Examiner's Report/ Lead Examiner Feedback

November 2014

NQF BTEC Level 1/Level 2 Firsts in Applied Science

Unit 8: Scientific Skills (20474E)

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Introduction

This report has been written by the lead examiner for the BTEC Principles of Science unit. It is designed to help you understand how learners performed overall in the exam. For each question there is a brief analysis of learner responses. You will also find example learner responses from Level 2 Pass and Distinction learners. We hope this will help you to prepare your learners for future examination series.

Overall comments

This was the third time this paper has been sat. Many learners appeared to be well prepared for the paper, as they were aware of key variables and how to control them. They were able to draw bar charts and attempted the longer answer questions with more confidence. Some learners were able to analyse results and were able to draw simple conclusions. Fewer learners than in June 2014 lacked basic knowledge of the specification they should have been taught. Consequently the performance on this paper was better than in June.

Whilst there were still some learners who found it difficult to communicate effectively what they were trying to say, many learners did well with this paper. They did so because they were able to follow their basic descriptions, improvements to a method and analysis of results, with linked consequences or conclusions. They were able to manipulate formula, draw graphs and retrieve information from graphs and tables. They were able to apply their understanding of variables, planning, data manipulation, conclusions and evaluations to new situations. Many learners were able to plan a method for a simple practical and could identify the variables to change, measure or control. Learners had clearly had practice at this skill.

Most learners clearly had not had frequent opportunity to scale a graph or bar chart that did not start at zero. Consequently, they struggled to comprehend the idea of ensuring the data spread on a bar chart took up as much space on the graph paper as possible.

It was pleasing to see more learners are able to put data into a results table. More learners knew what column headings to place where in a table and were able to place data in ascending or descending order. However, some were confused by the use of a categoric variable and associated data. Learners need to experience a variety of independent variables and understand how to tabulate these.

It was apparent that more learners had access to the basic equipment needed for the examination such as a calculator and ruler. This made it easier for them to draw the graphs and lines of best fit accurately and precisely enough to be given credit. The number of learners who tried to complete the calculations without a calculator was much fewer than in previous series. More appeared to know how to use a formula. However, there were still a significant number of learners who tried to use the numbers given in a variety of ways in search of the answer. Some learners did not understand the idea that an average is divided by the number of readings taken, rather than just by three every time.

Centres should continue to work with learners in assisting them with building their practical skills and skills in sentence construction, writing practical methods, conclusions and evaluations. This is clearly assisting learners in communicating their answers more coherently. Reading the question to comprehend what it is asking may seem obvious, but many learners evidently still do not do this and need to practice this.

Learners should also have the opportunity to plan their own practical activities and results tables, for a wide range of contexts from across the key stage 4 programme of

study and the BTEC Application of Science specification, so that they understand how variables and data should planned for and presented. Equally, giving learners more opportunity to plot graphs with a variety of different scales would enhance their performance in the examination.

Learners need to be introduced to the command words frequently through practicing exam technique and questions. This will ensure they know what is expected when they are asked, to state, describe explain or analyse.

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link: http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

Grade	Unclassified	Level 1 Pass	Level 2		
			Pass	Merit	Distinction
Boundary Mark	0	17	25	33	41

Q1

Most of the learners answered this question well gaining the two marks.

Both 1 mark

Write **one** letter in each row.

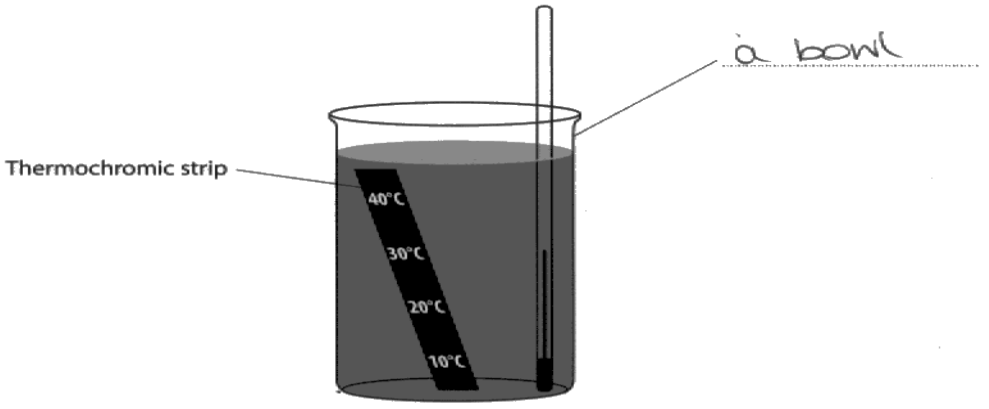
	Letter of apparatus
To measure body mass	E
To measure how quickly an athlete runs 100 m	A

Q2a

Most learners answered this question correctly by stating a beaker. However, a surprisingly large number of students identified the equipment as either a thermometer or cylinder.

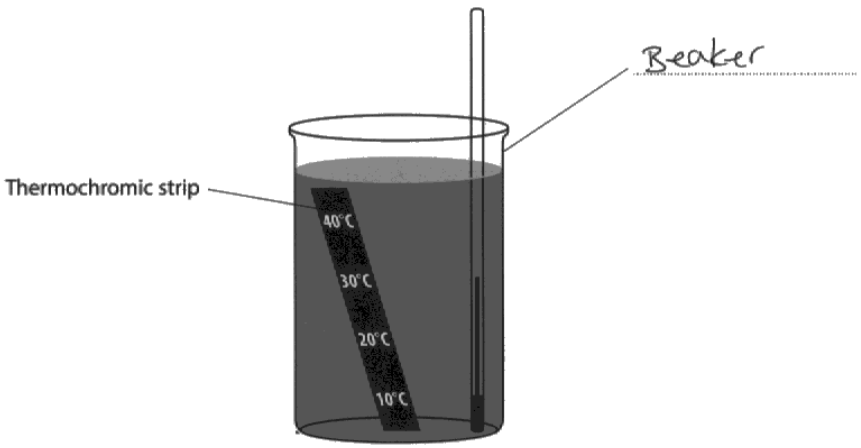
0 marks

(a) Complete the missing label from the diagram. (1)



1 mark

(a) Complete the missing label from the diagram. (1)



Q2b

This was a generally well understood question with most of the learners getting both marks. Common mistakes included learners answering that the water was hot and would cause injury, or reference to the thermometer strip meaning that the beaker does not need to be handled. Incorrect answers also stated that water is neutral and not an acid or harmful substance but did not refer to the temperature as asked in the question.

