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Examiners' Report
October 2025

Pearson Edexcel International Advanced Level in Biology

WBI16/01

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Introduction

Paper WBI16 tests learners' knowledge of practical skills. They are expected show that they can

- Solve problems set in practical contexts.
- Apply scientific knowledge to practical contexts.
- Comment on experimental design and evaluate scientific methods.
- Present data in appropriate ways.
- Evaluate results and draw conclusions with reference to measurement uncertainties and errors.
- Identify variables, including those that must be controlled.
- Plot and interpret graphs.
- Process and analyse data using appropriate mathematical skills
- Know and understand how to use a wide range of apparatus, materials and techniques safely, appropriate to the knowledge and understanding in this specification.
- Plan an investigation to test a hypothesis

There were a wide variety of responses on this paper and most learners were able to attempt all questions. It was very pleasing to see learners who considered the context of the question and gave answers with appropriate detail to achieve high marks. However some learners gave very generic answers, or gave details which did not match the context of the question, eg choosing irrelevant variables to control.

Question 1

This question related to growth of maggots on minced and whole turkey meat. Learners were provided with a graph showing the mean length of maggots over 192 hours on both types of meat.

1ai Learners were asked to state the time when maggots on whole turkey meat formed a pupa. The majority of learners correctly read the peak of the graph as 168 hours. Please note that it is not possible to say with certainty that the maggots began to develop into pupae at this time, as measurements were taken only once every 24 hours. A more correct answer would have been within the timescale 145 to 191 hours.

The most common errors were from learners who read the data from the line for minced turkey meat (rather than whole turkey meat).

1aii Learners were asked to calculate the fastest **rate** of growth of maggots on minced turkey meat. This required them to identify the steepest part of the correct graph and calculate the gradient, giving the answer with appropriate units. Around half were able to reach a correct answer with suitable units, ie 0.33 mm hr^{-1}.

The most common error in calculating was to invert the equation for gradient, and reach an incorrect answer of 3.0. A few learners calculated a percentage change. Those

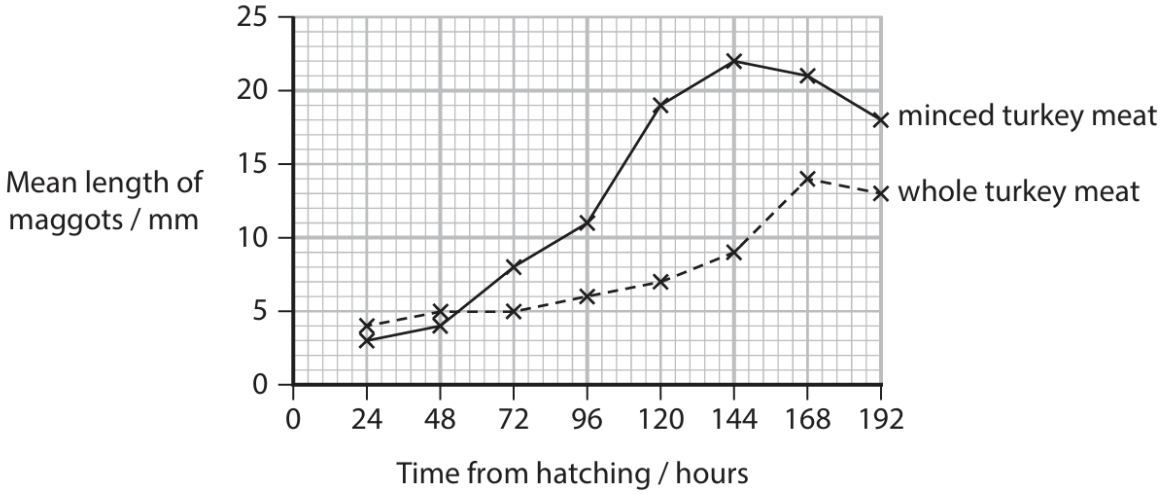
who got the units wrong sometimes gave them as hr mm^{-1}, or something totally inappropriate for rate, eg mm or seconds

1bi-ii Learners were asked to state two abiotic variables that could affect this investigation, and to describe how to control one of them. There were five appropriate variables listed in the mark scheme; temperature, oxygen concentration and mass of food were most commonly seen. However, many learners chose pH, which was not suitable in this case.

Learners are reminded to think about the context of the question and to choose variables that would actually make a difference to the result. Also, since the question asked for two variables, and an answer line was provided for each, learners should not provide a list of variables on each line.

A few lost the mark for 1bii because, although they suggested controlling temperature with a water bath, they did not state that it should be thermostatically controlled.

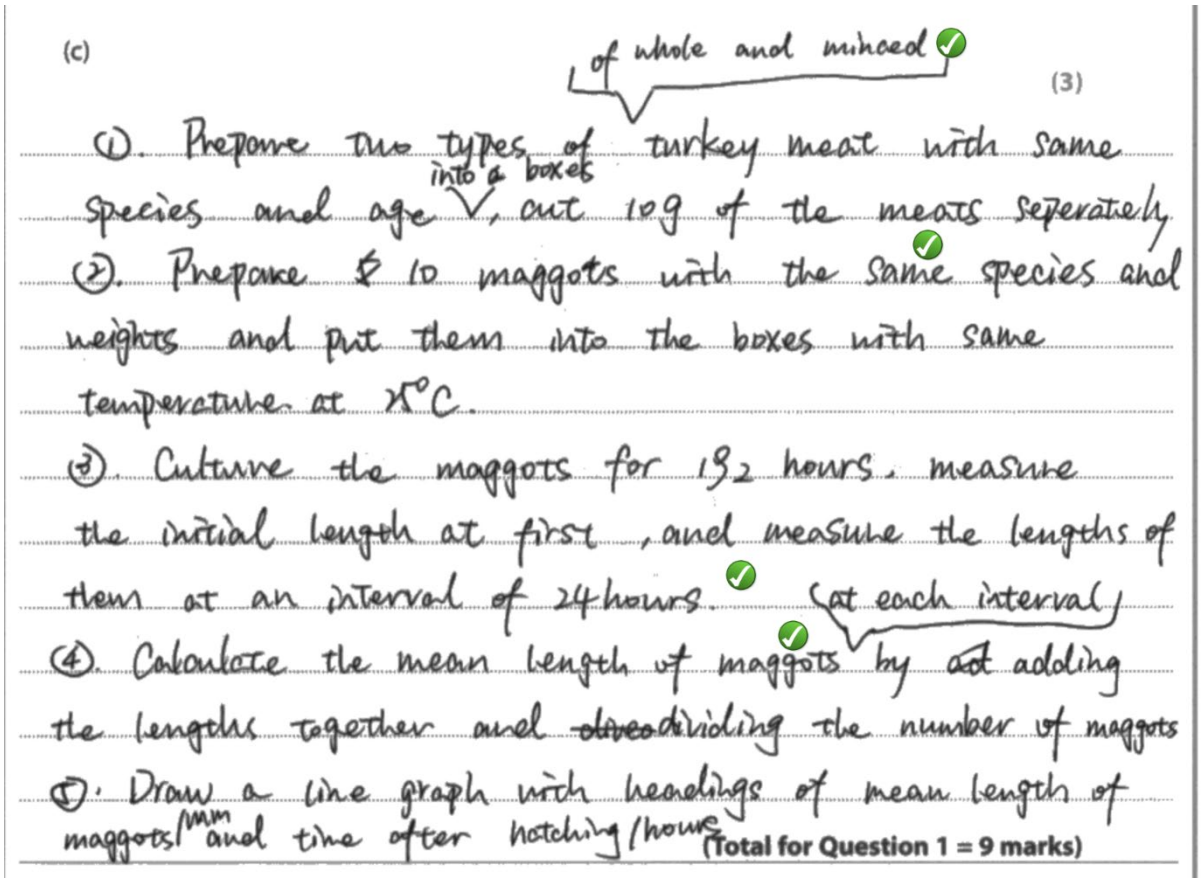
1c Learners were asked to describe a method that could be used to collect the data shown in the graph. The graph showed the mean length of maggots at 24-hour intervals on both whole and minced turkey meat.



There were four available marking points for three marks, with mark points 2, 3 and 4 most commonly seen. A few learners lost marks because they were not precise enough, eg

- saying that the length should be measured at regular intervals (rather than every 24 hours)
- saying that the length should be measured every day
- saying that data should be collected every 24 hours (without mentioning the length).

This is an example of an answer which achieved all four marking points



(c) (3)

of whole and minced

(1). Prepare two types of turkey meat with same species and age into a boxes, cut 10g of the meats seperately.

(2). Prepare 5 to 10 maggots with the same species and weights and put them into the boxes with same temperature at X°C.

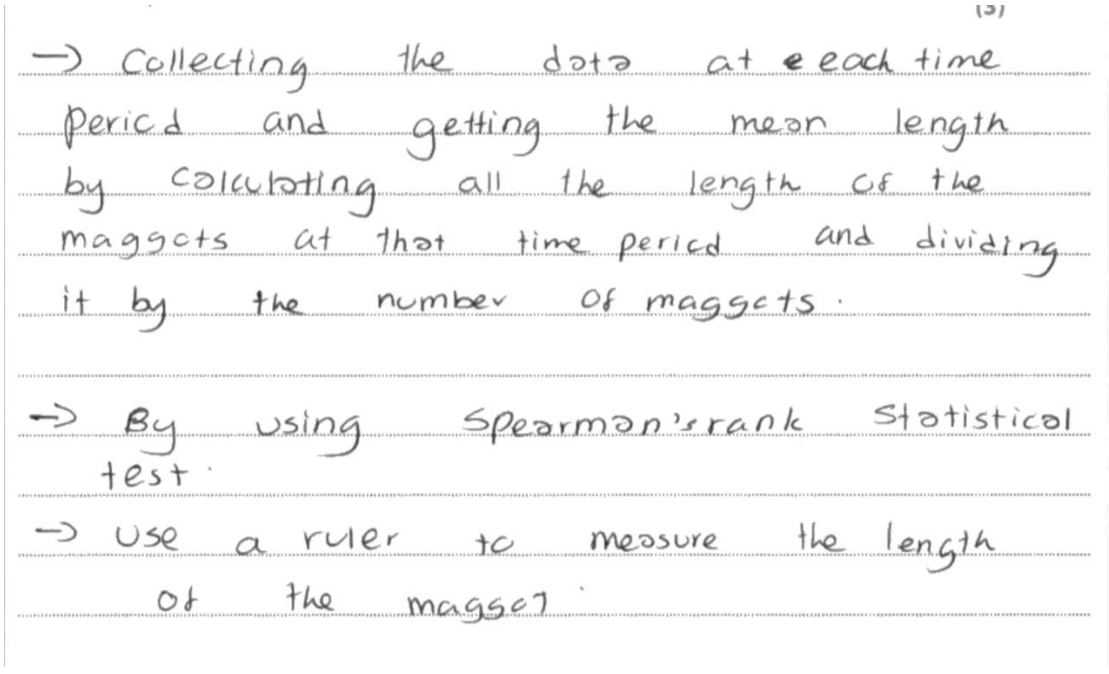
(3). Culture the maggots for 1½ hours. measure the initial length at first, and measure the lengths of them at an interval of 24 hours. (at each interval)

(4). Calculate the mean length of maggots by ~~not~~ adding the lengths together and ~~divide~~dividing the number of maggots

(5). Draw a line graph with headings of mean length of maggots/mm and time after hatching/hours

(Total for Question 1 = 9 marks)

This answer scored mark point 3 only. It came close to mark point 2, but did not refer to 24 hours.



