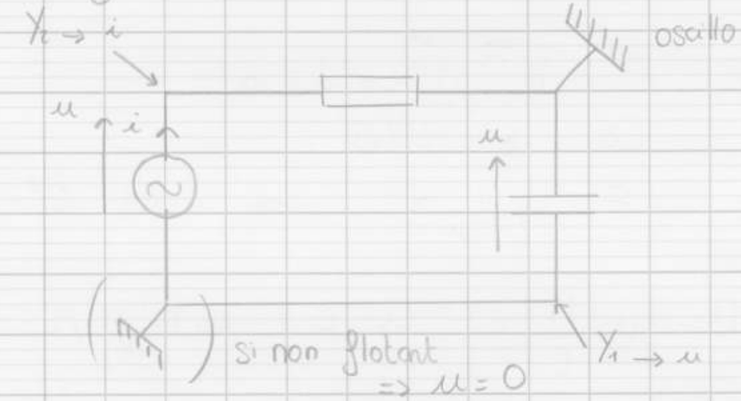
# Fiche révision electrocinetique : I

## Circuits electriques

- Arqs : si $T \gg L/c$
  ↳ terme $\mu_0 \varepsilon_0 \, \partial E / \partial t \ll \| \vec{rot} \, \vec{B} \|$

- Masse : point où $V = 0$
- Terre : point relié à la terre

=> géné flotant : masse et terre séparé
=> géné non flotant : masse et terre ensemble (bip ohmmetre)




* Considera° energetique

- $P = u_{AB} \, i$ (Démo : travail charge $dq$ travers dipôle)

  ↳ $P > 0$ recepteur
  ↳ $P < 0$ générateur
  } dans cette convention

* Loi Kirchhoff :

- $\sum i_e = \sum i_s$ Loi des noeuds

  ↳ Vient de $\operatorname{div} \vec{j} = 0$ ($\operatorname{div}(\vec{rot} \, \vec{B}) = \mu \operatorname{div} \vec{j} = 0$)
  puis ostrogradsky autour noeud

- $U_{géné} = \sum U_{dipôle}$ : loi des mailles

## Dipôles linéaires passifs

- Resistance : $u = Ri$
  $P = ui = Ri^2$
  $R = \rho L/S$ (ohm local $\vec{j} = \gamma \vec{E}$)

- Condensateur : $q = C.u$
  $i = C. du/dt$ => $u$ est $C^0$
  $E = \frac{1}{2} C u^2$

- Bobine : $\phi = \iint \vec{B} \, d^2\vec{S} = L. i$
  $u = L. di/dt$
  $E = \frac{1}{2} L. i^2$ => $i$ est $C^0$

  ↳ $B = \mu_0 \frac{N}{\ell} i$ => $L = \mu_0 N^2 S / L$

⚠ Bobine reelle a une resistance et $L/R$ = cste

- Association dipôle

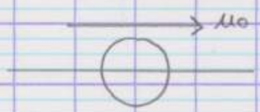
  - Serie / Derivation

| Serie | Derivation |
|---|---|
| $R_{tot} = \sum R_i$ | $1/R_{tot} = \sum 1/R_i$ |
| $1/C_{tot} = \sum 1/C_i$ | $C_{tot} = \sum C_i$ |
| $L_{tot} = \sum L_i$ | $1/L_{tot} = \sum 1/L_i$ |

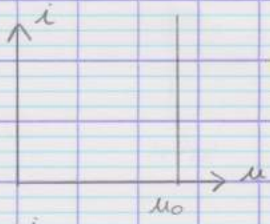
# Fiche révision électrocinétique II.

