L2 Lead Examiner Report 1903

March 2019

BTEC L2 Firsts in Applied Science

Unit 8: Scientific Skills

(20474E)

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March 2019
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Grade Boundaries

What is a grade boundary?

A grade boundary is where we set the level of achievement required to obtain a certain grade for the externally assessed unit. We set grade boundaries for each grade, at Distinction, Merit and Pass.

Setting grade boundaries

When we set grade boundaries, we look at the performance of every learner who took the external assessment. When we can see the full picture of performance, our experts are then able to decide where best to place the grade boundaries – this means that they decide what the lowest possible mark is for a particular grade.

When our experts set the grade boundaries, they make sure that learners receive grades which reflect their ability. Awarding grade boundaries is conducted to ensure learners achieve the grade they deserve to achieve, irrespective of variation in the external assessment.

Variations in external assessments

Each external assessment we set asks different questions and may assess different parts of the unit content outlined in the specification. It would be unfair to learners if we set the same grade boundaries for each assessment, because then it would not take accessibility into account.

Grade boundaries for this, and all other papers, are on the website via this link:

http://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

Unit name of number of unit.

Grade	Unclassified	Level 1 Pass	Level 2		
			Pass	Merit	Distinction
Boundary Mark	**0**	9	18	27	36

Introduction to the Overall Performance of the Unit

Performance across the paper was generally good, with far fewer blank answers than in some previous series. Learners were able to gain credit across many areas of the specification covered in the paper. Learners were able to; identify items of equipment and risks, identify precautions and attempt a plan of an experiment, comment on errors in a table, draw a line graph, describe trends in data, identify anomalies, calculate averages, perform calculations make simple inferences based on data provided, and improve an experiment.

The graph that learners were asked to draw in this paper was a line graph and this was better attempted than previous series, however compared to a bar chart, learners find drawing such graphs more of a challenge. The first six mark question on the paper asked learners to produce a plan based on information given. The plan related heating a thermistor and measuring its resistance as it was heated. It was evident that some learners had not seen this kind of experiment before and were unaware of what a thermistor was, a significant number thought that the thermistor heated the water. Some answers indicated that the stem of the question had not been read before the question was answered. The stem of the question gave learners some clear information as to how the equipment was set up and what was being measured. The final question related to improving an experiment to find the temperature rise in water from burning s crisp. This is a very familiar experiment to learners and answers were better than in the March 2018 series. Many learners were able to suggest a good number of relevant improvements. The command line of the question asked learners to explain improvements not just identify them. In many cases appropriate improvements were identified, but these were not explained, and this limited the marks awarded.

The calculations were better answered than in previous series, particularly Q3b which was the calculation of an average. Most learners were able to give the correct answer. The calculation relating to specific heat capacity was attempted by many learners, but poor algebra gave some problems as well as the use of significant figures in the final answer. Learners in most cases showed working and so gained partial credit in situations where they had made an error in the later stages of the calculation.

Learners were asked to take data off a graph in a number of questions and in different contexts, it is evident that learners are more confident in using graph data to aid their answers, quoting values from the graph to support the points they were making. Where learners were asked to comment on tends in data or analyse what a graph was showing answers were weaker. In many cases learners did not make sufficient points to score marks, the mark allocation for a question is always given and learners need to give a point per mark for points based questions.

It was evident in many responses that some learners were well prepared and had been able to draw on a wide range of practical activities to develop the skills tested in this paper. This was not always the case. Centres should provide a wide range of practical tasks to ensure that learners have the required experience.

In some cases, learners' answers to questions were not relevant as they had considered ideas not asked for in the question. This may have been due to some of the practicals used in this paper having been used in earlier papers to test other aspects of the specification.

Individual Questions

Question 1 was considered equipment and risks.

Q1ai Many learners scored the single mark for this question and were able to name a stop-watch as the piece of equipment. Some learners gave branded watches which were acceptable. A few learners misunderstood the question and wrote about the variable that needed measuring i.e. heart rate or pulse rate.

Q1bi Many learners scored the single mark for what was a well answered question. Most were able to give the risk, however a few simply repeated what they had been told in the question and stated that the risk was tripping or falling, or stated that the athlete would come to harm, which is not specific enough. The answer was looking for the effect on the person.

Q1bii was also answered well, but not as well as the first two questions. Some learners misunderstood the question and wrote about trying to prevent injury after tripping rather than preventing the tripping. Where the question was answered successfully the most common answers were securing the boxes, going slowly and tying shoe laces.

