EECE105L Mid Sem Exam Solutions

The following solutions provide a method to answer the questions. There can be more than one method to solve the questions.

If you need to answer the questions with variables as per your question, you can use the model answer key to compute the solution.

(1) Determine the power absorbed by R_3.

$V_1 = 107\ V \quad V_{RL1} = 77\ V \quad V_{RL2} = 54\ V$

$I_1 = 78.4\ mA \quad I_1 = 14.1\ mA \quad I_2 = 18.0\ mA$

$V_{R3} = V_{RL} = 54\ V$

$i_{R3} = i - i_1 - i_2 = (78.4 - 14.1 - 18)\ mA$

$= 46.3$

$P_{R3} = V_{R3} \cdot I_{R3} = 54 \times 46.3 = 2.5\ W$

(2) Average value and peak amplitude

$$\text{Average value} = \frac{(9.7 \times 4.4) + ((-2.3) \times 2) + (\frac{1}{2} \cdot 4.5 \times 7)}{4.4 + 2 + 7.0}$$

$= 4.02\ V$

Peak Amplitude $= 9.7 - 4.02 = 5.68\ V$

(Given $V_1 = 9.7\ V \quad V_2 = 4.5\ V \quad V_3 = 2.3\ V$

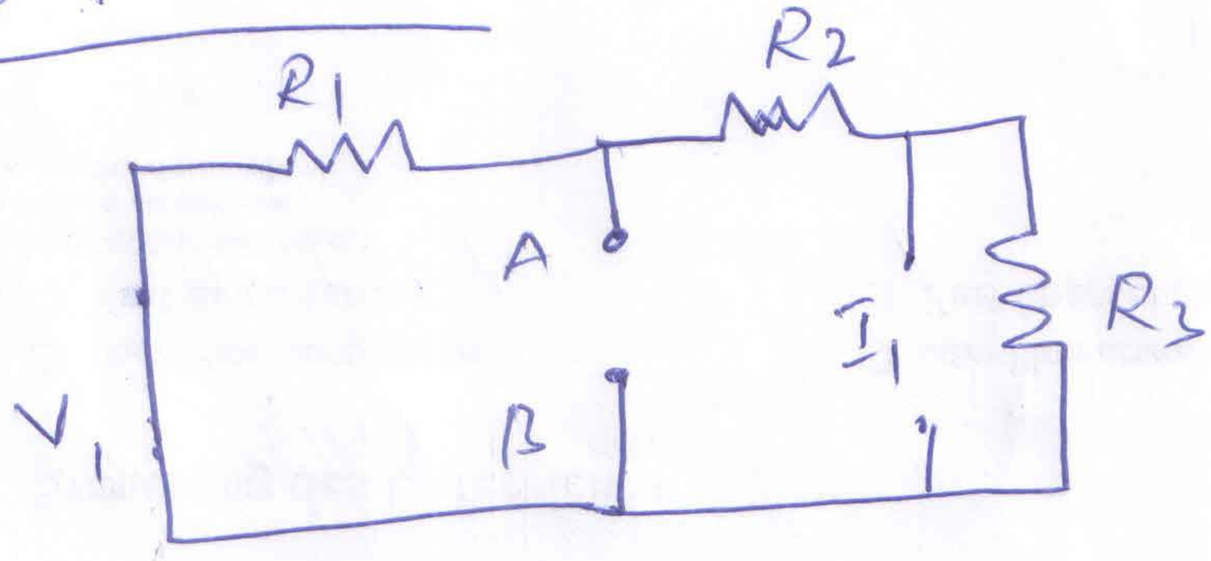
$t_1 = 4.4\ s \quad t_2 = 2.0\ s \quad t_3 = 7.0\ s$)

(3) When power delivered is maximum, $R_L = R_{th}$.

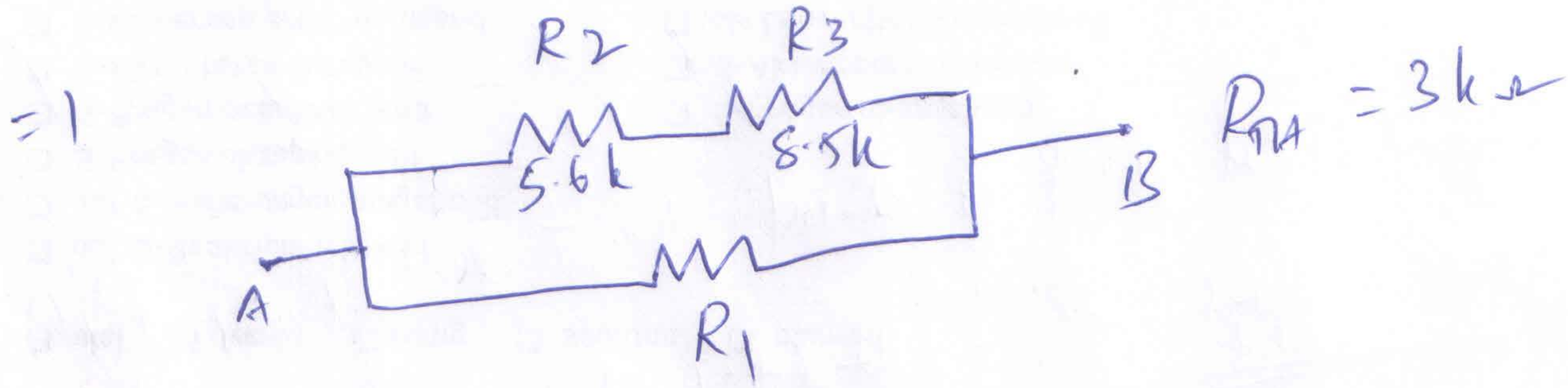
$R_L = 3\ k\Omega \quad R_2 = 5.6\ k\Omega \quad R_3 = 8.5\ k\Omega$

$V_1 = 4.3\ V \quad I_1 = 12.9\ mA$

To find R_{Th}:



$R_{AB} = R_{TH}$.



