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Examiners' Report
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GCE Biology 6BI08 01

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Introduction

This was the second exam for this paper, the international alternative to the individual investigation for unit 6, with a significant proportion of the candidates re-sitting the paper.

Although it is impossible to fully mimic the assessment and learning possible through the carrying out of an individual investigation we have tried to mirror the marking criteria for the individual investigation as far as possible.

This paper achieved a full range of marks with all questions, with question 1 more accessible and question 2 more challenging than the June 2010 exam.

With question 3 some candidates still struggled to identify what needed to be included in each section of the question and several candidates attempted to plan a similar investigation to that covered in June 2010, despite the different context and question used for this paper.

Key areas of weakness for some candidates tackling this paper include consideration of the value of preliminary work, application of knowledge and understanding and how to analyse and evaluate data obtained.

The mean mark for the paper was 25.9 (out of 50 max) with a standard deviation of 9.3.

Question 1(a)

This question was very well answered by the majority of candidates with many scoring 5 or 6 out of the available 6 marks. Many candidates included a pleasing level of specific detail, particularly when considering how to set up and incubate the plates. Unfortunately some candidates neglected to consider how they would measure and compare the effects of the antibiotics.

Some candidates ignored the context of the question and wrote at length about how to prepare and test plant extracts rather than antibiotics, clearly drawing on their recall of the AS rather than the A2 core practical.

Other errors include referring to agarose gels and proposing that the plates should be sealed completely so that they are air-tight (a good way to encourage the growth of potentially pathogenic anaerobes.)

A few centres appeared not to have covered this practical technique and this was shown in the poor responses of candidates.

Answer ALL questions

1 Agar plates spread with a suitable culture of bacteria can be used to test the effectiveness of different antibiotics.

(a) Describe how to investigate the effect of different types of antibiotic (the independent variable) on bacteria. Include details of a suitable **dependent** variable and how it can be measured.

(6)

The working area must first be cleaned using disinfectant
An agar plate is prepared by putting 2.5g of agar powder ~~and~~ into 100 ml distilled water. The ~~agar~~ solution ~~and~~ is boiled and stirred until the agar powder dissolves. The solution is then cooled to 50°C so that the solution is easy to handle. The solution is then poured into the steriled Petri dish. A fixed volume of bacterial broth is then pipetted into the steriled Petri dish. The Petri dish is then allowed to cool and set up. A Mast ring which contained different types of bacteria on each arms of the Mast ring is put firmly on the centre of agar plate by using autoclaved forceps. The Petri dish is then sealed ~~their~~ with adhesive tap and put upside down. The agar plate is left for nearly 24 hours incubated at 25°C and. The effect of different types of antibiotic can be ~~obse~~ determined by observing the diameter of clear zone. Diameter of the clear zone is the dependent variable. It can be measured by ~~using calculat~~ measuring its diameter at different point and calculate the average of the diameter. The larger the diameter the more effective the antibiotic.

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Examiner Comments

This is a good example of the quality of many of the responses seen. It demonstrates a good level of recall and selection of details from setting up the plates through to measuring the effect of the antibiotic.

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Examiner Tip

This response scored the full 6 marks available for this question.

Answer ALL questions

1 Agar plates spread with a suitable culture of bacteria can be used to test the effectiveness of different antibiotics.

(a) Describe how to investigate the effect of different types of antibiotic (the independent variable) on bacteria. Include details of a suitable **dependent** variable and how it can be measured.

(6)

the different types of antibiotics are infact substances of bacteria but having different remedie structure. the investigation of anibiotic is better investigated on nomenclatures before experimenting them on humans.
) first independent variable will be time and the time required for the bacteria to assume its role or function.,
) dependent variable can be the use of temprature and amout of Bacteria.
) most Bacterial investigations, consist of a medium, heat, temprature control, addition of nutrients to investigate the stregnth duration and combatness to fend of Bacteria

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Examiner Comments

Thankfully this type of response was rare, but it illustrates the type of response to this question by candidates who have had no experience of the core practical.

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Examiner Tip

In preparing for this paper candidates should have a good look at all of the core practicals in the specification and make sure they understand the underlying biological principals being explored as well as the practical techniques employed.

Question 1(b)

On the whole part (i) was well answered with many candidates able to identify one or two suitable variables. The most common mistake here was using a vague term such as amount as a variable rather than something that could be more precisely measured.

Part (ii) was often poorly answered as candidates often did not describe how their chosen variable could be controlled. For example many just said 'keep the concentration of the antibiotic the same' without saying how or even stating a value for the concentration to be used.

(b) (i) State **two** variables, other than the dependent and independent variable, which could affect the investigation.

(2)

1 if not sterilise properly, results would be ~~affected~~ contaminated.

2 if petri dish not seal air tight, bacterias can ~~escape~~ escape.

(ii) Suggest how **one** of the variables you have stated in (b)(i) could be controlled.

(1)

Petri dish can be held air tight by using a cellophone tape.

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Examiner Comments

This is an example of a candidate who did not have a clear idea of the different variables that should be controlled in this investigation.
Although concern about contamination is relevant, this response is too vague and could have been qualified to state that this would help ensure that only one type of bacteria was grown on the plate. Making the plates air-tight is not to be recommended and even if the bacteria could escape it would not affect the results. However, consideration of sealing all or none of the plates the same in order to ensure all bacteria have the same access (or lack of access) to oxygen/air would be worthy of credit as that variable will affect bacterial growth.

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Examiner Tip

When considering variables candidates would be wise to focus on those variables that are likely to affect the dependent variable - in this case the growth of the bacteria colonies. It is also a good idea to identify measurable variables and avoid terms such as 'amount'.

