PQ 5 Electricity Circuits

Q and A

Q1

Three resistors of 100 Ω, 140 Ω, and 80 Ω are placed in a series circuit.

a. Find the equivalent resistance. (Your answer should be between 0 – 500 Ω)

$$R_{eq} = R_1 + R_2 \ldots R_n$$

$$= 100 + 140 + 80 = 320\ \Omega$$

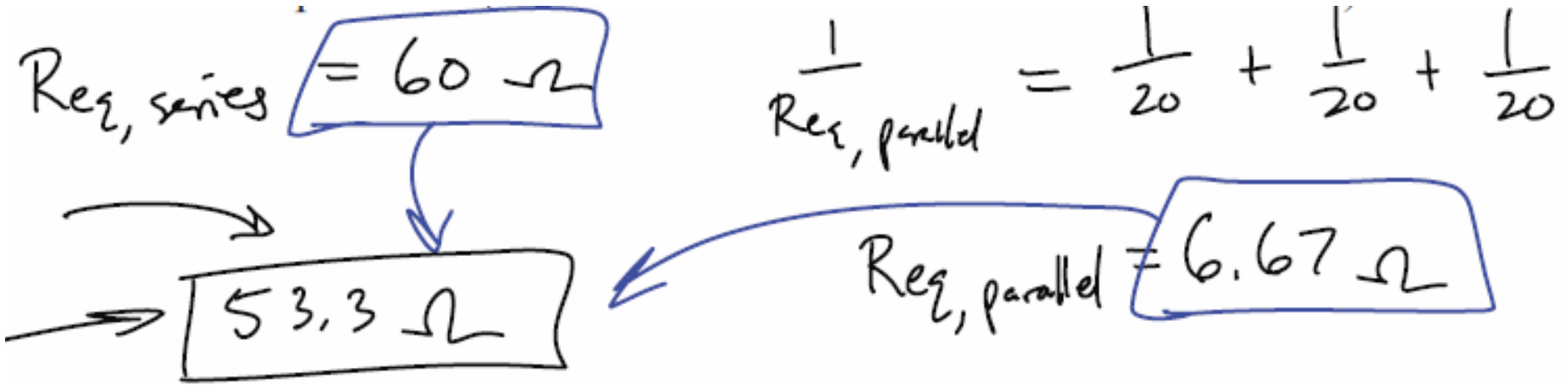
b. If you were to place these three resistors in parallel, what would the equivalent resistance be? (Your answer should be between 0 – 100 Ω)

$$\frac{1}{R_{eq}} = \frac{1}{100} + \frac{1}{140} + \frac{1}{80}$$

$$R_{eq} = 33.73\ \Omega$$

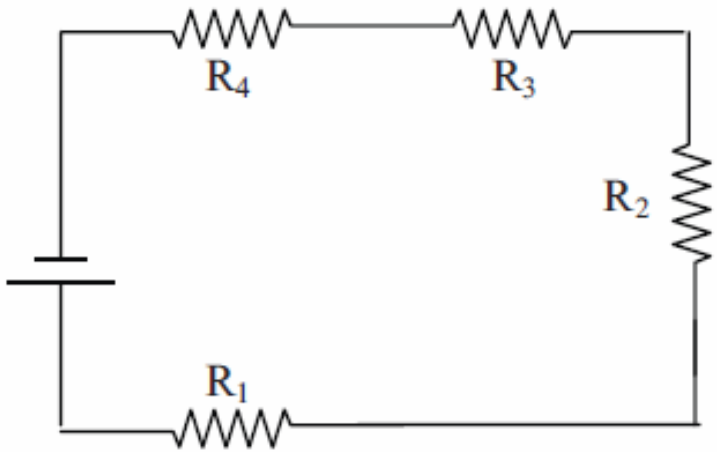
Q2

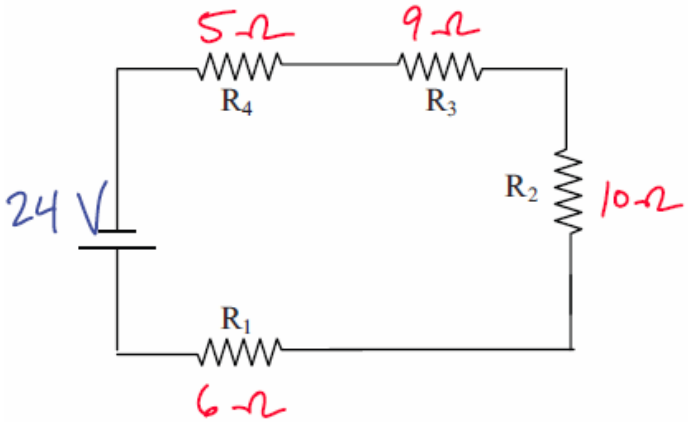
By how much is the resistance reduced if you change the circuitry of three 20 Ω resistors in series to three 20 Ω resistors in parallel? (Your answer should be between 40 – 60 Ω)



