

Commentary on candidate evidence

The candidate evidence has achieved the following marks for each section of the assignment.

Candidate 1

1 Aim

The candidate was awarded **1 out of 1 mark** because their aim describes clearly the purpose of the investigation.

2 Underlying physics

The candidate was awarded **1 out of 3 marks** because they demonstrate a limited understanding of the underlying physics relevant to the aim. There is additional underlying physics at the end of the report, but this does not alter the overall judgement of the candidate's understanding. The candidate could have described the operation of LEDs and could have given the equation relating switch on voltage and Planck's constant.

3 Data collection and handling

The candidate was awarded **3 out of 5 marks**. The marks were awarded as follows:

3(a) **1 out of 1 mark** was awarded because the method contains details of what is to be measured and how the experiment was carried out. The circuit diagram adds clarity, for example it shows the voltage was measured using a voltmeter.

3(b) **1 out of 1 mark** was awarded because the candidate has sufficient data. The range of colours of LED is appropriate to the aim and the candidate has repeated measurements of the dependent variable for each value.

3(c) **0 out of 1 mark** was awarded because there is no unit for the QV column so the mark cannot be awarded.

3(d) **1 out of 1 mark** was awarded because the table of data from the internet source is relevant to the candidate's experiment.

3(e) **0 out of 1 mark** was awarded because the candidate has given the full URL for the reference next to the second source. This cannot be used as a citation.

4 Graphical presentation

The candidate was awarded **2 out of 3 marks**. The marks were awarded as follows:

4(a) **1 out of 1 mark** was awarded because the candidate has drawn a scatter graph with suitable scales.

4(b) **0 out of 1 mark** was awarded because there is no unit for QV, so the mark is not awarded.

4(c) **1 out of 1 mark** was awarded because the candidate has plotted the points accurately and drawn an acceptable line of best fit.

5 Uncertainties

The candidate was awarded **1 out of 2 marks** because the reading uncertainties are plausible. The units are missing from the random uncertainties.

6 Analysis

The candidate was awarded **1 out of 1 mark** because they have correctly calculated the gradient of their line and stated its significance.

7 Conclusion

The candidate was awarded **0 out of 1 mark** because the aim is to determine h , but no value is given in the conclusion.

8 Evaluation

The candidate was awarded **2 out of 3 marks** because they make three evaluative statements, two of which can be awarded a mark. The first statement compares their data to the internet data but is insufficient to be awarded a mark because they have not stated that this could have reduced the random uncertainty. In the second statement the candidate correctly identifies a systematic uncertainty in their experimental data. In the third statement the candidate suggests an improvement to their procedure.

9 Structure

The candidate was awarded **0 out of 1 mark** because 'Higher Physics Assignment' is not an informative title.

Overall

The candidate was awarded a total of **11 out of 20 marks**.

Candidate 2

1 Aim

The candidate was awarded **1 out of 1 mark** because their aim describes the purpose of the investigation.

2 Underlying physics

The candidate was awarded **3 out of 3 marks** because they demonstrate a good understanding of the underlying physics. The underlying physics written by the candidate at the beginning does not relate to the practical work that the candidate has carried out however the sections labelled 'analysis' both contain more underlying physics relevant to their aim.

3 Data collection and handling

The candidate was awarded **3 out of 5 marks**. The marks were awarded as follows:

3(a) **0 out of 1 mark** was awarded because although two experimental procedures have been described, neither meets the standard required. For method 1, the circuit diagram is incorrect/incomplete. If the circuit diagram had been complete for method 1, then a mark could have been given. For method 2, the summary is insufficient to be awarded the mark.

3(b) **1 out of 1 mark** was awarded because for method 1 there is sufficient data.

3(c) **1 out of 1 mark** was awarded because for both experiments the tables have appropriate headings and units. All the mean and derived values are correctly calculated.

3(d) **1 out of 1 mark** was awarded because data from the second experiment is sufficient and relevant to the aim of the investigation.

3(e) **0 out of 1 mark** was awarded because although a source is referenced, the citation is incorrect. There is a (1) in the underlying physics, but this is not repeated with the reference.

4 Graphical presentation

The candidate was awarded **3 out of 3 marks**. The marks were awarded as follows:

4(a) **1 out of 1 mark** was awarded because graph 1 has correct axis and scales. Graph 2 has correct axis and scales.

4(b) **1 out of 1 mark** was awarded because graph 1 has correct units and labels. Graph 2 has correct units and labels.

