

Question			Expected response	Max mark	Additional guidance
14.	(a)		Axes appropriately labelled (quantity and units) and axes linearly scaled (1) [Allow for axes starting at zero or broken axes or an appropriate value] Data points plotted accurately (1) Appropriate line of best-fit (1)	3	If the origin is shown the scale must either be continuous, or the axis must be 'broken'. Otherwise, maximum 2 marks. If non-linear scale is used over the range of the data on either axis eg values from the table are used as the scale points. (0) marks Do not penalise if candidates plot <i>frequency</i> against <i>switch on voltage</i>. Accuracy of plotting should be easily checkable with the scale chosen. An appropriate scale to allow the accuracy of plotting to be checked must be linear over the range of the data.
	(b)		Choosing 2 points on their line (1) Calculate gradient: (1) (min 1 sig fig, max 4 sig figs) (Gradient works out as approx. 5.0×10^{-15})	2	Must be consistent with graph drawn for (a). Candidates are asked to calculate the gradient of their graph. Tolerance required depending upon best fit line drawn by the candidate. If candidates use values from the table, these points must lie on their line. If ($\times 10^{14}$) is not accounted for in the final answer, maximum 1 mark unless this being omitted is consistent with the graph drawn in (a). A unit is not required in the final answer, but if stated it must be correct. If candidate has a non-linear scale over the range of the values used in the substitution, (0) marks. If candidate has drawn a 'dot to dot' graph or no line, (0) marks.

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14.	(c)		$(h = e \times \text{gradient})$ $h = 1.60 \times 10^{-19} \times 5.0 \times 10^{-15} \quad (1)$ $h = 8.0 \times 10^{-34} \text{ Js} \quad (1)$	2	Must be consistent with (b) Must substitute the gradient of their graph, and not a single data point. If a single data point is substituted into in the calculation, award (0) marks Accept: correct alternative units If candidate has plotted frequency against switch on voltage, the formula becomes $\left(h = \frac{e}{\text{gradient}} \right)$ $h = \frac{1.60 \times 10^{-19}}{2.0 \times 10^{14}} \quad (1)$ $h = 8.0 \times 10^{-34} \text{ Js} \quad (1)$
	(d)		Repeat the measurements and take the mean. OR Use a greater range of colours/frequencies of LEDs. OR Carry out experiment in a dark room/use a viewing tube to see when LED first emits light. OR Use a photodiode to detect when the LED lights/use an ammeter to detect when the circuit conducts.	1	Accept: 'Average' for 'mean' Do not accept: 'Repeat the experiment and take the mean' on its own. Accept: Use more colours/frequencies of LEDs. Do not accept: Use more LEDs take more measurements on its own.

[END OF MARKING INSTRUCTIONS]