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Examiners' Report
January 2012

GCE Biology 6BI08 01

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Introduction

This was the fourth occasion on which the alternative to the practical investigation has been offered to international centres. The performance of students continues to improve and examiners are pleased to note many students performed well across all three questions on the paper.

Question 1 (a-b) (i)

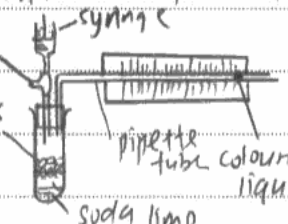
Many candidates were familiar with this core practical and showed an understanding of how a respirometer worked. However, only the better candidates scored well on this question.

1(a) Many students were able to describe key steps in the use of a respirometer, but did not explain their relevance e.g. students would describe adding potassium hydroxide to a boiling tube, but did not give the purpose. This meant they did not gain any credit for this point. Most students were able to describe several variables that need to be controlled. However, they often struggled to describe how these variables could be controlled - often describing a way of monitoring the variable. For example, to control temperature, many students described using a thermometer to check the temperature. This is not sufficient in laboratory based experiments – students should be describing the use of thermostatically controlled water baths etc. Similarly, pH can be controlled using a buffer solution, not by monitoring with a pH meter. There was often a lack of clarity about what students proposed to repeat. To gain credit they needed to make it clear that they intended to collect replicates at each temperature. Very few students described the use of a suitable inert control or the need to equilibrate the apparatus before beginning to record measurements.

A disappointing number of students did not recognise that the question was concerned with respiration and so described investigations of germination or plant growth.

1(b)i A surprising number of candidates incorrectly suggested light intensity as a variable that needed controlling. Many students listed more than two variables, but as light intensity was one of the first two, they only gained credit for one suggestion. Numerous correct suggestions gained credit, some of the more popular being size or mass of seed, age of seed, source of seed and moisture.

In this experiment, the independent variable is the temperature. First of all, a fixed number of seeds, say 10 seeds of a particular type of plant (say, maize, or bean) ~~is~~ are obtained. The seeds are all of the same batch, and from the same plant to ensure the same variety. A simple respirometer is set up as shown. The temperature is controlled by immersing the tubes in water



baths at temperatures of ~~0°C~~ 0°C, 10°C, 20°C, 30°C, 40°C, with time allowed for equilibration, so that the tubes are all of the same temperature with their respective water bath. The movement of the coloured liquid is recorded over 5 minutes, at interval of 1 minute, then by reading off the scale, and calculate the volume of oxygen used using the formula $\pi r^2 \times h$, h is the distance move, r is the radius of the pipette. The rate of respiration is found by volume of oxygen gas used over time (in this case, per 5 minute). Soda lime is used to absorb the carbon dioxide, so any movement of liquid is due to rate of consumption of oxygen. A control tube needed to be set up, ~~or~~ using a U-manometer, or another tube with empty tube (no seed). The experiment is repeated, to give replicates, and mean rate of respiration in seeds ~~in~~ is calculated.

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

(2)

variety of seeds, and also the age of seeds (how ~~m~~ long have them been produced - same batch or not). Mass of seeds.

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Examiner Comments

The candidate has answered this question well gaining full marks for 1(a) and 1(b)i.

1(a) Evidence for most marking points can be found in the answer. To be sure of marking point 5 (controlling temperature) the candidate should have described how to control temperature and not simply stated the use of water baths at particular temperatures. To be sure of gaining marking point 11 (suitable control) the candidate should have described the use of an inert material of similar mass to the seeds. e.g. glass beads or killed seeds.

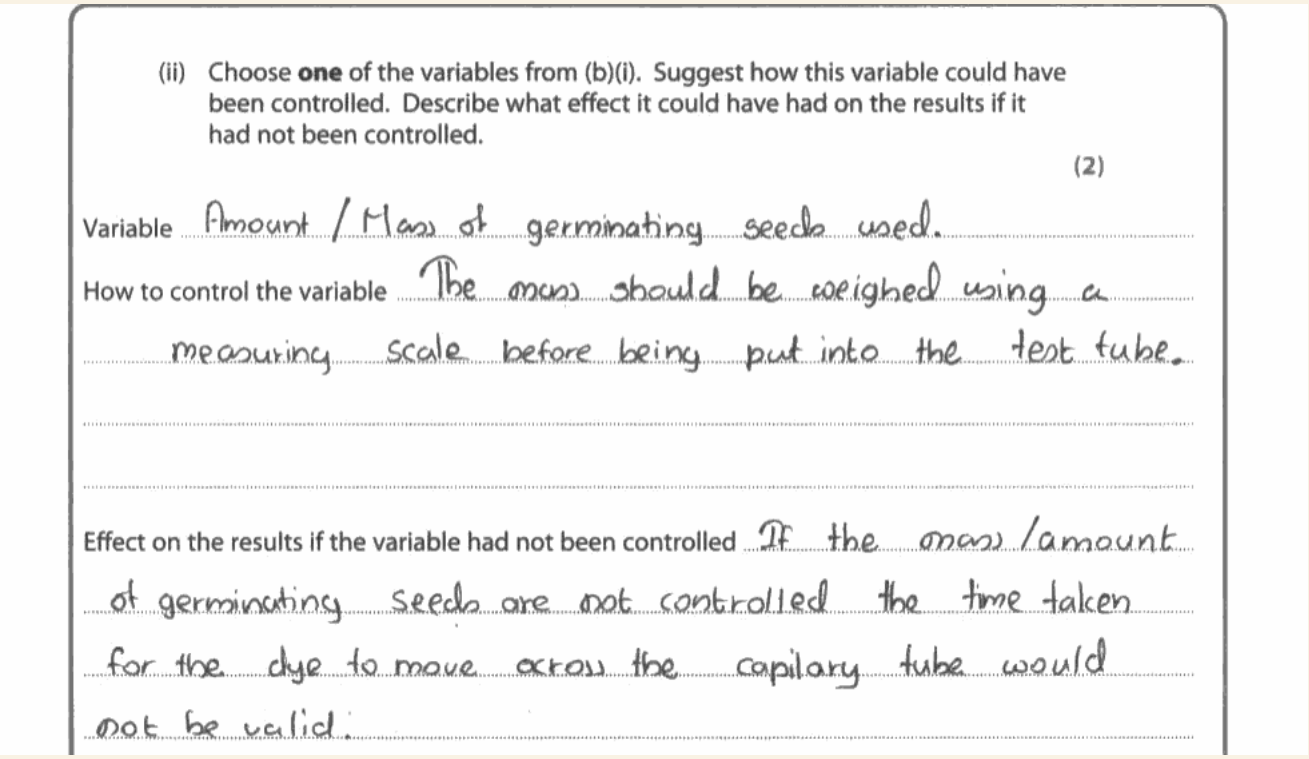
1(b)i The candidate has listed three variables. Only the first two were considered, variety and age of seeds. Fortunately, both are correct.