4(c) **1 out of 1 mark** was awarded because graph 1 has correctly plotted points and an acceptable line of best fit. Graph 2 has correctly plotted points and an acceptable line of best fit. Either graph would be awarded 3 marks.

5 Uncertainties

The candidate was awarded **1 out of 2 marks** because experiment 1 has plausible scale reading uncertainties but there is an error in calculating the random uncertainty in the third value for current. Experiment 2 has plausible scale reading uncertainties (ignoring the additional 0 in the ohmmeter uncertainty) but there is an error in calculating the third random uncertainty. Either of the treatment of uncertainties would be awarded 1 mark.

6 Analysis

The candidate was awarded **1 out of 1 mark** because the analysis of experiment 1 is correct. The gradient is correctly calculated, and its significance stated. The analysis of the second graph, to find the internal resistance, is also correct. Either analysis would be awarded the mark.

7 Conclusion

The candidate was awarded **1 out of 1 mark** because the conclusion answers the aim. The candidate has arrived at two different values for the internal resistance and both values are stated.

8 Evaluation

The candidate was awarded **3 out of 3 marks** because they have made 3 correct evaluative statements. The first statement identifies an issue with conducting the experiment and offers a valid remedy. The second statement identifies an issue and suggests a solution to the issue. The third statement identifies a possible improvement to the experimental procedure.

9 Structure

The candidate was awarded **1 out of 1 mark** because the report is clear and concise and has an informative title.

Overall

The candidate was awarded a total of **17 out of 20 marks**.

Candidate 3

1 Aim

The candidate was awarded **1 out of 1 mark** because their aim describes the purpose of the investigation.

2 Underlying physics

The candidate was awarded **0 out of 3 marks** because they have not demonstrated an understanding of any relevant physics at Higher level.

3 Data collection and handling

The candidate was awarded **3 out of 5 marks**. The marks were awarded as follows:

3(a) **0 out of 1 mark** was awarded because the summary lacks enough detail to be awarded the mark. The candidate has given no indication of what is being done in the experiment.

3(b) **1 out of 1 mark** was awarded because the candidate has sufficient data. The range of readings is appropriate to the aim and the candidate has repeated measurements of the dependent variable for each value.

3(c) **1 out of 1 mark** was awarded because the candidate's tables have correct units and headings. The mean values are correctly calculated and tabulated.

3(d) **0 out of 1 mark** was awarded because the candidate has used a literature source that has only three data sets. This is not sufficient to be awarded the mark.

3(e) **1 out of 1 mark** was awarded because the source is cited beside the data and referenced later in the report.

4 Graphical presentation

The candidate was awarded **3 out of 3 marks**. The marks were awarded as follows:

4(a) **1 out of 1 mark** was awarded because the candidate has drawn a scatter graph with suitable scales.

4(b) **1 out of 1 mark** was awarded because the axes of the graph have suitable labels and units.

4(c) **1 out of 1 mark** was awarded because the candidate has plotted the points accurately and drawn an acceptable line of best fit.

5 Uncertainties

The candidate was awarded **1 out of 2 marks** because the scale reading for the ac voltage is incorrect. The random uncertainties are correct.

6 Analysis

The candidate was awarded **1 out of 1 mark** because they have correctly calculated the gradient of their line and stated its significance.

7 Conclusion

The candidate was awarded **1 out of 1 mark** because the conclusion answers the aim.

8 Evaluation

The candidate was awarded **1 out of 3 marks** because they have provided three evaluative statements, however two of the statements cannot be awarded a mark. In statement 1, the justification is insufficient. Statement 2 is awarded a mark. The candidate has identified an issue with literature data and stated its effect. Statement 3 identifies an issue but offers no solution.

9 Structure

The candidate was awarded **1 out of 1 mark** because the report is clear and concise and has an acceptable title.

Overall

The candidate was awarded a total of **12 out of 20 marks**.

Candidate 4

1 Aim

The candidate was awarded **1 out of 1 mark** because their aim describes the purpose of the investigation.

2 Underlying physics

The candidate was awarded **2 out of 3 marks** because they have shown a reasonable understanding of the physics involved in their investigation. Relationships have been stated and the terms defined.

3 Data collection and handling

The candidate was awarded **3 out of 5 marks**. The marks were awarded as follows:

3(a) **0 out of 1 mark** was awarded because the summary states what will be measured and how it will be measured. However, there is no description of what is to be altered.

3(b) **1 out of 1 mark** was awarded because the candidate has a range of five values over a limited set of distances. This is just acceptable. The candidate has repeated measurements of the dependent variable for each value.

