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Sample Assessment Materials
For international centres only

GCE Biology

Edexcel Advanced Subsidiary GCE in Biology (8BI07)
First examination 2009

Edexcel Advanced GCE in Biology (9BI07)
First examination 2010

International Alternative to Internal Assessment
(Units 3B and 6B)

January 2008

A PEARSON COMPANY

Contents

A Introduction

These sample assessment materials have been prepared to support the specification.

Their aim is to provide the candidates and centres with a general impression and flavour of the actual question papers and mark schemes in advance of the first operational examinations.

B Sample question papers

Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	B	I	0	7	/	1	Signature	

Paper Reference(s)

6BI07/1

Examiner's use only

Team Leader's use only

Edexcel GCE

Biology Advanced Subsidiary

Unit 3B: Practical Biology and Research Skills

Sample Assessment Material

International Alternative to Internal Assessment

Time: 1 hour 30 minutes

Question Number	Leave Blank
1	
2	
Total	

Materials required for examination
Ruler, Calculator, HB Pencil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Use blue or black ink.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 2 questions in this question paper. The total mark for this paper is 40.
There are 12 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.

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Leave blank

Answer ALL questions

1. Sam studied the effect of varying the concentration of the stimulant drug caffeine on heart rate. She chose to use the water flea, *Daphnia*, for ethical reasons.

In her study, Sam attempted to keep the temperature of the various caffeine solutions constant. As an extension of this work, she decided to investigate the effect of temperature on heart rate in more detail.

In this new investigation Sam used a small glass chamber which could hold the *Daphnia* and water at a set temperature. The whole apparatus could be placed under a microscope so that the *Daphnia* heart could be seen. She videoed four *Daphnia* at each of five different temperatures for 30 seconds. She used a slow motion replay of the video to count the number of heart beats in 30 seconds for each *Daphnia* at each temperature. Her data are summarised in the table below:

Temperature (°C)	**Number of heart beats in 30 seconds**				**Mean heart rate / minute (bpm)**
	***Daphnia* 1**	***Daphnia* 2**	***Daphnia* 3**	***Daphnia* 4**	
5	91	75	84	69	
10	101	106	103	112	
18	125	124	119	127	
24	144	137	126	127	
30	160	175	160	180	

(a) (i) State and explain **one** ethical reason why Sam chose to use *Daphnia* for this investigation.

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(2)

Leave blank

(ii) Suggest **one** reason for her choice of maximum temperature (30 °C) and **one** reason for her choice of minimum temperature (5 °C) used.

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(2)

(iii) In her investigation, how did Sam try to ensure the reliability of her data?

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(1)

(iv) Which aspect of her investigation was improved when Sam decided to video the *Daphnia*?