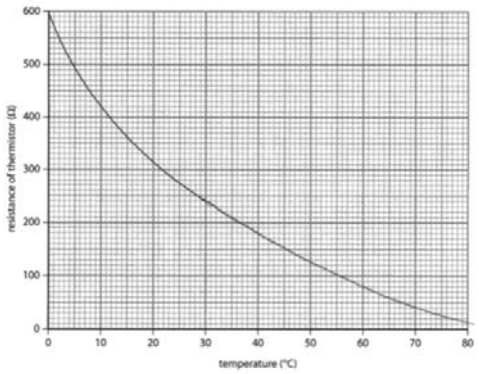
Question 2 considered variables, making predictions and planning an experiment.

Q2ai Learners found this question a challenge and there were many who did not score the mark. Most learners opted for a piece of equipment, most commonly the resistor, rather than a measurement. Those that were correct gave a detailed 'voltage across the resistor' answer. The idea of what a variable is and the difference between the independent and dependent variable is in an experiment does need to be made clear to learners by centres.

Q2aii This question was answered better than the previous one and the evidence indicates that learners are clearer as to what a control variable is and can identify these more easily compared to other types. Learners generally scored one or two marks for this question, with the most common answer being 'resistor' or 'voltmeter'. Where learners failed to score on this item it was as a result of giving the independent variable 'voltage' which was the answer to the previous question. Learners were not clear as to the difference between the term 'voltage' and 'voltmeter'. There were a range of acceptable answers in the mark scheme, but most learners chose the two already given.

Q2b This one mark question related to predicting from a partially drawn graph what would happen to the resistance of a thermistor as the temperature increased. What

was required in the answer was a trend. The ideal graph would have looked like the one shown below.



The graph had to continue downwards without levelling off or rising. Learners were not expected to know anything about the characteristics of the thermistor as this is a skills based paper, so as long as the graph continued downwards the mark was awarded. In many cases the graph levelled out, so did not show the continuing downward trend. The drawing of a good line was not being tested in this question, so wobbly lines, tramlining, etc were not penalised.

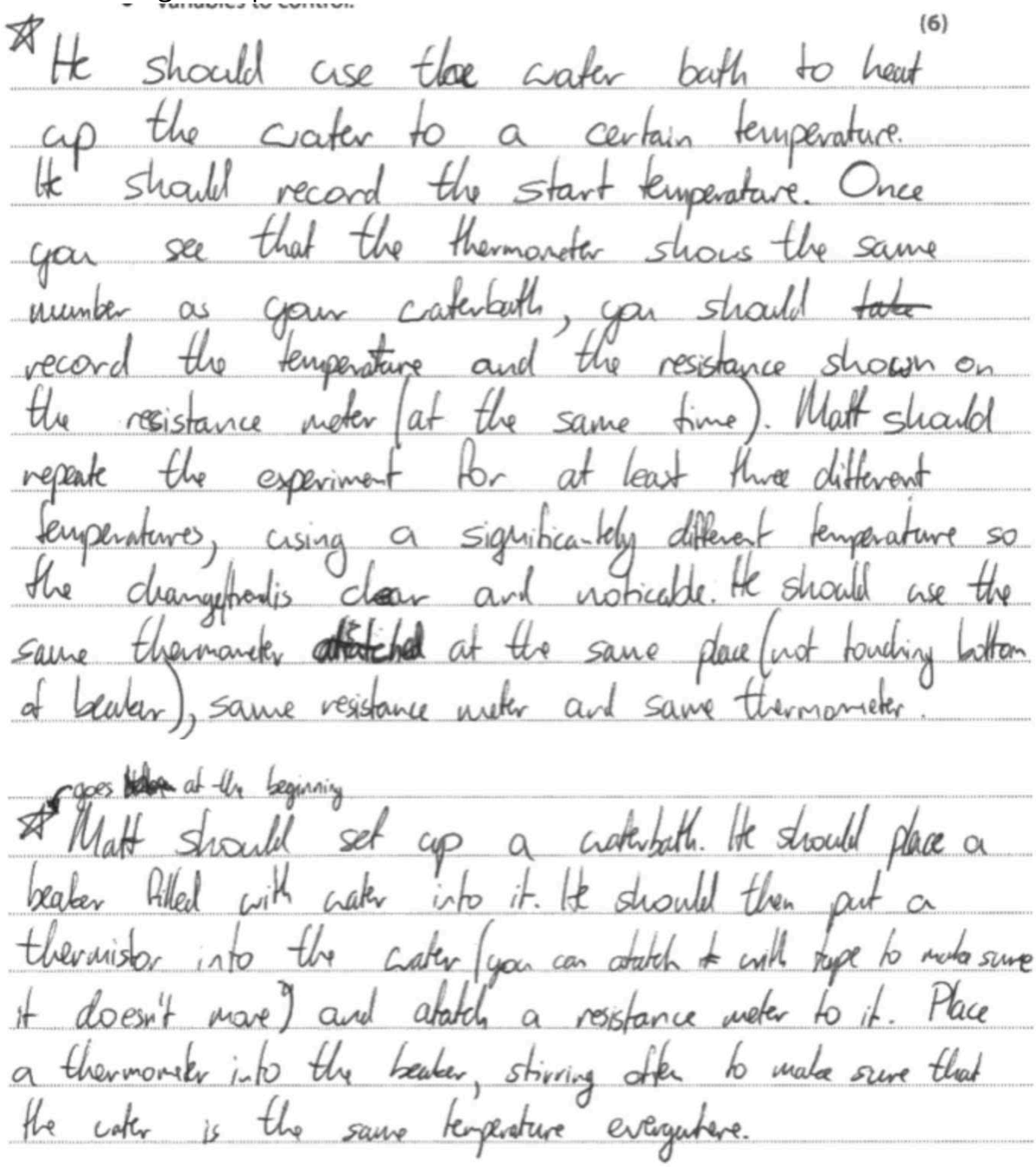
Q2c The first 6 mark question was about designing a plan for an experiment to measure the resistance of a thermistor at different temperatures. Most learners were awarded between 1 and 3 marks. Many learners recognised the need to measure the resistance at a range of different temperatures. Repeating readings at each temperature often scored although poor wording meant it was not always clear if they were repeating for reliability or repeating at different temperatures.

