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Examiners' Report
June 2013

GCE Biology 6BI08 01

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Introduction

The majority of candidates appeared to be well-prepared for this paper and were able to describe core practicals and apply them in the planning of an investigation.

This paper achieved a full range of marks, particularly with Q1 and Q2.

When candidates recognised the context in which the question was set, they generally found Q1 and Q3 accessible and many good answers were seen. In Q1(a) a disappointing number of students did not address the question asked. Rather than describe how to use a spirometer *trace* they described how to use the spirometer itself. A number of candidates still try to apply 'generic' answers to parts of Q3. This often results in little credit. With Q3, some candidates continue to find it difficult to identify what needs to be included in each section of the question.

Many candidates scored highly with Q2. This was particularly the case for parts (a), (b) and (c) of the question, in which candidates are expected to produce a null hypothesis, tabulate, present and analyse data provided for them. A surprising number of candidates were unable to tabulate the data successfully and many appeared uncomfortable with the idea of using median values.

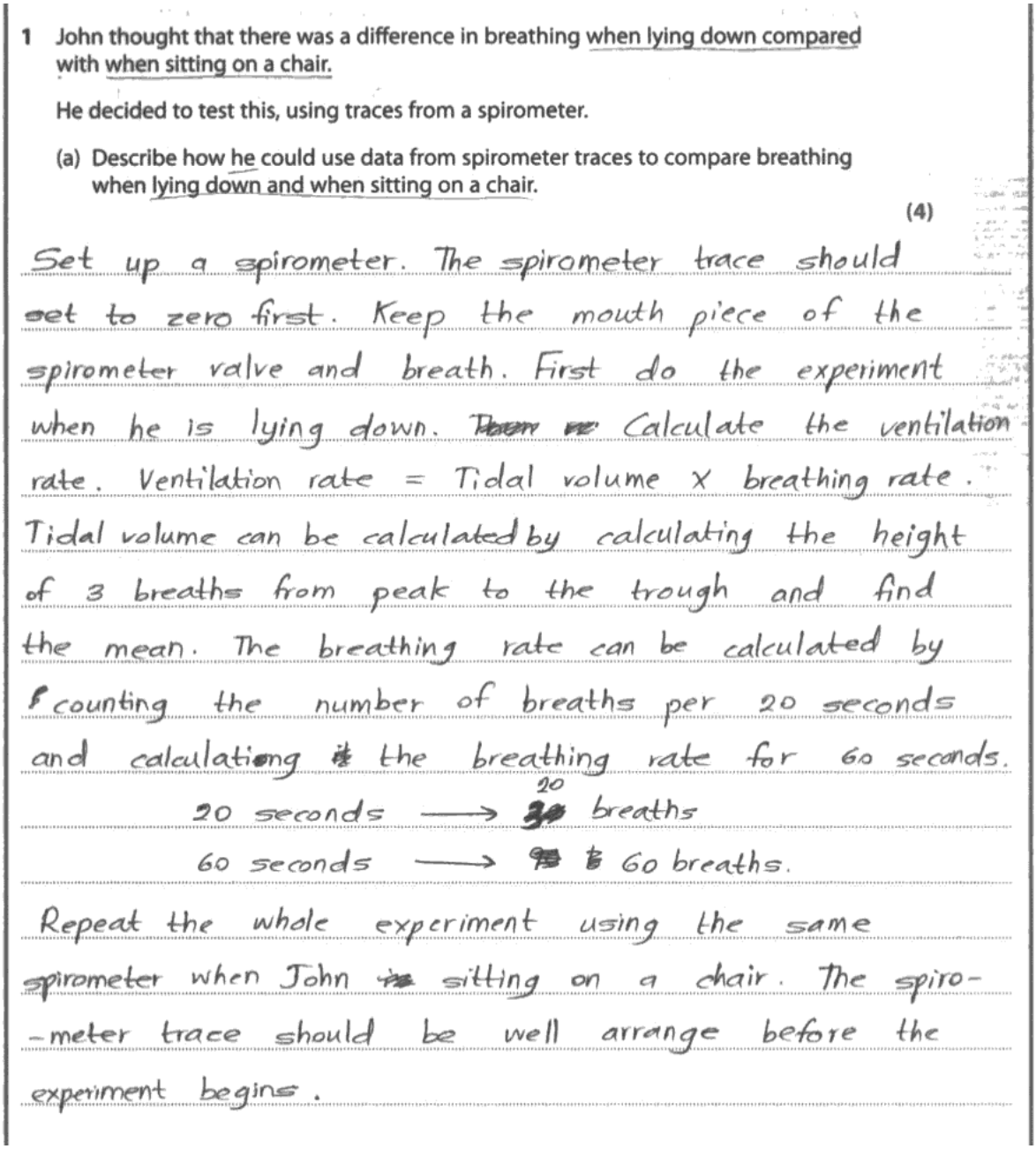
Those parts of Q1(c) and Q2(e), in which candidates needed to rely on their understanding of biological principles, were generally less well-answered.

Question 1 (a) (b)

A significant number of candidates gave detailed accounts of how to use a spirometer, rather than answering the question asked. Those candidates that did answer the question asked, often scored well. Candidates frequently gained MP1, 2 and 6. A relatively small number of candidates suggested that the spirometer (trace) should be calibrated, or clearly identified the units for the dependent variable (MP3 and 4). Attempts at describing how a dependent variable could be obtained from the traces often lacked clarity and were not considered creditworthy (MP5).

Candidates often gained both marks, for suggesting two suitable variables to control 1 (b)(i). However, they then frequently failed to provide an adequate description of how to control the variable or what effect lack of control would have on the dependent variable, 1 (b)(ii).

A large number of candidates identified soda lime (or equivalent CO_2 absorber) as a variable to control. In fact, the variable is the presence or absence of CO_2 and the method of control is to have an excess of soda lime.



1 John thought that there was a difference in breathing when lying down compared with when sitting on a chair.

He decided to test this, using traces from a spirometer.

(a) Describe how he could use data from spirometer traces to compare breathing when lying down and when sitting on a chair.

(4)

Set up a spirometer. The spirometer trace should set to zero first. Keep the mouth piece of the spirometer valve and breath. First do the experiment when he is lying down. Calculate the ventilation rate. Ventilation rate = Tidal volume x breathing rate. Tidal volume can be calculated by calculating the height of 3 breaths from peak to the trough and find the mean. The breathing rate can be calculated by counting the number of breaths per 20 seconds and calculating the breathing rate for 60 seconds.

20 seconds ⟶ breaths

60 seconds ⟶ 60 breaths.

Repeat the whole experiment using the same spirometer when John sitting on a chair. The spiro-meter trace should be well arrange before the experiment begins.

(b) (i) State **two** variables which need to be controlled to provide valid spirometer traces.

(2)

Temperature

Humidity

(ii) Choose **one** of the variables from (b)(i) above. Suggest how this variable can be controlled. Describe what effect this variable could have on the data from the spirometer traces if it is not controlled.