0 marks

(b) It is important to be safe when carrying out an investigation.

Explain why the temperature of the water in this investigation does **not** present a safety risk.

(2)

because it could break the glass and go everywhere.

1 mark

Because water isn't harmful/it's neutral. Also 40°C isn't that hot. There isn't any explosives.

2 marks

(b) It is important to be safe when carrying out an investigation.

Explain why the temperature of the water in this investigation does **not** present a safety risk.

(2)

Because it is not hot enough to burn your skin.

2C

A large number of learners identified two variables. However, many of these lost a mark by identifying the amount of water and size of beaker as two separate variables. The thermochromic strip was the second variable required for the second mark.

0 marks

(c) The temperature of the water is a variable that is changed.

State **two** variables that need to be kept the same during this investigation. **(2)**

1 Time

2 tempreture

1 mark

(c) The temperature of the water is a variable that is changed.

State **two** variables that need to be kept the same during this investigation. **(2)**

1 the amount of water

2 Beaber

2 marks

(c) The temperature of the water is a variable that is changed.

State **two** variables that need to be kept the same during this investigation. **(2)**

1 The Same amount of water

2 The thermochromic Strip

Q3

Many learners were able to give a simple plan or method and had the correct procedures in a logical sequence. However, they missed the finer details, stating the starting temperatures, noting the colour down and repeating the experiment to check for patterns and anomalies.

Many learners understood the idea of controls and mentioned keeping the temperature at 37 degrees. Many knew that they should repeat the procedure for each strip, but few were able to explain why a repeat of the whole investigation was needed. Very few learners were able to explain that they should wait for the colour on the strip to stabilise before taking a reading.

0 marks

3 Healthy body temperature is 37 °C.

Thermochromic strips can be used to measure body temperature.

Jane and Lukas want to investigate three different brands of thermochromic strip to find out which colours appear on each of the three strips at 37 °C.

Write a plan for this investigation.

(6)

Get three different brands of thermochromic strips and test them on three different people.

1 mark

Jane and Lukas first gather all of the equipment: ~~thermo~~ thermometer, thermochromic strip and some samples of the body. They then take the temperature to ensure it's at 37°c and the place the thermochromic strip on the sample and then write down the reaction.

2 marks

3 Healthy body temperature is 37 °C.

Thermochromic strips can be used to measure body temperature.

Jane and Lukas want to investigate three different brands of thermochromic strip to find out which colours appear on each of the three strips at 37 °C.

Write a plan for this investigation.

(6)

first - get our equipment ready

Second - place the thermochromic strip in the persons mouth

Third - wait for a minute

fourth - Take strip out and see what colour it has gone.

fith - wright down your results

Do the same two more times and have a look at the diffrences, then do the conclusing out.

3 marks

Thermochromic strips

Beaker

Thermometer

Water

Get water 37°C in a beaker and using a thermometer make sure the water is 37°C then use one brand of Thermochromic strip and see what colours appear Then repeat this but each time try a different brand of thermochromic strip.

4 marks

first What to do IS find the vaubans Which are: Controlled variblestempreture of 37°C then the Independent time in the beaker and the dependent varible Which is the thermochromic strips. Then they will find the equiptment they need. Equiptment - 3 duffrent Branas of thermochromic strips, water, kettle, thermometer and a Beaker. Then they will carry out the ~~ee~~ experiment. first they will boil the water in the kettle to 37°c then they will pour it in to the beaker then they will Put the themometer in to check its the right temP then they will Put each branes of thermochromic strip in and keep it in there for 2 minutes they will be writing the results into a table and when they have finished the experiment they will draw a graph with a line of Best fit then once that is finished they will be able to tell which thermochromic strip IS Best.

(Total for Question 3 = 6 marks)

5 marks

1.) prepare all eqvipment: (thermochromic strip, thermometer, kettle, 100ml of water, beaker)

2.) Boil 100ml of water to 37°c using a kettle and thermometer

3.) When the water reaches the correct temperature pour it into the beaker and immidiatly place thermochromic strip and thermometer into the beaker aswell.

4.) Wait for the thermochromic strip to change colour and and remove it from the water

5.) Record the resulls of the colour and repeat experiment using the alternate other 2 thermochromic strips.

I would gather 3 types of thermochromic strips, beaker of water (set at 37°c) and a thermometer to make sure the temperature is maintained.

First I would get the first thermochromic strip and would position it in water and wait for it to reach 37°c, I would repeat this process for the remaining two. I would record the colour it turned on a table. Each strip would be tested 3 times to make sure there are no anomalies or manufacturing issues with the strip.

The controlled variable is the temperature of the water as that is what we have control over. The dependant variable would be the colour the strips turned as that is what we are measuring. The independent variable would be the brand of strips as that is what is being changed.

I predict that each brand of thermochromic strip will have a similar/identical colour for 37°c.

Q4

This question was well answered, with most students scoring at least 2 marks generally for table headings and drinks with their associated numbers in the correct columns. A fair number of learners also gained the third mark for ascending or descending results.

The major of error seen was where the learners just labelled the column with grams, and in doing so, lost the mark for labelling the columns.

0 marks

4 Alfie and Tony investigated the mass of sugar found in cans of drink. Mass is measured in grams.

Here are their results.

Orangeade 35.5g	Lemonade 34.6g	
Cola 37.2g	Cream soda 38.8g	Ginger beer 36.1g

Put these results in the table with appropriate column headings and units.