(3)

→ Collecting the data at each time period and getting the mean length by calculating all the length of the maggots at that time period and dividing it by the number of maggots.

→ By using Spearman's rank Statistical test.

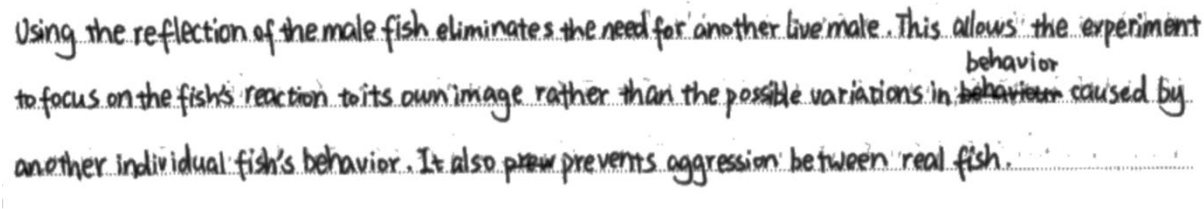
→ use a ruler to measure the length of the maggot.

Question 2

This question related to the Recommended Additional Practical: Investigate habituation to a stimulus. Learners were given information about the threat behaviour shown by a male Siamese fighting fish when another male approaches its territory. They were told that this threat behaviour was used to investigate habituation in the male fish.

2a Learners were asked why a mirror giving a reflection of the fish was used instead of another male. The most common correct answer was that if another male were used the animals may fight, or be harmed. Some learners gave the alternative answer that if another fish were used, its behaviour could not be controlled, or that the stimulus may not be the same every time.

This answer covered both of these points.



2b Learners were asked to describe an investigation that could be carried out to investigate the habituation of the male fish to its reflection in the mirror. Over 60% of learners scored at least half marks on this question.

Most scored mp1, but many forgot to remove the mirror from the tank or cover it (for mp3) so that the stimulus could be repeated. For mp2 we expected learners to say that the length of time the fins were extended should be recorded; this could also have been expressed as the time for the fins to go back to normal. Some learners incorrectly suggested recording the time for the fins to be fully extended, or the amount by which the fins were extended (which would have been very difficult to quantify).

Mark point 4 was for the idea of allowing the fish to rest after each trial. This could be written in several ways, eg

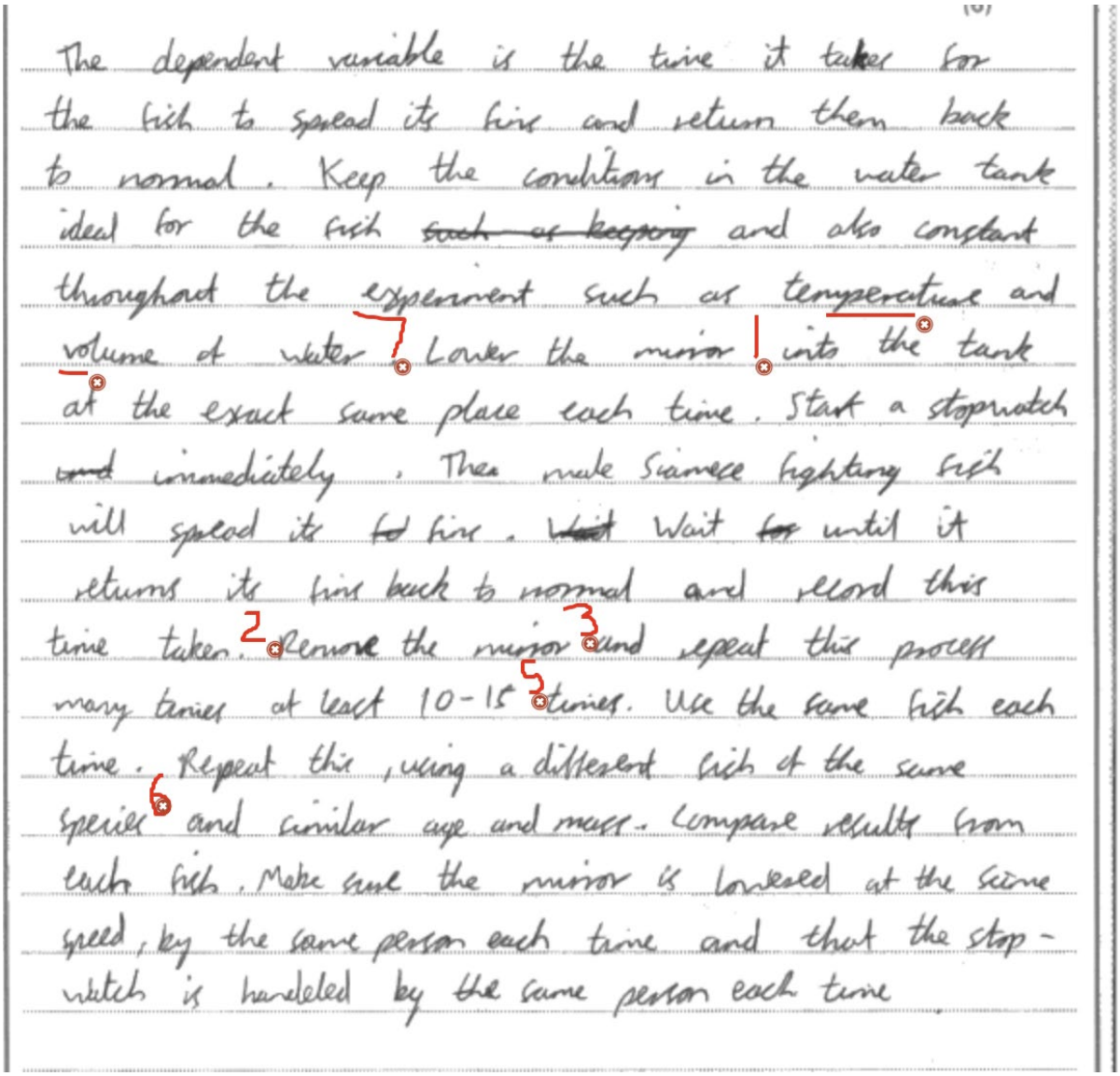
- leave the fish for 5 minutes before putting the mirror back in
- carry out the process four times an hour
- later, put the mirror back into the tank and record the time .....

Some learners correctly suggested repeating the process with the same fish (for mp6), but did not say how many times, or that it should be repeated until there was no response, which was needed for mp5. Note that mp5 could not be given if learners repeated for the same fish and then calculated a mean – the mean in this situation is not appropriate because we are looking for a reduction in duration of threat behaviour.

Mark point 6 was for repeating with other fish of the same species and mark point 7 was for controlling two relevant variables.

Many learners were able to achieve both of these marking points. Generally, the most commonly seen marking points were mp1, 6 and 7.

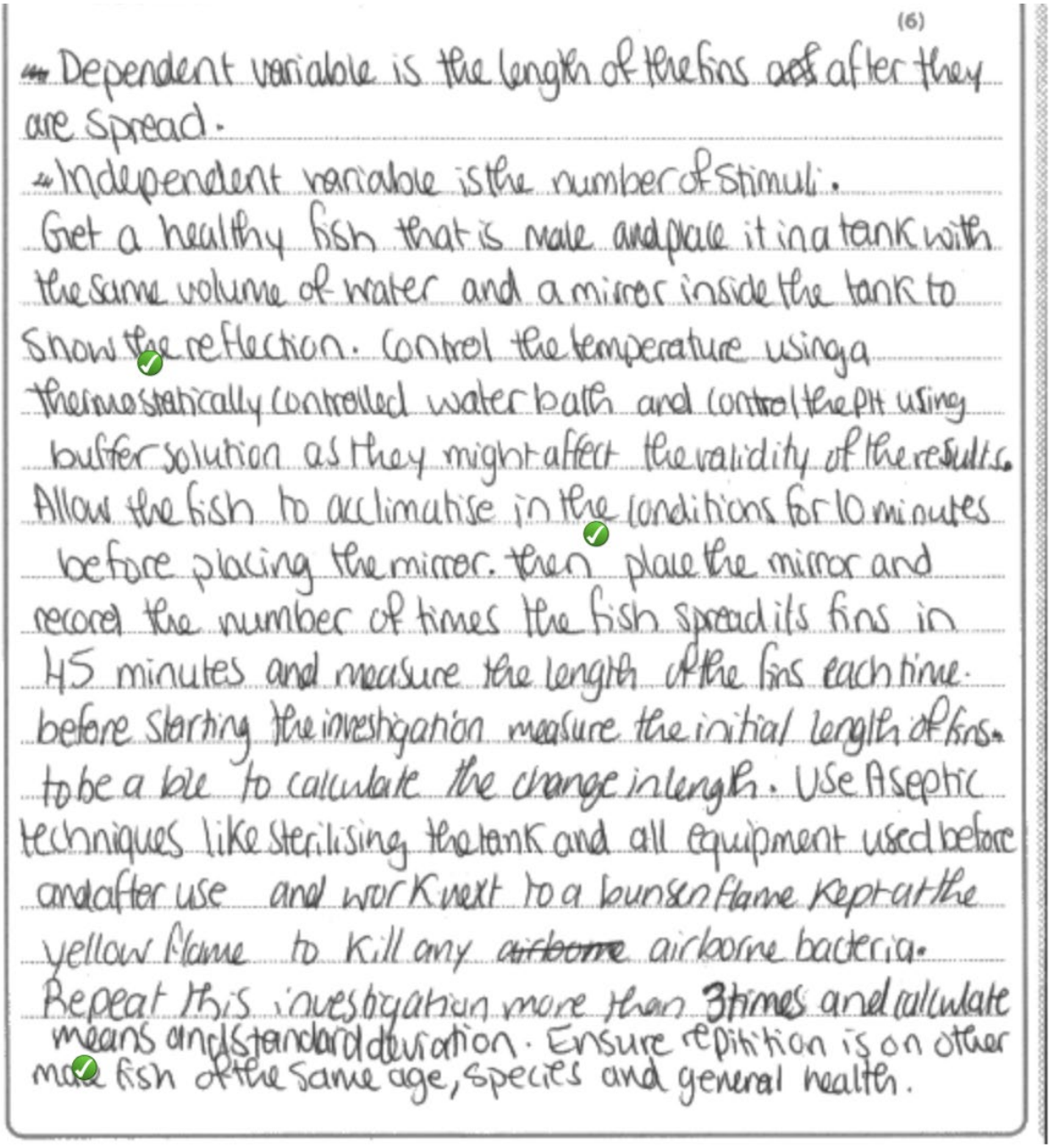
This very strong answer scored all except mark point 4.



