Practical Work No. 04: Direct Current Model: Power Distribution and Voltage Drop Calculation

1. Objective of the Practical Work

The objective is to define a set of methods for studying an electrical circuit traversed by direct currents (DC). Calculate the power and voltage drop in DC regime. Ohm's law is simple to understand and forms part of the fundamental concepts to know in electrotechnics.

2. Purpose of the Experiment

- Perform measurements of current, voltage, and power using a power meter.
- Determine the voltage drop in the realized circuits.
- Calculate the total power in the assembly of simple and mixed electrical circuits.

3. Concepts and Preparation Work

3.1. Some Laws of Electrical Circuits

Consider a circuit consisting of a generator (E (V)) connected to a resistance R (Ω) (expressed in ohms) using conducting wires (Figure 1).

Voltage is responsible for the movement of charges in an electrical circuit, the current is the flow of these charges, and the resistance of a circuit element opposes the passage of the current.

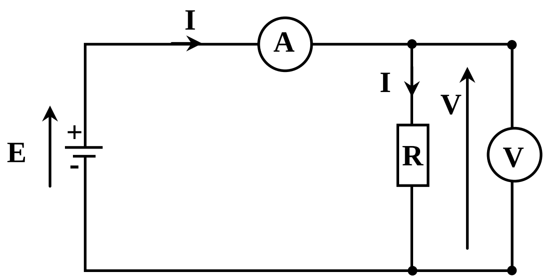


Figure 1. Simple resistive charge circuit.

Voltage V (expressed in Volts) is measured using a voltmeter (V). This is a measurement taken in parallel with a circuit element.

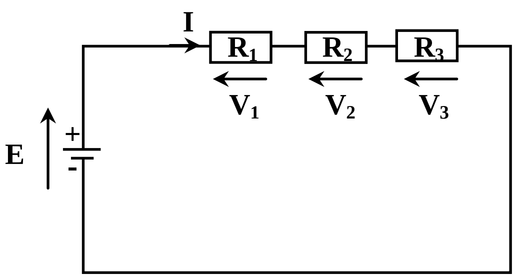
The current I (expressed in Amperes) is measured using an ammeter (A). This is a measurement taken in series with a circuit element.

According to Ohm's law, the measurements taken across a resistance must satisfy the relationship: $V = R\,I$, and thus the power $P = V\,I$.

Calculations:

Calculate the equivalent resistance for E =4.5V, R1=100Ω, R2=150Ω, R3= 200Ω, for the following cases:

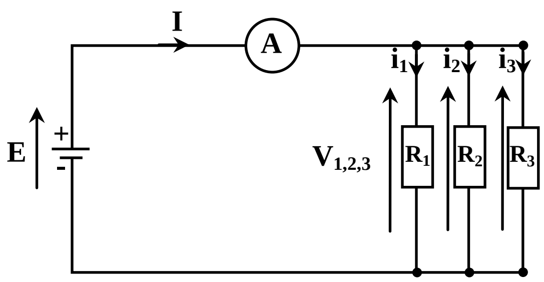
- R_1, R_2, R_3 are mounted in series: R_{eq}= ……………………Ω.



I = …………A
V_1 = ……….V
V_2 = ……….V
V_3 = ……….V
P_1 = ………………W
P_2 = ………………W
P_3 = ………………W
$P_{Total} = P_1 + P_2 + P_3$ = ……….…W

Figure 2. Simple circuit (three resistances mounted in series).

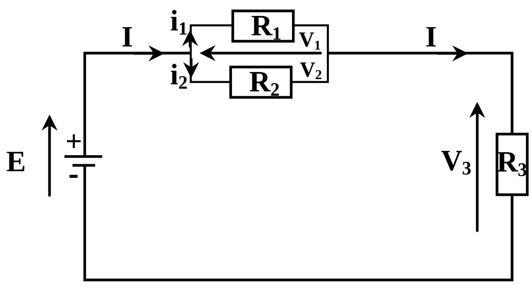
- R_1, R_2, R_3 are mounted in parallel: R_{eq}= …………..……Ω.



I = …….A, i_1 = ……A,
i_2 = ……A, i_3 = ……A,
V_1 = ……V,
V_2 = ……V
V_3 = ……V
P_1 = ………………W
P_2 = ………………W
P_3 = ………………W
$P_{Total} = P_1+P_2+P_3$ = ……….…W

Figure 3. Simple Circuit (three resistances mounted in parallel).

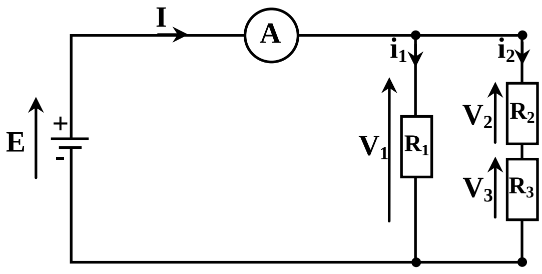
- R_1, R_2, R_3 are mounted in a mixed circuit ((R_1//R_2) R_3 in series).