(3)

Orangeade 35·5g Lemonade 34·6g	Cream soda 38·8g Ginger beer 36·1g Cola 37·2g.

1 mark

The Learner has put the data into opposing columns, but has labelled the columns incorrectly and has not put the data in ascending or descending order.

Mass in Sugar	Mass in grams
Cream Soda	38.8g
Cola	37.2g
Ginger Beer	36.1g
Lemonade	34.6g
Orangeade	35.5g.

2 marks

The learner has put the data into opposing columns and is ascending order. The learner loses the columns mark.

names	~~Ale~~ grames
Lemonade	34·6g
Orangeade	35·5g
Ginger beer	36·1g
cola	37·2g
Cream soda	38·8g

3 marks

Drink	Mass/g
Lemonade	34.6g
Orangeade	35.5g
Ginger beer	36.1g
Cola	37.2g
Cream soda	38.8g

Q5a

A well answered question with most learners attempting and gaining the mark. Some learners wrongly stated that none was the best, mistaking the result at ten minutes for the temperature reading.

0 marks

(a) State which insulating material was the best insulator.

(1)

None

1 mark

(a) State which insulating material was the best insulator.

(1)

Bubble wrap

Q5b

A well attempted question with learners being awarded the mark for identifying the temperature difference or drop as only 6 degrees or that it was the highest temperature throughout the experiment. A few learners did not gain the mark as they made no comparison between the temperature change of bubble wrap and the other materials.

0 marks

(b) State how the results show that this material was the best insulator.

(1)

because the bubble wrap keeps the heat in

1 mark

(b) State how the results show that this material was the best insulator.

(1)

Because the temperature dropped down slower and only loss 6° during the 10 minutes.

Q5ci

This was generally well answered, with the most common mistake being mistaking the result at ten minutes for the temperature reading.

0 marks

Time (minutes)	Temperature of water °C			
	None	Paper	Cotton wool	Bubble wrap
0	85	85	85	85
2	80	81	82	84
4	75	77	79	83
6	70	74	25	81
8	66	71	74	80
10	63	69	72	79
Temperature loss over 10 minutes	22	16	13	(6)

1 mark

Time (minutes)	Temperature of water °C			
	None	Paper	Cotton wool	Bubble wrap
0	85	85	85	85
2	80	81	82	84
4	75	77	79	83
6	70	74	(25)	81
8	66	71	74	80
10	63	69	72	79
Temperature loss over 10 minutes	22	16	13	6

Q5cii

Many learners were correctly able to state that the anomaly did not fit the pattern or decreased greatly or decreased then increased. Common incorrect answers were to give reasons why it was anomalous. Some learners failed to use the correct language in terms of patterns and trends. Other answers lacked detail but many were awarded the mark for stating that the results go down and then up again.

0 marks

(ii) State why Alec thinks this result is anomalous.

(1)

He might of measured it wrong of had mee

1 mark

(ii) State why Alec thinks this result is anomalous.

(1)

It doesn't match the pattern of the other numbers.

Q5di

A generally well answered question with the majority of the learners answering 'walls' correctly. Floor was the most common mistake made.

0 marks

(i) State from which part of the house the most energy is lost.

(1)

floors

1 mark

(i) State from which part of the house the most energy is lost.

(1)

The walls

Q5dii

This question was generally well answered by most learners, some stated 25% which is not a fraction and so was not awardable.

0 marks

(ii) State approximately what fraction of the energy is lost through the roof.

(1)

40%

1 mark

(ii) State approximately what fraction of the energy is lost through the roof.

(1)

$\frac{1}{4}$

(ii) State approximately what fraction of the energy is lost through the roof.

(1)

One quarter

Q6a

A well answered question by the majority of learners, correctly identifying cotton wool.

1 mark

Her results are shown in the table.

Material used as soundproofing	Sound level (decibels)
No material	94
Paper towel	90
Cotton wool	80
Newspaper	88
Fabric	86

(a) Using the table, identify the material that is the **most** effective at soundproofing.

(1)

