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Examiners' report

A LEVEL

BIOLOGY A

OCR Level 3 Advanced GCE in Biology A

H420

For first teaching in 2023

H420/02 Summer 2025 series

Version 1

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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. A selection of candidate responses is also provided. 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 and the mark scheme can be downloaded from Teach Cambridge.

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Paper 2 series overview

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

Although there were some challenging questions, many candidates coped well with the topics and skills being assessed, although there were some gaps in their knowledge of some learning outcomes from Modules 4 and 6.

Overall, candidates tackled the multiple-choice section very well, with relatively few no responses or candidates resorting to hybrid letters.

In section B, there were some straightforward questions that candidates did not do well on because they did not read the command word correctly, such as in Questions 19 (a) (i) and 19 (a) (ii). Candidates who read the stem of the question thoroughly provided more successful responses to Questions 17 (d) (all parts), 18 (c) (iv) and 19 (b) (ii).

The proportion of questions requiring mathematical skills remained at about 10 percent, as in all A Level Biology papers. Many candidates coped well with Question 18 (c) (i), which required them to calculate a Simpson's index to two significant figures. Candidates most commonly did not get marks here for incorrect rounding as opposed to misapplication of the formula. Some candidates were then unsure of how to interpret a Simpson's index value. Some candidates did not successfully calculate the actual diameter of the cell in Question 16 (a) (ii); they seemed unsure of unit conversions. Generally, candidates were not that familiar with the components of the Hardy Weinberg equations in Question 20 (b) (i). They need to be reminded that, although they are given the formulae in the examination, they need to remember how to apply it.

The first Level of Response (LoR) question, Question 16 (c), was well done by some candidates and many could list at least two general roles of mitosis and apoptosis and give one relevant example, allowing them to reach Level 2. It was possible to get full marks on this question with a concise, well-structured response (see item-specific feedback later in the report).

The second LoR, Question 19 (c), was generally not answered well. Low-scoring (or zero-scoring) responses to this question tended to consist of irrelevant information, without referencing any of the main types of variation: continuous, discontinuous, intraspecific and interspecific. Responses that continue at length often struggle to retain the coherence and relevance required to achieve the upper mark within a level. The answer spaces provided in the question booklet are indicative of the suggested length of a response, so this should be considered by candidates. This question relates very much to specification points 4.2.2 (f), 6.1.2 (a) and 6.1.2 (d), so candidates should have covered these principles multiple times throughout the two year course. Centres are reminded that candidates should be encouraged to use the specification as one of their revision tools.

Frequently, typed responses to Questions 16 (c) and 19 (c) exceeded one side of A4, which is too long. Typists should use the exam paper as a guide to how much to write for each part question throughout the paper and should make sure their typed responses are in the correct order, do not contradict their written responses in the exam paper and are correctly labelled. Frequently, the question number is typed incorrectly, which has the potential to lead to clerical errors.

Centres should remind candidates that if answers exceed the given space, that they should continue their response in the extra pages provided at the back of the booklet. This makes sure that their extra writing will be seen by examiners.

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Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• read and annotated the questions carefully before beginning their answer • paid attention to the command words, which was evident where candidates had used a highlighter to make the command word stand out • used any extra information given when compiling their answer • recalled and used precise key terms correctly • structured LoR responses using bullet points.	• did not read the stem of the question carefully • did not pay attention to the command words • used general rather than precise terms • could not link together their knowledge in Module 4 and Module 6.

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Section A overview

On the whole, candidates did well on these questions. Most attempted all questions with very few leaving any multiple-choice answer boxes blank. Very few candidates got all questions correct. Many candidates annotated their scripts with ticks and crosses against each multiple-choice option to show their thought processes. Although not essential to get the marks, this is an approach that should be further encouraged by centres, particularly when questions are phrased in the negative voice, e.g. Questions 3, 4, 10 and 11.

When candidates change their mind about an answer, they should cross out their answer and write it next to the box.

Question 1

1 Hydrogen bonds are important for the physical and chemical properties of water.

How do hydrogen bonds form in water?

A Electronegative (δ^-) oxygen atoms are attracted to the electropositive (δ^+) hydrogen atoms of adjacent water molecules.

B Electronegative (δ^-) oxygen atoms are attracted to the electropositive (δ^+) hydrogen atoms within the same water molecule.

C Electropositive (δ^+) oxygen atoms are attracted to the electronegative (δ^-) hydrogen atoms of adjacent water molecules.

D Electropositive (δ^+) oxygen atoms are attracted to the electronegative (δ^-) hydrogen atoms within the same water molecule.

Your answer ☐ **[1]**

Many candidates identified how hydrogen bonds form in water. The most common incorrect answer was B.

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Question 2

2 Water has many properties that are important for living organisms.

Which property of water molecules explains why small animals, such as pond skaters, are able to move over the surface of water without sinking?

A Adhesion

B Buoyancy

C Cohesion

D Density

Your answer ☐ **[1]**

This question caused more difficulty for candidates, with a fairly even spread of incorrect answers. Some candidates recognised that animals are able to move over the water surface because of cohesion. Some candidates confused cohesion with adhesion.

Misconception

? Candidates confused cohesion with adhesion, leading to incorrect explanations of how small animals move on water.

Question 3

3 What is a **disadvantage** of using microorganisms to make food for human consumption?

A Competition from contaminating microorganisms can reduce yield.

B Food produced by microorganisms is low in fat.

C Microorganisms can be grown on waste materials.

D Use of microorganisms for food production raises fewer ethical concerns than use of animals.

Your answer ☐ **[1]**

Most candidates recognised that potential contamination from competing microorganisms is a disadvantage of using microorganisms in food production.

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Question 4

4 Culturing microorganisms on nutrient agar requires aseptic techniques.

What is **not** part of a standard aseptic procedure when culturing microorganisms?

A Disinfect the work area before starting.

B Ensure equipment does not touch any unsterilised surfaces before use.

C Pass the agar plate through a Bunsen flame before use.

D Work near a Bunsen flame.

Your answer ☐ **[1]**

Most candidates understood that passing an agar plate through a flame is not part of aseptic procedure.

A suggested approach for a question phrased in the negative voice, is to write **IS** next to the options that are part of aseptic procedure, as a way of narrowing down potentially correct answers.

Assessment for learning

A suggested approach for a question phrased in the negative voice, is to write IS next to the options that are correct.

