AQA GCSE BIOLOGY (4401)

BIOLOGY



EXAM QUESTION PACK

UNIT B2 HIGHER TIER BL2HP PAPERS

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AQA

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Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
ADDITIONAL SCIENCE
BIOLOGY

H

Higher Tier Unit Biology B2

Friday 10 June 2016 Morning Time allowed: 1 hour

Materials
For this paper you must have:
- a ruler

You may use a calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2 should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

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ANSWER IN THE SPACES PROVIDED

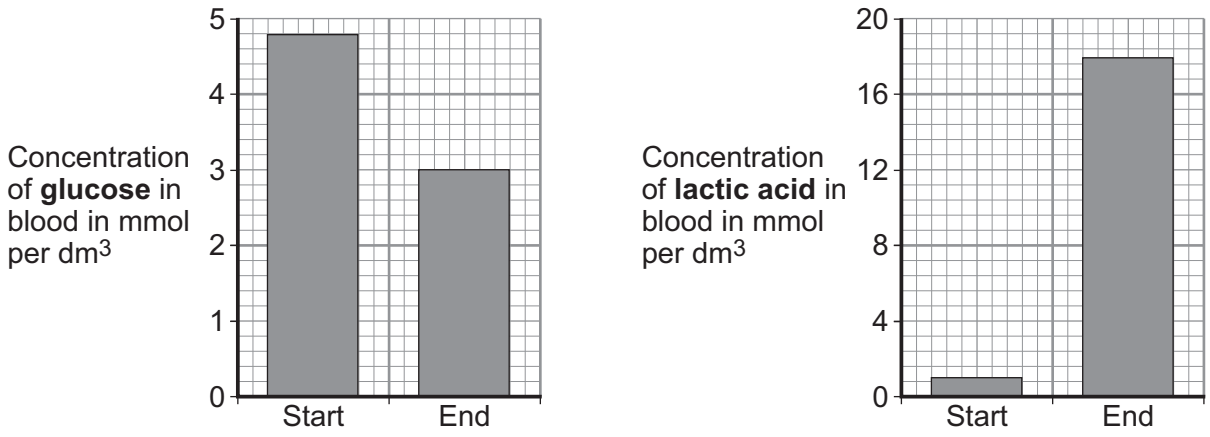
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Answer **all** questions in the spaces provided.

1 An athlete ran as fast as he could until he was exhausted.

1 (a) **Figure 1** shows the concentrations of glucose and of lactic acid in the athlete's blood at the start and at the end of the run.

Figure 1



1 (a) (i) Lactic acid is made during anaerobic respiration.

What does anaerobic mean?

[1 mark]

1 (a) (ii) Give evidence from **Figure 1** that the athlete respired anaerobically during the run.

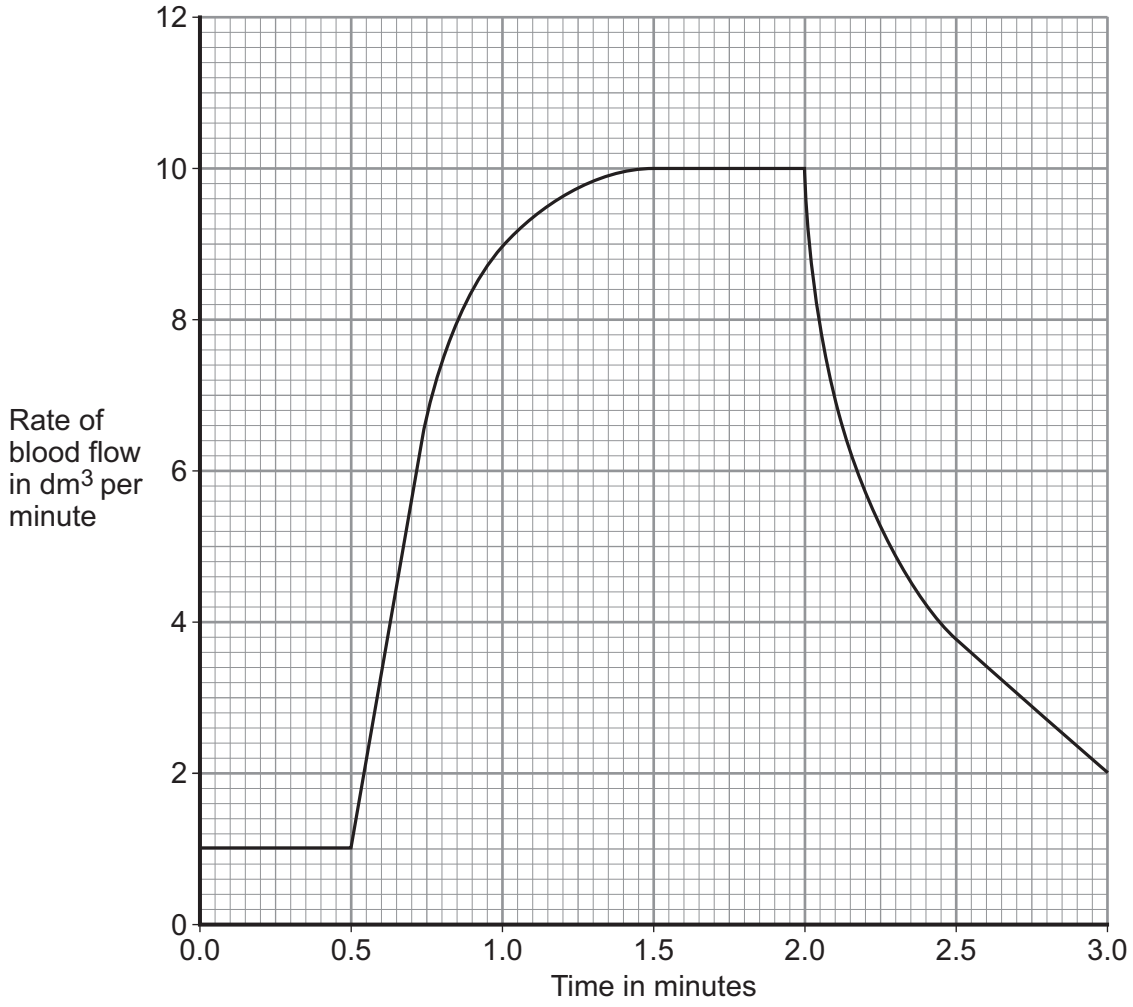
[1 mark]

Question 1 continues on the next page

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1 (b) **Figure 2** shows the effect of running on the rate of blood flow through the athlete's muscles.

Figure 2



1 (b) (i) For how many minutes did the athlete run?

[1 mark]

Time = _____ minutes

1 (b) (ii) Describe what happens to the rate of blood flow through the athlete's muscles during the run.

Use data from **Figure 2** in your answer.

[2 marks]

_____

_____

_____

_____

Do not write outside the box

1 (b) (iii) Explain how the change in blood flow to the athlete's muscles helps him to run.

[4 marks]

9

Turn over for the next question

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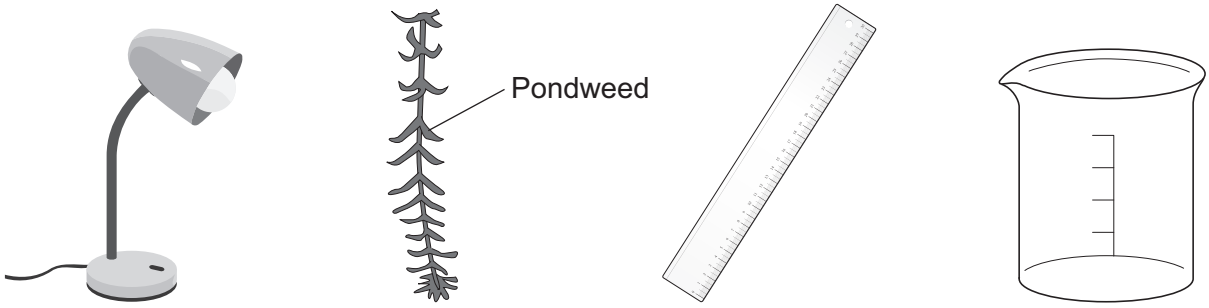
2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Light intensity, carbon dioxide concentration and temperature are three factors that affect the rate of photosynthesis.

How would you investigate the effect of **light intensity** on the rate of photosynthesis?

Figure 3 shows some of the apparatus you might use.

Figure 3



Not to scale

You should include details of:

- how you would set up the apparatus and the materials you would use
- the measurements you would make
- how you could make this a fair test.

[6 marks]

Do not write outside the box

Extra space _____

6

Turn over for the next question

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3 Enzymes are made and used in all living organisms.

3 (a) What is an enzyme?

[2 marks]

_____

_____

_____

_____

3 (b) Many enzymes work inside cells.

In which part of a cell will most enzymes work?

[1 mark]

Draw a ring around the correct answer.

cell membrane **cytoplasm** **nucleus**

3 (c) We can also use enzymes in industry.

Hydrogen peroxide is a chemical that can be used to preserve milk.

Adding a small amount of hydrogen peroxide to the milk kills the bacteria that cause decay. Hydrogen peroxide does not kill all disease-causing bacteria.

The enzyme catalase can be added later to break down the hydrogen peroxide to oxygen and water.

A different way of preserving the milk is by heating it in large machines to 138 °C for a few seconds.

Suggest **one** advantage and **one** disadvantage of using hydrogen peroxide and catalase to preserve milk instead of using heat treatment.

[2 marks]

Advantage of hydrogen peroxide and catalase _____

_____

_____

Disadvantage of hydrogen peroxide and catalase _____

_____

_____

5

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4 The stomach is an organ.

4 (a) To which organ system does the stomach belong?

[1 mark]

The _____ system

4 (b) The stomach wall contains the following types of tissue:

- epithelial tissue
- glandular tissue
- muscular tissue.

4 (b) (i) What is the function of epithelial tissue in the stomach?

[1 mark]

_____

_____

4 (b) (ii) Describe the functions of glandular tissue in the stomach.

[3 marks]

_____

_____

_____

_____

_____

_____

4 (b) (iii) Describe how muscular tissue helps the stomach to function.

[2 marks]

_____

_____

_____

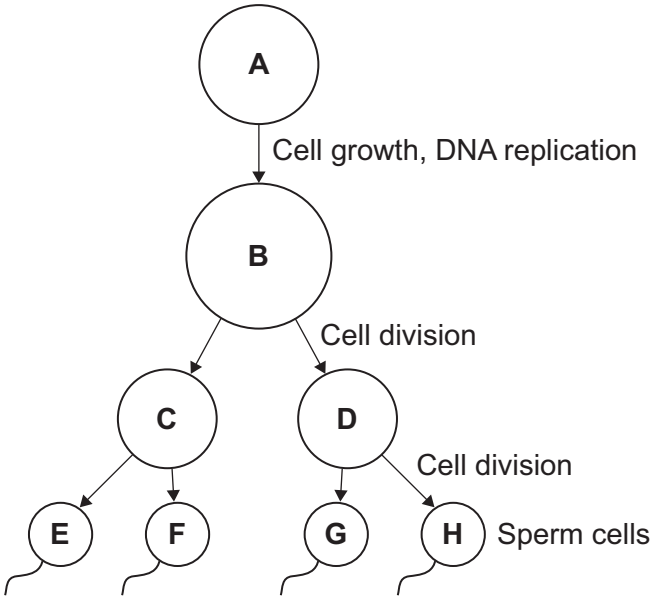
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7

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5 **Figure 4** shows the production of human sperm cells.

Figure 4



5 (a) Name the organ where the processes shown in **Figure 4** take place.

[1 mark]

_____

5 (b) (i) Not every cell in **Figure 4** contains the same amount of DNA.

Cell **A** contains 6.6 picograms of DNA (1 picogram = 10^{-12} grams).

How much DNA is there in each of the following cells?

[2 marks]

Cell **B** _____ picograms

Cell **C** _____ picograms

Cell **E** _____ picograms

5 (b) (ii) How much DNA would there be in a fertilised egg cell?

[1 mark]

_____ picograms

5 (b) (iii) A fertilised egg cell divides many times to form an embryo.

Name this type of cell division.

[1 mark]

_____

Do not write outside the box

5 (c) After a baby is born, stem cells may be collected from the umbilical cord. These can be frozen and stored for possible use in the future.

5 (c) (i) What are stem cells?

[2 marks]

5 (c) (ii) Suggest why it is ethically more acceptable to take stem cells from an umbilical cord instead of using stem cells from a 4-day-old embryo produced by In Vitro Fertilisation (IVF).

[1 mark]

5 (c) (iii) Stem cells taken from a child's umbilical cord could be used to treat a condition later in that child's life.

Give **one** advantage of using the child's own umbilical cord stem cells instead of using stem cells donated from another person.

[1 mark]

5 (c) (iv) Why would it **not** be possible to treat a genetic disorder in a child using his own umbilical cord stem cells?

[1 mark]

10

Turn over for the next question

Do not write outside the box

6 (a) Polydactyly is an inherited condition caused by a dominant allele.

Figure 5 shows the hand of a man with polydactyly. The man has an extra finger on each hand.

The man's mother also has polydactyly but his father does not.

Figure 5



6 (a) (i) The man is **heterozygous** for polydactyly.

Explain how the information given above shows that the man is **heterozygous** for polydactyly.

[3 marks]

6 (a) (ii) The man marries a woman who does **not** have polydactyly.

What is the probability that their first child will have polydactyly?

[1 mark]

Do not write outside the box

6 (b) The man has red hair. His sister has brown hair.

Both of their parents have brown hair.

Brown hair is caused by the dominant allele, **B**.

Red hair is caused by a recessive allele, **b**.

Complete the genetic diagram below to show how the man's parents were able to have some children with red hair and some with brown hair.

[5 marks]

	Father	**Mother**
Parental phenotypes:	_____	_____
Parental genotypes:	_____	_____
Gametes:	_____ _____	_____ _____

Offspring genotypes: _____

Offspring phenotypes: _____

9

Turn over for the next question

Do not write outside the box

7 Some students wanted to estimate the number of plantain plants in a grassy field.

The field measured 100 metres × 50 metres.

The students:
- chose areas where plantains were growing
- placed 10 quadrats in these areas
- counted the number of plantains in each of the 10 quadrats.

Each quadrat measured 25 cm × 25 cm.

Table 1 shows the students' results.

Table 1

Quadrat number	Number of plantain plants
1	2
2	1
3	4
4	1
5	3
6	2
7	4
8	1
9	1
10	1

7 (a) Complete the following calculation to estimate the number of plantain plants in the field.

Use the students' results from **Table 1**.

[3 marks]

Total number of plantains in 10 quadrats = _____

Total area of 10 quadrats = _____ m^2

Mean number of plantains per m^2 = _____

_____

Area of field = _____ m^2

Therefore estimated number of plantains in field = _____

_____

Do not write outside the box

7 (b) The students' method would **not** give a valid estimate of the number of plantain plants in the field.

Describe **three** improvements you could make to the students' method.

For each improvement, give the reason why your method would produce more valid results than the students' method.

[3 marks]

Improvement 1 _____

Reason _____

_____

Improvement 2 _____

Reason _____

_____

Improvement 3 _____

Reason _____

_____

6

Turn over for the next question

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8 **Figure 6** is a map showing a group of islands in the Pacific Ocean, near the coast of California, USA.

Figure 6



A species of fox, called the Island Fox, lives on each of the six islands shown in **Figure 6**.

Figure 7 shows an Island Fox.

Figure 7



The foxes on each island are slightly different from those on the other islands.

The Island Foxes are similar to another species of fox, called the Grey Fox.

The Grey Fox lives in mainland California.

Do not write outside the box

8 (a) Suggest how scientists could prove that the six types of Island Fox belong to the same species.

[2 marks]

8 (b) Scientists believe that ancestors of the modern Island Fox first colonised what is now Santa Cruz Island during the last Ice Age, approximately 16 000 years ago. At that time, lowered sea levels made the three northernmost islands into a single island and the distance between this island and the mainland was reduced to about 8 km.

8 (b) (i) How could the Island Fox have developed into a completely different species from the mainland Grey Fox?

[5 marks]

Question 8 continues on the next page

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8 (b) (ii) Suggest why the Island Foxes have developed into different varieties of the same species instead of six different species.

[1 mark]

_____

_____

_____

8

END OF QUESTIONS

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GCSE

Additional Science / Biology

BL2HP

Mark scheme

4408 / 4401

June 2016

Version/Stage: 1.0 Final Mark Scheme

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**.
Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

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Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation 'ecf' in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

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4. Quality of Written Communication and levels marking

In Question 2 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	without <u>oxygen</u>	allow not enough oxygen ignore air ignore production of CO_2 ignore energy	1	AO1 2.6, 2.6.2a
1(a)(ii)	more/high/increased lactic acid (at end)	allow approximate figures (to show increase) ignore reference to glucose	1	AO3 2.6, 2.6.2b
1(b)(i)	1.5	allow only 1.5 / 1½ / one and a half	1	AO3 2.6, 2.6.1g/h
1(b)(ii)	increases at first **and** levelling off suitable use of numbers eg rises to 10 / by 9 (dm^3 per min) **or** increases up to 1.5 (min) / levels off after 1.5 (min) (of x axis timescale) **or** after the first minute (of the run)	ignore subsequent decrease allow answer in range 1.4 to 1.5	1 1	AO2 2.6, 2.6.1g/h
1(b)(iii)	supplies (more) oxygen supplies (more) glucose for (more) respiration releases (more) energy (for muscle contraction)	need 'more/faster' once only for full marks allow removes (more) CO_2 /lactic acid / heat as an alternative for either marking point one **or** two, **once** only do **not** allow energy production or **for** respiration	1 1 1 1	AO1 2.6.1b/e/f/g/h 2.6.2d
Total			**9**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
2			6	AO1/2/3 2.3.1a/b/c/d +prac

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	A partial description of how the apparatus is set up **or** a description of how light is supplied **or** a simple description of how photosynthesis can be measured. **or** a control variable	A description of how the apparatus is set up **and** a description of how photosynthesis can be measured. **or** a description of how light intensity is varied **or** a control variable **or** any other relevant point	A description of how the apparatus is used to measure the **rate** of photosynthesis at different light **intensities** is given. For full marks reference must be made to a control variable **or** repeats

examples of the points made in the response

- apparatus set up:
  - weed in water in beaker
  - light shining on beaker
- method of varying the light intensity – eg changing distance of lamp from plant
- method of controlling other variables
  - use same pond weed **or** same length of pond weed
  - temperature: water bath or heat screen
  - CO_2
- leave sufficient time at each new light intensity before measurements taken
- method of measuring photosynthesis – eg counting bubbles of gas released or collecting gas & measuring volume in a syringe
- measuring **rate of photosynthesis** by counting bubbles for set period of time
- repetitions

extra information

allow information in the form of a diagram

Total		6

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	a catalyst / speeds up a reaction it is a protein **or** it is specific / described **or** it has an active site	ignore it is not used up allow it only acts on one molecule	1 1	AO1 2.5.1a/b
3(b)	cytoplasm		1	AO1 2.1.1a 2.6.1a
3(c)	**Advantage:** any **one** from: • heat would denature proteins (in milk) • heat alters texture or flavour (of milk) • catalase / enzyme is specific **or** only affects hydrogen peroxide • less energy / fuel / lower temperature used so less expensive **or** less pollution **Disadvantage:** any **one** from: • (some pathogens may survive) causing illness • catalase / enzyme left in milk **or** may cause allergies **or** may alter taste		1 1	AO3 2.5, 2.5.2j
Total			**5**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	digestive		1	AO1 2.2, 2.2.1d
4(b)(i)	covers / lines (surface)	allow protects ignore secretory functions	1	AO1 2.2.1b/c
4(b)(ii)	any **three** from: • produces enzyme(s) / protease • (digestive juice / enzyme) digests/breaks down protein • produces HCl / acid • (acid) kills bacteria/ pathogens **or** provides optimum pH	allow produces pepsin apply list principle for incorrect enzymes allow produces mucus allow (mucus) protects stomach lining against proteases **or** acid **or** against break down	3	AO1 2.2.1b/c 2.5.2b/c/e/ g
4(b)(iii)	contracts churns / mixes / moves stomach contents	ignore relaxes do **not** allow expands allow peristalsis **or** mechanical digestion	1 1	AO1 2.2.1b/c
Total			**7**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	testis / testes	allow testicle(s)	1	AO1 2.7.1f
5(b)(i)	**B** = 13.2 **C** = 6.6 **E** = 3.3	all 3 correct = 2 marks 2 or 1 correct = 1 mark If no marks awarded allow ecf for C **and** E based on answer to B ie C = ½ B **and** E = ½ C for one mark	2	AO2 2.7.1e/h
5(b)(ii)	6.6	allow twice answer for cell **E** in 5bi	1	AO2 2.7.1e/h/i
5(b)(iii)	mitosis	correct spelling only	1	AO1 2.7.1a/d/i
5(c)(i)	any **two** from: • cells that are able to divide • undifferentiated cells / not specialised • can become other types of cells / tissues **or** become specialised /differentiated	allow pluripotent	2	AO1 2.7.1k/l
5(c)(ii)	4-day embryo is a (potential) human life **or** destroying/damaging (potential) human life	allow cord would have been discarded anyway ignore reference to miscarriage allow cannot give consent	1	AO3 2.7
5(c)(iii)	perfect tissue match **or** hard to find suitable donors	allow same/matching antigens allow no danger of rejection allow no need to take immunosuppressant drugs (for life) ignore genetically identical **or** same DNA	1	AO2 2.7.1c

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(c)(iv)	stem cells have same faulty gene / allele / DNA / chromosomes	allow genetically identical ignore cells have the same genetic disorder	1	AO2 2.7.1c
Total			**10**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	man has (inherited) polydactyly (PD) allele (from mother) man has (inherited) other / normal / recessive allele from father because father does not have PD allele **or** if father had it father would have had PD **or** father only has normal allele **or** father is homozygous recessive	allow gene for allele	1 1 1	AO1/2/3 2.7, 2.7.2a/c/d 2.7.3a/b
6(a)(ii)	0.5 / ½ / 1 in 2 / 1:1 / 50%	do not allow 1:2 or 50/50 allow 50:50	1	AO3 2.7, 2.7.2a/c/d 2.7.3a/b
6(b)	parental phenotypes: both brown parental genotypes: both **Bb** gametes: **B** **b** and **B** **b** offspring genotypes: **BB** **(2)Bb** **bb** offspring phenotypes correctly assigned to genotypes: **BB** & **Bb** = brown **bb** = red	allow only on gametes answer line allow ecf from genotypes allow ecf from gametes do not penalise confusion of 'phenotypes' & 'genotypes' here	1 1 1 1 1	AO1/2/3 2.7, 2.7.2a/c/e
Total			**9**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	160 000	if incorrect answer / no answer: allow max. 2 for method: 1 mark for mean = total number ÷ area of ten quadrats eg $\frac{20}{0.625}$ or $\frac{20 \times 8}{5}$ or $\frac{160}{5}$ or 32 1 mark for final answer = mean x field area eg mean x 5000	3	AO2 2.4.1b
7(b)	Improvement: place quadrats randomly **and** Reason: avoid bias / (more) representative / (more) reliable Improvement: more quadrats **and** Reason: overcome random variation / (more) typical / (more) representative / (more) reliable / repeatable Improvement: larger quadrats **or** repeat when plants are bigger **and** Reason: less likely to miss plants	allow 1 mark if 2 correct improvements but no reasons / only incorrect reasons ignore accurate ,valid, precise and fair ignore anomalies	1 1 1	AO3 2.4, 2.4.1b
Total			**6**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	reference to interbreeding		1	AO1/2
	successfully between Island types	allow ref. to production of fertile offspring allow ref. to DNA analysis / comparison for 1 mark ignore ref. to grey fox	1	2.8.1f
8(b)(i)	(two ancestral populations) separated / isolated (by geographical barrier / sea)		1	AO1/2 2.8.1f
	and genetic variation (in each population) **or** different / new alleles **or** mutations occur		1	
	under different environment / conditions	allow abiotic or biotic example allow different selection pressures	1	
	natural selection occurs **or** better adapted survived to reproduce		1	
	so (favourable) alleles / genes / mutations passed on (in each population)	ignore they adapt to their environment	1	
8(b)(ii)	any **one** from: • continued to mate with one another • few beneficial mutations (between island varieties) • similar conditions on each island so similar adaptations/features fit		1	AO3 2.8.1f
Total			**8**	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

AQA

General Certificate of Secondary Education
Higher Tier
June 2015

Additional Science
Unit Biology B2

BL2HP

H

Biology
Unit Biology B2

Tuesday 12 May 2015 1.30 pm to 2.30 pm

For this paper you must have:
- a ruler.