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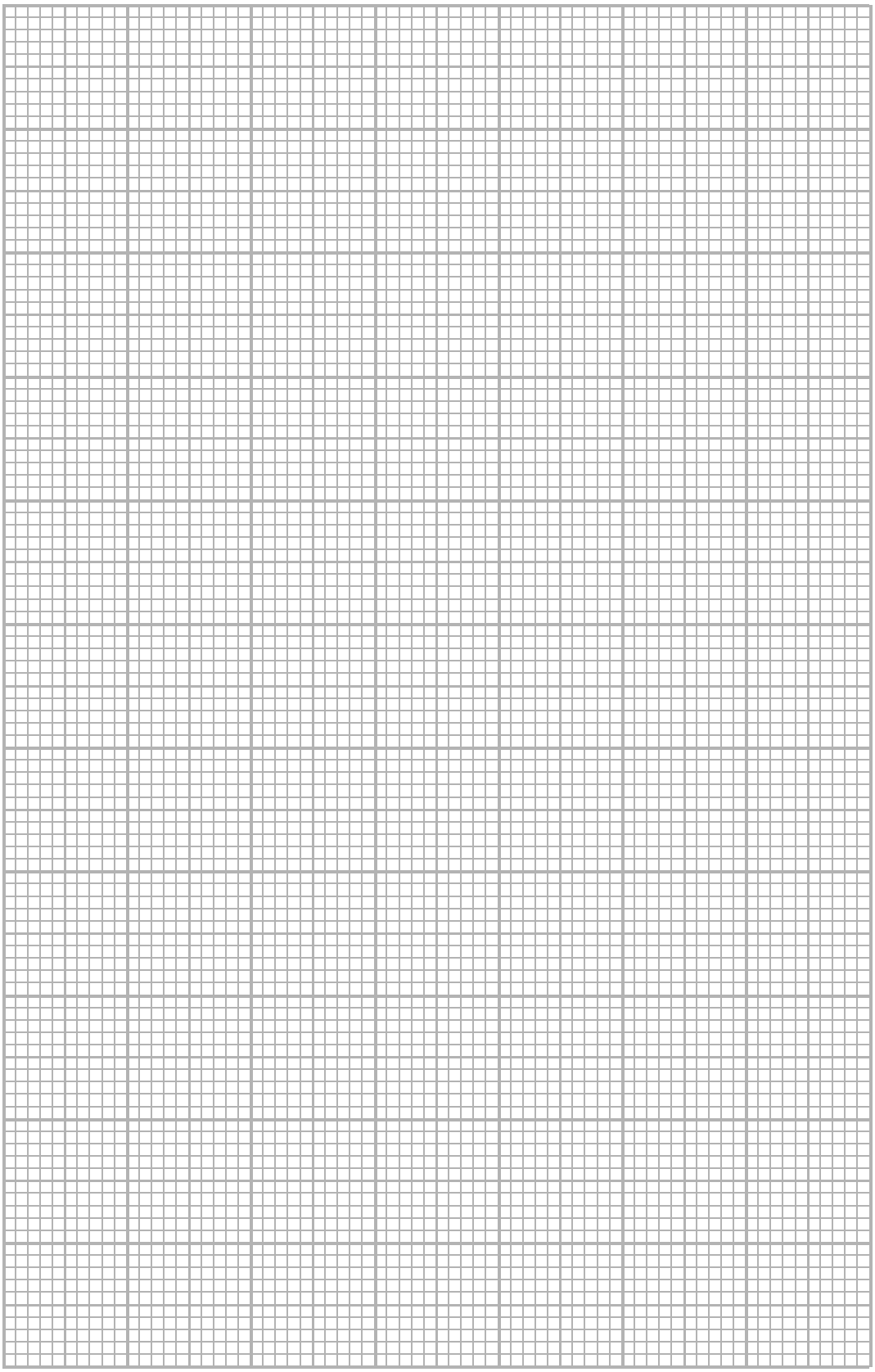
(1)

(b) (i) Calculate the mean heart rate in **beats per minute** for each temperature. Write your answers in the spaces provided in the table. Show your working in the space below.

(3)

Leave blank

(ii) Use these data to plot a fully-labelled graph to show the effect of temperature on the mean heart rate of *Daphnia*. On your graph, show the variability of the data.



(5)

Leave blank

(c) In order to get some idea of the validity of her data, Sam searched the Internet for similar studies. She could not find any studies that had used her method exactly, especially the video technique, but she did find data from studies in which direct observation had been used to count heart rates in *Daphnia*. She compared the results from one such study, shown in the following table, with her own.

Temperature (°C)	Mean heart rate (beats per minute)
5	75
10	160
15	155
20	205
25	200
30	212
40	175

(i) State **one** similarity and **one** difference in the conclusions Sam could make about the effect of temperature on *Daphnia* heart rate, based on these two sets of data.

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(2)

(ii) Suggest **one** explanation for the similarity and **one** explanation for the difference you have given above.

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(4)

Q1

(Total 20 marks)

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2. Read the following **draft** article carefully.

Trying times

On September 14, 1990, four-year old Ashanti DeSilva became the first patient to undergo medically-approved gene therapy. Ashanti was suffering from the genetic disorder severe combined immunodeficiency (SCID) because she had inherited a defective gene from each parent. The gene normally gives rise to an enzyme, adenosine deaminase, needed for efficient functioning of the immune system. Without this critical enzyme, Ashanti's immune system was weakened, leaving her vulnerable to infections.

The treatment for Ashanti involved removing some of her white blood cells, inserting normal copies of the defective gene into these cells and then returning the treated white blood cells to her blood circulation. The experiment went well and, after four infusions over four months, her condition improved. With the help of occasional follow-up treatments, she was transformed into a healthy teenager.

Further testing of gene therapy is under way, and the tests are run in the same way as for any drug. These tests involve several stages or phases.

In Phase I, scientists gather information about whether a drug is safe to give to humans and, if so, how much they can tolerate.

Administering a drug for the first time can be a frightening experience because the volunteers (usually between 10 and 100 of them), who are usually perfectly healthy, are taking a very real risk. The initial dose is typically very low, to minimize the possibility of a major reaction, but as the scientists raise the dose, the potential for problems increases. If there is a possibility of extremely serious side effects, Phase I testing is conducted in volunteers with the condition that the drug is intended to treat. Potential harm is then balanced by potential benefit.

