OCR

Oxford Cambridge and RSA

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A Level Biology A
H420/03 Unified biology
Sample Question Paper

Date – Morning/Afternoon
Time allowed: 1 hour 30 minutes

You must have:
- the Insert

You may use:
- a scientific or graphical calculator

First name									
Last name									
Centre number						**Candidate number**				

SPECIMEN

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **16** pages.

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Answer **all** the questions.

1 A group of students set up a simple respirometer, as shown in **Fig. 1.1**, and used it to determine the rate of respiration in germinating mung beans.

- They placed a small muslin bag of soda lime into the syringe and then added five germinating mung beans, which were held in place with the syringe plunger.
- The students measured the movement of the red fluid in the capillary tube.
- After each set of readings the plunger was reset to return the fluid to its original position.

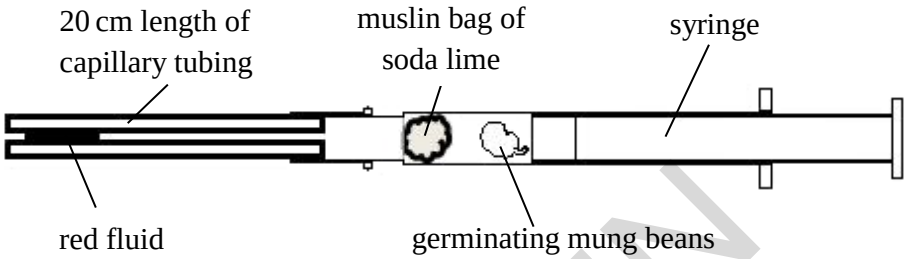

Fig. 1.1

The results are shown in **Table 1.1**.

Time (s)	Distance moved by the red fluid in capillary tube (mm)		
	1	2	3
0	0.0	0.0	0.0
30	11.5	12.0	12.5
60	22.5	21.5	17.5
90	31.0	32.0	32.5
120	41.5	42.0	42.5
150	53.0	54.0	53.5
180	63.0	63.0	64.0
210	72.5	71.0	71.5
240	78.5	79.5	79.0
270	87.5	88.5	87.0

Table 1.1

(a) Give **one** limitation of using this method to investigate respiration rate.

……

…… **[1]**

SPECIMEN

(b) Read the procedure carefully. Identify **one** variable that had not been controlled in this experiment **and** suggest an improvement to control that variable.

Variable ……

……

Improvement……

……

[2]

(c) Describe how you would add the red fluid to the capillary tube at the start of the experiment.

……

……

[1]

(d) The data shows an anomalous result at 60 seconds.

Explain why the result is considered to be anomalous **and** describe one correct way of dealing with this type of result.

……

……

……

……

[2]

(e) Using the data the student obtained, calculate the mean rate of respiration for germinating mung beans between 90 and 150 seconds.

Answer…… **[1]**

(f) What additional information would be needed to calculate:

(i) the volume of oxygen taken up by the seeds.

…… **[1]**

(ii) the oxygen uptake for this batch of seeds to be comparable with data from another type of bean.

…… **[1]**

SPECIMEN

(g)* The group of students wanted to find out if the rate of respiration of a small invertebrate animal was comparable to that of the mung beans.

Adapt the procedure used to investigate the respiration rate of a small invertebrate, such as a woodlouse or caterpillar, with that of mung beans.

Comment on the results you might expect from this experiment and the conclusions you might draw.

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…… **[6]**

SPECIMEN

2 This question is about the impact of potentially harmful chemicals and microorganisms.

(a) **(i)** Salts that a plant needs, such as nitrates and phosphates, are taken into root hair cells by active transport.

For which macromolecule does a plant need both nitrogen **and** phosphorus?

…… **[1]**

(ii) Flooding of fields by seawater can damage crops. Seawater contains dissolved salts, including sodium chloride.

How would flooding affect soil water potential?

…… **[1]**

(iii) Sodium chloride in solution dissociates into Na^+ and Cl^-.

Explain how the Casparian strip prevents these ions from reaching the xylem of the plant by the apoplast pathway.

……

……

……

…… **[2]**

(b) Plague is caused by the bacterium, *Yersinia pestis.*

(i) The bacterium is a rod-shaped cell that is approximately 3 μm long.

Yersinia pestis is viewed using a light microscope with a magnification of 1250.
What would be the length of the cell in the image produced by this microscope?