You may use a calculator.

A

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2 should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

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Do not write outside the box

Answer **all** questions in the spaces provided.

1 Lipase is an enzyme that digests fat.

1 (a) (i) Complete the equation to show the digestion of fat.

Use the correct answer from the box.

[1 mark]

glucose	**glycerol**	**glycogen**

fat $\xrightarrow{\text{lipase}}$ fatty acids + ...

1 (a) (ii) Name **one** organ that makes lipase.

[1 mark]

.....

1 (b) Some students investigated the effect of bile on the digestion of fat by lipase.

The students:
1 mixed milk and bile in a beaker
2 put the pH sensor of a pH meter into the beaker
3 added lipase solution
4 recorded the pH at 2-minute intervals
5 repeated steps 1 to 4, but used water instead of bile.

Suggest **two** variables that the students should have controlled in this investigation.

[2 marks]

1 .....

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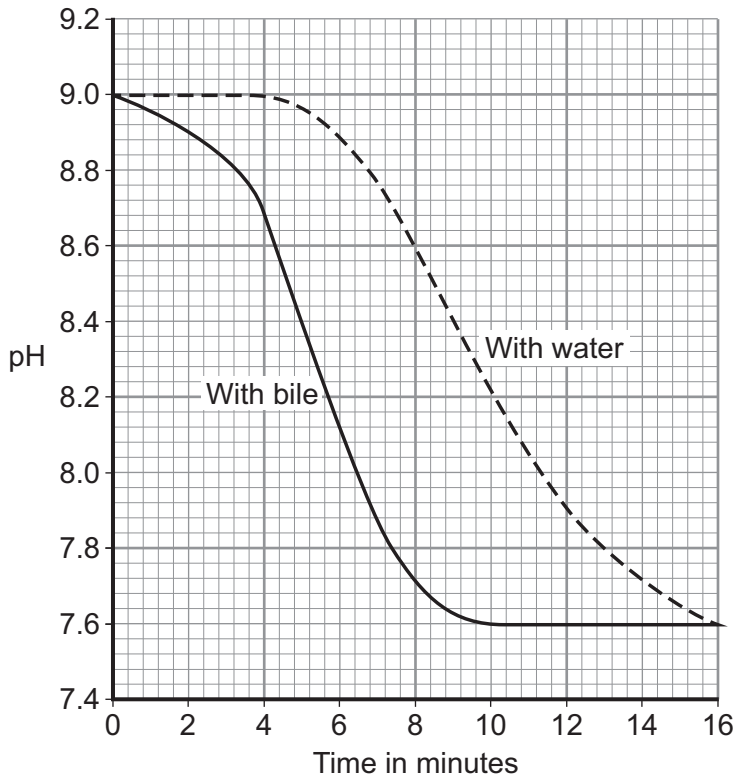
2 .....

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Do not write outside the box

1 (c) **Figure 1** shows the students' results.

Figure 1



1 (c) (i) Why did the pH decrease in both investigations?

[1 mark]

.....

.....

1 (c) (ii) Bile helps lipase to digest fat.

What evidence is there in **Figure 1** to support this conclusion?

[1 mark]

.....

.....

1 (c) (iii) Suggest **one** reason why the contents of both beakers had the same pH at the end of the investigations.

[1 mark]

.....

.....

7

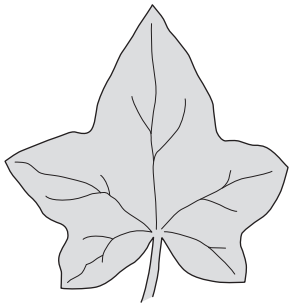
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2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

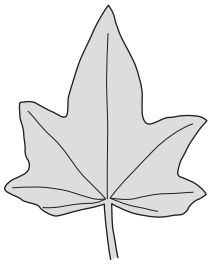
Ivy plants can grow up trees and walls.

Figure 2 shows two ivy leaves. One leaf is from an ivy plant growing up a tree in the centre of a shady woodland area. The other leaf is from an ivy plant growing up a tree in a sunny area at the edge of the woodland.

Figure 2



Ivy leaf from shady woodland area (centre of woodland)



Ivy leaf from sunny area (edge of woodland)

A student makes the following hypothesis.

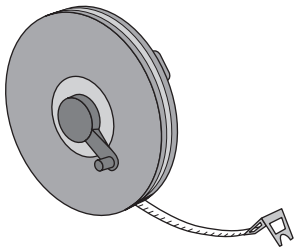
"The size of ivy leaves decreases as light intensity increases."

How would you use the apparatus shown in **Figure 3** to test this hypothesis?

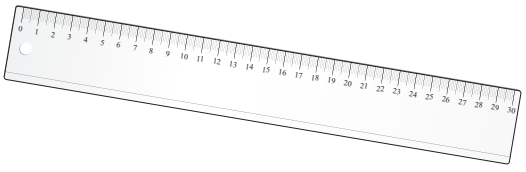
You should include details of how you would make sure the results are valid.

[6 marks]

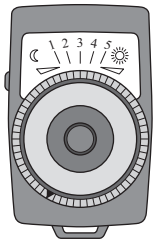
Figure 3



100 m tape measure



Ruler



Light meter

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Extra space .....

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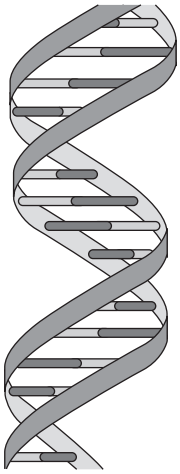
Turn over for the next question

Do not write outside the box

3 DNA is the genetic material of human cells.

Figure 4 shows the structure of part of a DNA molecule.

Figure 4



3 (a) (i) Describe where DNA is found in a human cell.

[2 marks]

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.....

3 (a) (ii) When a cell divides by mitosis the new cells are genetically identical.

What causes the cells to be genetically identical?

[1 mark]

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3 (b) Many genes have different forms called alleles.

3 (b) (i) A person has polydactyly (extra fingers or toes). Polydactyly is caused by a dominant allele.
What is the smallest number of copies of the dominant allele for polydactyly that could be found in a body cell of this person?

[1 mark]

.....

3 (b) (ii) Another person has cystic fibrosis. Cystic fibrosis (CF) is caused by a recessive allele.
How many copies of the recessive CF allele are there in a body cell of this person?

[1 mark]

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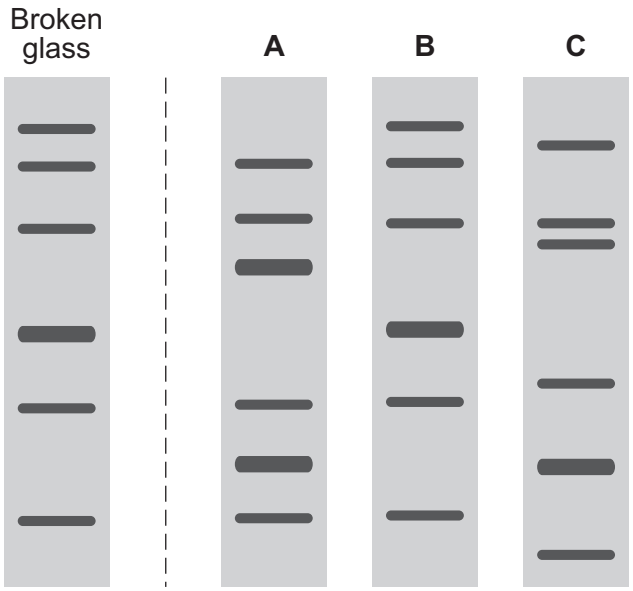
Do not write outside the box

3 (c) A burglar broke into a house. The burglar cut his hand on some broken glass. Scientists extracted DNA from the blood on the broken glass.

The scientists analysed the DNA from the glass and DNA from three suspects, **A**, **B** and **C**. The scientists used a method called DNA fingerprinting.

Figure 5 shows the scientists' results.

Figure 5



Which suspect, **A**, **B** or **C**, is most likely to have been the burglar?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

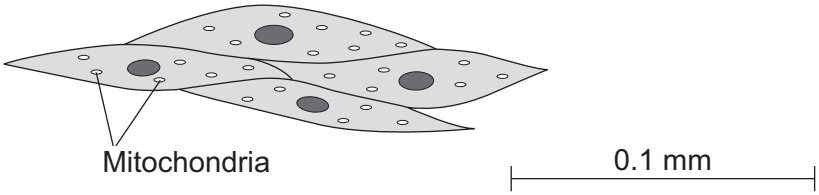
C ☐

6

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4 **Figure 6** shows some muscle cells from the wall of the stomach, as seen through a light microscope.

Figure 6



4 (a) Describe the function of muscle cells in the wall of the stomach.

[2 marks]

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4 (b) **Figure 6** is highly magnified.

The scale bar in **Figure 6** represents 0.1 mm.

Use a ruler to measure the length of the scale bar and then calculate the magnification of **Figure 6**.

[2 marks]

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Magnification = ... times

Do not write outside the box

4 (c) The muscle cells in **Figure 6** contain many mitochondria.

What is the function of mitochondria?

[2 marks]

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4 (d) The muscle cells also contain many ribosomes. The ribosomes cannot be seen in **Figure 6**.

4 (d) (i) What is the function of a ribosome?

[1 mark]

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4 (d) (ii) Suggest why the ribosomes **cannot** be seen through a light microscope.

[1 mark]

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8

Turn over for the next question

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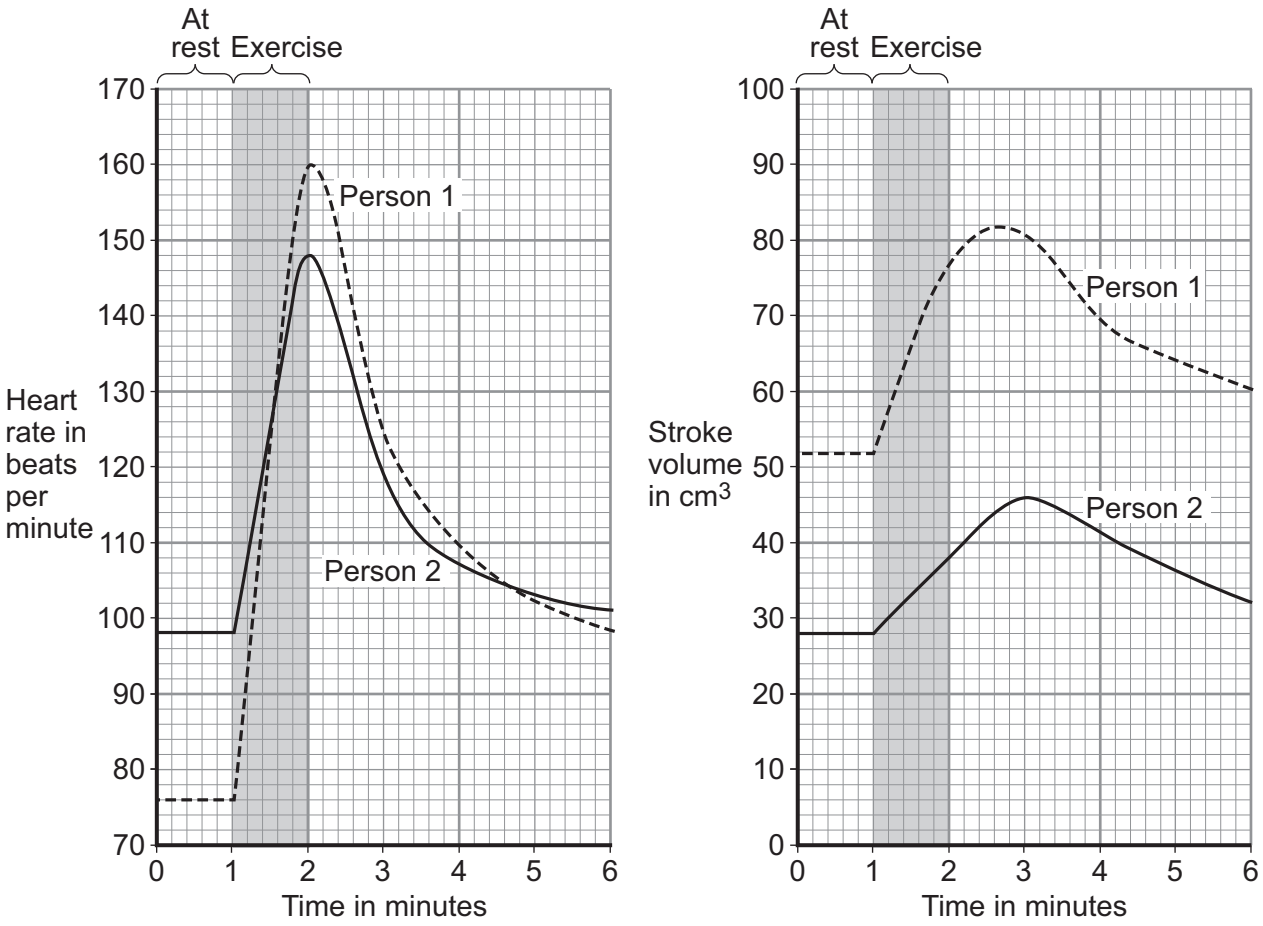
5 During exercise, the heart beats faster and with greater force.

The 'heart rate' is the number of times the heart beats each minute.
The volume of blood that travels out of the heart each time the heart beats is called the 'stroke volume'.

In an investigation, **Person 1** and **Person 2** ran as fast as they could for 1 minute. Scientists measured the heart rates and stroke volumes of **Person 1** and **Person 2** at rest, during the exercise and after the exercise.

Figure 7 shows the scientists' results.

Figure 7



Do not write outside the box

5 (a) The 'cardiac output' is the volume of blood sent from the heart to the muscles each minute.

Cardiac output = Heart rate × Stroke volume

At the end of the exercise, **Person 1**'s cardiac output = 160 × 77 = 12 320 cm^3 per minute.

Use information from **Figure 7** to complete the following calculation of **Person 2**'s cardiac output at the end of the exercise.

[3 marks]

At the end of the exercise:

Person 2's heart rate = ... beats per minute

Person 2's stroke volume = ... cm^3

Person 2's cardiac output = ... cm^3 per minute

5 (b) **Person 2** had a much lower cardiac output than **Person 1**.

5 (b) (i) Use information from **Figure 7** to suggest the **main** reason for the lower cardiac output of **Person 2**.

[1 mark]

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5 (b) (ii) **Person 1** was able to run much faster than **Person 2**.

Use information from **Figure 7** and your own knowledge to explain why.

[5 marks]

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9

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6 (a) Evidence about extinct species of animals and plants comes from fossils.

Figure 8 is a photograph of a fossil of a bird-like animal called *Archaeopteryx*. *Archaeopteryx* lived about 150 million years ago.

Figure 8



6 (a) (i) Suggest how the fossil of *Archaeopteryx* was formed.

[2 marks]

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6 (a) (ii) Scientists have found other fossils of the ancestors of modern birds, but the fossil record is very incomplete.

Suggest **two** reasons why there are gaps in the fossil record.

[2 marks]

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2 .....

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Do not write outside the box

6 (b) There are many different species of bird on the Earth today.

Describe how these different species may have evolved from an ancestor such as *Archaeopteryx*.

[4 marks]

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8

Turn over for the next question

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There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

7 Green plants can make glucose.

7 (a) Plants need energy to make glucose.

How do plants get this energy?

[2 marks]

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7 (b) Plants can use the glucose they have made to supply them with energy.

Give **four** other ways in which plants use the glucose they have made.

[4 marks]

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6

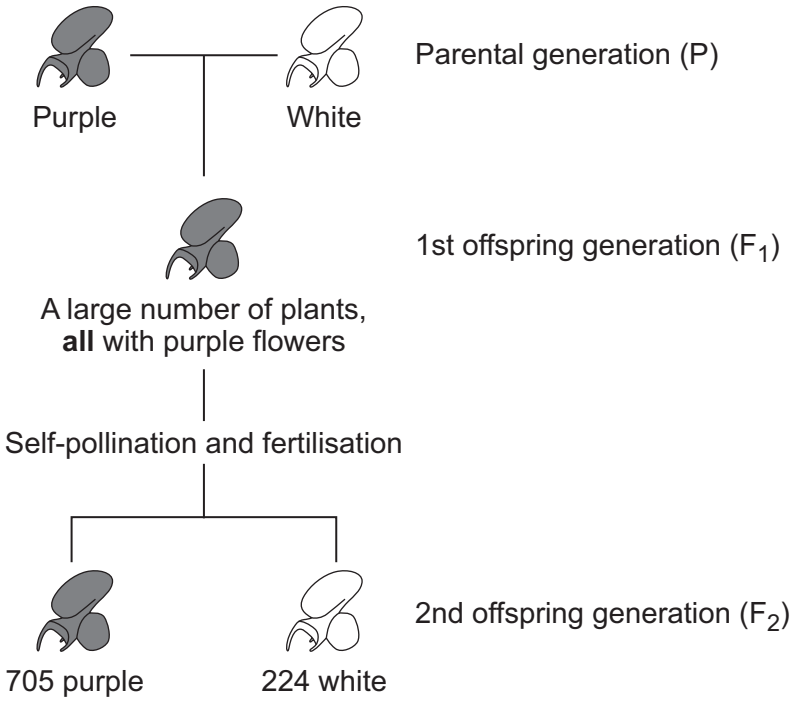
Turn over for the next question

Do not write outside the box

8 In 1866, Gregor Mendel published the results of his investigations into inheritance in garden pea plants.

Figure 9 shows the results Mendel obtained in one investigation with purple-flowered and white-flowered pea plants.

Figure 9



8 (a) (i) Calculate the ratio of purple-flowered plants to white-flowered plants in the F_2 generation.

[1 mark]

Ratio of purple : white = ...

8 (a) (ii) There was a total of 929 plants in the F_2 generation.

Mendel thought that the production of a large number of offspring plants improved the investigation.

Explain why.

[2 marks]

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Do not write outside the box

8 (b) (i) Some of the plants in **Figure 9** are homozygous for flower colour and some are heterozygous.

Complete **Table 1** to show whether each of the plants is homozygous or heterozygous. For each plant, tick (✓) **one** box.

[2 marks]

Table 1

	Homozygous	**Heterozygous**
Purple-flowered plant in the P generation		
White-flowered plant in the P generation		
Purple-flowered plant in the F_1 generation		

8 (b) (ii) Draw a genetic diagram to show how self-pollination of the F_1 purple-flowered plants produced mainly purple-flowered offspring in the F_2 generation together with some white-flowered offspring.

Use the following symbols:

N = allele for purple flower colour
n = allele for white flower colour

[3 marks]

8 (c) When Mendel published his work on genetics, other scientists at the time did not realise how important it was.

Suggest **two** reasons why.