(b) (i) State **two** variables, other than the dependent and independent variable, which could affect the investigation.

(2)

1 Temperature which bacteria is cultured.

2 Type of bacteria used.

(ii) Suggest how **one** of the variables you have stated in (b)(i) could be controlled.

(1)

Culture the bacteria in a thermostated oven in a fixed temperature.

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Examiner Comments

This is a typical example of a response which scored maximum marks for both parts of the question.
The two variables identified will have an effect on the dependent variable and the candidate identifies that you can use something with a thermostat to try and fix the temperature at a constant level.

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Examiner Tip

Part (ii) could be improved with the use of an incubator rather than an oven, together with a suggestion of what temperature to use for extra clarity.
For example some candidates suggested leaving the plates to grow in a fridge to maintain the temperature. It may help fix the temperature, but it is not very practical for measuring different rates of growth of bacteria if no bacteria can grow in any plates.
Some candidates automatically think of using a waterbath for controlling temperature showing some lack of thought over what would actually be practical for incubating petri dishes.

Question 1(c)

Most candidates had a reasonable grasp of aseptic techniques and most scored both marks available. Washing hands, disinfecting apparatus and benches, together with considering how to dispose of the used plates were the most common responses. However, some candidates did not think of specifics and either just said use aseptic techniques or think that goggles, gloves and a lab coat will protect them from everything.

(c) Give **two** ways in which this investigation should be carried out safely.

(2)

~~clean~~ ~~make sure that the gloves are on the~~

make sure that the hands are clean. ~~and~~ The flame does not burn or melt the petri dish, it should be maintain at safe distance.

~~The con~~ wear googles.

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Examiner Comments

This is an example of the type of non specific safety comment made by some candidates. For example 'make sure that the hands are clean' does not tell us how, when or why. This response did not score any marks.

(c) Give **two** ways in which this investigation should be carried out safely.

(2)

After the procedure is done, wash the hands with disinfectant solution and also clean up the table which carried out the experiment by using alcohol solution.

At the end of the experiment, terminate the petri dish carefully by placing it in a autoclave machine.

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Examiner Tip

This candidate identified three clear creditworthy safety precautions, although they only needed two, so scored both marks available.

Question 1(d)

This question also gave most candidates a mark, usually for identifying the risk of allergic reactions. It was very pleasing to see a number of candidates giving a good reasoned explanation of when to use a bactericidal rather than a bacteriostatic antibiotic.

Many candidates unfortunately focussed on whether the bacteria was already resistant to the antibiotic (ignoring the context and stem of the question) and a few thought that the patients themselves may become resistant to the antibiotic.

(d) To treat a bacterial infection, an antibiotic must be effective against the bacteria. Suggest **one** other factor that may need to be considered by a doctor when prescribing an antibiotic to treat a patient with a bacterial infection.

(1)

A doctor must be aware of whether the patient is resistance to the antibiotic

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Examiner Comments

Several candidates considered the antibiotic resistance of the patients. While it is true that patients need to be resistant to the antibiotics in order to have no side-effects, this is not clearly implied by this statement so no credit has been given. This is because some candidates do have this popular misconception about the patients rather than the bacteria becoming resistant to the antibiotics.

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Examiner Tip

To receive credit answers should be unambiguous if possible.

(d) To treat a bacterial infection, an antibiotic must be effective against the bacteria. Suggest **one** other factor that may need to be considered by a doctor when prescribing an antibiotic to treat a patient with a bacterial infection.

(1)

The doctor should check which type of antibiotic to prescribe for the patient. For example, if the patient's immune system is weakened, the doctor should not give a bacteriostatic antibiotic as it would stop the growth of the bacteria, but not kill it. Instead a bacteriocidal antibiotic should be given.

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Examiner Comments

This is an example of a very good response reasoning what type of antibiotic should be used. It was pleasing to see a number of candidates writing similar responses to this one.

(d) To treat a bacterial infection, an antibiotic must be effective against the bacteria. Suggest **one** other factor that may need to be considered by a doctor when prescribing an antibiotic to treat a patient with a bacterial infection.

(1)

~~Also~~ whether the patient could be allergic to the antibiotic or not.

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Examiner Comments

This is typical of the most common correct response given to this question.

Question 2(a)

Many candidates understood the need for equilibration. However for some candidates there was quite a lot of confusion about equilibration. The fact that the separate tubes were incubated was often missed so candidates wrote about constant temperatures and the temperature for the optimum activity of the enzyme. Some candidates even thought that 30°C is needed to sterilise the solutions and kill all bacteria present in the tubes.

2 Rennin is an enzyme, found in the stomach of mammals, that can form solid clots in milk. Rennin is often used in the first stage of cheese production.

A student was interested in discovering which conditions would be ideal for making cheese. She wanted to determine which concentration of rennin was likely to give her suitable rates of clotting of milk.

She prepared the following test tubes:

- Fourteen test tubes with 5 cm^3 milk
- Twelve test tubes, each containing 5 cm^3 of different concentrations of rennin
- Two test tubes with 5 cm^3 distilled water

She placed these test tubes in a water bath at 30°C and left them for 10 minutes. The content of each test tube containing milk was added to a test tube containing either rennin or distilled water. These were mixed and returned to the water bath. The time taken for the milk to clot (thicken) was recorded.

A copy of the student's raw results are below.

3% rennin 30 sec, 20 sec;
1.5% rennin 1min, 1min 30 sec;
0.5% rennin 3min 30 sec, 3min;
Distilled water did not clot.