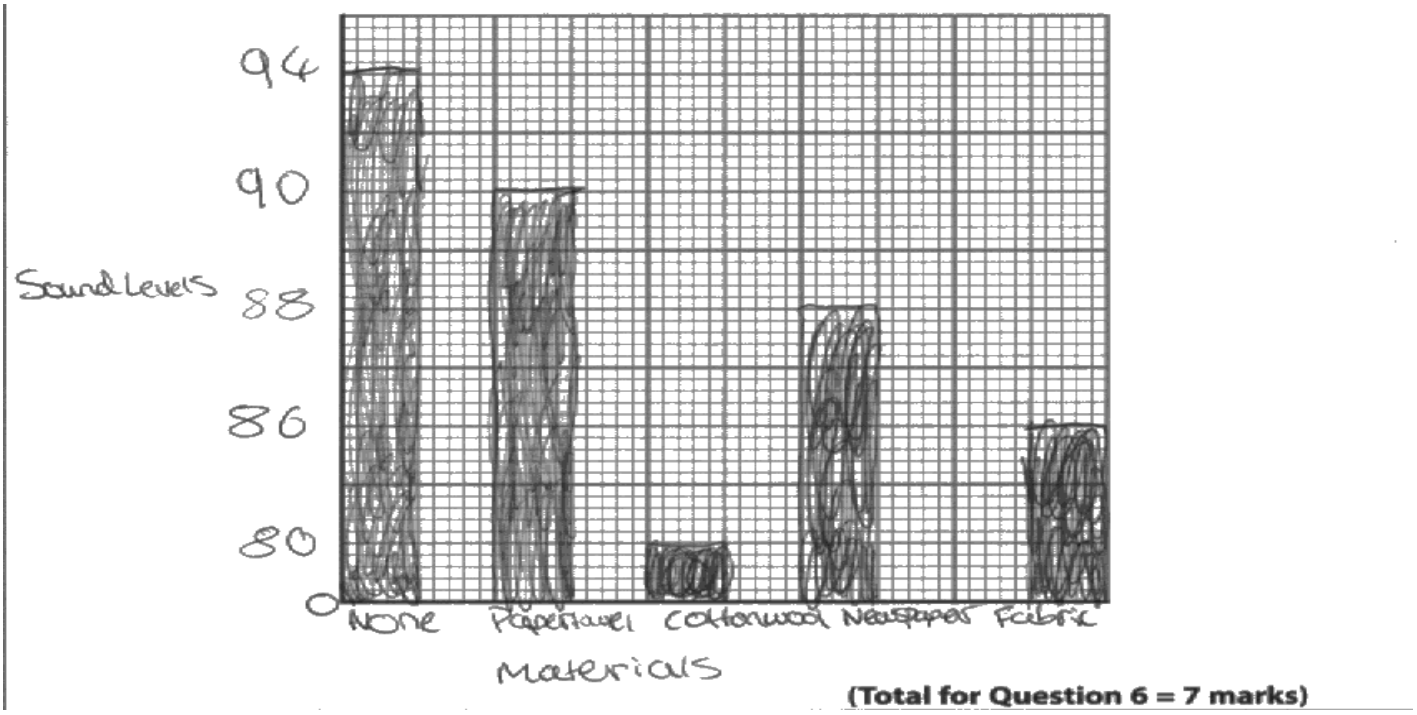
Cotton wool

Q6b

Generally learners were able to correctly label the y axis with units. Many learners plotted at least 3 bars correctly. A large number of learners did not use an appropriate scale for the graph which meant that the bar data range did not cover at least 50% of the paper. A significant number of learners did not use an equidistant scale on the y axis. Generally although the bars were labelled the labels were not clear. A significant number of learners did not draw a bar chart but attempted to draw a line graph instead.

1 mark

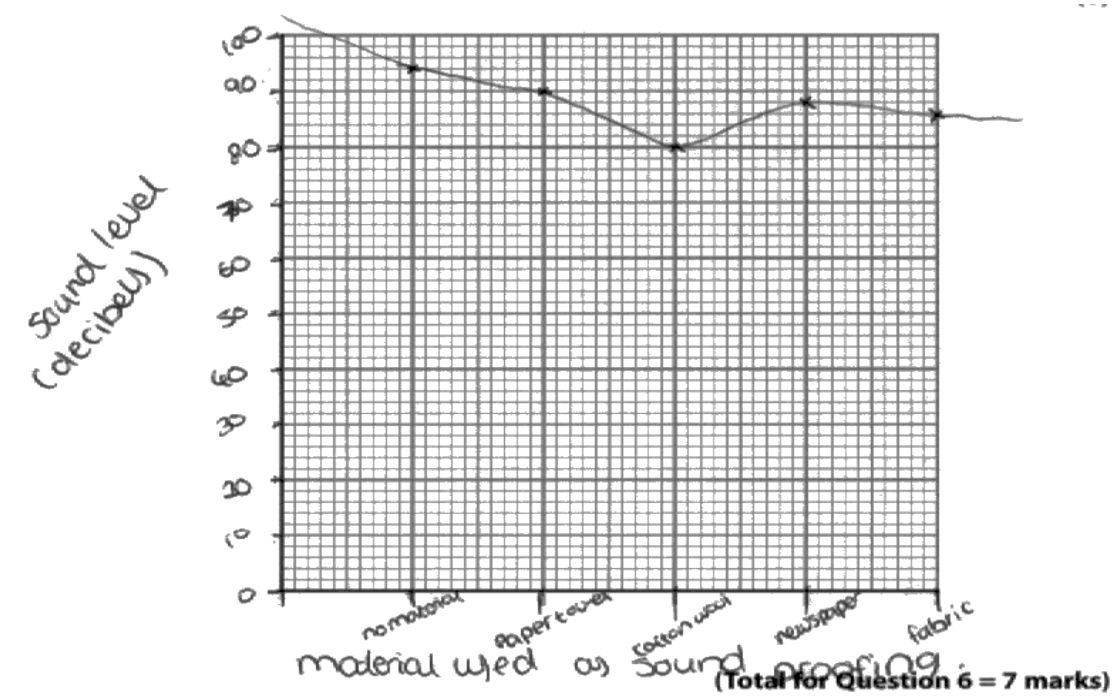
The learner has labelled the bars correctly, but has used a non-linear scale on the y axis. A maximum of two marks may be awarded for labelling the bars and y axis correctly. However, the learner has not given the units on the y axis.



(Total for Question 6 = 7 marks)