Answer**……**mm **[2]**

(ii) Photographs taken of the image obtained by the light microscope could be further enlarged using a projector.

Why might the enlarged image be unable to tell us more about the structure of *Yersinia pestis*?

……

…… **[1]**

SPECIMEN

(iii) Outbreaks of plague still occur occasionally. Plague is transmitted by several methods including droplet infection, close contact between people and fleas moving between infected rats and people.

Suggest **two** ways to minimise the spread of an outbreak of plague.

……

……

……

…… **[2]**

(c) Herbicides work in a number of different ways.

(i) Some herbicides, known as phenoxy herbicides, mimic the action of the auxin, indoleacetic acid (IAA).

What is the normal action of IAA in plant cells?

…… **[1]**

(ii) The herbicide atrazine works by disabling plastoquinone, one of the proton pumps in photosystem II.

Explain how atrazine would kill a susceptible plant.

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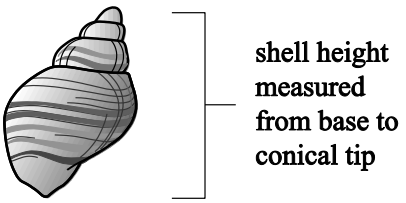
…… **[5]**

SPECIMEN

3 The effect of wave action on the height of the shells of the dog whelk (*Nucella lapillus*) was investigated by comparing an exposed shore and a sheltered shore.



- A random sampling technique was used to collect 50 shells from an exposed shore.
- The shell height was measured from the base to the conical tip. The whelk was returned to its location.
- The process was repeated for the sheltered shore.
- All the results were recorded in **Table 3.1**.

Location	Height of shell (mm)										Range	Mean	SD
Sheltered shore	26	28	27	26	28	23	28	23	26	28			
	29	29	29	29	29	28	29	29	29	29			
	30	31	30	29	32	29	30	29	30	32			
	33	35	34	32	35	32	34	32	33	35			
	37	39	38	37	39	35	38	36	37	39	16	31.3	4.1
Exposed shore	15	17	16	15	23	15	23	16	13	15			
	17	24	18	17	17	14	17	18	16	17			
	19	19	20	24	18	20	19	20	18	20			
	23	14	24	14	21	20	23	17	21	23			
	25	25	28	26	25	27	25	28	25	27	15	20.0	4.2

Table 3.1

(a) The t test can be used to determine the significance of the differences between shell height on the exposed shore and the sheltered shore.

(i) Calculate the *t* value for the data using the formula:

$$t = \frac{\left|\bar{x}_1 - \bar{x}_2\right|}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

where,

$\left|\bar{x}_1 - \bar{x}_2\right|$ is the difference in mean values of sample 1 and sample 2

s_1^2 and s_2^2 are the squares of the standard deviations of the samples

n_1 and n_2 are the sample sizes.

Give your answer to **two** decimal places.

Answer…… **[2]**

SPECIMEN

(ii) The null hypothesis is that there is no difference between the means of the two shell populations.

The critical values at 98 degrees of freedom are shown in **Table 3.2**.

Degrees of freedom	***p* = 0.10**	***p* = 0.05**	***p* = 0.01**	***p* = 0.001**
98	1.67	2.00	2.64	3.41

Table 3.2

Using the table of critical values, explain whether the student would be able to accept or reject the null hypothesis as a result of the *t* value you calculated in part **(i)**.

……

……

…… **[1]**

(b) The students organised the data from **Table 3.1** into classes.

