Name & ID ____

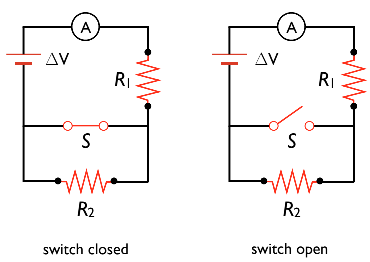
PH 102 / LeClair Summer II 2012

Quiz 4: Solutions

1. If the current carried by a conductor is doubled, what happens to the average time between collisions?

- ■ Nothing.
- □ It doubles.
- □ It decreases by two times.
- □ It increases by 4 times.
- □ It decreases by 4 times.

In our model of conduction, the average time between collisions is a property of the material and temperature, but it does not depend on the current. At a given temperature for a given material, it is a fixed constant that the *current depends on*, not the other way around.



2. Refer to the figures at left. What happens to the reading on the ammeter when the switch S is opened?

- □ the reading goes up
- ■ the reading goes down
- □ the reading does not change

When switch S is closed, resistor R_2 is shorted by a perfect wire, and plays no role (or, if you like, it is in parallel with a resistance of zero, which gives an equivalent resistance of zero). The current in the circuit would then be $\Delta V/R_1$. With switch S_2 open, R_1 and R_2 are in series. This means more resistance at the same battery voltage, so the current must go down, to a value $\Delta V/(R_1 + R_2)$.

3. When we power a light bulb, are we using up charges and converting them to light?

- □ Yes, moving charges produce "friction" which heats up the filament and produces light
- □ Yes, charges are emitted and observed as light
- □ No, charge is conserved. It is simply converted to another form such as heat and light.
- ■ No, charge is conserved. Moving charges produce "friction" which heats up the filament and produces light.

Charge is always, always conserved, and it can't be converted to anything else. In an *incandescent bulb*, collisions within the conducting filament convert electrical energy (but not charge!) to heat, enough that the filament temperature rises to the point of glowing.

4. An electric current of 1 mA flows through a conductor, which results in a 150 mV potential difference. The resistance of the conductor is:

- ■ $150\,\Omega$
- □ $6.7 \times 10^{-4}\,\Omega$
- □ $1.5 \times 10^{-6}\,\Omega$
- □ $6.7\,\Omega$

The resistance is the potential difference across the conductor divided by the resulting current:

$$R = \frac{\Delta V}{I} = \frac{150\,\text{mV}}{1\,\text{mA}} = \frac{0.150\,\text{V}}{0.001\,\text{A}} = 150\,\Omega$$