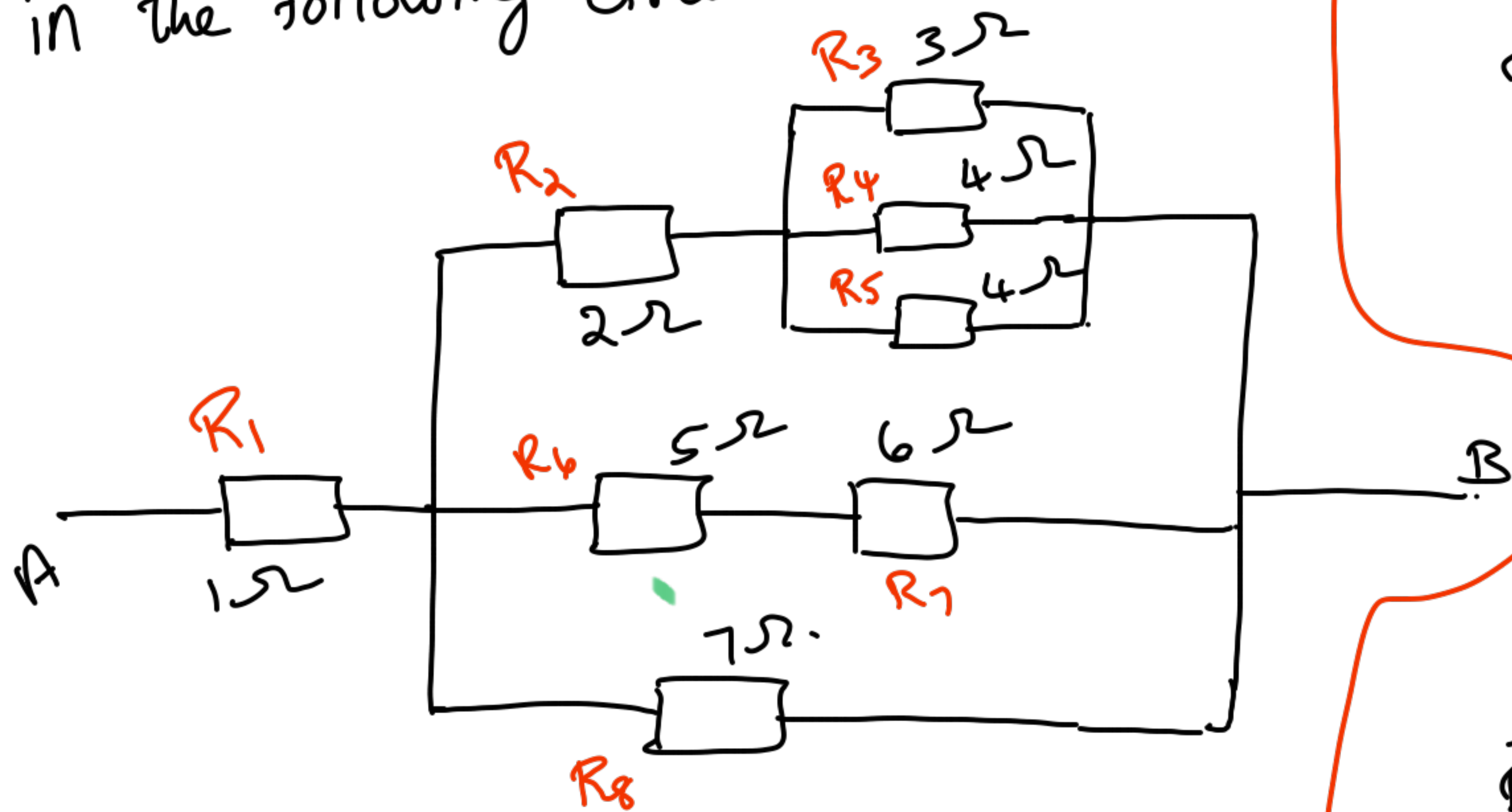


3) Calculate the total Resistance in the following Circuit.



Solution:

R_6 and R_7 are in series

$$R_{eq1} = R_6 + R_7 = 5 + 6 = 11\Omega$$

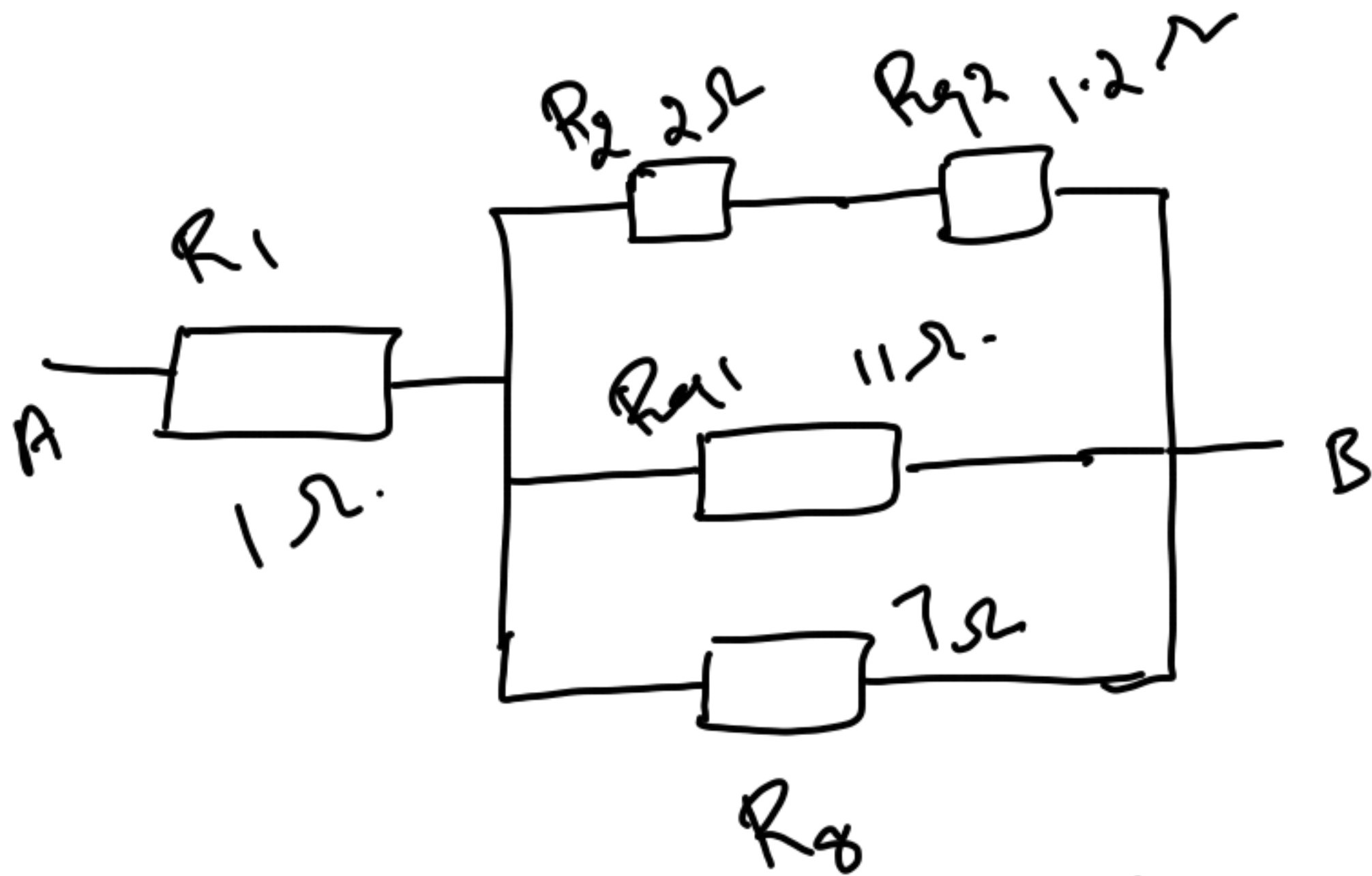
R_3 , R_4 and R_5 are in Parallel.

$$\frac{1}{R_{eq2}} = \frac{1}{3} + \frac{1}{4} + \frac{1}{4}$$

$$\frac{1}{R_{eq2}} = 0.83$$

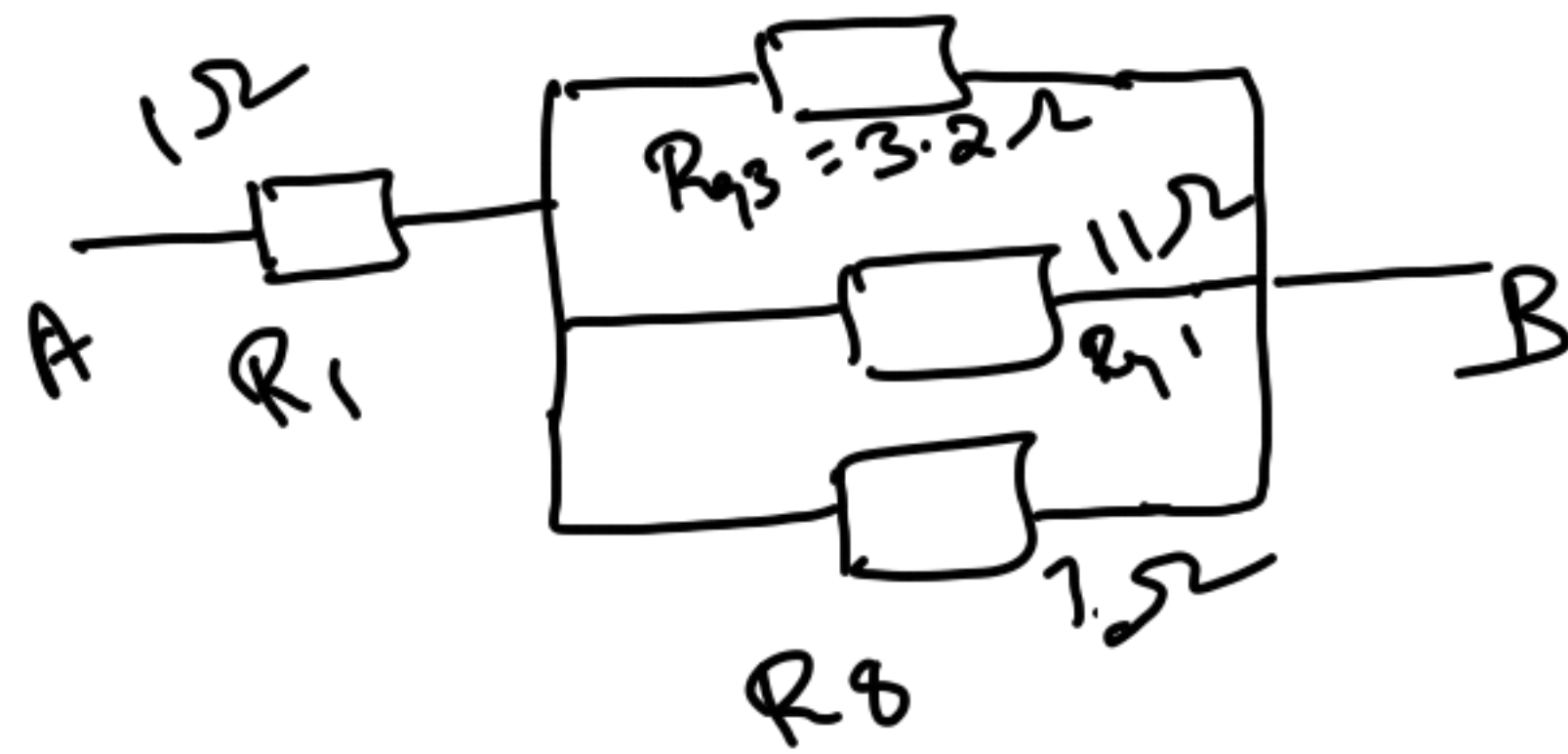
Taking Reciprocal on both side.