[2 marks]

1 .....

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2 .....

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10

END OF QUESTIONS

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GCSE

Additional Science / Biology

BL2HP

Mark scheme

4408 / 4401

June 2015

Version: 1.0 Final

STEMUP.CO.UK

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

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Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Quality of Written Communication and levels marking

In Question 2 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	glycerol		1	AO1 2.5.2f
1(a)(ii)	pancreas / small intestine	accept duodenum / ileum ignore intestine unqualified	1	AO1 2.5.2f
1(b)	any **two** from: • type of milk • volume / amount of milk • vol. bile equals vol. water • volume of lipase • concentration of lipase • temperature	ignore time interval ignore solution unqualified do **not** allow pH ignore starting pH ignore volume / amount of bile / water ignore concentration of bile accept amount of lipase if neither volume nor concentration given	2	AO3 2.5.2f,h
1(c)(i)	fatty acid (production)		1	AO2 2.5.2f,h
1(c)(ii)	faster reaction / digestion (with bile) **or** pH decreases faster (with bile) **or** takes less time (with bile) **or** steeper fall / line (with bile)	allow use of data ignore easier	1	AO3 2.5.2f,h

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(c)(iii)	all fat / milk digested **or** same amount of fatty acids present **or** (lower pH) denatures the enzyme / lipase	allow all reactants used up ignore reference to neutralisation allow enzyme won't work at low pH do **not** allow enzyme killed	1	AO2 2.5.2f,h
Total			**7**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref
2			6	AO1 / AO2 / AO3 2.4, 2.4.1a,b,prac

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	The apparatus needed to measure the leaf is identified **or** the apparatus needed to measure light intensity is identified **or** an appropriate use of the tape measure is identified.	There is a description of a leaf being measured at different locations **or** light being measured at different locations.	There is a description of a leaf **and** light being measured at different locations **and** repetitions are included **or** a control variable is described **or** appropriate mathematical treatment of the data is described

examples of points made in the response:

- use of tape measure to produce transect
- transect placed coming out of shady area (eg woodland) into lighter area
- repeat transects
- samples at same height above ground
- samples at same aspect (N / E / S / W) on trees
- measurement of length, or width, of leaves using ruler
- measure several leaves at each location
- use of light meter to measure light intensity
- repeat measurements of light intensity on several days
- measure light intensities at same time of day
- calculate mean for each location
- plot graph of mean leaf length, or width, vs. light intensity

extra information

allow attempt to overcome other variables – eg soil water / soil pH / temperature

Total		6

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	in the chromosome(s) in the nucleus	ignore genes / alleles allow nuclei allow mitochondria	1 1	AO1 2.7.2f, 2.7.1b
3(a)(ii)	the DNA / chromosomes / genes are replicated / copied / multiplied / doubled / duplicated	allow DNA is cloned ignore same DNA / chromosomes / genes if unqualified	1	AO1 2.7.1a,c,n
3(b)(i)	1 / one		1	AO2 2.7.2c,e, 2.7.3a,c
3(b)(ii)	2 / two		1	AO2 2.7.2c,d, 2.7.3a,b
3(c)	**B**		1	AO3 2.7.2i
Total			**6**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	contract / shorten to churn / move / mix food	ignore relax do **not** allow expand accept peristalsis / mechanical digestion ignore movement unqualified	1 1	AO1 2.1, 2.2.1b,c, 2.1.1e
4(b)	400	acceptable range 390-410 allow 1 mark for answer in range of 39 to 41 allow 1 mark for answer in range of 3900 to 4100	2	AO2 2.2.1b,c
4(c)	to transfer energy for use by (aerobic) respiration **or** from glucose	allow to release / give / supply / provide energy do **not** allow to 'make' / 'produce' / 'create' energy allow to make ATP ignore to store energy do **not** allow anaerobic energy released **for** respiration = max 1 mark	1 1	AO1 2.1.1a, 2.6.1d
4(d)(i)	to make protein / enzyme	ignore 'antibody' or other named protein	1	AO1 2.1.1a
4(d)(ii)	too small / very small	allow light microscope does not have sufficient magnification / resolution allow ribosomes are smaller than mitochondria ignore not sensitive enough ignore ribosomes are transparent	1	AO2 2.1.1a
Total			**8**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	5624	**allow 2 marks** for: • correct HR = 148 **and** correct SV = 38 plus wrong answer / no answer **or** • only one value correct **and** ecf for answer **allow 1 mark** for: • incorrect values **and** ecf for answer **or** • only one value correct	3	AO2 2.6, 2.6.1g
5(b)(i)	**Person 2** has low(er) stroke volume / SV / described	eg **Person 2** pumps out smaller volume each beat do **not** allow **Person 2** has lower heart rate	1	AO3 2.6, 2.6.1g
5(b)(ii)	**Person 1** sends <u>more blood</u> (to muscles / body / lungs) (which) supplies (more) oxygen (and) supplies (more) glucose (faster rate of) respiration **or** transfers (more) energy for use removes (more) CO_2 / lactic acid / heat **or** less lactic acid made **or** (more) muscle contraction / less muscle fatigue	 ignore aerobic / anaerobic allow (more) energy release allow aerobic respiration transfers / releases more energy (than anaerobic) do **not** allow makes (more) energy allow less oxygen debt if no other mark awarded, allow person 1 is fitter (than person 2) for max 1 mark	1 1 1 1 1	AO1 / AO2 2.6.1b,e,f, g,h, 2.6.2c,d
Total			**9**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	any **two** from: • (dead) animal buried in sediment • hard parts / bones do not decay **or** soft parts do decay • mineralisation (of hard parts / bones)	 allow imprint in mud allow (one of) the conditions for decay is missing – accept example, eg oxygen / water / correct temperature / bacteria allow replacement by other materials	2	AO1 / AO2 2.8.1a,b
6(a)(ii)	any **two** from: • conditions not right for fossilisation • geological activity has destroyed fossils / has destroyed evidence • fossils not yet found	 ignore references to soft-bodied allow a named / described example – eg vulcanism / earth movements / erosion allow description of why not yet found	2	AO3 2.8, 2.8.1a,c,d
6(b)	any **four** from: • separation / isolation (of different populations) • different environmental conditions (between locations) • mutation(s) occur **or** genetic variation (within each population) • better adapted survive **or** natural selection occurs • favourable alleles passed on (in each population) • eventually different populations unable to breed <u>successfully</u> with each other	 allow ‘survival of the fittest’ ignore animals adapt to their environment ignore reference to stronger survive allow genes for alleles allow unable to produce fertile offspring	4	AO1 2.8.1e,f
Total			**8**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	light is trapped / absorbed / used by chlorophyll / chloroplasts	extra answers cancel mark ignore solar / sunshine if no other marks awarded, allow 1 mark for photosynthesis / equation for photosynthesis	1 1	AO1 2.3, 2.3.1a,b
7(b)	(to make) starch (for storage) (to make) fat / oil (for storage) (to make) amino acids / proteins / enzymes (to make) cellulose / cell walls	ignore 'for growth' unqualified ignore respiration allow for active transport allow any other correct, named organic substances (eg DNA / ATP / chlorophyll / hormone) if no named examples, allow 'to make **named** cell structures' for max. 1 mark	1 1 1 1	AO1 2.3.1e,f, 2.6.1f
Total			**6**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)(i)	3.15 : 1	accept 3.147:1 **or** 3.1 : 1 **or** 3 : 1 do **not** accept 3.14 : 1 Ignore 705:224	1	AO2 2.7
8(a)(ii)	any **two** from: • fertilisation is random **or** ref. to chance combinations (of alleles / genes / chromosomes) • more likely to get theoretical ratios **or** see (correct) pattern **or** get valid results if large number • anomalies have limited effect / anomalies can be identified	 allow ref. to more representative / reliable do **not** allow more accurate **or** precise ignore fair / repeatable accept example of an anomaly	2	AO3 2.7, 2.7.2a
8(b)(i)	in sequence: Homozygous Homozygous Heterozygous	All 3 correct = 2 marks 2 correct = 1 mark 1 or 0 correct = 0 marks	2	AO3 2.7
8(b)(ii)	genetic diagram including: Parental genotypes: **Nn** and **Nn** **or** Gametes: **N** and **n** + **N** and **n** <u>derivation</u> of offspring genotypes: **NN Nn Nn nn** identification: **NN** and **Nn** as purple **and nn** as white	 allow other characters / symbols only if clearly defined allow genotypes correctly derived from candidate's P gametes allow correct identification of candidate's offspring genotypes but only if some F_2 are purple and some are white	 1 1 1	AO2 2.7

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(c)	any **two** from: • did not know about chromosomes / genes / DNA **or** did not know chromosomes occurred in pairs • had pre-conceived theories • Mendel's (mathematical) approach was novel concept • Mendel was not part of academic establishment • work published in obscure journal / work lost for many years • peas gave unusual results cf other species • Mendel's results were not corroborated until later / 1900	ignore genetics eg blending of inherited characters ignore religious ideas unless qualified allow his work was not understood or no other scientist had similar ideas allow he was not considered to be a scientist / not well known / he was only a monk allow he only worked on pea plants	2	AO1 2.7
Total			**10**	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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4	
5	
6	
7	
TOTAL	

General Certificate of Secondary Education
Higher Tier
June 2014

Additional Science
Unit Biology B2

BL2HP

H

Biology
Unit Biology B2

Tuesday 13 May 2014 9.00 am to 10.00 am

For this paper you must have:
- a ruler.

You may use a calculator.

A

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2 should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

Do not write outside the box

Answer **all** questions in the spaces provided.

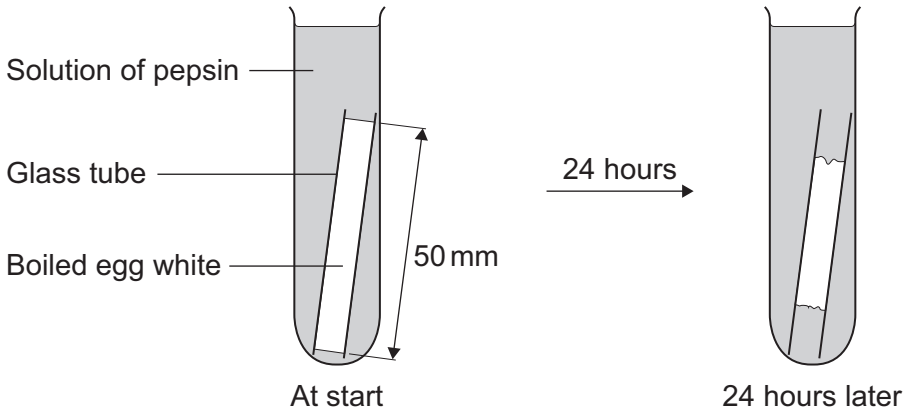
1 Some students investigated the effect of pH on the digestion of boiled egg white by an enzyme called pepsin. Egg white contains protein.

The students:

- put a glass tube containing boiled egg white into a test tube
- added a solution containing pepsin at pH 7
- set up six more tubes with solutions of pepsin at different pH values
- left the test tubes for 24 hours at room temperature.

Figure 1 shows one of the test tubes, at the start and at the end of the 24 hours.

Figure 1



1 (a) (i) Name the product of protein digestion.

[1 mark]

.....

1 (a) (ii) What type of enzyme digests protein?

Tick (✓) **one** box.

[1 mark]

amylase ☐

lipase ☐

protease ☐

Do not write outside the box

1 (b) The egg white in each tube was 50 mm long at the start of the investigation. **Table 1** shows the students' results.

Table 1

pH	Length in mm of boiled egg white after 24 hours
1	38
2	20
3	34
4	45
5	50
6	50
7	50

1 (b) (i) At which pH did the pepsin work best?

[1 mark]

pH .....

1 (b) (ii) The answer you gave in part **(b)(i)** may not be the exact pH at which pepsin works best.

What could the students do to find a more accurate value for this pH?

[2 marks]

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1 (b) (iii) There was no change in the length of the egg white from pH 5 to pH 7.

Explain why.

[2 marks]

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Question 1 continues on the next page

Do not write outside the box

1 (c) Pepsin is made by the stomach.

Name the acid made by the stomach which allows pepsin to work well.

[1 mark]

.....

8

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2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Diffusion is an important process in animals and plants.

The movement of many substances into and out of cells occurs by diffusion.

Describe why diffusion is important to animals and plants.

In your answer you should refer to:

- animals
- plants
- examples of the diffusion of named substances.

[6 marks]

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Extra space .....

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3 **Figure 2** shows an athlete running on a treadmill.

Figure 2



After running for several minutes, the athlete's leg muscles began to ache.
This ache was caused by a high concentration of lactic acid in the muscles.

3 (a) The equation shows how lactic acid is made.

glucose ⟶ lactic acid (+ energy)

Name the process that makes lactic acid in the athlete's muscles.

[1 mark]

.....

3 (b) Scientists investigated the production of lactic acid by an athlete running at different speeds.

In the investigation:

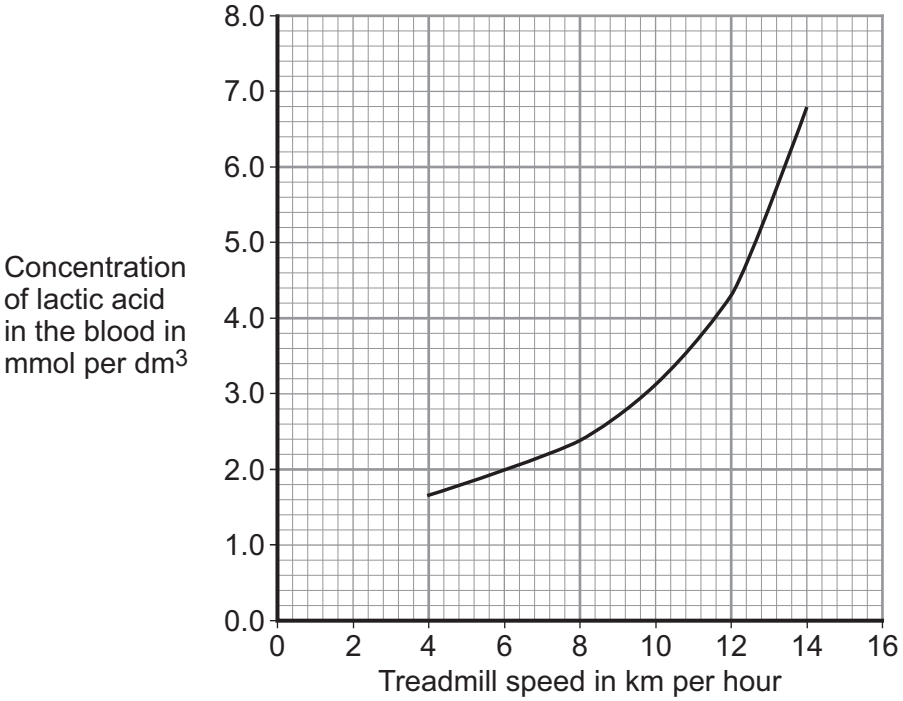
- the athlete ran on the treadmill at 4 km per hour
- the scientists measured the concentration of lactic acid in the athlete's blood after 2 minutes of running.

The investigation was repeated for different running speeds.

Figure 3 shows the scientists' results.

Do not write outside the box

Figure 3



3 (b) (i) How much more lactic acid was there in the athlete's blood when he ran at 14 km per hour than when he ran at 8 km per hour?

[2 marks]

.....

.....

.....

Answer = ... mmol per dm^3

3 (b) (ii) Why is more lactic acid made in the muscles when running at 14 km per hour than when running at 8 km per hour?

[3 marks]

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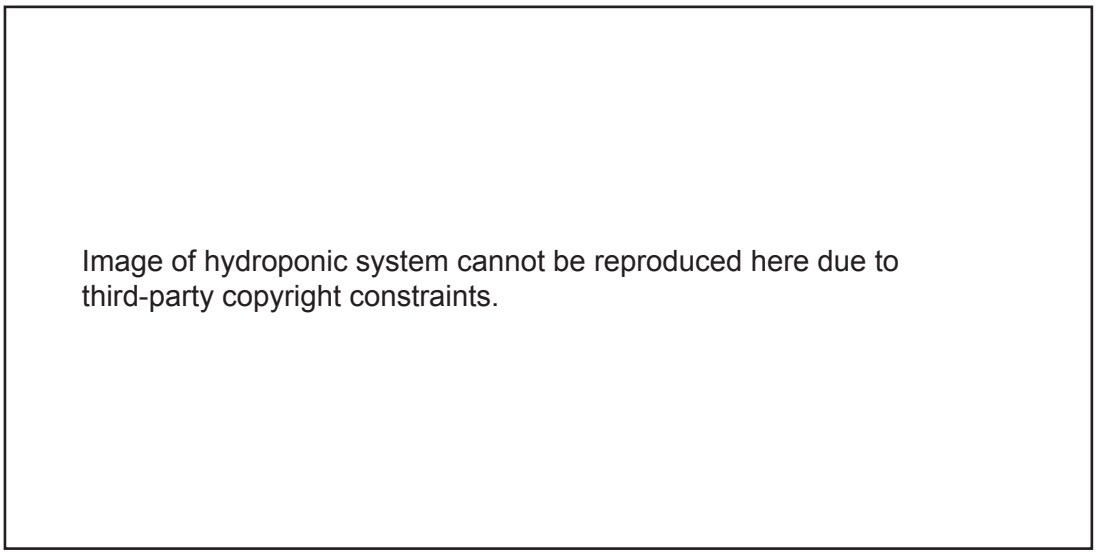
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4 Farmers sometimes grow crops in greenhouses without using any soil.

Figure 4 shows one way this can be done.

Figure 4



The pump for the solution sends water and ions to the plant roots.
The solution flows slowly past the roots and returns to the reservoir.
The concentration of the ions in the solution and its pH are controlled automatically.

4 (a) (i) It is an advantage to give ions to the plants as shown in **Figure 4** instead of growing the plants in a container of soil.

Give **one** reason why.

[1 mark]

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.....

4 (a) (ii) The air pump and airstone make bubbles of air in the solution of ions.
Gases from the air will dissolve in the solution.

Explain how this helps to keep the plants' roots alive.

[3 marks]

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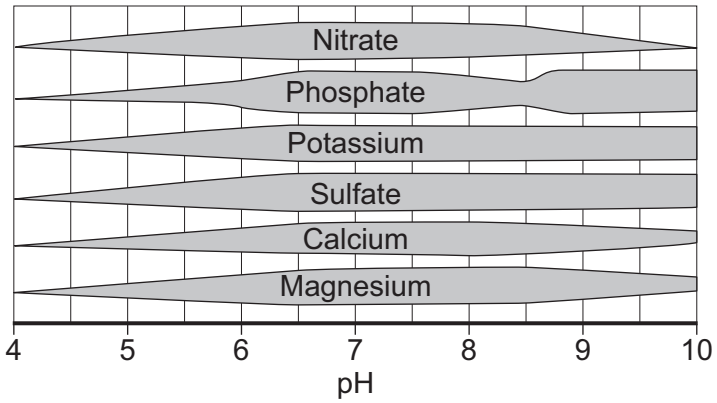
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4 (b) **Figure 5** shows how easy it is for plants to take in some ions at different pH values.

The thicker the bar in **Figure 5**, the easier it is for the plants to take in the ion.

Figure 5



4 (b) (i) The plants will grow better if the farmer keeps the solution at pH 7.

Use information from **Figure 5** to suggest why.

[1 mark]

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4 (b) (ii) Each molecule of chlorophyll contains a magnesium ion.

Why do plants need magnesium ions for healthy growth?

[2 marks]

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4 (b) (iii) Name **one** ion that plants take in to supply them with nitrogen.

[1 mark]

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4 (b) (iv) Give **one** reason why plants need a supply of the element nitrogen.

[1 mark]

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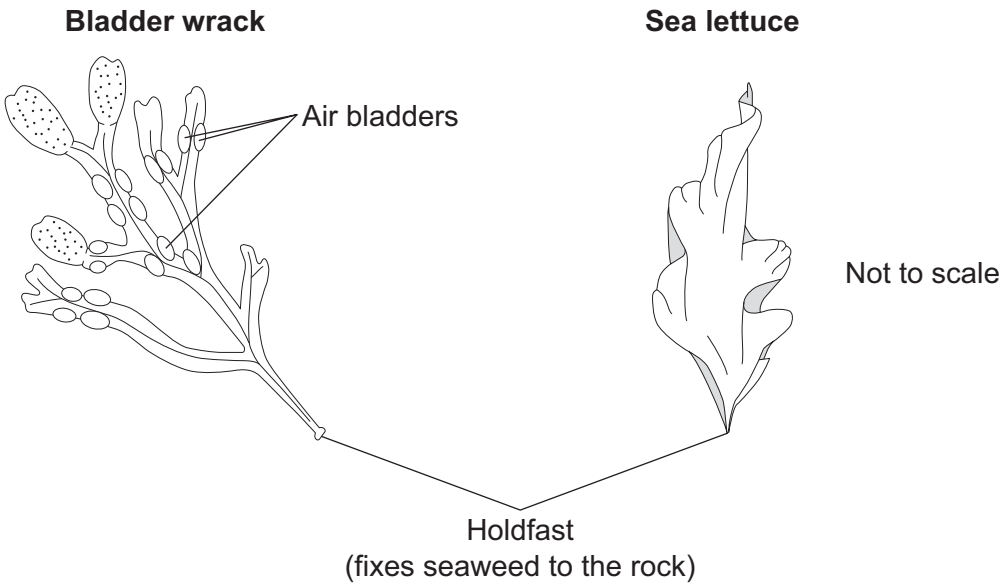
Do not write outside the box

5 At the seashore, the tide comes in and goes out twice each day.

Some students investigated whether two different species of seaweed could live only at certain positions on a rocky shore.
Seaweeds are plant-like organisms that make their food by photosynthesis.

