E2
Current and Resistance

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B.Sc in Applied Physics.

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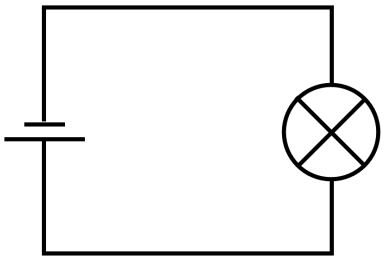
10:00 A.M - 1:00 P.M

1. Check that the battery is working.

Q1. Draw the single bulb circuit. Is the current through the bulb the same as the current through the battery?



The measured current in the bulb is the same as the current displayed on the power supply (0.25 Amps)

2. Bulbs in series.

Q2. Compare the brightness of the two bulbs with each other (pay attention to large differences only). Comment on the (relative) current in the two bulbs.

Bulbs are noticeably dimmer, voltage has not changed and the current from the power supply has dropped

Q3. Is the current the same as or different to the current in the single bulb circuit?

The current has dropped (from 0.25 A to 0.17 A)

Q4. What happens to the current when the number of bulbs in series increases? Can you predict the answer from the brightness behaviour?

As the number of bulbs in the series increases the current decreases, as the current decreases the bulb appears dimmer so therefore we can predict that as a bulb gets dimmer the current has decreased and as the bulbs get brighter the current has increased.

Q5. State the relationship between resistance, R, and current, I, in the circuit.

As the resistance (R) increases, the current (I) decreases, or:

$$R \propto \frac{1}{I}$$

3. Bulbs in parallel.

Q6. Compare the brightness of the two bulbs. What do you conclude about the relative current in the bulbs?

Both of the bulbs are equally as bright, the current from the power supply went from 0.25 Amps up to 0.5 Amps, so it's logical to conclude that each of the bulbs in parallel are receiving 0.25 Amps.

Q7. How does the brightness of each compare with that of the single bulb circuit? Test by unscrewing one of the bulbs.

Each of the bulbs appear to be as bright as the single bulb circuit, this backs up the idea that the current in the circuit doubled to supply each of the bulbs with 0.25 Amps, thus giving them the same brightness as the single bulb.

Q8. If a current I flows from the battery in the one bulb circuit, how much current will flow from the same battery when four similar bulbs are connected in parallel?

$$\text{One bulb in circuit: } = I$$

$$\text{Four bulbs in parallel: } = I \times 4$$

4. Extending the model.

Q9. Investigate and comment on the brightness of the bulbs for the open and closed switch positions.

Open: When the circuit is open A and B are half as bright as a single bulb
Closed: When the circuit is closed A and C appear dimmer while B is at full brightness

Q10. Measure the potential difference (commonly referred to as "the voltage") across each light bulbs in Figs. 1&2. Compare with the potential difference across the battery. Investigate the sum of the potential drops around the circuit. Note the direction of the voltage change.

Circuit 1: 2.2V and 2.16V
The total voltage in the circuit was 4.4V, so the two bulbs are receiving almost half the voltage each, however the second bulb had dropped about 0.04V compared to the first one.

Circuit 2: 4.34V and 4.34V
The total voltage in the circuit was 4.4V, so they're each receiving almost the total amount amount of voltage however they both have a drop of about 0.06V

Q11. Rank the potential difference across the bulbs in Fig. 3 compared to that of the single bulb circuit. How does the potential difference ranking compare with the current (brightness) ranking?

B = 3.4V
A and C = 0.96V

B is the brightest bulb and it has the highest voltage going through it, both A and C appear equally as dim and they both have the same voltage running through them.

5. Complete circuit.

Q12. Rank the bulbs in order of brightness in the circuit shown in Fig. 5. How does the potential difference AB compare to that of CD and to the power supply voltage?

1. Bulbs 4 = Brightest
2. Bulbs 1 & 2 = Equally bright
3. Bulbs 5 & 3 = Equally dim

AB = 4.28 V
CD = 4.33 V

The voltages are extremely similar with only a slight drop across AB

Q13. Predict the effect of removing bulb 1. Measure the potential difference between AB before and after removing the bulb. How does it change?

Removing bulb 1 should cause bulb 2 to get brighter but should have no affect on the potential difference between AB

Before: AB = 4.28V

After: AB = 4.28V

Q14. Predict the effect of removing bulb 5. Measure the potential difference between AB before and after removing the bulb. How does it change?

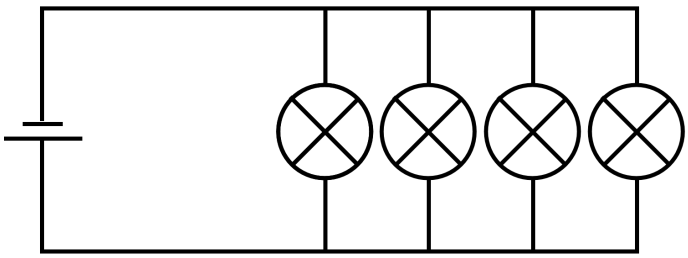
Removing bulb 5 should have no affect on the total potential difference between AB

Before: AB = 4.28V

After: AB = 4.3V

There was a slight increase in the voltage across AB of 0.02V

Q15. Can you connect four bulbs in the circuit such that they all have the same brightness? If so, draw the circuit diagram(s).



Four bulbs in parallel in our experiment would have the same brightness and would all have 4.4V and 0.25Amps.