# Instructions for candidates

This assessment applies to the assignment for Higher Physics.

This assignment is worth 20 marks. This contributes 20% to the overall marks for the course assessment.

Page 1

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Your assignment has two stages:

- research
- report

Page 2

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Your assignment has two stages:

- research
- report

In this assignment, you have to investigate a topic in physics by doing research.

Your research involves gathering data either from one experiment and an internet/literature source, or from two experiments.

In addition, you may gather extracts about the underlying physics from internet/literature sources.

You then produce a report on your investigation.

Your teacher or lecturer will not mark your report at any point. It is sent to SQA for marking.

Page 3

## Research stage

### Choosing your topic

- You need to choose a relevant topic in physics to investigate.
- You must agree your topic with your teacher or lecturer.

Page 4

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- You must agree your topic with your teacher or lecturer.

### Deciding your aim

- Once you have chosen your topic, you need to decide what the aim of your investigation is.
- Remember that:
  - you need to carry out and collect data from one experiment and find data from internet/literature source(s) which is relevant to your experimental data.

  Or
  - you need to carry out and collect data from two experiments related to your aim.
- Your teacher or lecturer will provide advice on the suitability of your aim.

Page 5

## Research stage

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  Or
  - you need to carry out and collect data from two experiments related to your aim.
- Your teacher or lecturer will provide advice on the suitability of your aim.

### Experimental research

- When choosing your experiment(s), remember that it/they must allow measurements to be taken.
- When carrying out your experiment(s), you must work either on your own or as part of a small group. If you are working as part of a small group, you must take an active part.
- Make sure you take a sufficient number of measurements over a wide enough range to meet the aim of your investigation.
- You must repeat measurements.
- You must estimate the scale reading uncertainty in all the measurements you make.
- You will use your raw experimental data during the report stage.

Page 6

## Internet/literature research

- If you have gathered experimental data from a single experiment, you need to find data from websites, books and/or journals that is relevant to your experimental data. This could be a table or a graph, or data from diagrams or text.
- In your report, you will need to describe the physics relevant to your aim. You can gather extracts from websites, books and/or journals to help you write your description of the underlying physics. During the report stage you will need to show your understanding by writing this description using your own words.
- It is important that you record where you get your data or extracts from in enough detail that another person could find it. This is known as a reference.

Page 7

## Report stage

### Producing the report

- The report must be all your own work.
- When producing your report, you will be supervised at all times.
- You have 2 hours to complete your report.

Page 8


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### Resources

During the report stage you are only allowed to have certain materials.

| You can have: | You cannot have a previously prepared: |
|---|---|
| • these instructions for candidates<br>• extracts you have gathered from websites, books and/or journals to help you describe the physics relevant to your aim<br>• the experimental method(s)<br>• your raw experimental data<br>• data from websites, books and/or journals that is relevant to your experimental data, if you have data from a single experiment<br>• the references to the sources of data or extracts | • draft of your report<br>• draft of your description of physics relevant to your aim<br>• specimen calculation or set of calculations for mean or derived values<br>• specimen calculation or set of calculations for uncertainties<br>• graph<br>• analysis of data<br>• conclusion<br>• evaluation |

Your teacher or lecturer cannot provide you with feedback or tell you how to improve your report.

Page 9

## Sample Assignment

To show you what is required for the assignment, we will do a sample assignment on **Ohm's Law**.

This is not actually a suitable topic for a Higher Physics assignment as it is actually a National 5 Physics topic.

Page 10

## Title

- Your title must tell the reader what your report is about.

Page 11


## Title

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Page 12

## Title

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**Ohm's Law**

Page 13

## Title

- Your title must tell the reader what your report is about.

**Ohm's Law**

**Note:** "Physics Assignment" is not a suitable title.

Page 14

## Aim

- Your aim must describe clearly the purpose of your investigation.

Page 15

## Aim

- Your aim must describe clearly the purpose of your investigation.

Take your time with this.

