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Examiners' Report
June 2015

IAL Biology WBI06 01

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Introduction

The paper provided a good spread of marks, but all question parts seemed to be accessible to students and many high-scoring scripts were marked. Students appeared to be very familiar with the antibiotic and vitamin C core practical techniques relevant to questions 1 and 3, and many very good answers to these questions were seen by the examiners. Some students encountered more difficulty in interpreting the data presented in question 2, and therefore the construction of an appropriate table and graph proved challenging. While some students continue to produce rather generic answers, the examiners felt that most students did better in answering the questions set and giving responses that were specific to the relevant experimental contexts. It is very encouraging to see progress in this direction, and the examiners hope that future students will continue to think for themselves and demonstrate their understanding of the principles of experimental design.

Question 1 (a)

Almost all students were familiar with an appropriate method for this investigation, the vast majority describing antibiotic-soaked filter paper discs being placed on agar plates. The question was well answered by many students, resulting in a modal mark of 5. It was encouraging to see clear descriptions of how quantitative results would be obtained in many answers. However, a surprising number of students suggested an unsuitable incubation time or temperature, in some cases incubating at or close to human body temperature, which is not safe practice. Students' answers also tended to be rather more vague when describing the preparation of agar plates or culture media and their inoculation with bacteria, perhaps because these aspects of the procedure may often be carried out by technicians in advance of the practical lesson.

1 Effective treatment of bacterial infections requires the selection of the most suitable antibiotic.

(a) Describe an experiment to investigate the effect of different antibiotics on **one** species of bacteria.

(5)

antibiotics will kill the bacteria. If the antibiotics are not taken regularly the bacteria will get resistant to that antibiotic

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Examiner Comments

This candidate has correctly identified the biological principle behind the question, bacterial resistance to antibiotics, but has not described any kind of experiment so was not able to access any marks.

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Examiner Tip

Make sure that you are familiar with all the Core Practicals from the A-level course. The examiners will expect you to understand how to use all the techniques.

1 Effective treatment of bacterial infections requires the selection of the most suitable antibiotic.

(a) Describe an experiment to investigate the effect of different antibiotics on **one** species of bacteria.

(5)

Select a specific species of bacteria eg:. E.coli. prepare an agar nutrient medium in the petridish. Use a plastic or glass spreader dipped in ethanol & heated with a bunsen burner to spread the bacteria evenly in the petri dish after the bacteria is transferred into the petridish by a sterile pippete. Prepare 5 different antibiotic solution ~~with a concentration of 0.1 moldm3 .~~ Take 0.5 moldm^3 of antibiotic solution and soak 3mm wide filterpaper discs with them. ~~Use a~~ place 5 disks each of the same size and concentration of their respective antibiotic on into the bacteria inoculated agar petridish. Use two tapes to seal the petridish. keep it upside down & incubate at 25°C for 48 days. Check which discs have clear zones which inhibit bacteria growth to find the most effective antibiotic treatment for the specified species of bacteria

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Examiner Comments

This answer scored 4 marks: mark point 3 for use of a named bacterium (*E. coli*), mark point 2 for inoculating the agar plate, mark point 4 for appropriate method of application of antibiotics, and mark point 6 for incubation at a suitable temperature. Unfortunately this student has suggested an incubation time of 48 days which is not suitable (they may have meant 48 hours), and has not described a method for measuring the clear zones.

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Examiner Tip

Re-read your answer to check that you have actually written what you meant - for example 48 hours, not 48 days.

Question 1 (b)

(i) Most students gave two appropriate variables, but in some cases answers were not applicable to this practical or were too vague to be meaningful. The examiners did not accept 'species of bacteria' here, since students were told in the stem of the question to use one species of bacteria, nor 'pH' alone without some further elaboration (a more specific answer such as 'pH of the culture medium' was accepted).

(ii) The second part of the question was more discriminating, especially the final mark as many students were not specific in their description of the effect of the uncontrolled variable on the results. Temperature was most commonly chosen, and in many cases this was effectively controlled by the use of a thermostatically controlled incubator. The use of an air conditioner or culturing at room temperature were not accepted as these are too imprecise. Although incubators may not be available in all centres, it is hoped students are aware that these are the standard apparatus for incubation of bacterial cultures. Some students had difficulty identifying a suitable control method, sometimes not helped by their choice of variable. Students are advised that it might be sensible to choose a variable with which they are familiar.

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

(2)

- Size of antibiotic disc
- Concentration of antibiotic in paper disc.

(ii) Suggest how **one** of the variables you have stated in (b)(i) could be controlled. Describe what effect it could have on the results if it is not controlled.

(2)

Variable Size of antibiotic disc.

How to control the variable Use discs of same diameter.

Effect on the results if the variable is not controlled The larger discs will produce larger ~~z~~ clear zone so effectiveness of antibiotic cannot be measured properly using a larger disc compared to others can result in less effective antibiotic ~~given~~ to appear more effective.

ResultsPlus
Examiner Comments

This student gained both marks in part (i) for two appropriate variables.

In part (ii), the first mark could not be awarded because the student did not say **how** to ensure that the discs were the same size. However, the second mark is awarded for a clear description of the correct consequence: a larger clear zone would be likely to be obtained if a larger disc were used.

3 marks were awarded in total.

