ECS 303: Quiz 2 Solution

Semester/Year: 2/2009

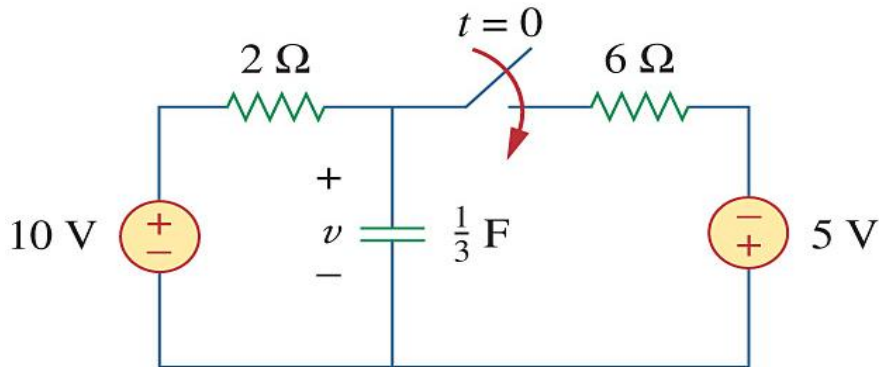
Course Title: *Basic Electrical Engineering*

Name	ID

Instructions

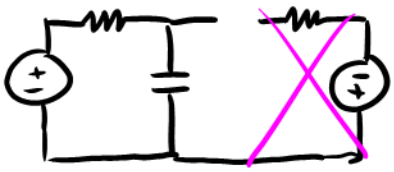
1. Separate into groups of no more than three persons.
2. Closed book. Closed notes.
3. Only one submission is needed for each group. Late submission will not be accepted.
4. **Do not panic.**

Find v(t) for t > 0 in the circuit below. Assume the switch has been open for a long time and is closed at t = 0. Numerically evaluate v(t) at t = 4.



Because the switch changes its position, we consider two circuits:

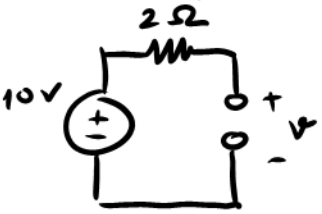
Case 1: t < 0



Don't have to consider because the open connection does not allow current to go through this part.

At $t = 0^-$, the circuit has been left in case 1 for a long time; therefore

capacitor → open circuit

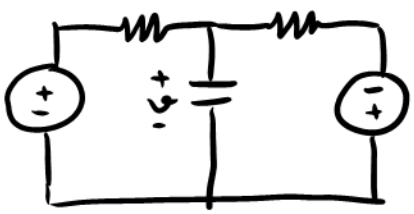


$v(0^-) = 10\ V$

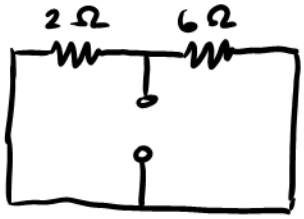
Because there can not be any voltage jump across the capacitor,

$$v(0) = v(0^-) = 10\ V.$$

Case 2 : $t > 0$



Find R_{th} :



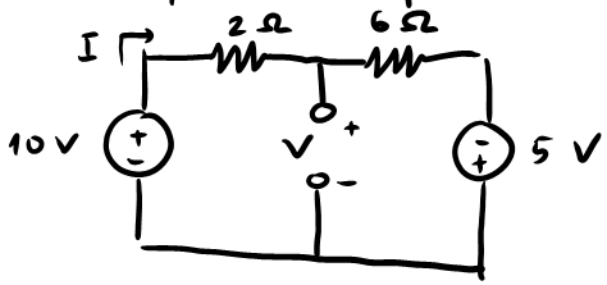
$$R_{th} = 2 /\!/ 6 = \frac{2 \times 6}{8} = \frac{3}{2}$$

Therefore,

$$\tau = R_{th} \times C = \frac{3}{2} \times \frac{1}{3} = \frac{1}{2}$$

Find $v(\infty)$:

capacitor → open circuit



$$I = \frac{10 + 5}{2 + 6} = \frac{15}{8}$$

$$V = 10 - I \times 2$$

$$= 10 - \frac{15}{4} = 10 - 3.75$$

$$= 6.25\ V$$

$$= v(\infty)$$

$$v(t) = v(\infty) + \left(v(0) - v(\infty)\right) e^{-t/\tau}$$

$$= \boxed{6.25 + 3.75\, e^{-2t}}, \quad t > 0$$

$$v(4) = 6.25 + 3.75\, e^{-8} = \boxed{6.251\ V}$$