ResultsPlus
Examiner Tip

Give proper thought to questions that ask you to give a specified number of responses e.g give two variables. Examiners will only mark the number requested in the question, and will mark your answer strictly in the order you list them.

Question 1 (b) (ii)

Many students identified light intensity as a variable that would need to be controlled in 1 (b)i. Unfortunately, they frequently continued with light intensity in 1(b)ii. There was no credit for attempts to describe an effect of light intensity on the experiment, but a mark was available if they gave an acceptable explanation of how to control light intensity. Very few candidates gained this mark because they did not clearly describe controlling both the light source and the distance between light source and respirometer.



(ii) Choose **one** of the variables from (b)(i). Suggest how this variable could have been controlled. Describe what effect it could have had on the results if it had not been controlled.

(2)

Variable Amount / Mass of germinating seeds used.

How to control the variable The mass should be weighed using a measuring scale before being put into the test tube.

Effect on the results if the variable had not been controlled If the mass / amount of germinating seeds are not controlled the time taken for the dye to move across the capilary tube would not be valid.

ResultsPlus
Examiner Comments

This candidate identified mass as a factor to control. One mark was awarded for correctly stating how mass can be controlled using a balance. The second mark was not awarded because the student did not state what effect changing mass would have on the results. e.g. increase in mass would increase the volume of oxygen consumed, or the liquid in the capillary tube would move further if the mass of seed was increased.

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Examiner Tip

Follow the instructions in a question carefully. Students are frequently asked to describe the effect of changing an independent or control variable on the result. For these questions you should make sure your answer refers to the dependent variable being measured. If possible you should also give a direction to the effect.

(ii) Choose **one** of the variables from (b)(i). Suggest how this variable could have been controlled. Describe what effect it could have had on the results if it had not been controlled.

(2)

Variable Number of seeds.

How to control the variable Use the same number of seeds (2 seeds) for each temperature.

Effect on the results if the variable had not been controlled

A higher number of seeds will increase the oxygen used as more oxygen is needed since respiration occurs more.

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Examiner Comments

This answer scored both marks. More seeds using more oxygen was accepted for the second mark. This answer would have been improved if the candidate had stated more seeds use an increased volume of oxygen.

Question 1 (c)

Although a number of students gave good answers, many students did not recognise that the seeds would switch to anaerobic respiration and were thus unable to explain what effect this would have on the results. Some focused on biochemical details such as the role of Krebs cycle and the production of ATP, while others stated that respiration would stop and the seeds would die or fail to germinate.

(c) If the seeds had not been exposed to any oxygen during this investigation, suggest the effect this may have on the results. Give an explanation for your answer.

(3)

There will not be any movement of liquid in the pipette tube. This is because no oxygen is consumed, resulting in no loss of pressure in the respirometer. Anaerobic respiration can occur but it will have no effect on the gas pressure. Any carbon dioxide released will be absorbed by soda lime.

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Examiner Comments

This student has clearly understood the question and produced an answer that gains full marks. The candidate states that there would be no movement of the liquid in the manometer tube. Then the candidate provides an explanation in terms of no oxygen consumption and any CO_2 produced being absorbed by the soda lime and thus having no effect on the gas pressure.

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Examiner Tip

Read questions carefully to make sure you fully answer the question. Many questions, like this one, will ask you to describe something and give an explanation.

(c) If the seeds had not been exposed to any oxygen during this investigation, suggest the effect this may have on the results. Give an explanation for your answer.

(3)

ATP cannot be generated. Rate of ~~transpi~~ respiration will be low because of the absence of oxygen.