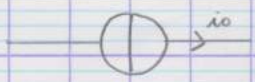
* Dipoles actif linéaires

• générateur idéal :

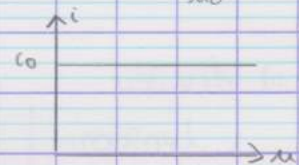



$u = u_0$

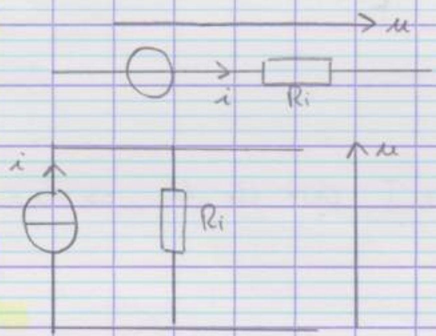



$i = i_0$




• générateur réel (on ajoute la résistance interne)

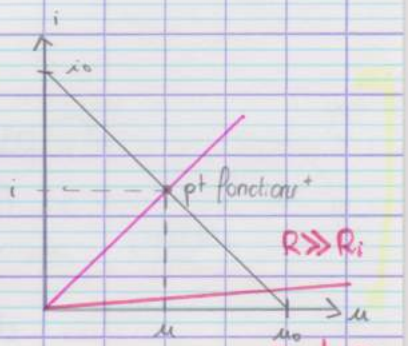



$u = u_0 - R_i\, i$

Modèle Thevenin

$i = i_0 - \frac{u}{R_i}$

Modèle Norton.




gène tension

• Alimentation stabilisée :

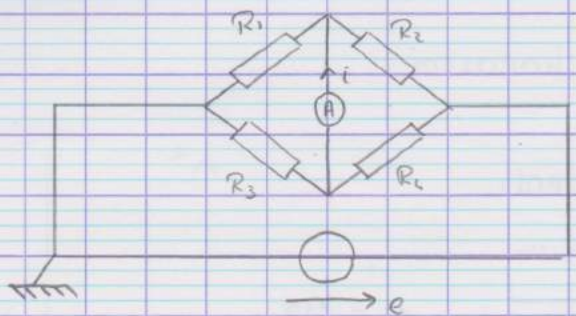

$R < U_0/i_0 \Rightarrow i = i_0$

$R > U_0/i_0 \Rightarrow u = u_0$

* Principe de superposition : $S_1 \rightarrow R_1 \ldots S_n \rightarrow R_n$

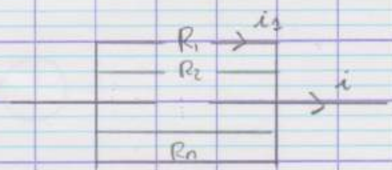
↳ $\lambda_1 S_1 + \ldots + \lambda_n S_n \longrightarrow \lambda_1 R_1 + \ldots + \lambda_n R_n$

* Pont de Wheatstone :



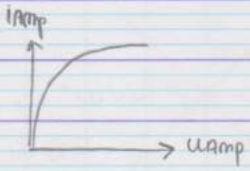

$i = 0 \iff R_1 R_4 = R_2 R_3$

* Pont diviseur



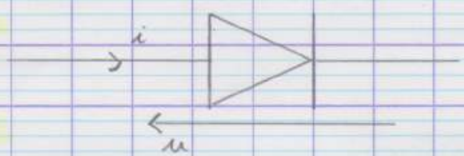

- courant : $i_1 = i \cdot \dfrac{1/R_1}{\sum 1/R_k}$

- tension : $u_1 = u \cdot \dfrac{R_1}{\sum R_k}$




* Dipoles non linéaires
- Ampoule : R dépend de T, donc de u $\Rightarrow u = R(u) \cdot i$

- diode :

