Name: Key

Notes - 20.1 Current

1. Electric current is defined to be the rate at which charge flows.

2. Write the equation for electric current. $I = \frac{\Delta Q}{\Delta t}$

3. The unit for electric current is ampere.

4. 1 ampere = 1 coulomb/second. $1\,A = 1\,\frac{C}{s}$

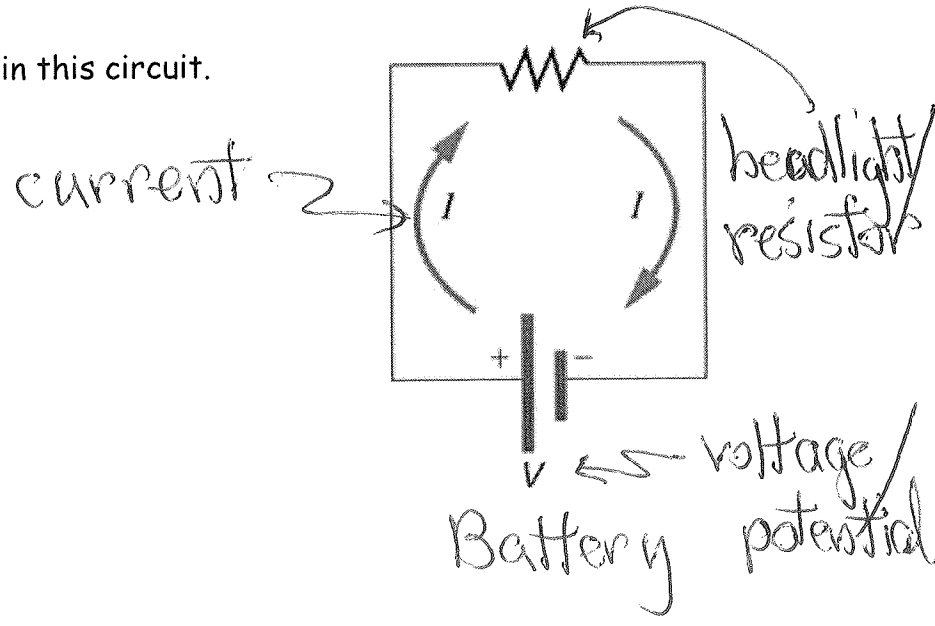
5. Example:
   A. What is the current involved when a truck battery sets in motion 720 C of charge in 4.00 s while starting an engine? Show your work.

$$I = \frac{\Delta Q}{\Delta t} = \frac{720\,C}{4.00\,s} = \boxed{180\,A}$$

   B. How long does it take 1.00 C of charge to flow through a handheld calculator if a 0.300-mA current is flowing? Show your work.

$$I = \frac{\Delta Q}{\Delta t} \Rightarrow \Delta t = \frac{\Delta Q}{I} = \frac{1.00\,C}{0.300\times10^{-3}\,A} = \boxed{3.33\times10^{3}\,s}$$

6. Label the terms and components in this circuit.



7. The direction of current flow is from positive to negative. The direction of conventional current is the direction that positive charge would flow.

8. In metal wires, current is carried by electrons. So it is negative charges that are moving.

9. The fact that conventional current is taken to be in the direction that positive charge would flow can be traced back to American politician and scientist Ben Franklin. He named the type of charge associated with electrons negative, long before they were known to carry current in so many situations. Franklin, in fact, was totally unaware of the small-scale structure of electricity.

10. It is important to realize that there is an electric field in conductors that is responsible for producing the current, unlike static electricity situations, where a conductor in equilibrium cannot have an electric field in it. Conductors carrying a current have an electric field and are not in static equilibrium. An electric field is needed to supply energy to move the charges.

11. If the 0.300-mA current through a wire is carried by electrons, how many electrons per second pass through it? Show your work.

$$0.300\times10^{-3}\,\frac{C}{s}\times\left(\frac{1e^-}{1.60\times10^{-19}C}\right)=1.88\times10^{15}\,\frac{e^-}{s}$$

12. Electrical signals are known to move very rapidly. Telephone conversations carried by currents in wires cover large distances without noticeable delays. Lights come on as soon as a switch is flicked. Most electrical signals carried by currents travel at speeds on the order of 10^8 m/s, a significant fraction of the speed of light. The electrons move much more slowly on average, typically drifting at speeds on the order of 10^{-4} m/s.

13. Show the direction of the drift velocity v_d, electric field E and the current I.