Appropriate control variables were seen more rarely, the variable that was most commonly given by some learners was 'the same thermistor'.

A significant number of learners provided information that did not gain credit, by providing an equipment list (given in the stem of the question) or referring to risk assessments/safety precautions, which is commendable but not in the rubric of the question. Very few gave the Bunsen burner as a means of heating the water with many candidates simply saying that the water was heated to a set temperature. However, a significant number thought that a thermistor was used to heat up a beaker of water or even to measure the temperature. This led to some learners wanting to change the resistance and then measure the effect of this on the temperature of water. The meter in the diagram showed a reading of 400 ohms, this confused a number of learners who thought that this was important and therefore wanted to maintain this reading throughout the experiment. The majority of learners thought that a stopwatch was a key piece of equipment although not all found a use for it. Some learners heated the water and then left it too cool, taking the temperature at regular intervals as it cooled and these were clearer about the use of the

stopwatch. There were some learners who went the other way i.e. heating the water and taking resistance readings as the water heated. However, many of these were taking reading at 10, 20 and 30 mins etc. without considering the small amounts of water they were heating for these lengths of time. Very few responses mentioned stirring the water or keeping the thermometer away from the bottom of the beaker.

The following example was awarded 5 marks



(6)

He should use the water bath to heat up the water to a certain temperature. He should record the start temperature. Once you see that the thermometer shows the same number as your waterbath, you should ~~take~~ record the temperature and the resistance shown on the resistance meter (at the same time). Matt should repeate the experiment for at least three different temperatures, using a significantly different temperature so the change/trend is clear and noticable. He should use the same thermometer ~~attached~~ at the same place (not touching bottom of beaker), same resistance meter and same thermometer.

goes ~~later~~ at the beginning

Matt should set up a waterbath. He should place a beaker filled with water into it. He should then put a thermistor into the water (you can attach it with tape to make sure it doesn't move) and attach a resistance meter to it. Place a thermometer into the beaker, stirring after to make sure that the water is the same temperature everywhere.

The learner gained the marks for stating that a water bath was used in line 1, in line 6 stating that the resistance shown on the resistance meter should be recorded, in line 8 for stating that the experiment is done at three different temperatures, in line 11 for

stating that the thermometer should not touch the bottom of the beaker and finally in line 18 that the water should be stirred.

This level of detail was not seen often. Learners are given some guidance in the introduction to the experiment and need to do what is asked of them. The need for risk assessments, apparatus lists etc as stated earlier are not required. Centres should provide learners with opportunities to practice these kinds of answers to ensure that they are well prepared for this type of question.

Question 3 considered presenting data and calculating averages.

