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Examiners' Report
June 2014

IAL Biology WBI06 01

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Introduction

Candidates continued to appear well prepared for the paper and seemed aware of the type of answer expected in each part of the paper. The full range of marks was awarded and there was no evidence of significant numbers of candidates running out of time. In general, candidates were more successful in describing the procedures involved in the core practicals than in explaining the underlying biology, and were more successful in processing and analysing data than in the design and planning of the investigation. Students do tend to find experimental design challenging, so this pattern is not unexpected, but it does suggest an area on which Centres could focus in order to improve performance: it is strongly recommended that students be given opportunities to plan and carry out their own investigations in order to develop the skills assessed in question three of this paper.

In question one, the relatively straightforward procedure of the snail habituation core practical proved to be an accessible context and most candidates scored well in the early parts of the question. However, explaining the mechanism of habituation was much more demanding and question 1(c) was very discriminating.

In question two, there was a progression from more accessible to more challenging elements: the calculation of means and tabulation of data were well within the capabilities of most candidates and most were able to correctly select a line graph, but fewer were able to carry out the statistical test correctly and reach the correct conclusion. Most candidates were able to make one or two basic points about validity but few gained the full three marks for part (e).

In question three, (a) candidates were successful in identifying safety considerations but ethical considerations were not so well described; (b) as in previous series, planning of preliminary practical work was an area of weakness; (c) many candidates scored the full 10 marks for the planning of the main data collection phase of the investigation and a good awareness of the need to control extraneous variables was demonstrated by most, but a significant number did not plan the investigation that was asked for in the question stem; (d) candidates struggled to select the correct ways to present and analyse the data from their own investigation - even candidates who had successfully presented and analysed given data in question two;(e) most candidates were able to identify uncontrolled variables as a limitation of their investigation, but few were able to go further than this and discuss other aspects of the experimental context.

In some cases candidates' answers (particularly to question three) consisted of very generic statements, sometimes taken verbatim from the mark scheme of a previous paper. It must be emphasised that, to gain credit, answers must be specific to the context of the practical or investigation in question. As has been mentioned in many previous examiners reports for this paper, stock phrases that are sufficiently vague to be applied to any investigation are likely to gain very few marks.

Question 1 (a)

Most candidates seemed familiar with this practical and were able to describe the key elements, but a much smaller proportion included sufficient detail to gain all five marks. The idea of allowing the snail to adjust to the environment before beginning the experiment was often omitted, and very few candidates mentioned a way of ensuring that the strength of the stimulus was the same each time. Some candidates described measuring the time taken for the snail or its eyestalks to withdraw using a stopwatch: the speed of withdrawal is too rapid to be sensibly measured by hand with a stopwatch, so this was not accepted. (The standard approach to this practical is to record the time taken for the snail to withdraw then re-emerge.) It was pleasing to see candidates taking great care to control extraneous variables and this is to be encouraged. However, in this case, control of variables was credited separately in part (b) so marks were not awarded for control of variables in part (a).

(a) Describe how you could investigate the habituation of a snail to a stimulus.

(5)

Obtain a garden snail and place it on a clean Perm surface. Let it get used to it's new surroundings. (Wait till it is fully ~~rem~~ re-emerged and it's eye stalks are fully extended.) Then using a damped cotton wool bud, firmly touch in between the eye stalks of the snail And immediately start the stop watch, and measure the time taken for it to fully re-emerge. Repeat this procedure until the snail stops responding to the touch of cotton wool bud. We can repeat the experiment using different snails, under same conditions.

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Examiner Comments

This was a clear answer that gained five marks. The idea of maintaining the strength of the stimulus is not mentioned, but other relevant details are included.

(a) Describe how you could investigate the habituation of a snail to a stimulus.

(5)

use different ~~stimulus~~ stimuli such as touch and heat to test the snail for the withdraw into its shell. Record number of times of the stimuli that makes the snail withdraw into its shell. Use different kind of snails to investigate the effect since different snails have different time for habituation. Then record the ~~differe~~ results to investigate the habituation of a snail to a stimulus.

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Examiner Comments

This answer did not include a clear description of how the investigation should be carried out and only scored one mark. Several of the comments made do not reflect good experimental design, for example using different stimuli and different kinds of snails would introduce extraneous variables.

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Examiner Tip

The phrase 'record the results' is very vague and should be avoided. Specify exactly **what** should be recorded: for example, in this case, record the time taken for the snail to fully re-emerge from its shell.

Question 1 (b) (i)

This question was generally well-answered and most candidates scored both marks. Some candidates stated variables relating to the stimulus, but marks were not available for these since the question specified variables **other than the stimulus**.

(b) (i) State **two** variables, other than the stimulus, which could affect the investigation.

(2)

- Age of the snail.
- Type of the snail.
- Surrounding of the snail.

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Examiner Comments

'Surrounding of the snail' is too vague for the award of the second mark. A-level candidates are expected to be able to refer to specific variables such as temperature, humidity, light intensity, etc.

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Examiner Tip

Think carefully about your choice of words, and consider whether there is a more specific term that would convey your meaning more clearly.

(b) (i) State **two** variables, other than the stimulus, which could affect the investigation.

(2)

Age of the snail.
The force of the brush stroke.

ResultsPlus
Examiner Comments

'Age of the snail' is a good point for one mark, but 'the force of the brush stroke' relates to the stimulus so could not gain the second mark.

ResultsPlus
Examiner Tip

Be sure to read the question carefully and take note of any specific instructions as to what should or should not be included in your answer.

Question 1 (b) (ii)

This question was also answered well by most candidates. There were two common mistakes which accounted for the vast majority of cases in which marks could not be awarded. Firstly, some candidates mentioned a way to **measure** the variable in question, rather than a way to **control** it: for example use of a thermometer was not credited as a method for controlling temperature, because it does not actually help to keep the temperature the same. Secondly, some candidates did not give a clear and specific effect on the results in the second part of the question. A statement that changes in temperature would 'affect the results' could not be awarded a mark since it simply repeats the question stem; a specific effect on the activity of the snail was needed, for example an increase in temperature increasing the rate of chemical reactions in the snail, allowing it to re-emerge more quickly.

(ii) Choose **one** of these variables. Suggest how this variable could be controlled.

Describe the effect the variable could have on the results if it is not controlled.

(2)

Variable Temperature

How to control the variable By using a air ~~conditio~~ conditioner fixed at 25°C temperature will be controlled.

Effect on the results if the variable is not controlled

If temperature is higher than normal snail will re-emerge in a shorter time so this will affect the time taken to snail re-emerge its tentacles fully. Time taken to snail re-emerge its tentacles will decrease

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Examiner Comments

This answer includes a clear method for controlling the temperature and a specific effect on the time taken for the snail to re-emerge: two marks.

