

Power, energy and electricity bills

Grade 8 science (Year 9 · Class 8) · Lab

Name: _____ Date: _____ Class: _____

How does the electrical power of a lamp change as the voltage across it changes? In this lab you measure the voltage and current for a small filament lamp, calculate the power at six settings and find the energy it transfers in one minute.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS3

Aim

To measure the current in a 12 V lamp at different voltages and to calculate its electrical power and the energy it transfers.

Equipment

- Variable low-voltage d.c. supply (0–12 V)
- 12 V, 6 W filament lamp in a holder
- Ammeter (0–1 A) and voltmeter (0–15 V)
- Switch, 6 connecting leads
- Stopwatch

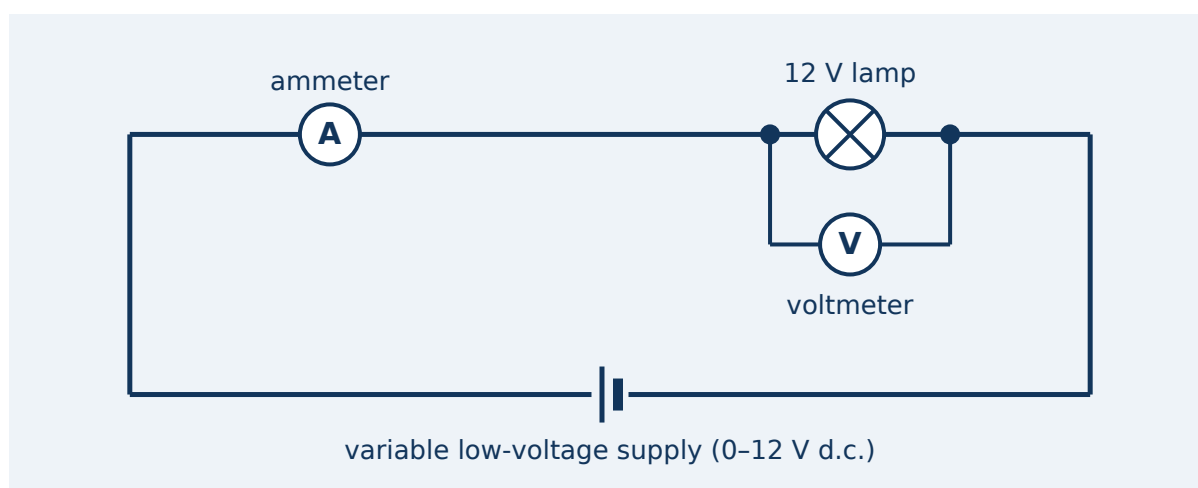
Safety

Safety

Use only the low-voltage supply, never the mains. Switch off before changing the circuit. The lamp gets hot, so do not touch the glass until it has cooled.

Method

1. Build the circuit shown. The ammeter is in series with the lamp and the voltmeter is across the lamp.
2. Set the supply to 2.0 V and switch on.
3. Read the voltage and the current at once, then switch off.
4. Repeat for 4.0, 6.0, 8.0, 10.0 and 12.0 V, switching off between readings.
5. At 12.0 V keep the lamp on for exactly 60 s to confirm the energy value.



Set-up: ammeter in series, voltmeter across the lamp.

Results

Sample measurements from one group:

Voltage V (V)	Current I (A)
2.0	0.20
4.0	0.31
6.0	0.38
8.0	0.44
10.0	0.48
12.0	0.52

Analysis questions

Question 1 Power at each setting

Calculate the power of the lamp at each voltage using $P = V \times I$.

Question 2 Graph of power against voltage

Plot a graph of power (y-axis) against voltage (x-axis) and describe its shape.

Question 3 Energy in one minute

Calculate the energy transferred by the lamp in 60 s at 12.0 V.

Question 4 Running cost

Calculate the energy in kWh if the lamp runs at 12.0 V for 5 hours, then the cost at 20 pence per kWh.

Question 5 Voltage and current ratios

The voltage was multiplied by 6 from the first to the last reading. By what factor did the current change? Suggest why it did not also rise six times.

Question 6 Uncertainty

The ammeter reads to ± 0.01 A and the voltmeter to ± 0.1 V. Find the percentage uncertainty in the power at 4.0 V.

Question 7 Better readings

Describe two changes that would give a more trustworthy power value at each setting.