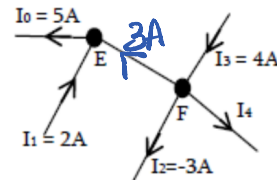


Correction TD4

QCM

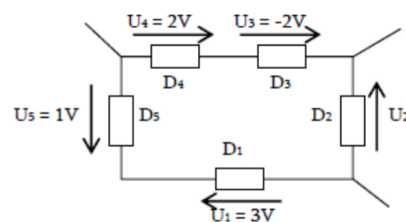
1) Que vaut l'intensité I_4 ?

- ☐ a. 7A
☒ b. 4A
☐ c. -4A



2) Quelle est la valeur de la tension U_2 ?

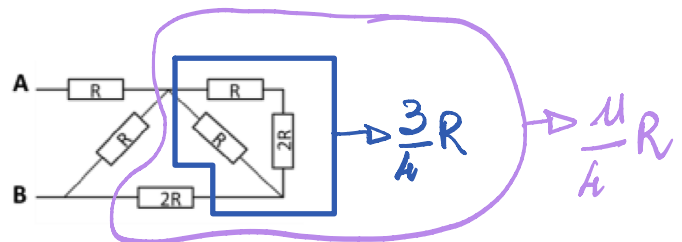
- ☐ a. 6V
☐ b. 8V
☒ c. 2V



3) Quelle est la résistance équivalente entre A et B ?

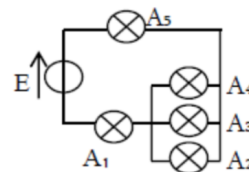
- ☐ a. 8R
☒ b. $26R/15$
☐ c. $11R/4$

$$R_{eq} = R + \frac{R \times \frac{1}{4}R}{15/4 R}$$



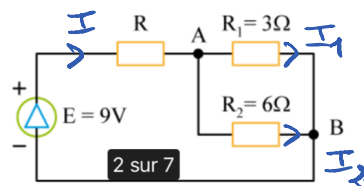
4) La luminosité d'une lampe est d'autant plus importante que l'intensité du courant qui la traverse est grande. Dans les montages suivants, composés de lampes identiques, on compare leur luminosité à l'intérieur de chacun des circuits :

- ☐ a. Les lampes A_2 , A_3 et A_4 brillent plus que A_5 et A_1 .
☒ b. Les lampes A_2 , A_3 et A_4 brillent moins que A_5 et A_1 .



5) Quelle doit être la valeur de la résistance R pour que la puissance dissipée dans la résistance R_1 soit égale à 12 W ?

- ☒ a. 1Ω
☐ b. 2Ω
☐ c. 3Ω



$$12W \Rightarrow I_1 = 2A$$

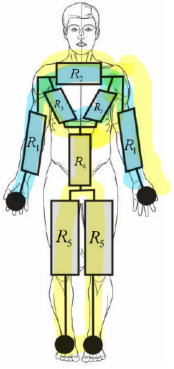
$$R_2 = 2R_1 \Rightarrow I_2 = \frac{I_1}{2} = 1A$$

$$I = 3A = \frac{9}{R + 2}$$

$$R_1 // R_2 \Leftrightarrow R_{eq} = 2 \Omega$$

$$R = 1 \Omega$$

Exercice 1



1) Schéma équivalent $\Rightarrow R_{eq} = R_1 + \frac{2R_3R_2}{2R_3 + R_2} + R_4 = 979 \Omega$

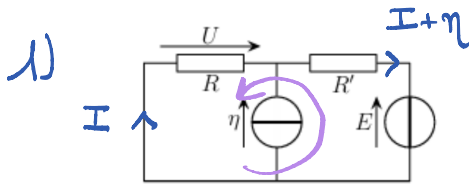
$$i = \frac{230}{979} = 0,235 A$$

2) Schéma équivalent $\Rightarrow R_{eq} = R_1 + \frac{R_3(R_2 + R_2)}{2R_3 + R_2} + R_4 + \frac{R_5}{2} = 973 \Omega$

$$i = \frac{230}{973} = 0,236 A$$

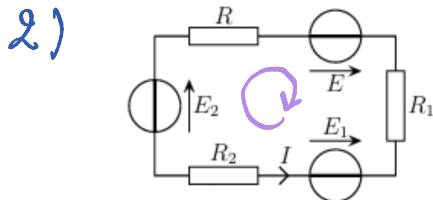
3) Donc chaque cas $i > 30 \text{ mA} \rightarrow$ il y a tétanisation des muscles