The trial team monitors the volunteers closely. To spot problems early, the scientists usually measure blood pressure and body temperature, collect blood and urine samples, and monitor for any other danger signs seen in animal studies which have been previously carried out. They also measure the level of the drug in the bloodstream or tissues to determine how it is distributed in the body, how rapidly it reaches a therapeutic level and how the body eliminates the compound. All this information helps to determine the safe dose of the drug. Phase I testing would cost about $10 million and would take between one and two years.

The main aim of Phase II testing is practical: to find the experimental conditions that will allow the final phase of the trial to give a definitive result. One criterion that must be established immediately is the end point: what the treatment can do. For instance, the usual end point sought when screening a new antibiotic is whether a patient is free of infection after treatment. However, many medical conditions cannot be so readily cured, so alternative end points are considered. These might include whether the progression of HIV/AIDS has slowed or whether the death rate from cancer has fallen.

Phase II marks the introduction of the control group to the trial. Almost all diseases are highly variable in their progress, with improvement occurring spontaneously in some patients. Scientists must be able to distinguish between a natural improvement and the effects of the treatment. Phase II would typically take 2 years, involve 50–500 volunteers and cost about $20 million.

Leave blank

Inclusion of a control group – which receives either a placebo or the best available therapy – makes it possible to measure the effect of the new treatment. Similarly, having a control group allows the scientists to check for possible side-effects. For example, a medication being tested for treatment of high blood pressure might be suspected of causing nausea. But nausea can occur in just about anyone – only if its incidence is significantly higher in the treatment group than in the control group will it be considered a problem.

Ideally, neither the scientists nor the volunteers know whether they are part of the treatment group or the control group – in other words, they are "blind" to the type of therapy being administered. During Phase II, scientists work hard to ensure that this blinding procedure is successful. For instance, if a placebo pill is used, it is made to look exactly like the drug and the volunteers are treated with either the drug or placebo in exactly the same way. Yet in some cases, keeping a trial blind is simply impossible. If the drug being tested causes some kind of mild side effect, the volunteers will quickly figure out that they are in the treatment group. Also, it is usually considered unethical to subject a patient to anaesthesia and placebo surgery when surgical procedures are being evaluated.

The final stage of the clinical trial process, Phase III, is the one most familiar to the general public. Hundreds, thousands, even tens of thousands of volunteers take part in Phase III tests, and results often receive much publicity.

By this point, the scientists running the trial have defined at least one group of patients who are expected to benefit from the treatment, how they benefit and the best way to administer treatment. The Phase III trial can provide confirmation that a drug works. If, after statistical analysis, the drug proves to be significantly more effective than the control treatment, the trial is called pivotal. Ordinarily, two pivotal trials are needed to prove the value of a new therapy to regulatory agencies such as the U.S. Food and Drug Administration or the European Agency for the Evaluation of Medicinal Products. However, if the first result is sufficiently persuasive, one trial can be enough. If an agency is convinced, it approves the drug for sale as a treatment for the disease. Phase III takes over 3 years, involves tens of thousands of people and may cost over $40 million.

964 words

References:

Human gene therapy. W. F. Anderson in Science, Vol. 256, pages 808–813; May 8, 1992.

Gene therapy: a handbook for physicians. Kenneth W. Culver. Mary Ann Liebert, Inc., Publishers, 1994.

Guide to Clinical Trials. Bert Spilker. Raven Press, New York, 1991.

International Stroke Trial (IST): A Randomized Trial of Aspirin, Subcutaneous Heparin, Both, or Neither among 19,435 Patients with Acute Ischemic Stroke. International Stroke Trial Collaborative Group in Lancet, Vol. 349, No. 9065, pages 1569–1581; May 31, 1997.

Oversight Mechanisms for Clinical Research. Ralph Snyderman and Edward W. Holmes in Science, Vol. 287, No. 5453, pages 595–597; January 28, 2000.

CenterWatch Clinical Trials Listing Service is available at www.centerwatch.com

Leave blank

(a) (i) One main biological aspect of this article is Drug Trials. Identify **one** other aspect of biology referred to in this article on which you could expand, given more time and resources. Describe briefly how you would search for further information.

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(ii) State **one** problem for humanity, capable of being solved scientifically, which the work in the article is attempting to address.

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(1)

(iii) State **one** other way in which the problem you have identified could be addressed.

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(1)

Leave blank

(b) It is possible that scientific solutions to human problems may give rise to other problems.

(i) Comment on **two** such problems which are likely to be associated with drug trialling. Your answers should be from **two** different aspects of biology from economic, environmental, ethical or social.

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(ii) Suggest **one** way in which the problem you have identified in (b)(i) could be overcome.

