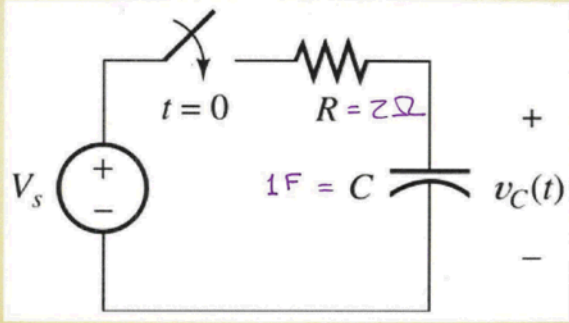
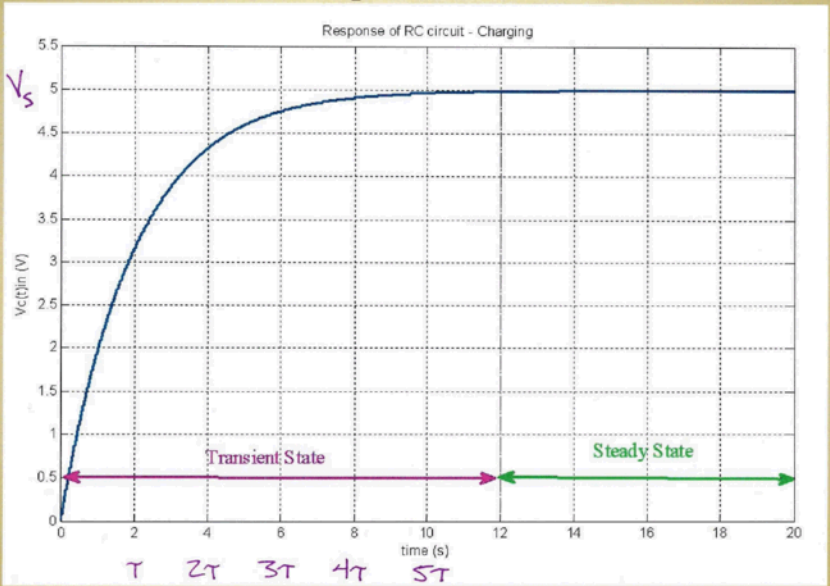
Example 8.7.2 – RC Circuit

- Find the expression for the voltage across the capacitor when $v_c(0^-) = 0$.



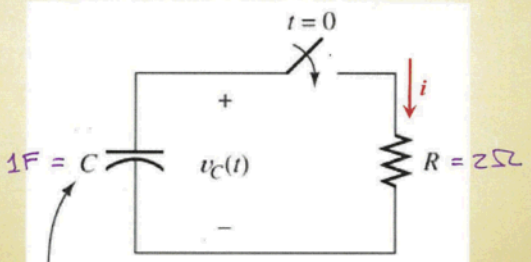
$\tau = RC$

Capacitor


Response of RC circuit - Charging
Vc(t)in (V)
time (s)
Vs
Transient State
Steady State
T
2T
3T
4T
5T

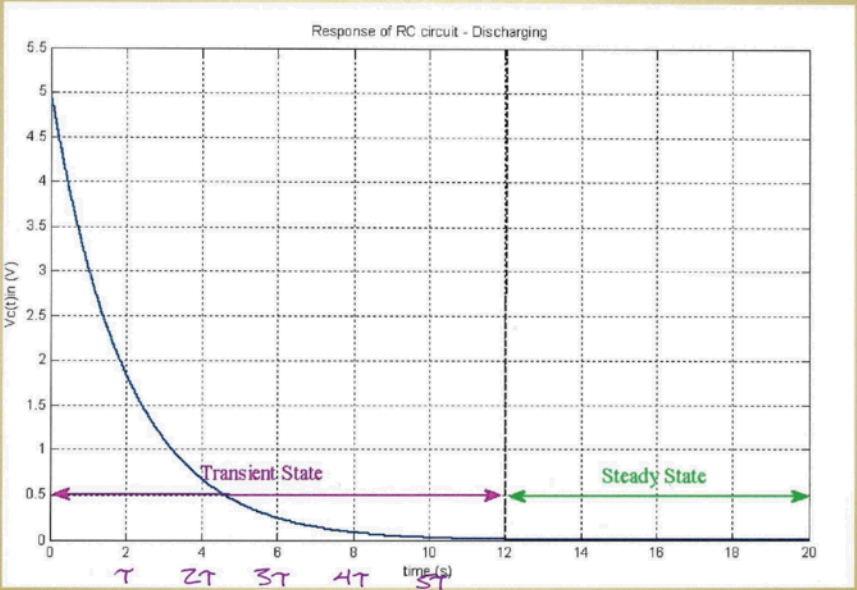
Example 8.7.1 – Discharge of a Capacitance through a Resistance

- Find the natural response of the voltage across the capacitor when the switch is closed at $t = 0$. Initially, the capacitor is charged to a voltage V_i



$\tau = RC$

Capacitor


Response of RC circuit - Discharging
Vc(t)in (V)
time (s)
Transient State
Steady State
T
2T
3T
4T
5T

