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

Streen Board IV curves Eectricity

Dr Andrew French

6 Minchester College

Last updated April/May 2017

an

Experimental setup

2V DV power

supply

PASCO USB data-logger hub with Voltage and current sensors Windows PC running CAPSTONE datalogging software /

Dell

415 DOITIN

Green Boards electricity kit 2V DV power supply

PASCO USB data-logger hub with Voltage and current sensors

R2

æ

1715177

Green Boards electricity kit

Voltage sensor connected across the lightbulb. Current sensor connected in series.

3

PASCO USB data-logger hub with Voltage and current sensors

TNARRU

олексиккеит

иомхими спясит уоцтаде УОГ

- 1

Current sensor inputs

Voltage sensor lead (it splits with red and black ends)

LL07-5d

Use **Capstone** to record current vs voltage curves for a given electrical component on the **Green Boards**

| Table title h | ere] | aber of digits shown based on the numb | ar style | | | | | | | | |
|---------------|-----------------------|--|----------|---------------|----------------------|---------|----------------|--------------------|----------------|----------------|--|
| | Lightbub | | er style | | | | | | | | |
| | Current, Ch 2 (mA) | Voltage (V) | | 0.20 | | | | | | | Lightbulb |
| 563 | 75.516 | 0.12473 | · · | | | | | | | and the second | |
| 564 | 75.516 | 0.12473 | | | | | | | and the second | | |
| 565 | 75.516 | 0.12473 | | | | | | | anter | | |
| 566 | 75.516 | 0.11986 | | 0.16 | | | | and the fact | | | |
| 567 | 75.516 | 0.12473 | | | | | | and a state of the | | | |
| 568 | 75.845 | 0.12473 | S (A) | | | | And a sub- | | | | |
| 569 | 75.845 | 0.12473 | CH | 012 | | - | and the second | | | | |
| 570 | 75.845 | 0.11986 | ent, | 0.12 | | / | | | | | |
| 571 | 75.845 | 0.12473 | nure o | | / | - And - | | | | | |
| 572 | 75.845 | 0.12473 | 0 | | 1 | | | | | | |
| 573 | 5.516 | 0.11986 | | 0.08 | 1 | | | | | | |
| 574 | 75.516 | 0.12473 | | | | | | | | | |
| 575 | 75.516 | 0.12473 | | | | | | | | | |
| 576 | 75.845 | 0.11986 | | 0.04 | | | | | | | and the second s |
| 577 | 75.187 | 0.12473 | | 0.04 | | | | | | | and the second s |
| 578 | 75.516 | 0.12473 | | | | | | | | | |
| 579 | 75.845 | 0.11986 | | | | | | | | | |
| 580 | 75.187 | 0.11986 | | 0.00 | discional instantion | | A CALLER AND A | | | | |
| 581 | 75.187 | 0.12473 | | | 0.0 | 0.4 | 0.8 | 1 | .2 | 1.6 | 2.0 |
| 582 | 74.859 | 0.11986 | | | | | V | oltage (V) | | | |
| 583 | 75.187 | 0.11986 | [Gra | ph title here | | | | | | | |

Set the unit (e.g. mA) and appropriate precision for the tabulated values and copy and paste the I,V values *directly* into a spreadsheet.

