Centre de formation professionnelle de Sion

Epreuve

Branche: Electrotechnique

Profession: Electronicien Mult.

Durée: 60-75 min.

Sujet: Kirchhoff, Thévenin et Norton

Année d'apprentissage: 1ère

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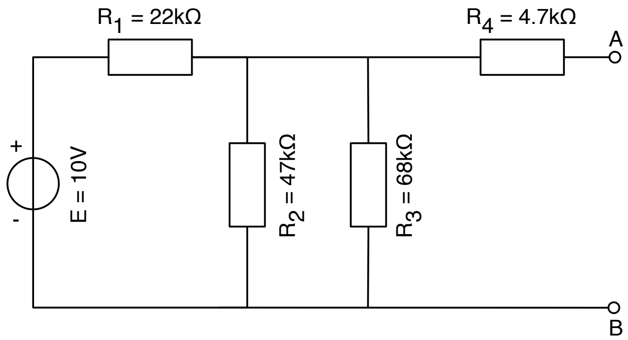
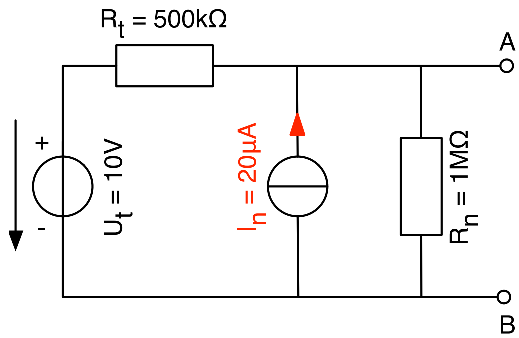
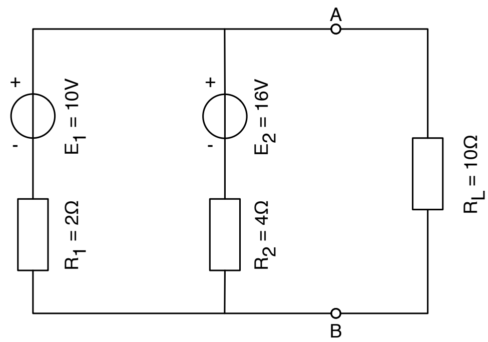
1. Dessiner et calculer les circuits équivalents de Thévenin et de Norton du schéma ci-dessous.



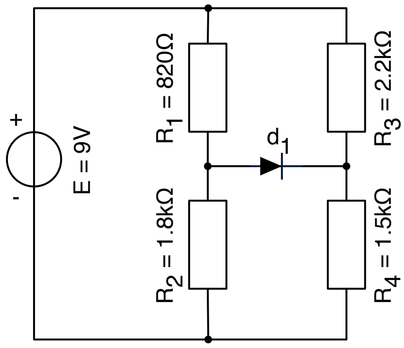
2. Trouver le circuit équivalent de Thévenin.



3. Déterminer les schémas équivalents de Thévenin et de Norton, puis calculer en utilisant Thévenin ou Norton la tension V_{RL}.
Vérifier la valeur calculée V_{RL} à l'aide des Lois de Kirchhoff.



4. Déterminer la puissance dissipée par la diode (considérer la 2ème approximation de la diode). Utiliser le théorème de Thévenin pour la résolution de ce problème.



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Corrections

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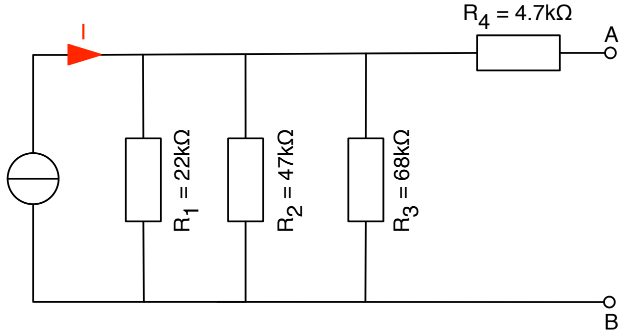
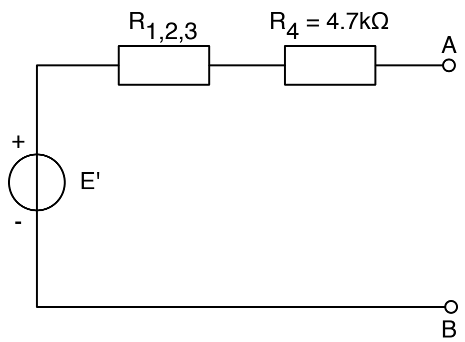
1.



