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Examiners' Report
June 2012

GCE Biology 6BI08 01

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Introduction

Many centres are becoming familiar with the format of questions used in this paper and the quality of answers produced by many students reflects this. The majority of candidates appear to be well prepared for the paper and are able to describe core practicals and apply them in the planning of an investigation.

When candidates recognised the context in which the question was set, they generally found question 1 and 3 accessible and produced good answers. However, some candidates try to apply 'generic' answers to these questions and fail to gain much credit. Candidates continue to score highly with question 2 where they are expected to present and analyse data provided for them. Those parts of question 1(c) and 1(e), where candidates needed to rely on their understanding of biological principles were less well-answered. With question 3, some candidates struggle to identify what material needed to be included in each section of the question.

Question 1 (a) (b)

This question sought to examine candidates' understanding of how to carry out a study on the ecology of a habitat.

Many candidates correctly identified two abiotic variables in part 1(b)(i). The most popular being light intensity and temperature. As in previous series the examiners did not accept unqualified use of terms such as light, sunlight, water, water availability, climate and wind.

Many candidates struggled to gain either of the available marks in 1(b)(ii). For the first mark candidates needed to suggest how to take into account or control a variable. In field studies many variables cannot be controlled. It is not sufficient to simply state how to measure such a variable. To gain a mark the candidates need to describe how to measure the variable and then what to do with the results e.g. "use a pH meter to measure the pH in each quadrat and only use quadrates with similar pH values" would be credited with a mark but simply statements such as "measure pH with a pH probe" would not.

For the second mark candidates were required to identify the effect of the variable on the results. The examiners were looking for a link between the variable being monitored or controlled and the dependent variable e.g. "in areas of greater light intensity more weeds might grow making it difficult to determine the effect of the weedkiller". Vague statements such as light intensity affects growth or "different soil pHs would make the results unreliable" were not accepted.

Many candidates produced sensible descriptions for part 1(a) and a pleasing number gained full marks for this part of the question. Most candidates suggested counting the number of plants in a quadrat as the dependent variable; the examiners accepted this. However, a better answer would have been percentage cover. Even when percentage cover was suggested few candidates went on to explain how percentage cover could be calculated (MP4). Common problems included the suggestion that interrupted belt transects be used and confusion between random and systematic sampling techniques. A number of candidates referred to the entire study area as the quadrat. Some candidates suggested throwing the quadrats to distribute them randomly - this suggestion did not gain any credit. A relatively large number of candidates identified different concentrations of weedkiller as the independent variable. In the context of this question it was the particular type of weedkiller used that was the independent variable. Weaker candidates often struggled with the context of the study and suggested experiments in greenhouses or laboratories and scored less well.

1 The unwanted plants growing in a field of cereal crops are called weeds.

Selective weedkillers can be used on fields of cereal crops. These kill broad-leaved weeds, without harming the cereal plants.

(a) Describe an experiment to investigate the effect of a new selective weedkiller in a field containing cereal plants and broad-leaved weeds.

(6)

The independent variable would be the selective weedkiller.
- You would divide the field into quadrats.
- In each quadrat you have to spray the same amount of ~~a diff~~ different weed killers. (you need to have different weedkillers because you want to compare the new selective weedkiller with them).
- Observe the quadrats every day and after a week measure the density of cereal plants compared to the broad-leaved weeds in each quadrat (dependent variable)
- Repeat the experiment for reliability of the results.
- Factors to be controlled are humidity, sunlight, water, nutrients and minerals, slope.
- You need to have a control so that you can compare your results with it. The control would be a substance that doesn't contain a plant growth regulator.

(b) (i) Suggest **two** abiotic factors that are variables in the investigation.

(2)

- amount of nutrients and minerals the plants are getting
- amount of sunlight

(ii) Choose **one** of the variables from (b)(i). Suggest how this variable could be taken into account or have been controlled. Describe what effect this variable could have had on the results.

(2)

Variable amount of nutrients and minerals

How the variable could be taken into account or controlled It can be controlled by ensuring the soil is the same throughout the field. And by measuring and sprinkling the same amount of nutrients in each quadrat.

Effect of the variable on the results If this is not controlled, more cereal plants would grow where the soil is suitable. Therefore the density could be higher because of the quality of soil and not because of the weedkiller

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Examiner Comments

This is a typical answer. The candidate scored 5 out of the available 6 marks for part 1(a) and 1 mark for each of parts 1(b)(i) and 1(b)(ii) - giving a total of 7 marks.
In part 1(a) the candidate demonstrates a reasonable understanding of the question.

If the candidate had used the term quadrat correctly and had described how to collect valid data using a gridded quadrat the answer would have gained full marks.

One mark was awarded in 1(b)(i). The use of the term nutrients here is far too vague and was ignored. Reference to minerals was accepted on this occasion, although a better answer would have been "mineral ion concentration in the soil". The second suggestion, sunlight was not accepted. Candidates at this level should refer to the relevant property of light e.g., light intensity.

In (b)(ii) The description as to how the variable can be controlled was not accepted as it was judged that the proposed method would not work. An acceptable answer would have been to suggest that "mineral ion concentration cannot be controlled but that specified mineral ions could be measured and areas of the field with similar concentration used in the investigation". For the second part of the answer, the candidate gave an acceptable description of the effect of the identified variable on the results and was given a mark.

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Examiner Tip

Make sure you understand and are able to use technical terms such as quadrat, light intensity and nutrient correctly. When asked to give examples of variables make sure you fully describe the variable. e.g., soil temperature rather than temperature.

1) Choose a 100m x 100m field of cereal crops.

2) Carry out random sampling technique by laying out quadrats of 1m x 1m at ~~a~~ random grids in the field.

3) Take 10 samples of quadrats and count the number of cereal ~~crop~~ plants and broad-leaved weeds in ~~the~~ each quadrat.

4) Use the new selective weedkiller on the quadrats.

5) The new selective weedkiller used is of the same concentration and volume ~~and is sprayed on the plants once a week.~~

6) Spray the new selective weedkiller on the plants once a week for a month.

7) Count the number of cereal plants and broad-leaved weeds in each quadrat at the end of the month.

8) Record the number of cereal plants and broad-leaved weeds before and after using the new selective weedkiller and calculate the change in number to investigate the effect of the new selective weedkiller.

9) Repeat the experiment twice on different fields with the same type of cereal plants and broad-leaved weeds.

