Candidate 1 – Pressure-Temperature

Marks Awarded and Commentary

Section	Expected Response	Maximum mark	Mark awarded	Commentary
1. Aim	An aim that clearly describes the purpose of the investigation.	1	1	The candidate's aim clearly described the purpose of the investigation.
2. Underlying Physics	An account of the physics relevant to the aim.	3	2	The candidate has shown a reasonable understanding of the physics relevant to the aim, showing an awareness of the kinetic theory. The statement that *'temperature is proportional to the speed of the particles'*, however, is incorrect. In addition, the candidate has not made the link between the *force* exerted by the particles hitting the walls of their container and the *pressure* of the gas.
3a. Brief description	A brief description of the approach used to collect experimental data.	1	1	The candidate's description of their experiment is given in sufficient detail for the marker to be able to visualise the nature of the experiment.

Section	Expected Response	Maximum mark	Mark awarded	Commentary
3b. Sufficient raw data	Sufficient raw data from the candidate's experiment.	1	0	The number of values given by the candidate is appropriate. No repeats have been included, but possibly it would not be appropriate due to time constraints. The candidate, however, has used a range of temperatures which is very limited and insufficient for the aim of the investigation, and so the mark for this section is not awarded. The range should have been increased by further heating and/or using an ice/water mix.
3c. Data table	Data from the candidate's experiment is presented in a suitable table.	1	1	The candidate has presented their data in a table with correct headings and units of measurement.
3d. Mean/ derived values	Mean and/or derived values are calculated correctly.	1	0	The candidate has not included calculations of mean or derived values.
3e. Internet/ literature data	Data relevant to the experiment from an internet/ literature source.	1	1	The candidate has included data from the internet which is relevant to their experiment.
3f. Reference	A reference for the source of the internet/ literature data.	1	1	The candidate has given a full URL for the website page containing the data given in the report.
4a. Appropriate format	A graph of the appropriate format.	1	1	The candidate has drawn a scatter graph, which is an appropriate format for the experimental data.
4b. Suitable scales	The axes have suitable scales.	1	0	The candidate has used a suitable linear scale for the y-axis of the graph. There is, however, an error in the scaling of the x-axis (-200 °C misplaced), and so the mark for this section is not awarded.

Section	Expected Response	Maximum mark	Mark awarded	Commentary
4c. Suitable labels and units.	The axes have suitable labels and units.	1	1	The candidate has labelled the axes of the graph with suitable labels and units of measurement.
4d. Accurately plotted data points	Accurately plotted data points and, where appropriate, a line of best fit.	1	0	It is not possible to check the accuracy of plotting due to data points which are excessively large. In addition, the candidate's line is not best fit – the line should be steeper with an x-intercept around -160 °C. The mark for this section is not awarded.
5. Analysis	A valid comparison of the experimental data with data from the internet/ literature.	1	1	The candidate has stated '*The graph from BBC … has a shape like mine*', which is acceptable as a comparison of the experimental data with the internet data.
6. Conclusion	A valid conclusion that relates to the aim and is supported by data.	1	1	The candidate has made a conclusion of a value for absolute zero based on data both from their experiment and from the internet source.
7. Evaluation	An evaluation of the experimental procedure.	2	2	The candidate has identified a factor which may have a significant impact on the accuracy of the experiment by implying that there is an invalid assumption made that the temperature of the water will be the same as the temperature of the air. The candidate has identified that placing the thermometer inside the flask could have minimised the effect of this factor.
8a. Title	The report has an informative title.	1	1	The candidate has included an informative title.
8b. Structure	A clear and concise report.	1	1	The candidate's report is clear and concise.
TOTAL		20	15	

Candidate 2 – Acceleration on a Slope

Marks Awarded and Commentary

Section	Expected Response	Maximum mark	Mark awarded	Commentary
1. Aim	An aim that clearly describes the purpose of the investigation.	1	0	The candidate's aim does not clearly describe the purpose of the investigation. It is unclear which property of the slope is being investigated, and so the mark for this section is not awarded.
2. Underlying Physics	An account of the physics relevant to the aim.	3	0	The candidate has demonstrated no understanding of the relevant physics. The linguistic style used in the reference to Newton's law of universal gravitation is at odds with that used in the rest of the report, and so the statement is judged not to demonstrate understanding. The remainder of the account of the underlying physics lacks the precision necessary to demonstrate even a limited understanding.
3a. Brief description	A brief description of the approach used to collect experimental data.	1	0	In the candidate's description, the 'module' measures acceleration, and so card/window dimensions and timings are not required. The candidate's description of their experiment, however, is not given in sufficient detail for the marker to be aware of which aspect of the slope is being measured. This becomes clear only with the results table.
3b. Sufficient raw data	Sufficient raw data from the candidate's experiment.	1	1	The candidate has given an acceptable number of values and has included repeated measurements. The range of slope angles is limited, but acceptable at this level.

