$e^{-1} = 0.3679$ $\quad$ $1-e^{-1} = 0.6321$

$e^{-2} = 0.1353$ $\quad$ $1-e^{-2} = 0.8647$

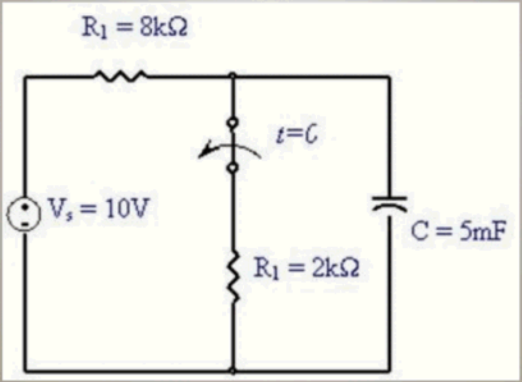
$e^{-3} = 0.0498$ $\quad$ $1-e^{-3} = 0.9502$

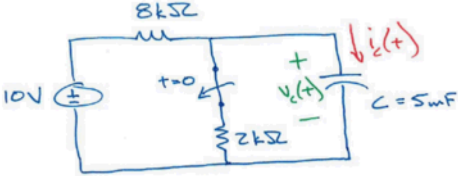
$e^{-4} = 0.0183$ $\quad$ $1-e^{-4} = 0.9817$

$e^{-5} = 0.0067$ $\quad$ $1-e^{-5} = 0.9933$

Example 8.7.5 – *RC* Circuit

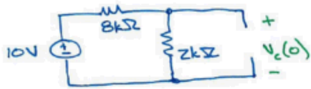
- Find the voltage across the capacitor when the switch is open at $t = 0$.





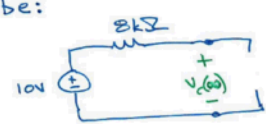
- Determine the initial condition.

Prior to $t=0$ the circuit is assumed to be in the steady state so $i_c = C\frac{dv_c(t)}{dt} = 0$.



$$v_c(0) = \frac{2k\Omega}{8k\Omega+2k\Omega}(10V) = 2V$$

- After the switch is opened the steady state will be:

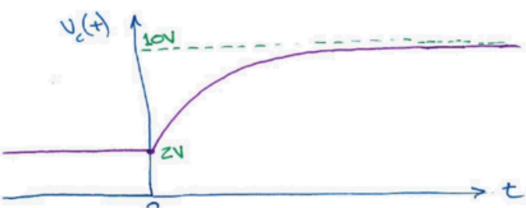


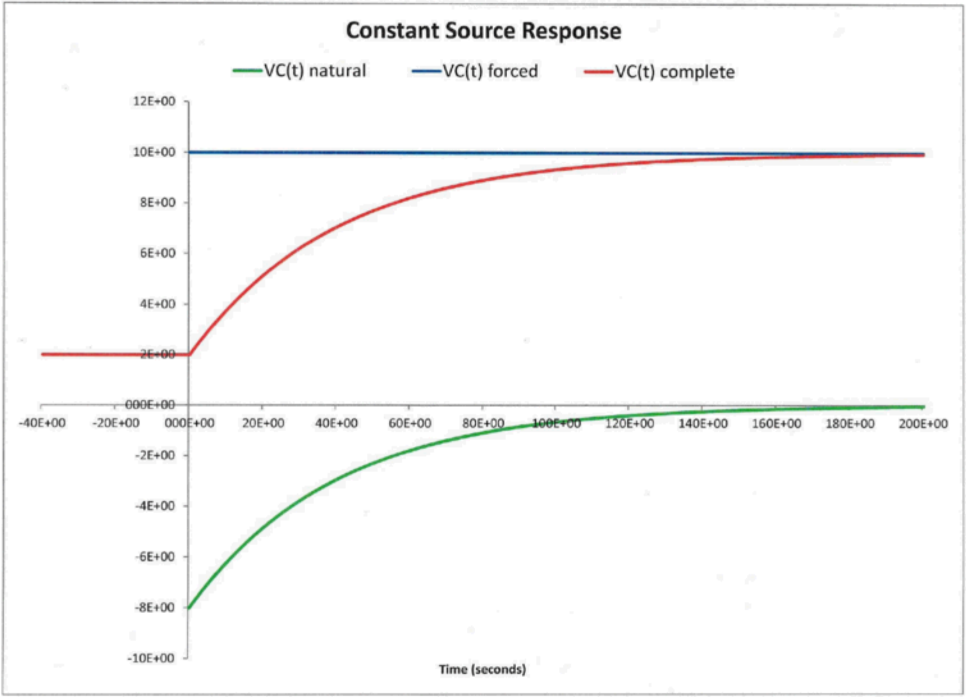
$$V_{oc} = 10V = v_c(\infty)$$

$$\tau = RC = 40 \text{ sec}$$

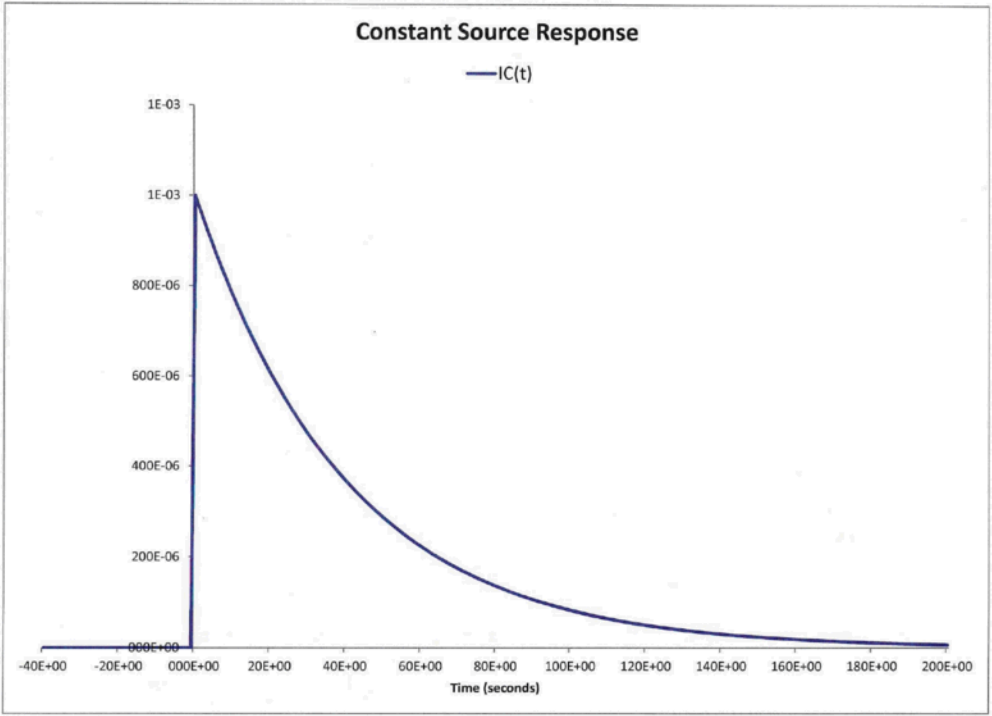
$$v_c(t) = V_{oc} + \left\{v_c(0) - V_{oc}\right\} e^{-\frac{t}{\tau}}$$

