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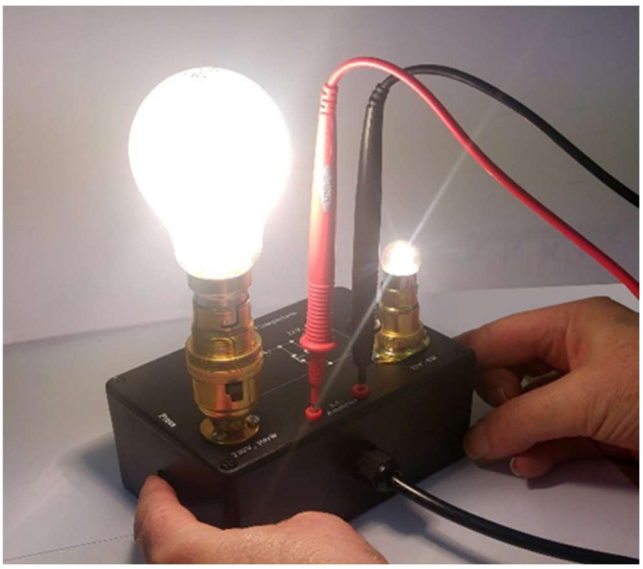
Lamp Brightness Comparison Experiments.



First set up a simple circuit with a 12V, 5W lamp in series with a multimeter set to 2A AC and connect this to a low voltage power supply set to 12VAC (the power supply should be capable of delivering at least 0.5A). Connect a multimeter set to 20VAC to read the exact voltage applied to the lamp.

Observe the brightness of the lamp and record the current and voltage readings.

Now using the Lamp Brightness Comparison unit, insert a 100W mains lamp into the socket and move the black slide switch to on, then insert the 12V, 5W lamp into the SBC socket.

Using a multimeter, select the 2A AC range and connect it to the red sockets on the unit using 2mm test probes. ***The use of an ammeter is essential for the correct operation of the experiment.***

Caution: Remember the meter probes are "live". Do not touch, strict supervision must be provided when in use with students.

Plug the unit into a suitable mains socket and the 100W mains lamp should illuminate. Once again observe the brightness of this lamp and record the current. It may be assumed that the mains voltage is 230V. **Note:** mains voltage may vary.

It is useful, at this stage, to compare the two current readings. The current through the 100W mains lamp will be approx. 0.4A and through the 12V, 5W (from the previous test) again approx. 0.4A. They are each carrying approximately the same current, **QUESTION:** why is the mains lamp brighter?

Predict what would happen if we wired the 100W mains lamp and the 12V, 5W lamp in series and connected them to the 230V supply. Would anything happen? Would one or both lamps blow?

Now depress the two black buttons on the sides of the unit, simultaneously, this will connect the two lamps in series. It may be noted that the mains 100W lamp is fractionally dimmer than it was, and that the current has reduced slightly.

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At this point it is worth considering the resistance of the lamp filaments. As **Resistance = Voltage/Current,** the resistance of each filament may be calculated from the measurements taken.

The idea of a potential divider may then be introduced. i.e. resistances in series share out the voltage in proportion to their relative resistance.

Using a rough calculation (which may be a little out because of the characteristics of various lamps*), the resistance of the 100W mains lamp is 529Ω and that of the 12V, 5W lamp is 28.8Ω.

(**Resistance = Voltage^2/Power**)

*** Example.** We purchased several 100W lamps to try out the system. They were all labelled 240V, even though the mains voltage has been 230V for the past 10 years. Using 240V as a baseline gives the resistance of a 100W lamp as 576Ω and the current through it is 0.399A. This agrees exactly with our measurements taken. We have put the calculations for using a 240V lamp in **bold** type below. It seems that the manufacturers have decided that it is not worth redesigning their products for the new harmonised voltage. In practice this means that a 100W, 240V lamp running on 230V only gives out 92W. (But at least it should last longer!)

The voltage will be shared as follows:-

Genuine 230V lamp	240V lamp
529 x 230V across the 100W lamp (529 + 28.8)	**576 x 230V** **(576 + 28.8)**
28.8 x 230V across the 5W lamp (529 + 28.8)	**28.8 x 230V** **(576+ 28.8)**

Note: that adding the two expressions together gives 230V.

The total current flow will be:-

230 A (529 + 28.8)	**230 A** **(576 + 28.8)**

Using a multimeter to read the resistance of the 100W lamp shows that the resistance is lower than calculated previously. **Question:** Why should this be? What effect would this have on the current flow?

Why do mains lamps most often "blow" when they are first switched on rather than when they have been on for some time?

We are now into the realms of temperature dependence. If the students want to pursue this they can use the 12V, 5W lamp and increment the voltage, take voltage and current readings and plot a graph of voltage against current. This graph may be compared with those of a carbon resistor or silicon diode.

Note: *The Lamp Brightness Comparison unit operates from the mains electricity and therefore must be used within the same regulatory requirements of all mains operated equipment. It should be tested regularly as a Portable Appliance; correct fuse rating must be adhered to, and the unit, cable and plug must be free from damage.*