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OCR
Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

J257

For first teaching in 2016

J257/03 Summer 2024 series

Version 1

ocr.org.uk/science

Contents

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 OCR.

Paper 3 series overview

J257/03 is the first of two higher tier papers assessing biology in the Biology B suite. This paper is a breadth paper which aims to assess a wide range of content from the specification. To do well on this paper candidates need to have a well-rounded understanding of the whole specification and need to be comfortable applying their knowledge to unfamiliar contexts. One question may bring in multiple elements of the specification in the sub sections of the question and candidates need to be well-practiced and comfortable with this style of question to yield the best results.

Candidates were clearly well prepared for this examination and rose to the challenge of the unfamiliar contexts. Omit rates were very low suggesting that candidates felt confident tackling the questions. Candidates did appear to understand the command words used, providing descriptions and explanations as appropriate. The only aspect which proved more difficult was when a comparison was required. The practical element that was tested showed some improvement which was pleasing to see, however, describing how to use a microscope still seems problematic to some candidates.

It was good to see candidates applying their mathematical techniques to the maths style questions, they were able to show how a ratio was derived, calculate percentage and probability. It was also good to see clear workings for these questions.

In questions where explanations are required, candidates should be encouraged to use the number of marks as a guide to the level of detail required in the response.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• gave detailed responses to questions requiring explanation, for example were able to explain why sweating would be less effective at cooling the body in a humid environment (Question 3 (b)), and could explain how body fluid composition affects cells (Question 6 (c)) • used scientific terminology clearly and without ambiguity – for example they were able to describe why a genetic disease caused by a dominant allele was more problematic (Question 11 (a)) • calculated probability correctly (Question 11 (b) (ii)) • could apply their knowledge successfully to unfamiliar contexts (Question 10 (d) (i), (ii) and (iii)) • could describe how a gas syringe would improve a practical procedure (Question 1 (a) (ii)).	• could not describe the method used to investigate the effect of light intensity of the rate of photosynthesis (Question 1 (a) (i)) or explain how a gas syringe would improve the procedure (Question 1 (a) (ii)) • were unable to give a full explanation as to how the body regulated temperature (Question 3 (a)) • found the mathematical components of the paper difficult, many were unable to calculate percentage (Question 2 (c)) • found it difficult to interpret data represented in pictorial form (Question 4 (b)) or in a graph (Question 10 (a)).

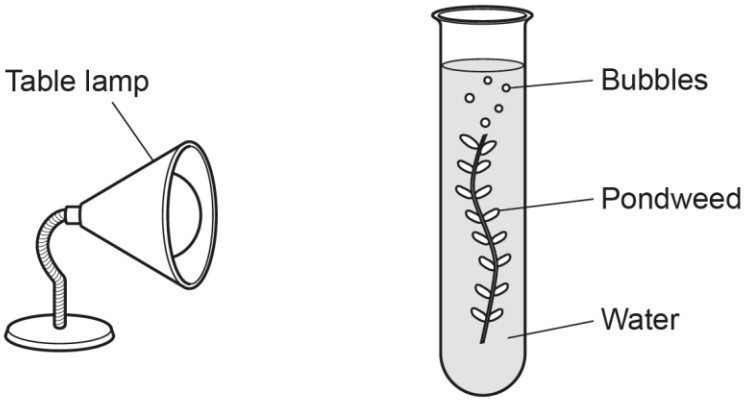
Question 1 (a) (i)

1 A student is investigating how light intensity affects the rate of photosynthesis.

(a)

(i) **Fig. 1.1** shows the equipment the student sets up.

Fig. 1.1



Describe the method the student will use with the equipment in **Fig. 1.1** to find how light intensity affects the rate of photosynthesis.

Include in your answer:
- what they will change
- what they will keep the same
- what data they will record.

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

It was clear from candidate responses that many of the candidates had either been given the opportunity to conduct this experiment in class or had observed the experiment. Most candidates answered this question well, successfully using the framework provided by the bullet points to include all three aspects required by the question in their response.

Many of the candidates that scored two marks were most often not given credit for the dependent variable, as although they had correctly determined that the number of bubbles were to be counted they did not state that the time period over which they should be counted should be kept constant. Most candidates named several variables that they would keep the same in their response, demonstrating their confidence in this aspect of practical planning. To further improve candidates should be encouraged to be more precise with their scientific language, for example they should state 'concentration' of carbon dioxide, rather than amount, the length of the pondweed, rather than the size, or the species of plant, rather than the type.

