Name ______________________ Date __________

CONCEPTUAL *Physics* PRACTICE PAGE

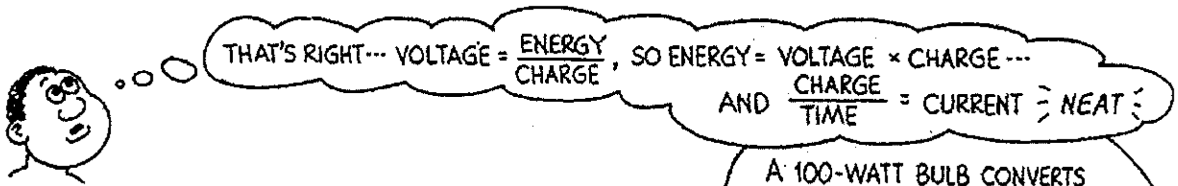
Chapter 23 Electric Current
Electric Power

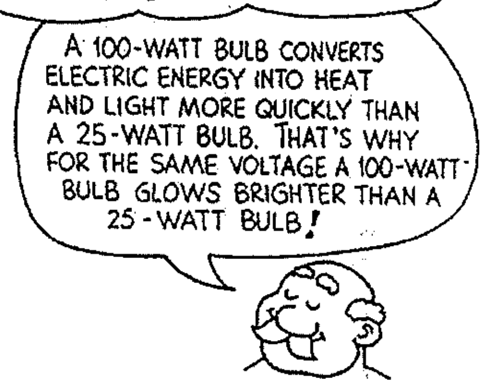
Recall that the rate at which energy is converted from one form to another is *power.*

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

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?

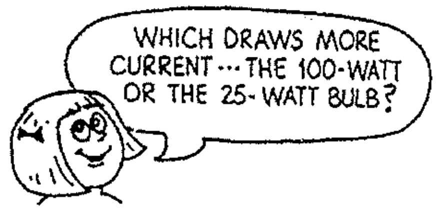
   ____

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

   ____

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

   ____



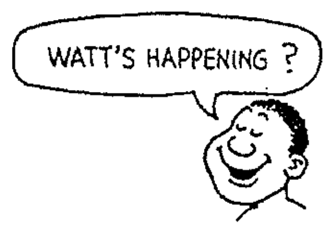
4. If part of an electric circuit dissipates energy at 6 W when it draws a current of 3 A, what voltage is impressed across it?

   ____

5. The equation

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

   rearranged gives energy converted = ______________________



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

   ____

7. One deterrent to burglary is to leave your front porch light on all the time. If your fixture contains a 23-W compact-fluorescent 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 bulb on for the entire month? Show your work.

   ____

Chapter 23 Electric Current
Circuit Happenings

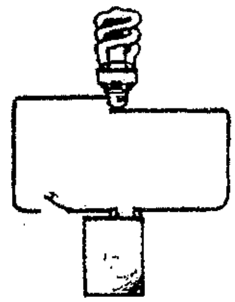


Figure 1

1. Figure 1 shows a very simple circuit—one battery, one bulb. Like a water pump that produces sustained water pressure in a pipe or system of pipes, the battery produces a sort of *electric pressure* called

   [voltage] [current] [energy],

   which energizes the bulb. The energy is supplied through an *electric field* that permeates the circuit at nearly the speed of light. So for practical purposes, when you close a switch and complete a circuit, voltage applied to the circuit occurs

   [almost instantaneously] [gradually].

2. With water pipes you have to supply the water that flows through them. But electric wires are "pipes" that contain their own "water"—electrons. So electrons are already in the wires of an electric circuit. Voltage causes them to flow. A battery supplies electrons with

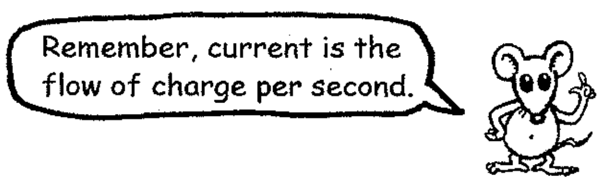
   [energy] [coulombs] [ohms].

3. Assume the battery supplies 6 volts to the circuit. A 6-volt "pressure" means that during each second 6 joules of energy from the battery is delivered to each coulomb of charge that flows in the circuit. If the resistance of the bulb is 1 Ω, then in accord with Ohm's Law, the flow of charge—the *current*—is

   [less than 6 amperes] [6 amperes] [more than 6 amperes].

   In other words, (V/R = 6 V/1 Ω = _______ amps). So the amount of *charge* that flows each second is

   [less than 6 coulombs] [6 coulombs] [more than 6 coulombs].



4. Energy is delivered to and dissipated at locations of circuit *resistance*, where energy is converted to heat and light. In the single-bulb circuit, most all the resistance is in the bulb's

   [filament] [connecting wires].

5. It is common practice to ignore all resistance in the circuit except the resistance in the bulb. That's because compared with the bulb filament's high resistance, the resistance offered by the connecting wires and the battery interior is

   [small] [large].

Hewitt Drew it!

Name ______________________________ Date __________

CONCEPTUAL **Physics** PRACTICE PAGE

Chapter 23 Electric Current

***Circuit Happenings**—continued*

6. Consider two identical bulbs, Figure 2, connected in *series*. The circuit has twice as much resistance. The voltage is the same because the battery is the same, and in accord with Ohm's Law, twice the resistance for the same voltage means the current is

   [half as much] [twice as much].