Example 1a

$$v_c(t) = V_{oc} + \left[v_c(0) - V_{oc}\right] e^{-\frac{t}{RC}}$$

$V_{oc} = V_s = 5V$

$R = 2\Omega$

$C = 1F$

$v_c(0) = 0$

$$v_c(t) = 5 + \left[0 - 5\right] e^{-\frac{t}{2}} = 5 - 5e^{-\frac{t}{2}} V$$

Example 1b

$$v_c(t) = V_{oc} + \left[v_c(0) - V_{oc}\right] e^{-\frac{t}{RC}}$$

$V_{oc} = 0$

$R = 2\Omega$

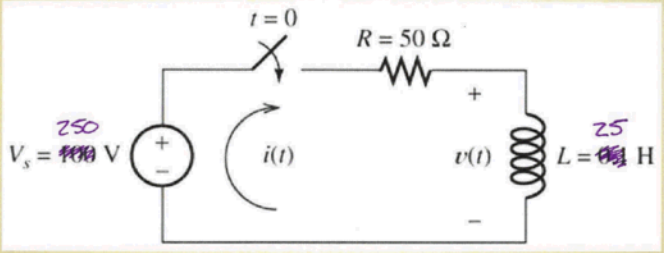
$C = 1F$

$v_c(0) = 5V$

$$v_c(t) = 0 + \left[5 - 0\right] e^{-\frac{t}{2}} = 5e^{-\frac{t}{2}} V$$

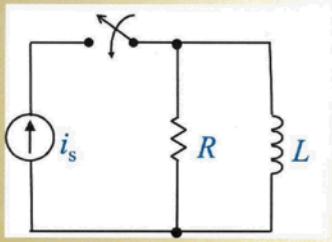
Example 8.7.3 – *RL* Circuit

- Find the express of the current.

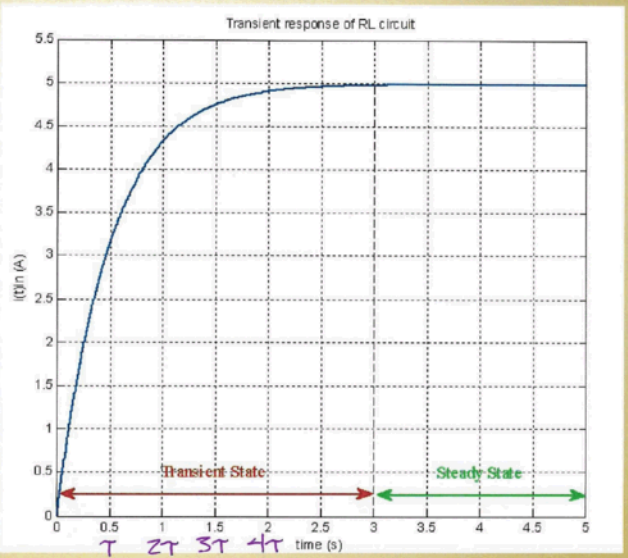


$$\tau = \frac{L}{R}$$

Inductor

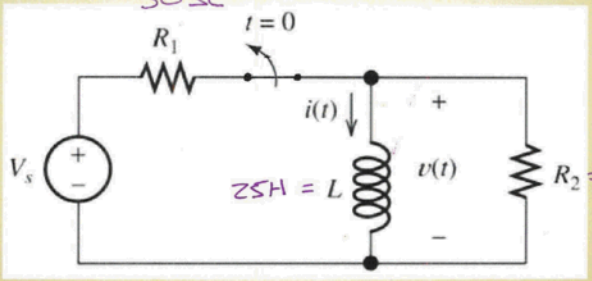


$$\tau = \frac{L}{R}$$



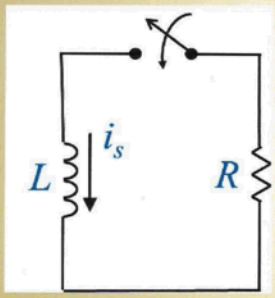
Example 8.7.4 – *RL* Circuit

- Find the express of the current

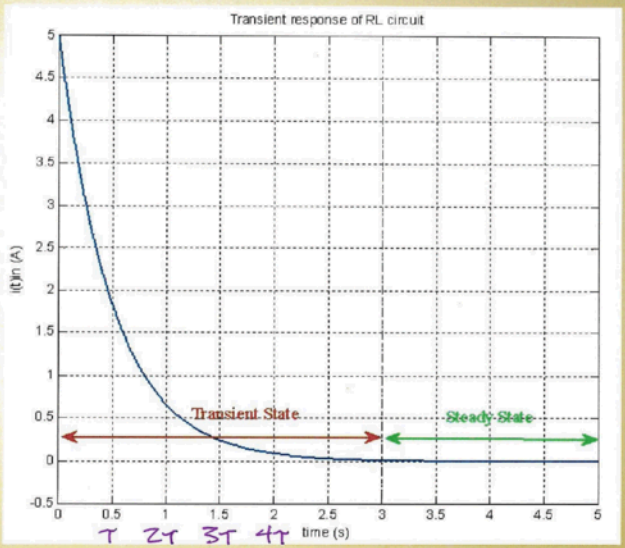


$$\tau = \frac{L}{R}$$

Inductor



$$\tau = \frac{L}{R}$$



Example 2a

$$i_L(t) = I_{sc} + \left[i_L(0) - I_{sc}\right] e^{-\frac{R}{L}t}$$

$$I_{sc} = \frac{250}{50} = 5\,A$$

$$R = 50\,\Omega$$

$$L = 25\,H$$

$$i_L(0) = 0$$

$$i_L(t) = 5 + [0-5]e^{-2t} = 5 - 5e^{-2t}\,A$$

Example 2b

$$i_L(t) = I_{sc} + \left[i_L(0) - I_{sc}\right] e^{-\frac{R}{L}t}$$

$$I_{sc} = 0$$

$$R = 50\,\Omega$$

$$L = 25\,H$$

$$i_L(0) = \frac{250}{50} = 5\,A$$

$$i_L(t) = 0 + [5-0]e^{-2t} = 5e^{-2t}\,A$$