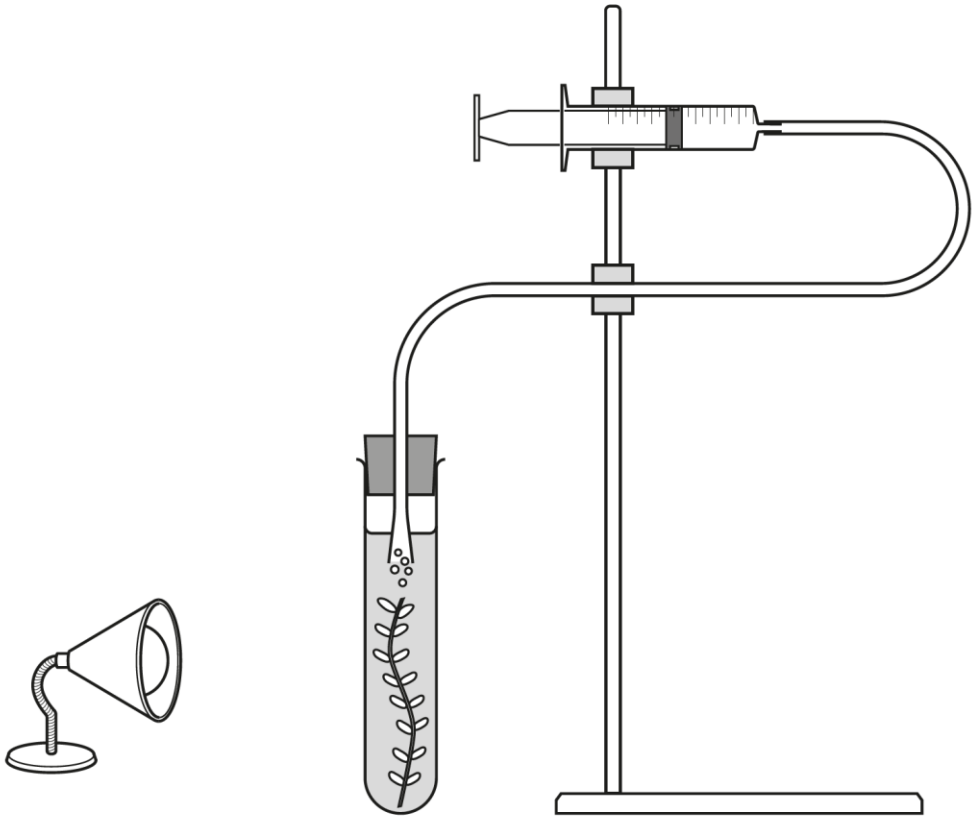
OCR support

The Language of Measurement in context: Biology support resource can be used with candidates to support their understanding of scientific language needed when discussing practicals.

Question 1 (a) (ii)

(ii) **Fig. 1.2** shows a different set of equipment that can be used.

Fig. 1.2



A second student suggests that the equipment shown in **Fig. 1.2** will improve the investigation.

Explain why.

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

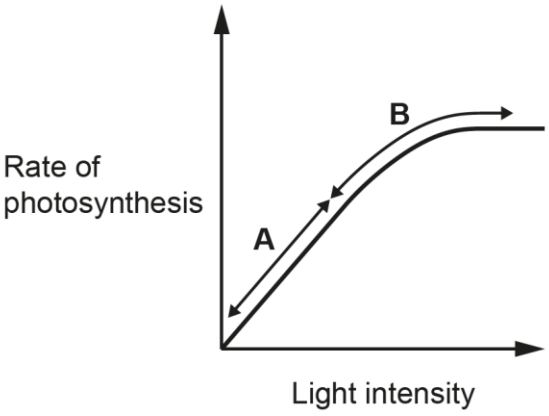
Candidates also performed well on this part of the question; many seemed familiar with the use of this piece of equipment. Common correct responses often focused on the gas syringe collecting the oxygen produced and therefore allowing volume to be recorded. Many explained that counting bubbles was a flawed technique as bubbles could be missed when counting or appreciated that the size of the bubbles varied.

Some candidates were less familiar with the equipment and thus found it difficult the explain how the experiment would be improved as a result, they had not appreciated that it would collect gas produced. Occasionally candidates stated that this equipment would reduce human error, but were not explicit in their explanation of this, and were therefore unable to gain credit.

Question 1 (b)

(b) **Fig. 1.3** shows the effect of changing the light intensity on the rate of photosynthesis.

Fig. 1.3



Which section or sections of the graph in **Fig. 1.3** show the relationship $y = mx + c$?

Tick (✓) **one** box.

Section **A** ☐

Section **B** ☐

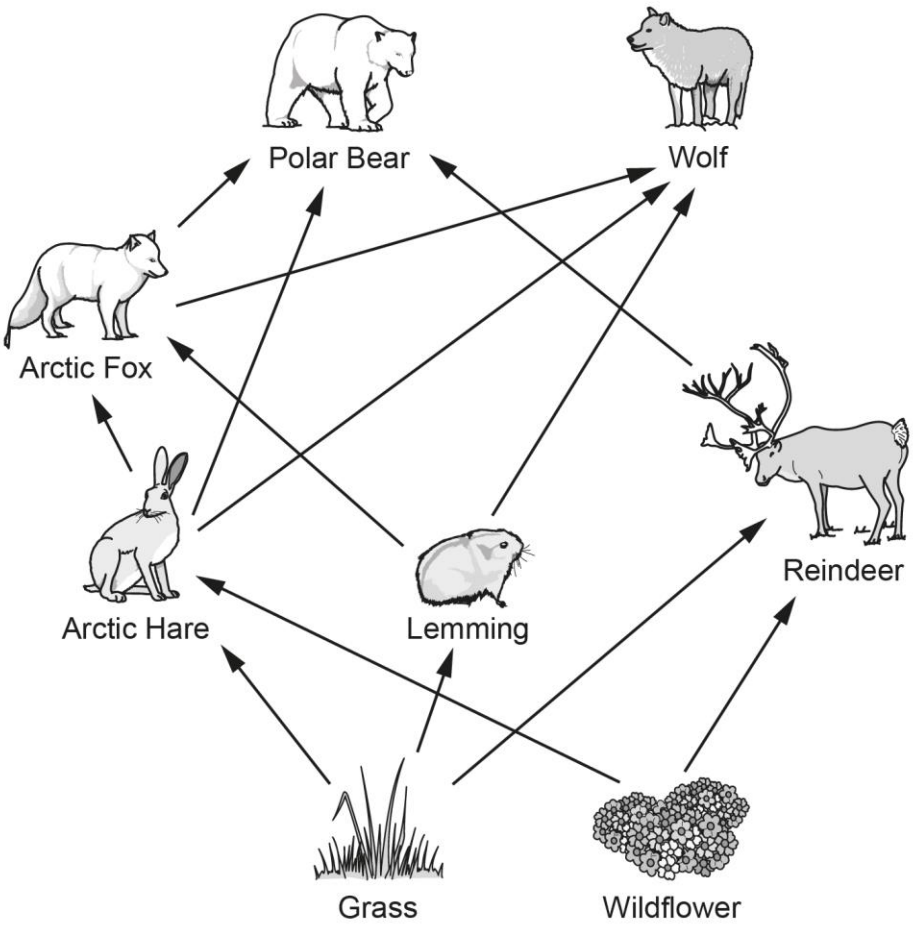
Sections **A** and **B** ☐

[1]

Candidates were clearly familiar with this mathematical relationship and applied it to the context with ease. Those that did not select Section A, often selected Section B.

