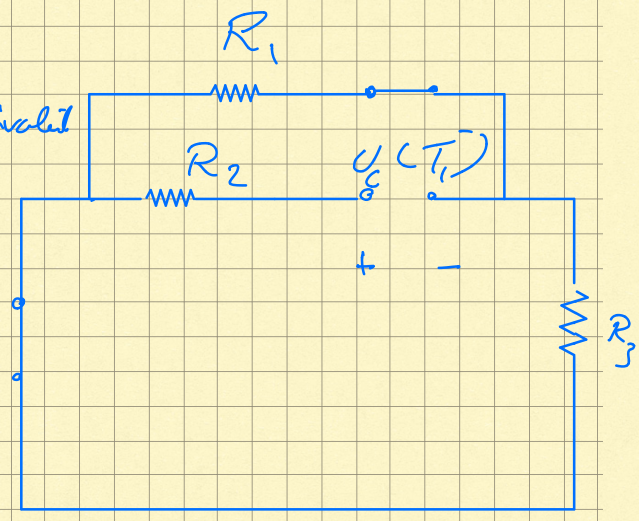
$t < T_1$

$v(t) = 0$, which is equivalent to a short circuit



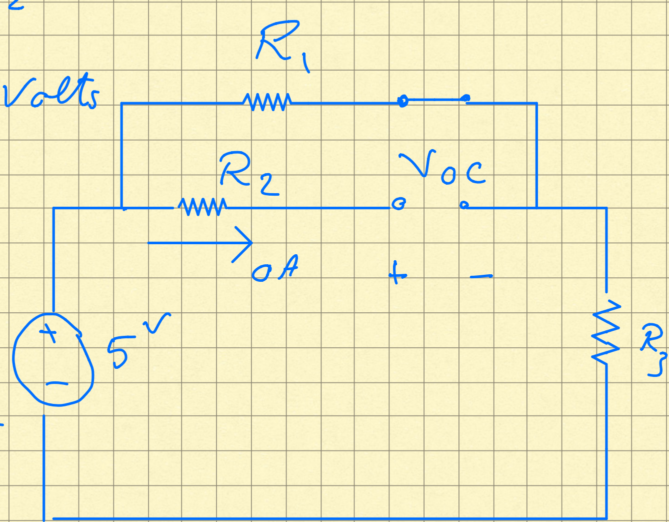
Without any sources in the circuit all voltages and currents are zero, Hence

$v_C(T_1^-) = 0$ Volts

$v_C(1^-) = 0$ Volts , $\boxed{v_C(t) = 0 \qquad t < 1}$

Next $T_1^+ < t < T_2$

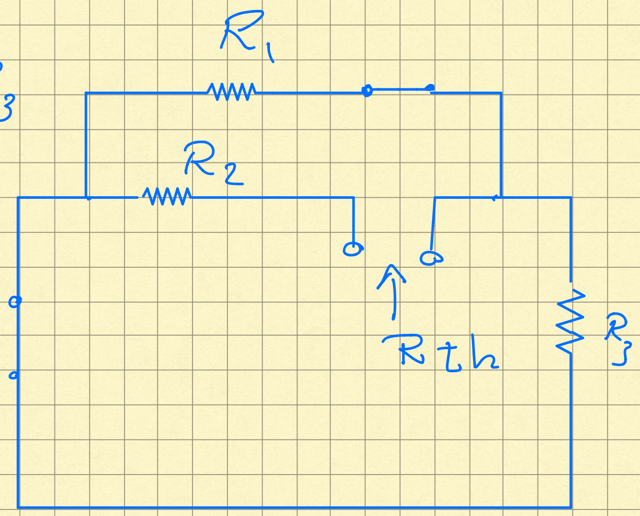
$v(t) = A = 5$ Volts



V_{OC} is the same voltage across R_1 Since R_1 and R_3 are in series, voltage across R_1 is

$$V_{OC} = \frac{R_1}{R_1+R_3} \times 5^V = 2.5\,V$$

R_{th}: To find R_{th}, we deactivate all independent sources, to get the circuit below



$$R_{th} = R_2 + R_1 \,//\, R_3$$

$$= 1 + \frac{2 \times 2}{2+2}$$

$$= 2\ \Omega$$

$$R_{th} C = 2 \times \frac{7}{6}$$

$$= \frac{7}{3} \text{ Seconds}$$

Therefore

$$v_c(t) = V_{oc} + [v_c(1^-) - V_{oc}]\, e^{-\frac{(t-1)}{RC}}$$

$$= 2.5 + [0 - 2.5]\, e^{-\frac{(t-1)3}{7}}$$

$$= 2.5\left(1 - e^{-\frac{(t-1)3}{7}}\right) \qquad 1^+ < t < 2^-$$

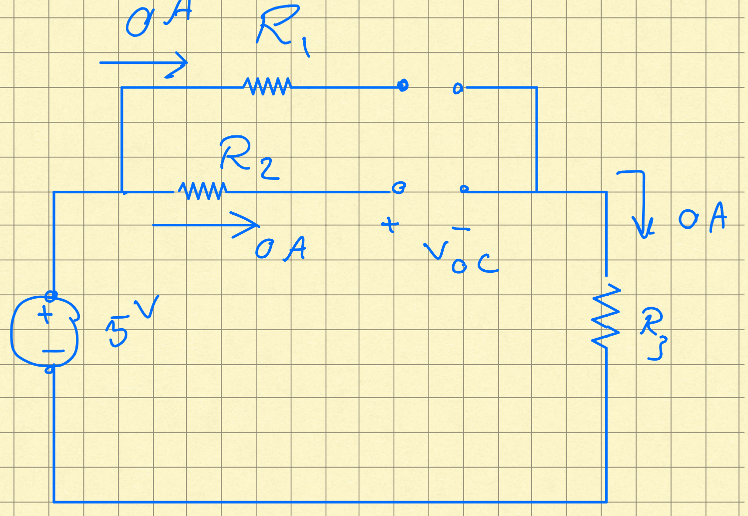
$$v_c(2^-) = 2.5\left(1 - e^{-\frac{(2-1)3}{7}}\right) = 0.8714$$

$t > T_2$, the switch opens

$$R_{th} = R_2 + R_3 = 3\ \Omega$$

$$R_{th} C = 3 \cdot \frac{7}{6} = \frac{7}{2} \text{ Seconds}$$

$V_{OC} = 5^V$



$$v_c(t) = V_{CC} + (v_c(2^-) - V_{CC})\, e^{-2\frac{(t-2)}{7}}$$

$$= 5 + (0.8714 - 5)\, e^{-2\frac{(t-2)}{7}}$$

$$= 5 - 4.12\, e^{-2\frac{t-2}{7}} \qquad 2^+ \leq t < \infty$$

$$v_c(t) = \begin{cases} 0 & t < 1 \text{ seconds} \\ 2.5\left(1 - e^{\frac{-(t-1)3}{7}}\right) & 1 < t < 2 \\ 5 - 4.12\, e^{\frac{-2t+4}{7}} & 2^+ \leq t < \infty \end{cases}$$