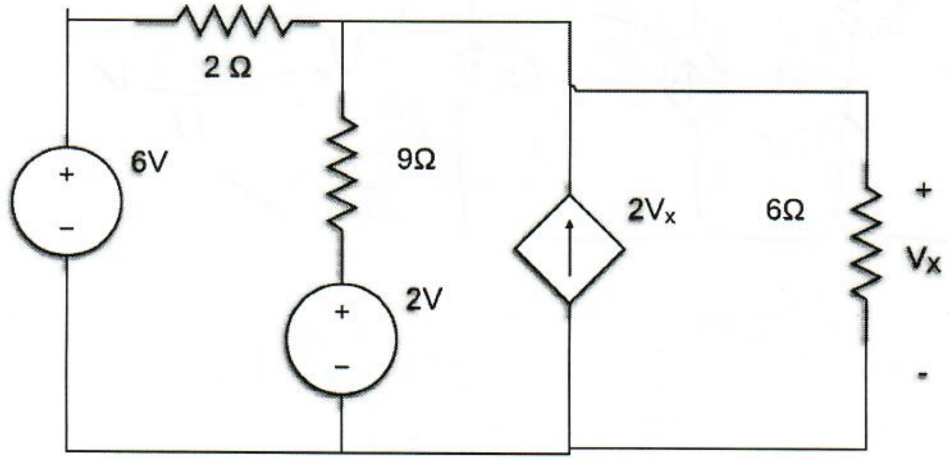
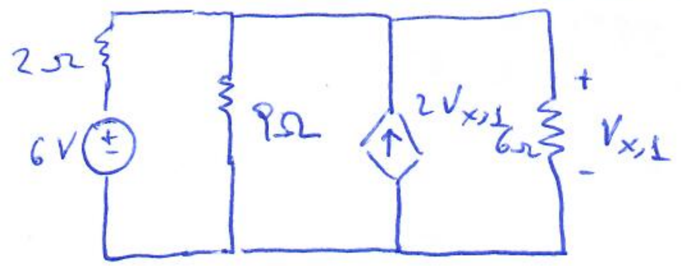
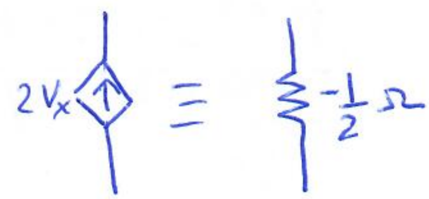
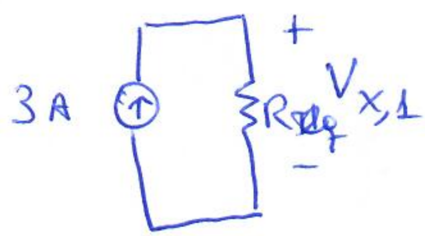
Q1. Find Vx by superposition in the circuit below. (8points)









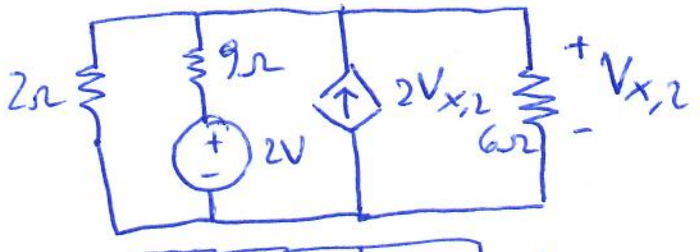
$$R_{eq} = 2\Omega \,||\, 9\Omega \,||\, -\tfrac{1}{2}\Omega \,||\, 6\Omega$$

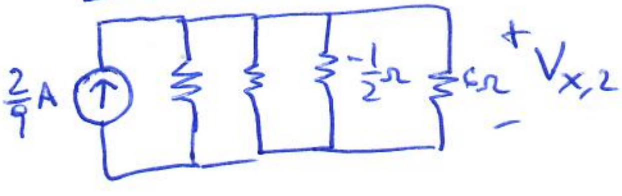
$$= \left(\frac{1}{2} + \frac{1}{9} - 2 + \frac{1}{6}\right)^{-1}$$

$$= \left(\frac{27+6+9-108}{54}\right)^{-1}$$

$$= -\frac{27}{33}\Omega$$

$$V_{x,1} = 3A\left(-\frac{27}{33}\Omega\right) = \frac{-27}{11}V$$



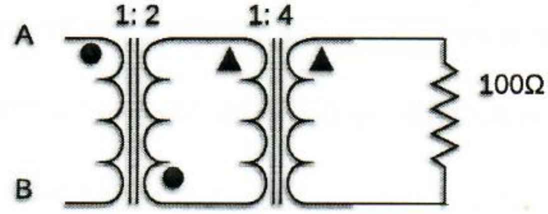


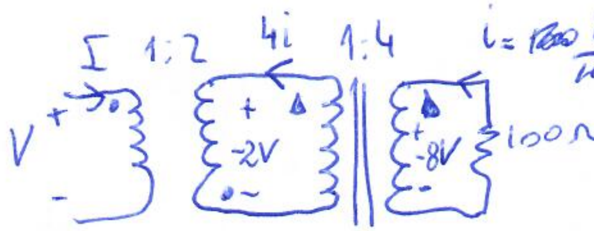
$$V_{x,2} = \frac{2}{9}A\left(\frac{-27}{33}\Omega\right) = \frac{-2}{11}V$$

$$V_x = V_{x,1} + V_{x,2}$$

$$V_x = \frac{-29}{11}V$$

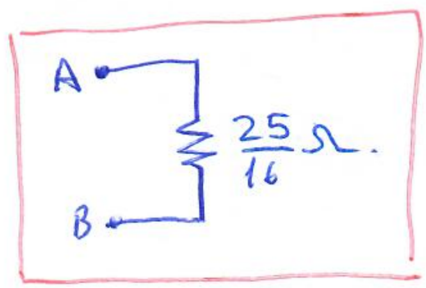
Q2. Find the Thevenin Equivalent between A and B. (8 points)





