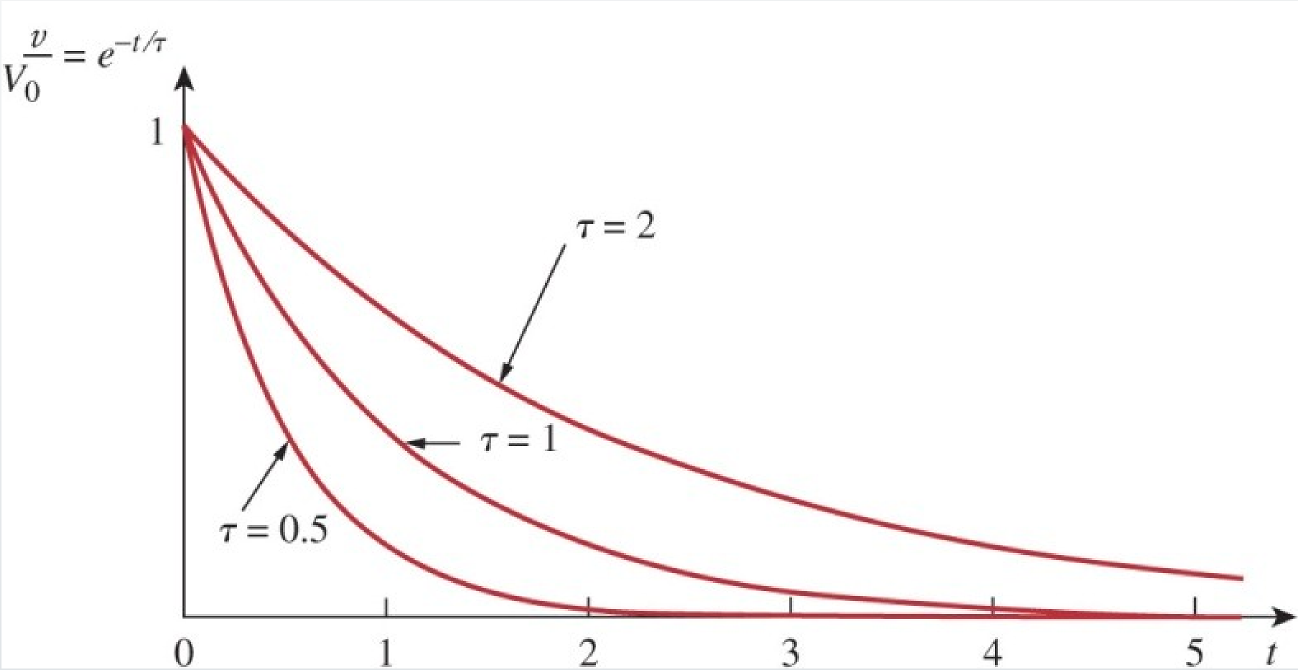
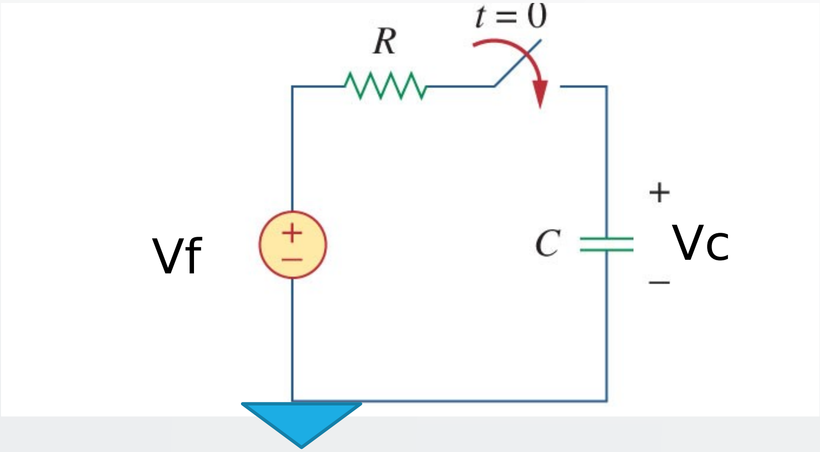
Circuitos de primer orden RC