$R_{TH} = 3k\Omega$

$$R_{TH} = R_1 // (R_2 + R_3)$$

$$\frac{1}{3k} = \frac{1}{R_1} + \frac{1}{(R_2 + R_3)} \Rightarrow$$

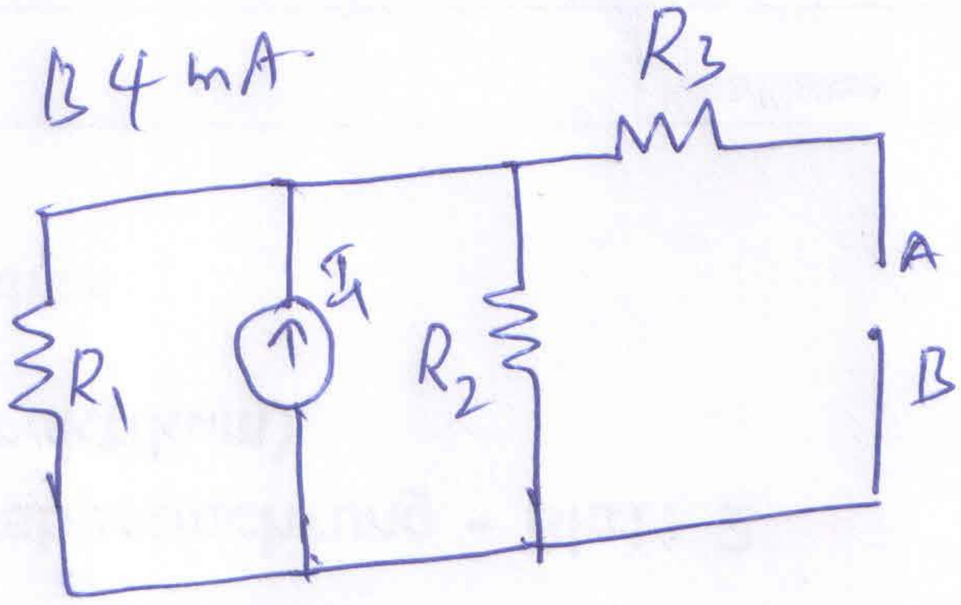
$$\frac{1}{R_1} = \frac{1}{3} - \frac{1}{5.6 + 8.5}$$

$$R_1 = 3.81\,k\Omega$$

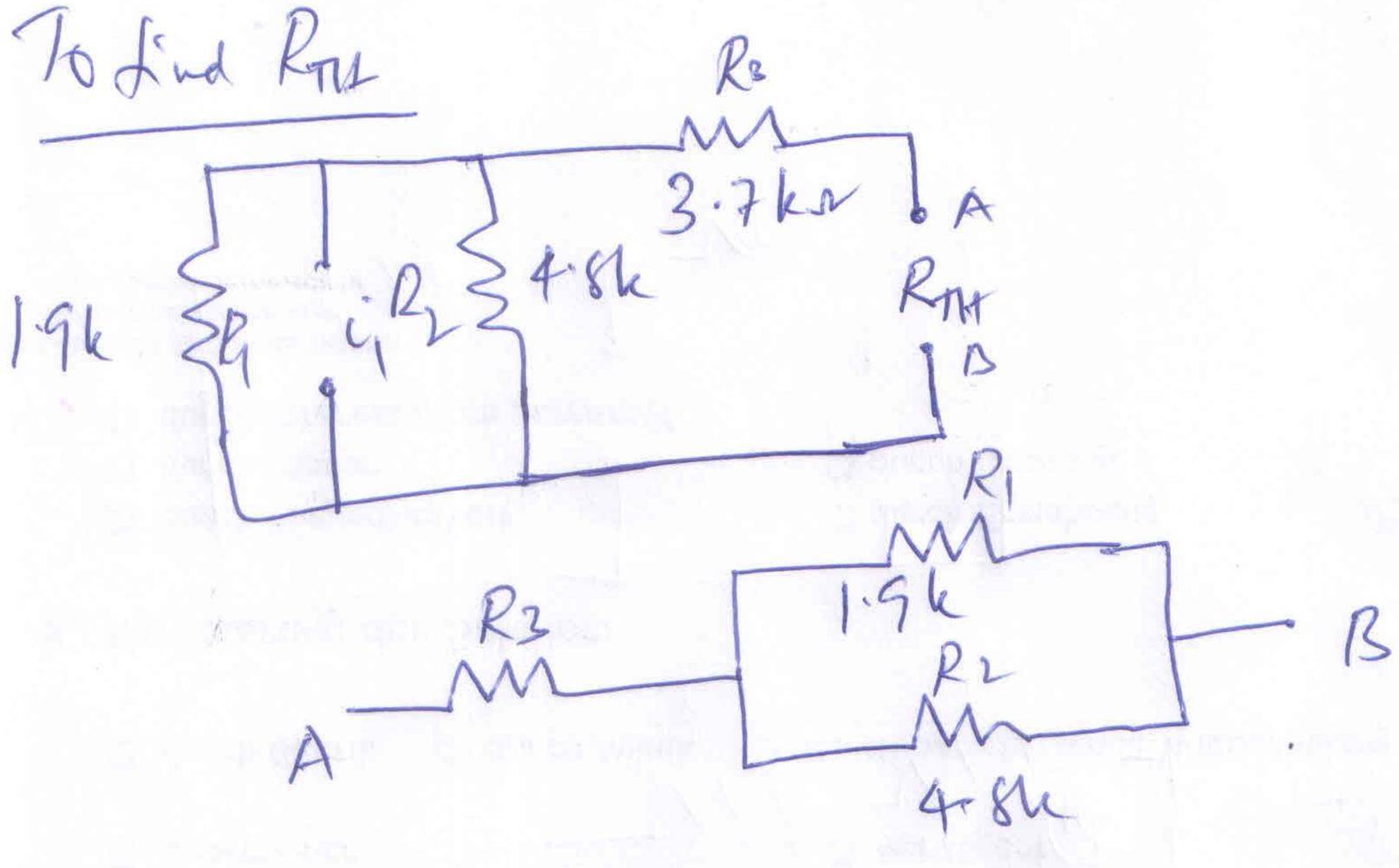
Q: Find the Thevinin's equivalent resistance in (kΩ) and current in (mA) through the load R_L.

