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Examiners' Report
June 2018

IAL Biology 6 WBI06 01

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Introduction

The paper provided a good spread of marks, but all question parts seemed to be accessible to students and many scripts were awarded high marks.

Many students appeared to have some difficulty with the context of question 1. There were many accounts that described a practical investigation that was more complicated than the one expected.

Most students had little difficulty in interpreting the data presented in question 2, and therefore the construction of an appropriate table and graph.

The context of question 3 was familiar to most candidates.

While some students continue to produce rather generic answers, the examiners felt that most students did better in attempting to answer the questions set and giving responses that were specific to the relevant experimental contexts.

It is very encouraging to see progress in this direction, and the examiners hope that future students will continue this trend in demonstrating their understanding of the principles of experimental design.

Question 1 (a)

This question required candidates to describe an investigation to determine the rate of ventilation of a locust at two different temperatures.

1 The photograph below shows a locust, *Locusta migratoria*.

Magnification ×1.0

Locusts are found in many countries. They are active insects in warm conditions.

The locust obtains oxygen from the air by contracting and relaxing its abdomen.

This action moves air into and out of the body to ventilate it.

(a) Describe an experiment to compare the rate of ventilation of locusts at two different temperatures.

(5)

Take Eight locusts of same age, same gender and ~~same~~ same mass. Keep one of the locust in a gauze and set up the respirometer. The respirometer should contain Sodalime of known volume measured using measuring cylinder. Control the temperature of the respirometer at 25°C by using a thermostatically controlled water bath. Open the syringe of the respirometer for 5 minutes for the locust to acclimatise and reach the rate of respiration at that temperature. This will also allow pressure change in air of apparatus. Close the apparatus by replacing the syringe so that apparatus is air tight. Immediatly start a stop watch and measure the distance moved by the coloured oil drop for ~~a~~ five minutes. Then find the rate of Oxygen uptake by distance moved by coloured oil drop multiplied by (measure the diameter with micrometer screw gauge) cross sectional area of capillary tube, and divide that answer by the time taken. Repeat the whole experiment by using a locust of same age and gender and mass. Controlling the temperature at 35°C. Measure the distance moves by oil drop for same time. Repet the experiment 3 more times at each temperature with same mass, age & gender of locust to get a mean rate of Oxygen uptake.

ResultsPlus
Examiner Comments

This answer gained 5 marks by describing a practical method carefully, even though the method was not quite appropriate to the context given in the question.

ResultsPlus
Examiner Tip

This question requires the candidate to think about the context given and then describe and appropriate method.

(a) Describe an experiment to compare the rate of ventilation of locusts at two different temperatures.

(5)

By using a respirometer the rate of ventilation can be found. First put soda lime on the ~~bottom~~ of the test tube to absorb CO_2 and put a gauze and put these locusts on top of it and fixed one tube and close the test tube. ~~Then~~ connect this tube to the u-tube containing a colour liquid and being placed on a water bath to control the temperature and fixed to a 3-way tap and make the colour liquid in a equilibrium position and do the ~~test~~ practical and at last measure the distance of movement of the colour liquid and can measure how the concentration of O_2 uptake.

ResultsPlus
Examiner Comments

This is an example of a candidate descibing a method from a practical investigation that does not suit the context given in this question.

ResultsPlus
Examiner Tip

Candidates that spend a little time planning answers usually produce answers that answer the questions asked.

Question 1 (b) (i) - (ii)

(i) At least one of the variables identified on the mark scheme was given by most candidates. (ii) Most candidates attempted to describe a control method for one of the variables stated in part (i), usually the description was sufficient to be awarded a mark. Very few candidates commented on the need for validity in experimental design, most made a sensible comment on the effect of the variable if not controlled.

(b) (i) State **two** abiotic variables, other than the independent variable, that could affect this experiment.

(2)

Mass of soda lime, Humidity, oxygen percentage in air.

(ii) Choose **one** of the abiotic variables you have identified in (i). Explain how this variable could be controlled. Describe what effect it could have on the results if it is not controlled.

(2)

Variable mass of soda lime

How this variable is controlled measure mass of soda lime using an electric balance.

Effect it could have on the results if it is not controlled.

less soda lime absorbs less CO_2, so the pressure inside the test-tubes increases

ResultsPlus
Examiner Comments

The two abiotic variables gained marks but part ii gained no marks.

