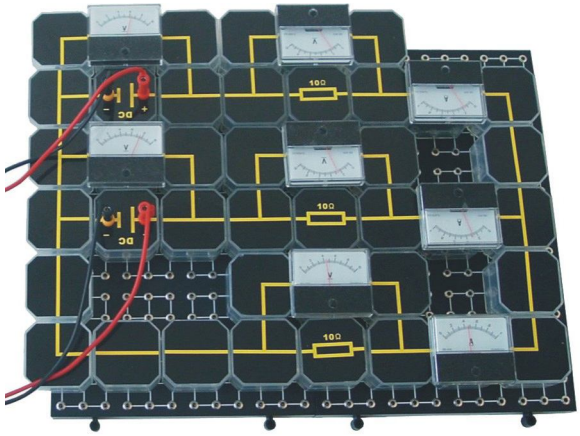
Experiment: Kirchhoff's Voltage Law



Purpose

1. To make students to understand the connection of the circuit and the correct operation of the voltmeter and ammeter.

2. To understand the theory of Kirchhoff's law and the actual circuit operation and application.

Theory

- **Kirchhoff's Laws**

Kirchhoff's current law(KCL): at any node in an electrical circuit, the sum of currents I_{in} flowing into that node is equal to the sum of currents I_{out} flowing out of that node. It can be written as,

$$\sum I_{in} = \sum I_{out}$$

It's also known as node rule, $\Sigma I=0$

Kirchhoff's voltage law(KVL):the directed sum of the electrical potential differences (voltage) around any closed network is zero. It can be written as,

$$\Sigma \Delta V = 0$$

Loop rule, $\Sigma\varepsilon - \Sigma IR = 0$. ($\varepsilon$: EMF)

- **Dual power circuit :**

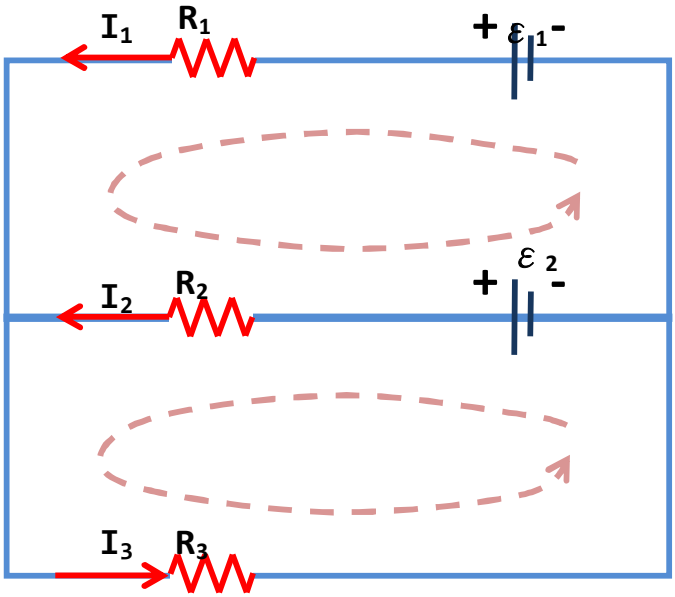


Fig. 2-1

Using the loop rule according to the above figure:

$$I_1R_1 - I_2R_2 = -\varepsilon_2+\varepsilon_1 \qquad (1)$$
$$I_2R_2 + I_3R_3 = \varepsilon_2 \qquad (2)$$

According to the node rule:

$$I_3 - I_1 - I_2 = 0 \qquad (3)$$

Calculate the above equations, we can obtain:

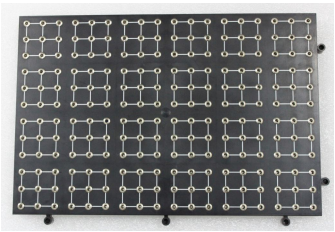
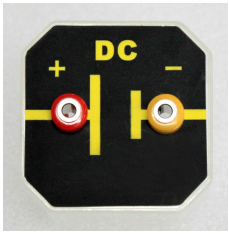
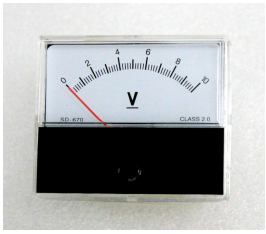
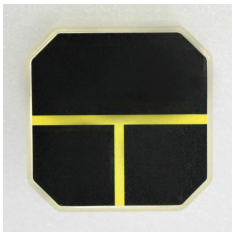
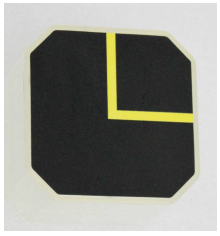
$$I_1 = \frac{\varepsilon_1(R_2+R_3)-\varepsilon_2R_3}{R_1R_2+R_2R_3+R_3R_1}$$

$$I_2 = \frac{\varepsilon_2(R_1 + R_3) - \varepsilon_1 R_3}{R_1R_2 + R_2R_3 + R_3R_1}$$