$R_1 = 1.9k\Omega$ $R_2 = 4.8k\Omega$ $R_3 = 3.7k\Omega$ $R_L = 1.8k\Omega$

$I_4 = 3.4\,mA$

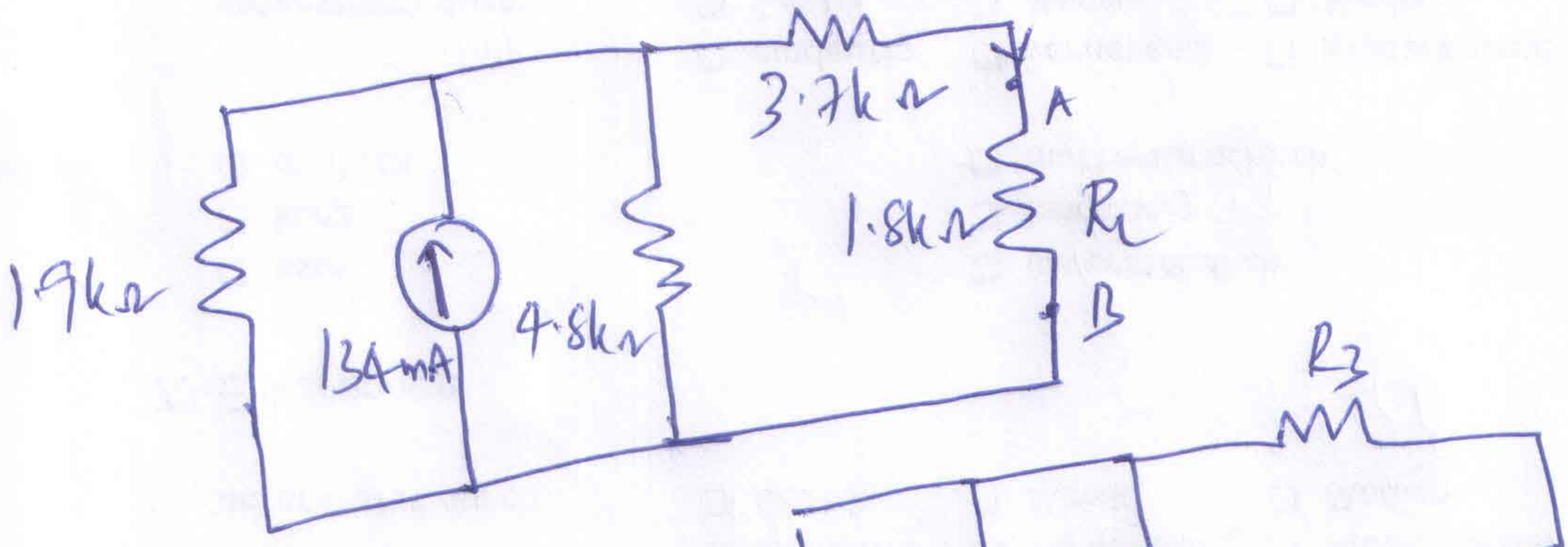


To find R_{TH}

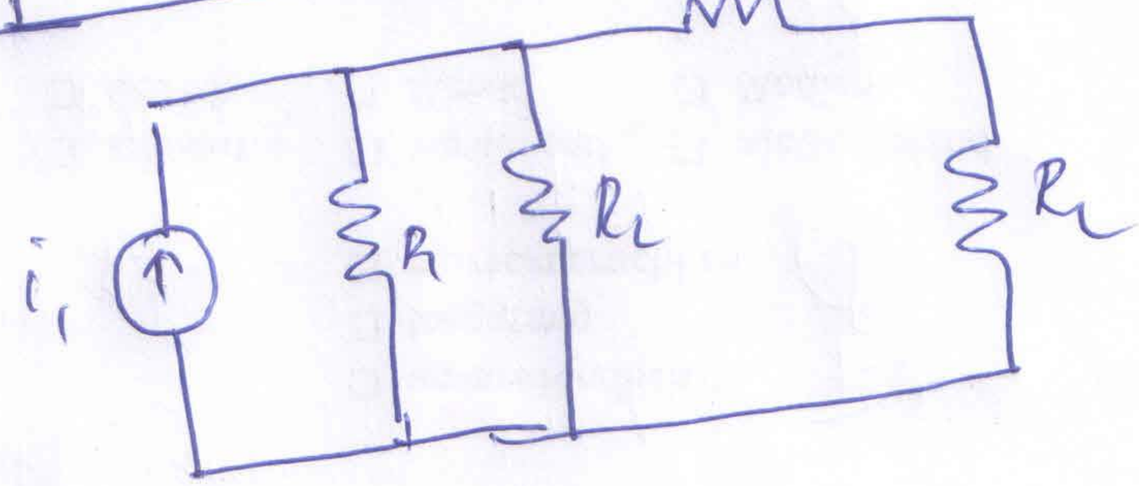


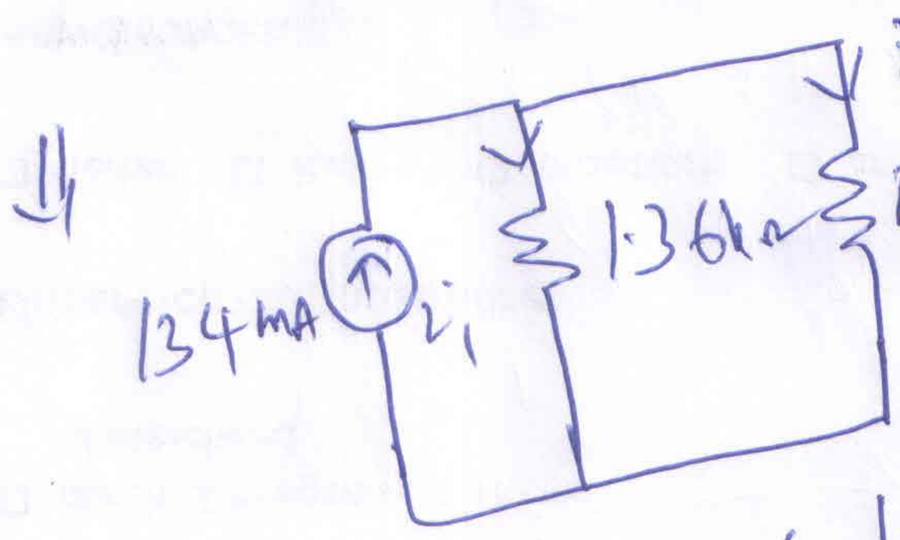
$R_{AB} = R_{TH} = R_3 + (R_1 \,||\, R_2)$