(2)

Variable Temperature

How to control the variable By closing all the doors and windows in the room and doing the experiment in the same time of the day. Temperature can be measured using a temperature probe.

Effect on the data from the spirometer traces if this variable is not controlled.

Temperature affects the ventilation rate. ~~The~~ ~~the~~ If the temperature increases the number of breaths per minute will increase. Also the tidal volume will increase. This will increase the ventilation rate.

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Examiner Comments

In 1 (a), the candidate has answered the question asked and has scored 3 marks. The candidate started by suggesting that the spirometer trace should be set to zero. This was not accepted as being equivalent to 'the spirometer trace should be calibrated', and MP4 was not awarded.

The candidate then clearly identified two suitable dependent variables, gaining MP1 and 2.

A third mark was awarded for the description of how tidal volume could be determined from the trace, MP5. This could have been awarded for the description of how breathing rate was determined.

The candidate did not give units for any of the dependent variables identified, so did not gain credit for MP3.

Both suggestions for control variables were accepted in part 1 (b)(i) and the candidate gained 2 marks.

In 1 (b)(ii), there is not sufficient detail of how the temperature would be controlled to gain the first mark. Use of an air-conditioned or temperature-regulated room would have been sufficient.

In attempting to explain the effect of changing temperature, the candidate has mixed up the effect of change in environmental temperature with fever. If the environmental temperature falls, this will result in increased muscle activity (shivering) and increased demand for oxygen and thus an increased breathing rate.

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Examiner Tip

The units of a variable are important. Remember to include suitable units when describing variables.

1 John thought that there was a difference in breathing when lying down compared with when sitting on a chair.

He decided to test this, using traces from a spirometer.

(a) Describe how he could use data from spirometer traces to compare breathing when lying down and when sitting on a chair.

(4)

Breathing rate can be ~~ob~~ obtained from spirometer traces. ~~Compare th~~ ~~the b~~ ~~The breathing rate of him sitt~~ sitting on ~~a chair and lying down is calculated.~~ Before the experiment starts, ~~calcul~~ ~~cal~~ calculated the initial breathing rate. ~~Start the ex Sta Experi~~ ~~from spirometer traces~~ Breathing rate is recorded when lying down and sitting on a chair. Compare the breathing rate. ~~John needs to be calm when experin~~ Temperature of surroundings must be ~~maintained.~~ ~~First, sit~~ When he is sitting on ~~the~~ a chair, start taking his breathing rate using spirometer after resting on the chair for one minute. Repeat the same method when lying down. Compare both breathing rate. The independent variable is lying down or sitting on the chair.

(b) (i) State **two** variables which need to be controlled to provide valid spirometer traces.

(2)

Temperature of surroundings. ~~Ther~~

~~Activity done before breathing rate~~

activity done before each experiment starts.

(ii) Choose **one** of the variables from (b)(i) above. Suggest how this variable can be controlled. Describe what effect this variable could have on the data from the spirometer traces if it is not controlled.

(2)

Variable Temperature

How to control the variable Experiment is done in air ~~conditioned~~ conditioned ~~room~~ room.

Effect on the data from the spirometer traces if this variable is not controlled.

Spirometer traces ~~are~~ will be invalid.

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Examiner Comments

In this example of 1 (a), the candidate has identified one dependent variable, breathing rate, for MP1. Nothing else was considered creditworthy.

Note, the reference to *repeat* was in the context of repeating the procedure when lying down. The candidate has not suggested taking repeat measurements in each position and MP6 cannot be awarded.

In 1 (b)(i), the candidate has identified two acceptable variables that need to be controlled: temperature of the surroundings (MP4) and activity of subject prior to testing (MP8).

In part 1 (b)(ii), an acceptable method of controlling temperature was given for the first mark. However, no credit can be given for statements such as *the trace will be invalid*. So, in this example, the second mark for (b)(ii) could not be awarded.

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Examiner Tip

Read questions carefully: marks can only be awarded for answers that address the question. This question asks how the data from a spirometer *trace* can be used. It does not ask how to use a spirometer.

1 John thought that there was a difference in breathing when lying down compared with when sitting on a chair.

He decided to test this, using traces from a spirometer.

(a) Describe how he could use data from spirometer traces to compare breathing when lying down and when sitting on a chair.

(4)

John should ask 15 people to help him test this hypothesis. Make sure all the 15 people are of the same age and gender. He should ask each one of them to put on the nose clip and breathe in and out through their mouth into the spirometer tube while ~~standing~~ sitting on a chair. This will cause the kymograph to draw a trace on the graph which will help him obtain the tidal volume and the number of breaths per minute. Using this he can get the dependent variable which is ventilation rate.

Ventilation rate = Tidal volume x number of breaths per minute.

$(dm^3 min^{-1})$ (dm^3) (min^{-1})

The experiment should be repeated by the same person while lying down.

This experiment should be repeated by the other 14 people and the mean ventilation rate while ~~standing~~ sitting on a chair and the mean ventilation rate while lying down.

(b) (i) State **two** variables which need to be controlled to provide valid spirometer traces.

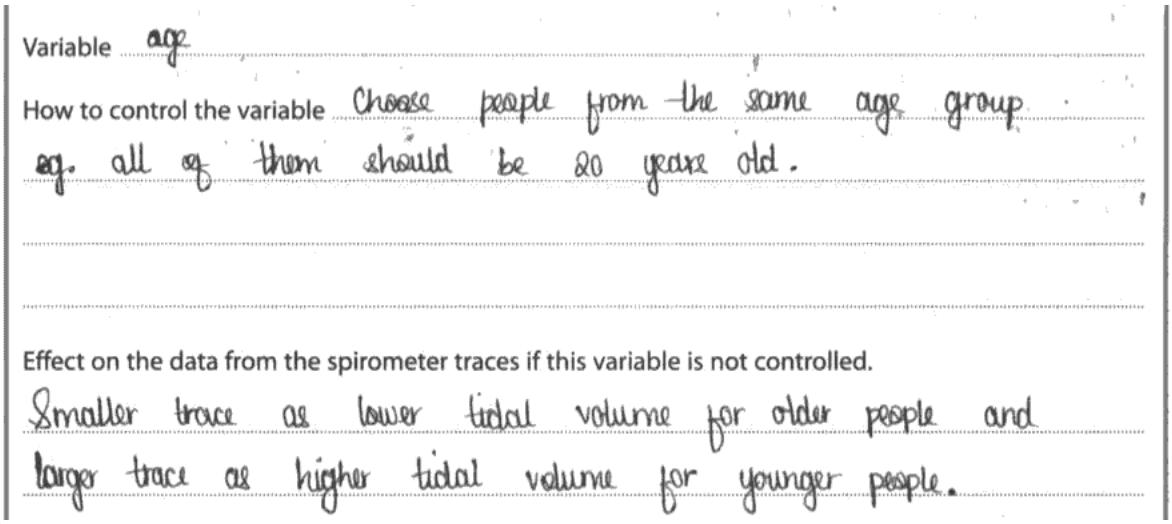
(2)

gender

age

(ii) Choose **one** of the variables from (b)(i) above. Suggest how this variable can be controlled. Describe what effect this variable could have on the data from the spirometer traces if it is not controlled.

