

DETERMINATION OF h USING LEDs

Specification reference: AS Unit 2.7 – Photons

Theory:

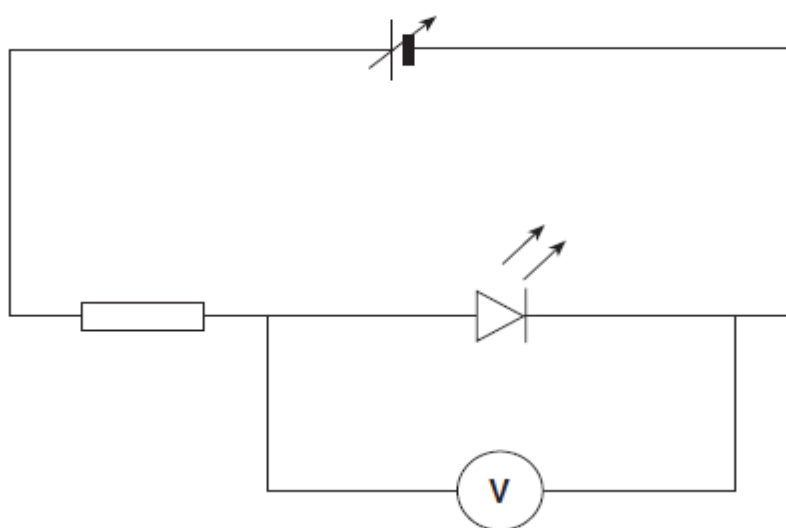
The Planck constant, h , can be determined by using a light emitting diode (LED) and measuring the minimum voltage, V_{\min} , at which light is just emitted by the diode. The Planck constant can then be determined from the equation $V_{\min} = \frac{hc}{e\lambda}$ where c is the speed of light $3.00 \times 10^8 \text{ m s}^{-1}$ and e is the electronic charge, $1.60 \times 10^{-19} \text{ C}$. A graph of V_{\min} against $\frac{1}{\lambda}$ should be a straight line with the gradient equal to $\frac{e}{hc}$.

Apparatus:

Variable d.c. power supply
 1 k Ω protective resistor
 Voltmeter (resolution $\pm 0.01 \text{ V}$) [multimeter set to appropriate range]
 Connecting leads
 Various LEDs – with known wavelengths

Experimental Method:

The circuit should be set-up as follows:



The voltage should be varied until light is just emitted by the LED. Record the voltage it corresponds to V_{\min} . The LED should be replaced and the procedure repeated for LEDs with different wavelengths of light. Plot a graph of V_{\min} (x-axis) against $\frac{1}{\lambda}$ (y-axis) and use it to determine a value for h .

Practical techniques:

- Use calipers and micrometers for small distances, using digital or vernier scales.
- Correctly construct circuits from circuit diagrams using D.C. power supplies, cells, and a range of circuit components, including those where polarity is important.
- Use ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data.

Relevant previous practical past papers:

- PH3 2006 Q2