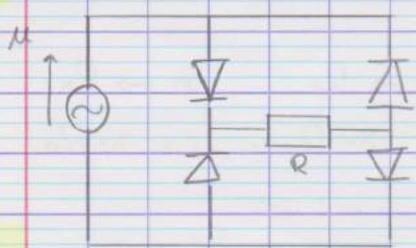


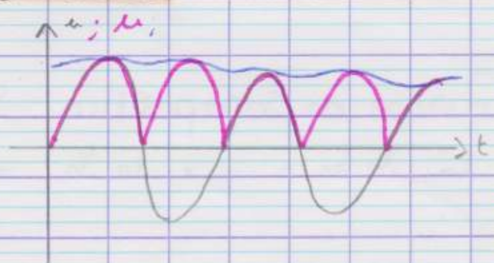


$\Rightarrow \boxed{i = i_0 \left[ \exp\left( u / k_B T/e - 1 \right) \right]}$

$i_0 \sim pA \qquad k_B T/e = 0{,}025V$

$\Rightarrow$ Redressement : Pont de Graetz



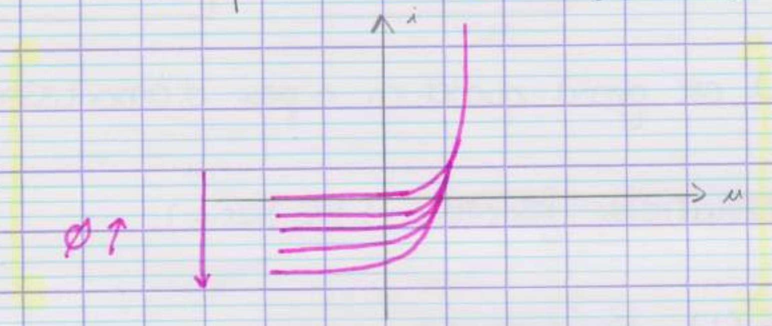




$\langle u \rangle = \dfrac{2U}{\pi}$

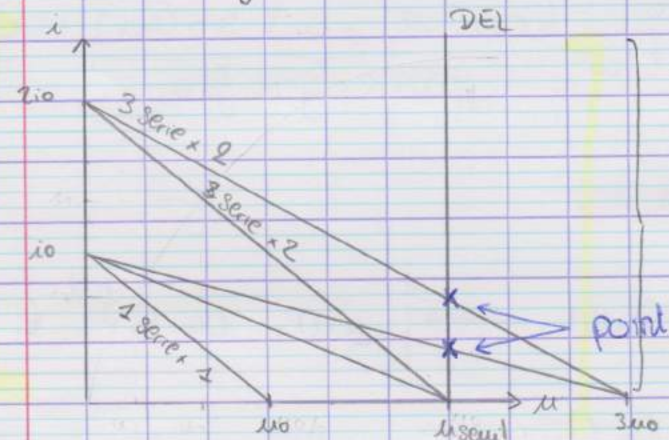
# Fiche révision électrocinétique III


• DEL : émet de la lumière quand un courant traverse. $u_{seuil} = 1,8\ V$.


• Photodiode : produit un courant quand reçoit lumière




• Point de fonctionnement :




point fonctionnemment

Dipôle non linéaire
ne respecte pas principe
superposition $u_2 \neq u_1/2$.

## Régime dépendant du temps

• Transitoire (RC ou RL série)

$$\boxed{u(t) = E(1 - e^{-t/\tau})} \qquad \boxed{\tau = RC.}$$

$$i(t) = C \cdot du/dt = E/R \cdot e^{-t/\tau}$$

$E_{tot} = E_C + E_R$ et $E_C = E_R$ : Equipartition énergie

• Oscillations libres (RLC série)

$$\boxed{\ddot{u}(t) + \frac{\omega_0}{Q}\dot{u}(t) + \omega_0^2 u(t) = E}$$

$$\boxed{\omega_0 = 1/\sqrt{LC}} \qquad \boxed{Q = L\omega_0/R}$$

↳ Q est grand quand on a peu d'amortissement

• Oscillations forcées (RC série)

• $E(t) = E_0 \cos(\omega t)$

$$\Rightarrow \boxed{u(t) = \frac{E_0}{1+\tau^2\omega^2}\Big(\underbrace{\cos(\omega t) + \omega\tau \sin(\omega t)}_{\text{partie régime forcé}} - \underbrace{e^{-t/\tau}}_{\text{transitoire}}\Big)}$$

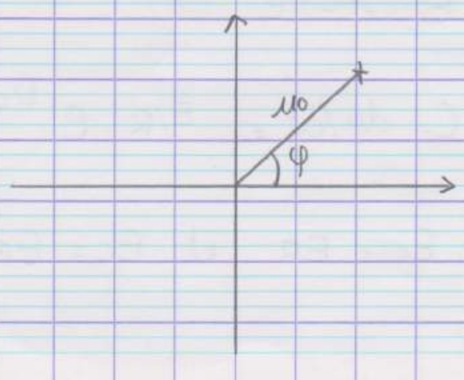
* Notation complexe :

$u(t) = U_1 \cos(\omega t + \varphi) \longrightarrow \boxed{\underline{u}(t) = U_1 e^{j\omega t} \cdot e^{j\varphi}}$