The dependent variable is the time it takes for the fish to spread its fins and return them back to normal. Keep the conditions in the water tank ideal for the fish ~~such as keeping~~ and also constant throughout the experiment such as temperature and volume of water. Lower the mirror into the tank at the exact same place each time. Start a stopwatch ~~and~~ immediately. Then make Siamese fighting fish will spread its ~~to~~ fins. ~~Wait~~ Wait ~~for~~ until it returns its fins back to normal and record this time taken. Remove the mirror and repeat this process many times at least 10-15 times. Use the same fish each time. Repeat this, using a different fish of the same species and similar age and mass. Compare results from each fish. Make sure the mirror is lowered at the same speed, by the same person each time and that the stop-watch is handeled by the same person each time

This answer scored mp 7 (on lines 5-6), mp1 (on line 10) and mp6 at the end.

It did not score mp2 as the candidate recorded length of fins (rather than time fins were spread); or mp5 as they did not repeat with the same fish, simply leaving the mirror in the tank for 45 minutes.



(6)

1 Dependent variable is the length of the fins after they are spread.

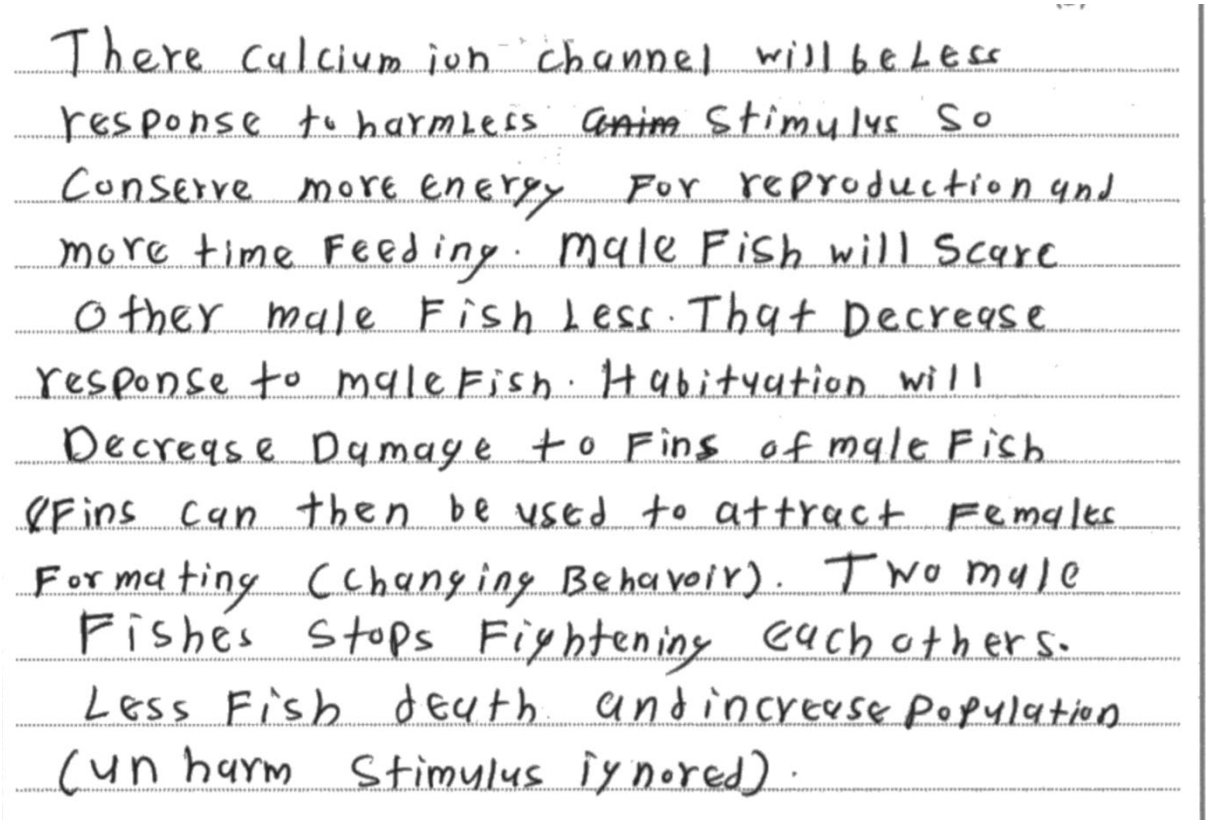
2 Independent variable is the number of stimuli.

Get a healthy fish that is male and place it in a tank with the same volume of water and a mirror inside the tank to show the reflection. Control the temperature using a thermostatically controlled water bath and control the pH using buffer solution as they might affect the validity of the results. Allow the fish to acclimatise in the conditions for 10 minutes before placing the mirror. Then place the mirror and record the number of times the fish spread its fins in 45 minutes and measure the length of the fins each time. before starting the investigation measure the initial length of fins. to be able to calculate the change in length. Use Aseptic techniques like sterilising the tank and all equipment used before and after use and work next to a bunsen flame kept at the yellow flame to kill any ~~airborne~~ airborne bacteria. Repeat this investigation more than 3 times and calculate means and standard deviation. Ensure repitition is on other male fish of the same age, species and general health.

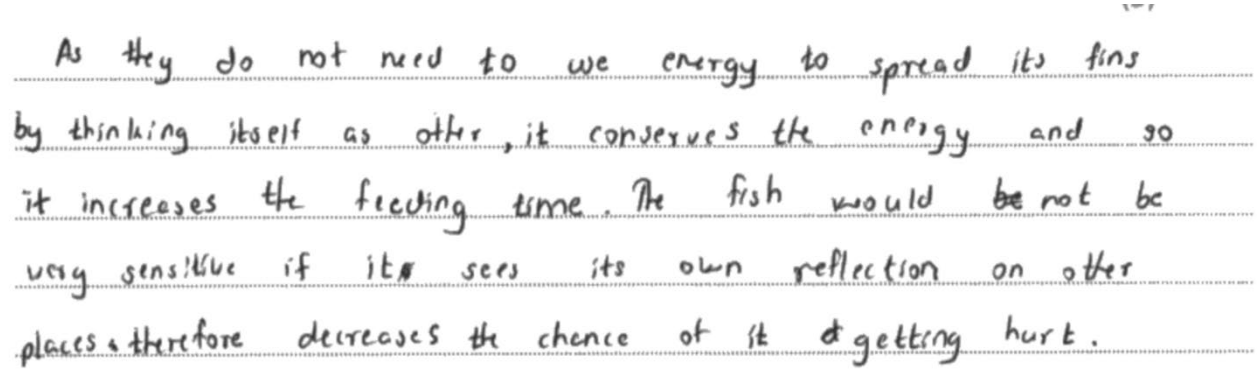
2c Learners were asked to explain the advantage of habituation of these male fish to their reflection. There were three marks available – some learners achieved the first mark for the fish using less energy. A few were able to describe a relevant use for the energy that was conserved eg used for feeding, or reproduction. The third mark was for stating that the fish were less likely to be injured or harmed.

Almost 50% of learners scored zero on this question. Some incorrect answers suggested that there were misconceptions about habituation in this context, for example that habituated fish would be **more** likely to defend their territory aggressively and would be more likely to attract a mate.

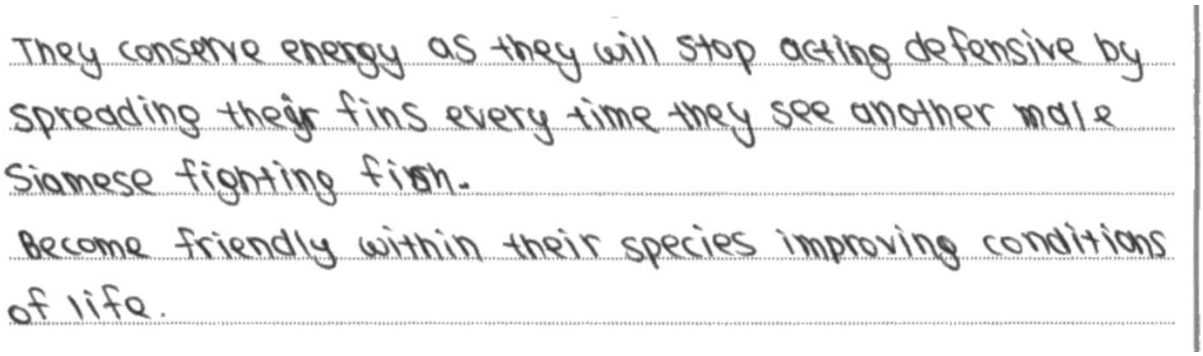
This is a rare example of an answer which scored full marks: mp1 on line 3, mp2 on line 3-4, and mp3 on line 6-7 and again at the end.


There calcium ion channel will be Less
response to harmLess ~~Anim~~ Stimulus So
Conserve more energy For reproduction and
more time Feeding. male Fish will Scare
other male Fish Less. That Decrease
response to maleFish. Habituation will
Decrease Damage to Fins of male Fish
(Fins can then be used to attract Females
For mating (changing Behavoir). Two male
Fishes stops Fiyhtening eachothers.
Less Fish death and increase Population
(un harm Stimulus iynored).

This also scored all three marks.


As they do not need to we energy to spread its fins
by thinking itself as other, it conserves the energy and so
it increases the feeding time. The fish would be not be
very sensitive if it sees its own reflection on other
places & therefore decreases the chance of it getting hurt.

This answer scored mp1 only.


They conserve energy as they will stop acting defensive by spreading their fins every time they see another male Siamese fighting fish.
Become friendly within their species improving conditions of life.

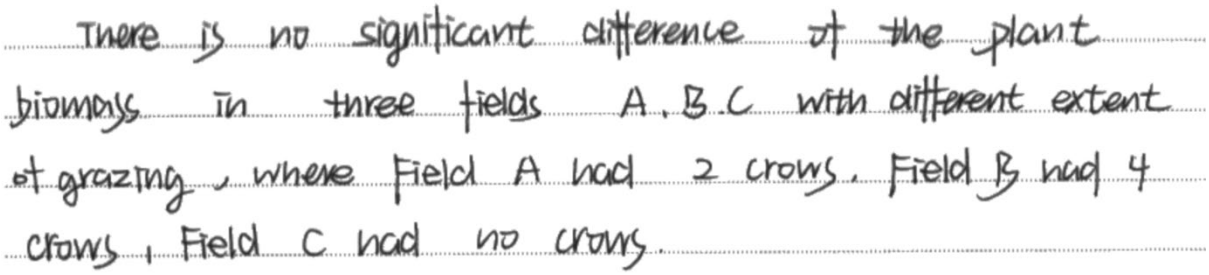
Question 3

This question asked learners to consider the effect of grazing on biomass of a grassland, to make a table and graph to display the data given and to carry out a statistical test.