Q3a Most learners understood that the table could be improved by adding a title to the fruit column or placing the mass of sugar data in ascending or descending order or both. Hardly any chose to put the fruits in alphabetical order. Many did not address the question by attempting to give suggested improvements to an experimental method that produced the data in the table. In previous series learners have been asked to complete a blank table and the question as awarded 3 marks. Learners found that writing down the errors, rather than constructing a correct table, which was how these skills were tested in the previous series, was more of a challenge .

Q3b This question was well answered, and it seems learners are able to deal with the idea of averages and calculate them. Nearly 90% of the cohort either scored one or two marks. Where full marks were not scored it was for adding and then dividing by the wrong number or for simply adding the numbers correctly, but then not dividing by 4 to give an answer of 41.2.

Question 4 considered anomalies and how they are dealt with in data and then drawing a graph from given data.

Q4ai Learners found this a challenge. Many learners circled 109, not realising that the rising trend was broken by the volume of 67.2. Other common wrong answers were the first and the last readings. Many learners did not notice that the values were rising by approximately 36 each time apart from the fourth value in the table (67.2). This question has the appearance of being quick to answer, it appears that in many cases little time was given by learners to look at the data as a whole before deciding on the anomaly.

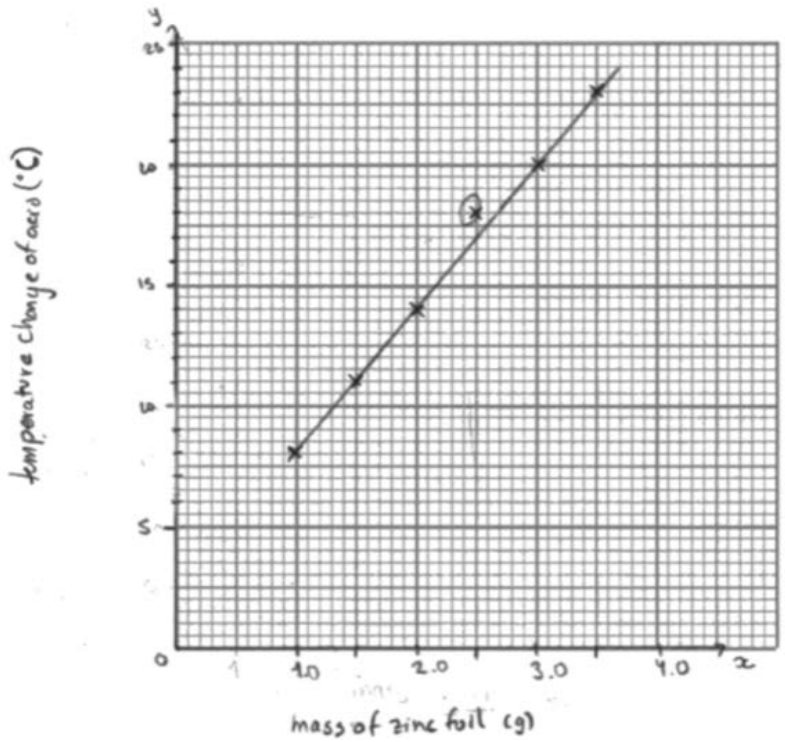
Q4aii Was well answered by most with the majority of learners scoring at least one mark. Repeating the result or the whole experiment was the most common correct answer however a significant number stated, ‘use a friends answer’.

Q4b The graph was the second of the 6 mark questions on the paper. In this examination the graph that was asked for was a line graph. These have proved

challenging in the past, however in comparison to responses seen on other recent papers where a line graph was asked for, performance has improved. Almost all learners were aware of the need to label both axes clearly including appropriate units. Occasionally units were missing but very few omitted the label all together. Scaling of the axes was more challenging in many cases. Scales selected were often non-linear across one or both axes. In many cases larger scaling would have made better use of the available graph paper. It was common for the data to take up less than half of the grid. One very common mistake was the scale of the zinc axis, going from 0 to 1 then up in 0.5 increments. Scales going up in 3's were sometimes seen which makes accurate plotting a greater challenge. There were a few learners who added to the graph by drawing line on the side to get the scale that was needed for the data set. Learners should be made aware by centres that an appropriate scale should use sensible numbers, such as 2,5,10 etc. Learners should additionally be made aware that as a result a graph starting at 0,0 may not be possible, but still be perfectly acceptable as long as it is able to cover the range of the data set. Centres should provide as many opportunities as possible to practice this skill.