$$Req_2 = \frac{1}{0.83} = 1.2 \Omega$$



R_2 and Req_2 are in Series

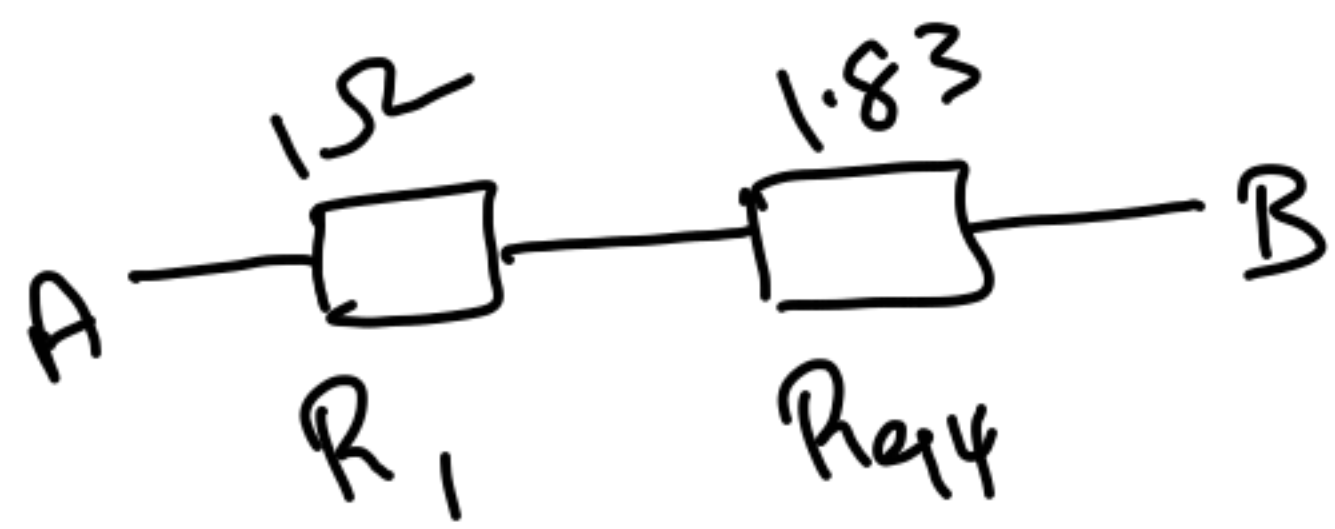
$$Req_3 = R_2 + Req_2 = 2 + 1.2 = 3.2 \Omega$$



Req_3 , Req_1 , Req_8 are in Parallel

$$Req_4 = \frac{1}{\frac{1}{Req_3} + \frac{1}{Req_1} + \frac{1}{Req_8}}$$

$$Req_4 = \frac{1}{\frac{1}{3.2} + \frac{1}{11} + \frac{1}{7}} = 1.83 \Omega$$

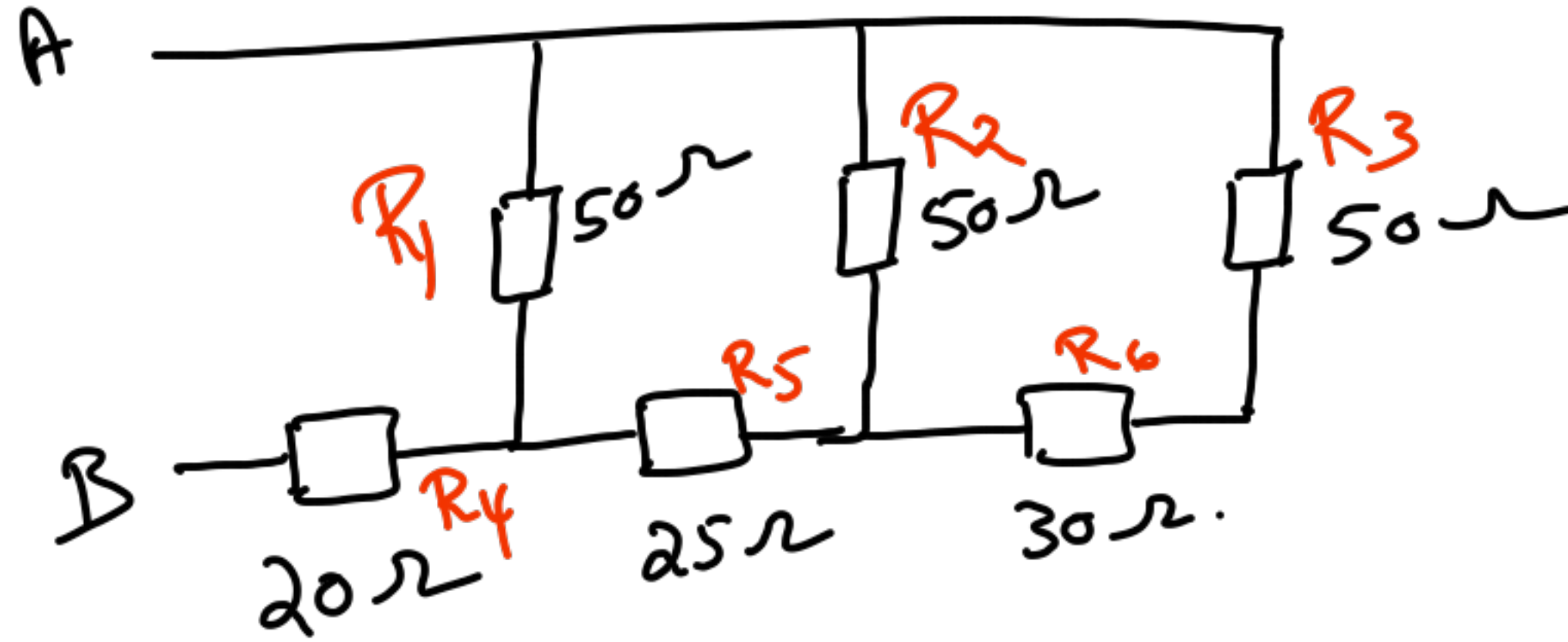


$$R_{AB} = R_{eq} = R_1 + R_{eq4}$$

$$= 1 + 1.83$$

$$R_{eq} = 2.83 \Omega.$$

4) Calculate the equivalent Resistance for the following circuit

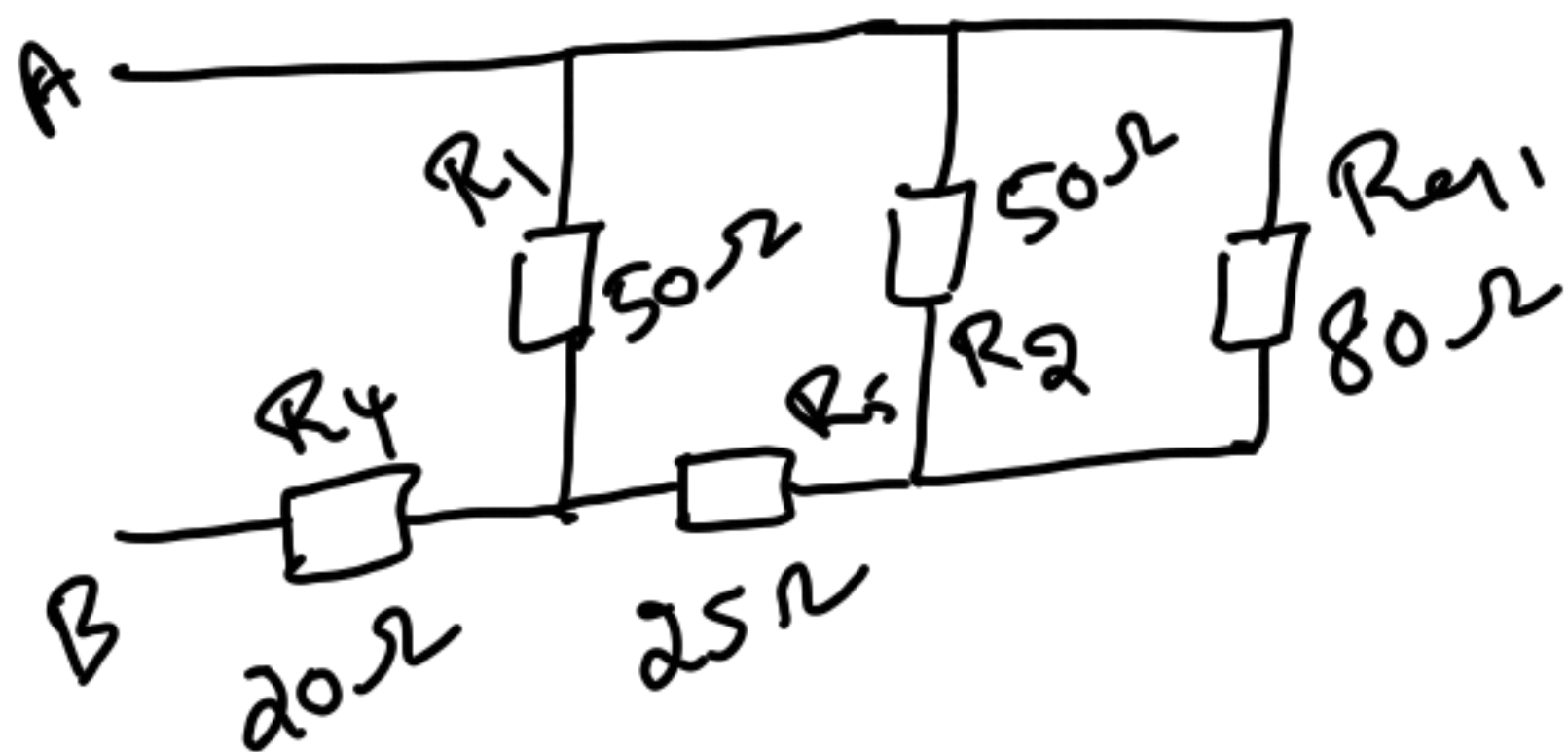


R_1	Series - R_4	R_1, R_2 & R_3 - Parallel	X
R_2	"	R_4, R_5 & R_6 - Series	X
R_3	"	R_3 series - R_6	✓