3a Learners were asked to make a suitable null hypothesis for the investigation.
We were expecting that learners would make a hypothesis stating that there is no difference in the biomass in two named conditions eg,

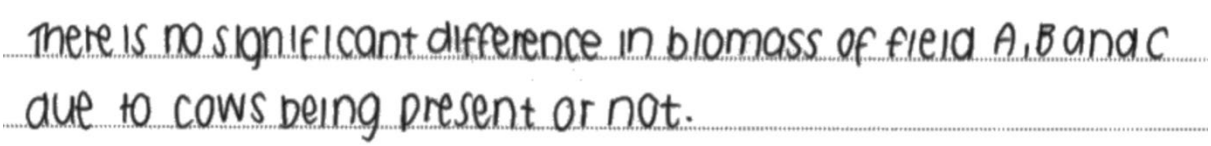
- there is no difference in the biomass in grazed and ungrazed fields
- there is no difference in the biomass with and without cows
- there is no difference in the biomass with different numbers of cows.

These are examples of creditworthy answers

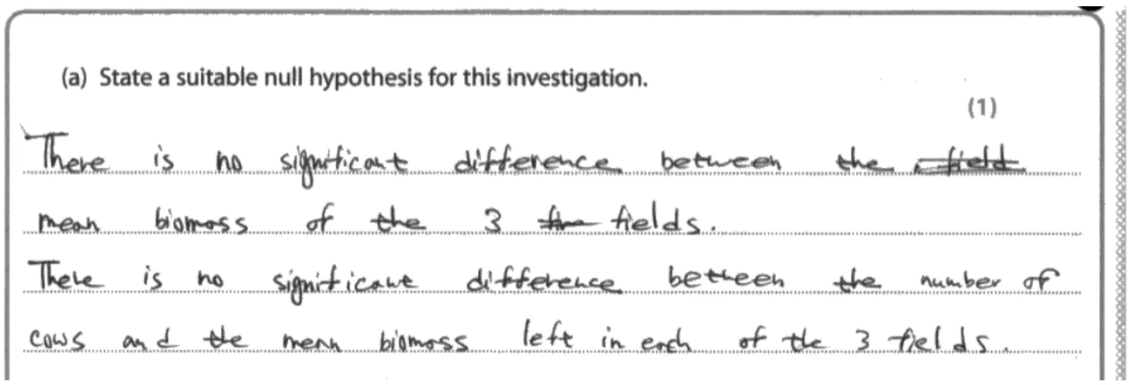

There is no significant difference of the plant biomass in three fields A, B C with different extent of grazing, where Field A had 2 crows. Field B had 4 crows, Field C had no crows.

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

(1)


there is no significant difference in biomass of field A, B and C due to cows being present or not.

This answer scored the mark for the second sentence; the first would not have been enough.

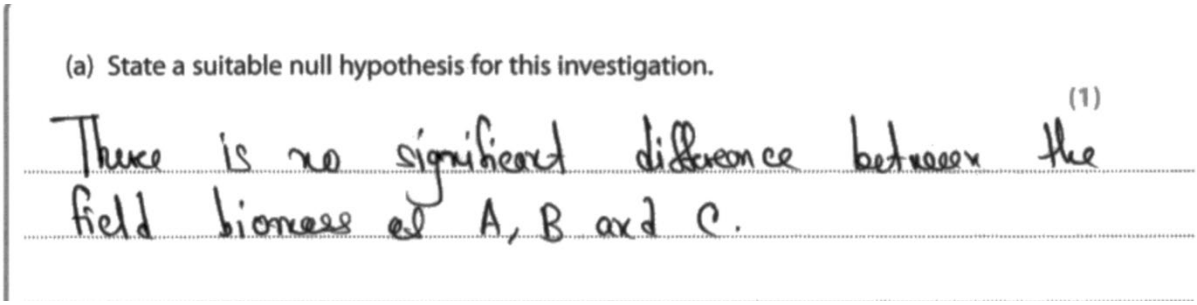


(a) State a suitable null hypothesis for this investigation.

(1)

There is no significant difference between the ~~field~~ mean biomass of the 3 ~~the~~ fields.
There is no significant difference between the number of cows and the mean biomass left in each of the 3 fields.

Some learners did **not** achieve this mark because they did not include the independent variable in their null hypothesis. The statement "there is no difference in the biomass in Fields A, B and C" was too vague to gain credit.



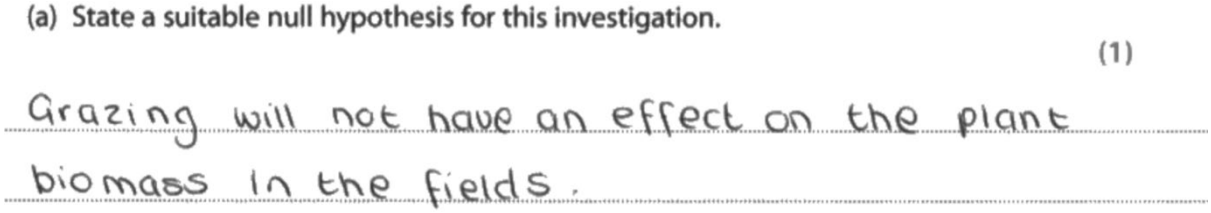
(a) State a suitable null hypothesis for this investigation.

(1)

There is no significant difference between the field biomass of A, B and C.

A number of learners chose a correlation hypothesis, eg there is no correlation between biomass and number of cows. We would normally expect at least five pairs of data to be available for a correlation test, but allowed it on this occasion.

A null hypothesis stating that there is no effect did **not** achieve the mark, as it does not link directly to a statistical test that could be used.



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

(1)

Grazing will not have an effect on the plant biomass in the fields.

3b Learners were provided with data and asked to draw a suitable table to display the data and the calculated means. Most were able to draw a suitable table to show the raw data, however full marks were rare, because many learners did not give the mean values to a consistent number of decimal places.

This answer was typical of those scoring two marks. It did not score mp3 as the number of decimal places was not consistent.

plant biomass (gm^{-2})		
Field A	Field B	Field C
212	151	145
198	158	211
160	125	200
153	118	192
148	128	203
Mean: 174.2	Mean: 136	Mean: 190.2

A small number of learners forgot to include units of mass in the header, or did not include raw data.

3c Learners were asked to draw a suitable graph to show the mean biomass and the number of cows, including an indication of variability of the data.
As we had accepted both difference and correlation hypotheses in part 3a, on this occasion we accepted both bar graphs and scatter graphs.

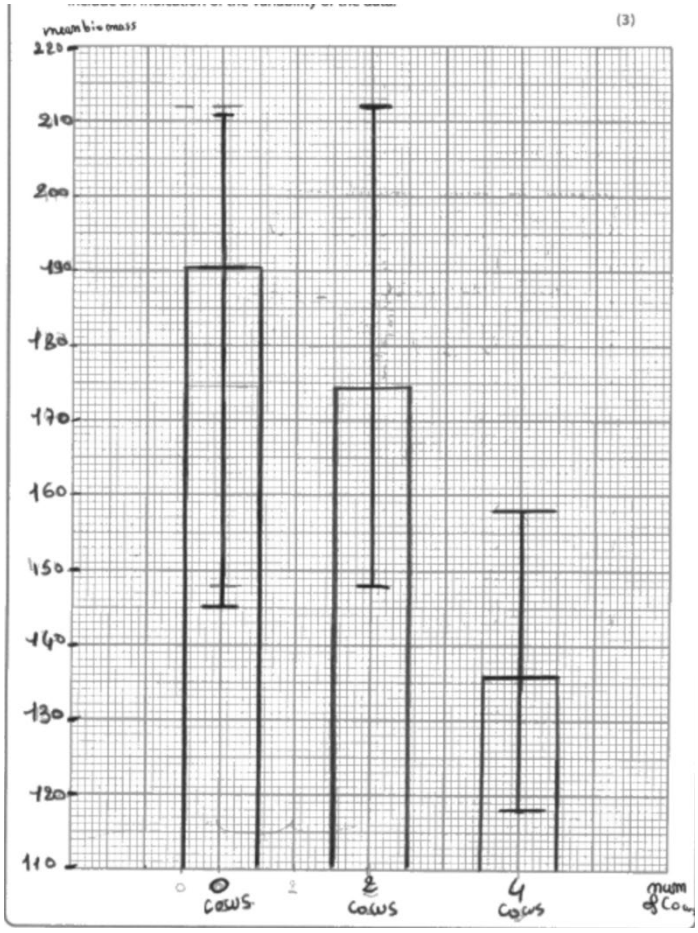
Bar graphs

- Full marks were rare, because many learners forgot to use the header **Mean** biomass gm^{-2}, or because they did not start the y-axis for a bar graph at zero, so did not score mp1.
- Most learners were able to plot the means and range bars accurately for mp2 and 3. A few used unsuitable scales which made accurate plotting very difficult.
- Some learners left out range bars altogether, or only plotted them for one bar. A few only plotted the upper/ lower value for the range bar; both are needed.

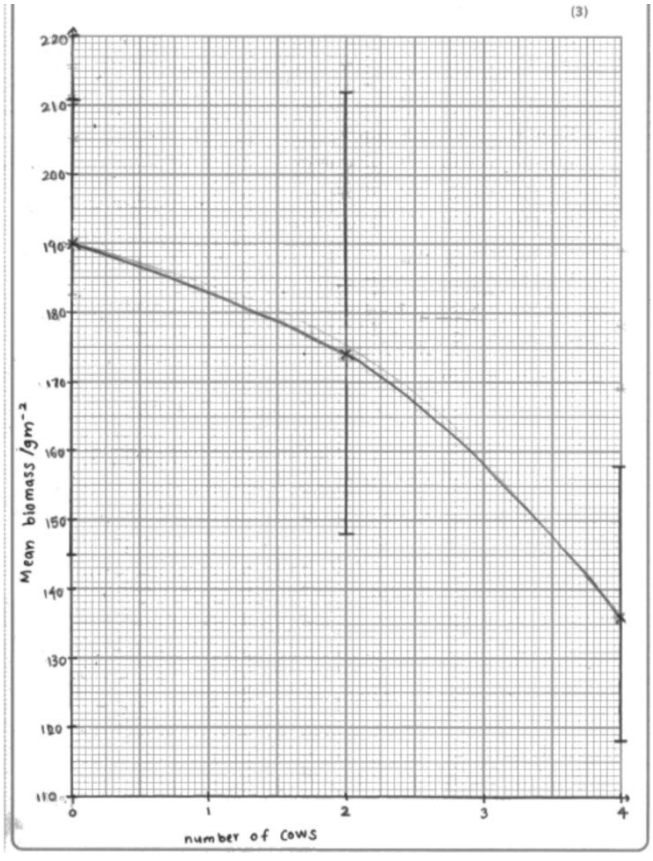
Scatter graphs

- The scale on both axes must be linear for a scatter graph, although there was no need for the y-axis to start at zero.
- Some learners forgot to use the header **Mean** biomass gm^{-2}.
- Plotting of mean values and range bars was generally accurate, lines of best fit were ignored.

