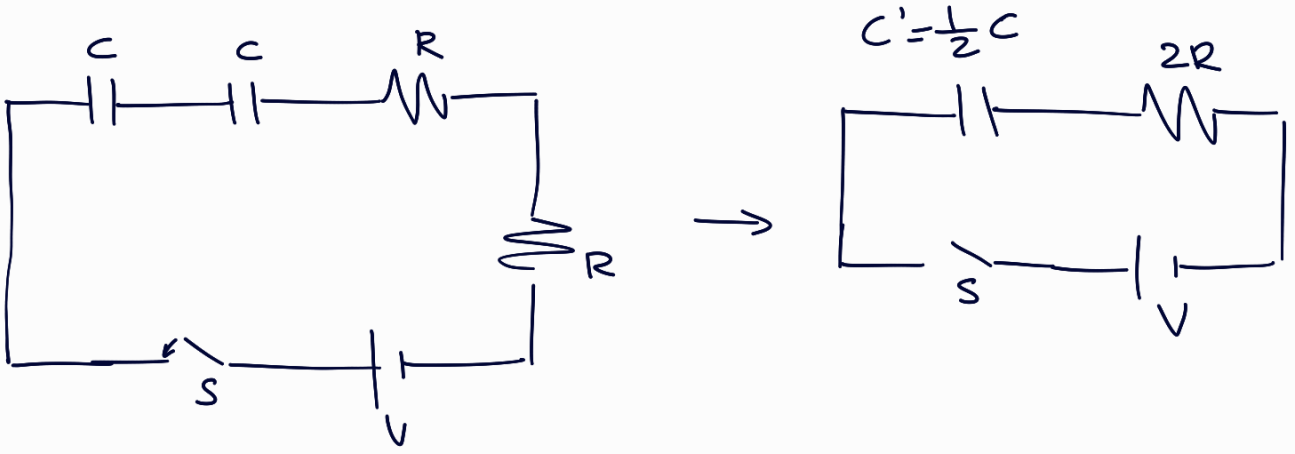
$$I_1 = \frac{\mathcal{E}}{R_1 + R_{34}} = \frac{3}{6}\,A = 0{,}5A$$

$$V_1 = R_1 I_1 = 2 \text{ V}$$

$$V_2 = 0 \text{ V}$$

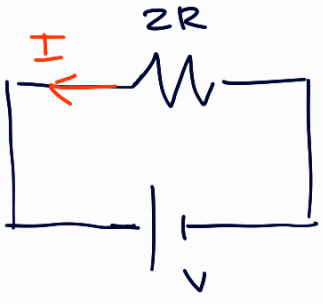
$$V_3 = V_4 = I_1 \cdot R_{34} = 1 \text{ V}$$

$$\Delta V_c = V_b - V_a = V_3 = 1 \text{ V}$$



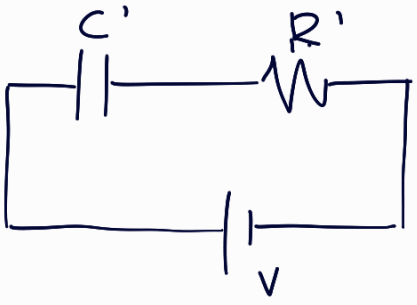

Chiudo il circuito:

A $t = 0^+$ : $C'$ → corto circuito




$$I = \frac{V}{2R} = 2{,}72 \text{ mA}$$

Dopo quanto tempo $i(t) = 1{,}2$ mA ?




