Établissement du courant dans un circuit comportant une bobine

Présentation de la bobine

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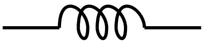

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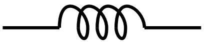

L

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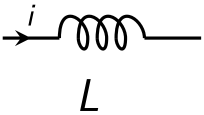

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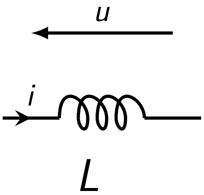

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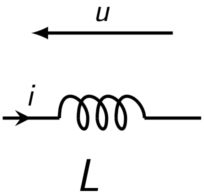
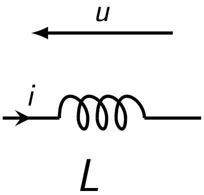


Définition de l'inductance L

Relation flux magnétique-intensité

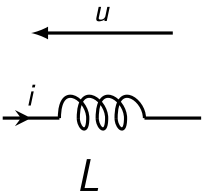
Présentation de la bobine



Définition de l'inductance L
Relation flux magnétique-intensité

$$\boxed{\Phi = \iint \vec{B} \cdot \mathrm{d}\vec{S} = L \times i}$$

Présentation de la bobine



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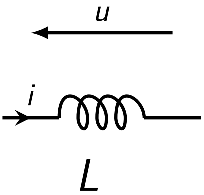

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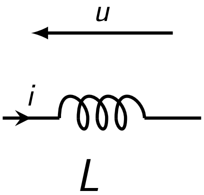
Relation intensité-tension

Présentation de la bobine



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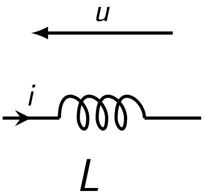
Relation intensité-tension $\boxed{u = L \, \dfrac{\mathrm{d}i}{\mathrm{d}t}}$

Présentation de la bobine



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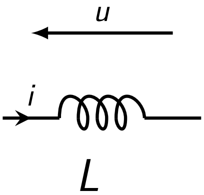
Comportement en régime permanent

Présentation de la bobine



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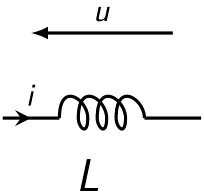
Comportement en régime permanent

$$\frac{\mathrm{d}}{\mathrm{d}t} = 0 \Longrightarrow u = 0$$

Présentation de la bobine



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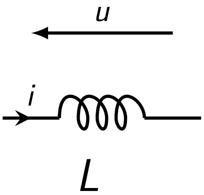
Comportement en régime permanent

$$\frac{\mathrm{d}}{\mathrm{d}t} = 0 \Longrightarrow u = 0 \qquad (\text{bobine} = \text{interrupteur fermé})$$

Présentation de la bobine



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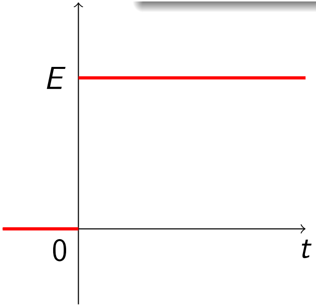
Comportement en régime permanent

$$\frac{\mathrm{d}}{\mathrm{d}t} = 0 \Longrightarrow u = 0 \qquad \text{(bobine = interrupteur fermé)}$$

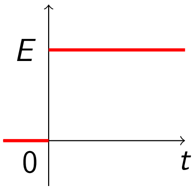
La bobine n'est "intéressante" qu'en régime variable.

