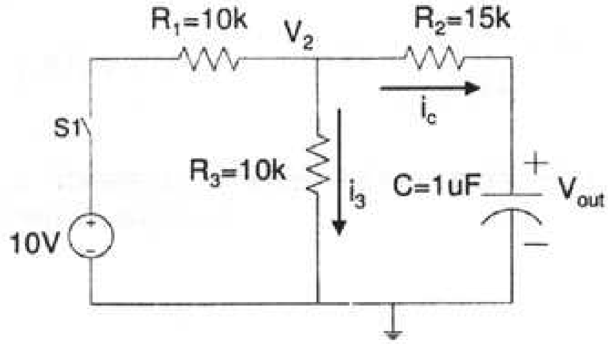
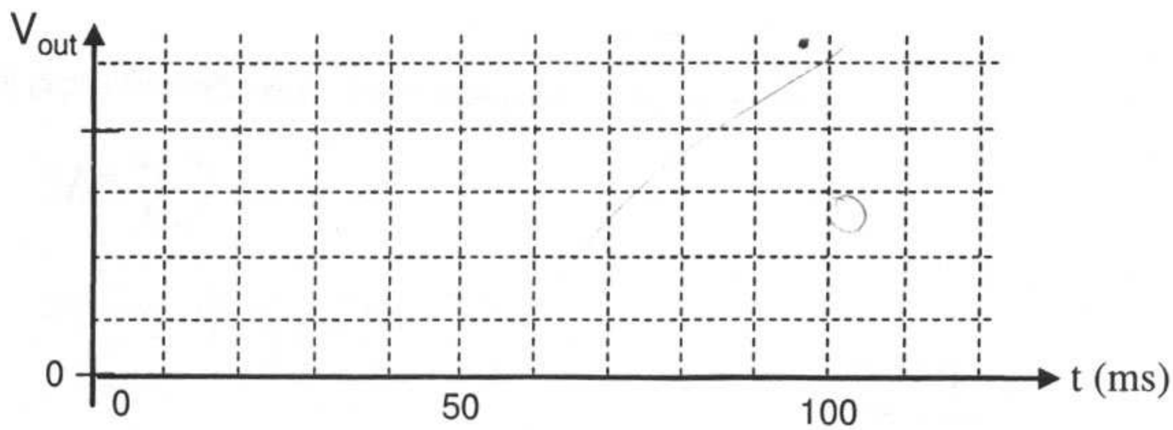
2. For t,0, the switch was open and V_{out}=0. At t = 0s, S1 closes. NOTE: $=10^{-6}$; k $=10^{3}$; $e^{-1}=0.37$; $e^{-2}=0.14$. Remember to put down units.



(a) (12 pts) Construct the differential equation of V_{out} in terms of all the given quantities. *Hint: you may solve this use Mesh of Nodal analysis, or even simpler, Thevnin equivalent circuit. Write all your steps.*

(b) (5pts) Write a closed-form expression for V_{out} (t) for t>0

(c) (8 pts) Plot V_{out} as a function of time t = 0 to t = 100ms. **Label the y-axis and all key points:** starting value, 1 time constant value, value at infinity



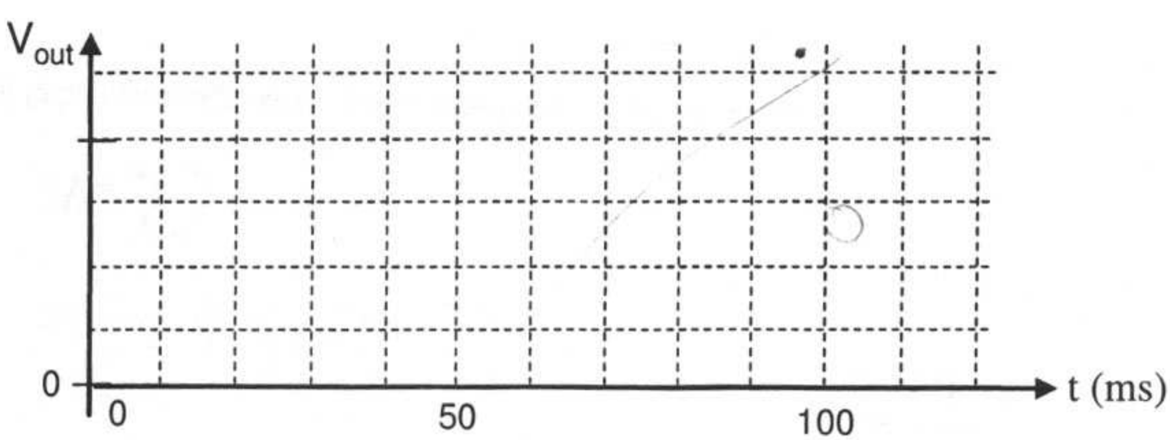
(d) (5pts) As t approaches infinity, what value will i_3 approach?

