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June 2025

GCE Biology A 9BN0 01

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Introduction

This paper explored a wide array of topics from the specification, giving candidates multiple opportunities to demonstrate their understanding. The full range of marks was awarded across all questions, allowing for clear differentiation and enabling high-achieving candidates to showcase advanced thinking skills.

Core practicals were assessed in a similar vein to previous years, with some questions requiring straightforward recall and others testing the ability to apply knowledge in unfamiliar contexts. While some candidates showed confusion by mixing up different practicals – highlighting gaps in their grasp of the underlying methods – stronger responses reflected a solid and accurate application of practical knowledge.

The use of key scientific terminology was an ever present requirement, and many candidates used it effectively. However, some lost marks due to incorrect or inconsistent terminology. Developing a strong command of vocabulary throughout the course can help reduce errors under exam pressure.

Extended-response (levels-based) questions were generally handled well by candidates who approached them with a clear plan. A successful strategy here often involves covering a broad range of relevant points rather than focusing too heavily on just one. It is important for candidates to expand upon the material provided rather than simply repeating it, while also ensuring all parts of the prompt are addressed in order to reach the top bands. The second of these questions proved more challenging for candidates than the first.

Question 1(a)

This question was designed to be a straightforward introduction to the paper and allow candidates to settle. Candidates were asked to **state** three changes that take place in the body of a mammal in the first 24 hours after death. The emphasis was on the first 24 hours. Whilst many candidates were able to use the command word effectively and simply list three correct changes using correct terminology, there were many candidates who did not heed the command word and gave detailed descriptions or explanations of these changes. No credit could be given for the details and would have cost the candidates valuable time. Additionally, neglecting to pay attention to the emphasis on 24 hours after death resulted in a number of candidates giving details of the colonisation of the body by the succession of insects. This goes beyond the first 24 hours and so does not answer the question being asked.

1 A sequence of changes takes place in the body of a mammal after death. Forensic scientists can use this to help determine the time of death.

(a) State three changes that take place in the body of a mammal in the **first 24 hours** after death.

(3)

- First 24 hours - Algor mortis where your body will decrease to ambient temperature
- 3 hours onwards - Rigor mortis, due to ~~the~~ anaerobic respiration, less ~~ATP~~ / no ATP produced for muscle contraction, muscles will be stiffened
- temperature can be measured by a rector flexometer
- ~~de~~ decomposition will start, which will lead to colour change, ~~of~~ dewlourisation.

ResultsPlus
Examiner Comments

This response achieved two out of the three marks available. It is an example where the candidate has gone beyond the scope of the command word and given details about some of the changes. Writing the terms 'algor mortis' and 'rigor mortis' alone would have yielded the same number of marks. Mark point 3 was not awarded as colour change or decolourisation was not qualified.

ResultsPlus Examiner Tip

Pay attention to the command word and make sure you know what they mean. Additionally, heed anything in bold – this is key to the question.

1 A sequence of changes takes place in the body of a mammal after death. Forensic scientists can use this to help determine the time of death.

(a) State three changes that take place in the body of a mammal in the **first 24 hours** after death.

(3)

Core body temperature ~~cools~~ cools as heat-producing reactions in the body stop.

Rigor mortis sets in (usually in the first 6-9 hours), causing stiffening of muscles and joints.

Autolysis of cells by enzymes ~~in the body~~ from cells and lysosomes, which begin the breakdown of tissues.

Putrefaction (or decomposition) ~~occurs which then~~ begins, causing the skin of the wall of the abdomen to turn a greenish colour (discoloration) due to the formation of sulphaemoglobin.

ResultsPlus Examiner Comments

This is an example of a response that achieved all three mark points, with two separate points made that would have been sufficient for mark point 3. The candidate has ignored the requirement for **three** changes and spent valuable time giving more along with details of each.

ResultsPlus Examiner Tip

If the question asks for a specific number of points, adhere to that. There will not be any

credit for writing more and will cost time.

