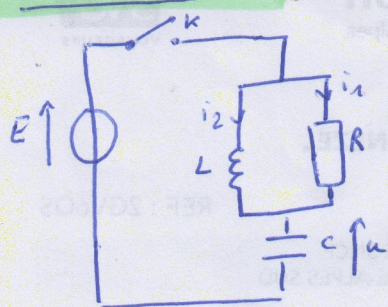


Exercice 1 :



$$\begin{cases} \text{LDM : } E = R i_1 + u & (1) \\ \text{Loi bobine : } L \frac{di_2}{dt} = R i_1 & (2) \\ \text{+ LDM} \\ \text{LDM : } i_1 + i_2 = C \frac{du}{dt} & (3) \end{cases}$$

a) La tension aux bornes d'un condensateur et l'intensité le courant traversant une bobine sont continus.

$$i_2(0^+) = i_2(0^-) = 0 \quad (\text{int. bobine})$$

$$u(0^+) = u(0^-) = 0 \quad (\text{ " " })$$

$$i_2(0^+) = 0$$

$$u(0^+) = 0$$

D'après (1) $R i_1(0^+) = E - u(0^+) \Rightarrow i_1(0^+) = E/R$

(3) $C \frac{du}{dt}(0^+) = i_1(0^+) + i_2(0^+) = \frac{E}{R} \Rightarrow \frac{du}{dt}(0^+) = \frac{E}{RC}$

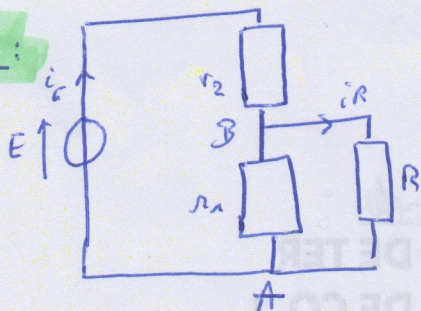
b) $t \rightarrow +\infty$. $u = cte \Rightarrow \frac{du}{dt} = 0$

$$i_2 = cte$$

(2) $\Rightarrow i_1 = 0$

et $u = E$ (1)

Exercice 2 :



La puissance dissipée dans R est $P_R = i_R^2 R$.

Or $i_R = \frac{r_1}{r_1 + R} i_E$ (PDI)

$$\Rightarrow P_R = \frac{R r_1^2}{(r_1 + R)^2} i_E^2$$

Puissance délivrée par le générateur:

$$P_E = E i_E$$

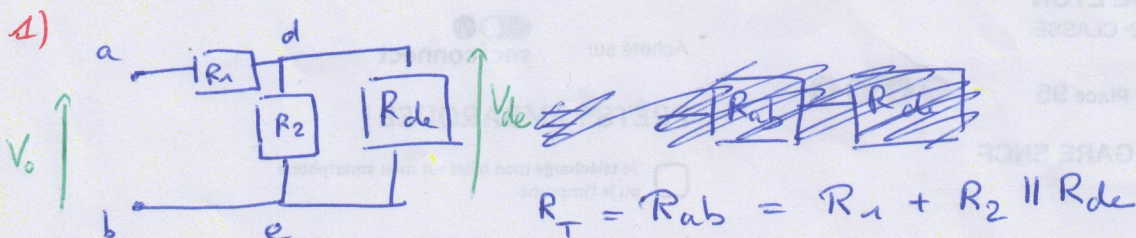
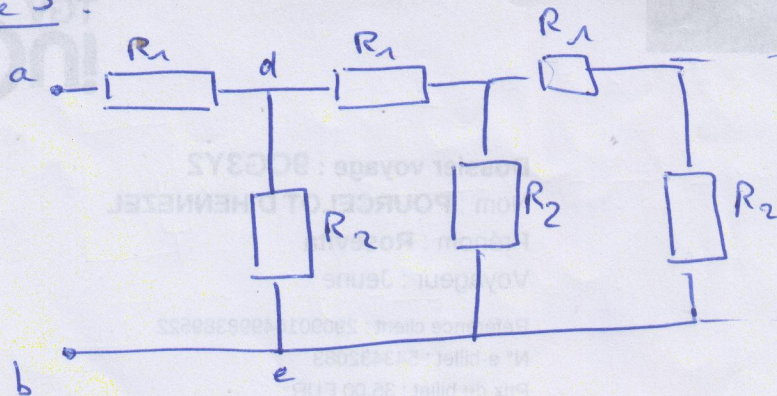
Or, $E = (r_2 + R_{eq}) i_E$ où $\frac{1}{R_{eq}} = \frac{1}{r_1} + \frac{1}{R} \Rightarrow R_{eq} = \frac{r_1 R}{r_1 + R}$

$$\Rightarrow E = \left(r_2 + \frac{r_1 R}{r_1 + R} \right) i_E \Rightarrow P_E = \left(r_2 + \frac{r_1 R}{r_1 + R} \right) i_E^2$$

