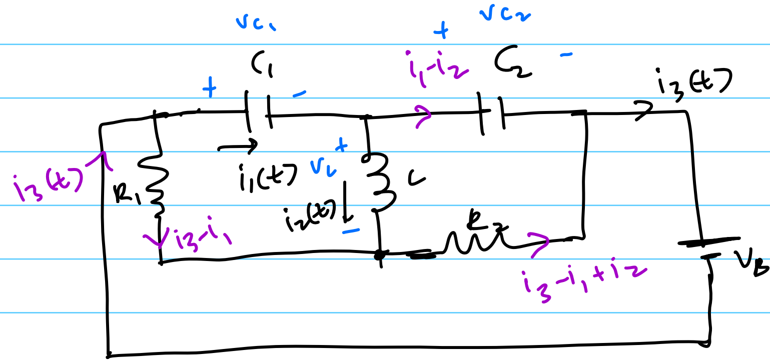
Ans. 1



KVL in loop 1

$$-v_{C_1} - v_L + (i_3 - i_1)R_1 = 0 \quad — (1)$$

$$i_1(t) = C_1 \frac{dv_{c_1}}{dt}$$

$$v_{C_1} \Rightarrow \frac{1}{C_1}\int i_1 dt \quad ; \quad v_{c_2} = \frac{1}{C_2}\int (i_1 - i_2) dt$$

$$v_L = L\frac{di_2}{dt}$$

from (1)

$$-\frac{1}{C_1}\int i_1 dt - L\frac{di_2}{dt} + (i_3 - i_1)R_1 = 0$$

$$\Rightarrow \boxed{i_1 R_1 + \frac{1}{C_1}\int i_1 dt + L\frac{di_2}{dt} - i_3 R_1 = 0} \quad — (A)$$

KVL in loop 2

$$v_L - v_{C_2} + (i_3 - i_1 + i_2)R_2 = 0$$

$$L\frac{di_2}{dt} - \frac{1}{C_2}\int(i_1 - i_2)\,dt + (i_3 - i_1 + i_2)R_2 = 0$$

$$\boxed{-\frac{1}{C_2}\int(i_1\,dt) - i_1 R_2 + i_2 R_2 + L\frac{di_2}{dt} + \frac{1}{C_2}\int i_2\,dt + i_3 R_2 = 0} \quad - (B)$$

<u>KVL in loop 3</u>

$$-V_{C_1} - V_{C_2} - V_B = 0$$

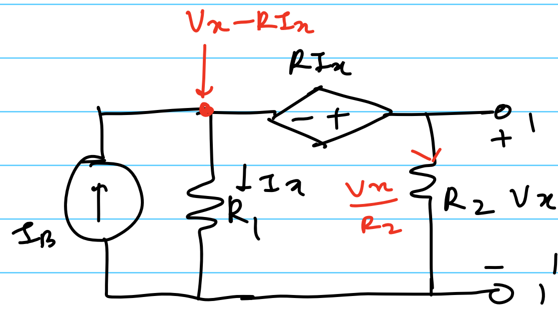
$$\frac{1}{C_1}\int i_1\,dt + \frac{1}{C_2}\int(i_1 - i_2)\,dt + V_B = 0$$

$$\boxed{\frac{1}{C_1}\int i_1\,dt + \frac{1}{C_2}\int i_1\,dt - \frac{1}{C_2}\int i_2\,dt + V_B = 0} \quad - (C)$$

Ans. 2

$I_B = 2mA, \; R_1 = 200\Omega$

$R_2 = 500\Omega, \; R = 300\Omega$



a) $V_{opencircuit}$

$$I_x = \frac{V_x - RI_x}{R_1}$$

$$I_x R_1 + R I_x = V_x$$

$$\boxed{I_x = \frac{V_x}{R_1 + R}} \quad — \; (1)$$

$$I_B = I_x + \frac{V_x}{R_2} \quad \text{(from KCL)}$$

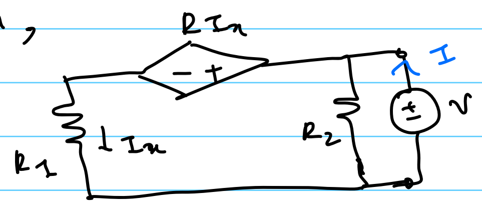
$$I_B = \frac{V_x}{R_1 + R} + \frac{V_x}{R_2}$$

$$I_B = \frac{V_x}{500\Omega} + \frac{V_x}{500\Omega}$$

$$\boxed{V_x = 250\Omega \times I_B \Rightarrow 250 \times 2m \Rightarrow 500mV}$$

↑ Vopen Circuit.