(2)


Variable age

How to control the variable Choose people from the same age group eg. all of them should be 20 yeare old.

Effect on the data from the spirometer traces if this variable is not controlled.

Smaller trace as lower tidal volume for older people and larger trace as higher tidal volume for younger people.

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Examiner Comments

In 1 (a), the candidate gained a maximum of 4 marks.

2 marks were given for clearly identifying appropriate dependent variables (MP1 and 2).

A third mark was given for using correct units (MP3).

A fourth mark was given for the idea of repeats, with reference to carrying out the test on 15 individuals (MP6).

The answer could have been improved by describing the need to calibrate the spirometer trace and by including a description of how to determine the breathing rate and the tidal volume from the trace.

In 1 (b)(i), the candidate has clearly identified two variables that should be controlled (MP2 and 3).

In 1 (b)(ii), a sensible method for controlling age has been described and a reasonable suggestion has been provided as to how not controlling the variable will affect the results.

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Examiner Tip

Some questions are split into more than one related part. When this happens, make sure that you read the whole question and plan how you will answer the whole question, before starting your answers.

For this part of Q1, you need to think about 1 (b)(ii) before producing your answer to 1 (b)(i).

Question 1 (c)

Excellent responses to this question were produced by a number of candidates. However, many candidates failed to address the question and expressed their understanding of the relevant physiology poorly, gaining few marks.

Some of the more serious errors included descriptions of:

- the breathing process
- action potentials

- the effects on heart rate
- a perceived role for stretch receptors
- the detection of changes in oxygen concentration.

(c) Suggest how breathing is controlled by the nervous system in response to changing position from lying down to sitting on a chair.

(4)

Muscles are more active when sitting than when lying down so therefore they respire more releasing CO_2 into the blood. This causes pH to fall and chemoreceptors in blood ~~cardio vascular~~ detect change and send impulses to the ~~cardio vase~~ ~~centre~~ medulla in the brain which in turn ~~sent~~ increases the frequency of impulses sent ~~off~~ along the sympathetic neurone to the intercostal muscles and ~~diaphg~~ ~~diaphg~~ diaphragm causing ~~prompting~~ them to contract harder and faster to increase CO_2 going out by expiration and O_2 coming in by inspiration.

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Examiner Comments

In this response, the candidate has gained a maximum of 4 marks.

The answer is succinct and clearly expressed.

Marks were awarded for:

- increased respiration (MP1)
- change in blood pH/CO_2 (MP6)
- identification of a role for the medulla (MP4)
- the idea that impulses are sent to the muscles involved in breathing - diaphragm and intercostal (MP8).

A mark could also have been awarded for correct reference to the role of the sympathetic nervous system (MP2).

Note that the candidate would not have gained MP5 because they suggest incorrectly that chemoreceptors are located in the blood.

Mention of a role for chemoreceptors by itself would have been acceptable, as would chemoreceptors in the carotid and aortic bodies.

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Examiner Tip

Remember, if you contradict yourself or if you make a scientific mistake in the same sentence, you will probably not gain credit for any correct science.

In this example, the idea of chemoreceptors is credit-worthy. However, chemoreceptors are not located in the blood, so a mark was not awarded.

(c) Suggest how breathing is controlled by the nervous system in response to changing position from lying down to sitting on a chair.

(4)

Responses are sent to the medulla oblongata in the brain and they are detected * by chemoreceptors which respond to a change in pH levels in the blood* the medulla oblongata is vital in regulating breathing levels. The medulla sends impulses and messages to the ~~lungs~~ heart down either the parasympathetic or symphatenc nerve and the heart responds by either increasing Heart rate and therefore amount of Oxygen or decreasing heart rate and therefore the amount of O_2 falls as well.

*~~due to the presence of CO_2~~ and CO_2 levels

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Examiner Comments

In this response, the candidate begins well by:

- describing the role of chemoreceptors (MP5)
- detecting changes in blood pH (MP 6)
- linking this with the medulla (MP4).

However, the rest of the candidate's answer describes regulation of heart rate and gains no further marks.

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Examiner Tip

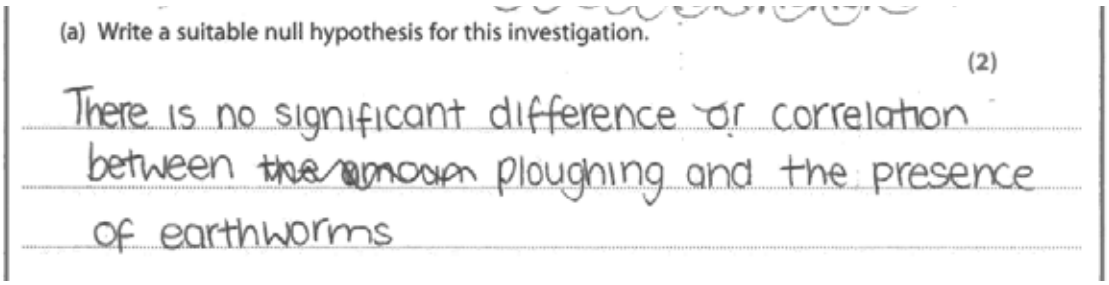
Make sure that you understand the question before you begin your answer.

Check that you have answered the question that was asked, once you have written your answer.

Question 2 (a)

Many candidates were able to write a reasonable null hypothesis. One mark was available for recognition that the test was for a difference between two conditions – so the null hypothesis should include reference to **no significant difference**. A second mark was available for a reasonable attempt at expressing the different conditions.

Considerable latitude was given for the way the candidates expressed themselves for the second mark, as long as they addressed the idea of the **number** of worms. Reference to the **presence** of worms was not accepted. Some candidates produced a list of options eg significant correlation or significant difference. Answers like this were considered a contradiction and did not gain the mark. Other responses produced vague terms such as 'significant effect' or omitted the idea of a significance. Again, no mark was awarded.


(a) Write a suitable null hypothesis for this investigation.

(2)

There is no significant difference or correlation between the amount ploughing and the presence of earthworms

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Examiner Comments

In this example the candidate suggested significant correlation or significant difference, so did not receive the first mark. They also referred to the presence, rather than the number, of worms, so did not receive the second mark either.

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Examiner Tip

Being able to produce a hypothesis and null hypothesis are important scientific skills. Make sure that you know when to use the appropriate significance terms – 'significant difference' and 'significant correlation'.

Think carefully about what is being tested. In this example, earthworms are present in both fields: what is being tested is the difference in **number** of earthworms.

(a) Write a suitable null hypothesis for this investigation.

(2)

There is no significante difference between the field A and field B.