Figure 6 shows the two species of seaweed that the students investigated.

Figure 6



5 (a) The students:

1 placed a 50-metre tape measure on the rocks at right angles to the sea

2 placed a quadrat next to the tape measure

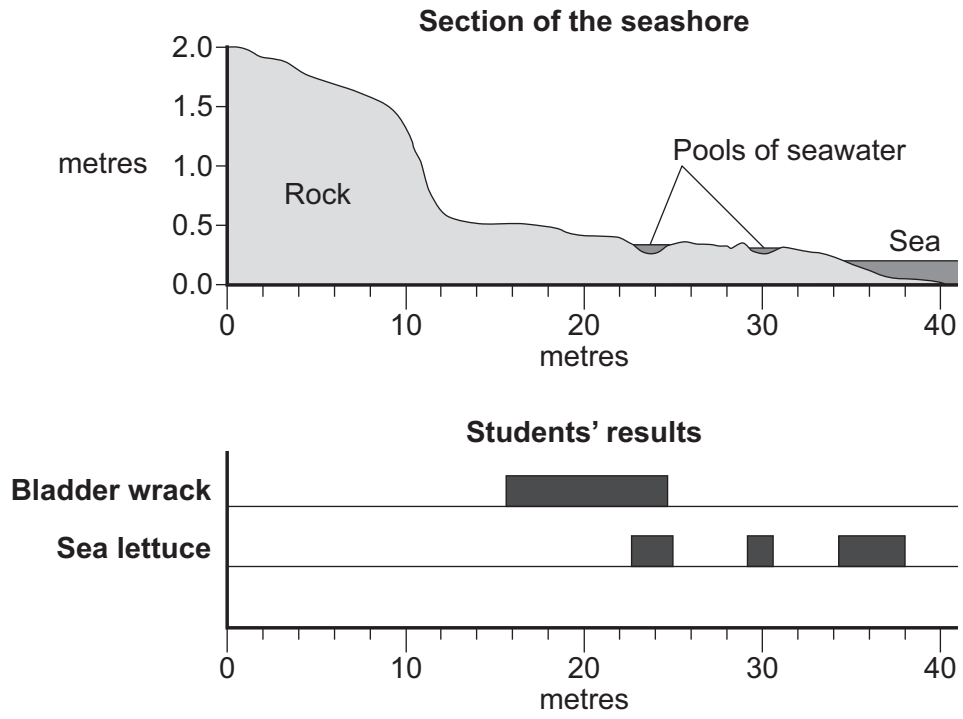
3 recorded whether each species was present or not.

The students repeated steps 2 and 3 every metre down the shore.

Figure 7 shows a section of the seashore and the students' results.

Do not write outside the box

Figure 7



5 (a) (i) The students placed the quadrat at regular intervals along a transect line rather than placing the quadrat at random positions anywhere on the rocky shore.

Explain why.

[2 marks]

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5 (a) (ii) How could the students have improved their investigation to ensure that they produced valid data?

[2 marks]

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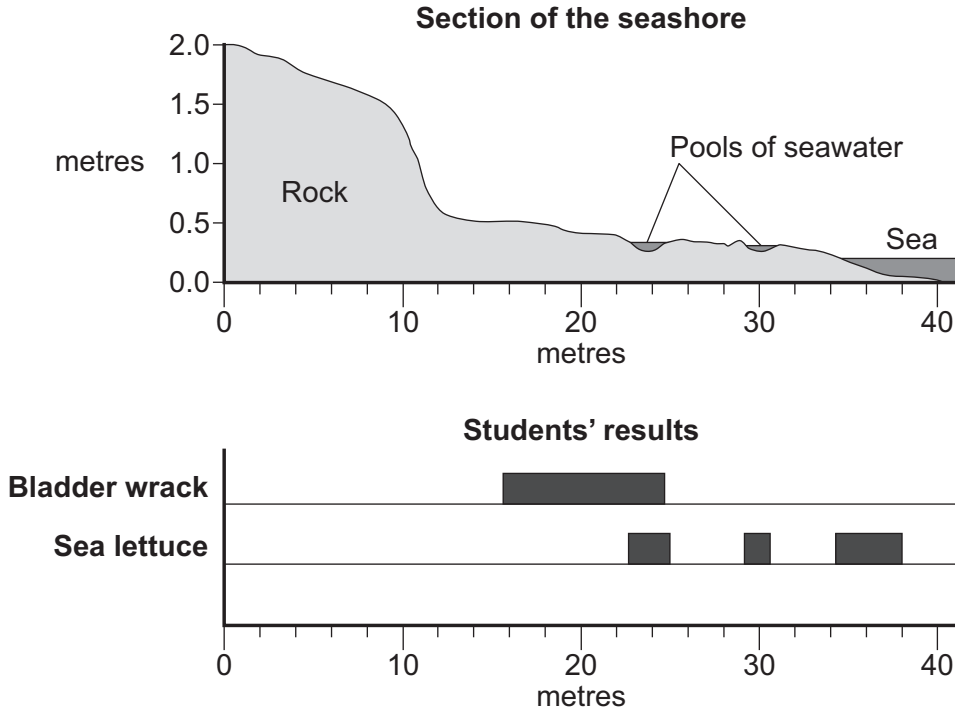
Question 5 continues on the next page

Turn over ▶

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5 (a) (iii) **Figure 7** is repeated here to help you answer this question.

Figure 7



The students concluded that bladder wrack is better adapted than sea lettuce to survive in dry conditions.

What is the evidence for this conclusion?

Use information from **Figure 7**.

[2 marks]

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Do not write outside the box

5 (b) The bladder wrack has many air bladders.
The air bladders help the bladder wrack to float upwards when the sea covers it.

Suggest how this helps the bladder wrack to survive.

[2 marks]

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8

Turn over for the next question

Do not write outside the box

6 Phenylketonuria (PKU) is an inherited condition. PKU makes people ill.

6 (a) PKU is caused by a recessive allele.

6 (a) (i) What is an allele?

[1 mark]

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6 (a) (ii) What is meant by recessive?

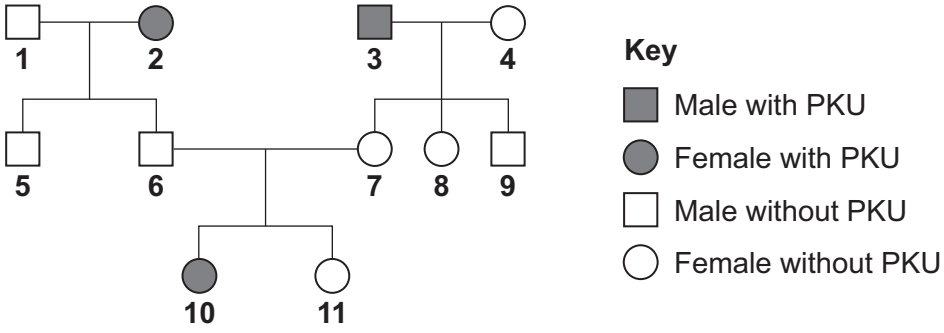
[1 mark]

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6 (b) **Figure 8** shows the inheritance of PKU in one family.

Figure 8



6 (b) (i) Give **one** piece of evidence from **Figure 8** that PKU is caused by a recessive allele.

[1 mark]

.....

.....

Do not write outside the box

6 (b) (ii) Persons **6** and **7** are planning to have another child.
Use a genetic diagram to find the probability that the new child will have PKU.

Use the following symbols in your answer:

N = the dominant allele for **not** having PKU
n = the recessive allele for PKU.

[4 marks]

Probability = ...

6 (c) Persons **6** and **7** wish to avoid having another child with PKU.

A genetic counsellor advises that they could produce several embryos by IVF treatment.

6 (c) (i) During IVF treatment, each fertilised egg cell forms an embryo by cell division.

Name this type of cell division.

[1 mark]

.....

6 (c) (ii) An embryo screening technique could be used to find the genotype of each embryo.

An unaffected embryo could then be placed in person **7**'s uterus.

The screening technique is carried out on a cell from an embryo after just three cell divisions of the fertilised egg.

How many cells will there be in an embryo after the fertilised egg has

divided three times? ☐

[1 mark]

Question 6 continues on the next page

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6 (c) (iii) During embryo screening, a technician tests the genetic material of the embryo to find out which alleles are present.

The genetic material is made up of large molecules of a chemical substance.

Name this chemical substance.

[1 mark]

.....

6 (d) Some people have ethical objections to embryo screening.

6 (d) (i) Give **one** ethical objection to embryo screening.

[1 mark]

.....

6 (d) (ii) Give **one** reason in favour of embryo screening.

[1 mark]

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12

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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7 (a) Fossils provide evidence for what early life forms were like. From the evidence, scientists think that life began on Earth more than 3 billion years ago.

Many early life forms were soft-bodied.
Explain why this makes it difficult for scientists to be certain about what these early life forms were like.

[2 marks]

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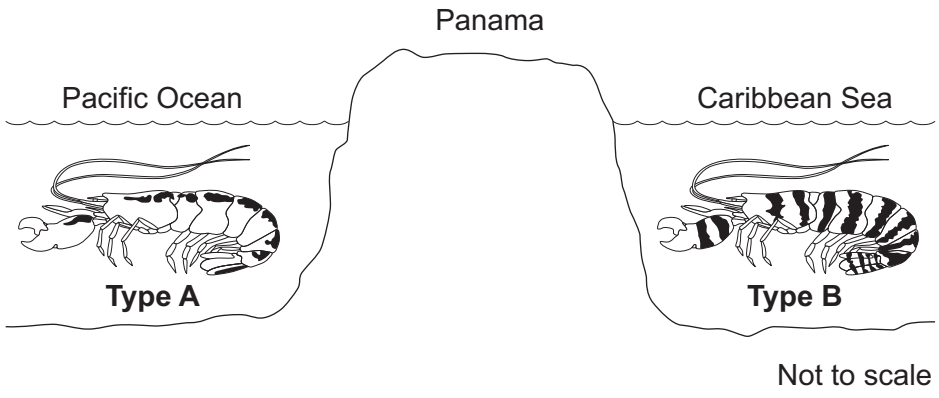
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7 (b) **Figure 9** shows two types of pistol shrimp.

The shrimps live in shallow, tropical seas on opposite sides of Panama.

Figure 9



Not to scale

Scientists put one **Type A** shrimp and one **Type B** shrimp together in a tank of seawater.
The two types of shrimp snapped their claws aggressively at each other.
They did not mate.

The scientists said that this was evidence for the **Type A** and **Type B** shrimps being classified as two different species.

7 (b) (i) Give **one** reason why the scientists' opinion may be correct.

[1 mark]

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7 (b) (ii) Suggest **two** reasons why the scientists' opinion may **not** be correct.

[2 marks]

1 .....

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2 .....

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7 (c) Panama is a narrow strip of land which today joins North America and South America. It was formed by land moving up from beneath the sea. Panama has separated the Pacific Ocean and the Caribbean Sea for the past 3 million years.

Explain how two different species of pistol shrimp could have developed from an ancestral species of shrimp.

[6 marks]

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11

END OF QUESTIONS

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AQA Qualifications

GCSE
ADDITIONAL SCIENCE / BIOLOGY

BL2HP
Mark scheme

4405 / 4401
June 2014

Version: 1.0 Final

STEMUP.CO.UK

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

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Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Quality of Written Communication and levels marking

In Question 2 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO / spec ref.
1(a)(i)	amino acid(s)	accept peptide(s) do **not** allow polypeptide(s)	1	AO1 2.5.2e
1(a)(ii)	protease		1	AO1 2.5.2e
1(b)(i)	2		1	AO3 2.5.2b, g
1(b)(ii)	repeat using smaller pH intervals between pH1 and pH3	do not allow other enzyme / substrate allow smaller intervals on both sides of / around pH2 allow smaller intervals on both sides of / around answer to (b)(i)	1 1	AO3 2.5.2b
1(b)(iii)	<u>enzyme / pepsin</u> denatured / shape changed <u>enzyme / pepsin</u> no longer fits (substrate)	do **not** allow enzyme killed allow enzyme 'destroyed' allow enzyme / pepsin does not work	1 1	AO1 / AO2 2.5.2a, b
1(c)	hydrochloric (acid)	allow phonetic spelling accept HCl allow HCL ignore hcl do **not** allow incorrect formula – e.g. H_2Cl / HCl_2	1	AO1 2.5.2g
Total			**8**	

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / spec ref.</th></tr>
<tr><td>2</td><td></td><td></td><td>6</td><td rowspan="5">AO1 2.1.2a,b, c, 2.2.1d, 2.3.1a,b, c,g, 2.6.1</td></tr>
<tr><td colspan="4">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a ‘best-fit’ approach to the marking.</td></tr>
<tr><td colspan="4">
<table>
<tr><th>0 marks</th><th>Level 1 (1–2 marks)</th><th>Level 2 (3–4 marks)</th><th>Level 3 (5–6 marks)</th></tr>
<tr><td>No relevant content.</td><td>An example is given of a named substance
or
a process
or
there is an idea of why diffusion is important eg definition.</td><td>At least one example of a substance is given
and
correctly linked to a process in either animals or plants.</td><td>There is a description of a process occurring in either animals or plants that is correctly linked to a substance
and
a process occurring in the other type of organism that is correctly linked to a substance.</td></tr>
</table>
</td></tr>
<tr><td colspan="4">
examples of points made in the response

Importance of diffusion:
• to take in substances for use in cell processes
• products from cell processes removed

Examples of processes and substances:
• for gas exchange / respiration: O_2 in / CO_2 out
• for gas exchange / photosynthesis: CO_2 in / O_2 out
• food molecules absorbed: glucose, amino acids, etc
• water absorption in the large intestine
• water lost from leaves / transpiration
• water absorption by roots
• mineral ions absorbed by roots
</td><td>
extra information

Description of processes might include:
• movement of particles / molecules / ions
• through a partially permeable membrane
• (movement of substance) down a concentration gradient

osmosis: turgor / support / stomatal movements
</td></tr>
<tr><td>Total</td><td></td><td></td><td>6</td><td></td></tr>
</table>

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Question	Answers	Extra information	Mark	AO / spec ref.
3(a)	anaerobic respiration	allow phonetic spelling	1	AO1 2.6.2a, b,d
3(b)(i)	4.4	4.2, 4.3, 4.5 or 4.6 with figures in tolerance (6.7 to 6.9 and 2.3 to 2.5) and correct working gains 2 marks 4.2, 4.3, 4.5 or 4.6 with no working shown or correct working with one reading out of tolerance gains 1 mark correct readings from graph in the ranges of 6.7 to 6.9 **and** 2.3 to 2.5 but no answer / wrong answer gains 1 mark	2	AO2 2.6.2a, b,d
3(b)(ii)	more energy is needed / used / released (at 14 km per hour) not enough oxygen (can be taken in / can be supplied to muscles) so more anaerobic respiration (to supply the extra energy) **or** more glucose changed to lactic acid	do **not** allow energy production ignore work allow reference to oxygen debt do **not** allow less / no oxygen allow not enough aerobic respiration	1 1 1	AO1 / AO2 2.6.2a, b,d
Total			**6**	

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Question	Answers	Extra information	Mark	AO / spec ref.
4(a)(i)	any **one** from: • can supply correct nutrients • can supply optimum concentrations / amount of nutrients • can maintain optimum pH	allow plants get enough (of required) nutrients ignore monitoring allow ions not lost / not wasted allow less chance of disease	1	AO2 2.3.1g, 2.4.1a
4(a)(ii)	provides oxygen (oxygen) for (aerobic) respiration (respiration) supplies energy (for the roots)	do **not** allow if extra gases or substances are given do **not** allow anaerobic allow use of energy – eg for <u>active</u> uptake of ions	1 1 1	AO1 / AO2 2.6.1b,e, 2.4.1a
4(b)(i)	plants can take in high amounts of all ions at this pH	allow the most ions taken up ignore reference to thickness of bars allow easier / easiest or faster / fastest	1	AO3 2.3.1g
4(b)(ii)	(to make chlorophyll which) traps light / energy for photosynthesis / for making food / for making organic substances	 allow correct named example – eg glucose / starch	1 1	AO2 2.3.1b
4(b)(iii)	nitrate	allow NO_3^- / NH_4^+ / ammonium ignore nitrite	1	AO1 2.3.1g
4(b)(iv)	to make protein / amino acids / enzymes	allow other correct example – eg DNA / ATP / chlorophyll / auxin	1	AO1 2.3.1g
Total			**9**	

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Question	Answers	Extra information	Mark	AO / spec ref.
5(a)(i)	to get data re position of seaweed / of organism in relation to distance from sea / distance down shore / how long each seaweed was exposed		1 1	AO2 2.4.1b
5(a)(ii)	repeat several times elsewhere along the shore	minimum = 2 repeats	1 1	AO3 2.4
5(a)(iii)	bladder wrack is further up the shore (than the sea lettuce) / exposed for longer sea lettuce (only) in rock pools / in the sea / (only) in water	ignore found in dry areas / on bare rock	1 1	AO3 2.4.1a,b
5(b)	gets more light / closer to light (so) more photosynthesis	allow better access to CO_2 allow 1 mark for light for photosynthesis allow 1 mark for CO_2 for photosynthesis ignore reference to oxygen for respiration 'more' only needed once for 2 marks	1 1	AO1 / AO2 2.4.1a, 2.3.1c
Total			**8**	

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Question	Answers	Extra information	Mark	AO / spec ref.
6(a)(i)	one form of a / one gene	do **not** allow 'a type of gene' allow a mutation of a gene	1	AO1 2.7.2c,e , 2.7.3a
6(a)(ii)	not expressed if dominant / other allele is present / if heterozygous **or** only expressed if dominant allele not present / or no other allele present	allow need two copies to be expressed / not expressed if only one copy / only expressed if homozygous	1	AO1 2.7.2c,e , 2.7.3a
6(b)(i)	two parents without PKU produce a child with PKU / **6** and **7** → **10**	allow 'it skips a generation'	1	AO3 2.7, 2.7.3a
6(b)(ii)	genetic diagram including: Parental gametes: 6: **N** and **n** **and** 7: **N** and **n** derivation of offspring genotypes: **NN Nn Nn nn** identification: **NN** and **Nn** as non-PKU **OR nn** as PKU correct probability only: 0.25 / ¼ / 1 in 4 / 25% / 1 : 3	accept alternative symbols if defined allow genotypes correctly derived from student's parental gametes allow correct identification of student's offspring genotypes do **not** allow 3 : 1 / 1 : 4 do **not** allow if extra incorrect probabilities given	1 1 1 1	AO2 / AO3 2.7, 2.7.3a
6(c)(i)	mitosis	correct spelling only	1	AO1 2.7.1a,c ,d
6(c)(ii)	8		1	AO2 2.7.1c,i, 2.7.3a, 2.7.3d
6(c)(iii)	DNA	allow deoxyribonucleic acid do **not** allow RNA / ribonucleic acid	1	AO1 2.7.2g, 2.7.3a, 2.7.3d

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Question	Answers	Extra information	Mark	AO / spec ref.
6(d)(i)	may lead to damage to embryo / may destroy embryos / embryo cannot give consent	allow avoid abortion allow emotive terms – eg murder religious argument must be qualified allow ref to miscarriage allow idea of avoiding prejudice against disabled people allow idea of not producing designer babies	1	AO3 2.7, 2.7.3a
6(d)(ii)	any **one** from: • prevent having child with the disorder / prevent future suffering / reduce incidence of the disease • embryo cells could be used in stem cell treatment	ignore ref to having a healthy child ignore ref to selection of gender allow ref to long term cost of treating a child (with a disorder) allow ref to time for parents to become prepared	1	AO3 2.7, 2.7.3a
Total			**12**	

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Question	Answers	Extra information	Mark	AO / spec ref.
7(a)	lack of fossils / fossils destroyed (due to soft parts) decaying / geological activity	allow lack of evidence allow an example – eg vulcanism or earth movements or erosion allow converse points re skeletons, shells, hard parts	1 1	AO1 2.8, 2.8.1 a,b,c
7(b)(i)	**A** and **B** did not mate successfully	'**A** and **B** did not mate' insufficient allow did not produce fertile offspring	1	AO2 2.8.1f
7(b)(ii)	any **two** from: • may not be mating season • **A** and **B** may not find each other attractive • this is just a one-off attempt / an anomaly / need repeats • may be juvenile / immature • may be the same sex	allow other sensible suggestion eg were put in unfavourable environment or one / both could be infertile	2	AO3 2.8.1f
7(c)	1. (two ancestral populations) separated (by geographical barrier / by land) / were isolated 2. genetic variation (in each population) **or** different / new alleles **or** mutations occur 3. different environment / conditions 4. natural selection occurs **or** some phenotypes survived **or** some genotypes survived 5. (favourable) alleles / genes / mutations passed on (in each population) 6. eventually two types cannot interbreed successfully	 allow abiotic or biotic example allow eventually cannot produce fertile offspring	1 1 1 1 1 1	AO1 / AO2 2.8.1f
Total			**11**	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

General Certificate of Secondary Education
Higher Tier
June 2013

Additional Science
Unit Biology B2

BL2HP

H

Biology
Unit Biology B2

Tuesday 14 May 2013 9.00 am to 10.00 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 3(b) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

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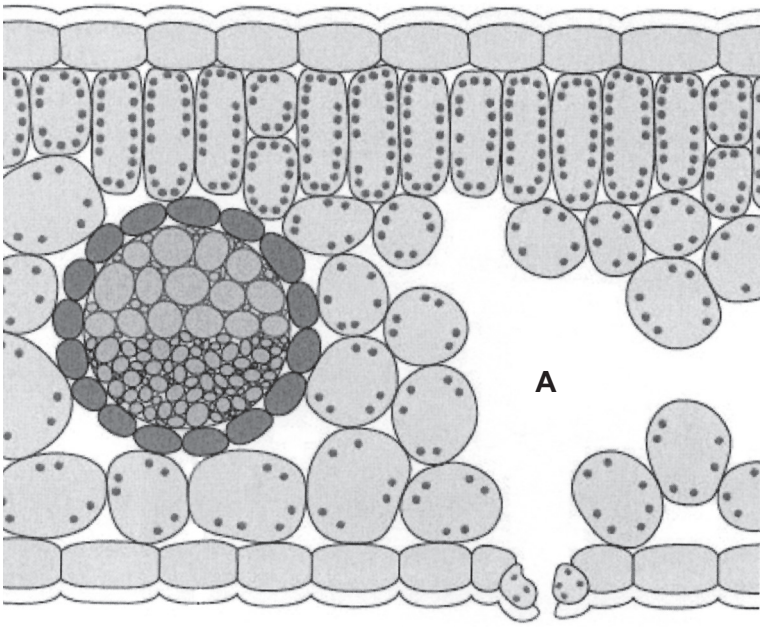
There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

Answer **all** questions in the spaces provided.

