

Examiners' Report
June 2012

GCE Biology 6BI07 01

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Introduction

The general upward trend in performance on this paper seems to have peaked. Many students now seem to be clear about the requirements of the core practicals, although a significant number still struggle with experimental design concepts such as IV, DV, reliability and validity.

Much more attention still needs to be paid to what the question is actually asking, or implying. One of the biggest failings is not answering questions in a comparative way when required. Rats vs *Daphnia* and drugs vs acupuncture were both required on this paper but many answered in a wholly non comparative way.

Another perennial concern is the clear attempt by many to use a past mark scheme to answer what they are assuming is the same question; candidates need to know that this will never be a sensible strategy.

Question 1 (a) (i)

This and the next question were often muddled by candidates, practical considerations being stated for ethical and vice versa.

- 1 In humans, lactic acid is produced by respiration when there is very little oxygen present. This lowers the pH of the blood which has an effect on the heart rate.

A student decided to investigate the effect of lactic acid on heart rate. Studying this in humans is difficult so he used water fleas (*Daphnia sp.*).

Daphnia were placed in solutions of different concentrations of lactic acid, kept at 25 °C. Their heart beats were observed using a microscope and the heart rates were recorded. The procedure was repeated three times for each concentration.

- (a) (i) Suggest **two** practical reasons why *Daphnia* was chosen for this investigation. (2)

- 1 they are transparent and their internal organs can be seen.
- 2 ~~they have a simple nervous system~~ *Daphnia* are abundant and can be easily obtained.



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Examiner Comments

A good two mark answer.

- (a) (i) Suggest **two** practical reasons why *Daphnia* was chosen for this investigation. (2)

- 1 The heart of *Daphnia* is ~~not~~ visible easily without any dissection.
- 2 ~~it is available~~ its heart is same as human heart, when it comes to investigating heart rate with different factors.



ResultsPlus
Examiner Comments

This is a common answer for one mark, that the heart can be seen without the practical problem of a dissection. However, the idea that the heart is like that of the human is not correct.



ResultsPlus
Examiner Tip

There is tendency to assume that all animals, indeed sometimes all living things, are like humans, just because they and humans are both alive. Assume that all organisms are different unless you have good reason to believe that this is not the case.

Question 1 (a) (ii)

(ii) Discuss the ethical implications of using *Daphnia* in this investigation.

(2)

Though we use *Daphnia* considering the above mentioned reasons, it is still a living organism and if its heart rate increases too much, it may die. Also, it can still feel pain as it has a nervous system.



ResultsPlus

Examiner Comments

A common error here was to suggest that *Daphnia* can feel pain, rather than say that an ethical consideration is that this is a possibility. This answer also demonstrates another error which is to say that the animal is a living organism and link this with possession of a nervous system and/or an ability to feel pain. Candidates rarely said it is an animal in this context.

(ii) Discuss the ethical implications of using *Daphnia* in this investigation.

(2)

Daphnia are invertebrates which have a less developed nervous system than vertebrates meaning effects such as pain will be reduced felt less. However, *Daphnia* can not give consent to be tested upon.



ResultsPlus

Examiner Comments

An excellent answer discussing both the likelihood of reduced sensitivity to pain and the lack of consent able to be given, gained this candidate two marks.

Question 1 (a) (iii)

On this question many got one mark for one or other parts of the answer, but only a small percentage of candidates gained two marks.

(iii) Explain why the temperature was kept at 25 °C in this investigation.

(2)

The temperature was kept at 25°C as it is a favourable temperature for ~~enzyme activity~~ ^{the} enzyme activity. The temperature was also ~~kept~~ kept constant to ensure that it did not have any effect on the heart rate of Daphnia.



ResultsPlus Examiner Comments

This is a two mark answer. Answers, such as this one, which addressed why temperature is kept constant AND why at this particular temperature, were rare.



ResultsPlus Examiner Tip

Always look at the number of marks available for a question. Here an available mark of two, indicates two points are needed.

(iii) Explain why the temperature was kept at 25 °C in this investigation.

(2)

Temperature change will change the heart rate of the Daphnia. This will produce unreliable results.



ResultsPlus Examiner Comments

This is typical of many answers which only addressed why temperature is kept constant and failed to address the other aspect, why at 25 C.



ResultsPlus Examiner Tip

Remember, 2 marks equals two points that you need to make.

