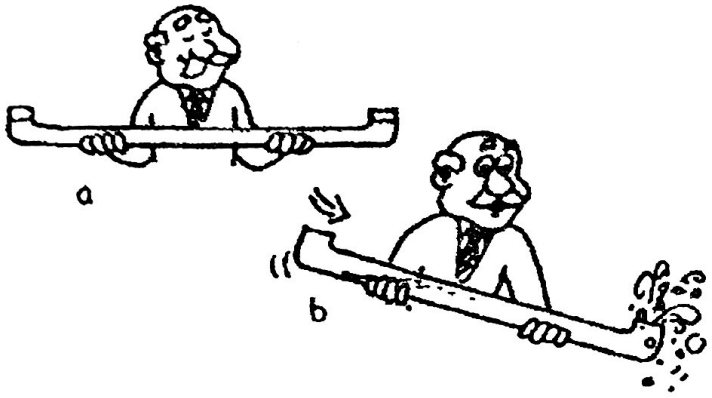
Name _____ Date _____

CONCEPTUAL **Physics** PRACTICE PAGE

Chapter 23 Electric Current

Flow of Charge



1. Water doesn't flow in the pipe when both ends (*a*) 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 the same electric potential. But tip the water pipe, as in (*b*), and water will flow. Similarly, charge will flow when you increase the electric potential of an electric conductor so there is a potential difference across the ends.

a. The unit of electric potential difference is

[volt] [ampere] [ohm] [watt].

b. It is common to call electric potential difference

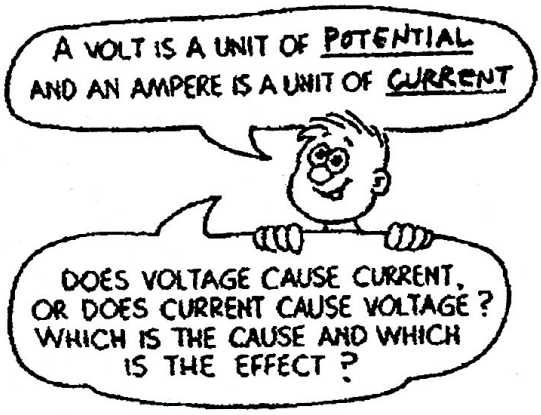
[voltage] [amperage] [wattage].

c. The flow of electric charge is called electric

[voltage] [current] [power]

and is measured in

[volts] [amperes] [ohms] [watts].



VOLTAGE (THE CAUSE) PRODUCES CURRENT (THE EFFECT).

Complete the statements:

2. 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 circuit 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

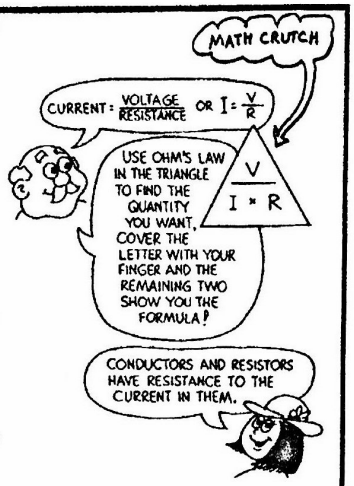
Similarly, which offers more resistance to the flow of charge, a thick wire or a thin wire?

THIN WIRE

CONCEPTUAL Physics PRACTICE PAGE

Chapter 23 Electric Current

Ohm's Law



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

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.

   a. What is the current initially through the fingers? 0.000015 A (15 μA)

   b. What is the current through the fingers when the resistance between them drops?
   0.000030 A (30 μA)

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

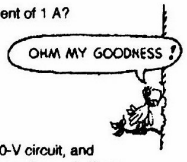
   1000 Ω

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

   10 Ω

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, RESISTANCE INCREASES WITH HIGHER TEMP OR GREATER CURRENT. AT 0.2 A, R = 10 V/0.2 A = 50 Ω; AT 0.5 A, R = 120 V/0.5 A = 240 Ω (APPRECIABLY GREATER).

Name _____ Date _____

CONCEPTUAL Physics PRACTICE PAGE

Chapter 23 Electric Current

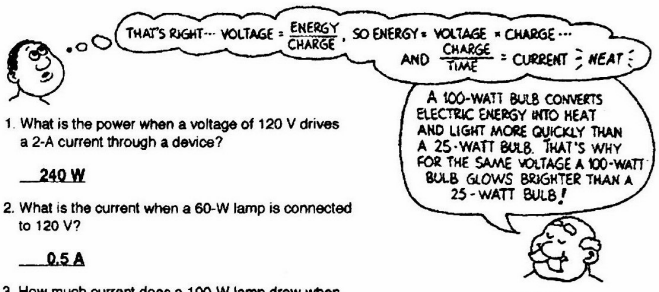
Electric Power

Recall that the rate at which energy is converted from one form to another is *power*.

$$\text{Power} = \frac{\text{energy converted}}{\text{time}} = \frac{\text{voltage} \times \text{charge}}{\text{time}} = \text{voltage} \times \frac{\text{charge}}{\text{time}} = \text{voltage} \times \text{current}$$

The unit of power is the *watt* (or *kilowatt*), so in units form,

Electric power (*watts*) = current (*amperes*) × voltage (*volts*), where 1 *watt* = 1 *ampere* × 1 *volt*.