Question 1(b)(ii)

Candidates generally scored well on this question that required them to make the link between an increase in temperature leading to the increase in the rate of decomposition and the function of enzymes. Most candidates achieved mark points 1 - 3, whilst a minority were able to recognise what would happen if the increase in temperature was too high as exemplified in mark point 4. Some candidates did not go beyond the description for mark point one and repeated themselves several times. Marks were generally lost because candidates did not refer to **kinetic** energy, opting for energy unqualified instead. Whilst we accepted the idea of more collisions or more enzyme-substrate complexes forming, it would be preferred if candidates recognised that it is the idea of this occuring **more frequently** which is a more accurate explanation of events.

(ii) Explain the effect of an increase in temperature on the rate of decomposition. (3)

An Increase of tempature, Increased the kinetic energy of the enzymes breaking down organic matter, therefore Increased rate of decomposition of more collision of enzyme and Substrate forming more enzyme Substrate complexes, Speeding up rate of reaction until ~~the~~ active Site denature.

ResultsPlus Examiner Comments

This response achieved mp2, mp1 and mp3. It clearly states an increase in kinetic energy of the enzymes, piecing together line 1 and 3 gives you mp1 and we can see both alternatives for mp3. The final statement '...until active site denature' is not quite enough for mp4. This needs to be clearly linked to a decrease in rate.

ResultsPlus Examiner Tip

Whilst we accepted the idea of 'more' unqualified, remember it is really about 'more frequent'.

(ii) Explain the effect of an increase in temperature on the rate of decomposition.

(3)

- Increase temperature increases the rate of decomposition as it causes the core body temperature to fall at a faster rate. This is because there are more frequent collisions between the remaining enzyme and substrate molecules which causes the stages of decomposition and the flies life cycle to occur at a faster rate.

ResultsPlus
Examiner Comments

This response achieves mp1 and mp3. The candidate has forgotten to tell us why there are more frequent collisions for mp2. The reference to 'more frequent' is the preferred response when referring to collisions between enzymes and substrates or fomation of complexes.

ResultsPlus
Examiner Tip

Don't forget to tell us about the kinetic energy!

(ii) Explain the effect of an increase in temperature on the rate of decomposition.

(3)

Increasing temperature increases rate of decomposition. Increasing temperature makes the temperature more optimal for organisms that are decomposing the body. This means ~~these~~ their metebolic process and enzymes are more effective and can increase the rate of decomposition.

ResultsPlus
Examiner Comments

This is an example where the candidate did not go beyond the descriptive aspect and repeated themselves for mp1. They clearly recognise enzymes are involved but needed to tell us **why** 'enzymes are more effective and can increase the rate of decomposition'. This response scored one mark.

ResultsPlus
Examiner Tip

Remember 'explain' requires you to give some details on how or why something happens.

Question 2(b)

This question required candidates to pick up on two aspects: 1) the link between global warming/climate change and increased temperature/droughts and 2) the idea this means the plants will survive and be available for future generations. Many candidates were able to achieve mp1 but not mp2; this is because they did not explain the sustainable aspect, paraphrasing the question instead.

The fruit of the enset plant is the main source of starch for many people.

Enset plants are resistant to drought and high temperatures.

Explain why these plants may be a sustainable food source as global warming brings about climate change.

(2)

Climate change can lead to high temperatures as greenhouse gases absorb infrared radiation, trapping it in the atmosphere. Climate change can also cause droughts as rainfall patterns change. Enset plants will be able to grow despite these changes, and are therefore a sustainable food source as they won't go extinct ~~like~~ like many other plants.

ResultsPlus
Examiner Comments

This is an example of a response that gave excellent detail for mp1 at the expense of mp2. The question has been paraphrased with the use of 'sustainable food source' without telling us what that actually means.

