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Examiners' Report
June 2010

GCE Biology 6BI08

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Introduction

This was the first session for this paper, the international alternative to the individual investigation for unit 6. Although it is impossible to mimic the assessment and learning possible through the carrying out of an individual investigation we have tried to mirror the marking criteria range as far as possible.

This paper achieved a full range of marks, particularly with question 3.

Candidates tended to score highly with question 2 where they had to present and analyse data provided for them, but most scored relatively poorly on question 1 where they needed to rely on their understanding of both the practical techniques and biological principles behind one of the core practicals.

With question 3 some candidates struggled to identify what needed to be included in each section of the section. Where possible examiners marked across sections to credit candidates to who had demonstrated an understanding of what to plan in an investigation even if they had included it in the wrong section. Just as in the main unit 6 reports key areas of weakness include consideration of the value of preliminary work and how to analyse and evaluate data obtained.

In preparing for this paper 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 also read the criteria for the unit 6 practical biology and investigative skills carefully and to get a good idea of the sort of things they need to consider when tackling a planning question. Although they are not required to carry out a specific statistical test they you 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.

Question 1(a)

1ai. The majority of candidates came up with a suitable factor (normally temperature). While many candidates were able to write a testable hypothesis, quite a few did not understand how to formulate a hypothesis based on the dependent and independent variables.

1aii. Use of biological knowledge to explain the hypothesis was variable. A good number of candidates were able to get all 3 marks using their knowledge of cell membrane structure. However, a number of candidates were less sure about the cell membrane structure, particularly in reference to lipids instead of phospholipids, but they managed to get some marks through commenting on proteins in/on the membrane and their denaturation at high temperatures. Quite a few candidates just related temperature to enzymes and denaturation without reference to the cell membrane and equally a number of candidates just referred to temperature and kinetic energy of molecules in relation to diffusion rather than the affect on the structure of the membrane.

This suggests that many candidates may not have understood what was happening when they covered this core practical during their course.

(a) (i) Suggest **one** factor that affects the permeability of the beetroot cell membrane.

Write a hypothesis for this investigation that the student could test.

(2)

Factor The concentration of alcohol solution.

Hypothesis There is a significant correlation between the concentration of alcohol solution and the permeability of beetroot cell membrane. As the concentration of alcohol increases, the permeability of beetroot cell also increases.

(ii) Use your biological knowledge and understanding to explain and justify this hypothesis.

(3)

The beetroot cell membrane consists of phospholipids bilayer. These phospholipids bilayer can be dissolved in the alcoholic solution. Hence, as the concentration of alcohol increases, more and more portion of phospholipid bilayer is dissolved, resulting in the increasing permeability of beetroot cell membrane.

This is an example of a good response that scored all 5 marks available.

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Examiner Comments

1ai. This candidate has identified a suitable factor and included the independent and dependent variable in the hypothesis. Reference to a significant correlation alone would have been a weak response, but they go on to suggest a clear trend. Ideally they should refer to what is measured in the investigation as their dependent variable, i.e. the intensity of the colour of the solution (or similar).
1aii. This response clearly shows what part of the membrane is affected and explains how the alcohol affects it. They also go on to explain the effect on permeability of the membrane and suggest a suitable trend that would be expected.

(a) (i) Suggest **one** factor that affects the permeability of the beetroot cell membrane.

Write a hypothesis for this investigation that the student could test.

(2)

Factor The thickness of beetroot's cell membrane.

Hypothesis The thicker the membrane of beetroot cell, the intensity of red colouration in the distilled water will be lesser.

(ii) Use your biological knowledge and understanding to explain and justify this hypothesis.

(3)

Beetroot's cell membrane is a semipermeable membrane which allows only certain ions or molecules to get into and out of cell. Membrane is made up of a layer of matrix like protein structure, mosaic pattern. A within this matrix, there are many ~~glyto~~ glycolipids and pore protein. As the membrane's matrix is very thick, not all the red liquid can pass out as it takes time. ~~as~~ and also due to the smaller surface area to volume ratio. Movement of liquid is only till equilibrium reached.

This response scored 0 marks.

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Examiner Comments

This is an example of a candidate with a relatively common misconception that cell membranes may be different widths.

(a) (i) Suggest **one** factor that affects the permeability of the beetroot cell membrane.

Write a hypothesis for this investigation that the student could test.

(2)

Factor: Temperature of water bath. ~~distilled water~~

Hypothesis: ~~Beetroot~~ Permeability of beetroot cell membranes increases as temperature increases.

(ii) Use your biological knowledge and understanding to explain and justify this hypothesis.

(3)

As temperature increases, cell wall is broken down. More pigment molecules are able to diffuse across ~~through~~ cell membrane as the enzymes in cell are denatured.

Intensity of red colouration in the distilled water increases.

This response scored two marks for ai) but no marks for aii).

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Examiner Tip

In preparing for this paper 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.