Circuito RC



$$\frac{Vf - V_c}{R} = i_c$$

$$i_c = C\frac{dV_c}{dt}$$

$$0 = C\frac{dV_c}{dt} + \frac{V_c}{R} - \frac{Vf}{R}$$

$$V_c(0) = V_{INc}$$

Solucionando la ecuación diferencial de primer orden

$$\boldsymbol{V_c(t) = (V_{INc} - Vf)\,e^{\frac{-t}{RC}} + Vf}$$

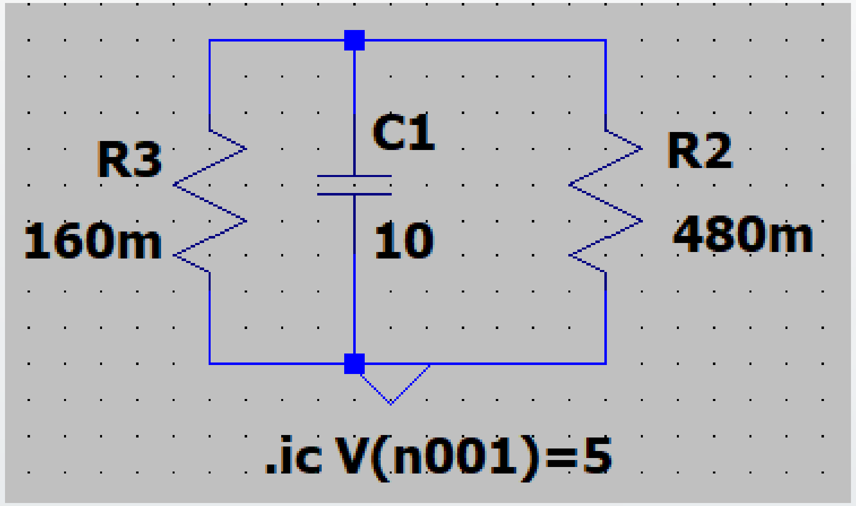
$$\boldsymbol{\tau}$$

Donde:

: Voltaje sobre el condensador
Voltaje inicial sobre el condensador
: Voltaje final sobre el condensador
C: Capacitancia
R: Resistencia equivalente que carga el condensador