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Question 5

5 Batch fermentation with microorganisms is used to produce a range of useful substances.

Which of the following are important for achieving maximum yield during a batch fermentation process?

1. Temperature should be maintained close to the optimum.
2. Temperature should be low to reduce costs.
3. Substrate should be constantly added to maintain a high concentration.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

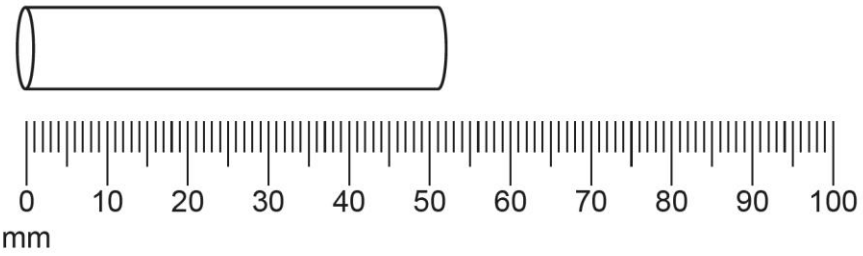
Candidates generally knew that the maintenance of an optimum temperature is important for achieving maximum yield during batch fermentation.

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Question 6

6 Some students are conducting an osmosis investigation using cylinders of potato.

They cut cylinders of potato 50 mm long using the ruler shown in the diagram.



What is the percentage uncertainty in the length of the potato cylinders?

A 0.25%

B 0.5%

C 1%

D 2%

Your answer ☐ **[1]**

The answers to this question varied, with less than half of candidates getting the mark. Some candidates chose 0.5 percent, presumably confusing percentage uncertainty with absolute uncertainty. Some candidates selected 1 percent rather than 2 percent, forgetting to double the absolute uncertainty to account for the measurements at either end of the potato.

The candidates that correctly answered this question showed their working next to the question.

Calculation:

Percentage uncertainty = ((2 x absolute uncertainty) / quantity measured) x 100

Absolute uncertainty = half the resolution of the instrument. Resolution is 1mm, therefore the absolute uncertainty is ½ = 0.5 mm

Percentage uncertainty = ((2 x 0.5) / 50) x 100

Percentage uncertainty = 2 %

OCR support

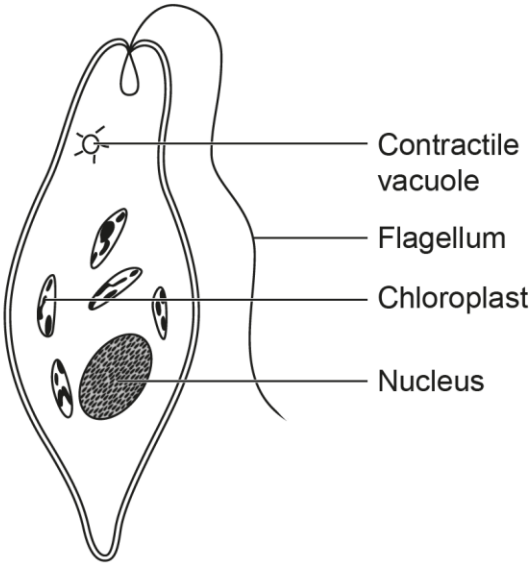
Language of measurement resource discusses the difference between uncertainty and absolute uncertainty.

Maths for biology resources can also be used to support with tutorial and quizzes.

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Question 7

7 The image shows an organism called *Euglena gracilis*.



Which kingdom does *Euglena* belong to?

A Animalia

B Plantae

C Prokaryotae

D Protoctista

Your answer ☐ **[1]**

Few candidates recognised the *Euglena* cell as Protoctista. Some chose Plantae, presumably not appreciating the lack of unicellular plant species or that plants do not generally have flagella or contractile (but rather, permanent) vacuoles. Some chose Prokaryotae, presumably seeing that it was a unicellular organism but ignoring the presence of membrane-bound organelles.

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Question 8

8 Plants can be cloned by taking cuttings.

New cuttings often experience water stress during the first few weeks.

Which of these practical procedures are used to reduce water stress?

1. Cover cutting with a plastic bag.
2. Remove leaves from cutting.
3. Rooting powder applied to cutting.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

Most candidates did not realise that covering cuttings, removing leaves and applying rooting powder can all reduce water stress. The common error was to think that rooting powder would have no influence, and therefore the most common incorrect answer was B.

Question 9

9 Mutations during DNA replication can involve a single nucleotide base being deleted from the genetic code.

Which term describes this mutation?

A Frameshift mutation

B Insertion

C Silent mutation

D Substitution

Your answer ☐ **[1]**

Most candidates recognised a description of a frameshift mutation.

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Question 10

10 The use of genetically modified (GM) crops in agriculture raises certain concerns.

What is **not** a valid concern about the use of GM crops in agriculture?

A Eating modified genes is harmful to consumers.

B Modified genes might spread to wild populations.

C Patenting of GM crops by large companies might disadvantage independent producers in developing countries.

D Pests might evolve resistance to pesticides contained in GM crops.

Your answer ☐ **[1]**

Many candidates knew that harm to consumers is no longer a legitimate concern when producing GM crops. Option B was the most commonly selected distractor.

Question 11

11 Which statement about DNA sequencing is **not** correct?

A High-throughput sequencing allows DNA to be sequenced quickly.

B Nucleotides are added to a growing strand by a polymerase enzyme.

C Sanger sequencing was the original method used for DNA sequencing.

D The sequence of amino acids in DNA samples is determined.

Your answer ☐ **[1]**

This question required close reading of the options to realise that 'amino acids in DNA' was incorrect. Only some candidates got this mark.

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Question 12

12 Artificial selection and natural selection are similar processes.

Which option describes only natural selection?

A Alleles are passed on to the next generation.

B Certain alleles become more frequent in the population.

C Phenotypic variation in the population can be reduced.

D Reproductive success is determined by a range of environmental factors.

Your answer ☐ **[1]**

Most candidates knew that natural selection, but not artificial selection, involves reproductive success being determined by a range of environmental factors.

Question 13

13 Reproduction can be sexual or asexual.

What is an advantage of sexual reproduction?

A Advantageous features are preserved between generations.

B Genetic variation is increased.

C Offspring are genetically identical to parents.

D The risk of mutation is reduced.