Question 2 (a)

2 The diagram shows the feeding relationships of some of the organisms that live in an Arctic ecosystem.



(a) What does each picture in the food web represent?

Tick (✓) **one** box.

A community ☐

A population ☐

An individual ☐

[1]

While many candidates did correctly identify that each picture in the food web represented a population, community was a common incorrect response.

Assessment for learning

Research has suggested that candidates are unsure as to what the pictures in a food web represent and the responses to this question would suggest that this is the case. This question could be used in class with candidates, as well as selecting the response they could be asked to explain why they have chosen that response. This may provide a greater insight into candidate understanding of food webs and allow any misunderstandings to be addressed.

Question 2 (b)

(b) Complete each sentence by writing in the correct number.

There are ..... producers in the food web.

There are ..... herbivores in the food web.

The arctic fox is in trophic level ..... .

[3]

Most candidates answered this question very well and were given full marks. The most common incorrect response was for the final sentence with many candidates identifying the trophic level that the artic fox is in as Level 2, suggesting that some candidates are unsure what a trophic level is. Very few candidates scored less than two marks on this question.

Question 2 (c)

(c) A lemming has a mass of 82 g.
An arctic fox eats the lemming, but only consumes 75 g of the lemming.

Calculate the percentage mass the arctic fox has consumed.

Give your answer to **3** significant figures.

Percentage mass consumed = ... % **[3]**

Candidates confidently approached this percentage calculation, the majority of which were given full marks. The most common error observed was the presentation of the percentage to four significant figures (91.46). Occasionally percentage change was calculated. It was pleasing to see candidates presenting their mathematical working clearly and this enabled examiners to award marks for correct steps when the final response was incorrect. It was clear centres had instilled good practice in their students.

Question 2 (d) (i)

(d) When lemmings are in short supply, the arctic fox will eat eggs.

(i) Eggs contain protein.

Which reagent is used to test for protein?

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

Candidates often find questions relating to biological molecule tests more challenging and this was observed in this question. Those that did correctly identify biuret as the reagent often found it challenging to spell the word correctly. Incorrect responses seen included ethanol, Benedict's and iodine.

Question 2 (d) (ii)

(ii) The yolk of the egg contains lipids.

Put a (ring) around the **two** components that make up a lipid.

amino acids **fatty acids** **glucose** **glycerol**

[2]

The majority of candidates correctly identified both fatty acids and glycerol as the two correct components of a lipid. For those that were only given one mark, this was often for fatty acids with glucose being the most common incorrect response.

Question 2 (d) (iii)

(iii) A student calculates the surface area and volume of an egg.

Surface area of the egg = 67.5 cm^2

Volume of the egg = 50 cm^3

Show that the surface area to volume ratio of the egg is 1.35 : 1.

[2]

This question was answered very well by candidates, and it was pleasing to see them transferring their mathematical skills to this question. Candidates presented their responses clearly using techniques learned in mathematics, for example using curly arrows.

Question 3 (a)

3

(a) Sam is visiting Norway where the average temperature in the winter is –6.8 °C.

Sam steps outside the hotel wearing only a jumper.

Complete the sentences to describe the processes that the body will use to regulate Sam's body temperature.

Use words from the list.

glands	**hypothalamus**	**muscles**	**pituitary**
receptors	**shivering**	**skin cells**	**sweating**

The external temperature is detected by ..... in the skin.

An electrical impulse is sent to the ..... which coordinates a response.

An electrical impulse is sent from the coordinator to the ..... .

The body will respond by ..... .

[4]

A large proportion of candidates were given full marks for this question. Some interesting patterns did emerge. For those candidates that were given three marks, the most common incorrect response was for the third sentence, with candidates opting for glands, skin, or receptors as the destination for the electrical impulse to be sent to. For those candidates that were given two marks the most common incorrect sentences completed were the first and second, with candidates often identifying the skin cells or hypothalamus as the detector and the impulse being sent to receptors.

Question 3 (b)

(b) Which method of cooling the human body would be the **least** effective in a **hot humid environment**?
Explain your answer.

Method .....

Explanation .....

.....

.....

.....

[3]

This question proved challenging for candidates. Those that did correctly identify sweating as the least effective method of cooling often found it difficult to explain why this was the case. Some were able to identify that the humid air would contain water but were unable to explain why this would impact the cooling mechanism, suggesting that candidates are less familiar with the mechanism by which sweating cools the body. Those that did appreciate that evaporation would be hindered often stated no sweat would be evaporated rather than less and very few were able to explain this in terms of thermal transfer. Some candidates thought that the additional sweat lying on the surface of the skin would get warm and that this would make the body hotter. Other common incorrect responses included vasodilation and vasoconstriction, shivering, wearing less clothes and fanning yourself.

Exemplar 1

Method ..... Sweating .....

Explanation ..... Sweating produces water on the skin which evaporates, adding more water vapour to the area and making it more humid, so it's less effective. .....

This was a common response observed during marking. The candidate clearly understands that sweating is the least effective method but has found it difficult to explain why.

Assessment for learning

Centres are encouraged to spend time explaining how sweat cools the body, as many candidates will also study chemistry and it would be a good opportunity to discuss latent heat of vaporisation.

Question 3 (c)

(c) Explain the importance of maintaining a constant internal temperature.

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.....

.....

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

Many candidates correctly identified the importance of temperature for the functioning of enzymes, with some developing this response further and considering the effect of elevated or low temperatures on the functioning of enzymes. Some incorrect responses saw candidates focusing their response on cells and organs. Many candidates did state that an optimum temperature was required but did not develop this further and link it to the importance of this temperature for chemical reactions in the body.

Question 4 (a)

4 A student is investigating the distribution of stomata on leaf surfaces.

The student removes 4 leaves from the same plant.