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Examiner Comments

This response illustrates another couple of common errors.
1. They refer to the cell wall rather than the cell membrane.
2. They describe the affect of temperature on enzymes in the cell rather than any component of the cell membrane.
3. They could have scored a mark if they had been clear what was happening to the pigment (belatin) molecules i.e. they were leaking from the vacuoles (cells).

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Examiner Tip

In explaining a hypothesis make sure that you are clear about what is being affected (in this case the components of the cell membrane, causing the membrane to become more permeable and allow the belatin pigment to leak out of the cell into the solution = the dependent variable) and how it is being affected by the factor that is changing (the independent variable).

Question 1(b)

1bi. Most candidates successfully identified at least one variable to control and many got two. The most common mistake here was using a vague term such as amount or size as a variable rather than something that could be more precisely measured like volume, mass or surface area.

1bii. A number of candidates did not relate the control method to their answer in (i).

Those that stated size gained a mark if they stated using a cork borer and then cut the cylinder to a stated length. However the name cork borer escaped some.

A lot of candidates gave a very general response to the last part of the question. They did not understand that the answer had to relate directly to effect on the results.

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Examiner Comments

Although size was not allowed, they did clarify length to salvage a mark for bi. Amount of water was too vague for a second mark for the factors, but they were given credit in part (bii) for measuring the 'amount'. The explanation of the effect also reveals a common misconception that osmosis is the process involved. They also fail to say how the colour intensity will be affected (e.g. decrease with increasing volume of water).

(b) (i) State **two** factors that need to be controlled in this investigation. (2)

1 The size of the beetroot, (length of the beetroot ~~column~~ must be same)

2 The amount of distilled water used for each temperature should be kept constant

(ii) Suggest how **one** of the factors you have stated in (b)(i) could be controlled. If this factor had not been controlled, what effect would it have on the results? (2)

How the factor is controlled 2) The amount of distilled water Measure using a measuring cylinder a known ~~the correct~~ amount, say $50cm^3$ of distilled water and then pour into the testube with the beet root.

Effect on the results if this factor is not controlled If factor is not controlled the amount of content coming out of the cell will be affected. More water causes more content to ~~[illegible]~~ spill into water. less water less content. The intensity measured from the colorimeter will be affected.

This response scored one mark for each part of the question.

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Examiner Tip

Please note measuring volume with a measuring cylinder was just accepted here, but A level candidates should know that this is insufficiently precise for most measurements of volume.

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Examiner Comments

bi) size and amount were too vague, particularly as the size here relates to the beetroot cells!
bii) This response gets the mark for measuring the same volume of water with a pipette and going on to successfully describe what would happen to the measurement of the dependent variable if the volume had been increased.

(b) (i) State **two** factors that need to be controlled in this investigation.
(2)

1 The Size of the beetroot cells

2 The amount of distilled water in the test tubes

(ii) Suggest how **one** of the factors you have stated in (b)(i) could be controlled.
If this factor had not been controlled, what effect would it have on the results?
(2)

How the factor is controlled you can measure accurately the amount of distilled water in the test tube by using a measuring pipette. This will allow you to measure out exactly the same volume of water being put in the test tubes.

Effect on the results if this factor is not controlled The colorimeter will get different readings, as ~~there~~ if there is more water in one test tube, the pigment will be more dilute, therefore the colorimeter will not get an accurate reading of light absorption.

This response scored no marks for part bi), but two marks for bii).

Question 1(c)

Many candidates did not understand the idea of systematic error.

Many candidates stated/identified the dependent variable and these, on the whole, referred to calibration of the colorimeter to reduce a systematic error. However, a lot of candidates did not stated/identified the dependent variable and consequently just listed general comments about reducing errors in the investigation.

(c) Describe how you could reduce systematic errors in the measurements of the dependent variable in this investigation.

(2)

Before measuring the intensity of red colouration in the distilled water with a colourimeter, you first have to calibrate the colourimeter. You also have to use a green filter. Also, before placing beetroot pieces in alcohol, rinse them with water to remove pigment from any broken cells

(Total for Question 1 = 11 marks)

This is an example of a good response scoring both available marks.

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Examiner Comments

This response identifies the dependent variable and demonstrates a good understanding of systematic errors in the context of this experiment, recognising that calibration, filter selection and rinsing will all help to reduce systematic errors.

(c) Describe how you could reduce systematic errors in the measurements of the dependent variable in this investigation.

(2)

To control the temperature you could use a thermometer. A thermometer gives you the exact reading of the temperature. ~~used~~ This reduces systematic errors because you know what the temperature is and can lower it or increase it to fit the course of the experiment.

(Total for Question 1 = 11 marks)

This response scored no marks.

ResultsPlus

Examiner Comments

This is typical of many responses that focussed on better measurement of the independent or control variables and did not therefore demonstrate an awareness of what a systematic error is.

(c) Describe how you could reduce systematic errors in the measurements of the dependent variable in this investigation.

