4 M.S.T.I

Le dipôle RL

1°) a) Loi des mailles

$$u_1 + u_2 - E = 0$$

$$u_1 + r i + L\frac{di}{dt} = E$$

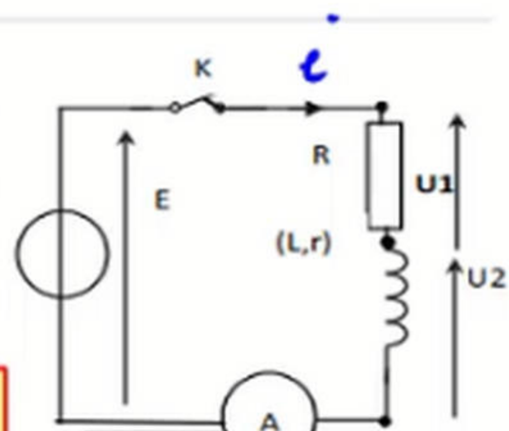


Fig1

$$u_1 = u_R = R i \Rightarrow \boxed{i = \frac{u_1}{R}}$$

$$\Rightarrow u_1 + r\frac{u_1}{R} + L\frac{d}{dt}\left(\frac{u_1}{R}\right) = E$$

$$u_1\left(1 + \frac{r}{R}\right) + \frac{L}{R}\frac{d}{dt}u_1 = E$$

$$u_1\left(\frac{R+r}{R}\right) + \frac{L}{R}\frac{d}{dt}u_1 = E$$

$$(R+r)u_1 + L\frac{du_1}{dt} = RE$$

$$\frac{du_1}{dt} + \frac{R+r}{L}u_1 = \frac{R}{L}E \quad ; \quad \frac{R+r}{L} = \frac{1}{\tau}$$

$$\Rightarrow \boxed{\frac{du_1}{dt} + \frac{1}{\tau}u_1 = \frac{RE}{L}}$$

b) $u_1(t) = A\, e^{-kt} + B$

* à $t = 0$ $i = 0$ $\Rightarrow$ $u_1 = R\,i = 0$

$\Rightarrow$ $0 = A e^{0} + B$ $\Rightarrow$ $\boxed{A = -B}$

* $\dfrac{du_1}{dt} = -kA e^{-kt} + 0$

* éq. diff $\Rightarrow$ $-kA e^{-kt} + \dfrac{1}{\tau}\left(A e^{-kt} + B\right) = \dfrac{ER}{L}$

$\Rightarrow$ $-kA e^{-kt} + \dfrac{B}{\tau} + \dfrac{A}{\tau} e^{-kt} = \dfrac{ER}{L}$

$\Rightarrow$ $\underbrace{A e^{-kt}}_{\text{varie}} \underbrace{\left(\dfrac{1}{\tau} - k\right)}_{\text{cte}} + \underbrace{\dfrac{B}{\tau}}_{\text{cte}} = \underbrace{\dfrac{ER}{L}}_{\text{cte}}$

$\Rightarrow$ $\dfrac{1}{\tau} - k = 0$ et $\dfrac{B}{\tau} = \dfrac{ER}{L}$

$\boxed{k = \dfrac{1}{\tau}}$ et $B = \dfrac{\tau E R}{L} = \dfrac{\cancel{L}\, E R}{(R+r)\,\cancel{L}}$

$$\Rightarrow \boxed{\lambda = +\frac{1}{\tau} \qquad B = \frac{RE}{R+r} \text{ et } A = -B = -\frac{RE}{R+r}}$$

$$\Rightarrow \quad u_1 = -\frac{RE}{R+r} e^{-\frac{t}{\tau}} + \frac{RE}{R+r}$$

$$\boxed{u_1(t) = \frac{RE}{R+r}\left(1 - e^{-\frac{t}{\tau}}\right)}$$

c) $u_L(t) = u_B(t) = E - u_1$

$$u_L(t) = E - \frac{RE}{R+r}\left(1 - e^{-\frac{t}{\tau}}\right)$$

$$= E - \frac{RE}{R+r} + \frac{RE}{R+r} e^{-\frac{t}{\tau}}$$

$$= \frac{\cancel{RE} - \cancel{RE} + rE}{R+r} + \frac{RE}{R+r} e^{-\frac{t}{\tau}}$$