Your answer ☐ **[1]**

Almost all candidates understood that an increase in genetic variation is an advantage of sexual reproduction.

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Question 14

14 Land can be used for producing food for human populations.

A 50 m^2 field can support a larger human population if used for growing crops for plant-based foods than if it was used for grazing animals, such as cows, for meat production.

Which option explains why the same field supports a larger human population if plant crops are grown?

A Biomass is lost between trophic levels in a food chain.

B Less energy is lost during respiration when humans eat plant-based foods.

C Plant-based foods are more easily digested than meat.

D The risk of heart disease is likely to be lower if humans eat plant-based foods rather than meat.

Your answer ☐ **[1]**

Most candidates understood that growing crops rather than farming animals can support a larger human population because of biomass loss between trophic levels or energy release from respiration.

We accepted B as an alternative correct answer as candidates may have interpreted that respiratory losses in plants may be smaller as they are lower in the food chain, rather than thinking about respiration as a cellular process. Fewer trophic levels prior to consumption means less energy loss.

Question 15

15 Ecosystems can provide resources in a sustainable way.

Which option describes the meaning of **sustainable** in the above sentence?

A Cost-effective use of a resource by humans.

B Managing a resource so biodiversity is maintained.

C Preventing human access to a resource so that it remains at its current level.

D Use of a resource in such a way that it will not run out.

Your answer ☐ **[1]**

Most candidates knew the meaning of the word 'sustainable'. The most common incorrect answer was B.

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Section B overview

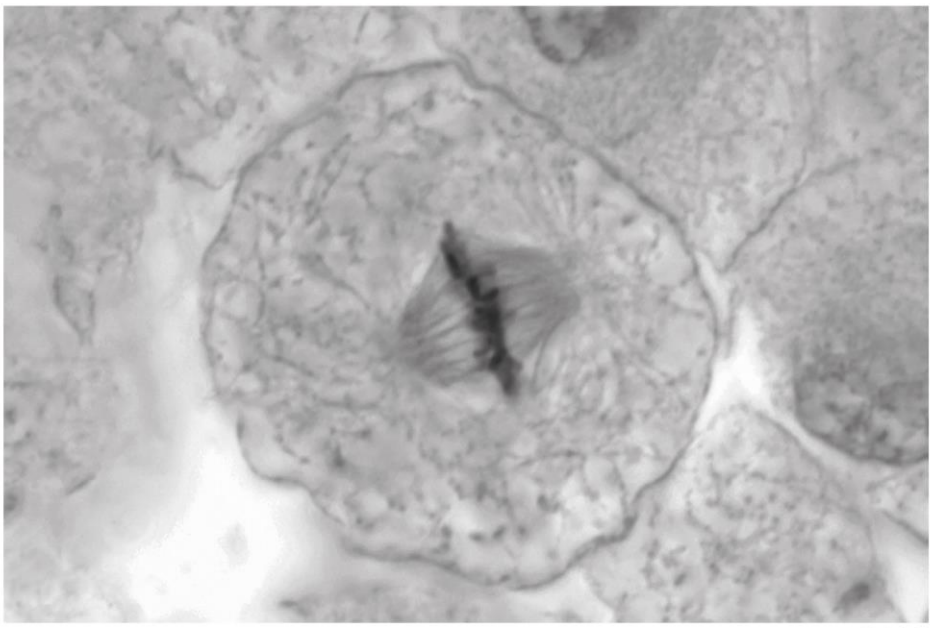
Most candidates were able to display a good understanding of microscopy, mitosis, apoptosis, conservation and molecular evidence for evolution.

There were some clear gaps in knowledge and understanding relating to autosomal linkage, epistasis, fossil evidence for evolution and variation.

Question 16 (a) (i)

16 Microscopy can be used to examine the structure of stem cells.

(a) The image shows a stem cell from a fish embryo viewed under a light microscope.



×2000

(i) Identify **two** pieces of evidence that suggest that the image was produced by a light microscope rather than a scanning electron microscope.

1 .....

.....

2 .....

.....

[2]

Many candidates wrote about the magnification as being evidence for the image being produced by a light microscope. However, electron microscopes can produce images at x2000, which means this is not evidence that can exclude the scanning electron microscope. Most candidates were still able to get at least 1 mark, with many getting 2 marks, usually by stating low resolution and 2D image.

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Question 16 (a) (ii)

(ii) Calculate the horizontal diameter of the cell shown in the image.

Give your answer in μm.

Diameter = ... μm **[2]**

Many candidates did not divide their ruler measurement by the magnification given. Only some candidates got 2 marks on this low demand question. Common areas of difficulty involved conversions from millimetres (mm) to micrometres (μm). It is advised that candidates measure images in mm rather than cm, as this is an easier conversion.

Calculation:

Actual diameter = image diameter / magnification

Image diameter = 66 – 68 mm (a range was accepted as correct)

Actual diameter = 68mm / 2000 = 0.034 mm

Convert to μm = 0.034 mm x 1000 = 34 μm

OCR support

The Mathematical Skills handbook is available here and includes guidance on the maths skill M0.1 Recognise and make use of appropriate units in calculations.

Maths for biology resources also offer tutorial and quizzes for every maths skill assessed in Biology.

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Question 16 (a) (iii)

(iii) Explain why staining is useful in microscopy.

Use structures visible in the image to support your answer.

.....

.....

.....

.....

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

Relatively few candidates mentioned 'contrast'. Most got at least 1 mark by recognising one of the structures in the image that is made visible by staining. Candidates should note that the question asks for 'structures visible in the image'. A nucleus is not visible as the cell is undergoing mitosis. Some candidates confused the cell surface membrane for the cell wall.

Question 16 (b) (i)

(b)

(i) State **two** features of stem cells, **not** visible under the microscope, that distinguish them from specialised cells.

1 .....

.....

2 .....

.....

[2]

Most candidates recalled that stem cells are undifferentiated. Fewer stated that they can carry out mitosis or that they can be multipotent, pluripotent, or totipotent. Some candidates were confused and stated names of organelles that could be present in or absent from stem cells, even though the question stated 'not visible under the microscope'.

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Question 16 (b) (ii)

(ii) Stem cells have a number of uses in medicine.

Explain why stem cells are useful tools in medical research.

.....

.....

.....

.....