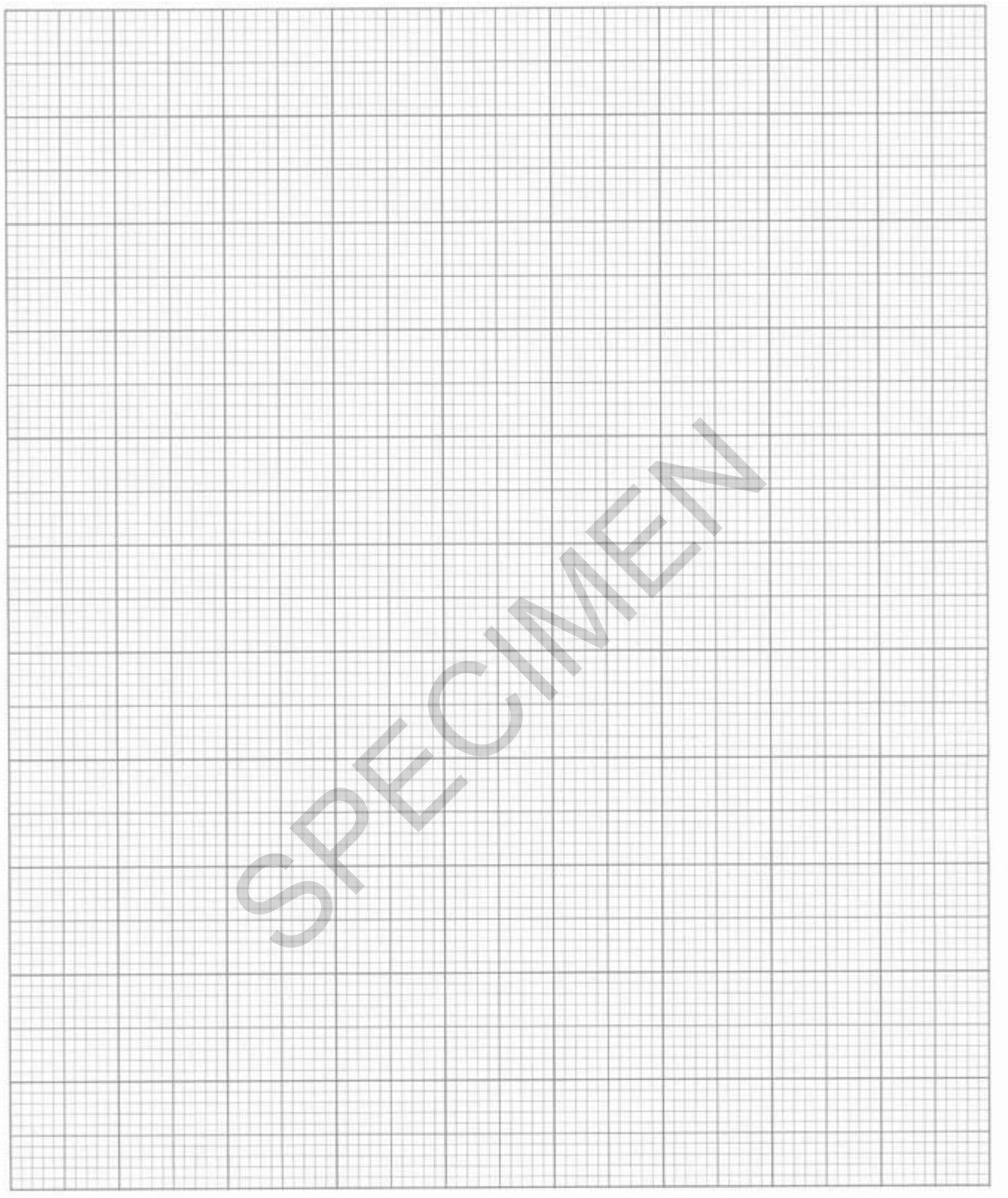
The organised data is shown in **Table 3.3**.

Sheltered shore			**Exposed shore**		
Height (mm)	**Tally**	**Total**	**Height (mm)**	**Tally**	**Total**
23–26	𝍸I	5	11–14	IIII	4
27–30	𝍸I 𝍸I 𝍸I 𝍸I II	22	15–18	𝍸I II	7
31–34	𝍸I 𝍸I I	11	19–22	𝍸I 𝍸I II	12
35–38	𝍸I IIII	9	23–26	𝍸I 𝍸I II	12
39–42	III	3	27–30	IIII	4

Table 3.3

Plot the most suitable graph of the data given in **Table 3.3**.

SPECIMEN



[4]

(c) Use the data and graph to discuss any correlation between the height of the whelk shell and the type of shore.

Suggest explanations for your findings.

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…… **[3]**

(d) Suggest a limitation of the procedure used to gather the data in this experiment and recommend how you could improve this.

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…… **[2]**

(e) How could the students improve the accuracy of their data?

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…… **[1]**

(f) Discuss the validity of the conclusions you have made during this experiment.

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……

…… **[3]**

SPECIMEN

4 Botulism is a condition resulting from the action of botulinum toxin. The main symptom of botulism is skeletal muscle weakness, which can be fatal.

(a) **(i)** Botulinum toxin is produced by the anaerobic bacterium *Clostridium botulinum*.
What information does the word 'anaerobic' suggest about the bacterium?