$C' = \frac{1}{2} C$

$R' = 2R$

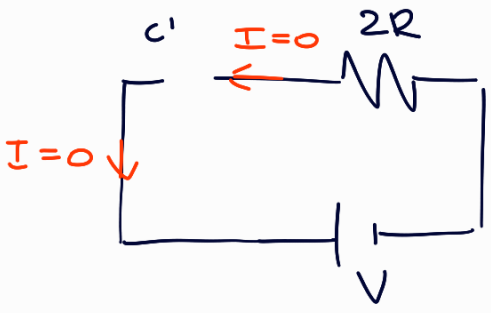
$$i(t) = \frac{dq}{dt} = I e^{-\frac{t}{RC}}$$

$$\Rightarrow e^{-\frac{t}{RC}} = \frac{i(t)}{I}$$

$$\Rightarrow -\frac{t}{RC} = \ln\left(\frac{i}{I}\right) \Rightarrow t = -RC \ln\frac{i}{I}$$

$$\Rightarrow t \cong 10.8 \text{ ms}$$

Per $t \to +\infty$ : C' → circuito aperto

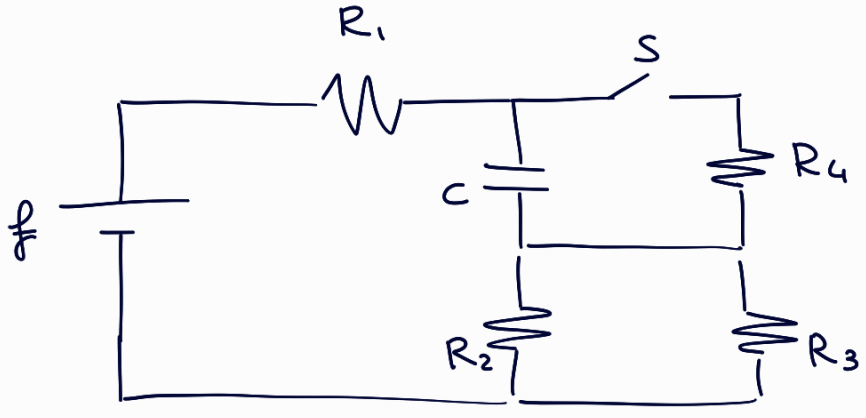



$$C' = \frac{1}{2}C$$

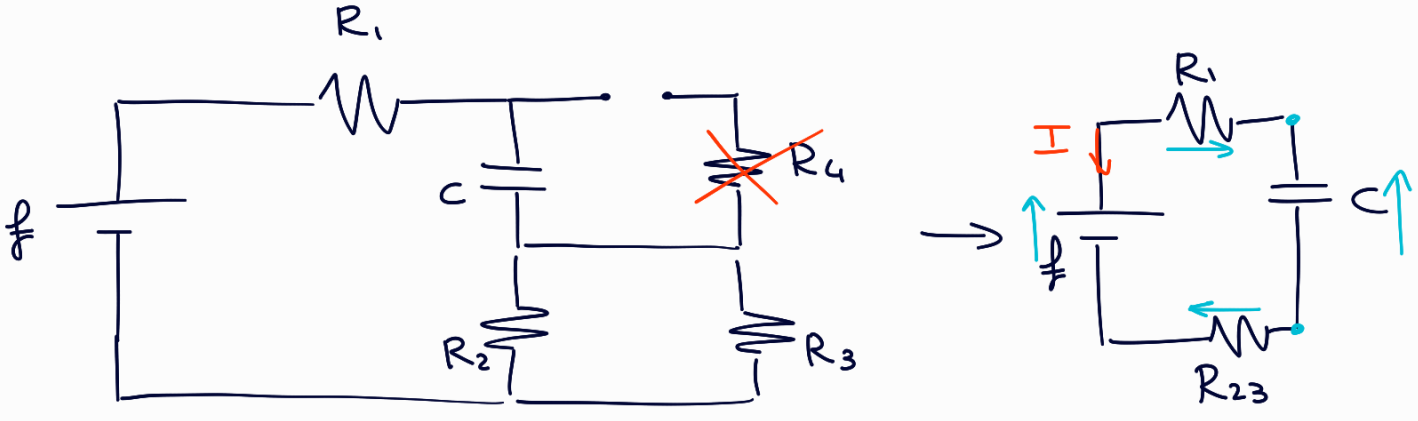
$$Q = C'V = \frac{1}{2}CV$$

$$U_1 = U_2 = \frac{Q^2}{2C} = \frac{1}{4}\frac{C^2V^2}{2C} = \frac{1}{8}CV^2 = 108\,\mu J$$