3 marks

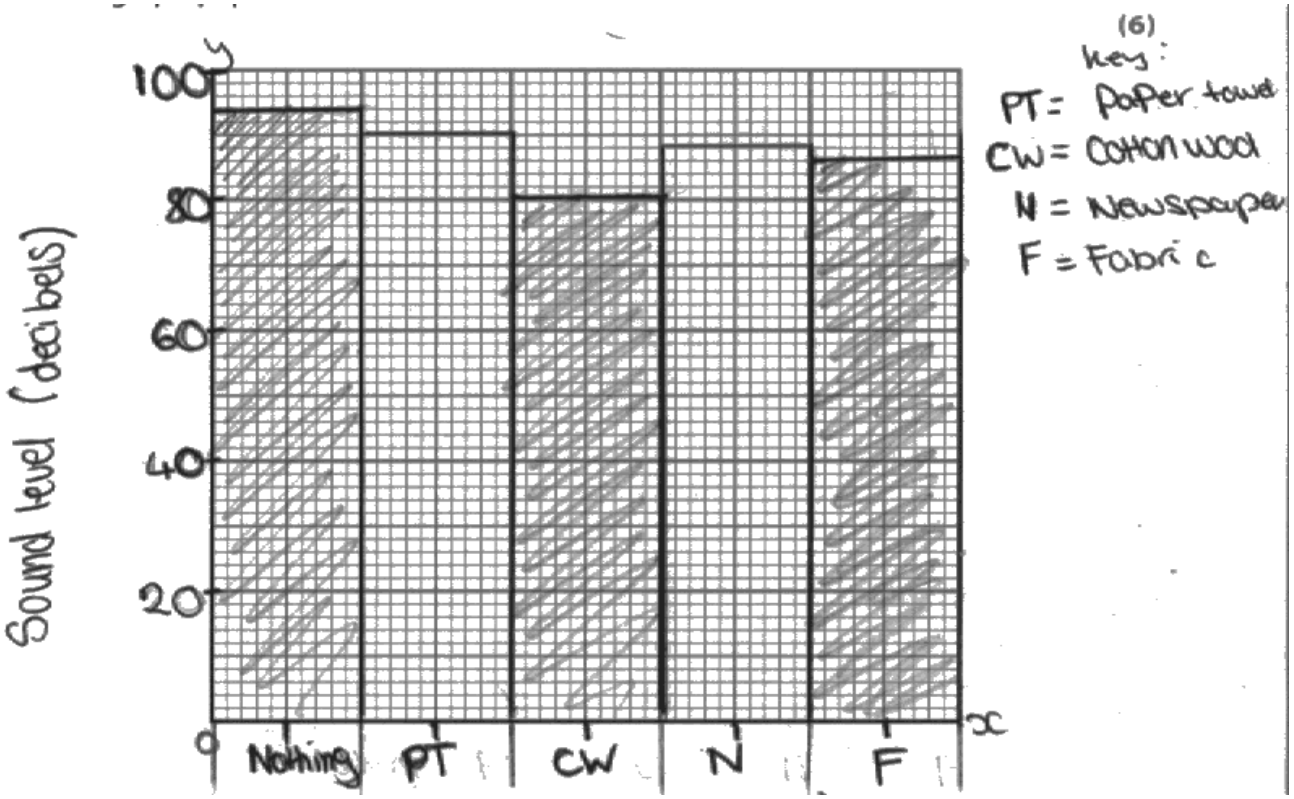
The learner has attempted a scatter graph and so can be awarded a maximum of 4 marks. The learner has the bars and axes labels correct and there are sequential numbers on the y axis to gain 1 mark. The learner has not used an appropriate scale to cause a data spread of at least half a page.



(Total for Question 6 = 7 marks)

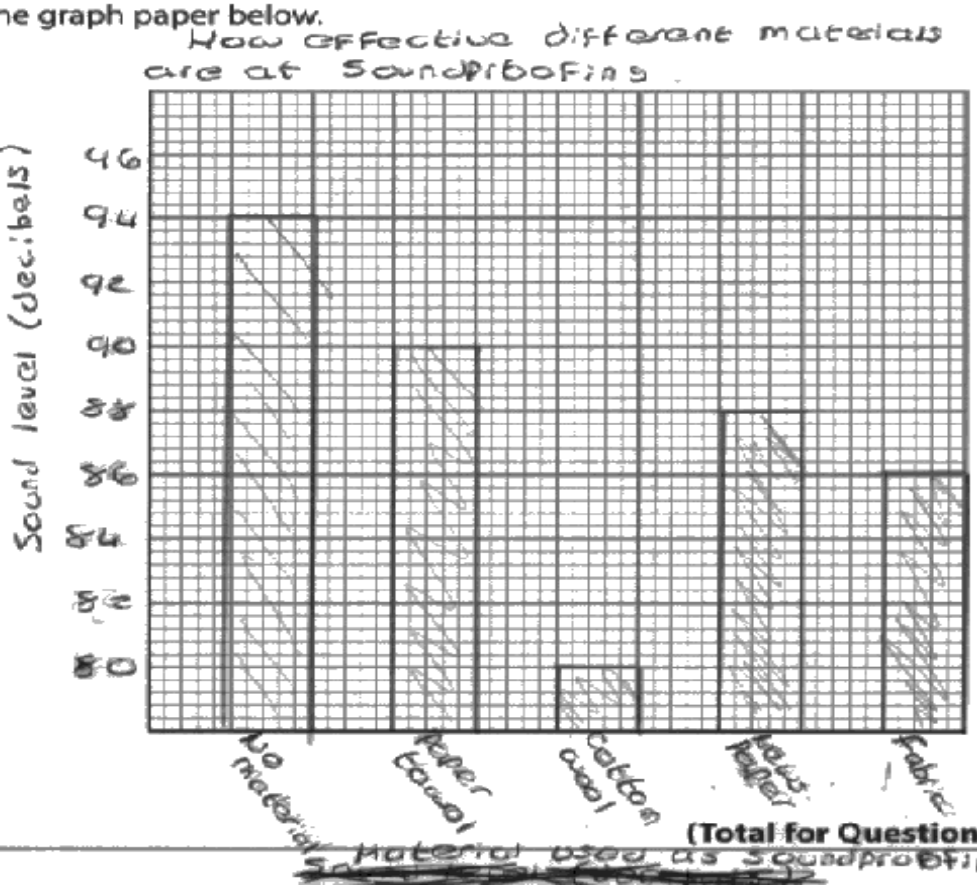
5 marks

Everything is correct accept the appropriate scale mark that would cause the data spread to cover at least half of the graph paper.



6 marks

Use the graph paper below.



(Total for Question 6 = 7

Q7a

A generally well answered question. Many learners were able to correctly calculate the average. However many learners added the values together but did not finish the calculation by dividing by 5.

Learners were given credit if they did divide the sum of the numbers they added together by five. Also if they showed how they would do the sum correctly. Learners should be encouraged to show their working out as in the event they get the final answer incorrect, they may still be able to be credited with marks.

0 marks

7 Zoey is watching a firework display.

She starts a timer when she sees the flash of the firework and stops her timer when she hears the bang.

She takes these measurements 5 times.

Zoey's results are shown in the table.

Measurement	Time (s)
1	6.1
2	6.5
3	5.8
4	6.0
5	6.2

(a) Calculate the average of Zoey's results. (2)

6.2 seconds

1 mark

(a) Calculate the average of Zoey's results. (2)

6.1 + 6.5 + 5.8 + 6.0 + 6.2 = 25.91

25.91 ÷ 5 = 5.18

= 5.18

2 marks

(a) Calculate the average of Zoey's results.