……

…… **[1]**

(ii) The toxin is initially produced as a large single polypeptide that has low potency.
After the toxin has been acted upon by a protease, two chains are produced which remain connected by a disulfide bond. In this form it is far more toxic.

Describe the action of the protease when it acts on the toxin.

……

…… **[1]**

(b) A mouse assay, using 99 mice, was used to determine the median lethal dose of the toxin.

(i) Suggest what is meant by the term *median lethal dose*.

……

…… **[1]**

(ii) The median lethal dose of the toxin is in the range of 5 – 50 ng kg^{-1} body mass, depending on the toxin type and the method of introduction into the body.

Calculate the probable lethal dose of the **least toxic** botulinum toxin for an individual with a body mass of 85 kg.

Show your working and give your answer in µg.

Answer…… µg **[2]**

SPECIMEN

(iii) The toxin acts primarily at the cholinergic nerve terminals of stimulatory motor neurones. Part of the molecule binds irreversibly to specific receptors on the presynaptic membrane. The toxin–receptor complex is then taken into the cytoplasm of the neurone where the disulfide bond is broken, releasing the section of the molecule which acts to block the release of the neurotransmitter.

Explain why botulism can be fatal.

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…… **[2]**

(c)* There are a number of different strains of the *Clostridium botulinum* bacterium. Different strains produce immunologically distinct forms of the toxin.

Explain why the toxins produced by the different strains are described as being 'immunologically distinct' and how they will be dealt with by the immune system.

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…… **[6]**

SPECIMEN

5 Termites are highly social insects. They are thought to have evolved from earlier forms of insect at least 150 million years ago, in the Jurassic geological period. They are related to cockroaches.

(a) **(i)** How might scientists a century ago have known that termites evolved in the Jurassic geological period?

……

…… **[1]**

(ii) What new source of evidence might help today's scientists to find out how closely related termites are to cockroaches?

……

…… **[1]**

(b) **Fig. 5.1**, on the insert, shows a termite mound, the nest of approximately one million individuals. The photograph was taken in Queensland Australia, about 3000 kilometres south of the equator.

(i) **Fig. 5.1** shows that the interior of the termite mound is full of interconnecting chambers. At the top of the mound some of these chambers open to the air outside.

Worker termites spend all their time working in brood chambers low in the mound, where eggs and larvae develop.

Explain how carbon dioxide produced in the respiring body cells of worker termites is removed to the air outside the termite mound.

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…… **[4]**

(ii) In Africa, closer to the equator, the mounds built by some species of termite are blade-shaped, with the long axis pointing North–South. **Fig. 5.2**, on the insert, shows an example of a termite mound in Africa.

Suggest why the African termites need to build mounds in this shape and orientation.

……

……

…… **[2]**

SPECIMEN

(c) Most termites eat only dead vegetable material, so their principle food source is cellulose. Cellulose is a polymer.

State the name of the monomer in cellulose.

…… **[1]**

(d)

Termites such as the species that built the mound in **Fig. 5.1** on the insert can be classed as 'keystone species'.

Use the information given to state one argument that supports this statement and one argument that does not.

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……

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…… **[2]**

END OF QUESTION PAPER

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A Level Biology A
H420/03 Unified biology
Sample Insert

Date – Morning/Afternoon
Time allowed: 1 hour 30 minutes

You must have:
- the Question Paper

SPECIMEN

INFORMATION
- This document consists of **4** pages. Any blank pages are indicated.

Fig. 5.1

Fig. 5.2

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Copyright Information:

Fig. 5.1: photo of three rocks © permission granted by Mr John Beazley

Fig. 5.2: picture of tree © permission granted Photoshot Holdings Ltd: http://www.alamy.com/

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…day June 20XX –Morning/Afternoon

A Level Biology A
H420/03 Unified biology

SAMPLE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 70

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This document consists of 20 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

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5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space

   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')

   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

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10. For answers marked by levels of response:

- Read through the whole answer from start to finish.
- Decide the level that **best fits** the answer – match the quality of the answer to the closest level descriptor.
- To select a mark within the level, consider the following:

  Higher mark: A good match to main point, including communication statement (in italics), award the higher mark in the level
  Lower mark: Some aspects of level matches but key omissions in main point or communication statement (in italics), award lower mark in the level.

Level of response questions on this paper are **1(g)** and **4(c)**.