ResultsPlus
Examiner Tip

Don't paraphrase questions - tell us what those words mean!

The fruit of the enset plant is the main source of starch for many people.

Enset plants are resistant to drought and high temperatures.

Explain why these plants may be a sustainable food source as global warming brings about climate change.

(2)

Despite the harsh conditions of little rain fall and frequent droughts they still grow. They ~~will still be~~ can be regrown and ~~are~~ meet the needs of the current generation and remain available for future generations. Global warming increases temperature leading to an increase in water levels and so these plants will be able to survive it and are sustainable.

ResultsPlus
Examiner Comments

This response achieves mp2 first and then mp1. They clearly state that the plants can be re-grown (despite harsh conditions) for now and future generations. They then make the link between global warming increasing temperatures on lines 4/5.

ResultsPlus
Examiner Tip

If there are two aspects to a question and two marks available, don't spend too much time writing lots of detail about one aspect at the expense of the other.

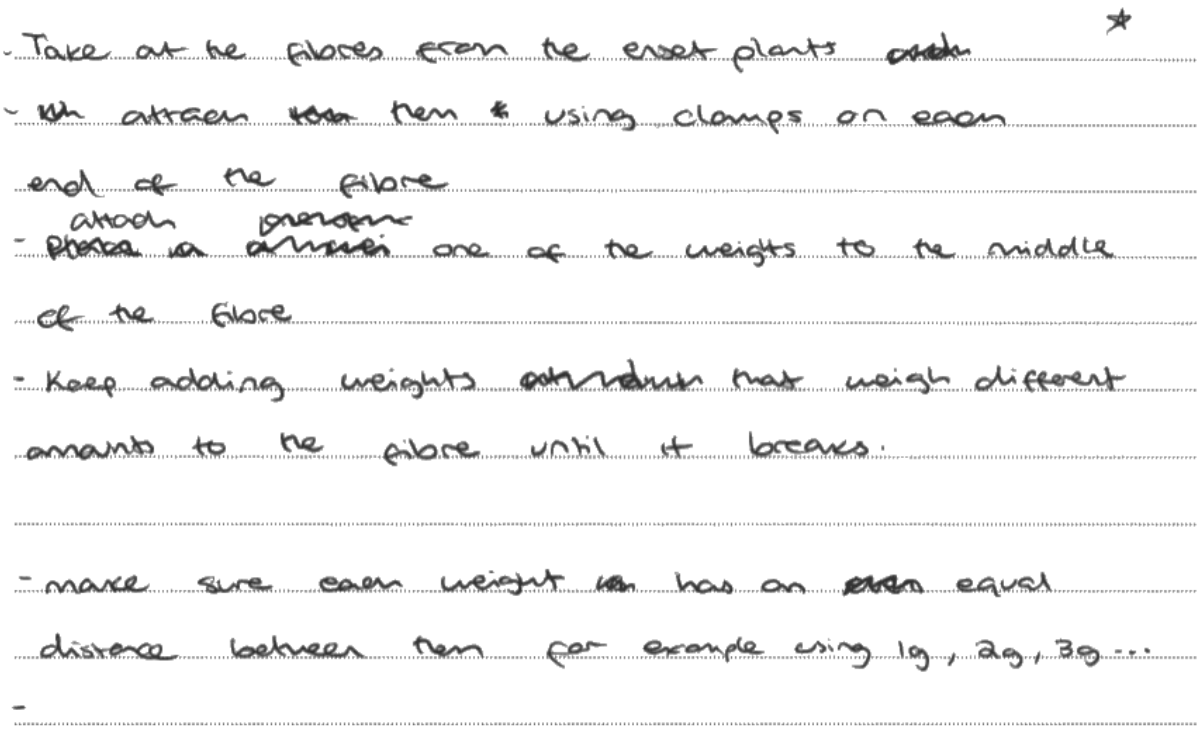
Question 2(c)

