Post-IGCSE Physics Course: Experimental Physics using Data Loggers and Computers



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Windows laptop running CAPSTONE software. Record voltage (proportional to rotation angle) and light intensity

Light intensity sensitivity dial Approx 2V DC voltage used with rotating potentiometer

CAPSTONE setup

- 1. Switch on the laptop and wait for boot routine to complete. Load **Capstone** software (a shortcut should be on the desktop)
- 2. Check interface is setup. Click on **Hardware setup** and click on the active ports. Select the voltage and lux meter options from the menu.



Set the Display to be a Table and Graph



Click in the **axis tabs** to set lux meter light intensity (y) vs voltage (x). Do this for the **table** as well.

Then press the **Record** button and start data logging.

For this experiment, carefully rotate the polariser back and forth. You will see a section of a cosine-squared graph being recorded. Note there will be some discontinuities at extreme ends of the rotation, due to the limited angular sweep of the rotating potentiometer which is connected to the assembly.



Once you have gathered sufficient data, **stop** the recording and then **export** the data using the **File** menu.

Choose **.csv** (Comma Separated Variable) output. Save this to a memory stick and transfer to a PC for analysis. (Excel or equivalent). Note if linear polarised light is incident upon a linear polariser with polarisation direction tilted by θ from the polarisation of the incident light



In our case unpolarized light passes through a fixed polarizer and then another (of the same material) which is rotated by angle θ . We therefore expect the light intensity I to vary as

$$\frac{I - I_{\min}}{I_{\max} - I_{\min}} = \cos^2 \theta$$

Theory

Analysis

Open the .csv file into Excel (or equivalent spreadsheet). Create a new Sheet and copy the raw data into this. This is to prevent accidental loss of original data!

Work out voltages which correspond to θ = 0 (alignment of polarizers) and θ = 90⁰ (crossed polarizers).

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Then work out

$$\frac{I - I_{\min}}{I_{\max} - I_{\min}} \text{ and } \cos^2$$

Note Excel defaults to RADIAN mode for trigonometric functions <cell ref> *PI()/180 is the conversion of degrees to radians.



To produce high quality diagrams from Excel, export the document to PDF and then take a screenshot from the PDF. (Set the General PDF settings to be 300dpi for snapshots first).



Voltage at alignment (theta = 0) Voltage at theta = 90 degrees



Imax	92
Imin	0