Name: _____

Period: _____

Current

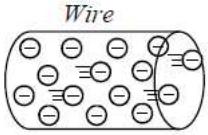
8.3

Current Flows

Current is the amount of charge flowing per second, just like gallons per second. More current means more coulombs per second. Current is NOT about the speed of the electrons. All current travels at the same speed. This *drift velocity* of electrons is actually very slow. It takes over an hour for an electron to travel one meter in a wire.

Less current. *More current.*

Current tells us how much charge passes thru a wire's "cross sectional area", which would be the area cut perpendicularly thru a solid (like a wire). The cross sectional area of a cylinder is a circle.



Electrical Current

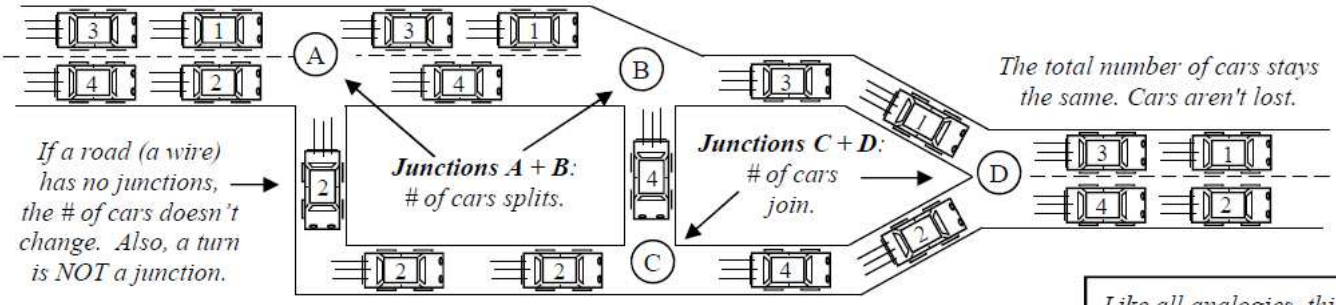
Current (*in Amperes [Amps]*) $\rightarrow I = \frac{Q}{t}$ ← Charge (*in Coulombs [C]*); Time (*in sec*)

Ex. A device draws 300 mA. How much charge does it use in 5 seconds?

I = 0.3 A t = 5 sec Q = ?	$I = \frac{Q}{t}$ so $Q = I(t)$ $= 0.3(5) = 1.5C$

Current in Circuits

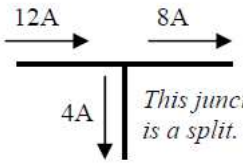
Current flows thru wires, much like water flows thru pipes. The following diagram shows how current can split, join, or remain constant in circuits.

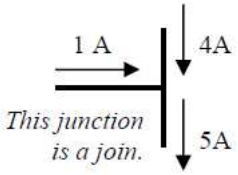


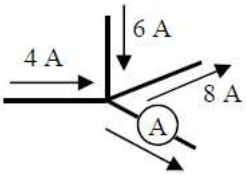
Cars driving on roads combine and split just like current flowing thru wires in circuits.

- The amount of current cannot change in a wire (*car 2, bottom left*), only at junctions.
- At a junction the current can split (A or B) or join (C or D). A turn is not a junction.
- ***"The amount of current flowing into a junction must equal the amount of current flowing out of the junction."*** This is known as **Kirchhoff's Junction Law**: $\Sigma I_{in} = \Sigma I_{out}$. This is just another statement of Conservation of Mass: # e's in = # e's out.

Like all analogies, this one has limitations. Cars are self-propelled: electrons are moved by electric fields from batteries. Also, roads are empty to begin with. ***Wires already have electrons in them.***







Ex. What does the ammeter read?

Kirchhoff's Junction Law: $\Sigma I_{in} = \Sigma I_{out}$

$4 + 6 = 8 + I$

$10 = 8 + I$

$I = 2$ Amps

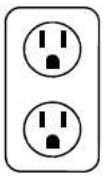
Types of Current

You use two kinds current every day: direct current (DC) and alternating current (AC).

DC

Direct Current (DC) flows in only one direction. Batteries provide direct current from chemicals and different metals.

Alternating Current (AC) flows one way and then reverses. The power in your house is AC, alternating 60 times a second.