(ii) Choose **one** of these variables. Suggest how this variable could be controlled.

Describe the effect the variable could have on the results if it is not controlled.

(2)

Variable Temperature

How to control the variable use a temperature probe

Effect on the results if the variable is not controlled If the temperature increases more than the optimum temperature of the snails, then cell metabolism decreases because enzymes may denature.

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Examiner Comments

In this case the temperature is measured but not controlled: a temperature probe does not change the temperature to ensure it stays the same. The effects described are not linked to the results of the investigation: although the comment about cell metabolism may be true, the candidate has not explained how this could affect the results recorded. Unfortunately this candidate did not gain either of the marks available.

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Examiner Tip

Ensure that your answers are appropriate to the biological context of the question. The questions in this paper are always about specific practical situations and it is expected that your answers will relate directly to these practicals.

Question 1 (c)

The quality of answers to this question was extremely variable: some candidates were able to give very detailed and accurate explanations of the cellular mechanisms of habituation, which others sadly were not able to make any attempt at an answer. We must emphasise that candidates are expected to understand the biology behind the core practicals as well as the procedures. Some candidates gave full descriptions of the role of calcium ions in transmission of a nerve impulse but made little or no reference to habituation; in these cases few or no marks could be awarded. There was also some confusion as to whether calcium ions were entering or leaving the cell, and some candidates conflated the roles of calcium ions and neurotransmitters.

(c) Suggest how calcium ions are involved in habituation in snails.

(4)

In the repeated stimulus, the continued stimulation of the presynaptic knob makes calcium ion channels less responsive so that less Ca^{2+} ions move into the presynaptic knob. As a result, less neurotransmitter is released in the synaptic cleft so that less and eventually no action potential is made on the post synaptic knob. Therefore, snails ~~are~~ are said to be habituated.

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Examiner Comments

A clear and logical answer which explains the change in movement of calcium ions and how this leads to habituation: four marks.

(c) Suggest how calcium ions are involved in habituation in snails.

(4)

Calcium ions are present in the synaptic cleft and when a stimulus arrive, calcium ions move into the pre-synaptic neurone which stimulates binding of vesicles to the pre-synaptic membrane and neurotransmitters get released by exocytosis. Neurotransmitters bind to receptors on post-synaptic membrane, increasing permeability of the membrane to Na^+ ions which could result in an action potential. However if the same stimuli continues for too long less calcium ions moves into the pre-synaptic neurone. And the stimuli no longer effect and is ignored.

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Examiner Comments

Most of this answer relates to the usual process of transmission of a nerve impulse. The candidate only briefly mentions the changes that take place following repeated stimulation at the end of the answer, so only gained one mark. Since the question is about habituation, the candidate would have done much better by addressing this right from the start.

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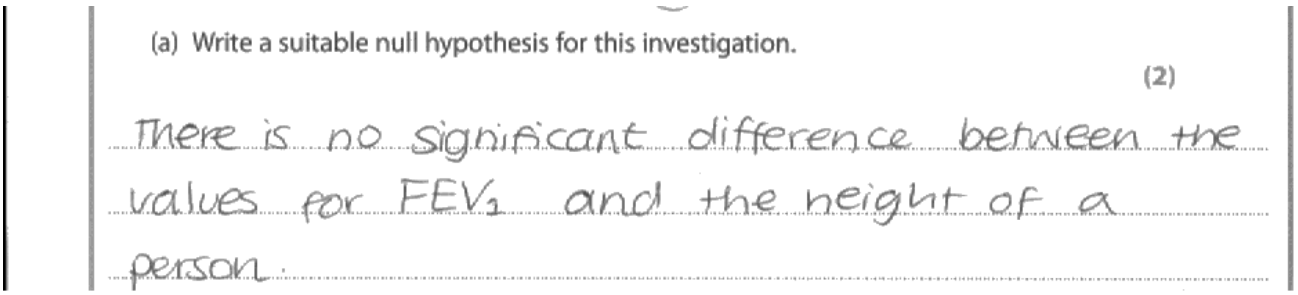
Examiner Tip

Make sure that you directly answer the question. If you are describing changes from the usual course of events, be specific about the changes and describe their nature by using terms such as more / fewer / greater / slower.

Question 2 (a)

There were three main aspects that the examiners were looking for in a sound null hypothesis: firstly, identification of the correct variables involved (height and FEV); secondly, a correct statement that this would be a test of **correlation** (not difference); thirdly, the idea of the **significance** of this correlation. Almost all candidates referred to the correct variables, but many made mistakes in either the second or third aspect. The most common error was to formulate a hypothesis based around significant difference, which is not appropriate in the context of the question.



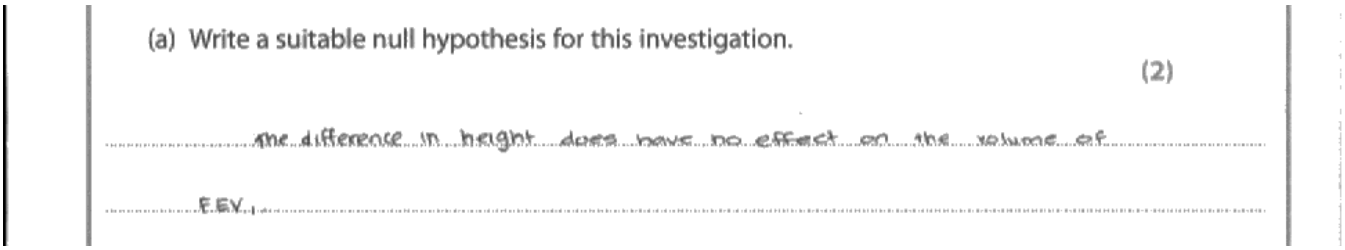
(a) Write a suitable null hypothesis for this investigation.

(2)

There is no significant difference between the values for FEV_1 and the height of a person.

ResultsPlus
Examiner Comments

This answer gained marking point 2 for correctly identifying the two relevant variables, height and FEV, but refers to a significant difference instead of a significant correlation so was not awarded marking point 1.



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

(2)

the difference in height does have no effect on the volume of FEV1

ResultsPlus
Examiner Comments

This answer also gained marking point 2 only for identifying the correct variables. The term 'effect' is too vague, and we need to be careful not to imply causation when we only have data about correlation.

ResultsPlus
Examiner Tip

Hypotheses and statistical tests make use of specific and precise scientific language. Use the correct terminology of **significant difference** or **significant correlation** to formulate a good hypothesis.