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Examiner Comments

One mark was awarded for the correct use of 'significant difference'. However, the candidate does not include reference to the number of worms in the fields so does not receive the second mark.

(a) Write a suitable null hypothesis for this investigation.

(2)

There is no significant difference between the number of ~~method of~~ ~~plou~~ earthworms in field A ploughed using one method and in field B ploughed using another method.

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Examiner Comments

In this response, the candidate uses the correct significance term and clearly expresses the idea of a difference in the number of worms associated with different ploughing methods. This answer was awarded both marks.

Question 2 (b) (c) (d)

This should have been a straightforward question for the majority of candidates.

In Q2 (b), candidates frequently gained marks for correctly determining the two median values. A disappointing number of candidates did not rank the data in the table, as instructed, and so did not gain MP3. Even more surprising was the large number of candidates that failed to include any idea of units in the table heading or used arbitrary units / AU.

For MP4 headings, ideally, candidates needed to include a reference to the correct area of the quadrat ($0.25m^2$). The examiners did accept (0.5m x 0.5m) and per quadrat in place of $0.25m^2$.

In Q2 (c), candidates were asked to plot a graph to display median values and to include an indication of the variability of the data. The majority of candidates gained the P mark, although this was often for plotting incorrect medians carried over from the tabulated data (2 (b)). A disappointing number of candidates did not give an indication of variability of the data. Simply adding range bars to their plots would have been sufficient. Many candidates did not include either, the term *median* or any units in their y-axis label, and did not gain the A mark.

Candidate responses in 2 (d) often scored well. Most candidates were able to determine the correct critical values and to compare them correctly with the smallest U value (MP1 and 2). Many then went on to accept correctly the null hypothesis (MP4) and to state that there was no significant difference between the number of earthworms in the different fields (MP3). Note that in order to be credited with MP3, candidates needed to refer to the number of earthworms, not just median values or presence of earthworms.

Many candidates still confuse the terms 'significant difference' and 'significant correlation'. Few candidates attempted MP5. Of those that did, many referred to large error bars or overlapping error bars but did not link this with wide variability of the data or the idea that the median values are close together.

(b) Prepare a suitable table to rank the data obtained. Identify the median number of earthworms from the quadrats in each field. (4)

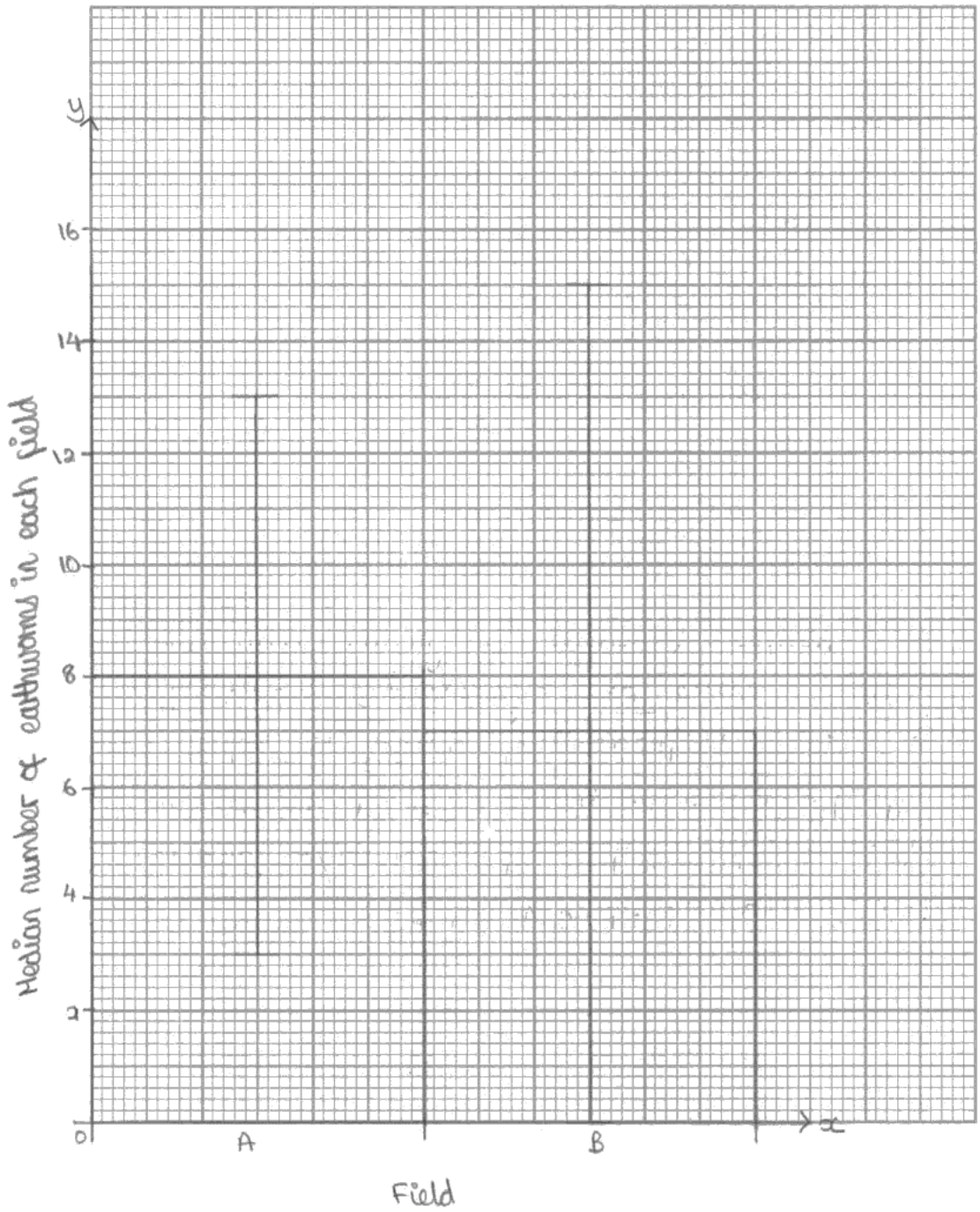
	Number of earthworms in individual quadrats											
Field	1	2	3	4	5	6	7	8	9	10	11	Median
A	10	4	13	9	9	3	8	5	4	-	-	8
B	15	6	12	0	3	8	9	10	7	4	6	7

Median A - 3, 4, 4, 5, 8, 9, 9, 10, 13

Median B - 0, 3, 4, 6, 6, 7, 8, 9, 10, 12, 15

(c) On the graph paper below, draw a suitable graph to show the effect of different methods of ploughing on the median number of earthworms from the quadrats in each field. Include on your graph an indication of the variability in the data.

(3)



(d) The farmer decides to apply the Mann-Whitney U test to the data. This statistical test determines if the difference between the medians is significant.

The calculations produced two U values for this set of data. In order to support a difference between the two medians, the smaller U value must be the same as, or less than, the critical value.

He obtained a result of U = 50 from the calculation (the smaller value).

