EE10 Midterm I

Department of Electrical Engineering, UCLA

Fall 2017

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:

Student ID:

Student on Left:

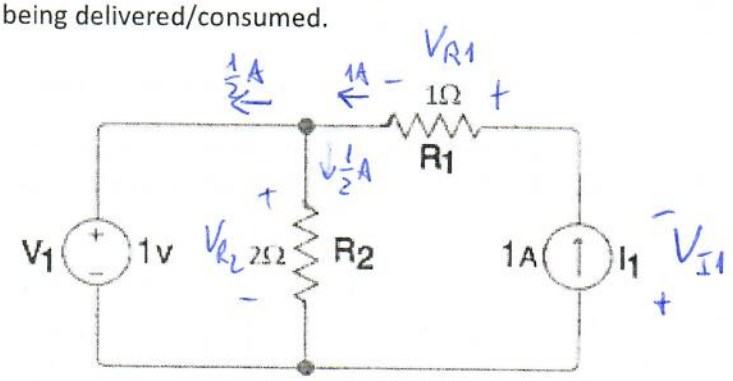
Student on Right:

Student in Front:

Problem	Maximum Score	Your Score
1	6	
2	10	
3	10	
4	4	
Total	30	

Q1. (6 points)

For each element clearly indicate whether power is being consumed or delivered. Also indicate the magnitude of the power being delivered/consumed.



$V_{R1} = 1A\ 1\Omega = 1V$

$V_{R2} = V_1 = 1V$

$V_{I1} = -V_{R1} - V_{R2} = -2V$

$P_{V_1} = V_1 \frac{1}{2}A = \frac{1}{2}W$ → Consumes $\frac{1}{2}$ W of power

$P_{R2} = V_{R2} \frac{1}{2}A = \frac{1}{2}W$ → Dissipates $\frac{1}{2}$ W of power

$P_{R1} = V_{R1}\ 1A = 1W$ → Dissipates 1W of power

$P_{I1} = V_{I1}\ 1A = -2W$ → Delivers 2W of power

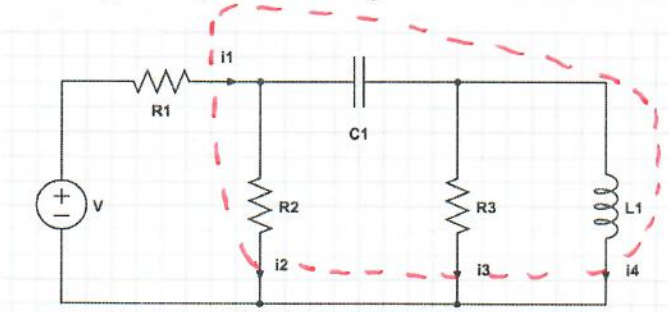
Q2. (2 + 2 + 3 + 3 = 10 points)

a) Draw the circuit graph for the circuit below. How many nodes does it have?

b) Draw its spanning tree. How many chords does it have?

c) Write the loop KVL equations corresponding to these chords.

d) Draw a suitable cut-set on the circuit below to relate the currents i_1, i_2, i_3, and i_4 in only one KCL equation. Also write the resulting KCL equation relating the four mentioned currents.

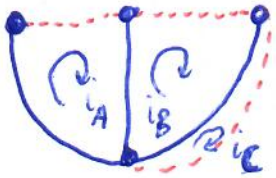


→ Point (d) cutset.

(a)

4 nodes.

(b)



3 chords

(c)

$$-V + i_A R_1 + (i_A - i_B) R_2 = 0$$

$$(i_B - i_A) R_2 + \frac{1}{C_1} \int_{-\infty}^{t} i_B \, dt + R_3 (i_B - i_C) = 0$$

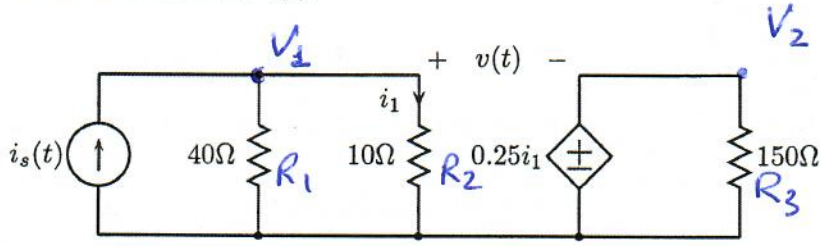
$$R_3 (i_C - i_B) + L_1 \frac{d}{dt} i_C = 0$$

(d)

$$-i_1 + i_2 + i_3 + i_4 = 0$$

Q3. 10 points

Find v(t) in the circuit below in terms of $i_s(t)$.



$$V_1 = i_s(t)\,\frac{R_1 R_2}{R_1+R_2} = 8\Omega\, i_s(t)$$

$$i_1 = i_s(t)\,\frac{R_1}{R_1+R_2} = \frac{4}{5}\, i_s(t)$$

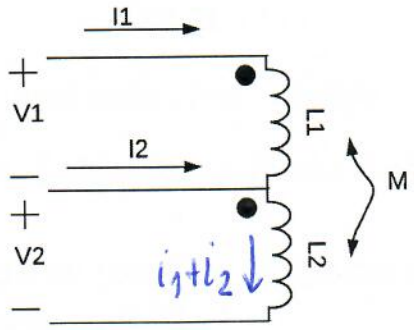
$$V_2 = \frac{1\Omega}{4} i_1(t)$$

$$V(t) = V_1(t) - V_2(t) = 8\Omega\, i_s(t) - \frac{1}{4}\Omega\,\frac{4}{5}\, i_s(t) =$$

$$\boxed{V(t) = \frac{39}{5}\Omega\, i_s(t)}$$

Q4. 4 points

Find V1 and V2 in terms of I1 and I2.



$$V_1 = L_1 \frac{di_1}{dt} + M \frac{d}{dt}(i_1+i_2)$$

$$V_2 = L_2 \frac{d}{dt}(i_1+i_2) + M \frac{di_1}{dt}$$