

Physics

Circuit Homework

1. Is a current-carrying wire electrically charged?
2. A simple penlight battery connects the terminals of a battery to the terminals of a light bulb. Explain the path taken by an **electron** as it makes its way through this circuit. Make sure you refer specifically to the positive and negative terminals of the battery in your description.
3. Describe the **current** flow through the circuit in **problem #2**, but again make sure you refer specifically to the positive and negative terminals of the battery in your description.
4. Suppose that 6 amps of current flows through the circuit in **problem #2**. How much charge passes through the battery in 10 seconds? How much charge passes through the light bulb in the same time?
5. What is the resistance of a lamp that draws 700 milliamps when 12 volts are connected across it?
6. If you increased the voltage in the circuit described in **problem #5** to 24 volts, how would this affect the resistance of the lamp? How would this affect the current through the lamp?
7. Assuming the resistance of your body is 100,000 ohms, how much current would flow through your body if you grabbed the terminals of a 12 volt battery? Going swimming for a while might reduce your body's resistance to only 1000 ohms. Now how much current would flow if you grabbed the battery terminals?
8. What happens to the brightness of a light bulb when the current flowing through it increases?
9. How much power will the lamp in **problem #5** use (assuming it's still connected to a 12 volt battery)?
10. How much energy would be dissipated if it took you 10 seconds to overcome the involuntary muscle spasms resulting from your **post-swimming** experiment in **problem #7**?
11. Are car headlights wired in parallel or series? How do you know?
12. When a pair of identical resistors are connected in series, which of the following is the same for both resistors: voltage across each, power dissipated in each, current through each? Which of your answers change if the resistors are different from each other?
13. A 10 ohm resistor is connected in series with an unmarked resistor, and 6 volts is applied to the circuit. If the voltage drop across the 10 ohm resistor is 5 volts, what is the voltage drop across the second resistor? What is its resistance?
14. Complete the **Series Circuits** worksheet (the one with the single bulb near the top).
15. When a pair of identical resistors are connected in parallel, which of the following is the same for both resistors: voltage across each, power dissipated in each, current through each? Which of your answers change if the resistors are different from each other?
16. To connect a pair of resistors so that their total resistance is greater than either one, should you connect them in parallel or in series? What if you want to make the total resistance less than the resistance of either one?
17. Will a pair of flashlight bulbs glow brighter if connected to a battery in parallel or in series with each other?

18. Complete the **Parallel Circuits** worksheet (the one with two bulbs near the top).
19. Two 10 ohm resistors are connected in parallel, and the voltage from two batteries connected in series is applied to them. One of the batteries is 6 volts, but the other is unmarked. If 3 amps of current flows through each resistor, what is the voltage of the unknown battery?
Hint: Calculate the voltage drop across each resistor, then use the voltage loop law.
20. A 20 ohm resistor is connected in parallel with an unmarked resistor, and 6 volts is applied to the circuit. If the total current flowing out of the battery is 500 milliamps, what is the resistance of the unknown resistor?
Hint: Calculate the current flowing through the known resistor, then use the current branch law.
21. Would you expect to find DC or AC in the filament of a regular incandescent light bulb in your home? What about the headlight of your car?
22. Your friend claims that it takes electrons less than a second to reach his house from the power plant, since the electric field propagates through the wires at nearly the speed of light (186,000 miles/second). Explain why this is not true. Explain why the electrons from the power plant will **never** reach his house.
23. Suppose that one of the circuit breakers in your home protects your refrigerator, your microwave, and your toaster. Are these three devices connected in series or in parallel with each other? Is each connected in series or in parallel with the circuit breaker?
24. Suppose that your computer, monitor, answering machine, and modem are all plugged into the same power strip. Are these devices connected in series or in parallel with each other? How does plugging a printer into the same power strip affect the total resistance in the circuit? How about the total voltage, total current, and total power dissipated by the circuit?
25. A common practice in homes and offices is to “chain” power strips by plugging one into the wall, plugging a second into the first, a third into the second, etc. Assume that the other devices connected to each strip draw a total of 10 amps. If each strip is rated to a maximum of 15 amps, explain why this is a dangerous idea.