Pearson
Edexcel

Examiners' Report
June 2024

IAL Biology WBI13_01

ResultsPlus

Introduction

This paper generated broadly similar results to previous series. However, there were a few areas that candidates had difficulty with. The most obvious of these was Q03(b)(v). The issue here was with the use of the command word 'evaluate'; this is one of the command words that candidates are expected to understand. Although it may not have been used often on this unit, it will have been encountered on others, and therefore candidates are expected to have seen it and thought about its meaning when doing past paper exercises. Any of the command words, listed on pages 68 and 69 of the specification under the heading taxonomy, may be used on any of the units at any level. In terms of teaching and learning strategy, then, a thorough understanding on what command words are asking for should be developed.

The other particular challenges were in questions Q03(b)(i) and Q03(b)(iii), again, almost certainly as a consequence of a combination of not taking on board what the command word was asking, and not reading the question carefully.

After these three questions, the next biggest challenges were on the 6 mark question Q02(d) and on Q01(e). In both cases, it was a lack of familiarity with what was being asked. In the 6 mark question, familiarity with experimental design, and in Q01(e) familiarity with the recommended additional practical, a problem that was noted in this report in 2023.

Question 1 (a)

A relatively simple question about experimental design in relation to the control of possibly confounding variables. As in so many cases, an incomplete understanding of what was needed contributed to some candidates not performing as well as they should have. The importance of doing something in relation to a specific step in the flowchart in the stem was what was being asked. However, a number of candidates answered it in much more general terms.

(a) Explain why, in **step 1**, it is important to cut the squid meat into equal sized pieces.

(2)

Because the results must be accurate, and making sure that the pieces are equal provides accuracy of the results.

ResultsPlus
Examiner Comments

An answer attempting to get a mark by using a word that the candidate thinks is relevant, but in this case it is not.

(a) Explain why, in **step 1**, it is important to cut the squid meat into equal sized pieces.

(2)

so you can accurately measure results, so they have the same mass and ~~results~~ reduce the amount of variables

ResultsPlus
Examiner Comments

A rather vague answer, which uses buzzwords like variables and accurately, but does not gain any marks. Although it is probably true that equal sized pieces will have equal mass, this common thought is not relevant as they could have different shapes. As the mark scheme indicates, it is surface area that's important.

ResultsPlus
Examiner Tip

You are unlikely to get marks for indiscriminate use of words, such as accurate, reliable and valid. These words *can* be used and gain marks as long as the context is correct, so you need to think carefully about your usage of these words and understand the meaning of each one.

(a) Explain why, in **step 1**, it is important to cut the squid meat into equal sized pieces.

(2)

As enzymes act on surface area diffrent surface areas will cause rate of enzyme activity to be diffrent thus making the investigation not valid

ResultsPlus
Examiner Comments

In this case, although not particularly well expressed, the candidate has appreciated that the importance of equal sized pieces of meat is that they have an equal surface area upon which the enzymes can act. It also uses the correct term in this context: valid. It is the investigation which it proposes will be valid by using equal sized pieces and investigation can be taken as a substitute for experiment in this context. The terms accurate, reliable and precise were often used. None of them are correct in this context.

Question 1 (b)(i)

The most accessible question on the paper, but there was still a significant proportion of candidates who did not get the mark.

(b) (i) Name a suitable control solution that could be used in **step 2.**

(1)

pH or the temperature

ResultsPlus
Examiner Comments

This demonstrates the common confusion in candidates' minds between a control and things that are controlled. This question was about a control, but the candidate has answered it in terms of what should be controlled, and this does not gain the mark.

ResultsPlus
Examiner Tip

It is very important that candidates understand the distinction between **a control** and **a controlled variable**. A control is set up such that none of the possible variables in the experiment can affect it.

A controlled variable is any variable that might affect the results, other than the independent variable, that is the thing that the experimenter is deliberately varying. The dependent variable is the variable that is being measured as it is affected by the independent variable.

(b) (i) Name a suitable control solution that could be used in **step 2.**

(1)

The solutions should be of equal amounts

ResultsPlus
Examiner Comments

Again, here is a candidate who is confusing a control with controlled variables.

(b) (i) Name a suitable control solution that could be used in **step 2**.

(1)

Ethanol

ResultsPlus
Examiner Comments

This candidate is clearly attempting to talk about a control, but there is no case for using ethanol and it is difficult to see why the candidate has suggested it.

(b) (i) Name a suitable control solution that could be used in **step 2**.

(1)

Water

ResultsPlus
Examiner Comments

Straightforwardly correct suggestion. The candidates are told that the pieces of squid are placed into solutions of bromelain or papain and candidates should be aware that all enzymes work in solution in water.

Question 1 (b)(ii)

A relatively straightforward question, which the majority of candidates were able to answer correctly. However, a significant minority did not do so.

(ii) State the importance of using a control in this study.

(1)

For comparison

ResultsPlus
Examiner Comments

The simple idea of the control being something against which the experimentals results can be compared was given a mark here.

Question 1 (c)

Far too many candidates failed to get a mark on this question. It is not particularly because they are required to get two correct answers for 1 mark, but because they are too used to writing lists of what they think might be right without really carefully thinking it through. So examiners saw lots of temperature, pH, volumes and concentrations of things. None of these are relevant in this case, some examples in what follows show this.

(c) Give **two** variables that need to be controlled in **step 3**.

(1)

1 Temperature

2 Use Same type and age of meat

ResultsPlus
Examiner Comments

Candidates appear to occasionally struggle to think of a second variable that needs to be controlled. This is obviously not going to get a mark in this case as the type of meat is squid and the age of the meat can be assumed to be the same in every piece. It is another example of a situation where the answer could be right in a different context.

(c) Give **two** variables that need to be controlled in **step 3**.

(1)

1 pH

2 temperature

ResultsPlus
Examiner Comments

Again an example where the candidate has simply quoted two often quoted variables, without really thinking about the context. Since they have been told in the stem that pH is something that is being measured, it doesn't makes sense to suggest that it should be controlled.

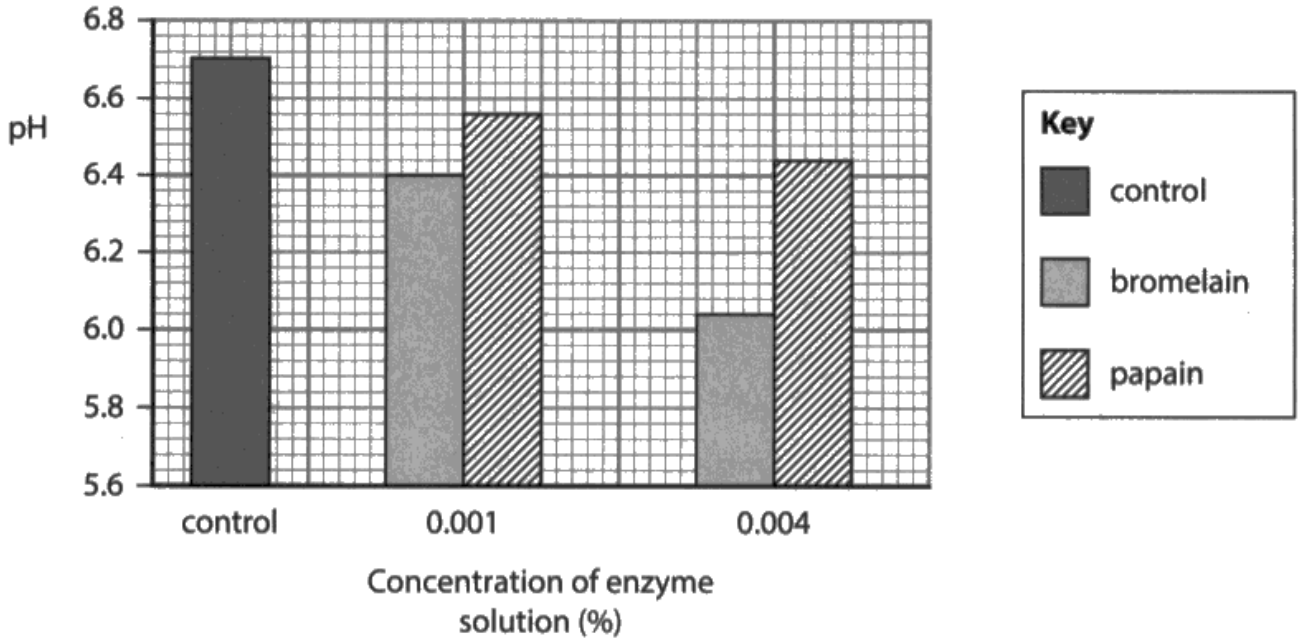
ResultsPlus
Examiner Tip

When asked about variables that need to be controlled in an experiment or investigation, candidates will often write down a pre-remembered list, which often includes such things as pH, temperature, the age, or gender of an organism and so on. There are cases where, of course, any one of these answers may be correct. However, there are cases where they will not be correct and what must be done is to think more deeply about what variables may affect the outcome and give those. Here the pH will not affect the outcome of an experiment, where the pH is the thing that is being measured, ie. the dependent variable.