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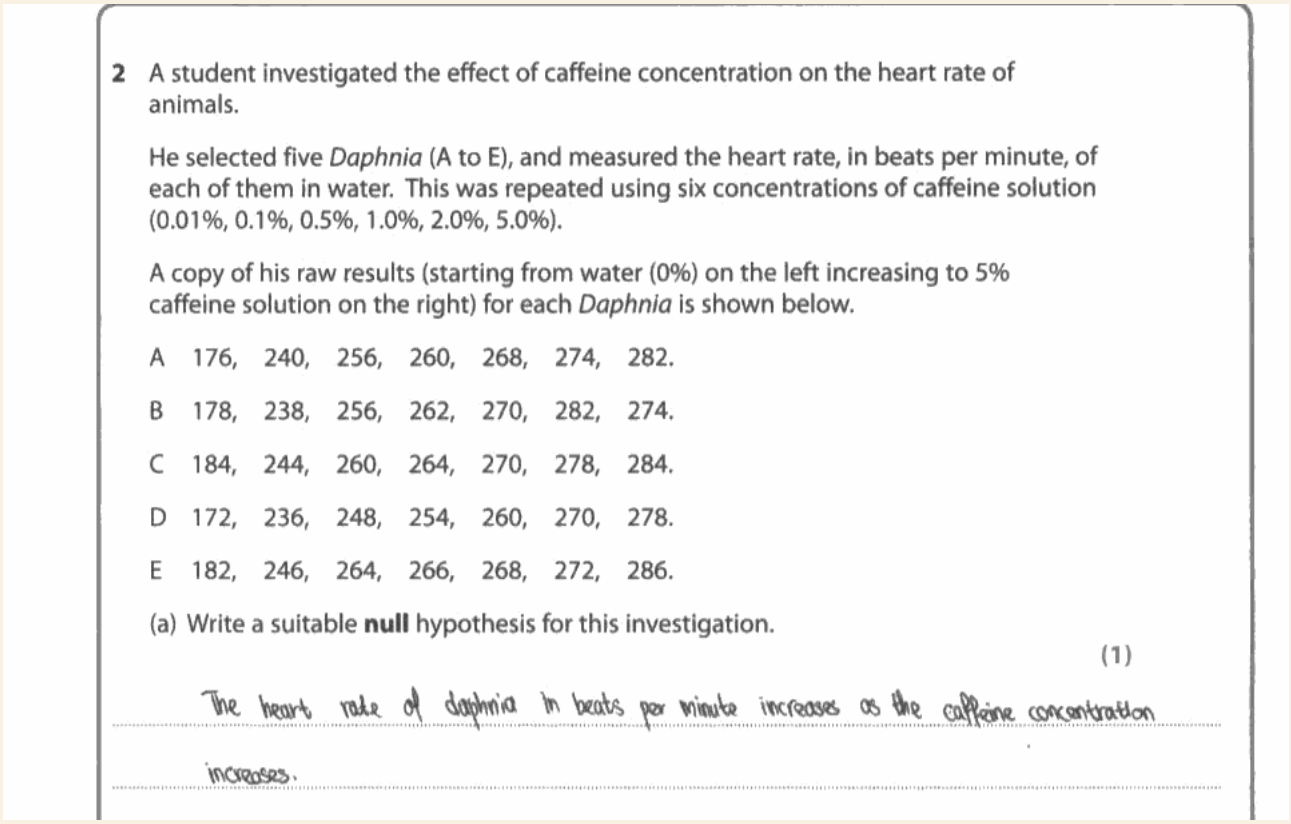
Examiner Comments

This candidate did not recognise that anaerobic respiration could still take place. The reference to respiration gains no credit by itself. If the candidate had referred to no aerobic respiration this would have gained one mark.

Question 2 (a)

Many students are able to give a suitable null hypothesis. The most frequent errors were to describe a hypothesis, (rather than a null hypothesis), forget to include any reference to a significant effect and to state that there was a significant difference between caffeine concentration and heart rate!



2 A student investigated the effect of caffeine concentration on the heart rate of animals.

He selected five *Daphnia* (A to E), and measured the heart rate, in beats per minute, of each of them in water. This was repeated using six concentrations of caffeine solution (0.01%, 0.1%, 0.5%, 1.0%, 2.0%, 5.0%).

A copy of his raw results (starting from water (0%) on the left increasing to 5% caffeine solution on the right) for each *Daphnia* is shown below.

A 176, 240, 256, 260, 268, 274, 282.

B 178, 238, 256, 262, 270, 282, 274.

C 184, 244, 260, 264, 270, 278, 284.

D 172, 236, 248, 254, 260, 270, 278.

E 182, 246, 264, 266, 268, 272, 286.

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

(1)

The heart rate of daphnia in beats per minute increases as the caffeine concentration increases.

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Examiner Comments

No mark was awarded because the candidate has given a hypothesis rather than a null hypothesis.

ResultsPlus
Examiner Tip

The examiner will often try to help students by putting a key word in bold. Pay particular attention to any emboldened words in the question.

2 A student investigated the effect of caffeine concentration on the heart rate of animals.

He selected five *Daphnia* (A to E), and measured the heart rate, in beats per minute, of each of them in water. This was repeated using six concentrations of caffeine solution (0.01%, 0.1%, 0.5%, 1.0%, 2.0%, 5.0%).

A copy of his raw results (starting from water (0%) on the left increasing to 5% caffeine solution on the right) for each *Daphnia* is shown below.

A 176, 240, 256, 260, 268, 274, 282.

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C 184, 244, 260, 264, 270, 278, 284.

D 172, 236, 248, 254, 260, 270, 278.

E 182, 246, 264, 266, 268, 272, 286.

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

(1)

There is no significant correlation between the coffeine concentration and the heart rate of animals.

ResultsPlus
Examiner Comments

This is an example of a concise and accurate null hypothesis. The student has referred to animals, which was accepted. However, it would have been better to use Daphnia.

Question 2 (b)

All three answers listed in the mark scheme were seen in the candidates' responses. However the most popular answer focused on the nervous system and pain. Many students were able to state that Daphnia would not feel pain and that this was because they have a simple nervous system, gaining both marks. A large number of students gave answers that related to practical advantages, e.g. translucent body and ease of observing heart beats. Some tried to turn this into an ethical point by implying the observation of heart rates in higher animals would require dissection. These answers gained no credit.

(b) State and explain **one** ethical reason why the student chose to use *Daphnia* for this investigation.

(2)

Daphnia has a very simple body system. It has a less complex nervous system. It will not feel pain while the experiment is being carried out.

ResultsPlus
Examiner Comments

A good answer that gains full credit.

(b) State and explain **one** ethical reason why the student chose to use *Daphnia* for this investigation.

(2)

Daphnia has simple nervous system and transparent. So, this is easy to see and count the heart beat which reflects how ~~of~~ human's heart will be affected by the caffeine just like Daphnia.

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Examiner Comments

The candidate has identified that Daphnia have a simple nervous system gaining one mark. However, the candidate then describes a practical advantage to using Daphnia which is not relevant to the question. Therefore, the candidate does not gain the second mark.

Question 2 (c-e)

This question was answered well by the majority of students, with many gaining between 6 and 8 marks.

2 (c) Most students were able to accurately calculate the mean values and record calculated values with consistent decimal places. A disappointing number still forgot to include units.