(b) (i) Suggest **two** abiotic factors that are variables in the investigation.

(2)

pH of the soil and light intensity on the plants.

(ii) Choose **one** of the variables from (b)(i). Suggest how this variable could be taken into account or have been controlled. Describe what effect this variable could have had on the results.

(2)

Variable pH of the soil.

How the variable could be taken into account or controlled Measure the pH of the soil with a pH meter and ensure that the pH of the soil in each quadrat is the same.

Effect of the variable on the results It can affect the number ~~ratio~~ of ~~the~~ cereal plants ~~to the broad-leaved weeds~~ as the ~~higher~~ lower the pH the lower the number of cereal plants.

ResultsPlus
Examiner Comments

In this answer the candidate gained 5 marks for 1(a), 2 marks for 1(b)(i) and 1 mark for 1(b)(ii) - a total of 8 marks.

The candidate has described the use of a quadrat but did not describe how to place the quadrats at random locations. Simply stating, use of a random sampling technique is not sufficient (MP3).

Two sensible abiotic factors suggested gains both marks in (b)(i) and a good description of how soil pH is taken into account gains one mark in (b)(ii).

The candidate did not describe how pH affects the results and did not gain a mark. At this level, candidates are expected to recognise that there will be an optimum pH and that changes either side of the optimum would result in less growth. Alternatively, the candidate could have suggested that the cereals and weeds grow best at different optimum pH values and therefore different soil pH values would favour growth of one over the other.

ResultsPlus
Examiner Tip

Candidates are often asked to suggest how not controlling a factor will affect the results. In your answer make sure that you link a change in the factor to an effect on the dependent variable e.g. increased light intensity will result in more growth of the broadleaved weeds.

(b) (i) Suggest **two** abiotic factors that are variables in the investigation.

(2)

The frequency of people trampling on the ~~field~~ field.

The distance of one ~~p~~ cereal crops to another.

(ii) Choose **one** of the variables from (b)(i). Suggest how this variable could be taken into account or have been controlled. Describe what effect this variable could have had on the results.

(2)

Variable The frequency of trampling on the field.

How the variable could be taken into account or controlled The field area of both are fenced so that they are no one that could go in to the field.

Effect of the variable on the results Trampling may injure the crops causing ~~it to~~ the percentage coverage to decrease.

ResultsPlus
Examiner Comments

In (b)(i) the candidate gave two biotic factors and gained no marks.

Although no marks were awarded in part (b)(i) the candidate was able to gain credit in (b)(ii).

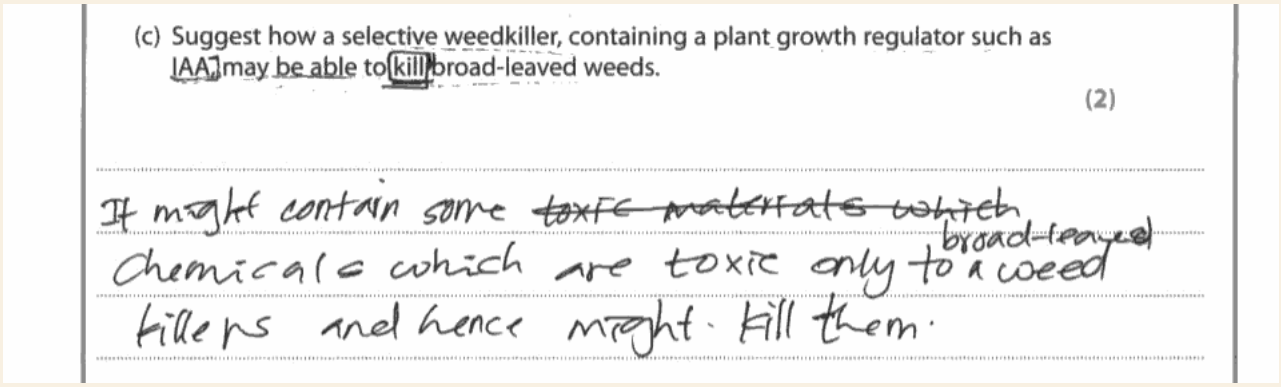
This was because both suggestions were relevant to the context of a field study and were considered sensible in the context of the variables identified in b(i). Many candidates did not gain credit because their suggestions were inappropriate in the context of the study e.g. controlling temperature using a water bath!

ResultsPlus
Examiner Tip

When a question has several closely related parts, you need to read the question carefully. Make sure you understand how later parts of the question are related to the question as a whole before trying to answer them.

Question 1 (c)

A disappointing number of candidates were unable to suggest how a weedkiller containing IAA might work. Many candidates produced answers based on cereal plants out-competing the broad leaf weeds and others suggested having broad leaves made the weeds more susceptible to the weed killer, neither gained any credit. Marks, when they were awarded, tended to be for suggesting the IAA stimulated cell elongation (MP1) inhibited enzymes (MP4), or interfered with some aspect of plant metabolism (MP3). A significant number of candidates suggested IAA stimulates growth but did not get across the idea of excessive growth so did not gain credit (MP2).



(c) Suggest how a selective weedkiller, containing a plant growth regulator such as IAA, may be able to kill broad-leaved weeds.

(2)

It might contain some ~~toxic materials which~~ broad-leaved chemicals which are toxic only to a weed killers and hence might kill them.

ResultsPlus
Examiner Comments

This response conveyed the idea that the weedkiller was toxic to broadleaved weeds and was given mark point 5.

ResultsPlus
Examiner Tip

Make sure you understand and are able to apply the biological knowledge relevant to the core practicals.

(c) Suggest how a selective weedkiller, containing a plant growth regulator such as IAA, may be able to kill broad-leaved weeds.

(2)

A selective weed killer may disrupt the activity of a specific enzyme(s) present in the weeds, but not in the desired plant crops, which disrupts the growth of the weeds, ~~possibly by making the weeds over use their reserves and nutrients such that they are "starved" and can no longer sustain the need~~, causing them to die.

ResultsPlus

Examiner Comments

This is a typical example of a candidate response to this part of the question. Clear reference to inhibition of enzymes gains a mark (MP4). The rest of the answer lacks sufficient clarity and detail to gain further credit.