AC

Converting between AC and DC:

Devices are designed for either AC or DC and cannot run off the other. To plug a battery powered devices into the wall requires an AC adaptor, which has a rectifier circuit in it. Car's produce only direct current. Using a house hold AC device in a car requires an inverter.

1. Which has more current: a slow river or a dentist's water pix?
2. Which has faster electrons: a wire with a lot of current or little current?

3. Why is it that when you plug in a string of lights, they all come on at the same time?

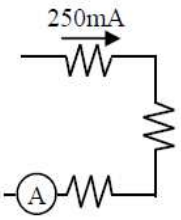
4. 24 Coulombs of charge pass thru the cross sectional area of a wire in 4 seconds. How much current is being provided by the battery?

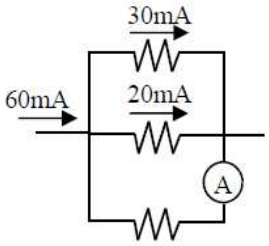
5. A typical vacuum cleaner pulls 12 amps. How much charge is used by a vacuum cleaner each minute?

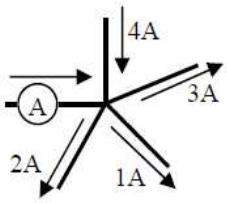
6. Currents as small as 100mA can be fatal because they can disrupt the heart.
   A. At this current, how much charge per second is being absorbed by the body?

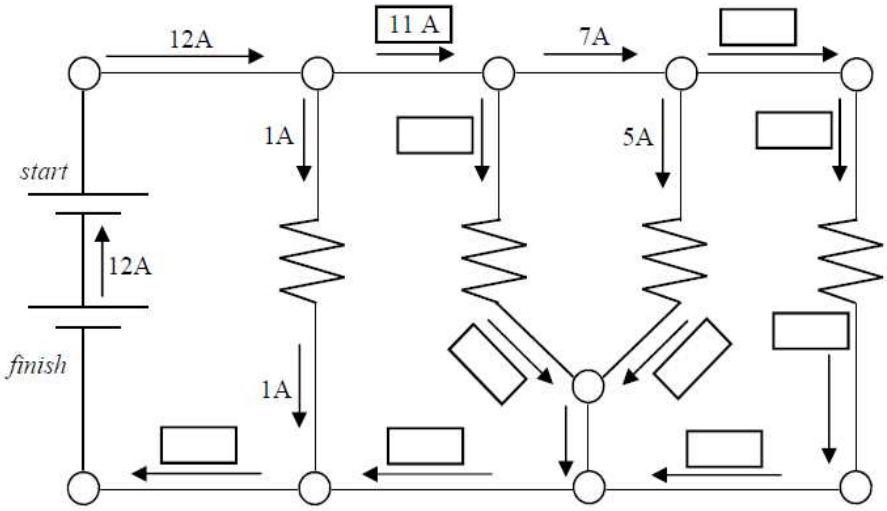
   B. Remembering that $|1\ e| = 1.602\times10^{-19}$ C, how many electrons are flowing into the body per second?

7. Ammeters are used to measure current. For each of the circuit segments determine the reading of the ammeter.





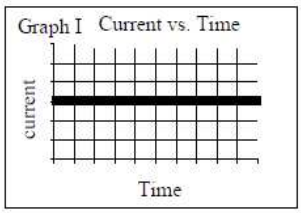


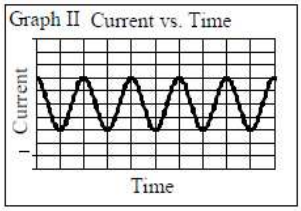


8. Begin where it says "Start", at the top battery.
   A. In each of the circles put one of the following:
      S (split);
      J (join);
      T (turn).
   B. In each of the boxes fill in the amount of current flowing thru that portion of wire.

9. What does AC stand for?
10. What does DC stand for?
11. AC or DC Current?

    A. ____ Current that changes polarity.
    B. ____ Current that is constant.
    C. ____ From a battery.
    D. ____ From a house power outlet.
    E. ____ Graph I at the right.
    F. ____ Graph II at the right.





12. How can a battery powered cell phone run off of a house outlet?

13. How can a hair drier be used in a car, which produces 12 Volts DC?