Page 16

## Aim

- Your aim must describe clearly the purpose of your investigation.

**Aim:** to find out about Ohm's Law.

Page 17

## Aim

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**Aim:** to find out about Ohm's Law.

This is not detailed enough and won't get the mark.
It could cost you further marks later on.

Page 18

Aim

- Your aim must describe clearly the purpose of your investigation.

**Aim:** to find out the how resistance affects the voltage and current in a circuit.

Page 19

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**Aim:** to find out the how resistance affects the voltage and current in a circuit.

This is not how you prove Ohm's Law so is an incorrect aim.

Page 20

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- Your aim must describe clearly the purpose of your investigation.

**Aim:** to find out the current affects the voltage across a resistor, and use this relationship to find the resistance.

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This is an acceptable aim.

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This is an acceptable aim.

Make sure this is what you do in your assignment.

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Aim

- Your aim must describe clearly the purpose of your investigation.

**Aim:** to find out the current affects the voltage across a resistor, and use this relationship to find the resistance.

This is an acceptable aim.

Make sure this is what you do in your assignment.

Feel free to change your aim slightly during your research.

Page 24

## Underlying physics

- You must describe the physics relevant to your aim.
- You must use your own words as much as possible.
- You may choose to include:
  - relationships or equations
  - definitions of symbols used
  - explanations or justifications of relationships or equations
  - explanations of physical properties
  - copies of diagrams which you would find difficult to draw
- You can quote from sources as long as you give a description or explanation showing that you understand the physics.
- Do not include a passage copied directly from a source. This would not show that you understand the physics.

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Consider this to be an open ended question.

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Research and show off what you know!

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Consider this to be an open ended question.

Research and show off what you know!

You can bring a copy of textbook and internet pages when you write your report but you can't have already turned it in to your own words beforehand.

Page 28

## Description of experiment(s)

- You must give only a **brief** description of the experiment you carried out.
- If you carried out two experiments, you should give a brief description of both. You will be awarded the mark if one of the two descriptions is acceptable.
- You must show that you can summarise your experimental method(s) and must not give a full description.
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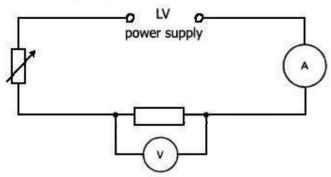


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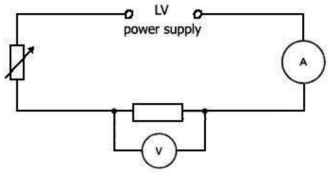


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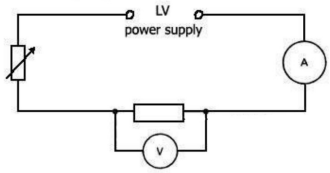


Keep it simple!

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Page 33

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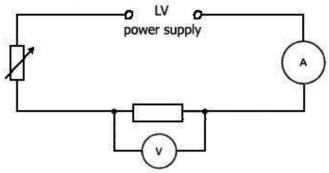


Keep it simple!

State how you changed the independent variable.
State how you measured the dependant and independent variables.

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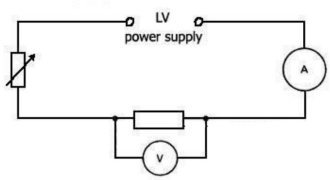


The current through the resistor was altered using a variable resistor and was measured with an ammeter.

The voltage across the resistor is measured with a voltmeter.

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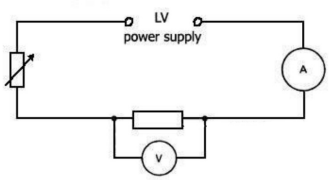


If you do two experiments, you should describe BOTH experiments.

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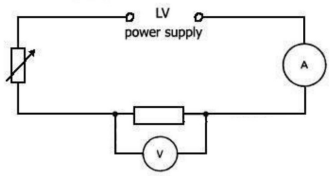


You can bring a copy of your experimental method when writing your report.