Plotting was almost always accurate or at least within the accepted tolerance. There was occasionally some confusion for those plotting points on to scales where 2 small squares were equivalent to 1oC as some learners appeared to forget the scale and therefore the last few plots were often more than one small square out. Many learners gave appropriate straight lines of best fit. Where these were not awarded learners either drew a line dot to dot and included the anomaly or forced their line through 0 and avoided most of the points apart from 0 and 23.

The graph below scored 6 marks.



Both axes are fully labelled, including units, the scale is appropriate, filling at least half the graph paper, the scale is linear on both axes, plotting is correct for all points and the line of best fit is appropriate. It should also be noted that the scale increased in sensible numbers on both axes, which makes plotting easier for learners.

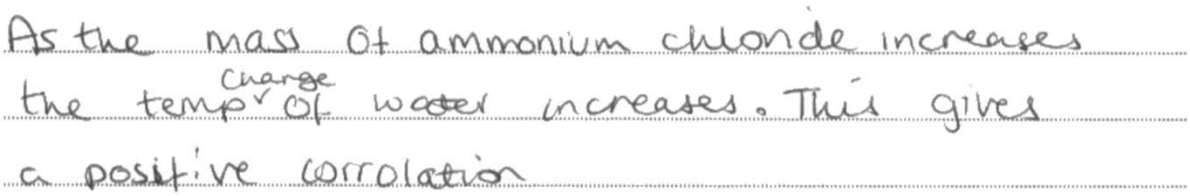
Question 5 considered the relationship in the data in a table, using a formula to calculate a value and finally explaining why a measured value may be different to a value from another source.

Q5ai Many learners scored the mark for this question. There were occasional errors in arithmetic which resulted in the mark not being gained.

Q5aii A significant number of learners achieved the first marking point on the mark scheme for this question although very few were able to expand this and gain the second marking point. Where learners did it was more often for explaining the proportional relationship rather than stating that it was proportional.

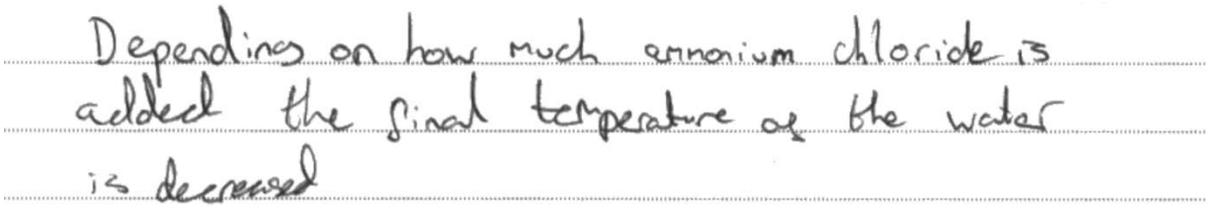
Where learners scored zero it was more often for relating the mass of ammonium chloride to the fall in temperate rather than grasping the subtlety of the question and giving the increase in temperature change.

This is an example of a 2 mark answer.



The learner has quoted the correct trend and described it as being a positive correlation.

This response scored 0 marks



The learner has been vague about the mass and has not considered the temperature change increasing.

Q5bi Not many candidates scored full marks for this calculation, but many achieved 2 marks for a correct answer that was not to two significant figures. Many learners were able to substitute the values into the equation, however progress from there was more varied. Many made errors in the required rearrangement at some stage. Relatively few were able to present their otherwise correct answer to the required accuracy. Some learners mistook 2sf for 2dp and gave an answer to two decimal places. Algebraic manipulation remains a challenge for many learners. In a large number of answers, the rearrangement was seen upside down. Learners need practice in performing calculations that involve substitution and rearrangement.