↳ $u(t) = \mathrm{Re}(\underline{u}(t))$

↳ $\boxed{\frac{d\underline{u}}{dt} = j\omega\, \underline{u}(t)}$

⇒ Représentation Fresnel :




Intérêt : permet de faire la somme de vecteurs facilement

# Fiche révision Electrocinétique IV.

- Impédance complexe

• $\underline{Z} = \dfrac{\underline{u}}{\underline{I}}$ : $\begin{cases} \underline{Z_R} = R \\ \underline{Z_C} = 1/jC\omega \\ \underline{Z_L} = jL\omega \end{cases}$ $\begin{cases} \text{Serie } \underline{Z} = \sum_i \underline{Z_i} \\ \text{Deriv } 1/\underline{Z} = \sum_i 1/\underline{Z_i} \end{cases}$

↳ $\boxed{\underline{u_1} = \underline{u} \cdot \dfrac{\underline{Z_1}}{\sum_i \underline{Z_i}}}$ $\boxed{\underline{i_1} = \underline{i} \, \dfrac{1/\underline{Z_1}}{\sum_i 1/\underline{Z_i}}}$

- Fonction de transfert.

• Cas general : $a_0 V_s + a_1 \dot{V_s} + \dots = b_0 V_e + b_1 \dot{V_s} + b_2 \ddot{V_s} + \dots$

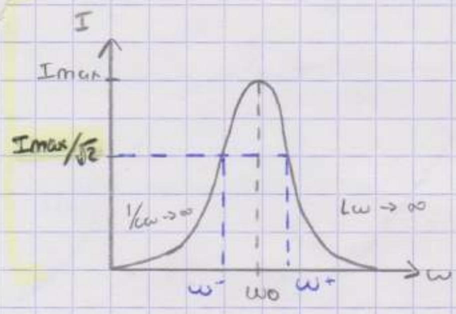
$\Leftrightarrow a_0 \underline{V_s} + j\omega a_1 \underline{V_s} + \dots = b_0 \underline{V_e} + j\omega b_1 \underline{V_s} + b_2 (j\omega)^2 \underline{V_e} + \dots$

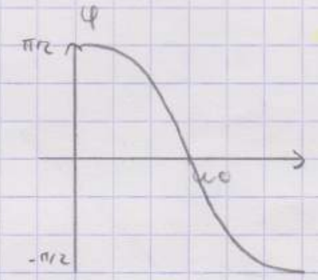
→ $\boxed{\underline{H} = \dfrac{\underline{V_s}}{\underline{V_e}}}$

=> Diagramme de bode : $\begin{cases} 20 \log(\underline{H}(\omega)) = f(\log \omega) \\ \varphi = f(\log \omega) \end{cases}$

- Resonance :

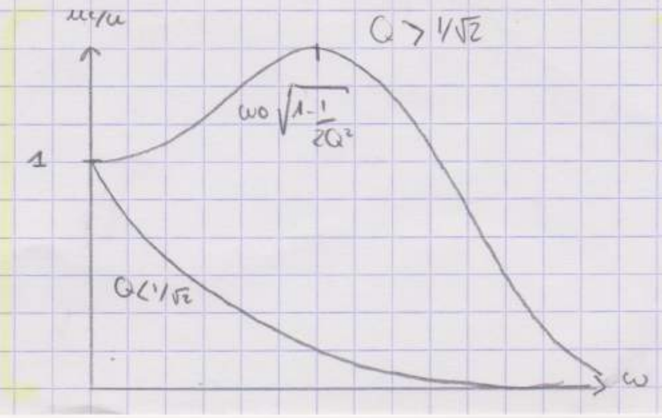
• Circuit RLC serie : $\underline{i} = \dfrac{\underline{u}/R}{1 + jQ\left(\frac{\omega}{\omega_0} - \frac{\omega_0}{\omega}\right)} = \underline{u}/\underline{Z}_{tot}$




=> Bande passante : $\boxed{\dfrac{\Delta\omega}{\omega_0} = 1/Q}$

$\dfrac{\underline{u_C}}{\underline{u}} = \dfrac{1}{\left(1 - \frac{\omega^2}{\omega_0^2}\right) + j\frac{1}{Q}\left(\frac{\omega}{\omega_0}\right)}$



## - Puissance en régime sinusoïdal forcé

- Déphasage : $\varphi_z = \varphi = \varphi_u - \varphi_i$ $\qquad (u e^{j\varphi_u} = Z e^{j\varphi_z} \cdot I e^{j\varphi_i})$

- Puissance : $\boxed{\langle P(t) \rangle = \frac{UI}{2} \cos(\varphi) = U_{eff} \cdot I_{eff} \cos(\varphi)}$ .