Question 2 (b) (c)

(b) On this occasion candidates were asked to tabulate the height and the **mean** FEV only: the raw data did not have to be included. However, large numbers of candidates did include the raw data in their table, thus spent time drawing a much larger table than was required. This time there was no mark penalty for including raw data, but candidates are reminded to read the question carefully and follow the instructions. The majority of candidates gained two or three marks. The most common mistake, by a wide margin, was omission of the second decimal place for the means - sometimes just for those means where the second decimal place was a zero (e.g. 3.10 became 3.1). The final decimal place should be included even if it is a zero, since the precision of the measurement has not changed.

(c) The appropriate type of graph for presenting a possible correlation between two continuous variables is a line/scatter graph, which was drawn by most candidates. Selecting the correct type of graph for the data is an important skill, so bar graphs were not able to gain full marks. Many candidates unfortunately did not include range bars as an indication of the variability of the data so did not gain the third mark available. Another common mistake was to start axes at zero then jump to a higher number before settling into a regular scale, resulting in a non-linear axis. This was only accepted if there was a clear discontinuity indicator between the zero and the correctly scaled part of the axis. It is very pleasing to see candidates selecting scales such that the data points fill the plot area, but in this case it is not necessary to place a zero at the origin.

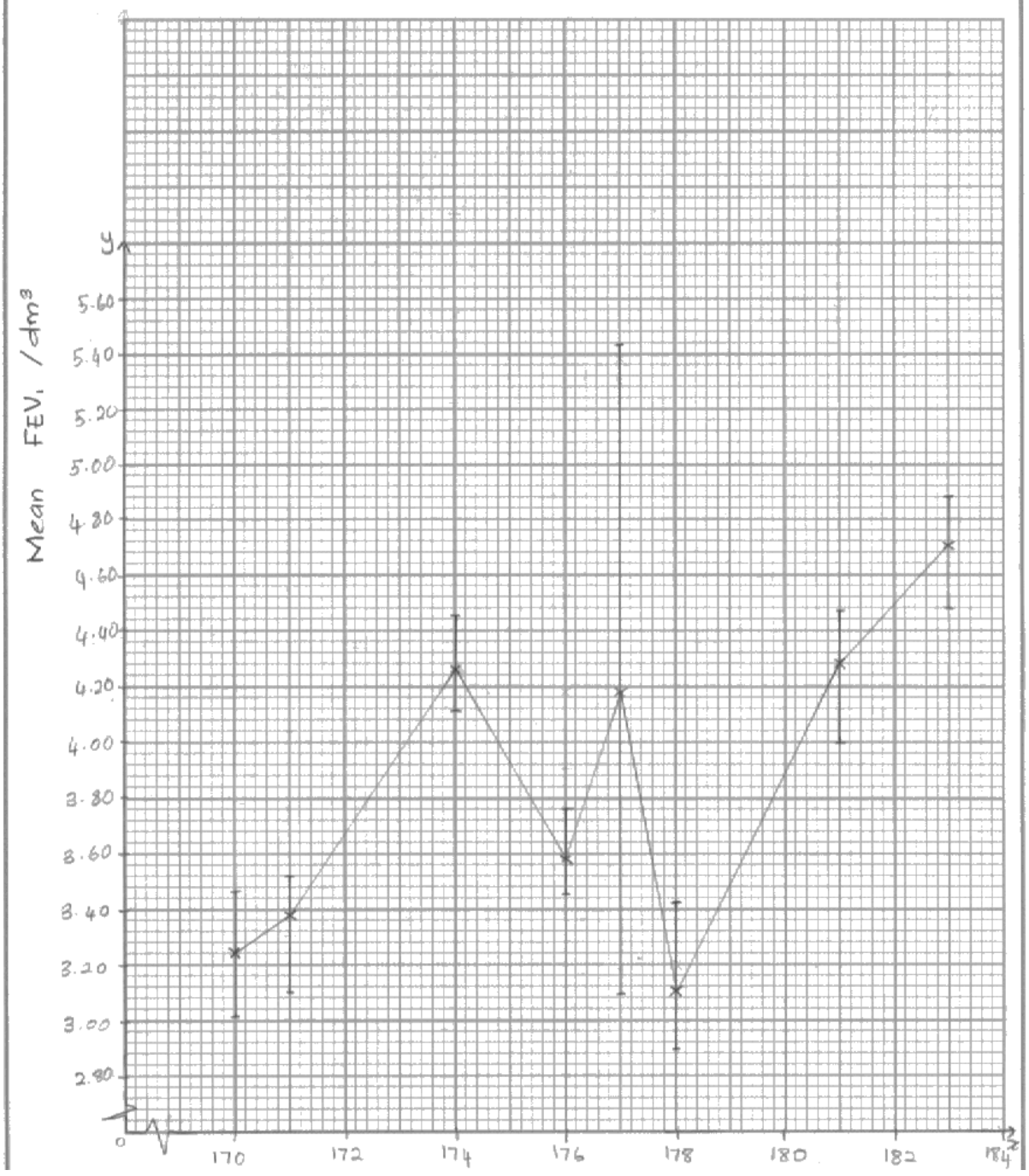
(b) Calculate the mean FEV_1 for each student. Display the data for the height and the mean FEV_1 for each student in a suitable table. (3)

Height /cm	FEV_1 / dm^3			
	T_1	T_2	T_3	Mean
178	2.99	3.42	2.89	3.10
174	4.45	4.24	4.11	4.27
177	3.09	4.05	5.43	4.19
181	4.00	4.36	4.47	4.28
183	4.48	4.88	4.75	4.70
170	3.25	3.46	3.01	3.24
171	3.52	3.15	3.48	3.38
176	3.55	3.45	3.76	3.59

(c) On the graph paper below draw a suitable graph to show the relationship between height and mean FEV_1.

Include on your graph an indication of the variability in the data.

(3)



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Examiner Comments

This answer scored full marks for both (b) and (c). The layout of the table is appropriate, all headings and units are accurate and means are calculated correctly and given to two decimal places. (This candidate has also included raw data when it was not required.) The graph has well-chosen scales which are fully and accurately labelled, points are plotted correctly and range bars are included. Since this is a scattergraph, it is not really appropriate to join the points in this way, but all lines were ignored on this occasion.

ResultsPlus
Examiner Tip

When you have finished your answer, read back through the question to check that you have included everything required. When answering this question, many candidates did not include range bars - perhaps because they had forgotten that part of the question by the time they had plotted the points.

