Experiment No.2

Ohm's law for linear and nonlinear circuit

Object

To study the relation between voltages and currents for linear elements.

Theory

In any electric circuit, the larger charge flows(current), the large amount of amount of energy converted to heat. This characteristic behavior of materials is referred to as the resistance of the material to the flow of electrical charge. The symbol for a resistor is shown in Fig.1

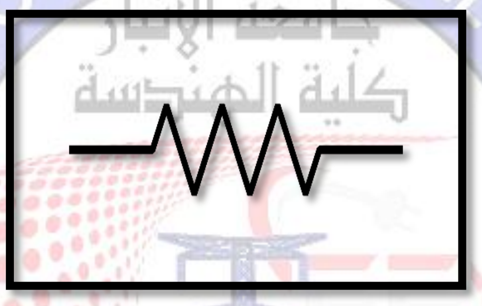

Fig.1

Ohm's law describes the relationship between the terminal voltage and current of a resistor, and stated as follows: -

The ratio of potential difference (V) between any tow points on a conductor to the current (I) flowing between them is constant, if the temperature of the conductor dose not change in the words: **R=V/I**

- V: is the potential difference and measured in volt (V).
- I: is the current flowing through the conductor and measured in Ampere(A).
- R: is the resistance of the conductor and measured in Ohm(Ω).

Ohm's Law for Linear Elements

The Fig.2 shows the linear (straight-line) graph between the voltage drop and the current flow through affixed resistance (R=20 Ω) & (R=40 Ω).

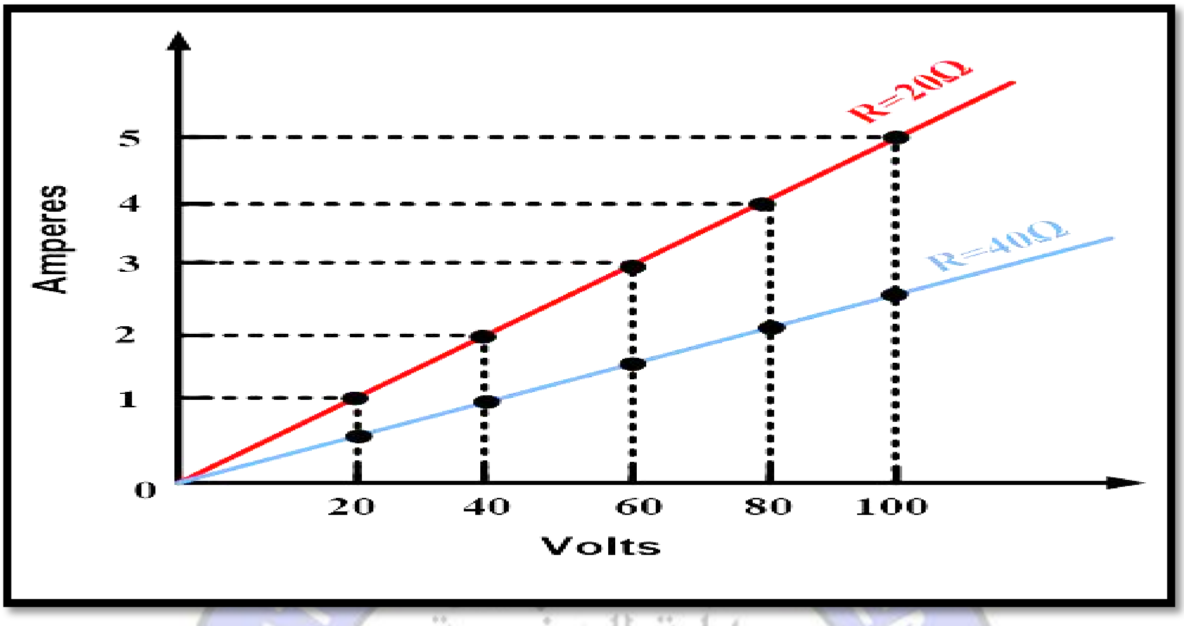

Fig.2

- Non-linear resistance: the incandescent lamp

The V/I characteristic of Fig.2 is that of a so-called perfect resistor, an ideal device which keeps a constant and unaltered resistance in all physical conditions.

In practice all materials have a V/I charstristics which is intrinsically non-linear and dependent on parameters such as temperature, mechanical stress, age, etc.…

In most case it is desirable that the resisters used in electronics have values which are as constant as possible, and therefore these components are mode out of materials selected for this purpose. In certain other cases a non-linear V/I catachrestic may turn out useful for specific purposes.

We shall examine some of these devices, starting, from a common incandescent lamp, which allows us understand the meaning of non-linear I/V charstristics.