$$= 10 + (2-10)e^{-\frac{t}{40}} = 10 - 8e^{-\frac{t}{40}} V$$

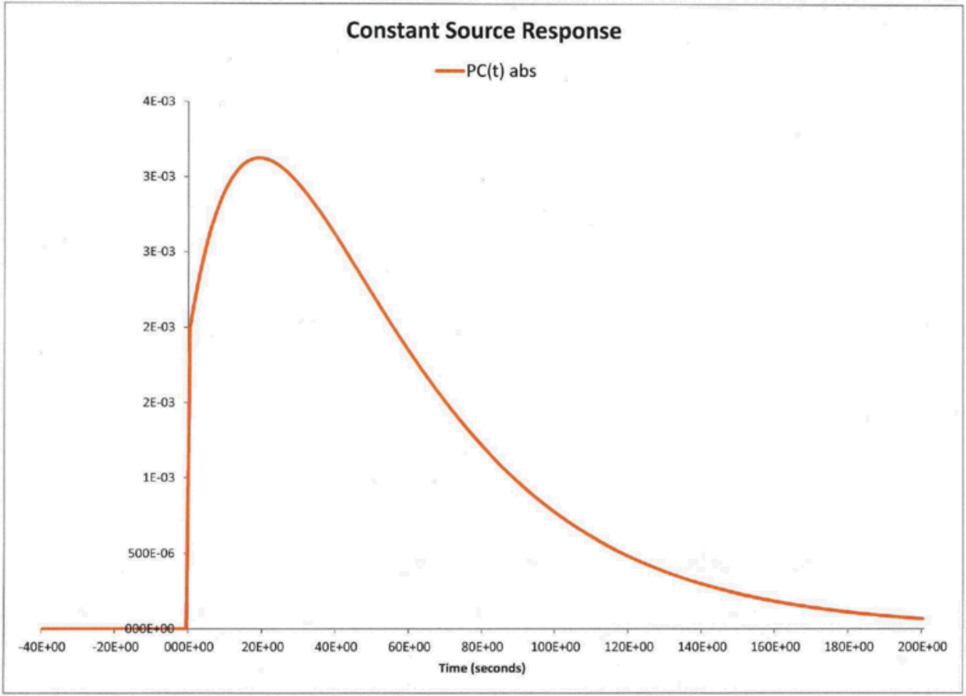


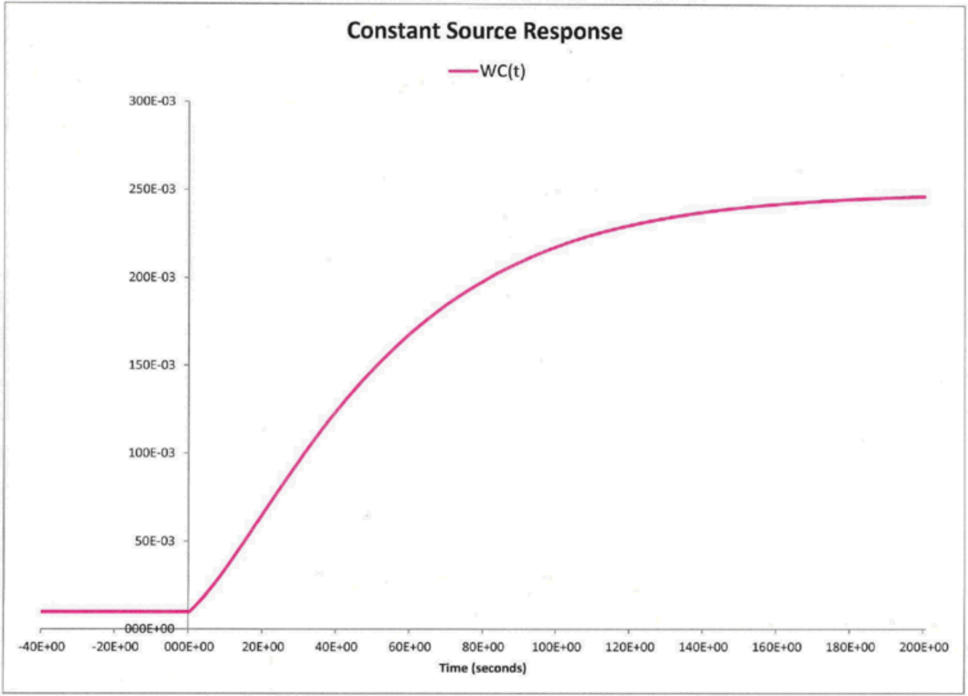


Constant Source Response
VC(t) natural
VC(t) forced
VC(t) complete
12E+00
10E+00
8E+00
6E+00
4E+00
2E+00
000E+00
-2E+00
-4E+00
-6E+00
-8E+00
-10E+00
-40E+00
-20E+00
000E+00
20E+00
40E+00
60E+00
80E+00
100E+00
120E+00
140E+00
160E+00
180E+00
200E+00
Time (seconds)



