

ECE10 Midterm I

Department of Electrical Engineering, UCLA

Spring 2019

Instructor: Prof. Gupta

1. Exam is closed book. Calculator and one double sided cheat-sheet is allowed.
2. Cross out *everything* that you don't want me to see. Points will be deducted for everything wrong!
3. No points will be given without proper explanations
4. Time allotted: 75 minutes

Name: [REDACTED]

Student ID: [REDACTED]

Student on Left: [REDACTED]

Student on Right: [REDACTED]

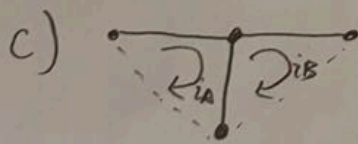
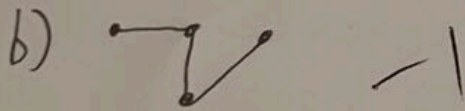
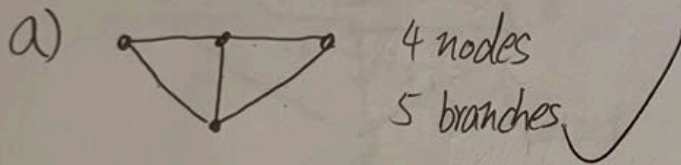
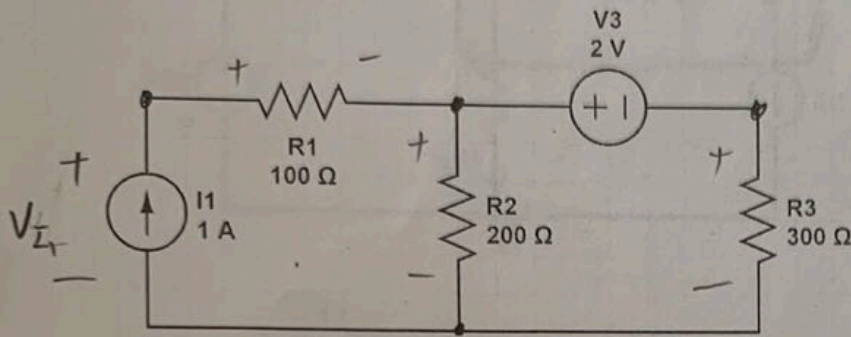
Student in Front: [REDACTED]

Problem	Maximum Score	Your Score
1	8	7
2	4	4
3	8	8
4	10	9
Total	30	28

Q1. (2+2+2+2 = 8 points)

For this circuit, please answer the following questions:

- How many nodes and how many branches?
- Please draw the equivalent graph after killing the independent sources.
- Please draw ONE spanning tree for the graph.
- Write the KVL equations based on the cut-set. Clearly mark which branch is the loop current flowing in.



$$i_A = I_1$$

$$V_1 = I_1$$

$$V_1 - i_A R_1 - (i_A - i_B) R_2 = 0$$

$$(i_A - i_B) R_2 - 2 - i_B R_3 = 0$$

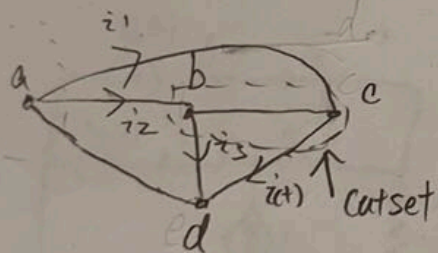
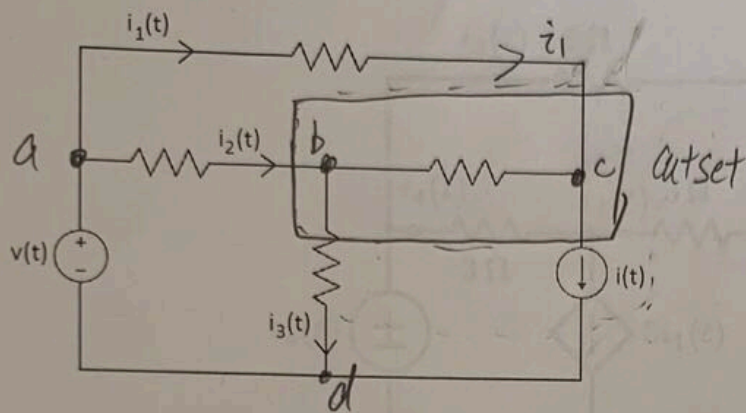
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V_{I_1} : voltage drop of I_1 $V_{I_1} - I_1 R_1 - (I_1 - i_B) R_2 = 0$

$$(I_1 - i_B) R_2 - 2V - i_B R_3 = 0$$

Q2. (4 points)

Draw the cutset relating i_1 , i_2 , i_3 and write exactly ONE KCL equation corresponding to the cutset.

