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Edexcel GCE

Biology

Advanced Subsidiary

Unit 3B: Practical Biology and Research Skills

Monday 9 January 2012 – Afternoon Time: 1 hour 30 minutes	Paper Reference 6BI07/01
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You must have: Ruler, Calculator, HB Pencil	Total Marks
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Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 40.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

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PEARSON

Answer ALL questions.

- 1** A student read about the benefits of an increased intake of vitamin C in the diet. However, she disliked eating fruit and did not want to take vitamin tablets. Therefore she wanted to obtain most of her daily intake of vitamin C from vegetables. She also read that vitamin C in vegetables is destroyed when they are cooked.

She decided to do a project on the effect of temperature on vitamin C content.

She heated orange juice samples in boiling tubes at five different temperatures, in a water bath. In each case, the tubes were left in the water bath for fifteen minutes and then cooled in a beaker of ice for five minutes.

She determined the vitamin C content of each sample by titrating it with a 0.1% DCPIP solution (2,6-dichlorophenolindophenol). The vitamin C in the orange juice decolourises the DCPIP solution.

She repeated this procedure five times for each temperature.

- (a) (i) State **two** variables that were controlled in this investigation.

(2)

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- (ii) Name **one other** variable, in her method, which should have been controlled. Describe how it could have been controlled.

(2)

Variable

How it could be controlled

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(b) The results of her investigation are shown in the table below.

Temperature / °C	Volume of juice needed to decolourise DCPIP / cm ³					Mean	Standard Deviation (SD)
	1	2	3	4	5		
20	4.1	4.2	4.2	4.2	4.0	4.1	0.09
23	3.9	3.8	4.0	3.8	3.8	3.9	0.09
30	6.6	6.6	6.1	6.5	6.6	6.5	0.22
40	7.4	7.1	7.1	7.1	7.0	0.15
50	8.5	8.5	8.4	8.5	8.3	8.4	0.09

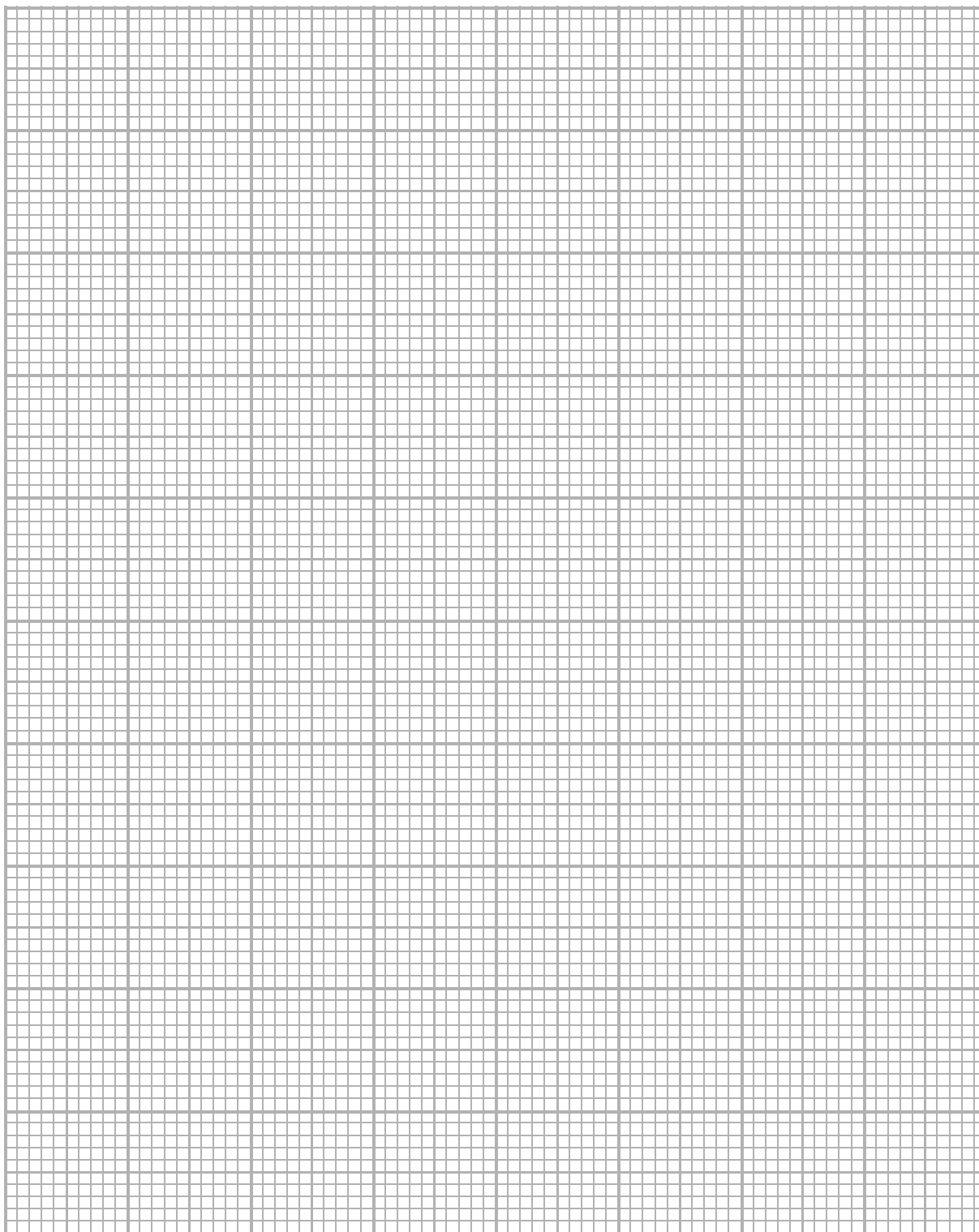
(i) Complete the table by calculating the mean volume of juice, kept at 40 °C, needed to decolourise DCPIP. Show your working.