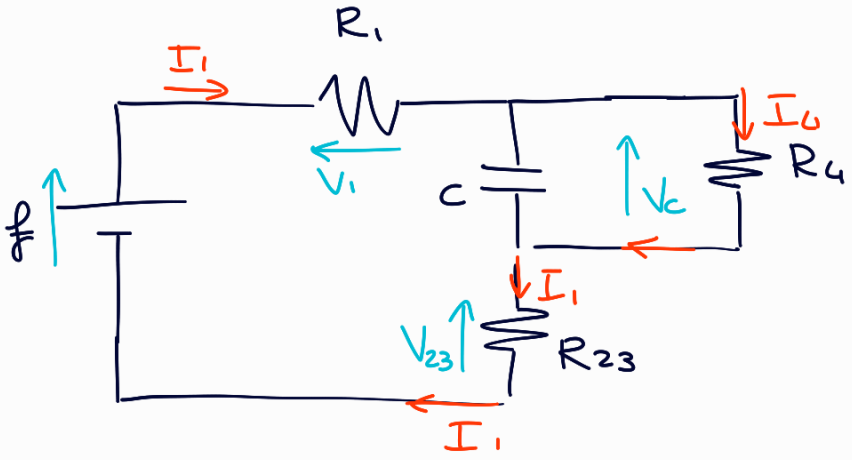
---




- ddp ai capi di C subito prima della chiusura:




C e⁻ carico $\Longrightarrow$ $V_C = \mathcal{f} = 12\,V$




$$R_{23} = \frac{R_2 R_3}{R_2 + R_3}$$

Per $t = 0^+$ : ho ancora $V_c = f$

$$f - I_1 R_1 - f - I_1 R_{23} = 0$$

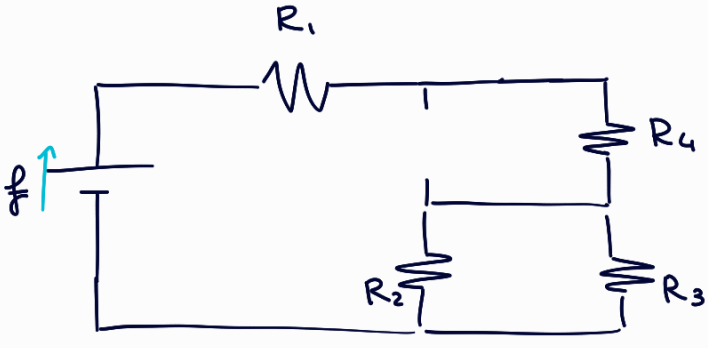
$$V_c - I_4 R_4 = 0 \Rightarrow f = I_4 R_4$$

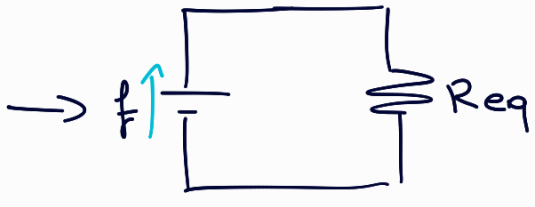
$$\Rightarrow I_4 = \frac{f}{R_4} = 1{,}2 \text{ A}$$

$$\Rightarrow I_1 = I_2 = I_3 = 0$$

Dopo molto tempo: $t \to +\infty$

C → circuito aperto




$$R_{eq} = R_1 + R_4 + R_{23} = \frac{173}{11}\ \Omega$$

$$I_1 = I_4 = I_{23} = \frac{f}{R_{eq}} = 0{,}76 \text{ A}$$

$$I_2 = \frac{V_2}{R_2} = \frac{V_{23}}{R_2} = \frac{I_1 R_{23}}{R_2} = 0{,}34 \text{ A}$$

$$I_3 = \frac{I_1 R_{23}}{R_3} = 0{,}41 \text{ A}$$

$$\Delta V_c = V_4 = R_4 I_4 = 7{,}63 \text{ V}$$