$= 3.7k + (1.9 \,||\, 4.8) = 5.06k\Omega$



Re drawing

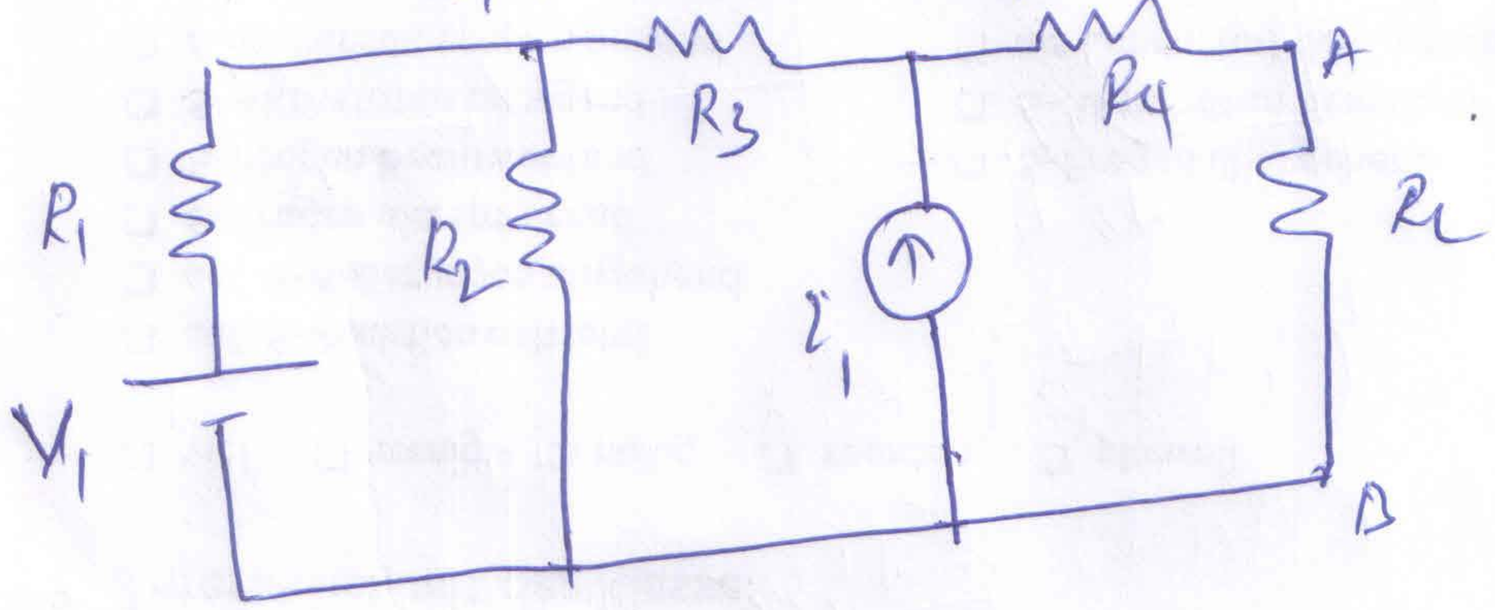




$i_L = \dfrac{134mA \times 1.36k\Omega}{(1.36 + 5.5)k\Omega} = \underline{26.57\,mA}$

Q For the circuit below, find the voltage across R_L.