Question 1 (d)(i)

As is so very often the case, many of the marks lost here were lost due to inadequate focus on what was being asked. In some cases, of course, the answer was simply wrong. However, in a significant number of other cases, the candidates had done the maths correctly but then decided to round their answer and get zero marks. Simply put, you would require 12.5 cm^3 not 13.0 cm^3.

(d) The graph shows the pH of the solutions measured at **step 4**.



(i) The 0.001% enzyme solution was prepared by diluting the 0.004% enzyme solution.

Calculate the volume of the 0.004% enzyme solution needed to make 50 cm^3 of 0.001% enzyme solution.

(1)

$C_1 V_1 = C_2 V_2$

$0.004 \times V_1 = 0.001 \times 50$

$V_1 = \frac{0.001 \times 50}{0.004} = 12.5$

Answer 13 cm^3

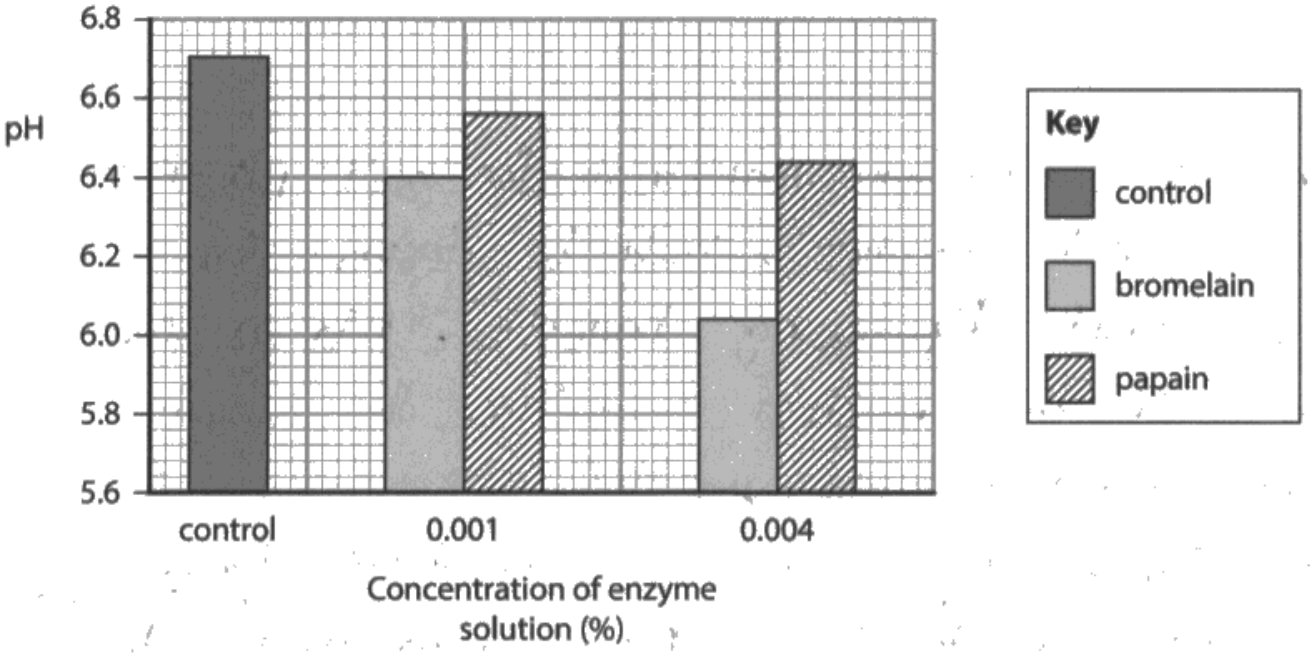
ResultsPlus
Examiner Comments

There was no case for rounding in this calculation and, since it was only out of 1 mark, rounding would lose that mark, as here.

ResultsPlus
Examiner Tip

You always need to think very carefully about rounding or quoting answers to mathematical calculations to a number of significant figures. Clearly, if you are asked to quote to two decimal places or three significant figures, then your strategy is simple. However, if you are not asked to quote to some predetermined number then you need to decide yourself whether it is relevant to do so. In this case, there was no logic for rounding, in fact 13 cm^3 would not yield the required volume of the required concentration of enzyme.

(d) The graph shows the pH of the solutions measured at **step 4**.



(i) The 0.001% enzyme solution was prepared by diluting the 0.004% enzyme solution.

Calculate the volume of the 0.004% enzyme solution needed to make 50 cm^3 of 0.001% enzyme solution.

(1)

$C_1V_1 = C_2V_2$

$\frac{0.001 \times 50}{0.004}$

Answer 12.5 cm^3

ResultsPlus
Examiner Comments

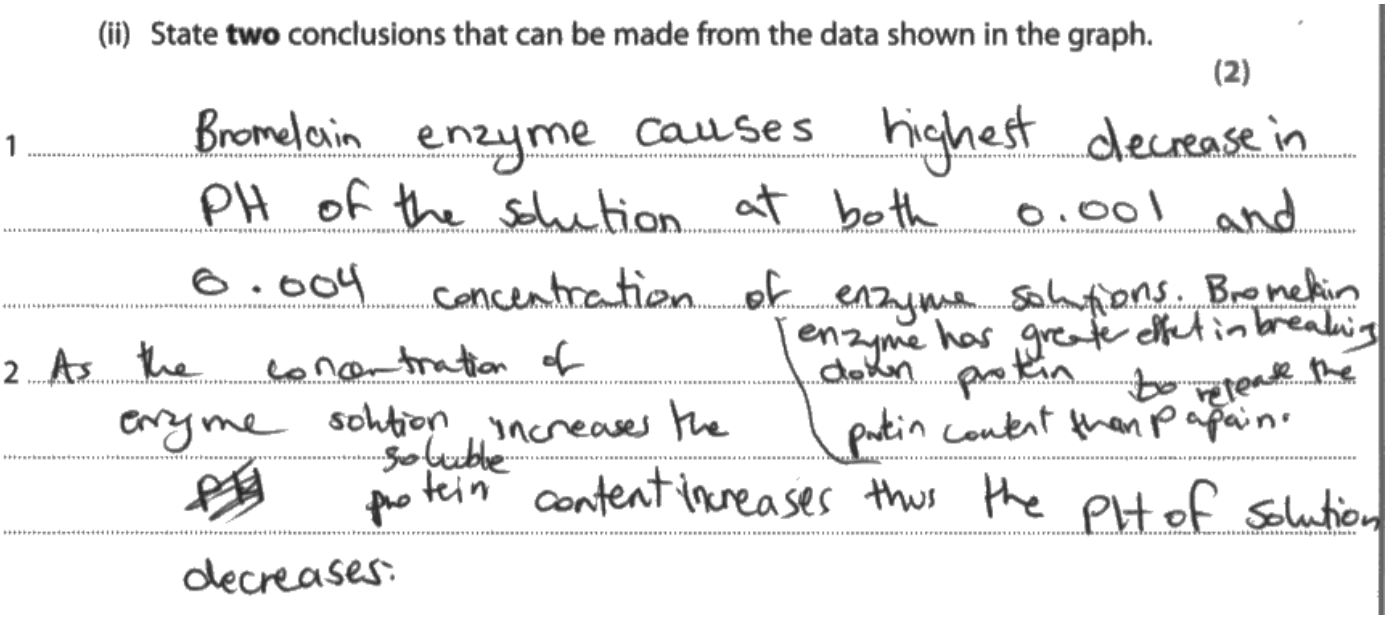
A correct answer, which many were able to provide.

Question 1 (d)(ii)

This question proved very challenging for candidates, perhaps because they didn't really think about what they were being asked to do. In the stem they are told:

The meat from squid is quite tough and is often treated with enzymes to break down the protein. Some fruits contain enzymes that can break down protein. A study compared the effects of two different concentrations of these two enzymes on the meat from squid.

So they are being asked to draw conclusions about the study, which was designed to look at the effects of enzymes on the meat from squid. Hardly any candidates read it this way. Instead, they wrote about the effect of the enzymes, and the different concentrations of enzymes, on the pH of the solution, making no attempt to deduce what that told them about the effects of these enzymes on the squid meat.



(ii) State **two** conclusions that can be made from the data shown in the graph.

(2)

1 Bromelain enzyme causes highest decrease in pH of the solution at both 0.001 and 0.004 concentration of enzyme solutions. Bromelain enzyme has greater effect in breaking down protein to release the protein content than papain.

2 As the concentration of enzyme solution increases the soluble protein content increases thus the pH of solution decreases.

ResultsPlus
Examiner Comments

Some candidates did manage to gain 2 marks on this question. However, it often seemed like something of an afterthought that gave them the second mark. So here we have a very typical answer about how bromelain causes a higher decrease in pH (than papain) and another one about how concentration of enzyme affects pH. However, in the extra part that they have written, they have said that bromelain enzyme has the greater effect in *breaking down protein*, and therefore can have a second mark. Without this apparent afterthought, this answer would be another of the many that got only 1 mark.