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

Most candidates got at least 1 mark, usually by outlining the use of stem cells to test drugs or grow tissues. Some candidates did not focus of the 'research' aspect of the question and went down the wrong route, describing transplants. Very few candidates referred to their use in studying disease or embryo development.

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Question 16 (c)*

(c)* The development of body form begins in embryonic stem cells.

Using examples, explain the importance of mitosis **and** apoptosis as mechanisms controlling the development of body form.

.....

.....

.....

.....

.....

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

Most candidates seemed to understand the processes of mitosis and apoptosis and were able to relate the processes to the development of body form. Common irrelevant or incorrect descriptions included mentions of 'cell growth' and/or extraneous details of the cell cycle. Some detailed descriptions of the two processes could not access higher levels because no clear examples were included. Many also clearly understood the role of homeotic genes in the control of both processes and many provided excellent accounts of the process of apoptosis, culminating in phagocytosis. Candidates were mostly aware of the example of digit separation as a role of apoptosis, and most understood that mitosis provides the initial structure of hands and limbs.

Assessment for learning

In Level of Response (LoR) questions that cover two or more areas, such as mitosis, apoptosis and examples of how they are involved in development of body form, each section should be clearly addressed.

Subheadings or tables are a good approach to these questions, as it clearly shows the distinction between the processes, but also allows candidates to link them together, for example, by referring to both processes being controlled by homeotic genes.

Candidates should know that it is acceptable to use bullet points in writing their responses. We are not assessing their ability to write in prose, but rather to communicate relevant and correct information.

OCR support

The guide to LoR questions supports candidates by providing guidance on how to tackle them with confidence.

It is available on the Teach Cambridge hub.

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Exemplar 1

The development of body form is controlled by homeobox genes which trigger mitosis and apoptosis in certain areas of the body by expressing genes in a specific order to create a body plan.

Mitosis is division of the nucleus and allows growth of an organism by cell division to increase number of cells to form a whole organism (pluripotent, totipotent.)

This helps form an embryo during pregnancy and ensures cells are genetically identical.

Apoptosis is programmed cell death and can be used to help seperate digits in fingers by killing cells between digits.

These help form a body plan and orientation of head and tail of an organism and body limbs.

This is an excellent response, as it shows that it is possible to be concise (writing in bullet points) while still getting 6 marks.

The candidate referred to both processes being controlled by homeobox genes.

For mitosis specifically, they referred to growth of an organism.

For apoptosis specifically, they referred to programmed cell death.

For examples, they have both digit formation and orientation of head and tail and body limbs.

Question 17 (a)

17 Animals can undergo natural and artificial cloning.

(a) Human identical twins are an example of natural animal clones.

Suggest why human identical twins do not look exactly identical.

.....

.....

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

This was generally well-answered with most candidates getting a mark. Successful answers had a combination of stating 'environment' and giving examples such as diet.

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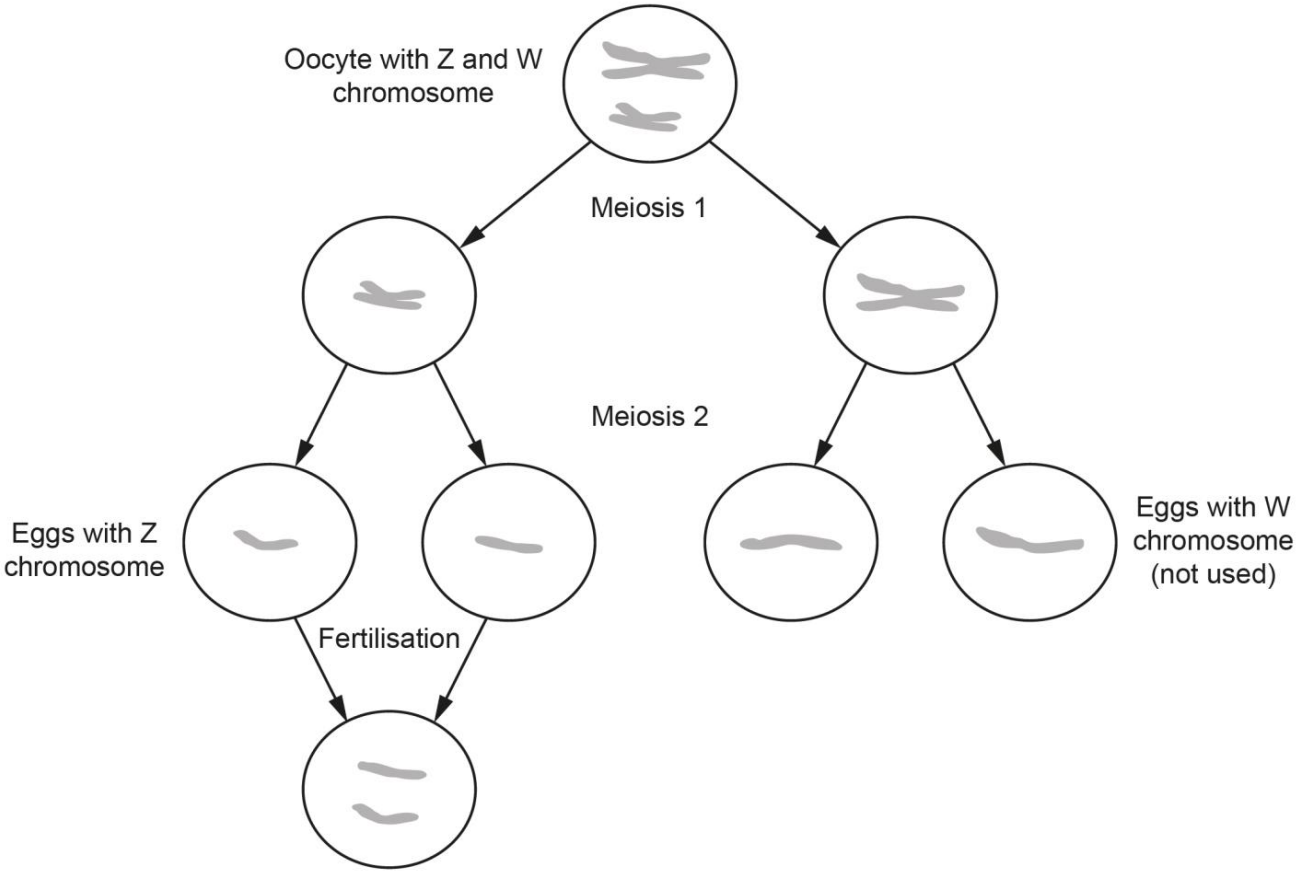
Question 17 (b) (i)

(b) Komodo dragons are large lizards.

