ECS 203 2014: Quiz 3 Sol

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.

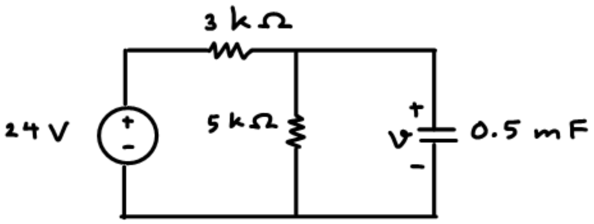
iii. ***Write down all the steps*** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.

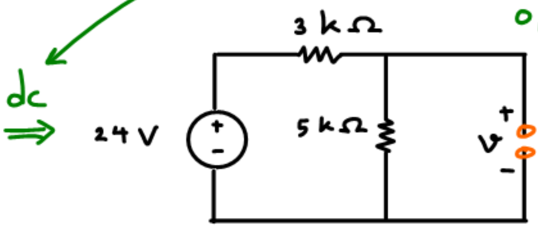
Name	ID
Prapun	555

Find the voltage v under dc condition in each of the following circuits.

under dc condition, capacitor becomes an open circuit. This same reasoning is applied in all parts.

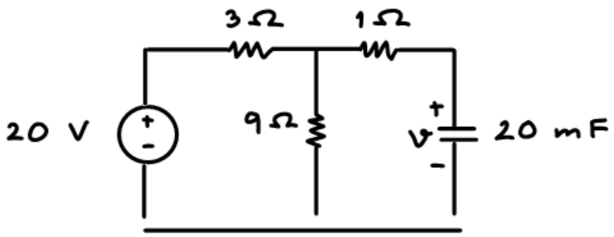
(a)

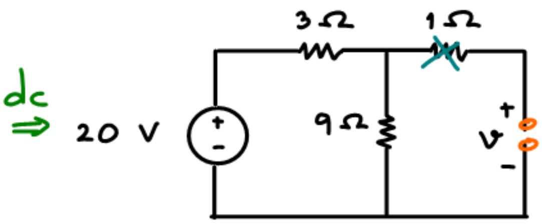




Note that v is the same as the voltage across the 5 kΩ resistor. By the voltage divider formula: $v = \frac{5\cancel{k}}{\cancel{5k}+\cancel{3k}}\times\overset{3}{\cancel{24}} = 15$ V

(b)



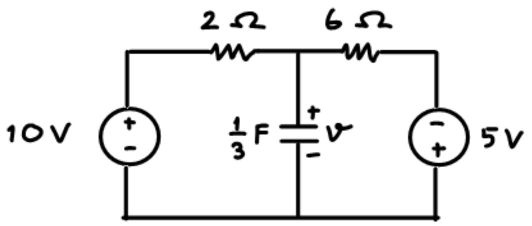


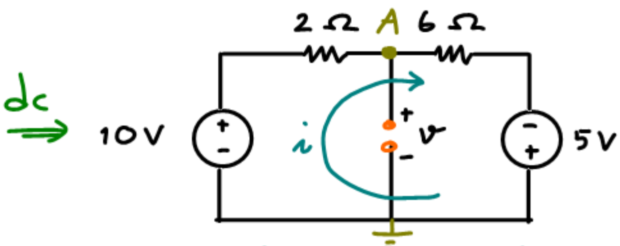
Here, note that the open circuit prevents any current to flow through the 1Ω resistor.