The table below shows the critical values for the Mann-Whitney U test at the $p = 0.05$ level.

	Sample size n_2					
Sample size n_1	**7**	**9**	**11**	**13**	**15**	**17**
7	8	12	16	20	24	28
9	12	17	23	28	34	39
11	16	23	30	37	44	51
13	20	28	37	45	54	63
15	24	34	44	54	64	75
17	28	39	51	63	75	87

What conclusions can be drawn from this investigation? Use the information provided in the table above and in the graph you have drawn.

(4)

The smaller U value is greater than the critical value at significance level of 0.05%. Therefore you accept the null hypothesis. There is no significant difference between the method of ploughing and the number of earthworms present.

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Examiner Comments

In part (b), the candidate has determined the two median values correctly (MP1 and 2), and has produced a table with accurate headings (MP4). However, the data is not ranked within the table, as instructed in the question and so MP3 was not awarded.

The graph produced for part (c) gained the B mark for correctly-drawn range bars. The y-axis label incorrectly refers to the number of worms in each field and the candidate has drawn a histogram (bars touching), which is incorrect, so neither the A nor the B marks were awarded.

In the response to part (d), the candidate has identified the critical value as being 23 (Circled in the table) for MP 2 and asserts correctly that the smaller U value is greater than the critical value (MP1).

The candidate then goes on to state that the null hypothesis should be accepted (MP4) and that there is no significant difference between the number of worms present when fields are ploughed by the different methods (MP3). For MP3, the answer must refer to the number of worms and not simply the presence.

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Examiner Tip

Take care with graphs. Since in this case the x-axis (field A and B) is not continuous, a bar graph should be used. Only use a histogram when you want to illustrate the distribution of data for a continuous variable. Axis labels must be accurate. If the data being plotted are median values, the axis label should include the term 'median'.

Units for the axis should come from the data - in this case, the number of worms per 0.25 m^2. Only use the term 'arbitrary units' if that is how the raw data are recorded.

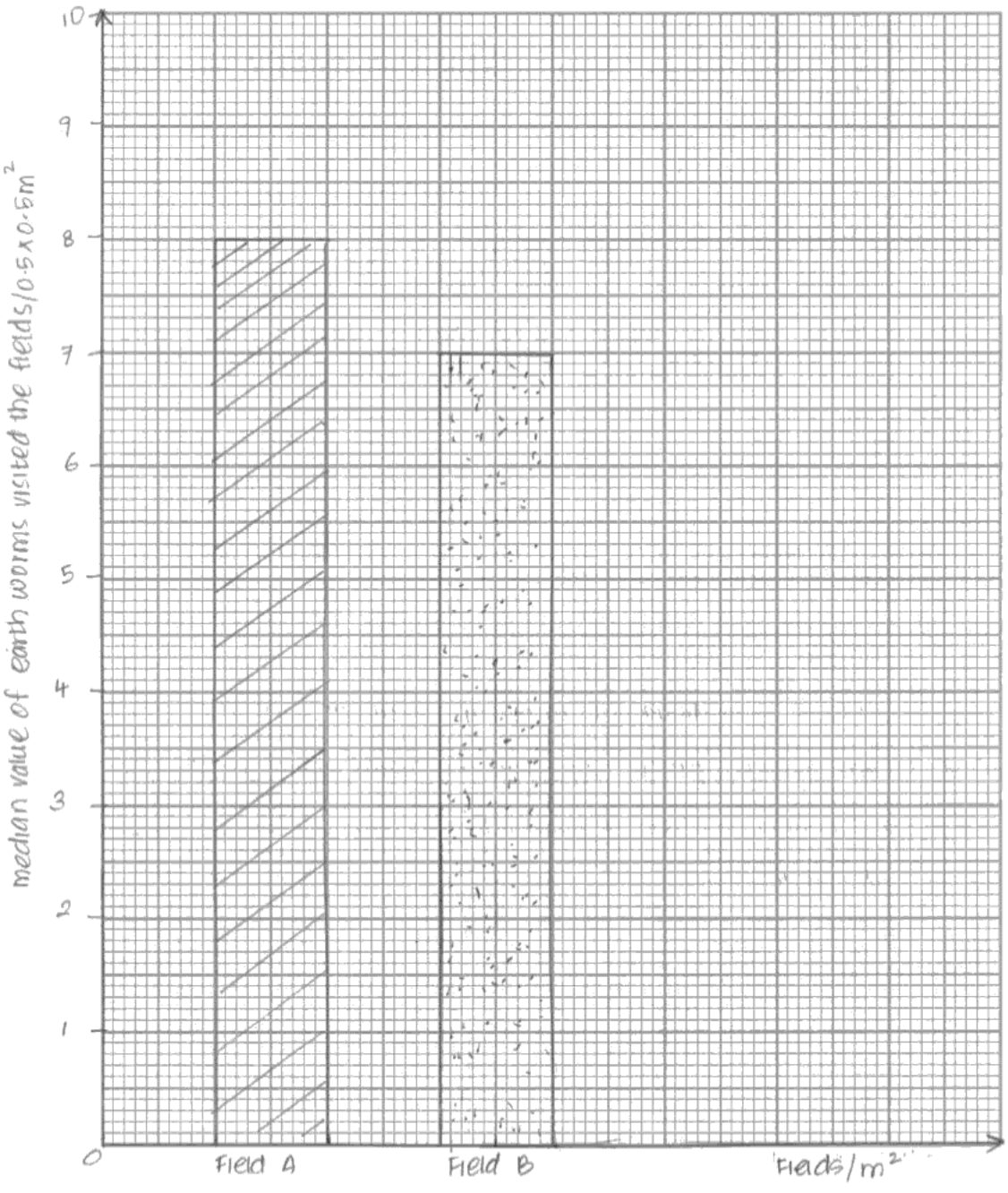
(b) Prepare a suitable table to rank the data obtained. Identify the median number of earthworms from the quadrats in each field.

(4)

	Number of earthworms visited in each quadrat/(0·5x0·5) m^2											median value
Field A	3	4	4	5	8	9	9	10	13	x	x	8
Field B	0	3	4	6	6	7	8	9	10	12	15	7

(c) On the graph paper below, draw a suitable graph to show the effect of different methods of ploughing on the median number of earthworms from the quadrats in each field. Include on your graph an indication of the variability in the data.

(3)



(d) The farmer decides to apply the Mann-Whitney U test to the data. This statistical test determines if the difference between the medians is significant.

The calculations produced two U values for this set of data. In order to support a difference between the two medians, the smaller U value must be the same as, or less than, the critical value.

He obtained a result of U = 50 from the calculation (the smaller value).

The table below shows the critical values for the Mann-Whitney U test at the $p = 0.05$ level.

(n − 1)

	Sample size n_2					
Sample size n_1	**7**	**9**	**11**	**13**	**15**	**17**
7	8	12	16	20	24	28
9	12	17	23	28	34	39
11	16	23	30	37	44	51
13	20	28	37	45	54	63
15	24	34	44	54	64	75
17	28	39	51	63	75	87

What conclusions can be drawn from this investigation? Use the information provided in the table above and in the graph you have drawn.

