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Examiners' report

BIOLOGY A

H420
For first teaching in 2015

H420/02 Summer 2019 series

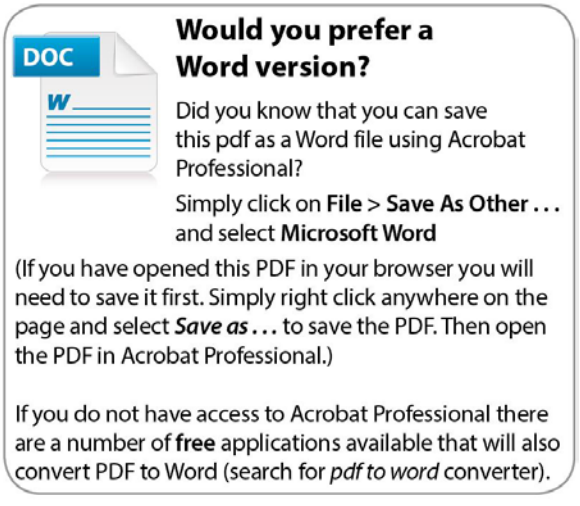
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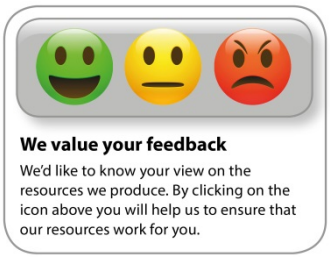
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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

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Paper 2 series overview

The Biological Diversity paper assesses Modules 1, 2, 4 and 6.

Many candidates found this paper challenging but there was no evidence of candidates running out of time.

Candidates scored well on questions 1, 2, 4, 7, 8, 10, 11, 14, 15, 16(c)(i), 16(d), 17(a)(iii), 18(b)(ii), 18(c)(i), 19(a)(i), 19(c)(i), 21(b) and 21(c).

Candidates wrote more concise answers to the Level of Response (LoR) questions this year and fewer used the additional pages available for these. Although using the extra space is entirely valid, centres are reminded that the answer to a question worth 6 marks should, on average be only twice as long as the answer to a question worth 3 marks. Responses that continue at length onto additional pages often struggle to retain enough coherence to achieve the upper mark within a given level but this was much less of an issue than in previous sessions.

Use of key terms was not such an issue as it has been in previous years. However, it is worth highlighting three things:

- The confusion between bases and amino acids was mentioned in the 2018 report for this paper but it was evident from 19(b)(ii) that this confusion still exists with many candidates.
- The term species has been used by candidates in many questions, including 18(c)(ii) and much of 19(b). Although often used correctly, many candidates appear to be using the term to mean 'individual organism', which often limited marks.
- Misunderstanding of terms used in the language of measurement, such as valid, repeatable, accurate etc. often costs candidates marks across all science specifications but the lack of understanding of the word 'valid' was evident in the responses of most candidates to 20(a)(ii).

On a number of questions, for example 16(b)(ii) and 16(d), some candidates appeared to repeat what they knew about a topic rather than answering the question that was asked. A large number of the questions on the paper tested learning outcomes from AS topics and there was evidence from questions 16 and 19(a) that candidates struggled with AS-level knowledge, particularly from Module 2.

In practical based questions, 16, 17(a) and 20(a) those candidates who had actually carried out the practical work in lessons were likely to have been at an advantage.

The proportion of questions requiring mathematical skill remained at around 10%, as in all A Level Biology papers. Many candidates coped well with the maths skills questions, but it is worth reminding candidates to check that their answer makes sense by estimating at least the order of magnitude of the expected answer. Many candidates were choosing an appropriate number of significant figures with which to quote their answers, but some gave answers to an unrealistic level of precision. Centres can find additional help with maths skills in the OCR Maths Skills Handbook(https://www.ocr.org.uk/Images/294471-biology-mathematical-skills-handbook.pdf).

Although the answer spaces provided on the paper are meant to suggest an appropriate length of answer, many candidates continue their answers beyond the space provided. Examiners were pleased that candidates were indicating when an answer extended onto the additional answer space. However, it was again noted that some centres are supplying additional sheets or answer booklets before candidates have used the additional answer space at the back of the question paper. When candidates' answers need to overrun the provided answer space it is strongly recommended that they use the additional pages at the back where their answer will definitely be seen by examiners. It is also essential that such answers are numbered correctly with the full question number, e.g. '20(c)(ii)', not just '(ii)'.

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Note

From this series students have been provided with a fixed number of answer lines and an additional answer space. The additional answer space will be clearly labelled as additional, and is only to be used when required. Teachers are encouraged to keep reminding students about the importance of conciseness in their answers. Please follow this link to our SIU (https://www.ocr.org.uk/administration/support-and-tools/siu/alevel-science-538595/)

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Section A overview

Candidates found many of the multiple choice questions challenging. Most candidates achieved 7 or 8 marks and there was some correlation between achievement in section A and that in the paper as a whole. There was evidence of candidate working on many of the questions and this approach was often successful. Many candidates are crossing out answers when they change their mind and writing their preferred answer next to the box. This is perfectly acceptable, and better than writing it on the additional pages, as long as the desired answer is unambiguous. A few candidates were overwriting previous letters and occasionally the resulting letter was open to interpretation. Such ambiguous responses were not credited.

Question 3

3 Biodiversity is important for the development of new medicines.

Which of the following statements about the development of new medicines is **incorrect**?

A Computer modelling can be used to identify useful medicinal compounds.

B Genetically modified bacteria can be used to synthesise medicines.

C Many pathogenic bacteria have become immune to antibiotics.

D Microorganisms are an important source of new medicines.

Your answer ☐ **[1]**

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Only a few candidates selected the correct answer (C) This might be due to some candidates not noticing the emboldened word or the meaning of the word 'immune' might have been overlooked.

Question 5

5 Hox genes contain a homeobox sequence of 180 base pairs.

Two species have a homeobox sequence of 180 base pairs where 1.7% of the base pairs are different.

Which of the following shows the number of amino acids coded for that would be different in the two species?

A minimum 0 and maximum 1

B minimum 0 and maximum 3

C minimum 1 and maximum 2

D minimum 1 and maximum 3

Your answer ☐ **[1]**

This was a challenging AO2 question, and only a few candidates got the correct answer (B).

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Question 8

8 Which of the following is **not** associated with the use of artificial selection in farm animals?

A health problems in more productive breeds

B inbreeding

C increased frequency of mutations

D reduced gene pool

Your answer ☐ **[1]**

Many candidates got the correct answer (C), suggesting that some candidates think that artificial selection causes mutations.