Male Komodo dragons have two Z chromosomes. Female Komodo dragons have one Z chromosome and one W chromosome.

A reproductively isolated female Komodo dragon can reproduce without a male using a process called parthenogenesis. All of the offspring are males.

This process is outlined in the diagram.



(i) The offspring are not the same sex as the parent.

Identify **two other** reasons why parthenogenesis in Komodo dragons is not an example of cloning.

1 .....

.....

2 .....

.....

[2]

Most candidates were able to recognise that the provided diagram showed meiosis (often described as crossing over or independent assortment) and that is the reason for parthenogenesis in Komodo dragons not being an example of cloning. Fewer candidates mentioned fertilisation. It was rare to see MP3 expressed in sufficient detail for it to gain credit (often there was a lack of reference to alleles or genes form the W chromosome).

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Question 17 (b) (ii)

(ii) Suggest why female mammals cannot produce male offspring by parthenogenesis.

.....

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

Many candidates stated that female mammals have two X chromosomes. A few candidates did not read 'mammals' in the question and wrote about W and Z chromosomes.

Question 17 (c) (i)

(c) Animals can be cloned artificially using embryo splitting.

This is the procedure for cloning by embryo splitting:

1. An egg from a female is fertilised by sperm from a male.
2. The zygote divides to form an embryo.
3. After a few days, the developing embryo is split into several smaller embryos.
4. After a few days, each smaller embryo is implanted into a surrogate mother.
5. Each embryo grows into a fetus and is born normally.

(i) State the property of the cells in the embryo that allows cloning to be successful.

.....

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

More successful candidates secured the mark for a single word answer. Other responses either identified the wrong potency or did not refer to <u>type</u> in their description.

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Question 17 (c) (ii)

(ii) Embryos from stage 3 above are sometimes frozen for later use.

State **one** advantage to agriculture of freezing embryos from stage 3.

.....

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

Answers to this question were wide ranging, and candidates found it challenging. Correct answers usually included reference to producing more animals when they were needed or when conditions are suitable. The most common answer referenced the idea of maintaining desired characteristics. Many did not appreciate the agricultural context of the question, though, and saw the frozen embryos as a solution to any species on the verge of extinction.

Question 17 (d) (i)

(d) Animals can be cloned artificially using a technique called somatic cell nuclear transfer (SCNT).

SCNT can be used to increase the population of an endangered species.

Przewalski's horse, *Equus przewalskii*, is a species of horse related to the domestic horse, *Equus caballus*. The common ancestor of both horse species is thought to have lived 45 000 years ago.

Przewalski's horse became extinct in the wild in the 1960s. Captive breeding from 12 individuals has increased the population and some have since been reintroduced to the wild.

The genetic diversity of all modern Przewalski's horses is very low.

In 2020 and 2022, SCNT using frozen cells from an individual that died 42 years previously has led to the birth of two cloned Przewalski's horses which appear to be free of health problems.

(i) Outline how genetic diversity in a species such as Przewalski's horse can be measured.

.....

.....

.....

.....

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

Relatively few of the candidates got both marks. Some candidates had learned the formula for genetic diversity and applied it to this question, getting 2 marks. Some mentioned polymorphic but omitted some key words, such as 'proportion' or 'number'.

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Assessment for learning



Sometimes, the answers to questions can be found in the specification.

This is an equation that candidates are expected to learn (please see pages 69 and 70 of the OCR H420 specification for a full list of these).

When revising, candidates could have a list of the specification points and could retrieve everything they can remember about each point from memory. Then use their notes, textbooks and past examination questions to review their answers.

Question 17 (d) (ii)

(ii) State why SCNT is more useful than embryo splitting when increasing the population of endangered species.

.....

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

Few candidates were given this mark, often writing answers about 'efficiency' or 'success rate' or 'speed' rather than the idea of a known outcome (or the use of one individual) or only one individual being needed.

Question 17 (d) (iii)

(iii) Suggest **one** reason why the health of the cloned Przewalski's horses is better than that of Dolly the sheep, the first mammal to be cloned by SCNT.

.....

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

Most candidates got this correct for mentioning developments/improvements in process/technique/knowledge. Fewer got the mark for the idea that DNA originated from a younger cell.

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Question 18 (a) (i)

18 Sampling is an important technique for assessing biodiversity.

(a) Sampling is used to measure the abundance of organisms in habitats.

(i) State why sampling is necessary when measuring the abundance of organisms in a habitat.

.....

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

A few candidates thought they needed to estimate the number of species or wrote about the sampling's benefits rather than necessity.

Question 18 (a) (ii)

(ii) Explain why it is important that sampling is random.

.....

.....

.....

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

The word 'bias(ed)' appeared to be well taught; many responses achieved MP2 or MP3.

Use of words such as repeatable, reproducible, valid, accurate, needs to be emphasised further by centres. 'Reliable' is not an acceptable term according to the language of measurement.

OCR support

The language of measurement resource provides guidance on how the above terms should be used within a practical activity related to experimental design and evaluation.

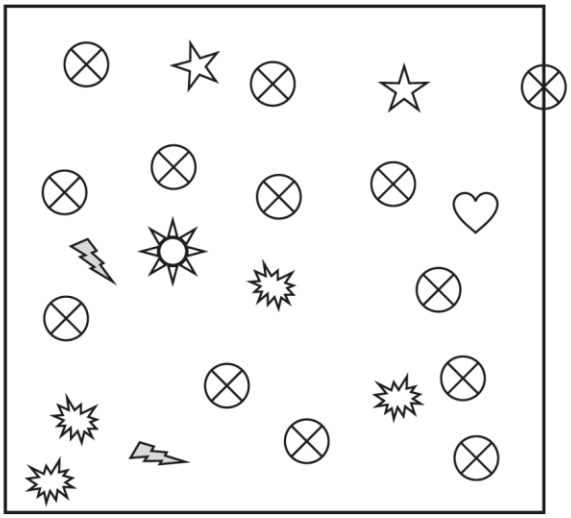
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Question 18 (b) (i)