(2)

Repeat the experiment at least 3 times at each different PH, to eliminate errors in human reaction time for example or in wrong reading of the calorimeter.
Also make another student to repeat the experiment, so that results can be compared

(Total for Question 1 = 11 marks)

This response scored no marks.

ResultsPlus

Examiner Comments

This is another typical wrong response where candidates consider repetition as the way to reduce errors, although this will often not reduce the effect of a systematic error.

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Examiner Tip

Under Practical Biology Skills in the specification it states: ‘Possible systematic errors and random errors in generating results are identified and explained.’
Candidates should therefore be supported in identifying systematic and random errors in their practical work, particularly the core practicals identified in the specification.

Question 2(a)

A large number of candidates do not know that you have to have the words 'no significant difference' (or similar) in a null hypothesis such as this. There was also a significant number of candidates who compared the two variables in the hypothesis (altitude and number of red blood cells in the blood) rather than comparing the two sets of measurements (number of red blood cells in blood before and after mountain training).

(a) Write a null hypothesis for this investigation.

(1)

There is no ~~the~~ significant difference ~~between~~ in the no. of RBC $\times 10^{12}$ / dm^3 of blood before mountain training and after mountain training.

A good response scoring the one mark available.

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Examiner Comments

This response correctly states a suitable null hypothesis for this investigation.

(a) Write a null hypothesis for this investigation.

(1)

Training for two weeks at a mountain camp, 2000 m above sea level ~~does~~ does not have an effect on the number of red blood cells in athletes' blood.

This response correctly states a suitable null hypothesis for this investigation. An example of a response not worthy of the mark.

ResultsPlus

Examiner Comments

This response does not score the mark as it does not refer to 'no significant difference' rather than just no effect.

Question 2(b)

This question was answered well by the large majority of candidates. However, the quality of tables varied considerably. The main errors that lost candidates marks were with units in the column headings and in a few cases the correct sign for the calculated differences.

(b) Calculate the difference in the number of red blood cells before and after the mountain training for each athlete. Prepare a table to display the raw data and your calculated values.

(4)

Athletes	number of red blood cells before mountain training $\times 10^{13}$ per dm^3	number of red blood cells after mountain training $\times 10^{12}$ per dm^3	Differences in the number of red blood cells. ($\times 10^{13}$ per dm^3)
A	5.0	4.9	−0.1
B	5.1	5.3	0.2
C	4.9	5.7	0.8
D	5.3	5.5	0.2
E	5.4	5.6	0.2
F	5.0	5.4	0.4
G	4.8	5.3	0.5
H	5.1	5.6	0.5
I	5.5	5.1	−0.4
mean	5.12	5.38	

A typical response that scores 4 marks out of 4.

ResultsPlus

Examiner Comments

A typical response that manages to meet all of the marks required for the question.

(b) Calculate the difference in the number of red blood cells before and after the mountain training for each athlete. Prepare a table to display the raw data and your calculated values.

(4)

Athletes	Number of red blood cells x 10^{12} per dm3		
	Before mountain training	After mountain training	Difference of number of red blood cells.
A	5.0	4.9	0.1
B	5.1	5.3	0.2
C	4.9	5.7	0.8
D	5.3	5.5	0.2
E	5.4	5.6	0.2
F	5.0	5.4	0.4
G	4.8	5.3	0.5
H	5.1	5.6	0.5
I	5.5	5.1	0.4

This response scored three of the four marks available.

ResultsPlus
Examiner Comments

This illustrates one of the typical errors where the candidate has ignored the negative values for the differences with candidates A and I.

(b) Calculate the difference in the number of red blood cells before and after the mountain training for each athlete. Prepare a table to display the raw data and your calculated values.

(4)

Athletes label	Number of red blood cells x 10^{12} per dm^3		
	Blood before Mountain training	Blood after Mountain training	
A	5.0	4.9	
B	5.1	5.3	
C	4.9	5.7	
D	5.3	5.5	
E	5.4	5.6	
F	5.0	5.4	
G	4.8	5.3	
H	5.1	5.6	
I	5.5	5.1	
	46.1	48.4	Total

This table only scores one of the four available marks.

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Examiner Comments

This table has not displayed the required values stated in the question i.e. the raw data and the calculated values for the differences. As a result the table is not suitable and the marks for calculating the differences are not available.

(b) Calculate the difference in the number of red blood cells before and after the mountain training for each athlete. Prepare a table to display the raw data and your calculated values.

(4)

Athletes	# of red blood cells At sea level	# of red blood cells Above sea level	difference
A	5.0	4.9	-0.1
B	5.1	5.3	0.2
C	4.9	5.7	0.8
D	5.3	5.5	0.2
E	5.4	5.6	0.2
F	5.0	5.4	0.4
G	4.8	5.3	0.5
H	5.1	5.6	0.5
I	5.5	5.1	- 0.4
Mean value	5.1	5.4	0.3

This response scores three of the four available marks.

This response has lost a mark through not including suitable units in the column headings.