Question 9

9 Which of the following is **not** a valid concern about the use of genetic modification?

A that antibiotic resistance genes could transfer to pathogenic bacteria

B that herbicide resistance genes could be transferred to wild species

C that certain seeds might not be available for use by poor farmers

D that the use of human embryos in stem cell production is unethical

Your answer ☐ **[1]**

Only a few candidates scored the correct answer (D) with most common incorrect answer (C). It is possible that some candidates did not appreciate that D is not about genetic modification.

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Question 10

10 Barnacles are small animals that live on rocky shores.

Adult barnacles are fixed to rocks and do not move about. They catch passing food in the water with modified limbs called cirri when the tide comes in.

Chthalamus stellatus is a species of barnacle found around UK shores.

Two students wished to estimate the population size of *C. stellatus* on a rocky shore near their school.

Which of the following could the students use for estimating the *C. stellatus* population?

1 an abundance scale, such as ACFOR
2 quadrat sampling
3 mark-release-recapture

A 1, 2 and 3

B only 1 and 2

C only 2 and 3

D only 1

Your answer ☐ **[1]**

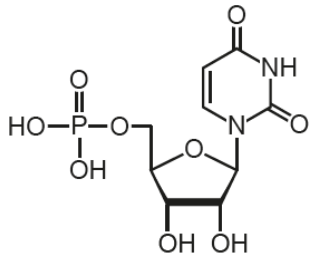
Most candidates were able to process the information in this question and apply their knowledge correctly, by identifying the correct answer (B).

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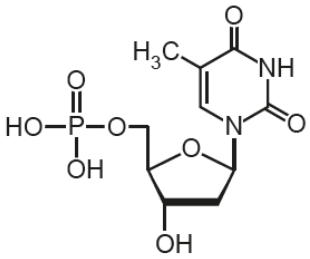
Question 12

12 Which of the following nucleotides contains uracil?

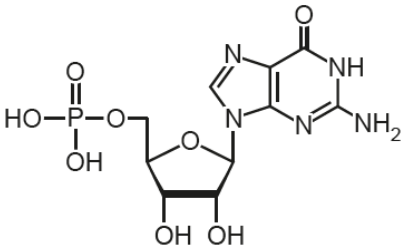
A



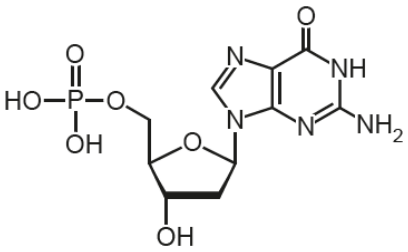
B



C



D



Your answer ☐ **[1]**

Many candidates didn't identify the correct answer (A)and the incorrect letters were evenly distributed. However, a basic knowledge of DNA and RNA structure ought to have allowed candidates to quickly discount B and D as being DNA rather than RNA.

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Question 13

13 The ability to roll one's tongue is under the control of a single gene. The gene has two alleles R and r.

People who can roll their tongues can have the genotypes RR or Rr. People who cannot roll their tongues have the genotype rr.

A survey by a student showed that 12% of the population in a single school cannot roll their tongues.

The student then used the Hardy-Weinberg principle to calculate the number of heterozygous individuals in the school.

Which of the following represents the percentage of heterozygous individuals at the student's school?

Use the equations: $p + q = 1$ and $p2 + 2pq + q2 = 1$

A 21.1%

B 22.7%

C 42.8%

D 45.3%

Your answer ☐ **[1]**

Erratum notice

Turn to **page 7** of the **question paper** and look at **question 13.**

Find the Hardy-Weinberg equations at the end of the question.

Cross out the equation $p2 + 2pq + q2 = 1$ and replace with $p^2 + 2pq + q^2 = 1$

The line should now read:

Use the equations: $p + q = 1$ and $p^2 + 2pq + q^2 = 1$

Candidates appeared not to have been put off by the erratum notice and many candidates were able to carry out the calculation correctly and achieve the mark. Many showed their working on the paper.

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Section B overview

Performance in Section B often correlated with that in Section A. Most candidates were able to display a good understanding of cloning by nuclear transfer and lipid biochemistry. Questions testing Module 2, including 16 and 17(a) revealed gaps in the knowledge and understanding of some candidates. Other topics, such as sustainable timber production and plant cloning in questions 18 and 20 appear to have been lightly covered by some centres or lightly-revised by many candidates.

Question 16 (a) (i)

16 Water moves by osmosis in living organisms.

(a) (i) Define osmosis.

.....

.....

.....

..... **[2]**

Only a few responses achieved both available marks in this knowledge of isolation question. Many candidates gained 1 mark for correct reference to a water potential gradient, although candidates who misunderstood the meaning of gradient, often wrote 'from a high water potential gradient to a low water potential gradient', were not awarded the mark. Only a few candidates referred to diffusion or net movement. It is worth noting that use of the term 'water concentration' is not credited at A Level. References to a semi permeable, or simply 'cell' membrane, were also not credited.

Question 16 (a) (ii)

(ii) Plants rely on osmosis for support.

Explain the importance of osmosis in plant support.

.....

.....

.....

.....

.....

..... **[3]**

A fair amount of candidates scored at least 1 mark in this question. Most candidates did not fully appreciate the meaning of 'support' and appeared to interpret 'support' as 'benefit'. Most responses focussed only a small part of their answer on cell turgor, usually gaining a mark for reference to turgid cells, but many described the whole plant, or the xylem, as being turgid. Response that limited the turgidity to a single cell were also not credited as the question was about supporting plants. A lot of candidates referenced to photosynthesis and transport but were not credited.

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Exemplar 1

When a plant cell is placed in a solution of higher water potential than the cytoplasm, water moves into the cell down a water potential gradient. This influx of water makes the cell's contents e.g. the vacuole and the cell membrane push against the cell wall making it turgid and this provides support for the plant and prevents it becoming flaccid. **[3]**

prevents the entry of any more water molecules.

This response has interpreted the question correctly, focussing on the role of osmosis in support and it is awarded the first marking point by the clear implication that water has entered the vacuole. However, it does not mention turgor and, while there is the idea of pressure against the cell wall, the word 'pressure' is not used. The key word 'turgid' has been used but 'it' appears to refer to the cell wall rather than to plant cells in general. Therefore, the answer scored only 1 mark.

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Question 16 (b) (i)

(b) The apparatus shown in Fig. 16 can be used to demonstrate osmosis.

