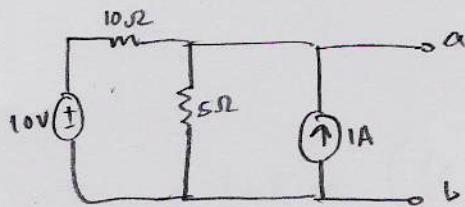
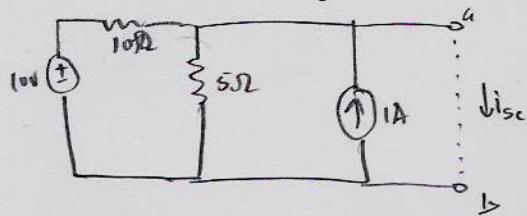


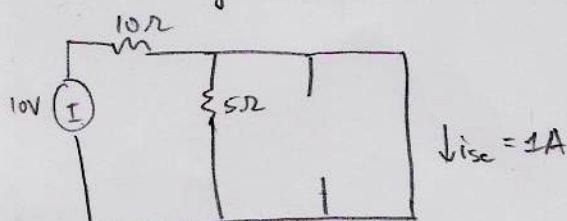
① Find the Thevenin equivalent circuit for



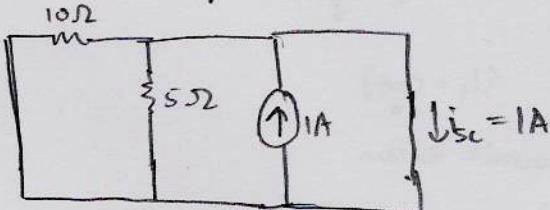
1. calculate i_{sc} using superposition



10V src only:

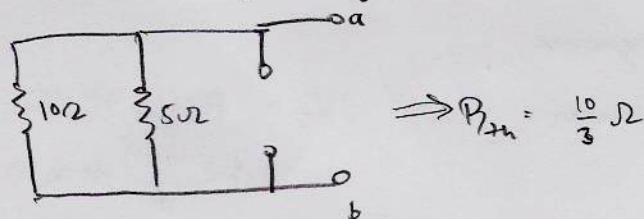


1A src only:

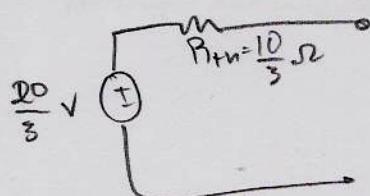


Therefore $i_{sc} = 2A$

2. calculate R_{th} by zeroing out sources:

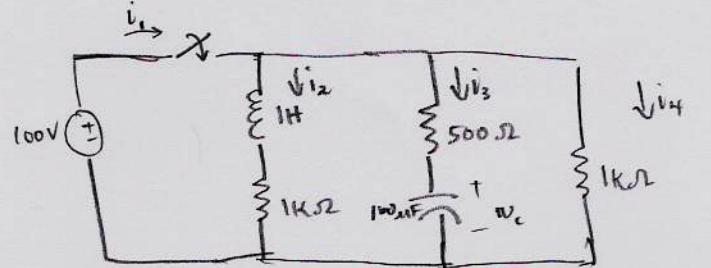


$$V_{th} = i_{sc} R_{th} = \frac{20}{3} V$$



② Let $*$ denote the operation of combining capacitances in parallel. Then

$$4\mu F * (6\mu F + 7\mu F + 10\mu F) * (2\mu F + (3\mu F * (57\mu F + 12\mu F))) \approx 8\mu F$$



In steady state, the inductor becomes a short circuit (why?) and the capacitor becomes an open circuit (why?).

$$\Rightarrow i_1 = i_2 + i_4 \quad (i_3 = 0 \text{ A})$$

$i_2/i_4 \rightarrow$ current divider

$$i_1 = \frac{100V}{0.5\text{k}\Omega} = \cancel{200 \text{ mA}}$$

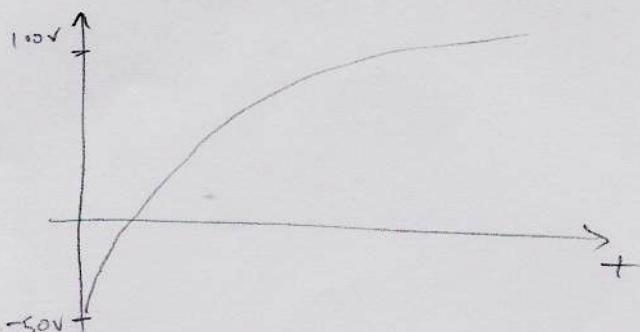
$$i_2 = i_4 = \cancel{100 \text{ mA}}$$

④ $v_c(t)$ is the solution to a first order differential equation

$$\Rightarrow v_c(t) = V_s + k_2 e^{-t/RC} = 100 + K_2 e^{-t/1000}$$

$$v_c(0+) = 100 + k_2 = -50 \Rightarrow k_2 = -150$$

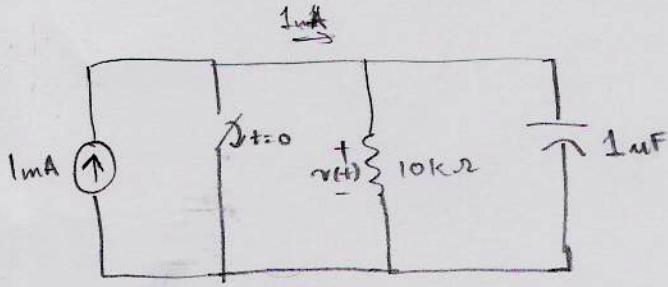
$$\Rightarrow v_c(t) = 100 - 150 e^{-1000t}$$



$$\begin{aligned} V_s &= R_i(t) + v_c(t) \\ &= RC \frac{dv_c(t)}{dt} + v_c(t) \end{aligned}$$

↑
first order homogeneous
differential equation

(5)



$$I_{MA} = \frac{v(t)}{R} + C \frac{dv(t)}{dt} \rightarrow I_0 = v(t) + 0.01 \frac{d}{dt} v(t)$$

The solution is of the form $v(t) = K_1 + K_2 e^{-t/RC}$

$$= K_1 + K_2 e^{-100t}$$

$$v(0+) = 0 = K_1 + K_2$$

$$I_0 = K_1 + K_2 e^{-100t} + 0.01 \left[K_2 e^{-100t} (-100) \right]$$

$$I_0 = K_1$$

$$\Rightarrow K_2 = -10$$

$$v(t) = 10 - 10e^{-100t}$$

(6) a) 0V

b) 5V

c) switch is in position A for a long time so $v_{out}(t=0-) = 0V$

~~$$\frac{Vs}{R} = (V_{out}(t)) + v_{out}(t)$$~~

~~$$Vs = RC \frac{dv_{out}(t)}{dt} + v_{out}(t)$$~~

$$v_{out}(t) = K_1 + K_2 e^{-t/RC} = K_1 + K_2 e^{-10^7 t}$$

$$v_{out}(0+) = 0 = K_1 + K_2$$

$$K_1 = V_s \quad (\text{pattern matching})$$

$$v_{out}(t) = 5 + 5e^{-10^7 t}$$

~~d) max current : $5V / 25k\Omega = 200mA$~~