Leaf 1 – they cover the lower surface of the leaf in waterproof grease.
Leaf 2 – they cover the upper surface of the leaf in waterproof grease.
Leaf 3 – they cover both surfaces of the leaf in waterproof grease.
Leaf 4 – neither surface of the leaf is covered in waterproof grease.

The results of the experiment are shown in the diagram

Leaf 1	Leaf 2	Leaf 3	Leaf 4
Slight wilting	Significant wilting	No sign of wilting	Dry and shrivelled
			

(a) Explain why applying waterproof grease to both sides of the leaf prevented wilting.

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

Candidates found this question a little more challenging, for some there appeared to be a lack of knowledge as to the role of the stomata whereas others did not make the link between water leaving the leaf and the leaf wilting. There was some confusion apparent regarding the role of the guard cells; some candidates did not appreciate that these cells control the opening and closing of the stomata, but instead thought water left the leaves via the guard cells.

Question 4 (b)

(b) The student looks at the results and writes this conclusion:

> 'Stomata are located on both surfaces of the leaf, but there are more stomata on the lower surface of the leaf.'

Explain how the results of the investigation support the student's conclusion.

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

Many candidates successfully processed the information given to explain how the results of the investigation supported the student's conclusion, with the vast majority comparing the degree of wilting in leaf 1 and leaf 2, relating this to the side of the leaf that was covered in grease and therefore using this as an indication of the number of stomata present. The lack of detail in the explanation was the most common reason for candidates to be given one mark.

Question 4 (c)

(c) Which structure brings water to the leaf from the roots?

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

Most candidates correctly identified the xylem as the structure that brings water to the leaf from the roots. The most common incorrect response was phloem or stem. Root hair cells was also seen but was rare.

Question 5 (a)

5 Rats are considered a pest to many farmers as they eat their crops.

A chemical called warfarin can be used to kill rats.

Some rats developed a natural resistance to warfarin.

(a) What is the most likely cause of this resistance?

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

Mutations was a common response observed for this question. Centres should remind candidates that they need to be more specific in their response and should indicate that this is a mutation observed in the DNA or a gene. The most common incorrect response was natural selection.

Question 5 (b)

(b) Complete the sentences to explain how more rats developed resistance to warfarin.

Use words from the list.

allele	**die**	**genome**	**reproduce**
respire	**ribosome**	**survive**	

Rats that were resistant to the warfarin were more likely to ..... and

..... and therefore pass on the ..... for resistance to their offspring.

[3]

Candidates were well versed in the stages of natural selection and as a result this question was answered very well by candidates. The most common incorrect response was 'genome' which was selected in the place of 'allele'. Occasionally 'survive' was given for the second part of the process.

Question 5 (c)

(c) State the names of the **two** scientists who developed the theory of evolution by natural selection.

..... and .....

[1]

Candidates found this question challenging. Most could recall Charles Darwin as one of the scientists who developed the theory of evolution by natural selection, but a significant number were unable to identify the second scientist as Alfred Russel Wallace. Many candidates left the second response blank, but those that did attempt to name a second scientist often named Mendel, Lamark, Einstein and even Mendeleev. Centres are encouraged to discuss the important role that Wallace played in the development of this theory.

Question 5 (d)

(d) Explain why some people do **not** accept this modern theory of evolution.

.....

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

Most candidates answered this question well with many highlighting an individual's religious beliefs as a reason why they do not accept this modern theory of evolution, and this was the most common response observed. It was pleasing to see some other considerations to include different interpretations of the evidence and the idea that it is difficult to observe evolution in real time.

Question 6 (a)

6

(a) The human body has two communication systems:

- the hormonal system
- the nervous system.

State **two** ways that the response generated by the hormonal system is different to the response generated by the nervous system.

1 .....

2 .....

[2]

This question proved more challenging to candidates. Some candidates did not appreciate that they needed to make a comparison between the two systems, and this was the most common reason for some candidates not being given marks on this question. There were some examples of very good responses; these candidates answered the question concisely demonstrating a clear understanding of the differences between the two systems. The most common comparisons routinely given were for identifying that the hormonal system was slower to act and the effects of this system were longer lasting.

Question 6 (b)

(b) ADH is a hormone that controls the water balance in the body.

Draw lines to connect each question with the correct answer.

Which structure releases ADH?	Cerebellum
	Kidney tubules
Where does ADH have its effect?	Pancreas
	Pituitary gland

[2]

Many candidates were clearly familiar with both the structure that releases ADH and where ADH has its effect and were subsequently given both marks. When only one mark was given, this was more often for the second question; 'where does ADH have its effect'. The most common incorrect response was selecting the pancreas, and this was often selected for both the structure releasing ADH and where it has its effect.

Question 6 (c)

(c) What effect will body fluids that contain too much water have on cells?

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

The most common response that gained credit in this question was for the identification that body fluids containing too much water would cause cells to swell or burst. Some candidates did go on to explain why this happened, identifying that cells would take in more water and in some cases correctly identifying that water would move into cells by osmosis, but the explanation for the bursting of cells was observed less frequently. It may be helpful to remind candidates that the number of marks attributed to a question is a useful guide as to the level of detail required in the response. In some cases, candidates misinterpreted the question and discussed osmoregulation and ADH.

Question 7 (a)

7 Some babies are born with cataracts.

(a) Cataracts affect the lens.

What role does the lens have in the functioning of the eye?

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

Candidates found this question more challenging. There were many incorrect descriptions of the role of the lens, to include controlling the amount of light entering the eye, confusing the role of the lens with the iris. Some candidates did explain that the lens refracted light but did not indicate that the light rays were focused onto the retina.

Question 7 (b) (i)

(b) Surgical removal of cataracts in babies can be done, but there may be problems after surgery.

In a trial, scientists removed the lens from 12 babies with cataracts but left behind the stem cells.

All the babies grew a new lens within 3 months.