R_3 and R_6 are in series

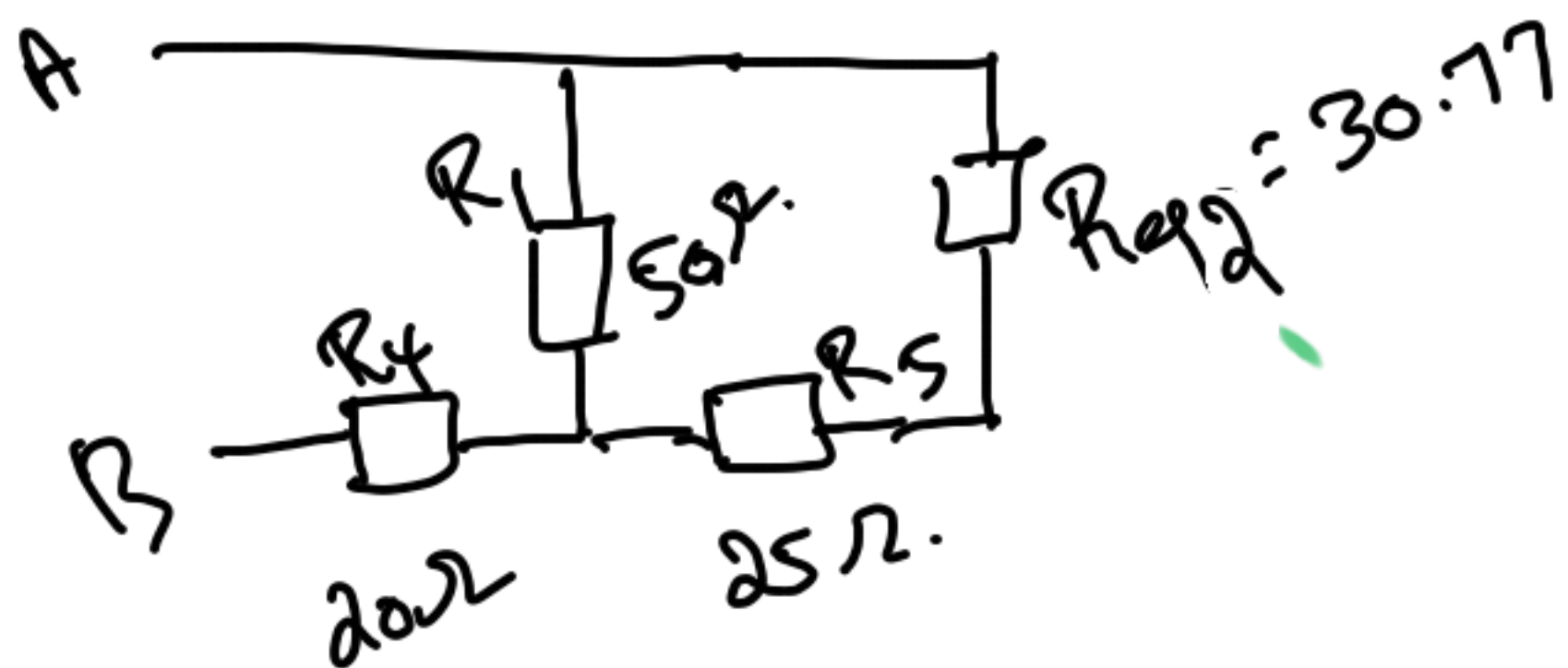
$$R_{eq1} = R_3 + R_6 \\ = 50 + 30$$

$$R_{eq1} = 80 \Omega$$



R_2 and R_{eq1} are in parallel.

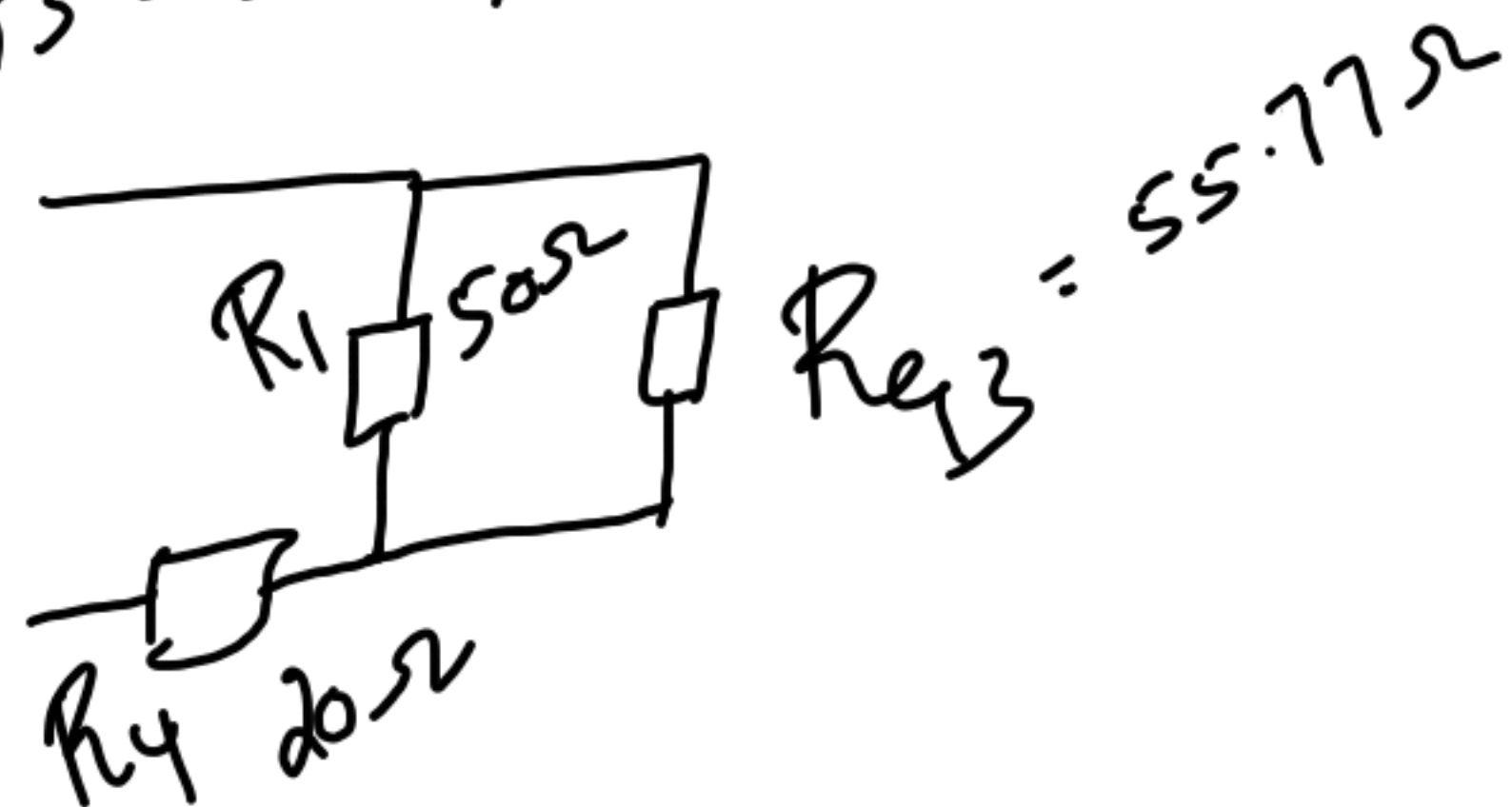
$$R_{eq2} = \frac{1}{\frac{1}{R_2} + \frac{1}{R_{eq1}}} = \frac{1}{\frac{1}{50} + \frac{1}{80}} = 30.77 \Omega$$



R_5 and R_{eq2} are in series

$$R_{eq3} = R_5 + R_{eq2} = 25 + 30.77$$

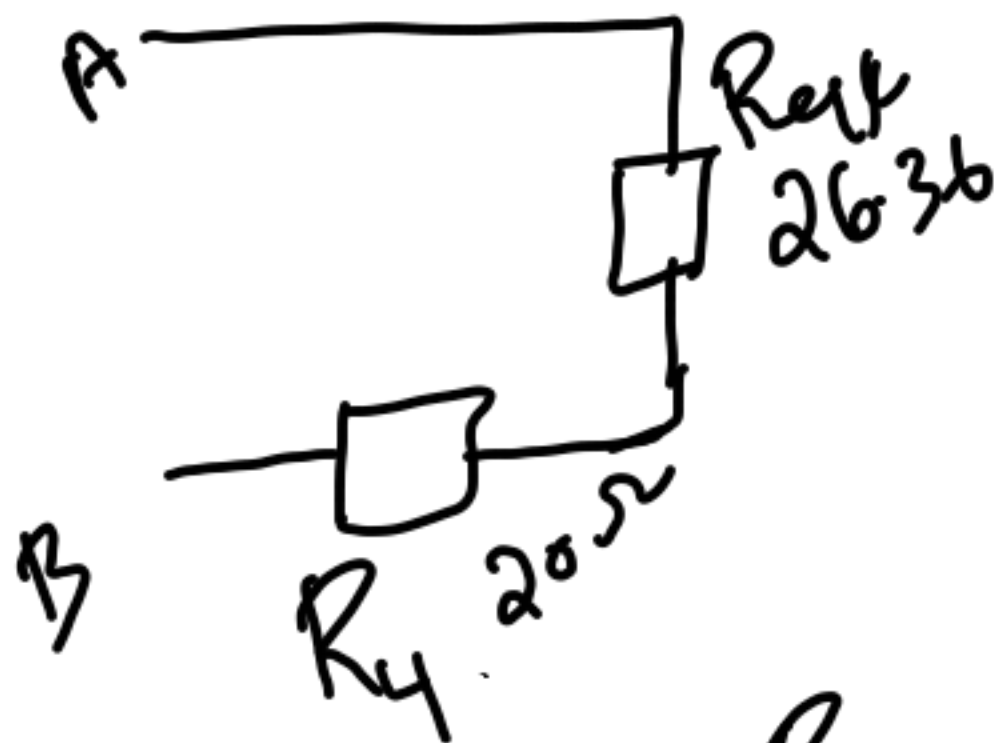
$$R_{eq3} = 55.77 \Omega$$



R_1 and R_{eq3} are in parallel

$$R_{eq4} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_{eq3}}} = \frac{1}{\frac{1}{50} + \frac{1}{55.77}}$$

