SPH3U UNIVERSITY PHYSICS

ELECTRICITY & MAGNETISM

- Electrical Resistance (P.523-526)

Electrical Resistance

*When charges pass through a material or device, they experience an opposition or **electrical resistance (R)** to their flow, resulting in a loss of electric potential energy. Resistance is measured in ohms (Ω). All substances resist the flow of charges to some extent.*

ELECTRICAL RESISTANCE (R)

- degree to which a substance resists the flow of electric current through it
- SI unit is ohm (Ω)

Electrical Resistance

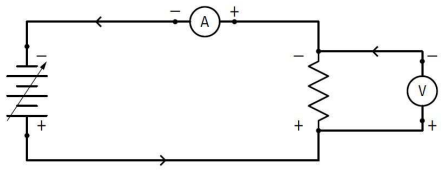
***Resistors** are electrical devices that have a specific resistance. There are many different types of resistors. For example, lightweight carbon resistors are used in electronics; heavier ceramic resistors are used in larger circuits. Dimmer switches and the volume controls on a stereo are examples of variable resistors – resistors that allow you can change their resistance.*

RESISTOR

- any material that can slow current flow
- circuit symbol is ─/\/\─

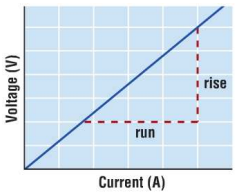
Electrical Resistance

To measure the amount of resistance that a quantity of moving charge encounters, we compare the electric potential difference the charge experiences as it passes through a load with the amount of electric current.



Electrical Resistance

By varying the potential difference of the source and making simultaneous measurements of current (I) and potential difference (V), the following graph of V vs I can be obtained. From the graph we see that the ratio V/I (i.e. the resistance) is a constant.



NOTE!

German physicist Georg Ohm used this ratio to formulate Ohm's Law. ***Ohm's Law*** *states that, as long as the temperature remains constant, V = IR.*

$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

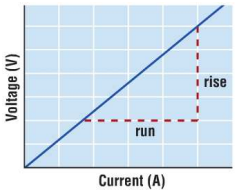
$$\text{slope} = \frac{\text{voltage } (V)}{\text{current } (I)}$$

$$\text{slope} = \text{resistance } (R)$$

Electrical Resistance

RECALL!

*A material that obeys Ohm's Law is said to be "**ohmic**." Thus, a straight line on a V-I graph indicates an "**ohmic**" material whereas a curved line indicates a "**non-ohmic**" material.*



$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

$$\text{slope} = \frac{\text{voltage } (V)}{\text{current } (I)}$$

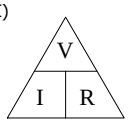
$$\text{slope} = \text{resistance } (R)$$

Ohm's Law

OHM'S LAW

- as long as the temperature stays constant (i.e. $V \propto I$)

$$V = IR$$



V=IR I=V/R R=V/I

where V is the potential difference (V)
I is the current (A)
R is the resistance (Ω)

Ohm's Law

PRACTICE

1. What is the potential difference across a toaster of resistance of 13.8 Ω when the current through it is 8.7 A?

   V = 120 V

Ohm's Law

PRACTICE

2. Calculate the resistance of a load with a voltage of 25 V and a current of 410 mA.

   R = 61 Ω

Ohm's Law

PRACTICE

3. In a circuit where voltage is kept constant, state what happens to the current if the resistance is doubled? quadrupled? halved? (Hint: since $I = V/R$ then $I \propto 1/R$)

   I x ½
   I x ¼
   I x 2

Ohm's Law

PRACTICE

4. Find the missing values in the table below. Take care with units.

Current	Voltage (V)	Resistance (Ω)
25 mA	12	480
1.2 A	612	510
375 µA	0.250	667
3.6 A	120	33
667 mA	1.5	1500

✔ Check Your Learning

TEXTBOOK

P.526 Q.2-6,9,12