

Photons, work functions and matter waves

AP Physics 2 (algebra-based) · Lab answers

Model answers use the sample table above. Your readings will differ a little, so focus on the method: reciprocal wavelength, gradient, conversion to h and an honest comparison with the accepted value.

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 15

Question 1 Reciprocal of wavelength

$1/0.635 = \mathbf{1.575}$, $1/0.605 = \mathbf{1.653}$, $1/0.590 = \mathbf{1.695}$, $1/0.525 = \mathbf{1.905}$, $1/0.470 = \mathbf{2.128}$ μm^{-1} .

Question 2 Plot the graph

The points lie close to a **straight line through the origin**, as $eV = hc / \lambda$ predicts.

Question 3 Gradient

Gradient = $(2.59 - 1.91) / (2.128 - 1.575) = 0.68 / 0.553 = \mathbf{1.23 \text{ V} \cdot \mu\text{m}}$ ($1.23 \times 10^{-6} \text{ V} \cdot \text{m}$).

Question 4 Planck constant

$h = \text{gradient} \times e / c = 1.23 \times 10^{-6} \times 1.60 \times 10^{-19} / 3.00 \times 10^8 = \mathbf{6.56 \times 10^{-34} \text{ J} \cdot \text{s}}$.

Question 5 Percentage difference

$(6.63 - 6.56) / 6.63 \times 100 = \mathbf{1.1 \%}$, which is within the experimental uncertainty.

Question 6 Meaning of the intercept

The theory predicts **zero intercept**. The line gives $V = 1.91 - 1.23 \times 1.575 = -0.03 \text{ V}$, which is very close to zero.

Question 7 Predict a violet LED

$1/0.405 = 2.469 \mu\text{m}^{-1}$, so $V = 1.23 \times 2.469 = \mathbf{3.04 \text{ V}}$. Uncertainty: judging when the LED first glows depends on the observer and the room light, so the voltage is uncertain by about $\pm 0.03 \text{ V}$; a photodiode would be better.