$$I_3 = \frac{\varepsilon_1 R_2 + \varepsilon_2 R_1}{R_1R_2 + R_2R_3 + R_3R_1}$$

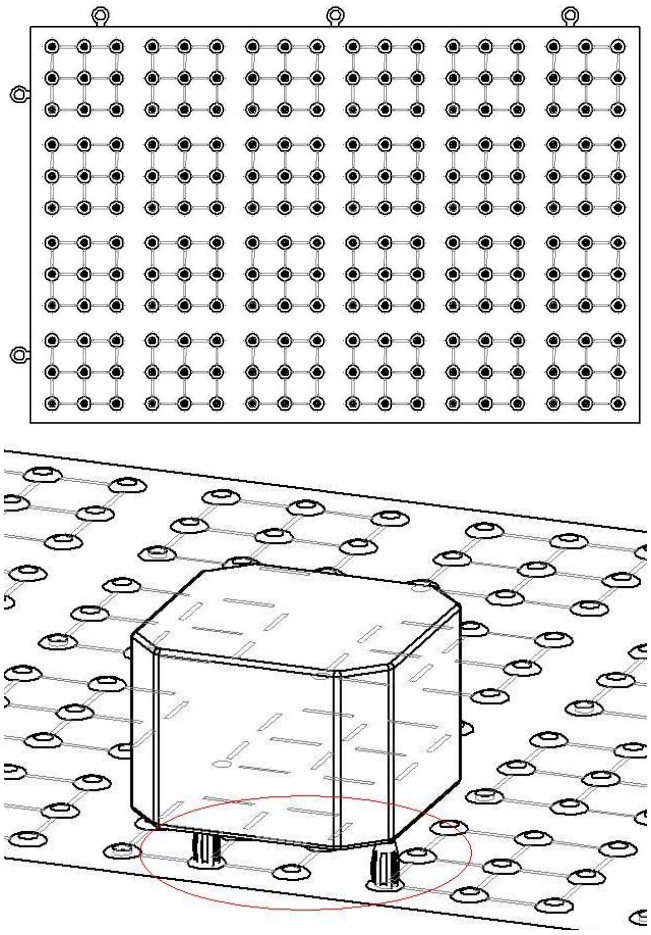
Instrument

NO	Accessory	Quantity
1	Bread Board	1
2	DC Power Supply (E01-931A-Y01)	Not included
3	DC External Port	2
4	Voltmeter	5
5	Galvanometer	3
6	Adjustable resistance × 10Ω	3
7	I-shaped Connecting Wire	5
8	T-shaped Connecting Wire	12
9	L-shaped Connecting Wire	12
10	Connecting Wire	4

Accessories			
			
1	E01-931A-Y01	3	4
			
5	6	7	8
			
9	10		

- **HOW TO USE：**

Must insert the circuit elements at the relative position as shown in the figure below, then we can make a complete circuit.



How to connect the element

Notice

1. Do not insert and remove the electronic components too hard in order to avoid the damage of breadboard contacts.

2. Please contact us if the components are damaged. Do not change the components by yourself.

Procedure

- **Kirchhoff's Law**

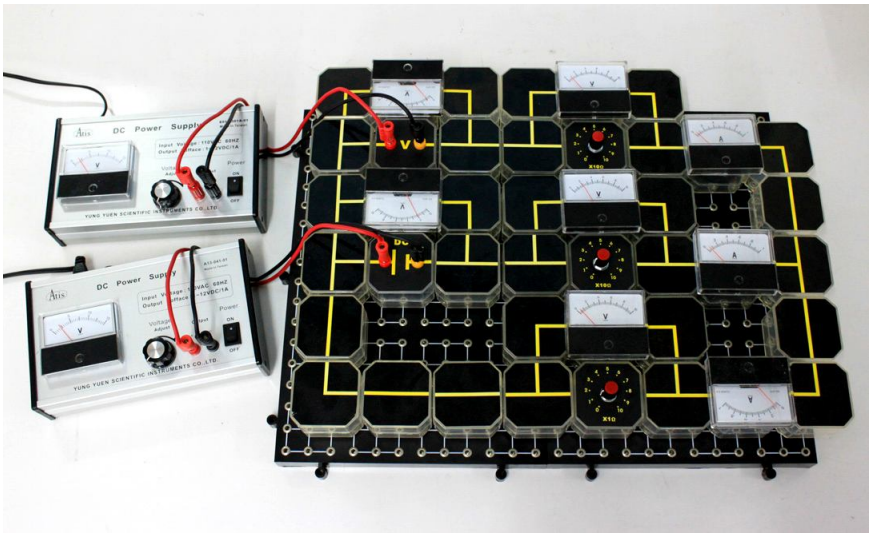


Fig. 4-1 Kirchhoff's Law

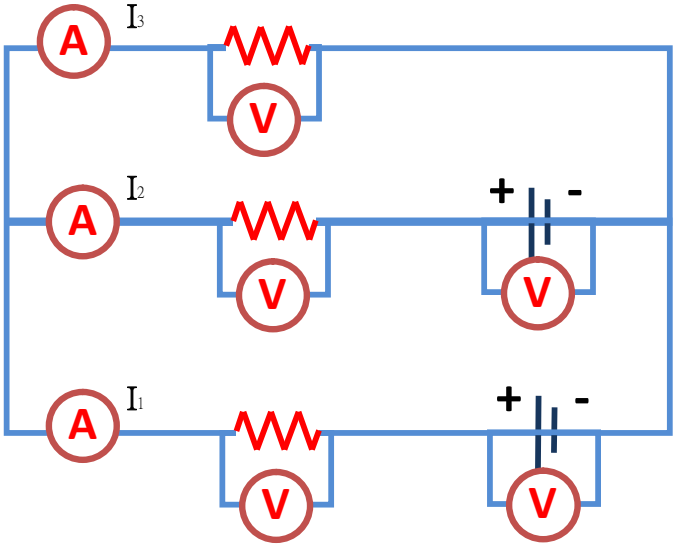


Fig. 4-2 Dual Power Connection

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