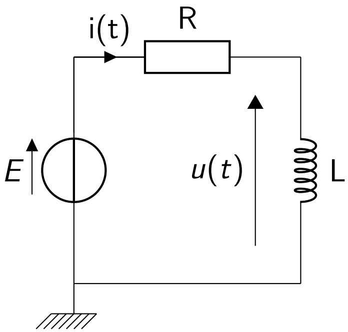
Circuit RL et échelon de tension

Circuit RL et échelon de tension

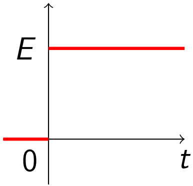


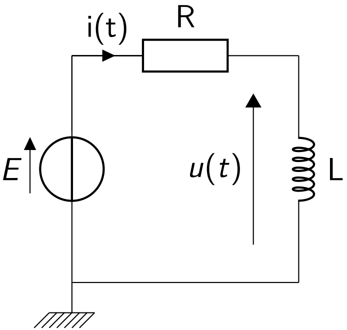
Circuit RL et échelon de tension





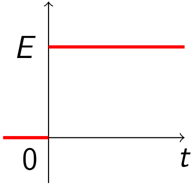
Circuit RL et échelon de tension

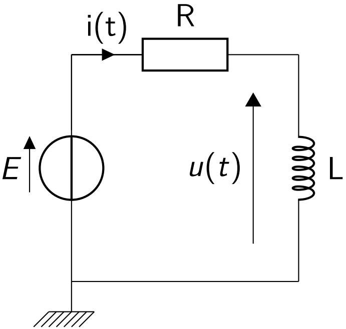




Loi des mailles

Circuit RL et échelon de tension

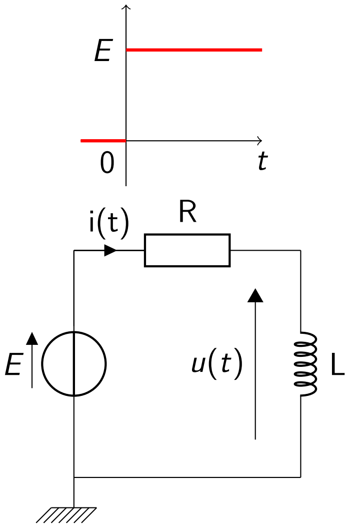




Loi des mailles

$$E = u(t) + R\,i(t)$$

Circuit RL et échelon de tension

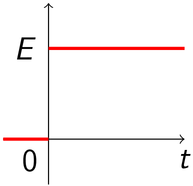


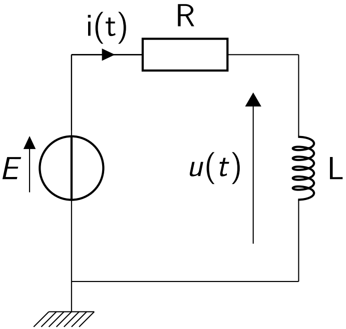
Loi des mailles

$$E = u(t) + R\, i(t)$$

$$\Longrightarrow E = L\,\frac{\mathrm{d}i(t)}{\mathrm{d}t} + R\, i(t)$$

Circuit RL et échelon de tension





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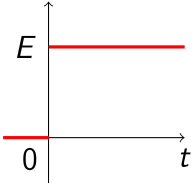
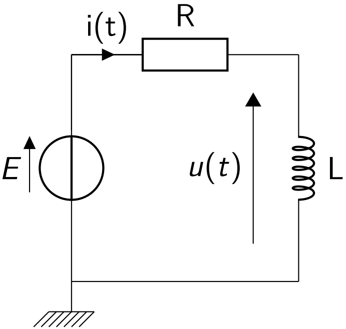
Posons $\tau = L/R$ et réorganisons :

Circuit RL et échelon de tension





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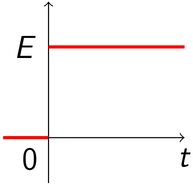
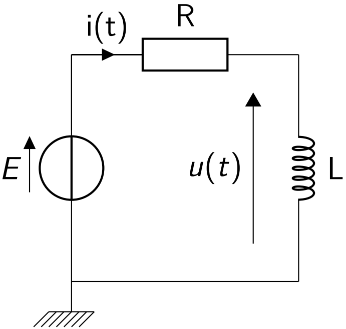
Posons $\tau = L/R$ et réorganisons :

$$\boxed{\frac{\mathrm{d}i(t)}{\mathrm{d}t} + \frac{i}{\tau} = \frac{E}{L}}$$

Circuit RL et échelon de tension





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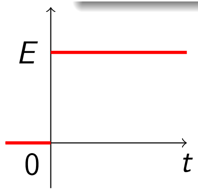
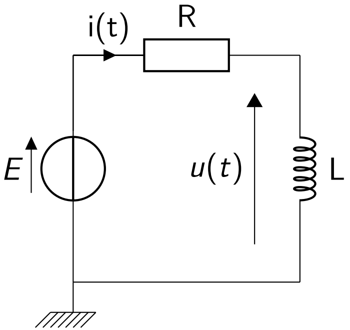
Équation différentielle du premier ordre avec second membre.