Question 1 (a) (iv)

This should have been a simple experimental design but in the event less than half gained any marks at all.

(iv) Apart from temperature, name **one other** variable that should be controlled. Describe how it could be controlled. (2)

Variable Volume of lactic acid solution

How it could be controlled by ~~using~~ using a measuring cylinder or pipette to get accurate ~~answers~~ results



ResultsPlus Examiner Comments

By far the most common answer given was that lactic acid volume was a control variable. The concentration is the IV in this experiment and the volume will have no effect.

(iv) Apart from temperature, name **one other** variable that should be controlled. Describe how it could be controlled. (2)

Variable pH

How it could be controlled using a buffer at optimum (constant) pH of 7.



ResultsPlus Examiner Comments

Candidates will often try and get away with stock answers. This is probably what led many to suggest pH as a control variable here. Lactic acid concentration, and thus pH, is the IV in this case. This may indicate a lack of thought, which is the main skill often lacking in exams. Remembering that many marks are available for things other than a memory of some facts is one of the greatest single actions which students could take to increase their performance.



ResultsPlus Examiner Tip

Remember, exams are much more than tests of memory.

Question 1 (b) (i)

It was intended that candidates took their cue as to the rounding of the calculated figure from all the others already in the table.

(b) To present the results of his investigation, the student calculated the means and the standard deviation for each concentration.

The means and standard deviation are shown in the table below.

Lactic acid concentration / arbitrary units	Heart rate of <i>Daphnia</i> / beats per minute				Standard Deviation
	1	2	3	Mean	
0.0	282	275	277	278	3.6 281.6
1.0	266	220	251	246	23.5 269.5
4.0	200	193	176	189	12.3 200.3
10.0	140	160	157	152.3	10.8 163.1
80.0	70	60	67	66	5.1 71.1

(i) Complete the table by calculating the mean heart rate for the lactic acid concentration of 10.0 arbitrary units. Show your working below.

(2)

$$\frac{140 + 160 + 157}{3} = \frac{457}{3}$$

$$= 152.3$$



ResultsPlus
Examiner Comments

This answer quoted to one decimal place is inappropriate and gains only one of the two marks available.

(b) To present the results of his investigation, the student calculated the means and the standard deviation for each concentration.

The means and standard deviation are shown in the table below.

Lactic acid concentration / arbitrary units	Heart rate of <i>Daphnia</i> / beats per minute				Standard Deviation
	1	2	3	Mean	
0.0	282	275	277	278	3.6
1.0	266	220	251	246	23.5
4.0	200	193	176	190	12.3
10.0	140	160	157	<u>152</u>	10.8
80.0	70	60	67	66	5.1

(i) Complete the table by calculating the mean heart rate for the lactic acid concentration of 10.0 arbitrary units. Show your working below.

(2)

$$\begin{aligned} 140 + 160 + 157 &= 457 \div 3 \\ &= 152,33 \\ &= \boxed{152} \end{aligned}$$



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Examiner Comments

A simple two marks here.

