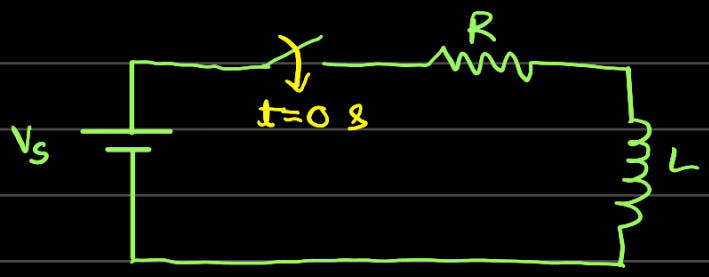
Day-6



$$V_s = iR + L\frac{di}{dt} \Rightarrow \frac{V_s}{L} = i\frac{R}{L} + \frac{di}{dt}$$

$$\Rightarrow i = e^{-\frac{Rt}{L}} \int \frac{V_s}{L} e^{\frac{Rt}{L}} dt$$

$$= \left(\frac{V_s}{R} e^{Rt} + C\right) e^{-Rt/L}$$

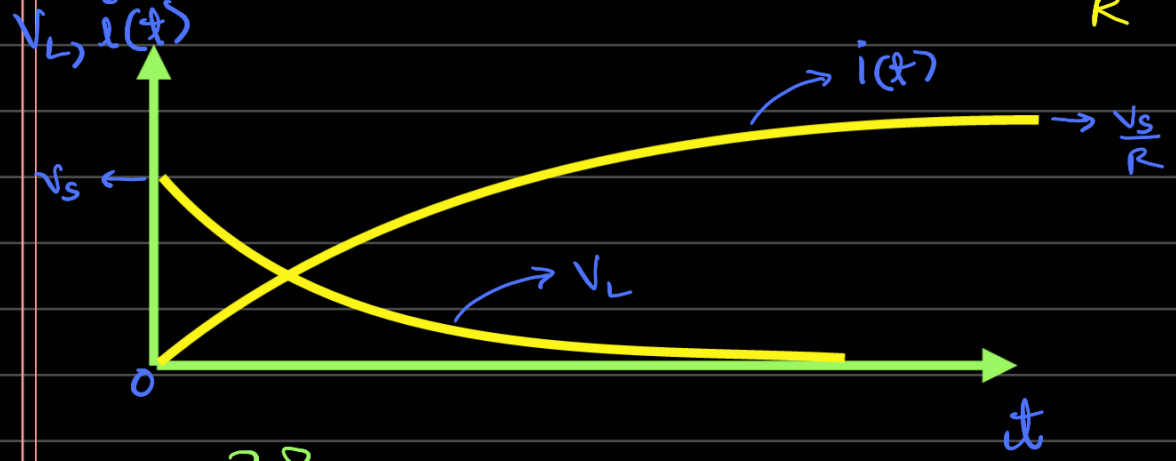
$$= \frac{V_s}{R} + Ce^{-Rt/L}$$

at $t = 0$, $i = i_0$

$$\Rightarrow C = i_0 - \frac{V_s}{R}$$

$$\therefore i = i_0 e^{-Rt/L} + \frac{V_s}{R}\left(1 - e^{-Rt/L}\right)$$

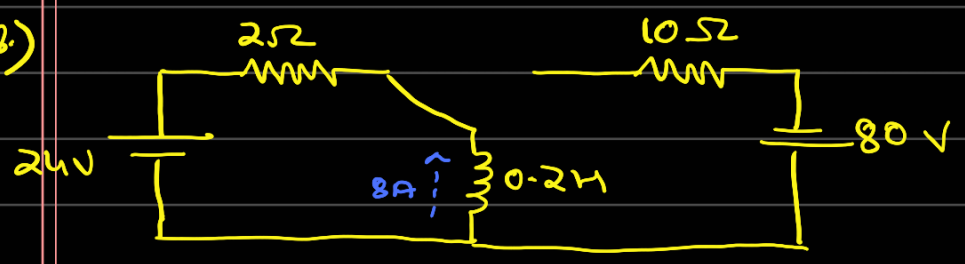
we define time constant $\tau = \frac{L}{R}$



1)

a.) Find $i(t)$ for $t \geq 0$.

Ans.)



(8A)

$$i = \frac{24}{2}\left(1 - e^{\frac{-2t}{0.2}}\right) + (-8)e^{\frac{-2t}{0.2}}$$

$$= 12 - 20e^{-10t}$$

b.) V_L at $t=0$.

Ans.) $$V_L = L\frac{di}{dt}\Big|_{t=0}$$

$$= 0.2 \times 20 \times 10$$
$$= 40\ V$$

c.) Time after $t=0$; $V_L = 24\ V$.

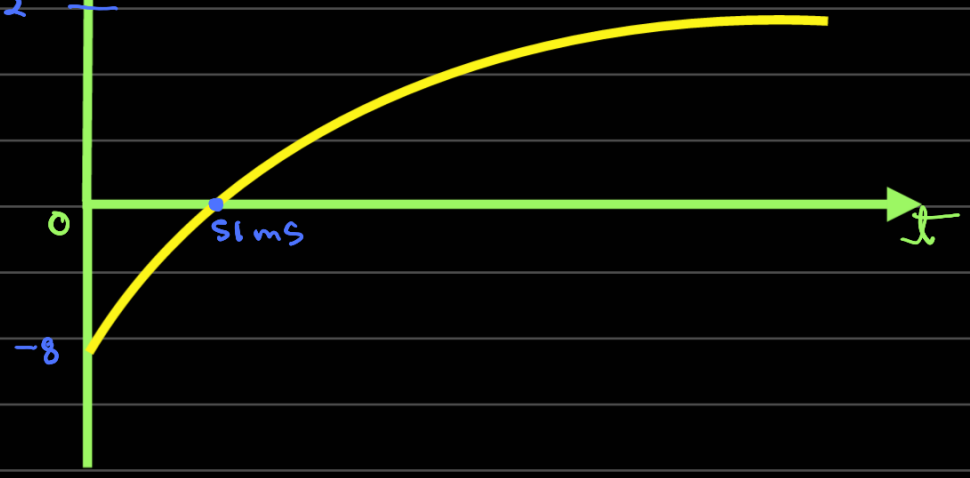
Ans.) $$24 = 0.2 \times 20 \times 10\, e^{-10t}$$