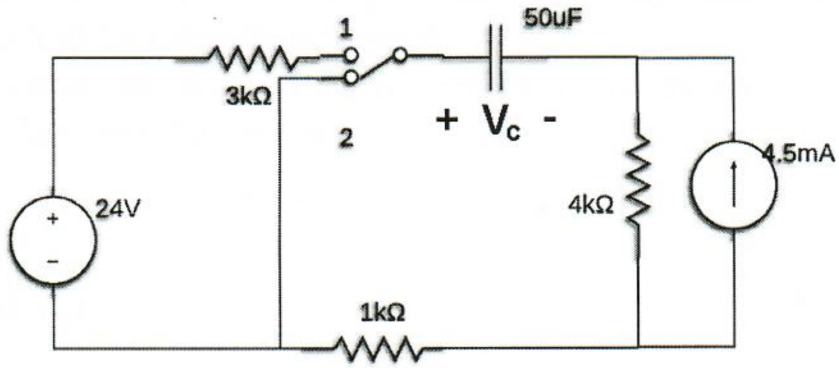
$i = \frac{8V}{100\Omega} = \frac{2V}{25\Omega}$

$I = 8i = 8\frac{8V}{100\Omega} \rightarrow V = I\frac{100\Omega}{64} \triangleq R_{eq}$

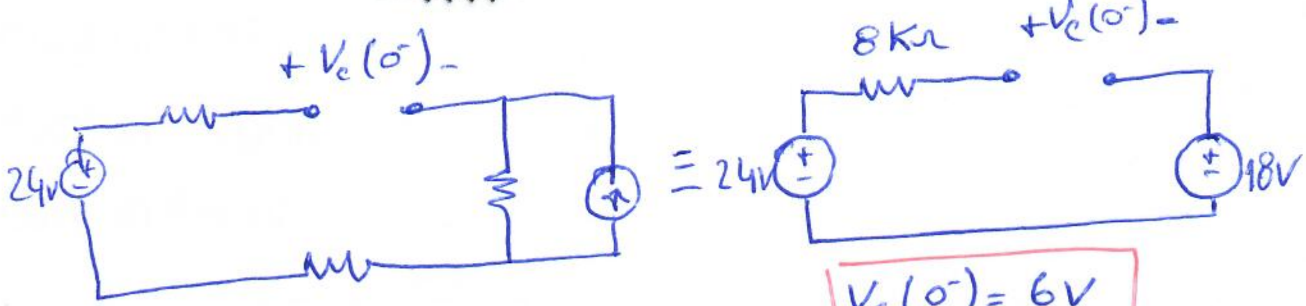


Q3. In the circuit below, the switch was moved from position 1 to position 2 at t=0. It had been in position 1 for a very long time before then. (14 points)

- **(a) Draw the equivalent circuit at $t=0^-$ and use it to find the initial condition Vc(0+). (4 points)**
- **(b) Draw the final condition $t\to\infty$ circuit to find out the final condition Vc(inf) . (3 points)**
- **(c) Use Thevenin equivalent to find out the time constant of the circuit for t>0. (4 points)**
- **(d) Now find Vc(t) for t > 0. (3 points)**

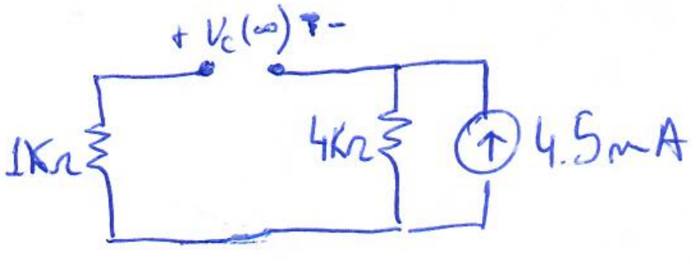


(a)



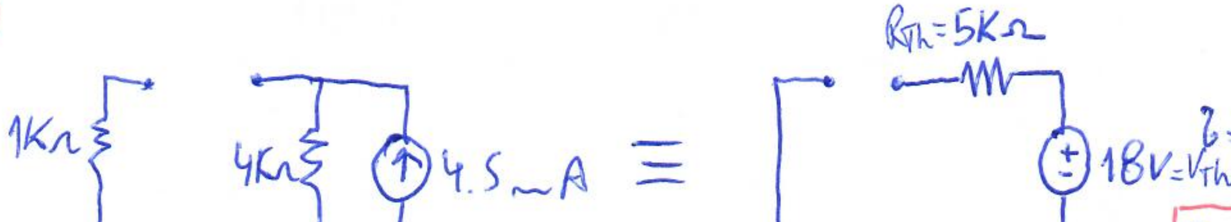
$V_c(0^-) = 6V$

(b)



$V_c(\infty) = -4k\Omega \cdot 4.5mA = -18V$

(c)



$\tau = 50\mu F \cdot 5k\Omega$

$\tau = 250 msec$

(d) $V_c(t) = V_c(\infty) + [V_c(0^+) - V_c(\infty)]e^{-t/\tau}$

In this case $V_c(0^-) = V_c(0^+)$ →

$V_c(t) = -18V + 24V e^{-\frac{t}{2.5\times10^{-1} sec}}$ $t > 0$