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Leave blank

(c) Discuss the likely validity of the information in the article. You may quote from it to support your answer.

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(3)

(d) With the article, the author wants to include a flow chart to show the key stages in drug trialling. Draw a possible flow chart in the space below.

(4)

Leave blank

(e) The editor of the publication to which the article is sent likes the idea of the flow chart and asks the author to make other improvements, through better planning and organization of the article, and the use of further visual aids. Give some suggestions as to how some of these requirements might be achieved.

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(3) **Q2**

(Total 20 marks)

TOTAL FOR PAPER: 40 MARKS

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Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	B	I	0	8	/	1	Signature	

Paper Reference(s)

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Examiner's use only

Team Leader's use only

Edexcel GCE

Biology Advanced

Unit 6B: Practical Biology and Investigative Skills

Sample Assessment Material

International Alternative to Internal Assessment

Time: 1 hour 30 minutes

Question Number	Leave Blank
1	
2	
3	
Total	

Materials required for examination
Ruler, Calculator, HB Pencil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Use blue or black ink.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 3 questions in this question paper. The total mark for this paper is 50.
There are 12 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.

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Answer ALL questions

1. Respirometers are designed to measure respiration rate. They do this by recording the volume of oxygen taken up by the respiring tissue. In most cases, when a tissue is undergoing aerobic respiration, the volume of oxygen taken up by the tissue is equal to the volume of carbon dioxide given off. This poses a problem because there is no overall volume change.

(a) Explain how a respirometer you have used is designed to overcome this problem and describe how it could be used to measure the volume of oxygen taken up by respiring tissue in a human.

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(b) Changes in temperature can cause large differences in the volume of a gas. Explain how temperature was controlled when using your respirometer.

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(c) Describe the measurements you would take when using a respirometer and any calculations necessary to determine the **rate** of oxygen uptake in a sample of respiring tissue.

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(d) A student used a respirometer to compare the rate of respiration of yeast cells using two different sugars, glucose and sucrose, as substrates.

(i) Suggest a suitable hypothesis for this investigation.

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(1)

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

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(2)

Q1

(Total 12 marks)

2. Caffeine is a drug that is found in many common drinks, including tea and coffee. One of its effects is to increase heart rate.

A student formed the hypothesis that the effect of caffeine on heart rate would be less in those people who regularly drank caffeine-rich drinks compared to those who never drank any caffeine-containing drinks.

He carefully selected two groups of 10 female volunteers of the same age, body mass and fitness levels. The first group regularly drank caffeine-rich drinks whilst the second group drank no caffeine-containing drinks.

Each group was asked to rest for 10 minutes and the resting heart rate of each volunteer was measured and recorded. They were then given 100 cm^3 of strong coffee containing caffeine to drink.

After resting for a further 20 minutes, the heart rate of each volunteer was measured again.

A copy of the student's laboratory notes showing the results is given below.

Volunteers who regularly drank caffeine number of beats in one minute

Volunteer	A	B	C	D	E	F	G	H	I	J
Before drinking coffee	81	72	83	84	75	88	88	73	81	70
After drinking coffee	84	74	85	84	77	92	91	72	81	73

Volunteers who did not drink any caffeine number of beats in one minute

Volunteer	K	L	M	N	O	P	Q	R	S	T
Before drinking coffee	77	83	64	74	70	74	82	73	76	77
After drinking coffee	80	85	66	84	73	77	86	75	81	84

Leave blank

(a) Calculate the difference in heart rate before and after drinking coffee for each volunteer. Prepare a table to display the raw data and your calculated values in such a way that the effect of drinking 100 cm^3 of strong coffee on the two groups can be compared.