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Examiner Tip

When you are controlling variables, stating that the variable must be kept constant is not the same as saying **how** you would do it. Be sure to mention the practical steps you would take to ensure that the variable remains the same. In this case, for example, the student could have punched out the filter paper discs using the same hole punch.

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

(2)

Size of the filter paper discs.

Temperature.

(ii) Suggest how **one** of the variables you have stated in (b)(i) could be controlled. Describe what effect it could have on the results if it is not controlled.

(2)

Variable Temperature

How to control the variable Temperature probe.

Effect on the results if the variable is not controlled If the temperature is too low, the bacteria can die.

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Examiner Comments

This student scored both marks in part (i) for two correct variables.

Unfortunately neither mark could be awarded in part (ii). The student has mentioned a temperature probe, but this is an instrument for **measuring** temperature rather than **controlling** it: a temperature probe would measure any changes in temperature, but would not stop changes from occurring. In the second part of the answer, the student has not given a specific effect on the results that would be obtained in the experiment.

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Examiner Tip

When suggesting an effect on the results of the experiment, be specific about how your measurements of the dependent variable would be likely to change.

Effect on the results if the variable is not controlled

If the temperature is allowed to reach above 30°C there is a chance for pathogenic bacteria harmful to humans growing together with the species of bacteria used in this experiment

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Examiner Comments

This student has made a safety point about suitable temperature of incubation, but did not answer the question about the effect on the results if temperature was not controlled.

Question 1 (c)

Fewer than expected students gained this mark. Some appeared to have misread the question and simply described a safety precaution without giving a reason. Many others were not at all clear about the reason for their stated precaution. In some cases students suggested reasons related to the quality of the results that would be obtained; these could not be credited because the question specifically asked about a **safety** precaution.

(c) Give a reason for **one** safety precaution that needs to be taken in this investigation.

(1)

The experiment should be done in aceptic conditions.

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Examiner Comments

This candidate has not given a reason.

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Examiner Tip

Be sure to read the question carefully and do what it asks. This question says 'give a reason', and only one mark is available, so there is no mark for mentioning a safety precaution without a reason.

(c) Give a reason for **one** safety precaution that needs to be taken in this investigation.

(1)

~~Use antiseptic techniques to prevent bacteria from growing~~ after

Wear gloves to prevent bacteria getting onto skin

ResultsPlus
Examiner Comments

This candidate needed to be more specific in order to gain the mark. There are huge numbers of bacteria present on human skin all the time - so why would a few more be a cause for concern? If they were pathogens, this would indeed present a safety risk.

Question 1 (d)

There was no expectation that students should be familiar with the mechanism of action of tetracycline in order to answer this question; they were required to apply their knowledge of the role of the ribosome. Many students successfully deduced a lack of protein synthesis to gain the first mark, although some got confused and suggested that transcription (rather than translation) would not take place. Far fewer students went on to access mark points 2 or 3, one of which was needed fully to address the question of how tetracycline works as an antibiotic. A number of students seemed to be completely at a loss to answer this question, which is a little disappointing since it is hoped that at this stage they are sufficiently familiar with the function of the ribosome to be able to make a suggestion.

(d) Tetracycline is an antibiotic that binds to bacterial ribosomes. Suggest how tetracycline works as an antibiotic.

heat resistant gloves

(2)

Tetracycline is a bacteriocidal antibiotic It binds to bacterial ribosome and prevents the reproduction of bacteria ~~as it prevents DNA of~~

ResultsPlus
Examiner Comments

Part of this answer is a repetition of information given in the question stem (tetracycline binds to bacterial ribosomes), which cannot earn any marks. The student also uses the term bactericidal and suggests that bacterial reproduction is prevented, but neither of these answer the question as to **how** tetracycline works, so this answer scored 0 marks.

ResultsPlus
Examiner Tip

Do not spend your time re-writing information that is given to you in the question: this will not earn any marks.

(d) Tetracycline is an antibiotic that binds to bacterial ribosomes. Suggest how tetracycline works as an antibiotic.

(2)

When it binds to the ribosomes it inhibits the ability of the bacteria to make proteins, so they cannot grow or divide by binary fission and they die as proteins are essential for any life to form. For example the enzymes for respiration wouldn't be made and the bacteria would die because of it.

(Total for Question 1 = 12 marks)

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Examiner Comments

This is an example of a good answer that scored 2 marks. The student has deduced that protein synthesis would be inhibited, and has gone on to explain how this would harm the bacterium in order to gain the second mark.

Question 2 (a)

The vast majority of students formulated the correct null hypothesis. A very few referred to a significant correlation instead of a significant difference.

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

(2)

There is no difference in the number of these larvae found on the livers of male and female marine fish.

ResultsPlus
Examiner Comments

This student scored one mark for correctly identifying the independent and dependent variables, but did not refer to a **significant** difference. The word 'significant' is very important. It is quite unlikely that exactly the same number of larvae will be found in both genders of fish - but is the difference just down to chance, or does it reflect a real biological phenomenon?

ResultsPlus
Examiner Tip

Make yourself familiar with the formal wording of hypotheses and statistical testing: it is important to be precise.

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

(2)

There is no significant correlation between the number of these larvae found on the livers of male and female fish. Thus null hypothesis accepted and hypothesis rejected.