Q3

The circuit below has a 24 V battery connected to resistors $R_1 = 6\ \Omega$, $R_2 = 10\ \Omega$, $R_3 = 9\ \Omega$, $R_4 = 5\ \Omega$. Calculate the equivalent resistance and the net current of the circuit. (Your answer should be between 20 – 35 Ω, and between 0 – 1 A, respectfully)





$$R_{eq} = R_1 + R_2 + R_3 \ldots R_n$$

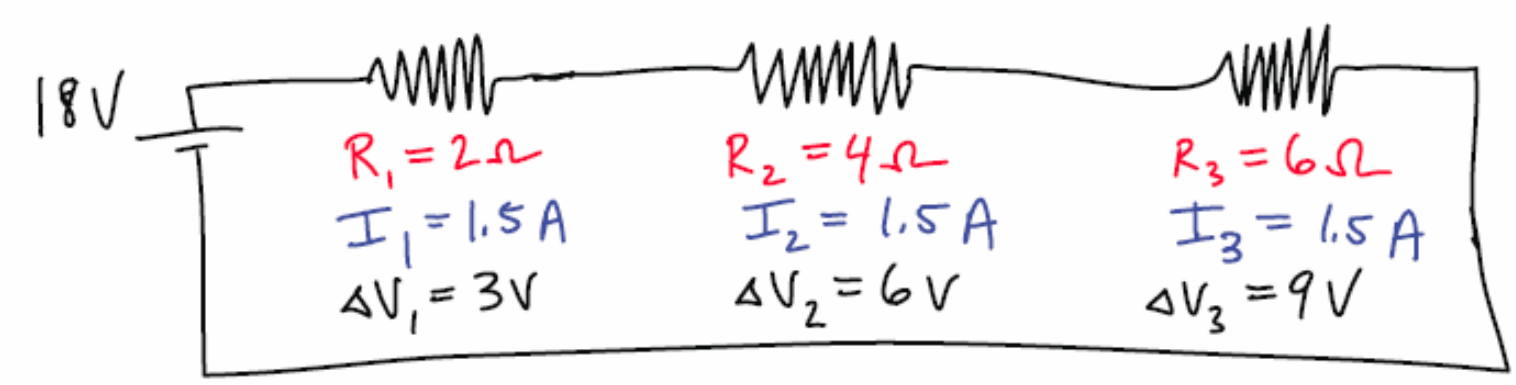
$$R_{eq} = 30\ \Omega$$

$$I_{net} = \frac{\Delta V_{tot}}{R_{eq}} = .8\ A$$

Q4

Three resistors are connected in series with an 18 V battery. $R_1 = 2\ \Omega$, $R_2 = 4\ \Omega$, $R_3 = 6\ \Omega$

a. Draw a schematic diagram.



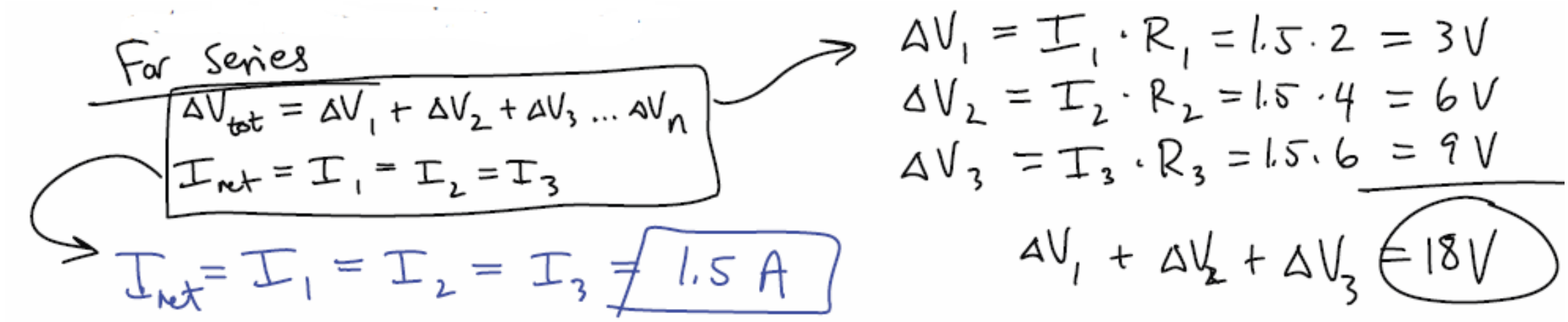
b. Determine the equivalent resistance, and net current for the circuit. (Your answer should be between 10 – 20 Ω, and between 1 – 3 A respectfully)