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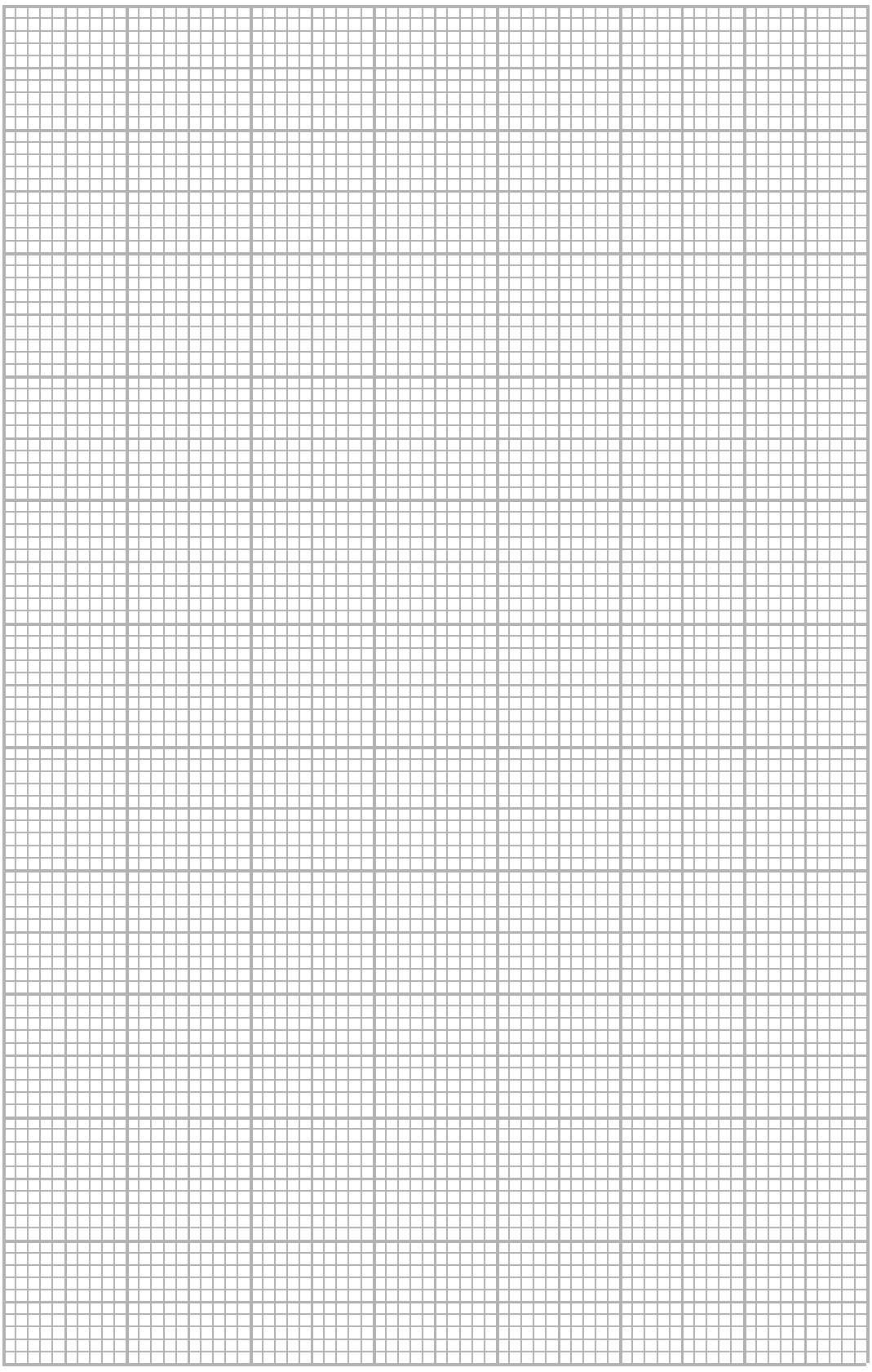
(b) On the graph paper below, use the data from your table to compare the two groups in suitable graphical form.



(3)

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(c) Write below the **range** of increases in heart rate shown by the data for volunteers who regularly drank caffeine.

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(1)

(d) Draw **on your graph** a suitable method of representing this range of data.

(1)

(e) Identify a reading, if any, in the data from regular caffeine drinkers which could be described as an anomaly.

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Give one reason for your answer.

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(2)

(f) The student applied a *t*-test to the data to test his hypothesis.

He calculated the value of *t* to be 2.22

The table below shows the critical values of *t* with 18 degrees of freedom, at different significance levels.

Significance level (p)	0.2	0.1	0.05	0.02	0.01	0.001
Critical value of *t*	1.33	1.73	2.10	2.46	2.88	3.92

What conclusions can be drawn from this investigation? Use the information provided to explain your answer.

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Q2

(Total 15 marks)

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3. Coconut palms are trees often found growing close to the sea. A student formed the hypothesis that the yield of coconuts from each tree would decrease as the distance from the sea became less because the salt levels in the soil might inhibit growth.

Plan an investigation to test this hypothesis.

Your answer should give details under the following headings.

(a) A consideration of what sampling techniques might be appropriate to this investigation and any safety or ethical issues you would need to consider.

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

(c) A detailed method explaining exactly how you would carry out this investigation and how important variables are to be controlled or monitored.

(d) A clear explanation of how your data is to be analysed in order to make conclusions concerning this hypothesis.

(e) The limitations of your proposed method.

(a) A consideration of what sampling techniques might be appropriate to this investigation and any safety or ethical issues you would need to consider.