ResultsPlus
Examiner Comments

This student has mistakenly referred to a significant correlation instead of a significant difference. It is also not appropriate to decide whether to accept or reject the null hypothesis at this stage. However, the student scored one mark for identifying the correct variables.

Question 2 (b)

The experimental context for this question provided a relatively small data set comprising only whole numbers, and a bar chart with two bars was the appropriate form of graphical presentation. Unfortunately many students were distracted by the presentation of the data, in the form of lab notes from theoretical students A-D, and did not manage to focus on the key information. The examiners were somewhat taken aback to see many answers in which students had added up the total number of larvae found by each student, an irrelevant factor in the context of the investigation, leading to incorrect means and often the omission of the raw data from the table. Labelling also displayed confusion between the gender of the fish and the gender of the larvae (or even, in some cases, the gender of the students!). A few students added arbitrary units (au) as units for the numbers of larvae, but this was not correct. In general the quality of graphs was better than that of tables, and many students benefitted from 'error carried forward' marks which were awarded to those who had made mistakes in the table but went on to plot their tabulated data correctly. Students are reminded that a bar graph requires an axis label on the x-axis, in addition to labels for each bar.

(b) For each fish examined, the students recorded the sex of the fish (female ♀ or male ♂) and the number of larvae observed.

The results collected by the students are shown below.

Student A	Student B
♀ 12, ♂ 4, ♀ 9, ♂ 7, ♀ 0	♀ 5, ♂ 8, ♂ 1

Student C	Student D
♀ 0, ♂ 2, ♀ 18	♀ 2, ♂ 11, ♂ 6, ♂ 2, ♀ 25

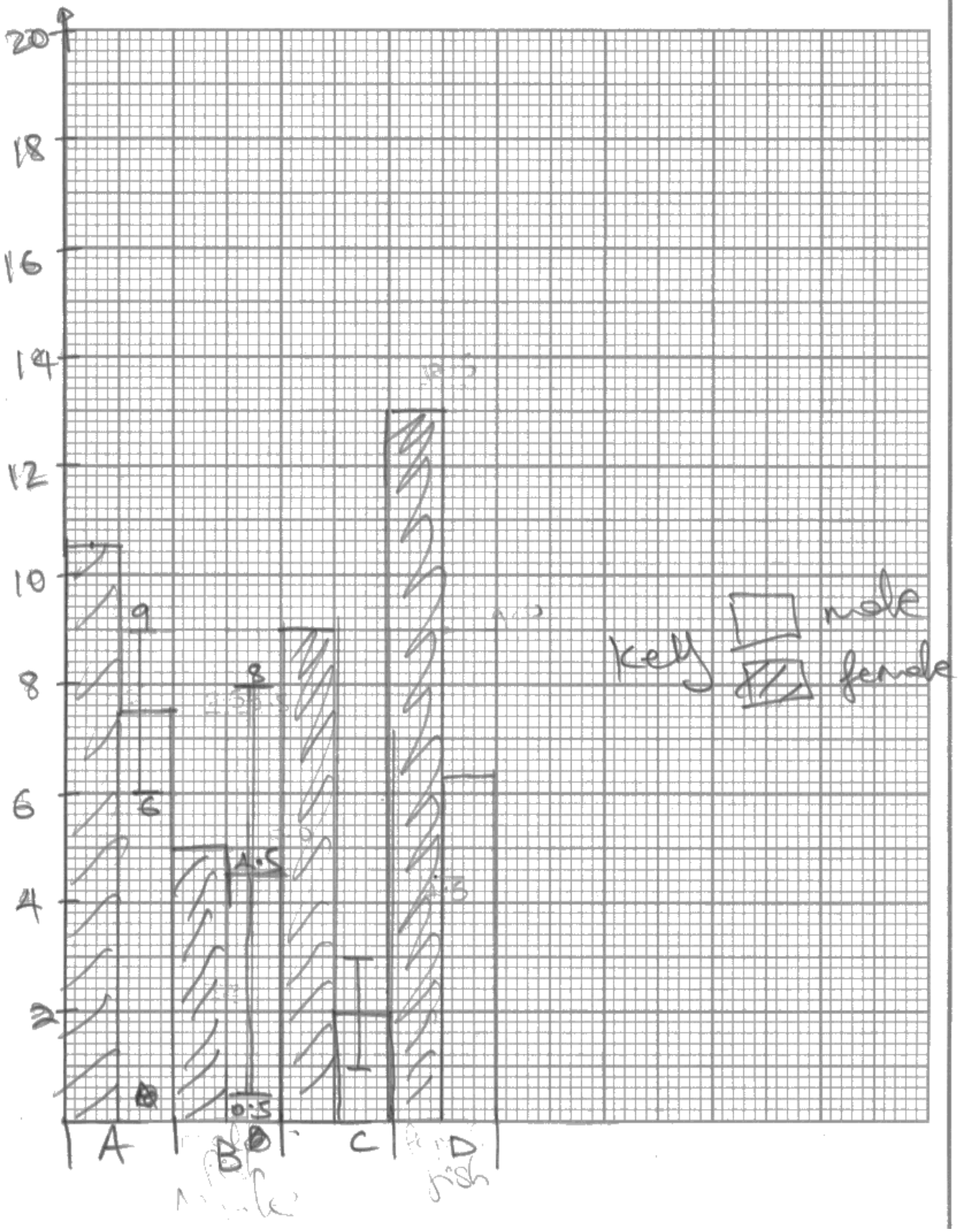
(i) Calculate the mean number of larvae found in male and female fish.