1 The diagram shows a section through a plant leaf.



1 (a) Use words from the box to name **two** tissues in the leaf that transport substances around the plant.

epidermis	**mesophyll**	**phloem**	**xylem**

..... and .....

(1 mark)

1 (b) Gases *diffuse* between the leaf and the surrounding air.

1 (b) (i) What is *diffusion*?

.....

.....

.....

.....

(2 marks)

1 (b) (ii) Name **one** gas that will diffuse from point **A** to point **B** on the diagram on a sunny day.

.....

(1 mark)

4

Turn over ▶

Do not write outside the box

2 Some students were asked to investigate the distribution of clover in a field of grass. They noticed that the clover grew in patches amongst the grass.

2 (a) The students decided to use quadrats.

Describe how the students should decide where to place the quadrats to investigate the distribution of the clover.

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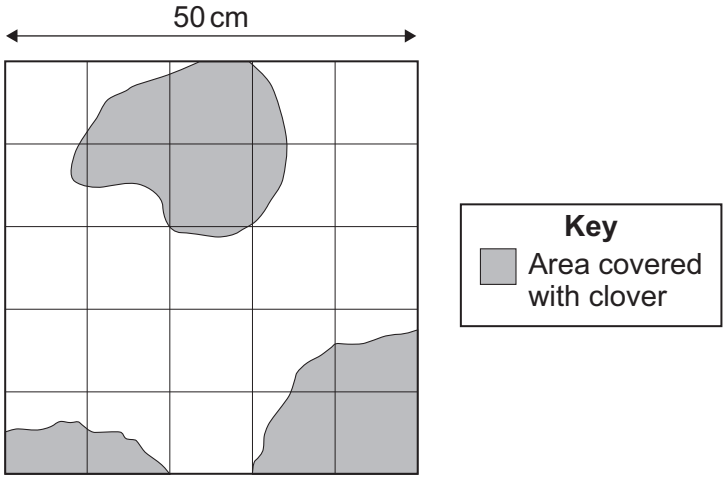
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(2 marks)

2 (b) The diagram shows one of the quadrats the students used.



2 (b) (i) Estimate the number of squares of the quadrat covered with clover.

.....

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Number of squares = ...

(1 mark)

Do not write outside the box

2 (b) (ii) Describe how you worked out your answer to part **(b)(i)**.

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(1 mark)

2 (b) (iii) Use your answer from part **(b)(i)** to calculate the percentage of the quadrat covered by the clover.

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Answer = ... %

(2 marks)

2 (c) Suggest **one** factor that could account for the distribution of the clover plants.

.....

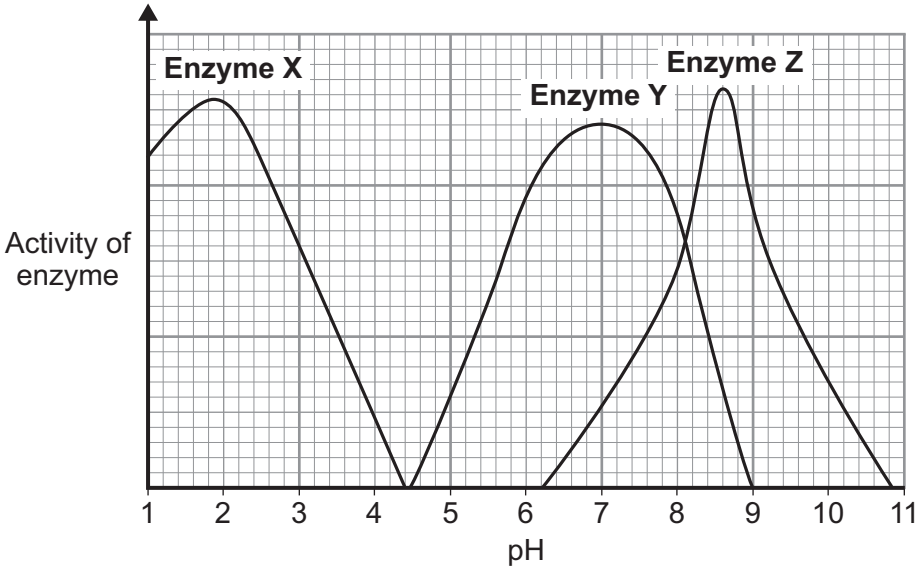
(1 mark)

7

Turn over for the next question

Do not write outside the box

3 (a) The graph shows the effect of pH on the activities of three enzymes, **X**, **Y** and **Z**.
These enzymes help to digest food in the human digestive system.
Each enzyme is produced by a different part of the digestive system.



3 (a) (i) What is the optimum (best) pH for the action of enzyme **Z**?

.....

(1 mark)

3 (a) (ii) The stomach makes a substance that gives the correct pH for enzyme action in the human stomach.

Name this substance. .....

(1 mark)

3 (a) (iii) Which enzyme, **X**, **Y** or **Z**, will work best in the human stomach?

.....

(1 mark)

Do not write outside the box

3 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Different parts of the human digestive system help to break down molecules of fat so that they can be absorbed into the body.

Describe how.

To gain full marks you should refer to:

- the enzyme and where the enzyme is produced
- the products of digestion
- any other chemicals involved.

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(6 marks)

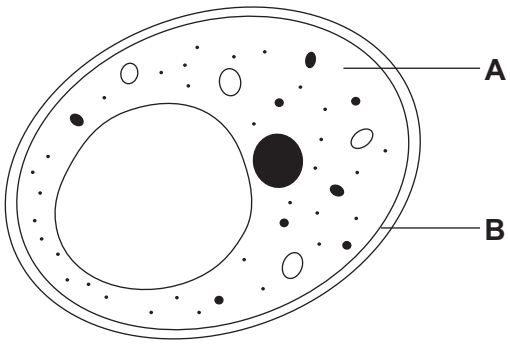
9

Turn over ▶

Do not write outside the box

4 **Diagram 1** shows a yeast cell.

Diagram 1



4 (a) Name structures **A** and **B**.

A .....

B .....

(2 marks)

4 (b) Yeast cells can respire anaerobically.

The equation for anaerobic respiration in yeast is:

glucose ⟶ alcohol + carbon dioxide (+ energy)

Give **one** way in which anaerobic respiration in yeast cells is different from anaerobic respiration in human muscle cells.

.....

.....

(1 mark)

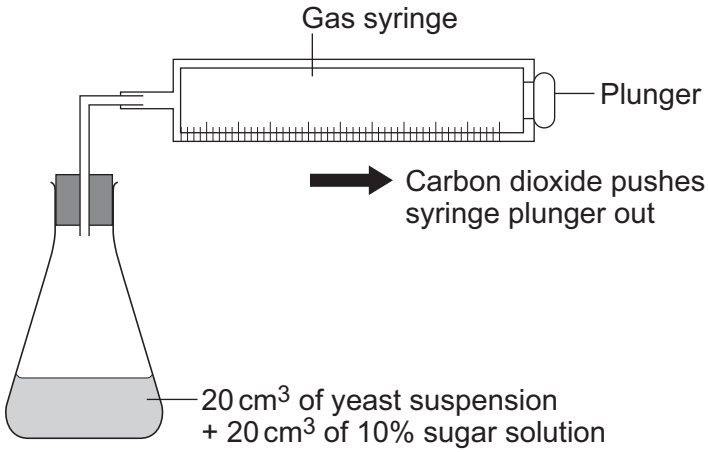
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4 (c) Yeast can use other types of sugar instead of glucose.
Some scientists investigated the effect of three different types of sugar on the rate of anaerobic respiration in yeast.

The scientists:

- used the apparatus shown in **Diagram 2** with glucose sugar
- kept the apparatus at 20 °C
- repeated the investigation with fructose sugar and then with mannose sugar
- repeated the investigation with water instead of the sugar solution.

Diagram 2



4 (c) (i) Give **two** control variables the scientists used in this investigation.

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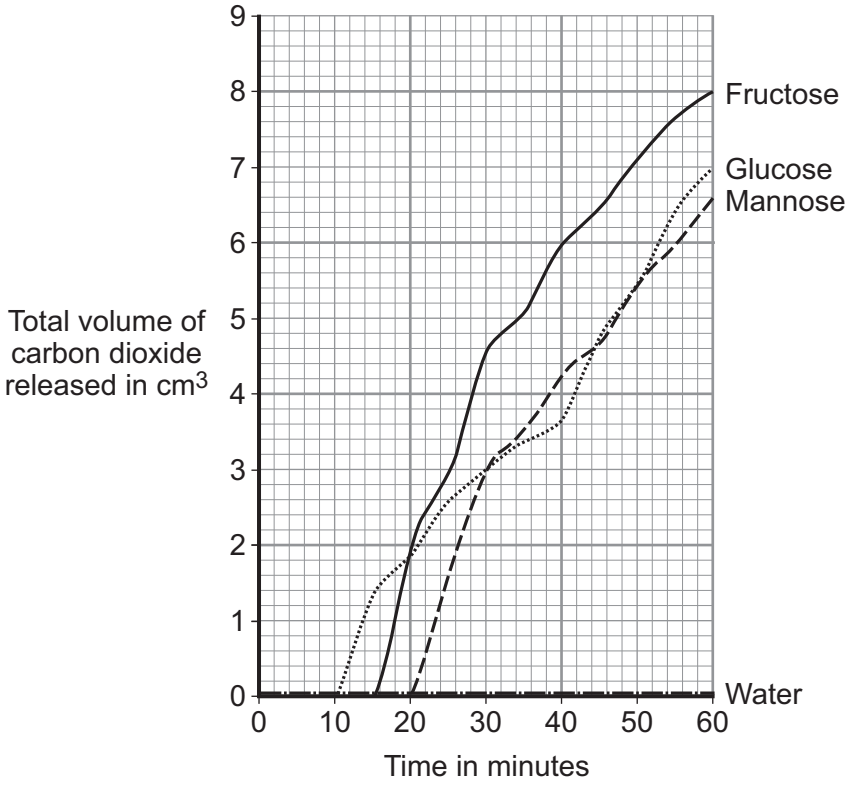
(2 marks)

Question 4 continues on the next page

Turn over ▶

Do not write outside the box

4 (c) (ii) The graph shows the scientists' results.



From this information, a company decided to use fructose to produce alcohol and **not** mannose or glucose.

Explain the reason for the company's choice.

.....

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.....

(2 marks)

7

Do not write outside the box

5 (a) Complete the equation for photosynthesis.

..... + water $\xrightarrow{\text{light energy}}$ ..... + ...

(3 marks)

5 (b) The rate of photosynthesis in a plant depends on several factors in the environment. These factors include light intensity and the availability of water.

Describe and explain the effects of **two other** factors that affect the rate of photosynthesis.

You may include one or more sketch graphs in your answer.

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(5 marks)

8

Do not write outside the box

6 A certain gene codes for the production of an enzyme called 'HEXA'.

One human genetic disorder causes damage to nerve cells in the brain.
This disorder is caused by a small change in the DNA of the HEXA gene.
People with this disorder make a changed HEXA enzyme that does not work.

6 (a) Explain how a change in the DNA of the HEXA gene can result in the production of a changed HEXA enzyme that does not work.

.....

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(3 marks)

6 (b) The gene coding for the HEXA enzyme is found on chromosome number 15.

6 (b) (i) How many chromosomes are there in the nucleus of a human nerve cell? .....

(1 mark)

6 (b) (ii) A boy had the changed HEXA gene on the chromosome number 15 that he inherited from his father.
The changed HEXA gene coded for a HEXA enzyme that does not work.
The boy did **not** develop the genetic disorder.

Explain why the boy did **not** develop the genetic disorder.

.....

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(2 marks)

Do not write outside the box

6 (b) (iii) The boy grew up and got married.

A blood test showed that his wife had also inherited the same changed HEXA gene.

There is a 1 in 4 chance that this couple's first child will have the genetic disorder.

Use a genetic diagram to explain why.

Use the following symbols in your explanation:

H = allele for making the normal HEXA enzyme
h = allele for making a HEXA enzyme that does not work.

(3 marks)

9

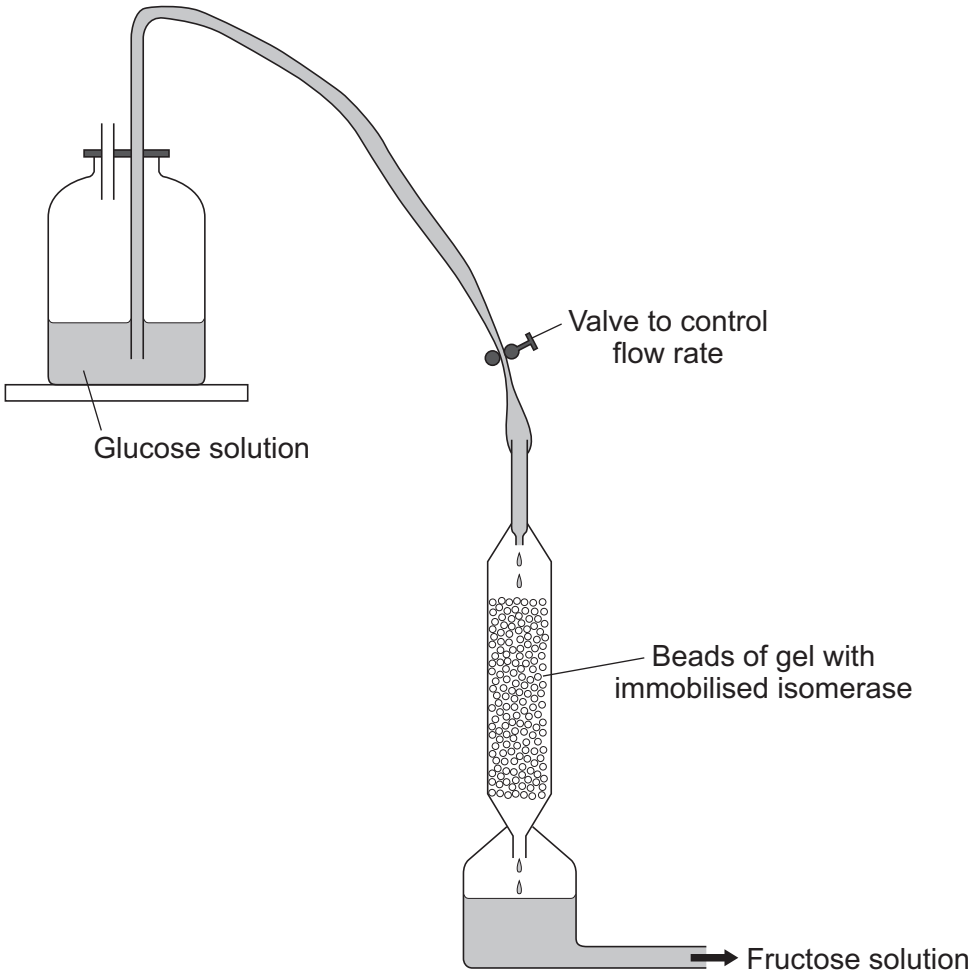
Turn over for the next question

Do not write outside the box

7 Isomerase is an enzyme which can change glucose into fructose.
Fructose is often used instead of glucose in products like slimming foods.

In industry, isomerase is often 'immobilised' within beads of gel.
The beads are placed in a glass column.
The isomerase stays attached to the beads and a solution of glucose is allowed to flow between the beads in the column.

The diagram shows how immobilised isomerase is used.



7 (a) An alternative method of changing glucose into fructose would be to mix a solution of the isomerase with the glucose solution in a large container.
Suggest **two** advantages of using isomerase immobilised in a column of beads.

1 .....

.....

2 .....

.....

(2 marks)

Do not write outside the box

7 (b) A manufacturer investigated the effect of using different flow rates of glucose solution on the rate of fructose production.

The table shows the results.

Flow rate in dm^3 per minute	Rate of fructose production in mg per minute
1	150
2	325
3	480
4	608
5	650
6	650
7	650

The manufacturer decides to use a flow rate of 5 dm^3 per minute.

Suggest why the manufacturer chose this flow rate.

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(2 marks)

7 (c) Fructose is a much sweeter sugar than glucose.

Explain why manufacturers of slimming foods may wish to use fructose as a sweetener instead of glucose.

.....

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.....

(2 marks)

6

Turn over ▶

Do not write outside the box

8 The photographs show the flowers of two closely-related species of plant.

Species A



Species B



The drawings show chromosomes from one cell in the root of each plant during cell division.

Species A



One chromosome

Species B



One chromosome

8 (a) The drawings show that each chromosome has two strands of genetic material.

8 (a) (i) How does a chromosome become two strands?

.....

.....

(1 mark)

Do not write outside the box

8 (a) (ii) Explain why each chromosome must become two strands before the cell divides.

.....

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.....

.....

(2 marks)

8 (b) For sexual reproduction, the plants produce gametes.

8 (b) (i) Name the type of cell division that produces gametes. .....

(1 mark)

8 (b) (ii) How many chromosomes would there be in a gamete from each of these two plant species?

Species A ☐ **Species B** ☐

(1 mark)

8 (b) (iii) It is possible for gametes from **Species A** to combine with gametes from **Species B** to produce healthy offspring plants.

How many chromosomes would there be in each cell of one of the offspring plants?

☐

(1 mark)

Question 8 continues on the next page

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8 (c) (i) Look back at the information at the start of the question and the information from part **(b)**.

What evidence from these two pieces of information supports the belief that **Species A** and **Species B** evolved from a common ancestor?

.....

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.....

(2 marks)

8 (c) (ii) For successful gamete production to take place, chromosomes that contain the same genes must pair up.

The drawings showing the chromosomes of **Species A** and of **Species B** are repeated below.

Species A



One chromosome

Species B



One chromosome

The offspring plants cannot reproduce sexually.

Suggest an explanation for this.

.....

.....

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.....

(2 marks)

10

END OF QUESTIONS

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Question 8 Photograph Species B: © Thinkstock

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Version 1.0



General Certificate of Secondary Education
June 2013

Additional Science / Biology BL2HP

(Specification 4408 / 4401)

Unit 2: Biology 2

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

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Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

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Quality of Written Communication and levels marking

In Question 3(b) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

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Question 1

question	answers	extra information	mark
1(a)	xylem **and** phloem	either order allow words ringed in box allow mis-spelling if unambiguous	1
1(b)(i)	movement / spreading out of particles / molecules / ions / atoms	ignore names of substances / 'gases'	1
	from high to low concentration	accept down concentration gradient ignore 'along' / 'across' gradient ignore 'with' gradient	1
1(b)(ii)	oxygen / water (vapour)	allow O_2/O2 ignore O^2/O allow H_2O/H2O ignore H^2O	1
Total			**4**

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Question 2

question	answers	extra information	mark
2(a)	chose places randomly method of obtaining randomness, e.g. (grid and) random numbers	 allow thrown qualified e.g. over shoulder, eyes shut allow max 1 for mention of a transect with sampling at regular or random intervals	1 1
2(b)(i)	7 **or** 8	allow fractions / decimals between 7 and 8	1
2(b)(ii)	count number of whole squares and add estimate of area covered by part squares	allow reference to counting squares with ½ cover or more allow clear working on diagram and / or (b)(i)	1
2(b)(iii)	28 – 32 (in range)	allow ecf if answer incorrect allow **1** mark for reasonable reference to divided by 25 or multiplied by 4	2
2(c)	nutrients / minerals / ions / fertiliser / water	allow light / pH / trampling / soil texture / grazing / mowing / weed killer / where seeds originally fell ignore pollution / soil / competition if unqualified ignore temperature / wind	1
Total			**7**

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Question 3

question	answers	extra information	mark
3(a)(i)	8.6	accept value in range 8.5 to 8.7	1
3(a)(ii)	hydrochloric acid / HCl	accept HCL accept hydrogen chloride ignore hcl / etc.	1
3(a)(iii)	X		1

Question 3 continues on the next page . . .

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Question 3 continued . . .