Section	Expected Response	Maximum mark	Mark awarded	Commentary
3c. Data table	Data from the candidate's experiment is presented in a suitable table.	1	0	The unit of angle is given in each data cell. The unit of acceleration used in the heading in the second column is, however, incorrect, and so the mark for this section is not awarded.
3d. Mean/ derived values	Mean and/or derived values are calculated correctly.	1	0	The candidate has calculated a mean value from repeated measurements of acceleration. The second calculation, however, has been incorrectly rounded (should be 2·40**7**), and so the mark for this section is not awarded.
3e. Internet/ literature data	Data relevant to the experiment from an internet/ literature source.	1	1	The internet data that the candidate has included shows the variation of acceleration with the *sine* of the angle of the slope, although the candidate seems unaware of this. While not identical, it is, however, relevant to the candidate's experiment and so is acceptable.
3f. Reference	A reference for the source of the internet/ literature data.	1	1	The candidate has given a full URL for the website page containing the data given in the report.
4a. Appropriate format	A graph of the appropriate format.	1	1	The candidate has drawn a scatter graph, which is an appropriate format for the experimental data.
4b. Suitable scales	The axes have suitable scales.	1	1	The candidate has used suitable linear scales for the axes of the graph.
4c. Suitable labels and units.	The axes have suitable labels and units.	1	0	The candidate has labelled the x-axis of the graph correctly with variable and unit. The unit of acceleration on the y-axis, however, is incorrect and so the mark for this section is not awarded.

Section	Expected Response	Maximum mark	Mark awarded	Commentary
4d. Accurately plotted data points	Accurately plotted data points and, where appropriate, a line of best fit.	1	0	The candidate has not used graph paper with both major and minor gridlines. The lack of minor gridlines means that it is not possible to check the accuracy of plotting, and so the mark for this section is not awarded.
5. Analysis	A valid comparison of the experimental data with data from the internet/ literature.	1	0	The candidate has stated *'The graph shows the same shape as mine*', although seems unaware that the quantities plotted on the x-axes of the graphs are not the same, making the comparison invalid, and so the mark for this section is not awarded.
6. Conclusion	A valid conclusion that relates to the aim and is supported by data.	1	0	In awarding the mark for the conclusion, the aim of the assignment has been clarified by the data stated by the candidate. The candidate has made the conclusion that acceleration and angle of slope are directly proportional, which is a valid conclusion based on the candidate's graph. However, it is not a valid conclusion based on the second graph, and so the conclusion is not supported by *all* the data in the report, and so the mark for this section is not awarded.
7. Evaluation	An evaluation of the experimental procedure.	2	0	The candidate has not completed the evaluation of the experiment.
8a. Title	The report has an informative title.	1	1	The candidate has included an informative title.
8b. Structure	A clear and concise report.	1	1	The candidate's report is clear and concise.
TOTAL		20	7	

Candidate 3 – Boyle's Law

Marks Awarded and Commentary

Section	Expected Response	Maximum mark	Mark awarded	Commentary
1. Aim	An aim that clearly describes the purpose of the investigation.	1	1	The candidate's aim clearly described the purpose of the investigation.
2. Underlying Physics	An account of the physics relevant to the aim.	3	1	The candidate has shown a limited understanding of the physics relevant to the aim. The candidate has not explained that the particles hit the walls more often due to a reduction in wall area rather than to an increase in particle speed. In addition, there is no discussion of how pressure relates to force and area and no reason explicitly given for plotting *p* against *1/V.*
3a. Brief description	A brief description of the approach used to collect experimental data.	1	1	The candidate's description of their experiment is given in sufficient detail for the marker to be able to visualise the nature of the experiment.
3b. Sufficient raw data	Sufficient raw data from the candidate's experiment.	1	0	The range of the independent variable is *just* adequate, but the candidate has not made repeated measurements when it would be appropriate to do so. The mark for sufficient data is therefore not awarded.
3c. Data table	Data from the candidate's experiment is presented in a suitable table.	1	1	The candidate has shown the experimental data and derived values in a table with correct headings and units.
3d. Mean/ derived values	Mean and/or derived values are calculated correctly.	1	1	The candidate has correctly calculated derived values (1/volume) from the experimental data. The inclusion of a specimen calculation is good practice.