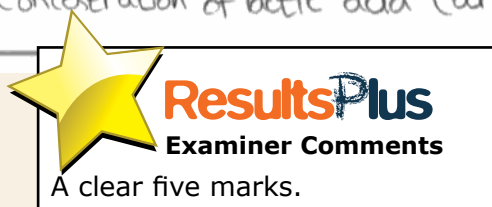
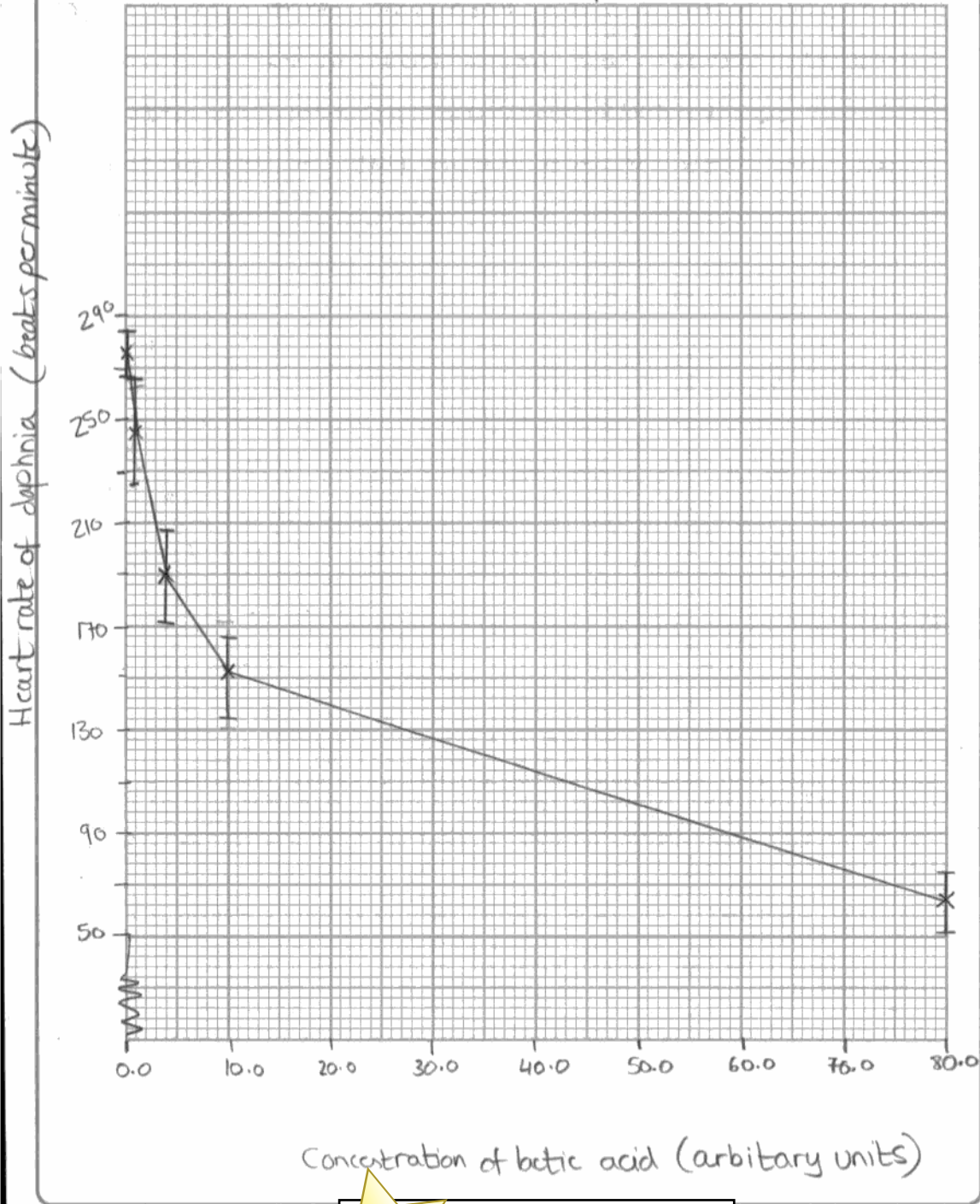
Question 1 (b) (ii)

The standard of graph plotting was very high this series. Very few chose other than a line graph, most got the axes the right way round and labelled them correctly. Plotting was accurate and the majority chose the sure route of dot to dot straight lines as here.

The main errors were in relation to plotting of SD. In some cases they were not symmetrical and a significant minority plotted the SD values separately. A small number this time failed to plot SD at all.

(ii) Plot a suitable graph to show the effect of lactic acid concentration on the mean heart rate of *Daphnia*. On your graph, include the standard deviations.

The effect of concentration of lactic acid on the heart rate of daphnia (5)



Question 1 (b) (iii)

Most candidates did not read describe and explain, or could give no sensible explanation, as only a small minority gained 2 marks.

This answer fills all space, no question about that, but simply answers the describe part. In the past marks would have been available for the kind of manipulation of data displayed here. This cannot be the case this time as the question has only two marks and one must be for the explanation part. This shows, amongst other things, poor exam technique, part of which is looking at the marks available and constructing an answer to take this into account. To address **describe** at great length, as here, and never address **explain** is clearly an example of this. This type of answer was extremely common.

(iii) Describe and suggest an explanation for the trend shown by this graph.

(2)

As lactic acid concentration increases, heart rate decreases, as well.