2(d) Many students produced acceptable tables. Those who put the independent variable in the left hand column found it easier to gain all three marks. Common errors include missing or incorrect units. A few students did not follow the instruction in the question to include all the raw data.

2 (e) Many students were able to plot sensible graphs gaining 2 or 3 marks. Common errors were not including 'mean' in the y-axis label and not showing axis breaks. A small number of candidates used a non-linear x-axis, and some plotted a bar graph rather than a scatter/line graph.

(c) Calculate the mean heart rates for each concentration of caffeine.

(3)

Mean heart rates at :

a) 0.0% : $\frac{176+178+184+172+182}{5} = 178.4$

b) 0.01% : $\frac{240+238+244+236+246}{5} = 240.8$

c) 0.1% : $\frac{256+256+260+248+264}{5} = 256.8$

d) 0.5% : $\frac{260+262+264+254+266}{5} = 261.2$

e) 1.0% : $\frac{268+270+270+260+268}{5} = 267.2$

f) 2.0% : $\frac{274+282+278+270+272}{5} = 275.2$

g) 5.0% : $\frac{282+274+284+278+286}{5} = 280.8$

Mean heart rate at 0.0% caffeine concentration ..178.4..

Mean heart rate at 0.01% caffeine concentration ..~~246.8~~ 240.8..

Mean heart rate at 0.1% caffeine concentration ..256.8..

Mean heart rate at 0.5% caffeine concentration ..261.2..

Mean heart rate at 1.0% caffeine concentration ..267.2..

Mean heart rate at 2.0% caffeine concentration ..275.2..

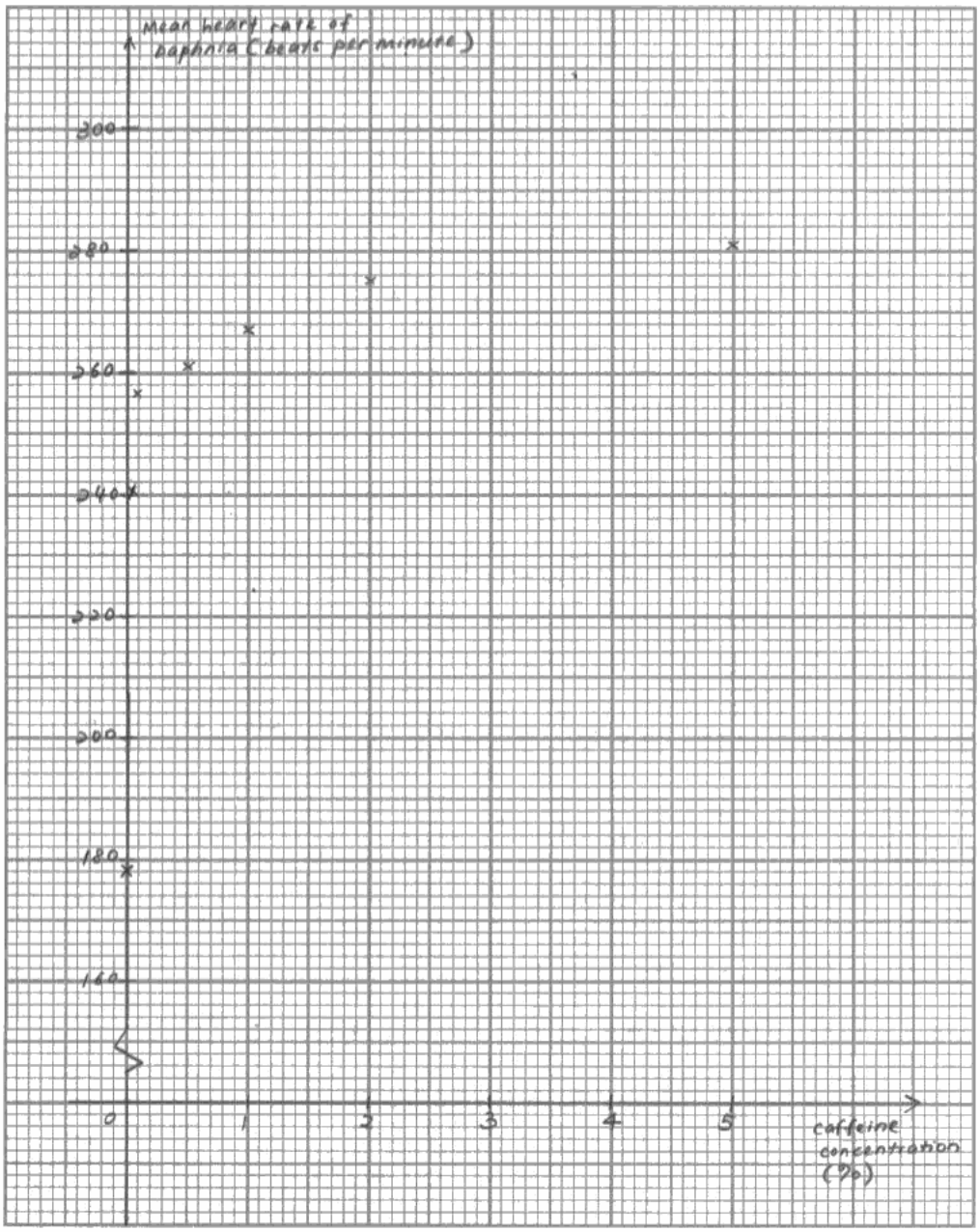
Mean heart rate at 5.0% caffeine concentration ..280.8..

(d) Prepare a table to display the raw data and your calculated values for the mean heart rates. (3)

concentration of caffeine solution (%)	Heart rate of daphnia (beats per minute)					
	A	B	C	D	E	Mean
0.0	176	178	184	172	182	178.4
0.01	240	238	244	236	246	240.8
0.1	256	256	260	248	264	256.8
0.5	260	262	264	254	266	261.2
1.0	268	270	270	260	268	267.2
2.0	274	282	278	270	272	275.2
5.0	282	274	284	278	286	280.8

(e) On the graph paper below, draw a suitable graph to illustrate the effect of caffeine concentration on the mean heart rate of *Daphnia*.