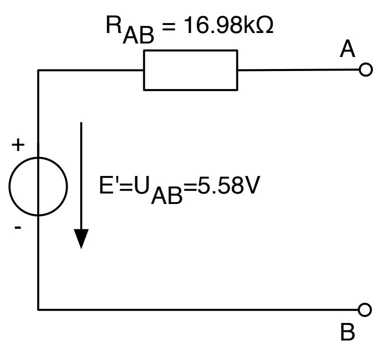
$$I = \frac{E}{R_1} = \frac{10}{22 * 10^3} = 454.\overline{54}\mu A$$

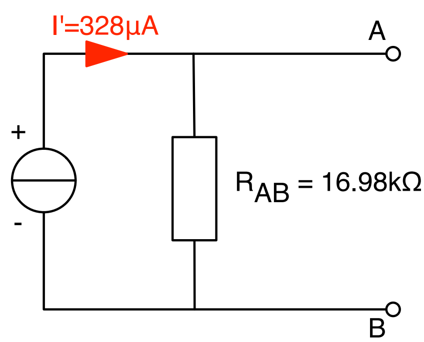
$$R_{1,2,3} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} = \frac{1}{\frac{1}{22*10^3} + \frac{1}{47*10^3} + \frac{1}{68*10^3}} = 12.28k\Omega$$



$$E' = R_{1,2,3} * I = 12.28 * 10^3 * 454.\overline{54} * 10^{-6} = \underline{\underline{5.58V}}$$

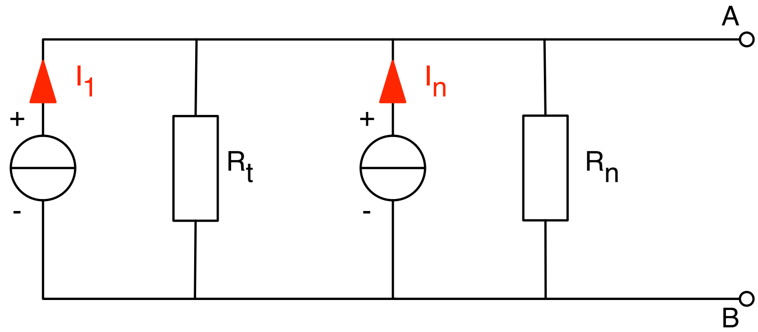
$$R_{A,B} = R_{1,2,3} + R_4 = 12.28 * 10^3 + 4.7 * 10^3 = \underline{\underline{16.98k\Omega}}$$



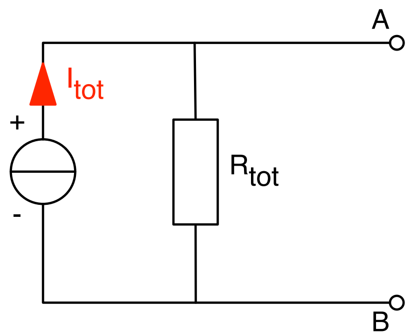


$$I' = \frac{U_{AB}}{R_{AB}} = \frac{5.58}{16.98 * 10^3} = \underline{\underline{328.62\mu A}}$$

2.