Page 37

## Experimental data

- You must include a table showing all of the measurements you recorded in your experiment.
- If you carried out two experiments, you should include a table of measurements from each experiment. You will be awarded the mark if one of the two tables is acceptable.
- Make sure you include column headings and units.
- You must calculate mean values for your repeated measurements. These must be included in your table.
- Any derived values needed for graphing must be included in your table.

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RULE OF FIVE
There should be a minimum of **five** values of independent variable and the experiment should be repeated **five** times.

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All averages should be calculated when you write the report, not before.

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### Raw Data

| Current (mA) | Voltage 1 (V) | Voltage 2 (V) | Voltage 3 (V) | Voltage 4 (V) | Voltage 5 (V) | Average Voltage (V) |
|---|---|---|---|---|---|---|
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 50 | 0.43 | 0.42 | 0.39 | 0.41 | 0.39 | |
| 100 | 0.78 | 0.78 | 0.78 | 0.81 | 0.81 | |
| 150 | 1.20 | 1.21 | 1.22 | 1.21 | 1.22 | |
| 200 | 1.61 | 1.59 | 1.59 | 1.60 | 1.61 | |
| 250 | 1.98 | 2.00 | 1.99 | 2.01 | 2.02 | |

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| 250 | 1.98 | 2.00 | 1.99 | 2.01 | 2.02 | 2.00 |

Page 42

## Graphical presentation

- You must produce a scatter graph of your experimental data.
- If you carried out two experiments, you should include scatter graphs of your data from both experiments. In this case, both graphs will be marked, and you will be awarded the mark for the better of your graphs.
- You must use graph paper or graphing software. If you are using graphing software, include both major and minor gridlines, and use plotting symbols which are clear but not too large.
- A line or curve of best fit should usually be drawn. However, if there is no obvious pattern to your plotted data points, you should not try to draw a line or curve of best fit.
- The graph(s) must be large enough to allow points to be read accurately and have suitable scales. It/they must also have labels and units on the axes.

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Graphs can be completed using Excel or graph paper.

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Graphs can be completed using Excel or graph paper.

If using Excel, make sure that major and mnor gridlines are selected and data points aren't too large.

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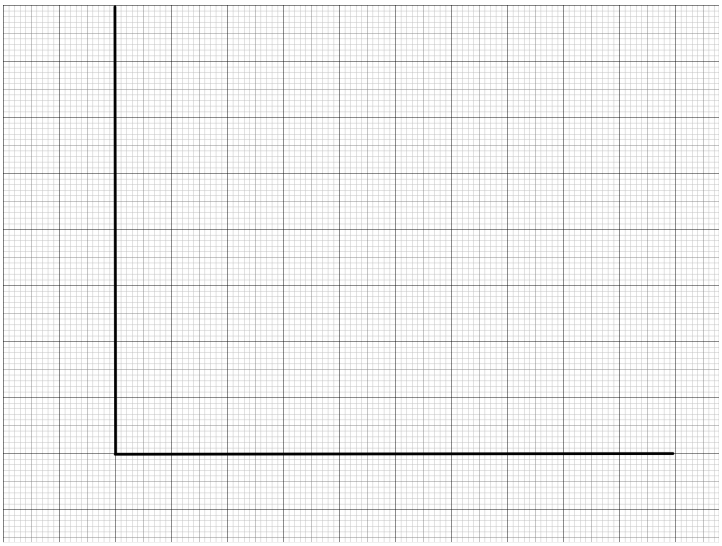
Graphs can be completed using Excel or graph paper.