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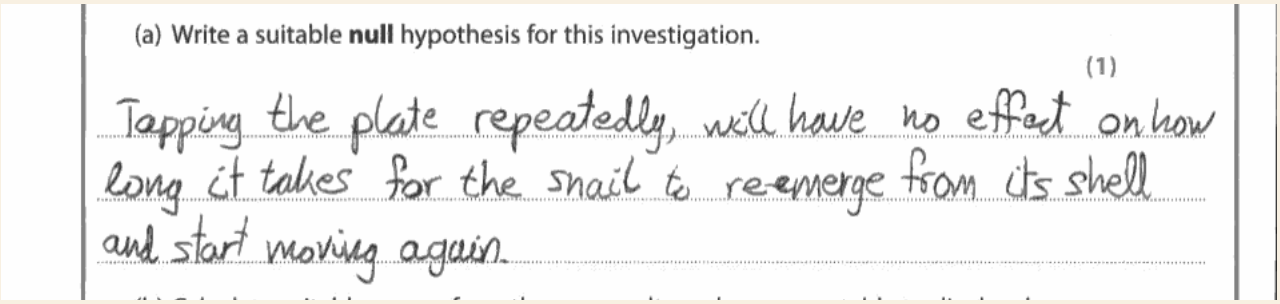
Examiner Tip

Avoid using vague terms such as disrupting growth. Instead, state how growth might be disrupted. In this example marks could have been gained for suggesting that the selective weedkiller (IAA) stimulates excessive growth of the broad-leaved weeds or alternatively for suggesting that it might interfere with a metabolic process such as photosynthesis.

Question 2 (a)

Writing a null hypothesis is an important practical skill, and one that is regularly examined. It is disappointing that many candidates cannot write a suitable null hypothesis.

Common mistakes made by candidates included; the use of significant difference or significant relationship when describing a significant correlation, and the use of, repeated tapping, rather than number of taps.



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

(1)

Tapping the plate repeatedly, will have no effect on how long it takes for the snail to re-emerge from its shell and start moving again.

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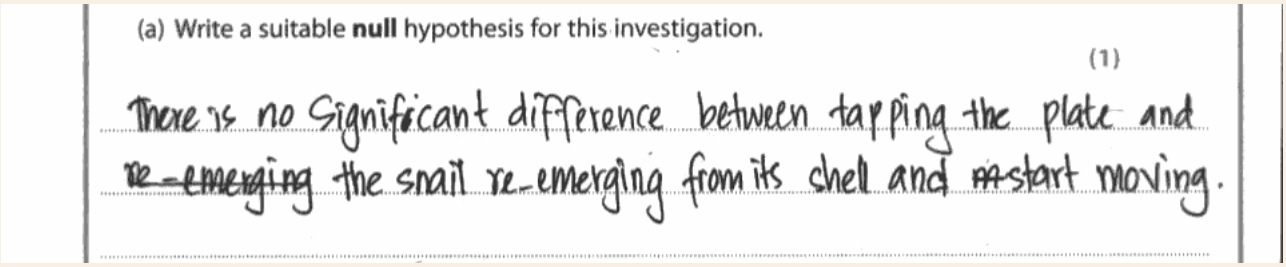
Examiner Comments

This answer illustrates two common mistakes. Firstly, the candidate has referred to "tapping the plate repeatedly" when they should be describing the number of taps. Secondly, the candidate has not used the term significant correlation.

ResultsPlus
Examiner Tip

When writing a null hypothesis, make sure you refer correctly to the independent and dependent variable and include an appropriate reference to significance.



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

(1)

There is no Significant difference between tapping the plate and re-emerging the snail re-emerging from its shell and ~~re~~start moving.

ResultsPlus
Examiner Comments

In this example, the student has confused significant difference with significant correlation. Use the term significant difference when comparing two groups or populations e.g. there will be no significant difference in the time taken to re-emerge after the first and after the seventh tap. In contrast "significant correlation" is used when comparing the two continuous variables e.g., there will be no significant correlation between the number of taps and the time taken to re-emerge.

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

(1)

There is no ~~significance~~ significant correlation between ~~tapping~~ number of times the plate is tapped and the time taken for the snail to re-emerge from its shell.

ResultsPlus

Examiner Comments

In this response the candidate has included all the elements of a good null hypothesis, correct reference to the: independent variable – number of times the plate is tapped, dependent variable – time for snail to re-emerge and appropriate significance term – significant correlation.

Question 2 (b) (c) (d)

Many candidates exhibited good data tabulation and graphing skills and it was pleasing to see many candidates getting high marks for this part of the question. However, a significant number of candidates chose to use the individual snail as the independent variable and calculated the mean values for the three snails. Although penalised in part (b), on this occasion, credit was available for parts (c) and (d).