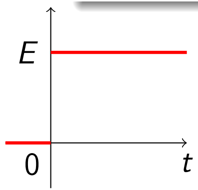
Circuit RL et échelon de tension

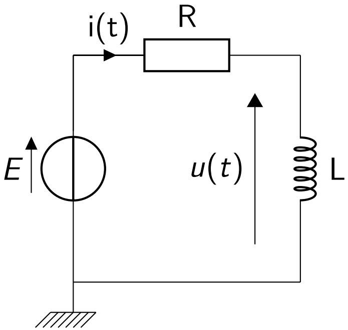




$$\frac{\mathrm{d}i(t)}{\mathrm{d}t} + \frac{i}{\tau} = \frac{E}{L}$$

Circuit RL et échelon de tension

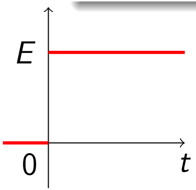


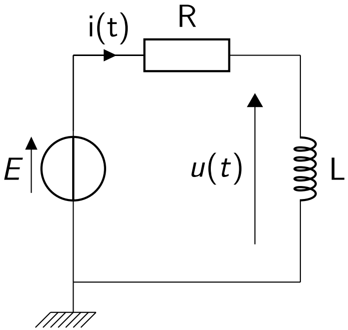


$$\frac{\mathrm{d}i(t)}{\mathrm{d}t} + \frac{i}{\tau} = \frac{E}{L}$$

Solution $i(t) = i_\mathrm{h} + i_\mathrm{p} \Longrightarrow i(t) = A\,e^{-\frac{t}{\tau}} + \frac{E}{R}$

Circuit RL et échelon de tension





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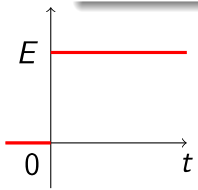
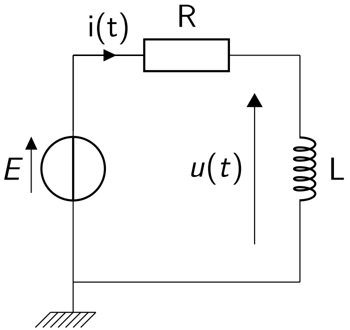
CI $\quad$ à $t = 0$, $i(t) = 0 \Longrightarrow A = -E/R$

Circuit RL et échelon de tension





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CI $\quad$ à $t = 0$, $i(t) = 0 \Longrightarrow A = -E/R$

$$\boxed{i(t) = \frac{E}{R}\left(1 - e^{-\frac{t}{\tau}}\right)}$$

Circuit RL et échelon de tension

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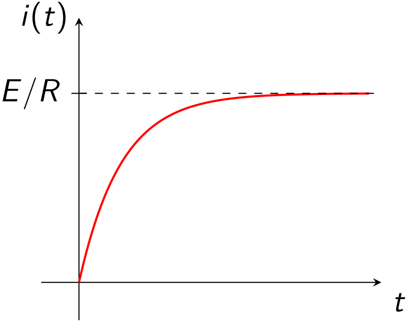
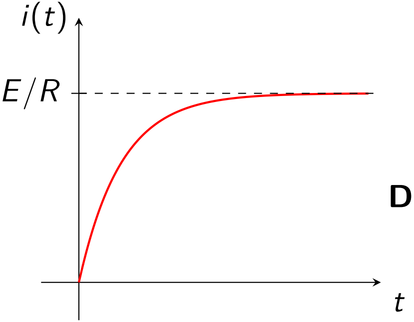
Circuit RL et échelon de tension



$$\boxed{i(t) = \frac{E}{R}\left(1 - e^{-\frac{t}{\tau}}\right)}$$

Circuit RL et échelon de tension



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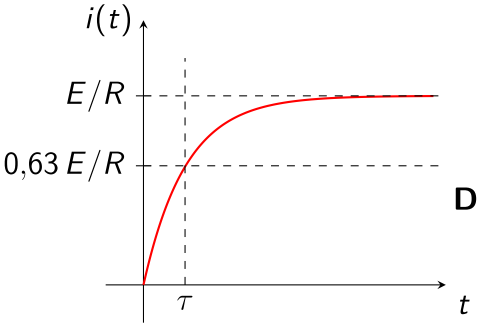
Détermination de τ

Circuit RL et échelon de tension

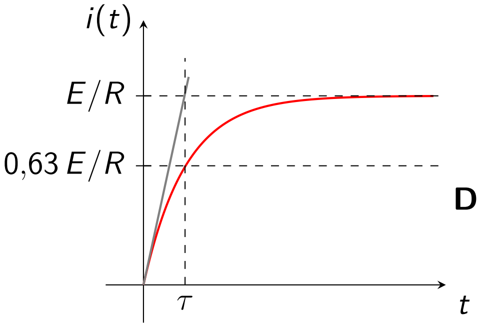


$$\boxed{i(t) = \frac{E}{R}\left(1 - e^{-\frac{t}{\tau}}\right)}$$

Détermination de τ

- Pour $t = \tau$, $i(t) = 0{,}63\,E/R$;

Circuit RL et échelon de tension



$$\boxed{i(t) = \frac{E}{R}\left(1 - e^{-\frac{t}{\tau}}\right)}$$

Détermination de τ

- Pour $t = \tau$, $i(t) = 0{,}63\,E/R$;
- La tangente en $t = 0$ à la courbe coupe l'asymptote $i = E/R$ en $t = \tau$.