# Physics Unit 3 and 4: Investigation Time: 45 minutes

# Experimental determination of Planck’s constant using the threshold voltage of LEDs

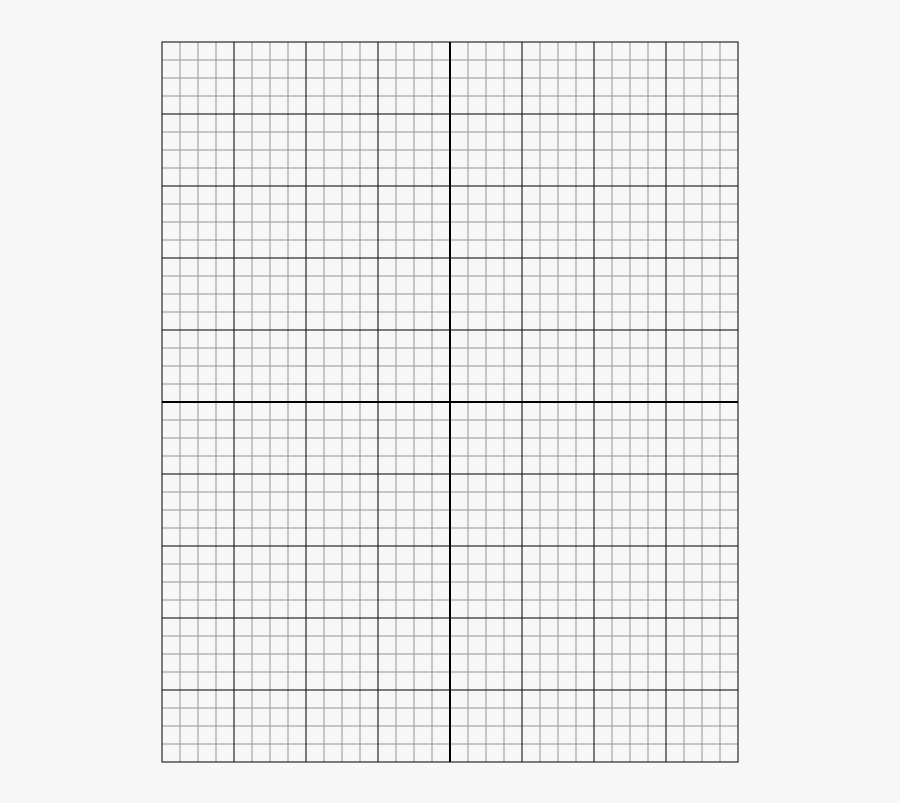
1. Starting with equations from the Formulae and Data Booklet, derive that the relationship between the threshold voltage at which an LED turns on () and the wavelength of light produced by an LED () is . (3 marks)
2. Describe a suitable method for safely varying the voltage applied to the LED and recording this voltage. A basic circuit diagram should be included in your answer. (4 marks)

1. Describe a significant source of uncertainty for either the LED wavelength or the threshold voltage in your experiment. Include an estimation of the absolute uncertainty this adds to the data. (2 marks)

**The second-hand data in the table below is to be used to answer questions 4 and 5.**

|  |  |  |  |
| --- | --- | --- | --- |
| LED Colour | Wavelength (nm) | Threshold Voltage (V) | Voltage Uncertainty (V) |
| Red | 635 | 1.58 |  |
| Orange | 623 | 1.73 |  |
| Yellow | 585 | 1.81 |  |
| Green | 525 | 2.44 |  |
| Blue | 470 | 2.55 |  |

1. Based on the combination of factors affecting the threshold voltage, it is suitable to approximate the uncertainty of the threshold voltage as . Fill in the “Voltage Uncertainty” column of the second-hand data. (2 marks)
2. On the grid paper on the next page, produce a graph that can confirm the relationship between threshold voltage and LED wavelength given in question 1. Your choice of axes should produce a linear graph. Include error bars for the threshold voltage and a line of best fit. (5 marks)



1. Calculate the gradient of the line of bets fit. Include units. (3 marks)
2. Use the gradient to determine the value of Planck’s constant. (3 marks)
3. Calculate the percentage difference between your determination of Planck’s constant and the currently accepted value. (2 marks)
4. An organisation claims they have developed the world’s first purple LED and it can be powered using a AA battery (1.5 V). Comment on the whether this claim is physically sound in relation to the findings of this investigation. (3 marks)

**End of Test**