Ejemplo 1

Calcule el si el condensador tiene un voltaje inicial de 5 v



$$V_c(t)=(V_{INc}-Vf)e^{\frac{-t}{\tau}}+Vf$$

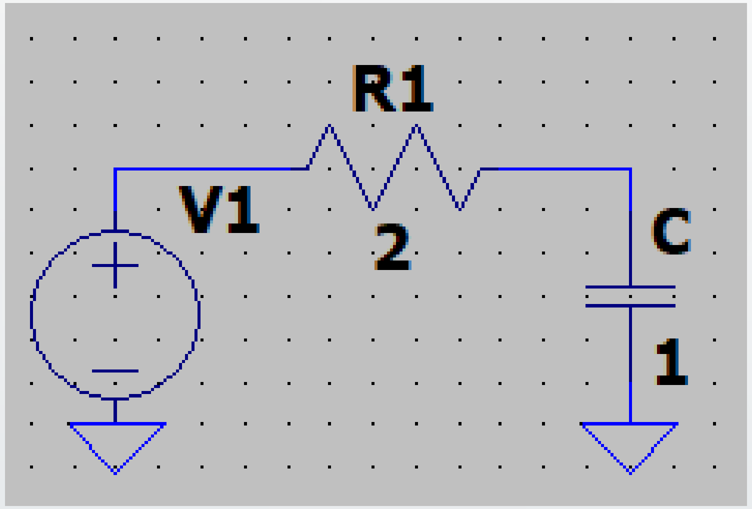
$$\tau=R*C=120m*10=1.2$$

R/ $$V_c(t)=(5-0)e^{\frac{-t}{1.2}}+0$$

$$i_c(t)=-\frac{5}{1.2}e^{\frac{-t}{1.2}}*10$$

Ejemplo 2

Calcule el si el condensador tiene un voltaje inicial de 2 V y



$$V_c(t) = (V_{INc} - Vf)e^{\frac{-t}{\tau}} + Vf$$

$$V_{INc} = 2$$

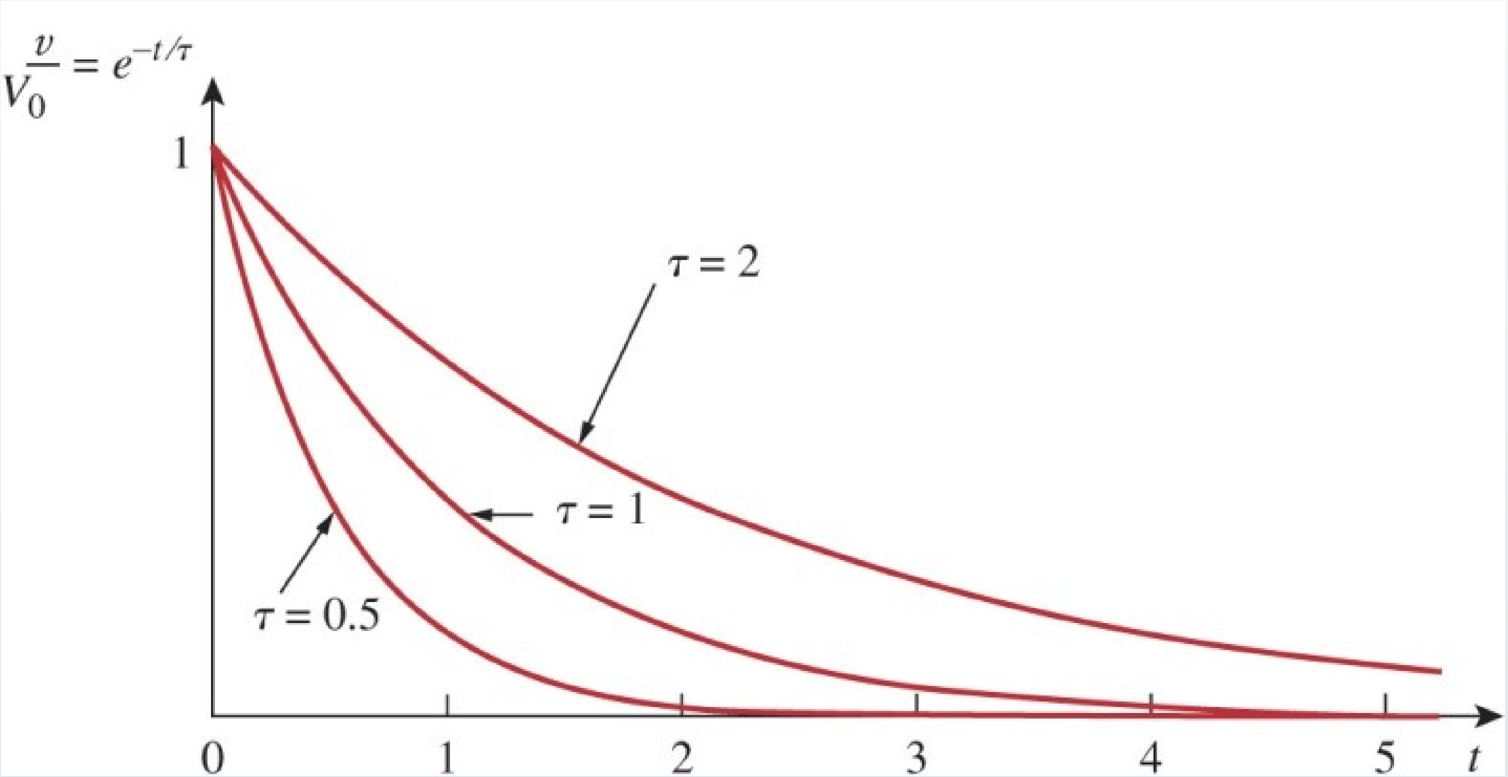
$$Vf = 5$$

$$\tau = 2$$

R/

$$V_c(t) = (2 - 5)e^{\frac{-t}{2}} + 5$$

Tiempo de carga



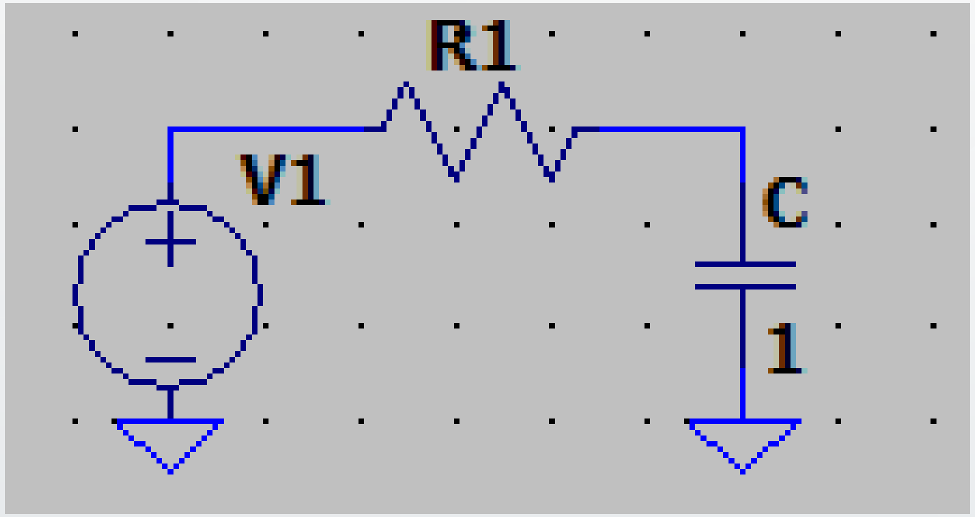
El tiempo de carga o descarga es el tiempo que le toma al voltaje sobre un condensador pasar de su valor inicial al final y depende de