(2)

$6.1 + 6.5 + 5.8 + 6.0 + 6.2 = 30.6$

$30.6 \div 5 = \underline{6.12}$

Q7b

One mark was frequently awarded for the substitution; however the unwillingness of learners to divide a small number by a bigger number meant that the answer was wrong. The majority of learners who did not score well on this question for example, divided 340/300 rather than 300/340.

0 marks

The speed of sound can be calculated using the following formula.

$$\text{Speed (m/s)} = \frac{\text{distance (m)}}{\text{time (s)}}$$

The average speed of sound is 340 m/s.

(b) Calculate how long it would take for the sound to reach Zoey if the fireworks are 300 m away.

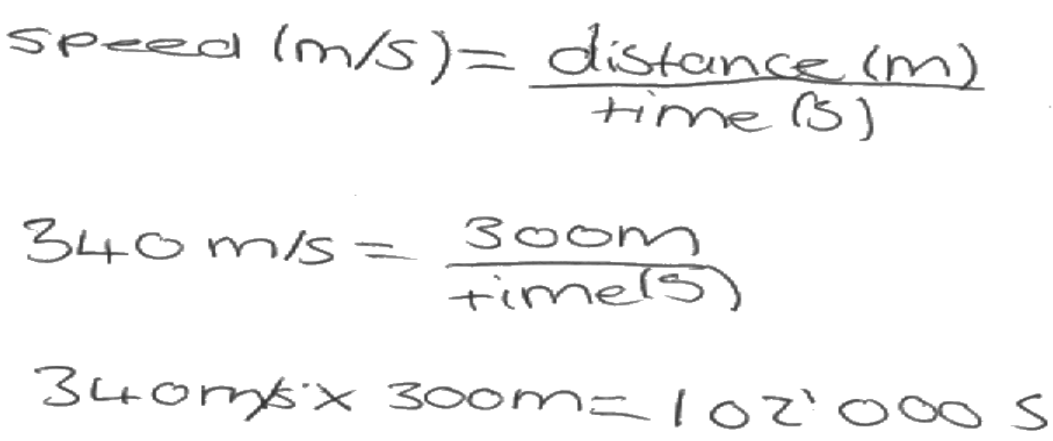
(2)

$340 \div 300$ $1.13\dot{3}$

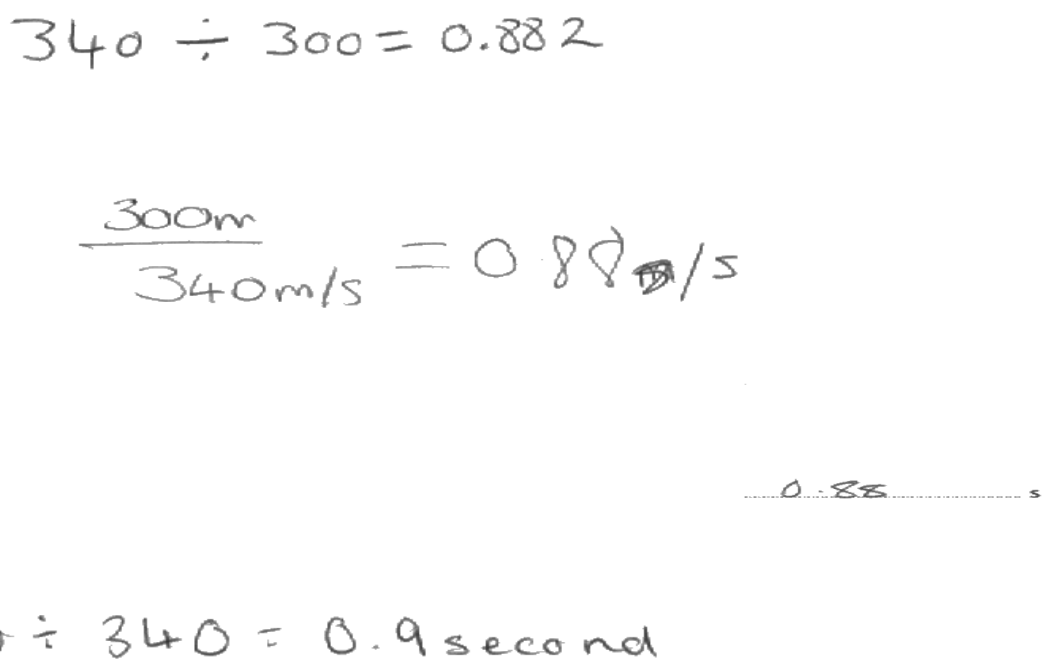
$1.13\dot{3}$ s

1 mark

This learner was awarded 1 mark for correctly substituting the values for speed and distance into the equation.



2 marks - correct answer.



Q8ai

This question was well attempted with the anomaly generally identified for a mark.