This graph did not score mp1 as the y-axis did not start at zero.



This graph scored all three marks.



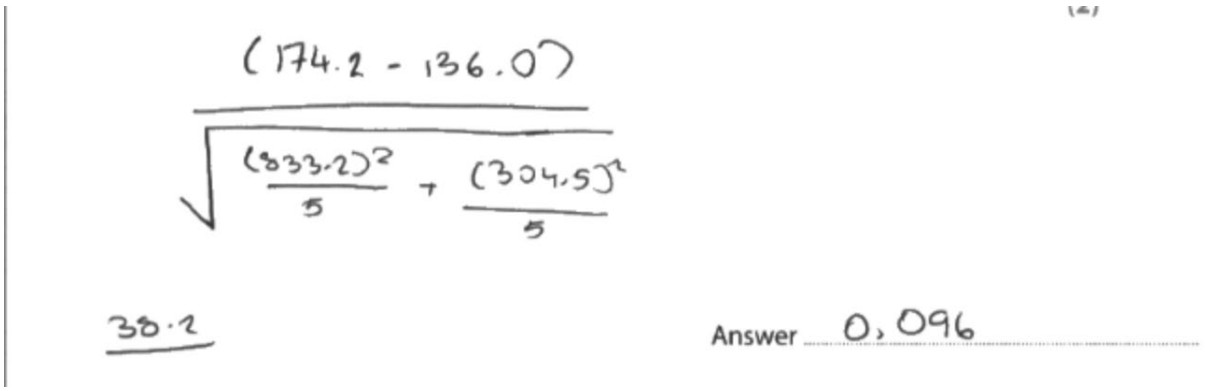
3di Learners were asked to analyse the data for fields A and B by calculating a *t*-value. Most were able to do this successfully for 2 marks.

$$t = \frac{(174.2 - 136)}{\sqrt{\frac{833.2}{5} + \frac{304.5}{5}}} = 2.53$$

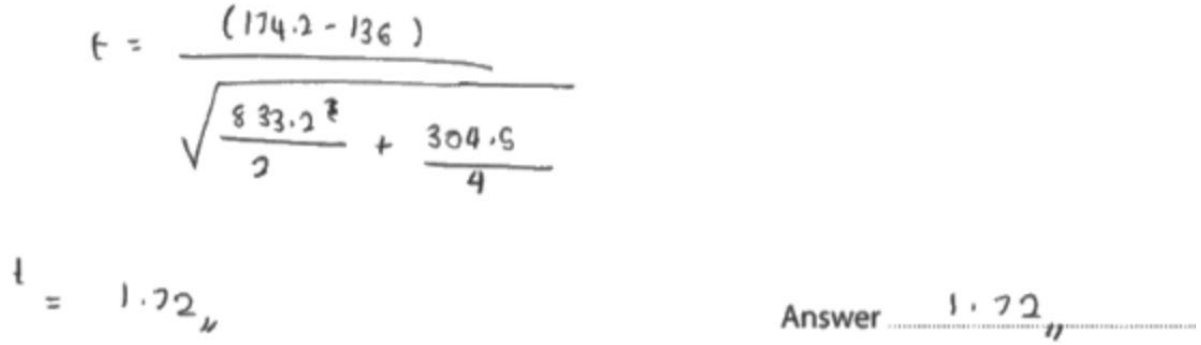
Answer 2.53

Where means had been calculated incorrectly, ecf was applied so both marks were available to learners.

The most common errors were to square the S_A and S_B values when these had already been squared.



A small number of learners wrongly used 2 and 4 as the n values, rather than the number of samples for each treatment (which was 5).

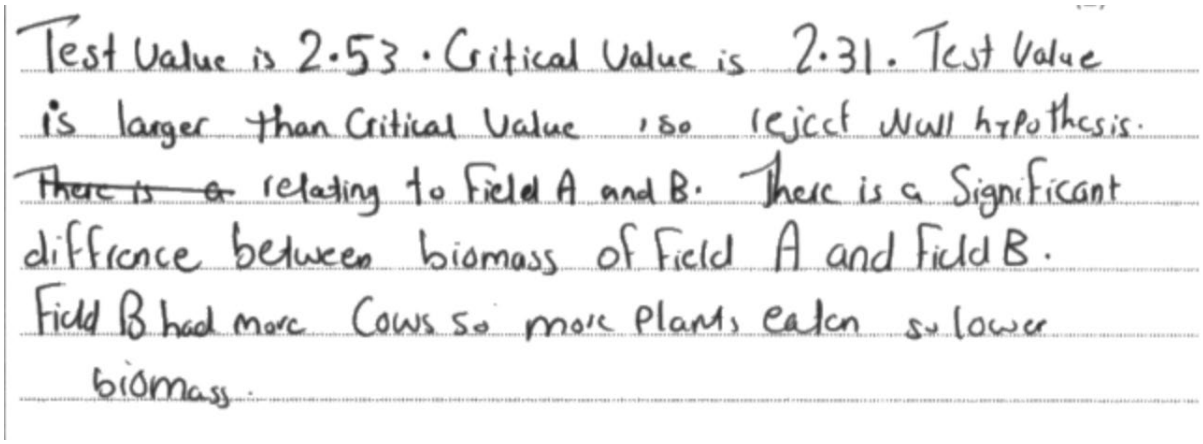


3dii Learners were asked to comment on the conclusion that could be drawn from this investigation, using the information from the graph and critical values table to support their answer.

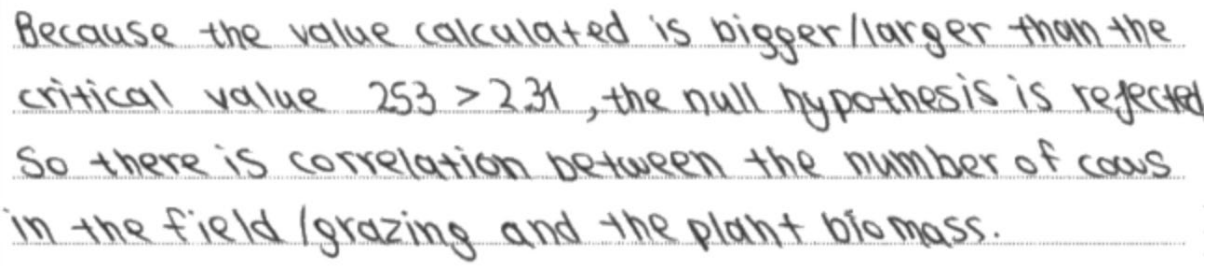
Many were able to gain mp2 for comparing their own *t*-value to the correct critical value from the table (2.31).

Some also gained mp3 for stating that the null hypothesis should be rejected, so the difference in biomass (between fields A and B) was **significant.**

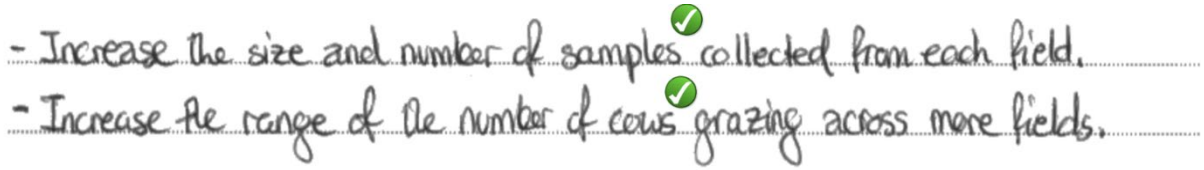
This answer gained all three marking points (mp1 on lines 5-6).


Test Value is 2·53 · Critical Value is 2·31. Test Value is larger than Critical Value, so reject Null hypothesis. ~~There is a~~ relating to Field A and B. There is a Significant difference between biomass of Field A and Field B. Field B had more Cows so more plants eaten so lower biomass.

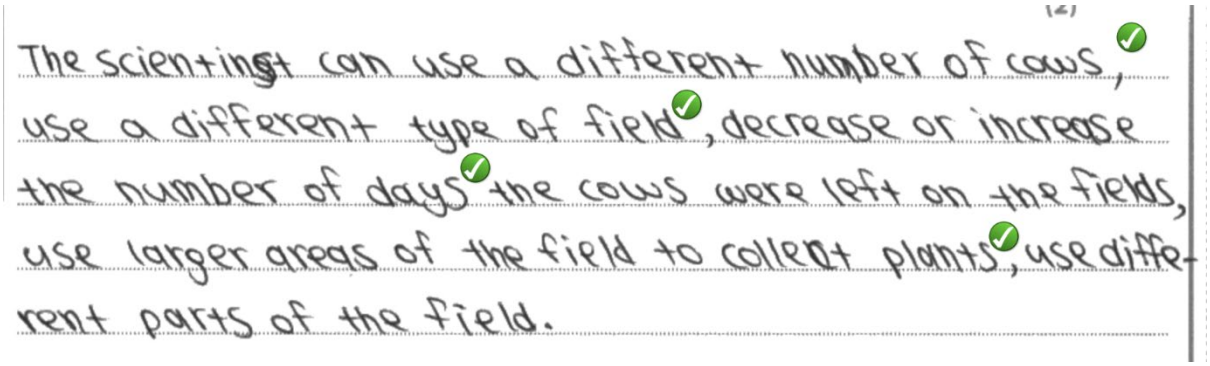
This answer scored mp2 but not mp3 as it refers to a correlation. The conclusion analysing the results of a *t*-test can never be a statement referring to a significant correlation.


Because the value calculated is bigger/larger than the critical value 2·53 > 2·31, the null hypothesis is rejected So there is correlation between the number of cows in the field/grazing and the plant biomass.

3e Learners were asked how they extend the investigation to collect more data to either support or reject the null hypothesis. Most were able to suggest two suitable amendments to the method.


- Increase the size and number of samples collected from each field.
- Increase the range of the number of cows grazing across more fields.

This answer achieved all four marking points.


The scientist can use a different number of cows, use a different type of field, decrease or increase the number of days the cows were left on the fields, use larger areas of the field to collect plants, use different parts of the field.

The most commonly seen answers which did **not** gain credit were

- Repeating the investigation - this would not extend the investigation at all.
- Carrying out the investigation again in larger fields (since there was no indication that the cows were short of food, so it would be unlikely to affect the biomass).