2% rennin 45 sec, 40 sec;
1% rennin 1min 30 sec, 1min 30 sec;
0.2% rennin 7min, 7min 30 sec;

(a) Explain why the test tubes containing milk, rennin and distilled water were left in the water bath for 10 minutes before they were mixed.

(1)

To control the dependent variable of temperature as an increase or decrease will in turn increase or decrease the rate of clot respectively.

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Examiner Comments

This is typical of a response that did not make it clear why the tubes were left in the waterbath **before** mixing, rather than just for the duration of the reaction. It therefore did not gain the available mark.

2 Rennin is an enzyme, found in the stomach of mammals, that can form solid clots in milk. Rennin is often used in the first stage of cheese production.

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Distilled water did not clot.

2% rennin 45 sec, 40 sec;
1% rennin 1min 30 sec, 1min 30 sec;
0.2% rennin 7min, 7min 30 sec;

(a) Explain why the test tubes containing milk, rennin and distilled water were left in the water bath for 10 minutes before they were mixed.

(1)

To equilibrate the temperature of milk, rennin, and distilled water in the test tube with the surrounding water bath temperature to ensure all have an even temperature of 30°C.

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Examiner Comments

This is a response typical of those candidates who demonstrated a clear understanding of equilibration and therefore gained the available mark.

Question 2(b) - (d)

2(b) The table was much more discriminating this year achieving a full range of marks from 0 to 5.

Most candidates included suitable units and the conversion of times to seconds and the calculation of the mean rates were usually done well.

The most common error was omitting any reference to distilled water.

A significant number of candidates left out the raw data columns despite the instruction given in the question stem. It would be helpful if candidates used the same number of decimal points in any one column and limited these to 3 significant figures. It would also be helpful if the mean rates were expressed in a uniform way (some candidates used a combination of different scales.)

2 (c) Most candidates were able to select an appropriate format and scale for their graphs. Some candidates made plotting errors, sometimes due to using very awkward scales. Several candidates failed to use continuous scales ignoring the change in the position of the decimal point.

A few candidates chose bar charts for presenting this data, or neglected to label the axes properly.

2(d) Although a majority of the candidates correctly recognised an anomalous result few gained the second mark for giving a good reason – they tended to try and explain what could cause an anomalous result rather than give reasons for their identification. A few candidates correctly referred to the position of the point in relation to a trend or the line of best fit.

Some candidates just described the trend of the results or referred to the fact that there were two different readings for the concentration 1.5%. They didn't realise that this was a measure of reliability and not on whether the mean was an anomaly. A significant number said the reading at 1.5% was too low or 3% was too high.

(b) Convert the times recorded into the SI units of seconds and prepare a suitable table to display these raw results and each of the following.

(i) The mean time for clotting for each concentration of rennin.

(ii) The mean rate of milk clotting, calculated using the equation below

$$\frac{1}{\text{mean time for milk to clot / seconds}} = \text{mean rate of clotting / s}^{-1}$$

(5)

Concentration of rennin / %	Mean time for clotting / s			Mean rate of clotting / s^{-1}
	1	2	Mean	
0.0	0	0	0	0
0.2	420	450	435	0.002
0.5	210	180	195	0.005
1.0	90	90	90	0.011
1.5	60	90	75	0.013
2.0	45	40	43	0.023
3.0	30	20	25	0.040

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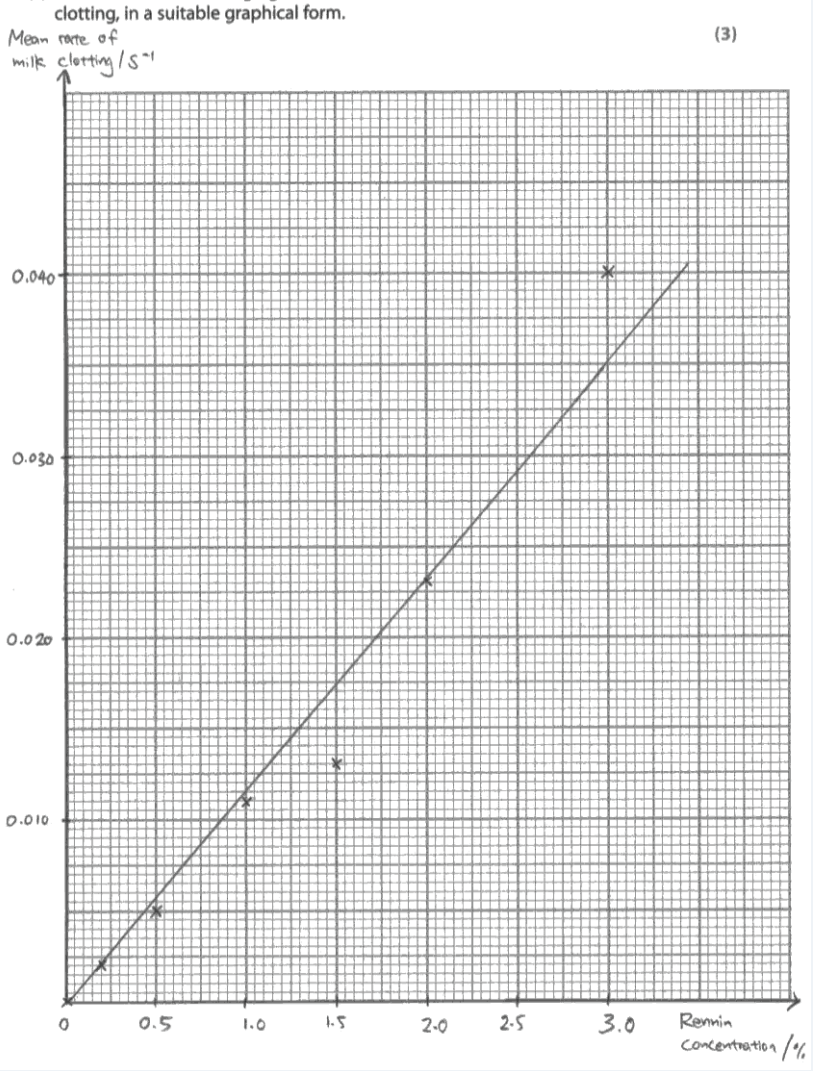
Examiner Comments