(3)



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Examiner Comments

This candidate has calculated mean values, and recorded them all to 1 decimal place. However, they have forgotten to include units so only gain 2 marks for 2(c).

The table is well designed and contains all the relevant information gaining 3 marks for 2(d).

The graph is plotted accurately, has appropriately labelled axis, a clearly identified axis break on the y - axis and is a sensible size. So this answer gains all 3 marks for 2(e).

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Examiner Tip

Get into the habit of using units when describing data and recording calculated values.

(c) Calculate the mean heart rates for each concentration of caffeine. (3)

A $\frac{176+240+256+260+268+274+282}{7}$

B $\frac{178+238+256+262+270+282+274}{7}$

C $\frac{184+244+260+264+270+278+284}{7}$

D $\frac{172+236+248+254+260+270+278}{7}$

E $\frac{182+246+264+266+268+272+286}{7}$

Mean heart rate at 0.0% caffeine concentration ..... 178.4 ← $\frac{176+178+184+172+182}{5}$

Mean heart rate at 0.01% caffeine concentration ..... 240.8 ← $\frac{240+238+244+236+246}{5}$

Mean heart rate at 0.1% caffeine concentration ..... 256.8 ← $\frac{256+256+260+248+264}{5}$

Mean heart rate at 0.5% caffeine concentration ..... 261.2 ← $\frac{260+262+264+254+266}{5}$

Mean heart rate at 1.0% caffeine concentration ..... 267.2 ← $\frac{268+270+270+260+268}{5}$

Mean heart rate at 2.0% caffeine concentration ..... 275.2 ← $\frac{274+282+278+270+272}{5}$

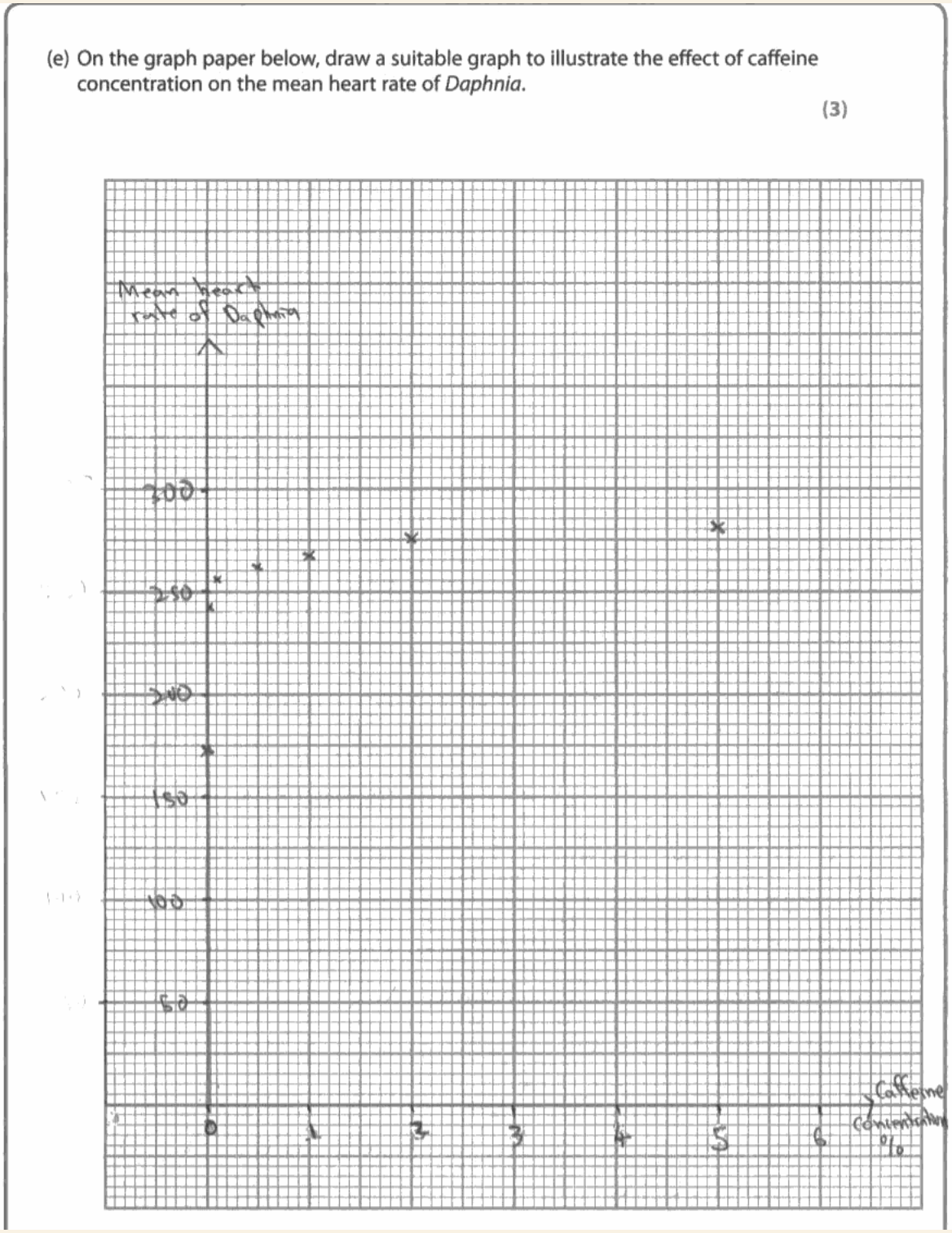
Mean heart rate at 5.0% caffeine concentration ..... 280.8 ← $\frac{282+274+284+278+286}{5}$

(d) Prepare a table to display the raw data and your calculated values for the mean heart rates. (3)

	Heart rate of Daphnia					
	A	B	C	D	E	Mean heart rate of Daphnia
Concentration of caffeine/%						
0.0	176	178	184	172	182	178.4
0.01	240	238	244	236	246	240.8
0.1	256	256	260	248	264	256.8
0.5	260	262	264	254	266	261.2
1.0	268	270	270	260	268	267.2
2.0	274	282	278	270	272	275.2
5.0	282	274	284	278	286	280.8

(e) On the graph paper below, draw a suitable graph to illustrate the effect of caffeine concentration on the mean heart rate of *Daphnia*.