Question 4

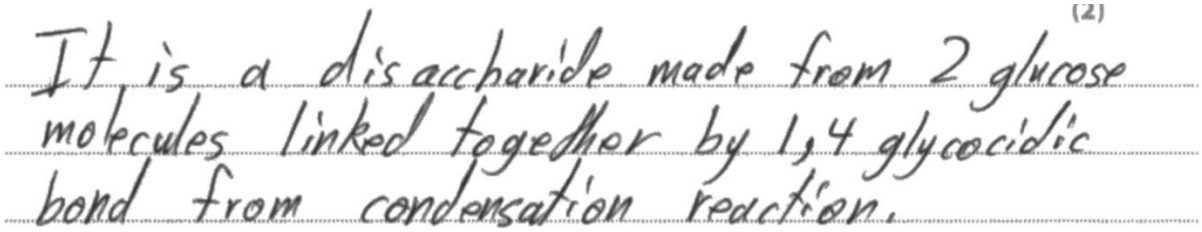
This question related to the digestion of starch in wheat grains and was linked to Core Practical 18.

4a Learners were asked to describe the structure of maltose. Although many had a good idea of the structure, full marks were rare because answers lacked detail.

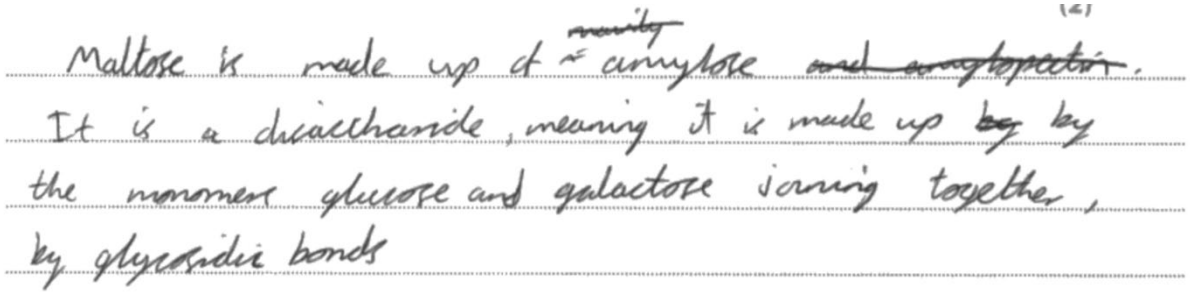
Mp1 needed the information that **two** molecules of glucose were joined or that it was a **disaccharide** made of glucose.

Mp2 needed the information that there was a **1-4** glycosidic bond.

This answer achieved both available marks.


It is a disaccharide made from 2 glucose molecules linked together by 1,4 glycocidic bond from condensation reaction.

This answer scored zero.


Maltose is made up of ~~mainly~~ amylose ~~and amylopectin~~. It is a disaccharide, meaning it is made up ~~by~~ by the monomers glucose and galactose joining together, by glycosidic bonds

Part 4b told learners that a student had formed a null hypothesis

"Two varieties of what digest starch at different rates"

Questions 4bi, 4bii, 4biii and 4bib all related this this.

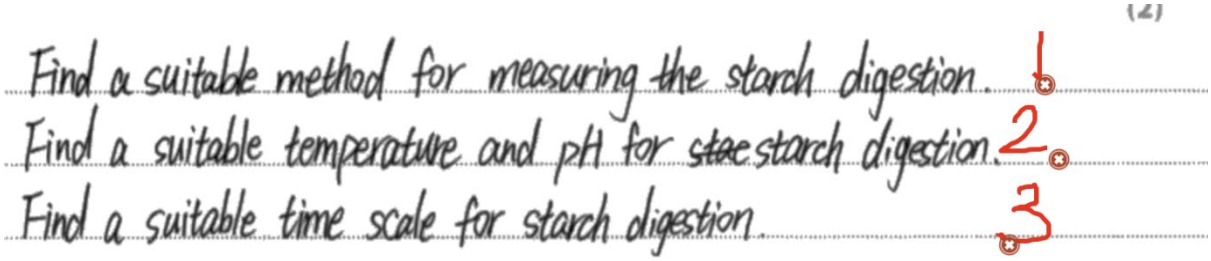
4bi Learners were asked to describe preliminary practical work that might be done to ensure the proposed method would provide quantitative results. In this situation, it would be important to **find out** key things eg

- How to measure the digestion of starch
- What conditions eg temperature or pH would be most suitable for the investigation
- What mass of wheat to use
- How long to leave the investigation before collecting results.

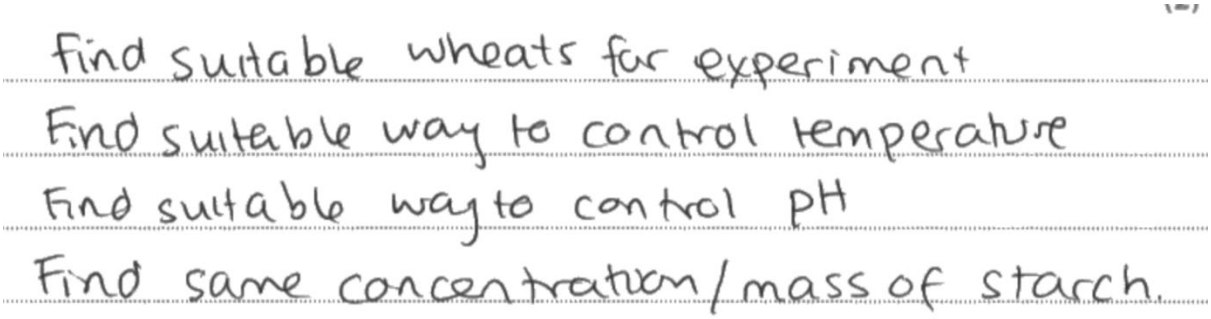
No credit was given for finding out relatively trivial things which the student might already be expected to know, eg. how to measure the diameter of the clear zone, or how to control incubation temperature.

Also centres should note that for preliminary work, no credit is given for sourcing biological materials, eg wheat grains of two varieties, or "housekeeping activities", eg making agar plates.

This answer included three credit-worthy points and scored both available marks.



Although this answer suggested four things, it did not score, as the first was sourcing biological materials; suggestions two and three were for were finding out how to **control** the variable, rather than finding a suitable temperature or pH; the fourth suggestion was to find the **same** concentration or mass a starch, rather than a **suitable** concentration or mass, which would have scored.



4bii Learners were asked to devise a detailed method to test the hypothesis, including how to control and monitor important variables, to provide quantitative results. Nine marks were available.

We expected learners to modify Core Practical 18, and most did this. A few learners chose to base their answer on Core Practical 1 (a semi-quantitative method using iodine solution to estimate the concentration of starch); this was not ideal as the question asked for a quantitative method.

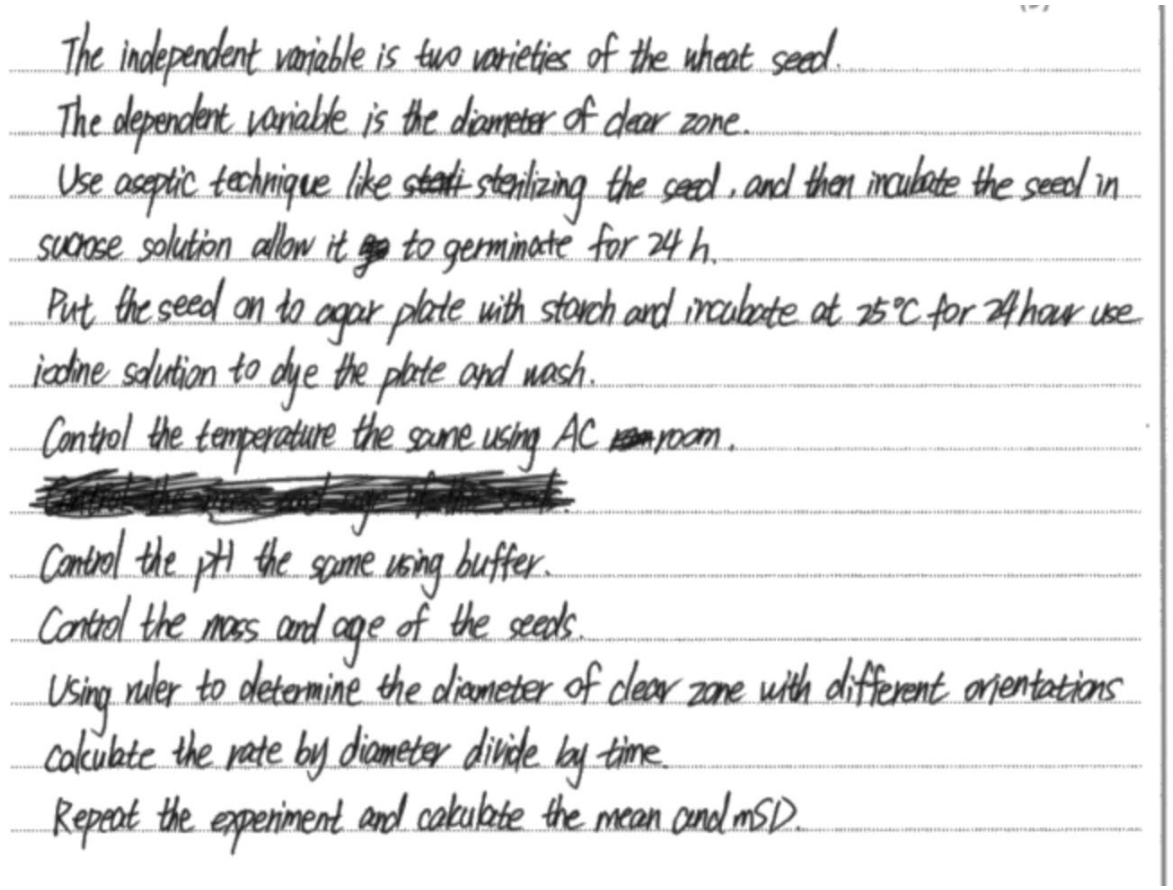
Some learners made no attempt to investigate the rate of digestion of starch and instead based their investigation on the growth of the embryo. They were unable to achieve some of the marking points, but could still score on mp3, 8, 9, 10 and 11.

Overall, this question was reasonably well done, and some learners scored full marks for logically written answers covering all of the main points.