(i) Explain how the new lens grew from the stem cells.

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

This question was found more challenging by candidates. While many candidates could correctly identify that stem cells were unspecialised/undifferentiated cells, fewer developed this idea to explain that these cells would differentiate into lens cells. Some candidates that did develop their response would often also refer to genes being switched on or off as a mechanism to specialise the cells. The role of mitosis in the production of more cells was seen less frequently.

Question 7 (b) (ii)

(ii) Suggest why some parents may be concerned about this trial procedure being used on their babies.

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

Many candidates answered this question very generally and did not engage with the stimulus material provided. Common responses focused on the general dangers associated with surgery, and this was insufficient to gain credit. The question focuses on a trial procedure, using a small sample of babies and candidates were expected to engage with this information to suggest why parents may have concerns. Some candidates discussed the ethics of using stem cells from embryos, highlighting that they had not engaged with the stimulus material which detailed the source of the stem cells. The most common response that was given credit was for the potential for unknown long term side effects such as blindness. Candidates should be encouraged to read the stimulus material carefully, to think about the different parts presented, to construct their response so that it is tailored to the context presented, before formulating a response.

Question 8 (a)

8 *Salmonella* is a communicable disease caused by bacteria.

Salmonella bacteria can enter the body in contaminated food.

A doctor sees a patient with symptoms that suggest they have food poisoning caused by *Salmonella* bacteria.

The doctor decides to take a sample from the patient to send to a laboratory for further testing.

(a) Suggest a suitable sample that could be taken from the patient that can be tested for *Salmonella* bacteria.

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

Candidates performed well on this question and a range of responses was observed. This included vomit, faeces, blood, and saliva as well as named tissue samples from the digestive system.

Question 8 (b)

(b) When the sample arrives at the laboratory the scientists first make a culture of the bacteria.

Explain why the scientists make a culture.

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.....

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

Many candidates found this question more challenging. Those that did correctly identify that by culturing the bacteria the scientists would have more bacterial cells often did not consider why more cells may be needed and did not develop their response to consider the need to carry out multiple tests.

Misconception

? Some candidates described the purpose of culturing bacteria as a way to 'grow' bacteria. The word growth is often misunderstood by candidates. Centres are encouraged to tackle this misconception.

Question 8 (c)

(c) The scientists take a sample from the culture.

They prepare a slide so they can view the bacteria.

They use a stain that turns *Salmonella* bacteria pink.

Describe how the scientist can use a light microscope to determine if the patient's symptoms are caused by *Salmonella*.

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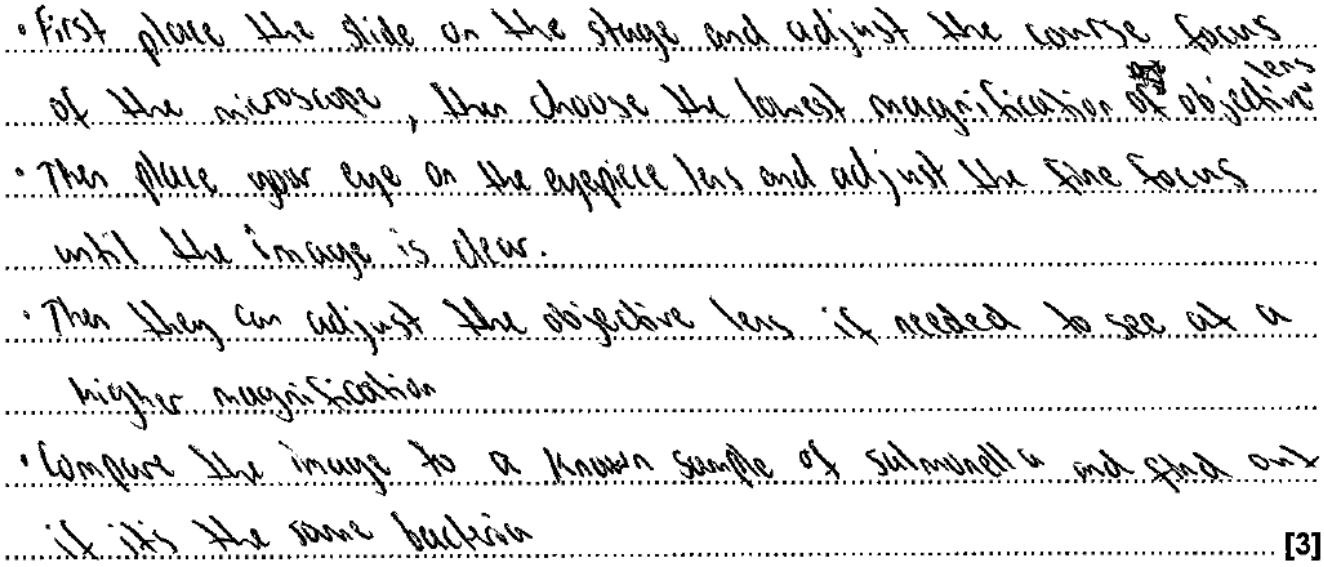
..... **[3]**

Some candidates misinterpreted this question and did not pick up on the requirement to describe how to use a light microscope. Responses that did describe how a light microscope should be used were often lacking in detail. The best responses were methodical in their approach, stated the name of the part of the microscope to be used and how to use it. Many candidates stated that a lens should be selected but did not indicate that this should be the lowest objective lens or did not explain the slide should be placed on the stage. Some candidates described at length how to prepare a slide which was not asked for in the question. The response that gained credit most often was for the acknowledgement that if *Salmonella* was present the bacteria under the microscope would appear pink. Very few candidates described the role of the focusing knobs and there was some confusion about the terms resolution and magnification. Some candidates thought that the light microscope could be used to identify features of the prokaryote cell.

Exemplar 2



In this exemplar the candidate has very clearly described how to use the light microscope to view the slide, demonstrating their understanding of the procedure. Unfortunately, they did not discuss what they would observe to confirm *Salmonella* as the bacterium present and were therefore given two marks.