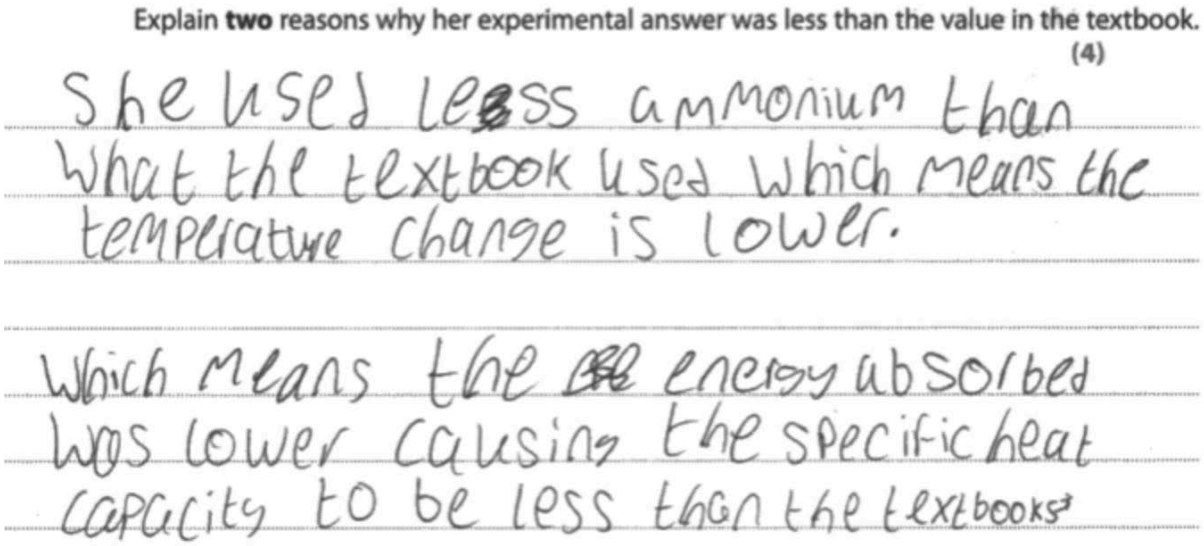
Q5bii This question was targeted at merit and distinction learners; however, it was clear that the detail of this this question was not well understood by learners and was very challenging to all learners including the most able. Very few learners were able to provide the detail required to explain why the reading was LESS than the textbook value. Some recognised that the mass of ammonium nitrate or volume of water/solution may have been different but did not provide an answer to show why the reading would be LOWER than the accepted value. Where correct reasons were recognised, there was no further EXPLANATION as to why this would have produced a value lower than the textbook value. Common incorrect answers that did not address the question were as follows.

- Val was doing it wrong
- Misread the amount she was adding, measured the temp change incorrectly
- Mistake in the calculation
- Could have used 21g instead of 20g, measured the mass incorrectly

- Didn't check reliability
- Didn't record results correctly
- Used ammonium chloride instead of ammonium nitrate (from previous question)

The incorrect responses that have been identified are in most cases generic and lacked direct relevance to the question set. The stem of the question indicated that the value obtained was less than that in a textbook, so an explanation comparing the difference was being looked for.

The example below achieved 3 marks.


Explain **two** reasons why her experimental answer was less than the value in the textbook.

(4)

She used less ammonium than what the textbook used which means the temperature change is lower.

Which means the energy absorbed was lower causing the specific heat capacity to be less than the textbooks

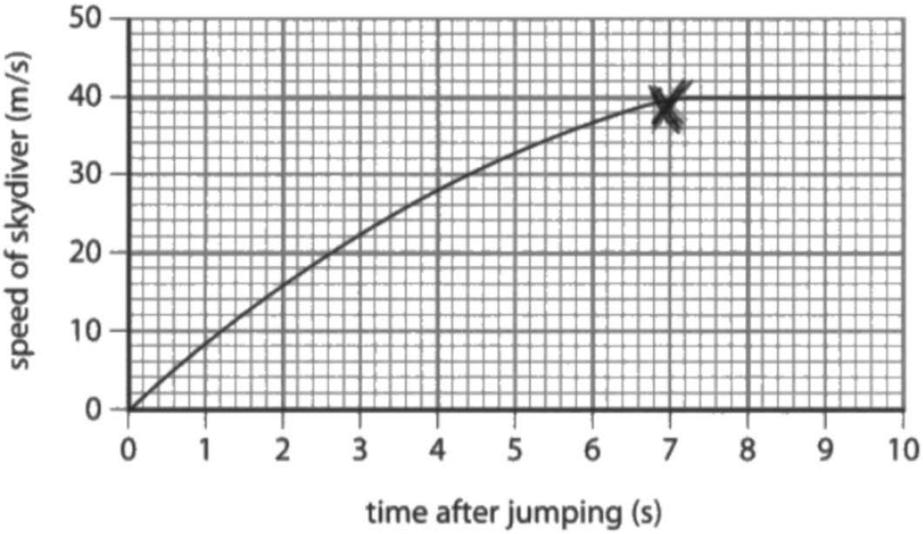
The learner has identified that less of the 'ammonium' was used in the first paragraph and it is linked to a lower absorption or energy which is in the second paragraph. In addition, the learner states that the temperature change was lower, but this is not explained in terms of there being less water. The answer is not as clear as it could be, however there is a linked pair from the mark scheme, via a comment on temperature. This was sufficient for three marking points to be identified. The 'ammonium' rather than 'ammonium nitrate' in the first line was ignored as the name of the chemical is given in the stem of the question.