(e) (5 pts) Now, suppose someone disturbed the circuit and S1 is re-opened at 40 ms again! Construct the new differential equation.

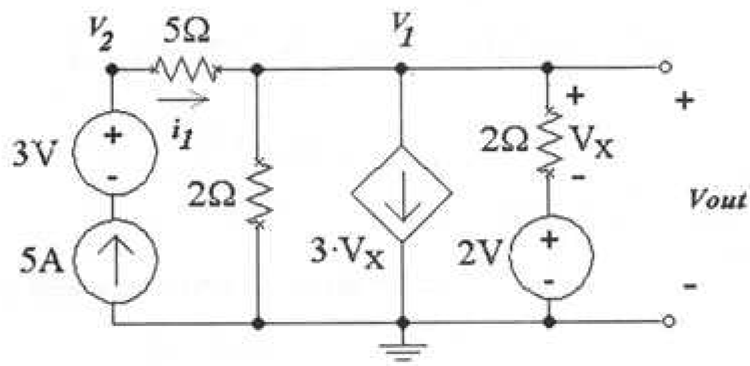
(f) (6pts) What is the new time constant? What is the new expression for $V_{out}(t)$ for t>40 ms.

(g) (5pts) in this case, as t approached infinity, what value will i_3 approach?

(h) (5pts) plot the new V_{out} from t = 0ms to 100 ms to include the re-opening of the switch at 40 ms. **Label the y-axis and all key points:** starting value, value at switching point, 1 time constant values, value at infinity.



1. (50 pts) Equivalent Circuit.



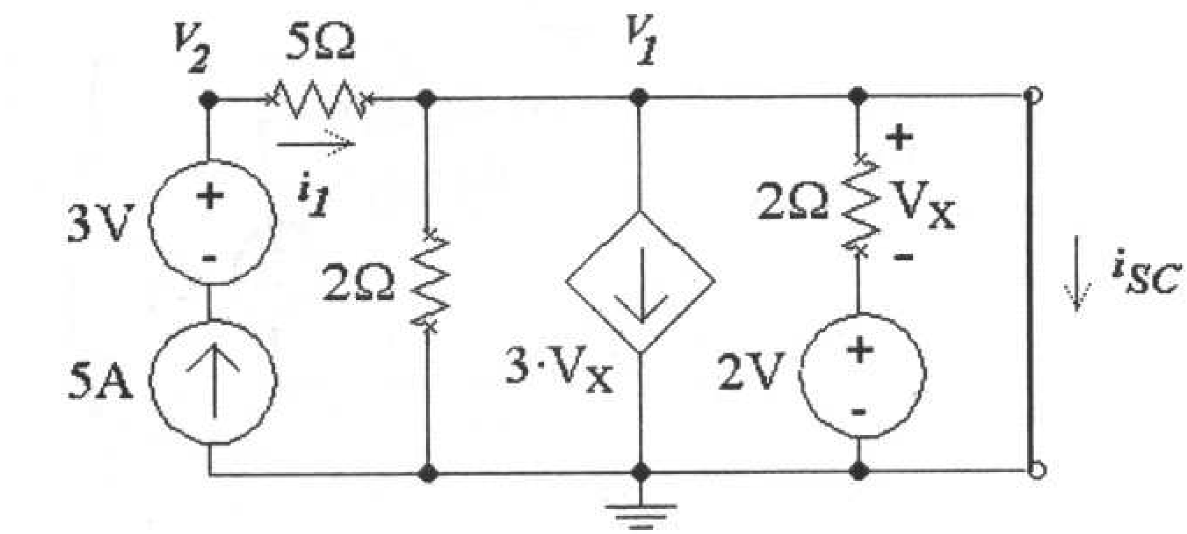
(b) (5pts) Use KVL, write down the equation of V_x in terms of V_1 and/or V_2

(c) (5 pts) Use KCL, write down the equation for V_1 and solve for V_1.

(d) (5 pts) Use KCL write down the equation for V_2 and solve for V_2.

(e) (5 pts) Solve for V_{out} (this is simply the Thevenin Voltage)

(f) Now we short the two end terminals



(5 pts) What is V_1 ?

(g) (5 pts) What is V_x?

(h) (5 pts) what is I_{sc}?

(i) (5 pts) what is the Thevenin Resistance?

(j) (5 pts) draw the Thevernin Equivalent Circuit.