Therefore, there is no voltage drop across the 1Ω resistor and hence v is the same as the voltage across the 9Ω resistor. Furthermore, since there is no current through the 1Ω resistor, it is simply a hanging branch which can be eliminated from our consideration. By the voltage divider formula,

v = voltage across the 9Ω resistor $= \frac{9}{9+3}\times 20 = \frac{\overset{3}{\cancel{9}}}{\underset{4}{\cancel{12}}}\times\underset{5}{\cancel{20}} = 15$ V

(c)





Method 1: Mesh analysis: There is only one mesh. Applying KVL gives

$10 - i\times 2 - i\times 6 + 5 = 0$. This implies $i = \frac{15}{8}$ A. So, $v = 10 - \frac{15}{\underset{4}{\cancel{8}}}\times\cancel{2}$

$= \frac{25}{4} = 6.25$ V

Method 2: Nodal analysis: KCL @ A gives

$3\times\frac{v_A-10}{\cancel{2}} + \frac{v_A-(-5)}{\cancel{6}} = 0 \Rightarrow v_A = \frac{25}{4}$. Note that $v = v_A$.

ECS 203 2014: Quiz 4 **Solution**

Instructions

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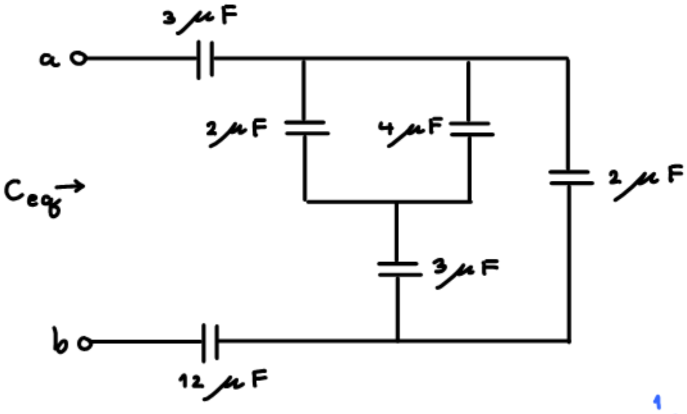
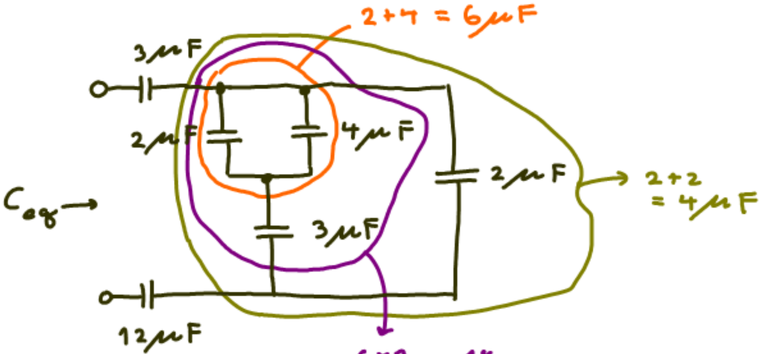
Prapun	**555**

1) Compute the equivalent capacitance C_{eq} to the right of the two terminals a-b





$$\frac{6\times3}{6+3} = \frac{18}{9} = 2\,\mu F$$

$$\frac{1}{C_{eq}} = \frac{1}{3} + \frac{1}{4} + \frac{1}{12}$$

$$= \frac{4+3+1}{12} = \frac{8}{12} = \frac{2}{3}$$

$$C_{eq} = \frac{3}{2} = 1.5\,\mu F$$

Alternatively, in case you don't want to combine all three capacitors at once, you can do it two at a time.

$$\text{series}(3\mu F, 4\mu F) = \frac{3\times4}{3+4}\mu F = \frac{12}{7}\mu F$$

$$\text{series}\left(\frac{12}{7}\mu F, 12\mu F\right) = \frac{\frac{12}{7}\times12}{\frac{12}{7}+12} = \frac{12\times12}{12+12\times7} = \frac{\cancel{12}\times12}{\cancel{12}\times8}$$

$$= \frac{12}{8} = \frac{3}{2}\mu F$$

Alternatively,

$$\text{series}(3\mu F, 12\mu F) = \frac{3\times12}{3+12} = \frac{\cancel{3}\times12}{\cancel{15}\,5} = \frac{12}{5}\mu F$$