(b) This table has a good format and all of the calculations are correct. Unfortunately it is not true that the distilled water took 0 seconds to clot so this candidate lost one mark and scored four of the five marks available for this part of the question.

(c) Show the effect of changing the rennin concentration on the mean rate of milk clotting, in a suitable graphical form.

(3)



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Examiner Comments

(c) This graph was a suitable format, with appropriate scales, labels and all points were plotted correctly. The line of best fit was not needed, but the one included here is appropriate and will help candidates identify anomalous points.

(d) Identify an anomalous result in the data for the different rennin concentrations.

(2)

Rennin concentration at 1.5%

Give **one** reason for your answer.

The mean time of clotting shows a very big difference which

60 seconds and 90 seconds.

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Examiner Comments

(d) This candidate has used the graph to spot the anomalous result, but their reasoning is not clear enough as three other enzyme concentrations also had a difference of 30 seconds between the two sets of measurements. This response therefore only scored one of the two marks available.

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Examiner Tip

Think carefully about what the raw results tell you and what makes sense.
When asked to give a reason for identifying an anomalous result, explain how you spotted it.

(b) Convert the times recorded into the SI units of seconds and prepare a suitable table to display these raw results and each of the following.

(i) The mean time for clotting for each concentration of rennin.

(ii) The mean rate of milk clotting, calculated using the equation below

$$\frac{1}{\text{mean time for milk to clot / seconds}} = \text{mean rate of clotting / s}^{-1}$$

(5)

concentration of rennin / %	1st reading / s	2nd reading / s	Mean time for clotting / s	Mean rate of milk clotting / s^{-1}
0.2	420	450	$\frac{420+450}{2} = 435$	0.00023
0.5	210	180	$\frac{180+210}{2} = 195$	0.00511
1.0	90	90	$\frac{90+90}{2} = 90$	0.01111
1.5	60	90	$\frac{60+90}{2} = 75$	0.0133
2.0	45	40	$\frac{45+40}{2} = 42.5$	0.0235
3.0	30	20	$\frac{30+20}{2} = 25$	0.0400

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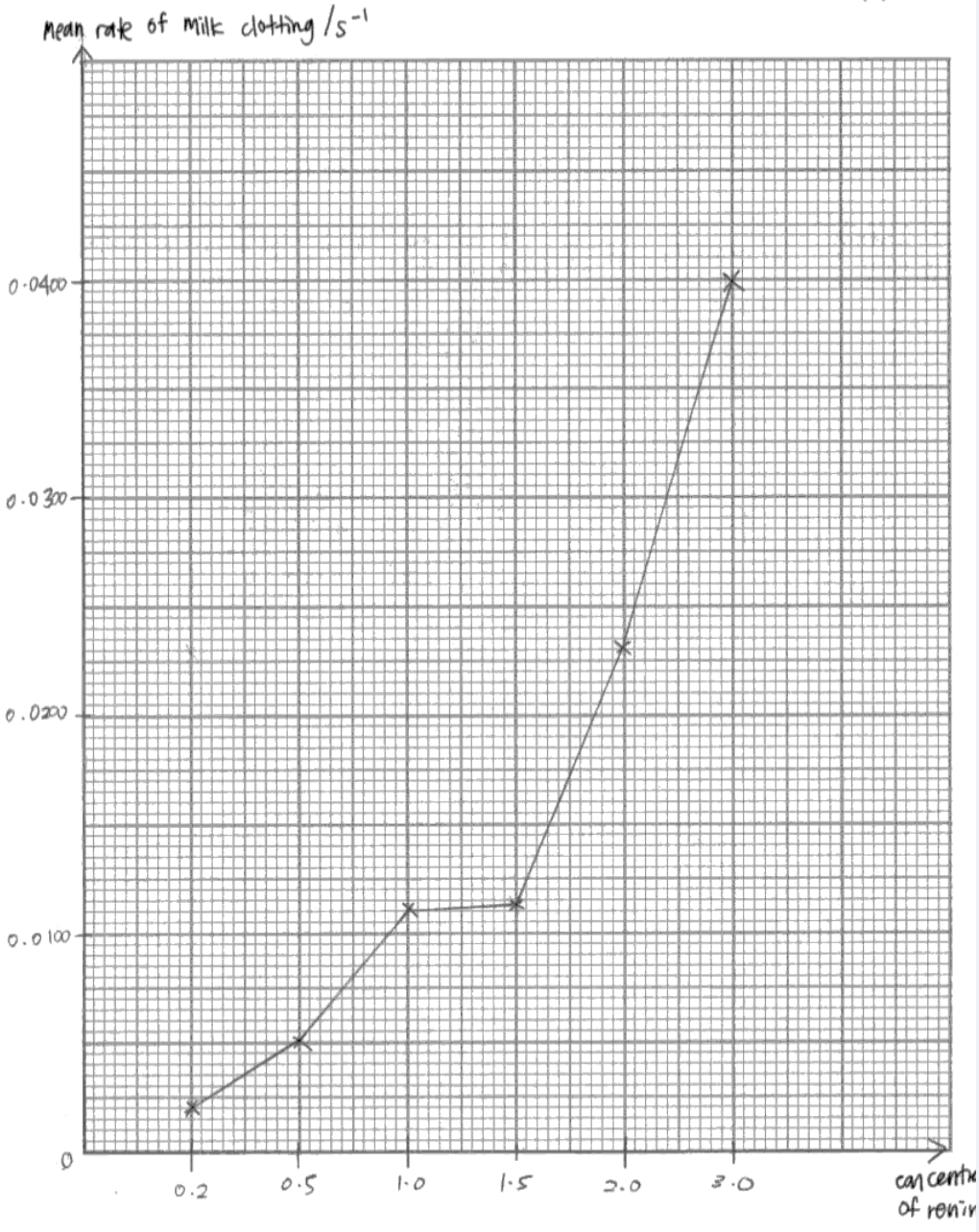
Examiner Comments