Question 6 considered identifying information, reading data, and interpreting data from a graph.

Q6ai Very large numbers of learners correctly placed the cross in the correct section of the graph. It was acceptable to place the cross on the '7' line or to the right of the '7' line. Where learners failed to score was most often because the cross was placed near to the '7', but because the cross was large and thickly drawn the cross was not on

the '7' line or to the right of it.

This response achieved 0 marks



The cross is large and thickly drawn, the centre is to the left of the '7' line, but parts are to the right. Had the cross been drawn with thinner lines it may have been possible to see exactly where the cross was with reference to the '7' line.

Q6aii Most learners were able to give the mark scheme answer which was 22(m/s). It was very rare to see this question answered incorrectly.

Q6b.Many learners found the graph a challenge. Some interpreted the graph as a height or distance time graph rather than a speed time graph. Many learners considered the time of fall or wrote about which skydiver landed first, and so did not answer the question set. Most learners were able to identify C as the skydiver with the biggest parachute, and some were also able to give correct interpretations of the speed/time graph, although this was often confused and sometimes contradictory. Fewer were able to put both together consistently to provide a coherent answer. The award of three marks was rare. The idea that the biggest parachute resulted in the lowest speed was often recognised. Reaching this speed fastest was less frequently seen. Discussion of relative rates of change in speed or the significance of gradient was very rare. Many gave the incorrect skydiver (invariably A) but gained a mark for at least one correct reason (for C though) as the last two marks on the mark scheme were not dependent on the first being scored. Some learners thought that a larger parachute would be heavier and consequently would descend more quickly and end up at a higher terminal speed.

This example achieved 3 marks.

Analyse the evidence to conclude which skydiver has the biggest parachute.

(3)

Skydiver C decelerates the fastest after opening their parachut and after reaching their new terminal velocity their speed is slower than the other two. This all shows that the skydiver with the largest surface area parachute is C

The learner has identified the correct skydiver, stated that the skydiver decelerated the fastest and then gone on to state that the speed would be lower than the other two. Such concise answers were rare.

Question 7 considered conclusions and improvements to experiments.

Q7a Many learners were able to interpret the data correctly to establish that, per packet, B contained more energy. Many also suggested that the wrong conclusion had been reached by reading the energy/100g – which shows that per 100g, crisps from pack A provided the most energy. Very few used the data to show that pack B contains a greater mass of crisps. This question was worth three marks, but learners did not use all the information given to gain these and often stopped once one comment was given. Some candidates took the data and divided to see how many packets make up the energy in100g but then gave no reason why they had done it so and did not go on to say anything about the amounts/mass of crisps in each bag. A small number of learners used this question as an opportunity to demonstrate their knowledge on healthy eating, which was not relevant to the question set.

This response achieved 3 marks

(a) Comment on why the evidence does not support the conclusion.

(3)

Because Per 100g Packet A has more energy but because it is on energy per Packet Packet B has more energy so will give more energy the eating packet A. Packet A is ½ of the 100g energy making it 25g Packet B is ½ of the total energy making it 50g so Packet B has more calories in the Packet.

The learner has identified that packet A contains more energy per 100g, and also identified that packet B has more energy per packet compared to packet A. Finally, in the last line the learner states 'so packet B has more content in the packet' (compared to packet A).

Q7b This was the final 6 mark question on the paper and was levels based. The question was targeted across a range of grades. Very few learners scored at level 3 (5/6 marks) with the majority scoring at level1 (1/2 marks) Most learners were scoring at level 1 because whilst they gave relevant improvements, very few gave an explanation linked to the improvements.
Commonly suggested improvements included