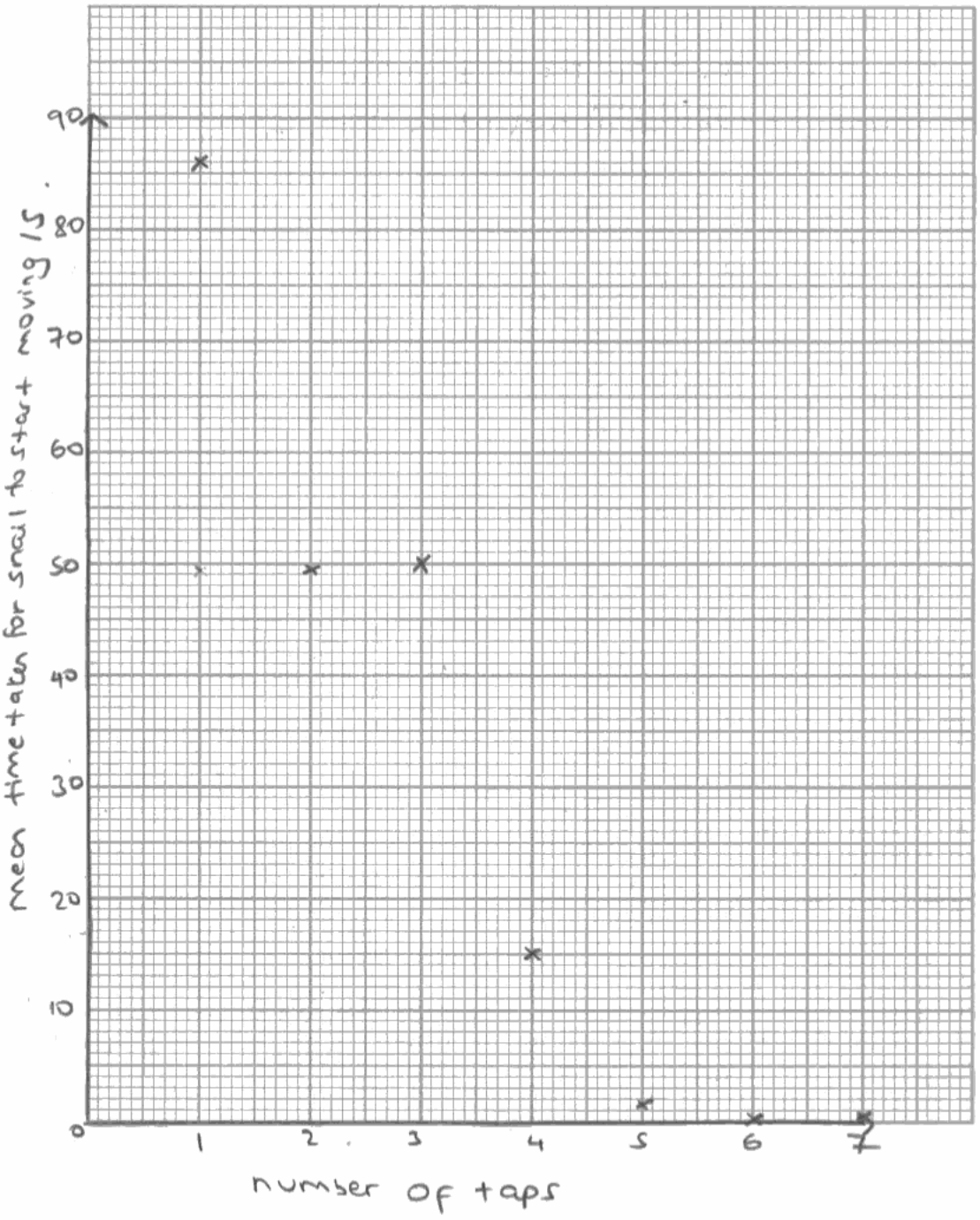
(b) Calculate suitable means from the raw results and prepare a table to display these and the raw data for this investigation.

(4)

number of taps	Time for snail to re-emerge/s A	B	C	mean time /s
1	80	108	60	86.0
2	40	60	48	49.3
3	30	40	80	50.0
4	10	15	20	15.0
5	0	5	0	1.7
6	0	0	0	0.0
7	2	0	0	0.7

(c) On the graph paper below, draw a suitable graph to show the effect of repeated tapping on the time taken for a snail to start moving again.

(3)



(d) State an anomalous result in the data.

(2)

7th tap (0.7 seconds)

Give **one** reason for your answer.

After the ~~the~~ 3rd ~~(after)~~ tap the time taken ~~to~~ for the snail to re-emerge ~~decreased~~ decreased and at the 7th tap the time increased, so an anomalous result.

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Examiner Comments

The table has a suitable format, correct heading and units and includes all raw data and calculated means. However, a mistake with the first calculated mean means they only gain 3 marks for part (b).

A scatter graph with suitable axis and axis labels is drawn, with data correctly plotted (allowing error carried forward from the table). Allowing the award of all three available marks for part (c)

Two marks were awarded for part (d). The first for identifying the result for the seventh tap as being anomalous. The second mark was for a sensible suggestion as to why, it was identified as anomalous.

ResultsPlus
Examiner Tip

Take care with calculations. Double check your answers and make sure you use an appropriate number of decimal places.

(b) Calculate suitable means from the raw results and prepare a table to display these and the raw data for this investigation.

(4)

Number of repeated taps	time taken for snail to re-emerge /s			
	A	B	C	Mean
1	90	108	80	92.7
2	40	60	48	49.3
3	30	40	80	50.0
4	10	15	20	15.0
5	0	5	0	1.67
6	0	0	0	0
7	2	0	0	0.67

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Examiner Comments

The table has a suitable format, correct heading and units and includes all raw data and calculated means, so gets mark points 1, 2 and 4. Some calculated means were recorded with too many decimal places so mark point 3 could not be awarded for part (b).

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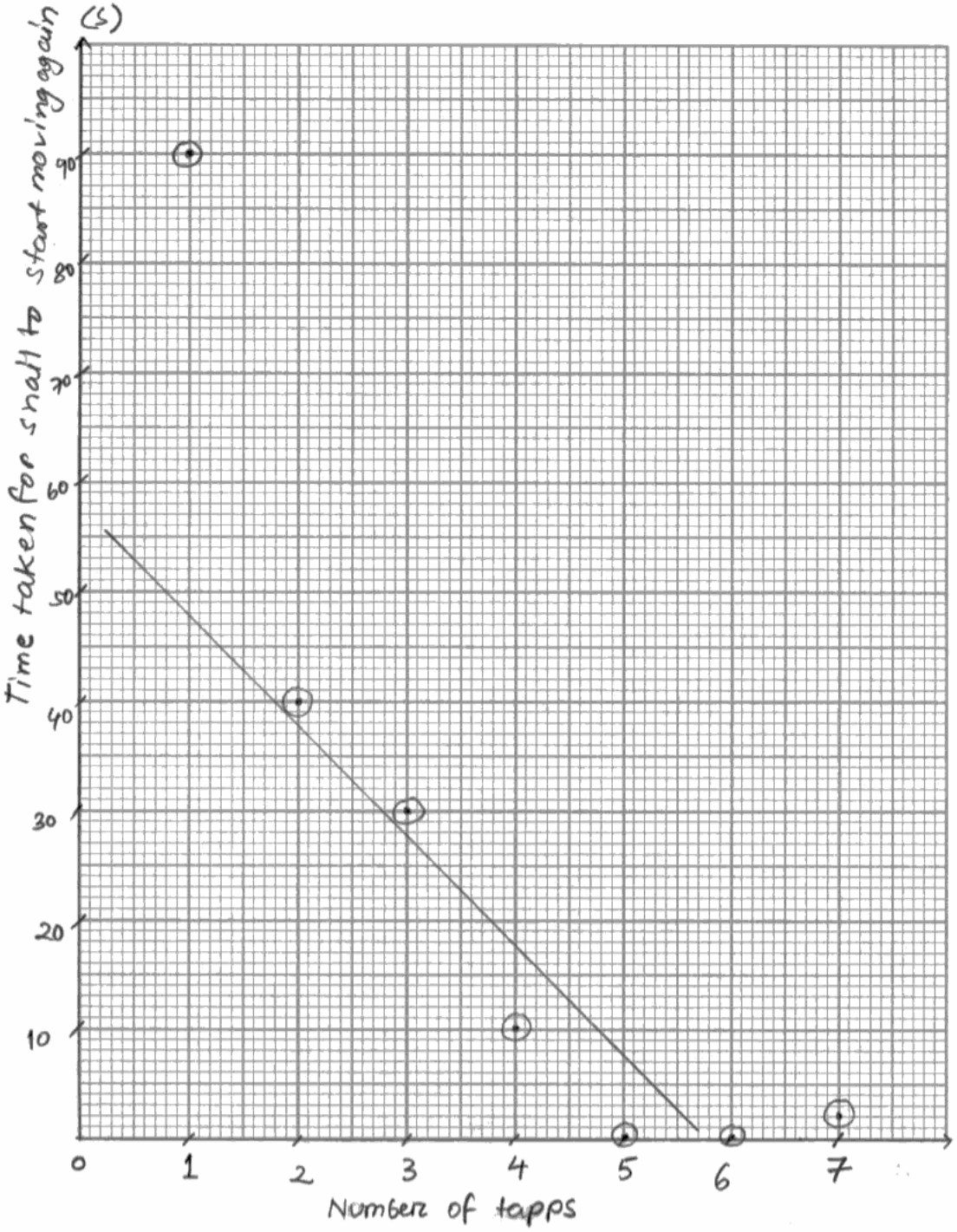
Examiner Tip