ResultsPlus
Examiner Tip

Only give two answers if two were asked for.

(b) (i) State **two** abiotic variables, other than the independent variable, that could affect this experiment.

(2)

~~Species, Age of locusts and~~ light intensity and humidity

(ii) Choose **one** of the abiotic variables you have identified in (i). Explain how this variable could be controlled. Describe what effect it could have on the results if it is not controlled.

(2)

Variable Light intensity

How this variable is controlled using the same light bulb of the same wavelength and intensity placed at the same distance

Effect it could have on the results if it is not controlled.

Change in light intensity would affect the rate of ventilation of the Locusts

ResultsPlus
Examiner Comments

This candidate selected two appropriate abiotic factors and described a control and effect to gain four marks.

ResultsPlus
Examiner Tip

All candidates should have a clear understanding of the terms abiotic and biotic.

Question 1 (c)

Candidates often gave answers that could only be awarded the marks for comments about enzymes. Some candidates hinted at increased oxygen demand, respiration and ATP production but failed to make it clear that these would increase.

(c) Suggest why temperature has an effect on the rate of ventilation in locusts.

(3)

- As temperature increases, the activity of enzymes increases.
- The kinetic - energy of the enzyme and substrate molecules increases
- therefore more collisions take place and more enzyme - substrate complexes are formed.
- As the metabolic reactions in the body are increased & more carbon dioxide is formed.
- Therefore ventilation rate increases to ~~[illegible]~~ take in more oxygen and for the produced carbon dioxide to more out.

ResultsPlus
Examiner Comments

This example gained three marks.

(c) Suggest why temperature has an effect on the rate of ventilation in locusts.

(3)

Rate of ventilation is an enzyme controlled reaction so as temperature increases, molecules have more kinetic energy so they move more with more frequent collisions. Therefore enzyme and substrate molecules collide more and thus increasing the volume of air used which in turn increases the rate of ventilation.

ResultsPlus
Examiner Comments

This style of answer was frequently given to gain the mark relating to enzyme activity. Increasing the volume of air is an example of a comment that is not enough for marking point 1.

Question 2 (a)

The context of this question was the different responses of the curaua plant to complete fertilizer and fertilizer without potassium ions.

Nearly all candidates gave clear statements that gained both marks.

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

(2)

There is no significant difference between the type of fertiliser used and the plants growth.

ResultsPlus
Examiner Comments

This response gained the first mark but the remainer of the statement is not clear enough for marking point 2.

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

(2)

There is no significant difference between the mineral content in dry leaves (and therefore the growth) of plants in complete fertiliser and those in fertiliser without potassium ions.

ResultsPlus
Examiner Comments

Two marks awarded.

Question 2 (b) (c)

Most candidates provided a suitable table format with complete headings, raw data and means entered correctly.

Most graphs were awarded all three marks. Only a small number of candidates provided an incomplete label for the y axis or made an error in potting the range bars.

(b) Calculate the mean mineral content for each set of results.