(4)

the calculated smaller u value is 50 which is greater ~~les~~ than the critical value 45 at a significance level of 0.05 ~~of~~ so at 95% of confidence level I am going accept this null hypothesis there is a significant difference between the ploughing of the soil to the earthworms visiting the soil.

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Examiner Comments

In part 2 (b), the candidate has produced a table with ranked data and with accurate headings (MP3 and 4). The use of (0.5 x 05) m^2 is acceptable for the unit mark. Both medians are identified correctly for MP1 and 2.

The candidate has drawn a bar graph and plotted both medians correctly (P mark). Unfortunately, the candidate has made two errors with axis labels - missing out the brackets around the 0.5 x 0.5 on the y-axis and inventing units for the x-axis. So, the A mark was not awarded. As the candidate did not plot range bars, the B mark could not be awarded.

In the response to part 2 (d), the candidate states correctly that the smaller U value is greater than the critical value (MP1) and the null hypothesis should be accepted. However, they do not identify the correct critical value and state incorrectly that there is a significant difference in the number of worms found with different ploughing methods. So MP2 and 3 could not be awarded.

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Examiner Tip

Do not forget that when asked to use information from different sources, there will be marks available for using information from each source. In part 2(d), as well as marks for interpreting the statistics, there was a mark available for describing the wide variability of the data or median values being close together.

Question 2 (e)

A large number of candidates scored well on this question. Most candidates suggested that other factors may not have been taken into consideration (MP1) and many recognised that the sample size was small (MP2). Relatively few candidates made reference to the wide variability of data (MP3).

Many candidates produced an extensive list of different variables that might not have been controlled. For a question like this, with three available marks, one mark will usually be awarded for the idea of lack of control. A second mark might be awarded for a specific example but it is very unlikely that all three marks will be awarded for the same idea.

Many candidates, incorrectly, suggested different sample sizes in the two fields.

(e) Suggest why it may not be reasonable to draw a valid conclusion from the results of this investigation.

(3)

1) The farmer didn't use the same number of quadrats in each field
2) The number of quadrats used is few - the sample size is small
3) The ~~amount~~ volume of detergent poured in each quadrat was not standardised.

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Examiner Comments

In this response, the candidate has suggested that the sample size is small (MP2) and has identified a variable that might not have been controlled. This was accepted as sufficient for MP1.

(e) Suggest why it may not be reasonable to draw a valid conclusion from the results of this investigation.

(3)

Other factor are not taken into consideration such as humidity of soil, light intensity, pH of soil and temperature. Sample size ~~use~~ is small. The experiment is carried out only in 2 different fields.

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Examiner Comments

The candidate was awarded MP1 and 2.

MP1 was awarded for suggesting that other factors need to be taken into account.

MP2 was awarded for the idea that the sample size is small.

The idea that the study only took place in two fields was seen as being equivalent to a small sample size.

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Examiner Tip

When asked to make suggestions and there are several marks available for your answer, make at least as many clear and distinct suggestions as there are marks available.

Question 3 (a)

3 Plants can be grown in glasshouses, using hydroponics. Hydroponics is a method of growing plants that replaces soil with solutions containing mineral ions.

Plan an investigation to find the optimum concentration of magnesium ions in the mineral ion solution used to grow the plants.

Your answer should give details under the following headings.

(a) A consideration of whether there are any safety or ethical issues you would need to consider.

(2)

to seal ~~around~~ around petridish

Use cling film ✓ to prevent contamination of bacteria. Wear a gloves as the magnesium ~~or culture solution~~ might be irritant to our skin. There is no ethical issues that we have to consider.

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Examiner Comments

In this response, the candidate has gained 2 marks.

Suggesting that magnesium ion solutions could be irritant gains MP3 and suggesting no ethical issues gains MP 1.

The first sentence would not have been sufficient for MP5. The candidate does not link the growth of bacteria to hydroponics and they do not identify a safety concern with bacterial contamination.

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Examiner Tip

Make sure that you link any ethical or safety issues you make, with the investigation.

3 Plants can be grown in glasshouses, using hydroponics. Hydroponics is a method of growing plants that replaces soil with solutions containing mineral ions.

Plan an investigation to find the optimum concentration of magnesium ions in the mineral ion solution used to grow the plants.

Your answer should give details under the following headings.

(a) A consideration of whether there are any safety or ethical issues you would need to consider.

(2)

It might cause allergic reaction.

~~Avoid to touching~~

There is no significant ethical issues.

ResultsPlus
Examiner Comments

For this response, the candidate was awarded 1 mark, MP1.

In the first statement, the candidate did not identify what might be causing an allergic reaction and could not be awarded either MP2 or 3.

ResultsPlus
Examiner Tip

Make sure that you include all important details in your answers. If your answers are too succinct, you may miss important details.

Question 3 (b)

(b) Suggestions for preliminary work that you might undertake to ensure your proposed method would provide meaningful data.

(3)

Practise the proposed method beforehand. Use a range of suitable concentration of magnesium ions for the plant growth. Select a suitable timescale while conducting the experiment. Use a same batch of plants for the experiment.

ResultsPlus
Examiner Comments

In this example, the candidate did not score any marks.

To "practise the proposed method" is insufficient for MP1. Candidates need to say why, eg "practise the method to see if the method works".

Similarly, selecting a suitable time scale is not enough for MP6. Candidates need to relate this to the investigation eg "select a suitable time-scale to measure growth of the plants".

Other statements made by the candidates are about how the investigation will be conducted and not about carrying out preliminary work.

ResultsPlus
Examiner Tip

Link your answers with the dependent variable in the investigation.

In this response, the candidate should have said "select a suitable time scale to measure growth of the plants".

(b) Suggestions for preliminary work that you might undertake to ensure your proposed method would provide meaningful data.

(3)

Decide on the dependant variable & how to measure it e.g measuring the rate of growth of plants by using their fresh mass.

Decide on which plant species will work best for this investigation, & check optimum conditions for growth of this species.

Check, find out & decide the length of time for which

the investigation should be carried out.

Practice your proposed method to check if it works.

ResultsPlus
Examiner Comments

In this example, the candidate scored the maximum of three marks. These were awarded for MP4, 5 and 1.

They would not have been awarded MP2 because they did not refer to hydroponics, or MP6, because they did not refer to time required to measure growth.

ResultsPlus
Examiner Tip

Remember, preliminary work is work that you would do before carrying out your main investigation. It is about finding out what 'conditions' you would need in order to carry out your main investigation.