I = …….A, i_1 = ……A,
i_2 = ……A, i_3 = ……A,
V_1 = ……V,
V_2 = ……V
V_3 = ……V
P_1 = ………………W
P_2 = ………………W
P_3 = ………………W
$P_{Total} = P_1+P_2+P_3$ = ……….…W

Figure 4. Simple Circuit (three resistances mounted in a mixed configuration).

- R_1, R_2, R_3 are mounted in a mixed circuit (R_1//(R_2+R_3) in series).



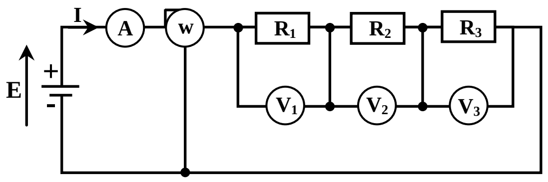
$I = \ldots\ldots.A$, $i_1 = \ldots\ldots A$,
$i_2 = \ldots\ldots A$, $i_3 = \ldots\ldots A$,
$V_1 = \ldots\ldots V$,
$V_2 = \ldots\ldots V$
$V_3 = \ldots\ldots V$
$P_1 = \ldots\ldots\ldots\ldots\ldots\ldots W$
$P_2 = \ldots\ldots\ldots\ldots\ldots\ldots W$
$P_3 = \ldots\ldots\ldots\ldots\ldots\ldots W$
$P_{Total} = P_1+P_2+P_3 = \ldots\ldots\ldots\ldots W$

Figure 5. Simple circuit (three resistors in a mixed configuration) (R_1// (R_2+R_3)).

4. Practical Part

4.1. Simple Circuits

4.1.1. Resistances in Series

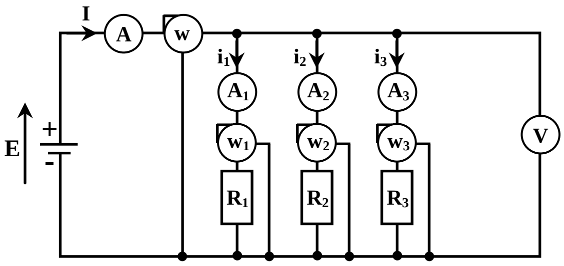


- Assemble the circuit where R_1, R_2, R_3 are mounted in series.
- Power your circuit with a voltage E = 4.5V.
- Complete the table below.

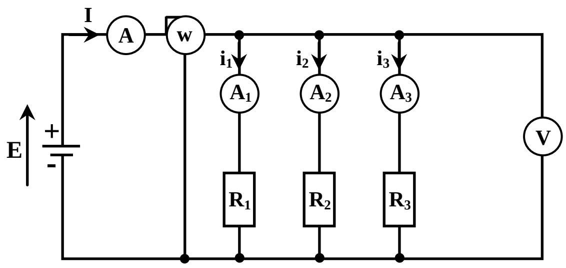
	R_1=100 Ω	R_2=150 Ω	R_3=200Ω
I (mA)			
V (Volts)			
P (W)			
P_{Total} (W)			

4.1.2. Resistances in Parallel

- Assemble the circuit where R_1, R_2, R_3 are mounted in parallel.



or

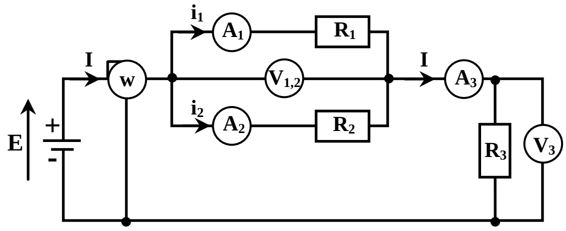


- Power your circuit with a voltage E=4.5V.
- Complete the table below.

	R_1=100 Ω	R_2=150 Ω	R_3=200Ω
I (mA)			
V (Volts)			
P (W)			
P_{Total} (W)			

4.1.3. Mixed Circuits

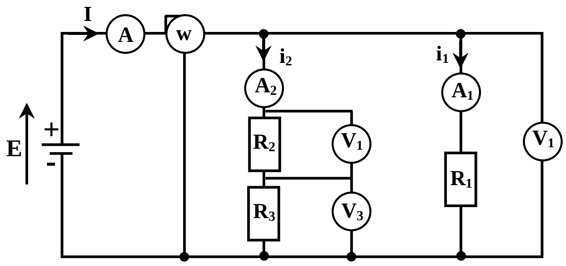
- Assemble the circuit where R_1, R_2, R_3 are mounted as follows:



- Power your circuit with a voltage E = 4.5V.
- Complete the table below.

	R_1=100 Ω	**R_2=150 Ω**	**R_3=200Ω**
I (mA)			
V (Volts)			
P (W)			
P_{Total} (W)			

- Assemble the circuit where R_1, R_2, R_3 are mounted as follows:



- Power your circuit with a voltage E = 4.5V.
- Complete the table below.

	R_1=100 Ω	**R_2=150 Ω**	**R_3=200Ω**
I (mA)			
V (Volts)			
P (W)			
P_{Total} (W)			

5. Conclusion

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