Greatest heart rate is at 0 concentration of lactic acid. Lactic acid is harmful to the heart. When O_2 concentration decreases Daphnia undergoes anaerobic respiration, producing more lactic acid and causing heart to beat even more slowly. At 80.0 lactic acid concentration, heart rate has reduced by 212 beats per minute from zero lactic acid concentration.



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Examiner Comments

This answer indicates that some candidates are not thinking clearly when applying memorised information, in this case 'there will be marks for manipulation'. This should be remembered as 'there *may* be marks for manipulation but each case needs to be assessed on its own merits'.

(iii) Describe and suggest an explanation for the trend shown by this graph.

(2)

As the lactic acid concentration increases, there is an overall decrease in the mean heart rate of the Daphnia per minute. As the lactic acid ~~con~~ concentration increased the pH of the surrounding solution falls. Due to this, enzymes ~~will no longer~~ responsible for respiration of cardiac muscle, ^{of the heart} will no longer be in their optimum pH. As a result these respiratory enzymes will be denatured and fewer enzyme substrate complexes are formed per second. Due to this, less energy is released for respiration of the cardiac muscle and mean heart beat rate per minute decreases.



ResultsPlus
Examiner Comments

An excellent answer which addresses both parts of the question and makes a good suggestion.

Question 1 (c)

This question clearly required a comparative answer, comparing and contrasting both the two sets of data and rats and *Daphnia*. Many were content to only describe the rate results and simply not address the question asked.

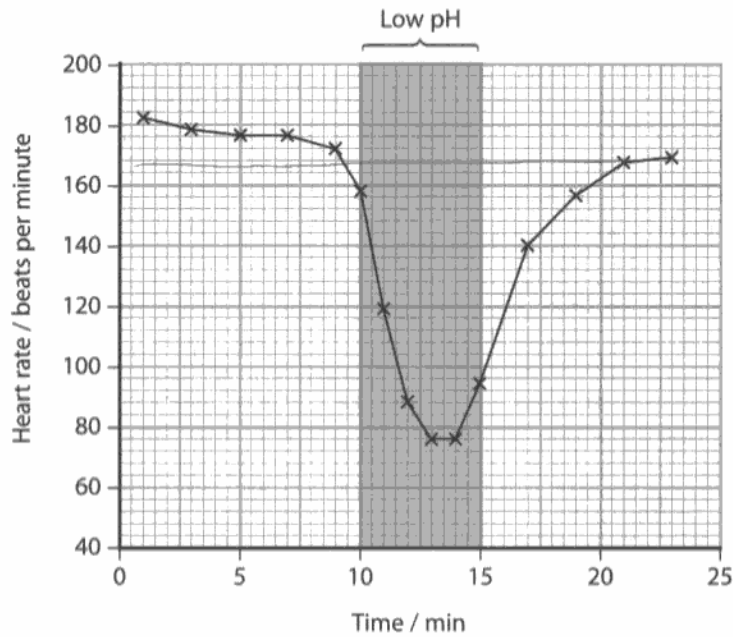
A small minority of the best candidates were able to give a balanced answer which addressed the aspects which supported the student conclusion, having understood that a low pH is achieved with an increased lactic acid concentration. It would then be rounded off with some reference to the differences in the studies (mammal vs invertebrate, isolated heart vs one *in situ*).

Many answers failed to pick up on the comparative nature of this question and answered a 'describe the effect of pH on rat heart rate' question.

Many questions on a biology paper require a comparative answer. Words and phrases such as 'alternatively', 'on the other hand' and 'in contrast' should be commonly used. In addition, arguments on both sides are often needed.

(c) In order to check the validity of his data, the student looked for information in the literature about lactic acid and heart rates.

He found the following graph on the effect of pH changes on the heart rate of rats in a peer-reviewed journal.



The shaded area on the graph shows when the isolated rat heart was subjected to a low pH.

Comment on the significance of these data for the student's *Daphnia* investigation.

(3)
 at first 5 min of the time the heart rate was decreasing very gradually, from 182 to 178 till it reached 10 minutes and dropped suddenly from 168 to 78, ~~then~~ it then rapidly increased again at about 15 minutes from 90 till 168 when it then was steady.



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 Examiner Comments

This was a poorly answered question gaining no points.