Prepare a suitable table to display the raw data and your calculated mean values. (3)

Student	No. of larvae found on Males	mean	females	mean
A	4, 7	7.5	12, 9, 0	10.5
B	8, 1	4.5	5, 0	5
C	2	2	0, 18	9
D	11, 6, 2	6.3	2, 25	13.5
mean (nearest whole number)				
range				
SD				

(ii) On the graph paper below, draw a suitable graph to compare the mean number of larvae and the variability of the data in male and in female fish.

(3)



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Examiner Comments

(i) This table scored 1 mark for including the correct raw data. Means are calculated for each of students A-D, rather than overall means for male and female fish, which is not correct data processing. Unfortunately the table headings do not make it clear that the data relate to male and female **fish**: the examiners looked for a clear reference to fish for the award of mark point 1.

(ii) This graph did not score any marks. The axes are not labelled and the graph itself is not suitable in the context of the investigation described in the question. When marking the graph the examiners allowed an 'error carried forward' where the table contained calculation errors, but students were still expected to produce the correct format of graph displaying overall mean values for male and female fish.

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Examiner Tip

Think about the aim of the experiment to help you select an appropriate way to process the data. In this case the experiment was looking for a difference between male and female fish, therefore calculating and graphing mean values for males and females would be helpful in reaching a conclusion.

(b) For each fish examined, the students recorded the sex of the fish (female ♀ or male ♂) and the number of larvae observed.

The results collected by the students are shown below.

Student A

♀ 12, ♂ 4,
♀ 9, ♂ 7, ♀ 0

Student B

♀ 5, ♂ 8, ♂ 1

Student C

♀ 0, ♂ 2, ♀ 18

Student D

♀ 2, ♂ 11, ♂ 6,
♂ 2, ♀ 25

(i) Calculate the mean number of larvae found in male and female fish.

Prepare a suitable table to display the raw data and your calculated mean values.

(3)