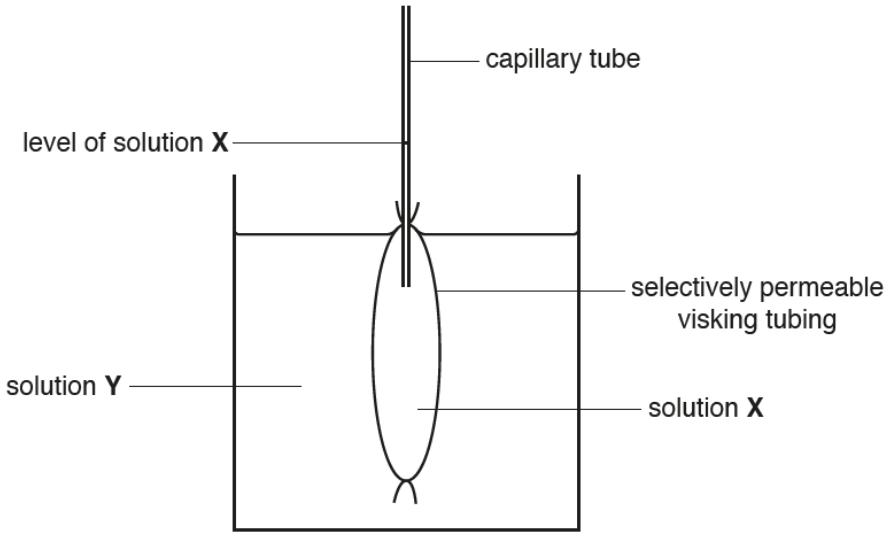


Fig. 16

When the capillary tube with visking tubing bag was placed in solution **Y**, the level of solution **X** inside the capillary tube rose from 10.5 mm to 26.5 mm.

(i) The ruler used to measure the distance along the capillary tube was accurate to the nearest 0.5 mm.

Calculate the percentage uncertainty of the measurement.

uncertainty = ... % **[2]**

Only a few candidates knew exactly what to do here and gained both marks. A smaller number of candidates carried out a correct calculation but they only considered uncertainty at one end, so scored 1 mark. A number of candidates used an inappropriate number of significant figures and were therefore didn't score full marks for the calculation.

i	**OCR support**	The 'Maths for Biology' website offers support on calculating uncertainties as well as the correct use of significant figures: https://www.ocr.org.uk/subjects/biology/maths-for-biology/handling-data/

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Question 16 (b) (ii)

(ii) What conclusions can be drawn about the composition of solutions **X** and **Y**?

.....

.....

.....

..... **[2]**

Many candidates scored one mark for getting the water potentials the right way round. However, only a few candidates expanded their answer. Most candidates did address the issue of solute concentration but often did not express this with sufficient precision. For example, 'solution X is more concentrated' was not awarded a mark. A few candidates explained the processes that were happening, rather than answering the question being asked, which was to draw conclusions.

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Question 16 (c) (i)

(c) A group of students used the following method to investigate osmosis in plant cells.

- Cut pieces of plant material of equal surface area ensuring no skin is present.
- Rinse to remove cell debris.
- Gently pat the plant pieces dry with a paper towel.
- Weigh each piece and record mass.
- Put the plant piece in a 200 cm^3 beaker.
- Cover plant piece with 50 cm^3 of sucrose solution.
- Use sucrose solutions of 0, 0.1, 0.3, 0.5, 0.7 mol dm^{-3}.
- Leave for 24 h.
- Remove the piece of plant material.
- Dry carefully using a paper towel.
- Weigh the plant piece and record the mass.
- Calculate the percentage change in mass for each piece.
- Repeat twice for each sucrose concentration.

The students investigated material from three different plants: carrot, courgette and potato. Their results are shown in Table 16.

Plant	Sucrose concentration / mol dm^{-3}	Percentage change in mass			
		Replicate 1	Replicate 2	Replicate 3	Mean
Carrot	0	+ 6.0	+ 5.8	+ 5.8	+ 5.87
	0.1	+ 4.2	+ 4.1	+ 4.3	+ 4.20
	0.3	+1.5	+1.5	+1.3	+ 1.43
	0.5	– 2.4	– 2.3	– 2.1	– 2.27
	0.7	– 6.3	– 6.1	– 6.3	– 6.23
Courgette	0	+ 7.9	+ 7.8	+ 7.6	+ 7.77
	0.1	+ 5.5	+ 5.5	+ 5.5	+ 5.50
	0.3	+ 1.9	+ 1.8	+ 2.0	+ 1.90
	0.5	– 1.2	– 1.4	– 1.1	– 1.23
	0.7	– 4.3	– 4.4	– 4.1	– 4.27
Potato	0	+ 5.7	+ 5.8	+ 5.7	+ 5.77
	0.1	+ 3.1	+ 2.9	+ 3.0	+ 3.00
	0.3	– 0.3	– 0.4	– 0.6	– 0.43
	0.5	– 2.4	– 2.2	– 2.5	– 2.37
	0.7	– 6.1	– 5.9	– 5.1	– 5.70

Table 16

(i) Explain why it was necessary to calculate **percentage** change in mass.

.....

.....

.....

..... **[2]**

A number of candidates gained both marks here and some well-expressed answers were seen. A minority of candidates referred, incorrectly, to a percentage being more precise, accurate or reliable.

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i	**OCR support**	Appendix 4 of the Practical Skills Handbook, provides information on terms used in measurement and conventions for recording and processing experimental measurements. This is in line with the 'The Language of measurement' booklet: https://www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf

Question 16 (c) (ii)

(ii) The students identified replicate 3 of the potato in 0.7 mol dm^{-3} sucrose as anomalous.

Suggest a practical error by the students that might have caused this result to be anomalous and explain the likely effect of this error.

.....

.....

.....

.....

..... **[2]**

Most candidates identified the correct practical error. However, having identified a reasonable error, usually inadequate drying, most were unable to relate this to the data in the table and describe a potato mass being recorded as heavier than it really was.

Most responses discussed errors such as reading the mass incorrectly or using the wrong solution, which didn't score any marks. Candidates are advised that answers to practical questions that cite avoidable human error are not likely to attract marks.

Question 16 (c) (iii)

(iii) Use Table 16 to identify which plant cells contained the highest concentration of sucrose.

Justify your conclusion.

.....

.....

.....

.....

.....

..... **[3]**

The vast majority of candidates correctly identified the courgette. Many candidates were able to justify this with reference to the highest mass gain (0mol dm^{-3}) and least mass loss (0.7 mol dm^{-3}). Some candidates were not successful because units, mol/dm^3, were omitted from their answers. Only a few candidates discussed the range of concentrations that were likely to be isotonic with the courgette cells and hence gained all 3 marks. Answers that discussed movement of sucrose revealed a fundamental misunderstanding about osmosis and were not credited.