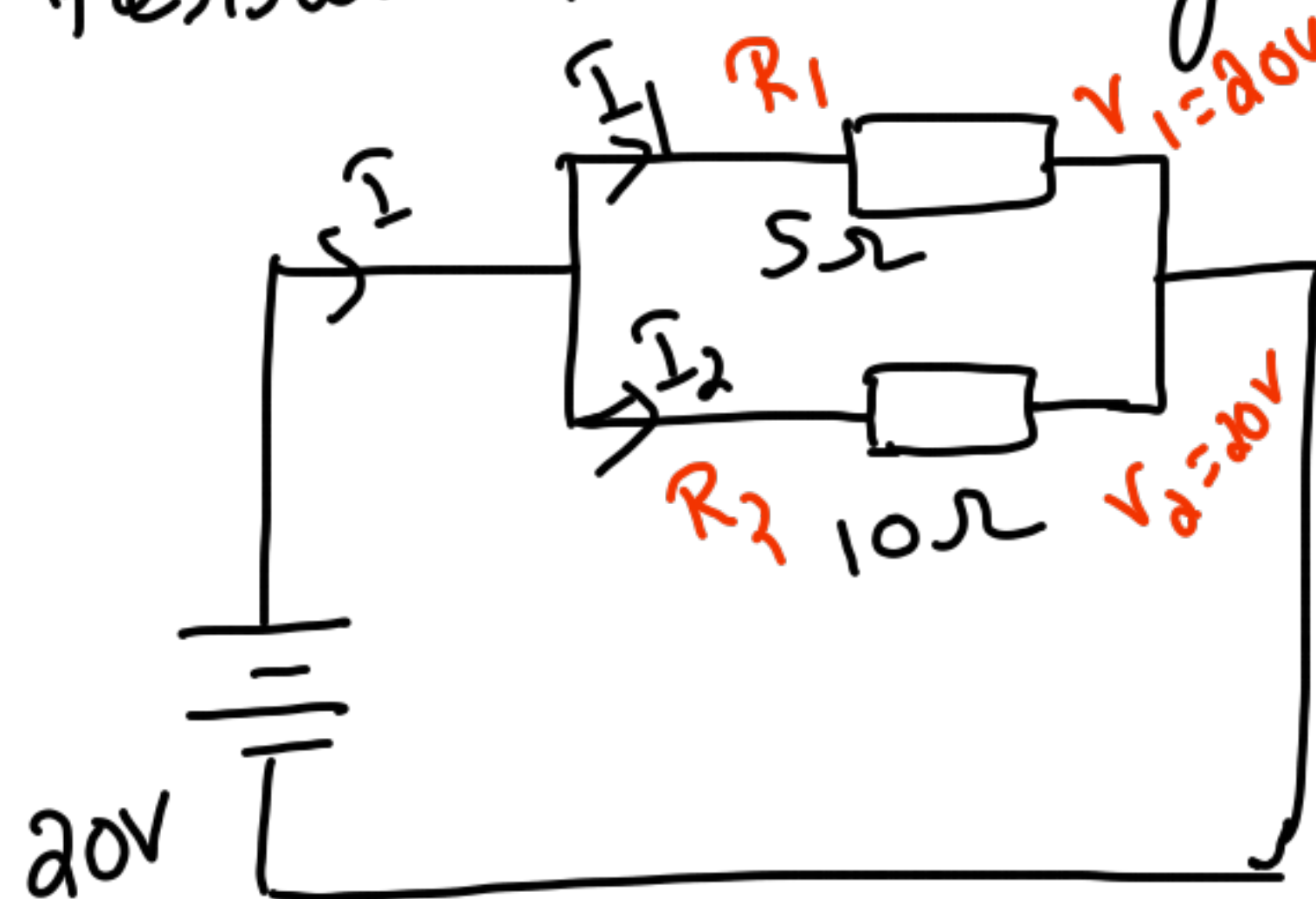
$$R_{eq4} = 26.36 \Omega$$



$$R_{eq} = R_4 + R_{eq4}$$

$$R_{eq} = 20 + 26.36 = 46.36 \Omega$$

5) Calculate the current across each Resistor in the following Circuit.

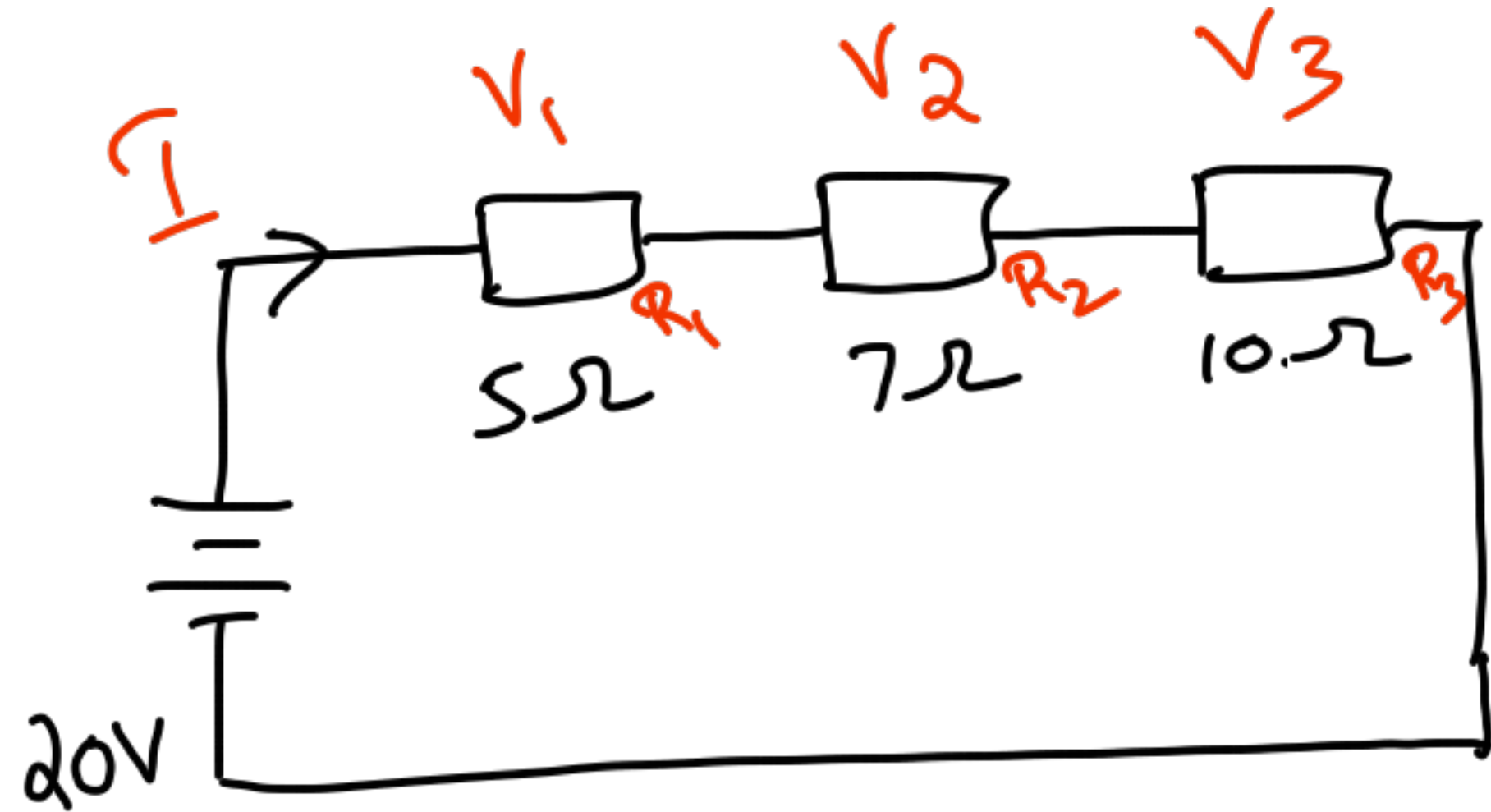


$$I_1 = \frac{V}{R_1} = \frac{20}{5} = 4 A$$

$$I_2 = \frac{V}{R_2} = \frac{20}{10} = 2 A$$

Total current
 $I = I_1 + I_2 = 4 + 2 = 6 A$

6) Calculate the Voltage and Current across each component in the circuit



$$R_T = R_{eq} = R_1 + R_2 + R_3 \\ = 5 + 7 + 10$$

$$R_T = 22\Omega$$

$$I = \frac{V}{R_T}$$

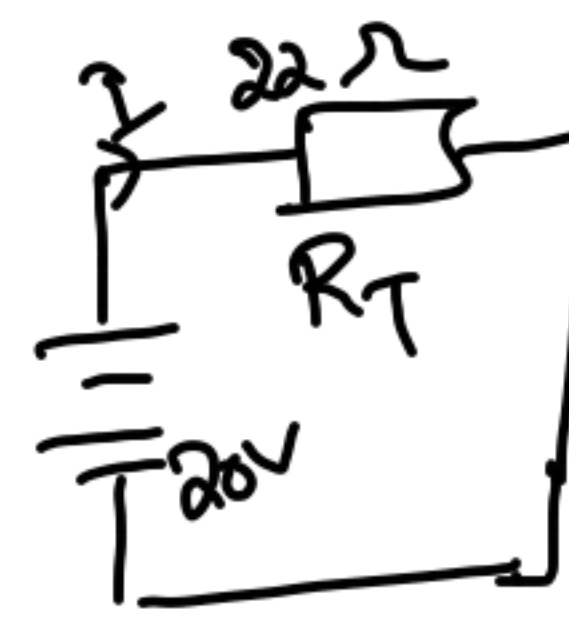
$$I = \frac{20}{22}$$

$$I = 0.91A$$

$$V_1 = I R_1 = 0.91 \times 5 = 4.55V$$

$$V_2 = I R_2 = 0.91 \times 7 = 6.37V$$

$$V_3 = I R_3 = 0.91 \times 10 = 9.1V$$



(or) Voltage divider Rule

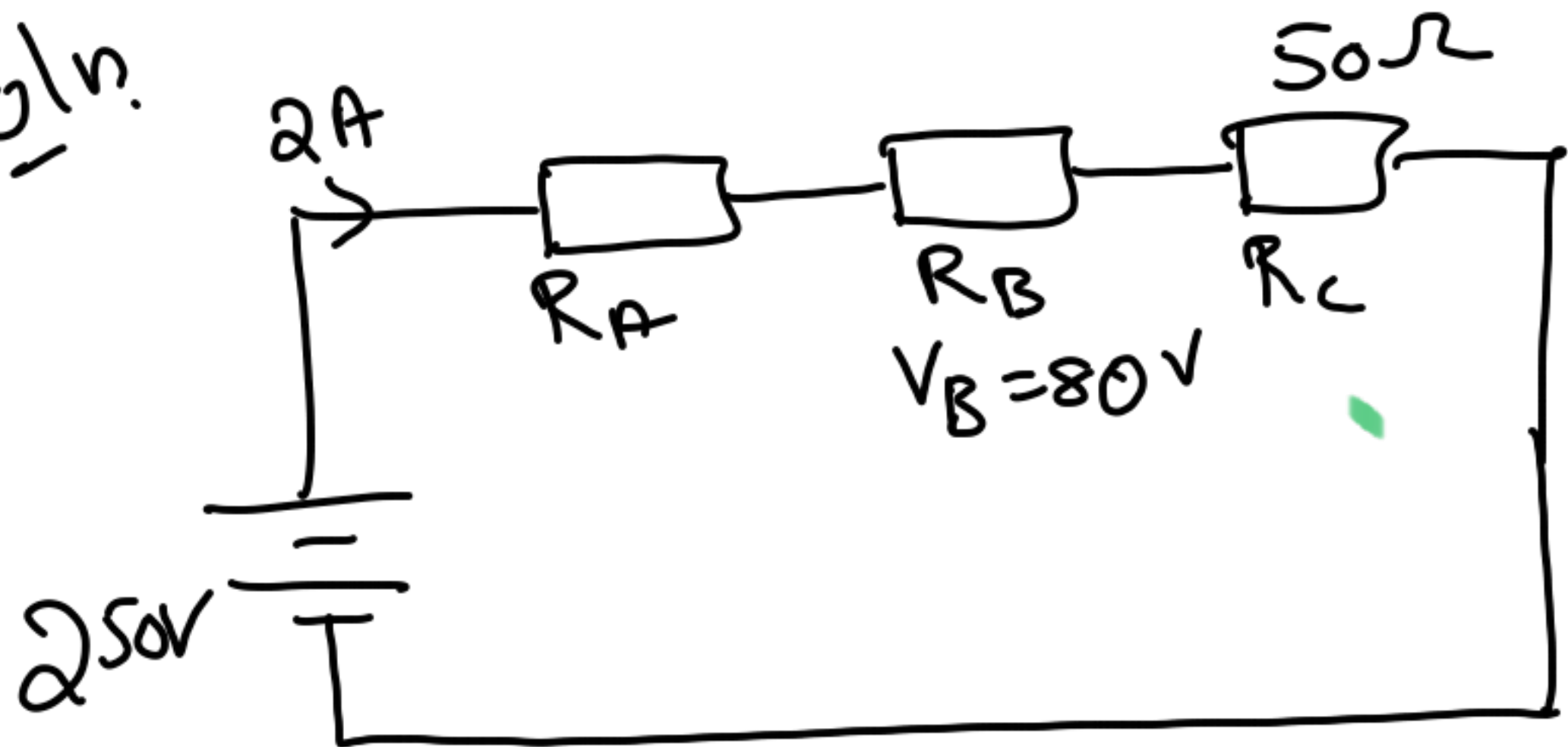
$$V_1 = \frac{V}{R_T} \cdot R_1 = \frac{20}{22} \times 5 = 4.55 \text{ V}$$

$$V_2 = \frac{V}{R_T} R_2 = \frac{20}{22} \times 7 = 6.37 \text{ V}$$

$$V_3 = \frac{V}{R_T} R_3 = \frac{20}{22} \times 10 = 9.1 \text{ V}$$

7) Three Resistors (R_A , R_B and R_C) are Connected in series across a 250V source $R_C = 50 \Omega$, $V_B = 80 \text{ V}$. Total current is 2A. Calculate R_A and R_B