1. What is the power when a voltage of 120 V drives a 2-A current through a device?

   240 W

2. What is the current when a 60-W lamp is connected to 120 V?

   0.5 A

3. How much current does a 100-W lamp draw when connected to 120 V?

   0.83 A

4. If part of an electric circuit dissipates energy at 6 W when it draws a current of 3 A, what voltage is impressed across it?

   2 V

5. The equation

$$\text{power} = \frac{\text{energy converted}}{\text{time}}$$

rearranged gives energy converted = POWER × TIME

6. Explain the difference between a kilowatt and a kilowatt-hour.

   A KILOWATT IS A UNIT OF POWER; Kw-HOUR IS UNIT OF ENERGY (POWER × TIME)

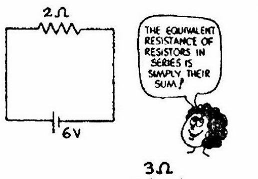
7. One deterrent to burglary is to leave your front porch light constantly on. If your fixture contains a 60-W bulb at 120 V, and your local power utility sells energy at 10 cents per kilowatt-hour, how much will it cost to leave the light on for the entire month? Show your work on the other side of this page.

   E = P × t = 60 W × 1 mo × 30 day/1 mo × 24 h/1 day × 1 kW/1000 W = 43.2 kWh
   MULTIPLY BY $0.10/kWh = $4.32

Name ______________________ Date ________

CONCEPTUAL **Physics** PRACTICE PAGE

Chapter 23 Electric Current
Series Circuits

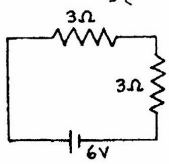


1. In the circuit shown at the right, a voltage of 6 V pushes charge through a single resistor of 2 Ω. According to Ohm's law, the current in the resistor (and therefore in the whole circuit) is

   __3__ A.

2. Two 3-Ω resistors and a 6-V battery comprise the circuit on the right. The total resistance of the circuit is __6__ Ω.

   The current in the circuit is then __1__ A.



3. The equivalent resistance of three 4-Ω resistors in series would be

   __12__ Ω.

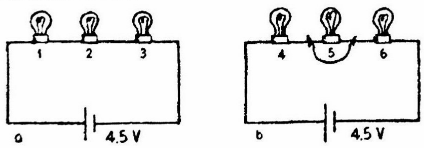
4. Does current flow *through* a resistor, or *across* a resistor? __THROUGH__

   Is voltage established *through* a resistor, or *across* a resistor? __ACROSS__

5. Does current in the lamps of a circuit occur simultaneously, or does charge flow first through one lamp, then the other, and finally the last in turn?

   __SIMULTANEOUSLY (SPEED OF LIGHT)__

6. Circuits *a* and *b* below are identical with all bulbs rated at equal wattage (therefore equal resistance). The only difference between the circuits is that Bulb 5 has a short circuit, as shown.



   a. In which circuit is the current greater? __b__

   b. In which circuit are all three bulbs equally bright? __a__

   c. Which bulbs are the brightest? __4 AND 6__

   d. Which bulb is the dimmest? __5 (NOT LIT)__

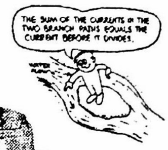
   e. Which bulbs have the largest voltage drops across them? __4 AND 6 (2.25 V EACH)__

   f. Which circuit dissipates more power? __b (GREATER CURRENT, SAME VOLTAGE)__

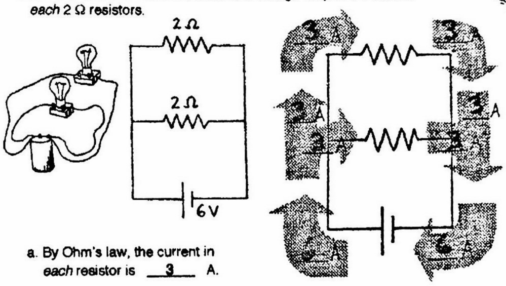
   g. Which circuit produces more light? __b (MORE POWER)__

CONCEPTUAL **Physics** PRACTICE PAGE

Chapter 23 Electric Current
Parallel Circuits



1. In the circuit shown below, there is a voltage drop of 6 V across *each* 2 Ω resistors.

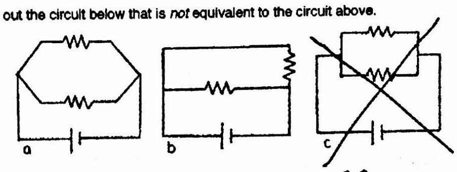


   a. By Ohm's law, the current in *each* resistor is __3__ A.

   b. The current through the battery is the sum of the currents in the resistors, __6__ A.

   c. Fill in the current in the eight blank spaces in the diagram above of the same circuit.

2. Cross out the circuit below that is *not* equivalent to the circuit above.



3. Consider the parallel circuit at the right.

   a. The voltage drop across each resistor is

   __6__ V.

   b. The current in each branch is:

   2-Ω resistor __3__ A.

   2-Ω resistor __3__ A.

   1-Ω resistor __6__ A.

   c. The current through the battery equals the sum of the currents which equals __12__ A.

   d. The equivalent resistance of the circuit equals __0.5__ Ω.