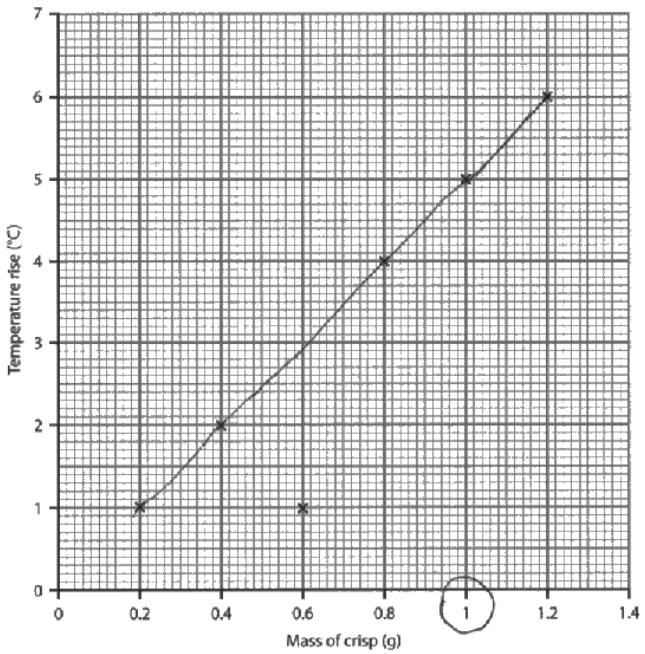
Q8aii

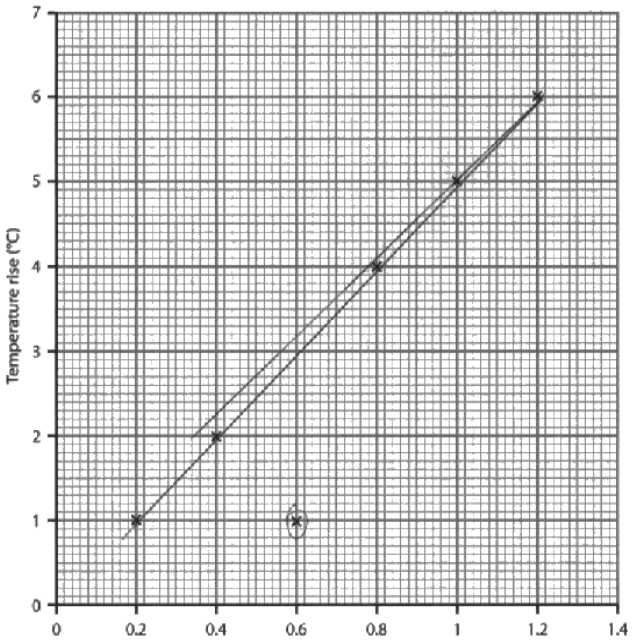
This question was well attempted and answered. Most learners identified the response B than D.

8aiii

A well attempted and executed question but some learners lost marks due to not using a ruler. The question clearly tells the learners to draw a straight line of best fit. If they did not draw a straight line they were not awarded and also if they drew multiple lines or tram-lines.

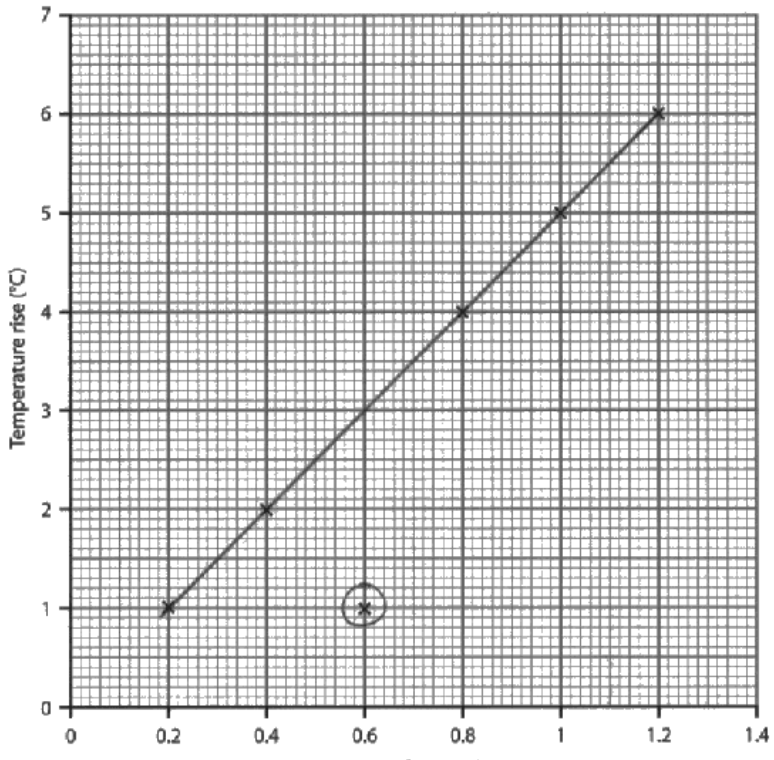
0 marks





1 mark

Here is a graph of their results.



Q8b

This was a more challenging calculation for learners. The idea of a rate was difficult for many to comprehend. However, some learners scored both marks and many scored 1 mark for getting part way to the answer. The division by 2 scored well or the value of 5 degrees. A common incorrect answer was 0.5, without any working. A fair number of learners did not put their working out down and gave a bald incorrect answer. There was the likelihood that if there was working out present, then a compensatory mark may well have been possible to award. Learners should be advised to show their working out when completing calculations.

0 marks

5.2 °C/min

1 mark

5.2 ÷ 2 = 2.6

2.6 °C/min

2 marks

5 ÷ 2

2.5 °C/min

Every minute ~~it~~ the temp goes up 2.5° (2)

After two it is 5°. Halg 5° to get 2.5°

Q9a

A well attempted and answered question with no temperature rise being identified for the mark.

9 Laura investigated reactions between metals and metal salt solutions.

She measured the temperature rise for each metal and metal salt solution reaction.

Here is a table of her results.

Metal + metal salt solution	Temperature rise (°C)
zinc + copper sulfate	2.5
zinc + magnesium sulfate	0.0
magnesium + copper sulfate	12.1
magnesium + zinc sulfate	7.6
copper + zinc sulfate	0.0
copper + magnesium sulfate	0.0

0 marks

(a) Laura does not think that copper reacts with zinc sulfate.

State why she thinks this.

(1)

Because there's no reaction between them.

1 mark

(a) Laura does not think that copper reacts with zinc sulfate.

State why she thinks this.

(1)

Because the temperature rise was 0.0 °C

(a) Laura does not think that copper reacts with zinc sulfate.

State why she thinks this.

(1)

Because the temperature has stayed the same/hasn't risen.

Q9b

This proved a challenging item. Learners seldom scored anything like full marks.
It appeared that this quite straightforward experiment appeared to not be understood by many learners. Despite the question asking for the metal, many answers were given in terms of the reactants. This meant that the most commonly scored mark was for stating that magnesium and copper sulfate gave the highest temperature rise. Some mentioned the fact that magnesium was the most reactive. However, learners rarely mentioned that magnesium reacts with zinc or copper sulfate or that there was no temperature rise when zinc or copper is added to magnesium sulfate. The compensatory marking point was awarded quite often, as many learners either thought there was insufficient evidence and that repeats should have been done.