| | А | В | C | D | E | F | G | Н | 1 | J | K | L | М |
|----|---|----------------|------------------|------------|---------------------------|----------------|----------------|-----------------------|-------------|-------------|--|-----|---|
| 1 | | Datalogging Ex | periment 07: G | ireen boa | rd I,V curv | es (Electricit | ty) | | | | | | |
| 2 | | Winchester Co | llege. April 27t | n 2017. A. | French & | A. Chesters | | | LIGHTBUL | В | | | |
| 3 | | | | | | | | | | | | | |
| 4 | | Current (mA) | Voltage (V) | | | | | | | | | | |
| 5 | | 76.174 | 0.11499 | | | | | Light | bulb | | | | |
| 6 | | 75.845 | 0.11499 | | 250 | | | | | | | | |
| 7 | | 76.174 | 0.11499 | | 250 - | | | | | | | | 7 |
| 8 | | 76.174 | 0.11499 | | | | | | | | | | |
| 9 | | 75.845 | 0.11499 | | | | | | | | | | |
| 10 | | 75.845 | 0.11499 | | | | | | | | | | |
| 11 | | 75.845 | 0.11499 | | 200 | | | | | | | | |
| 12 | | 75.845 | 0.11499 | | 200 - | | | | | | 1.14 | 1 | |
| 13 | | 76.174 | 0.11499 | | | | | | | | 19 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | | |
| 14 | | 76.174 | 0.11499 | | | | | | | | 2 | | |
| 15 | | 75.516 | 0.11499 | | | | | | 7 | 11.8 . 49.1 | | | |
| 16 | | 75.187 | 0.11499 | | | | | | | . / | וחחוט | ing | |
| 17 | | 75.516 | 0.11499 | | ⊴ ¹⁵⁰ - | | | | ····· | | | | - |
| 18 | | 75.845 | 0.11499 | | <u></u> | 11 | ohting | and the second | | | | | |
| 19 | | 75.845 | 0.11499 | | ż | LI | SILLIS | and the second second | | | | | |
| 20 | | 75.845 | 0.11499 | | le l | | - and a second | | | | | | |
| 21 | | 76.174 | 0.11499 | | Ľ, | | | | | | | | |
| 22 | | 76.174 | 0.11499 | ` | U 100 - | | | | | | | | - |
| 23 | | 75.845 | 0.11499 | | | | | | Notice | e diffei | rence | | |
| 24 | | 76.174 | 0.11499 | | | 1 | | | | | | | |
| 25 | | 76.174 | 0.11499 | | | | | | betwe | en lig | nting | | |
| 26 | | 76.174 | 0.11499 | | | | | | un the | hulh | | | |
| 27 | | 76.174 | 0.11499 | | 50 - | | | | | | | | - |
| 28 | | 75.845 | 0.11499 | | | | | | and di | immin | g it | | |
| 29 | | 76.174 | 0.11499 | | | | | | | | | | |
| 30 | | 76.174 | 0.11499 | | | | | | | | | | |
| 31 | | 76.174 | 0.11499 | | | | | | | | | | |
| 32 | | 76.174 | 0.11499 | | 0 - | | | | | | | | |
| 33 | | 76.174 | 0.11499 | | (| D | 0.5 | | 1 | | 1.5 | | 2 |
| 34 | | 76.502 | 0.11499 | | | - | | | - /_li / | | | | - |
| 35 | | 76.174 | 0.11499 | | | | | ۱ ۱ | oltage / | v | | | |
| 36 | | 76.502 | 0.11499 | | | | | | | | | | |
| 37 | | 76.174 | 0.11499 | | | | | | | | | | |
| 38 | | 77.818 | 0.11986 | | | | | | | | | | |

