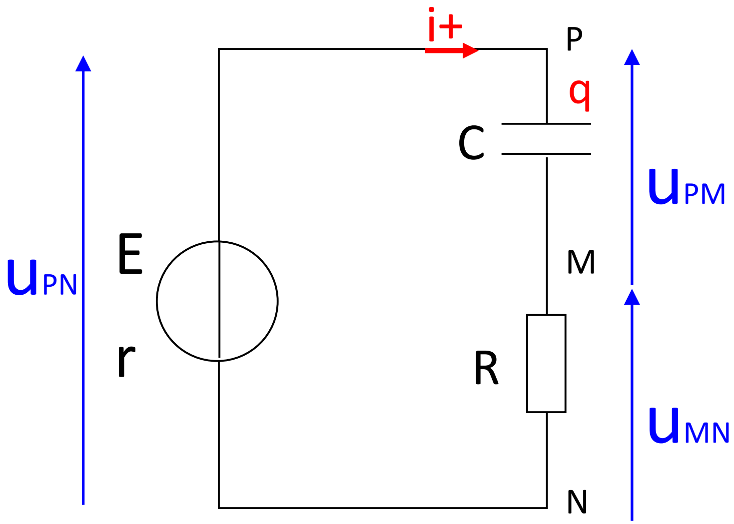
DIPOLE R-C

Charge



$u_{PN} = u_{PM} + u_{MN}$

$E - r\,i = u_c + R\,i$

$E - r\,i = q/C + R\,i$

$$\frac{du_c}{dt} + \frac{u_c}{(R+r)C} = \frac{E}{(R+r)C}$$

ou

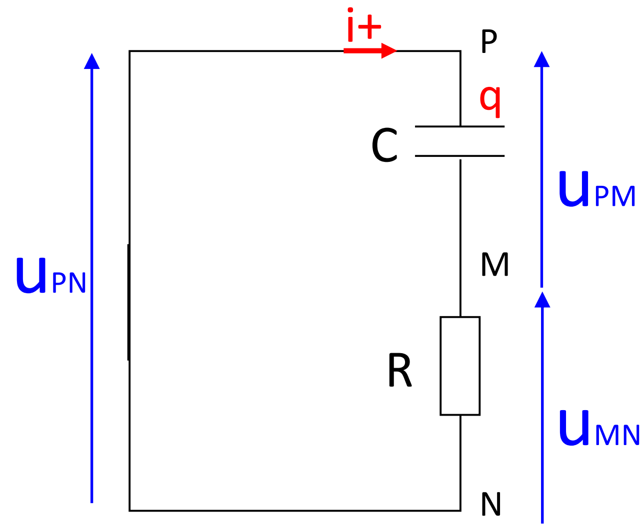
$$\frac{dq}{dt} + \frac{q}{(R+r)C} = \frac{E}{R+r}$$

$i = + dq/dt$ et $q = C.u_c$

donc $i = C.\dfrac{du_c}{dt}$

Équation différentielle

Décharge



$u_{PN} = 0 = u_c + R\,i$

$= q/C + R\,i$

$$\frac{du_c}{dt} + \frac{u_c}{RC} = 0$$

ou

$$\frac{dq}{dt} + \frac{q}{RC} = 0$$

Charge | Décharge

Solutions

Charge :

$$u_C = U_{C_m}\,(1 - e^{-t/\tau})$$
$$q = Q_m\,(1 - e^{-t/\tau})$$

Décharge :

$$u_C = U_{C_0}\, e^{-t/\tau}$$
$$q = Q_0\, e^{-t/\tau}$$

Adaptation aux conditions

Charge :

$t = 0$: $u_C = 0$

$t \to \infty$ $du_C/dt \to 0$ alors dans équa. diff. :

$u_C \to E = U_{C_m} = Q_m / C$

Alors $u_C = E\,(1 - e^{-t/\tau})$ et **$q = CE\,(1 - e^{-t/\tau})$**

Décharge :