(ii) State **two** conclusions that can be made from the data shown in the graph.

(2)

1 The higher the concentration of both Bromelain and papain the more acidic its environment (lower pH), because more proteins are broken down to amino acids.

2 Bromelain has higher effect on "digestion" of squid meat.

ResultsPlus
Examiner Comments

Another answer which gains 2 marks, this time rather more convincingly. The second point does not address pH at all but is entirely focused on the effect of one enzyme in comparison to the other on the digestion of squid meat.

Question 1 (e)

This question gave rise to the full range of marks 0 to 4, with a good number obtaining 4. Not surprisingly, candidates knew the correct test for protein, although Benedict's and occasionally iodine were seen. Fewer were clear that in order to obtain something even semiquantitative, some control would have to be exerted over the conditions of the test, so the third mark point was less frequently seen. The idea of comparing with colour standards was not that well understood, with many candidates wanting to resort straight away to a colorimeter, which is not what this practical is at all about. The least convincing mark was mark point one where candidates maybe stumbled onto it by saying something which to the examiner looked as if they were separating the squid meat from the liquid around it; very few made an explicit statement about removing the squid meet or filtering, or some such technique.

(e) Describe a method for estimating the soluble protein concentration in the beakers in **step 4**.

(4)

Filter each beaker (using filter paper and funnel/narrow stem) and remove insoluble protein to obtain the filtrate. Test the filtrate for protein using Biuret's reagent. add biuret's reagent drop by drop until color change permanently from blue to purple. Compare the colors obtained with a color chart done using solutions of known (soluble) protein concentrations. Each grade represents a known protein concentration in the color chart. (use a calibrated colorimeter and measure the color intensity by measuring the light absorption and convert the color intensities obtained to protein concentrations). use same volume of filtrate and same filtration (extraction) technique.

ResultsPlus
Examiner Comments

This example gains all 4 marks with a clear statement at the beginning for the first mark point, use of biuret, use of colour standards and, at the end, some control over the volume of filtrate being used for the test.

ResultsPlus
Examiner Tip

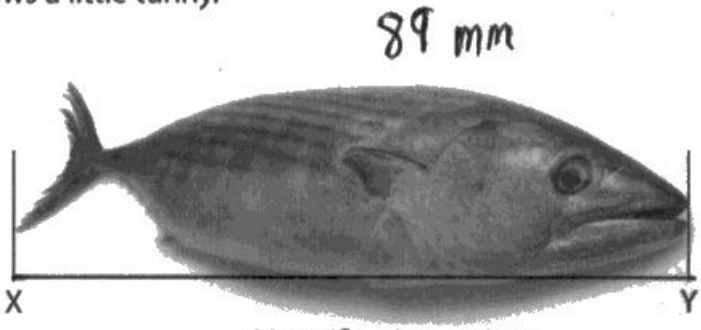
When you are having to describe something you may not have done, try to visualise yourself doing it in the laboratory or in the field, thinking about each step and how it needs to be performed and why. So here for example, there would be no point in testing the tubes with the fruit juice, and the squid meat in them, for protein because there will be protein in the squid meat. It would be necessary to separate the liquid from any remaining squid meat in step 4.

Question 2 (a)

Although it is not mentioned in relation to measuring fish, it is clear on the specification that candidates are supposed to understand the idea of scale (it is actually mentioned in relation to core practical 5 (spec. 3.8)). A good number were seen to be leaning on their GCSE knowledge, and quoting the magnification triangle. In this particular example, the triangle should have given rise to the equation **actual size = image size/magnification**. About 2/3 of candidates were able to come up with the correct answer; those who did not, simply didn't understand the calculation or, again, did inappropriate rounding.

2 Little tunny is a fish found in the Atlantic Ocean.

The photograph shows a little tunny.



Magnification × 0.09

(Source: © Picture Partners/Alamy Stock Photo)

(a) Calculate the actual length of this fish between **X** and **Y**.

Give your answer in metres. 8.9cm so 0.089 m

(1)

$\frac{0.089}{0.09} = 0.9\dot{8}\ m \approx 1\ m$

Answer 0.9̇8 m

ResultsPlus
Examiner Comments

This answer indicates how important attention to detail is on an A-level paper. The candidate has clearly measured the photograph at 89 mm. They have then done the correct calculation 0.089 (from the measurement) divided by 0.09 from the magnification given. The answer comes out at 0.988888 recurring, which they have indicated by the dot over the eight in the centre of the page. But 0.9888 recurring does not round to 0.98, it rounds correctly to 0.989, 0.99 or 1m, all of which were acceptable answers.

2 Little tunny is a fish found in the Atlantic Ocean.

The photograph shows a little tunny.

Magnification × 0.09

(Source: © Picture Partners/Alamy Stock Photo)

(a) Calculate the actual length of this fish between **X** and **Y**.

Give your answer in metres.

100 cm = 1 m

8.9 ÷ 100

(1)

Answer 0.089 m

ResultsPlus
Examiner Comments

A not uncommon error was for the candidate to ignore the magnification value given under the photograph and simply convert their measurement into metres as if this were a photograph at life size of the fish. Ideas of scale and magnification are required by this syllabus.

Question 2 (b)

This question caused some difficulty for candidates. Many confused a hazard and a risk, and others lost marks due to not appreciating that the question required them to complete the table to show one hazard for the dissection and one for the preservation of the heart, and simply wrote about formalin twice.

Complete the table to show **one** hazard for the dissection and **one** for the preservation of the heart.

(4)

Hazard	How to reduce the risk
1 Use of Scalpel to cut can cause an injury	use scalpel on white tiles & handle ~~xxx~~ any other cutting tool with care.
2 Harmful to skin ~~xxxxxx~~	wear gloves & a lab coat

ResultsPlus
Examiner Comments

This response quotes the use of a scalpel as a hazard, which is a correct suggestion. It then quotes the risk of using a scalpel as an injury due to a cut. Finally, it goes on to suggest a couple of ways of reducing the risk. This all gains 2 marks.

In the next line of the table, the hazard is actually a risk, but we can deduce from the fact that they are quoting from the table about formalin that the hazard they are discussing is the use of formalin. This could not be awarded the mark but, because we know what they're talking about, the wearing of gloves is a perfectly acceptable way of reducing the risk that the use of formalin would cause.

This response gets a total of 3 marks.

ResultsPlus
Examiner Tip

All practical work in science will involve a risk assessment. You need to be very clear in your mind about the difference between a hazard, a risk and a strategy to reduce the risk. Try doing risk assessments for a range of practicals to test your understanding of this.

Complete the table to show **one** hazard for the dissection and **one** for the preservation of the heart.

(4)

Hazard	How to reduce the risk
1 Formalin is irritating if it comes in contact with skin	Wear protective gear : lab coat, masks goggles, gloves. Rinse with water immediately if it comes in contact
2 Risk of being cut while dissecting the fish	Wear gloves and excercise caution while cutting open the fish

ResultsPlus
Examiner Comments

In this response, the first row of the table gains 2 marks. The hazard of formalin is quoted and a variety of ways of reducing the risk caused by this hazard are given.

On the second line the hazard given is actually the risk posed by the hazard, but the risk reducing strategy is OK.

3 marks in total.

Complete the table to show **one** hazard for the dissection and **one** for the preservation of the heart.

(4)

Hazard	How to reduce the risk
1 Irritating Eyes	~~Were~~ wearing Safely goggles and a Lab Coat to protect eyes
2 Sensitisation by Skin Contact	wearing a lab coat and safety gloves

ResultsPlus
Examiner Comments

Neither irritating eyes nor sensitisation of the skin are hazards but risks. However, since we know what the candidate is talking about as the two risks are copied from the table, it is possible to 'imagine' the correct hazard when marking the second column. So, wearing gloves or goggles would be suitable risk reduction measures. In this case though, the candidate has dealt with a preservation problem in both rows, so only 1 mark can be given.

Complete the table to show **one** hazard for the dissection and **one** for the preservation of the heart.

(4)

Hazard	How to reduce the risk
1 Sharp scalpel used can cut skin	Wear gloves and keep hand away from scalpel
2 Formalin can irritate eyes	Wear safety goggles

ResultsPlus
Examiner Comments

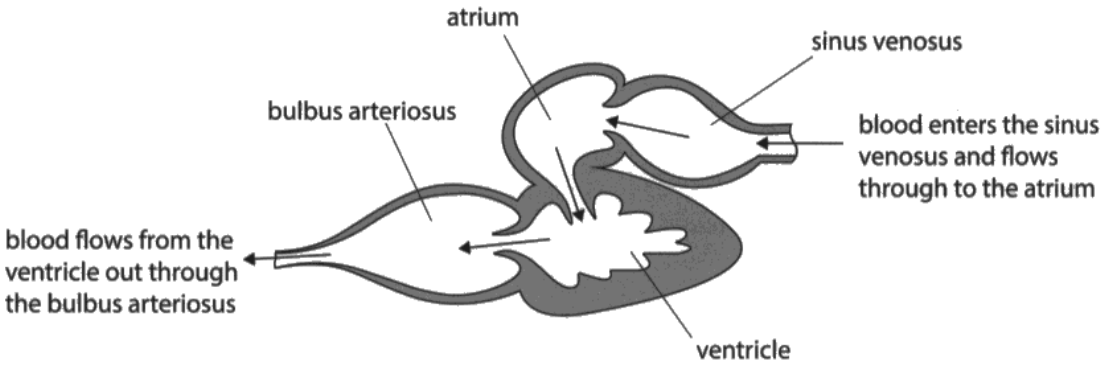
Scalpel use is all that is needed in the top row and formalin is correct in the bottom row. Both risk reduction measures are okay too.