Given $R_L = 295\,\Omega$ $R_1 = 71\,\Omega$ $R_2 = 154\,\Omega$
$R_3 = 192\,\Omega$ $R_4 = 82\,\Omega$
$V_1 = 7\,V$ $I_1 = 0.4\,mA$



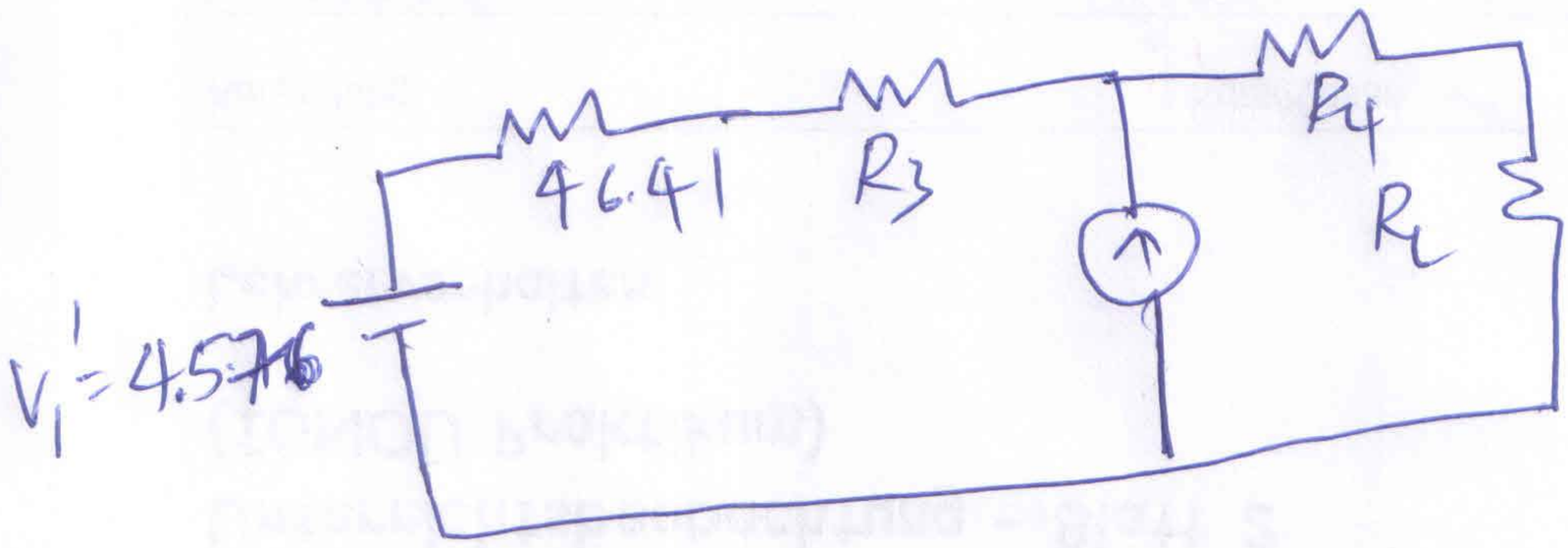
Apply source transformation to source V_1 & R_1