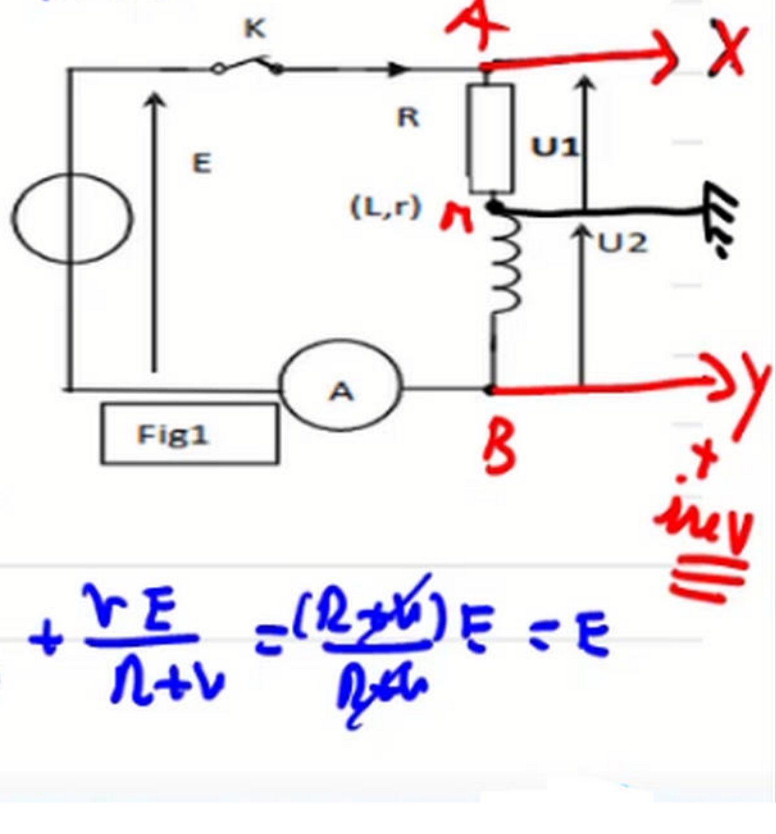
NETSCHOOL1
ACADEMY

$$\Rightarrow \boxed{u_2(t) = \frac{RE}{R+r} e^{-\frac{t}{\tau}} + r\frac{E}{R+r}}$$

Avec $\boxed{U_0 = \frac{RE}{R+r}}$ et $\boxed{b = \frac{rE}{R+r}}$

Rq : $I_P = \frac{E}{R+r}$

2) a)



b)

*

$t=0$ $i=0 \Rightarrow$

$u_1 = Ri = 0$

$\Rightarrow$ courbe (1)

* $t=0$ $u_2 = \frac{RE}{R+r} + \frac{rE}{R+r} = \frac{(R+r)}{R+r}E = E$

$\Rightarrow$ courbe (2)

c) * à $t = 0$ $u_2 = E$

$\Rightarrow$ $\boxed{E = 6\,V}$

* $U_0 = R \frac{E}{R+r} = R I_0$

$= (U_1)_{max} = 5\,V$

3°) a) $\boxed{I_p = \frac{U_0}{R}}$

$I_p = \frac{5}{50} = 0{,}1\,A$

b) Regime permanent

$\Rightarrow$ $E = (R+r) I_p$ (1)

$U_0 = R I_p$ (2)

$$\frac{(1)}{(2)} \quad \frac{E}{U_0} = \frac{R+r}{R}$$

$$\Rightarrow \quad R+r = R\,\frac{E}{U_0}$$

$$r = \frac{RE}{U_0} - R$$

$$\Rightarrow \quad \boxed{r = R\left(\frac{E}{U_0} - 1\right)}$$

AN $\quad r = 50\left(\frac{6}{5} - 1\right) = 10\,\Omega$.

c) méthode de la tangente à l'origine $\Rightarrow$ $\boxed{\tau = 1\,ms}$

$$\boxed{\tau = t_A}$$

$$\mathcal{E} = \frac{L}{R+r}$$

$$\boxed{L = (R+r)\,\mathcal{E}}$$

$$L = (50+10) \cdot 2 \cdot 10^{-3}$$

$$\boxed{L = 0{,}12 \text{ H}}$$