(b) This table scored three of the five available marks. It illustrates two of the most common errors: (i) not including all of the raw data - distilled water results, (ii) column headings need to be clear - 1st reading does nit indicate what was measured.

(c) Show the effect of changing the rennin concentration on the mean rate of milk clotting, in a suitable graphical form.

(3)



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Examiner Comments

(c) This graph demonstrates a fairly common error in that the candidate has not used a continuous scale for the x axis.

(d) Identify an anomalous result in the data for the different rennin concentrations.

(2)

0.2%

Give **one** reason for your answer.

It takes average 435 seconds to clot. 435 seconds is long compared to the other renin concentrations.

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Examiner Comments

(d) 0.2% is not a suitable anomaly, even with the error made in drawing the graph for part (c). Candidates commonly selected 0.2% or 3% as anomalies because they had the highest and lowest values, taking no consideration of the trends in the results.

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Examiner Tip

Think carefully about the purpose of graphs and what they reveal about the data obtained.

Question 2(e)

The majority of candidates were able to interpret the significance of the calculated r value and the critical value table at the correct significance/confidence level. A few candidates got mixed up between significance, confidence and probability levels referring to the term in relation to the values they were quoting.

Several candidates only stated their conclusions in terms of the null hypothesis, or stated that there was a significant difference between the enzyme concentration and the rate of milk clotting, rather than a conclusion for the investigation identifying what the effect of increasing the enzyme

concentration actually is. Ideally candidates should have been referring to the presence of a significant positive correlation.

A very small number of candidates clearly did not understand the statistics at all and tried to describe the trends within the table of significance levels for Spearman rank correlation, despite this being a clear requirement of the specification for unit 6 (Interpretation and evaluation).

(e) The student applied a Spearman rank correlation to explore the relationship between the rate of clotting and the rennin concentration.
From her calculation, she obtained a Spearman rank correlation of 1.0.

Table of significance levels for Spearman rank correlation.

Significance level (p)	0.20	0.10	0.05	0.01	0.001
Critical value of *r*	0.55	0.67	0.76	0.88	0.95

What conclusion can be drawn from this investigation? Use the information in the table to explain your answer.

(2)

Conclusion: as the significance level (p) for Spearman rank correlation is decreasing the critical value of r is increasing slowly.

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Examiner Comments

This response failed to score any marks and is typical of that seen by candidates who do not understand the statistical analysis and therefore attempt to interpret trends in the table of significance values rather than using them to interpret the experimental data obtained.

(e) The student applied a Spearman rank correlation to explore the relationship between the rate of clotting and the rennin concentration.
From her calculation, she obtained a Spearman rank correlation of 1.0.

Table of significance levels for Spearman rank correlation.

Significance level (p)	0.20	0.10	0.05	0.01	0.001
Critical value of *r*	0.55	0.67	0.76	0.88	0.95

What conclusion can be drawn from this investigation? Use the information in the table to explain your answer.

(2)

The Spearman rank correlation of 1·0 is higher than the critical value, r of 0·76 at significance level of 0·05. Thus, the hypothesis is accepted ~~with~~ because when the concentration of rennin used increases, the mean rate of clotting of the milk decreases.

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Examiner Comments

This response gains the first mark for using the correct critical value, however, the conclusion lacks some precision.

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Examiner Tip

When concluding from statistical tests it is best to identify if the trend is significant. In this case there is a **significant** positive correlation.

(e) The student applied a Spearman rank correlation to explore the relationship between the rate of clotting and the rennin concentration.
From her calculation, she obtained a Spearman rank correlation of 1.0.

Table of significance levels for Spearman rank correlation.

Significance level (p)	0.20	0.10	0.05	0.01	0.001
Critical value of *r*	0.55	0.67	0.76	0.88	0.95

What conclusion can be drawn from this investigation? Use the information in the table to explain your answer.

(2)

The calculated rank correlation value of 1.0 is higher than the value at significance level of 5% which is 0.76. There is a significant correlation between the rennin concentration and mean rate of milk clotting. An increase in rennin concentration results in an increase of mean rate of milk clotting.

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Examiner Comments

This example scored both available marks having provided a clear conclusion making use of the statistical analysis provided.

Question 2(f)

Many candidates failed to score on this item as they tended to **describe** the relationship between rennin concentration and the rate of clotting of milk rather than **explain** the relationship in terms of enzyme action. Candidates are expected to be able to draw on their knowledge and understanding of the A level specification in both planning and analysing.