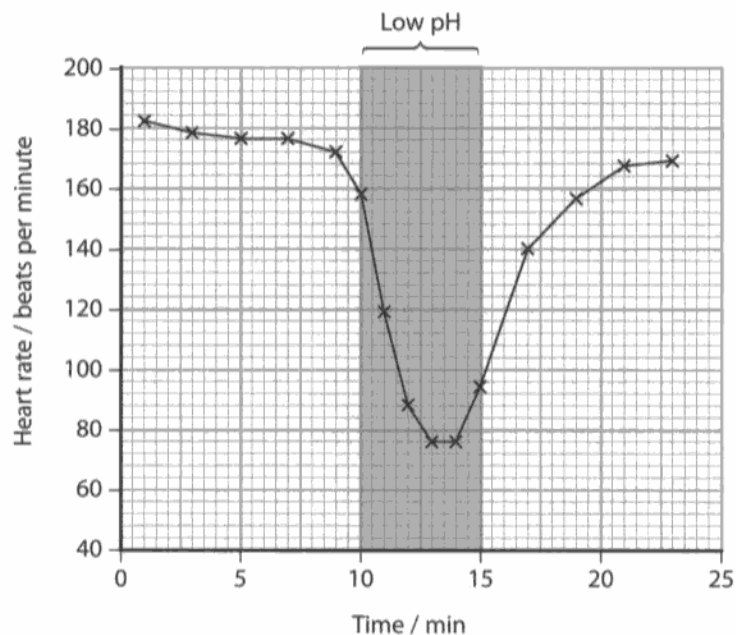
ResultsPlus
 Examiner Tip

In this case, the trend of pH lowering heart rate is supported BUT the work is done on a rat and some riders should be suggested for full credit.

(c) In order to check the validity of his data, the student looked for information in the literature about lactic acid and heart rates.

He found the following graph on the effect of pH changes on the heart rate of rats in a peer-reviewed journal.

pH ↓ [] Aerol ↑, no O₂



The shaded area on the graph shows when the isolated rat heart was subjected to a low pH.

Comment on the significance of these data for the student's *Daphnia* investigation.

(3)

~~The low pH shows~~ The low pH region shows the ~~low~~ reducing of heart rate. ~~The~~ The lowest heart rate is at 76 beats per minute. The highest heart rate is at around 182 beats per minute. Heart beat drop from highest to lowest is about 2.3 times. The low pH shows more lactic acid, this shows less oxygen, hence the heart rate reduce due to lack of O₂ and all activity of organism slow down. ~~and~~



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Examiner Comments

This response makes no attempt to answer the question asked. It simply describes the data, but does not relate it to the student data on *Daphnia*.

Question 2 (a)

- (a) A visit or issue report requires a problem to be identified.
Suggest a problem that this extract identifies.

(1)

Effectiveness of acupuncture treatment for pain relief.



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Examiner Comments

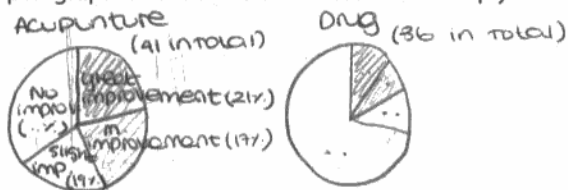
A straightforward correct answer which mentions both acupuncture and pain.

Question 2 (b)

Very few candidates appreciated that sample sizes are different. The display problem this causes can be solved.

- (b) Explain how you could make a comparative visual presentation of the data in the table in paragraph 4. Use a sketch or sketches to help you.

(2)



Given that the total number of patients was different for ^{each group.} A
I would use ~~two pie charts~~ ^{2 pie charts} to help me represent
the data, showing the numbers ~~in percentages~~
of the group. (colour coded).



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Examiner Comments

This candidate answers well, by the use of two pie charts.



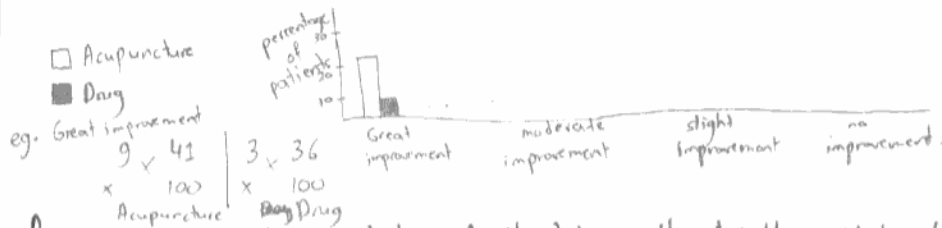
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Examiner Tip

Or you could plot percentages on a bar chart.