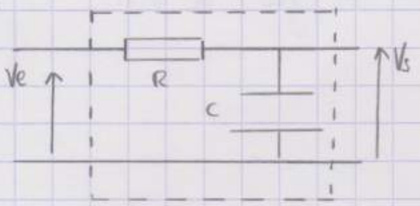
↳ $U_{eff} = U/\sqrt{2}$ $\qquad I_{eff} = I/\sqrt{2}$

⚠ Notant $Z = R + jX$ . $P = R I_{eff}^2$

⇒ Adaptation impédance : on cherche $\varphi = 0$

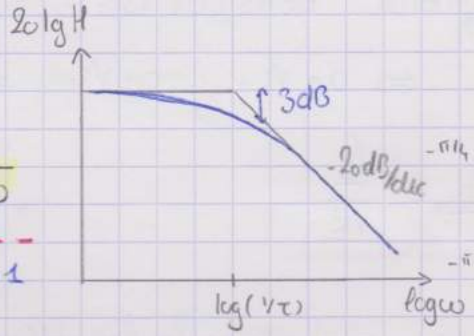
## - Filtrage passif

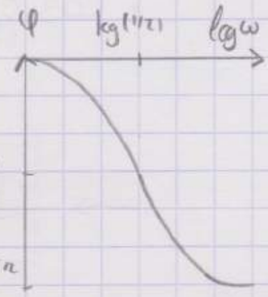
* passe bas :



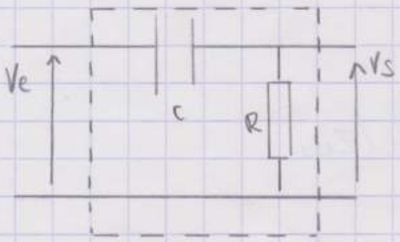

$$\frac{V_s}{V_e} = \frac{1}{1 + jRC\omega}$$

intégrateur à $\omega \gg 1$



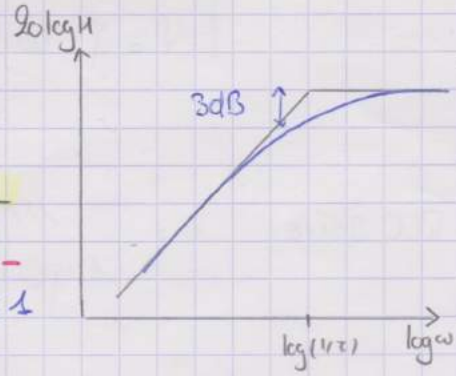



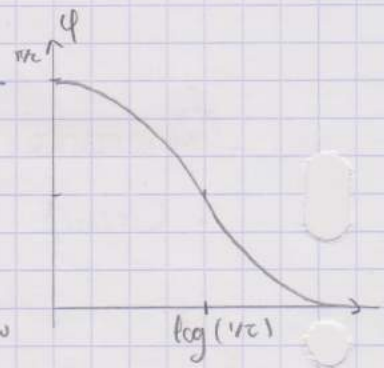

* passe haut



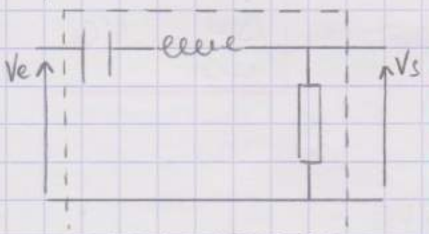

$$\frac{V_s}{V_e} = \frac{jRC\omega}{1 + jRC\omega}$$

dérivateur à $\omega \ll 1$




* passe Bande :




$$\frac{V_s}{V_e} = \frac{1}{1 + jQ\left(\frac{\omega}{\omega_0} - \frac{\omega_0}{\omega}\right)}$$