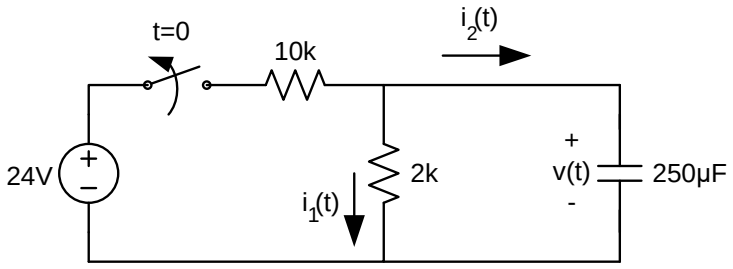
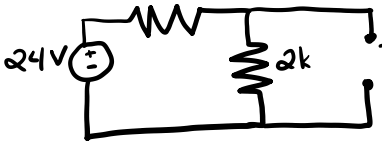


1. Find $v(t)$ for <u>all</u> time

Before $t=0$



$V_0 = \frac{2}{2+10}24 = \frac{2}{12}24 = 4V$

After $t=0$

$\tau = RC = (2k)(250\mu) = 500m = \frac{1}{2}$

$v_c(t) = V_0 e^{-t/\tau} = 4e^{-2t}$

$$v(t) = \begin{cases} 4V, & t < 0 \\ 4e^{-2t}, & t \geq 0 \end{cases}$$

2. Find $i_1(t)$ for $t > 0$

by Ω's Law, $i_1(t) = v(t)/2k$

$= \boxed{2e^{-2t}\,mA,\ t \geq 0}$

3. Find $i_2(t)$ for $t > 0$

by $i = Cv_c'$

$i_2(t) = Cv_c'(t) = (250\mu)(-8e^{-2t}) = -2000e^{-2t}\,\mu A$

$= \boxed{-2e^{-2t}\,mA}$

4. Roughly, when is cap 99% discharged?

$\approx$ 99% discharged at $t = 5\tau$

$= 5(\frac{1}{2}) \approx \boxed{2.5s}$

5. Exactly, when cap 50% discharged?

Exact 50% discharged when $v = 50\%$ of $4V = 2V$

$2 = 4e^{-2t}$, solve for t

$\frac{1}{2} = e^{-2t}$

$\ln(\frac{1}{2}) = -2t \Rightarrow t = -\frac{1}{2}\ln(\frac{1}{2}) = \boxed{0.347s}$

check: makes intuitive sense; a little less than $\tau = 0.5$ sec