A total of 4 marks.

Question 2 (c)

There was a good spread of marks on this question, with only a few failing to score at all. The best answers were those which gave clear comparisons, very often under the headings similarities and the heading differences. In other cases, at the other end of the scale, were those candidates who just wrote a continuous piece of prose, in which one or two comparative points, could sometimes be discerned. It would be well to help candidates with their approach to compare and contrast questions, and how to structure them, so that the examiner can clearly see what they are trying to say.

(c) The diagram shows the heart of a fish.



Compare and contrast the structure of the heart of a fish with the heart of a mammal.

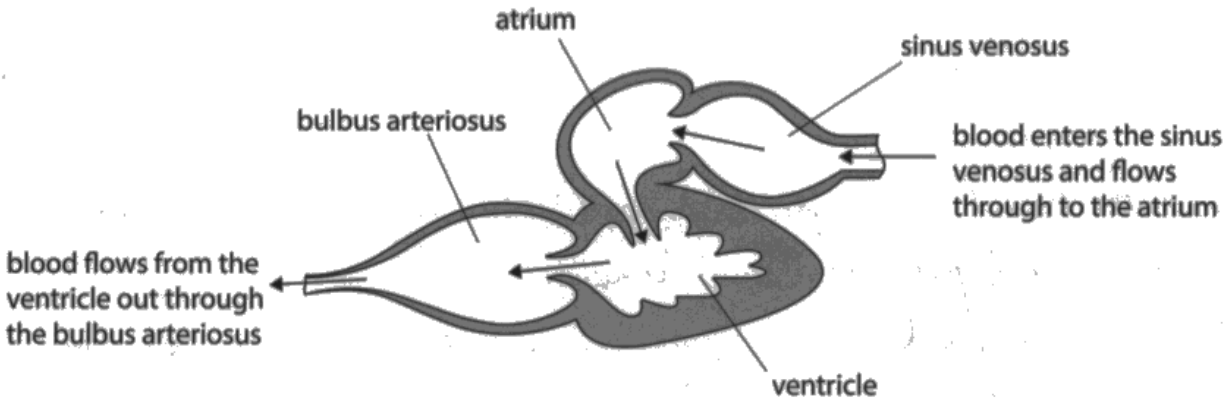
(3)

The structure of a fish and mammal heart are different as the atrium of the fish heart is much more bigger than that of the mammal heart, allowing for more oxygenation out of the blood while having little to no semi lunar valves being present which may lead to a backflow of the blood which is not present in the heart of the ~~mammal~~ mammal.

ResultsPlus
Examiner Comments

In this script the candidate has made an incorrect statement about structure, as there is no information about comparative size of fish and mammal atria. After that their points relate to function, so no marks.

(c) The diagram shows the heart of a fish.



Compare and contrast the structure of the heart of a fish with the heart of a mammal.

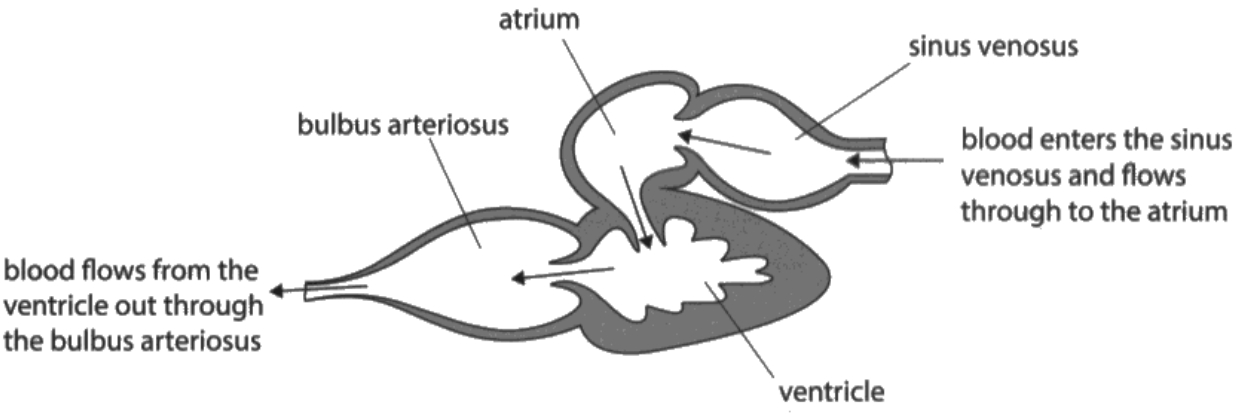
(3)

Blood enters the sinus venosus and flows through to the atrium, ~~then~~ into the atrium and going to ventricle, ~~next~~ next to bulbus arterious, then blood flows from the ventricle out throught the bulbus arteriosus.

ResultsPlus
Examiner Comments

This answer would have benefitted from more careful reading of the question. It is largely **functional** in its points and there is no attempt at a **comparison**.

(c) The diagram shows the heart of a fish.



Compare and contrast the structure of the heart of a fish with the heart of a mammal.

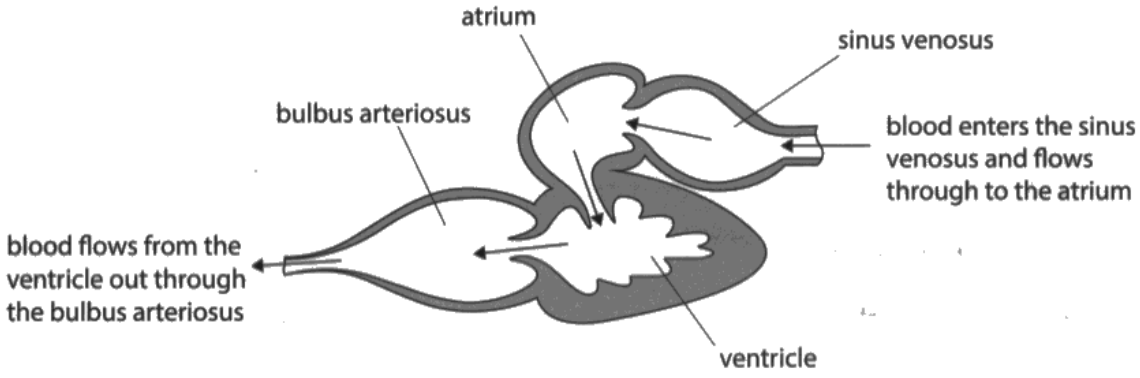
(3)

A fish has a single circulatory system, which means that the blood is pumped through the heart once before being pumped back to the heart. The blood first enters the heart through the sinus venosus and flows through the atrium then downwards to the ventricle and finally passes by the bulbus arteriosus before leaving and being pumped out to the rest of the body. Mammals have a double circulatory system, which means that blood passes through the heart twice before being pumped out to the rest of the body.

ResultsPlus
Examiner Comments

This is possibly an example of a candidate filling the space with information that they know, and maybe thinking that they have done enough therefore to gain the marks. However, they have gained only one mark because they have only made effectively one comparative point about the structure of the two hearts.

(c) The diagram shows the heart of a fish.



Compare and contrast the structure of the heart of a fish with the heart of a mammal.

(3)

- Similarities: both contain ventricle and atrium, both use ventricle to pump blood out of the heart.

- Differences: fish has one circulation, mammals have double circulation.

In fish blood enters from sinus venosus, in mammals blood enters from the vena cavas.

ResultsPlus
Examiner Comments

An answer structured in such a way that the examiner is left in no doubt as to what are being put forward as differences and what are being put forward as similarities. This is clearly the way forward in compare and contrast questions.

ResultsPlus
Examiner Tip

Compare and contrast is a command word and as such, it is well worth while to think about how you should approach any question which includes it. It will always require at least one similarity or difference, otherwise it is just compare *or* contrast. In addition, it is a very good idea to set out your comparisons under the headings similarities and differences.