(3)



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Examiner Comments

This candidate has made the common mistake of leaving out the units for the calculated mean values, table headings and axis label. There is also a plotting error for the first point.

(c) Calculate the mean heart rates for each concentration of caffeine. (3)

$0.0\% = \frac{176 + 178 + 184 + 172 + 182}{5} = 178.4$ #

$0.01\% = \frac{240 + 238 + 244 + 236 + 246}{5} = 240.8$ #

$0.1\% = \frac{256 + 256 + 260 + 248 + 264}{5} = 256.8$ #

$0.5\% = \frac{260 + 262 + 264 + 254 + 266}{5} = 261.2$ #

$1.0\% = \frac{268 + 270 + 270 + 260 + 268}{5} = 267.2$ #

$2.0\% = \frac{274 + 280 + 278 + 270 + 272}{5} = 275.2$ #

$5.0\% = \frac{282 + 274 + 284 + 278 + 286}{5} = 280.2$ #

Mean heart rate at 0.0% caffeine concentration 178.4 beats per minute

Mean heart rate at 0.01% caffeine concentration 240.8 beats per minute

Mean heart rate at 0.1% caffeine concentration 256.8 beats per minute

Mean heart rate at 0.5% caffeine concentration 261.2 beats per minute

Mean heart rate at 1.0% caffeine concentration 267.2 beats per minute

Mean heart rate at 2.0% caffeine concentration 275.2 beats per minute

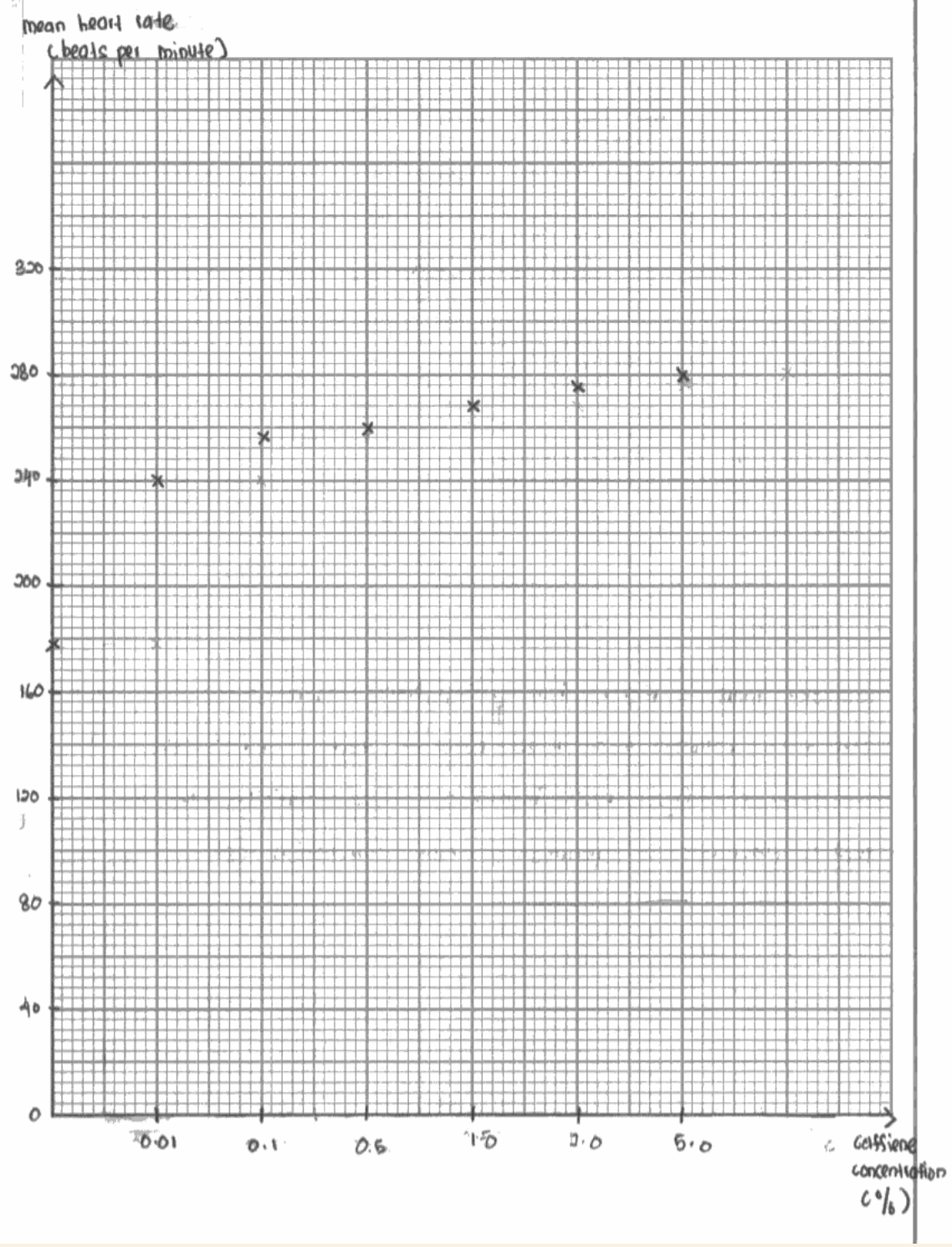
Mean heart rate at 5.0% caffeine concentration 280.8 beats per minute

(d) Prepare a table to display the raw data and your calculated values for the mean heart rates. (3)

caffeine solution conc. (%)	Heart rate (in beats per minute)					mean heart rate (beats per minute)
	A	B	C	D	E	
0.0	176	178	184	172	182	178.4
0.01	240	238	244	236	246	240.8
0.1	256	256	260	248	264	256.8
0.5	260	262	264	254	266	261.2
1.0	268	270	270	260	268	267.2
2.0	274	280	278	270	272	275.2
5.0	282	274	284	278	286	280.8

(e) On the graph paper below, draw a suitable graph to illustrate the effect of caffeine concentration on the mean heart rate of *Daphnia*.