The **most commonly seen errors** were as follows:

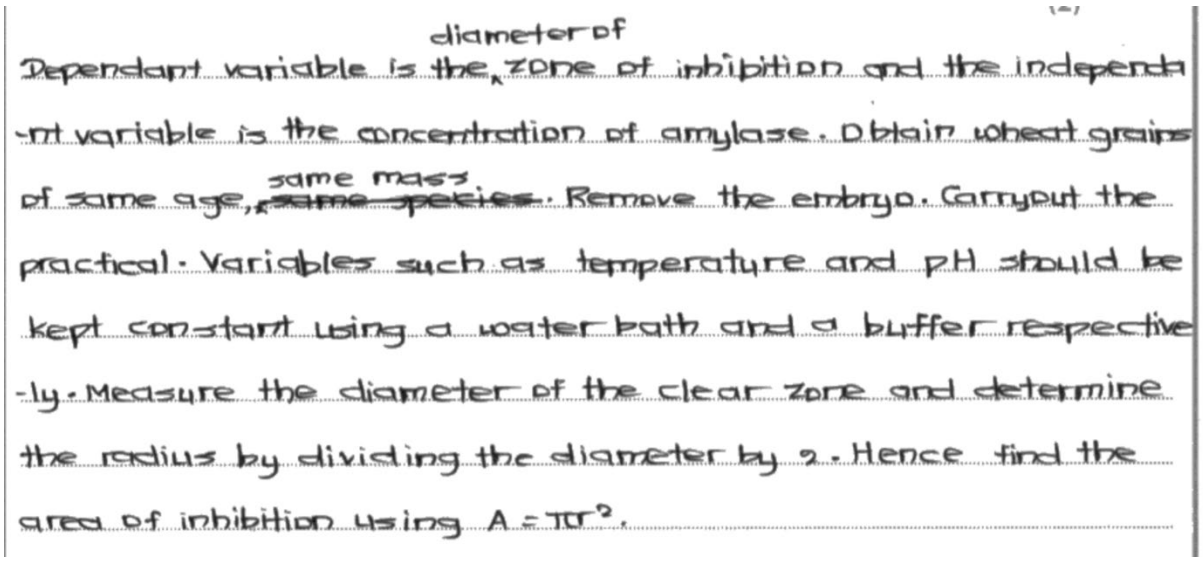
- Mp1: referring to the dependent variable as the diameter / area of the clear zone, without referring to time (this was needed because the hypothesis was about rate of digestion).
- Mp2: forgetting to include starch in the agar (this was needed because without it, the iodine solution would not produce a colour change).
- Mp3: forgetting this altogether, despite the introduction to Question 4 stating "*During germination, the embryo stimulates the release of amylase….*".
- Mp7: many learners forgot about calculating rate altogether.
- Mp8 and 9: some learners suggested a variable which should be controlled eg age or mass of grains but did not say how this could be done, eg by choosing grains from the same batch or by measuring the mass on a balance and choosing those with the same mass.
- Mp11: while almost all learners suggested repeating the investigation, some gave no reason for this, and some simply said it as to calculate the mean.

This strong answer gained mp10 (line 1), mp5 (line 3), mp3 (line 4), mp2 (line 5), mp6 (line 6), mp8 (line7), mp9 (line 9), mp7 (line 11-12), mp11 (line 13). It therefore scored full marks.



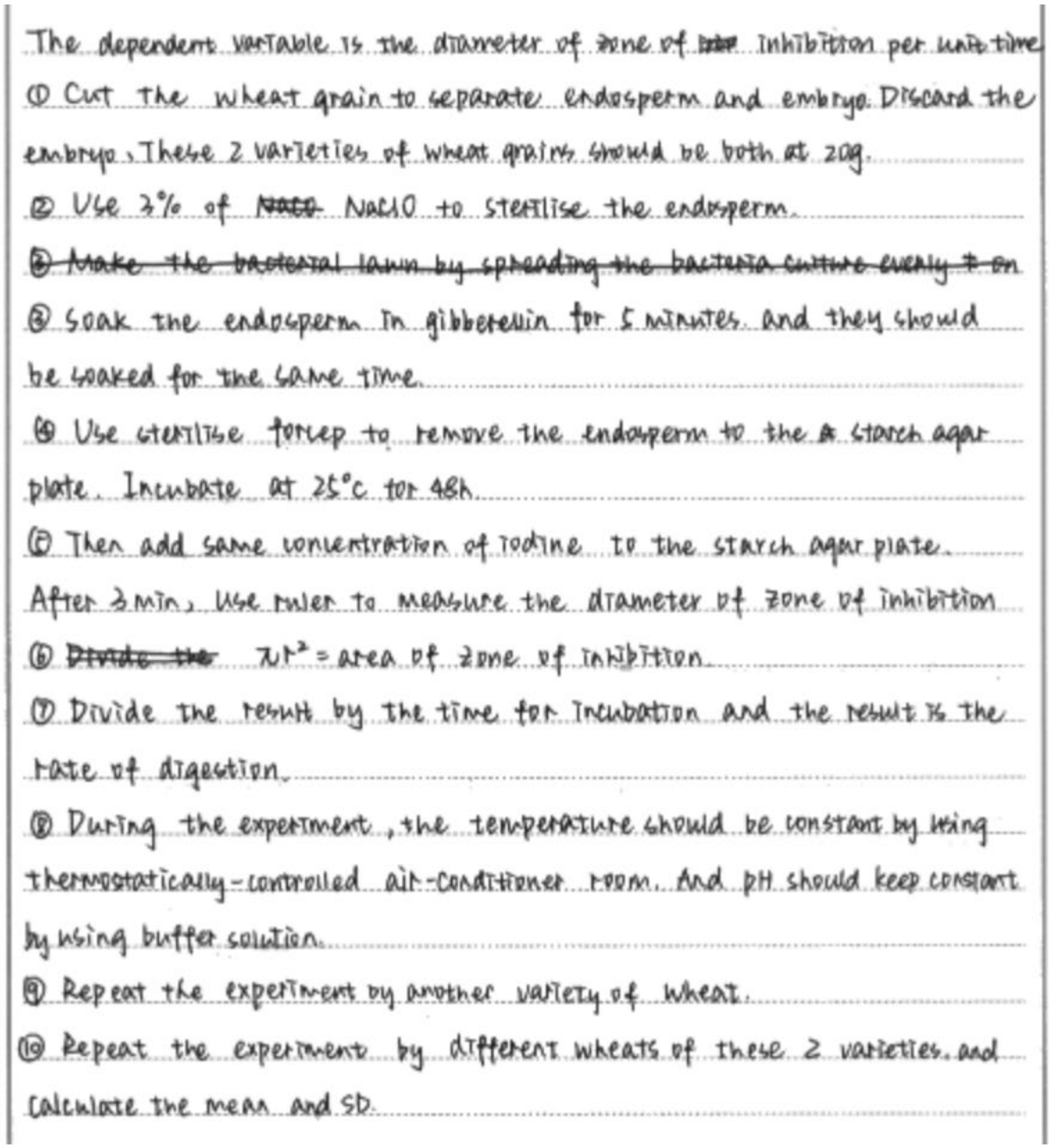
The independent variable is two varieties of the wheat seed.
The dependent variable is the diameter of clear zone.
Use aseptic technique like ~~steril~~ sterilizing the seed, and then incubate the seed in sucrose solution allow it ~~go~~ to germinate for 24 h.
Put the seed on to agar plate with starch and incubate at 25°C for 24 hour use iodine solution to dye the plate and wash.
Control the temperature the same using AC ~~room~~ room.
[redacted]
Control the pH the same using buffer.
Control the mass and age of the seeds.
Using ruler to determine the diameter of clear zone with different orientations
calculate the rate by diameter divide by time.
Repeat the experiment and calculate the mean and mSD.

This short answer scored mp8 only (for controlling pH with a buffer). It came close to scoring mp9 but the water bath should have been thermostatically controlled. The rest of the answer lacked the necessary detail.



Dependant variable is the diameter of zone of inhibition and the independent variable is the concentration of amylase. Obtain wheat grains of same age, same mass ~~same species~~. Remove the embryo. Carryout the practical. Variables such as temperature and pH should be kept constant using a water bath and a buffer respectively. Measure the diameter of the clear zone and determine the radius by dividing the diameter by 2. Hence find the area of inhibition using $A = \pi r^2$.

Another strong answer achieving all 11 marking points: mp1 (on line 1), mp4 (on lines 2-3), mp10 (on line 3), mp4 again (on line 4), mp3 (on line 6), mp5 (on line 8 for sterilised forceps), mp2 and 6 (on line 10), mp7 (on lines 11-14), mp8 and 9 (on lines 15-17), mp11 (on lines 19-20).



The dependent variable is the diameter of zone of ~~the~~ inhibition per unit time

① Cut the wheat grain to separate endosperm and embryo. Discard the embryo. These 2 varieties of wheat grains should be both at 20g.

② Use 3% of ~~water~~ NaClO to sterilise the endosperm.

~~③ Make the bacterial lawn by spreading the bacteria culture evenly on~~

③ Soak the endosperm in gibberellin for 5 minutes and they should be soaked for the same time.

④ Use sterilise forcep to remove the endosperm to the ~~a~~ starch agar plate. Incubate at 25°C for 48h.

⑤ Then add same concentration of iodine to the starch agar plate. After 3 min, use ruler to measure the diameter of zone of inhibition

⑥ ~~Divide the~~ πr^2 = area of zone of inhibition

⑦ Divide the result by the time for incubation and the result is the rate of digestion.

⑧ During the experiment, the temperature should be constant by using thermostatically-controlled air-conditioner room. And pH should keep constant by using buffer solution.

⑨ Repeat the experiment by another variety of wheat.

⑩ Repeat the experiment by different wheats of these 2 varieties. and calculate the mean and SD.

4biii Learners were asked to describe how their results should be recorded, presented and analysed in order to draw conclusions from the investigation.

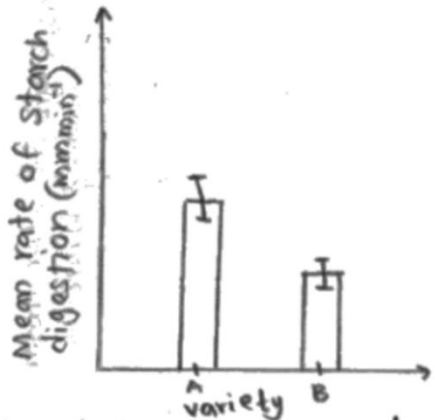
Many were able to draw a suitable table, suggest an appopriate graph with labelled axes and a suitable stats test to analyse the data.

For mp1, the most common error was to have a heading of "Rate of digestion" – this was not appropriate because rate is not **raw data**. Some learners including incomplete headers, eg "diameter / mm" or "Time / s". A few learners chose inappropriate units or forgot to include them altogether.

For mp2 the most common error was to sketch axes and label them, but without writing or drawing what type of graph should be drawn (line graph or bar graph).