Question 2 (d)

This was a rather unusual question for this paper in that it does not relate to any particular core practical, although the general context is that of the recommended additional practical on heart structure. However, this question is testing investigation design and analysis. The simplest points, which many got, would be to have an adequate sample size (five tends to be acceptable in these situations), and to standardise the measurements. Basically, standardising the fish and heart measurements is the equivalent in this case of controlling variables. We then need to know what exactly is being measured; many candidates were content with saying measure the size which is, of course, not possible unless we know what aspect of size to measure. The final 2 marks were about the analysis, plotting of a graph, which was quite often seen, and carrying out of a relevant statistical test, which was rarely seen.

(d) A student suggested that:

The larger a fish is, the larger its heart will be.

Devise a method that could be used to collect and analyse data to test this suggestion.

(6)

Same number
Collect ~~a large sample~~ of fish, of same species of a different sizes (small/medium-sized/large). Fish must be of same age and gender. Separate fish into 3 groups (fish obtained must be of same environmental conditions). Control temperature (of fish) (using thermostatically controlled water baths) at same salt concentration of water. Dissect/(cut) each fish of different sizes using, Measure ~~length~~ mass of each heart for every fish group size, using an electronic balance for more accurate results. Repeat experiment for each ~~fish group~~ size of fish. Plot a graph, of ~~mass of heart~~ size of fish (x-axis) and mass of heart. Calculate average/mean value of mass and exclude anomalous results. Use a large sample for each fish size to increase variability.

ResultsPlus
Examiner Comments

This answer starts off gaining marking point 2, then secures 4 by weighing the heart and finally 7 for a reasonable idea of the graph to be plotted. In amongst this, it talks about keeping environmental conditions the same and repeating things, both rather stock answers which gain nothing in this question. Had it measured the mass of the fish rather than simply the size, mark point 3 could have been gained.

(d) A student suggested that:

The larger a fish is, the larger its heart will be.

Devise a method that could be used to collect and analyse data to test this suggestion.

(6)

Find 20 recently dead fish of different sizes and ensure they are all dry before weighing them and noting down their mass. Then perform a dissection ensuring that gloves, safety goggles, mask and lab coat is worn. Dissect the heart out and ~~the~~ drain out all the blood inside the heart before weighing it to find out the ~~weight of~~ mass of the heart. Then according to the information obtained, plot a graph to determine the correlation between the mass of a fish and the mass of its heart. The ~~the~~ larger the number of fish dissected and weighed the more valid and reliable the graph becomes. Moreover, when weighing the fish and heart, use the same electronic balance but wipe it down in between weighs to ensure accuracy.

ResultsPlus
Examiner Comments

A very good answer gaining all 6 marks. In order marks 1,5,3,6,4 and 7 were gained. Some pre-treatment of the fish and the heart would be required, but was rarely seen in candidate answers.

ResultsPlus
Examiner Tip

In any investigation, whether it be experimental or observational, it is important to follow the "rules" laid down by science. You need to think about sample size, precisely what you are going to measure, what you are going to do in order to make results comparable to each other, and then how the data you have gathered might be analysed.

(d) A student suggested that:

The larger a fish is, the larger its heart will be.

Devise a method that could be used to collect and analyse data to test this suggestion.

(6)

Prepare finishes with a range of sizes.
Wear gloves and goggles. < measure the size of the fishes
Remove the heart of the fishes and measure their sizes at different orientations.
Needs to include the width and the height.
Plot the data on a graph.
Draw a most ~~suited~~ suitable line to see if there is ~~the~~ correlation between the fish size and the heart size.

ResultsPlus
Examiner Comments

Here is an answer which gains just 2 marks but could so easily have doubled that. In the first line, it gets the second mark point, and then mark point 4 when it talks about width and height of the heart. But it then simply talks about measuring the *size* of the fish. If the candidate had thought "how can I measure the size of a fish" they might have come up with measure the length or measure the mass. Hopefully, they would have realised that you cannot measure the size without saying what aspect of size you are going to measure.

The candidate also realises that the question asks for an analysis of the data, so suggests plotting a graph, but it is not possible to give any marks without a little bit more detail about what the graph is going to be of. What is going to be plotted against what? So, this could easily have been 4 marks.

Question 3 (a)(i)

A relatively simple calculation which many candidates were able to perform with no problem. However, the issue of significant figures raised its head on a rather large number of responses. Many were content with 9.06 as their final answer, and it is not clear why when two significant figures were asked for very clearly in the question. It could be that they simply did not see or ignored this instruction, or it could be that they think that 9.06 represents two significant figures. So, some training in this area would seem to be indicated.

(i) The percentage decrease in the vitamin C content of the fruit with no coating, over the 60-day period, was 43.75%.

Calculate the difference in the percentage decreases for the fruit coated with chitosan and the fruit with no coating.

Give your answer to two significant figures.

(2)

nC -> 43.75

ch -> 34.69

$\frac{0.32 - 0.49}{0.49} \times 100$

43.75 - 34.69

Answer 9.06 %.

ResultsPlus
Examiner Comments

A rather large, and slightly worrying, number of candidates lost the second mark by ignoring the instruction to give the answer to two significant figures.

ResultsPlus
Examiner Tip

Always read every word of a question, they are all there for a purpose, and if you ignore them, you are likely to answer the question incorrectly.

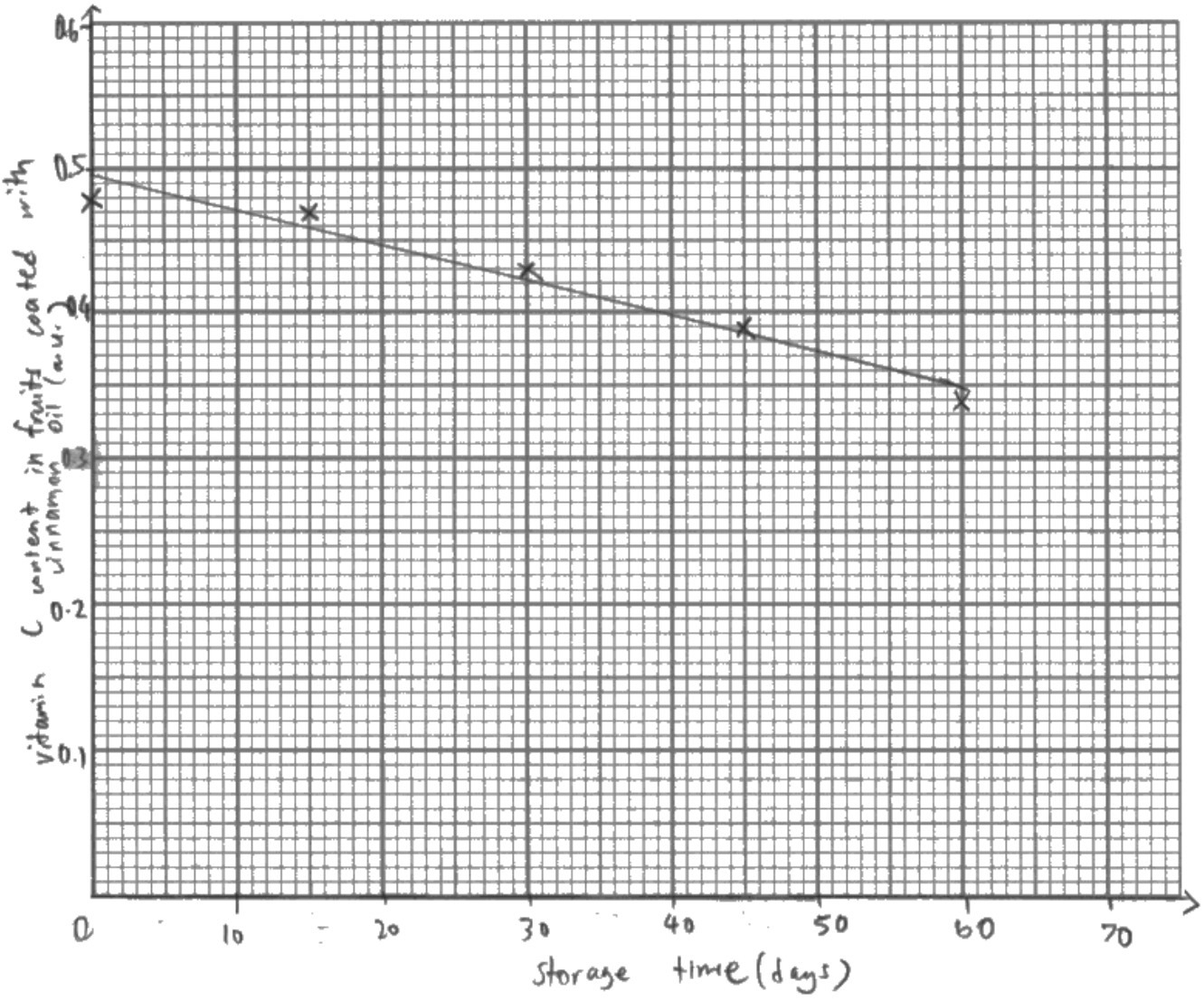
Question 3 (a)(ii)

This is a fairly straightforward plotting a graph question, a regular feature of this paper. The issue this time was in relation to drawing a suitable line of best fit.