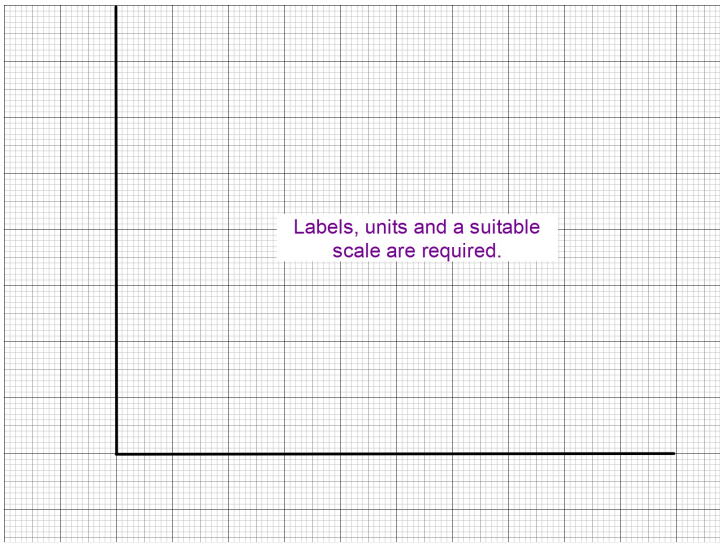
If using Excel, make sure that major and mnor gridlines are selected and data points aren't too large.

A scatter graph is the only acceptable graph.
No bar or pie charts allowed!

Page 46



Page 47

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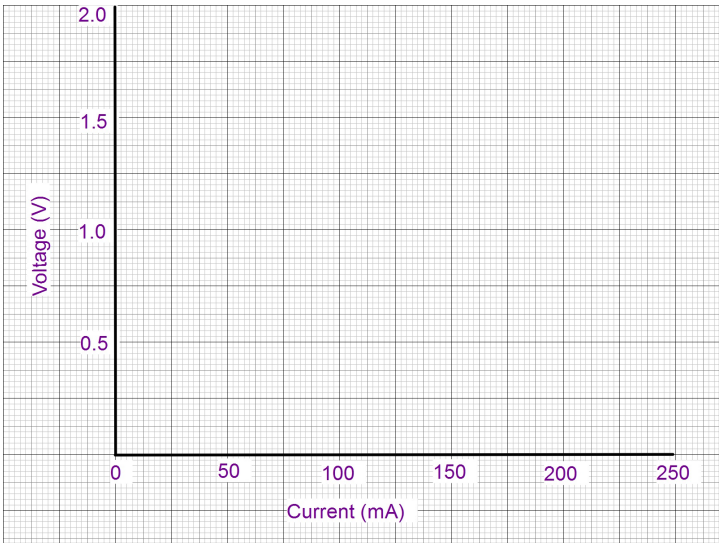
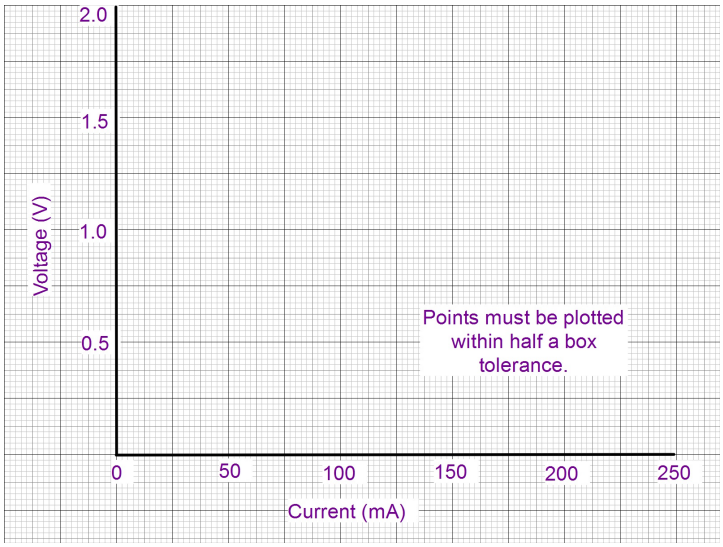