Exercice 2

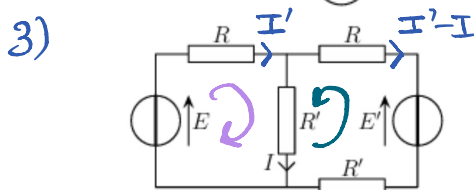


$$RI + E + R'(I + \eta) = 0 \quad I = - \frac{E + \eta R'}{R + R'}$$

$$U = -RI = R \frac{E + \eta R'}{R + R'}$$



$$E_2 + RI + E + R_1 I - E_1 + R_2 I = 0 \quad I = \frac{E_1 - E_2 - E}{R + R_1 + R_2}$$



(1) $E - RI' - R'I = 0 \rightarrow I' = \frac{E - RI}{R}$

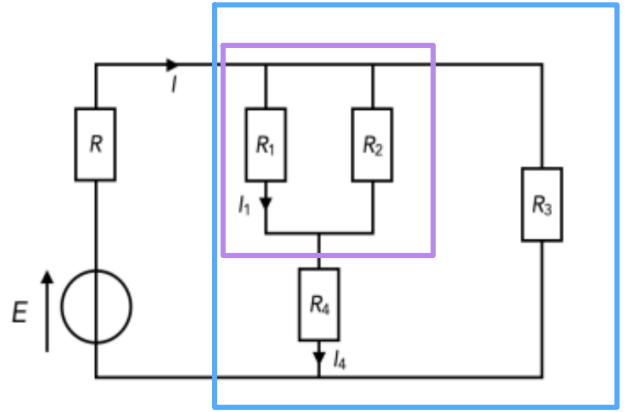
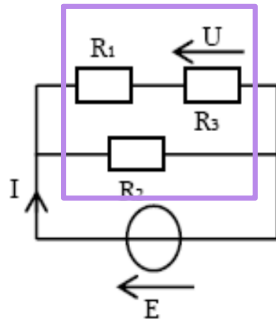
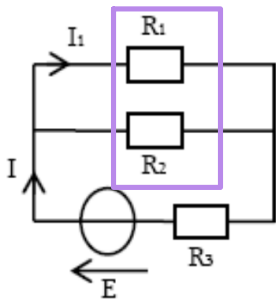
(2) $E' + (R' + R)(I' - I) - R'I = 0$

(2) $\Rightarrow E' + (R' + R) \left(\frac{E - RI}{R} - I \right) - R'I = 0$

$$E' + \frac{R' + R}{R} E - \underbrace{\left((R' + R) \left(1 + \frac{R'}{R} \right) + R' \right)}_{\frac{R' + R^2}{R} + R + R' + R'} I = 0$$