(b) Calculate the mean FEV_1 for each student. Display the data for the height and the mean FEV_1 for each student in a suitable table. (3)

no. of Students	height/cm	FEV1 /dm³ Trial 1	Trial 2	Trial 3	Mean
1	170	3.25	3.46	3.01	3.24
2	171	3.52	3.15	3.48	3.38
3	174	4.45	4.24	4.11	4.26
4	176	3.55	3.45	3.76	3.58
5	177	3.09	4.05	5.43	4.19
6	178	2.94	3.42	2.89	3.1
7	181	4.00	4.36	4.47	4.27
8	183	4.48	4.88	4.75	4.70

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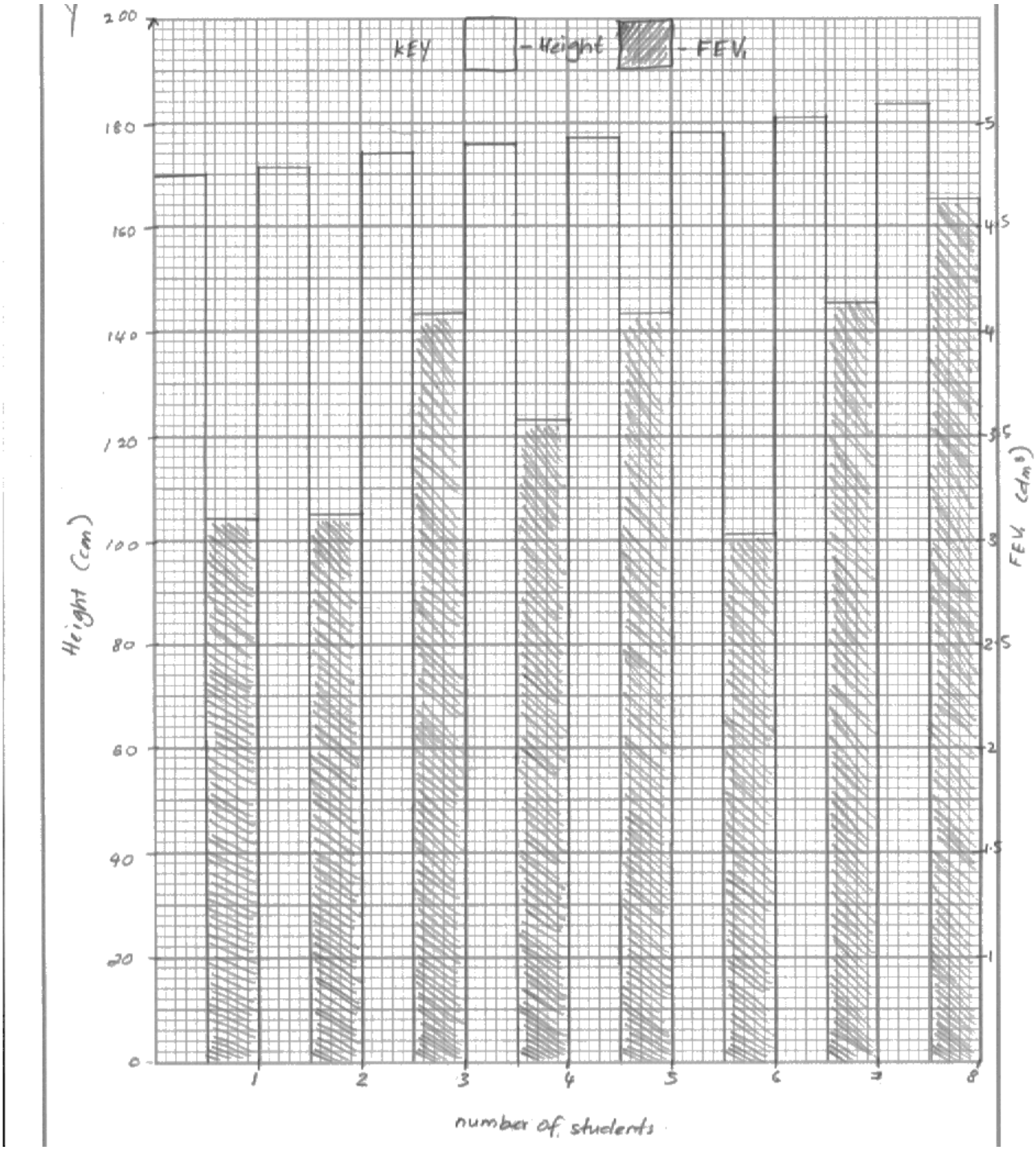
Examiner Comments

(b) The table is well laid out with correct headings and units for height and FEV, so two marks can be awarded. Raw data is included unnecessarily, so the candidate wasted some time, and the first column titled 'number of students' is rather misleading because there were not 8 students with height 183cm! Unfortunately the candidate has not included two decimal places for all the means (3.10 is written as 3.1).



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Examiner Comments

This candidate has made a fair attempt at the table, but the graph is not appropriate.

(c) No marks could be awarded here since the wrong type of graph has been selected, the layout of the axes does not allow the relevant variables to be plotted against each other and no range bars are included. The axis label should also specify the variable precisely as **mean** FEV (dm^3).

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Examiner Tip

Think about the purpose of an investigation to help you select an appropriate graph. In this case, the question stem stated that Nigel wanted to investigate whether the height of a person is related to FEV - therefore it would be appropriate to plot FEV against height. We are told that Nigel selected students of different heights, then measured their FEVs - so we can tell that height is the independent variable which should be placed on the x-axis while FEV is the dependent variable which should be placed on the y-axis. Both height and FEV are continuous variables (they can be plotted along a scale), so a scattergraph is the appropriate type of graph.

Question 2 (d)

Almost all candidates were able to identify the relevant critical value from the table provided and make a correct comparison between the calculated value and the critical value. There was then some confusion about whether the null hypothesis should be accepted or rejected, but most made the correct decision. Of those candidates who correctly accepted the null hypothesis, not all went on to state the conclusion explicitly (no significant correlation between height and FEV). However, it was pleasing to see many clear answers that addressed marking points 2-5 in a very logical manner. The question directed that candidates should refer to their graph in their answer, but significant numbers of candidates did not mention the graph so lost the opportunity to access one of the marking points.

(d) Nigel used a statistical test to investigate the significance of the relationship between the height of an individual and FEV_1. His calculation gave a value of 0.65.

The table below shows some values for this statistical test at three significance levels of 0.1, 0.05 and 0.01.

Number of students tested	Significance level (p)		
	0.1	0.05	0.01
4	0.90	0.95	0.99
5	0.81	0.88	0.96
6	0.73	0.81	0.92
7	0.67	0.75	0.87
8	0.62	0.71	0.83
9	0.58	0.67	0.80
10	0.55	0.63	0.77

Use the information provided in this table and in your graph to draw conclusions from this investigation.