Soln.



$$R_B = \frac{V_B}{I} = \frac{80}{2} = 40 \Omega.$$

$$V_C = I R_C = 2 \times 50 = 100V$$

Total voltage

$$V = V_A + V_B + V_C$$

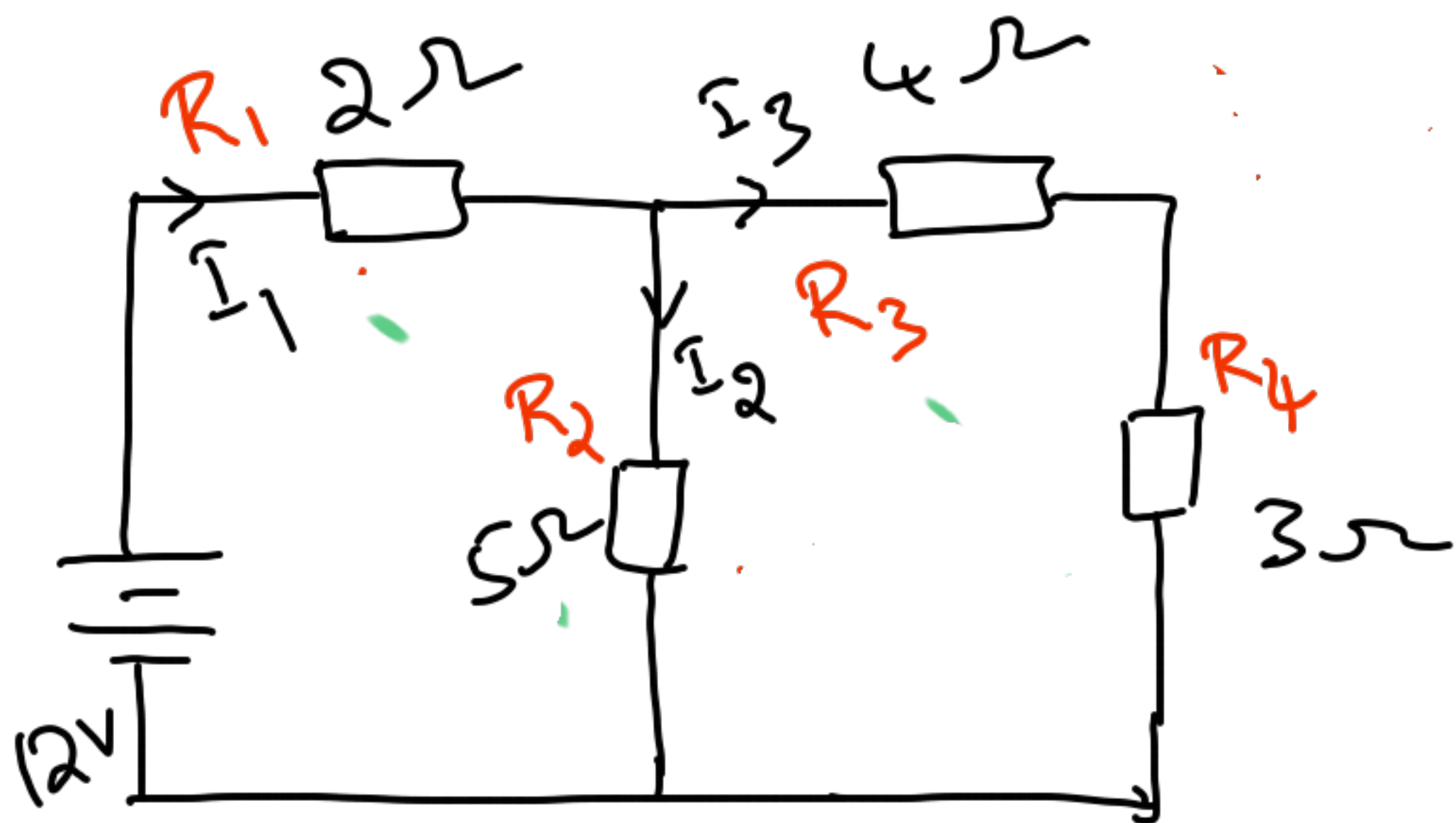
$$250 = V_A + 80 + 100$$

$$V_A = 250 - 80 - 100$$

$$V_A = 70V$$

$$R_A = \frac{V_A}{I} = \frac{70}{2} = 35 \Omega$$

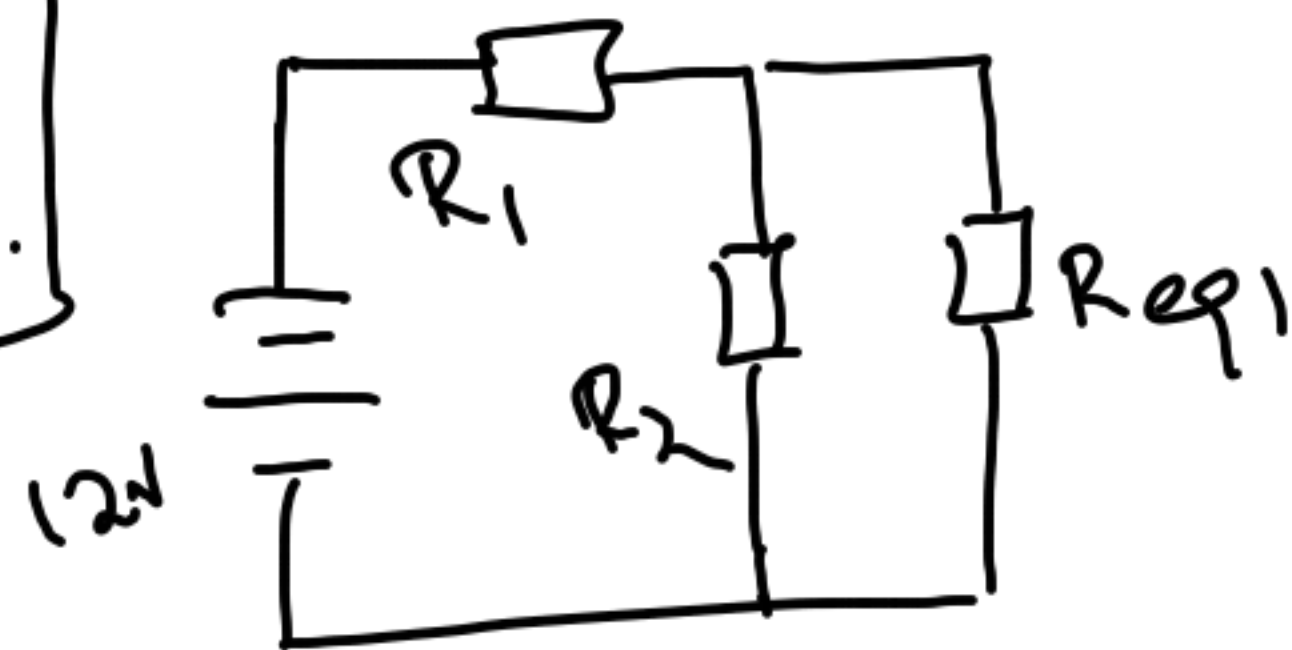
8) Calculate the current flowing through various Resistors in the circuit.



Soln

R_3 and R_4 in series

$$R_{eq1} = R_3 + R_4 = 4 + 3 = 7\Omega$$



R_{eq1} and R_2 are in parallel.

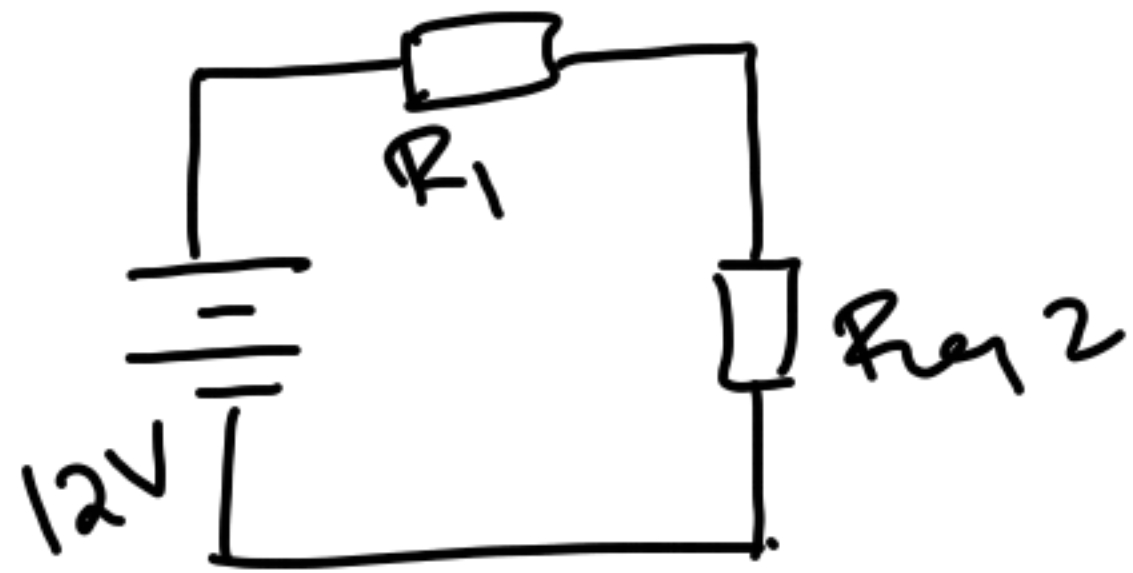
$$\frac{1}{R_{eq2}} = \frac{1}{R_2} + \frac{1}{R_{eq1}}$$

$$= \frac{1}{5} + \frac{1}{7}$$

$$\frac{1}{R_{eq2}} = 0.341$$

Taking Reciprocal on both side.