~~male = 8 35/9 = 5~~
~~female = 18~~

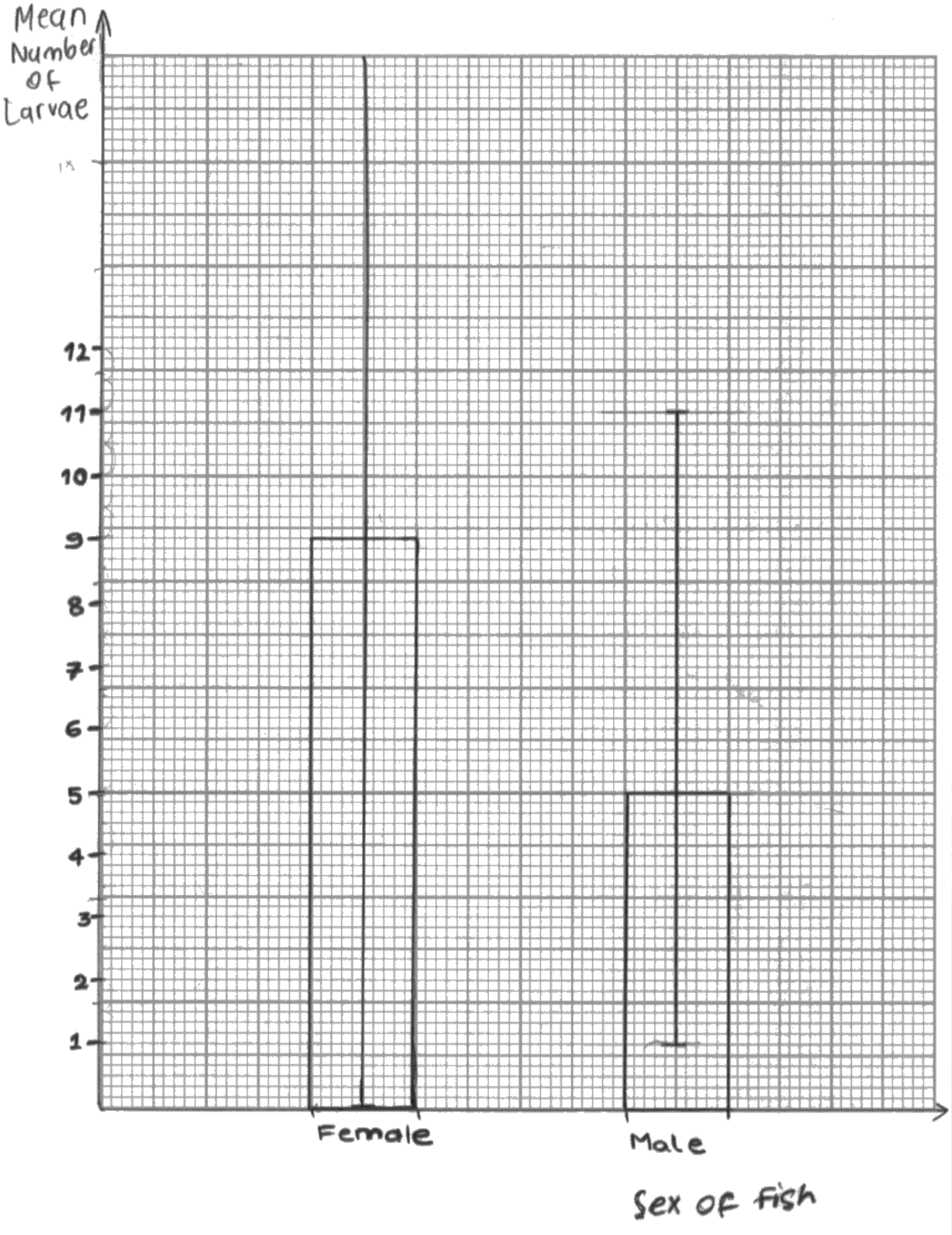
male
$\frac{41}{8}$
$= 5.$

female
$\frac{71}{8}$
$= 9$

(sex of fish) Gender	Number of larvae observed					Number of fish observed
	Student A	Student B	Student C	Student D	Mean	
Female	21	5	18	27	9	8
Male	11	9	2	19	5	8

(ii) On the graph paper below, draw a suitable graph to compare the mean number of larvae and the variability of the data in male and in female fish.

(3)



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Examiner Comments

(i) This table scored 2 marks. The headings are clear and correct, and the correct means have been calculated. However, the raw data are not included; instead, the total numbers of larvae counted by each student have been added up- but this is not useful information in the context of the investigation.

(ii) This graph scored 2 marks. The axes are correctly labelled and mean values for male and female fish are correctly plotted. The student has also made a good attempt to include range bars, but unfortunately the scale on y-axis is not long enough to accommodate the larger range bar.

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Examiner Tip

When choosing the scale for your graph, think about the size of the range bars as well as the values of the points.

Question 2 (c)

As in the past, students demonstrated good understanding of how to interpret the statistical test with many scoring 3 or 4 marks. A number of students produced a very clear answer to gain the first three mark points, but after stating that the difference was significant, did not use their graph to specify which gender of fish had the higher mean number of larvae. Mark point 5 was extremely rarely awarded: the idea of **greater** variability in the data for female fish than male was distinct from the idea of wide variability across the whole data set, credited in 2d. A significant minority of students selected a critical value with more than one degree of freedom, despite being told in the question stem that the test statistic had been calculated with one degree of freedom. Students are advised to look out for information in the stem that will help them to answer the question.

(c) The students carried out a Chi-squared test to analyse their results.

This test is used to determine if the difference between the mean number of larvae observed and the expected number of larvae is significant.

The calculated value of Chi-squared for these results was found to be 8.03 with one degree of freedom.

The table below shows some critical values for the Chi-squared test.

Degrees of freedom	Probability level		
	0.05	0.01	0.001
1	3.84	6.64	10.83
2	5.99	9.21	13.82
3	7.82	11.34	16.27

What conclusion can be drawn from the investigation?

Use this information and your graph to explain your answer.

(4)

The calculated value 8.03 is greater than the critical value 3.84 at 95% confidence level, so the null hypothesis is rejected and hypothesis is accepted. Hence ~~Therefore~~, there is significant difference in the number of larvae found on the livers of male and female fish, as female have more number of larvae on their livers compared to the male fish.

ResultsPlus
Examiner Comments

This answer scored 4 marks.

ResultsPlus
Examiner Tip

Practise the steps involved in the interpretation of a statistical test: they form a logical sequence that you should be able to apply to any experimental context.

(c) The students carried out a Chi-squared test to analyse their results.

This test is used to determine if the difference between the mean number of larvae observed and the expected number of larvae is significant.

The calculated value of Chi-squared for these results was found to be 8.03 with one degree of freedom.

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3	7.82	11.34	16.27

What conclusion can be drawn from the investigation?

Use this information and your graph to explain your answer.

(4)

The calculated value of Chi-squared was 8.03, it is greater than critical value with one degree of fridom at 0.05 significance level which is 3.84. I will reject my null hypothesis. There is significant difference between number of larvae observed on livers of infected male and female fish and expected number of larve on livers of infected male and female fish.

ResultsPlus
Examiner Comments

This answer scored 3 marks. The student has interpreted the statistical test correctly, but has not referred to the graph to state the nature of the significant difference. A chi-squared test was used, so it was acceptable for students to refer to a difference between observed and expected values.

ResultsPlus
Examiner Tip

Remember to look at your graph to find the conclusion from the investigation. The statistical test can tell you that there is a significant difference, but you must use the graph to see what that difference is.

Question 2 (d)

This question proved to be a good discriminator. The vast majority of students were able to score at least one mark, usually mark point 1 for the idea of uncontrolled variables or mark point 3 for recognition that the sample size was very small. Mark point 4 was also frequently awarded, but relatively few candidates made all of these points to gain the full three marks. Mark point 2 was rarely awarded, perhaps because it was quite specific to this particular experimental context.

(d) Suggest why any conclusions drawn from this investigation may not be valid.

(3)

Other factors which may effect the number of larvae ~~ar~~ were not considered. These factors include health, diet of the fish and temperature of the place where they were kept. Age, size, ~~and~~ species and gender of fish were not controlled. A small sample of fish were investigated. There is a wide variability in data so it ~~isn't~~ is not very reliable.