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11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

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12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

SPECIMEN

Question			Answer	Marks	Guidance
1	(a)		*idea that* the oxygen will leak from the connectors so reduce the gas movement ✓ **or** oxygen uptake may not be a good representation of respiration rate in germinating seedlings ✓ **or** a small volume of gas is being measured in the capillary ✓ **or** measurements only taken every 30 seconds ✓ **or** difficult to read the meniscus (may be subjective) ✓	1	**ALLOW** seal not air tight so will not prevent gas escaping during the experiment **or** *the idea* that gas leakage is a problem and needs to be prevented. **ALLOW** the respiratory substrate stored in the seed will affect the oxygen needed **or** the idea that if photosynthesis has begun oxygen uptake will be disrupted. **ALLOW** need to record the maximum volume of gas taken up during the experiment **ALLOW** alternative wording e.g. 'more frequent readings are needed'.

SPECIMEN

Question	Answer	Marks	Guidance
(b)	*Variable* the mass of the seeds is not given ✓ *Improvement* take the mass of the seedlings at the start ✓ *Variable* the volume / mass of soda lime is not specified ✓ *Improvement* use a known mass of soda lime each time ✓ *Variable* the size of the syringe is not given ✓ *Improvement* use a 2 cm^3 syringe ✓ *Variable* the capillary tube internal diameter is not given ✓ *Improvement* use a capillary tube of length 20 cm and a 1 mm internal diameter ✓ *Variable* temperature not controlled ✓ *Improvement* allowing apparatus to**,** stabilise / equilibrate to temperature**,** before taking readings ✓ *AVP* ✓	**2**	The control method must be suitable, and be directly linked to the variable. **ALLOW** suggested mass values. **ALLOW** suggested mass values. **ALLOW** alternative size if suitable for the activity. **ALLOW** *idea that* only a linear measurement is obtained not a volume. **ALLOW** alternative size if suitable for the activity. **ALLOW** use of a water bath and thermometer to stabilise the temperature. Must be explicit to provide valid data e.g. no scale on the capillary tube, no timing, no details of how to take the readings. Details must be workable and suitable to provide valid results e.g. scale on the capillary tube, use of timing devices, description of how to take readings from the scale etc.

SPECIMEN

Question			Answer	Marks	Guidance
	(c)		dipped into a small beaker and allowed to run ✓	1	**ALLOW** suitable details of how the red fluid is added.
	(d)		*Explanation* it is more than 10% from the mean **or** it is different from the other data at 60 seconds **or** it does not follow trend for the times for replicate 3 ✓ *Action* anomaly should be identified and excluded from processing **or** anomaly must be identified but could be included in calculations **or** repetition to obtain another reading ✓	2	**ALLOW** 'it is out of line' **ALLOW** 'it is out of line'
	(e)		0.36 mm s^{-1} ✓	1	Rate and units required for the mark.
	(f)	(i)	the internal diameter of the capillary tube ✓	1	
		(ii)	the mass of the bean seeds ✓	1	

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Question	Answer	Marks	Guidance
(g)*	**Level 3 (5–6 marks)** Describes a clear and detailed experiment that has been effectively adapted for use with chosen invertebrate to allow for the comparison of the rate of respiration with that of mung beans. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes an experiment to compare the rate of respiration of chosen invertebrate with mung beans but there is insufficient detail of the procedure to allow a valid comparison. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** An attempt to describe an experiment to investigate the respiratory rate of an invertebrate but little comparison with mung beans. If results or conclusion suggested, likely to be muddled or inaccurate. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** No response or no response worthy of credit.	6	**Relevant points include:** **experiment** • mass of invertebrate and mass of beans the same • safe and ethical use of invertebrates e.g. add screen so that animal(s) cannot touch the muslin bag • bigger syringe needed (5-10 cm^3) • keep temperature constant / same for both assays • keep light constant / same for both assays • use same mass of soda lime in both assays • measuring distance moved by coloured, red liquid at regular time intervals • repeat experiments. **results and conclusions** • invertebrates rate of respiration is expected to be higher than the rate of respiration of the beans *because* • invertebrates are moving around • metabolic processes require energy / generate heat.
	Total	**15**	

