Unit 22 – Session 2

In sections 22.7 through 22.12, we will expand on our work from Session 1, and develop an understanding and working model of current and electrical potential difference (voltage).

Just a few reminders from last time:

- We'll use the symbol $\Delta V$ (= $V_B - V_A$) to represent potential difference, also called voltage. It has the same units as electrical potential: joules/coulomb (J/C), which is called a volt (V). The Δ here doesn't mean *change*, but instead means *difference* – the potential at point B minus the potential at point A, with both $V_B$ and $V_A$ being measured at the same time.

- We'll use the symbol $i$ or $I$ to represent current. It has the units of coulombs/second (C/s), which is called an ampere (A).

- A light bulb will not light unless there is a potential difference between the side of the bulb and the bottom of the bulb, $V_{side} - V_{bottom} \neq 0$ V.

- If you connect one side of a battery directly to the other side of a battery with only wires in between, you will burn the battery up. This is called a short circuit – the current is taking a short cut around, or bypassing, any light bulbs.

# Unit 22 – Session 2 (Brief summary)

We've only looked at fairly simple circuits this session, but there are a few things that we can conclude. We'll expand on and refine these ideas as we make more complex circuits in the next session, and in Unit 23.

- The current drawn from (entering black end, leaving copper end) a battery (and then flowing in the whole circuit for our simple circuits) depends on two things: 1) the potential difference of the battery, and 2) the resistance of the circuit (number of light bulbs *and* how they are arranged).

- Based on the above, a battery is **not** a source of constant current. The same battery connected to different circuits will not produce the same current in each circuit (more current in the one-bulb circuit than in the two-bulb circuit).

    - Don't confuse "constant current" with the current being the same value everywhere in the circuit.

- A battery **is** a source of constant potential difference. The chemicals in the battery react to keep the potential difference the same between the two ends of the battery (until the chemicals are used up – that is when the battery "dies"). The batteries we are using are 1.5 V batteries, so the chemicals react to keep the potential of the copper end always 1.5 V higher than the potential of the black end.

# Unit 22 – Session 2 (summary continued)

- Current, potential difference, and potential energy are all different concepts.
    - We seem to like to define things based on positive quantities, so conventional current is in the direction a *positive* charge would move in the circuit to decrease its potential energy. In metal wires, the objects actually moving are electrons. Electrons moving to the left, say, represent a conventional current to the right.
    - Current is a measure of how much charge goes past a location each second. Since charge is a *property* of the actual electrons that are moving in the circuit, and electrons don't lose this property, current is not "used up" when it flows through a light bulb.
    - The electrons also have potential energy (which is not a property of the electron). When a ball free falls toward the Earth, it loses gravitational potential energy (but not mass), which becomes kinetic energy. Similarly, when an electron goes through the light bulb filament, it loses electrical potential energy (but not charge). However, it doesn't change speed, so that potential energy instead becomes light energy (some) and thermal energy (mostly).
    - The electrons don't lose any of their potential energy when they flow through the wires. The electrons gain back their potential energy when they flow through the battery.