Set up the equipment's as shown in Fig.3

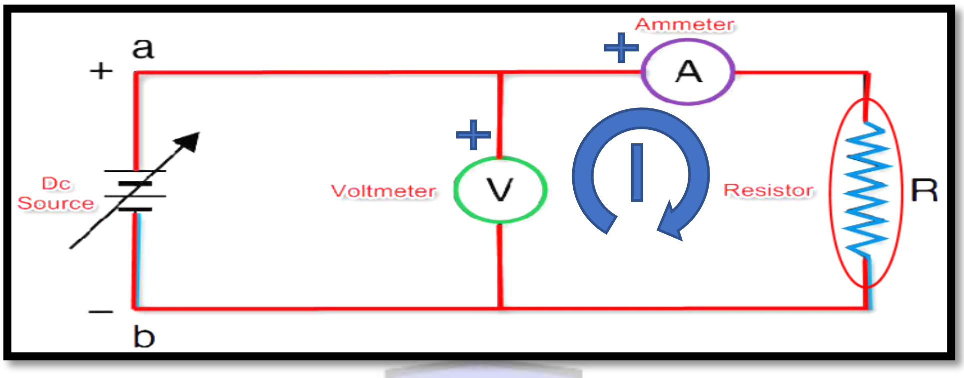

Fig.3

A variable voltage generator is used to power an incandescent lamp. The voltage is changed in steps from 0 to 12V and the current in the lamp is measured and recorded at each step.

The result plotted in a graph appear as in Fig.4

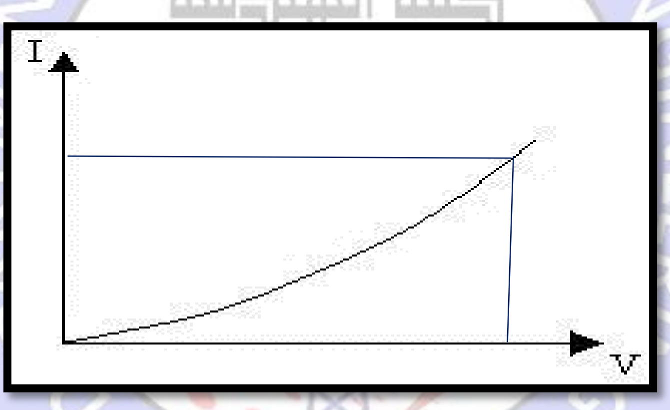

Fig.4

The reason of the progressive bending of the charstristics resides in the <u>TEMPERATURE COEFFICIENT</u> of the material of which the filament is made.

The temperature coefficient in this case is positive:

- If the supply voltage is increased, the filament receives more power and therefore its temperature rises.
- The resistance of the filament increases for rising temperature and the filament drains less current than if the resistance remained constant.

Let's just note that a positive temperature coefficient for an incandescent lamp is very healthy for the lamp itself, consider the case of a hypothetical negative temperature coefficient lamp connected to the mains. An accidental rise in the line voltage would raise the temperature of the lamp draw more current and power from the line. This would in turn, further heat the lamp and so on, up to a rapid burning-out of the filament.

Note the following:

- The current rises for growing voltages.
- If the voltage doubles (e.g. 5V to 10V), the current also doubles (5mA to 10mA).

Procedure

1. Connect the circuit shown in Fig.5

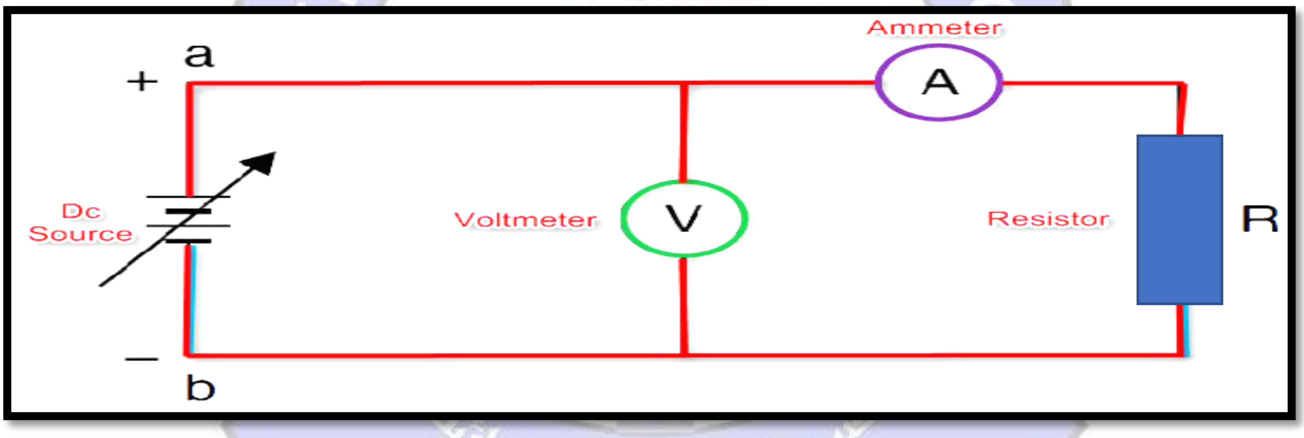

Fig.5

2. Increase the applied voltage from the D.C power supply from (0 – 10) V, in step of (2)V, measure the current through the (1KΩ) resistor in each step and record the measured result in the second column of table.1.