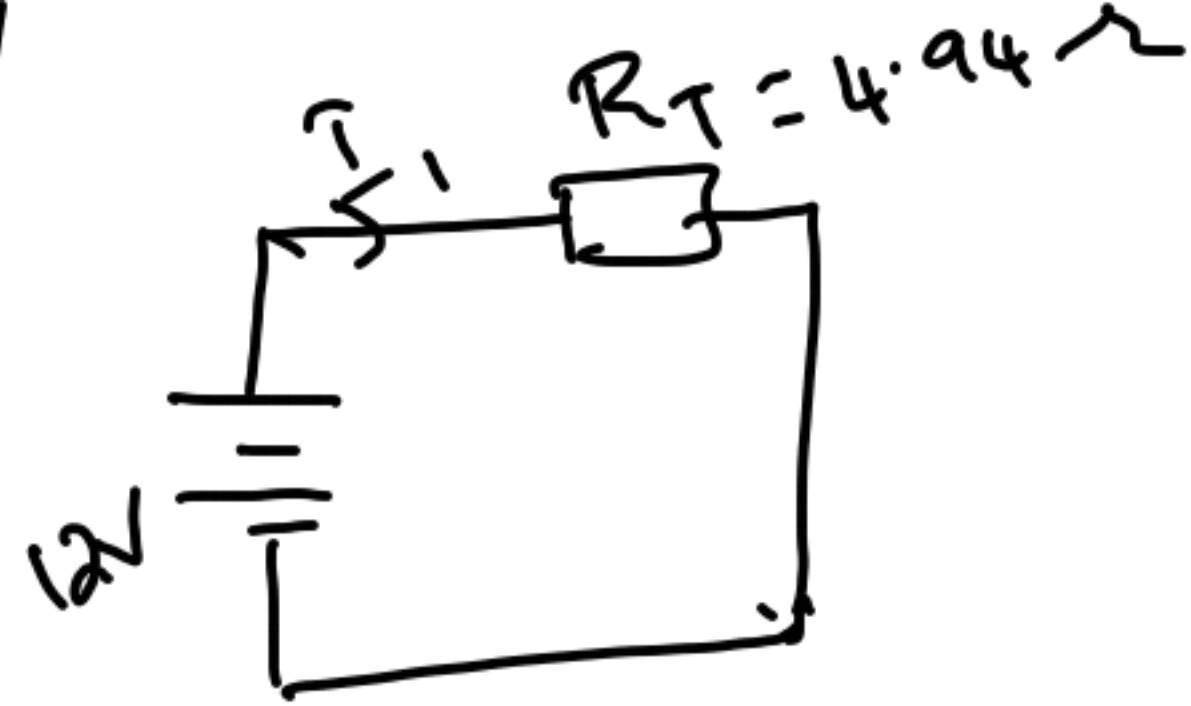
$$R_{eq2} = \frac{1}{0.341} = 2.94 \Omega$$



R_1 and R_{eq2} are in Series

$$R_T = R_{eq} = R_1 + R_{eq2} \\ = 2 + 2.94$$

$$R_T = 4.94 \Omega$$

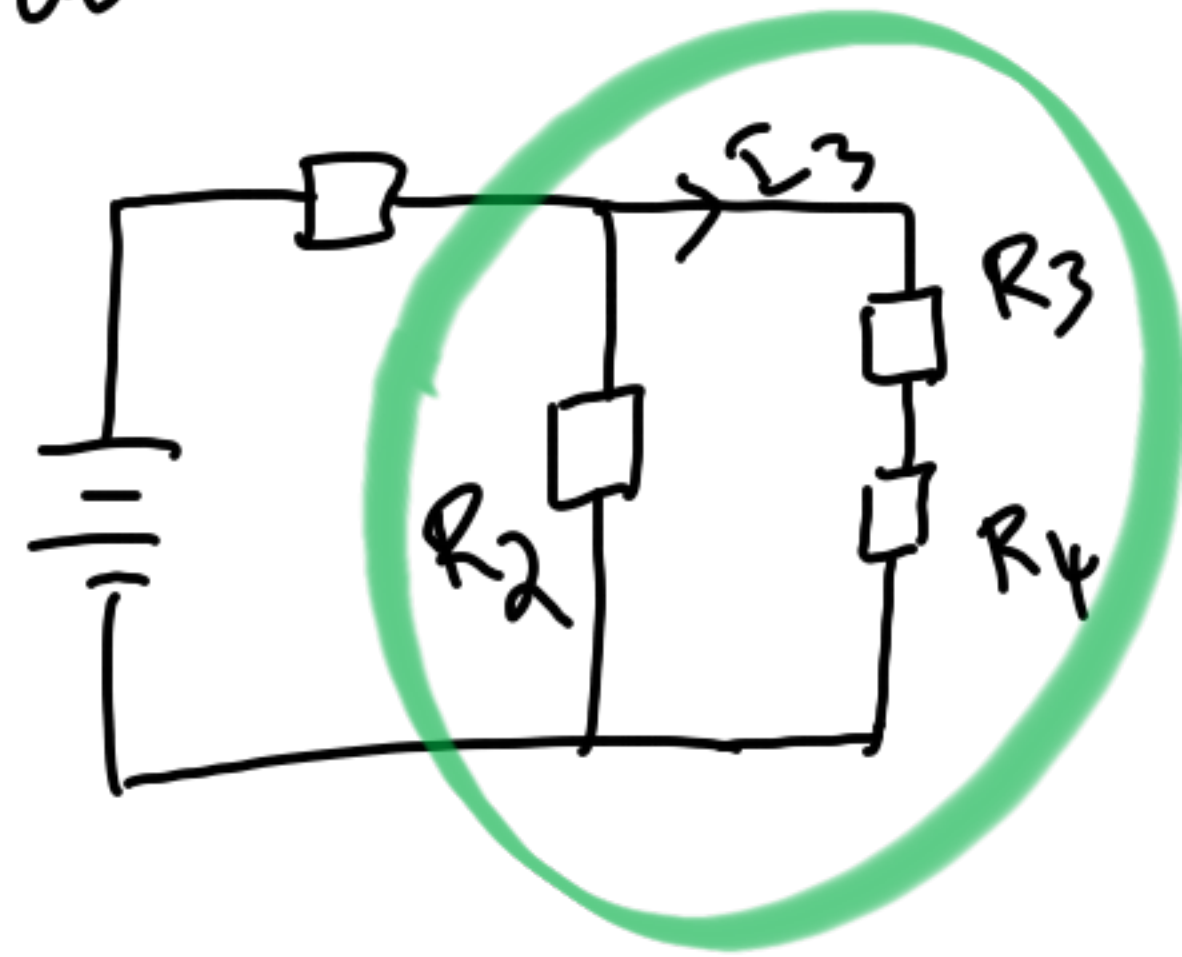


$$I_1 = \frac{V}{R} = \frac{12}{4.94}$$

$$I_1 = 2.42 \text{ A}$$

Apply current divider Rule.

$$I_2 = \frac{I_1 \times R_{T\text{parallel}}}{R_2}$$



$$I_2 = \frac{2.42}{5} \times \left(\frac{1}{\frac{1}{5} + \frac{1}{(4+3)}} \right)$$

$$I_2 = 1.41 \text{ A}$$

$$I_3 = \frac{I_1}{(R_3 + R_4)} \times R_{T \text{ parallel}}$$

$$= \frac{2.42}{7} \times \left(\frac{1}{\frac{1}{5} + \frac{1}{(4+3)}} \right)$$

$$I_3 = 1.01 \text{ A}$$

$$R_{T \text{ parallel}} = \frac{1}{\frac{1}{R_2} + \frac{1}{(R_3 + R_4)}}$$

$$I_1 = I_2 + I_3$$

$$I_3 = I_1 - I_2$$

$$(or) \quad I_3 = 2.42 - 1.41$$

$$I_3 = 1.01 \text{ A}$$

$$\text{Current across } 2\Omega = 2.42 \text{ A}$$

$$\text{Current across } 5\Omega = I_2 = 1.41 \text{ A}$$

$$\text{Current across } 4\Omega \text{ \& } 3\Omega = I_3 = 1.01 \text{ A}$$

Current divider Rule

$$I_1 = \frac{\text{Total current} \times \text{Total Resistance (Parallel)}}{\text{Own Resistance}}$$

9) A battery with a terminal voltage of 10V is connected to a circuit consisting of two 20Ω and two 15Ω resistors all connected in series. Assuming the battery has negligible internal resistance calculate.

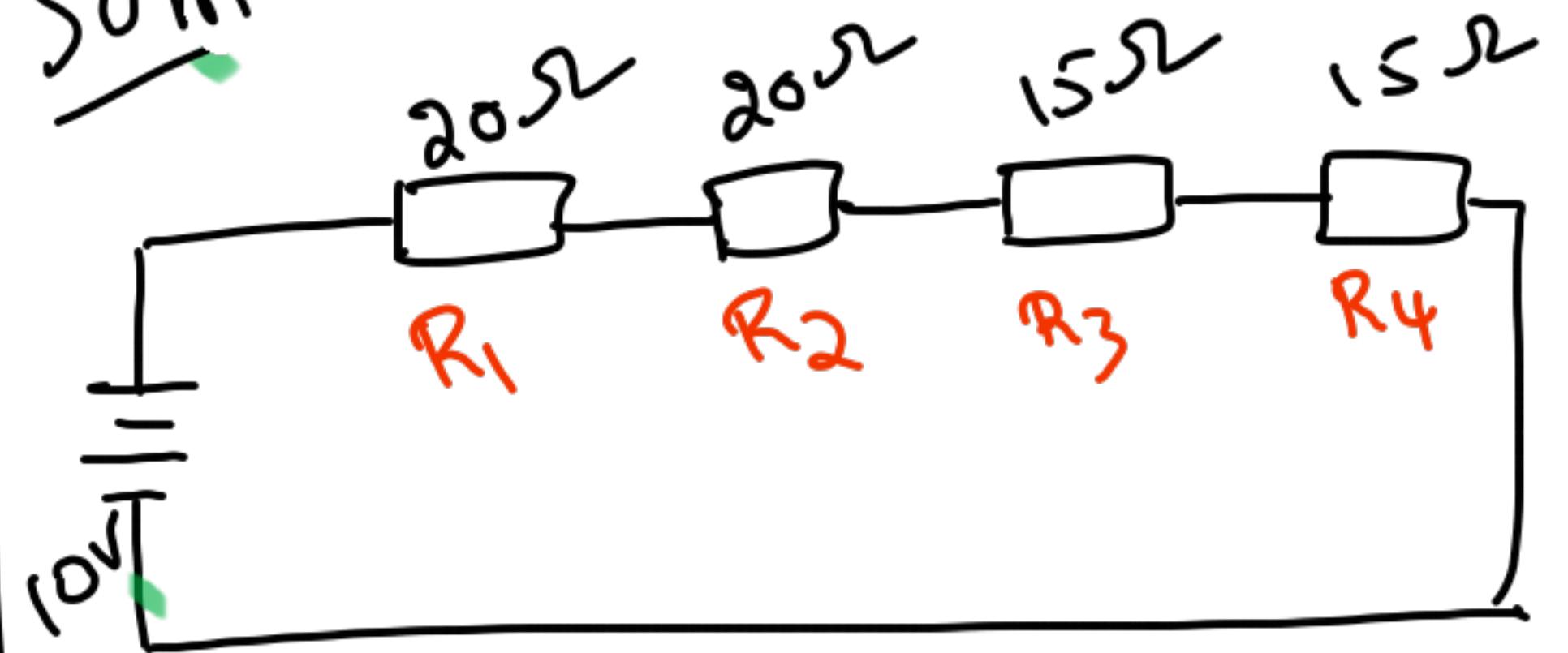
a) Equivalent total Resistance of the Circuit

b) Current through each Resistor

c) Potential drop across each Resistor

d) determine the total power dissipated by each Resistor and power supplied by the battery.