(ii) **Plot a suitable graph to show the relationship between storage time and the vitamin C content in the fruits coated with cinnamon oil.**

Draw a line of best fit through the data.

(4)



ResultsPlus
Examiner Comments

A good number of candidates struggled with drawing an appropriate line of best fit on this graph. In this example, the candidate has managed to do that together with suitable axes which are correctly labelled, and the points plotted on a linear scale. So, this answer gains all 4 marks.

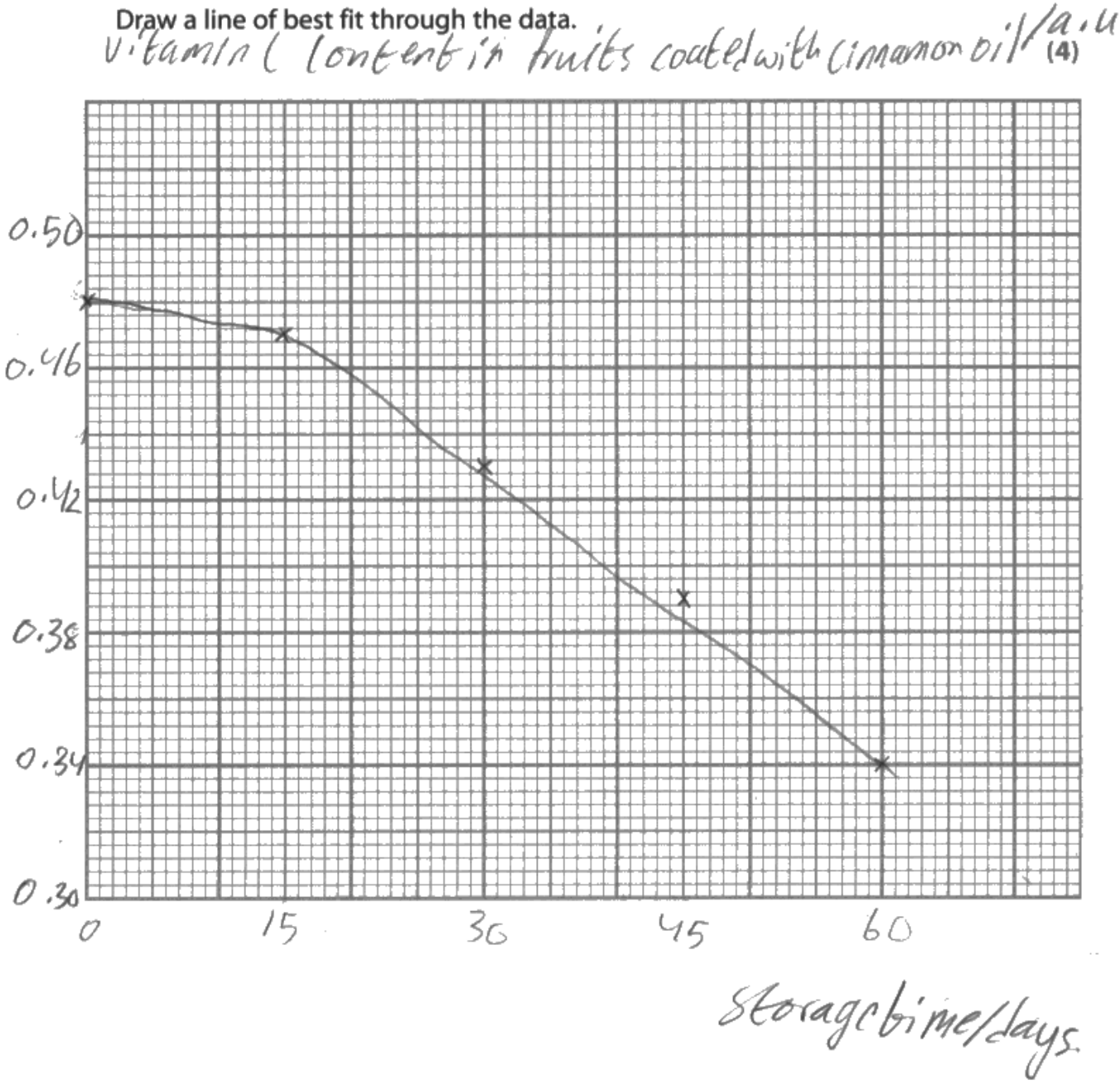
ResultsPlus
Examiner Tip

A line of best fit should follow the direction of the slope, should have as many points on one side as on the other, or as close as possible to that, and the points should be a balanced distance from the line.

In this case there are five points, so we would expect two on one side and three on the other. That is not quite enough though, the distance of these points from the line needs to be about the same, when totalled, on both sides. This candidate has three points above and two points below, so that is fine. The two points below are both rather further away from the line than any of the points above, so on balance, the three points would have an average distance about the same as the two points below.

(ii) Plot a suitable graph to show the relationship between storage time and the vitamin C content in the fruits coated with cinnamon oil.

Draw a line of best fit through the data. **(4)**



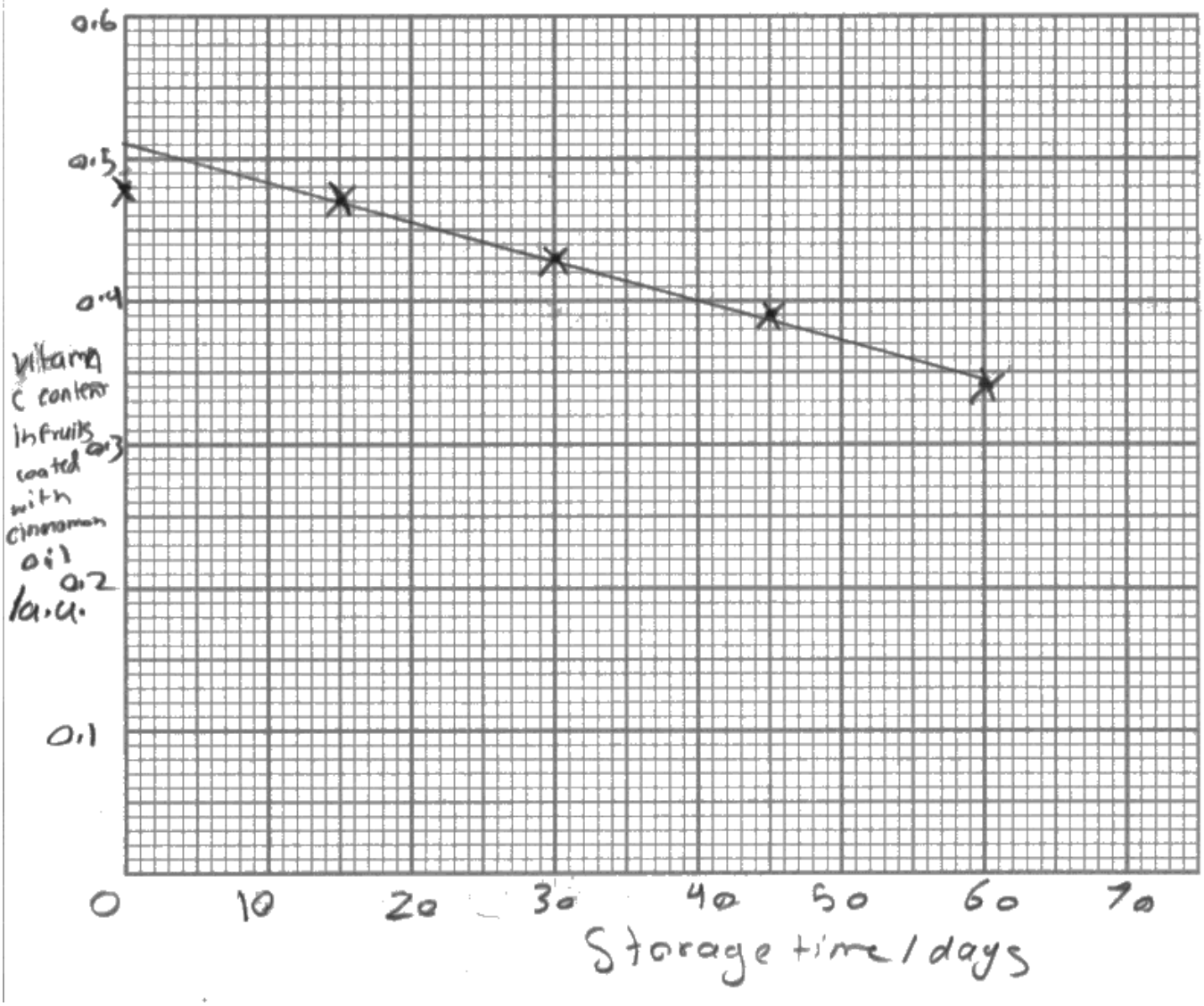
ResultsPlus
Examiner Comments

This answer could not achieve the appropriate line of best fit mark, as such a line must be a straight line.

(ii) Plot a suitable graph to show the relationship between storage time and the vitamin C content in the fruits coated with cinnamon oil.

