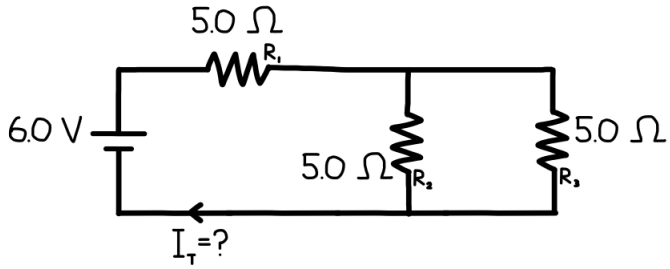
2- Combination Circuits

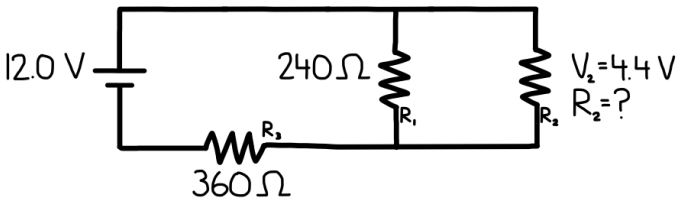
1) A **6.0 V DC battery** is connected to a circuit consisting of **three resistors**, as shown in the diagram.



- $R_1 = 5.0\ \Omega$ is connected **in series** with a parallel combination of:
  - $R_2 = 5.0\ \Omega$
  - $R_3 = 5.0\ \Omega$

(a) Determine the **equivalent resistance** of the parallel section containing $R_2$and R_3.
(b) Determine the **total resistance** of the circuit.
(c) Determine the **total current** supplied by the battery.
(d) Determine the **current through** R_1.
(e) Determine the **current through** $R_2$and R_3.
(f) Determine the **voltage drop across each resistor**.

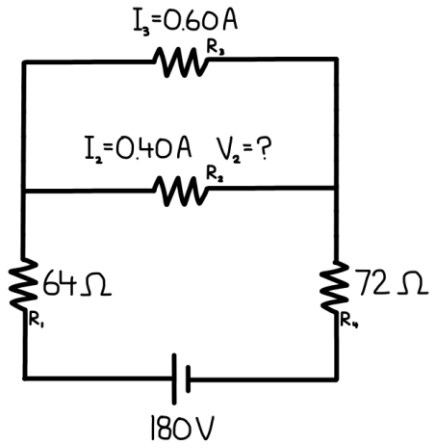
2) A **12.0 V DC battery** is connected to a circuit consisting of **three resistors**, as shown in the diagram.



- $R_3 = 360\ \Omega$is connected **in series** with a parallel combination of:
  - $R_1 = 240\ \Omega$
  - R_2, whose resistance is **unknown**
    - The **voltage drop across** $R_2$is $V_2 = 4.4\ \text{V}$

(a) Determine the **voltage across the parallel section** of the circuit.
(b) Determine the **current through** R_1.
(c) Determine the **current through** R_2.
(d) Determine the **resistance of** R_2.
(e) Determine the **equivalent resistance** of the parallel section.
(f) Determine the **total resistance** of the circuit.
(g) Determine the **total current** supplied by the battery.

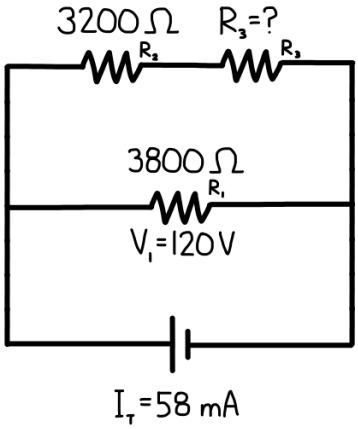
3) A **180 V DC power source** is connected to a circuit consisting of **four resistors**, arranged as shown in the diagram.



- $R_1 = 64\ \Omega$and $R_4 = 72\ \Omega$are connected **in series** with the rest of the circuit.
- Between the top and bottom nodes, there are **two resistors in parallel**:
  - R_2, carrying a current of $I_2 = 0.40$ A
  - R_3, carrying a current of $I_3 = 0.60$ A

(a) Determine the **total current** supplied by the power source.
(b) Determine the **voltage across the parallel section** of the circuit.
(c) Determine the **voltage across** R_2.
(d) Determine the **resistance of** R_2.
(e) Determine the **resistance of** R_3.
(f) Verify that your results are consistent with **Ohm's Law** and the rules for **series–parallel circuits**.

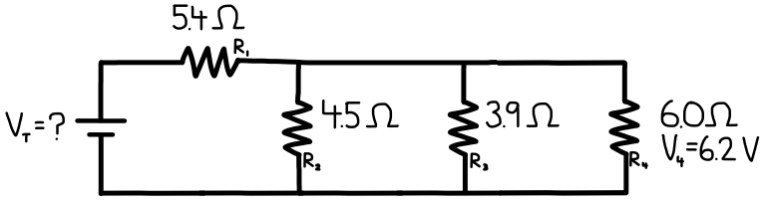
4) A DC power source is connected to a circuit consisting of **three resistors**, arranged as shown in the diagram.