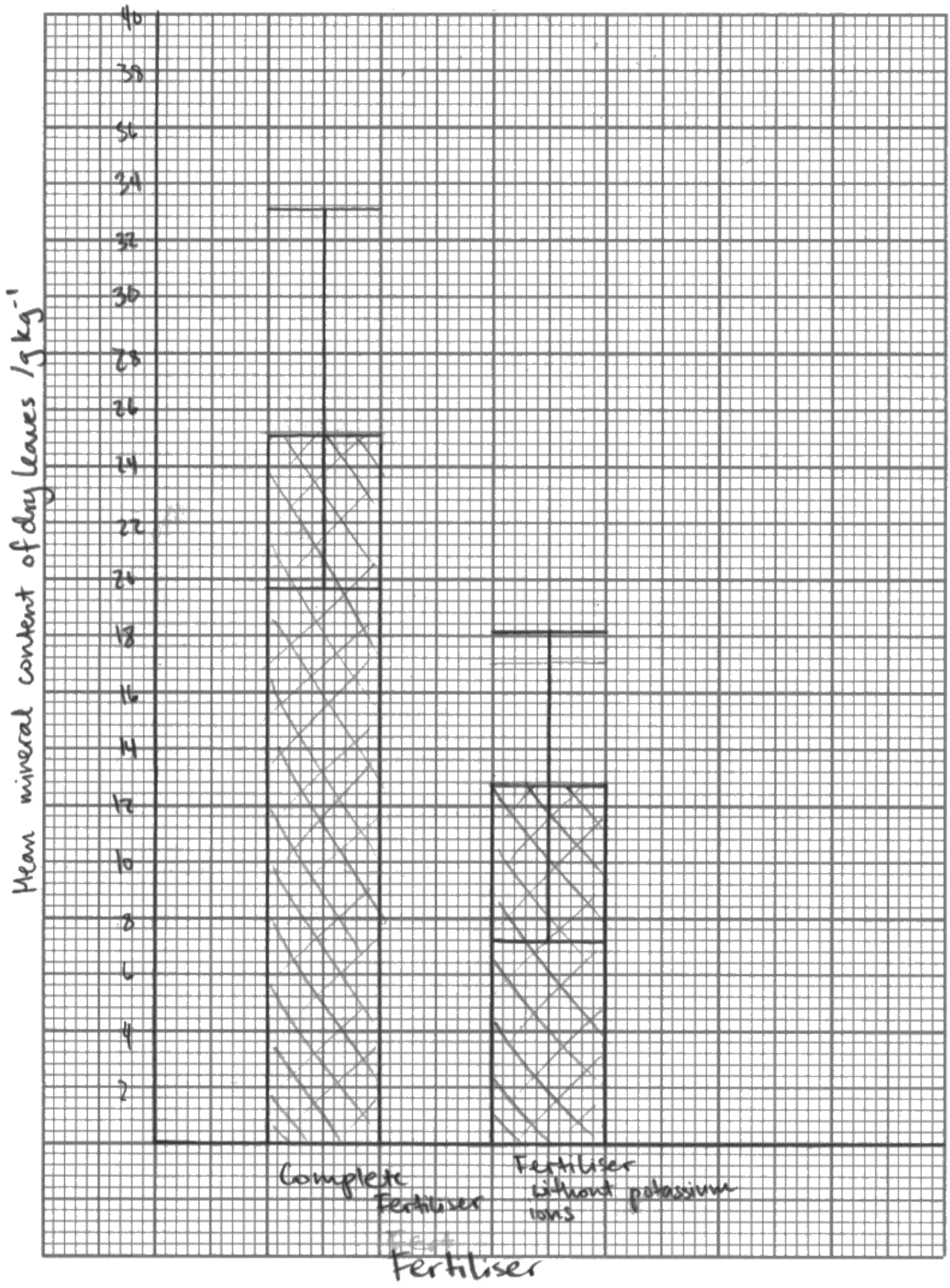
Prepare a table to display the **raw data** and your calculated **means**. **(3)**

Fertiliser	Mineral content of dry leaves / g kg^{-1}	Mean
Complete Fertiliser	24.3, 33.1, 26.7, 30.6, 32.0, 28.4, 20.5, 24.8, 19.9, 29.9, 23.5, 28.3, 19.6, 19.8, 24.6	25.2
Fertiliser without potassium ions	8.9, 9.6, 10.3, 10.5, 7.4, 18.2, 13.9, 14.2, 15.2, 7.4, 17.2, 13.8, 16.7, 15.8, 9.9	12.6

(c) On the graph paper below, draw a graph to show the mean mineral content for each set of results.

Include an indication of the variability of the data.

(3)



ResultsPlus
Examiner Comments

This example of neat work gained three marks for the table and three marks for the graph.

(b) Calculate the mean mineral content for each set of results.

Prepare a table to display the **raw data** and your calculated **means**.