Question 2(c)

Most candidates gained two marks for correctly understanding and applying the term anomalous result. A few candidates lost marks by not explaining why they had decided a result was anomalous, instead they provided biological explanations about what could have caused an anomalous result e.g. disease.

(c) Identify an anomalous result in the data from the athletes.

(2)

Athlete 'I' has a negative change, ~~-0.4~~ -0.4

Give **one** reason for your answer.

Almost all other athletes has an increase in the red blood cell count while athlete I has a decrease.

This response scored both available marks.

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Examiner Comments

This was the most common response to this question.

(c) Identify an anomalous result in the data from the athletes.

(2)

Subject C had an increase d 0.8×10^{12} cells/dm^3

Give **one** reason for your answer.

Because the magnitude of the value of the difference is very much different from all the others. The range of differences in other individuals is 0.2 to 0.5. ~~There are two decreases in two subject, (which makes the~~

This response scored both available marks.

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Examiner Comments

This response was also worthy of full credit demonstrating that anomalous results are any results that do not fit the general trend.

Question 2(d)(e)

2d. Almost all candidates produced the right calculation. The main error here was missing units. A few candidates, incorrectly, gave answers to 3 or more decimal places, and a few made mistakes in rounding down instead of up.

2e. The majority of candidates produced a good bar chart showing the results. Some missed out 'mean' when labelling the y axis or failed to give the units properly. Few candidates included error bars, which are a useful addition when plotting means to show the range of results obtained. A few candidates produced graphs of a very small, unsuitable, scale, or used very awkward scales (e.g. going up 0.7 per 10 squares) often resulting in plotting errors.

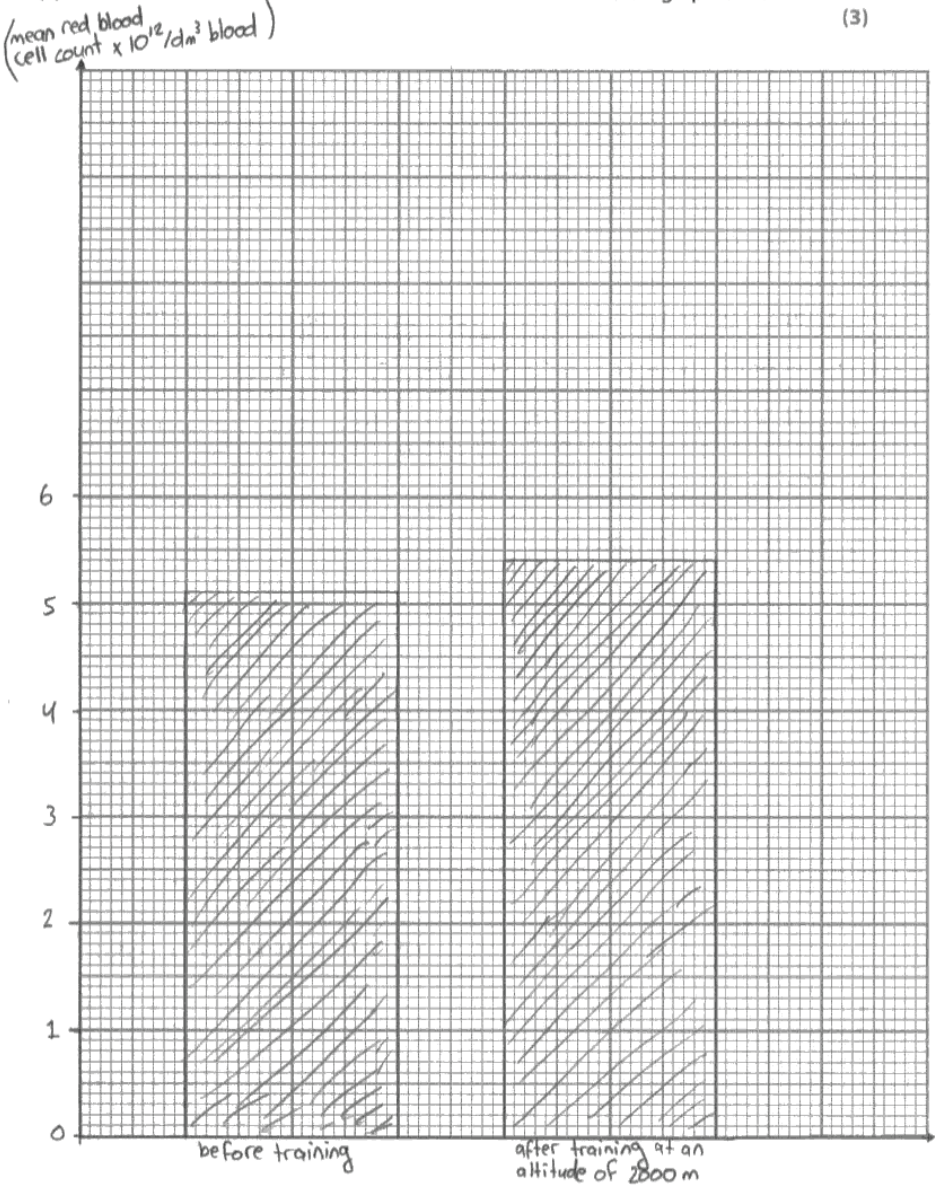
(d) Calculate the mean number of red blood cells per dm^3 of blood for the group of athletes before and after mountain training.