7. So the current in each bulb is

   [less than 3 amps] [3 amps] [more than 3 amps],

   and in every part of the circuit.

8. In which bulb does the charge first flow?

   [The bulb on the left] [The bulb on the right] [Both at once]

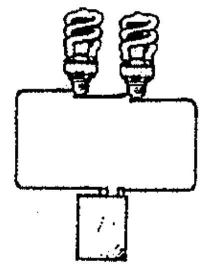


Figure 2

9. Current occurs in all parts of the circuit [step by step] [instantaneously].

10. The 6 volts across the circuit divides among the two bulbs. Since bulb resistance is the same, the voltage impressed across each bulb in this series circuit is

    [less than 3 volts] [3 volts] [more than 3 volts].

11. This checks with Ohm's Law: (3 V/1 Ω) = __________ amps. In the overall circuit, (6 V/2 Ω) = _______ amps. So compared with the single bulb of Figure 1 the bulbs are

    [brighter] [dimmer].

12. When the two identical bulbs are connected in *parallel*, Figure 3, voltage among them

    [divides] [does *not* divide].

13. Each bulb still connects across the 6-V battery, so compared with the brightness of the lone bulb in Figure 1, each bulb glows

    [dimmer] [the same] [brighter].

14. That's because each bulb is energized with a full 6 volts, and the current in each bulb is

    [3 amps] [4 amps] [6 amps].

15. A little thought will show that the current in the battery must be

    [6 amps] [8 amps] [12 amps].

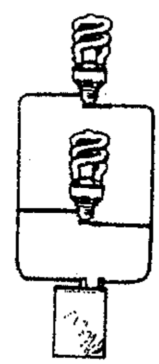


Figure 3

16. In accord with Ohm's Law, the battery supplies twice the current to the circuit because *the equivalent resistance* of the circuit is half that of Figure 1. Similar to increased checkout lanes in a supermarket, more branches in a parallel circuit reduce resistance and allow for a flow that is

    [less] [greater].

Hewitt Drew it!

Chapter 23 Electric Current

***Circuit Happenings**—continued*

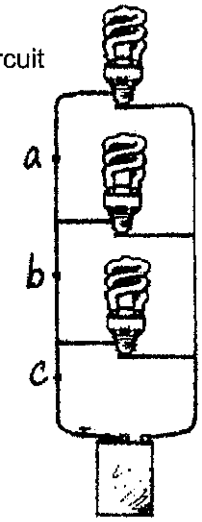


Figure 4

17. Adding a third identical bulb in parallel, Figure 4, further reduces the overall circuit resistance, resulting in a total current that is

    [less] [the same] [more].

18. Each bulb draws 6 amps, so the current supplied by the battery (and the current *in* the battery) is

    [6 amps] [12 amps] [18 amps].

    This is consistent with Ohm's Law; for the same voltage, one-third the resistance results in current increased by

    [three] [six] [twelve].

19. Consider points *a*, *b*, and *c*, in Figure 4. A little thought will show that current through point *a* is

    [6 amps] [12 amps] [18 amps].

    Current through point *b* is

    [6 amps] [12 amps] [18 amps],

    and current through point *c* is

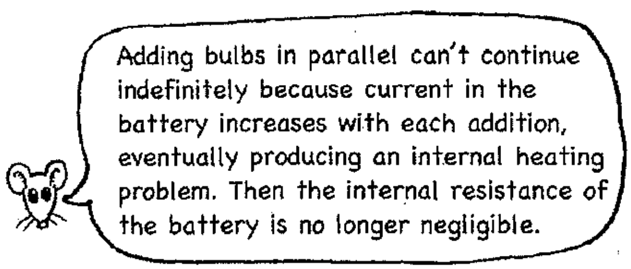
    [6 amps] [12 amps] [18 amps].

    It's like buses leaving a terminal that branch into three streets. If 18 buses leave the terminal and branch equally along three streets, then six buses occupy a street. How many return to the terminal?

    [6] [12] [All 18]

    Likewise with electric current—6 amps in three bulbs means current in the battery is

    [6 amps]. [12 amps] [18 amps].



20. Notice that in the three circuits in Figure 5, each bulb is connected across the full 6 volts of the battery. The battery "senses" these three circuits as

    [entirely different] [the same].

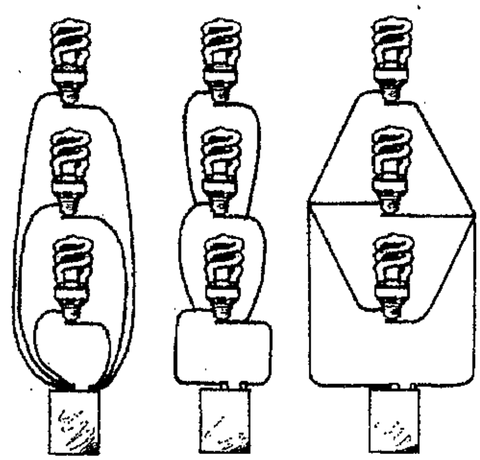


Figure 5

Hewitt Drew it!