Lightbulbs in circuits

Physics 225 – Background wiki

SERIES OR PARALLEL CIRCUITS

Two lightbulbs can be combined either in **series** or in **parallel** to form a circuit. Figure 3.1 shows a diagram of two different lightbulbs in series.

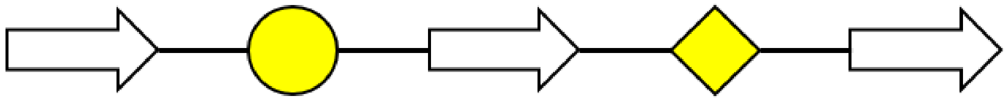

Figure 3.1: Lightbulbs in series. The circle and the diamond represent two different lightbulbs. The size and direction of the arrows indicate the relative strength and direction of the flow of current.

In Figure 3.1, notice that the current flows through the first lightbulb, and then the same current must also flow through the second lightbulb. There are no other paths available.

The second method of combining lightbulbs in a circuit is in parallel. Figure 3.2 below shows a diagram of two different lightbulbs connected in parallel.

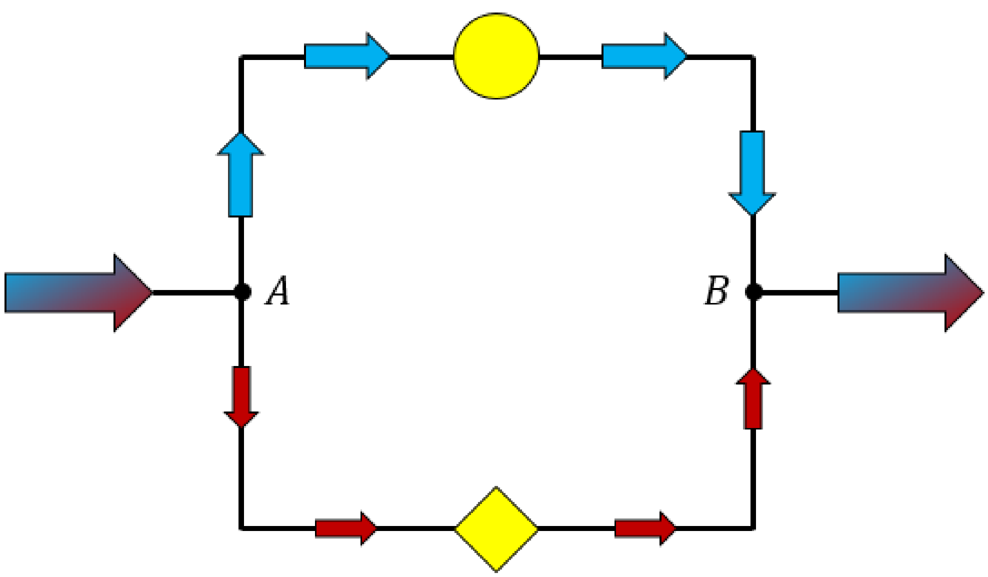

Figure 3.2: Lightbulbs in parallel. The circle and the diamond represent two different lightbulbs. The size and direction of the arrows indicate the relative strength and direction of the flow of current.

In Figure 3.2, notice that the current coming into the network from the left splits at junction A. Some current travels through the circle bulb, and the rest travels through the diamond bulb. The current re-combines at junction B and travels out of the network.

COMBINED SERIES/PARALLEL CIRCUITS

Multiple lightbulbs can also be combined using a mixture of series and parallel connections. A schematic of such a combination is shown in Figure 3.3 below.

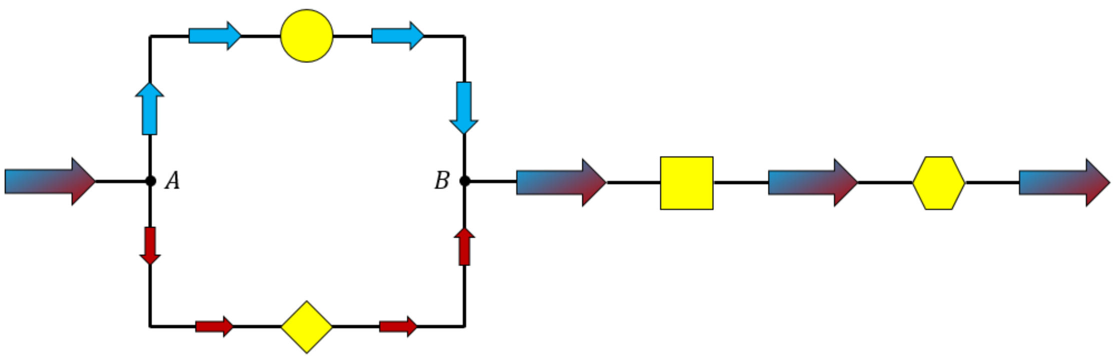

Figure 3.3: Four different lightbulbs connected in a combination of series and parallel.