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

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

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(d) A clear explanation of how your data is to be recorded, presented and analysed in order to make conclusions about this hypothesis.

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(e) The limitations of your proposed method.

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(3) **Q3**

(Total 23 marks)

TOTAL FOR PAPER: 50 MARKS

END

C Sample mark schemes

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Unit 3B: Practical Biology and Research Skills

Question Number	Question	
1 (a) (i)	State and explain **one** ethical reason why Sam chose to use *Daphnia* for this investigation.	
	Answer	**Mark**
	simple nervous system / invertebrate; reduced awareness of pain/eq.; **or** transparent; heart visible without need for dissection/eq.; **or** abundant in nature; no threat to it or its dependent species (food chains); **or** bred for fish food; will thus die anyway; **or** may be clones; therefore no loss of genetic variation;	**2**

Question Number	Question	
1 (a) (ii)	Suggest **one** reason for her choice of maximum (30°C) and **one** reason for her choice of minimum (5°C) temperature used.	
	Answer	**Mark**
	lower temp leads to inactivity /freezing; higher temp leads to enzyme denaturation;	**2**

Question Number	Question	
1 (a) (iii)	In her investigation, how did Sam try to ensure the reliability of her data?	
	Answer	**Mark**
	controlling temperature/eq;	**1**

Question Number	Question	
1 (a) (iv)	Which aspect of her investigation was improved when Sam decided to video the *Daphnia*?	
	Answer	**Mark**
	accuracy;	**1**

Question Number	Question	
1 (b) (i)	Calculate the mean heart rate in **beats per minute** for each temperature. Write your answers in the spaces provided in the table. Show your working in the space below.	
	Answer	**Mark**
	answers are 5 — 159.5 10 — 211.0 18 — 247.5 24 — 267.0 30 — 337.5 All means correct with consistent decimal places 3 marks; One error = 2marks Two errors = 1 mark Three errors = 0 marks	**3**

Question Number	Question	
1 (b) (ii)	Use these data to plot a fully-labelled graph to show the effect of temperature on the mean heart rate of *Daphnia*. On your graph, show the variability of the data.	
	Answer	**Mark**
	correct orientation of axes; axes correctly labelled including units with suitable scale (minimum half page); correct plotting of all points; sensible line; error bars/range bar to indicate variability/eq;	**5**

Question Number	Question	
1 (c) (i)	State **one** similarity and **one** difference in the conclusions Sam could make about the effect of temperature on *Daphnia* heart rate, based on these two sets of data.	
	Answer	**Mark**
	sim: rise in temp leads to increase in heart rate (up to 30°C); diff: obvious peak in secondary data, none in Sam's / eq ;	**2**

Question Number	Question	
1 (c) (ii)	Suggest **one** explanation for the similarity and **one** explanation for the difference you have given above.	
	Answer	**Mark**
	reference to kinetic effects on enzymes and the substrate; increase rate of respiration increases oxygen demand/increased rate of reaction increases heart muscle activity/eq; Above 30°C enzymes/proteins begin to denature; Reduced heart rate because of heart made of protein/eq; Daphnia become exhausted;	**4**

Question Number	Question	
2 (a) (i)	One main biological aspect of this article is Drug Trials. Identify **one** other aspect of biology referred to in this article on which you could expand, given more time and resources. Describe briefly how you would search for further information.	
	Answer	**Mark**
	gene therapy/genetics/enzyme biochemistry/immunity/SCID; specific details of web and /or library search (e.g. appropriate keywords, search engines etc.);;	**3**

Question Number	Question	
2 (a) (ii)	State **one** problem for humanity, which can be solved scientifically, which the work in the article is attempting to address.	
	Answer	**Mark**
	(genetic/social/etc) disease/eq;	**1**

Question Number	Question	
2 (a) (iii)	State **one** other way in which the problem you have identified could be addressed.	
	Answer	**Mark**
	depending on (a) (ii): diseases which could be addressed through better diet; exemplified; **OR** diseases which could be addressed through environmental improvements; exemplified; **OR** diseases which could be addressed through lifestyle improvements: exemplified: **OR** diseases which could be addressed through a named alternative medical treatment e.g. using a virus to attack bacterial infections;	**1**

Question Number	Question	
2 (b) (i)	Comment on **two** such problems which are likely to be associated with drug trialling. Your answers should be from **two** different aspects of biology: economic, environmental, ethical or social.	
	Answer	**Mark**
	ethical; ethics of drug trials discussed (informed consent); social; implications of drug trials discussed (payment / encourages less well off volunteers (students etc.) ; economics; comment on high costs / long time; **any two for two marks each**	**4**