- The **total current** supplied by the source is $I_{\text{total}} = 58$ mA
- One branch contains a single resistor:
  - $R_1 = 3800\ \Omega$
  - The voltage across this resistor is $V_1 = 120$ V
- The other branch contains **two resistors in series**:
  - $R_2 = 3200\ \Omega$
  - R_3, whose resistance is **unknown**

(a) Determine the **voltage of the power source**.
(b) Determine the **current through** R_1.
(c) Determine the **current through the branch containing** R_2**and** R_3.
(d) Determine the **voltage across the series combination of** R_2**and** R_3.
(e) Determine the **resistance of** R_3.

5) A circuit consists of a **DC power source** connected to **four resistors**, arranged as shown in the diagram.



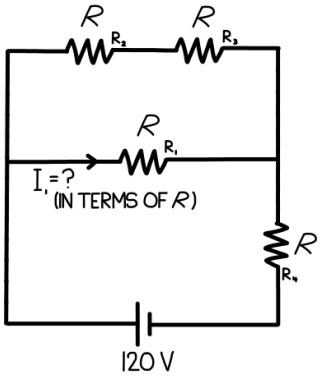
- $R_1 = 5.4\ \Omega$is connected **in series** with a parallel network of three resistors:
  - $R_2 = 45\ \Omega$
  - $R_3 = 39\ \Omega$
  - $R_4 = 60\ \Omega$, The **voltage across** $R_4$is $V_4 = 6.2\ \text{V}$
- The **voltage of the power source**, V_T, is **unknown**.

(a) Determine the **voltage across the parallel section** of the circuit.
(b) Determine the **current through** R_4.
(c) Determine the **current through** $R_2$and R_3.
(d) Determine the **total current entering the parallel section**.
(e) Determine the **voltage drop across** R_1.
(f) Determine the **voltage of the power source**, V_T.

Important Instructions

- **Do not substitute numerical values** for R.
- All answers must be expressed **symbolically in terms of** R.
- Final expressions should be **fully simplified**.

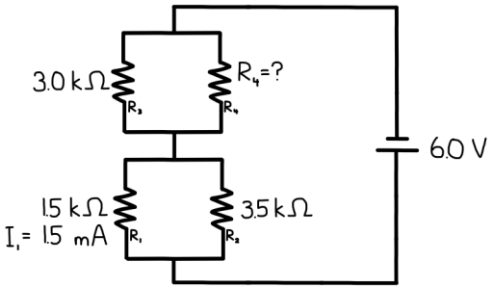
6) A **120 V DC power source** is connected to a circuit consisting of **four identical resistors**, each with resistance R, arranged as shown in the diagram.



- Two resistors are connected **in series** along the top branch.
- One resistor is connected **alone** in the middle branch.
- One resistor is connected **in series** on the right side of the circuit.
- The current through the middle resistor is labeled I_1.

(a) Determine the **equivalent resistance** of the top branch in terms of R.
(b) Determine the **equivalent resistance** of the parallel section in terms of R.
(c) Determine the **total resistance** of the circuit in terms of R.
(d) Determine the **total current** supplied by the battery in terms of R.
(e) Determine the **current through the middle resistor**, I_1, **in terms of** R.

7) A **6.0 V DC power source** is connected to a circuit consisting of **four resistors**, arranged as shown in the diagram. The circuit is made of **two parallel sections connected in series**:



Lower parallel section

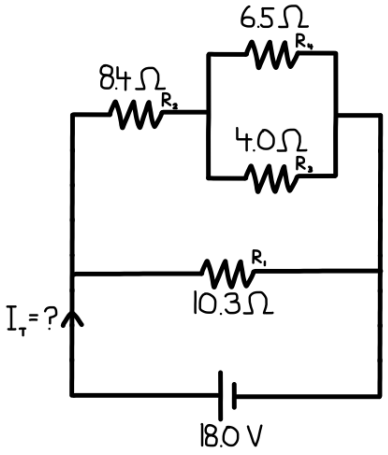
- $R_1 = 15\ \text{k}\Omega$, The current through $R_1$is $I_1 = 1.5\ \text{mA}$
- $R_2 = 35\ \text{k}\Omega$

Upper parallel section

- $R_3 = 3.0\ \text{k}\Omega$
- R_4, whose resistance is **unknown**

(a) Determine the **voltage across the lower parallel section**.
(b) Determine the **current through** R_2.
(c) Determine the **total current** flowing through the circuit.
(d) Determine the **voltage across the upper parallel section**.
(e) Determine the **current through** R_3.
(f) Determine the **resistance of** R_4.

8) An **18.0 V DC battery** is connected to a circuit consisting of **four resistors**, arranged as shown in the diagram. The circuit has **two branches in parallel**:



Upper branch

- A resistor $R_2 = 84\ \Omega$is connected **in series** with a parallel combination of:
  - $R_3 = 6.5\ \Omega$
  - $R_4 = 4.0\ \Omega$

Lower branch

- A single resistor $R_1 = 10.3\ \Omega$

The **total current supplied by the battery**, I_T, is unknown.

(a) Determine the **equivalent resistance of the parallel pair** $R_3$and R_4.
(b) Determine the **total resistance of the upper branch**.
(c) Determine the **equivalent resistance of the entire circuit**.
(d) Determine the **total current** supplied by the battery.
(e) Determine the **current in each branch**.