Page 49

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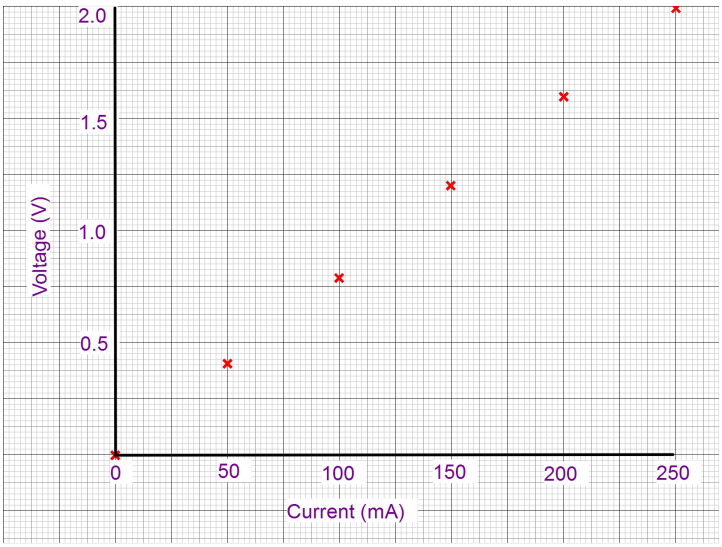
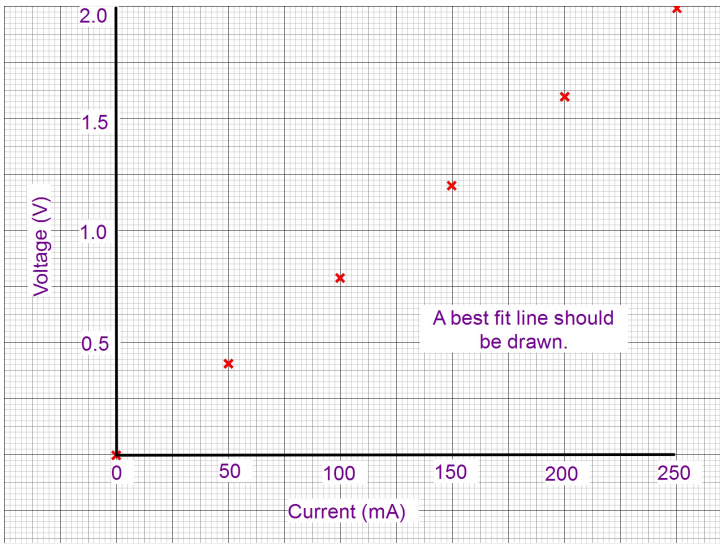
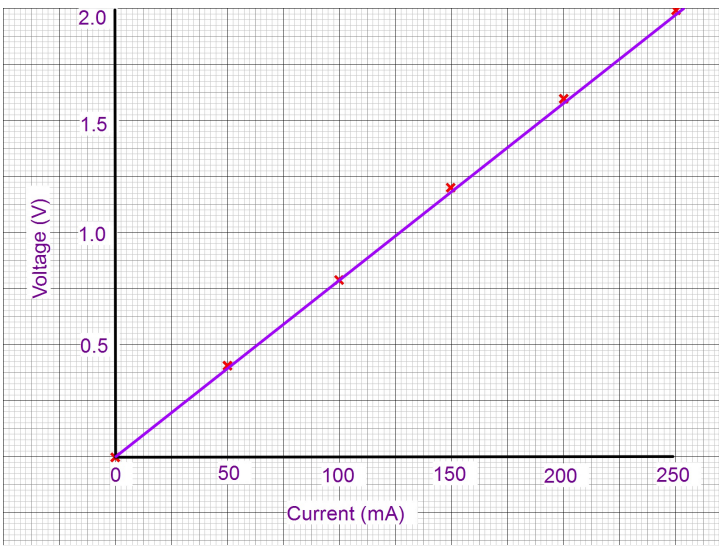



Page 51




Page 52




Page 53

**Uncertainties**

- You must include scale reading uncertainties for all the measurements you have made in your experiment, and calculate the random uncertainty in your repeated measurements.
- If you carried out two experiments, you should include the uncertainties in the measurements from both experiments. Both sets of uncertainties will be marked, and you will be awarded the mark for the better set.