ResultsPlus
Examiner Comments

This is an example of a good answer that addresses mark points 1, 3 and 4, so scored 3 marks.

(d) Suggest why any conclusions drawn from this investigation may not be valid.

(3)

Because the sample size is very small. There is no ~~other~~ information about the other variables that need to be controlled. There is less variability of the data.

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Examiner Comments

This answer scored 1 mark, gaining mark point 3 only. The second sentence refers to the control of variables but is too vague for the award of mark point 1. The final sentence shows an awareness that the variability of the data is important, but unfortunately this student does not make a clear point about variability - there is less variability than what?

ResultsPlus
Examiner Tip

If you use the terms 'more' and 'less', be clear about which two things you are comparing.

Question 3 (a)

This answer scored two marks. There is a clear statement that there are no significant ethical issues. The student then gives a safety precaution (wearing gloves) which is not awarded a mark, but in the final sentence the safety risk is specified (burning the skin) so mark point 2 can be awarded.

Question 3:The basic technique required for this investigation was identical to a Core Practical: measuring the vitamin C content of food. The test of students' investigative skills was therefore in the design of a logical multi-step procedure in which vegetables were cooked, kept warm and then processed appropriately for measurement of vitamin C. There were also many parameters to be determined in advance of the main data collection phase, so 4 marks were available for preliminary practical work in part 3(b) instead of the 3 marks in some previous investigations.

3a:

A little over half of students scored both marks here. However, the examiners feel that more students are capable of accessing both marks.

The two most common mistakes could easily be avoided in future. Many students equivocated over ethical issues, producing an answer that was not at all clear as to whether there were ethical concerns or not: to gain the mark students are expected to make a decision and either identify an ethical issue or state clearly that there are none.

In this case there were no significant ethical issues. The examiners did not accept the idea of a waste of vegetables that could otherwise be eaten as an ethical concern, since very small quantities were required for the investigation.

Students also tended to describe safety precautions that might be required without identifying the safety risk that these were intended to mitigate. For example, it was frequently suggested that gloves should be worn while carrying out the practical work, but it was not clear what harm was risked by an experimenter who did not wear gloves.

3 A student observed that vegetables are often cooked and then kept warm for a period of time before being eaten.

The student formulated the following hypothesis:

The longer the vegetables are kept warm after cooking the lower their vitamin C concentration.

Plan an investigation to test this hypothesis, using one named vegetable.

Your answer should give details under the following headings.

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

(2)

There ~~is~~ are no significant ethical issues. Safety issues include wearing gloves to handle warm objects. & One might burn the skin while cooking.

ResultsPlus
Examiner Comments

This answer scored two marks. There is a clear statement that there are no significant ethical issues. The student then gives a safety precaution (wearing gloves) which is not awarded a mark, but in the final sentence the safety risk is specified (burning the skin) so mark point 2 can be awarded.

ResultsPlus
Examiner Tip

Be sure to identify the safety **risk**, not just the safety precaution.

3 A student observed that vegetables are often cooked and then kept warm for a period of time before being eaten.

The student formulated the following hypothesis:

The longer the vegetables are kept warm after cooking the lower their vitamin C concentration.

Plan an investigation to test this hypothesis, using one named vegetable.

Your answer should give details under the following headings.

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

(2)

Starting by different type and age of a Cabbage. ~~Cooking~~ Cooking it for a few minutes to Concentrate and leave it to ~~we~~ get warm for a while, Check the Concentration of each Cabbage and the presence of vitamin C. There will be no ethical issues for humans animals and the Cabbage itself.

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Examiner Comments

This answer scored one mark at the very end, for correctly identifying that there are no ethical issues. However, the first part of the answer does not belong in part (a).

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Examiner Tip

When answering question 3, be sure to follow the headings for each of parts (a) - (e). The examiners will expect to find the relevant parts of your investigation under the appropriate heading.

Question 3 (b)

This question produced a very even spread of marks, with approximately a quarter of students achieving each of the scores from 1 to 4. There were some more straightforward aspects of the preliminary work which were accessible to the majority of students, such as identifying a suitable vegetable and cooking conditions, but also some aspects that required more forethought, such as determining a method by which the vegetable should be processed for vitamin C testing and the appropriate volumes and concentrations of solutions to be used in the test itself. This question is a part of the paper where rather generic answers have a tendency to creep in; there were quite a number of references to timescales and to the measurement of the dependent variable which were too vague to be credited. Students are reminded that their answers must relate to the context of the investigation.

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

(4)

Check to see if proposed method works and gives valid results. The indipendent variable which is the time kept warm after the vegetable is cooked can be controlled using a stopwatch from once cooked until the time its vitamin C content is tested. The dependant variable which is the vitamin C concentration can be measured using a suitable indicator such as DCPIP, using titration methods.

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Examiner Comments

This answer scored one mark, gaining mark point 1 only. The preliminary practical work should be used to make decisions about various aspects of the method, but this student simply makes statements about what they will do.

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Examiner Tip

The purpose of preliminary practical work is to find things out that will help with the design of the main method. If you already know what you will do, it does not need to feature in the preliminary work!