| | А | В | С | D | E | F | G | Н | I | J | K | L | Μ | Ν | 0 | Р | Q | R | S |
|----|---|----------------|------------------|------------|------------------|-------------|---|--------------|---------------|-----|----------------|----------|-----|---|--|----------|-----|--------------|----|
| 1 | | Datalogging Ex | periment 07: G | ireen boar | d I,V curves (El | ectricity) | | | | | | | | | | | | | |
| 2 | | Winchester Col | lege. April 27th | n 2017. A. | French & A. Ch | esters | | | FIXED RESISTO | ORS | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | |
| 4 | | R1 | | | R2 | | | R3 | | | | | | | | | | | |
| 5 | | Current (mA) | Voltage (V) | | Current (mA) | Voltage (V) | | Current (mA) | Voltage (V) | | 350 - | | | | | | | | |
| 6 | | 51.187 | 0.75783 | | 59.406 | 0.55329 | | 180.396 | 1.05003 | | | | | | | | | | |
| 7 | | 51.187 | 0.75783 | | 59.406 | 0.55329 | | 180.396 | 1.0549 | | | | | | | | | | |
| 8 | | 51.187 | 0.75783 | | 59.406 | 0.55329 | | 180.396 | 1.0549 | | 200 | | | | | | | | |
| 9 | | 51.187 | 0.7627 | | 59.406 | 0.55329 | | 180.725 | 1.0549 | | 500 - | | | y = 171.2 | 9x 🥖 | | | | |
| 10 | | 50.858 | 0.75783 | | 59.406 | 0.55329 | | 180.725 | 1.05003 | | | | | $R^2 = 0.99$ | 81 🧨 | | | | |
| 11 | | 51.187 | 0.75783 | | 59.406 | 0.55329 | | 180.396 | 1.0549 | | | | | | A | | | | |
| 12 | | 51.515 | 0.75783 | | 59.406 | 0.55329 | | 180.725 | 1.0549 | | 250 + | | | | | | | | |
| 13 | | 51.187 | 0.75783 | | 59.077 | 0.55329 | | 180.725 | 1.0549 | | | | | | | 102.27 | | | |
| 14 | | 51.187 | 0.75783 | | 59.406 | 0.55329 | | 180.396 | 1.0549 | | | | | · · · ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; | y - | 102.27x | | . D1 | |
| 15 | | 51.187 | 0.7627 | | 59.077 | 0.55329 | | 180.396 | 1.0549 | | ₹ 200 - | | | | R ² | = 0.9981 | | • 11 | |
| 16 | | 51.187 | 0.75783 | | 59.406 | 0.55329 | | 182.04 | 1.06951 | | Ť | | | | and the second s | | | • R2 | |
| 17 | | 51.187 | 0.75783 | | 59.077 | 0.55329 | | 183.355 | 1.06951 | | Iel | | | | and the | | | • R3 | |
| 18 | | 51.187 | 0.7627 | | 59.406 | 0.55329 | | 185.985 | 1.08412 | | ð 150 – | | - / | | | | | — Linear (R1 | 1) |
| 19 | | 51.187 | 0.7627 | | 59.735 | 0.55329 | | 188.287 | 1.1036 | | | | | | | | | Lin | 2 |
| 20 | | 51.844 | 0.77731 | | 59.077 | 0.55329 | | 188.944 | 1.1036 | | | | | | and a | f . | | — Linear (K2 | 2) |
| 21 | | 52.173 | 0.77731 | | 59.406 | 0.55329 | | 191.903 | 1.12308 | | 100 + | | | | | | | — Linear (R3 | 3) |
| 22 | | 52.173 | 0.78218 | | 59.406 | 0.55816 | | 195.191 | 1.13769 | | | | | | y = (| 5.359X | | | |
| 23 | | 52.502 | 0.78218 | | 59.406 | 0.55329 | | 198.15 | 1.16204 | | | · · · / | | | R ² = | 0.9977 | | | |
| 24 | | 52.83 | 0.78218 | | 60.064 | 0.5679 | | 199.794 | 1.17665 | | 50 - | / | / | | | | | | |
| 25 | | 52.83 | 0.78218 | | 60.721 | 0.57277 | | 202.096 | 1.18152 | | | | | | | | | | |
| 26 | | 52.83 | 0.78218 | | 60.721 | 0.57277 | | 202.096 | 1.18152 | | | | | | | | | | |
| 27 | | 52.502 | 0.78218 | | 61.05 | 0.57277 | | 205.383 | 1.201 | | 0 | | | | | | | | |
| 28 | | 52.502 | 0.78218 | | 61.05 | 0.57277 | | 205.383 | 1.201 | | 0 | 0 | 5 | 1 ' | 5 | 2 | 25 | | |
| 29 | | 52.502 | 0.78218 | | 60.721 | 0.57277 | | 208.342 | 1.22535 | | · · · | | | Voltage /V | | - | 2.0 | | |
| 30 | | 52.502 | 0.78218 | | 61.05 | 0.57277 | | 209.329 | 1.23022 | | | | | voitage / v | | | | | |
| 31 | | 52.502 | 0.78218 | | 61.05 | 0.57277 | | 210.644 | 1.2497 | | | | | | | | | | |
| 32 | | 52.83 | 0.78218 | | 60.721 | 0.57277 | | 213.274 | 1.25457 | | Resistance | es /ohms | | | | | | | |
| 33 | | 52.502 | 0.78218 | | 61.05 | 0.57277 | | 212.616 | 1.2497 | | | | | | | | | | |
| 34 | | 52.83 | 0.78218 | | 61.05 | 0.57277 | | 214.26 | 1.27405 | | R1 | 15.30 | | | | | | | |
| 35 | | 52.502 | 0.78218 | | 61.05 | 0.57277 | | 217.219 | 1.27405 | | R2 | 9.78 | | | | | | | |
| 36 | | 51.844 | 0.78218 | | 61.05 | 0.57277 | | 216.891 | 1.26918 | | R3 | 5.84 | | | | | | | |
| 37 | | 51.844 | 0.78218 | | 61.05 | 0.57277 | | 217.877 | 1.29353 | | | | | | | | | | |