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Question			Answer	Marks	Guidance
2	(a)	(i)	DNA / RNA / nucleic acid ✓	1	
		(ii)	lower / reduce / make more negative ✓	1	
		(iii)	*two from* **1** strip is impervious to**,** water / solutions ✓ **2** forces water / solutions**,** to pass through**,** plasma / cell surface, membrane ✓ **3** phospholipid (bilayer)**,** repels / AW**,** ions / charged particles ✓	2	**1** **IGNORE** ref to suberin. **3** The idea of charge / ion impermeability is wanted here. **ALLOW** answer in terms of ions / charged particles needing channels because phospholipid bilayer does not allow charged particles through.
	(b)	(i)	3.75 ✓✓	2	**ALLOW** 3,750 μm or 0.375 cm for **one** mark. **ALLOW** 1 mark for correct working e.g. 3 x 1250
		(ii)	(with light microscope) no further resolution (at ×1250) ✓	1	**IGNORE** ref to further detail, as implied in question. **ALLOW** ref to resolution not the same as magnification.
		(iii)	*two from* stay keep indoors / increase ventilation / wear masks ✓ measures to, exclude / not attract / kill**,** rats/fleas ✓ strict / immediate quarantine for persons with symptoms ✓	2	**ALLOW** (longer term) measures to reduce overcrowding.
	(c)	(i)	(stimulates) cell**,** elongation / division ✓	1	**IGNORE** ref to action outside the cell, or to unqualified "growth" etc.

SPECIMEN

Question			Answer	Marks	Guidance
		(ii)	*three from* **1** reduced / no**,** proton pumping / proton motive force / chemiosmosis ✓ **2** photophosphorylation stops ✓ **3** less / no**,** ATP produced ✓ **4** less / no**,** reduced NADP produced ✓ **5** no**,** Calvin cycle / carbon fixation / light independent stage ✓ *plus* **6** no**,** TP / (hexose) sugars**,** made ✓ **7** no respiratory substrate / respiration ceases ✓	**5**	**3 ALLOW** cessation of vital process that needs ATP **IF** ATP mentioned but **IGNORE** respiration (as credited in mp 7).
			Total	**15**	

SPECIMEN

Question			Answer	Marks	Guidance
3	(a)	(i)	t = 13.61 ✓ ✓	2	**ALLOW** correct working for 1 mark. $\frac{[31.3 - 20.0]}{\sqrt{\frac{4.1^2}{50} + \frac{4.2^2}{50}}} = \frac{11.3}{\sqrt{\frac{16.81}{50} + \frac{17.64}{50}}} = \frac{11.3}{\sqrt{0.3362 + 0.3528}} = \frac{11.3}{\sqrt{0.689}}$ $= 11.3 / 0.830 = 13.61$
		(ii)	probability is highly significant, calculated t value is greater than the critical value at 0.001 / there is a chance (probability) of below 0.001 that the differences in the shell height seen can be due to chance **and** the null hypothesis can be rejected ✓	1	
	(b)		histogram correctly plotted for the values ✓ two sets of data distinguished by a key or other suitable method to identify them ✓ *x* axis labelled 'height (mm)' **and** *y* axis labelled 'number of dog whelks / *Nucella lapillus* / shells / class ' ✓ makes good use of the graph paper **and** both axes are correctly scaled with ascending equidistant intervals ✓	4	**DO NOT ALLOW** a bar chart or a line graph as neither would represent the data correctly. **ALLOW** a correlation scattergram. **ALLOW** '% of the sample' for the *y* axis if this has been calculated.

SPECIMEN

Question			Answer	Marks	Guidance
	(c)		three from positive correlation between the height of the whelk shell and the type of the shore ✓ correct calculation of the correlation coefficient ✓ (histogram / data, indicates that) shore exposure has an impact on height ✓ Nucella show adaptation to harsher wave action ✓ shells measured may not all be exposed to wave action ✓	3	**ALLOW** correlation is strong or a reference to relationship such as:- taller shell height and sheltered shore or shorter shell height and exposed shore**.** **ALLOW** little overlap on the histogram bars. **ALLOW** the idea that the differences may be due to direct wave action or adaptation.
	(d)		no detail for the random sampling technique was given / *Nucella* from the whole population may not have been sampled ✓ **and** use(two) metre tapes to set out a grid and use randomly generated coordinates ✓ no measuring instrument specified ✓ **and** use vernier callipers with a precision of more than 0.5 mm ✓ incorrect identification of *Nucella* / several types of shelled molluscs that are similar to *Nucella* ✓ **and** use a sea shore key to correctly identify the whelk ✓ classification of the shore as sheltered or exposed was subjective ✓ **and** use an approved shore classification (such as Ballantine's) ✓	2	**Limitation and improvement must be linked for 2 marks.**