To find $R_{Thevenin}$,



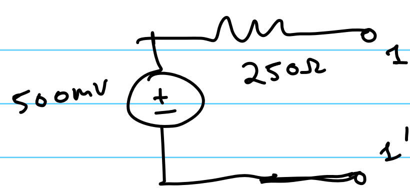
$$I_x = \frac{V - I_x R}{R_1}$$

$$\boxed{I_x = \frac{V}{R + R_1}}$$

$$I = \frac{V}{R_2} + I_x$$

$$I = \frac{V}{R_2} + \frac{V}{R + R_1}$$

$$\boxed{R_{eff} \Rightarrow \frac{V}{I} = (R + R_1) \| R_2 \Rightarrow 250\Omega}$$



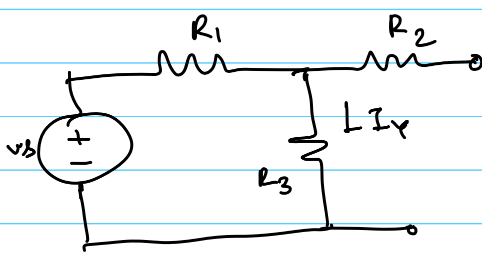
← Thevnin's equivalent.

b)

$$\boxed{P = \frac{V^2}{R_8} \Rightarrow \frac{(250m)^2}{250\Omega} = 2.5 \times 10^{-4} W}$$

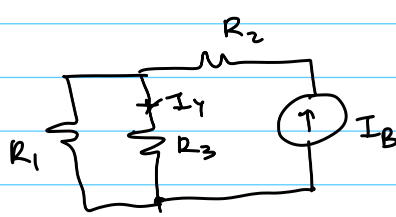
Ans.3

Due to V_B only



$$I_Y = \frac{V_B}{R_3 + R_1}$$

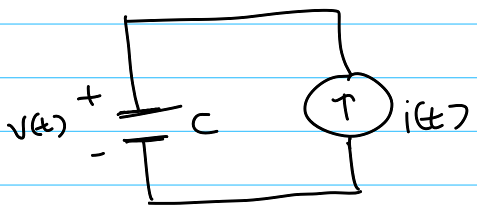
Due to I_B only

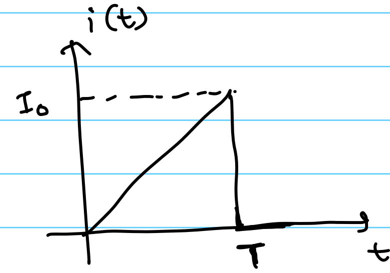


$$I_Y = \frac{I_B R_1}{R_1 + R_3}$$

$$\boxed{I_{y\,total} \Rightarrow \frac{V_8}{R_3+R_1} + \frac{I_B R_1}{R_3+R_1}}$$

Ans.4





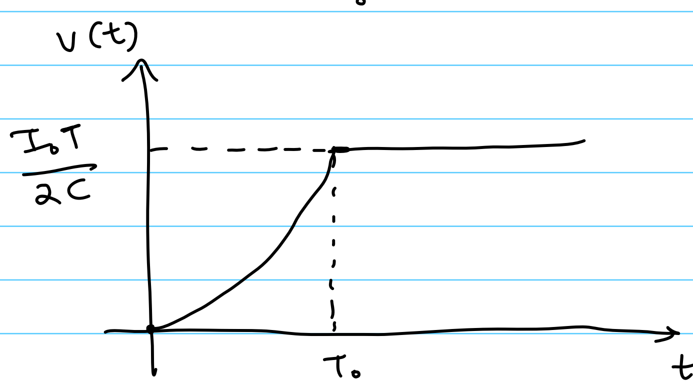
a) $$I = C\frac{dv}{dt}$$

$$v \Rightarrow \frac{1}{C}\int I\,dt$$

from $0<t<T$; $i(t) = \frac{I_0 t}{T}$

So, $$v(t) = \frac{1}{C}\int_0^t \frac{I_0 t}{T} \quad \text{for} \quad 0<t<T_0$$

$$\Rightarrow \frac{1}{C}\left|\frac{I_0 t^2}{2T}\right|_0^t \Rightarrow \frac{I_0 t^2}{2CT}$$



Once current goes to zero, voltage will be constant across the capacitor.

b) Energy stored in capacitor

$$E \Rightarrow \frac{1}{2} C V_{Final}^2 \Rightarrow \frac{1}{2} \times C \times \left(\frac{I_0 T}{2C}\right)^2 \Rightarrow \underline{\underline{\frac{I_0^2 T^2}{8C}}}.$$

c) Energy delivered by current source.

$$E = \int V I \, dt \Rightarrow \int V \, C \frac{dV}{dt} \, dt \Rightarrow \frac{C V_{Final}^2}{2} \Rightarrow \underline{\underline{\frac{I_0^2 T^2}{8C}}}.$$