3(b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5.			6
0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**	
No relevant content.	There is a simple description of part of a process including a reference to at least one of: mechanical digestion, lipase, product of enzyme action, bile, site of production or site of digestion	There is a description of at least one process <u>linking</u> ideas.	There is a clear description of the process including reference to the majority of: mechanical digestion, lipase, bile, where they are produced, products, function of bile and site of digestion / absorption	

examples of biological points made in the response:

- mechanical breakdown in mouth / stomach
- fats →fatty acids and / or glycerol
- by lipase
- (produced by) pancreas
- and small intestine
- fat digestion occurs in small intestine
- bile
- produced by liver
- neutralises acid from stomach
- produces alkaline conditions in intestine
- refs. to increased surface area related to emulsification or chewing
- products are small molecules / water-soluble
- products absorbed by small intestine

Total			**9**

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Question 4

question	answers	extra information	mark
4(a)	A = cytoplasm B = (cell) membrane		1 1
4(b)	in yeast: makes alcohol / makes CO_2 / does not make lactic acid	'it' equals yeast do not allow uses / involves alcohol / CO_2	 1
4(c)(i)	any **two** from: • volume of yeast / suspension • volume of sugar / solution • concentration of sugar • temperature	 allow amount of yeast amount of sugar = max 1 for sugar (total) volume = 1 mark if no other volume ignore concentration of yeast	2
4(c)(ii)	most / more CO_2 given off with fructose **or** faster CO_2 production **or** faster respiration so (rate of) alcohol production will be greatest / more (with fructose)	'it' equals fructose allow faster fermentation do **not** allow aerobic respiration	1 1
Total			**7**

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Question 5

question	answers	extra information	mark
5(a)	LHS – carbon dioxide / CO_2	allow CO2 ignore CO^2	1
	RHS glucose / carbohydrate / sugar	in either order allow starch allow $C_6H_{12}O_6$ / C6H12O6 ignore $C^6H^{12}O^6$	1
	oxygen	allow O_2 /O2 ignore O^2 / O	1

Question 5 continues on the next page...

Question 5 continued...

question	answers	extra information	mark
5(b)	any **five** from: • factor 1: CO_2 (concentration) • effect - as CO_2 increases so does rate and then it levels off or shown in a graph • explanation: (graph increases) because CO_2 is the raw material or used in photosynthesis / converted to organic substance / named eg **or** (graph levels off) when another factor limits the rate. • factor 2: temperature • effect – as temperature increases, so does the rate and then it decreases or shown in a graph • explanation: (rise in temp) increases rate of chemical reactions / more kinetic energy **or** (decreases) because the enzyme is denatured.	accept points made via an annotated / labelled graph allow warmth / heat allow 'it peaks' for description of both phases allow molecules move faster / more collisions context must be clear = high temperature allow other factor plus effect plus explanation: eg light wavelength / colour / pigments / chlorophyll / pH / minerals / ions / nutrients / size of leaves 2nd or 3rd mark can be gained from correct description and explanation	5
Total			**8**

Question 6

question	answers	extra information	mark
6(a)	changes code /sequences of bases **or** sequence of amino acids is different		1
	the enzyme has different / wrong shape / structure	allow the active site is changed	1
	so substrate will not fit into enzyme / will not join to enzyme		1
6(b)(i)	46	allow 23 pairs	1
6(b)(ii)	also inherited (from mother) normal chromosome 15 / normal allele / normal gene / boy is heterozygous / **Hh**	allow the boy is a carrier	1
	(allele for) this disorder is recessive **or** the normal allele would give a working enzyme	ignore converse	1
6(b)(iii)	genetic diagram including: Parental gametes: **H** and **h** from both parents	accept alternative symbols, if defined	1
	<u>derivation</u> of offspring genotypes: **HH Hh Hh hh**	allow alternative if correct for student's parental genotypes / gametes	1
	identification of **hh** (having the disorder) if 1 in 4		1
Total			**9**

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Question 7

question	answers	extra information	mark
7(a)	any **two** from: • product not contaminated with enzyme or is pure • enzyme can be reused • continuous flow process possible • enzyme more stable / can be used at higher temperature	 allow enzyme not wasted / less enzyme is needed allow enzyme lasts longer ignore refs. to cost / cheaper	2
7(b)	maximum fructose production / maximum enzyme activity **or** increase in flow rate does not increase production higher rate leaves some glucose unchanged	accept optimum / best allow glucose not wasted / extra glucose wastes money	1 1
7(c)	less (fructose) needed (for same sweetness) (less fructose) → less fattening / fewer 'calories'	ignore fructose is sweeter unqualified ignore refs. to cost / cheaper	1 1
Total			**6**

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Question 8

question	answers	extra information	mark
8(a)(i)	DNA replication / copies of genetic material were made	'it' = a chromosome allow chromosomes replicate / duplicate / are copied ignore chromosomes divide / split / double	1
8(a)(ii)	one copy of each (chromosome / chromatid / strand) to each offspring cell	ignore ref. to gametes and fertilisation	1
	each offspring cell receives a complete set of / the same genetic material	allow 'so offspring (cells) are identical'	1
8(b)(i)	meiosis	allow mieosis as the only alternative spelling	1
8(b)(ii)	Species A = 4 **and** Species B = 8		1
8(b)(iii)	sum of A + B from (b)(ii) e.g. 12		1

Question 8 continues on the next page...

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Question 8 continued...

question	answers	extra information	mark
8(c)(i)	similarities between chromosomes **or** similarities between flowers described	 e.g. shape of petals / pattern on petals / colour / stamens	1
	can breed / can <u>sexually</u> reproduce	allow can reproduce with each other / they can produce offspring	1
8(c)(ii)	any **two** from: • offspring contain 3 copies of each gene / of each chromosome / odd number of each of the chromosomes • some chromosomes unable to pair (in meiosis) • (viable) gametes not formed / some gametes with extra / too many genes / chromosomes **or** some gametes with missing genes / chromosomes		2
Total			**10**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

General Certificate of Secondary Education
Higher Tier
January 2013

Additional Science
Unit Biology B2

BL2HP

H

Biology
Unit Biology B2

Tuesday 22 January 2013 9.00 am to 10.00 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 1(c) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

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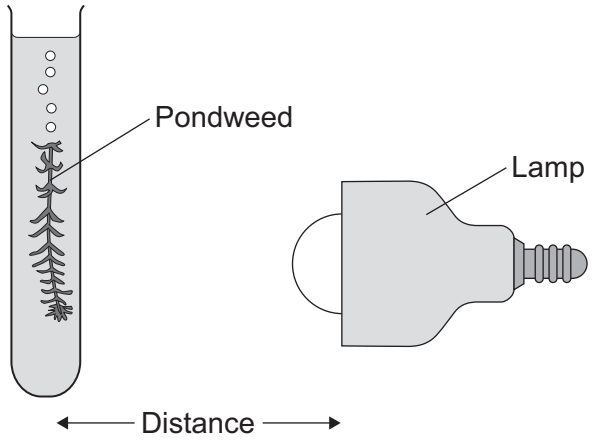
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Answer **all** questions in the spaces provided.

1 Some students investigated the effect of light intensity on the rate of photosynthesis.

They used the apparatus shown in **Diagram 1**.

Diagram 1



The students:

- placed the lamp 10 cm from the pondweed
- counted the number of bubbles of gas released from the pondweed in 1 minute
- repeated this for different distances between the lamp and the pondweed.

1 (a) The lamp gives out heat as well as light.

What could the students do to make sure that heat from the lamp did **not** affect the rate of photosynthesis?

.....

.....

(1 mark)

Do not write outside the box

1 (b) The table shows the students' results.

Distance in cm	Number of bubbles per minute
10	84
15	84
20	76
40	52
50	26

1 (b) (i) At distances between 15cm and 50cm, light was a limiting factor for photosynthesis.

What evidence is there for this in the table?

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.....

(1 mark)

1 (b) (ii) Give **one** factor that could have limited the rate of photosynthesis when the distance was between 10cm and 15cm.

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(1 mark)

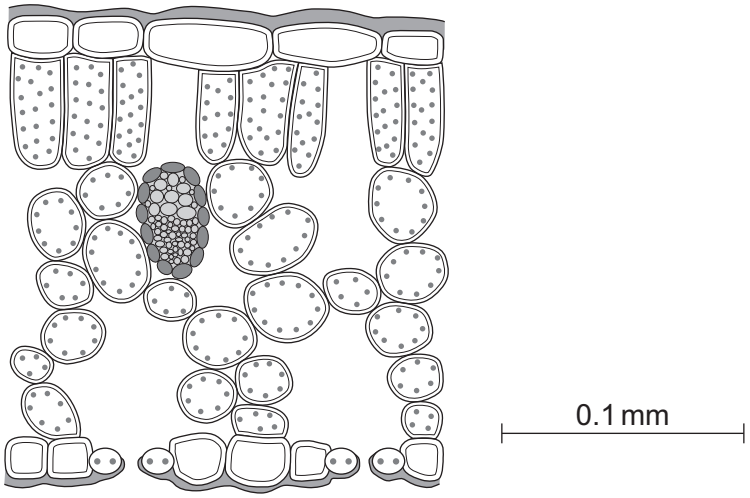
Question 1 continues on the next page

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1 (c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Diagram 2 shows a section through a plant leaf.

Diagram 2



Describe the structure of the leaf and the functions of the tissues in the leaf.

You should use the names of the tissues in your answer.

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(6 marks)

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Turn over for the next question

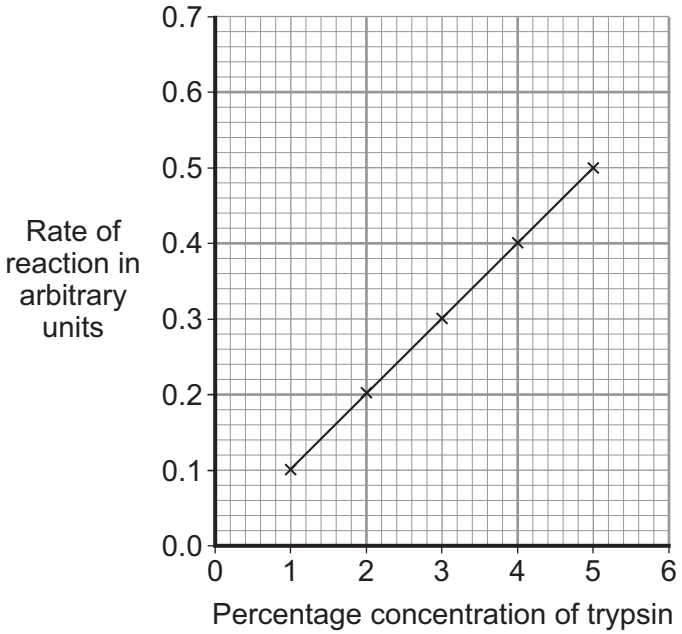
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2 Trypsin is a protease enzyme. Trypsin will digest a protein called gelatine which covers the surface of photographic film.

Some students investigated the time taken to digest the gelatine with trypsin.
The students used five different concentrations of trypsin.

The rate of reaction was calculated from the time taken for the gelatine to be digested.

The graph shows the students' results.



2 (a) (i) Describe the relationship between the concentration of trypsin and the rate of reaction.

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(2 marks)

2 (a) (ii) Use the graph to predict the rate of reaction with 6% trypsin.

..... arbitrary units

(1 mark)

Do not write outside the box

2 (b) In industry, trypsin is used to pre-treat some baby foods.
In their experiment, the students used 1–5% trypsin at 20°C.
The baby food manufacturers make most profit if they use 0.5% trypsin at 35°C.

Suggest why the manufacturers make most profit with these conditions.

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(4 marks)

2 (c) (i) Describe the effect trypsin would have on the baby food.

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(2 marks)

2 (c) (ii) Apart from protease enzymes, give **one** other use of a **named** enzyme in industry.

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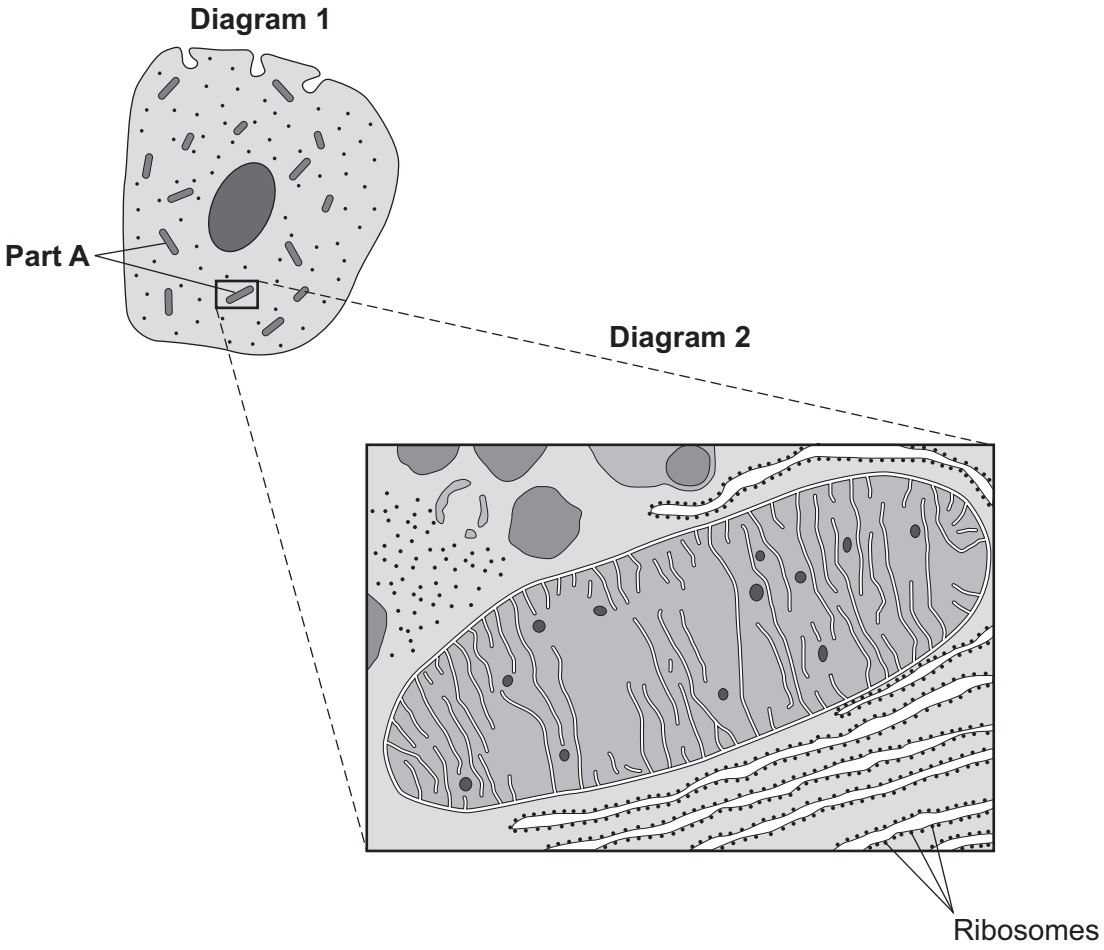
(2 marks)

11

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3 **Diagram 1** shows a cell from the pancreas.

Diagram 2 shows part of the cell seen under an electron microscope.



Part **A** is where most of the reactions of aerobic respiration happen.

3 (a) (i) Name part **A**.

.....

(1 mark)

3 (a) (ii) Complete the equation for aerobic respiration.

glucose + oxygen ⟶ ..... + ... (+ energy)

(2 marks)

Do not write outside the box

3 (a) (iii) Part **A** uses oxygen.

Explain how oxygen passes from the blood to part **A**.

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(3 marks)

3 (b) The pancreas cell makes enzymes.

Enzymes are proteins.

Describe how the ribosomes and part **A** help the cell to make enzymes.

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(3 marks)

9

Turn over ▶

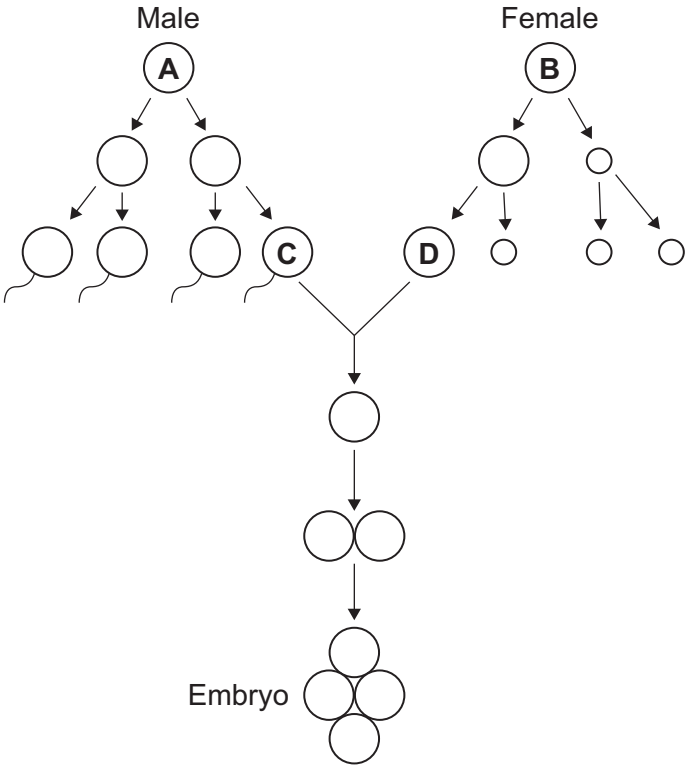
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4 The diagram shows some of the cell divisions that occur during human reproduction.



4 (a) (i) Name the type of cell division that produces cell **D** from cell **B**.

.....

(1 mark)

4 (a) (ii) Which organ in the male body produces cell **C** from cell **A**?

.....

(1 mark)

4 (b) (i) Cells **A** and **B** each contain 46 chromosomes.

How many chromosomes would there be in the nucleus of cell **C**? ☐

(1 mark)

4 (b) (ii) Why is it important that cell **C** has this number of chromosomes?

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(2 marks)

5

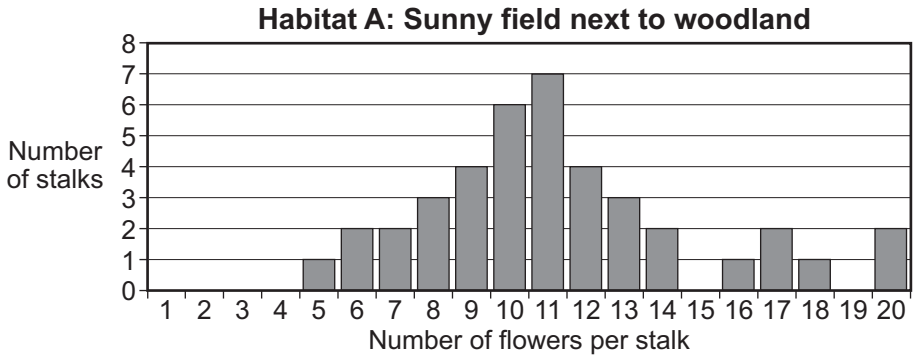
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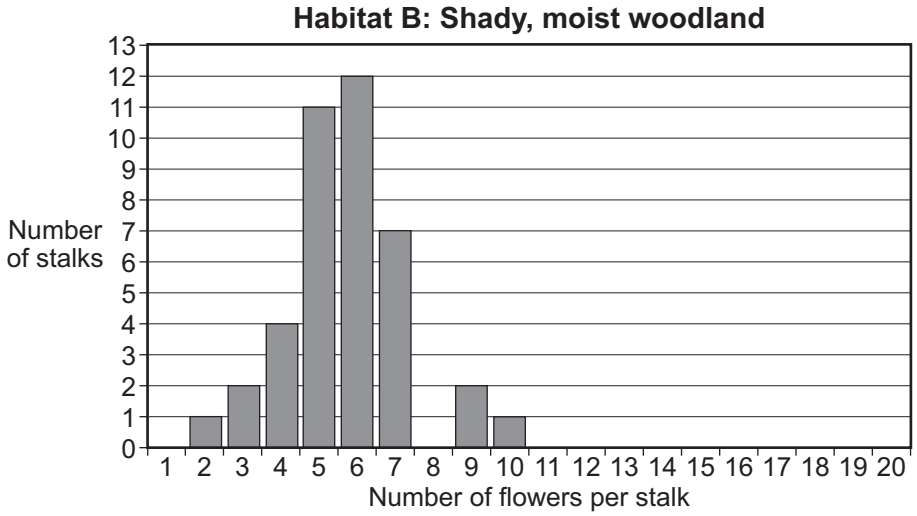
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5 Some students studied bluebell plants growing in two different habitats.

Habitat **A** was a sunny field next to woodland.
Habitat **B** was a shady, moist woodland.

A bluebell plant can have several flowers on one flower stalk. The students counted the number of flowers on each of 40 bluebell flower stalks growing in each habitat. The bar charts show the results.





5 (a) The students wanted to collect valid data.

Describe how the students should have sampled the bluebell plants at each habitat to collect valid data.

.....

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(2 marks)

Do not write outside the box

5 (b) (i) The students used the bar charts to find the mode for the number of flowers per stalk in the two habitats.

The mode for the number of flowers per stalk in habitat **A** was 11.

What was the mode for the number of flowers per stalk in habitat **B**?

Mode = ...

(1 mark)

5 (b) (ii) The students suggested the following hypothesis:

'The difference in the modes is due to the plants receiving different amounts of sunlight.'

Suggest why.

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(2 marks)

5 (b) (iii) Suggest how the students could test their hypothesis for the two habitats.

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(2 marks)

5 (c) Suggest how receiving more sunlight could result in the plants producing more flowers per stalk.