Soln



a) Total Resistance.

$$R_T = R_1 + R_2 + R_3 + R_4$$

$$R_T = 20 + 20 + 15 + 15 = 70\Omega$$

b) Current

$$I = \frac{V}{R_T} = \frac{10}{70}$$

$$I = 0.14 \text{ A}$$

Current across R_1 , R_2 , R_3 and R_4 is 0.14 A

c) Voltage across each Resistor.

$$V_1 = I \cdot R_1$$
$$= 0.14 \times 20$$

$$V_1 = 2.86 \text{ V}$$

$$\text{As } R_1 = R_2$$

$$V_2 = V_1 = 2.86 \text{ V}$$

$$V_3 = V \cdot R_3$$
$$= 0.14 \times 15$$

$$V_3 = 2.14 \text{ V}$$

$$\text{As } R_3 = R_4$$

$$\text{So, } V_3 = V_4 = 2.14 \text{ V}$$

d) Power,

$$P = VI$$

$$P_1 = V_1 I = 2.86 \times 0.14 = 0.4 \text{ W}$$

$$P_2 = V_2 I = 2.86 \times 0.14 = 0.4 \text{ W}$$

$$P_3 = V_3 I = 2.14 \times 0.14 = 0.31 \text{ W}$$

$$P_4 = V_4 I = 2.14 \times 0.14 = 0.31 \text{ W}$$

Power across the battery.

$$P_{\text{battery}} = V \times I = 10 \times 0.14 \\ = 1.43 \text{ W}$$

10) A Resistive Circuit is powered by a 50V Voltage source. The Resistors are connected in a combination of series and parallel. Calculate.

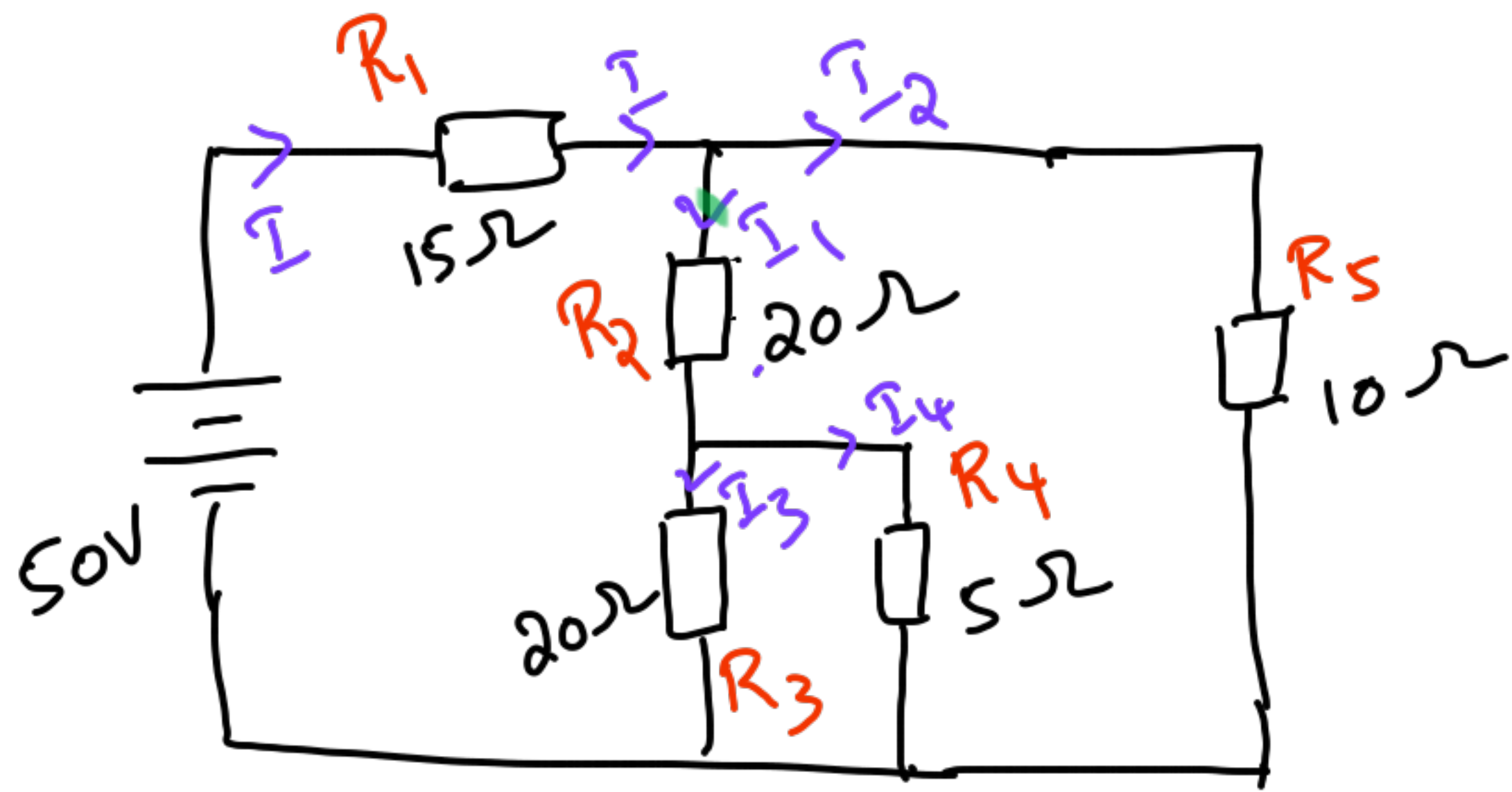
i) Total Resistance in the circuit

ii) Total current in the circuit.

iii) Current across each Resistor

iv) Voltage drop across each Resistor

v) Power dissipated across R_4 and R_5 .

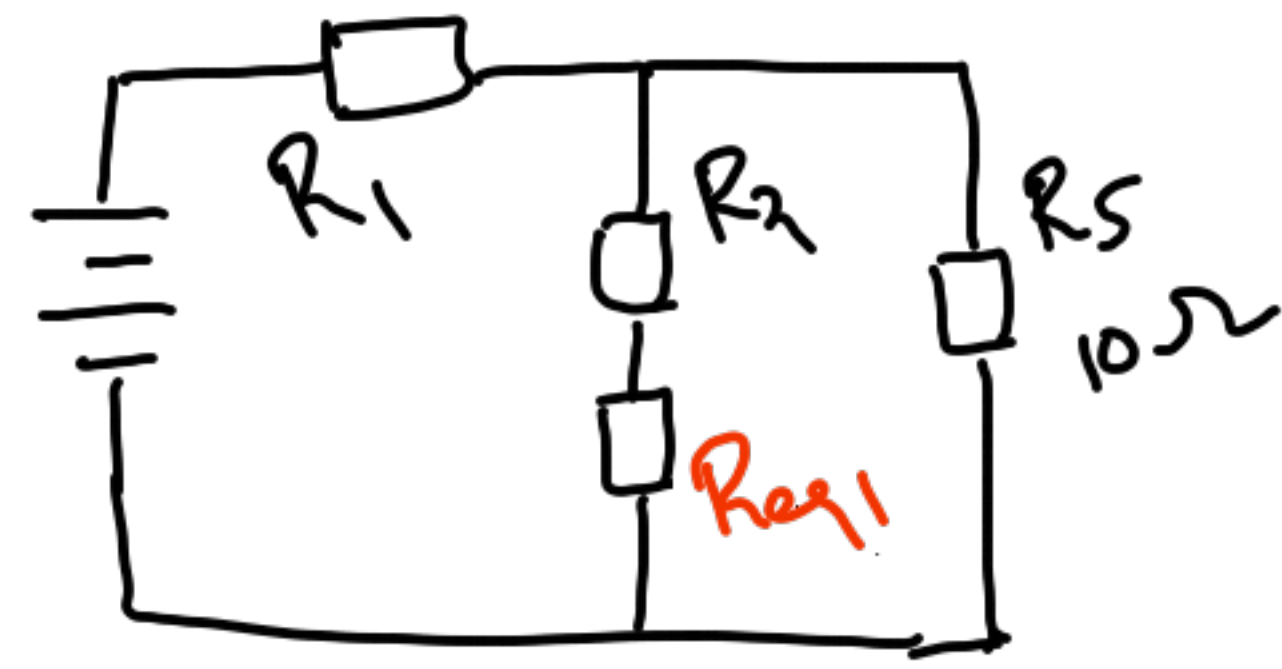


Soln.

R_3 and R_4 are in parallel.

$$R_{eq1} = \frac{1}{\frac{1}{R_3} + \frac{1}{R_4}} = \frac{1}{\frac{1}{20} + \frac{1}{5}} = 4\Omega$$

$$\frac{1}{R_{eq1}} = \frac{1}{R_3} + \frac{1}{R_4}$$

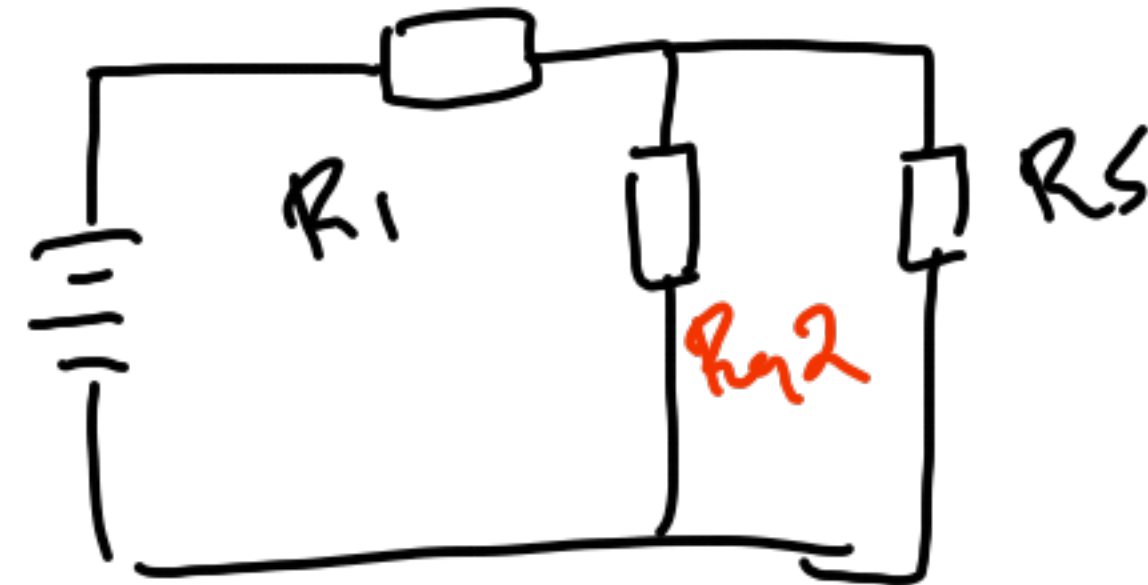


R_2 and R_{eq1} are in series

$$R_{eq2} = R_2 + R_{eq1}$$

$$= 20 + 4$$

$$R_{eq2} = 24\Omega$$



R_{eq2} is parallel with R_5

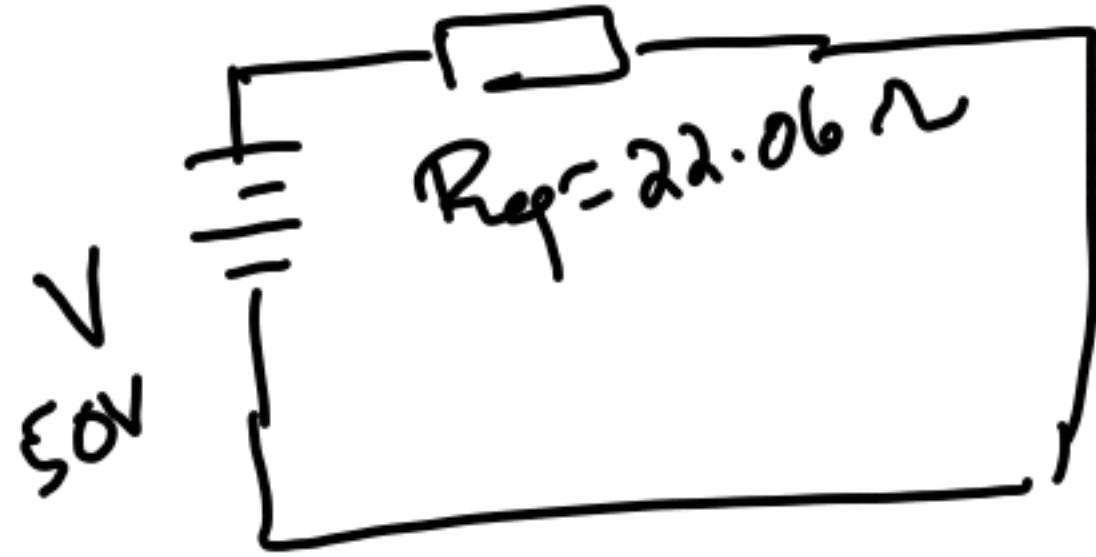
$$R_{eq3} = \frac{1}{\frac{1}{R_{eq2}} + \frac{1}{R_5}}$$
$$= \frac{1}{\frac{1}{24} + \frac{1}{10}}$$