(2)

Mean number of red blood cells before training $5.1 \times 10^{12}/dm^3$ of blood

Mean number of red blood cells after two weeks training at 2000 m $5.4 \times 10^{12}/dm^3$ of blood

(e) Present the calculated mean red blood cell counts in a suitable graphical form. **(3)**



This response scored all five marks available.

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Examiner Comments

This is an example of a good response scoring maximum marks for each section.

(d) Calculate the mean number of red blood cells per dm^3 of blood for the group of athletes before and after mountain training.

(2)

Mean number of red blood cells before training $5.1 \times 10^{12} \cdot dm^{-3}$

Mean number of red blood cells after two weeks training at 2000 m $5.5 \times 10^{12}\ dm^{-3}$

mean before training = $\frac{5.1+4.9+5.3+5.4+5.0+4.8+5.1}{7}$

$= \frac{35.7}{7}$

$= 5.1 \times 10^{12}\ dm^{-3}$

mean after training = $\frac{5.3+5.7+5.5+5.6+5.4+5.3+5.6}{7}$

$= \frac{38.4}{7}$

$= 5.5 \times 10^{12}\ dm^{-3}$

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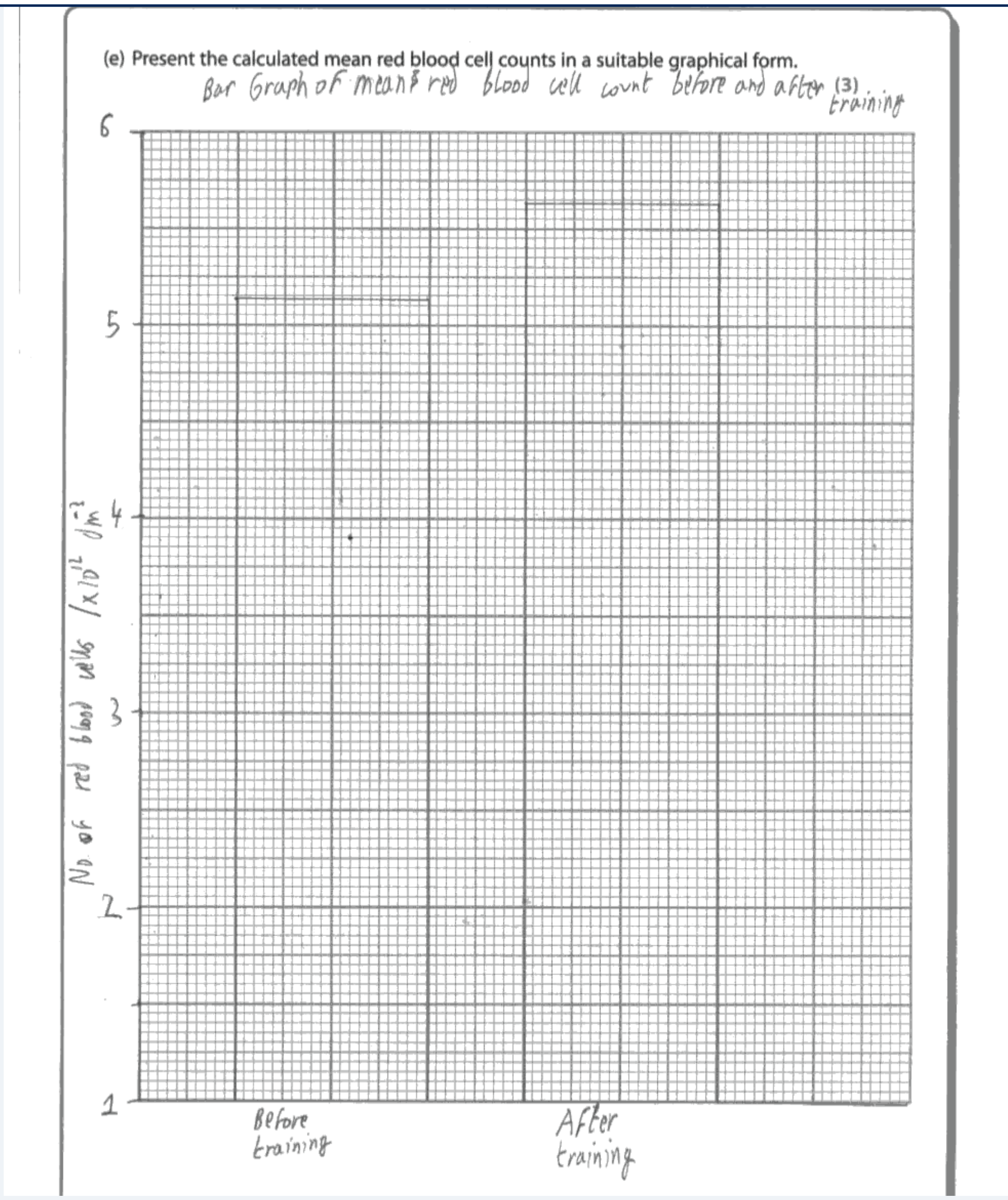
Examiner Comments

2d) The second difference has been calculated incorrectly, as they have chosen to exclude a couple of the athletes from their calculation, without providing a clear justification.
2e) although we would allow an error carried forward for the graph, the second bar was still plotted incorrectly and the axis should have been labelled as the mean number of red blood cells per litre of blood as this is what has been plotted.