Make sure you record calculated values using a sensible number of decimal places. This will usually be the same as for the raw data. Be consistent with the number of decimal places used.

(c) On the graph paper below, draw a suitable graph to show the effect of repeated tapping on the time taken for a snail to start moving again.

(3)



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Examiner Comments

In this response, the candidate has selected an appropriate graph type and has plotted the calculated means correctly. However, the y-axis label should refer to the mean time taken and this means the candidate only gains two of the available three marks. The inappropriate line of best fit was ignored.

ResultsPlus
Examiner Tip

Make sure that axis labels are complete. If you have plotted mean values then your axis label should state this.

(d) State an anomalous result in the data.

(2)

at 4 minutes of tapping

Give **one** reason for your answer.

some other factor may have ~~spooked~~ scared the Snail causing it to take longer than expected to re-emerge.

ResultsPlus
Examiner Comments

In this response the candidate has correctly identified a potential anomalous result. However, the candidate then gave an explanation for the anomalous result rather than a reason for selecting it as their answer. Many candidates made this mistake.

ResultsPlus
Examiner Tip

Read questions carefully and make sure you answer the question asked.

Question 2 (e)

This proved to be a challenging question. Many candidates were able to gain some marks by comparing the calculated correlation value with the correct significance level but did not clearly state a conclusion and did not use an understanding of habituation to explain the conclusion. Stronger candidates were able to provide a statistical interpretation as well as apply their biological knowledge of habituation.

(e) The student used a statistical test to investigate the significance of the correlation between the mean time for the snails to start moving and the repeated tapping. His calculation gave a negative correlation value of 0.93.

The table below shows significance levels and correlation values for this statistical test.

	Significance level (p)				
Number of means	**0.50**	**0.20**	**0.10**	**0.05**	**0.01**
4	0.60	1.00	–	–	–
5	0.50	0.80	0.90	–	–
6	0.37	0.66	0.83	0.89	1.00
7	0.32	0.57	0.71	0.79	0.93
8	0.31	0.52	0.64	0.74	0.88
9	0.27	0.48	0.60	0.70	0.83
10	0.25	0.46	0.56	0.65	0.79

What conclusions can be drawn from this investigation?
Use the information provided in the table above and on the graph you have drawn, together with your knowledge and understanding of habituation, to **explain** your answer.

(5)

The calculated correlation value is 0.93 which is greater than the correlation value at 5% significant level which is 0.79. The null hypothesis is rejected. There is significant negative correlation between the mean time for the snails to start moving and the number of taps. The greater the number of taps, the smaller the ~~time needed~~ mean time for the snails to start moving. The snails became habituated to the sound of the taps and learnt that the taps posed no danger to them. They learnt to gradually ignore the ~~taps~~ tapping. The calcium ion channels in the presynaptic knobs in their brains become inactivated and they learn not to respond to the stimuli.

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Examiner Comments

This is an example of a response that gained full marks. Three marks were awarded for correct interpretation of the statistics, identification of the critical value as being 0.79, stating that the calculated value is greater than the correlation value at the 5% significance level and describing the correlation between the number of taps and time to re-emerge.
The candidate then provides a biological explanation that was worth a further two marks.

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Examiner Tip

When using statistical data, that has been calculated or selected from tables make sure you clearly state the values being used. You are unlikely to gain credit for vague statements such as the calculated value is greater than the significance level value.

	Significance level (p)				
Number of means	0.50	0.20	0.10	0.05	0.01
4	0.60	1.00	–	–	–
5	0.50	0.80	0.90	–	–
6	0.37	0.66	0.83	0.89	1.00
7	0.32	0.57	0.71	0.79	0.93
8	0.31	0.52	0.64	0.74	0.88
9	0.27	0.48	0.60	0.70	0.83
10	0.25	0.46	0.56	0.65	0.79

What conclusions can be drawn from this investigation?
Use the information provided in the table above and on the graph you have drawn, together with your knowledge and understanding of habituation, to **explain** your answer.

(5)

calculated value = 0.93, critical value (0.05 significance) = 0.71
The calculated value is greater than the critical value. So at 95% confidence level, the null hypothesis is rejected and there is a significant correlation between the number of repeated tap and time taken for the snail to re-emerge. The graph shows that there is a gradual decreament of time as the number of the repeated tap increases but there are some rises in some points as well.

(Total for Question 2 = 15 marks)

When the number of the repeated tap increase the neurones become less responsive and so it gets habituated to it.

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Examiner Comments

Many candidates produced responses similar to this one. The candidate gained one mark for the correct comparison of the calculated value with the critical value at the 95% confidence level. A second mark was gained for a reasonable description of the significant correlation between the number of taps and time taken to re-emerge. The remainder of the answer lacked sufficient detail to gain further credit.