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Question 16 (d)

(d) Water has many properties that are essential for living organisms.

Explain how properties relating to the **density** of water contribute to the survival of organisms.

.....

.....

.....

.....

.....

..... **[3]**

A lot of candidates gained 2 marks for a discussion of the density of idea and its ability to insulate the water below. Fewer candidates also gained a third mark, usually for reference to ice being a habitat, buoyancy, or animals being able to swim. A minority of candidates did not refer to density, and discussed other properties of water, such as specific heat capacity or surface tension, which were not credited.

Exemplar 2

Water is denser as a liquid than it is as a solid, so when water in a body of water like a pond freezes, the ice floats to the surface. This layer of ice forms an insulating layer to help maintain the temperature of the denser water below for the organisms living in it so they don't freeze. A temperature too low would also stop enzymes working as it is too far from their optimum temperature, and enzymes are important in processes like respiration. Ice is less dense as it is a lattice so hydrogen bonds hold atoms further apart. **[3]**

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Turn over

This response gained 2 marks. The reference to organisms living in it is not sufficiently informative to gain either the 3rd or the 6th marking point. The response then mentions some information about the thermal properties of water, unrelated to density and finally explains the reason for ice's low density without relating this further to the survival of organisms.

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Question 17 (a) (i)

17 DNA can be obtained from a variety of plant and animal cells.

(a) A group of students tried to purify some DNA from leek cells using the following method. They decided that exact volumes were not necessary.

1. Grind a leek leaf to a fine pulp using a pestle and mortar.
2. Add salt and cold water and mix again for at least 10 s.
3. Add protease enzyme and mix again for at least 10 s.
4. Filter the liquid into a test tube and stand for at least 10 min.
5. Tilt the test tube and gently pour in ice-cold ethanol.
6. A white layer of DNA forms between the sample and the ethanol.
7. Extract the white layer carefully using a glass rod.

(i) State the purpose of step **1**.

.....

..... **[1]**

A number of candidates achieved this mark. Many discussed increasing surface area or breaking cell membranes or breaking open nuclei, which didn't score any marks.

Question 17 (a) (ii)

(ii) Suggest why a protease enzyme added in step **3** is needed to purify DNA.

.....

..... **[1]**

Mainly higher ability candidates gained a mark in this question. Most referred to non-specific proteins and some responses even referred to DNA as a protein, which were not credited.

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Question 17 (a) (iii)

(iii) The students considered using pineapple juice as a source of protease enzyme.

Suggest why this would **not** be an appropriate source of protease when attempting to produce a pure sample of leek DNA.

.....

..... **[1]**

Many candidates correctly made the link between pineapple juice and pineapple DNA. Responses that questioned the effectiveness of pineapple protease were not credited. Not were those that suggested pineapple juice would stain the DNA.

Question 17 (a) (iv)

(iv) State one important step that the students had left out of their method.

.....

..... **[1]**

A few candidates omitted this question, while many candidates suggested heating or safety precautions, which were not credited.

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Question 17 (b) (i)

(b) Genes isolated from DNA can be used in gene therapy.

Cystic fibrosis (CF) is a disease that could be treated using gene therapy.

Healthy individuals have a gene that codes for a channel protein, called CFTR, found in the plasma membrane of a variety of cells, including those lining the airways of the lungs.

People suffering from CF have two copies of a recessive allele and so their cells do not synthesise the correct channel protein.

The allele that codes for the functioning CFTR protein can be inserted into the DNA of CF sufferers. The cells can then synthesise the correct CFTR protein and function as normal.

(i) The treatment of cystic fibrosis is described as **somatic** gene therapy. Another type of gene therapy is known as **germ-line** gene therapy.

Complete the table below to show **three** differences between somatic gene therapy and germ-line gene therapy.

Somatic	Germ-line

[3]

Most candidates gained at least one mark but only a few scored full marks. References to inheritability, the type of cell involved, or the longevity of treatment were regularly credited but relatively few candidates discussed inserting genes or alleles. Many responses were not awarded marks because of lack of clarity, for example referring to the treatment 'affecting' the offspring rather than being passed on. A few candidates discussed legal and ethical issues and were not credited for this.

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Exemplar 3

Somatic	Germ-line
Legal in most countries	Illegal in most countries
Will only affect the patient and not offspring.	Will affect the cell and any offspring produced.
Will only alleviate symptoms	Can cure disease all together.

Exemplar 3 didn't score any marks. The first row addresses legal issues which are not covered by the mark scheme. The second row is vague about inheritances, merely stating that offspring are (or are not) 'affected' by the treatment. The third row hints at the idea of permanent and temporary but, again, is not explicit enough.

Question 17 (b) (ii)

(ii) Some attempts at gene therapy have resulted in changes to the functioning of other genes.

Explain how inserting a new gene into a chromosome could affect the functioning of other genes in that chromosome.

.....

.....

.....

..... **[2]**

This was a synoptic question about mutations and gene expression but only a few candidates scored any marks. Many candidates did not appear to appreciate the significance of 'in that chromosome'. A number of candidates discussed epistasis and a minority discussed aspects of meiosis, which were not credited.

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Question 17 (b) (iii)

(iii) CF occurs when individuals have two copies of a recessive allele.

Huntington's disease is a lethal disease caused by a dominant allele that codes for the protein huntingtin.

Suggest why gene therapy is unlikely to work as a treatment for Huntington's disease.

.....

..... **[1]**

This stretch and challenge question was answered correctly by very few high ability candidates. Most responses tended to reword the question without adding to the information given; for example, writing 'because the Huntington's disease allele is dominant'. Few candidates seemed to appreciate that alleles are dominant because they synthesize a particular protein and, in the case of Huntington's disease, huntingtin would continue to be synthesised even in the presence of a healthy allele.

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Question 18 (a)

18 The Lake District is the largest National Park in England, covering an area of 2362 km^2.

It contains a wide variety of species, some of which are under threat or endangered. The resident human population is 41 000. In 2016 the Lake District received 18.4 million tourists.

The proportion of Lake District land used for different purposes is shown in Fig. 18.

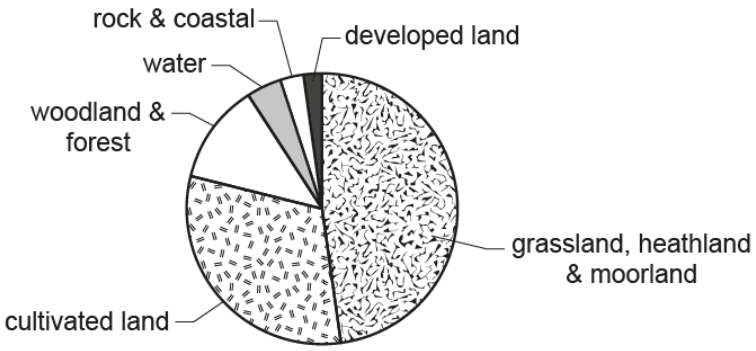


Fig. 18

(a) Explain **one** way in which tourists can lead to an increase in the biodiversity of an area.