Question 8 (d)

(d) Explain why it is important that aseptic techniques are used at all stages of the procedure.

.....

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

Many candidates correctly identified that the purpose of aseptic techniques is to prevent contamination from other microorganisms, unfortunately some candidates simply stated to prevent contamination which was insufficient for the mark. There were some examples of candidates considering the role of the aseptic techniques to prevent the spread of the *Salmonella* bacteria that was being cultured.

Question 8 (e) (i)

(e) Bacteria reproduce asexually.

(i) State **one** advantage of asexual reproduction.

.....

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

This question was answered very well by candidates. The most common responses identified asexual reproduction as a fast process, or one which did not require a mate. Some candidates did state lack of genetic variation as an advantage but did not qualify this by explaining how this would be an advantage.

Question 8 (e) (ii)

(ii) State **one** disadvantage of asexual reproduction.

.....

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

This question was also answered well by candidates. Those who were not given a mark often stating a lack of variation, without stipulating genetic variation.

Question 9 (a)

9

(a) Monoclonal antibodies can be produced in the laboratory and used to treat disease.

Put statements **A** to **E** in the correct order to describe how monoclonal antibodies are made.

A Antibody producing cells are removed from the animal.

B Antigens are injected into an animal.

C Cells are cultured to produce clones.

D Cells producing the correct antibody are selected.

E White blood cells which produce the antibodies are made by the animal.

Write **one** letter in each box.

One has been done for you.

B				

[3]

The most common mistake observed on this question was placing D before A (BEDAC).

Question 9 (b)

(b) Draw a line to connect each **disease** to the type of **pathogen** that causes the disease.

Disease	Pathogen
Athletes foot	Bacteria
HIV	Fungus
Influenza	Protist
Malaria	Virus

[3]

This question proved more challenging for candidates; many candidates opted to draw one line to each of the four boxes on the right, incorrectly selecting bacteria as the type of pathogen for either influenza or HIV.

Question 9 (c) (i)

(c) The United Nations collects data on global diseases.

The table shows regional data about the number of new HIV infections in 2022.

Region	Estimated number of new HIV infections
Asia and the Pacific	3.0×10^5
Caribbean	1.6×10^4
Eastern and Southern Africa	5.0×10^5
Eastern Europe and central Asia	1.6×10^5
Latin America	1.1×10^5
Middle East and North Africa	1.7×10^4
Western and central Africa	1.6×10^5
Western and central Europe and North America	5.8×10^4

(i) Which region had the highest estimated number of new HIV infections in 2022?

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

The majority of candidates were able to demonstrate their understanding of standard form and selected the correct region.

Question 9 (c) (ii)

(ii) Suggest **two** reasons why the number of HIV infections was greater in this region than in other regions.

1 .....

2 .....

[2]

A good range of responses were observed for this question. The most common responses focused on a reduction in the use of barrier contraception, increased levels of unprotected sex or lack of education on sexually transmitted diseases. Some candidates gave less precise responses which were insufficient for a mark, for example stating less contraceptives were used, without appreciating that only barrier contraceptives would prevent transmission or referred more generally to less education. Very few responses considered an increase in infections due to contaminated blood products or the role of HIV screening. There were some responses that suggested there may be some misconceptions about transmission of this disease, such as poor sanitation.

Question 9 (c) (iii)

(iii) The data provided by the United Nations is an estimation and is not the actual number of new HIV infections.

Explain why the data is only an estimation.

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.....

.....

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

This question proved more challenging; few candidates were given both marks. The most common correct responses centred around a failure or reluctance to be tested, with a wide variety of reasons for this occurring being given.

Question 9 (c) (iv)

(iv) HIV destroys an important type of white blood cell called CD4.
The 'normal' range for CD4 white blood cells is 800–1200 cells per mm^3 of blood.

One particular person living with HIV has <200 CD4 cells per mm^3.

Describe the likely impact of this on the person's health.

.....

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

Many candidates had the right idea about the consequences of lower white blood cell counts but did not communicate their ideas well, and many responses lacked appropriate biological vocabulary. Some candidates referred to weakened immune systems but did not qualify this by explaining the impact this would have on health, and others used terms such as 'illness' or 'sickness'.

Question 10 (a)

10 **Fig. 10.1** and **Fig. 10.2** show the United Nations population projections for the year 2100.

Fig. 10.1 shows the projections made in 1975.

Fig. 10.2 shows the projections made in 2020.