(3)



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Examiner Comments

This candidate has calculated the mean values correctly and included units gaining all three marks for 2(c). The table is well designed and contains all the relevant information again gaining all three marks for 3(d). The candidate has used a non linear scale for the x axis of the graph. Everything else about the graph is correct so the candidate was awarded 2 of the available 3 marks for 3(e).

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Examiner Tip

Brush up on your graphing skills. Make sure you can plot with a sensible linear axis, that you can give appropriate labels to your axis and that if you break the axis you clearly show the break.

Question 2 (f)

Many candidates answered the first part of this question well, demonstrating that they understood how to interpret the statistical test result. However, most students missed the point that they needed to explain the result.

(f) The student used a statistical test to investigate the significance of the correlation between the mean heart rates and the caffeine concentrations.
His calculation gave a correlation value of 1.00. > 0.79

The table below shows significance levels and correlation values for this statistical test.

Number of means	Significance level (p)				
	0.50	**0.20**	**0.10**	**0.05**	**0.01**
4	0.60	1.00	–	–	–
5	0.50	0.80	0.90	–	–
6	0.37	0.66	0.83	0.89	1.00
7	0.32	0.57	0.71	0.79	0.93
8	0.31	0.52	0.64	0.74	0.88
9	0.27	0.48	0.60	0.70	0.83
10	0.25	0.46	0.56	0.65	0.79

What conclusions can be drawn from this investigation?

Use the information provided in the table above and in the graph you have drawn, together with your knowledge and understanding, to **explain** your answer.

(4)

Calculated value 1.00 is bigger than critical value which is 0.79 a
at ~~our~~ 5% significance level, there is a ~~positive correlation~~
significant positive correlation between mean heart rates and caffeine
concentrations. there is a significant increase in mean heart rates
when caffeine concentration increases. We reject the null
hypothesis and accept hypothesis at 5% significance level.

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Examiner Comments

This candidate has used the information provided in the table to draw a valid statistical conclusion of a significant correlation between the concentration of caffeine and heart rate.
This gains three marks. A simple statement that caffeine is a stimulant would have gained the final mark.

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Examiner Tip

Always read questions carefully. Pay particular attention to any words that are in bold.

(f) The student used a statistical test to investigate the significance of the correlation between the mean heart rates and the caffeine concentrations.
His calculation gave a correlation value of 1.00.

The table below shows significance levels and correlation values for this statistical test.

Number of means	Significance level (p)				
	0.50	0.20	0.10	0.05	0.01
4	0.60	1.00	–	–	–
5	0.50	0.80	0.90	–	–
6	0.37	0.66	0.83	0.89	1.00
7	0.32	0.57	0.71	0.79	0.93
8	0.31	0.52	0.64	0.74	0.88
9	0.27	0.48	0.60	0.70	0.83
10	0.25	0.46	0.56	0.65	0.79

What conclusions can be drawn from this investigation?

Use the information provided in the table above and in the graph you have drawn, together with your knowledge and understanding, to **explain** your answer.

(4)

This experiment is carried on seven concentrations therefore the number of means is (7-1) = 6, Six means. And according to his calculation the correlation value is 1.00 therefore the ~~sigmi~~ chi-square value is 0.01 as 1.00 > 0.89 this means that there is an effect of different caffeine concentrations on the heart rate. As the caffeine concentration increases the heart rate also increases.

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Examiner Comments

This candidate has gone some way towards explaining the statistical significance of the result. Recognising that the calculated correlation value is greater than the significance value, together with the description of a significant correlation, gains two marks. However, the student used an incorrect significance value (0.89) and did not give any explanation for the effect of caffeine, so did not gain the third mark.

Question 3

Many candidates were able to gain a significant number of marks on this question. The style and format of the question was similar to previous years and candidates had a clear idea as to how to gain credit. Candidates who scored less well appear to have been confused by the context of the question and described completely inappropriate investigations, e.g. growing crops in fields.

3(a) While many students were able to identify a number of relevant safety issues, a surprising number of students struggled with this part of the question. The most frequent correct response was to identify the potential irritant/allergenic nature of plant material. A common error was to simply describe the risk of infection/contamination to the tissue culture without saying how this might become a safety issue. Some simply stated that aseptic techniques should be used.

3(b) Many students were able to gain full marks on this part of the question by correctly identifying three important aspects of preliminary work. A small number did not appreciate what was meant by preliminary work and simply launched into their investigation. A number of candidates made generic statements about using the internet etc. to find out unspecified information, which did not gain credit.

3 (c) Many students scored highly on this question. However, it was clear that many did not have a good grasp of what they were investigating. Many candidates described inappropriate combinations of dependent variable and time period for the study.

3(d) Candidates who used an example table and sketch graph to illustrate their answer often scored highly on this question. Many gained credit for a table showing the collection of raw data and calculation of relevant mean values. Few students were able to explain how a change in growth could be calculated. Many students also gained credit for a sketched scatter graph, with appropriate axis labels and the description of a correlation test. A small number of students suggested inappropriate statistical tests.

3 (e) Many students gained one mark for stating that it was difficult to control all the variables affecting tissue growth. A much smaller number were able to identify a specific example of an uncontrolled variable. Many of those that did suggested genetic variation. Unfortunately, the context of the question is about growing clones, and these students had usually described, in part (c), how they would control for genetic variability, so they gained no credit here.