(f) Give an explanation for the relationship between rennin concentration and the rate of clotting of milk.

(2)

As rennin concentration increases the rate of clotting of milk increases.

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Examiner Comments

This is typical of responses where candidates describe the relationship between rennin concentration and the rate of clotting of milk rather than explain the relationship in terms of enzyme action. It therefore fails to score any marks.

(f) Give an explanation for the relationship between rennin concentration and the rate of clotting of milk.

(2)

Rennin is an enzyme which hydrolyses casein in the milk to caseinogen, which forms the clot. As more ~~rennin~~ of the enzyme is present, more active sites will be available so the casein are hydrolysed even faster, and thus the milk clots faster.

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Examiner Comments

This response identifies that there are more enzyme active sites available so scores one mark, but fails to explain rather than describe the impact.

(f) Give an explanation for the relationship between rennin concentration and the rate of clotting of milk.

(2)

When the ~~an~~ concentration of rennin enzymes increases, the number of active sites available also increases. There are more frequency of collision between the enzyme rennin and the milk. Hence, more enzyme - substrate complex are formed. The rate of ~~the~~ clotting of milk thus increases.

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Examiner Comments

This final example clearly explains why an increase in enzyme concentration will increase the rate of milk clotting and therefore gains both marks available.

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Examiner Tip

Don't forget that candidates are expected to be able to draw on their knowledge and understanding of the A level specification to inform planning and analysis in unit 6.

Question 3

It was disappointing that a significant number of candidates tried to lever in a method that would have been more suitable for the summer 2010 paper rather than the context for this paper. They therefore appeared to have learned the previous mark scheme and just quoted it verbatim without any examples, justification or qualification for the context of this question.

(a) Many candidates did not understand this part of the question and wrote general statements to do with the method.

Many candidates just stated that they would use systematic sampling without explaining how or why, despite random sampling being a more suitable method.

Safety and ethical issues varied but were often vague. Insect bites, snake bites, plant thorns and poisonous plants made up the bulk of the safety issues. Ethical issues were on the whole quite vague however a few candidates recognised that their proposed methods of removing all plants and animals in a wood in order to plant a few primrose seeds may disrupt the habitat!

(b) There were some good responses to this part of the question. However, many candidates clearly do not understand the value and purpose of preliminary work. Very few candidates identified the need to determine an appropriate dependent variable. A significant number of candidates appeared to have learned the previous mark scheme and just quoted it verbatim without any examples, justification or qualification

(c) Many candidates had trouble with clearly defining a suitable dependent variable for the investigation. There was great confusion about the definitions and distinction between Abundance, %frequency and density, some candidates using them interchangeably, or getting the methods of calculating them completely wrong. A number of candidates did not count or measure anything, which made marking section (d) very difficult or impossible.

Most candidates gained at least two marks for identifying two variables which needed to be controlled but many candidates failed to explain how to control them. Some gave details of how to measure a range of abiotic factors without making it clear how doing this would help to cope with variation. Several candidates wrote at length about variables to control and very little else' so their method was incomplete.

It was surprising that many candidates did not consider the need to measure light intensity or how to do it.

Many candidates referred to repeats, but these were often samples, not of whole experiments, it was often just thrown in because it is on the previous mark scheme.

There were many candidates that chose to plan the experiment in a greenhouse or laboratory (or even remove all plants and animals from an existing area of woodland) and look at germination, not really representative of the context of the question. The quality of written communication was very variable. Many reports were disorganised and some where very difficult to follow. The use of scientific vocabulary was variable. Spelling varied considerably. Grammatical errors were due to the disjointed and bitty descriptions given by many candidates.

(d) Some candidates did not understand what was expected of this section and just used it to finish the method here and put what they would measure etc.

Tables were often poor with correct headings missing (not helped by candidates not being clear about what they wanted to measure as a dependent variable). Means were often considered but not always correctly e.g. just including averages for a particular quadrat number rather than numbers of plants

found in areas with the same light intensity.

Graphs varied considerably. A number of candidates chose the correct format for the data suggested from their table. A number of candidates chose the correct statistical test for their data, t tests, Mann Whitney U and Spearman's rank being the main ones chosen. However many students did not know which test was suitable for the data as they had presented and proposed statistical tests that were inappropriate to what they were proposing to do e.g. suggesting a t test for a scatter diagram.

Some candidates again just appear to have learnt the previous mark scheme and quoted it without any reference to the data they should have collected or stating the graph or statistical test they would use.

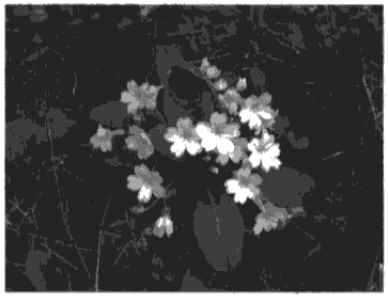
(e) Most candidates gained a mark for saying there were abiotic factors that were difficult to control, although few recognised that light intensity changes during the day.

Some of the better responses recognised other limitations such as the effect of competition from other plants. Few scored all three marks. A significant number of candidates referred to predators of the primroses.

Although not a perfect response, this response is typical of responses at the highest grade boundaries scoring 17 out of a possible total of 23 marks.

3 The intensity of shade cast by the canopy of trees, in a woodland environment, may influence the distribution of plants growing on the floor of the woodland.

A student observed that there were more primrose plants growing in some areas of the woodland.
He formed the hypothesis that the abundance of primrose plants would increase with an increase in light intensity.