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(2 marks)

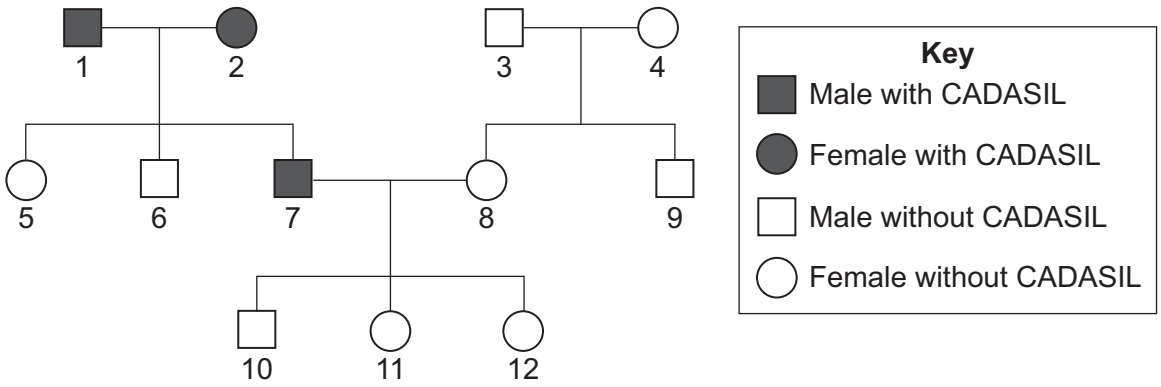
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6 CADASIL is an inherited disorder caused by a dominant allele.

CADASIL leads to weakening of blood vessels in the brain.

The diagram shows the inheritance of CADASIL in one family.



6 (a) CADASIL is caused by a *dominant allele*.

6 (a) (i) What is a *dominant allele*?

.....

.....

(1 mark)

6 (a) (ii) What is the evidence in the diagram that CADASIL is caused by a dominant allele?

.....

.....

(1 mark)

6 (a) (iii) Person **7** has CADASIL.

Is person **7** homozygous or heterozygous for the CADASIL allele?

Give evidence for your answer from the diagram.

.....

.....

(1 mark)

Do not write outside the box

6 (b) Persons **7** and **8** are planning to have another baby.
Use a genetic diagram to find the probability that the new baby will develop into a person with CADASIL.

Use the following symbols to represent alleles.

D = allele for CADASIL
d = allele for not having CADASIL

Probability = ...

(4 marks)

6 (c) Scientists are trying to develop a treatment for CADASIL using stem cells.

Specially treated stem cells would be injected into the damaged part of the brain.

6 (c) (i) Why do the scientists use stem cells?

.....

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.....

.....

(2 marks)

6 (c) (ii) Embryonic stem cells can be obtained by removing a few cells from a human embryo.

In 2006, scientists in Japan discovered how to change adult skin cells into stem cells.

Suggest **one** advantage of using stem cells from adult skin cells.

.....

.....

(1 mark)

10

Turn over ▶

Do not write outside the box

7 *Howea forsteriana* and *Howea belmoreana* are two species of palm tree.

The two *species* grow together on a small island in the South Pacific.

7 (a) What is meant by the term *species*?

.....

.....

.....

.....

(2 marks)

Do not write outside the box

7 (b) The table gives some information about these two species of palm tree.

	Howea forsteriana	***Howea belmoreana***
Optimum pH of the soil for growth of the palm tree	pH 8	pH 6
Height above sea level of most common habitat	30 to 60 metres	above 120 metres
Month when most palm trees flower	October	December
Method of pollination	Wind carries pollen	Wind carries pollen

Scientists believe that these two species of palm tree began to evolve from a single species over 2 million years ago.

Suggest how these two different species developed.

In your answer you should use information from the table and your own knowledge.

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(5 marks)

7

END OF QUESTIONS

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Version 1.0



General Certificate of Secondary Education
January 2013

Additional Science / Biology BL2HP

(Specification 4408 / 4401)

Unit: Biology 2

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from: www.aqa.org.uk

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

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Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

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Quality of Written Communication and levels marking

In Question 1(c) students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

BL2HP

Question 1

question	Answers	extra information	mark
1(a)	any **one** from: • add a water bath • heat screen • use LED • low energy bulb / described	ignore 'check temperature'	1
1(b)(i)	rate / number of bubbles decreases **or** less oxygen / gas released	accept converse with reference to increasing light **or** shorter distance ignore reference to rate of photosynthesis	1
1(b)(ii)	temperature / CO_2 (concentration)	accept 'it was too cool' **or** not enough CO_2 accept number of chloroplasts / amount of chlorophyll allow heat allow CO2 do **not** allow CO^2	1

Question 1 continues on the next page . . .

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BL2HP

Question 1 continued . . .

<table>
<tr><th>question</th><th colspan="4">Answers</th><th>extra information</th><th>mark</th></tr>
<tr><td rowspan="4">1(c)</td><td colspan="4">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a ‘best-fit’ approach to the marking.</td><td></td><td>6</td></tr>
<tr><td>0 marks</td><td>Level 1 (1-2 marks)</td><td>Level 2 (3-4 marks)</td><td colspan="2">Level 3 (5-6 marks)</td></tr>
<tr><td>No relevant content.</td><td>There is a brief description of at least 1 tissue or at least 1 function of an indicated part of the leaf.
The account lacks clarity or detail.</td><td>There is a clear description which includes at least 1 named tissue and at least 1 correct function described for an indicated part of the leaf.</td><td colspan="2">There is a detailed description of most of the structures and their functions.</td></tr>
<tr><td colspan="6">examples of responses:
• epidermis
• cover the plant
• mesophyll / palisade
• photosynthesises
• phloem
• xylem
• transport.
The following points are all acceptable but beyond the scope of the specification:
• (waxy) cuticle – reduce water loss
• epidermis – no chloroplasts so allows light to penetrate
• stomata / guard cells – allow CO_2 in (and O_2 out) or controls water loss
• palisade (mesophyll) – <u>many</u> chloroplasts to trap light
– near top of leaf for receiving more light
• spongy (mesophyll) – air spaces for rapid movement of gases</td></tr>
<tr><td>Total</td><td colspan="4"></td><td></td><td>9</td></tr>
</table>

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Question 2

question	Answers	extra information	mark
2(a)(i)	directly proportional **or** 0.1 rise in rate for 1% rise in concentration	gains full marks accept increased concentration: increased rate **or** positive correlation **or** proportional for **1** mark	2
2(a)(ii)	0.6	allow ± 0.01	1
2(b)	(0.5 % trypsin) cheaper (35 °C) faster reaction so takes less time to make product extra heating cost outweighed by savings on enzyme cost	ignore more profit allow (35 °C) optimum / best temperature	1 1 1 1
2(c)(i)	any **two** from: • breaks down / digests food • from protein into amino acids / peptides • makes soft(er) / runni(er)	 allow pre-digests protein / food allow easier for baby to digest allow description of texture change allow make (more) soluble	2

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
2(c)(ii)	correct named enzyme correct function Eg carbohydrase starch → sugar **or** lactose → glucose **or** making sugar syrup **or** isomerase glucose → fructose **or** making slimming foods **or** lipase fats / oils → fatty acids **or** removal of grease stains	 to gain **2** marks function must relate to correctly named enzyme accept amylase / maltase / lactase accept other correct example	1 1
Total			**11**

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Question 3

question	answers	extra information	mark
3(a)(i)	mitochondrion / mitochondria	must be phonetically correct	1
3(a)(ii)	carbon dioxide / CO_2 water / H_2O	in either order accept CO2 but **not** CO^2 accept H2O **or** HOH but not H^2O	1 1
3(a)(iii)	diffusion high to low concentration through (cell) membrane **or** through cytoplasm	 allow down a concentration gradient do **not** accept cell wall	1 1 1
3(b)	ribosomes make proteins / enzymes using amino acids part A / mitochondria provide the energy for the process	 allow ATP do **not** accept produce or make energy	1 1 1
Total			**9**

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Question 4

question	answers	extra information	mark
4(a)(i)	meiosis	allow mieosis	1
4(a)(ii)	testis / testes	allow testicle	1
4(b)(i)	23		1
4(b)(ii)	fuses / joins with cell D / with egg cell **or** used in fertilisation prevents doubling of chromosome number / restores original no. / 46 / diploid no. / normal no. / full no.	allow fuse with another cell accept 23 from each parent / from each gamete	1 1
Total			**5**

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Question 5

question	answers	extra information	mark
5(a)	use of quadrat / point frame randomly placed / random sampling	allow description ignore reference to transects	1 1
5(b)(i)	6		1
5(b)(ii)	more light in A / in field / where sunny more / better / faster photosynthesis in A / with more light	ignore sun allow converse	1 1
5(b)(iii)	use light meter / measure light intensity in both habitats take many measurements at same time of the day **or** laboratory / field investigation with 2 batches high light and low light (1) count or number of flowers in each (1)	 counting point is dependent on investigation point	1 1
5(c)	more glucose / energy available for growth	allow other named product eg protein allow if more energy produced dependent on 1st mark	1 1
Total			**9**

BL2HP

Question 6

question	answers	extra information	mark
6(a)(i)	allele expressed even when other allele present **or** expressed if just one copy of allele is present **or** expressed if heterozygous	if present other allele not expressed	1
6(a)(ii)	2 affected parents have unaffected child **or 1** and **2** → **5** / **6** **or** if recessive all of **1** and **2**'s children would have CADASIL		1
6(a)(iii)	heterozygous – has unaffected children **or** because if homozygous all children would have CADASIL		1
6(b)	genetic diagram including: correct gametes: **D** and **d** **and** **d** (and **d**) derivation of offspring genotypes: **Dd** **Dd** **dd** **dd** identification of **Dd** as CADASIL **or dd** as unaffected correct probability: 0.5 / ½ / 1 in 2 / 50% / 1 : 1	accept alternative symbols, if defined ignore 7 / 8 or male / female allow just **Dd** **dd** if ½-diagram allow ecf if correct for student's gametes allow ecf if correct for student's gametes	1 1 1 1
6(c)(i)	stem cells can differentiate **or** are undifferentiated / unspecialised can form blood vessel cells / brain cells **or** stem cells can divide		1 1

Question 6 continues on the next page . . .

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Question 6 continued . . .

question	answers	extra information	mark
6(c)(ii)	ethical argument – eg no risk of damage to embryo **or** adult can give consent for removal of cells **or** adult can re-grow skin **or** if from a relative then less chance of rejection **or** if from self then no chance of rejection **or** skin cells more accessible	more ethical qualified ignore religion unqualified	1
Total			**10**

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BL2HP

Question 7

question	answers	extra information	mark
7(a)	organisms that can breed together	accept converse points re. 2 different species	1
	successfully	accept produces fertile offspring	1
7(b)	any **two** from: (live at) • different pH of soil • different height above sea level • different flowering times **AND**		2
	genetic variation / mutation / different alleles (produced in isolated populations)		1
	natural selection acts differently on the two populations **or** different characteristics in the two populations survive **or** different alleles passed on in the two groups		1
	eventually resulting in interbreeding no longer possible		1
Total			**7**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

General Certificate of Secondary Education
Higher Tier
June 2012

Additional Science BL2HP
Unit Biology B2

H

Biology
Unit Biology B2

Monday 21 May 2012 9.00 am to 10.00 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 3(b) should be answered in continuous prose. In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

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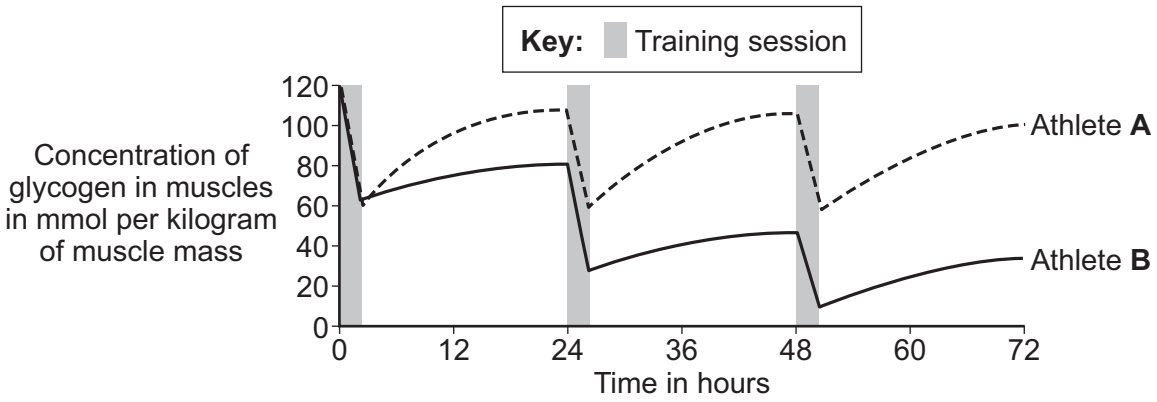
Answer **all** questions in the spaces provided.

1 Glycogen is stored in the muscles.

Scientists investigated changes in the amount of glycogen stored in the muscles of two 20 year-old male athletes, **A** and **B**.
Athlete **A** ate a high-carbohydrate diet. Athlete **B** ate a low-carbohydrate diet.

Each athlete did one 2-hour training session each day.

The graph shows the results for the first 3 days.



1 (a) (i) Give **three** variables that the scientists controlled in this investigation.

.....

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(3 marks)

Do not write outside the box

1 (a) (ii) Suggest **two** variables that would be difficult to control in this investigation.

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(2 marks)

1 (a) (iii) Describe **one** way in which the results of Athlete **B** were different from the results of Athlete **A**.

.....

.....

(1 mark)

1 (b) Both athletes were training to run a marathon.

Which athlete, **A** or **B**, would be more likely to complete the marathon?

Use information from the graph to explain your answer.

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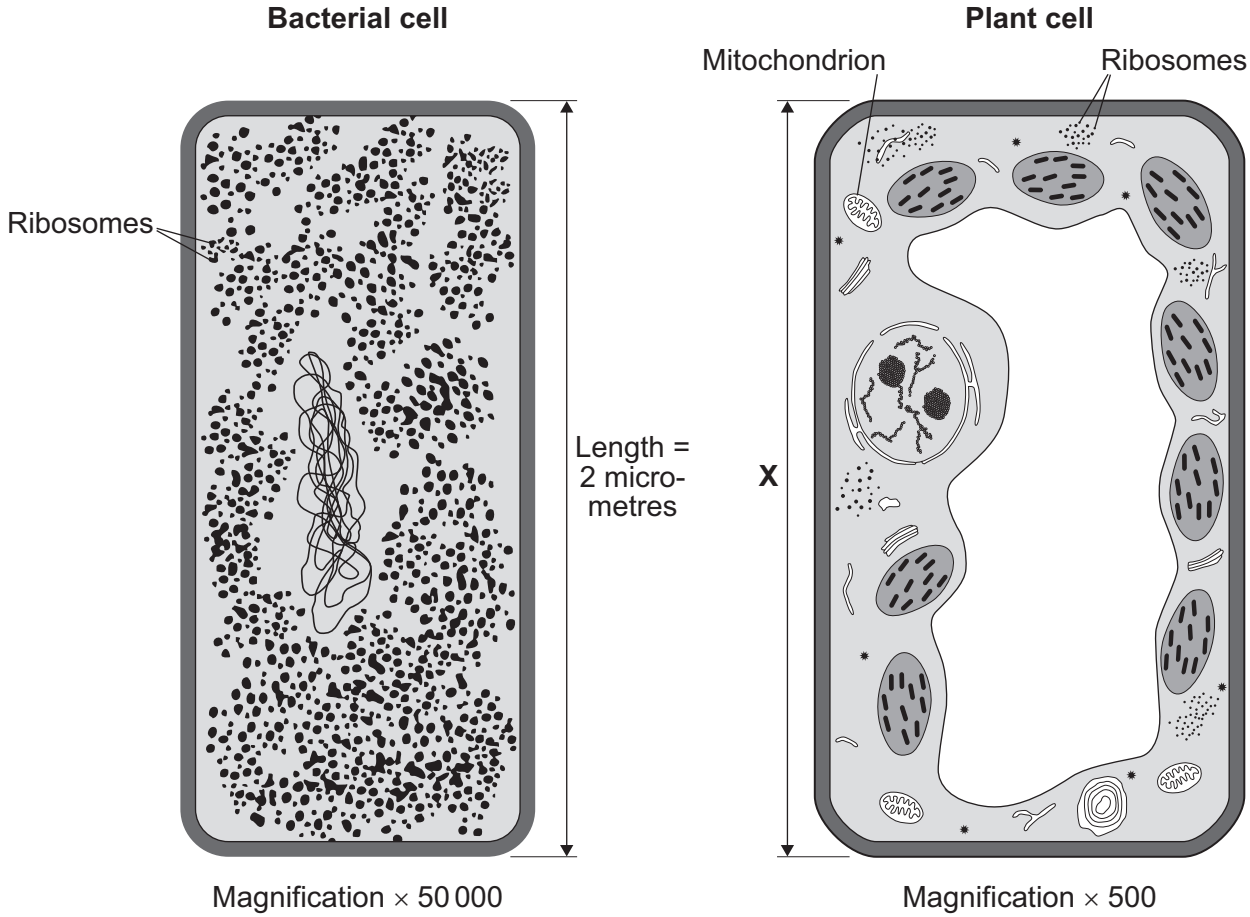
(4 marks)

10

Turn over for the next question

Do not write outside the box

2 The diagram shows two cells, a bacterial cell and a plant cell.



2 (a) (i) Both the bacterial cell and the plant cell contain ribosomes.

What is the function of a ribosome?

.....

.....

(1 mark)

2 (a) (ii) The plant cell contains mitochondria but the bacterial cell does **not** contain mitochondria.

Give **one** other way in which the plant cell is different from the bacterial cell.

.....

.....

(1 mark)

Do not write outside the box

2 (b) (i) Both cells are drawn the same length, but the magnification of each cell is different.

The real length of the bacterial cell is 2 micrometres.
Calculate the real length, **X**, of the plant cell. Give your answer in micrometres.

Show clearly how you work out your answer.

.....

.....

.....

X = ... micrometres
(2 marks)

2 (b) (ii) Most mitochondria are about 3 micrometres in length.

The plant cell contains mitochondria but the bacterial cell does **not** contain mitochondria.

Use your answer to part **(b)(i)** and the information in the diagram to suggest why.

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(1 mark)

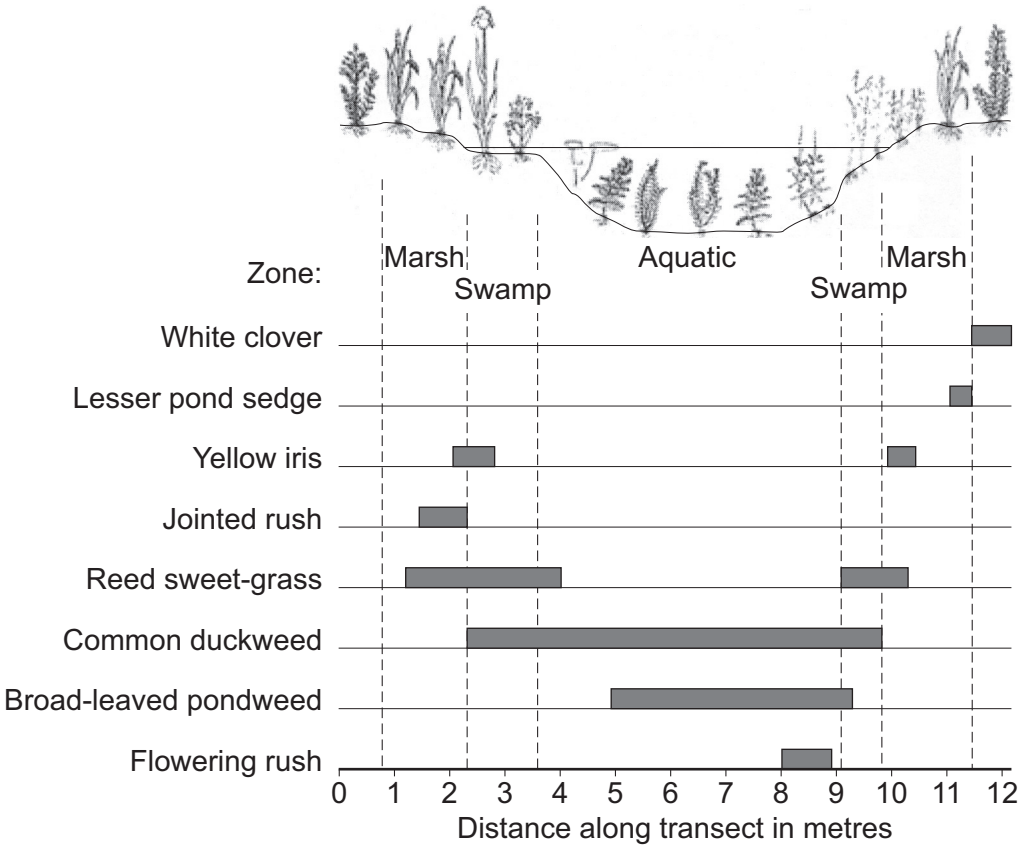
5

Turn over for the next question

Do not write outside the box

3 Some students investigated the distribution of some of the plants growing in and around a shallow stream. They sampled along a transect line.

The diagram shows their results.



3 (a) (i) Name the **one** species that grew only in the driest conditions.

.....

(1 mark)

3 (a) (ii) Only **one** species grew in the marsh, the swamp and in the aquatic zones.

Which species?

.....

(1 mark)

3 (a) (iii) Duckweed grows floating in water. What evidence is there for this in the students' results?

.....

.....

(1 mark)

Do not write outside the box

3 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Describe how you would use a $\frac{1}{2}$-metre $\times$ $\frac{1}{2}$-metre quadrat frame and a 30-metre tape measure to obtain data similar to the data shown in the diagram.

You should include details of how you would make sure that you would obtain valid results.

