SNC1D PHYSICS

THE CHARACTERISTICS OF ELECTRICITY

- Ohm's Law (P.458-462)

Activity: Investigating Ohm's Law (D23/P.465)

INSTRUCTIONS

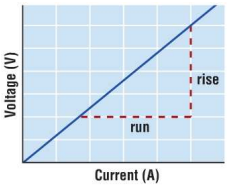
A. Read the activity "D23: Investigating Ohm's Law".
B. Follow the instructions given (i.e. procedure 1 to 8).
C. Answer the questions given (i.e. analysis 9 to 12).
D. Submit a formal lab report using the QHMMOCA format.
   - H (hypothesis) – omit
   - M (method) – be sure to make note of any changes (see below)
   - C (conclusion) – answer question #13

NOTE!

- Use PhET – Circuit Construction Kit (DC only).
- Use resistor values of 50 and 100 Ω.
- Use voltage values of 15, 30, 45 and 60 V.
- Right-click on the battery/resistor in order to change their values.

Relating Current, Voltage, & Resistance

The activity you just completed was very similar to one done by the German physicist Georg Ohm in which he discovered a mathematical relationship between potential difference (V), current (I), and resistance (R). ***Ohm's law*** *states that, as long as the temperature remains constant, V = IR. However, Ohm's findings apply only to certain types of materials.*



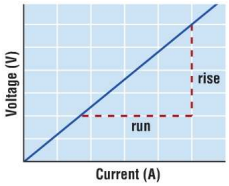
$$\text{slope} = \frac{\text{rise}}{\text{run}}$$

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

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

Relating Current, Voltage, & Resistance

For these materials, when you plot a graph of the voltage versus the current, you get a straight-line or linear relationship. The slope of the straight line represents the resistance of the material. And since the slope of the straight line remains constant so too does the resistance. As such, we usually refer to these materials as ***"ohmic"*** *materials because they obey Ohm's law.*



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

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

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

Relating Current, Voltage, & Resistance

PRACTICE

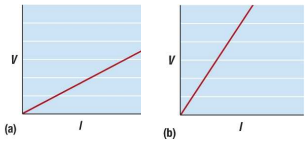
1. If the graph for an "ohmic" material is linear, what type of graph would you expect for a "non-ohmic" material? Explain your answer.

   a non-linear or curved graph since the resistance of the material changes as the voltage increases

Relating Current, Voltage, & Resistance

PRACTICE

2. Which of the following graphs shows a load with a greater resistance? Explain your answer.



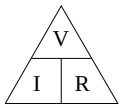
(b) since it is steeper (slope of graph = resistance)

Ohm's Law

OHM'S LAW

- as long as the temperature stays constant

$V = IR$



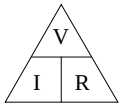
V=IR I=V/R R=V/I

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

Ohm's Law

PRACTICE

3. In a circuit where the voltage is kept constant, state what happens (expressed as a multiplier) to the current if the resistance is:
   (a) doubled?
   (b) quadrupled?
   (c) halved?



(a) x ½
(b) x ¼
(c) x 2

Using Ohm's Law

SAMPLE PROBLEM 1 Calculating the Resistance of a Load

A load has 1.2 A of current flowing through it. The voltage across the load is 6.0 V. Calculate the resistance of the load.

Given: $I = 1.2\ \text{A}$
$V = 6.0\ \text{V}$

Required: resistance (R)

Analysis: $R = \frac{V}{I}$

Solution: $R = \frac{6.0\ \text{V}}{1.2\ \text{A}}$
$R = 5.0\ \Omega$

Statement: The resistance of the load is 5.0 Ω.

Using Ohm's Law

SAMPLE PROBLEM 2 Calculating the Current through a Resistor

A 110 Ω resistor is connected to a power supply set at 12 V. Calculate the current going through the resistor.

Given: $R = 110\ \Omega$
$V = 12\ \text{V}$

Required: electric current (I)

Analysis: $I = \frac{V}{R}$

Solution: $I = \frac{12\ \text{V}}{110\ \Omega}$
$I = 0.11\ \text{A}$

Statement: The current going through the resistor is approximately 0.11 A.

Using Ohm's Law

SAMPLE PROBLEM 3 Calculating the Potential Difference across a Resistor

A toaster oven has a 24.0 Ω resistor that has 5.00 A of current going through it when the toaster is on. Calculate the potential difference across the resistor.

Given: $R = 24.0\ \Omega$
$I = 5.00\ \text{A}$

Required: potential difference (V)

Analysis: $V = IR$

Solution: $V = (5.00\ \text{A})\ (24.0\ \Omega)$
$V = 120\ \text{V}$

Statement: The potential difference across the resistor is 120 V.

✔ Check Your Learning

1. A resistor is connected to a 36 V power supply. An ammeter measures a current of 2.0 A going through it. Determine the resistance of the resistor.

   R = 18 Ω

✔ Check Your Learning

2. A laptop computer adapter has a voltage of 18 V and a resistance of 4.0 Ω. The adapter gets warm when operating. Determine the current going through the adapter.

   I = 4.5 A

✔ Check Your Learning

3. Typical household circuits can carry a maximum current of 15 A. If a wire has a resistance of 8.0 Ω, determine the voltage across the energy source.

   V = 120 V

✔ Check Your Learning

4. When you turn the key to start a car, it completes a circuit. The starter motor is part of the circuit and has a voltage of 12 V. The starter motor requires a very large current of 500 A which only flows while the car is starting. Calculate the resistance of the starter motor.

   R = 0.024 Ω

✔ Check Your Learning

TEXTBOOK

P.460 Q.1,2
P.461 Q.1-2
P.461 Q.1,2 ☜ Q.2 (625 mA = 0.625 A)

WIKI (PHYSICS)

✎.... 1DPHYS - QUIZ2 (Electric Circuits)

REMEMBER!

Be sure to check, correct, and total your quiz before handing it in.