D'où $\eta = \frac{P_R}{P_E} = \frac{R r_1^2}{(r_1 + R)^2} \times \frac{(r_1 + R)}{(r_1 + R) r_2 + r_1 R}$

$$\Rightarrow \eta = \frac{R r_1^2}{(r_1 + R) [(r_1 + r_2) r_2 + r_1 R]}$$

Exercice 3 :



On dit que $R_{ab} \approx R_{de} \Rightarrow R_T \approx R_{de}$. (Nb de cellules important)

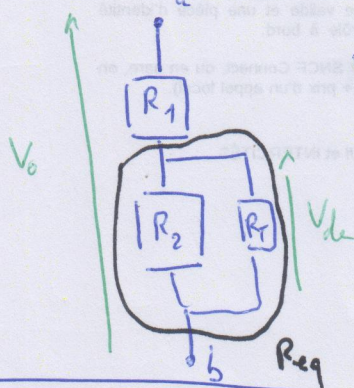
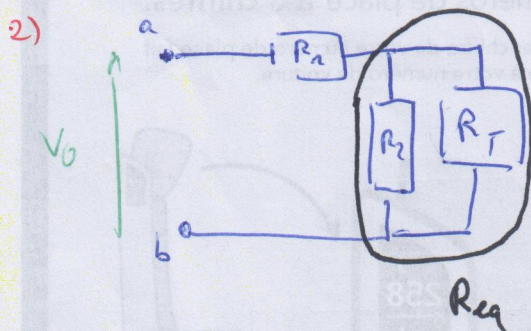
Donc $R_T = R_1 + (R_2 \parallel R_T) \rightarrow \frac{1}{R_{eq}} = \frac{1}{R_2} + \frac{1}{R_T} \Rightarrow R_{eq} = \frac{R_2 R_T}{R_2 + R_T}$

$$R_T = R_1 + \frac{R_2 R_T}{R_2 + R_T} \Leftrightarrow R_T - R_1 = \frac{R_2 R_T}{R_2 + R_T}$$

$$\Leftrightarrow R_T^2 + R_2 - R_1 R_2 - R_1 R_T - R_2 R_T = 0$$

$$\Leftrightarrow R_T^2 - R_1 R_2 - R_1 R_T = 0$$

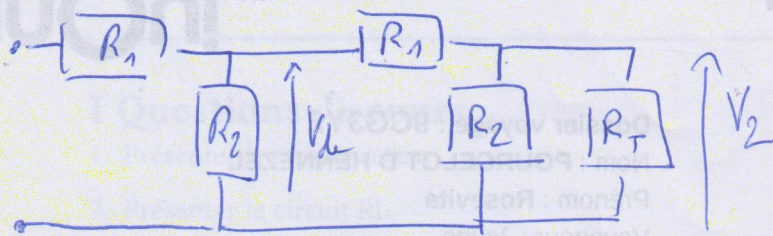
$$\Rightarrow R_T = \frac{1}{2} (R_1 + \sqrt{R_1^2 + 4R_1 R_2})$$



$$V_{de} = \frac{R_{eq}}{R_1 + R_{eq}} V_0 = \frac{V_0}{1 + \frac{R_1}{R_{eq}}}$$

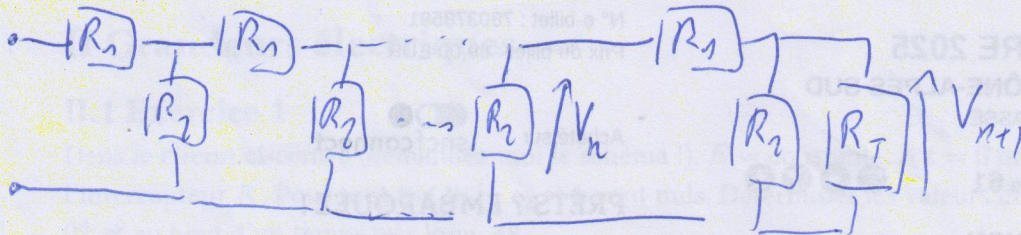
Donc $V_{de} = \frac{V_0}{1 + \beta}$ où $\beta = R_1 \left(\frac{1}{R_2} + \frac{1}{R_T} \right)$

Pour une cellule supplémentaire on avait $V_2 = \frac{R_{eq}}{R_1 + R_{eq}} V_{de} = \left(\frac{1}{1 + \beta} \right) \left(\frac{1}{1 + \beta} \right) V_0$



$$V_2 = \frac{1}{1+\beta} V_0$$

$$= \frac{1}{(1+\beta)^2} V_0$$



$$V_{h+1} = \frac{1}{1+\beta} V_h \Rightarrow V_{h+1} = \frac{1}{(1+\beta)^{n+1}} V_0$$