.....

.....

.....

..... **[2]**

Many candidates achieved at least 1 mark here. Many candidates seemed to have forgotten the term 'ecotourism', but some appreciated that the money spent by tourists could be used on conservation. Others then went on to give a specific example of a project that could increase biodiversity. A minority of candidates argued that the increased urban development associated with tourism would lead to an increase in biodiversity because urban areas are more diverse than monoculture. Such responses were not given any credit.

?	**Misconception**	The most common misconception here was that candidates thought that the seeds/spores/bacteria, and even pets, brought by tourists would boost the biodiversity, or that their behaviour (e.g. trampling or dropping food) would change the ecosystem to benefit more organisms.

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Question 18 (b) (i)

(b) The Lake District contains large areas where timber is produced. One of the aims of the management of National Parks is to produce timber sustainably.

(i) Using Fig. 18, **estimate** the percentage of land that is covered by woodland and forest.

estimate = ... % **[1]**

A few candidates achieved this mark. Candidates who didn't achieve the mark did not appreciate the significance of the emboldened word 'estimate' and wrote an answer that was within the acceptable range but to 3 significant figures.

i	**OCR support**	The 'Maths for Biology' website offers support on how to estimate results: https://www.ocr.org.uk/subjects/biology/maths-for-biology/arithmetic-and-numerical-computation/

(ii) Timber can be produced economically by a technique called clear felling. Clear felling can damage biodiversity.

Explain how it is possible to produce timber sustainably using clear felling.

.....

.....

.....

.....

..... **[2]**

Question 18 (b) (ii)

Most candidates achieved at least one mark here. Even candidates who did not fully understand the concept of clear felling were able to offer reasonable suggestions such as replanting or limiting the size of the area that is felled. Many candidates stated 'allow trees to grow' without reference to being fully regrown before harvesting, so they couldn't be awarded marking point 4.

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Question 18 (b) (iii)

(iii)* A traditional timber-production process that is still used in parts of the Lake District is coppicing.

Describe the process of coppicing **and** explain the potential benefits of coppicing to the biodiversity of a woodland.

.....

.....

.....

.....

.....

..... **[6]**

Those who had a good understanding of coppicing and its benefits were able to move beyond Level 1 easily.

Responses that were limited to Level 1 tended to fall into two categories: Some had little idea of what coppicing was but they were able to describe some clear benefits for biodiversity of rotational felling. Others described the process well but did not clearly describe the benefit.

Responses in level two described clearly the processes involved in coppicing and at least one benefit to biodiversity that coppicing brings, usually in the form of increased light penetration to ground level. Many Level 2 responses also included information about economic benefits in terms of timber production.

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Exemplar 4

Coppicing is cutting a tree not fully, and leaving parts of it out of the ground, allowing them to regrow from the same roots, they need to cut it a little high, so animals including deers to not have access to them and eat them. As you cut the tree, as it is regrowing environmental factors and selection pressures allows them to adapt to the new situation, this means the tree is better adapted and this increases in biodiversity, or cutting old trees allows sun light to pass through to lower levels allowing more plants to grow of a new type, which increases the [6]

Additional answer space if required.

biodiversity, by allowing more plants to grow and reproduce

Towards the end, this response explains one clear benefit of coppicing with regard to light penetrating to ground level. However, the description of the process is weak, with the suggestion of some confusion about coppicing and pollarding, so the response is limited to Level 1.

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Exemplar 5

The process of coppicing is cutting tree stems close to the ground to promote the growth of many side shoots. Once the side shoots have grown they can then be harvested for timber whilst leaving the tree alive so that it regrows new branches that can be harvested again. The potential benefits of coppicing to the biodiversity of woodland is due to it being occuring on a rotational basis. One year a section of woodland may be harvested, however others are left to provide a habitat for different species living there. This ensures biodiversity is maintained. As trees aren't removed completely biodiversity overtime may increase as branched the trees provide good shelter and areas for birds to nest as well as food for insects. This could increase the number of species in the area and both species evenes and richnes which overall [6]

Additional answer space if required.

increases biodiversity

This response describes coppicing well together with one clear benefit of coppicing, habitat variety, achieving Level 2.

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Question 18 (c) (i)

(c) Many schools visit the Lake District to undertake Biology fieldwork.

A group of students investigated the biodiversity of five herb plants they found in adjacent coppiced and mature areas of woodland in the spring of 2016.

Their results are shown in Table 18.

	Number of individuals (n)	
Species	**Coppiced**	**Mature**
Bluebell	35	46
Dog's mercury	2	12
Foxglove	5	1
Herb robert	20	4
Wood sorrel	8	4
Total	70	67

Table 18

(i) The students calculated the Simpson's Index of Diversity (D) for the mature area to be 0.489.

Use the information in Table 18 to work out the Simpson's Index of Diversity (D) for the area of coppiced woodland.

Use the formula: $D = 1 - \left(\Sigma\left(\frac{n}{N}\right)^2\right)$

D = ... **[3]**

The majority of candidates achieved all three marks. Some marks were not awarded because of incorrect rounding or inappropriate use of significant figures. Some candidates missed out on working marks by not clearly showing their working in the space provided.

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Question 18 (c) (ii)

(ii) Use the example of the students' fieldwork to explain how biodiversity can be considered at different levels.

.....

.....

.....

.....

.....

..... **[3]**

Most candidates discussed species richness and species evenness and were able to access one mark. However, many candidates did not link these terms to the students' fieldwork as the question instructed them to do and so they missed out on a second mark. Others attempted to link species richness and evenness to the fieldwork but an obvious misunderstanding about the meanings of these terms often made this impossible – it was clear from many candidates' answers that they understood species richness to mean the number of individuals in a species. Only a few candidates referred to habitat diversity, although when they did they often gained two marks for referring to the example of coppiced and mature. Many candidates referred to genetic diversity but almost none of these pointed out that this was not addressed by the students.

Some candidates discussed vertical levels within woodland. None of these approaches achieved any credit.