$$R_{eq3} = 7.06 \Omega$$

R_{eq3} Series with R_1

$$R_{eq} = R_1 + R_{eq3}$$
$$= 15 + 7.06$$
$$R_{eq} = 22.06 \Omega$$

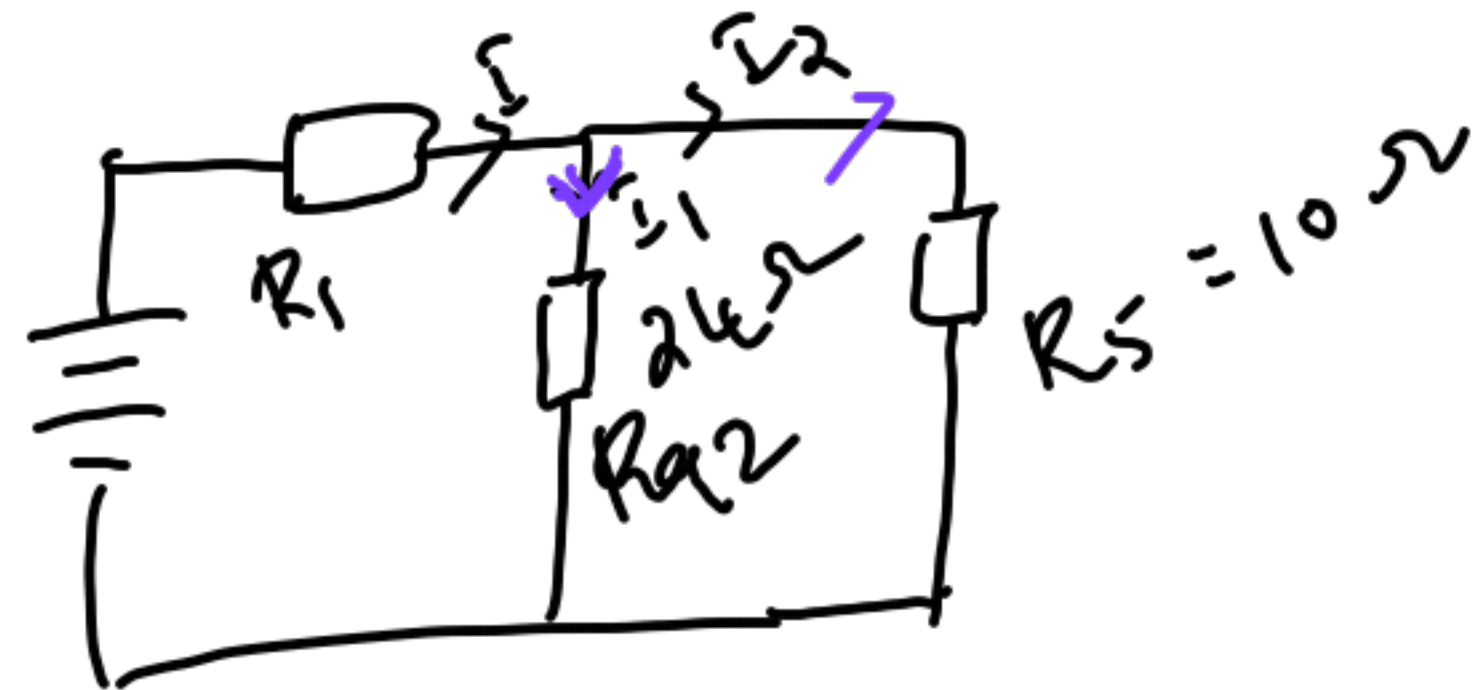
b) Total current



$$I = \frac{V}{R_{eq}} = \frac{50}{22.06}$$

$$I = 2.27 A$$

c) To find current across each Resistor.



Apply Current divider Rule.

$$I_1 = \frac{I}{R_{eq2}} \times R_{T \text{ Parallel.}}$$

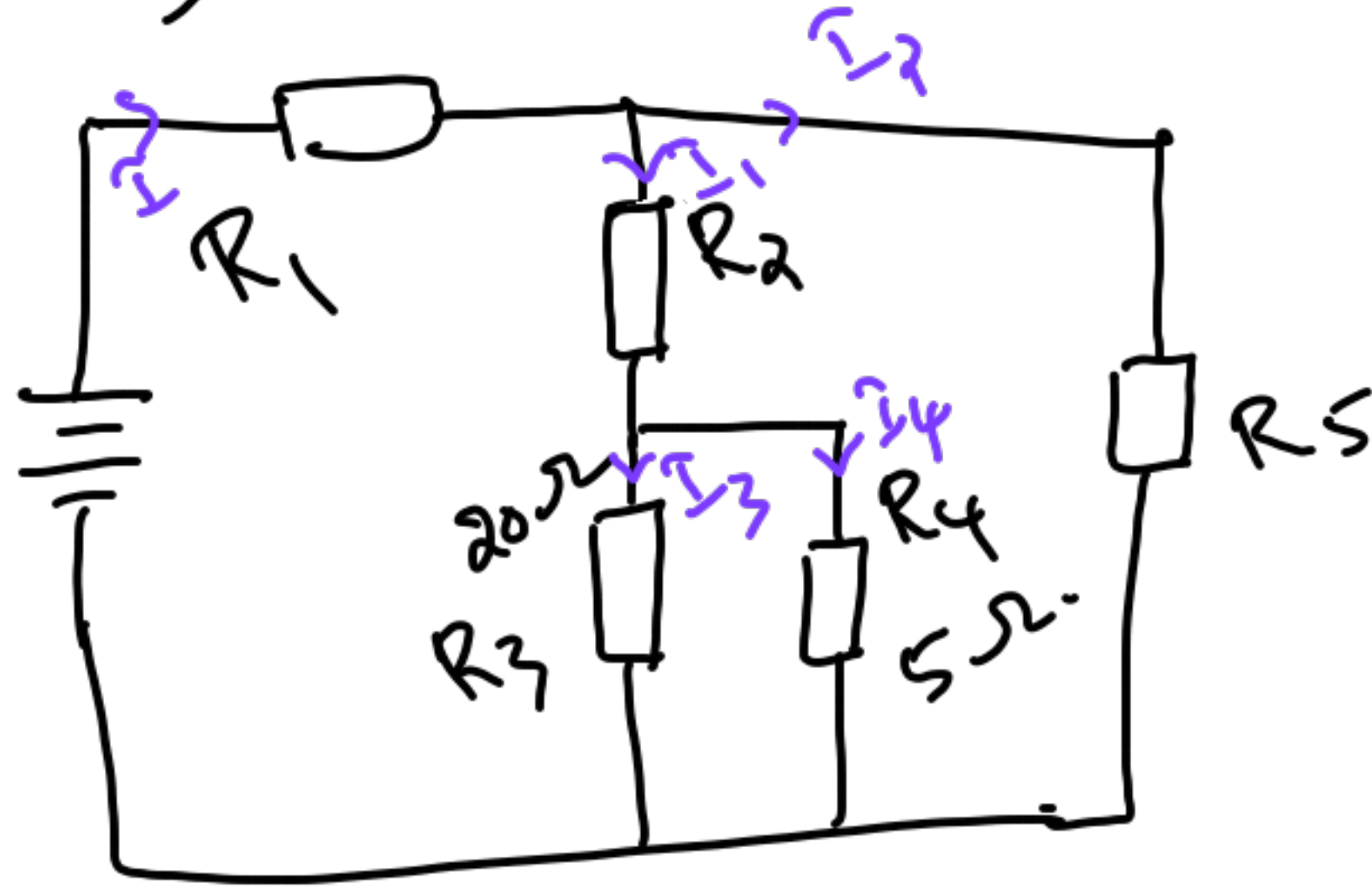
$$I_1 = \frac{2.27}{24} \times \left(\frac{1}{\frac{1}{24} + \frac{1}{10}} \right)$$

$$I_1 = 0.667 \text{ A}$$

$$I_2 = \frac{I}{R_5} \times R_{T \text{ Parallel.}}$$

$$I_2 = \frac{2.27}{10} \times \left(\frac{1}{\frac{1}{24} + \frac{1}{10}} \right) = 1.6 \text{ A}$$

Apply Current divider Rule in R_3 and R_4 .



$$I_3 = \frac{I_1}{R_3} \times R_{T \text{ Parallel}(1)}$$

$$I_3 = \frac{0.667}{20} \times \left(\frac{1}{\frac{1}{R_3} + \frac{1}{R_5}} \right)$$

$$I_3 = \frac{0.667}{20} \times \left(\frac{1}{\frac{1}{20} + \frac{1}{5}} \right)$$

$$I_3 = 0.13 \text{ A}$$

$$I_4 = \frac{I_1}{R_4} \times R_{T \text{ Parallel}(1)}$$

$$I_4 = \frac{0.667}{5} \times \left(\frac{1}{\frac{1}{R_3} + \frac{1}{R_4}} \right)$$

$$I_4 = \frac{0.667}{5} \times \left(\frac{1}{\frac{1}{20} + \frac{1}{5}} \right)$$

$$I_4 = 0.53 \text{ A}$$

Current across R_1 is $I = 2.27 \text{ A}$

Current across R_2 is $I_1 = 0.667 \text{ A}$

Current across R_3 is $I_3 = 0.13 \text{ A}$

Current across R_4 is $I_4 = 0.53 \text{ A}$

Current across R_5 is $I_2 = 1.6 \text{ A}$

d) Voltage across each Resistor

Voltage across Resistor R_1

$$V_1 = I \cdot R_1 = 2.27 \times 15 = 34.05 \text{ V}$$

Voltage across Resistor R_2

$$V_2 = I_1 \times R_2 = 0.667 \times 20 = 13.34 \text{ V}$$

Voltage across Resistor R_3

$$V_3 = I_3 \times R_3 = 0.13 \times 20 = 2.6 \text{ V}$$

Voltage across Resistor R_4

$$V_4 = I_4 \times R_4 = 0.53 \times 5 = 2.65 \text{ V}$$

Voltage across Resistor R_5

$$V_5 = I_2 \times R_5 = 1.6 \times 10 = 16V$$