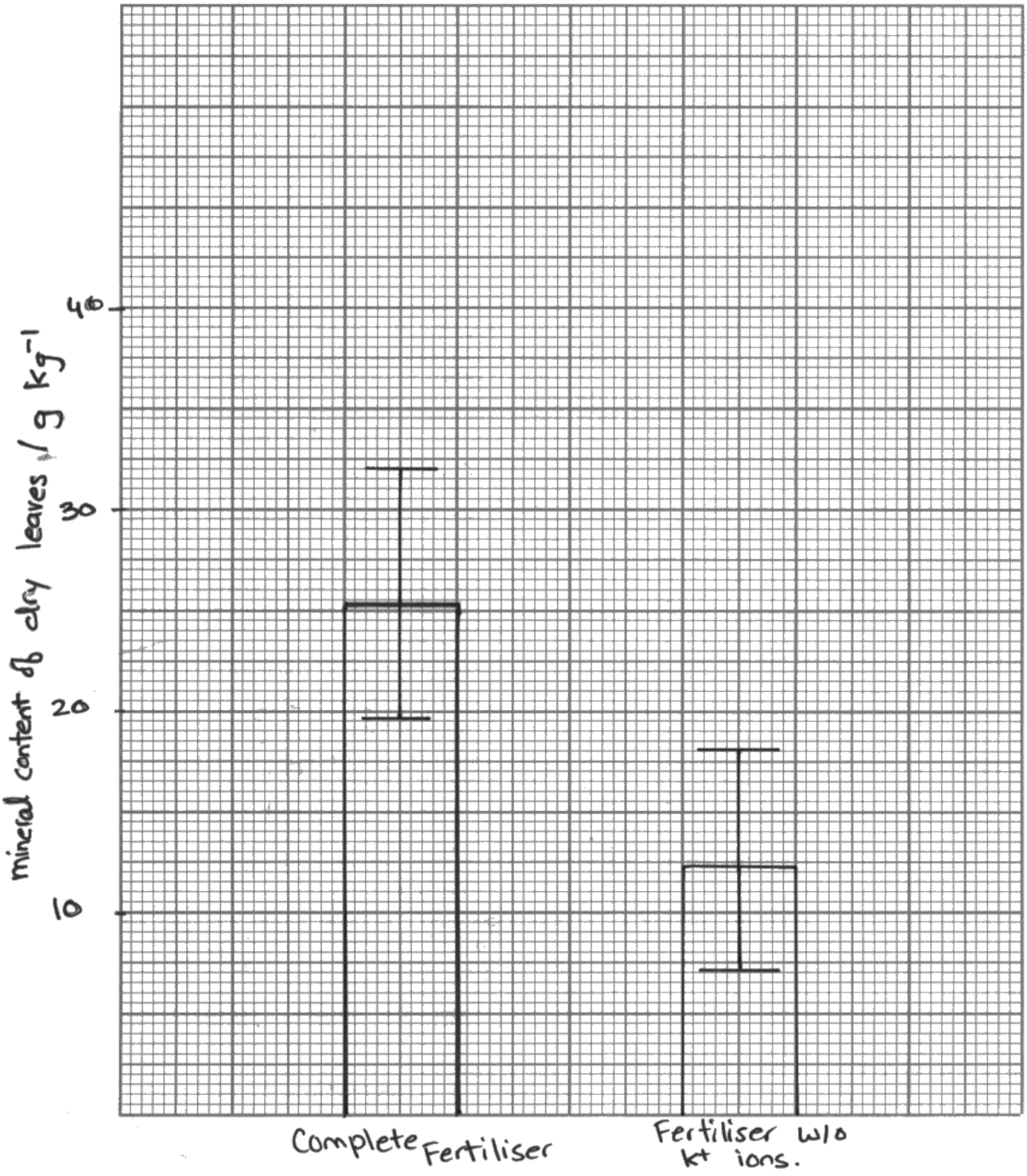
(3)

# Reading	Mineral Content of dry leaves / g kg^{-1}	
	Complete Fertiliser	Fertiliser w/o K^+ ions
1	24.3	8.9
2	33.1	9.6
3	26.7	10.3
4	30.6	10.5
5	32.0	7.4
6	28.4	18.2
7	20.5	13.9
8	24.8	14.2
9	19.9	15.2
10	29.9	7.4
11	23.5	17.2
12	20.3	13.8
13	19.6	16.7
14	19.8	15.8
15	24.6	9.9
mean	25.2	12.6

(c) On the graph paper below, draw a graph to show the mean mineral content for each set of results.

Include an indication of the variability of the data.

(3)



ResultsPlus
Examiner Comments

The table gained three marks, however the graph label for the y axis was incomplete and an error was made plotting the range bars.

Question 2 (d)

Most candidates selected the correct critical value of 2.05 from the table provided and then completed their answer as shown on the mark scheme.

(d) A student applied a *t*-test to these data and calculated a *t* value of 8.19.

The number of degrees of freedom for this test is calculated using the formula

$$\text{Degrees of freedom} = (n_1 - 1) + (n_2 - 1)$$

where n_1 and n_2 represent the size of each sample.