$\frac{V_1}{R_1} = \frac{7}{71} = 0.0986\,A$

$(R_1 \parallel R_2)$ and applying source transformation,

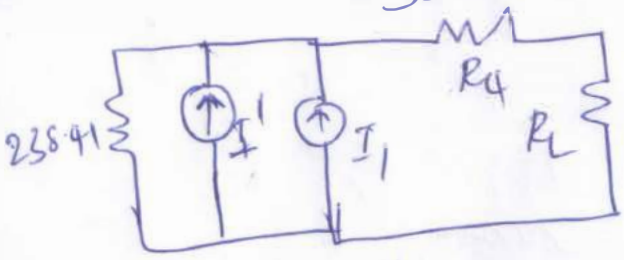
$R_1 \parallel R_2 = 46.41$

$V_1' = 4.576\,V$

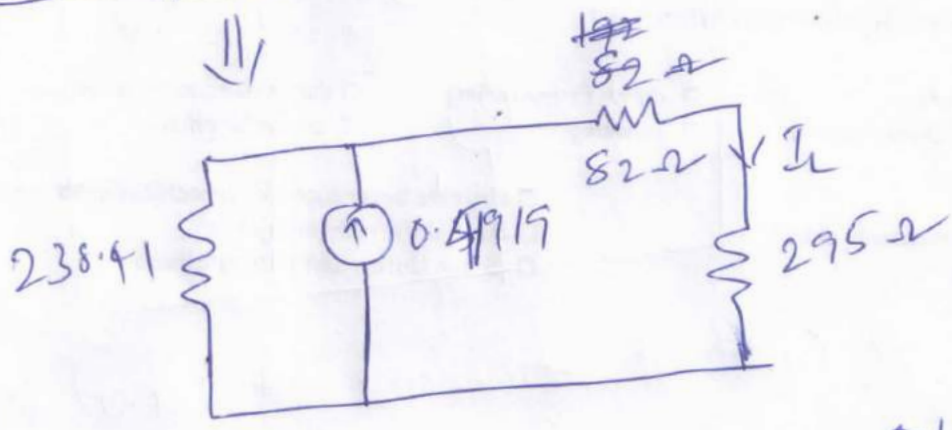


Applying Source transformation to V_1' and $(46.41 + R_3)$

$$I' = \frac{4.5 \cdot 76}{238.41} = 0.01919\ A$$



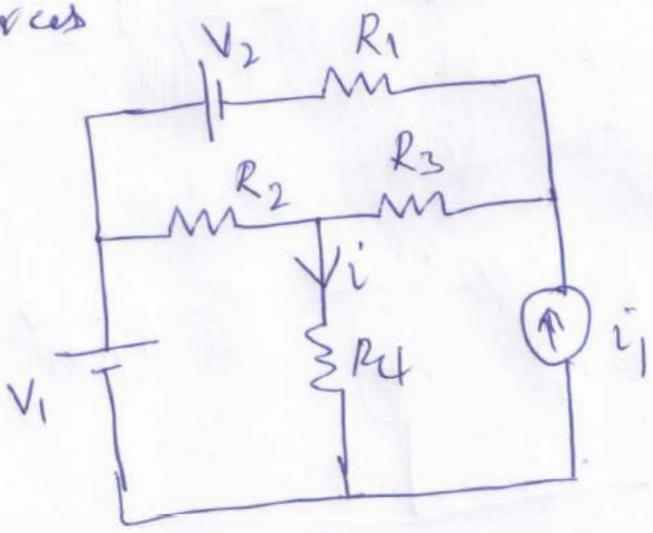
$$I' + I_1 = 0.01919 + 0.4$$
$$= 0.41919\ A$$



$$I_L = \frac{0.41919 \times 238.41}{(238.41 + 82 + 295)} = 0.162\ A$$

$$V_L = I_L R_L = 47.9\ V$$

Q: Find the current through Resistor R_4 due to sources

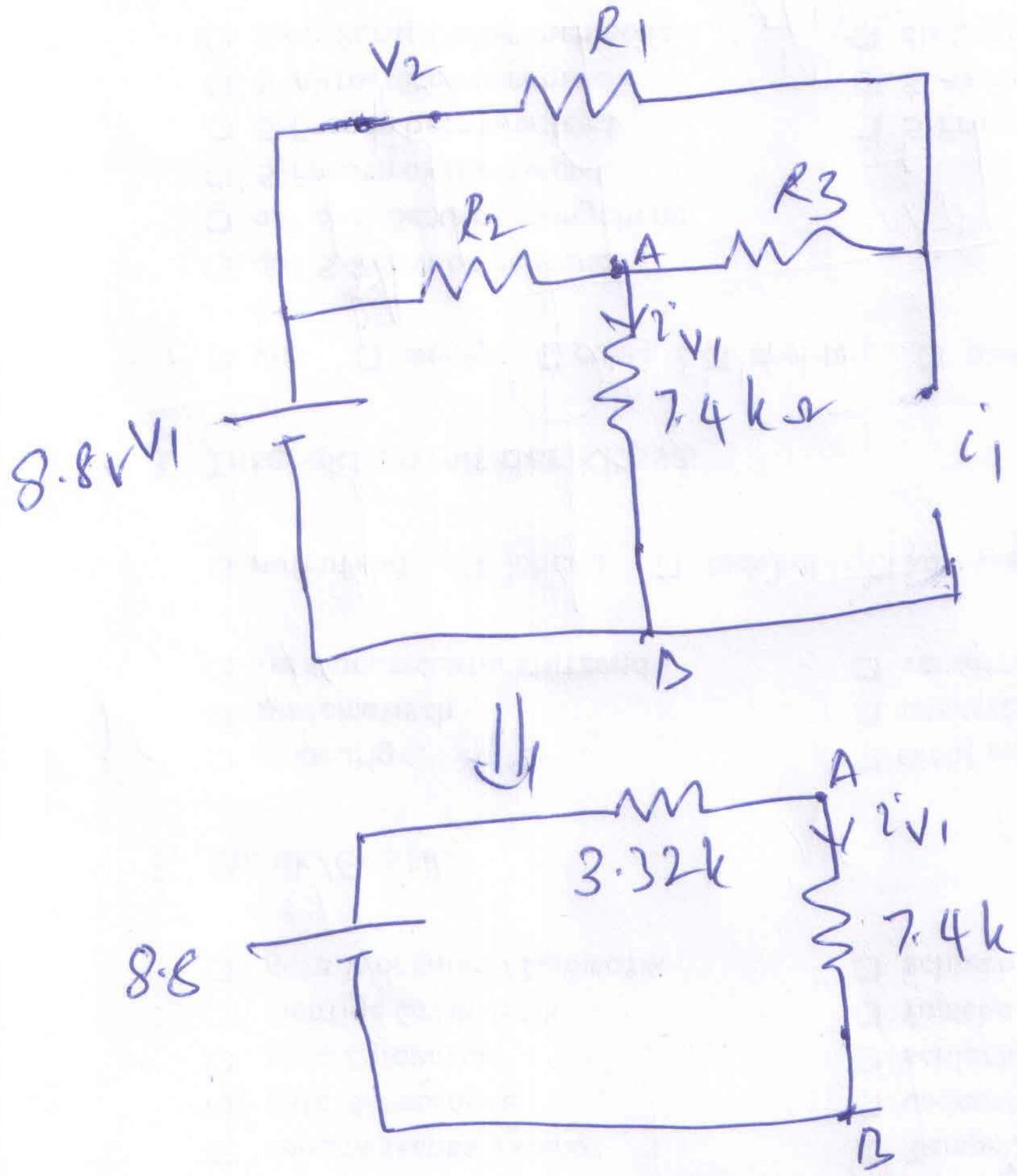


Given $R_1 = 4.6\,k\Omega$ $R_2 = 5.1\,k\Omega$ $R_3 = 4.9\,k\Omega$

$R_4 = 7.4\,k\Omega$

$V_1 = 8.8\ V$ $V_2 = 7.3V$ $i_1 = 5.7\,mA$

Current through R_4 due to source V_1 (I_{V_1}):



R_1 ; R_3 are in Series.