1equivale al 63% de carga del condensador

5equivale aproximadamente al tiempo total de carga del condensador

Ejemplo 3

Calcule el , si) y R1 vale 1Ω, 2Ω y 3Ω



$$V_c(t)=(V_{INc}-Vf)e^{\frac{-t}{\tau}}+Vf$$

$$V_c(t)=(-1)e^{\frac{-t}{\tau}}+1$$

$$\tau_1=1$$
$$\tau_2=2$$
$$\tau_3=3$$

Ejemplo 4

Calcule

$$V_c(t)=(V_{INc}-Vf)e^{\frac{-t}{RC}}+Vf$$

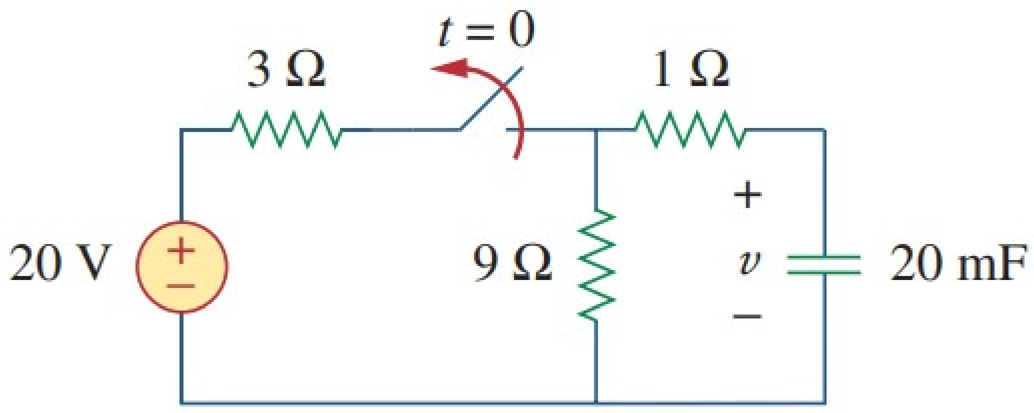


Figure 7.8
For Example 7.2.

$$V_{INc}=20 * \frac{9}{9+3}=15\,V$$

$$Vf=0\,V$$

$$R=10\,\Omega$$

$$\tau=20\,m * 10=0.2\,s$$

$$V_c(t)=(15-0)e^{\frac{-t}{0.2}}+0$$

7.7 Assuming that the switch in Fig. 7.87 has been in position A for a long time and is moved to position B at $t = 0$, Then at $t = 1$ second, the switch moves from B to C. Find $v_C(t)$ for $t \geq 0$.

