Physics 08-01 Ohm's Law *Name:* _____

Current

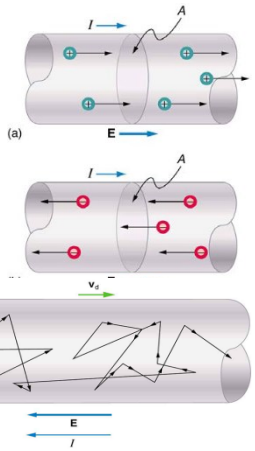
- _____ of _____ of _____
- Amount of _____ per unit _____ that crosses one _____

$$I = \frac{\Delta Q}{\Delta t}$$

- Symbol: (_____)
- Unit: _____ (A)

Small computer speakers often have power supplies that give 12 VDC at 200 mA. How much charge flows through the circuit in 1 hour and how much energy is used to deliver this charge?

- Electrons are the _____ that _____ through _____
- Historically thought _____ charges move
- _____ current is the _____ flow of _____ charges
- Flows from _____ terminal and into _____ terminal
- _____ current flows the _____ way



Drift Velocity

- _____signals travel near _____ of _____, but _____ travel much _____
- Each new electron _____ one ahead of it, so current is actually like _____

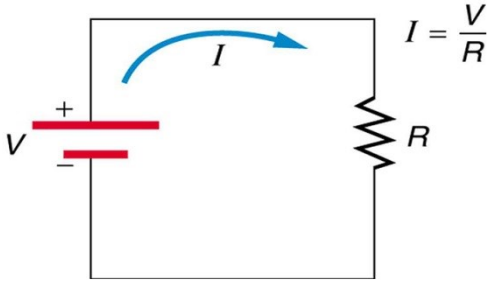
$$I = \frac{\Delta Q}{\Delta t} = qnAv_d$$

  - q = charge of each electron, n = free charge density, A = cross-sectional area, v_d = drift velocity

Ohm's Law

$$I = \frac{V}{R} \text{ or } V = IR$$

- V = emf, I = current, R = resistance
- Unit: V/A = _____ (Ω)



Resistors

- Device that offers _____ to _____ of charges
- _____ wire has very _____ resistance
- Symbols used for _____

Our speakers use 200 mA of current at maximum volume. The voltage is 12V. The current is used to produce a magnet which is used to move the speaker cone. Find the resistance of the electromagnet.

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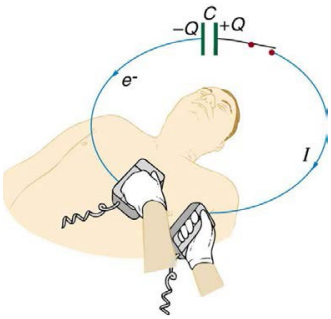
Practice Work

1. Can a wire carry a current and still be neutral—that is, have a total charge of zero? Explain.
2. Car batteries are rated in ampere-hours (A·h). To what physical quantity do ampere-hours correspond (voltage, charge, …), and what relationship do ampere-hours have to energy content?
3. Why are two conducting paths from a voltage source to an electrical device needed to operate the device?
4. In cars, one battery terminal is connected to the metal body. How does this allow a single wire to supply current to electrical devices rather than two wires?
5. The IR drop across a resistor means that there is a change in potential or voltage across the resistor. Is there any change in current as it passes through a resistor? Explain.
6. What is the current in milliamperes produced by the solar cells of a pocket calculator through which 4.00 C of charge passes in 4.00 h? (OpenStax 20.1) **0.278 mA**
7. A total of 600 C of charge passes through a flashlight in 0.500 h. What is the average current? (OpenStax 20.2) **333 mA**
8. What is the current when a typical static charge of 0.250 μC moves from your finger to a metal doorknob in 1.00 μs? (OpenStax 20.3) **0.250 A**
9. Find the current when 2.00 nC jumps between your comb and hair over a 0.500-μs time interval. (OpenStax 20.4) **4.00 mA**
10. A defibrillator sends a 6.00-A current through the chest of a patient by applying a 10,000-V potential as in the figure below. What is the resistance of the path? (OpenStax 20.7a) **1.67 kΩ**
11. During open-heart surgery, a defibrillator can be used to bring a patient out of cardiac arrest. The resistance of the path is 500 Ω and a 10.0-mA current is needed. What voltage should be applied? (OpenStax 20.8) **5.00 V**
12. (a) A defibrillator passes 12.0 A of current through the torso of a person for 0.0100 s. How much charge moves? (b) How many electrons pass through the wires connected to the patient? (See figure.) (OpenStax 20.9) **0.120 C, 7.50×10^{17} electrons**



13. A clock battery wears out after moving 10,000 C of charge through the clock at a rate of 0.500 mA. (a) How long did the clock run? (b) How many electrons per second flowed? (OpenStax 20.10) **2.00×10^{7} s, 3.13×10^{15} electrons/s**
14. What current flows through the bulb of a 3.00-V flashlight when its hot resistance is 3.60 Ω? (OpenStax 20.18) **0.833 A**
15. Calculate the effective resistance of a pocket calculator that has a 1.35-V battery and through which 0.200 mA flows. (OpenStax 20.19) **6.75 kΩ**
16. (a) Find the voltage drop in an extension cord having a 0.0600-Ω resistance and through which 5.00 A is flowing. (b) A cheaper cord utilizes thinner wire and has a resistance of 0.300 Ω. What is the voltage drop in it when 5.00 A flows? (c) Why is the voltage to whatever appliance is being used reduced by this amount? What is the effect on the appliance? (OpenStax 20.22) **0.300 V, 1.50 V**
17. A power transmission line is hung from metal towers with glass insulators having a resistance of 1.00×10^{9} Ω. What current flows through the insulator if the voltage is 200 kV? (OpenStax 20.23) **0.200 mA**