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Examiner Tip

Make sure you understand and can apply the biological knowledge relevant to the core practicals.

Question 3

This question was based on a core practical; describe how to investigate the effect of different antibiotics on bacteria (4.6.18). Most students seemed to be familiar with the idea of measuring inhibition of bacterial growth. The vast majority of students described methods based on measuring the size of the inhibition zone on agar plates covered with a bacterial lawn.

In 3(a) the examiners were looking for candidates to identify different risks and then suggest how to reduce these risks. Therefore, identifying alcohol as being flammable gains a mark and suggesting keeping it away from flames gets a second mark. A number of students simply listed a large number of different risks or focussed their attention exclusively on one risk. These types of response did not allow the award of all three marks.

The majority of candidates seemed to find it difficult to engage in the context of the question and this made it particularly difficult for them to gain credit in 3(b) and 3(e). To be awarded marks in 3(b) candidates were expected to relate the need for preliminary work to establish conditions for the proposed study. Good answers identified practical work that would allow the identification of a suitable dependent variable, determination of factors affecting the dependent variable and control of these factors. Generic statements such as find out what factors affect the dependent variable, or carryout a literature search to find the best conditions, are not sufficient.

Many students simply seemed to equate alcohol with antibiotic. As a result they often made errors in the proposed plans 3(c) e.g. suggesting the use of antibiotic masts or drying the alcohol soaked disks before placing them on the bacterial lawn.

3 Many hospitals and other public buildings now use alcohol-based hand gels to help prevent the spread of infection. These hand gels contain a high concentration of an alcohol (such as ethanol) and a mixture of other components to help thicken and perfume the gel.

Plan an investigation to discover the minimum concentration of ethanol that is needed to inhibit the growth of a specific type of bacterium.

Your answer should give details under the following headings.

(a) A consideration of the safety issues and how you would minimise the risk.

(3)

The agar dish would need to be incubated at a temperature between 27 and 30 °C to avoid the growth of harmful, pathogenic bacteria. Also ~~eye~~ safety goggles and gloves should be worn as ethanol may be an irritant. Wash down any surfaces after the experiment and wash your hands to prevent any spread of bacteria. To prevent the growth of other bacteria, aseptic techniques such as flaming should be used throughout the investigation.

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Examiner Comments

This is an example of a good answer to part (a) that easily gains all three available marks. The candidate has identified two risks and linked each to suitable control measures.

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Examiner Tip

Make sure that you can identify risks and then suggest appropriate measures to reduce the risks associated with all the practical activities that you have carried out.

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

(3)

Practice the method to see if the method really works. Control all the other variables such as temperature of the surrounding, light intensity and volume of bacterium so it will not affect the experiment. Determine the suitable timescale of the experiment to obtain the best results.

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Examiner Comments

Many candidates produced responses similar to this one for part (b). Only one mark was awarded, for stating that the method needs to be practiced. Statements about the need to control different variables, are not relevant to preliminary work. Instead, the candidate should have described preliminary work that could be carried out to determine specific conditions (e.g. concentration of bacteria to use, best way to prepare the bacterial lawn, incubation temperature for the type of bacteria selected) for the experiment. Rather than state that "the timescale for the experiment should be determined" the candidate should have engaged in the context of the investigation and referred to determining the timescale for measuring the inhibition of growth of the bacteria.

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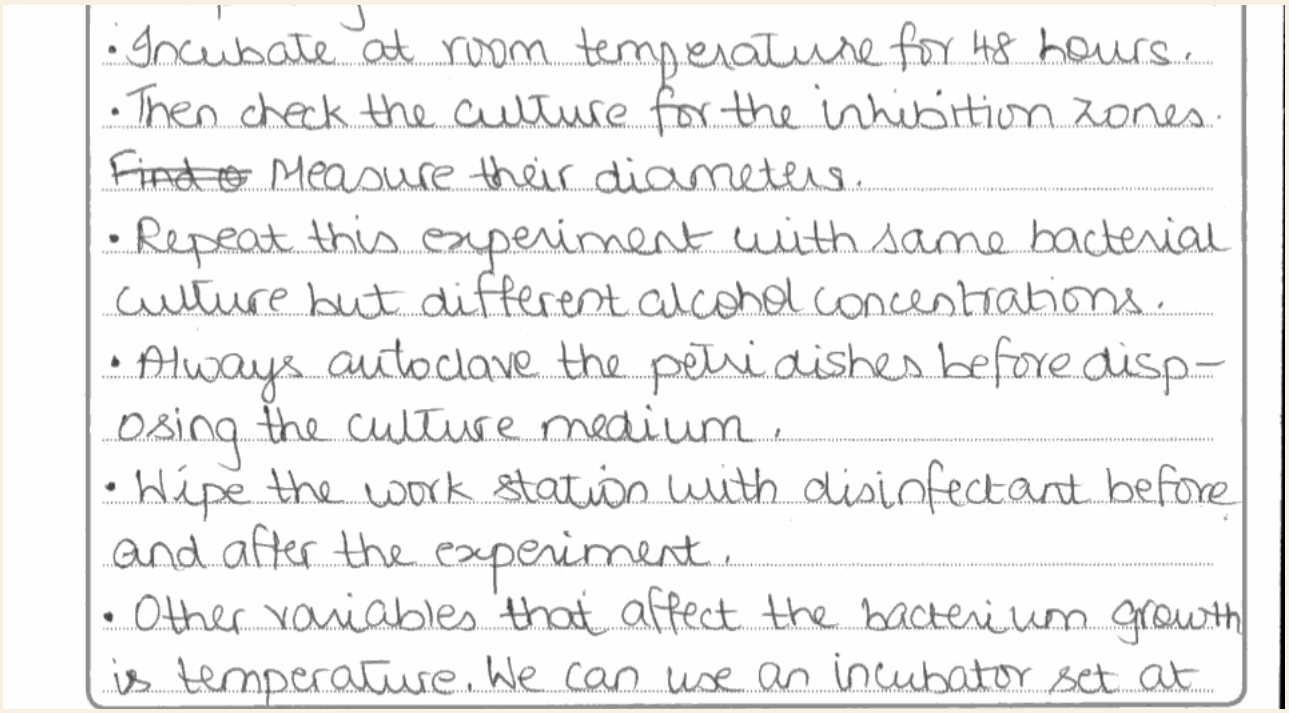
Examiner Tip

Avoid making generic or vague statements. Try to engage in the context of the investigation linking your answer to the independent and dependent variables where appropriate.