This candidate scored all three marks.

variety	Diameter of clear zone (mm)					
	1	2	3	4	5	mean
A						
B						

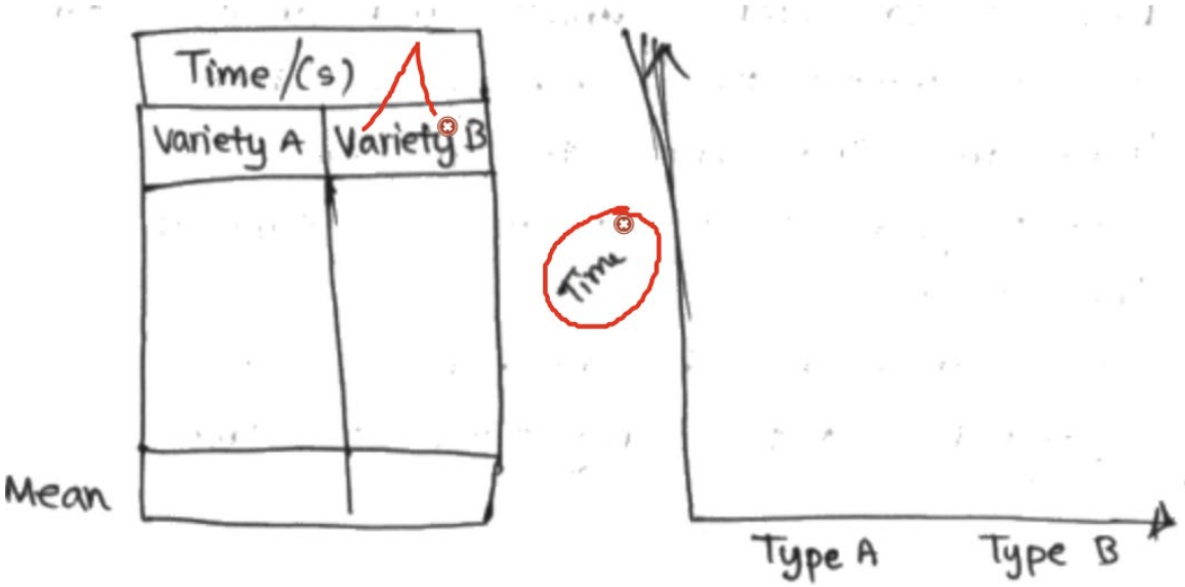


Raw data table with headings, units & means calculated from repeats

Plot a bar graph with labelled axes

Use student t-test

This candidate did not achieve mp1 or 2 because the header and axis labels were incomplete ("Time" is not enough – time for what?). However they achieved mp3.

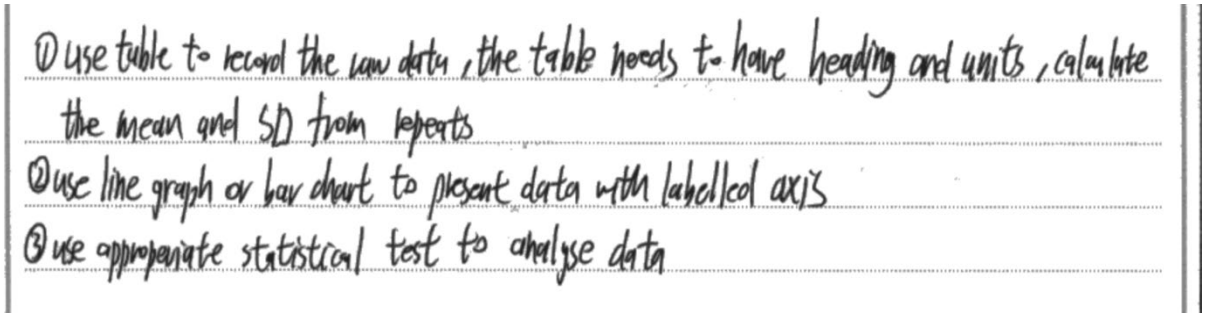


Draw tables with suitable heading with units of time, raw data and means calculated from repeats.
Use a bar graph format with labelled axes.
Suitable statistical test to check for any significant difference between results such as t-test.

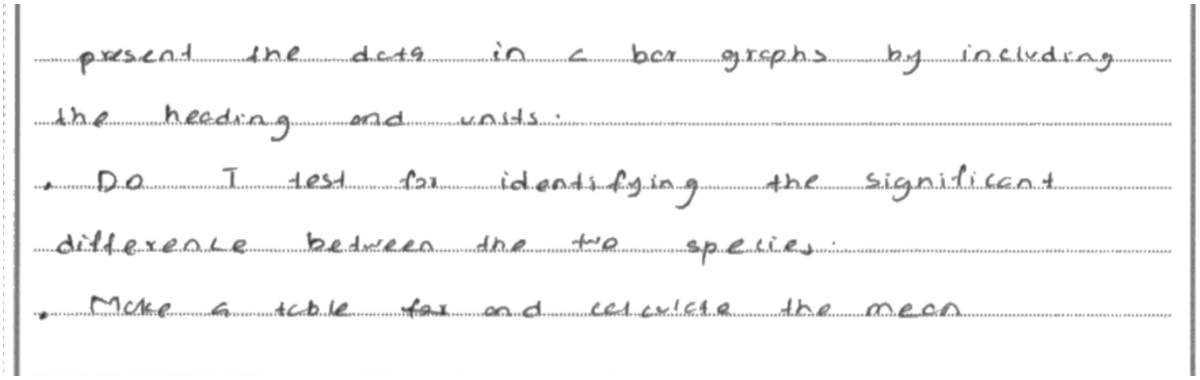
A significant number of learners simply gave a generic answer which echoed the mark scheme and gained no credit. The table, graph and stats test must be specific to the investigation they carried out to achieve marks.

These are two examples of answers which did not score for this reason.

The phrase "the table needs to have heading and units" is not enough – we need to know what they are. Also "use line graph or bar chart with labelled axis" does not include the detail needed to score. "Use appropriate statistical test to analyse data" is not precise enough.

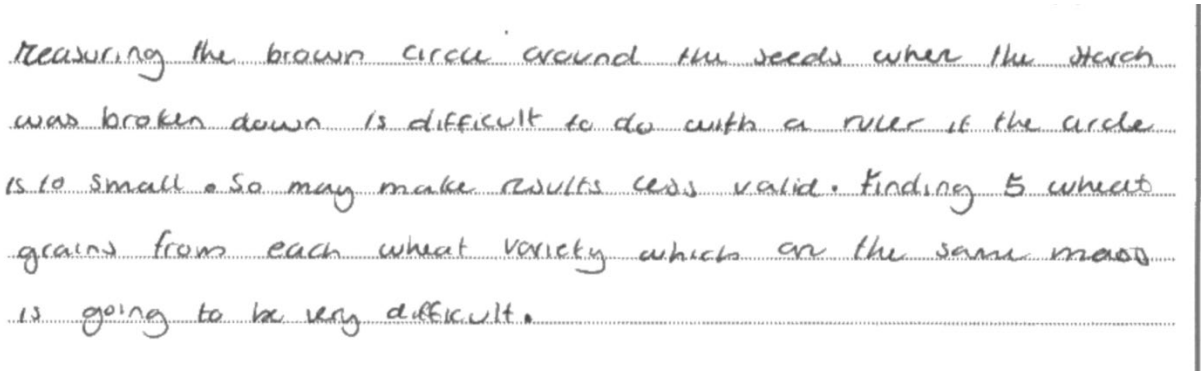


This candidate scored mp3 for the t-test, but the rest of the answer lacked the detail needed.

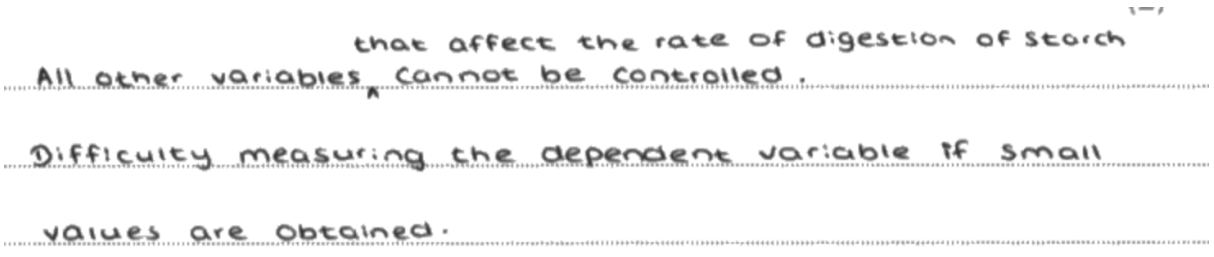

present the data in a bar graphs by including the heading and units.
. Do I test for identifying the significant difference between the two species.
. Make a table for and calculate the mean

4biv Learners were asked to suggest two limitations of their proposed method. Many were able to suggest at least one which was appropriate to this investigation.

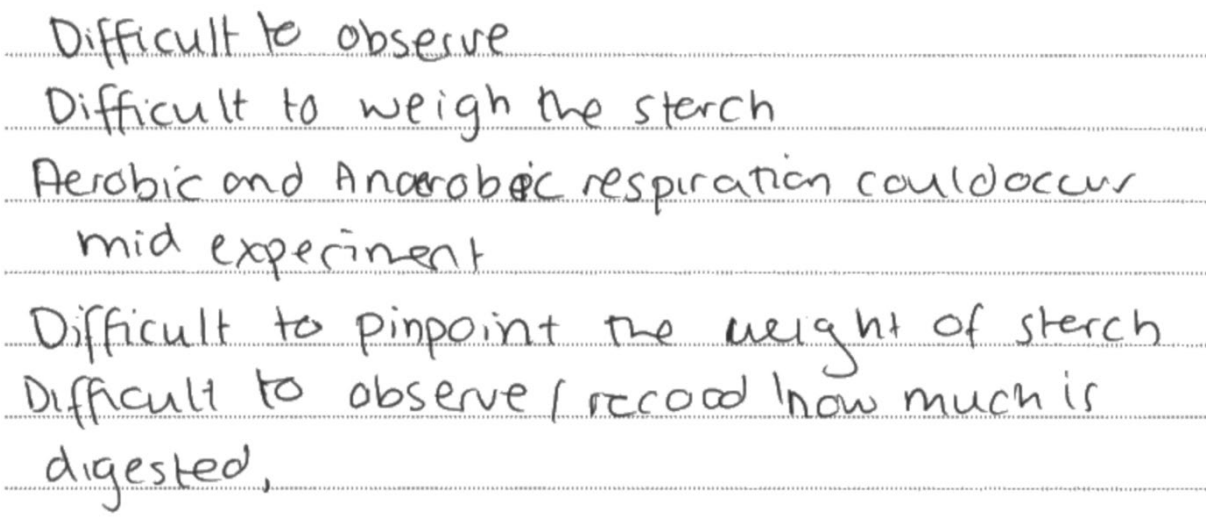
This candidate scored mp3 and 1, as their limitations related directly to this investigation.


Measuring the brown circle around the seeds when the starch was broken down is difficult to do with a ruler if the circle is to small . So may make results less valid. Finding 5 wheat grains from each wheat variety which are the same mass is going to be very difficult.

This answer was very vague and did not relate directly to the investigation, so did not score.


that affect the rate of digestion of starch
All other variables cannot be controlled.
Difficulty measuring the dependent variable if small values are obtained.

The most common error was to suggest limitations which were not in the right context, ie had been seen on mark schemes for other investigations.



Advice for learners

- Make sure that you are familiar with all of the core and recommended practicals, as you know you will be asked about them on this exam paper.
- Think about why you are carrying out the different steps and where errors could occur in practicals.
- Consider when a bar graph or line graph is more suitable. If it is a bar graph, always start the scale on the y axis at zero. Choose a sensible scale which makes plotting easy.
- Make sure you can write a null hypothesis, and that you know how to complete and analyse the required stats tests.
- Remember that every answer must be in the context of the question that has been set. It is not enough to learn the points from previous mark schemes.