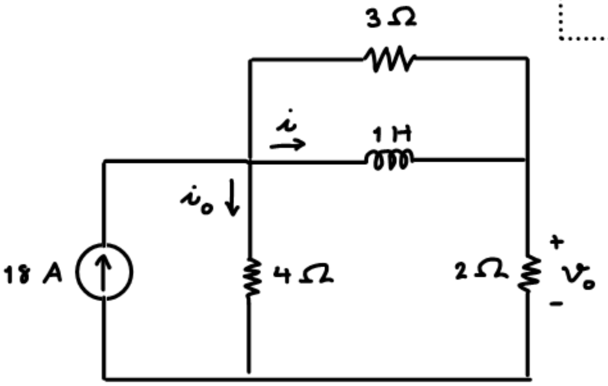
$$\text{series}\left(\frac{12}{5}\mu F, 4\mu F\right) = \frac{\frac{12}{5}\times4}{\frac{12}{5}+4} = \frac{12\times\cancel{4}}{\underset{3}{\cancel{12}}+\cancel{4}\times5} = \frac{12}{8} = \frac{3}{2}\mu F$$

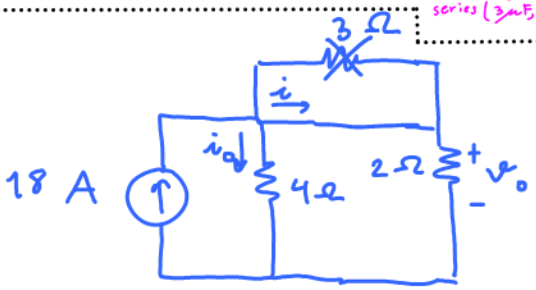
Alternatively

$$\text{series}(4\mu F, 12\mu F) = \frac{4\times12}{4+12} = \frac{\cancel{4}\times\overset{3}{\cancel{12}}}{\cancel{16}} = 3\mu F$$

$$\text{series}(3\mu F, 3\mu F) = \frac{3\times3}{3+3} = \frac{9}{6} = \frac{3}{2}\mu F$$

2) Find i, i_o, v_o under dc condition.





Current divider:

$$i = \frac{4}{2+4}\times18 = 12\text{ A}$$

$$i_o = \frac{2}{4+2}\times18 = 6\text{ A}$$

Ohm's law

$$v_o = 12\times2 = 24\text{ V}$$

ECS 203 2014: Quiz 5 **Solution**

(Free)

Instructions

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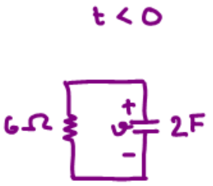
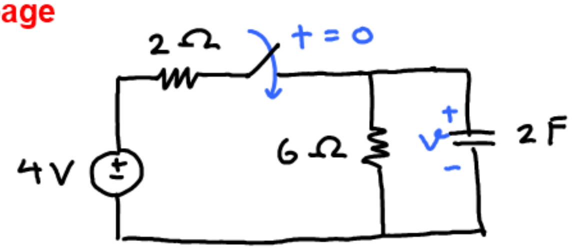
Name	ID
Prapun	

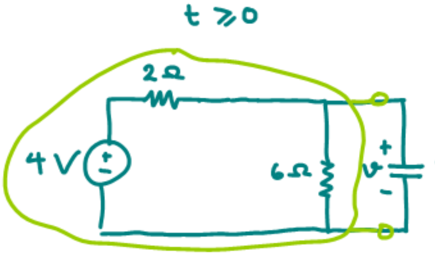
For this quiz, your answers should be of the form X.XXX, e.g., 1.214, 0.767, 0.000.