3(c) **1 out of 1 mark** was awarded because the candidate's table has correct units and headings. The mean values are correctly calculated and tabulated, the sample calculations do not have units, but they are given in the table.

3(d) **1 out of 1 mark** was awarded because the data from the internet source is relevant to the candidate's experiment.

3(e) **0 out of 1 mark** was awarded because the source is referenced but there is no citation.

4 Graphical presentation

The candidate was awarded **3 out of 3 marks**. The marks were awarded as follows:

4(a) **1 out of 1 mark** was awarded because the candidate has drawn a scatter graph with suitable scales.

4(b) **1 out of 1 mark** was awarded because the axes of the graph have suitable labels and units.

4(c) **1 out of 1 mark** was awarded because the candidate has plotted the points accurately and drawn an acceptable line of best fit.

5 Uncertainties

The candidate was awarded **2 out of 2 marks** because they have given plausible reading uncertainties. The random uncertainties have been calculated correctly.

6 Analysis

The candidate was awarded **0 out of 1 mark** because although the gradient is calculated correctly and inserted into the relationship, the further analysis that then follows is invalid as the graph does not pass through the origin.

7 Conclusion

The candidate was awarded **0 out of 1 mark** because the conclusion stated by the candidate is invalid as the line does not pass through the origin.

8 Evaluation

The candidate was awarded **1 out of 3 marks** because although they make four evaluative statements, only one of them is awarded a mark. Statement one is insufficient to award a mark. Statement two is not awarded a mark as a reduction in random uncertainty would improve the precision but not the accuracy. Statement three is correct as measuring the background light and subtracting it from the reading would help reduce the systematic uncertainty. Statement four is not awarded a mark as ruler with 1 mm divisions is already being used.

9 Structure

The candidate was awarded **1 out of 1 mark** because the report is clear and concise and has an informative title.

Overall

The candidate was awarded a total of **13 out of 20 marks**.

Candidate 5

1 Aim

The candidate was awarded **1 out of 1 mark** because this aim is acceptable.

2 Underlying physics

The candidate was awarded **1 out of 3 marks** because they demonstrate a limited understanding of the underlying physics.

3 Data collection and handling

The candidate was awarded **5 out of 5 marks**. The marks were awarded as follows:

3(a) **1 out of 1 mark** was awarded because the method contains details of what is to be measured and how the experiment was carried out. The diagram aids clarity.

3(b) **1 out of 1 mark** was awarded because the candidate has sufficient data. The range of readings is appropriate to the aim and the candidate has repeated measurements of the dependent variable for each value.

3(c) **1 out of 1 mark** was awarded because the candidate has constructed two tables which are considered together. Both tables have appropriate headings and units. All the mean and derived values are correctly calculated.

3(d) **1 out of 1 mark** was awarded because the data from the internet source is relevant to the candidate's experiment.

3(e) **1 out of 1 mark** was awarded because the source is cited beside the data and referenced later in the report. A date is included.

4 Graphical presentation

The candidate was awarded **2 out of 3 marks**. The marks were awarded as follows:

4(a) **1 out of 1 mark** was awarded because the candidate has drawn a scatter graph with suitable scales.

4(b) **1 out of 1 mark** was awarded because the axes of the graph have suitable labels and units.

4(c) **0 out of 1 mark** was awarded because the line has been forced through origin and so the mark is not awarded.

5 Uncertainties

The candidate was awarded **1 out of 2 marks** because a mark is awarded for the scale reading uncertainty stated in the section 'uncertainties', both attempts at random uncertainties are missing a unit and so the second mark is not awarded.

6 Analysis

The candidate was awarded **0 out of 1 mark** because they have correctly calculated the gradient of their line and stated its significance. However, the equation stated to calculate the gradient is incorrect and so the mark is not awarded. Refer to General Marking Principle 11, example 2.

7 Conclusion

The candidate was awarded **1 out of 1 mark** because the conclusion answers the aim.

8 Evaluation

The candidate was awarded **2 out of 3 marks** because although they make three evaluative statements, only two of them are awarded a mark. The first statement concerning the temperature is not awarded a mark as the candidate has not stated that the temperature will affect the refractive index. The second statement is awarded a mark as the candidate has identified a problem with conducting the experiment and offered a valid solution. The last statement indicates that increasing the number of repeated readings will decrease the random uncertainty due to the variation in the results.

9 Structure

The candidate was awarded **1 out of 1 mark** because the report is clear and concise and has an informative title.

Overall

The candidate was awarded a total of **14 out of 20 marks**.