$$I = \frac{E' + \frac{R' + R}{R} E}{3R' + R + \frac{R^2}{R}}$$

Exercise 3



$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

$$I = \frac{E}{R_3 + R_{eq}}$$

$$I_1 = I \frac{R_2}{R_1 + R_2}$$

$$U = E \frac{R_3}{R_1 + R_3}$$

$$R_{eq} = \frac{(R_1 + R_3) R_2}{R_1 + R_2 + R_3}$$

$$I = \frac{E}{R_{eq}}$$

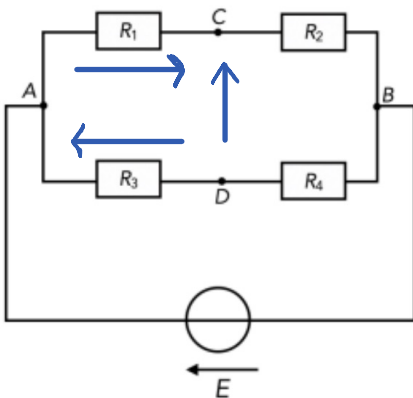
$$R_{eq1} = \frac{R_1 R_2}{R_1 + R_2}$$

$$R_{eq} = \frac{(R_1 + R_{eq1}) R_3}{R_1 + R_{eq1} + R_3}$$

$$I = \frac{E}{R + R_{eq}}$$

$$I_1 = I \frac{R_2}{R_1 + R_2}$$

Exercise 4



$$1) U_{CD} = U_{AD} + U_{CA} = E \left(\frac{R_3}{R_3 + R_4} - \frac{R_1}{R_1 + R_2} \right)$$

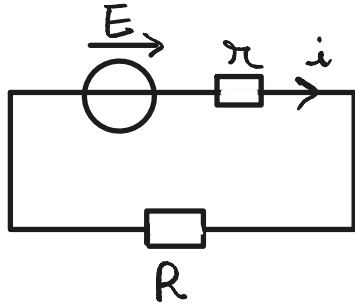
$$2) U_{CD} = 0 \Leftrightarrow \frac{R_3}{R_3 + R_4} = \frac{R_1}{R_1 + R_2}$$

$$\Leftrightarrow R_2 R_3 = R_1 R_4$$

$$\Leftrightarrow R_2 R_3 = R_1 R_4 \quad R_1 = \frac{R_2 R_3}{R_4}$$

$$3) \text{ AN: } R_1 = \frac{100 \times 1827}{5000} = 36,5 \, \Omega$$

Exercice 5



$$1) i = \frac{E}{x+R}$$

$$2) P_R = Ri^2 = R \frac{E^2}{(x+R)^2}$$

$$3) \frac{dP}{dR} = 0 \Leftrightarrow \frac{E^2}{(x+R)^2} + RE^2 \frac{-2}{(x+R)^3} = 0$$

$$\Leftrightarrow 1 - 2 \frac{R}{x+R} = 0$$

Exercice 6

$$\Leftrightarrow x+R=2R \Leftrightarrow x=R \Rightarrow P_{\max} = \frac{E^2}{4R}$$

$$1) R_{AB} = \frac{(2R+R')R}{3R+R'}$$

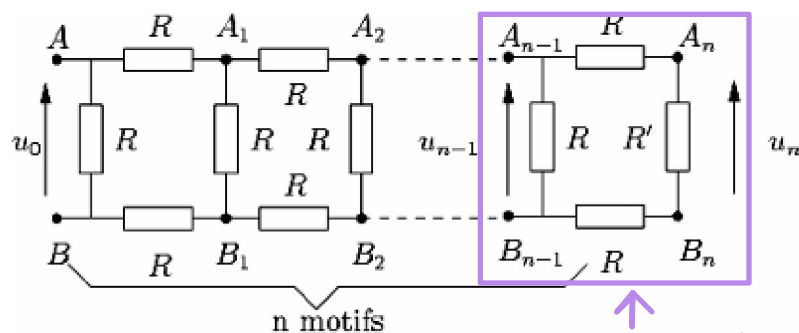
$$R_{AB} = R' \Leftrightarrow (3R+R')R' = (2R+R')R$$

$$\Leftrightarrow R'^2 + 2RR' - 2R^2 = 0 \quad \Delta = 4R^2 + 8R^2 = 12R^2$$

$$R' = \frac{-2R + 2\sqrt{3}R}{2} = (\sqrt{3}-1)R \quad (\text{seule solution } > 0)$$

$$2) \text{ pont diviseur de tension : } u_m = \frac{R'}{3R+R'} u_{m-1} \quad \text{ou } u_{m-1} = \frac{R'}{3R+R'} u_{m-2}$$

$$\Rightarrow u_m = \left(\frac{R'}{3R+R'} \right)^m u_0$$



$$3) R_{AB} = R' = (\sqrt{3}-1)R$$

Exercise 7

1) $R_{Ax} = \rho x$ $R_{Bx} = (D-x)\rho$

2) (1) $E = U + \rho x i_1$

(2) $E = U + (D-x)\rho i_2$

(3) $I = i_1 + i_2$

3) $\hookrightarrow i_1 = \frac{\Delta U}{\rho x}$

$\hookrightarrow i_2 = \frac{\Delta U}{(D-x)\rho}$

$$(3) \Rightarrow I = \Delta U \left(\frac{1}{\rho x} + \frac{1}{(D-x)\rho} \right) = \Delta U \frac{D\rho}{\rho^2 x(D-x)}$$