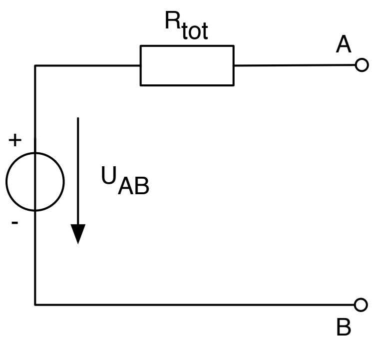


$$I_1 = \frac{U_t}{R_t} = \frac{10}{500 * 10^3} = 20\mu A$$



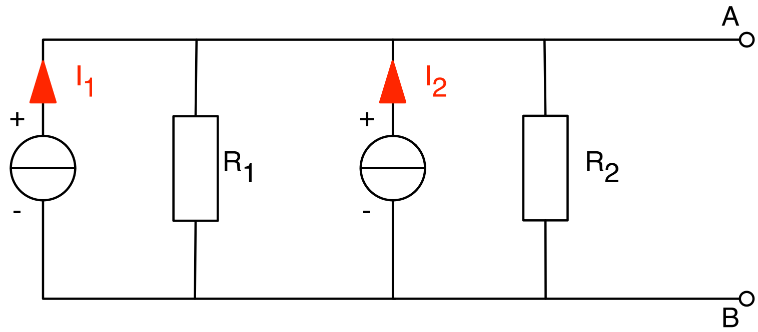
$$I_{tot} = I_1 + I_2 = 20 * 10^{-3} + 20 * 10^{-3} = 40\mu A$$

$$R_{tot} = \frac{R_t * R_n}{R_t + R_n} = \frac{500 * 10^3 * 1 * 10^6}{500 * 10^3 + 1 * 10^6} = \underline{\underline{333.\bar{3}k\Omega}}$$



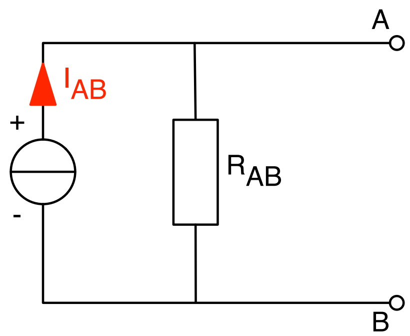
$$U_{AB} = R_{tot} * I_{tot} = 333.\bar{3} * 40 * 10^{-6} = \underline{\underline{13.\bar{3}V}}$$

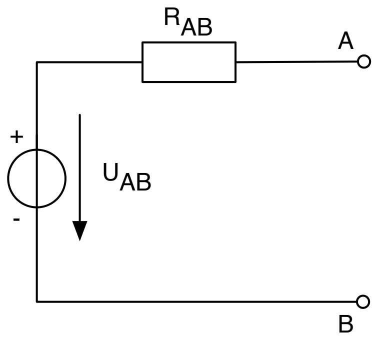
3.



$$I_1 = \frac{E_1}{R_1} = \frac{10}{2} = 5A$$

$$I_2 = \frac{E_2}{R_2} = \frac{16}{4} = 4A$$

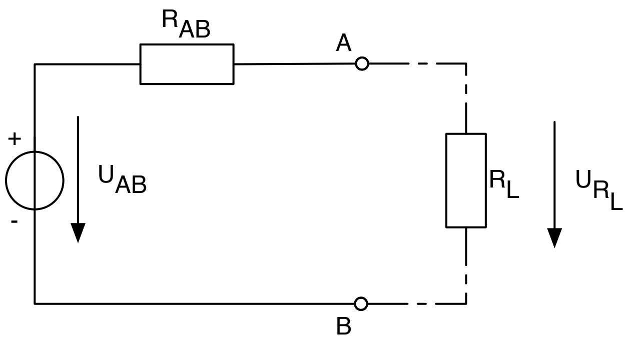




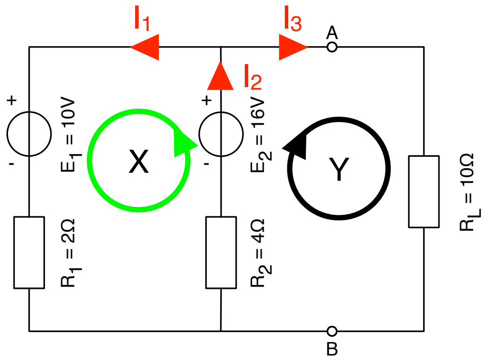
$$I_{AB} = I_1 + I_2 = 5 + 4 = \underline{\underline{9A}}$$

$$R_{AB} = \frac{R_1 * R_2}{R_1 + R_2} = \frac{2 * 4}{2 + 4} = \underline{\underline{1.\bar{3}\Omega}}$$

$$U_{AB} = R_{AB} * I_{AB} = 1.\bar{3} * 9 = \underline{\underline{12V}}$$



$$U_{R_L} = R_L * \frac{U_{AB}}{R_{AB} + R_L} = 10 * \frac{12}{1.\bar{3} + 10} = \underline{\underline{10.588V}}$$



LdN: $I_2 = I_1 + I_3$ 1

LdM:

X: $E_2 - E_1 = R_1 * I_1 + R_2 * I_2$ 2

Y: $E_2 = R_2 * I_2 + R_L * I_3$ 3

$$\left.\begin{array}{ll} 1 & I_1 - I_2 + I_3 = 0 \\ 2 & I_1 * R_1 + I_2 * R_2 = E_2 - E_1 \\ 3 & I_2 * R_2 + I_3 * R_L = E_2 \end{array}\right\}$$

$$\left\{\begin{array}{rcr|r} I_1 - I_2 + I_3 & = & 0 & -2 \\ 2I_1 + 4I_2 & = & 6 & 1 \\ 4I_2 + 10I_3 & = & 16 & \end{array}\right. \Longleftrightarrow$$

$$\left\{\begin{array}{rcr|r} I_1 - I_2 + I_3 & = & 0 & \\ 6I_2 - 2I_3 & = & 6 & -2 \\ 4I_2 + 10I_3 & = & 16 & 3 \end{array}\right. \Longleftrightarrow$$

$$\left\{\begin{array}{rcr} I_1 - I_2 + I_3 & = & 0 \\ 6I_2 - 2I_3 & = & 6 \\ 34I_3 & = & 36 \end{array}\right.$$

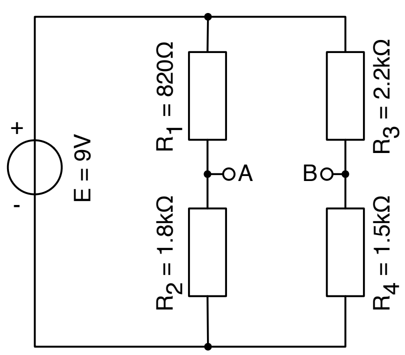
$=> I_3 = 1.0588A$

$=> I_2 = 1.353A$

$=> I_1 = 294.2mA$

$U_{R_L} = R_L * I_3 = 10 * 1.0588 = \underline{\underline{10.588V}}$

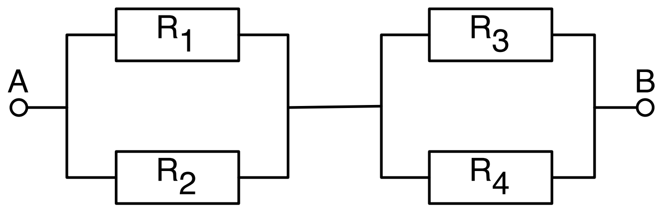
4.



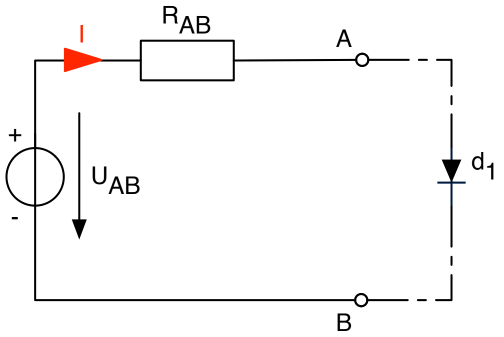
$$U_{R_2} = R_2 * \frac{E}{R_1 + R_2} = 1.8 * 10^3 * \frac{9}{820 + 1.8 * 10^3} = 6.183V$$

$$U_{R_4} = R_4 * \frac{E}{R_3 + R_4} = 1.5 * 10^3 * \frac{9}{2.2 * 10^3 + 1.5 * 10^3} = 3.648V$$

$U_{AB} = U_{R_2} - U_{R_4} = \underline{\underline{2.534V}}$



$$R_{AB} = \frac{R_1 * R_2}{R_1 + R_2} + \frac{R_3 * R_4}{R_3 + R_4} = \frac{820 * 1.8 * 10^3}{820 + 1.8 * 10^3} + \frac{2.2 * 10^3 * 1.5 * 10^3}{2.2 * 10^3 + 1.5 * 10^3} = \underline{\underline{1.455k\Omega}}$$



$$I_{diode} = \frac{U_{AB} - U_d}{R_{AB}} = \frac{2.534 - 0.7}{1.455 * 10^3} = 1.26mA$$

$$P_{diode} = U_d * I_d = 0.7 * 1.26 * 10^{-3} = \underline{\underline{882\mu W}}$$