0 marks

(b) Laura made a hypothesis at the beginning of her investigation.

'Reacting metals and metal salt solutions together will show which metal is the most reactive.'

Use her table of results to explain if there is enough evidence in the table to identify the most reactive metal.

(4)

No because there were half of the Metal + Metal salt solutions didnt with any sort of temperature so her results were not good enough.

1 mark

There is enough evidence in her table to identify the most reactive metal as it shows that the temperature rises for each reaction expect a couple of them. However some of the metal has not reacted with the metal salt solution but that could just mean that the metal and the metal salt solution aren't reactive with eachother. The most reactive metal was the magnesium, which shows that metal is the most reactive. But also there isn't enough evidence in her table to identify the most reactive as some of the metals did not react with the metal salt solution and the temperature did not rise.

2 marks

the most Reactive metal and metal salt solution is magnesium + Copper sulfate. this being because the highest tempreture rise was 12.1. The two lowest was Copper + Zinc sulfate and Copper + Magnesium sulfate Because they both rised 0.0 tempreture therefor the most Reactive metal is magnesium + Copper Sulfate.

3 marks

(b) Laura made a hypothesis at the beginning of her investigation.

'Reacting metals and metal salt solutions together will show which metal is the most reactive.'

Use her table of results to explain if there is enough evidence in the table to identify the most reactive metal.

(4)

From her results the most reactive metal is magnesium, I know this because the magnesium + copper sulfates temperature rised by 12.1°C and a magnesium + zinc sulfate rised by 7.6°C which shows the higher increase out of them all because zinc being the metal and copper sulfate being the metal salt solution rised by 2.5 which shows zinc is less reactive than magnesium. Also copper + zinc sulfate temperature rised by 0.0 which is no rise which shows copper is less reactive than zinc and magnesium.

Q10

This question was well attempted by the majority of learners and many were awarded a pass of one or two marks. A fair number of learners achieved a merit with three/four marks, but the lack of explanation of the improvements that had been identified prevented students from gaining the maximum marks. The most commonly awarded improvement was to say repeat the experiment, but lacking any follow-up explanation. Specifying the range of juices and the procedure with the indicator paper were also popular, but again without reason provided.

It appears for this item learners need further practice in providing an explanation of the things asked for.

0 marks

10 Zac wants to investigate the pH levels of different fruit juices.

He will use universal indicator paper to test the pH.

Here is his method:

1. Choose different fruit juices.
2. Use universal indicator paper.
3. Record results.

Zac thinks that he can improve his method so that it is repeatable.

Explain the improvements he could make to this method.

(6)

use same amount of fruit juices each time

Pass/1 mark

10 Zac wants to investigate the pH levels of different fruit juices.

He will use universal indicator paper to test the pH.

Here is his method:

1. Choose different fruit juices.
2. Use universal indicator paper.
3. Record results.

Zac thinks that he can improve his method so that it is repeatable.

Explain the improvements he could make to this method.

(6)

Choose better branded juices & test the experiment more than once maybe 3 or 4 times for each ouree to make sure that it is accurate

Pass/2 marks

He should choose three different fruit juices, for example 'orange, mango & apple juice! Then use the universal indicator paper, he should wait 30 seconds before recording his results. He will be able to repeat this experiment three times on each juice.

(b)

use the same amount of fruit juices and make sure they are all fresh. Repeat each fruit juice 3 times and work out the average for each fruit juice, this is so you can get a more accurate result.

Merit/4 marks

- Firstly when chosing different fruit juices make sure they are different brands with different variations of fruit.
- When using the universal indicator paper you must change it for a new one as an different fruit juice you test.
- Make sure you record the amount of time it took to get results of the universal indicator paper to make it fair each time.
- Do not use the same beaner for every fruit juice because then the juices will mix resulting in a unfair investigation.
- Make a graph after writing up the results to see a clear increase or decrease after all juices are tested.
- Make sure you label if they are: an Acid, neturol or Alkali.

~~(He could use a different container for all the fruit juices).~~

- He could make the universal indicator paper all the same size
- He could use a measuring cylinder to measure the same amount of fruit juice each time
- He could repeat the process 3 times to avoid anomalous results
- He could use the same type of ~~container for each juice~~ beaker but use a different ~~container~~ beaker for each juice so that the PH levels aren't effected by remainders of the previous fruit juice used ~~(cont...ly)~~. Alternatively, he could wash and rinse the ~~container~~ beaker well to make sure it's clean.

Distinction/ 5 marks

(6)

① Choose five different juices, with the same amount of ml (mililitres)
② Select one drink at a time (make sure all of the juice is used).
③ Using universal indicator paper, dip it into the juice and record the result which would be; acid, alkaline; or neutral. You could also record if it is a strong acid or alkaline.
④ Do the same to each of the five fruit juices and record the results in the same way. We can record the results in a table.
⑤ If you would like it to be a really accurate test you can repeat the test at least 3 times for each juice so that you would work out the average, and exclude any anomalous results.
⑥ Make sure you clean up after yourself safely.

Distinction/6 marks

(6)

He does not say what the amount of fruit juices needed therefore that should be added and this should be controlled to make it a fair test the same amount will be needed as he is going to be testing different juices meaning the different juices will the one being changed, it will be the independant variable and the thing he will be measuring is the pH level of the juice meaning that will be the independant variable. He could say how results to make and that they should be repeated to make it a reliable test and to get a variety of results. He did not mention how many types of fruit juices he will be needing or the amount of it and to make it repeatable he has to carry out a number of tests to get a pattern and results which are not anomalous He should do at least 3 tests to get an average. To make results accurate he could use a pH meter instead of the paper so it is accurate and results are more reliable. He should include a range.

(Total for Question 10 = 6 marks)

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