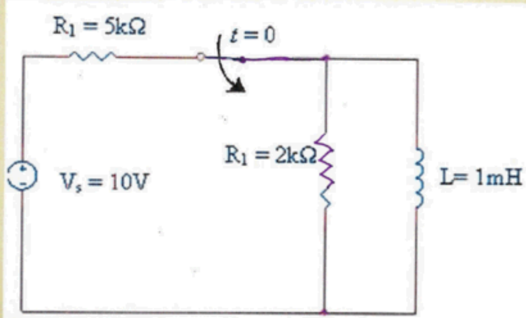
Constant Source Response
IC(t)
1E-03
1E-03
800E-06
600E-06
400E-06
200E-06
000E+00
-40E+00
-20E+00
000E+00
20E+00
40E+00
60E+00
80E+00
100E+00
120E+00
140E+00
160E+00
180E+00
200E+00
Time (seconds)

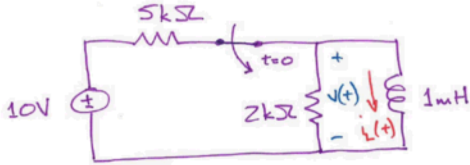

Constant Source Response
PC(t) abs
4E-03
3E-03
3E-03
2E-03
2E-03
1E-03
500E-06
000E+00
-40E+00
-20E+00
000E+00
20E+00
40E+00
60E+00
80E+00
100E+00
120E+00
140E+00
160E+00
180E+00
200E+00
Time (seconds)


Constant Source Response
WC(t)
300E-03
250E-03
200E-03
150E-03
100E-03
50E-03
000E+00
-40E+00
-20E+00
000E+00
20E+00
40E+00
60E+00
80E+00
100E+00
120E+00
140E+00
160E+00
180E+00
200E+00
Time (seconds)

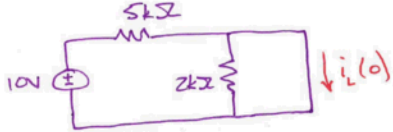
Example 8.7.6 – *RL* Circuit

- Find the expression for the current going through the inductor after the switch is open





Determine the initial inductor current.



$$i_L(0) = \frac{10V}{5k\Omega} = 2mA$$

After the switch is opened

$I_{sc} = 0$

$R = 2k\Omega$

$L = 1mH$

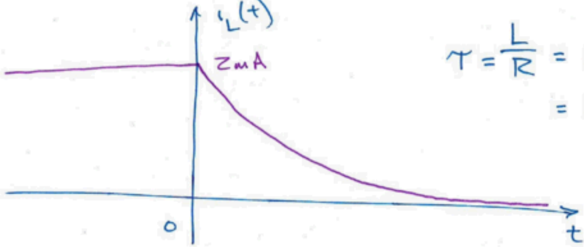
$i_L(0) = 2mA$

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

$$= 0 + [.002 - 0]e^{-\frac{2000}{.001}t}$$

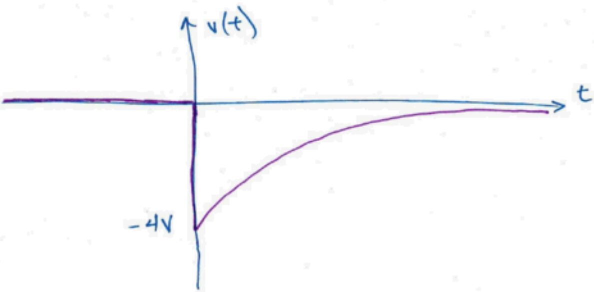
$$= .002e^{-2\times10^6 t} \text{ A}$$

$$v(t) = L\frac{di_L(t)}{dt} = (.001)(.002)(-2\times10^6 e^{-2\times10^6 t}) = -4e^{-2\times10^6 t} \text{ V}$$



$\tau = \frac{L}{R} = 0.5 \times 10^{-6}$

$= 0.5\,\mu sec$



$P_{abs}(t) = i_L(t)v(t) = -.008\,e^{-4\times10^6 t}$ W

$P_{sup}(t) = -P_{abs}(t) = .008\,e^{-4\times10^6 t}$ W