$R_{eq} = 2 + 4 + 6 = \boxed{12\ \Omega}$

$I_{net} = \frac{\Delta V_{tot}}{R_{eq}} = \frac{18}{12} = \boxed{1.5A}$

Q4 continued

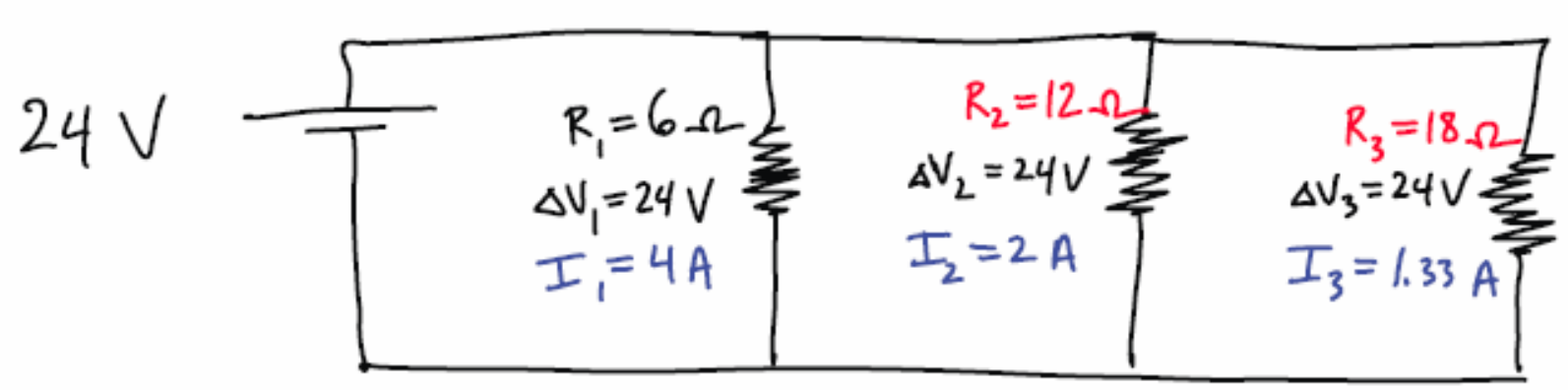
c. Determine the current in each resistor, and the potential difference across each resistor. (Each resistor should have the same current, and the sum of the potential differences should equal the potential difference in the battery)



Q5

Three resistors are connected in parallel with a 24 V battery. $R_1 = 6.0\ \Omega$, $R_2 = 12.0\ \Omega$, $R_3 = 18.0\ \Omega$

a. Draw a schematic diagram.



b. Determine the equivalent resistance, and net current in the circuit. (Your answer should be between 0 – 10 Ω, and between 0 – 10 A respectfully)

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{12} + \frac{1}{18}$$

$$\frac{1}{R_{eq}} = \frac{6}{36} + \frac{3}{36} + \frac{2}{36}$$

$$R_{eq} = \frac{36}{11} = 3.273\ \Omega$$

$$\Delta V_{tot} = I_{net} R_{eq}$$

$$I_{net} = \frac{\Delta V_{tot}}{R_{eq}}$$

$$I_{net} = 7.33\ A$$

Q5 continued

c. Determine the current in each resistor, and potential difference across each resistor. (The sum of the currents should equal the net current, and each resistor should have the same potential difference)