MEASUREMENTS IN LIGHTBULB CIRCUITS

In a lightbulb circuit, as in any circuit, there are two key quantities which we can measure: the current traveling through a component and the electric potential difference (or voltage) across a component.

- **Electric current** (symbol I) is the rate at which charge flows *through* a wire or component and is measured in Coulombs per second, or Amperes (A).
- **Voltage** (symbol ΔV) is the difference in electric potential between two points (or across some portion of the circuit) and is measured in volts (V).

MEASUREMENTS IN SERIES

When two lightbulbs are wired in series, the current through them must be the same. In series, there are no junctions or splits; the current cannot “choose” any other paths. However, the voltage across each bulb can be different.

In summary: in series, same current, different voltage. Figure 3.4 provides a pictorial representation of this idea.

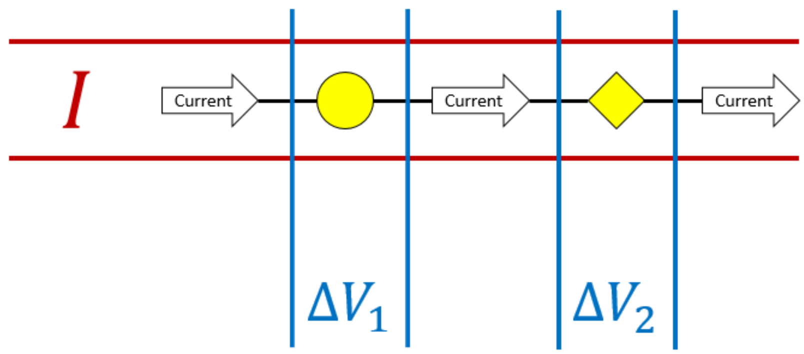

Figure 3.4: A visual representation of same current, different voltage in series.

MEASUREMENTS IN PARALLEL

Two lightbulbs in parallel follow opposite rules regarding current and voltage as lightbulbs in series. Revisit Figure 3.2. Notice that a battery could be connected at points A and B in the circuit. Then, anything connected to point A is at the same "location" as that end of the battery, and vice versa for point B. Anything connected in parallel within those points must then have the same voltage (that of the battery). However, in parallel, the current splits at the junctions. The current can "choose" different paths (and favors the path of least resistance, as we will learn soon).

In summary: in parallel, same voltage, different current. Figure 3.5 shows a pictorial representation of this concept.

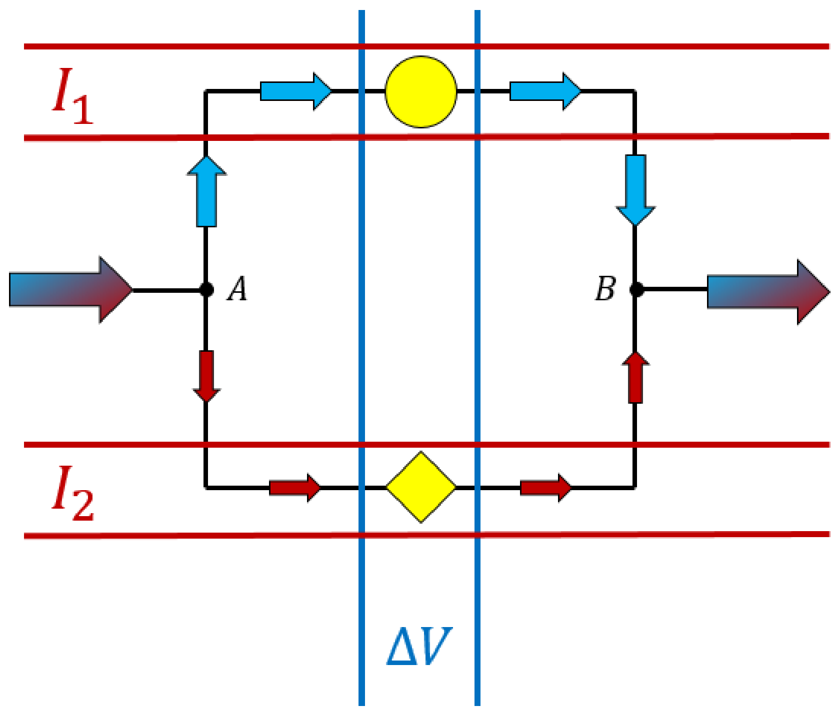

Figure 3.5: A visual representation of different current, same voltage in parallel.

POWER

If you have ever bought lightbulbs at the store, you might have noticed that they are often labeled by their **power** in Watts (W). **Watts** represent the amount of energy in Joules delivered to the lightbulb in one second. (So the unit Watts is the same as energy per time, or Joules per second.)

For a lightbulb like you use in the laboratory, you can calculate power (P) using current (I) and voltage (ΔV):

$$P = \Delta V * I \quad \text{(Equation 1)}$$

Credits

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