?	**Misconception**	Despite the use of the word 'levels' in the specification many candidates had different interpretations of the word. Some thought that levels meant 'areas' e.g. coppiced and mature woodland; others, that it referred to classification, from kingdoms to species and individuals.

i	**OCR support**	OCR 'Delivery Guide' on Biodiversity: https://www.ocr.org.uk/qualifications/as-a-level-gce-biology-a-h020-h420-from-2015/delivery-guide/module-ba04-module-4-biodiversity-evolution-and-disease/delivery-guide-badg011-biodiversity-421

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Question 19 (a) (i)

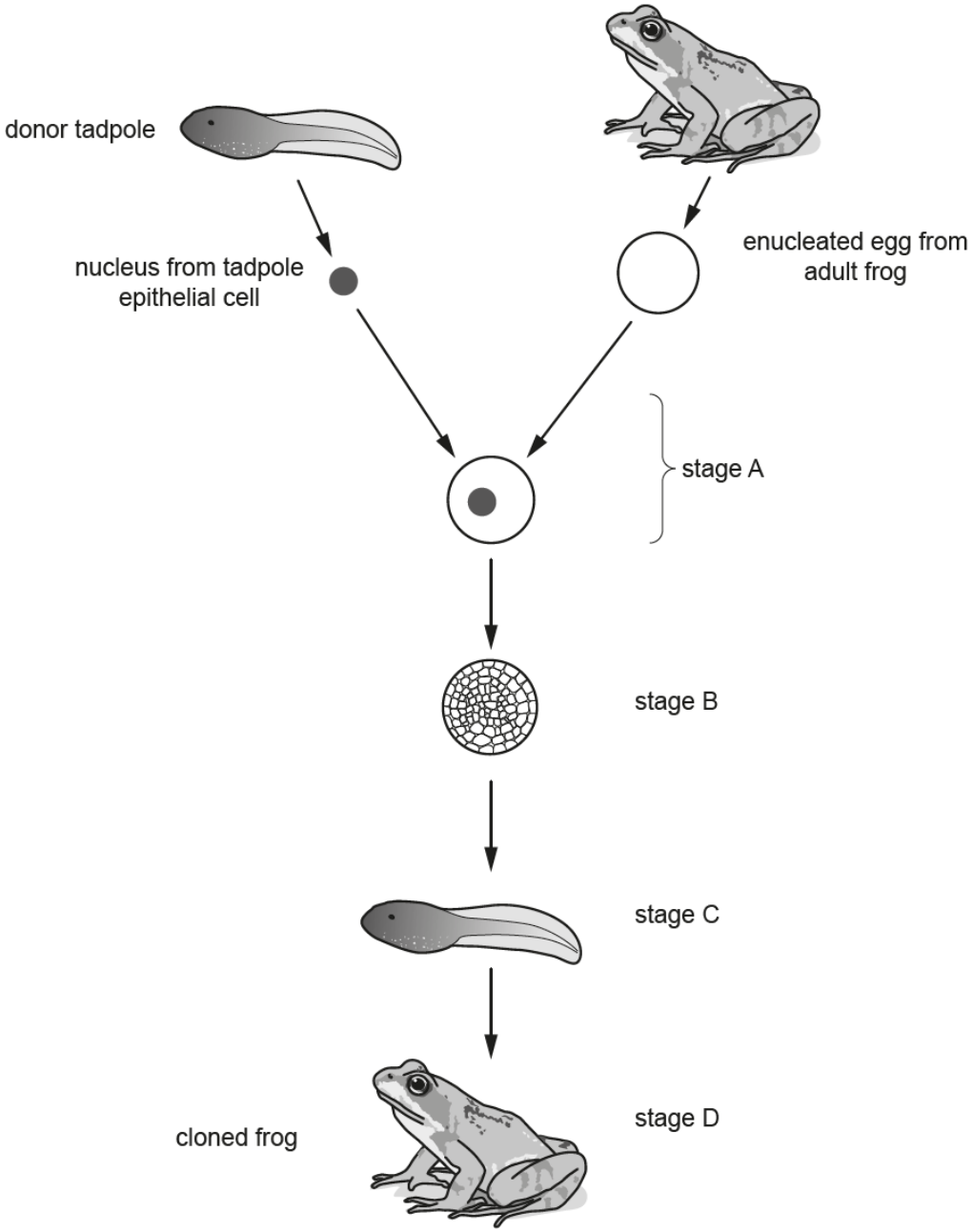
19 It is possible to clone animals using a technique called somatic cell nuclear transfer (SCNT).

The most well-known example of this was the cloning of Dolly the sheep in 1996.

(a) Thirty years before Dolly the sheep, successful cloning of an animal was carried out using a frog, *Xenopus laevis*.

Frogs lay eggs in water. These eggs then develop and hatch into swimming tadpoles. When the tadpoles grow to a certain size they develop into adult frogs.

The cloning process is outlined in Fig. 19.1.



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Fig. 19.1

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(i) Describe what is happening at stage A **and** suggest a practical procedure that could allow this to occur.

.....

.....

.....

..... **[2]**

Many candidates gave detailed answers that were specific to the process shown in the diagram, enabling them to gain full credit. The most common errors were failing to specify where the nucleus came from or not correctly identifying the practical procedure used. Electroporation was the most common incorrect response.

Question 19 (a) (ii)

(ii) Identify a key difference between the processes between stages A and C and the cloning of Dolly the sheep.

.....

..... **[1]**

Most candidates understood the process and realised that Dolly required a surrogate mother. However, many answers stated that the egg, zygote or nucleus would be implanted, rather than the embryo.

Question 19 (a) (iii)

(iii) The frog produced by the process in Fig. 19.1 is not a complete clone of the donor tadpole.

Suggest why the cloned frog might not be considered a complete clone of the donor tadpole.

.....

..... **[1]**

Only a few candidates scored the mark in this question. Some candidates mentioned genetic information from the egg cell but did not specify that it would have come from the mitochondria. Some responses mentioned mutations, but usually failed to state that these were random or spontaneous.

?	**Misconception**	A common incorrect response was to cite environmental differences showing a misconception about these causing genetic differences in the clone rather than influencing phenotype.

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Question 19 (b) (i)

(b) The success of SCNT has been investigated in many species.

Sheep are more closely related to mice than they are to *Xenopus* frogs.

Fig. 19.2 shows the percentage of SCNT procedures that were successful in mice and *Xenopus* when the donor nucleus was taken from cells at different stages of development.

- The *Xenopus* data were published in 1962.
- The mouse data were published in 1998.