$t = 0$: $u_C = U_{C_0} = Q_0 / C$

$t \to \infty$ $du_C/dt \to 0$ $u_C \to U_{C_m} = 0$

Alors $u_C = (Q_0/C)\; e^{-t/\tau}$ et **$q = Q_0\, e^{-t/\tau}$**

Temps caractéristique : constante de temps τ

Charge :

$$\frac{du_c}{dt} + \frac{u_c}{(R+r)C} = \frac{E}{(R+r)C}$$

$$\frac{E}{\tau} e^{-t/\tau} + \frac{E(1 - e^{-t/\tau})}{(R+r)C} = \frac{E}{(R+r)C}$$

$$\frac{1}{\tau} = \frac{1}{(R+r)C} \Longrightarrow \boxed{\tau = (R+r)C}$$

Décharge :

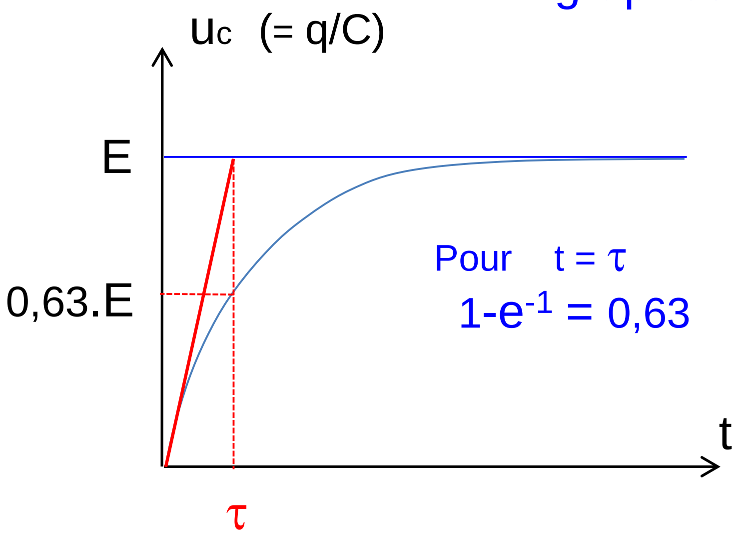
$$\frac{du_c}{dt} + \frac{u_c}{RC} = 0$$

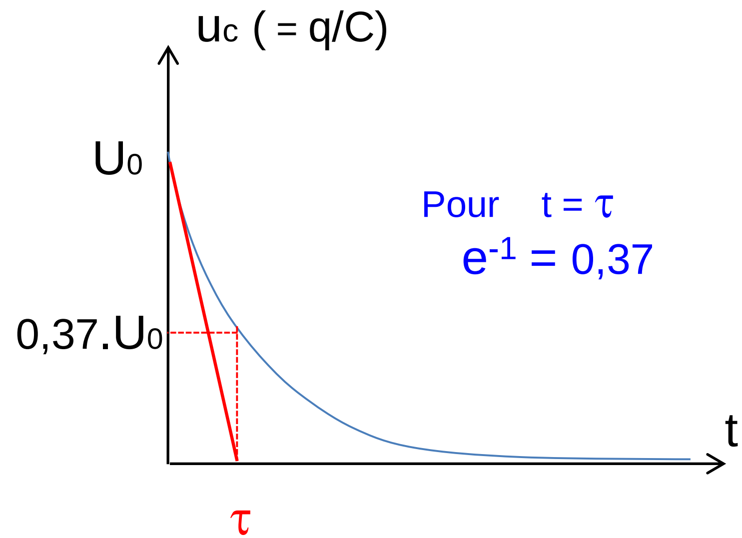
$$-\frac{U_{Cm}}{\tau} e^{-t/\tau} + \frac{U_{Cm} e^{-t/\tau}}{RC} = 0$$

$$\frac{1}{\tau} = \frac{1}{RC} \Longrightarrow \boxed{\tau = RC}$$

Charge	Décharge

graphes de u_c (t) ou q(t)





graphes de i(t) = dq/dt

$$i(t) = \frac{CE}{\tau} e^{-t/\tau} = \frac{CE}{(R+r)C} e^{-t/\tau} = \frac{E}{(R+r)} e^{-t/\tau} = I_0 e^{-t/\tau}$$

$$i(t) = -\frac{Q_0}{\tau} e^{-t/\tau} = -\frac{Q_0}{RC} e^{-t/\tau} = I_0 e^{-t/\tau}$$