PhyzJob: The Simple Circuit - Concepts, Ratios, and a Flower

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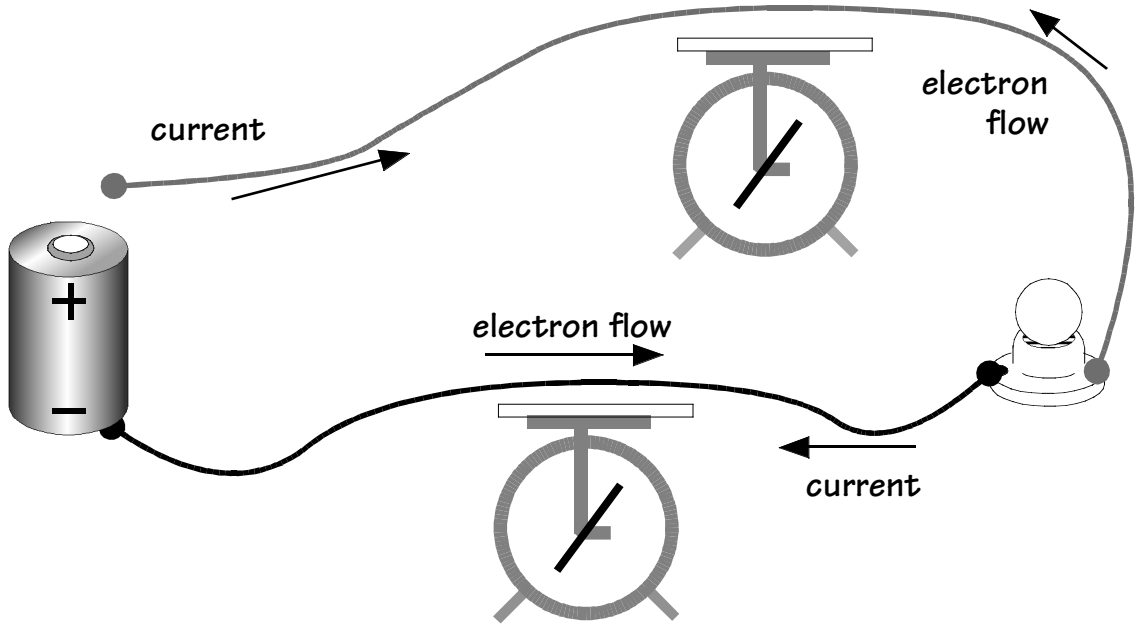
The wires used to connect a battery to a light bulb pass directly over a pair of electroscopes as shown in the diagram. The gray wire connects the positive terminal of the battery to the bulb; the black wire connects the negative terminal of the battery to the bulb. The needles on both electroscopes are deflected because each electroscope has a piece of positively charged acetate on it. Questions 1-7 refer to this circuit.



CONCEPTS

1. What will happen to the indication on each electroscope when the circuit is completed? Describe and explain!

   Nothing! Each wire remains neutral as charge passes through it. As many electrons hop off of the wire as hop on to it each second.

2. On each wire, show the direction of
   a. electron flow.
   b. conventional current.

3. In this circuit,
   a. what is delivered to the device (bulb)? Hint: What goes to the bulb and never comes back?

      Energy.

   b. How is it delivered? Hint: What goes to the bulb and does come back?

      Charge (electrons).

RATIOS

4. In 8.3 s, 2.5 C of charge pass a certain point on one of the wires.
   a. How many seconds pass while a single coulomb passes a certain point in the circuit?

      8.3 / 2.5

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b. How many coulombs of charge pass a certain point in the circuit in each second?

2.5 / 8.3

c. What is the current in the wire?

2.5C / 8.3s = 0.30A

5. In 6.7s, 3.0J of energy is delivered to the bulb.
a. What is the meaning of 6.7/3.0 in this context?

The number of seconds it takes for each joule to be delivered.

b. What is the meaning of 3.0/6.7 in this context?

The number of joules delivered in each second.

c. What is the power rating of the bulb when operated in these conditions?

3.0J / 6.7s = 0.45W

6. a. How much energy is provided to each coulomb of charge that moves through the circuit? (Hint: consider the charge that moves and the energy that's delivered in each **second:** see 4.c. and 5.c.)

J/C: In one second, 0.30C of charge delivers 0.45J of energy. So the number of joules of energy provided by each coulomb of charge is 0.45 / 0.30 = 1.5.

b. What is the name of this quantity? Voltage

c. Which device in the circuit does this quantity characterize?

The battery.

7. a. How many volts would be needed to drive a single ampere of current through this circuit? Hint: consider the **ratio** stated in the question.

V/A: When 1.5V of voltage is applied to the circuit, 0.30A flows. The number of volts needed to make each amp of current flow is 1.5/0.3 = 5.

b. What is the name of this quantity? Resistance

c. Which device in the circuit does this quantity characterize?

The bulb.

A FLOWER?

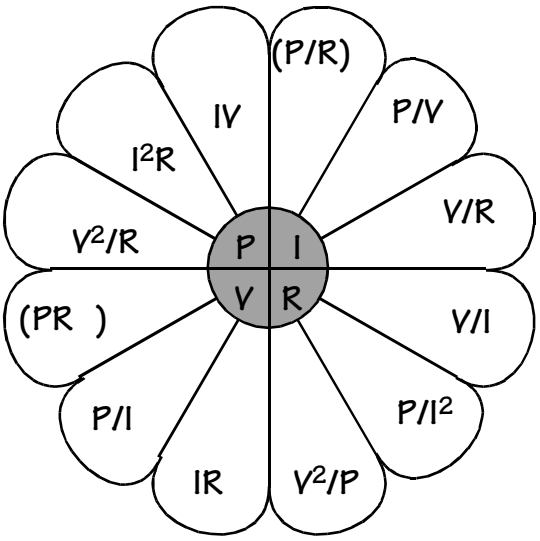
8. When taken together, Ohm's law and Joule's law can be used to fill each petal on the circuit flower. Once completed, the flower shows 12 relationships among current, voltage, resistance, and power.
a. Write Ohm's law (using *I*, *R*, and *V*).

b. Write Joule's law (using *I*, *P*, and *V*).

c. Rewrite Joule's law without using *I*.

d. Rewrite Joule's law without using *V*.

e. Rearrange the equations you've got to complete each petal of the flower.



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