Plan an investigation to test this hypothesis.

Your answer should give details under the following headings.

(a) An outline of a suitable sampling technique for this investigation and whether there are any safety and ethical issues you would need to consider.

(3)

Assuming that there is a gradual increase in density in woodlands as it progresses, and that light intensity reduces with density (thicker canopy), systematic sampling using a belt transect should be used. Quadrats placed at regular intervals will be used to judge the abundance of primrose plants. Since no plants will be harmed during this investigation, the only minor ethical issues will be disturbing native animals and trampling on plants on the ground. Regarding safety, a tour guide can be used to prevent getting lost. The tour guide should also know how to respond under threat from predators, if any. Long sleeve shirts, trousers and boots should be used to prevent cuts from thorns or branches.

ResultsPlus
Examiner Comments

(a) This response justifies the use of systematic sampling with a belt transect through the use of an area with increasing density of canopy. They also correctly consider the relative lack of ethical issues and identify some relevant safety considerations. It therefore scores all three marks available for this section.

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

(3)

Research on what conditions make it suitable for primrose plants to grow.
Find a suitable woodland relatively close to you that has primrose plants, whose densities vary across the woodland. The woodland must have several different ranges of light intensity hitting the ground.
Obtain permission from respective authorities to conduct the investigation, if necessary.
Research about any similar studies conducted in the past, to help analyse results and increase validity.

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

(10)

1 Lay a belt transect 1m wide and several metres long. There should be significant differences in the amount of light reaching the ground of the woodland of your choice, and preferably there is a discernible pattern along the transect (ie. as the transect progresses, light intensity reduces). Ensure it is straight
2 A controlled environment (eg. greenhouse) would be very difficult to conduct this investigation, since I assume it would take very long for the distribution of primroses to change with light.
3 As such, it would be exceedingly difficult to ensure edaphic factors, temperature etc. remain constant in

ResultsPlus
Examiner Comments

(b) This response covers part of the need for preliminary work - in this case selection of a suitable area with suitable conditions for primrose growth. However, preliminary work is also useful for practicing methods, determining what to measure (the dependent variable), etc, so only scores one mark (out of three for this section.

a woodland area. We should therefore assume (and hope!) that these factors remain constant across the woodland.

4 If one is not akin to hoping, you can take soil samples and temperature readings at every point where primrose distribution is recorded. Factors such as soil pH, soil air content etc. can later be checked in a laboratory.

5 1m x 1m quadrats should be placed along the belt transect a fixed distance apart from each other (eg. separated by 10m or 20m). Distance markers can be placed along the transect to guide you on placement of quadrats, or measuring tape can be used.

6 At each quadrat, record the light intensity using a light meter. The probe should be placed in the centre of the quadrat and as close to the ground as possible. This should be repeated in all quadrats, with the placement and distance of the light meter from the ground kept constant.

7 The primrose plants in each quadrat should then, either be counted manually one by one (if there are not too many), or estimated using the DAFOR scale, where: D - dense A - abundant F - frequent O - occasional R - rare, and where density reduces from D → R.

8 Since I am a perrenial pessimist, I have decided also to take soil samples from each quadrat site (after counting primroses) and air temperature readings at each quadrat. Ensure the mercury level remains constant before taking the temperature reading. Label the soil samples with the distance marker at which the quadrat is placed or closest to.

9 The soil samples shall later be used to check soil pH and air ~~and moisture~~ content of soil in the laboratory.

10 The recordings should be recorded in a table.

11 The act. of sampling (light reading, primrose count, soil sample) should be done simultaneously or as close to each other as possible (in regard to time) such that the time of day does not interfere. It should also be done on the same day so factors such as air temperature and humidity remain constant, and there are no seasonal changes.

12 The ~~light intensities~~ primrose count should be grouped according to light intensity. Thus a suitable range of light intensities must be made (eg. 0-10%, 10-20%, 20-30%, 30-40% and so on, with all those primrose growing in a light intensity of 0-10% grouped together in one class, so that average primrose count at 0-10% light intensity can be computed, increasing reliability).

ResultsPlus

Examiner Comments

(c) This description of the method clearly describes what is to be measured, where and how in a clear account. Lots of variables are identified and measured, but there is little attempt to control variables or consider how to take them into account beyond just measuring them. To improve, this response could also consider how much data is needed for statistical analysis and how to repeat the investigation for reliability. (This scored 8 of the 10 available marks).

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

(4)

Raw data presentation:

Quadrat distance along belt transect (m)	Light intensity (%)	Primrose count	Soil pH	Air temp(°C)	% Air in soil

Then organised to make the following table:

Light intensity (%)	Primrose Count Quadrat 1	Quadrat 2	Quadrat 3	Average Primrose count
0-10				
10-20				
⋮				
90-100				

This is if primroses were counted manually. If the DAFOR scale is used, substitute D = 5, A = 4, F = 3, O = 2, R = 1 and enter the numbers in the table so the average can be computed.

Results will be presented by a line graph.

The 0-10% light intensity range shall be taken as 5% light intensity (its median) and so on for other light ranges (ie. 10-20% → 15%, 20-30% → 25% etc.)

A line graph should then be drawn with:

x- axis - light intensity (%)

y- axis - abundance of primrose (arbitrary units).

A Mann-Whitney U test can be applied to the results to test if the null hypothesis (primrose abundance unaffected by light intensity) is accepted or rejected.

ResultsPlus

Examiner Comments

(d) This response gains three of the four marks available. The candidate considers how to present the raw data and then makes a reasonable attempt at grouping results for different light intensities for reliability. A suitable graph is described (although it would be clearer if it was sketched out). Unfortunately the statistical test chosen is not suited to the analysis of this graph type.