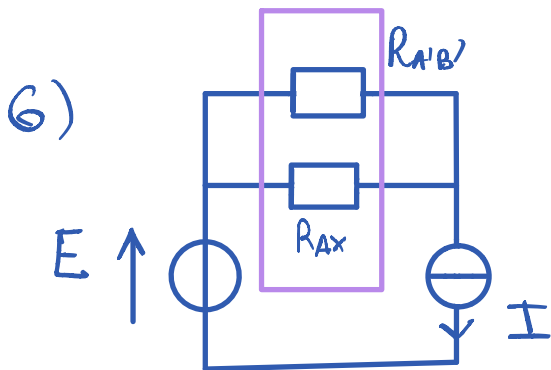
$$\Delta U = \frac{I}{D\rho} \rho^2 x(D-x)$$

4) ΔU maximale $\Leftrightarrow \frac{d(\Delta U)}{dx} = 0 \Leftrightarrow \frac{d}{dx} (x(D-x)) = 0$

$$\Leftrightarrow D-x + x \times (-1) = 0 \Leftrightarrow x = \frac{D}{2}$$

$$\Delta U_{\max} = \frac{I}{D\rho} \rho^2 \frac{D^2}{4} = \frac{I \rho D}{4}$$

5) $I \frac{\rho D}{4} \leq \Delta U_{\text{th}} \Leftrightarrow D \leq \frac{4 \Delta U_{\text{th}}}{I \rho}$ $D_{\max} = \frac{4 \Delta U_{\text{th}}}{I \rho} = 4,5 \text{ km}$



avec $R_{Ax} = \rho x$ et $R_{A'B'} = \rho D + \rho(D-x)$
 $= 2\rho D - \rho x$

$$7) R_{\text{eq}} = \frac{R_{A'B'} R_{Ax}}{R_{A'B'} + R_{Ax}} = \frac{\rho^2 x(2D-x)}{2\rho D} = \rho \frac{x(2D-x)}{2D}$$

$$8) \Delta U = R_{eq} I = e \frac{x(2D-x)}{2D} I$$

$$9) \frac{d\Delta U}{dx} = 0 \Leftrightarrow \frac{d}{dx} (x(2D-x)) = 0$$

$$\Leftrightarrow 2D - x + x(-1) = 0 \Leftrightarrow x = D$$

$$10) \Delta U_{max} = e \frac{D(2D-D)}{2D} I = e \frac{D}{2} I < \Delta U_M$$

$$\Leftrightarrow D_{max} = 2,25 \text{ km}$$

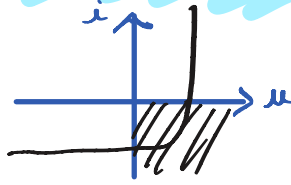
Exercice 8

1) $I_p = \frac{1}{2} P_e = \frac{1}{2} E S$ AN: $I_p = 0,14 A$

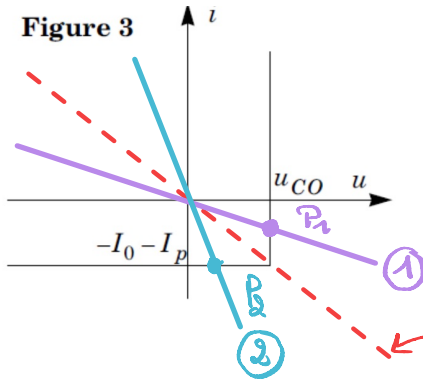
$I_p = -i(0)$ $i(0)$ est le courant de court-circuit