(b) Explain how you could make a comparative visual presentation of the data in the table in paragraph 4. Use a sketch or sketches to help you.

(2)



A comparative visual presentation of the data in the table could be done using a "bar-chart". The x-axis would show the improvement ^{the} patient had shown, e.g. great, moderate, slight or no improvement and the y-axis would show the percentage of patients. A bar would represent patients that made acupuncture and a second bar of different colour, patients who had taken a drug for each one of the improvements. This way we could compare the difference in the percentage of patients that have shown each improvement ~~by doing~~ by doing



ResultsPlus

Examiner Comments

This answer uses the other solution to the different sample size problem by plotting percentages on a bar graph rather than raw numbers.

Question 2 (c)

Most candidates do not demonstrate how to write a proper reference so I would like to draw centres' attention to this statement in the previous report:

Centres are reminded that the assessment of this question is based on the criteria and support materials for the Visit/Issue report, viz: 'bibliography' given ie. most details of source, author, data, pages used,

(c) The student's bibliography is not arranged clearly. Part of the student's bibliography is shown below.

'In this report I used a paper, called Acupuncture versus medical treatment for migraine and muscle tension headaches by Loh and others from a peer reviewed journal published in 1984 called Neurology, Neurosurgery and Psychiatry. It was in Volume 47 and on pages 333-337.'

(i) Rewrite this in a suitable format for a bibliography.

(3)

Loh and others, 'Acupuncture versus medical treatment for migraine and muscle tension headaches', Neurology, Neurosurgery and Psychiatry, Vol. 47, pg. 333-337, 1984.

(ii) Apart from the format of the references in the bibliography, in what way is the bibliography incomplete?

(1)

The website source does not include the date on which it was visited.

Also, the source of the study entitled, 'Incidence of adverse effects during acupuncture therapy - a multicentre survey' has not been included.



ResultsPlus Examiner Comments

This answer does not put the date in the correct place and includes the term Vol and the words 'and others' instead of et al. This gains only one mark for the correct journal reference.

This is a common fault as many candidates more or less copy what they are given and gain zero for this approach. The best most could come up with, however, was to say that the date and time of the visit to the website was not recorded. This was given the mark.

(c) The student's bibliography is not arranged clearly. Part of the student's bibliography is shown below.

'In this report I used a paper, called Acupuncture versus medical treatment for migraine and muscle tension headaches by Loh and others from a peer reviewed journal published in 1984 called Neurology, Neurosurgery and Psychiatry. It was in Volume 47 and on pages 333-337.'

(i) Rewrite this in a suitable format for a bibliography.

(3)

In this report I used a paper, called Acupuncture versus medical treatment for migraine and muscle tension headaches by Loh and others from a paper peer reviewed journal in Volume 47, pages 333-337, published in 1984 called Neurology, Neurosurgery and Psychiatry.

(ii) Apart from the format of the references in the bibliography, in what way is the bibliography incomplete?

(1)



ResultsPlus Examiner Comments

This is an example of what many candidates did despite many clues given in the passage. There was a reference, which was not quoted in the passage and there was one quoted but not in the list.



ResultsPlus Examiner Tip

Practice referencing!

Question 2 (d)

This question was very poorly answered with the majority achieving no marks.

(d) Comment on the validity of the information presented in paragraphs 4 to 7.

(2)

The information in paragraphs 4, 5, and 6 are valid as they were found in peer-reviewed journals. One is not confident of the information in paragraph 7 as the source is not included in the bibliography, so one does not know whether the study was peer reviewed



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Examiner Comments

This candidate gains one for reference to the sources being peer reviewed.

(d) Comment on the validity of the information presented in paragraphs 4 to 7.

(2)

It is not very valid because it was not done on a bigger range of patients and because not all patients ~~were~~ ~~are~~ using acupuncture method had the drug method of treatment. Also a table was not constructed including the group using placebo. Also it writes that with acupuncture there are also side effects.



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Examiner Comments

This answer gains one mark for a comment about the shortcomings of the report.

Question 2 (e)

(e) Suggest **two** ways in which the study, as described in paragraph 4, could be improved.