This response is typical of candidates near the E boundary scoring 6 of the 23 available marks.

(e) The limitations of your proposed method.

(3)

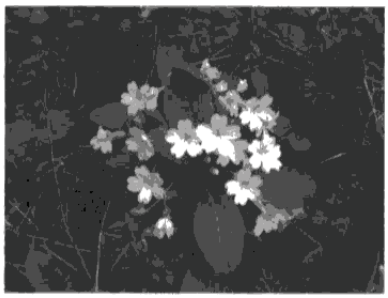
Some factors may change along the belt transect, that are impossible to keep constant (such as soil decomposers), which may affect results.
The genetic makeup of the different primroses may be different, allowing some to grow where others don't, which may affect results.
Other biotic factors, such as the distribution of organisms that consume the primrose, or people plucking primroses, may affect results.

ResultsPlus
Examiner Comments

(e) This response gives a reasonable consideration of some of the biotic and abiotic limitations of the method and therefore scores two of the three available marks. To reach full marks some consideration about the issues around realiably measuring the changing light levels would have been worth including.

3 The intensity of shade cast by the canopy of trees, in a woodland environment, may influence the distribution of plants growing on the floor of the woodland.

A student observed that there were more primrose plants growing in some areas of the woodland.
He formed the hypothesis that the abundance of primrose plants would increase with an increase in light intensity.



Plan an investigation to test this hypothesis.

Your answer should give details under the following headings.

(a) An outline of a suitable sampling technique for this investigation and whether there are any safety and ethical issues you would need to consider.

(3)

- ~~Need of~~ Systamatic sampling should be done.
- There might be some unwanted ~~unwanted~~ plant or ~~harmful~~ animal present which may disturb the experiment procedure.
- There is less ethical concern in this investigation.

ResultsPlus

Examiner Comments

(a) This response scores no marks for this section. There is no justification for systematic sampling (when random sampling would probably be more appropriate). There are no clear safety considerations and they don't explain what they are comparing the ethical issues to.

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

(3)

- Visit the site to practise the proposed method.
- It have to make sure that only one variety of species of primrose is present.
- Soil test should be done, it have to ~~same~~ make sure that other variable ~~are~~ should be kept constant.

ResultsPlus
Examiner Comments

(b) This response scored one mark for identifying that one value of preliminary work is to practice the proposed method.

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

(10)

• Experiment have to be done in a woodland. An area of about 100m² is choosed to do this investigation. water content of the soil and nutrient level is ~~same through out the~~ kept constant. Same species of prime rose one is used. It hass been seen that one part of the field is more shaded with canopy of trees. And in other part more light can reach the trees. Growth of primrose is monitored for about a month at different light intensities ~~and~~ and at different time of the day. A transect is used to measure the growth. ~~Recording of every new flower~~ Recording of germination of seeds and growth of the flower is taken. The whole procedure is further repeated for two times. And a controll experiment should be done to see the reliability.

ResultsPlus

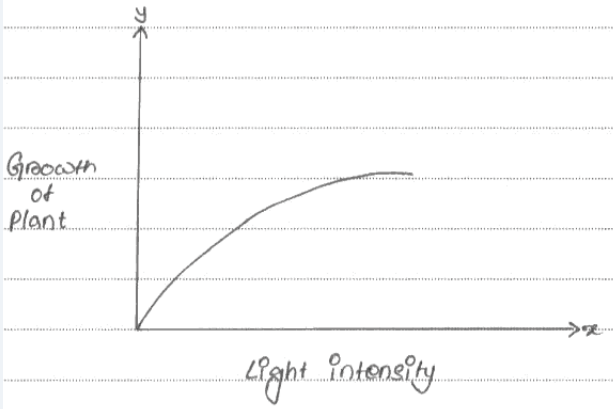
Examiner Comments

(c) This method manages to identify a couple of other variables to consider and recognises the value of repeats. However, it fails to consider what the dependent and independent variable are and how to measure them. This is not the only candidate to confuse transect and quadrat as measuring devices.

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

(4)

Growth of plant in dark / length	Growth in bright light/l	Growth in medium light	Result of repeat		
Mean growth					



ResultsPlus

Examiner Comments

(d) There is no clarity about what is to be measured so neither the sketched table or graph is worthy of credit.

(e) The limitations of your proposed method.

(3)

Difficult to maintain all abiotic factors.
Some seed might not germinate, and ~~ple~~ some plants can be damaged by birds or other animals.
Difficult to maintain sampling technique.
Some pale primrose can be counted twice.

ResultsPlus

Examiner Comments

(e) This response scores one mark for recognising that it is difficult to control all abiotic variables.

ResultsPlus

Examiner Tip

Candidates should be advised to read what they write, particularly for the main method (section c) to make sure they have clearly stated what they are measuring and how they are going to measure it. Consideration should also be given to reliability and validity when planning investigations.

While it is to be encouraged that candidates make full use of past papers and mark schemes to help them prepare for an exam, some candidates unfortunately demonstrated the tendency to quote parts of the previous mark scheme whether they were relevant or not.

To do well on this paper candidates need to think through the context of the question and apply

their knowledge and understanding of the core practicals and How Science Works skills and criteria carefully.

If it is not possible for candidates to carry out their own full investigations it should be encouraged that they practice planning and evaluating how to carry out a variety of investigations in a variety of contexts, together with practicing analysing data so that they develop confidence in considering how to present and interpret data.

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