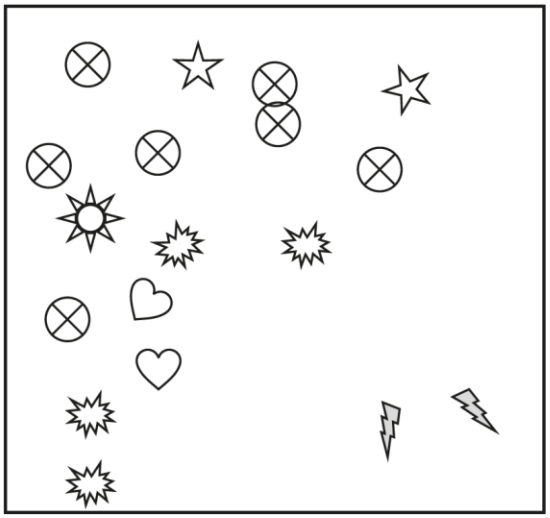
(b) Quadrat sampling is a useful tool for measuring the abundance and distribution of plant species.

A student sampled plants on an area of sports field. Observations recorded by the student for two of the quadrats are shown in the image below. The symbols represent different plant species.

Quadrat A



Quadrat B



(i) State the species richness in quadrat **A**.

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

Most candidates got this mark. The most common mistake was counting the number of individual organisms. Some didn't realise that the answer needed to be a number, and offered adjectives, such as 'high'.

Question 18 (b) (ii)

(ii) Compare the species evenness in quadrats **A** and **B**.

.....

.....

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

Few candidates got this mark by offering a comparison and an explanation. It is important to note that marks are never given for binary choices.

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Question 18 (c) (i)

(c) Some students investigate the biodiversity of flying insect species in different parts of their school grounds.

The school has an area of wildflower meadow and some planted flower beds.

This is the method they use:

1. Select an area of wildflower meadow.
2. Pass a sweep net back and forward 5 times.
3. Shake the net into a tray and close with a transparent lid.
4. Use a key to identify the types of insect.
5. Release insects.
6. Repeat the procedure 9 times in different areas of the wildflower meadow.
7. On the same day, repeat steps 1 to 6 for the planted flower beds.

Their results for the wildflower meadow are shown in the table below.

Category	**Number of individuals**		
Bumblebees	15		
Other bees	32		
Ladybirds	2		
Other beetles	5		
Painted lady butterfly	2		
Red admiral butterfly	3		
Other butterflies	5		
Wasps	25		
Flies	11		
Total			

(i) Calculate the Simpson's Index of Diversity for the wildflower meadow.

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

You may use the table above for working out.

Give your answer to **2** significant figures.

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

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This question was generally well-answered, but candidates who did not get full marks usually rounded intermediate values. Centres should encourage candidates to use the whole values and only round at the end.

OCR support

The OCR Maths skills handbook provides guidance on common rounding errors, on page 17.

Question 18 (c) (ii)

(ii) Explain the significance of the value for *D* calculated in part **(i)**.

.....

.....

.....

.....

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

Very few candidates got 2 marks for this question, as they did not 'explain', which the question demanded.

Many candidates were given 0 marks as they gave a general description of how to interpret a Simpson's index value, rather than using their answer to part (i) to explain the significance in **this** meadow.

Question 18 (c) (iii)

(iii) Describe how the students should select their sampling areas for steps **1** and **6**.

.....

.....

.....

.....

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

This was generally well-answered with most candidates getting 1 or 2 marks.

This is random sampling, which is referenced earlier in the question stem, so any reference to systematic or stratified sampling meant that MP1 could not be given.

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Misconception

There appears to be a common misconception surrounding the different types of sampling techniques used in ecological fieldwork. These include random, systematic, and stratified, among others. Understanding when and why each method is used is key to developing good fieldwork practice.

The Field Studies Council (FSC) provides clear and accessible explanations of these sampling methods.

Question 18 (c) (iv)

(iv) Suggest **two** improvements that the students could make to step **2** of their method. For each improvement explain how that would increase the validity of the results.

Improvement 1 .....

.....

Explanation 1 .....

.....

Improvement 2 .....

.....

Explanation 2 .....

.....

[4]

Only a few candidates were given 3 or 4 marks. Many candidates got no marks.

Use of sweep nets is part of 4.2.1 (b) in the specification, so this is a teaching point that needs greater emphasis. For future preparations, this question will be a good discussion point in lessons, while also focusing on key experimental language of measurement.

OCR support

The language of measurement resource provides guidance how key terms should be used within a practical activity related to experimental design and evaluation.

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Question 18 (c) (v)

(v) Suggest and explain **one** limitation with step **7** of the students' method.

.....

.....

.....

.....

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

This question was generally answered well; however, there were some candidates who got no marks.

Responses that referenced different times of day/different seasons with a simple explanation were able to get 2 marks with ease.

Question 18 (c) (vi)

(vi) Identify **one** problem with the way in which the students categorised their flying insect species that could reduce confidence in the calculated value for Simpson's Index of Diversity.

.....

.....

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

Most candidates referenced 'species' rather than 'type'. Most candidates got this mark.

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Question 19 (a) (i)

19 The Farne Islands are a group of small islands off the coast of Northern England.

The Farne Islands are a National Nature Reserve and Site of Special Scientific Interest. They are home to many species of bird, including arctic terns, guillemots, cormorants, shags, eider ducks, razorbills, and a variety of gulls. Particularly popular with the public are puffins. Considered by some to be a keystone species, puffins are small birds with large colourful beaks that fly very close to the surface of the sea. They come to the islands only to breed, nesting in underground burrows.

Local tour operators transport large numbers of visitors to the islands each year but no visitors are allowed on the islands during the winter to allow conservation work to be carried out. Such work includes repairing boardwalks and fences, tagging individual birds, and counting how many puffin burrows have been in use.

In 2023, an outbreak of bird flu caused a drop in the numbers of many species, including puffins, and visitors were banned from the islands. Local tour operators reported a drop in income.

(a)
(i) Identify evidence from the information above that supports each of the following claims:

Puffins are important for aesthetic reasons .....

.....

Puffins are important for ecological reasons .....

.....

Puffins are important for economic reasons .....

.....

[3]

As an introduction to Question 19, candidates were given a passage about the Farne Islands which are a National Nature Reserve. This meant that all part questions in Question 19 would refer back to this introduction and would help to inform candidate responses, but not all candidates used the information in the passage throughout Question 19.