Fig. 10.1

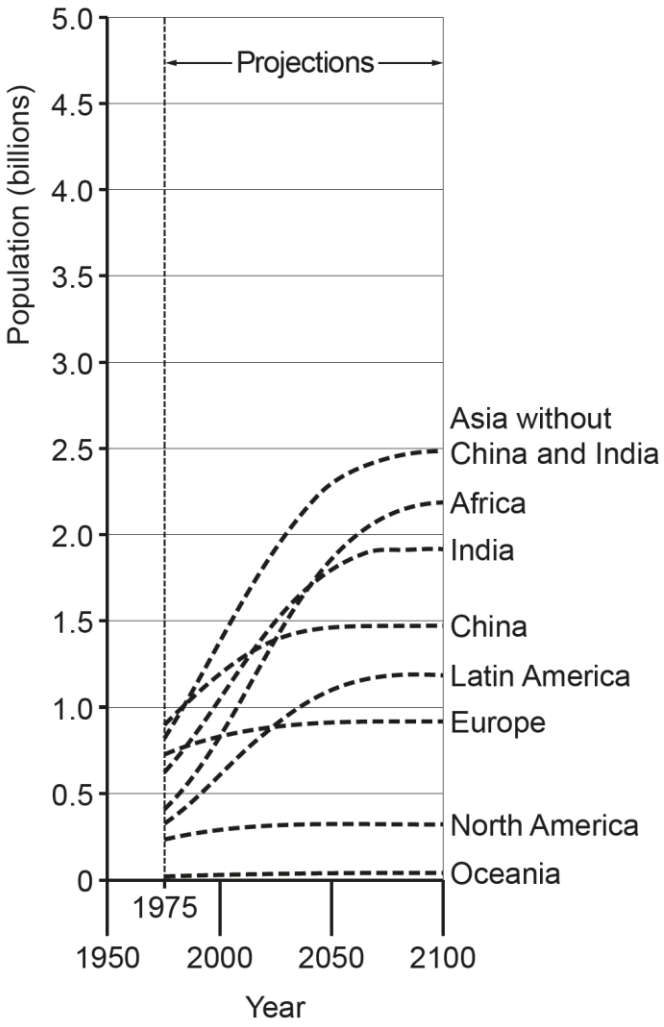
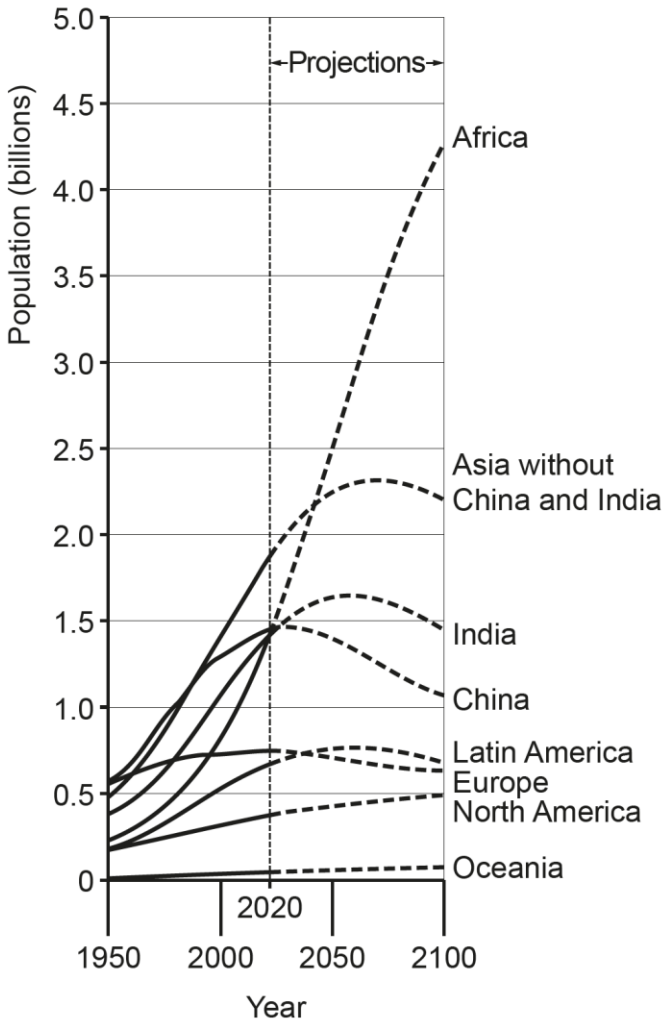


Fig. 10.2



(a) State **two** differences between the projections made in 1975 and those made in 2020.

1 .....

.....

2 .....

.....

[2]

Candidates that analysed the graphs and understood that they provided data which predicted population size tended to perform better on this question. Some candidates made simple statements about the projection for 2020 or 1975 but did not compare the projections. Those that were given two marks were methodical in their approach to the question, taking one area, stating what the prediction in 1975 predicted for 2100 and then directly compared this with the change in the prediction made in 2020. Some comparisons were too general, for example stating that most countries in the 2020 predictions showed a decrease. The most common correct comparison given was for identifying that the predication for Africa was far greater in 2020 compared to that in 1975.

Question 10 (b)

(b) Suggest why the United Nations revises their projections regularly.

.....

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

There were some interesting responses provided by candidates to this question, demonstrating their ability to engage well with the context. Some candidates focused on the idea that changes in population will happen regularly and therefore predictions would need to be updated; within these responses candidates often gave a reason for this – identifying the cause of such a population change and cited war or pandemics as a potential cause of change. Others took a slightly different approach to this question and considered why countries may need the projections, giving examples of resource planning for the future.

Question 10 (c)

(c) Scientists are concerned about food security for future generations.

Describe **two** biological factors that affect food security.

1 .....

.....

.....

2 .....

.....

.....

[2]

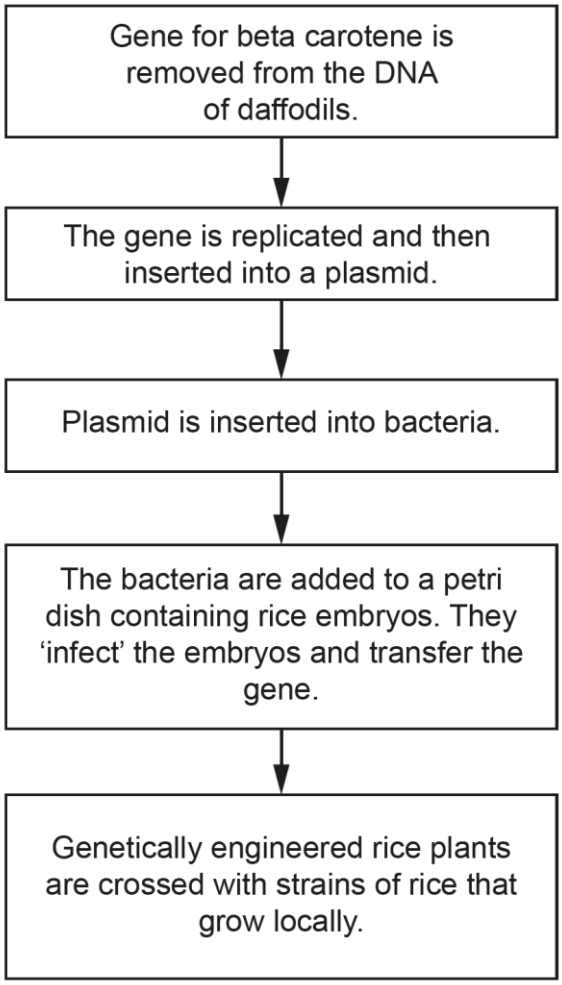
This was a more challenging question with many candidates not seeming to spot that the question required biological factors that would affect food security. As a result, many candidates discussed abiotic factors that would have an impact on food security; common incorrect responses focused on drought, floods or climate change. Those that did name biological factors were often too general in their responses, for example simply stating disease or pests as a reason. They needed to develop this response to include the idea that it would be an outbreak or new disease or pest that would threaten food security. Some candidates stated predators as a threat and perhaps had thought of this more from the perspective of an ecosystem as opposed to food security for human populations.