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### Scale Reading Uncertainties

Page 55

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### Scale Reading Uncertainties

All currents were measured with a digital ammeter so all current measurements have a scale reading uncertainty of **± 1 mA**.

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### Scale Reading Uncertainties

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All voltages were measured with a digital voltmeter so all voltage measurements have a scale reading uncertainty of **± 0.01 V**.

Page 57

## Uncertainties

- You must include scale reading uncertainties for all the measurements you have made in your experiment, and calculate the random uncertainty in your repeated measurements.
- If you carried out two experiments, you should include the uncertainties in the measurements from both experiments. Both sets of uncertainties will be marked, and you will be awarded the mark for the better set.

### Scale Reading Uncertainties

All currents were measured with a digital ammeter so all current measurements have a scale reading uncertainty of **± 1 mA**.

All voltages were measured with a digital voltmeter so all voltage measurements have a scale reading uncertainty of **± 0.01 V**.

Make sure that your scale reading uncertainties make sense when compared to the numbers in your data!

Page 58

## Uncertainties

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### Random Uncertainties

Page 59

## Uncertainties

- You must include scale reading uncertainties for all the measurements you have made in your experiment, and calculate the random uncertainty in your repeated measurements.
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### Random Uncertainties

Sample calculation for average voltage = 0.41 V:

Page 60

## Uncertainties

- You must include scale reading uncertainties for all the measurements you have made in your experiment, and calculate the random uncertainty in your repeated measurements.
- If you carried out two experiments, you should include the uncertainties in the measurements from both experiments. Both sets of uncertainties will be marked, and you will be awarded the mark for the better set.

### Random Uncertainties

Sample calculation for average voltage = 0.41 V:

$$\Delta V_{random} = \frac{\text{max - min}}{\text{no of readings}} = \frac{0.43 - 0.39}{5} = \mathbf{0.008\ V}$$

Page 61

## Uncertainties

- You must include scale reading uncertainties for all the measurements you have made in your experiment, and calculate the random uncertainty in your repeated measurements.
- If you carried out two experiments, you should include the uncertainties in the measurements from both experiments. Both sets of uncertainties will be marked, and you will be awarded the mark for the better set.

| Average Voltage (V) | Random Uncertainty (V) |
|---|---|
| 0.00 | 0.00 |
| 0.41 | 0.008 |
| 0.79 | 0.006 |
| 1.21 | 0.004 |
| 1.60 | 0.004 |
| 2.00 | 0.008 |

Page 62

## Uncertainties

- You must include scale reading uncertainties for all the measurements you have made in your experiment, and calculate the random uncertainty in your repeated measurements.
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|---|---|
| 0.00 | 0.00 |
| 0.41 | 0.008 |
| 0.79 | 0.006 |
| 1.21 | 0.004 |
| 1.60 | 0.004 |
| 2.00 | 0.008 |

That is all that is required.

One mark for scale reading uncertainties and one mark for random uncertainties!

Page 63

## Data from an internet/literature source or second experiment

- If you carried out a single experiment, you must include data from an internet/literature source that is relevant to your experimental data.
- If you carried out two experiments, you must include the data from your second experiment.

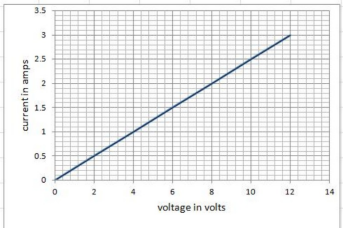
Page 64

## Data from an internet/literature source or second experiment

- If you carried out a single experiment, you must include data from an internet/literature source that is relevant to your experimental data.
- If you carried out two experiments, you must include the data from your second experiment.