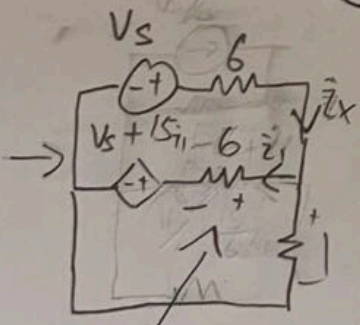
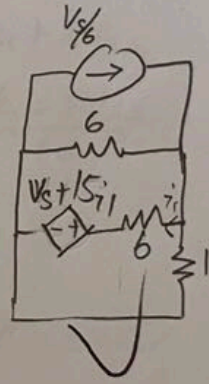
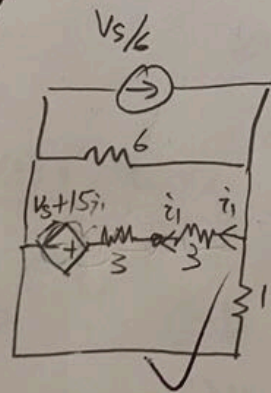
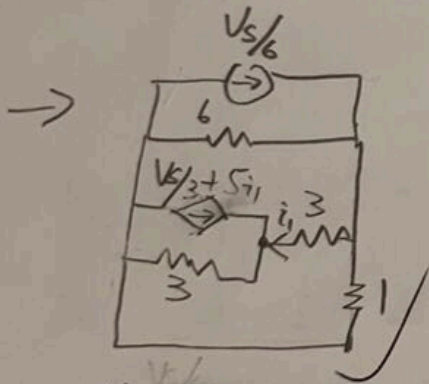
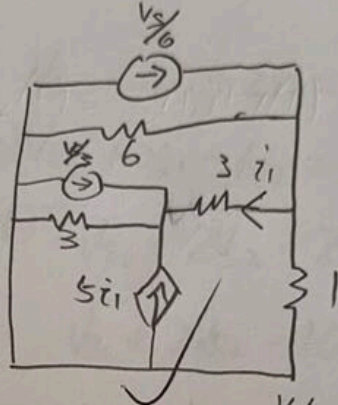
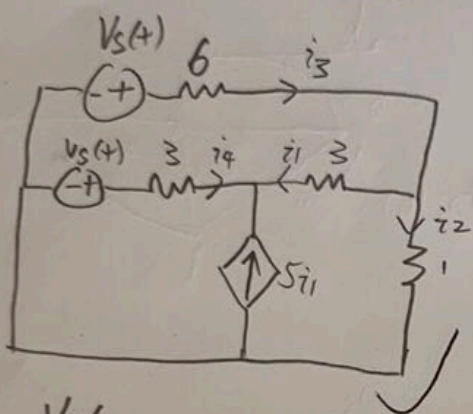
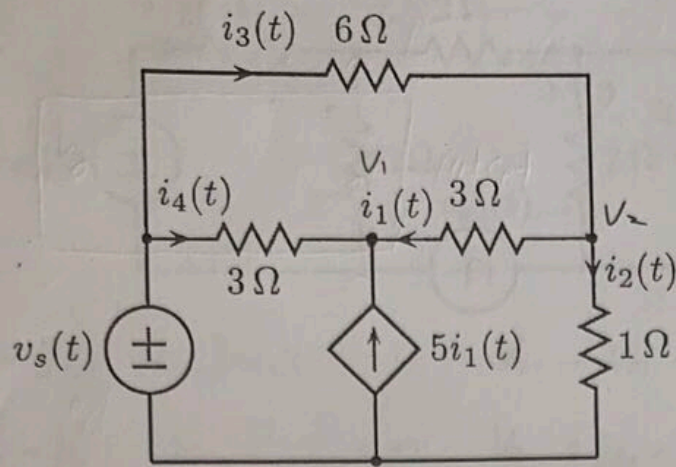


$$i_1(t) + i_2(t) = i_3(t) + i(t)$$



Q5. 8 points

Find i_1 in terms of v_s using source transformations.