$I_1 = \frac{\Delta V_1}{R_1} = \frac{24}{6} = 4\ A$

$I_2 = \frac{\Delta V_2}{R_2} = \frac{24}{12} = 2\ A$

$I_3 = \frac{\Delta V_3}{R_3} = \frac{24}{18} = 1.3\ A$

$7.3\ A$

$\Delta V_{tot} = \Delta V_1 = \Delta V_2 = \Delta V_3$

$I_{net} = I_1 + I_2 + I_3 \ldots I_n$

For Parallel

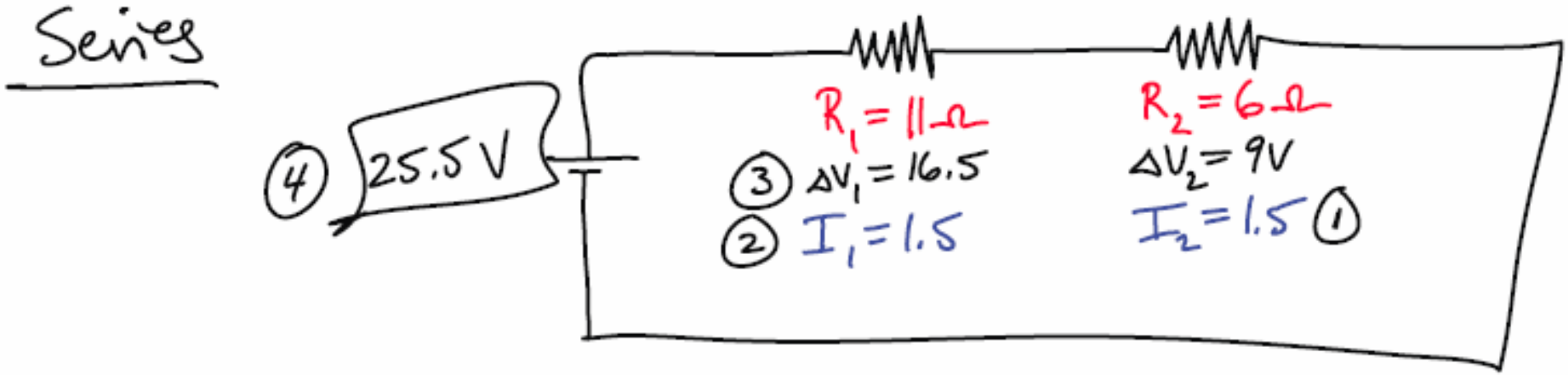
$\Delta V_1 = 24\ V$

$\Delta V_2 = 24\ V$

$\Delta V_3 = 24\ V$

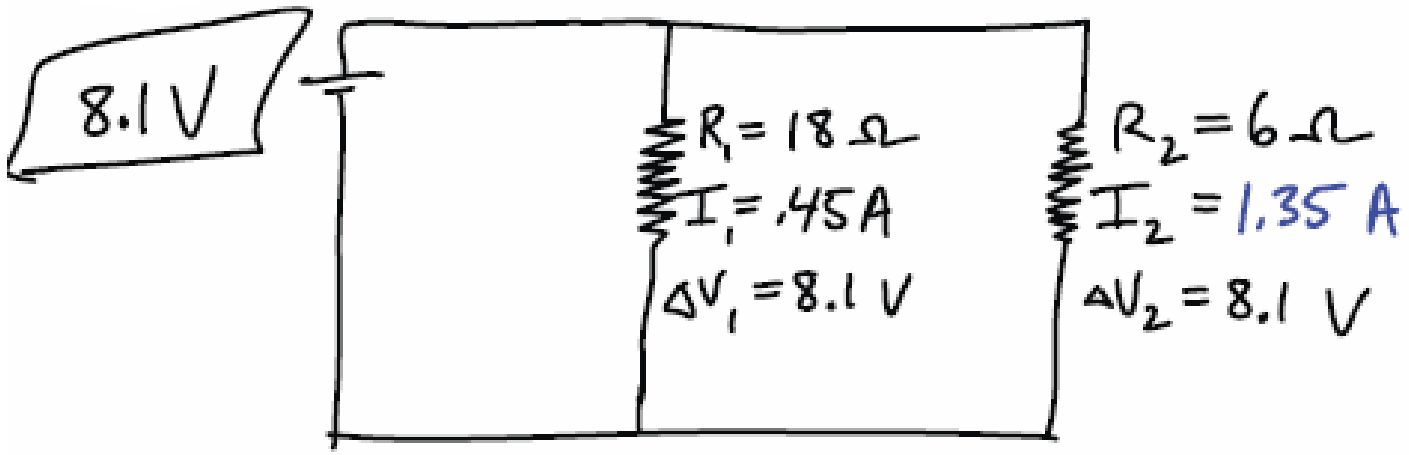
Q6

An 11.0 Ω resistor and a 6.0 Ω resistor are connected in series with a battery. The potential difference across the 6.0 Ω resistor is measured as 9 V. Find the potential difference across the battery. (Your answer should be between 20 – 30 Volts)