Candidates were generally successful at picking out the evidence from the passage to support the claims that puffins are important for aesthetic, ecological and economic reasons. For aesthetic reasons, the most common response was that they had large colourful beaks. Some candidates were not sure of an ecological reason and there were a variety of responses for this one. Most candidates were confident that economic linked to tourism, but some gave general statements about tourism or ecotourism without linking back to the evidence in the passage about tour operators.

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Question 19 (a) (ii)

(ii) The Farne Islands can be seen as an environmental resource that is affected by human activities.

Identify **one** example of conservation that is necessary as a direct result of human activities.

.....

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

Candidates were directed to identify one example of conservation on the Farne Islands, but many candidates gave unrelated examples of conservation instead of focusing in on the information regarding the repair of boardwalks and fences. Few candidates did use the passage and the banning of visitors, but this would be an example of preservation and not conservation.

Question 19 (a) (iii)

(iii) There are no mammalian predators, such as rats and stoats, on the Farne Islands. Mammalian predators eat birds and their eggs.

Part of the conservation work involves ensuring that the islands remain free of these mammalian predators.

Suggest how human activity could be responsible for the arrival of these predators.

.....

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

Many candidates think that if litter was dropped, rats would come, despite being told there were none on the islands. Candidates should be reminded that it is essential to read the question carefully.

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Question 19 (a) (iv)

(iv) There are two types of conservation: *in situ* and *ex situ*.

State the type of conservation taking place on the Farne Islands and give a reason for your choice.

Type .....

Reason .....

.....

[1]

Most candidates selected *in-situ* conservation, but a few did choose *ex-situ*. Most candidates were specific that *in-situ* conservation required the species to remain in their natural habitat or that they would not be removed from their natural habitat or environment. However, some candidates gave vague statements of species staying on the Island without a mention of habitats.

Question 19 (b) (i)

(b) Puffins, like many species on the Farne Islands, eat small fish. Their main predators are large gulls. Puffins are on the IUCN Red List for threatened species.

The puffin population can be estimated from the number of burrows that are occupied.

After the bird flu outbreak in 2023 the number of occupied burrows declined.

(i) It is important not to disturb the burrows and there is not enough money available to allow puffin burrows to be constantly monitored, either by humans or cameras.

Suggest **one other** type of evidence that could be used to infer that a burrow was being occupied by puffins.

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

Many responses seemed to get this mark and all the alternatives listed on the mark scheme were regularly seen. Although, many candidates did not appreciate the significance of the information they were presented with in the question: if it is important not to disturb the burrows then evidence of, e.g., eggs inside the burrows could not be gathered; if there is not enough money for constant monitoring of burrows, then it would be unlikely that the money would be found to estimate the population of small fish or for the use of thermal imaging equipment.

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Question 19 (b) (ii)

(ii) Discuss the effect a decline in puffin population could have on other species in the area.

.....

.....

.....

.....

.....

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

Most candidates found it difficult to get full marks on this question, with many getting 2 marks for identifying that the gull population would decrease and the fish population would increase. More successful responses homed in on competition, which would increase between the gulls or fish but decrease in another species that ate the fish. This was the most common way to get full marks.

Some general answers referred generally to competition and predator-prey relationships and got no marks.

Question 19 (b) (iii)

(iii) Explain why the existence of a predator can improve the long-term survival of a species such as the puffin.

.....

.....

.....

.....

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

Only a few candidates were able to be given both marks. Most candidates focused on carrying capacities and food supplies running out, but for those that identified the significance of the long-term survival aspect of the question, they went on to give good explanations of natural selection operating with the predator being the selection pressure and that the weaker individuals would die, leaving only the better adapted individuals to reproduce and pass on the advantageous alleles to their offspring. A few candidates gave general statements of genes being passed on without realising that a species would contain the same genes and that it is the version of the gene – the advantageous allele that would be passed on.

Most candidates were given no marks for their responses as they discussed predator-prey cycles.

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Question 19 (c)*

(c)* The sea around the Farne Islands contains a large population of grey seals, *Halichoerus grypus*, and a small population of common seals, *Phoca vitulina*.

The table contains some information about these two species of seal.

	Length (m)	Mass (kg)
Grey Seal	1.9–2.3 (males) 1.6–2.0 (females)	180–300 (males) 100–190 (females)
Common Seal	1.45–1.85 (sexes similar)	65–150 (sexes similar)

Use the information in the table to describe the different types of variation between organisms and the underlying causes of this variation.

.....

.....

.....

.....

.....

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

Only a few candidates answered this question well. Few candidates used their specification knowledge on the different types of variation learning outcome that lists intraspecific and interspecific variation, continuous and discontinuous variation and the genetic and/or environmental causes of variation. With this in mind, it was fairly straightforward to describe that the range of qualitative values of both length and mass of either seal species showed continuous variation, best displayed on a histogram, with a combination of both genetic and environmental causes. The harder part was to identify the **difference** in the length or mass of the male and female grey seal. As male and female were being compared, the data was categoric and would be best displayed on a bar chart. The cause is only genetic and likely controlled by one or a small number of genes. Most candidates did not use the variation terms at all. Some focused on interspecific and intraspecific variation so limited their performance to a Level 2. Many candidates gave long descriptions of how adaptation would be the cause of variation; some candidates added in competition and speciation.

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Exemplar 2

Inter
Intra
Continuous
Discontinuous

The table contains some information about these two species of seal.

	Length (m)	Mass (kg)
Grey Seal	1.9–2.3 (males) 1.6–2.0 (females)	180–300 (males) 100–190 (females)
Common Seal	1.45–1.85 (sexes similar)	65–150 (sexes similar)

Use the information in the table to describe the different types of variation between organisms and the underlying causes of this variation.

The length and mass of the common seal is an example of discontinuous variation. There is 2 extreme values 1.45m and 1.85m with every degree of variation inbetween. This is caused by both genetic and environmental factor. As genes determine maximum length possible but environmental factors eg. diet determine whether this is reached. The mass between the male grey seal and male common seals is an example of discontinuous variation, As there is 2 distinct categories 180-300kg and 65-150kg. This difference is ~~controlled by~~ genetic is due to genetic factors, The variation in Mass between male and female grey seals is an example of intraspecific variation as they belong to the same species. The variation [6]

Extra answer space if required.

in mass between grey and common seal is an example of interspecific variation as they belong to different species. The variation inbetween within grey seal is discontinuous variation controlled by genes as there are 2 distinct categories male and female

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This candidate described both continuous and discontinuous variation in detail, as well as given causes. This exemplar also has data to support both forms of variation, although data to support one of these was sufficient to achieve Level 3.

