PHYSICS 12

FINDING INFORMATION ABOUT MORE COMPLEX CIRCUITS

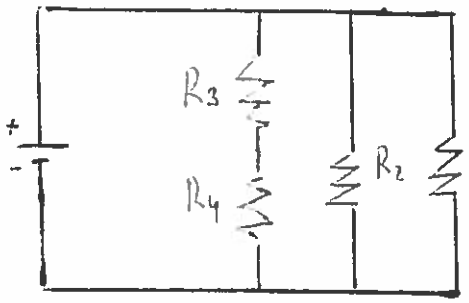
Parallel:

$$\frac{1}{\Sigma R} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}$$

Series:

$$\Sigma R = R_1 + R_2 + \cdots + R_n$$

1. Find the equivalent resistance of the electric circuit below:



$R_1 = 10\Omega$, $R_2 = 5\Omega$, $R_3 = 8\Omega$, $R_4 = 4\Omega$

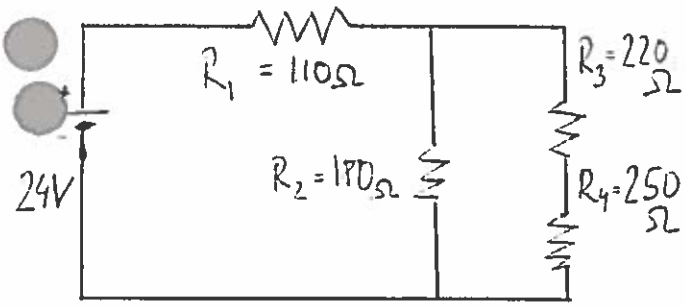
$R_3 + R_4 = 12\Omega$

ΣR: $\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{5} + \frac{1}{12} = \frac{6+12+5}{60} = \frac{23}{60}$

$\therefore \Sigma R = \frac{60}{23}\Omega \approx 2.6\Omega$

- Before using the formula for equivalent resistance for resistors in parallel R_3 and R_2 must be added using the formula for resistors in series.

2. Find the current in the electric circuit below:



Step 1: locate all resistors in parallel R2, R4, and R3

Step 2: add R_3 and R_4 using the formula for resistors in series

Step 3: Find the resistance from R_2 and (R_3 + R_4) using the formula for resistors in parallel

Step 4: Find the equivalent resistance using the result from step 3 and adding R_1 using the formula for resistors in series

Step 5: Use Ohm's law to fin the electric current

$R_3 + R_4 = 220 + 250 = 470\Omega$

R_p: $\frac{1}{\Sigma R_p} = \frac{1}{180} + \frac{1}{470} = \frac{470+180}{84600} = \frac{650}{84600}$ $\Rightarrow \Sigma R_p = \frac{84600}{650} = 130\Omega$

ΣR: $R_1 + 130\Omega = 110 + 130 = 240\Omega$

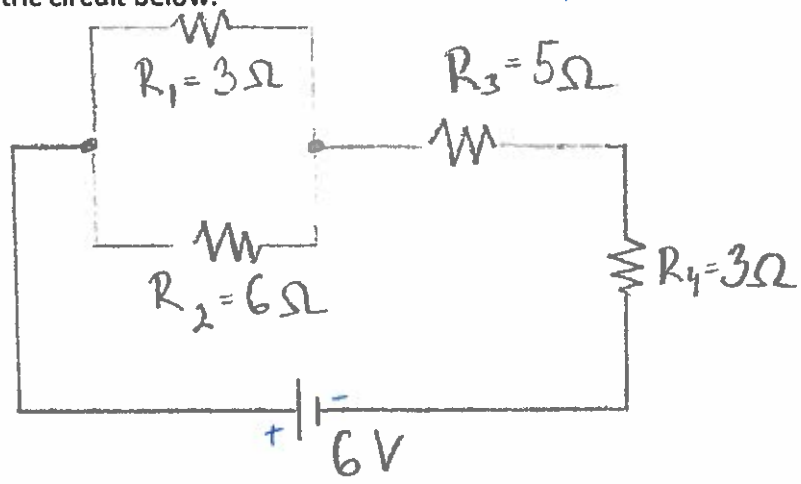
$I = \frac{V}{R} = \frac{24}{240} = 0.1\ A$

Potential rise : from − to + 6 V across the battery

Potential drop : from + to − $V_{loop} + V_3 + V_4 \Rightarrow V_{loop} = \Sigma rise - \Sigma drop$

3. Find as much information as you can about the electric circuit below:

- Find the equivalent resistance
- Find the electric current at the battery
- Find the electric current for each resistor
- Find the potential in every closed loop using the Second Kirchhoff's Rule ($\Sigma V_{battery} = \Sigma V_{resistors\ in\ a\ loop}$)
- Use Ohm's Law to find missing information when 2 out of 3 quantities are known



$\Sigma R = R_4 + R_3 + R_p$

$= 3 + 5 + 2 = \underline{10\ \Omega}$

$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{3}$

$= \frac{1+2}{6} = \frac{3}{6}$

$R_p = \frac{6}{3} = 2\ \Omega$

$I_{bat.} = \frac{V_{bat}}{R_{eq}} = \frac{6}{10} = \underline{0.6\ A}$

$I_4 = I_3 = I_{battery} = 0.6\ A$

to find I_1 and I_2 V_1 and V_2 must be known first

but $V_{battery} = V_4 + V_3 + V_{loop}$

$V_4 = (3)(0.6) = \underline{1.8\ V}$

$V_3 = (5)(0.6) = \underline{3.0\ V}$

$6 = 1.8 + 3.0 + V_{loop}$

$\therefore V_{loop} = 6 - 3.0 - 1.8$

$= \underline{1.2\ V}$

Recall: Resistors in parallel have the same voltage across each

$\therefore V_1 = V_2 = V_{loop} = 1.2\ V$

$I_1 = \frac{V_1}{R_1} = \frac{1.2}{3} = \underline{0.4\ A}$ $I_2 = \frac{V_2}{R_2} = \frac{1.2}{6} = \underline{0.2\ A}$