Question Number	Question	
2 (b) (ii)	Suggest **one** way in which the problem you have identified in (b)(i) could be overcome.	
	Answer	**Mark**
	as appropriate to (b) (i) e.g. do not offer payment; have a proper explanation and consent system; do detailed cost benefit in the long term;	**1**

Question Number	Question	
2 (c)	Discuss the likely validity of the information in the article. You may quote from it to support your answer.	
	Answer	**Mark**
	Valid: citing of up to 2 references from list for 2;; citing of involvement of national/international agencies in the process;	**3**

Question Number	Question	
2 (d)	With the article, the author wants to include a flow chart to show the key stages in drug trialling. Draw a possible flow chart in the space below.	
	Answer	**Mark**
	Flow Chart drawn: clear (e.g boxes and arrows, codes for processes and stages etc.) in correct order; all basic detail shown in chart, not too detailed;;	**4**

Question Number	Question	
2 (e)	The editor of the publication to which the article is sent likes the idea of the flow chart and asks the author to make other improvements, through better planning and organisation of the article, and the use of further visual aids. Give some suggestions as to how some of these requirements might be achieved.	
	Answer	**Mark**
	discussion of use of sub-headings; suggestion for 1 or 2 such sub-headings; suggestion for at least one visual aid; detail of visual aid;	**3**

Unit 6B: Practical Biology and Investigative Skills

Question Number	Question	
1 (a)	Explain how a respirometer you have used is designed to overcome this problem and describe how it could be used to measure the volume of oxygen taken up by respiring tissue in a human.	
	Answer	**Mark**
	carbon dioxide is absorbed in the apparatus / eq ; named absorber (e.g. sodium hydroxide/potassium hydroxide/soda lime) ; therefore there will be a decrease in volume/pressure which can be measured / eq ;	**3**

Question Number	Question	
1 (b)	Changes in temperature can cause large differences in the volume of a gas. Explain how temperature was controlled when using your respirometer.	
	Answer	**Mark**
	use of water bath /eq ; allow to equilibrate before sealing apparatus ; suitable named temperature (20 – 40 $^{\circ}$C) [Reject room temperature] ;	**2**

Question Number	Question	
1 (c)	Describe the measurements you would take when using a respirometer and any calculations necessary to determine the **rate** of oxygen uptake in a sample of respiring tissue.	
	Answer	**Mark**
	measure movement of liquid in capillary/manometer/U tube ; in a fixed time ; measure diameter/radius of tube ; volume = $\pi r^2 l$ (l = distance moved by liquid in tube / eq) ; (volume) divided by time to give rate;	**4**

Question Number	Question	
1 (d) (i)	A student used a respirometer to compare the rate of respiration of yeast cells using two different sugars, glucose and sucrose, as substrates. Suggest a suitable hypothesis for this investigation.	
	Answer	**Mark**
	accept sensible testable hypothesis naming glucose and sucrose in some relationship e.g. Yeast cells respire faster when using glucose as a substrate ;	**1**

Question Number	Question	
1 (d) (ii)	Use your biological knowledge and understanding to explain and justify your hypothesis	
	Answer	**Mark**
	explanation must be linked to hypothesis given and use A-level biological knowledge and understanding e.g. yeast will respire faster using glucose because glucose is the starting point for glycolysis reactions in respiration; it is the first molecule to be phosphorylated ; **OR** yeast will respire sucrose faster because it can be broken down into molecules of glucose and fructose ; providing double the substrate for glycolysis ; **OR** yeast will respire sucrose more slowly because sucrose needs to be hydrolysed to glucose and fructose ; In order to enter glycolysis ; **OR** rate of uptake of sugars differs ; larger molecules may be taken up more slowly /eq ;	**2**

Question Number	Question	
2 (a)	Calculate the difference in heart rate after 20 minutes for each volunteer. Prepare a table to display the raw data and your calculated values in such a way that the effect of drinking 100 cm^3 of strong coffee on the two groups can be compared.	
	Answer	**Mark**
		4

Regular caffeine drinkers Heart rate (b.p.m.)				Non- caffeine drinkers Heart rate (b.p.m)			
subject	**before**	**after**	**change**	**subject**	**before**	**after**	**change**
A	81	84	3	K	77	80	3
B	72	74	2	L	83	85	2
C	83	85	2	M	64	66	2
D	84	84	0	N	74	84	10
E	75	77	2	O	70	73	3
F	88	92	4	P	74	77	3
G	88	91	3	Q	82	86	4
H	73	72	-1	R	73	75	2
I	81	81	0	S	76	81	5
J	70	73	3	T	77	84	7
		Mean change	**1.8**			**Mean change**	**4.1**

suitable table format ;

correct rows and columns with accurate headings ;

all changes correct ;

both means correct ;