The table below shows critical values of *t*.

Degrees of freedom	p = 0.05	p = 0.025	p = 0.01
15	2.13	2.49	2.95
16	2.12	2.47	2.92
17	2.11	2.46	2.90
18	2.10	2.44	2.88
19	2.09	2.43	2.86
20	2.09	2.42	2.84
21	2.08	2.41	2.83
22	2.07	2.41	2.82
23	2.07	2.40	2.81
24	2.06	2.39	2.80
25	2.06	2.38	2.79
26	2.06	2.38	2.78
27	2.05	2.37	2.77
28	2.05	2.37	2.76
29	2.04	2.36	2.76
30	2.04	2.36	2.75

What conclusion can be drawn from this investigation?

Use your graph and the information in this table to explain your answer.

(4)

Degrees of freedom is 28. Critical value is 2.05 at 95% significance. Calculated value of t is greater than critical value, so null hypothesis is rejected. There is a significant difference between mineral content of dry leaves with complete fertiliser and mineral content of dry leaves with fertiliser lacking potassium. Mean mineral content of leaves with complete fertiliser is ~~be~~ higher than that of fertiliser lacking potassium. Error bars do not overlap.

ResultsPlus
Examiner Comments

All four marks awarded.

(d) A student applied a *t*-test to these data and calculated a *t* value of 8.19.

The number of degrees of freedom for this test is calculated using the formula

$$\text{Degrees of freedom} = (n_1 - 1) + (n_2 - 1)$$

where n_1 and n_2 represent the size of each sample.

The table below shows critical values of *t*.

Degrees of freedom	p = 0.05	p = 0.025	p = 0.01
15	2.13	2.49	2.95
16	2.12	2.47	2.92
17	2.11	2.46	2.90
18	2.10	2.44	2.88
19	2.09	2.43	2.86
20	2.09	2.42	2.84
21	2.08	2.41	2.83
22	2.07	2.41	2.82
23	2.07	2.40	2.81
24	2.06	2.39	2.80
25	2.06	2.38	2.79
26	2.06	2.38	2.78
27	2.05	2.37	2.77
28	2.05	2.37	2.76
29	2.04	2.36	2.76
30	2.04	2.36	2.75

What conclusion can be drawn from this investigation? 8.19 > 2.05

Use your graph and the information in this table to explain your answer.

(4)

The graph shows areliable data. The Calculated value is 8.19 and the critical value at 5% Significance level is 2.05, which is means Calculated value is greater than critical value. Therefore we have to reject the null hypothesis, that there is No Significance defference between Complete fertilisers and without potassium ion affects the growth of plant.

ResultsPlus
Examiner Comments

Unfortunately this answer claimed there was no significant difference so only three marks awarded.

Question 2 (e)

This question proved to be challenging for most candidates. Although suitable biotic or abiotic factors were frequently stated only a very small number of candidates explained the possible effect of the factor on the growth of plants.

(e) Suggest why it may **not** be possible to draw valid conclusions from an investigation in which curaua plants were grown in a field.

Give reasons for your answer.

(4)

- Small sample size is taken to carry the experiment.
- Difficult to control all variables since it is in the environment.
- Temperature can cause an affect. If temperature increases then more metabolic rate as a result more uptake of nutrients from the soil which leads to inaccurate in result.
- PH of the soil is also a factor effect it.
- Water uptaken as more ~~wa~~ water is taken more minerals are also taken this leads to inaccurate in the results.

ResultsPlus
Examiner Comments

This answer gained marking point 1 and then marking point 4 as an abiotic factor was identified and the effect explained.

(e) Suggest why it may **not** be possible to draw valid conclusions from an investigation in which curaua plants were grown in a field.

Give reasons for your answer.

(4)

- Sample size is small, only 15 for each group.
- The error bar (variability) of the mean mineral content of dry leaves of plants with potassium in fertiliser is very large.
- Other variables cannot be controlled easily / were not controlled in this experiment such as: predation, rain, temperature, etc. These can all affect the result.
- Not all curaua plants may behave the same.
- Fertiliser may not have minerals (ions) distributed evenly.

ResultsPlus
Examiner Comments

This response only gained the mark for difficult to control variables. Other factors were identified but not explained.

Question 3 (a)

The context of this question was the germination of sunflower seedlings at different temperatures.