2) $u_{co} = 0,55 V$ par lecture graphique

3) la photodiode est en convention récepteur: $P = u i$ représente la puissance reçue, elle fournit donc de l'énergie lorsque $u i < 0$ (u et i de signes opposés)



4) $u = -R_c i$ $i = -\frac{u}{R_c}$



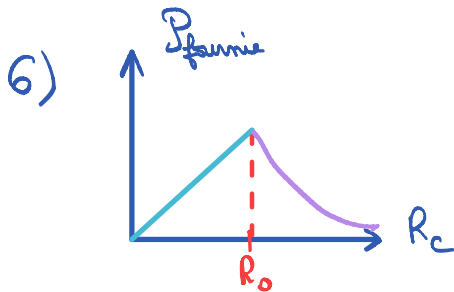
Cas 1: $R_c > R_0 \rightarrow$ point de fonctionnement P_1

Cas 2: $R_c < R_0 \rightarrow$ point de fonctionnement P_2

droite de pente $-1/R_0 = -\frac{I_0 + I_p}{u_{co}}$

5) Cas 1: $u = u_{co}$ $i = -\frac{u_{co}}{R_c}$ $P_{fourni} = -u i = \frac{u_{co}^2}{R_c}$

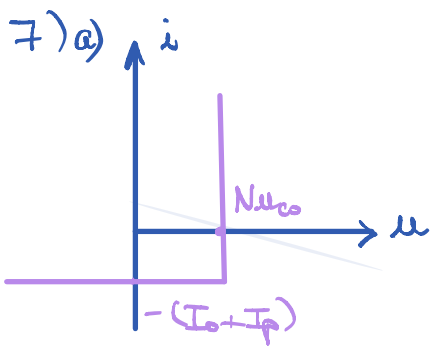
Cas 2: $i = -(I_0 + I_p)$ $u = -R_c \times -(I_0 + I_p)$ $P_{fourni} = R_c (I_0 + I_p)^2$



résistance optimale $R_{opt} = R_0$

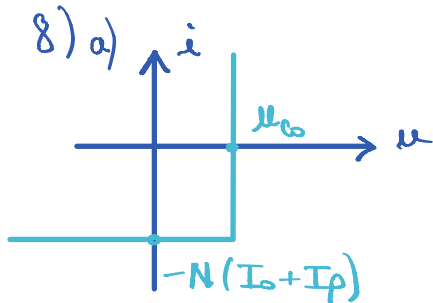
$P_{max} = R_0 (I_0 + I_p)^2 = u_{co} (I_0 + I_p)$

AN: $R_{opt} = 3,9 \Omega$



en série : même i , on somme les tensions

$$b) R_{opt,s} = \frac{N u_0}{I_0 + I_p} = N R_{opt}$$



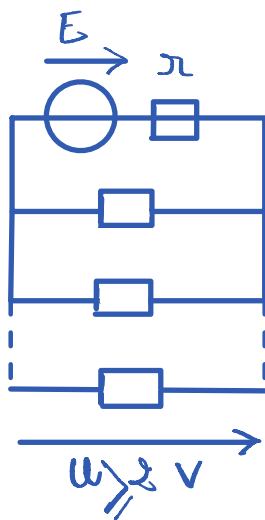
en parallèle : même u , on somme les intensités

$$b) R_{opt,p} = \frac{u_0}{N(I_0 + I_p)} = \frac{R_{opt}}{N}$$

9) Il faut choisir R_e la plus proche possible de la résistance optimale.

$5 \times 3,9$ proche de 20 : on choisit 5 cellules en série
 $\uparrow$ $\uparrow$
 N R_{opt}

Exercice 9



N résistances en parallèle $R_{eq} = \frac{R}{N}$

$$u = E \frac{R_{eq}}{R_{eq} + r} \geq 2V < u_{min}$$

$$\Leftrightarrow E \frac{R}{R + Nr} \geq u_{min} \Leftrightarrow N \leq R \frac{E - u_{min}}{r}$$

$$N \leq 1050$$