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

(10)

- To investigate the minimum concentration of ethanol that is required to inibit growth of specific bateriom, take the ethanol concentration as the independent variable.
- ~~Use~~ Materials and apparatus: Sterile pipettes, filter paper discs, different ethanol concentrations, sterile forceps, petri dish, bunsen flame, adhesive tape, marker pen, industrial denatured alcohol, disinfectant spray, paper towel
- ~~Using sterile pi~~ Inoculate an agar plate with the correct species of bacterium using aseptic techniques. ~~Allow~~ Allow the agar to set.
- Now use different sterile pipettes to transfer 0.1cm^3 of ethanol of various concentrations onto different filter papers & discs.
- Use different pipettes to prevent cross contamination.
- ~~Tape~~ Leave these filter papers on an open crucible to dry.
- Take the agar plate and at the back, divide the plate into four quadrats with a marker pen. This is for each different concentration.
- With the help of sterile ~~pipe~~ forceps place ~~one~~ each of the dry filter paper ~~discs~~ discs in one quadrant.
- ~~Tape down~~ You can use a paper disc dipped in distilled water as a control
- Tape down the lid of the plate, but not completely.



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Examiner Comments

This is an example of a response in which the candidate demonstrates a reasonable understanding of the required investigation but omits the detail required to gain many of the available marks. The candidate has identified alcohol concentration as the independent variable, suggested temperature as a factor to control and described incubation for 48 hours, gaining three marks. "Use an incubator set at a particular temperature" and "incubate at room temperature" together were considered sufficient for a description of how the temperature is controlled, gaining a fourth mark. A common mistake made by many candidates was to suggest drying the alcohol soaked disks before applying them to the agar plate.

One mark was awarded for SPG.

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Examiner Tip

Write your account in continuous prose, to be eligible for both SPG marks. You should not bullet point your answer.

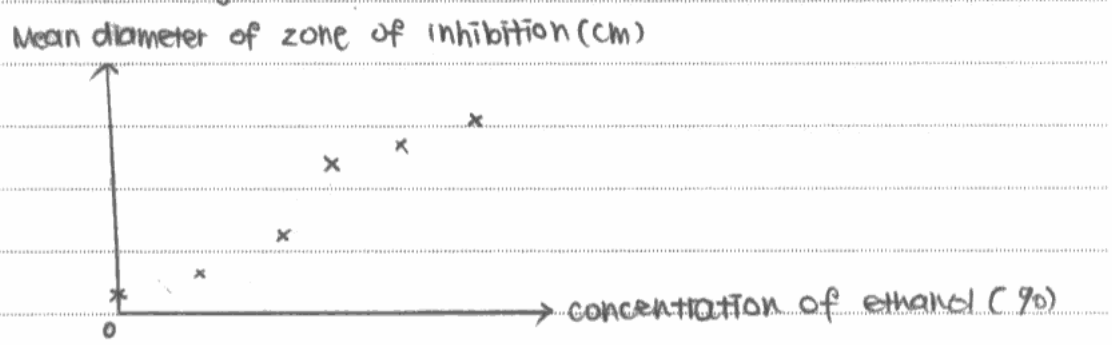
(d) A clear explanation of how your data are to be recorded, presented and analysed in order to draw conclusions from your investigation.

(4)

The data is recorded in a table. The mean is calculated.

Concentration of ethanol (%)	Diameter of zone of inhibition (cm)				Mean = $\frac{\text{Total 4 readings}}{4}$ (cm)
	1	2	3	4	
Distilled water					
1.0					
2.0					
3.0					
4.0					
5.0					

A scatter diagram is drawn as shown below.



A Spearman's Rank correlation test is used to analyse the data. If the calculated correlation value, r is larger than its critical value at 95% confidence level, then there is a correlation between the concentration of ethanol and the diameter of zone of inhibition of bacteria. ~~The ethanol concentration with largest inhibition zone w~~

(e) The limitations of your proposed method.

(3)

It is hard to control all the factors affecting the rate of bacterium growth. The gel medium prepared may not be the same pH as the hand gels. ~~Not all the ethanol is diffisy diffused into the gel medium and~~ It is very difficult to ensure that all ethanol is diffused into the gel medium. There may be some other limiting factors that affect the growth of bacterium besides the ethanol itself. Measuring zone of inhibition does not correspond to the rate of inhibition of that bacterium itself. necessarily

ResultsPlus
Examiner Comments

This is an example of a response that obtained all four available marks for part (d) and all three marks available for part (e).

The candidate has produced clear tables with suitable headings to show collection of replicate raw data and the calculation of mean values. A sketch graph, again with appropriate labels including units, and reference to the correct statistical test are also given.

The candidate has engaged in the context of the investigation in part (e). One mark was awarded for suggesting it is difficult to control all factors affecting the rate of growth of bacteria, a second for suggesting that the conditions in the experiment are different to those in hand gels and the third for recognising that it is difficult to ensure diffusion of all the ethanol into the agar gel.

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Examiner Tip

You may find it easier to gain marks for part (d) by drawing out the table and producing a sketch graph. However, remember to include units in the table headings and axis labels.

3 Many hospitals and other public buildings now use alcohol-based hand gels to help prevent the spread of infection. These hand gels contain a high concentration of an alcohol (such as ethanol) and a mixture of other components to help thicken and perfume the gel.

Plan an investigation to discover the minimum concentration of ethanol that is needed to inhibit the growth of a specific type of bacterium. E-coli
stop

Your answer should give details under the following headings.

(a) A consideration of the safety issues and how you would minimise the risk.

(3)

Since there is use of high concentrations of ethanol. care should be taken while handelling it and hand^gloves should be worn throughout the experiment and lab coats too as there is a danger of it falling on the person carrying out the experiment.

We are using bacteria in the investigation hence care should be taken as they could be harmful to humans ∴ only use bacteria that is not very harmful and the temperatures should always be maintained below 37°C so no ~~human~~ bacteria affecting humans can grow.

~~A lot Since there is a risk of the bacteria getting resistant which we don't want, The experiment should be~~

→ Prepare concentrations of the ethanol in beakers

→ Obtain bacteria e.g. E-coli e.g. from . . .