3) Il y a $n=200$ motifs. $R_T = \frac{1}{2} (R_1 + \sqrt{R_1^2 + 4R_1R_2})$ A.N: $R_T = 19.8 \text{ M}\Omega$

V_{200}
 V_0

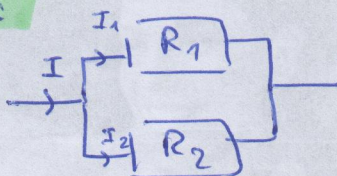
$$\beta = R_1 \left(\frac{1}{R_2} + \frac{1}{R_T} \right) \text{ A.N: } \beta = 1.8 \times 10^{-2}$$

$$n = \frac{10 \times 10^{-6}}{2 \times 10^{-3}} = \frac{2 \times 10^{-3} \times 10^6}{10} = 200$$

$$\frac{V_{200}}{V_0} = \frac{1}{(1+\beta)^{200}} = \frac{1}{(1+1.8 \times 10^{-2})^{200}} \approx \frac{1}{35} = 2.8\%$$

Le signal s'est fortement atténué

Exercice 5:



$$P = R_1 I_1^2 + R_2 I_2^2 = R_1 I_1^2 + R_2 (I - I_1)^2$$

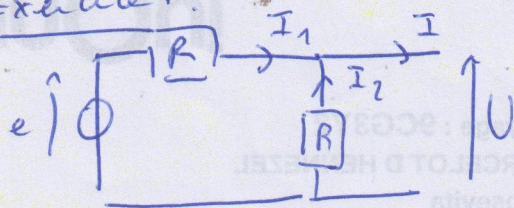
$$\frac{dP}{dI_1} = 2R_1 I_1 - 2R_2 (I - I_1)$$

$$\frac{d^2P}{dI_1^2} = 2R_1 + 2R_2 > 0 \text{ donc minimum.}$$

$$R_1 I_1 = R_2 (I - I_1) \Rightarrow R_1 I_1 = R_2 I_2$$

Donc la répartition des courants qui minimise la puissance dissipée est telle que on a la loi d'Ohm.

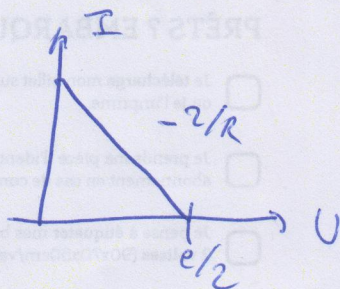
Exercice 7:



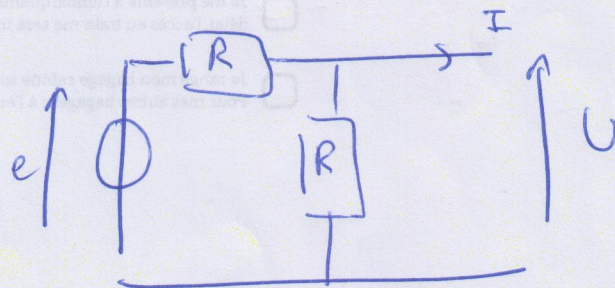
$$\begin{cases} U = e - RI_1 \\ U = -RI_2 \\ I = I_1 + I_2 \end{cases}$$

$$I = \frac{e-U}{R} - \frac{U}{R} \Rightarrow U = \frac{e}{2} - \frac{R}{2} I$$

$\equiv$ source de Thévenin fem $\frac{e}{2}$ R interne $R/2$



Exercice 6:



1)

$$v_0 - v_1 = R_1(i_0 + i_1) \quad (1) \quad v_0 - R_1 i_0 = R_2(i_0 - i_1) \quad (2)$$

$$(2) \rightarrow i_1 \text{ puis } i_1 \text{ de (1)} \Rightarrow v_1$$

$$v_1 = \left(1 + \frac{R_1}{R_2}\right) v_0 - R_1 \left(2 + \frac{R_1}{R_2}\right) i_0 \quad \text{et} \quad i_1 = -\frac{1}{R_2} v_0 + \left(1 + \frac{R_1}{R_2}\right) i_0$$

2) Voltmètre en dérivation. Borne COM sur le pot. le + faible.

3) Régime alternatif, mesure de la tension efficace U_{eff} .

$$\langle u^2(t) \rangle = \frac{1}{T} \int_0^T u_{ab}^2(t) dt = \frac{1}{T} \int_0^T A^2 \cos^2(\omega t + \varphi) dt = \frac{A^2}{T} \int_0^T \cos^2(\omega t + \varphi) dt = \frac{A^2}{2}$$

$$\text{Puis } U_{eff} = \sqrt{\langle u^2(t) \rangle} = A/\sqrt{2}$$

On préfère l'oscilloscope dans ce cas.