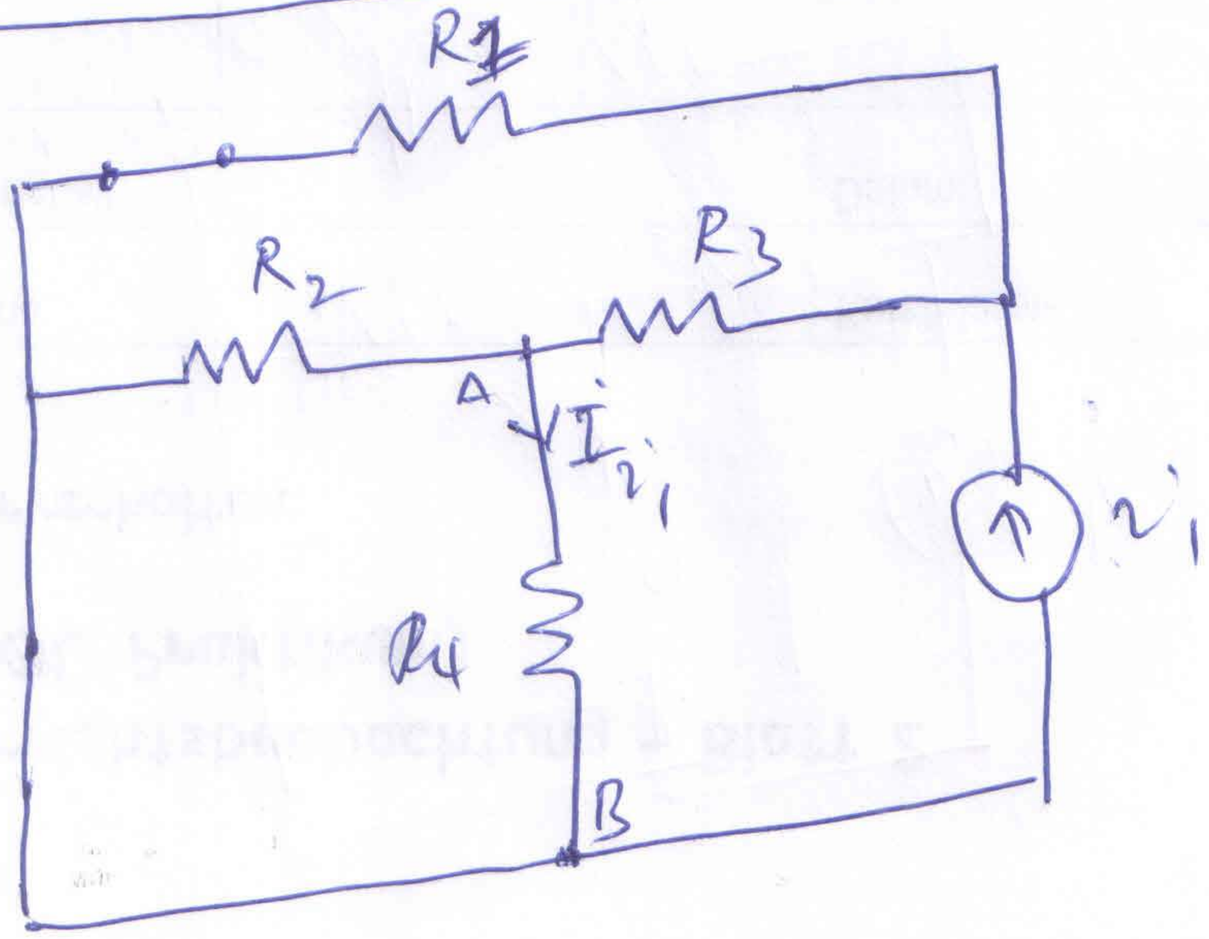
R_2 ; $(R_1 + R_3)$ are in parallel.