This response scores one mark (out of two) for 2d) and one mark (out of three) for 2e.

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Examiner Tip

Follow the question directions carefully for calculations and make sure you remember to bring your calculator into the exam.

When plotting graphs, chose a scale that will spread your data over the majority of the page, but use a simple scale that uses the decimal paper to make plotting easier and quicker. Remember that you need to clearly show that you have broken the axis between 0 and your next labelled data line if you are just plotting the top of the data range to magnify the differences between the two sets of data (e.g. plotting 5.0 upwards). Finally make sure axes are carefully labelled with a description of what the variable is and include the correct SI units.

Question 2(f)

The majority of candidates were able to interpret the significance of the calculated t value and the critical value table at the correct significance/confidence level. However, the majority of candidates only stated their conclusions in terms of the null hypothesis rather than a conclusion for the investigation identifying what the effect of the altitude training actually is.

A very small number of candidates clearly did not understand the statistics at all, despite this being a clear requirement of the specification for unit 6 (interpretation and evaluation).

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Examiner Comments

This is an example of a typical response scoring all three marks where the candidate has identified the effect of altitude training on the number of red blood cells, correctly interpreting the results of the statistical calculation using 5% confidence levels.

(f) A *t*-test was applied to the data to test the null hypothesis.
The calculated value of *t* was 2.24.
The table below shows the critical values of *t* with 16 degrees of freedom, at different significance levels.

Significance level (p)	0.20	0.10	0.05	0.01	0.001
Critical value of *t*	1.34	1.75	2.12	2.92	4.02

What conclusion can be drawn from this investigation? Use the information in the table to explain your answer.

(3)

The calculated value of t is higher than the critical ~~vat~~ value of t at the 95% confidence level. There the null hypothesis is rejected and the hypothesis is accepted. ~~that~~ There is a significant difference between the mean number of red blood cells in per dm³ of blood in the athletes before and after training at 2000m above sea level for two weeks. It can be concluded, from this investigation, that the mean number of red blood cells increases ~~after~~ after training at 2000m above sea level as the mean number of red blood cells in per dm³ of blood is greater in athletes after training at 2000m above sea level.

(Total for Question 2 = 15 marks)

This response scored all three marks available.

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Examiner Comments

This is an example of a typical response scoring two marks for correctly interpreting the results of the statistical calculation using 5% confidence levels. However, they have failed to identify what the trend/ difference in the results caused by the altitude difference is.

(f) A *t*-test was applied to the data to test the null hypothesis.
The calculated value of *t* was 2.24.
The table below shows the critical values of *t* with 16 degrees of freedom, at different significance levels.

Significance level (p)	0.20	0.10	0.05	0.01	0.001
Critical value of *t*	1.34	1.75	2.12	2.92	4.02

What conclusion can be drawn from this investigation? Use the information in the table to explain your answer.

(3)

The calculated t value (2.24) is greater than the critical t value (2.12) at 95% confidence level ($p = 0.05$). Hence, there is a significant difference between the number of red blood cell counts per dm^3 blood after training at different sea level i.e. normal sea level and 2000 m above sea level.

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Examiner Tip

If asked to draw a conclusion and there is a difference/trend in the results - don't forget to say what it is.

(Total for Question 2 = 15 marks)

This is typical of the majority of responses that only scored two of the three available marks.

Question 3

This question achieved a very wide range of marks with many candidates recognising the features of a good investigation, but many candidates clearly did not know where to start or what to consider.

3a. Many candidates did not understand this part of the question and wrote general statements to do with the method.

Many candidates trotted out descriptions of how to do random sampling with quadrats without relating it to the question in any coherent way.

Sometimes it was possible to confirm that the sampling was to compare the differences in yield with difference in seed sowing density by looking at the answer to 3c.

Safety and ethical issues varied but were often vague. Insect bites, snake bites, plant allergies and soil pathogens made up the bulk of the safety issues. Ethical issues were on the whole too vague i.e. avoid damaging the environment or trampling plants/insects.

3b. There were some good responses to this part of the question. However, many candidates clearly do not understand the value and purpose of preliminary work. Very few candidates identified the need to determine an appropriate dependent variable.