(4)

Calculated Value = 0.65

Critical Value = 0.71

The calculated value is less than the critical value

so the ~~null~~ hop hypothesis is proved

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Examiner Comments

This candidate makes a good start by identifying the critical value and correctly comparing the critical and calculated values, so earns two marks. However, the answer does not specify which hypothesis is supported.

ResultsPlus
Examiner Tip

Try not to refer to 'proving' a hypothesis. In science we are never able to prove that a hypothesis is correct, we are only able to gather more and more evidence that suggests it is likely to be correct. New evidence collected in the future might change our opinion - you can probably think of several instances where this has occurred over the history of science.

(d) Nigel used a statistical test to investigate the significance of the relationship between the height of an individual and FEV_1. His calculation gave a value of 0.65.

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5	0.81	0.88	0.96
6	0.73	0.81	0.92
7	0.67	0.75	0.87
8	0.62	0.71	0.83
9	0.58	0.67	0.80
10	0.55	0.63	0.77

Use the information provided in this table and in your graph to draw conclusions from this investigation.

(4)

The calculated value 0.65 is greater than less than critical value at 0.05 (0.71). Here the test can be spearman's correlation, so we can accept the null hypothesis and reject the alternate hypothesis. Therefore we can conclude that there is no significant relationship between height of the person and FEV1. Graph shows there is an increase in FEV1 with height of the person, but there is a decrease of FEV1 at 176 cm and 178 cm.

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Examiner Comments

This answer carries out the statistical test correctly, clearly setting out each step. A sensible reference to the graph is also included, allowing this candidate to score maximum marks.

ResultsPlus
Examiner Tip

If the question asks you to refer to your graph (or to other data), be sure to do so or you may not be able to earn all the marks available.

Question 2 (e)

Most candidates were able to discuss the potential influence of other variables and/or the small sample size as factors that reduce the validity of the conclusion, but relatively few went on to mention either marking point three or four. Candidates are encouraged to refer back to the details of the investigation in question when making qualitative judgements on points such as validity.

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

(3)

Because the experiment was done only for 8 students and so the graph is not so valid.

ResultsPlus
Examiner Comments

This candidate has made one relevant point - the idea of small sample size - so gained one mark. It is not really correct to say that the **graph** is not valid; the graph simply displays the data, which may or may not be valid.

ResultsPlus
Examiner Tip

The number of marks available for each question is a guide as to the number of points you should aim to include in your answer. This answer is very brief and does not contain enough for three marks.

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

(3)

From the graph, the FEV$_1$ of an individual vary in different height, but there are ~~not~~ no relationship between FEV$_1$ and height, therefore, no valid conclusion can be made from the result of this investigation.

ResultsPlus
Examiner Comments

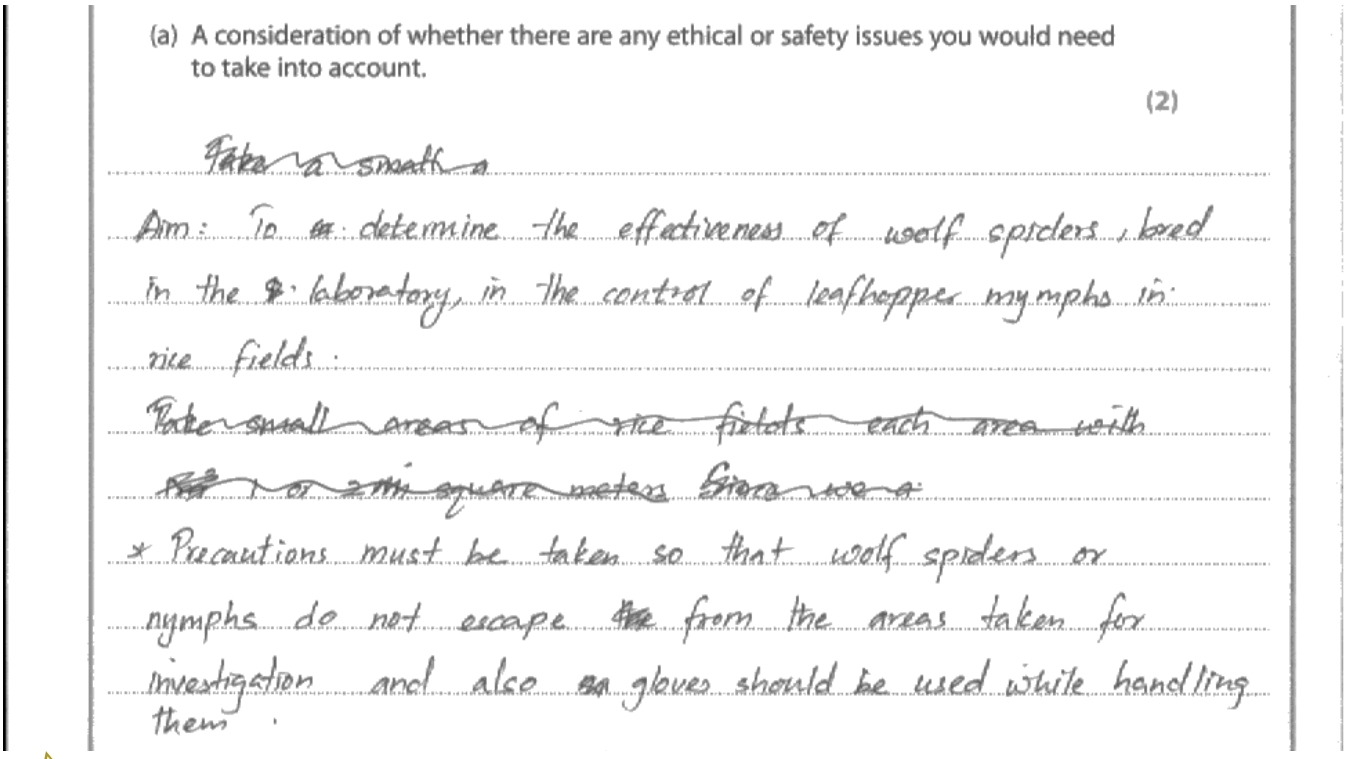
In this example the candidate has confused the drawing of a conclusion with the presence of a correlation. It is perfectly acceptable to conclude that there is no evidence of a correlation between the independent and dependent variables. Whether or not a correlation is found, this is still a conclusion and the validity of this conclusion can still be considered. This answer did not score any marks.