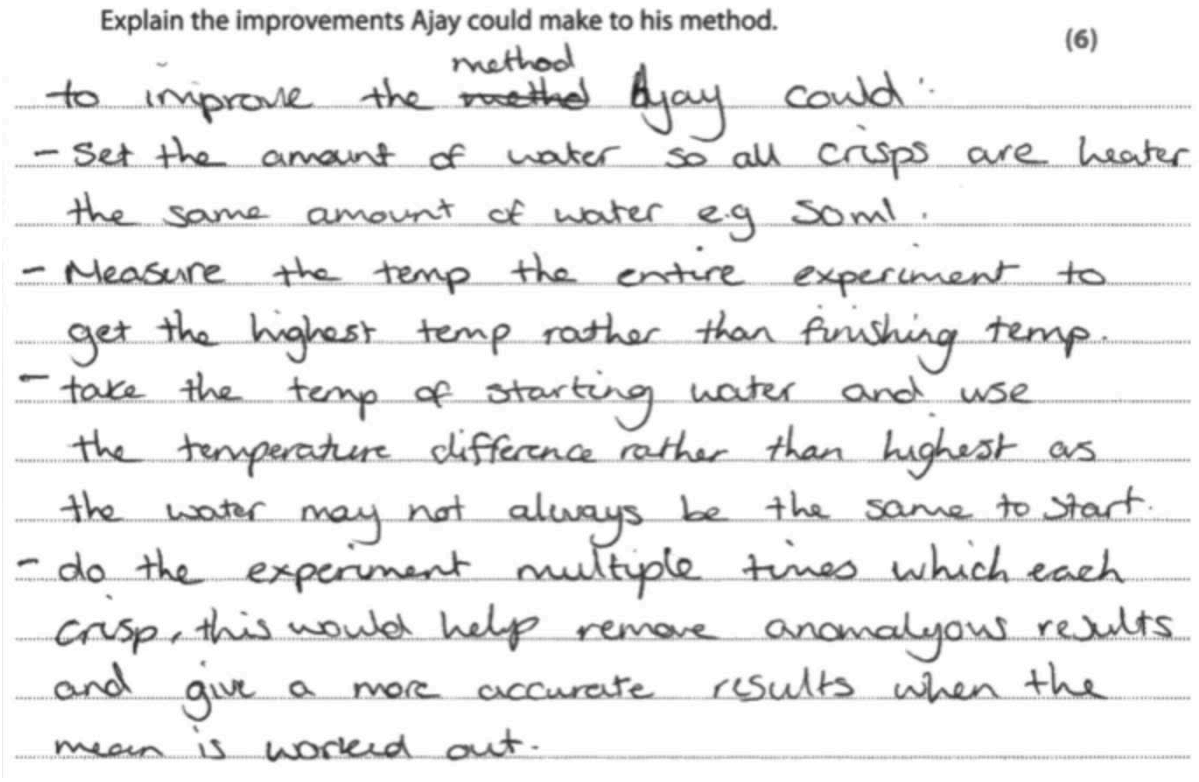
- use a certain volume of water
- the same mass/size of crisp
- repeat the test

These improvements secured marks at Pass level, but most learners went on to state simply that these were done to make it a fair test or more accurate and this was not sufficient to explain the improvement.

Holding the crisp the same distance below the boiling tube and the need to measure the starting temperature were also seen but less often. Most of the learners that suggested taking the starting temperature as an improvement failed to give the explanation relating this to allowing the temp change to be measured.

Very few learners gave any procedural improvements that would have led to more accurate readings. Some learners were able to extend their account to Merit level by following the rubric of the question and EXPLAINING why their statements would bring about the given improvement to the method.
Several learners gave risk assessments or comments on safety which while valid did not contribute to improve the given method.

This example achieved 6 marks in the Distinction band.



Explain the improvements Ajay could make to his method. (6)

to improve the ~~method~~ method Ajay could:
- Set the amount of water so all crisps are heater the same amount of water e.g 50ml.
- Measure the temp the entire experiment to get the highest temp rather than finishing temp.
- take the temp of starting water and use the temperature difference rather than highest as the water may not always be the same to start.
- do the experiment multiple times which each crisp, this would help remove anomalyous results and give a more accurate results when the mean is worked out.

The learner has identified that the same amount of water is used and given an explanation, they have then gone onto state that the temperature before and after is to be found and given an explanation. Finally, the learner states that the experiment is repeated and given an explanation. This response shows a comprehensive ability to explain improvements across different aspects of the experiment.

Summary

Learners should:

- have opportunities to engage in a wide range of different practical activities to ensure that they have used a range of equipment, considered risks and means of avoiding them.
- read the questions set carefully and ensure that they are providing an answer to the question set, in some cases learners spent a good deal of time in giving details of risk assessments or equipment lists, when these were not asked for
- when drawing a graph ensure that all of the graph paper is used, by choosing a suitable scale for the data set.
- make sure that when asked to explain an idea that there is a statement and a justification.
- When answering a describe question give a logical sequence.

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