Q7

A 18.0 Ω resistor and a 6.0 Ω resistor are connected in parallel to a battery, and the current in the 18.0 Ω resistor is found to be 0.45 A. Find the potential difference across the battery. (Your answer should be between 5 – 10 Volts)



Q8

Two identical parallel-wired strings of 40 bulbs are connected to each other in series. If the equivalent resistance of the combination is 130.0 Ω when it is connected across a potential difference of 120.0 V, what is the resistance of each individual bulb? (Your answer should be between 2 – 3 kΩ)

Each resistor has X Ω

$$\frac{1}{R_1} = \frac{1}{x} + \frac{1}{x} + \frac{1}{x} \cdots$$

$$\frac{1}{R_1} = \frac{40}{x}$$

$$R_1 = \frac{x}{40}$$

$$R_{eq} = R_1 + R_2$$

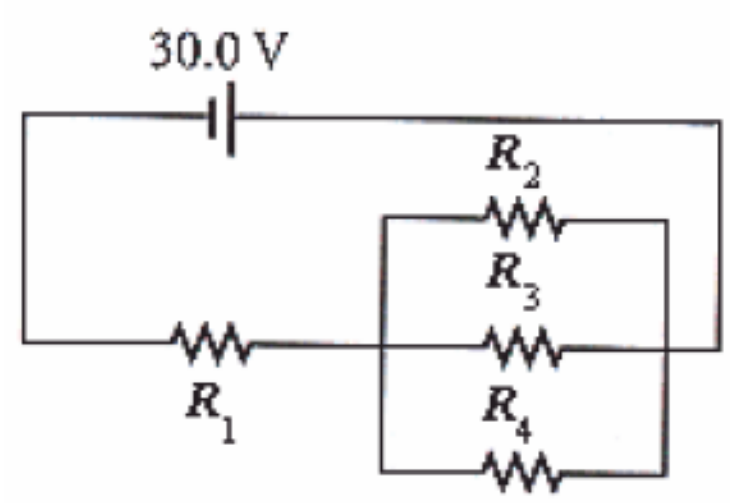
$$130 = \frac{x}{40} + \frac{x}{40}$$

$$130 = \frac{x}{20}$$

$$x = 2600\ \Omega$$

Q9

Find the equivalent resistance of the circuit shown below, if $R_1 = 13.0\ \Omega$, $R_2 = 24.0\ \Omega$, $R_3 = 10.0\ \Omega$ and $R_4 = 3.0\ \Omega$. (Your answer should be between 15 – 20 Ω)



① $\frac{1}{R_{eq}} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$

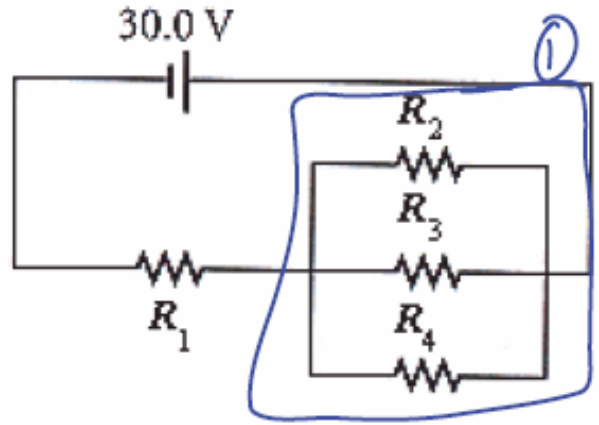
$\frac{1}{R_{eq}} = \frac{1}{24} + \frac{1}{10} + \frac{1}{3}$

$R_{eq} = 2.105\ \Omega$

$R_{eq} = ① + 13$

$R_{eq} = 2.11 + 13$

$R_{eq} = 15.11\ \Omega$



Q10

The equivalent resistance of the circuit below is 60.0 Ω. If $R_1 = 45.0\ \Omega$, $R_2 = 5.0\ \Omega$, $R_3 = 5.0\ \Omega$ and $R_4 = 45.0\ \Omega$, find the resistance of R. (Your answer should be between 34 – 40 Ω)