$$v_s - 6i_x - i_1 6 - (v_s + 15i_1) = 0 \quad -6i_x = 21i_1 \quad i_x = -\frac{21}{6}i_1$$

$$v_s + 15i_1 + 6i_1 - (i_x - i_1) = 0$$

$$v_s + 22i_1 - i_x = 0$$

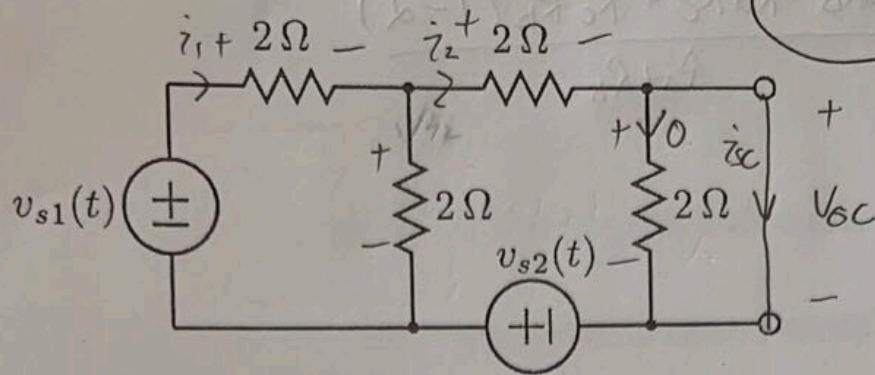
$$v_s + 22i_1 + \frac{21}{6}i_1 = 0$$

$$i_1 = -\frac{v_s}{22 + \frac{21}{6}} \text{ please simplify.}$$

can't source transform because dependent source depends on $i_1(t)$

Q4. 10 points

Find the thevenin equivalent of the circuit below at the two nodes on the right using superposition.



$$V_{s1} - 2i_1 - 2(i_1 - i_2) = 0$$

$$V_{s1} - 2i_1 - 2i_1 + 2i_2 = 0$$

$$V_{s2} + 2(i_1 - i_2) - 2i_2 - 2i_2 = 0$$

$$V_{s2} + 2i_1 - 2i_2 - 4i_2 = 0$$

$$\textcircled{1} V_{s1} - 4i_1 + 2i_2 = 0$$

$$\textcircled{2} V_{s2} + 2i_1 - 6i_2 = 0$$

$$\textcircled{1} + 2 \times \textcircled{2} \quad V_{s1} + 2V_{s2} + 2i_2 - 12i_2 = 0$$

$$V_{s1} + 2V_{s2} - 10i_2 = 0$$

$$10i_2 = V_{s1} + 2V_{s2}$$

$$i_2 = \frac{V_{s1} + 2V_{s2}}{10}$$

$$V_{Th} = V_{oc} = 2 \cdot i_2 = \frac{V_{s1}(t) + 2V_{s2}(t)}{5}$$

$$I_{sc}: V_{s1} - 2i_1 - 2(i_1 - i_2) = 0$$

$$\textcircled{1} V_{s1} - 4i_1 + 2i_2 = 0$$

$$V_{s2} + 2(i_1 - i_2) - 2i_2 - 0 = 0 \quad \textcircled{2} V_{s2} + 2i_1 - 4i_2 = 0$$

$$\textcircled{1} + 2 \times \textcircled{2} \quad V_{s1} + 2V_{s2} - 4i_1 + 4i_1 + 2i_2 - 8i_2 = 0$$

$$V_{s1} + 2V_{s2} - 6i_2 = 0$$

$$i_2 = i_{sc} = \frac{V_{s1} + 2V_{s2}}{6}$$

$$R_{TH} = \frac{V_{oc}}{I_{sc}} = \frac{V_{s1} + 2V_{s2}}{5} \cdot \frac{6}{V_{s1} + 2V_{s2}} = \frac{6}{5} \Omega$$