Draw a line of best fit through the data.

(4)



ResultsPlus
Examiner Comments

In this example, the axes are correct, properly labelled, and the points are plotted correctly on a linear scale. However, the line of best fit is not suitable, the way the candidate has drawn it. There is one point below the line and effectively four points on it, so it does not quite meet the criteria.

It would be very well worthwhile practising drawing lines of best fit before taking the examination. There are plenty of websites that allow this to be done.

Question 3 (a)(iii)

This question is quite like ones on many past papers in principle, although it takes a slightly different approach. Rather than asking for what could be done to measure variability, or in order to calculate the standard deviation, this one looks at repeatability. It gave a good spread of marks from 0 to 3.

(iii) **This data has no indication of repeatability.**

Describe how data could have been collected in this investigation and presented to show its repeatability.

(3)

they taked a fruit which is covered with cinammon they grind it ~~and after solution~~ to get a liquid - they added DCPIP solution drop by drop, after each drop - they swirl the solution until it become colourless, they related it every 15 days to get a reliable result and see how vitamin C content is found, Count number of drops needed to completely ~~decont~~ decolourise the solution.

ResultsPlus
Examiner Comments

This candidate has answered the question "describe how data could have been collected in this investigation". This, of course, is not the question that was asked.

(iii) This data has no indication of repeatability.

Describe how data could have been collected in this investigation and presented to show its repeatability.

(3)

investigation ~~(repit)~~ repeated under the same conditions,
Means and standard deviations calculated using formulas.
~~Sta~~ Graph of mean vitamin C contents is plotted and standard deviations added as error bars

ResultsPlus
Examiner Comments

The candidate has understood what is required in this question. In order to collect and present data to show repeatability, we need to carry out the investigation a number of times (collect data) and then calculate means and standard deviations together with presenting them on a graph.

Question 3 (a)(iv)

This question is asking candidates to combine some knowledge from CP2 with an understanding of good experimental design. It yielded mark totals across the range, but the majority got either 1 or 2.

(iv) A coating made from a combination of chitosan and cinnamon oil was also tested.

Describe an investigation to determine if this coating is more effective than the two coatings used separately in preserving the vitamin C content.

(3)

Cover a jujube fruit with the coating made from chitosan and cinnamon, mentic extracts from the fruit at diffet time intervals, use DCPIP solution to measure vitamin C content

ResultsPlus
Examiner Comments

The simplest way of getting 1 mark in this question is to realise that the test for vitamin C involves the use of DCPIP. Many candidates, like the one here, achieved only this mark.

(iv) A coating made from a combination of chitosan and cinnamon oil was also tested.

Describe an investigation to determine if this coating is more effective than the two coatings used separately in preserving the vitamin C content.

(3)

Coat the jujube fruits with the combination. Measure the vitamin C content using DCPIP solution. Take a sample of the coated jujube fruits and turn it into liquid, juice. Take a known volume of the jujube juice solution in a pipette and slowly add drops to DCPIP, stop when it decolourises. The less drops it takes the more the vitamin C content in the fruit. Repeat this process at an interval of 15 days. Calculate the percentage difference of vit C content between the 60th day and the first day.

ResultsPlus
Examiner Comments

Very few candidates talked about a standardisation of the coating method. Candidates should have realised that they are going to compare a double coated fruit with single coated fruits. So, the only thing that should be different about the double coated fruit is the double coating. This means that the coating must be applied in exactly the same way as it was when the coating was single.

Question 3 (b)(i)

In this question, a simple but important to laboratory technique was tested. It was rather poorly answered with a majority getting no marks at all. It is felt that this was largely due to a misreading of the question, leading to answers which simply told the examiner how to fill a pipette and ignored the key words **measure an accurate volume.**

(i) The diagram shows a graduated pipette.

The pipette was used to prepare the suspension of bacteria.

Describe how to use a graduated pipette to measure an accurate volume.

(2)

put the suspention in a beaker and place the pipette in the beaker Then suck ~~[illegible]~~ the suspention into the pipette with a volume higher than what you need. Then put it at eye level and drop the suspention slowly until the meniscus ~~reaches~~ reaches the desired volume

ResultsPlus
Examiner Comments

A number of candidates were able to gain both marks here by mention of the reading being related to the position of the meniscus, and the reading being taken with the meniscus held at eye level.

ResultsPlus
Examiner Tip

There is a range of scientific equipment you are expected to be familiar with and possibly to have used or have seen in use in a film. These are not listed in the specification but you will have come across them if you have done all the practical work that is recommended or required.

(i) The diagram shows a graduated pipette.

The pipette was used to prepare the suspension of bacteria.

Describe how to use a graduated pipette to measure an accurate volume.

(2)

By getting any air out of the pipette first, then ~~or~~ any thing in it other than ~~the~~ bacteria, then place it in the ~~sy~~ bacteria suspension and measure the volume, pump out anything or any substances present in the graduated pipette other than the suspension of bacteria, to only measure the volume of ~~bacteria~~ suspension of bacteria.

ResultsPlus
Examiner Comments

Quite a significant proportion of candidates were at a loss as to how to answer this question. Most of those who achieved no marks simply talked about how to draw liquid into a pipette ignoring, or not appreciating the significance of, the phrase "to measure an accurate volume".

(i) The diagram shows a graduated pipette.

The pipette was used to prepare the suspension of bacteria.

Describe how to use a graduated pipette to measure an accurate volume.

(2)

measure from bottom of the mensucus to avoid parallex error

ResultsPlus
Examiner Comments

A very economical answer from a candidate clearly confident about what is required here. This kind of answer was far less common than would have been hoped.

Question 3 (b)(ii)

A very straightforward calculation, but still some candidates failed to score. This was usually because they ignored the instruction to give the answer in standard form, or they did not know how to give the answer in standard form.

(ii) The suspension of bacteria containing 5×10^5 bacteria per cm^3 was used.

Each agar plate was spread with 0.2 cm^3 of this suspension.

Calculate the number of bacteria that were added to each agar plate.

Give your answer in standard form.

(1)

$0.2 \times 5 \times 10^5 = 100000$

Answer 1×10^5

ResultsPlus
Examiner Comments

A clear and correct answer.

ResultsPlus
Examiner Tip

In science, where very large and very small numbers are often involved, it is very important to understand how to express numbers in standard form.

(ii) The suspension of bacteria containing 5×10^5 bacteria per cm^3 was used.

Each agar plate was spread with 0.2 cm^3 of this suspension.

Calculate the number of bacteria that were added to each agar plate.

Give your answer in standard form.

(1)

$(5 \times 10^5) \times 0.2 cm^3$

=

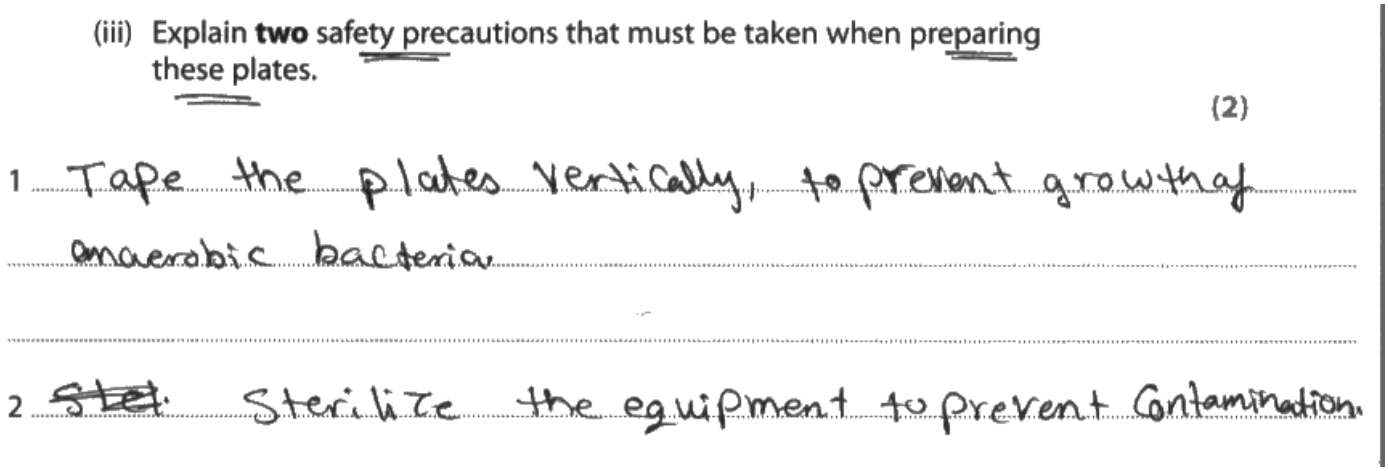
Answer 100,000

ResultsPlus
Examiner Comments

It was not uncommon for candidates to get the maths right, but then ignore the instruction to give the answer in standard form. Since the calculation was given only 1 mark, this inattention to that detail cost them.

Question 3 (b)(iii)

In past papers, candidates have often been asked to state precautions that they would take under certain circumstances. Here, they were asked to explain the precautions and found this quite challenging.