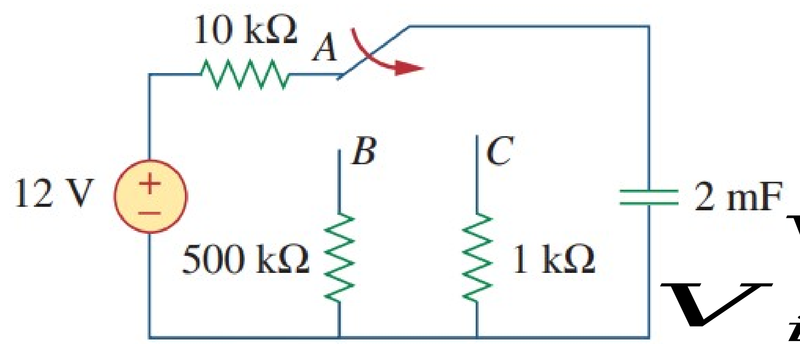


Figure 7.87
For Prob. 7.7.

$$V_{icB} = 12$$

$$V_{fB} = 0$$

$$\tau = 500\,k\,2\,m = 1000$$

$$V_c(t) \begin{cases} (12-0)\,e^{\frac{-t}{1000}} + 0 & 0<t<1 \\ i_i & 1<t \end{cases}$$

$$V_{icC}(t = 1\,s) = (12-0)\,e^{\frac{-t}{1000}} + 0$$

$$V_{icC}(t = 1\,s) = 11.99$$

$$V_{fC} = 0$$

$$\tau = 1\,k\,2\,m = 2$$

R/

$$V_c(t) \begin{cases} (12-0)\,e^{\frac{-t}{1000}} + 0 & 0<t<1 \\ (11.99-0)\,e^{\frac{-(t-1)}{2}} + 0 & 1<t \end{cases}$$

Ejercicios

7.39 Calculate the capacitor voltage for $t < 0$ and $t > 0$ for each of the circuits in Fig. 7.106.

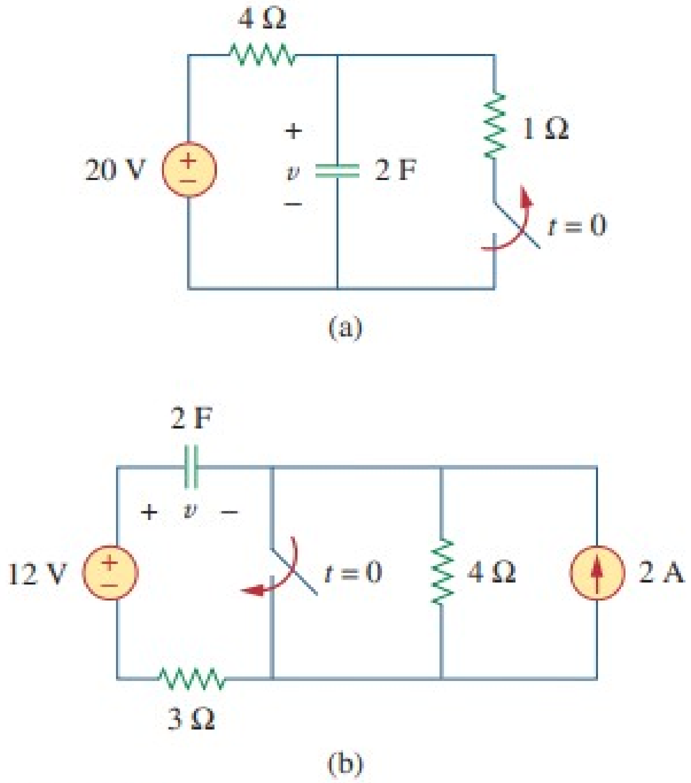


Figure 7.106
For Prob. 7.39.

7.4 The switch in Fig. 7.84 has been in position A for a long time. Assume the switch moves instantaneously from A to B at $t = 0$. Find v for $t > 0$.

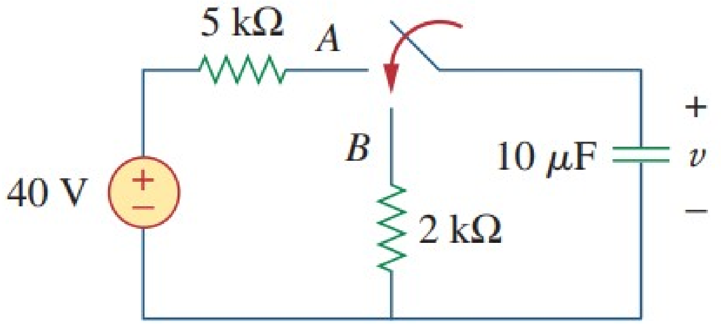


Figure 7.84
For Prob. 7.4.