Question 10 (d) (i)

(d) Scientists think genetic engineering may be one solution for the food security problem.

Scientists have genetically engineered rice to contain beta carotene, which the body can use to make vitamin A.

The diagram shows stages involved in this process.



(i) Explain why it is important that only the gene that is required from the daffodil is removed from the daffodil DNA.

.....

.....

.....

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

This question was found more challenging by candidates. Very few candidates made the link between the genes being transferred and that these genes would code for proteins that would then be made by the recipient of the gene. Candidates did appreciate that transferring additional genes could have undesirable effects on the rice plant. Some candidates thought that removing additional genes from the daffodil may have problematic effects on the daffodil, demonstrating some misunderstandings about gene technologies.

Question 10 (d) (ii)

(ii) Explain why the scientists replicate the genes that have been isolated before inserting them into the plasmids.

.....

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

This question also proved to be found more challenging, and many candidates did not seem to understand what the word 'replicate' means or were unaware of the reasons why scientists make multiple copies of the gene.

Question 10 (d) (iii)

(iii) What vector is used to genetically engineer rice?

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

Many candidates correctly identified the plasmid or bacterium as the vector. Daffodil was an incorrect response given with reasonable frequency, but the range of incorrect responses suggested that candidates may not understand what a vector is.

Question 10 (d) (iv)

(iv) Suggest why the genetically engineered rice plants are crossed with strains of rice that already grow locally.

.....

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

This question was more challenging for candidates, with very few considering that the strains of rice growing locally would be adapted to grow in those environmental conditions. Incorrect responses focused on the taste of the rice, access the growing rice or to allow the rice to reproduce. Genetic engineering contexts that are unfamiliar can prove more difficult for candidates and centres are encouraged to discuss a range of novel applications of genetic engineering with their students.

Question 11 (a)

11 PKD (Polycystic Kidney Disease) is a genetic condition found in cats.
It is caused by a dominant allele of a single gene.

(a) Explain why cat breeders will be more concerned about a genetic condition that is caused by a dominant allele than a recessive allele.

.....

.....

.....

.....

.....

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

This was a more challenging question for candidates. It highlighted that while candidates do generally have a good understanding of inheritance and the role played by dominant and recessive alleles they find it challenging to use the terminology accurately. The most common correct response for this question was the identification that a disease caused by a dominant allele would require only one allele to be present as this would always be expressed in the phenotype, while a disease caused by a recessive allele would require two copies of the allele to be expressed. Many candidates would explain this correctly but would then continue their explanation and state that the presence of a dominant allele made an individual more likely to have the disease. A common incorrect statement often seen was stating that a dominant allele is more likely to be expressed. Very few candidates developed their explanation to explain that a dominant allele would mean that the condition would be more common in a population and that this would be problematic for the cat breeder.

Exemplar 3

A dominant allele is more likely to be expressed than a recessive allele, because it will always be expressed if it is present whereas a recessive allele can only be expressed if the organism is homozygous for that allele. Therefore even if a cat has the recessive allele for a condition caused by it, that individual will not be affected by the condition if the other allele is dominant.

In this exemplar the candidate has explained that when dominant alleles are present they are always expressed in the phenotype. Their first statement about dominant alleles being more likely to be expressed than recessive alleles contradicts the correct statement. They were given 0 marks.

Question 11 (b) (i)

(b) A male cat which is homozygous recessive mates with a female cat that is heterozygous for PKD.

(i) Show how these cats could produce kittens that have PKD.

Use a Punnett square.

Use **D** to represent the dominant allele and **d** to represent the recessive allele.

[4]

Candidates performed very well on this question, demonstrating that they are both familiar with the terms homozygous and heterozygous and well-practiced in completing Punnett squares. Those candidates that were given three marks often did not identify on the Punnett square (or as a percentage statement) which genotypes from the cross would result in kittens with PKD.

Question 11 (b) (ii)

(ii) When the male homozygous recessive cat mates with the female heterozygous cat, they have 2 kittens.

Calculate the probability that both kittens have PKD.

Probability = ... **[2]**

Candidates found this probability question more challenging. While they are well versed at determining the probability from a Punnet square, they found it challenging to apply their mathematical understanding of calculating probability to this context.

Question 11 (c)

(c) The cat breeder could use genome sequencing to determine which of the kittens has PKD. Genome sequencing costs a lot of money.

Suggest why the cat breeder decides to spend this money.

.....

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

Candidates engaged well with this question and a wide variety of suggestions were seen. Most centred on the need to treat a kitten with the disease earlier or to inform the cat breeder whether to sell kittens with PKD or indeed use in a breeding programme. Other candidates considered the economic argument and explained that kittens without PKD could be sold for a higher price.

Question 11 (d)

(d) Cats have 38 chromosomes in a body cell.

How many chromosomes will a cat have in a sperm cell?

Tick (✓) **one** box

19 ☐

38 ☐

57 ☐

76 ☐

[1]

The majority of candidates clearly understood that the number of chromosomes in a sperm cell was half that in a body cell. The most common incorrect response was 38, but incorrect responses were seen infrequently.

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