### Internet Data (1):

| voltage across | current through |
|---|---|
| V | A |
| 0 | 0 |
| 2 | 0.5 |
| 4 | 1 |
| 6 | 1.5 |
| 8 | 2 |
| 10 | 2.5 |
| 12 | 3 |




Page 65

## Citation and reference for a source of data/information from the internet/literature

- You must include a reference to a source of data/information.
  - If you carried out a single experiment, your reference must be to the source of data obtained from the internet/literature which is relevant to your experimental data.
  - If you carried out two experiments, your reference must be to a source of information gathered to support your description of the underlying physics.
- You must cite the internet/literature source within the body of the report, near to the relevant data/information, with the reference listed later in the report.
  - If you carried out a single experiment and have included data from an internet/literature source in your report, you must cite this source next to the data.
  - If you carried out two experiments, you must cite your source(s) of the information that supports your description of the underlying physics. This must be cited next to the information.
  - You can cite a source in many ways. One way is to put a number, for example (1), next to the data/information and the same number beside the reference included later in the report.
- You must include the following information in the reference:

| Source | Reference |
|---|---|
| Website | full URL for the page or pages, with date accessed |
| Journal | title, author, journal title, volume and page number |
| Book | title, author, page number and either edition or ISBN |

Page 66

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**References**

(1) https://johnvagabondscience.wordpress.com/2010/09/28/resistance-and-ohms-law/ (19th February 2019)

Page 67

## Analysis

You must include a discussion of the data from your experiment. In physics this usually involves the calculation of a gradient, the calculation of a constant and/or the calculation of an absolute uncertainty in a final value. If you carried out two experiments, you should include an analysis of both experiments. Both analyses will be marked, and you will be awarded the mark for the better analysis.

Page 68

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$$\text{gradient} = \frac{0.79 - 0}{0.1 - 0} = \mathbf{7.9}$$

Page 69

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$$\text{gradient} = \frac{0.79 - 0}{0.1 - 0} = \mathbf{7.9}$$

The resistance of the resistor is 7.9 Ω.

Page 70

## Conclusion

You must state a conclusion that relates to your aim and is supported by all the data included in your report.

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Be careful - make sure that the conclusion fully answers the aim!

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**Aim:** to find out the current affects the voltage across a resistor, and use this relationship to find the resistance.

Page 73

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**Aim:** to find out the current affects the voltage across a resistor, and use this relationship to find the resistance.

**Conclusion:** The resistance of the resistor is 7.9 Ω.

Page 74

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**Aim:** to find out the current affects the voltage across a resistor, and use this relationship to find the resistance.

**Conclusion:** The resistance of the resistor is 7.9 Ω.

Doesn't fully answer the aim.

Page 75

## Conclusion

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**Aim:** to find out the current affects the voltage across a resistor, and use this relationship to find the resistance.

**Conclusion:** As the current flowing through a resistor increases, the voltage increases. The resistance of the resistor is 7.9 Ω.

Page 76

## Conclusion

You must state a conclusion that relates to your aim and is supported by all the data included in your report.

Be careful - make sure that the conclusion fully answers the aim!

**Aim:** to find out the current affects the voltage across a resistor, and use this relationship to find the resistance.

**Conclusion:** As the current flowing through a resistor increases, the voltage increases. The resistance of the resistor is 7.9 Ω.

This is almost a good conclusion but a bit more detail is required.

Page 77

## Conclusion

You must state a conclusion that relates to your aim and is supported by all the data included in your report.

Be careful - make sure that the conclusion fully answers the aim!

**Aim:** to find out the current affects the voltage across a resistor, and use this relationship to find the resistance.

**Conclusion:** The current flowing through and the voltage across a resistor are directly proportional. The resistance of the resistor is 7.9 Ω.

Page 78

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You must state a conclusion that relates to your aim and is supported by all the data included in your report.

Be careful - make sure that the conclusion fully answers the aim!

**Aim:** to find out the current affects the voltage across a resistor, and use this relationship to find the resistance.