This candidate has also correctly referred to intraspecific and interspecific variation. They did not need to do this for Level 3 unless they had less detail for continuous and discontinuous variation.

Question 20 (a) (i)

20 Plants are often used to investigate genetic inheritance.

(a) Genetic crosses are used to investigate the inheritance of two genes at the same time. This is known as dihybrid inheritance.

Gregor Mendel investigated dihybrid inheritance in pea plants. When parent plants that were both heterozygous for two different genes were crossed, the ratio of phenotypes in the offspring was 9 : 3 : 3 : 1.

(i) Sweet pea is another species of plant.

- Sweet pea flower colour is coded for by a gene with two alleles: blue (**B**) and red (**b**).
- Sweet pea pollen shape is coded for by a gene with two alleles: long (**L**) and round (**l**).

When parents that were both heterozygous for the two genes were crossed, the ratio of phenotypes in the offspring was **3** (blue and long) : **1** (red and round).

The inheritance of flower colour and pollen shape in sweet pea is not affected by epistasis.

Explain what can be concluded from the phenotypic ratio **not** being the expected 9 : 3 : 3 : 1 for Mendelian dihybrid inheritance.

.....

.....

.....

.....

.....

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

This question differentiated between those who were confident with autosomal linkage and those who didn't. However, with four other MPs, compensation was given from points like 'no crossing over' and 'no independent assortment'.

Some tried for sex linkage; some tried for codominance; others referenced epistasis, not having assimilated the question's guidance.

Just under half of candidates got no marks for their responses.

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Assessment for learning



To help candidates navigate these concepts more confidently, centres should emphasise the distinctions between linkage, epistasis, and independent assortment.

Question 20 (a) (ii)

(ii) Explain why epistasis affects the offspring ratio in a genetic cross.

.....

.....

.....

.....

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

This question was generally not well-answered with most candidates getting no marks.

'Epistatic' and 'hypostatic' were mentioned by the most successful candidates.

Few candidates were able to expand their answers beyond 'one gene masks the expression of another'. Even fewer linked this to changing the phenotype. There was confusion of gene and allele in the less successful answers.

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Question 20 (b) (i)

(b) In pea plants, flower colour is controlled by two alleles: purple (dominant) and white (recessive).

- 600 pea plants are growing in a large greenhouse.
- 564 of the plants have purple flowers.

(i) Use the Hardy–Weinberg principle to calculate the number of heterozygous individuals in the greenhouse.

Use the equations:

$p + q = 1$

$p^2 + 2pq + q^2 = 1$

Number of heterozygous individuals = ... **[3]**

Further practice is needed by candidates on these calculations, as they follow a similar formula each time. They should first look to identify q^2 and then go from there.

Many candidates were given no marks, either for a lack of coherent workings shown or a misunderstanding of the processes required to do a successful calculation.

Calculation:

White flowers (q^2) = 600 - 564 = 36

q^2 = 36/600, q = √0.06, **q = 0.245**

Using p + q = 1 equation to calculate value for p : 0.245 + p = 1

p = 0.755

Proportion of heterozygous individuals: 2pq = 2 (0.245) (0.755) = 0.36995

Heterozygous individuals: 600 x 0.36995 = 221.97 ~ 222

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Question 20 (b) (ii)

(ii) Estimates made by using the Hardy–Weinberg principle can be inaccurate.

Use the information above to suggest **one** reason why the answer calculated in part **(b)(i)** might be **accurate**.

.....

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

Despite the word 'accurate' being emboldened, many candidates wrote about why it may be inaccurate. Careful reading of the question is key here.

The most commonly credited responses referred to the sample size being large.

Question 21 (a)

21 Antibiotics are drugs that treat bacterial infections.

The first antibiotic became widely available in the second half of the 20th century and antibiotics have been widely used ever since.

Many bacteria have now evolved resistance to antibiotics.

(a) Explain why the evolution of antibiotic resistance has implications for human populations.

.....

.....

.....

.....

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

Many candidates were able to explain that the antibiotic would no longer kill the resistant bacteria or treat the infection it caused. Some candidates also recognised that the death rate would increase and that new antibiotics would be needed. The main reason for an explanation to not be credited was due to vague statements that antibiotics no longer being effective, or that bacteria could not be treated, or that bacterial infections could not be killed.

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Question 21 (b)

(b) Explain how antibiotic resistance in bacteria provides evidence for the theory of evolution by natural selection.

.....

.....

.....

.....

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

Most responses included thorough explanations of how bacteria evolve resistance to an antibiotic by natural selection. However, almost all candidates missed the part of the question that asked them to explain how this process provided *evidence* for evolution by natural selection. Many responses were able to get some marks for stating that the antibiotic acted as a selection pressure, but the other two marking points were very rarely given.

Question 21 (c) (i)

(c) Biological molecules provide another strand of evidence supporting the theory of evolution by natural selection.

(i) Complete the sentences using the most appropriate terms.

Mutations in DNA are random, so the more time that has passed the more mutations will have occurred. The sequence of ..... in DNA and the sequence of ..... in ....., such as haemoglobin and cytochrome c, can be ..... between species.

Species with more similar biological molecules are likely to have evolved from a common ancestor more ..... than species with less similar biological molecules.

This helps to explain why species with different features that live close together geographically often have very similar sequences in their biological molecules.

[5]

This gap-fill question about molecular evidence supporting the theory of evolution was generally answered well. Some candidates incorrectly put that DNA was made up of amino acids. It was fairly frequent to see the second and third gaps being given incorrect terms. The most common error was to give 'closely' for the last gap.

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Question 21 (c) (ii)

(ii) Explain how fossils can be used to support the theory of evolution by natural selection.

.....

.....

.....

.....

.....

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

Candidates generally did not get all marks for this last question. The most common mark given was for explaining how evolution is the change in features over time. Some candidates also knew that the deeper the fossil, the older the fossil and that fossils can be dated. A few explained that fossils showed when species became extinct or that fossils could have DNA extracted and sequenced for molecular comparison.

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