Nearly all candidates gave a response about safety risks. Some commented on ethical issues though this was not required to answer the question.

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

(2)

no ethical issues, wear gloves, flower leaves may contain irritants that can cause allergic reactions

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Examiner Comments

This candidate has identified the risk of irritants from plants and the risk of an allergy from this.

Question 3 (b)

The examiners were pleased to see candidates frequently suggested some sensible preliminary work that was relevant to the main investigation. There was little evidence of generic answers being given by candidates here.

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

(3)

Practise your proposed method to see if it works. Find suitable conditions for sunflower seedlings growth for example suitable mineral ion concentrations and suitable pH and suitable light intensity. Find a suitable range of temperature that you will use and also find a suitable dependent variable, suitable method to measure growth rates. See if sunflower seedlings will be affected from temperature and also find other variables that may need to be taken into consideration. The sunflower seedlings need to be taken from the same source/plant.

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Examiner Comments

This answer describes appropriate preliminary work for three marks.

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

(3)

Make a mini-trial to see if the proposed method will work. Find the right temperatures so that seedlings will not die. Find the right time to do this investigation so that only temperature will affect the rate of growth.

ResultsPlus
Examiner Comments

This answer gained marking point 1 and 2. The last sentence is too vague to gain a mark.

Question 3 (c)

Nearly all the candidates gave detailed accounts in a logical order that confirmed they had carried out this type of investigation in a laboratory. All the marking points were regularly seen by the examiners. Some candidates did not define the dependent variable with sufficient care to gain credit.

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

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

(10)

The dependent variable in this experiment is the rate of growth, which can be found by measuring the increase in mass divided by time taken. The independent variable is the temperature.

First, obtain ~~8~~ 6 sunflower seeds from same parent, to reduce genetic variation and its influence, and of same age and size. Plant in suitable soil ~~&~~ maintaining ~~all other~~ variables across them all (such as soil, temperature and water etc..). Once they have grown to the point where the cotelydons have started to appear cut just below shoot apex. Prepare molten agar and place in 6 ~~test~~ test tubes all of same volume (of agar). ~~Plant~~ place the ~~seedlings (the plants~~ seedlings after they've been cut in the agar.

Place each test tube in a water bath of a different temperature, ~~ranging from~~ (such as 20°, 25°, 30, 35, 40°, 45°).

Place a cling on the seedlings to prevent microorganisms from entering and competing for nutrients.

As volume of agar, initial size of seedling, as well as exposure to light and duration it is kept in test tube affect the growth of the seedling, these ~~need~~ need to be controlled. The latter two can be controlled by placing test tubes at equal distances from a lamp, and by leaving them in test tubes for a total of

6 weeks. ~~Weight~~
weigh the seedlings every week for six weeks, and calculate the rate of growth in the way mentioned previously.
Repeat the whole experiment 3 more times, to increase reliability, and find means.

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Examiner Comments

This answer gained 5 content marks and 2 for quality of written communication.

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

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

(10)

The independant variable is temperature, place the sun flower seedlings in a range of temperatures (10°C, ~~15°C~~, 20°C, ~~25°C~~, 30°C, ~~35°C~~, 40°C, 50°C, 60°C)

Distribute ~~the seeds into~~ same number of seeds into the plot eg: (20 seeds) for each plot and place each plot in a thermostatically controlled room at (10°C) each temperature.

The dependant variable is the rate of growth, this can be measured by ~~eg~~ counting the number of ~~seeds~~ leaves or number of seeds germinated over a 1 week period of time.

Variables such as light intensity should be controlled by placing light bulbs of same wattage at the same distance in to the plots or by placing on a light bank. The pH of the soil should be kept constant.

The humidity can be controlled by using humidifiers Make sure that the same soil is place for all plots. The gradient of slope ~~—~~ make sure that the plot is flat land and it doesn't have a slope. Age of ~~eg~~ seeds should be controlled Temperature range from (10°C, 20°C, 30°C, 40°C, 50°C, 60°C)

After 1 week ~~e~~ count the number of leaves in ~~each temperature~~ ~~25~~ 10°C or count the number ~~of seeds that are~~ of seedlings. and record the data.

~~Repeat the experiment under each temperature for atleast 3 times and count th.~~

Make sure that the seeds are of the same species, take seeds from one plant, X-ray seeds for embryo to check if they are viable.