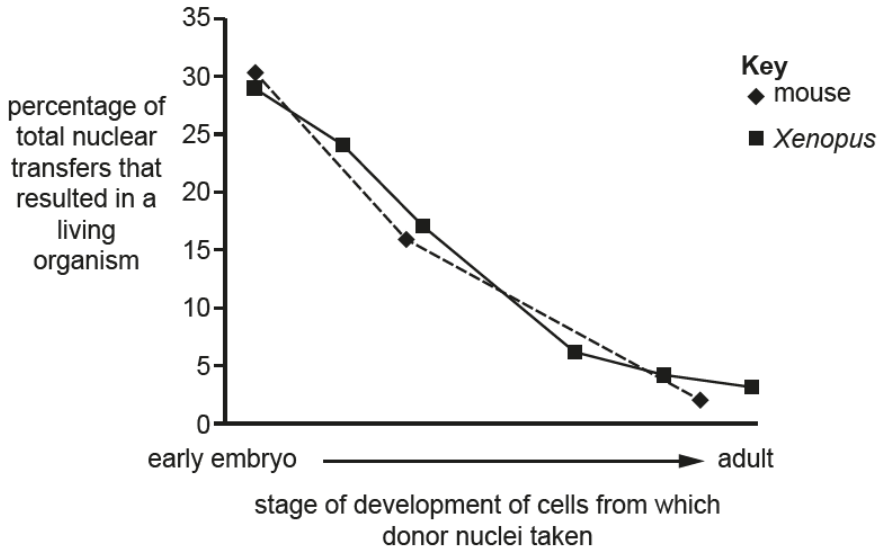


Fig. 19.2

(i) Suggest why the x-axis does not show the age of the donor nuclei.

.....

.....

.....

.....

..... **[2]**

Many candidates gained at least one mark here but only few gained two. Many described the non-importance of the 'age of the donor nuclei', implying that it could not be accurately determined or that all nuclei were the same age.

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Question 19 (b) (ii)

(ii) Dolly the sheep suffered health problems throughout her life and died at an early age.

The donor nucleus that was used to create Dolly came from a sheep that was already five years old. The normal lifespan of a domestic sheep is ten years.

A student concluded that Dolly's health problems were caused by the stage of development of the sheep that provided the donor nucleus.

List three reasons why the information in Fig. 19.2 does **not** support the student's conclusion.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

Many candidates achieved at least 1 mark. Marking points 1 and 3 were most commonly awarded with some candidates correctly describing other marking points. Critical thinking about the link between evidence and conclusions is an important AO3 skill that will be tested in GCE science examinations. Many answers quoted figures from the graph about the success of nuclear transfers in terms of live births which did not answer the question that was asked.

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Question 19 (c) (i)

(c) One measure of the success of cloning procedures is the number of pregnancies that result in live births.

Table 19 shows information from the work of many scientists about the success of SCNT in four different species.

Species	Number of pregnancies	Number of live births
Goat	26	8
Monkey	3	2
Mouse	438	56
Sheep	110	48

Table 19

(i) Calculate the percentage of pregnancies that resulted in live births in goats and mice.

live births in goats = ... %

live births in mice = ... %

[2]

Most candidates scored 2 marks in this question. The most common errors were incorrect rounding or giving answers with inappropriate numbers of significant figures.

i	**OCR support**	The 'Maths for Biology' website offers support on the correct use of significant figures: https://www.ocr.org.uk/subjects/biology/maths-for-biology/handling-data/

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Question 19 (c) (ii)

(ii) Compiling results from different scientists can have problems as their investigations may not have been controlled in the same way.

List **three** factors that should have been controlled when compiling the data to include in Table 19.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

Many candidates were able to score at least 1 mark here by identifying one or more factors relating to the surrogate mothers. A significant number of answers made vague references to 'animals', without clearly stating which animals they were discussing, surrogate, nucleus donor, egg donor or clone, so they were not credited at this level. Other common errors included references to the number of animals, the breed/species of animal and the method of nuclear transfer. Many candidates appeared to be using the word 'species' to refer to an individual animal.

1 The age of ~~the~~ ~~spec~~ each individual of species

2 Their diet as

3 Their health ~~of~~

[3]

Exemplar 6

The candidate might be thinking along the right lines. However, they have not stated precisely, or at all, which animals are being referred to.

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Question 20 (a) (i)

20 Plant cloning is often used by farmers to produce new plants.

A plant that is often cloned by taking cuttings is lavender, *Lavandula angustifolia*.

(a) A farmer had two fertiliser solutions, solution **A** and solution **B**, and wanted to investigate which one to use on lavender plants. In order to ensure the investigation would be valid, two cuttings were needed from the same parent plant.

(i) Describe how to clone a plant by taking a cutting.

.....

.....

.....

.....

.....

..... **[4]**

This was anAO1 question about Learning Outcome 6.2.1(a)(ii). A lot of candidates wrote about micropropagation, which is Learning Outcome 6.2.1(b)(i). Those candidates didn't score any marks Others who attempted to describe taking a cutting, were able to gain a mark for dipping the cutting in rooting powder. Most other marking points were seen regularly but very few mentioned choosing a healthy shoot in the first place.

i	**OCR support**	OCR 'Delivery Guide' on Cloning and biotechnology (6.2.1): https://www.ocr.org.uk/qualifications/as-a-level-gce-biology-a-h020-h420-from-2015/delivery-guide/module-ba06-module-6-genetics-evolution-and-ecosystems/delivery-guide-badg023-cloning-and-biotechnology-621

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Question 20 (a) (ii)

(ii)* The farmer grew one of the cuttings in soil fertilised with solution **A** and the other cutting in soil fertilised with solution **B**.

The farmer took several other precautions to increase the validity of the investigation, including:

- growing the plants in the same type of soil
- exposing the plants to the same light intensity.

After a set period of time the farmer measured the increase in height of the lavender plants. The farmer's results are shown in the table below.

Fertiliser solution	Increase in height (cm)
A	20.3
B	15.4

The farmer concluded that solution **A** increased the height of lavender more. A student said that, even though the investigation was **valid**, the results did not give strong support to the farmer's conclusion.

Describe **and** explain how the investigation could be improved in order to have more confidence in any conclusions drawn from the results.

.....

.....

.....

.....

.....

..... **[6]**

This level of response question could be answered well using very few of the available answer lines. However, many candidates filled the answer lines with irrelevant material and there was no logical line of reasoning in their answer. Hence, they didn't achieve the communication mark within a given level, particularly at Levels 2 and 3.

Most candidates were aware of the importance of replicates but few appreciated that, with an investigation such as this, replication can be achieved by increasing the number of individuals in each group. Few responses communicated this idea clearly, most simply stated 'do it 3 times', which, in the context of an investigation such as this, is not really an appropriate answer. Having mentioned repeats, most candidates mentioned calculating a mean and some were able to say that this would increase the accuracy of the mean. Many responses mentioned identifying anomalies. However, those who stated that anomalies could merely be omitted from a mean without much consideration were not highly credited. Responses that mentioned standard deviation or the use of statistical tests often gained higher level marks.

