ECS 203 2014: Quiz 5 **Solution**

(Free)

Instructions

i. Separate into groups of no more than three persons. Make sure the group members are not exactly the same as any of your earlier groups.

ii. Only one submission is needed for each group. Late submission will not be accepted.

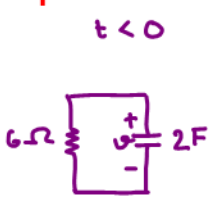
iii. ***Write down all the steps*** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.

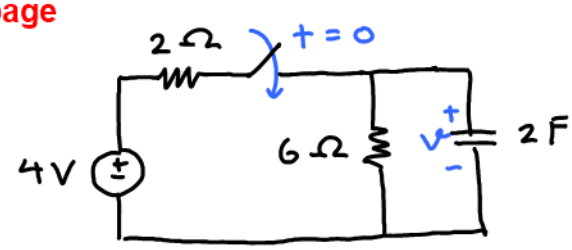
Name	ID
Prapun	

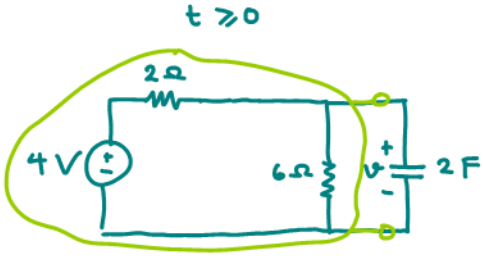
For this quiz, your answers should be of the form X.XXX, e.g., 1.214, 0.767, 0.000.

1. Consider the circuit below. Find v(t) at t = -3, 0, 3, 6, ∞.

See explanation on the next page







$v(t) = 0, \quad t < 0$

$v(0^-) = 0$ } no jump

$v(0) = 0$

$V_{th} = 3V$

$R_{th} = \frac{3}{2}\Omega$

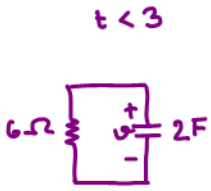
$\tau = R_{th} \times C = \frac{3}{2} \times 2 = 3$ sec

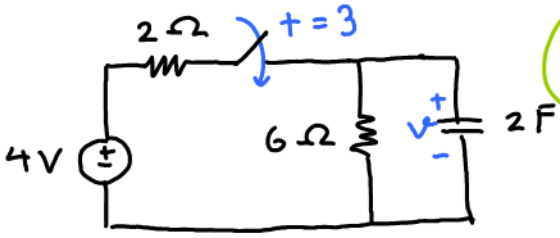
$v(t) = e^{-t/3}(0 - 3) + 3$

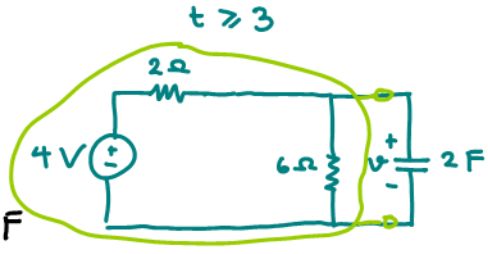
$= 3 - 3e^{-t/3}, \quad t \geq 0$

t	-3	0	3	6	∞
$v(t)$	0.000	0.000	1.896	2.594	3.000

2. Consider the circuit below. Find v(t) at t = -3, 0, 3, 6, ∞.







$v(t) = 0, \quad t < 3$

$v(3^-) = 0$ } no jump

$v(3) = 0$

$V_{th} = 3V$; $R_{th} = \frac{3}{2}\Omega$

$\tau = R_{th} \times C = \frac{3}{2} \times 2 = 3$ sec

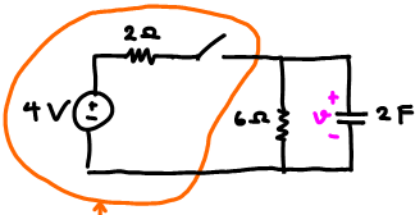
$v(t) = e^{-\frac{t-3}{3}}(0 - 3) + 3$

$= 3 - 3e^{-\frac{t-3}{3}}, \quad t \geq 3$

t	-3 (<3)	0 (<3)	3	6	∞
$v(t)$	0	0	0	1.896	3

a)

$t<0$



The open SW disconnects this part from the part that has capacitor.

The remaining part does not have any source. It has been left in this configuration for a long time (starting from time $-\infty$). So, it has reached its steady-state with capacitor → open circuit.

With the broken connection, there can't be any current in the loop. Therefore, there can not be any voltage across the resistor. From the picture, v is the same as the voltage across the resistor. Hence,

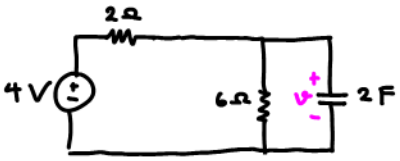
$v(t)=0,\ t<0.$

In particular, $v(0^-)=0.$

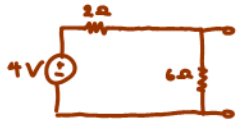
↓ no jump in capacitor's voltage.

$v(0)=0$

$t\geq 0$



We first find the Thevenin equivalent circuit at the capacitor's terminals.



R_{th}

$R_{th} = 2//6$

$= \frac{2\times 6}{2+6} = \frac{12}{8}$

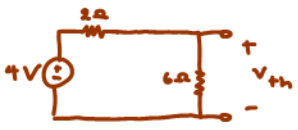
$= \frac{3}{2}$

↓

$\tau = R_{th} \times C$

$= \frac{3}{2} \times 2 = 3$ s.

V_{th}



By voltage divider formula,

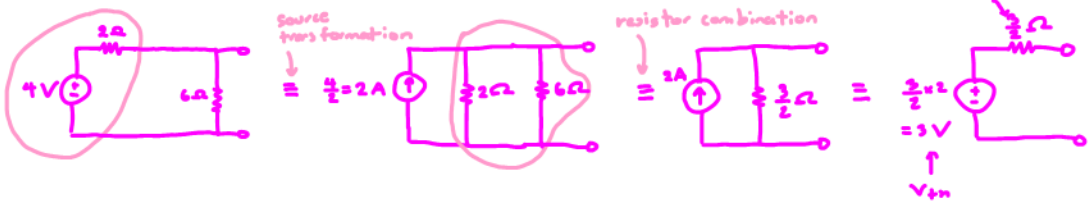
$V_{th} = \frac{6}{2+6} \times 4 = 3\,V$

↑ This is $v(\infty)$

Therefore, $v(t) = 3 + (0-3)\,e^{-t/3},\ t\geq 0.$

$= 3 - 3e^{-t/3},\ t\geq 0$

Remark: One could also use source transformation to find V_{th} and R_{th}:



b) Note that the analysis/calculation will be exactly the same as part (a) except that t_0 now $= 3$ instead of $= 0$.

Using exactly the same analysis as in part (a), we have

$v(t) = 0,\quad t<3$

$v(3^-) = 0 = v(3)$

$v(t) = 3 + (0-3)\,e^{-(t-3)/\tau},\quad t\geq 3.$

$= 3 - 3e^{-(t-3)/3},\quad t\geq 3$