3c. Many candidates had trouble with clearly defining a suitable dependent variable for the investigation. Many were comparing differences in density of germinating seeds to the density of sown seeds rather than percentage germination relative to sowing density. Few realised it was a question of measuring something about the plant growth, for example, dry mass in g per unit area. Describing differences in sowing density for an independent variable was usually more satisfactory although many candidates did not provide specifics about planting the seeds at different densities and too many students just referred to planting seeds their seeds 'too far apart' and 'too close together' as their independent variable. Most candidates gained at least two marks for identifying two variables which needed to be controlled but many candidates failed to explain how to control them. Some gave details of how to measure a range of abiotic factors without making it clear how doing this would help to cope with variation. Several candidates wrote at length about variables to control and very little else so their method was incomplete.

The quality of written communication was very variable. Many reports were disorganised and some where very difficult to follow. The use of scientific vocabulary was variable. Spelling varied considerably. Grammatical errors were due to the disjointed and bitty descriptions given by many candidates.

3d. Some candidates did not understand what was expected of this section and just used it to finish the method here and put what they would measure etc.

Tables were often poor with correct headings missing. Means were often considered but not always correctly. Graphs varied considerably. A number of candidates chose the correct format for the data suggested from their table. A number of candidates chose the correct statistical test for their data, t tests and Spearman's rank being the main ones chosen. However many students did not know which test was suitable for the data as they had presented and proposed statistical tests that were inappropriate to what they were proposing to do e.g. suggesting a t-test for a scatter diagram.

3e. Most candidates gained a mark for saying there were abiotic factors that were difficult to control unless one used a greenhouse. Some of the better responses recognised other limitations such as the effect of animals eating the seeds, that greenhouse conditions might not correspond to those in the field and the difficulties of ensuring genetically uniform seed. Few scored all three marks. A significant number of candidates referred to predators of the seeds.

(a) An outline of a suitable sampling technique for this investigation and whether there are any safety and ethical issues you would need to consider.

(3)

For this investigation, I will use a line transect to observe the seeds of the turnips. I will need to make sure that sun screen is worn to protect myself from the sun rays. Appropriate shoes must be worn as there may be rocks on the ground so ~~a~~ hard wearing shoes need to be ~~work~~ worn to protect you from stepping on something sharp. Becareful to not stand on any plants as this will kill them.

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

(4)

Use a guide book which has pictures of plants to distinguish what are parsnips. Take a random walk along the ground where you will plant the parsnips to make sure that ~~they~~ there are no other plants which may affect the growth of the parsnips. Plant one parsnip seed to see how much water & other factors it needs to start growing. Determine how much is too close or too far away by observing other parsnips which are being grown. This will also determine that this is the right time of year to grow parsnips.

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

(10)

Find ~~two~~ three areas of the same size & turn over the soil in each to remove the larger stones & other plants & also makes the ground ~~more~~ easier to plant seeds in it. Mark these areas as the area which has the seeds too close, too far away & the control area. There needs to be a control area to make sure that it is the distance which is affecting the growth of the parsnips. Buy a packet of parsnip seeds & have 10 seeds in each area which means that a statistical test can be done later on. By having the same seeds from one packet makes the ~~experiment~~ investigation more reliable as they are likely to be from the same parent plant. In the first area (too close) plant the seeds in a row with the same distance between them of 10cm. The seeds need to be planted at the same depth everytime of 4cm. Once the seeds have been planted they should be covered with the same soil (from a soil bag - same ingredients for reliability) & then watered using a measuring ~~jug~~ cylinder with the same volume of water. The same procedure needs to be done with the area with the parsnips too far away & the control. The seeds in the too far away area need to be the same distance of 1m. This can be measured using a measuring tape. For the control area, the distance between the seeds will be ~~30cm~~ 45cm which is halfway between the other two areas. Make sure the same depth of putting the seed into the soil is constant. Once all the seeds have been watered make sure that there are two abiotic factors the same. In this investigation this will be the amount of rainfall & light intensity. Leave the seeds for 72 hours to grow & come back at the same time to monitor the progress. Count the number of parsnips which have emerged from the soil. A pasnip has emerged from the soil when it is at least 1cm out of the soil. Measure using a ruler. Make sure that the results have been recorded in a suitable table. By using a systematic approach of a line transect you are able to move down the rows of the area to count how many parsnips there are without harming any another living organism as you are keeping to a path. Each area will be repeated 3 times in order to draw up reliable evidence.