ResultsPlus
Examiner Tip

Accepting the null hypothesis is an important conclusion. For example, if a new drug is being trialled, the null hypothesis might be that there is no significant difference in survival rates between patients treated with the existing drug and with the new drug. Accepting the null hypothesis might suggest that it is not worth spending money on the expensive new drug when the existing drug works just as well.

Question 3 (a)

Most candidates were able to identify relevant safety considerations in this context, most commonly the risk of being bitten by the spider. Some candidates mentioned precautions that should be taken (e.g. wearing gloves when handling the spiders) without identifying the safely issue they were trying to protect against, so could not be awarded a mark. Ethical issues were less well dealt with by candidates, with many suggesting that there were no significant ethical issues. This is an example of candidates attempting to apply answers from previous mark schemes; in some previous investigations the scenario has not presented any significant ethical issues, but this was clearly not the case when live animals were being used and the balance of the ecosystem was being manipulated. Credit was not given for the suggestion that breeding spiders in captivity *per se* was an ethical problem, a more specific ethical point relating to the care or welfare of the spiders was required. The idea that release of wolf spiders into rice fields might present a (specified) risk to humans living or working in the area was accepted as a safety, rather than an ethical, issue.



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

(2)

Take a small a

Aim: To determine the effectiveness of wolf spiders, bred in the laboratory, in the control of leafhopper nymphs in rice fields.

Take small areas of rice fields each area with [illegible] square meters Give no a

* Precautions must be taken so that wolf spiders or nymphs do not escape from the areas taken for investigation and also gloves should be used while handling them.

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Examiner Comments

A number of candidates included an 'aim' in their answer to one of the parts of question three. Candidates are encouraged to answer the question that is actually asked in each of parts (a) - (e): none of these questions asked for an aim, so it was not required. This response goes on to describe precautions that might be taken without identifying the safety or ethical issues that these precautions would address, so did not gain any marks.

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Examiner Tip

The format of question three may not be the same as the way in which you have been asked to write investigations or lab reports at school. Be sure to read the prompt for each part (a - e) and write what is asked for. You may find it helpful to answer past papers to practise.

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

(2)

- Safety issues: wearing a lab coat, eye goggles and disposable gloves when doing the experiment

- having proper aseptic techniques after experiment
- If handling any glass ware being careful not cut yourself.
- ~~not disturb~~ minimizing the disturbance to the natural environment.

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Examiner Comments

In this response the candidate has not adequately considered the investigation to be carried out and does not score any marks. The first point, headed 'safety issues', actually lists safety precautions (some of which are appropriate) but does not mention any risks that would necessitate these precautions. The second and third points relate to aseptic technique and glassware which are not relevant to this investigation, and the final point is too vague to gain any credit.

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Examiner Tip

You do not have to answer the questions in the order in which they appear in the paper. If you find it difficult to identify safety or ethical issues before you have planned your investigation, you could answer 3(c) first then come back to 3(a) once you have written about the methods you would use. Whatever the order in which you choose to write your final answers, it is a good idea to think through the whole investigation first. You should feel free to write notes to help to organise your thoughts, simply cross out any work you do not wish to be marked before you hand in your paper.

Question 3 (b)

Unfortunately, describing appropriate preliminary practical work continues to be challenging for many candidates: typically only one mark was scored here, for the idea of practising the method to check that it would work. Credit was not given for the idea of determining factors that should have been known *a priori*, such as the dependent and independent variables, nor for generic statements that did not take account of the circumstances of the investigation in question. Some candidates' answers consisted entirely of points taken from previous mark schemes; these were largely inappropriate for this investigation and gained very little credit. However, it was encouraging to see some candidates score full marks with answers that showed they had really thought about what they would need to know in order to carry out the investigation successfully.

Perhaps a reason for students' difficulties in this area is that they are often not involved in preliminary work that goes on 'behind the scenes' to prepare regular classroom practical activities. Due to the limited teaching time available, students are often given a method or list of materials in which concentrations of solutions, species of organism, incubation times and temperatures are already given - or, if not, there is a tendency to turn to the internet for suggested values of these variables. It is important that students are aware that the experimental conditions suggested by their teachers or other sources originally had to be determined through preliminary practical work, and it is recommended that students are given opportunities to plan and carry out investigations in which preliminary practical work is required. During regular practical work where detailed procedures are given, a brief discussion of how the suggested conditions might have been determined could be included.

This candidate scored one mark for the idea of practising the method to check if it would work. The other points do not refer specifically to the investigation in question and in some cases are not appropriate: it is unlikely that any instrument could give a reading of leafhopper density.

(b) A description of appropriate preliminary practical work that you might undertake to ensure your proposed method would provide meaningful data.

(3)

- Carry out a practice test to check if the proposed method works and to check for any problems that might be encountered.
- Identify a suitable dependent variable and a suitable instrument to measure it.
- Identify other variables that could affect the experiment and how they can be monitored/controlled.

ResultsPlus

Examiner Comments

One purpose of preliminary practical work is to determine appropriate conditions or values of the controlled variables for the main data collection phase of the investigation. You should refer to specific conditions and variables that are relevant to your investigation.

(b) A description of appropriate preliminary practical work that you might undertake to ensure your proposed method would provide meaningful data.

(3)

Practice the experiment and decide on a method to measure the dependent variable. Find a plot in the rice field which has a lot of ~~nym~~ ~~hea~~ leafhopper nymphs. make an internet search to find predators of wolf spider and other predators of leafhopper nymph.

ResultsPlus
Examiner Comments

This candidate did not get a mark for reference to practising the method because no reason is given, and 'decide on a method to measure the dependent variable' is unfortunately an example of the type of stock answer that is too vague to be credit-worthy. (An example of a more specific answer that did gain credit is: "Try using the Lincoln Index and random quadrat sampling to estimate the population of leafhoppers. Repeat each method 5 times to see which gives more reliable results, then use that method for the investigation.")This answer improves in the second sentence; the idea of finding a site with plenty of leafhopper nymphs is a good example of a sensible preliminary step and shows that the candidate has thought about the scenario of the investigation. This gains one mark. Use of an internet search does not constitute practical work so is not credited. However, the candidate is correct to identify other predators as an important consideration; a practical suggestion would have been to check the numbers of other predators at each of the proposed sites.

ResultsPlus
Examiner Tip

Selecting suitable sites can be an important part of preliminary practical work for an investigation carried out in the field. However, to gain credit you would need to be specific about what a 'suitable' site might be in the context of the investigation. Testing alternative methods for measuring a certain variable could also be appropriate preliminary work, but the variable and methods should be specified and appropriate to the situation.