Section	Expected Response	Maximum mark	Mark awarded	Commentary
3e. Internet/ literature data	Data relevant to the experiment from an internet/ literature source.	1	1	The candidate has included data from the internet which is relevant to their experiment.
3f. Reference	A reference for the source of the internet/ literature data.	1	1	The candidate has given a full URL for the website page containing the data given in the report.
4a. Appropriate format	A graph of the appropriate format.	1	1	The candidate has drawn a scatter graph, which is an appropriate format for the experimental data.
4b. Suitable scales	The axes have suitable scales.	1	1	The axes of the candidate's graph have suitable linear scales.
4c. Suitable labels and units.	The axes have suitable labels and units.	1	1	The axes of the graph have suitable labels and units.
4d. Accurately plotted data points	Accurately plotted data points and, where appropriate, a line of best fit.	1	1	The high number of sig figs in the data makes equivalent precision in plotting difficult, but the candidate has correctly plotted data points to within ± ½ box tolerance. The line of best fit is acceptable.
5. Analysis	A valid comparison of the experimental data with data from the internet/ literature.	1	1	The candidate's statement '*Both graphs are a straight line through the origin*' is a valid comparison between the graph drawn from experimental data and the graph from the internet source.
6. Conclusion	A valid conclusion that relates to the aim and is supported by data.	1	1	The candidate has made a conclusion that relates to the aim and is supported by the data in the report.

Section	Expected Response	Maximum mark	Mark awarded	Commentary
7. Evaluation	An evaluation of the experimental procedure.	2	2	The candidate has identified a factor which may have had a significant effect on the accuracy of the experiment, and has explained what was done to minimise this factor.
8a. Title	The report has an informative title.	1	1	The candidate has included an informative title.
8b. Structure	A clear and concise report.	1	1	The candidate's report is clear and concise.
TOTAL		20	17	

Candidate 4 – Specific Heat Capacity

Marks Awarded and Commentary

Section	Expected Response	Maximum mark	Mark awarded	Commentary
1. Aim	An aim that clearly describes the purpose of the investigation.	1	1	The candidate's aim clearly described the purpose of the investigation.
2. Underlying Physics	An account of the physics relevant to the aim.	3	3	Found in various sections of the report, the candidate's account of the underlying physics demonstrates a good understanding. The account is marked holistically, and the specific heat capacity calculation (the *gradient of the graph* issue is ignored) and the *energy=power×time* calculation, although not part of the 'underlying physics' paragraph, are given credit in this section. To be awarded full credit in this section, the physics does not need to be perfect, or even excellent. The incorrect abbreviation for unit of specific heat capacity (J/kg/°C rather than J/kg °C or J kg^{-1} $°C^{-1}$), for example, is ignored.
3a. Brief Description	A brief description of the approach used to collect experimental data.	1	1	The candidate's description of their experiment is given in sufficient detail for the marker to be able to visualise the nature of the experiment.
3b. Sufficient raw data	Sufficient raw data from the candidate's experiment.	1	1	The candidate has given an acceptable number of values with an appropriate range. The candidate has not included repeated measurements, but, given time constraints, in this investigation it would possibly not be appropriate to do so.

Section	Expected Response	Maximum mark	Mark awarded	Commentary
3c. Data table	Data from the candidate's experiment is presented in a suitable table.	1	1	The candidate has presented experimental data and derived values in two tables. Both tables have correct headings and units of measurement.
3d. Mean/ derived values	Mean and/or derived values are calculated correctly.	1	1	The candidate has correctly calculated values for the energy supplied and the rise in temperature. Although not explicitly stated, the initial temperature of the copper block can be implied from the sample calculations.
3e. Internet/ literature data	Data relevant to the experiment from an internet/ literature source.	1	1	The candidate has included data from the internet relevant to their experiment.
3f. Reference	A reference for the source of the internet/ literature data.	1	0	The candidate has not given a full URL for the website page containing the data value of the specific heat capacity of copper.
4a. Appropriate format	A graph of the appropriate format.	1	0	The candidate has produced a line graph, which is not an appropriate format for their data, and so the mark for this section is not awarded.
4b. Suitable scales	The axes have suitable scales.	1	1	Both axes have suitable linear scales.
4c. Suitable labels and units.	The axes have suitable labels and units.	1	1	The axes of the graph have suitable labels and units.
4d. Accurately plotted data points	Accurately plotted data points and, where appropriate, a line of best fit.	1	0	The candidate has used excessively large data points, which makes the checking of the accuracy of plotting difficult. The mark for this section is not awarded.

Section	Expected Response	Maximum mark	Mark awarded	Commentary
5. Analysis	A valid comparison of the experimental data with data from the internet/ literature.	1	1	The candidate's statement *'This is a bit lower than the value obtained from the expeiment'* is a valid comparison between the experimental data and the data from the internet source.
6. Conclusion	A valid conclusion that relates to the aim and is supported by data.	1	1	Although not part of the 'conclusion' paragraph, the candidate's stated values for the specific heat capacity of copper, both from experiment and internet, is a valid conclusion to the investigation.
7. Evaluation	An evaluation of the experimental procedure.	2	2	The candidate has identified heat loss to the surrounding air as a factor which had a significant effect on the accuracy of the experiment, and has explained what could be done to minimise this factor.
8a. Title	The report has an informative title.	1	1	The candidate has included an informative title.
8b. Structure	A clear and concise report.	1	1	The candidate's report is clear and concise.
TOTAL		20	17	