The question stated, in bold, that the investigation had been valid. This was meant to indicate to candidates that discussing improvements to validity would not be credited in this question. However, most candidates either did not appreciate the significance of this statement in the question or did not understand what 'valid' meant. Most responses were filled with discussion of how variables could be controlled.

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?	**Misconception**	There was a lot of misunderstanding here when using the statistical tests. It is worth noting that using Student's t-test allows us to assess the significance of a *difference* between two means, not whether the *results* are significant or not. Also standard deviation cannot, on its own, tell us if a difference is significant.

i	**OCR support**	Centres can find additional help with maths skills in the OCR Maths Skills Handbook, as well as the Mathematical skills statistics booklet: https://www.ocr.org.uk/Images/294471-biology-mathematical-skills-handbook.pdf https://www.ocr.org.uk/Images/338621-mathematical-skills-statistics-booklet.doc Appendix 4 of the Practical Skills Handbook, provides information on terms used in measurement and conventions for recording and processing experimental measurements. This is in line with the 'The Language of measurement' booklet: https://www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf

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Exemplar 7

Repeat the same investigation and calculate using cuttings from three different lavender plants and calculate the mean increase in height for fertiliser solutions A and B. * Include a control - take a cutting of a lavender plant and place it in soil that hasn't been fertilised at all; this will show weather whether the fertiliser solution actually does increase the height of the plants compared to no fertiliser solution at all.

* This increases the repeatability of the exp experiment which will increase the confidence in the conclusion.

Draw a graph of increase in height [6]

Also against fertiliser solution + add range bars. If range bars don't overlap then the farmer can be more confident in his conclusions. as there is a distinct difference between the heights of plants fertilised by A and B

Although there is a small amount discussion about validity in the middle, the majority of the answer is correct and relevant and, for the most part, well-expressed so the response achieves Level 2 and the communication mark is awarded. Had the candidate also discussed standard deviation or carrying out a statistical test, it would certainly have achieved Level 3.

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Question 20 (b)

(b) Cloning plants is also known as vegetative propagation.

Identify **three** advantages of vegetative propagation in agriculture.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

Only a few candidates scored marks in this question. Most discussed improvement to crops, which can be achieved by selective breeding or genetic engineering. With the exception of marking point 2, all points on the mark scheme were seen regularly. Most attempts at describing uniformity either did not link it to a desirable quality or merely described increasing the numbers of plants with a given quality. Commonly seen statements such as 'quick', 'cheap' or 'large numbers can be produced' without further qualification were not credited.

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Question 21 (a) (i)

21 Lipids are an important group of biological molecules.

(a) Lipoproteins are roughly-spherical structures that transport lipids in the blood.

Fig. 21 shows a simplified drawing of a section from the widest part of a lipoprotein.

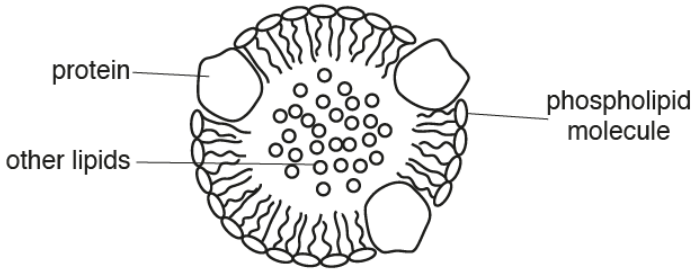


Fig. 21

(i) Calculate the number of phospholipid molecules in the outer surface of the lipoprotein shown in Fig. 21.

Assume that the pattern of proteins and phospholipids shown in Fig. 21 is continued across the whole surface of the lipoprotein.

Use the formula: Surface area of sphere = $4\pi r^2$

number of phospholipid molecules = ... **[2]**

Candidates found this question very challenging with only a few candidates arriving at the correct answers of 140 or 141. There were some very unrealistic answers (e.g. thousands or tens of thousands). Candidates should be encouraged to consider whether their numerical answer looks like it might be reasonable.

i	**OCR support**	There is a tutorial on estimating results on the 'Maths for Biology' website: https://www.ocr.org.uk/subjects/biology/maths-for-biology/arithmetic-and-numerical-computation/

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Question 21 (a) (ii)

(ii) Lipoproteins with fewer phospholipids and more protein in the outer layer are known as high density lipoproteins.

Lipoproteins with a larger number of phospholipids but less protein are known as low density lipoproteins.

Use this information to explain why lipids can increase the buoyancy of aquatic animals.

.....

.....

..... **[1]**

Only a few candidates were awarded a mark in this stretch and challenge question. Candidates were provided with some information from which they had to draw a conclusion about the relative densities of lipids and proteins. Most restated information provided in the question or speculated about the relative content of lipoproteins in aquatic animals.

Question 21 (b)

(b) Complete the passage by choosing the most appropriate word from the list.

bile carbon hydrogen insoluble

nitrogen oxygen permeability production solid soluble

stability storage vitamins

Lipids have many roles in living organisms. Some are used for energy ..... in adipose cells. Unsaturated fatty acids contain at least one double bond between two ..... atoms and so contain fewer ..... atoms. All lipids are ..... in water so need to be transported in the blood by lipoproteins. Cholesterol molecules increase the ..... of membranes, and cholesterol is also used to synthesise steroid hormones and ..... .

[6]

This was well answered with most candidates gaining all of the available marks. Few achieved less than 4 marks.

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Question 21 (c)

(c) Triglycerides are a type of lipid molecule that can be broken down during hydrolysis reactions.

Using the structure of triglyceride molecules as an example, explain what is meant by hydrolysis.

.....

.....

.....

.....

..... **[2]**

Most candidates gained a mark for using or adding water. Breaking 3 ester bonds was rarely seen, however, some candidates did achieve this point by mentioning ester bonds broken by the mention of 3 fatty acids or 3 water molecules. Several candidates used diagrams to support their answers, but these were often unlabelled. Candidates are encouraged to draw fully annotated diagrams in order to facilitate to better access the marking points. Reference to the meaning of 'lysis' was rarely seen or credited.

Common errors included misnaming the bonds, usually as glycosidic or phosphodiester, or saying that water was produced or hydrogen added.

Copyright information

Question 18

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Question 19 (c)

Adapted from 'Scientific and Medical Aspects of Human Reproductive Cloning', Table 1, p114, National Research Council, 2002. Reproduced by permission of National Academies Press.

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