(2)

Use same number of patients
Use patients of ^{with} same age



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Examiner Comments

This is all that was needed for the 2 marks.

Question 2 (f)

This was one of the best answered questions on the paper, with a large majority gaining 2 or 3 marks.

(f) The student writes about economic implications of acupuncture in paragraphs 8, 11 and 12.

Using the information in these three paragraphs, discuss the economic implications of the use of acupuncture in the treatment of pain.

(3)

Acupuncture if accepted as normal usual method of treatment in hospitals would decrease the need for pain relief drugs. This would mean amount spent on medication by patients would decrease but medication drug production manufacturers will be in huge loss. However research shows the total cost of acupuncture treatment would be higher than medication. This might be due to the need of many equipments and training of doctors which would cost a lot of money.



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Examiner Comments

An excellent answer which addresses the two sides of the argument that acupuncture might save on the cost of drugs but, in the end, will be more costly and with at least one reason for this given.



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Examiner Tip

Be always prepared to give two sides to an argument, especially where the command word is discuss.

Question 2 (g) (i)

- (g) (i) Using the information in the report, review the evidence for acupuncture as an effective treatment for pain.

(3)

In paragraph 4, total number of patients were 41 and nine had great improvement when acupuncture used as compared to three great improvements out of 36 when drug was used.

In paragraph 5, acupuncture was about 20% more effective than the placebo in relieving headaches.

In paragraph 6, frequency of headaches and pain relief drug consumption decreased after patients with tension type headache underwent acupuncture.



ResultsPlus Examiner Comments

This answer makes two good points about acupuncture effectiveness using data from the passage. The third mark could have been gained for saying that the 20% difference was not found to be significant.

- (g) (i) Using the information in the report, review the evidence for acupuncture as an effective treatment for pain.

(3)

In the first study, the statistics show that half of the ~~some~~ patients who used acupuncture had either, slight, moderate or great improvement while only a quarter of the drug patients had slight, moderate or great improvement. Therefore telling us it's quite effective. The second study though shows there ^{was} ~~is~~ no really difference between the placebo treatment and acupuncture, showing the effectiveness is not very significant.



ResultsPlus Examiner Comments

Two marks from discussion, using data, of the effectiveness of acupuncture against drugs and against a placebo.

Question 2 (g) (ii)

It was very worrying that over half of the candidates think that a placebo is some form of treatment!

- (ii) With reference to the student's report, discuss the alternative solution to the use of acupuncture in the treatment of pain.
Give the numbers of the paragraphs, in the report, you have used.

(3)

An alternative solution to the use of ~~of~~ acupuncture is the use of placebo. This was found in paragraphs 5 and 6. Acupuncture is ^{20%} more effective than placebo in the treatment of pain, but the difference was not significant. The frequency of headaches and pain relief drug consumption decreased significantly with time after the two treatments and the results showed that there is no significant difference between acupuncture and placebo and this shows that placebo is also effective and can be used instead of acupuncture.



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Examiner Comments

This answer is typical of many. The candidate has simply not understood what a placebo is and suggests it is a form of treatment. Such answers gained no marks.

- (ii) With reference to the student's report, discuss the alternative solution to the use of acupuncture in the treatment of pain.
Give the numbers of the paragraphs, in the report, you have used.

(3)

An alternative to acupuncture would be medical treatment, drugs. These are not as effective as acupuncture as seen in paragraph 4 and present more harmful and more common risks as seen in paragraph 9. However, the use of ~~drugs as~~ medical drugs as treatment does not involve the ethical implications associated with acupuncture as seen in paragraph 10, and are less costly to maintain than acupuncture, as seen in paragraph 12.



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Examiner Comments

In contrast, this answer names drugs as an alternative for one mark and then correctly refers to sections discussing their effectiveness and side effects for a further two.

Paper Summary

Read all the information given in the questions very carefully, it is there for a purpose.

Always manipulate data in questions asking you to describe a trend from a graph, table etc. Do not just quote figures. Make sure any manipulation is mathematically correct and with units, if appropriate.

Thoroughly review all core practicals. Be clear about all the details and implications of each. Question 1 will always be based on one of these.

Review your understanding of basic experimental design. Be clear about the different types of variables (IV, DV etc.).

Make sure you understand how to write references properly.

Be very clear that you understand what we mean by economic, environmental, social and ethical implications of biology.

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