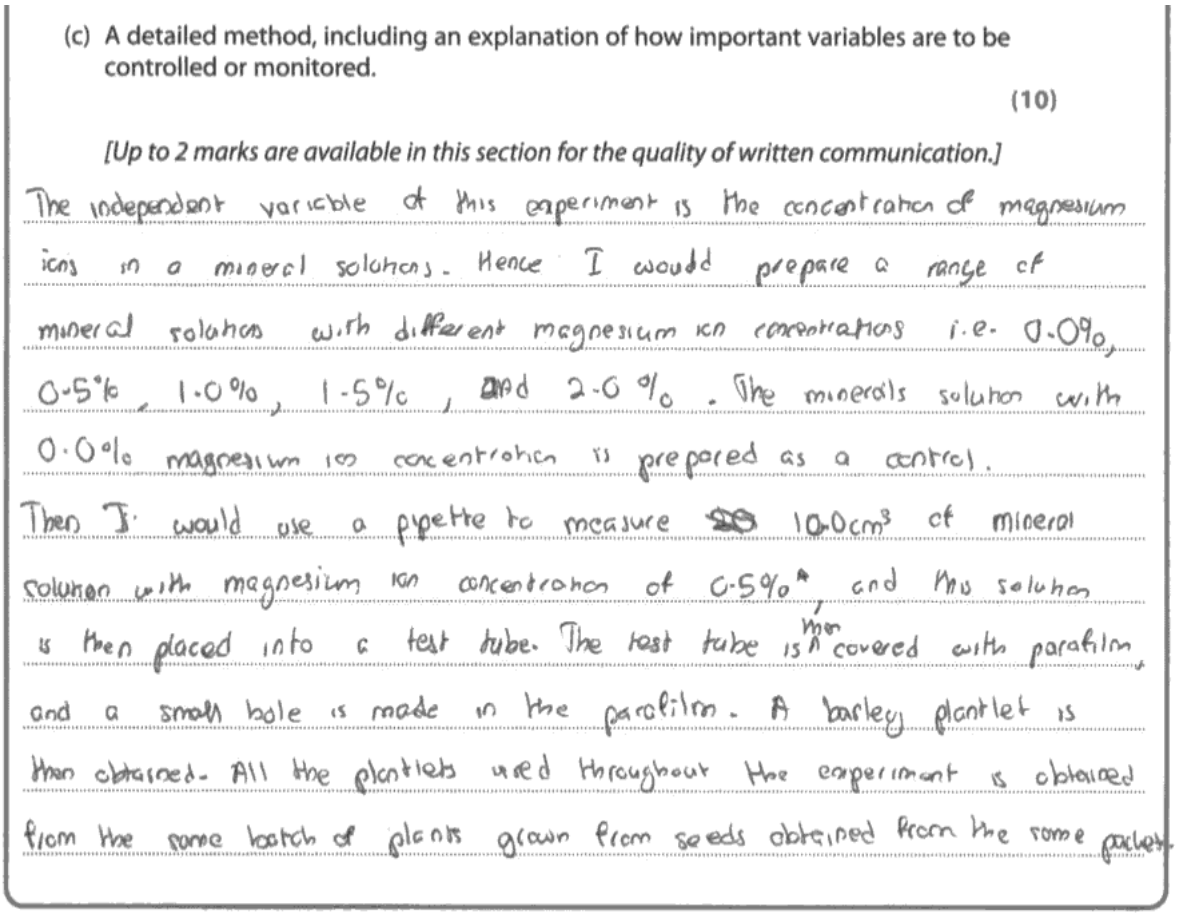
Question 3 (c) (d)

In general, answers to Q3 (c) were completed well and most candidates scored highly on this question. The biggest challenge for candidates was deciding on a suitable dependent variable, with a number of candidates suggesting change in dry mass.

A significant number of candidates chose to describe investigations that involved growing plants in soil or on agar dishes, rather than in hydroponic units. However, the nature of the mark scheme allowed them access to the majority of the marks. Two 'Spelling, Punctuation and Grammar' (SPaG) marks were available to candidates for this question. Some candidates produced answers in the form of a set of bullet points or a list. This generally precluded the award of both SPaG marks. A few candidates still confused independent and dependent variables and some seemed unsure as to when to control, and when to monitor, a variable.

Many candidates scored highly on part 3 (d), often obtaining MP2, 3 and 4. Whilst many candidates described how they would record a change in growth (MP2) and the production of mean values for change in growth (MP3), they often failed to describe the collection of raw data (MP1). Some candidates suggested using an inappropriate graph type, eg bar graph, or simply drew a set of axes without any indication of the graph type (MP4).

Most candidates suggested using an inappropriate statistical test (often Spearman correlation or t-test) and did not attempt to explain how the graph could be used to identify the optimum magnesium concentration (MP5).



(c) A detailed method, including an explanation of how important variables are to be controlled or monitored.

(10)

[Up to 2 marks are available in this section for the quality of written communication.]

The independent variable of this experiment is the concentration of magnesium ions in a mineral solution. Hence I would prepare a range of mineral solution with different magnesium ion concentrations i.e. 0.0%, 0.5%, 1.0%, 1.5%, and 2.0%. The minerals solution with 0.0% magnesium ion concentration is prepared as a control.

Then I would use a pipette to measure ~~20~~ 10.0cm³ of mineral solution with magnesium ion concentration of 0.5%, and this solution is then placed into a test tube. The test tube is then covered with parafilm, and a small hole is made in the parafilm. A barley plantlet is then obtained. All the plantlets used throughout the experiment is obtained from the same batch of plants grown from seeds obtained from the same packet.

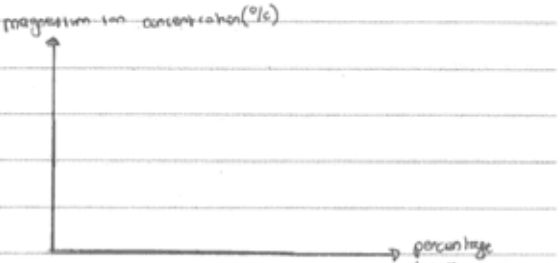
This is to ensure genetic uniformity. The mass of the plantlet is then measured using an electronic weighing balance. The rock of the plantlet is then pushed through the hole in the parafilm to ensure that the roots are immersed in the solution below. The test tube is then covered with aluminium foil, to prevent entry of light into solution. The test tube is then placed in a thermostatically controlled waterbath at 30°C, this to control the temperature of the plantlet. A bench lamp is also placed at a distance of 5 cm throughout the experiment. This is to control the light intensity received by the plantlet throughout the experiment. The volume of mineral solution is also controlled in the experiment, by measuring 10 cm^3 using a pipette. After a period of 7 days, the plantlet is removed from the test tube and is blotted dry. The mass of the plantlet is then measured, and hence the percentage change in mass of the plantlet is calculated. The percentage change in mass of the plantlet is the dependent variable of this experiment.

The ~~entire~~ experiment is then conducted with mineral solutions of magnesium ion concentrations of 0.0%, 1.0%, 1.5% and 2.0%. The entire experiment is then repeated twice at each magnesium ion concentration and the mean percentage change in mass is obtained. All the variables are ~~[illegible]~~ controlled in each repetition.