(iii) Explain **two** safety precautions that must be taken when preparing these plates.

(2)

1 Tape the plates vertically, to prevent growth of anaerobic bacteria.

2 ~~Stet.~~ Sterilize the equipment to prevent Contamination.

ResultsPlus
Examiner Comments

Some allowance was made in the use of English to explain what was being done. For example, a significant number of candidates talked about taping the plates vertically and this was taken to mean that the lid was only partially sealed. If this was coupled with the reason being to avoid growth of anaerobes, then the mark could be given.

ResultsPlus
Examiner Tip

Even familiar command words, such as explain, are often ignored, but they must be taken into account when writing an answer. So you cannot merely state something like a safety precaution when preparing plates of microorganisms if the question asks you to explain the safety precaution. You must understand the requirements of all the command words listed in the specification under the heading of **taxonomy** on page 68.

(iii) Explain **two** safety precautions that must be taken when preparing these plates.

(2)

1 wear gloves

2 [redacted] keep away from heat.

ResultsPlus
Examiner Comments

This response is typical of many seen, which completely fails to appreciate that the question asked for an ***explanation*** of two safety precautions, not simply a statement of them. Wearing gloves and keeping away from heat were very unlikely to have gained the marks even if they had explained why.

Question 3 (b)(iv)

This question generated the full range of marks and worked well. A little bit more attention to detail would have given many candidates an extra mark or two. For example, those who said that the temperatures of incubation had to be different because the microorganisms have different optimum temperatures could have got the mark if they changed "microorganisms" to "enzymes".

(iv) The table shows some differences between the method using bacteria and the method using fungi.

Type of microorganism	Type of agar	Incubation temperature / °C	Length of incubation / hours
bacteria	nutrient agar	35	24
fungi	potato dextrose agar	28	72

Suggest why different conditions were used when growing these two types of microorganism.

(3)

Type of agar ~~Different~~ Different microorganisms grow on different medium. Has ~~diff~~ different food ~~con~~ content.

Incubation temperature ~~Both~~ Different microorganisms have different optimum temperature.

Length of incubation Different microorganism take longer to form.

ResultsPlus
Examiner Comments

This response could have relatively easily gained 3 marks instead of 1. The suggestion that different microorganisms have different food requirements is sufficient for the first mark point. Different microorganisms having different optimum temperatures would have got the mark if it had talked about the enzymes of different microorganisms having different optimum temperatures. Finally, if it had said that fungi take longer to grow, then that also would probably have gained a mark.

(iv) The table shows some differences between the method using bacteria and the method using fungi.

Type of microorganism	Type of agar	Incubation temperature / °C	Length of incubation / hours
bacteria	nutrient agar	35	24
fungi	potato dextrose agar	28	72

Suggest why different conditions were used when growing these two types of microorganism.

(3)

Type of agar bacteria feed on nutrients and fungi feed on potato dextrose, make sure they have enough food for energy supply.

Incubation temperature The optimum temperature for enzymes in bacteria and fungi are different, this make sure they can have maximum enzyme activity for living.

Length of incubation The rate of enzyme breaking down agar is different, so the ~~reaction~~ rate of reaction is different. the time required is different.

ResultsPlus
Examiner Comments

In this example, the *type of agar* answer tells us nothing beyond the information in the stem. The reasons for the *different incubation temperature* is clearly correct in this case. It is possible that an answer that involved information about the efficiency of enzymes breaking something down could have gained the mark here. However, it was never going to be a possibility in this case as it does not give specific details about bacteria compared with fungi.

(iv) The table shows some differences between the method using bacteria and the method using fungi.

Type of microorganism	Type of agar	Incubation temperature / °C	Length of incubation / hours
bacteria	nutrient agar	35	24
fungi	potato dextrose agar	28	72

Suggest why different conditions were used when growing these two types of microorganism.

(3)

Type of agar bacteria and fungi need different nutrients for their own metabolic processes and in different demands

Incubation temperature enzymes in each microorganism are different so different optimal temperature for high enzyme activity is needed

Length of incubation bacteria reproduce very fast, so they will need less time to produce a colony that can be tested than fungi

ResultsPlus
Examiner Comments

This response has three good suggestions and gains all 3 marks.

Question 3 (b)(v)

This question proved very demanding for most candidates. This is almost certainly, at least in part, as a consequence of their lack of understanding of the command word *evaluate*. However, it is not just this. Candidates fell into three groups. Those who understood what they were required to do, although never managed to do it more than twice or occasionally three times. Those who seemed to begin to understand the requirements, but merely stated problems with the investigation without actually explaining why they were problems. The third group just answered the question as if it had asked them to comment on the data, as has so often been the case in this type of question in the past.

Evaluate the usefulness of this data when making conclusions about the antimicrobial activity of cinnamon oil and chitosan in this investigation.

(4)

Chitosan has a higher ~~antimic~~ antimicrobial properties than cinnamon oil, this is because the diameter of zone of inhibition is higher in chitosan. However, this ~~expe~~ data could be more useful if it contains errors bars, as you would be able to see any overlaps and whether the data is valid or not. Both of the extracts ~~are~~ have higher antimicrobial properties in the S. aureus bacteria and ~~the~~ lower antimicrobial properties in A. flavus.

ResultsPlus
Examiner Comments

This answer is a fairly typical mix of relevant information with irrelevant information. So the statement that chitosan has higher antimicrobial properties than cinnamon oil is correct, but not relevant to the question asked. It becomes promising after this with a sentence starting with the word "however" and continuing with an explanation as to how the data could be more useful. Sadly, the explanation does not go far enough and doesn't tell us why it would be more useful if it had error bars in terms which are clear enough at this level. The explanation falls apart at the end when it says we don't know whether the data is *valid* or not.

ResultsPlus
Examiner Tip

If a command word has never appeared before on a past paper, or only appeared rarely, you should still be prepared for its appearance on the paper that you sit. So the very important suggestion is to make yourself familiar with all the command words and how they should be interpreted.

Evaluate the usefulness of this data when making conclusions about the antimicrobial activity of cinnamon oil and chitosan in this investigation.

(4)

The S. aureus is the most effective type of microorganism, since it has the largest diameter of zone of growth inhibition, this means it has killed the greatest, so it has the greatest antimicrobial activity. The chitosan is more effective than cinnamon oil, in all types of microorganisms. Chitosan has a greater antimicrobial activity than cinnamon oil. A. flavus has the lowest diameter of zone of growth inhibition, so it has the lowest antimicrobial activity. SD values are not calculated, so the results do not show if it is reliable or not. The highest diameter of zone inhibition of growth inhibition in Chiosan is 18.4mm; for the cinnamon oil is 17.6mm. The lowest for chitosan is 14.8mm; the lowest for cinnamon oil is 14.4mm.

(Total for Question 3 = 24 marks)

TOTAL FOR PAPER = 50 MARKS

ResultsPlus
Examiner Comments

This answer almost entirely misses the point of this question. It talks for most of it about the relative effects of the coatings on the different microorganisms. In this way, it is answering a "comment on these data" question. It does mention the fact that standard deviations are not calculated but does not make enough of this to get a mark.

Evaluate the usefulness of this data when making conclusions about the antimicrobial activity of cinnamon oil and chitosan in this investigation.

(4)

A conclusion that chitosan has slightly more growth of inhibition, therefore, more antimicrobial activity than cinnamon oil as seen on the bar chart. This investigation does have a great range of different samples of bacteria, and therefore a larger sample increases the reliability of this study as it has been tested throughout different conditions. However, no error bars are present within the bar chart which means that no mean or standard deviation has been calculated. As a result, there were no repeats which reduces the ~~reliability~~ reliability of this study as no conclusions can be made from an investigation completed once. To continue, during the investigation they only measured the diameter of the zone of growth inhibition. Hence, this makes the results less ~~precise~~ precise and accurate as the diameter is not the same all around the zone of inhibition. Calculating the area using πr^2 would have been more efficient.

(Total for Question 3 = 24 marks)

ResultsPlus
Examiner Comments

This is an example of a high scoring response, although even here, the candidate struggles to express themselves clearly.

It is one of the very few that gives a positive evaluation of the usefulness of the data by saying that a range of samples had been studied (mark point 1). The route to mark point 4 is long but the idea that "no conclusions can be made from an investigation completed once" finally clinches it. They say enough for mark point 5 at the end.

Paper Summary

Based on their performance on this paper, candidates are offered the following advice. Much of this advice mirrors that of previous series:

- All nine core practicals and all five recommended assessed practicals should be thoroughly studied and thought about before the examination, not in it.
- Make sure you thoroughly understand the basic elements of the scientific method as taught at A Level. One variable is varied (the IV), one is measured, as the IV is varied, (the DV) and any other variables which may affect the DV are kept at constant values.
- All command words should also be studied and their usage practiced, again long before sitting in the exam room. A detailed study of past papers, alongside mark schemes and examiners' reports, will be very helpful.