(2)



- (ii) Plot a suitable graph to show the effect of temperature on the mean volume of juice needed to decolourise DCPIP. On your graph, include the standard deviations.

(5)



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(iii) Use the results of this investigation to describe the effect of temperature on the vitamin C content of orange juice.

(2)

(iv) Using the information in the table, comment on the reliability of these data.

(2)



- (c) To check the validity of her results, she found some data about the effects of cooking on fresh vegetables.

The data are shown in the table below.

Vegetable	Percentage loss of vitamin C due to cooking (%)
Soko (<i>Celosia argentea</i>)	38
Tete (<i>Amaranthus hybridus</i>)	35
Cassava (<i>Manihot esculenta</i>)	30
Okra (<i>Hibiscus esculentus</i>)	36

- (i) Compare these data with those that the student obtained in her study and comment on the validity of her results.

(3)

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- (ii) Suggest what further information she would need in order to make a valid comparison of her results with these published data.

(2)

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(Total for Question 1 = 20 marks)



2 Read the following extract from a student's draft and **unfinished** report on the topic of stem cells.

- 1 It is hardly possible to open a newspaper these days without seeing something about stem cells. It is the self renewing property of stem cells which makes them so special.
- 2 In plants, many cells remain totipotent for life and differentiation can be reversed. Stem cells have, therefore been used by botanists for a long time. The conservation of rare species is one of the uses which has been made of this knowledge.
- 3 At Kew Gardens in London, a project to help in the conservation of some very rare species of mosses was started in 2000. Scientists combined techniques of tissue culture in an environment free of bacteria, fungi etc. (called axenic culture) with low temperature preservation to assist in the conservation of the mosses (bryophytes) in what is called an *ex situ* project. This means the project is carried out off site (that is, away from the actual habitat of the species being conserved).
- 4 Using these methods the scientists have successfully cultured 18 species of very rare mosses at the last count. The problem still remains, though, that the reason these species are rare is because of a lack of suitable habitat for them to live in.
- 5 In humans, adult mature stem cells are multipotent. Embryonic stem cells (ES cells) are pluripotent and can develop into many human tissue cells. ES cells are obtained from a human embryo five days after fertilisation. ES cells can only be obtained by destroying the embryo. It is suggested that if cultured correctly, ES cells could have the capability of developing into almost any fully functioning organ or tissue of the body.
- 6 Stem cells provide hope for patients suffering from conditions including cancer, diabetes, Parkinson's disease, Alzheimer's disease and muscle or tissue damage. Entire organs may be able to be developed from embryonic stem cells.
- 7 In cancer patients undergoing chemotherapy or radiotherapy, the stem cells present in the treated area can be completely destroyed. Stem cell replacement is already being tested. This is known as autologous stem cell rescue.
- 8 It has been suggested that it is adult stem cells themselves that are the origins of many, if not all, cancers. Robert Weinberg, a cancer geneticist at the Whitehead Institute in Cambridge, Mass. stated, "I think this is one of the most interesting developments in cancer research in the last five years," and also, "I think more and more people are accepting it and evidence is accumulating that cancer stem cells exist in a variety of tumours," (Quoted in Jiang, Dennis 'The Stem Cells That Promise No Miracles', The Journal of Young Investigators, 18 (3), 2008).