Question 3 (c)

Most candidates approached this part of the investigation well, clearly identifying the independent, dependent and controlled variables and describing a logical method. Many candidates addressed more than enough mark points to score the maximum eight marks available for the scientific content of the answer. Most candidates were able to gain the full two marks for quality of written communication, but a significant number wrote in note form or bullet points so could not be said to have written in the 'continuous prose' required for level three QWC performance (see mark scheme).Some candidates misunderstood what the investigation was about, selecting inappropriate independent and/ or dependent variables, but these candidates could still gain credit for sound application of the principles of experimental design (such as control of extraneous variables and repetition of data collection). The prompt for the investigation left candidates free to use a with spiders / without spiders design, or to experiment with varying numbers of spiders. Both of these approaches were equally acceptable, but methods involving simply releasing one density of spiders without the use of a control area (no spiders released) were not awarded marking point two since there would be nothing with which to compare the effect of the spiders. Candidates displayed good working knowledge of a wide range of ecological sampling techniques, although sometimes the methods or sampling areas suggested were not appropriate for an organism as small as a leafhopper (actual size was indicated by the magnification given below the photograph in the question stem).

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

(10)

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

The population change of the Leafhopper Nymph is the dependant variable This can be monitored by a random quadrat sampling. Where random plots of fixed area are chosen and marked and the number of Nymph in each are counted and recorded.

The Number of Leafhopper Nymph hunted by each Wolf spider is the Independant variable. known number
before the Lab bred Wolf Spiders are introduced into the field that has been marked at 100 m^2 that is divided into smaller quadrats of 1 m^2 boxes. The initial number of Leafhopper Nymphs are counted in each quadrat and recorded. known number of into the marked field.
Then the Wolf Spiders are introduced. The Next day the numbers of Leafhopper Nymphs are

counted and recorded in each quadrat and the total number of Wolf spiders are counted and recorded aswell.
Continue this for 7 days altogether.
The density of rice plants are to be kept constant in each quadrat and the level of water in the rice field must also be kept constant. This can be done by measuring the initial level of water in the field and then water must be added if it is lost or removed if extra is present. The density of the rice plants can be maintained by planting the same number of plants that are equidistant from eachother per m^2 of area.
The results must be arranged in a suitable tabular form and an appropriate graph must be drawn for the values obtained - to compare the results.
Repeat the experiment atleast 5 times and get the average values before drawing any conclusions

ResultsPlus
Examiner Comments

This response scored ten marks, as follows, in order as the response is read:mark point 3 for correct identification of the dependent variable;mark point 5 for a sensible method of counting the nymphs (the size of the quadrat is clarified later in the answer);mark point 4 for counting the initial numbers of nymphs;mark points 6 and 7 for two good controlled variables that are specific and directly relevant to this investigation - the density of rice plants and the level of water;mark points 8 and 9 for very clear explanations of how these variables are controlled;mark point 10 for appropriate repetition of the experiment; QWC two marks (some errors were noted, but overall level 3 was judged to be the best fit).

Mark point 1 was not awarded because the independent variable is not correct, and mark point 2 cannot be given because there is no control area where no spiders are released for comparison. (The method does describe counting the nymphs before and after the release of the spiders, but in the absence of a control it would not be clear whether any change in nymph numbers could be attributed to the spiders.)

This response demonstrates that an answer does not have to be perfect to score well. The candidate has made a significant mistake in identifying the independent variable incorrectly, but has given a strong description of the control of relevant extraneous variables.

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

(10)

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

About ten same set ups with a fixed number of leafhopper nymphs are cultured in the same environment with same temperature and humidity. 5 of these set-ups are introduced with wolf spiders, while the other 5 are unaffected. The set-ups are allowed to stay in the same condition for two ~~##~~ months, where they are weekly checked and the number of remaining leafhopper nymphs is counted and charted.

The independent variable is types of treatment to leafhopper nymph, that is, whether wolf spiders are present or not. The dependent variable is population of nymphs, which is measured by the number of leafhopper nymphs present.

The control variables include nutrition, temperature, humidity, etc. They can be monitored by supplying the same nutrition to all set-ups, and keeping the set ups in the same area with the same temperature and humidity. These factors are important as they may affect the living of leafhopper nymphs and their reproduction cycles, as well as that of spiders.

The experiment can also be repeated to ensure higher reliability. For higher accuracy, more accurate appliances such as temperature box can be used.

ResultsPlus
Examiner Comments

This response scored nine marks, as follows, in order as the response is read: mark point 4 for a 'fixed number of leafhoppers' in each experimental set-up - this conveys the correct idea of needing to know the initial number of leafhoppers; mark points 6 & 7 for identification of the controlled variables of temperature and humidity (NB 'same environment' and 'nutrition' were too vague for the award of these marks); mark point 2 for appropriate design (with and without spiders); mark point 10 for repeats: 5 set-ups have spiders introduced while 5 do not; mark point 1 for clear statement of the independent variable; mark point 3 for clear statement of the dependent variable; QWC 2 marks.

Mark point 5 was not awarded because the candidate simply refers to counting the nymphs. This would only be appropriate if the experimental set-ups were very small, but there is no indication of their size so it is not clear if a sampling method would be required. Mark points 8 & 9 cannot be awarded because the response is a little confused about monitoring vs controlling variables: the measures mentioned in the third paragraph for monitoring the variables are really control measures, and they are not specific enough about **how** the variables would be controlled. At the end, perhaps the reference to a 'temperature box' means a thermostatically controlled incubator, but this is not sufficiently clear.

ResultsPlus
Examiner Tip

When describing the control of variables, be specific about **how** you will make sure that the variable remains the same - it is not enough simply to say that it will or should stay the same.

Question 3 (d)

This question differentiated well. Most candidates were able to draw a table including space for repeat readings and calculation of a mean, but some tables did not take account of the **raw** data that would need to be collected: if the candidate intended to calculate a percentage change in leafhopper numbers, initial and final leafhopper numbers must be recorded first. Many candidates had difficulty selecting an appropriate type of graph and statistical test to suit their data. If the experimental design was spiders vs no spiders, a bar chart was expected, whereas a line/scatter graph was appropriate if a range of different spider densities was used. It was also expected that the statistical test used should be appropriate to the experimental design: if the design was spiders vs no spiders, a test of difference between the two conditions such as a t-test would be needed; if varying numbers of spiders were used, a test of correlation between spider numbers and nymph numbers would be needed, such as Spearman's rank correlation test. Some candidates suggested two alternative possibilities for the statistical test, one of which was a test for a significant difference while the other was a test of significance of correlation (e.g. either a t-test or Spearman's rank correlation test).

These responses were not awarded mark point 4 since the candidate was not clear which type of test should be used.