For fixed resistors, line of best fits (trendlines) can be used to determine the resistances, using Ohm's Law V = IR

| | А | В | С | D | E | F | G | Н | 1 | J | К | L | Μ |
|----|---|-----------------|---------------------|--------------|----------------|-----------|---|-------|----------|----------|-----|---|---|
| 1 | | Datalogging Exp | periment 07: Green | board I,V | curves (Ele | ctricity) | | | | | | | |
| 2 | | Winchester Coll | ege. April 27th 201 | 17. A. Frend | ch & A. Che | sters | | DIODE | | | | | |
| 3 | | | | | | | | | | | | | |
| 4 | | Current (mA) | Voltage (V) | | | | | | Diada | | | | |
| 5 | | 717.29 | 1.47372 | | | | | | Diode | | | | |
| 6 | | 716.961 | 1.47372 | | 80 | 0 | | | | | | | |
| 7 | | 715.646 | 1.46885 | | | | | | | | | | |
| 8 | | 712.359 | 1.46398 | | | | | | | | | | |
| 9 | | 707.098 | 1.45911 | | 70 | n — | | | | | | | |
| 10 | | 704.468 | 1.45911 | | /0 | U | | | | | -# | | |
| 11 | | 707.098 | 1.46885 | | | | | | | | | | |
| 12 | | 710.057 | 1.44937 | | 60 | 0 | | | | | | | |
| 13 | | 688.358 | 1.43476 | | 60 | | | | | | | | |
| 14 | | 684.412 | 1.41041 | | | | | | | | 2 | | |
| 15 | | 717.948 | 1.47859 | | | | | | | 1 | | | |
| 16 | | 709.728 | 1.43963 | | 50 | 0 | | | | 1 | | | |
| 17 | | 682.769 | 1.42015 | | ٩u | | | | | <u>(</u> | | | |
| 18 | | 677.508 | 1.43963 | | 5 | | | | | 1 | | | |
| 19 | | 662.384 | 1.42502 | | <u>ដ្</u> ដ 40 | 0 | | | | | | | |
| 20 | | 676.522 | 1.42989 | | Ľ | | | | | 1 | | | |
| 21 | | 641.343 | 1.3471 | | 5 | | | | | 4 | | | |
| 22 | | 594.985 | 1.33736 | | 30 | 0 | | | | <u>,</u> | | | |
| 23 | | 565.395 | 1.29353 | | | | | | لو | | | | |
| 24 | | 521.996 | 1.27405 | | | | | | <u> </u> | | | | |
| 25 | | 533.503 | 1.27892 | | 20 | 0 | | | | | | | |
| 26 | | 517.722 | 1.27405 | | | | | | 1 | | | | |
| 27 | | 520.352 | 1.26918 | | | | | | | | | | |
| 28 | | 493.064 | 1.23509 | | 10 | n — | | | 1 | | | | |
| 29 | | 486.488 | 1.20587 | | 10 | | | | / | | | | |
| 30 | | 459.857 | 1.18639 | | | | | | | | | | |
| 31 | | 451.967 | 1.13769 | | | 0 | | | | | | | |
| 32 | | 436.185 | 1.16691 | | | U - | | | | | | | |
| 33 | | 408.239 | 1.14256 | | | 0 | | 0.5 | - | L | 1.5 | | 2 |
| 34 | | 414.157 | 1.14256 | | | | | | Volta | ge /V | | | |
| 35 | | 409.883 | 1.13282 | | | | | | | U-,- | | | |
| 36 | | 391.472 | 1.11334 | | | | | | | | | | |
| 37 | | 387.526 | 1.09873 | | | | | | | | | | |