3 When scientists genetically modify a plant to contain a useful gene, they usually produce clones of the plant for further testing and evaluation.

Plant tissue culture can be used to grow a large number of clones from small pieces of plant tissue. Plant growth regulators are used in tissue cultures to control the growth of the plant tissue.

Plan an investigation to test the following hypothesis: '*The higher the concentration of a plant growth regulator the greater the rate of growth of the plant tissue.*'

Your answer should give details under the following headings.

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

(2)

Safety issues include risks of plant growth regulator causing irritation or allergies.

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

(3)

Preliminary work would include practicing the proposed method to ensure it works. Also, to identify other variables that would ~~be~~ need to be taken into account and ways of controlling them. Identify the range of acceptable amounts of plant growth regulators to be used. Also, determine the ~~ideal~~ most ideal conditions to grow tissue cultures

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

(10)

The dependent variable would be the length of the hypocotyl of the plant~~s~~ tissue grown.

The independent variable would be the concentration of plant growth regulator used.

One variable that needs to be controlled would be the temperature. This is kept constant using a thermostat set at 30°C. Another variable that needs to be controlled would be the ~~amount of min~~ concentrations of minerals given to the plant tissue. This is controlled by giving each culture $5cm^3$ of minerals

Ten seedlings are grown on a damp sponge. Ensure seedlings are

of the same batch and species of plant. Once ~~grown~~ germinated and leaves can be visible, use scissors and cut the plant just below the growing apex of the shoot.

~~250cm³ Nutrient agar~~ 250 cm³ of agar is prepared and poured into ten short necked-test tubes until half filled. The agar is left to cool and set.

Next, ~~pipette~~ pipette 5 cm³ of plant growth regulators of 2% concentration into each test tube ~~to~~ filled with agar. The explants are then pushed into the agar without the leaves touching the agar. One explant is placed in each test tube. They are placed in a test tube rack and left for 5 days. ~~After 5 days~~ The tops of the tubes are covered with cling film to prevent bacteria from dropping on the plants. After 5 days, length of ~~the~~ hypocotyl measured using a ruler.

The experiment is repeated using concentrations of plant growth regulators of 5%, 10%, 20% and ~~30%~~ 30%.

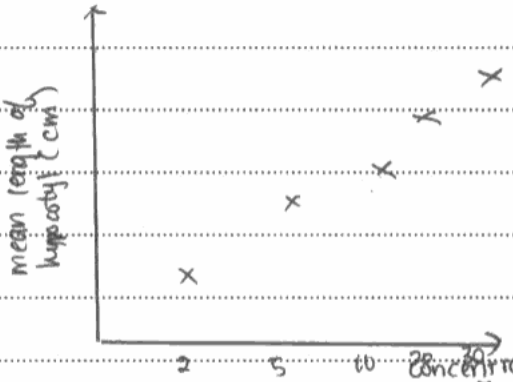
The ~~whole~~ experiment is then repeated 3 times for each concentration of plant growth regulators.

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

(4)

Concentration of growth regulator (%)	Mean Length of hypocotyl / cm (of 10 plants)				
	1	2	3	4	mean
0%					
5%					
10%					
20%					
30%					

Graph of concentration of growth regulator against length of hypocotyl.



The statistical test used is a Spearmans correlation test. If r value greater or equal to critical value at 95% confidence level, then there is significant correlation between length of hypocotyl and concentration of growth regulator.

Table of concentration of growth regulator and length of hypocotyl recorded. mean is calculated by adding lengths at each concentration and dividing by number of times experimented. Graph is a scatter diagram of mean length of hypocotyl against concentration of plant growth regulator. The null hypothesis states that there is no significant correlation between length of hypocotyl and concentration of plant growth regulator.

(e) The limitations of your proposed method.

(3)

The 4 limitations are that it is difficult to measure accurately the length of the hypocotyl. measurement of length not neccesarily a true measure of ~~growth~~ growth. Also, difficult to keep some variables constant such as light intensity.

ResultsPlus
Examiner Comments

3(a). The candidate has identified one sensible risk gaining a mark.
3(b) This part of the question has been answered well, with the candidate identifying three important aspects of preliminary work (mark points 1, 5 and 3) gaining all three marks.

3(c) The candidate has produced a good answer that could gain credit for many of the mark points available, gaining a maximum of 8 for content. The account is well written with good use of technical terms and gains both SPG marks, giving the maximum available mark of 10. Although the candidate identified variable to control (mark points 7 and 8) they did not describe how these variables could be controlled (mark points 9 and 10), a common mistake with this question.

3(d) The candidate produced a sensible table based on the proposed investigation. Suitable headings and space to record replicate data, and a calculated mean value gained two marks. The candidate did not describe how to calculate a change in growth. This is a common mistake on this question (mark point 2). A scatter graph was suggested, together with the use of Spearman Rank statistic to gain a further two marks. Overall, the candidate gained all four available marks.

3(e) The candidate gained all three available marks (mark point 1, 2 and 6).

ResultsPlus
Examiner Tip

Make sure you use information such as section headings, and the number of marks available to help you plan how to answer large questions like this one. Also make sure that the answer you give for each part of the question makes sense in terms of the previous parts. You will not gain credit if you contradict yourself.

Paper Summary

In order to achieve the best possible marks candidates need to spend an appropriate period of time preparing for this exam. Candidates should have a good look at all of the core practicals in the specification and make sure they understand the underlying biological principles being explored, as well as the practical techniques employed.

They should read the criteria for the unit 6 practical biology and investigative skills carefully to get a good idea of the sort of things they need to consider when tackling a planning question.

Although candidates are not required to carry out a specific statistical test, they should be aware of which types of test are appropriate for which types of data, so they can plan to collect sufficient data for analysis.

Candidates need to read questions carefully and ensure that they answer the question completely

Candidates should make sure they understand what they are being asked to do. This is particularly important in question 3 when they may be asked to plan investigations set in an unusual context.

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