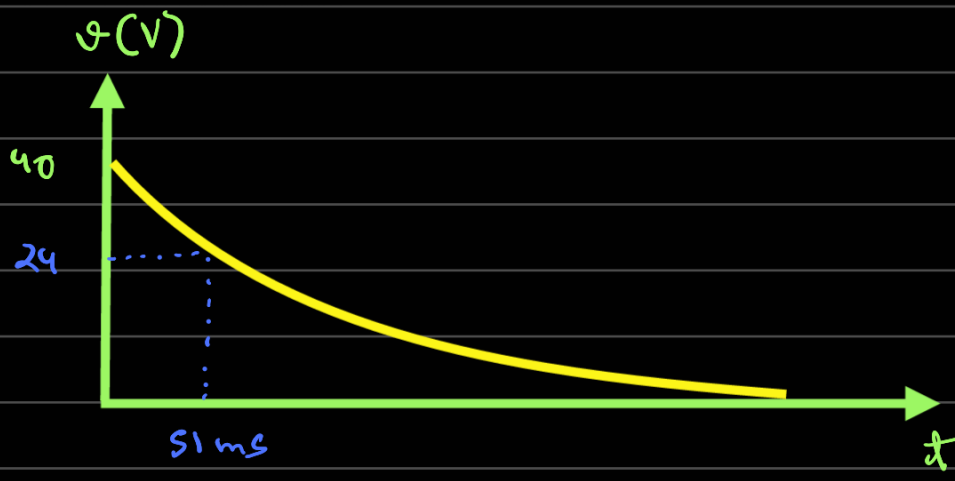
$$\Rightarrow t = -0.1 \ln 0.6$$

$$= 0.051\ s$$

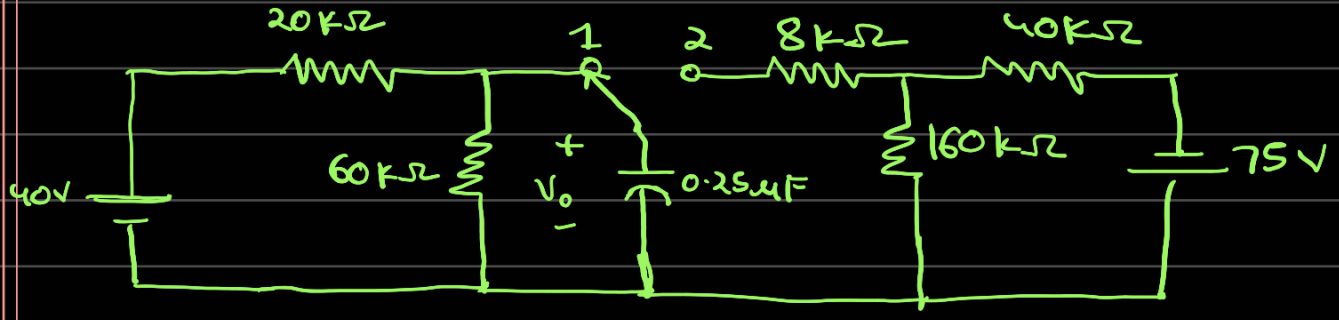
d.) Plot $i(t)$, $v(t)$ vs t.

Ans.)





2.)



Find $v_o(t)$, $i_o(t)$ after switching from 1 to 2 at $t=0$

Ans.) $V_o(t=0) = \frac{40}{20+60} \times 60 = 30\ V$

At $t \geq 0$, make Thevenin eq.

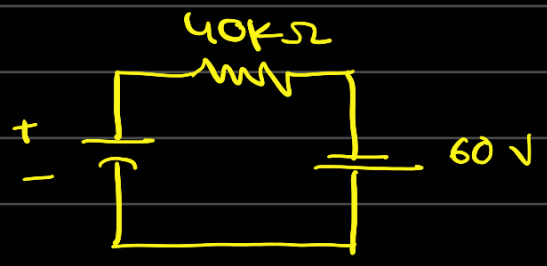
$$R_{Th} = 8 + \frac{40 \times 160}{200}\ k\Omega = 40\ k\Omega$$

$$V_{Th} = \frac{75}{40+160} \times 160$$

$$= \frac{75}{200} \times 160$$

$$= 60$$

$$= 60 \text{ V}$$



$$V(t) = 30 - (30 + 60)\, e^{-\frac{t}{40 \times \frac{1}{4} \times 10^{-3}}}$$

$$= 30 - 90\, e^{-100t} \quad \text{V}$$

$$i(t) = C\frac{dV}{dt}$$

$$= 0.25 \times 10^{-6} \times 90 \times 100\, e^{-100t} \quad \text{A}$$

$$= 2.25\, e^{-100t} \quad \text{mA}$$