Power supply (volt)	I measured (mA)	I calculated (mA)	Error %
0			
2			
4			

6			
8			
10			

Table 1.a

3. For non-Linear resistance.

Power supply (volt)	I measured (mA)	R calculated (Ω)
0		
2		
4		
6		
8		
10		

Table 1.b

Discussion

1. Plot a graph from the measured data of table.1, to show the relationship between V & I.
2. Calculate the slope and resistance value from the graph above.
3. From the graph above, is the relationship between V&I linear or non-linear?
4. From the result shown in Fig.6, find the resistance and slope value

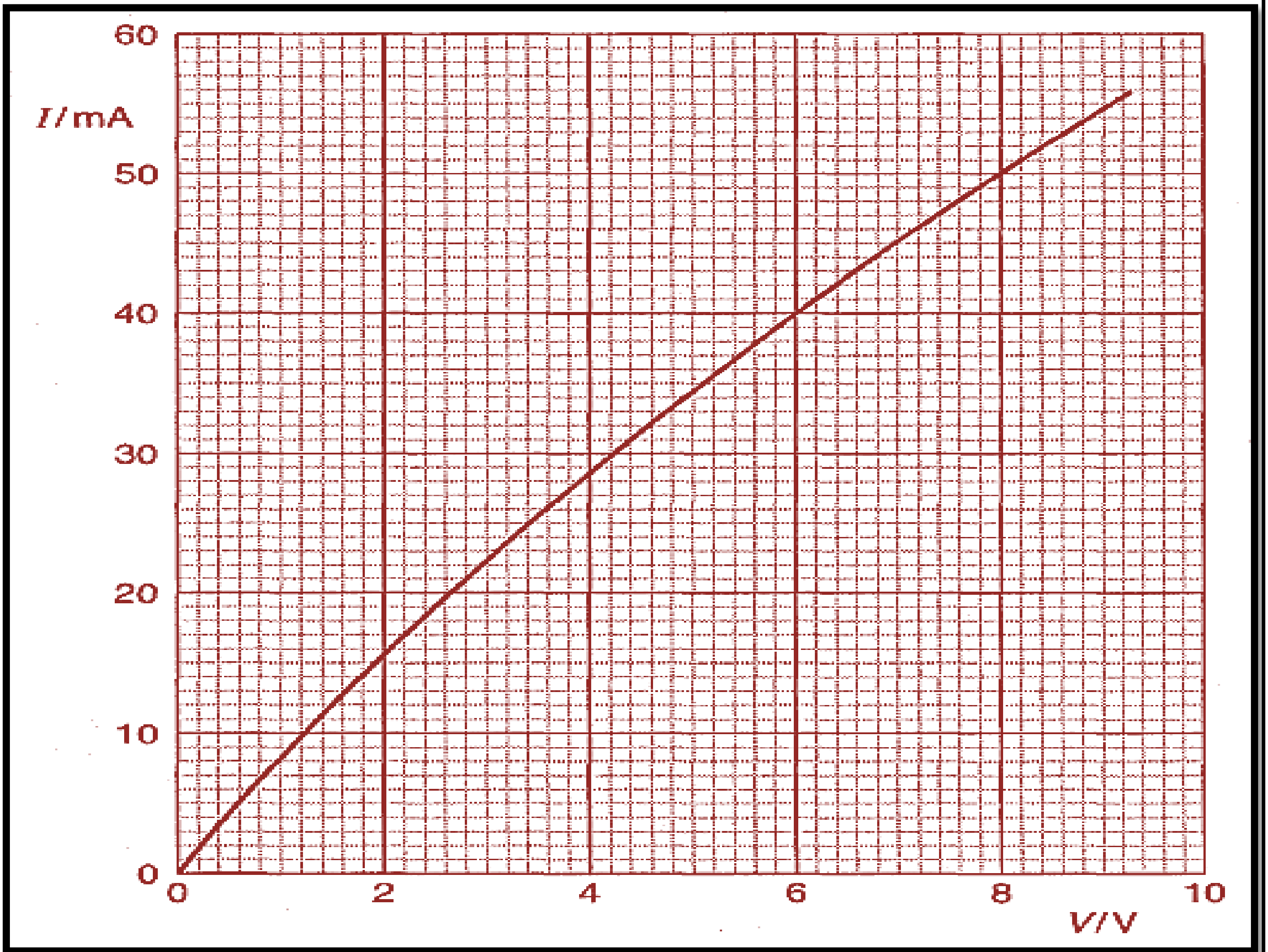

Fig.6

5. Can you tell me, what is the difference between number (2) and number (4)?