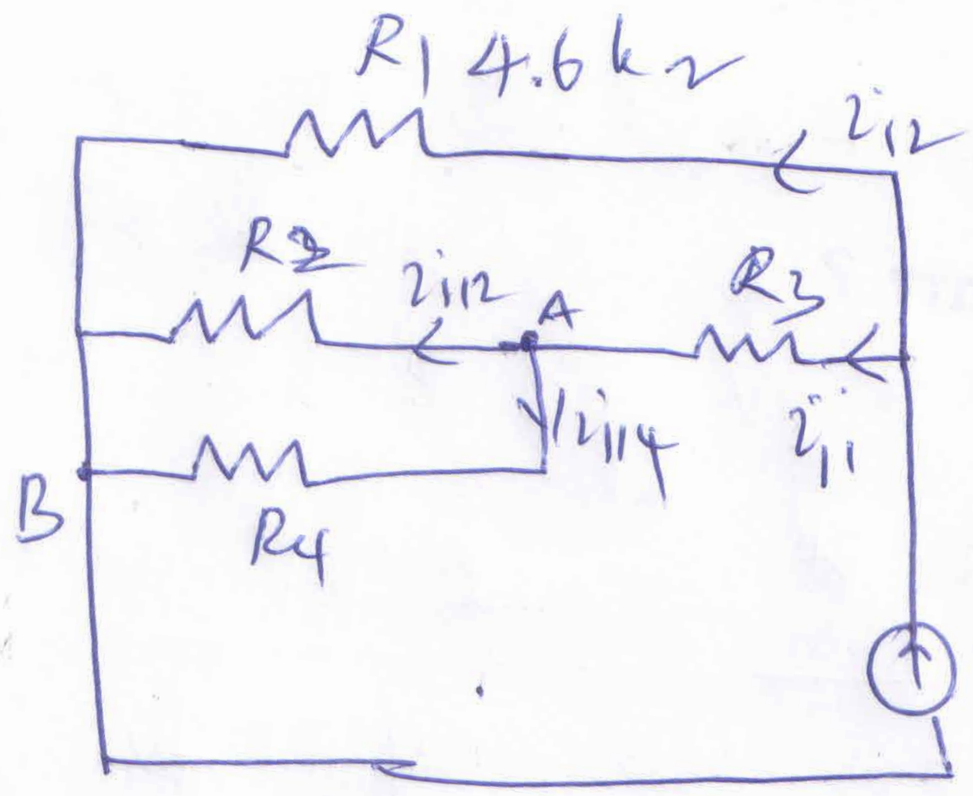
$R_1 + R_3 = 9.5\,k\Omega$

$R_2 \,||\, (R_1 + R_3) = 3.32\,k\Omega$

$i'_{V_1} = 0.821\,mA$ (A to B)

Current through R_4 due to source $2i_1$ (I_{2i_1}):





$R_2 // R_4 = 3.02 k\Omega$

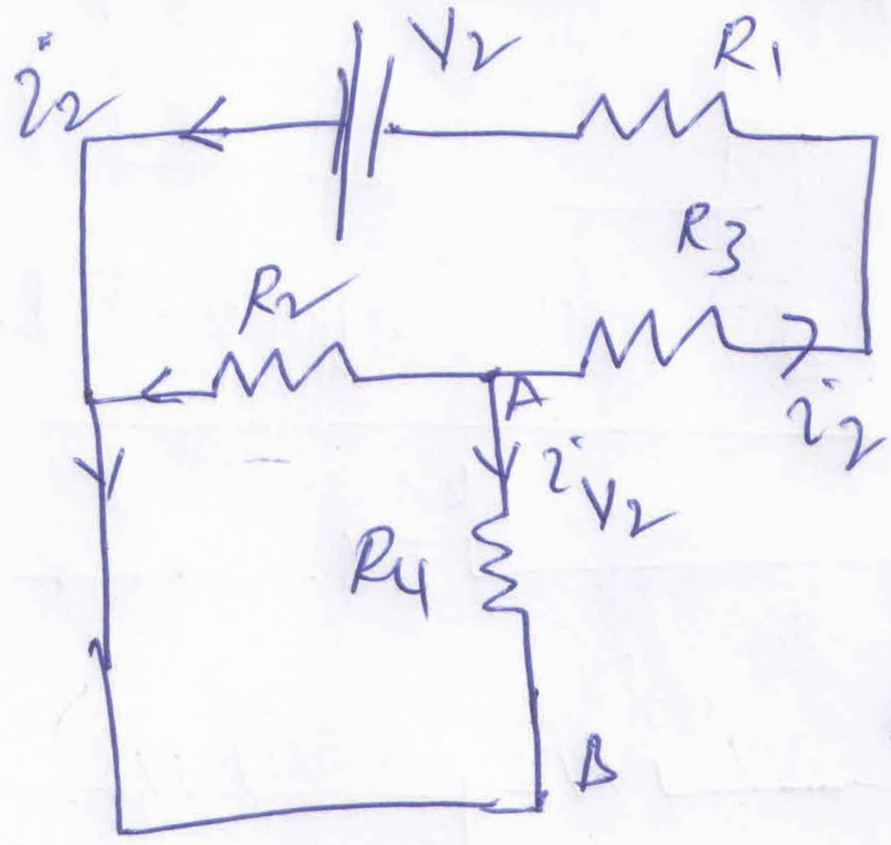
$R_3 + (R_2 // R_4) = 7.92 k\Omega$

$$i_{11} = \frac{i_1 \times 4.6 k\Omega}{(4.6k + 7.92k)} = \frac{5.7 \times 10^{-3} \times 4.6}{12.52} = 2.094 mA$$

$$i_{114} = \frac{i_{11} \times R_2}{R_2 + R_4} = \frac{2.094 \times 5.1}{5.1 + 7.4} = 0.854 mA \quad (A \text{ to } B)$$

$$i_{114} = I_{i_1} = 0.854 (mA)$$

Current through R_4 due to source V_2 (I_{V_2}):



R_1, R_3 are in Series

$R_1 + R_3 = 9.5 k\Omega$

R_2 and R_4 are in parallel.

$R_2 // R_4 = 3.02 k\Omega$

$$i_2 = \frac{V_2}{R} = \frac{7.3}{9.5 + 3.02} = 0.583 mA$$

$$i_{V_2} = \frac{i_2 \cdot R_2}{R_2 + R_4} = \frac{0.583 \times 5.1}{5.1 + 7.4} = 0.238 mA \quad (B \text{ to } A)$$

$i = 0.821 + 0.859 - 0.238 = 1.44\,mA$