**Conclusion:** The current flowing through and the voltage across a resistor are directly proportional. The resistance of the resistor is 7.9 Ω.

This is a good conclusion!

Page 79


## Conclusion

You must state a conclusion that relates to your aim and is supported by all the data included in your report.

Be careful - make sure that the conclusion fully answers the aim!

**Aim:** to find out the current affects the voltage across a resistor, and use this relationship to find the resistance.

**Conclusion:** The current flowing through and the voltage across a resistor are directly proportional. The resistance of the resistor is 7.9 Ω.

This is a good conclusion!


(If you say two variables are directly proportional, make sure that your graph is a straight line through the origin).

Page 80

## Evaluation

You must make three statements, supported by justification, which evaluate the data/information you have included.

The statements can relate to

- your experimental procedures
- your results
- your uncertainties
- data from your internet/literature source

Two or three of the statements can evaluate your experiment(s). No more than one of your statements can evaluate data from your internet/literature source.

Page 81


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This can be positive, negative or comparative.

Page 83


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For example:

Page 84

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Two or three of the statements can evaluate your experiment(s). No more than one of your statements can evaluate data from your internet/literature source.

This can be positive, negative or comparative.

For example:

The resistance of the resistor was measured with an ohmmeter and found to be 8.1 Ω so the experiment can be considered a success because it gave an accurate value of resistance.

Page 85


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Two or three of the statements can evaluate your experiment(s). No more than one of your statements can evaluate data from your internet/literature source.

This can be positive, negative or comparative.

For example:

The resistance of the resistor was measured with an ohmmeter and found to be 8.1 Ω so the experiment can be considered a success because it gave an accurate value of resistance.


The random uncertainties were kept low by repeating the experiment five times.

Page 86


## Evaluation

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The statements can relate to

- your experimental procedures
- your results
- your uncertainties
- data from your internet/literature source

Two or three of the statements can evaluate your experiment(s). No more than one of your statements can evaluate data from your internet/literature source.

This can be positive, negative or comparative.

For example:


A more precise value of resistance could be found by using a voltmeter and ammeter that give numbers to more decimal places. This would reduce the scale reading uncertainty.

Page 87


## Evaluation

You must make three statements, supported by justification, which evaluate the data/information you have included.

The statements can relate to

- your experimental procedures
- your results
- your uncertainties
- data from your internet/literature source

Two or three of the statements can evaluate your experiment(s). No more than one of your statements can evaluate data from your internet/literature source.

This can be positive, negative or comparative.

For example:


The experimental and internet data both agree that current through and voltage across a resistor are directly proportional.

Page 88

| Section | Description | Marks |
|---|---|---|
| Title and structure | An informative title and a structure that can easily be followed. | 1 |
| Aim | A description of the purpose of your investigation. | 1 |
| Underlying physics | A description of the physics relevant to your aim, which shows your understanding. | 3 |
| Data collection and handling | A brief description of an approach used to collect experimental data. | 1 |
| | Sufficient raw data from your experiment. | 1 |
| | Data from your experiment, including any mean and/or other derived values, presented in a table with headings and units. | 1 |
| | Numerical or graphical data relevant to your experiment obtained from an internet/literature source, or raw data relevant to your aim obtained from your second experiment. | 1 |
| | A citation for an internet/literature source and the reference listed later in the report. | 1 |
| Graphical presentation | The axes have suitable scales. | 1 |
| | Suitable labels and units on the axes. | 1 |
| | All data points plotted accurately and, where appropriate, line or curve of best fit drawn. | 1 |
| Uncertainties | Scale reading uncertainties shown for all measurements and random uncertainty in measurements calculated. | 2 |
| Analysis | Discussion of experimental data. | 1 |
| Conclusion | A conclusion relating to your aim based on all the data in your report. | 1 |
| Evaluation | Three evaluative statements supported by justifications. | 3 |
| Total | | 20 |

Page 89

Page 90