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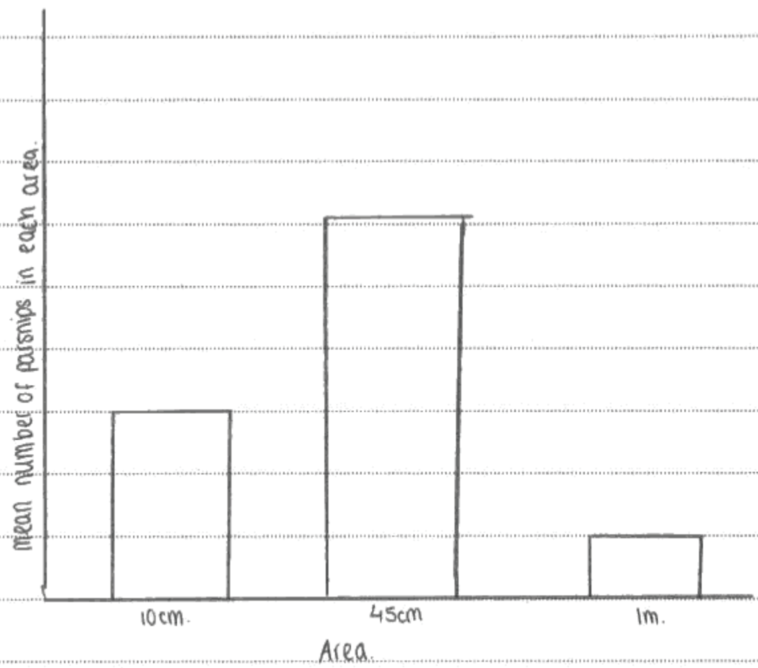
(d) A clear explanation of how your data is to be recorded, presented and analysed, in order to draw conclusions from your investigation.

(4)

A statistical ~~or~~ test will be chosen, in this case it will be a ~~t-test~~ r-test as the mean ~~mean~~ number of parsnips will be counted in each area of the control, too close & too far away. The null hypothesis for this experiment will be, ~~the n~~ that there is no significant difference between the number of parsnips & the distance they are away from each other.

Area	number of parsnips of each area. 1	2	3	mean number of parsnips
10 cm between them				
45 cm between them				
1m between them				



ResultsPlus
Examiner Comments

This response achieved 3 marks (out of 3) for section a (although one mark came from the method section), 2 out of 4 for section b, 10 out of 10 for section c, 4 out of 4 for section d and 2 out of 3 for section e.
It helps to illustrate that covering general points regarding clear identification of variables (especially the dependent and independent variable) and issues around the prior planning, analysis and evaluation of an investigation can provide access to the majority of marks available.

(e) The limitations of your proposed method.

(3)

As we are working outside, we are not able to control all the abiotic factors like the pH of the soil or the amount of rainfall that falls on that area. This may affect the results. Other living organisms may eat the parsnip shoots before we get to it (72 hours). We may think that it will not grow while it may have been eaten. The seeds we get from the packet may already be dead which means we will think that it is the distance between them.

(Total for Question 3 = 24 marks)

TOTAL FOR PAPER = 50 MARKS

This is an example of a good response that scored 21 of the 24 marks available.

ResultsPlus
Examiner Tip

Read the criteria for the unit 6 practical biology and investigative skills carefully and you will get a good idea of the sort of things you need to consider when tackling a planning question like this. Although you are not required to carry out a specific statistical test you should be aware of which types of test are appropriate for which types of data so you can plan to collect sufficient data for analysis.

(a) An outline of a suitable sampling technique for this investigation and whether there are any safety and ethical issues you would need to consider.

(3)

- Sampling along a transect at regular intervals.
- Ensure that the seeds are originated from the same species.
- Minimum disturbance to the environment and soil.

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

(4)

~~Practice proposed method - method~~

- Practice proposed method.
- Consider what other variables need to be taken into account.
- Ensure the seeds are from the same species.

.

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

(10)

- Using transect.
- Sample along a regular interval.
- check how many data ~~are~~ is related or the same with the statistical test.
- Ensure that the seeds are from the same species.
- Apply t test.
  - check the pH of the soil by using pH meter.

  ~~[illegible]~~

  - Pesticides is sprayed to the crops to avoid pests.

ResultsPlus
Examiner Comments

This response shows that the candidate understood several of the elements of investigation design, but failed to flesh out the details, particularly in the main planning section. The dependent and independent variables have not been clearly defined and as a result of the brief and disjointed style no credit for quality of written response has been awarded.
3a Only just got 1 out of 3 marks available.
3b 3 out of 4 marks available.
3c 2 out of 10 marks available.
3d 0 out of 4 marks available.
3e 1 out of 3 marks available.

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

(4)

- A clear table which matches method of description with headings and units.
- Mean calculated from repeated data.
- Use correlation tests.
- ~~Scatter graph~~ Draw a ~~is used to~~ scatter graph.

(e) The limitations of your proposed method.

(3)

- Difficult to control all the abiotic factors that affect the growth of the seeds.
- Difficult to divide the distance ~~for~~ for ~~sowing~~ sowing the seeds.
- Risk of disturbance to the ecosystem and ~~[illegible]~~ habitat.

(Total for Question 3 = 24 marks)

TOTAL FOR PAPER = 50 MARKS

This response scored 7 out of the 24 marks available.

Grade Boundaries

Grade	Max. Mark	a*	A	B	C	D	E	N
Raw boundary mark	50	41	36	31	27	23	19	15
Uniform boundary mark	60	54	48	42	36	30	24	18

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