Question Number	Question	
2 (b)	On the graph paper below use the data from your table to compare the two groups in suitable graphical form.	
	Answer	**Mark**
	correct graphical format = bar chart ; axes labelled with units or bars keyed correctly ; Means plotted accurately ;	**3**

Question Number	Question	
2 (c)	Write below the **range** of increases in heart rate shown by the data for volunteers who regularly drank caffeine.	
	Answer	**Mark**
	2 – 4 beats per minute ;	**1**

Question Number	Question	
2 (d)	Draw **on your graph** a suitable method of representing this range of data.	
	Answer	**Mark**
	suitable range bar accurately plotted on the graph ;	**1**

Question Number	Question	
2 (e)	Identify a reading, if any, in the data from regular caffeine drinkers which could be described as an anomaly. Give one reason for your answer.	
	Answer	**Mark**
	subject H / 73-72 ; the only subject/measurement in which the heart rate decreased after drinking caffeine ;	**2**

Question Number	Question	
2 (f)	The student applied a t-test to the data to test this hypothesis. He calculated the value of *t* to be 2.22 The table below shows the critical values of *t* with 18 degrees of freedom, at different significance levels. Significance level (p) 0.2 0.1 0.05 0.02 0.01 0.001 Critical value of *t* 1.33 1.73 2.10 2.46 2.88 3.92 What conclusions can be drawn from this investigation? Use the information provided to explain your answer.	
	Answer	**Mark**
	the value of t is greater than the critical value ; figures quoted 2.22 > 2.10 ; at the 95% confidence level ; therefore there is a <u>significant</u> difference between the increase in heart rate of those who drink caffeine regularly compared to those who do not ;	**4**

Question Number	Question	
3 (a)	A consideration of what sampling techniques might be appropriate to this investigation and any safety or ethical issues you would need to consider.	
	Answer	**Mark**
	need some form of systematic sampling / regular samples along a transect eq ; to provide a suitable range of distances from the sea ; possible risk of coconuts falling / collecting coconuts ; possible risk from indigenous animals / unidentified plants / insect bites ; reference to minimising disturbance to the habitat ;	**3**

Question Number	Question	
3 (b)	Suggestions for preliminary work that you might undertake to ensure your proposed method would provide meaningful data.	
	Answer	**Mark**
	visit site to….. practice proposed method / see if proposed method will work ; check most suitable method of measuring yield ; select suitable intervals of sampling to give sufficient data for analysis; consider what other variables need to be taken into account /eq; check if there is more than one species of coconut palm ;	**3**

Question Number	Question	
3 (c)	A detailed method including an explanation of how important variables are to be controlled or monitored.	
	Answer	**Mark**
	site selected to minimise effect of **two** named variables e.g. light intensity, surrounding vegetation, slope etc ; use of transect ; method of selecting palms / accept sampling at regular distance etc ; stated number of measurements matched to stats test; exact distance defined e.g. from water's edge or first strand line/eq ; ref to same species of palm ; exactly what is to be measured stated (mass, number in crown, diameter etc) ;	**8**

SPG award up to 2 marks

Level	Mark	Descriptor
Level 1	0	The account is very disorganised and is very difficult to follow. Scientific vocabulary is very limited with many spelling and grammatical errors.
Level 2	1	There is some disorganisation in the account which is not always in the correct sequence. Some relevant scientific vocabulary is used. The account is not always in continuous prose and there are grammatical errors and some important spelling mistakes.
Level 3	2	The account is well organised with no undue repetition and a correct sequence. There is good use of scientific vocabulary in the context of the investigation described. The account is written in continuous prose which is grammatically sound with no major spelling errors.

Question Number	Question	
3 (d)	A clear explanation of how your data is to be recorded, presented and analysed in order to make conclusions about this hypothesis	
	Answer	**Mark**
	clear table which matches method description with headings and units; means calculated from repeat data ; scattergraph format with correctly labelled axes ; use of correlation test (Spearman's Rank eq) ;	**4**

Question Number	Question	
3 (e)	The limitations of your proposed method.	
	Answer	**Mark**
	difficult to standardise measurement of yield / milk content of coconuts / ripeness ; difficult to harvest / assess coconuts high on palm ; ref to effect of storm damage/eq / close to edge of sea ; difficult to control all abiotic factors affecting yield ; ref to difficulty of sampling technique (e.g. uneven arrangement of palm trees) ;	**3**

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Authorised by David Davies

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