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

(4)

Practise proposed method to see if proposed method work. Determine the type of vegetable to be used. Determine a range of time, that the vegetables are kept after cooking., Determine the dependent variable, which is the vitamin C concentration. ~~De~~ C Carry out experiment to ~~see~~ determine ~~if~~ ~~ho~~ method to measure vitamin C concentration. Carry out experiment to determine method to extract juice from vegetable in order to find their vitamin C ~~contro~~ concentration. Consider other variables ~~thar~~ that will affect vitamin C concentration in vegetables and need to take into account.

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Examiner Comments

This answer scored 4 marks. The four correct points made are as follows:

- practise the proposed method to see if it will work (mark point 1)
- determine the type of vegetable to be used (mark point 2)
- determine the range of times that the vegetables are kept after cooking (mark point 4)
- determine the method to extract juice from the vegetable to find the vitamin C concentration (mark point 5).

However, this student also made some points that could not be credited. Preliminary practical work is not used to determine the dependent variable: this should be decided by the experimenter. (In this case, students needed to deduce the dependent variable from the hypothesis given in the introduction to the question.) The examiners also did not award marks for determining a method for measuring vitamin C concentration because students are expected to know how to do this, having carried out the Core Practical. Finally, **considering** other variables is not practical work so does not address the question.

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Examiner Tip

Make sure that your preliminary practical work really is **practical** work!

Question 3 (c)

Almost all students took the correct Core Practical as a starting point, the vast majority describing a titration with DCPIP as the method for measuring the dependent variable. There were many excellent and very detailed descriptions; understandably a number of students got mixed up as to which colour change they were expecting, and some seemed to think that they needed to record the time taken (rather than the volume of solution added) for the colour change to occur. Students varied in their ability to take an overview of the whole process, some describing a very logical sequence of preparation, cooking, warming and blending while others tended to get lost and miss out one or more of these steps. In general students showed a good awareness of the need to control variables and were able to identify appropriate variables that should be controlled. Descriptions of methods to control these variables were not always suitable, and sometimes these descriptions amounted to little more than a restatement of the fact that the variable should be kept the same. Many students' methods included a titration with vitamin C solution of known concentration for calibration purposes. This was credited as a reasonable course of action, but was not necessary to gain full marks because absolute values of vitamin C concentration were not required in order to test the hypothesis (the longer the storage time, the lower the vitamin C concentration). The examiners wish to draw the attention of teachers and students to the criteria for Quality of Written Communication which carries two marks in this question. Please note that the criteria for Level 3 include writing in continuous prose; some students unfortunately set out their answers as bullet points and therefore cannot access Level 3.

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

(10)

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

The independent variable is the time peas are stored in warm temprature after cooking. The peas are stored at 5 different time periods after cooking. The dependent variable is the vit c content of the peas which will be measured by measuring the volume of the peas juice needed to decolourise 1% DCPIP. 300 grams of peas are cooked in the same container and immediatly after cooking 50 g is placed into ea 5 test tubes each. The test tubes are all placed in a ~~flu~~ water mostatically controlled water bath set at 60°C. ~~50 grams of the~~ The remaining 50 g. of cooked peas is ~~used~~ crushed to extract its juice and the juice is placed in a ~~pip~~ burette. 1 cm^3 of 2% DCPIP solution is placed using a pippette into a test tube and the peas juice titrated onto it drop by drop till the colour of vit c just changes from blue to colourless. The volume of pea juice required to decolourise the DCPIP is recorded. After the set time for each

test tube the volume needed to decolourise DCPIP is measured. The volume of DCPIP used must only be a one measured using a pipette. Repeat the whole experiment 2 more times and calculate the mean for each storage time. The cooking time must be kept the same in the repitions.

ResultsPlus
Examiner Comments

This is a clear and logical plan which scored the full 10 marks. The student has given precise details of how variables will be controlled, such as the use of a thermostatically controlled water bath and a pipette.

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

(10)

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

The independent variable for this experiment is the amount of time the vegetable is left warm. Six different time values are used ~~for th for~~ example 0 mins, 5 mins, 10 mins, 15 mins, 20 mins and 30 mins. The temperature is kept constant using a water bath with thermostat. The independent variable ~~for~~ is the concentration of vitamin C which is measured by ~~usin~~ recording the volume of juice ~~vitamin C~~ needed to neutralise 1 cm^3 of DCPIP by titration. The juice extracted is taken in a burette and the exact volume to change the colour of DCPIP solution from blue to ~~colour~~ pink is recorded. The same end point should be maintained by using a standard solution. The same volume of DCPIP should be used and measured with a pipette. The age and storage conditions of tomatoes should be same and this is controlled by selecting them from the same batch. The experiment should be repeated at each time range. A control experiment is done by allowing the vegetable no time after cooking.