SPECIMEN

Question	Answer	Marks	Guidance
(e)	*one from* increase the number of, *Nucella* used in the data collection / samples ✓ replicate / repeat, the entire experiment again ✓	1	**ALLOW** a value given such as increasing number to 100 from each shore. **ALLOW** an understanding of the *idea* that the procedure has only been carried out once for each shore.
(f)	*not valid* a small percentage of N*ucella* sampled and some areas not sampled at all which would lead to skewed data ✓ human interpretation of the measurement causes accuracy of the data to be questioned ✓ genetic variations or sub species not taken into account ✓ *valid* random sampling techniques mean no bias in collection ✓ 100 *Nucella* sampled in total (50 in each area) so large sample size ✓ precise instructions for consistent measurement of shell height ✓	3	**ALLOW** reverse arguments made. *idea that* conclusion will be distorted
	Total	16	

SPECIMEN

Question			Answer	Marks	Guidance
4	(a)	(i)	it (only) respires in the absence of oxygen ✓	1	Must imply that the absence of oxygen is the preferred/essential condition. e.g. 'can respire in the absence of oxygen' does not really imply this, as this statement also applies to aerobic organisms.
		(ii)	it hydrolyses a peptide bond between two amino acids (residues) which are joined by a disulfide bond ✓	1	
	(b)	(i)	amount that is required to kill the 50th mouse when they are arranged in order of lethal dose ✓	1	
		(ii)	4.25 (μg) ✓ ✓	2	**ALLOW** 1 mark for correct working using, least lethal dose is 50 ng kg^{-1} 50 × 85 = 4250 ng /1000 = 4.25 μg
		(iii)	*two from* intercostal muscles are / diaphragm muscle is**,** weakened / paralysed ✓ *idea that* ventilation and oxygenation of blood is**,** reduced / compromised ✓ cells / (named) organ(s)**,** cannot**,** obtain oxygen for respiration/ carry out aerobic respiration ✓	2	
	(c)*		**Level 3 (5–6 marks)** A full explanation of why strains are immunologically distinct **AND** a description of more than one method of action of the immune system. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*	6	**Relevant points include:** **immunologically distinct** • toxins produced by each strain will be (slightly) different • each (botulinum) toxin will have different **,** 3D shape / amino acid sequence / DNA nucleotide coding sequence • toxin **,** acts as / is **,** antigen • immune response determined by shape of antigen • different compounds will have different shapes

SPECIMEN

Question			Answer	Marks	Guidance
			Level 2 (3–4 marks) A full explanation of why strains are immunologically distinct **AND** an attempt to describe a method of action of the immune system. **OR** A description of more than one method of action of the immune system **AND** an attempt to explain why strains are immunologically distinct. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** An attempt to explain why strains are immunologically distinct **AND** an attempt to describe a method of action of the immune system. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** No response or no response worthy of credit.		**immune system** • antigen presenting cells ingest antigen and display antigen on their surfaces • interaction between APCs and T-helper cells causes production of interleukins • B cells activated by T-helper cells • clonal selection and clonal expansion • B cells differentiate into plasma cells • plasma cells produce **,** antibodies / immunoglobulins • by protein synthesis antibodies bind to and neutralise toxins.
			Total	**13**	

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Question			Answer	Marks	Guidance
5	(a)	(i)	fossils in, known-age / Jurassic, strata / rocks ✓	1	
		(ii)	DNA / cytochrome c ✓	1	
	(b)	(i)	carbon dioxide diffuses down concentration gradient out of the respiring cell ✓ carried through body from cell (to tracheoles) by blood passing out via tracheoles / trachea / spiracles ✓ respiration generates heat ✓ hot gases expand and are less dense so rise up by convection through the mound to vents at mound-top ✓	4	
	(b)	(ii)	*shape,* large or increased surface area to volume ratio ✓ smallest area exposed to greatest heat ✓	2	Response **must** be linked to context of avoiding overheating / needing to get rid of heat.
	(c)		β / beta glucose ✓	1	
	(d)		*argument for* important, (N or C) recyclers / saprotrophs ✓ *argument against* not a predator ✓ large in abundance/ biomass (so effect on environment not disproportionate) ✓	2	
			Total	11	

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