(d) A clear explanation of how your data are to be recorded, presented and analysed in order to draw conclusions from your investigation.

(4)

Magnesium ion concentration %	Change in mass (g) 1	2	3	mean	Percentage (%) change in mass
0.0					
0.5					
1.0					
1.5					
2.0					



- I would plot a line graph for this experiment.

- To analyse the data, I would conduct a Spearmen rank correlation test. The null hypothesis is, that there is no significant correlation between the magnesium ion concentration and the percentage change in mass. This null hypothesis ~~is~~ is then tested at the 5% significance level.

ResultsPlus
Examiner Comments

The candidate response to Q3 (c) gained the maximum mark of 10.

MP3 and 4 were awarded for identification of magnesium ions as the independent variable and suggesting a suitable range of concentrations to test.

MP11 was awarded for a clear description of the control of the source of plants.

MP6 and 8, and 7 and 9, were awarded for control of temperature and volume of solution. Control of light intensity could also have gained two of these marks.

MP5 was awarded for consideration of the time period over which to measure growth.

Marks could also have been awarded for the description of how plant growth (change in mass) would be measured and for the need for repeats (MP2 and 10).

The candidate response to 3 (d) was awarded 2 marks. These are for calculating a change in mass (MP2) and calculating mean values (MP3).The candidate did not allow for the recording of the original raw data ie initial and final mass, so could not be awarded MP1.

Although the candidate suggested plotting a line graph, which is acceptable, the x and y axes were not acceptable. The dependant variable should be on the y-axis, so MP4 could not be awarded. Since the investigation is looking to identify an optimum concentration of magnesium, use of a correlation statistic is not appropriate and gains no credit.

The account was considered to be well-written in continuous prose, so was awarded both SPaG marks.

ResultsPlus
Examiner Tip

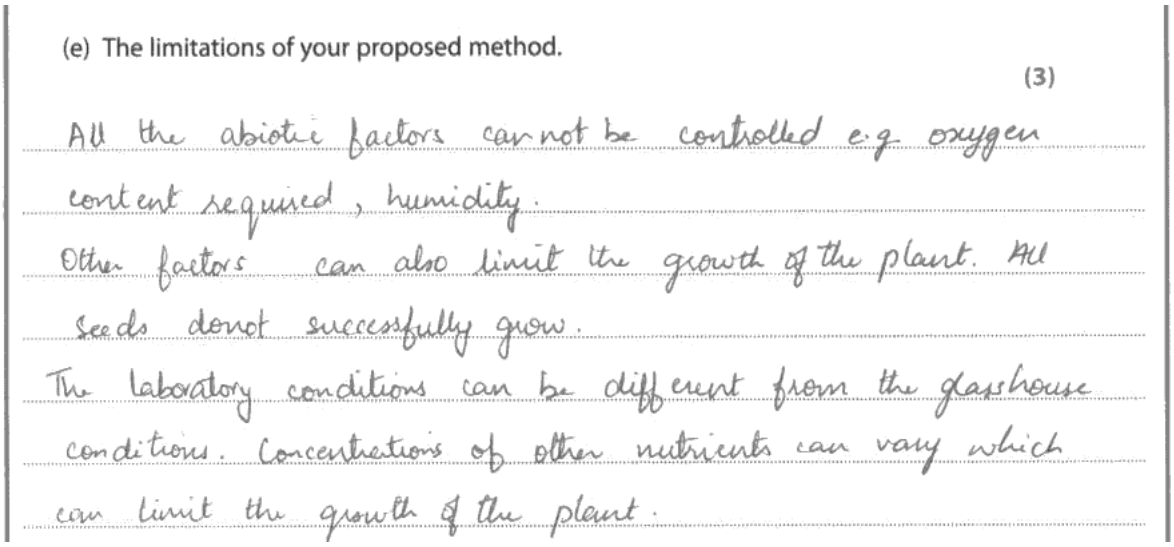
When describing how your data could be analysed, think about the purpose of the investigation. If you are trying to find an optimum value, as in this investigation, the best approach is to plot a line graph. Use the graph to identify the lowest value giving the desired effect. Correlation statistics are not appropriate in this situation.

Question 3 (e)

Few candidates scored well in this question. The most frequently-awarded marks were MP1 and MP3. As with other parts to the question, candidates who did not link the answer to the context of the investigation did not receive marks. This was particularly the case for MP1, with many candidates suggesting it is "difficult to control all variables" rather than it is "difficult to control all variables affecting plant growth".

Many candidates suggested variables that are difficult to control, which could be controlled, eg temperature, and did not obtain MP2.

Few candidates suggested the need for additional minerals (MP4) or a reasonable difficulty associated with measuring the dependent variable (MP5).



(e) The limitations of your proposed method.

(3)

All the abiotic factors can not be controlled e.g. oxygen content required, humidity.
Other factors can also limit the growth of the plant. All seeds donot successfully grow.
The laboratory conditions can be different from the glasshouse conditions. Concentrations of other nutrients can vary which can limit the growth of the plant.

ResultsPlus
Examiner Comments

The candidate mentions the problem of controlling variables but does not link this with plant growth and was not awarded MP1.

Neither of the specific variables identified was accepted for MP2. Oxygen concentration was not considered relevant in the context of the investigation and was ignored. Humidity was considered a variable that could be controlled in a hydroponics investigation.

MP3 was awarded for reference to other limiting factors.

Reference to other nutrients was not sufficient for MP4. Candidates need to identify clearly the need for more than one mineral ion, for this mark.

ResultsPlus
Examiner Tip

Make sure that you put your answers in context.

Here, the investigation was about plant growth. This means your answers need to relate to plant growth.

(e) The limitations of your proposed method.

(3)

There is difficulty in controlling all the factors affecting growth of the plant. There may be other factors ~~peice concentration of magn~~ that act as a limiting factor to the growth of plant. The experimental conditions may not represent ~~real~~ normal conditions for the growth of plants. There might be contamination of bacteria in solution.

ResultsPlus
Examiner Comments

This response was awarded the maximum of 3 marks.

MP1 was awarded for suggesting that it is difficult to control all factors affecting plant growth.

MP3 was awarded for suggesting the presence of other limiting factors.

MP2 was awarded for reference to bacterial contamination, which was accepted as an example of an uncontrolled variable.

Paper Summary

Based on their performance on this paper, candidates are offered the following advice:

- Candidates should make sure that they understand the underlying biological principles being explored in each of the core practicals.
- When planning their answers to questions, candidates should ensure that they understand the context in which the question is set and must apply their answer to this context eg determine the optimum time to measure plant growth and not simply determine the optimum time for the experiment. It is particularly important to bear this in mind when using mark schemes with previous papers, in preparing for this examination.
- Ensure that tables and graphs are drawn with suitable headings and labels, including appropriate units.
- It is important to distinguish between the terms 'significant difference' and 'significant correlation'.
- When a question is split into several parts, read all parts of the question carefully and plan the answer before starting to answer the question.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

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