ResultsPlus

Examiner Comments

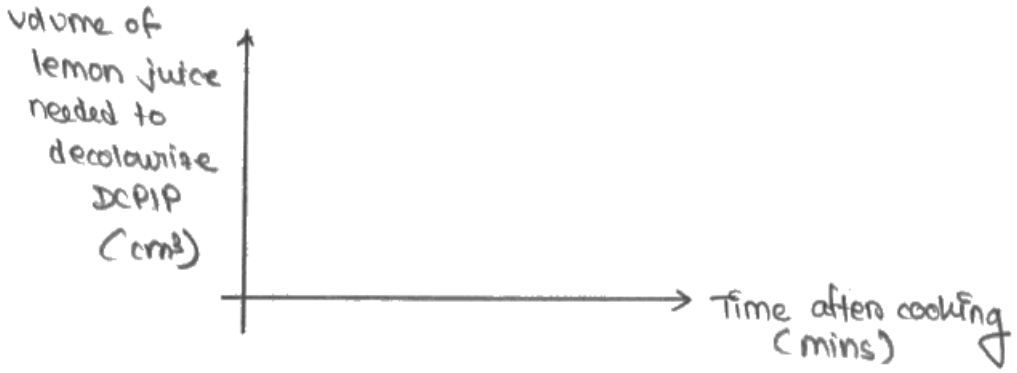
This answer also scored 10 marks, although the student was not so clear about the overall experimental sequence involved. However, this student demonstrates sound understanding of the principles of experimental design including how to vary the independent variable, measure the dependent variable and control extraneous variables.

Question 3 (d)

This question was better answered than has sometimes been the case in the past, and the examiners were pleased to see more students selecting a correct graphical format and appropriate statistical test. Unfortunately this time quite a large proportion of students drew tables that did not include raw data (e.g. volume of vegetable extract needed to decolourise DCPIP), instead recording only vitamin C concentration – but this could not be directly measured and would have to be calculated secondarily.

(d) A clear explanation of how your data are to be recorded, presented and analysed in order to draw conclusions from your investigation. (4)

Time after cooling (mins)	Volume of lemon juice needed to decolourise DCPIP (cm^3)			
	1	2	3	mean
0				
5				
10				
⋮				
30				



The mean volume is calculated and the data is recorded in a table as shown above. Using the data, a graph is drawn with time after cooling (mins) on the x axis and volume of lemon juice needed to decolourize DCPIP (cm^3) on the y axis. The graph will be a scatter plot. A spearmans Rank correlation test is carried out as we are ~~comparing~~ investigating the correlation between time the lemon juice is kept warm after cooling and the vitamin C content of the ~~feed~~ juice. The more volume of lemon juice needed, the lesser the concentration of vitamin C.

ResultsPlus
Examiner Comments

This was an excellent answer that scored the full four marks.

The table is clearly set out to contain raw data and units are included in the table headings. Means are calculated appropriately from repeat readings.

The sketch of the graph axes does not specify the type of graph that would be plotted, but the student states in the text that it is a scatter plot.

The student also gives a good explanation of how the results should be interpreted, including the use of an appropriate statistical test.

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

(4)

time kept warm in min	number of drops needed to decolorise DCPIP					mean
10						
20						
30						
40						
50						

analyse results doing a t-test

ResultsPlus
Examiner Comments

This student started well, gaining the first two marks for a correct table and use of means. But unfortunately there is no sketch or description of the graph that should be used to present the data, and the statistical test mentioned is not suitable.

ResultsPlus
Examiner Tip

Notice that the question asks how the data would be **recorded and presented**, so both a table and a graph are needed.

Question 3 (e)

Mark points 1, 2 and 5 were the most frequently awarded, but students found this the most challenging question on the paper and the modal mark was 1. Many students made some reference to uncontrolled variables, but in some cases these were not specific enough to gain mark point 1. The examiners had hoped that more students might comment on the difficulty of judging the endpoint of the titration, since this is a limitation that applies directly from the Core Practical technique used. Students are encouraged to consider the limitations of the techniques used in the Core Practicals, as these limitations may also apply when the techniques are used in the context of an investigation.

(e) The limitations of your proposed method.

(3)

difficult to control all factors affecting Vitamin C content of the tomatos, such as the conditions they were stored of before the experiment. impossible to control genetic variation even if from same parent plant

ResultsPlus
Examiner Comments

This student has addressed mark point 1 well, but did not go on to discuss any other limitations.

ResultsPlus
Examiner Tip

Aim to discuss some other limitations as well as the effect of uncontrolled variables.

(e) The limitations of your proposed method.

(3)

It is difficult to determine the end point of colour change of DCPIP. It is difficult to control all other factors affecting vitamin C conentration. Other factors like light intensity, age of vegetable may be acting as limiting factor.

ResultsPlus
Examiner Comments

This student has made two good points, first mark point 2 then mark point 1. However, the final sentence suggesting that light or age of the vegetable might act as limiting factors does not really make sense: limiting factors for what? And what is the relevance of light?

Paper Summary

Advice for future students:

- Make sure you are clear about the difference between monitoring a variable and actively controlling it.
- When you have a choice of variables to discuss, you may find it easier to choose a variable you are familiar with and have controlled or manipulated before.
- When deciding how to process or present data, think about the aim of the investigation then process the data in a way that will help you to reach a conclusion.
- Remember to label both axes of a graph, even if it is a bar graph. The x-axis still needs a label, in addition to the labels for individual bars.
- Read the stem of the question carefully and look out for pieces of information that will help you to answer the question.
- Remember to write in continuous prose (not bullet points) if Quality of Written Communication is being assessed.
- When you do a Core Practical, think about the limitations of the techniques involved. These limitations may be relevant when the same technique is used in an investigation.

Grade Boundaries

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

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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