The only situation in which alternative tests were credited was if both were appropriate, for example if the candidate suggested a t-test or Mann-Whitney U test for with/without spiders data. Common mistakes were for tables and graphs to be labelled in a way that did not make the nature of the results clear (e.g. Site A and Site B, instead of spiders present and spiders absent), and for means to be calculated across different numbers of spiders instead of across repeats for the same number of spiders. It is not a requirement that candidates draw their tables and graphs - full, clear written descriptions are entirely acceptable - but some candidates who attempted a written description did not manage to explain themselves clearly or missed out important details of headings or labels.

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

(4)

	Number of nymphs killed after 1 week			
Number of wolf spiders	1	2	3	Mean
0				
1				
2				
5				
10				

Calculate the number of nymphs killed by subtracting the number of nymphs remaining alive from the initial number of nymphs. Calculate an average value of nymphs remaining for each quantity of wolf spiders. Then plot number of nymphs remaining against number of wolf spiders on a bar chart. Then perform a statistical test like Spearmans rank correlation test to see if there is any correlation between number of wolf spiders and number of nymphs remaining.

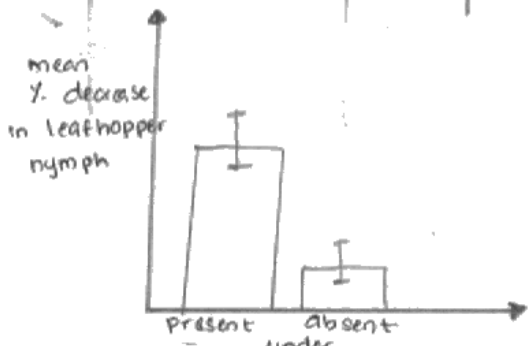
ResultsPlus
Examiner Comments

This response gained two marks. The table is clear, tidy and well organised, but unfortunately cannot be used for recording the original raw data so mark point one cannot be awarded. As the candidate explains in the text, the number of nymphs killed must be calculated by subtracting the number of nymphs remaining from the initial number of nymphs - so the table should have space for these two sets of raw data. Mark point two is earned for means calculated from appropriate repetitions. A bar chart is not appropriate since a range of numbers of spiders is used, so mark point three cannot be awarded, but Spearman's test is appropriate for mark point four.

ResultsPlus
Examiner Tip

When drawing a table to record data, be sure to include the original observed measurements that would be recorded during the experiments. You might include additional columns for calculated values such as a difference or percentage change, but the raw data must be recorded before any calculations can be made.

Field : Spiders added or not	Initial number of leafhopper nymph		Final number of leafhopper nymph		Mean decrease in leafhopper nymph	mean % decrease in leafhopper nymph.
	Trial 01	Trial 02	Trial 01	Trial 02		
Spiders added						
NO spiders						



Tabulate the data under the columns above.

Plot a graph of mean percentage decrease in leafhopper nymph against the presence availability of wolf spider. this is a bar graph.

Carry out a t-test. Calculate the t value for the data and compare with the critical value at 5% significance level. If the t value is greater than the critical value, the hypothesis is accepted and there is a significance difference between the % decrease in leafhopper nymph and the presence of wolf spider.

ResultsPlus
Examiner Comments

This answer gained all four marks. The candidate has calculated a percentage decrease, but has included space in the table for the raw data first. Ideally one would hope for more than two trials, but two was accepted as a minimum because the correct principles of table construction are demonstrated (the table could easily be expanded to allow for more repeats). A bar graph is correctly selected and fully labelled, and a t-test is also correctly chosen. The description of the use of the t-test is not quite right (it would test for a significant difference between the % decrease in leafhopper nymphs **in the presence and absence** of the wolf spider), but the meaning was considered to be sufficiently clear from the context to allow the award of the mark in this case.

ResultsPlus
Examiner Tip

When describing the use of a statistical test, re-read your answer to check that you have correctly described what is being tested.

Question 3 (e)

The vast majority of marks awarded here related to uncontrolled variables, i.e. mark points one, two and three. It is pleasing that most candidates show an awareness of the difficulty of control all extraneous variables effectively, and are able to give at least one example of an uncontrolled variable. Responses frequently included references to laboratory conditions which pointed in the direction of mark point five, but these comments were often too vague to actually gain the mark. Again it must be emphasised that, to gain credit, candidates are expected to refer specifically to the investigation in question. Very few candidates commented on the difficulties of counting leafhoppers, although in practice this would be likely to constitute a significant limitation in this investigation.

(e) The limitations of your proposed study.

(3)

→ ~~difficult~~ difficult to control all the variables

→ another factor may act as a limiting factor.

→ There may be difference in environment.

ResultsPlus
Examiner Comments

This candidate gains one mark for the basic idea of the difficulty of controlling all variables, but the reference to a limiting factor is too vague (a specific example would be required), and the third point is not clear.

ResultsPlus
Examiner Tip

When discussing limitations, think about **details** of the method and variables involved in the investigation you have planned. Refer to **specific factors** that may reduce precision, accuracy, reliability or validity.

(e) The limitations of your proposed study.

(3)

- Other variables are difficult to control such as temperature.
- There is a limiting factor such as predator of wolf spider which affects the control of leafhopper lymphs.
- Experimetal conditions may not represent the natural conditions of the field.

ResultsPlus
Examiner Comments

This response scored three marks. The general point about difficulty of controlling variables is made, followed by the specific example of temperature. Predators of wolf spiders are then identified as a further possible confounding variable. These predators should not really be described as a 'limiting factor', but the candidate has made it clear that they could affect the dependent variable. This point is a good example of a candidate considering the scenario of the investigation and thinking for themselves about factors with the potential to affect the results. The final comment about natural conditions is too vague to earn a mark (had three marks had not already been awarded).

Paper Summary

Based on the performance of candidates in this series, future candidates are offered the following advice:

- When carrying out the core practicals, make sure you understand what the results mean in the context of the biology you are studying. Think about which biological principles are being demonstrated, and the mechanisms at work inside the organisms involved.
- Be very clear about the difference between the terms precise, accurate, reliable and valid, and think about what these mean in different practical contexts.
- Find out which types of graphs and statistical tests are appropriate for use with different types of data, and practise selecting the correct data processing techniques for different situations.
- Discuss the purpose of preliminary practical work with your teacher. Bear in mind that it must be practical, and is not used to determine factors or variables that you already know.
- It can be useful to refer to mark schemes from past Unit 6 papers to help you prepare for the exam, because these indicate the types of answer expected for the various styles of question. However, do **not** try to re-use answers from previous mark schemes: your answers **must** be specific to the context of the practical or investigation you are asked about.

Grade Boundaries

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

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