Concept-Development Practice Page   34-1

Electric Current

1. Water doesn't flow in the pipe when
   (**a**) both ends are at the same level.
   Another way of saying this is that water
   will not flow in the pipe when both ends
   have the same potential energy (PE).
   Similarly, charge will not flow in a conductor
   if both ends of the conductor are at the same
   electric potential. But tip the water pipe and
   increase the PE of one side so there is a difference
   in PE across the ends of the pipe, as in (**b**), and water
   will flow. Similarly, increase the electric potential of one
   end of an electric conductor so there is a potential difference across the ends, and charge will
   flow.
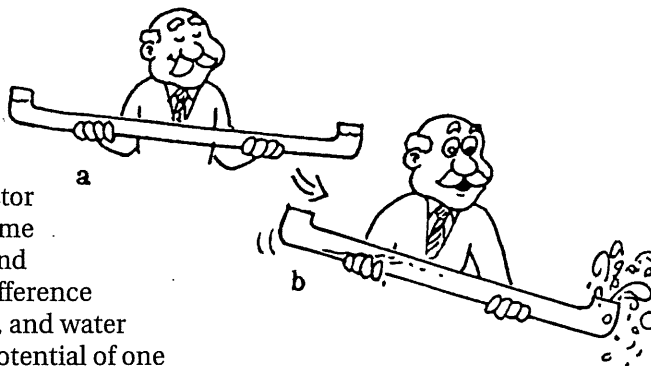
   a. The units of electric potential difference are

   (**volts**) (amperes) (ohms) (watts)

   b. It is common to call electric potential difference

   (**voltage**) (amperage) (wattage)

   c. The flow of electric charge is called electric

   (voltage) (**current**) (power),

   and is measured in

   (volts) (**amperes**) (ohms) (watts)

   > A VOLT IS A UNIT OF **POTENTIAL** AND AN AMPERE IS A UNIT OF **CURRENT**

   > DOES VOLTAGE CAUSE CURRENT, OR DOES CURRENT CAUSE VOLTAGE? WHICH IS THE CAUSE AND WHICH IS THE EFFECT?

   Voltage (the cause) produces current (the effect).

2. Complete the statements:

   a. A current of 1 ampere is a flow of charge at the rate of_____**one**____coulomb per second.

   b. When a charge of 15 C flows through any area in a circuit each second, the current is
      _____**15**_____A.

   c. One volt is the potential difference between two points if 1 joule of energy is needed to move
      _____**one**_____coulomb of charge between the two points.

   d. When a lamp is plugged into a 120-V socket, each coulomb of charge that flows in the current
      is raised to a potential energy of ____**120**_____ joules.

   e. Which offers more resistance to water flow, a wide pipe or a narrow pipe? ___**Narrow pipe**___
      Similarly, which offers more resistance to the flow of charge, a thick wire or a thin wire?
      Thin wire

Conceptual PHYSICS

(The triangle technique shown in the cartoon aids skill development rather than
concept development — sort of a math crutch.)

Ohm's Law

CURRENT = $\frac{VOLTAGE}{RESISTANCE}$ OR $I = \frac{V}{R}$

USE OHM'S LAW IN THE TRIANGLE TO FIND THE QUANTITY YOU WANT, COVER THE LETTER WITH YOUR FINGER AND THE REMAINING TWO SHOW YOU THE FORMULA!
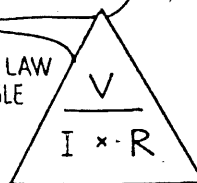
$\frac{V}{I \times R}$

1. How much current flows in a 1000-ohm resistor when 1.5 volts are impressed across it?

   0.0015 A

2. If the filament resistance in an automobile headlamp is 3 ohms, how many amps does it draw when connected to a 12-volt battery?

   4 A

CONDUCTORS AND RESISTORS HAVE RESISTANCE TO THE CURRENT IN THEM.

3. The resistance of the side lights on an automobile are 10 ohms. How much current flows in them when connected to 12 volts?

   1.2 A

4. What is the current in the 30-ohm heating coil of a coffee maker that operates on a 120-volt circuit?

   4 A

5. During a lie detector test, a voltage of 6 V is impressed across two fingers. When a certain question is asked, the resistance between the fingers drops from 400 000 ohms to 200 000 ohms. What is the current (a) initially through the fingers, and (b) when the resistance between them drops?

   (a) 0.000015 A (15 micro-amperes)   (b) 0.000030 A (30 micro-amperes)

6. How much resistance allows an impressed voltage of 6 V to produce a current of 0.006 A?

   1000 ohms

7. What is the resistance of a clothes iron that draws a current of 12 A at 120 V?

   10 ohms

OHM MY GOODNESS!

8. What is the voltage across a 100-ohm circuit element that draws a current of 1 A?

   100 V

9. What voltage will produce 3 A through a 15-ohm resistor?

   45 V

10. The current in an incandescent lamp is 0.5 A when connected to a 120-V circuit, and 0.2 A when connected to a 10-V source. Does the resistance of the lamp change in these cases? Explain your answer and defend it with numerical values.

    Yes, the resistance increases with greater current and therefore higher temperature. At 0.2 A, the
    resistance $R = (10\ V)/(0.2\ A) = 50\ \Omega$; at 0.5 A, the resistance $R = (120\ V)/(0.5\ A) = 240\ \Omega$ (appreciably
    greater).

Conceptual PHYSICS