→ pp

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

(3)

* Decide on the different ranges of concentrations of ethanol to be used and how to obtain them.
* Decide on what bacteria to use and where to obtain them from
* Decide on how the measurment of the effectivness of the concentration of ethanol in inhibiting the growth of bacteria will be measured ~~i.e~~ e.g by measuring the diameter.. etc.

Prepare all the aparatus requires and the material needed to sterilise them and ~~see~~ check how long the proposed method will take.

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

(10)

* Prepare ~~10~~ 9 different concentrations of ~~30cm³~~ 3 cm^3 ethanol. for example. 2 10%, 20%, 30%, 40%, ... 80%, 90%, 100%. Place these concentrations using a sterile pipette into ~~a~~ seperate beakers.

obtain a lawn of bacteria e.g E.coli from the soil, mix these with sterilised water of about $100cm^3$.

~~Prepare Agar plates Molten Agar and mix~~ nutrient

Prepare Molten nutrient Agar weighing 5g. ~~Mix Mix~~ in Mc cartney bottles. Using a sterilised pipette and drop all the soil water in the pipette. Pipette out drop by drop the soil mixture into the Mc cartney bottle that contains the Agar mixture. Shake the contents

well to distribute the bacteria well.

~~Di~~

Prepare 8 petri-dishes of the same size. Sterilise these petridishes well and pour the Agar mixture and the soil mixture into the petri-dish by opening the lid of the petri-dish. This is called pour plating, use a spreader to well spread the ~~bac~~ mixture

Close the lid of the petri-dish.

~~From~~ Obtain small disks of paper ~~of size~~ with the diameter of 0.5cm. Sterilise these disks and using a sterilised forceps ~~pla~~ Dip the discs in the 10% ethanol. After Dipping them well take one of the petri dishes prepared earlier and place the disk in the middle. ~~Incubate~~

Seal the petri dish with a cross using a clear ~~&~~ tape, this is to allow air to move in but no bacteria to move out of the petri dish. Leave this petri-dish into a closed surface sterilised cabinet. ~~of~~ for 5 days.

~~At~~ Repeat this procedure for all the other 7 concentrations of the ethanol.

Key variables that need to be controlled or monitored in this experiment are. the intensity of light reaching the petri-dishes, there should be least amount of light reaching it as it may cause the growth of ~~for~~ algae. which will affect the experiment.

Also the temperature at which the petr-dishes are kep should be the same for all the concentrations as it affects the growth of bacteria.

After the 5days the diameter of the clear zone in the petri dish around the disk is measured. from this the mean minimum concentration that has a clear zone could be known.

Repeat this procedure 2 more times for all the concentrations. so that the mean is obtained.

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

(4)

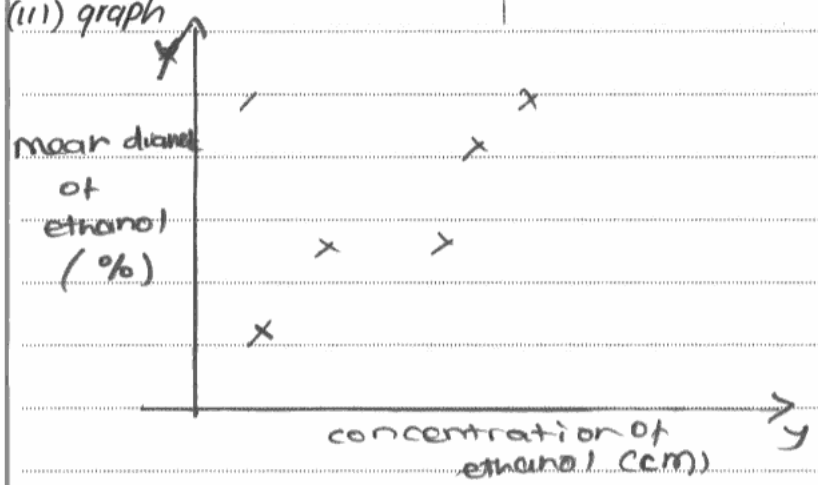
(i) Raw data.

Concentration of ethanol (%)	diameter of clear zone (cm)		
	Trial 1	Trial 2	Trial 3
0			
10			
20			
⋮			
80			

(ii) Sumarised data

concentration of ethanol (%)	Mean diameter of clear zone / cm
0	
10	
20	
⋮	
80	

(iii) graph



iv) data analysis

a spearmans correlation test at 5% significant level.

(e) The limitations of your proposed method.

(3)

The ~~tai~~ bacteria may not be equally distributed in the petri dish. Since we are ~~using~~ sterilising all the equipment including the petri dish ~~th~~ and we usually sterilise with ethanol, there might be an extra amount of ethanol in the petri dish than we actually know. It may be difficult to know exactly what the minimum concentration is as the range used ~~is~~ has intervals of 10 i.e very large.

(Total for Question 3 = 23 marks)

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Examiner Comments

Marks awarded for methods of reducing risk, were only credited if an appropriate risk had been identified (a).

In the first paragraph, the candidate did not identify a sensible safety issue. Therefore, reference to wearing gloves did not gain a mark. In the second paragraph, the candidate identifies potentially harmful bacteria as a risk and suggests incubating the cultures at temperatures below 37°C as a sensible method of reducing the risk, gaining two marks.

The candidate clearly identifies three important areas of preliminary work gaining all three available marks in part (b).

A reasonable, comprehensive description of the planned investigation is presented gaining 8 marks and both QWC marks were awarded - giving a total of 10 for 3(c).

In (d) the candidate suggests suitable tables for raw and summary data with appropriate headings and units gaining three marks. The candidate then sketched a scatter graph but the axis labels have the wrong units so was not awarded a mark. Reference to a suitable correlation test, Spearman's Rank, gains the fourth available mark.

In part (e) the candidate suggests uneven distribution of the bacteria as a limitation gaining one mark. None of the other suggestions were considered credit worthy.

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Examiner Tip

When making suggestions, always relate your answer to the context of the investigation e.g. check suitable conditions for the growth of bacteria - not just check for suitable conditions.

Paper Summary

In preparing for this paper candidates should make sure they understand the underlying biological principles explored as well as the practical techniques employed. When planning their answers to questions candidates should ensure they understand the context in which the question is set and they should apply their answers to this context. It is particularly important to bear this in mind when using mark schemes with previous papers in preparing for this exam.

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