- 9 Parkinson's disease affects normal coordination of the patient's body due to a loss of nerve cells in the brain that produce a neurotransmitter known as dopamine. It is speculated that if ES cells or adult stem cells could be cultured correctly into dopamine producing nerve cells, they could replace the lost nerve cells of the patient. Unlike several other diseases, patients with Parkinson's disease could easily benefit from stem cell research.
- 10 Recently it has been discovered that cell replacement therapy is more effective than full organ transplantation. This is when healthy stem cells (either from the patient themselves or from an external source) are directly inserted to replace dying or dead stem cells of an organ by intravenous catheter. By doing this the risks of rejection (when the immune system detects a replaced organ or tissue as "foreign" and subsequently attempts to destroy it) are lowered significantly and the ethical debate regarding therapeutic cloning is eliminated.
- 11 There are many and widespread ethical concerns regarding the destruction of human embryos to gather ES cells. Using ES cells suggests that a human embryo's value does not equal the rights of a living human being. This argument also suggests that the value of using stem cells in medicine outweighs the rights of embryonic 'life'. In-vitro fertilisation produces several embryos and some of these are discarded. Should these embryos be used in research rather than being wasted?
- 12 There are several counter-arguments. Pro-life groups maintain that a human embryo's rights are the same as those of a living human being. They argue that the value of stem cell research is not proven and there may be side effects in stem cell cultures such as tumours. Now it is believed that adult stem cells can be potentially cancerous, adding further weight to critics of such research. Many religious groups do not agree with the use of stem cells in medicine believing that human life begins at fertilisation. Views on stem cell research are widely different in different countries.
- 13 One argument suggests that the economic burden that stem cell research places upon nations is too great and the vast sums needed to further enhance such research could be far more usefully spent elsewhere. The counter argument to this states that with more money, the benefits could be great with regard to disease management and organ donation shortages which could be overcome.



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

(1)

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- (b) The student intended to include a flow diagram showing the details of the *ex situ* project described in paragraph 3.

Which of the visit or issue assessment criteria, A, B, C or D, listed below, would the flow diagram address? Explain your answer.

- A. Describe the biological methods and processes involved in producing data or solutions to problems
- B. Identify two implications (ethical, social, economic or environmental) of the applied biology encountered
- C. Use information or arguments obtained from three or more sources
- D. Evaluate at least two references used in the report

(2)

Criterion

Explanation

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- (c) Using the information in paragraphs 3 and 4 and your own knowledge, suggest **one** advantage and **one** disadvantage of *ex situ* conservation.

(2)

Advantage

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Disadvantage

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- (d) Some of the statements in the passage have no supporting evidence.
For example, paragraph 12 states that:

“Many religious groups do not agree with the use of stem cells in medicine.”

To find some evidence to support this statement, the student carried out an Internet search and found information from source A and source B.

Source A

A survey asked the following question:

“Regardless of whether or not you think it should be legal, for each issue, please tell me whether you personally believe that in general it is morally acceptable or morally wrong.”

Issues	Morally acceptable (%)	Morally wrong (%)
Medical research using stem cells obtained from human embryos	62	30
The death penalty	62	30
Gambling	63	32
Abortion	40	48

Source B

Issues	Catholics (%)	Non-Catholics (%)
Medical research using stem cells obtained from human embryos	63	62
The death penalty	61	68
Gambling	72	59
Abortion	40	41



(i) Discuss the usefulness of these sources of evidence as support for the statement in paragraph 12.

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(ii) The student presented some of these data in a visual form.

Describe how the relevant data in source A and source B could be presented in a suitable visual form.

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- (e) A visit or issue report should identify two of the following implications: ethical, social, economic or environmental.

The student found the information shown in the table below.

Research area	Cost of research in 2009 / millions of dollars
Parkinson's disease	162
Cancer	5629
Stem cell research	1044
Transplantation	571

- (i) Which of these implications is addressed by the information in this table? (1)

- (ii) State the paragraph number where this table should be included. (1)

- (iii) With reference to Parkinson's disease in paragraphs 6 and 9, suggest how stem cell therapy may affect the cost of research into this disease. (3)



(f) The student's bibliography, shown below, is incomplete.

Bibliography

Jiang, Dennis, 'The Stem Cells That Promise No Miracles'

(i) Using information from the passage, complete the reference shown above.

(2)

(ii) Suggest **one** other way in which this bibliography could be improved.

(1)

(Total for Question 2 = 20 marks)

TOTAL FOR PAPER = 40 MARKS



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