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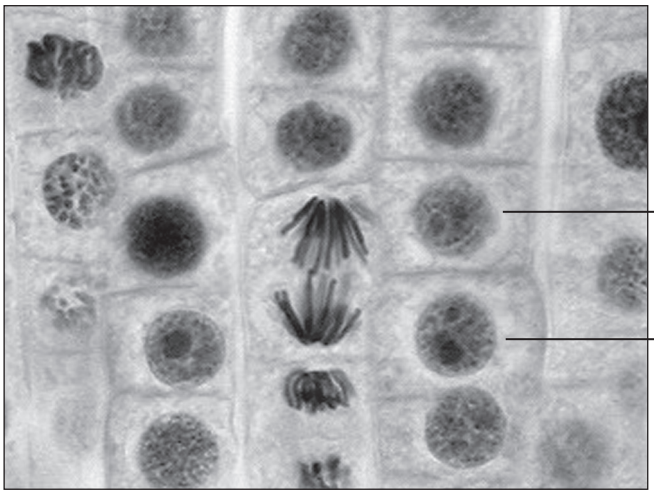
(6 marks)

9

Turn over for the next question

Do not write outside the box

4 The photograph shows some cells in the root of an onion plant.



Photograph: © Karen Wynne, Tyler Junior College

4 (a) Cells **X** and **Y** have just been produced by cell division.

4 (a) (i) Name the type of cell division that produced cells **X** and **Y**.

.....

(1 mark)

4 (a) (ii) What happens to the genetic material before the cell divides?

.....

(1 mark)

4 (b) A gardener wanted to produce a new variety of onion.

Explain why sexual reproduction could produce a new variety of onion.

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(3 marks)

5

Do not write outside the box

5 (a) Complete the equation for photosynthesis.

..... + ... $\xrightarrow{\text{light energy}}$ ..... + oxygen

(2 marks)

5 (b) Scientists investigated how temperature affects the rate of photosynthesis.
The scientists grew some orange trees in a greenhouse.
They used discs cut from the leaves of the young orange trees.

The scientists used the rate of oxygen production by the leaf discs to show the rate of photosynthesis.

5 (b) (i) The leaf discs did not produce any oxygen in the dark.

Why?

.....

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(1 mark)

5 (b) (ii) The leaf discs took in oxygen in the dark.

Explain why.

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(2 marks)

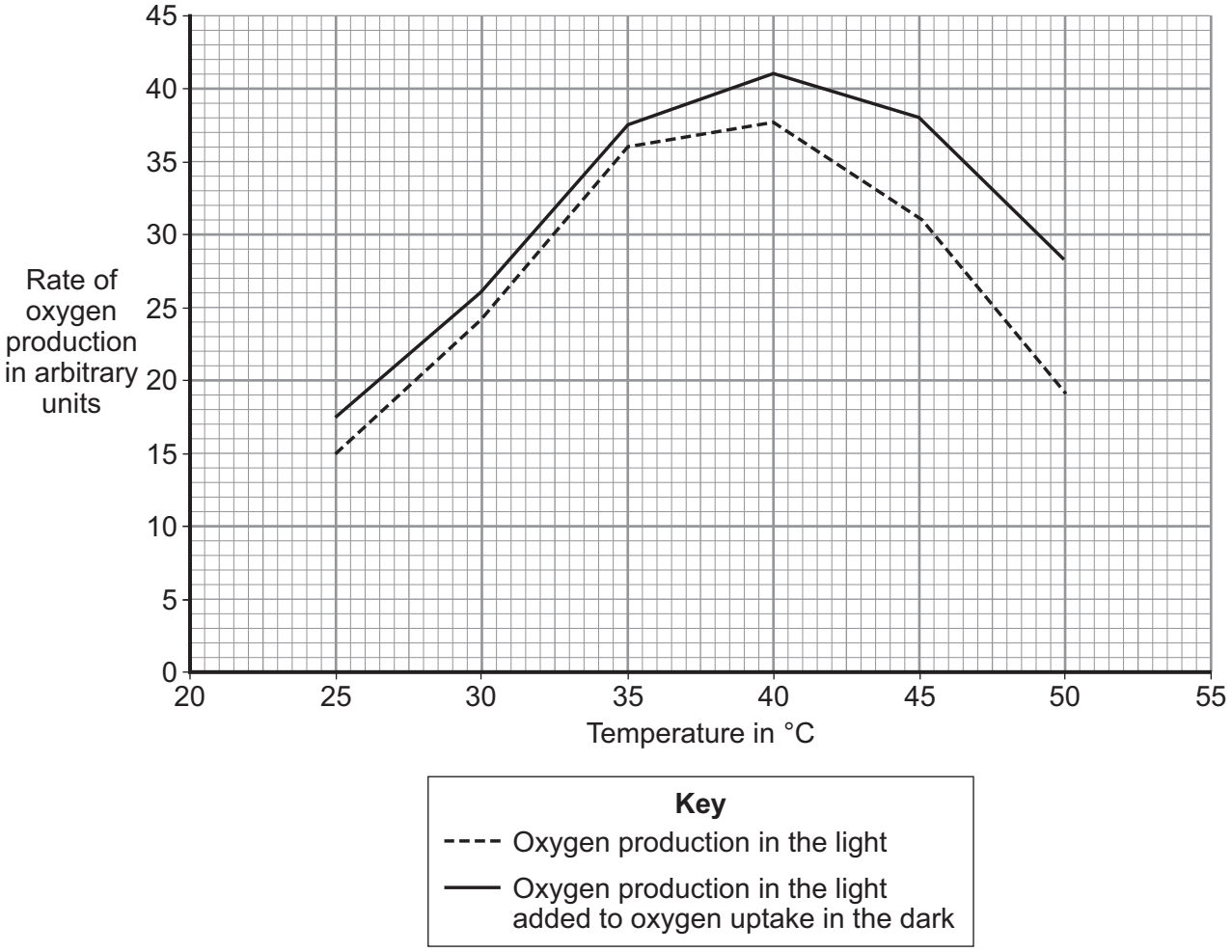
Question 5 continues on the next page

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5 (c) In their investigation, the scientists measured the rate of oxygen release by the leaf discs in the light. The scientists then measured the rate of oxygen uptake by the leaf discs in the dark.

The graph shows the effect of temperature on

- oxygen production in the light
- oxygen production in the light added to oxygen uptake in the dark.



Use the information from the graph to answer each of the following questions.

5 (c) (i) Describe the effect of temperature on oxygen production in the light.

.....

.....

.....

.....

(2 marks)

Do not write outside the box

5 (c) (ii) Explain the effect of temperature on oxygen production in the light when the temperature is increased:

from 25 °C to 35 °C

.....

.....

.....

from 40 °C to 50 °C.

.....

.....

.....

(2 marks)

5 (d) A farmer in the UK wants to grow orange trees in a greenhouse. He wants to sell the oranges he produces at a local market.
He decides to heat the greenhouse to 35 °C.

Explain why he should **not** heat the greenhouse to a temperature higher than 35 °C.
Use information from the graph in your answer.

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(3 marks)

12

Do not write outside the box

6 (a) How do fossils provide evidence that species alive today have evolved from simpler organisms?

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(3 marks)

6 (b) The photographs show two species of gull.

Herring gull (*Larus argentatus)*



Photograph: © John Howard/Science Photo Library

Lesser black-backed gull (*Larus fuscus)*

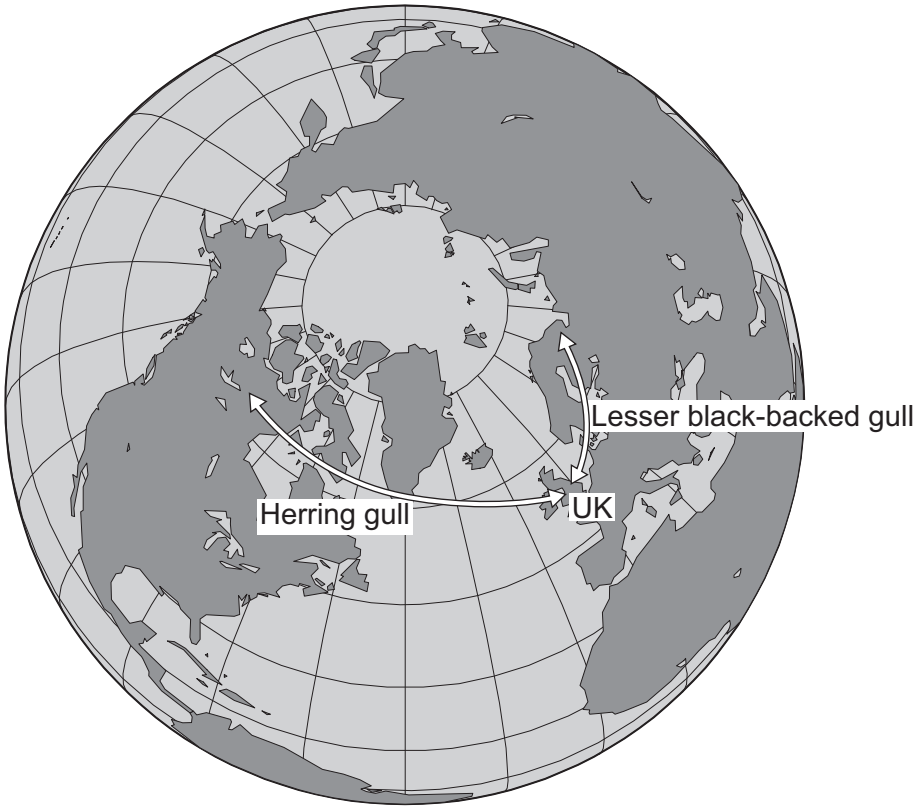


Photograph: © John Devries/Science Photo Library

Both species are now found in the UK but the two species cannot interbreed with each other. Scientists believe that these two species have evolved from a common ancestor.

The map on the next page shows a view of the Earth from above the North Pole.
The map also shows where these two species are found.

Do not write outside the box



6 (b) Suggest an explanation for the development of these different species.

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(6 marks)

9

Turn over ▶

Do not write outside the box

7 People with cystic fibrosis make large amounts of thick, sticky mucus in their lungs. Cystic fibrosis is caused by the inheritance of recessive alleles.

7 (a) What do each of the following mean?

7 (a) (i) Alleles

.....

.....

(1 mark)

7 (a) (ii) Recessive

.....

.....

(1 mark)

7 (b) Mr and Mrs Brown have a child with cystic fibrosis. They hope to have another child. They want to know the probability that their next child will have cystic fibrosis. They visit a genetic counsellor who explains, "You are both heterozygous for cystic fibrosis. There is a 1 in 4 (25%) chance that your next child will have cystic fibrosis."

Use the following symbols in answering the questions.

N = allele for being unaffected by cystic fibrosis
n = allele for cystic fibrosis

7 (b) (i) Mr and Mrs Brown both have the same genotype.

What is their genotype? .....

(1 mark)

Do not write outside the box

7 (b) (ii) There is a 1 in 4 chance that Mr and Mrs Brown's next child will have cystic fibrosis. Use a genetic diagram to explain why.

(3 marks)

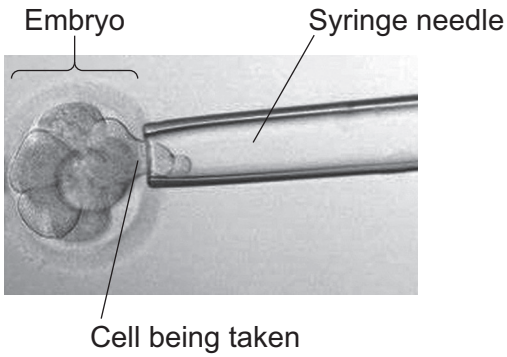
Question 7 continues on the next page

Do not write outside the box

7 (c) Mr and Mrs Brown do **not** want to have another child with cystic fibrosis. The genetic counsellor explains two different methods for finding out whether an embryo has cystic fibrosis. The methods are:

- pre-implantation genetic diagnosis (**PGD**)
- chorionic villus sampling (**CVS**).

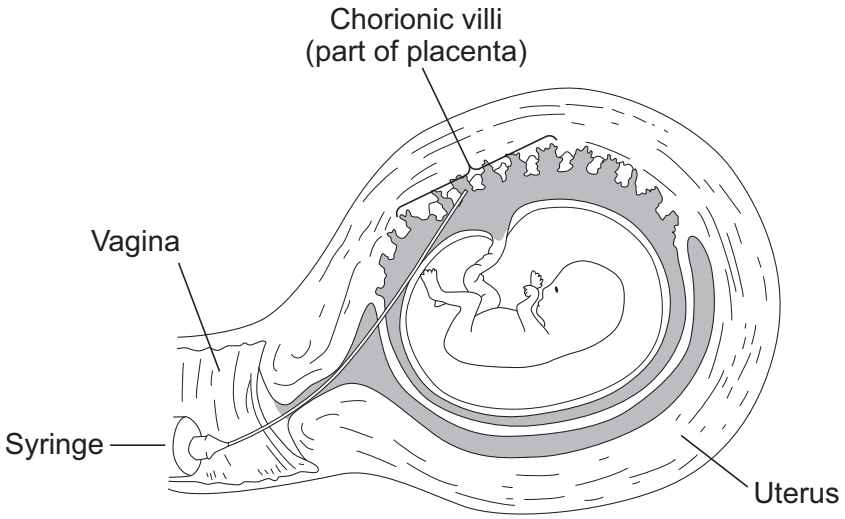
In **PGD**, eggs are fertilised in dishes and allowed to grow into embryos. A cell is taken from each embryo when the embryo is 3 days old. The photograph shows how the cell is taken.



Photograph: © Pascal Goetgheluck/Science Photo Library

The DNA in the cell can then be tested. The possibility of a false positive result is about 1 in 6. An unaffected embryo can then be placed in the woman's uterus. The procedure costs about £6000.

CVS can only be done after 9 weeks of pregnancy. A tiny piece of the placenta is taken out using a tube attached to a syringe. This is grown in tissue culture for about 7 days. The diagram below shows how **CVS** is done.



Do not write outside the box

The DNA in the cells can then be tested. About 2 in every 100 women have a miscarriage because of **CVS**. The possibility of a false positive result is about 1%. The procedure costs about £600. Following a positive result, the parents must then decide whether to terminate the pregnancy.

7 (c) The genetic counsellor thinks that **PGD** is a better method than **CVS** for detecting cystic fibrosis in an embryo.

Evaluate this opinion.

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(4 marks)

10

END OF QUESTIONS

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Version : 10/08/2012



General Certificate of Secondary Education

Additional Science 4408 / Biology 4401

BL2HP Unit Biology 2

Mark Scheme

2012 examination – June series

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Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

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Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

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Quality of Written Communication and levels marking

In Question 3(b) students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

BL2HP

Question 1

question	answers	extra information	mark
1(a)(i)	any **three** from: • age (of athlete) • gender (of athlete) • starting concentration of glycogen • type / intensity of exercise • length of exercise period • number of training sessions • time interval between exercise sessions • exercise at same time of day	if diet given as answer = max **2** if none of these points gained amount of exercise = **1** mark if last four points not awarded allow time (for exercise) for **1** mark ignore references to amount of energy ignore they are both athletes	3
1(a)(ii)	any **two** from: • intensity of exercise • amount of exercise between sessions • starting concentration of glycogen • fitness / health • metabolic rate / respiration rate • amount / mass of muscle / physique • aspects of diet qualified, eg amount of food eaten	do **not** accept amount of carbohydrate if no other marks awarded allow height / mass / weight for **1** mark	2

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1(a)(iii)	(B has) less glycogen **or** (B's glycogen) fell more **or** (B's glycogen) built up less	he = B accept use of approximate figures allow other correct observations from graph eg A is lower at end of first session ignore rate of fall	1

1(b)	athlete **A** (no mark)	to gain full marks 'more' must be given at least once	
	athlete **A** had more glycogen / **B** has less (only if A chosen to complete marathon)	accept converse argument for **B**	1
	(glycogen / glucose) used in respiration	ignore anaerobic	1
	(more) energy released / available in athlete **A**	allow 'energy made'	1
	and either energy used for movement / muscle action / to run **or** (extra) glycogen → (more) glucose		1

Total			**10**

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Question 2

question	answers	extra information	mark
2(a)(i)	makes / produces / synthesises protein / enzyme		1
2(a)(ii)	plant cell has nucleus / vacuole / chloroplasts / chlorophyll **or** plant cell is much larger	'It' = plant cell allow correct reference to DNA or chromosomes allow plant cell has fewer ribosomes allow cellulose (cell wall)	1
2(b)(i)	200	correct answer with or without working gains **2** marks if answer incorrect, allow **1** mark for $\frac{2 \times 50{,}000}{500}$ **or** $\frac{100{,}000}{500}$ **or** 100	2
2(b)(ii)	bacterial cell is too small / bacterial cell about same size as a mitochondrion / 'no room'	ignore references to respiration	1
Total			**5**

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Question 3

question	answers	extra information	mark
3(a)(i)	(white) clover		1
3(a)(ii)	reed sweet-grass	allow reed allow grass	1
3(a)(iii)	(only) found in swamp and aquatic zones **or** only found in water **or** doesn't grow in marsh	ignore wet conditions	1

3(b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 2, and apply a 'best-fit' approach to the marking.				6
	0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**	
	No relevant content.	There is a basic description which describes how a quadrat **or** a metre tape could be used to collect data	There is a clear description of how a quadrat **and** a metre tape could be used to collect data along a line	There is a clear, logical and detailed description of a method that will produce valid, repeatable results across / at intervals along the stream.	
	examples of procedural points made in the response: • use of tape measure to produce transect • placing of quadrats • transect placed across stream • score presence of each plant species • use quadrat at regular intervals along tape • repeat transect several times (≥ 3) • along stream • at random **or** regular intervals				

Total			**9**

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Question 4

question	answers	extra information	mark
4(a)(i)	mitosis	correct spelling only	1
4(a)(ii)	replicates / doubles / is copied / duplicates	accept cloned ignore multiplied / reproduced	1
4(b)	fertilisation occurs / fusion (of gametes)	accept converse for asexual, eg none in asexual / just division in asexual	1
	so leading to mixing of genetic information / genes / DNA / chromosomes	genes / DNA / chromosomes / genetic information comes from 1 parent in asexual ignore characteristics	1
	<u>one</u> copy (of each allele / gene / chromosome) from each parent **or** gametes produced by meiosis **or** meiosis causes variation	meiosis must be spelt correctly	1
Total			**5**

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Question 5

question	answers	extra information	mark
5(a)	LHS: carbon dioxide **AND** water	in either order accept CO_2 **and** H_2O allow CO2 and H2O if names given ignore symbols do **not** accept CO^2 / H^2O / Co / CO ignore balancing	1
	RHS: sugar(s) / glucose / starch / carbohydrate(s)	accept $C_6H_{12}O_6$ allow C6H12O6 do **not** accept $C^6H^{12}O^6$	1
5(b)(i)	light is needed for photosynthesis **or** no photosynthesis occurred (so no oxygen produced)		1
5(b)(ii)	oxygen is needed / used for (aerobic) respiration	full statement respiration occurs **or** oxygen is needed for anaerobic respiration gains **1** mark	2
5(c)(i)	(with increasing temperature) rise then fall in rate use of figures, ie max. production at 40 °C **or** maximum rate of 37.5 to 38		1 1

Question 5 continues on the next page . . .

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Question 5 continued

question	answers	extra information	mark
5(c)(ii)	<u>25 – 35 °C</u> **either** faster movement of particles / molecules / more collisions **or** particles have more energy / enzymes have more energy **or** temperature is a limiting factor over this range <u>40 – 50 °C</u> denaturation of proteins / enzymes	 ignore denaturation of cells ignore stomata	 1 1
5(d)	above 35 °C (to 40 °C) – little increase in rate **or** >40 °C – causes decrease in rate so waste of money **or** less profit / expensive because respiration rate is higher at >35 °C **or** respiration reduces the effect of photosynthesis		1 1 1
Total			**12**

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Question 6

question	answers	extra information	mark
6(a)	fossil is (remains / impression of) organism that lived a long time ago	if numbers, ≥ 1000s years	1
	fossils show changes over time **or** older fossils simpler **or** fossils simpler than present-day species		1
	fossils have similar features to present-day species	allow fossils allow us to compare old species with present-day species	1
6(b)	isolation / separation / splitting		1
	by geographical barrier / sea	ignore other examples	1
	there was variation (in these isolated populations) / different alleles	accept mutation	1
	different environmental conditions **or** example eg climate / predators / food		1
	natural selection acted on the isolated populations	accept became adapted in each area	1
	OR		
	only certain allele(s) passed on to offspring / different alleles passed on in different environments	allow genes	
	so differences lead to inability to interbreed	allow differences described – eg mismatch of genitalia / different courtship displays / different breeding seasons	1
Total			**9**

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Question 7

question	answers	extra information	mark
7(a)(i)	(alternative) forms / types of a / the same gene		1
7(a)(ii)	only expressed if 2 copies inherited **or** not expressed if other allele present	 allow over ruled / over powered by the other allele	1
7(b)(i)	**Nn**	ignore heterozygous	1
7(b)(ii)	genetic diagram including:	accept alternative symbols, if defined	
	gametes: **N** and **n** from both parents	accept alternative symbols if correct for answer to (b)(i)	1
	correct derivation of offspring genotypes: **NN Nn Nn nn**	allow if correct for candidate's parental genotypes / gametes	1
	identification of **nn** as having cystic fibrosis		1

Question 7 continues on the next page . . .

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Question 7 continued

question	answers	extra information	mark
7(c)	**Argued evaluation** any **four** from: • PGD higher financial cost • PGD occurs before pregnancy / implantation • PGD does not involve abortion so less trauma / less pain / ethical comparison • PGD higher incidence of false positive / use of numbers so higher risk of destroying healthy embryo • PGD no chance of miscarriage whereas CVS does **or** PGD less chance of miscarriage	accept CVS only costs £600 accept detected at earlier stage so less unethical / less trauma accept PGD has (surplus) embryos so some destroyed / unethical	4
Total			**10**

UMS Conversion Calculator www.aqa.org.uk/umsconversion

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