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

See explanation on the next page







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

$\left.\begin{array}{l} v(0^-)=0 \\ v(0)=0 \end{array}\right\}$ no jump

$V_{th} = 3V$

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

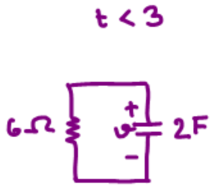
$\tau = R_{th}\times C = \frac{3}{2}\times 2 = 3\,sec$

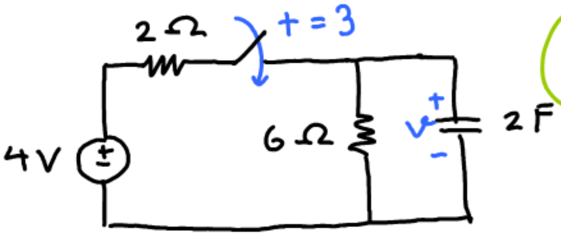
$v(t) = e^{-t/3}(0-3)+3$

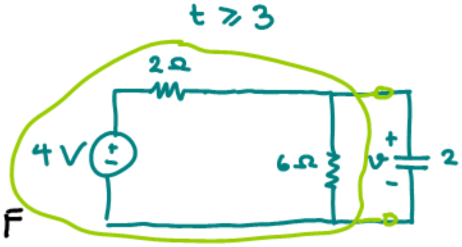
$= 3-3e^{-t/3},\quad t\geq 0$

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, ∞.







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

$\left.\begin{array}{l} v(3^-)=0 \\ v(3)=0 \end{array}\right\}$ no jump

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

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

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

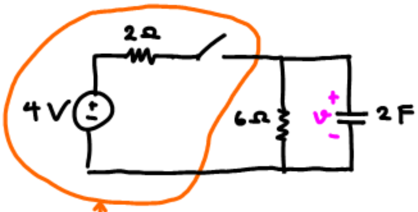
$= 3-3e^{-\frac{t-3}{3}},\quad t\geq 3$

<3 <3

t	-3	0	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 (open) 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,

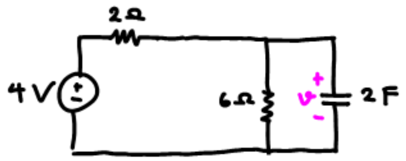
$$v(t) = 0, \quad t < 0.$$

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

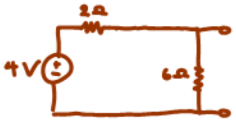
$$\Downarrow \text{ no jump in capacitor's voltage.}$$

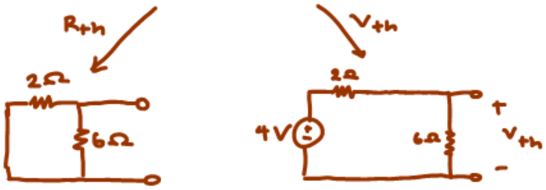
$$v(0) = 0$$

$t \geq 0$



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





$$R_{th} = 2 // 6 = \frac{2\times 6}{2+6} = \frac{12}{8} = \frac{3}{2}$$

$$\Downarrow$$

$$\tau = R_{th} \times C = \frac{3}{2} \times 2 = 3 \text{ s.}$$

By voltage divider formula,

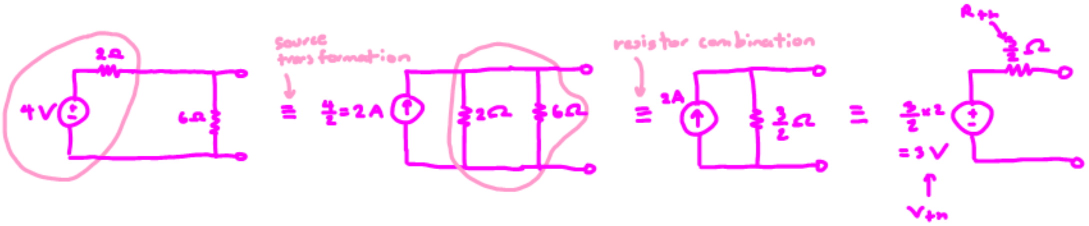
$$V_{th} = \frac{6}{2+6} \times 4 = 3\,V$$

↑ This is $v(\infty)$

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

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

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

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

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

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

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