Repeat the experiment under each temperature for atleast 3 times and ~~count the~~ find the mean number of seedling.

Repeat the experiment keeping all other variable constant and changing the temperature for rest of the temperatures

Count the number of leaves at different temperatures.

$$\text{rate} = \frac{1}{\text{time}}$$

ResultsPlus
Examiner Comments

This is a carefully written answer which includes a correct statement about the dependent variable.

Ten marks awarded.

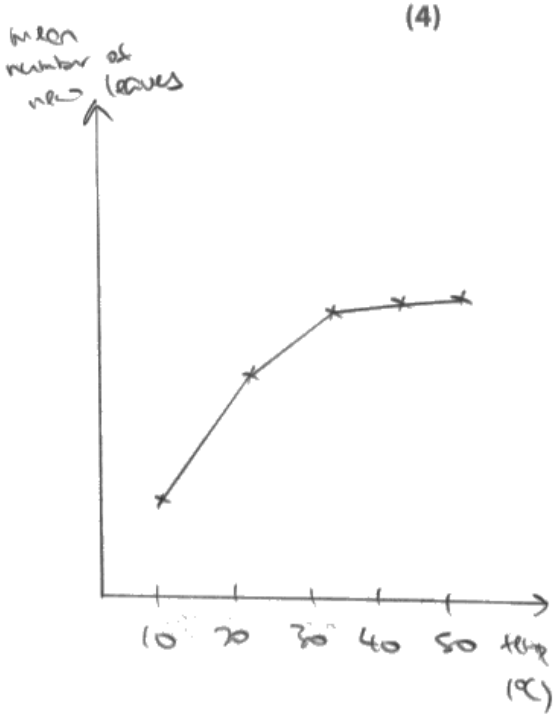
Question 3 (d)

Most candidates presented tables in an appropriate format. However some tables were not given headings with units or the heading and the units given were not appropriate for recording raw data. A table does need to show that repeats could be recorded. The majority of candidates did suggest an appropriate statistical test.

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

(4)

Temperature (°C)	number of new leaves				
	1	2	3	4	mean
10°C					
20°C					
30°C					
40°C					
50°C					



A table with appropriate units and headings should be used. Include raw data as well as means calculated from repeat data. The number of new leaves can be calculated by final number of leaves − initial number of leaves. A line graph should also be used, with mean number of leaves on the y-axis and temperature (°C) on the x-axis. Range bars should be included. A spearman's rank test should be used to test for significance of correlation between temperature and rate of growth. Rate of growth can be calculated by $\frac{\text{number of new leaves}}{\text{time}}$.

ResultsPlus
Examiner Comments

This answer gained 4 marks. The table and sketch graph could be easily understood.

ResultsPlus
Examiner Tip

Candidates should be reminded that units should not appear in the body of a table.

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

rate of growth /cm 1/day

(4)

Temperature of seedling's environment /°C	length of seedling /cm at specific days													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
10														
20														
30														
40														
50														

Temperature/°C	Growth rate / cm/day					
	Raw data					Mean
10						
20						
30						
40						
50						

2

The data will be recorded using ~~a~~ tables. The layout of the tables ~~is~~ are shown above. The data will be presented using a line graph. X-axis will be temperature of seedling's environment. Y-axis will be mean rate of growth. The data will be analysed using a statistical test, ~~the Spearman's~~ correlation test. The experiment will be repeated and mean growth rates will be calculated which will be plotted on line graph. The variability in growth rate will be plotted using range bars.

ResultsPlus
Examiner Comments

This is another example of a complete answer gaining 4 marks.

Question 3 (e)

Most candidates attempted to describe the limitations of their proposed method. All the marking points were seen regularly.

(e) The limitations of your proposed method.

(3)

It would be hard to control all of the variables such as light intensity, and there may be a variable that hasn't been controlled but could effect the growth rate of the seedlings. There ~~may be~~ May be difficult to weigh each seedling which could influence the results.

ResultsPlus
Examiner Comments

This answer gained marking point 1 and 2.

Paper Summary

Based on their performance on this paper, candidates are offered the following advice:

- Read the question carefully before providing an answer
- Carefully check all calculations and rounding up of values.
- Draw neat, fully labelled tables and graphs
- Use subject specific terms to help support an answer
- Plan descriptions of investigations before writing to give the best chance of gaining the marks available

Grade Boundaries

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