This required candidates to be familiar with core practical 8. The mark scheme for this followed a typical example for a four-mark practical question - control variable, method, repeats and data processing. This is an approach candidates would benefit from taking when revising their core practicals. Many candidates were able to achieve three out of the four available marks; those that achieved mp4 for the correct equation were in the minority, suggesting candidates had not practised processing data obtained from this investigation and so had not become familiar with it. Candidates are obviously well rehearsed with the idea of repeating experiments to allow calculation of a mean as this was frequently seen although some did repeat their investigation but forgot to tell us what they were going to do with the replicate sets of data. A significant proportion of candidates got addition of weights or masses muddled although they often achieved this mark point by reference to addition of 5g, 10g etc, for example.

(c) Leaves of enset plants can be used to make fibres for weaving.

Describe how the tensile strength of fibres from enset plants can be determined.

(4)



ResultsPlus
Examiner Comments

This response achieved mp2 only. Had the last comment not been added, it would not have been possible to award this mark.

ResultsPlus
Examiner Tip

When giving details on practicals, think about what control variables you need to have in place to make it valid.

(c) Leaves of enset plants can be used to make fibres for weaving.
Describe how the tensile strength of fibres from enset plants can be determined.
(4)

force / cross sectional area
pulling force

Cut out equal lengths and width of enset plants. Attach one end of the enset plant fibre to a clamp stand and the other end to another clamp stand. Ensure plant fibre is straightened across 2 clamp stands. Add increasing masses to the centre of the plant fibre eg at 5g intervals. Note down the mass required to snap a plant fibre. Repeat 3x for each distance and calculate a mean. Repeat the experiment for different distances. Use the formula: (force ÷ cross sectional area) to determine tensile strength. CV: type of plant species used, intervals of masses and length and width of plant fibre by using a ruler.

(Total for Question 2 = 7 marks)

ResultsPlus
Examiner Comments

This is an excellent example that achieves all four of the mark points.

ResultsPlus
Examiner Tip

Organise your response into a logical order before commiting pen to paper. A few seconds spent doing that can save you time in the long run.

(c) Leaves of enset plants can be used to make fibres for weaving.

Describe how the tensile strength of fibres from enset plants can be determined.

(4)

- tensile strength = weight ÷ surface area.
- extract single plant fibres from the enset plant for example, tweezers.
- clamp each side to hold in place.
- Add weight to the fibre and record when it breaks.
- Use variety of weight, increasing slowly.
- we some % species, age of plant when repeating. repeat 5× times and calculate a mean.

ResultsPlus
Examiner Comments

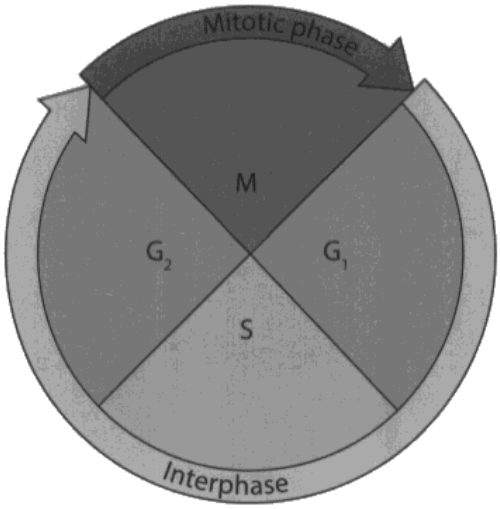
This is an example of a response where the candidate has just written down everything they can remember about the practical without thinking about details. They have achieved mp3 at the end but there is nothing else creditworthy. The first line does not get mp4 as surface area is not equivalent to cross-sectional area. Reference to use of same species is also not relevant as the question is specifically about enset plants and so this is already given in the question.

Question 3(a)(i)

Candidates were frequently able to achieve one of the two available marks here. However, it was evident that attention has not been paid to the different parts of the interphase by candidates. Lots of references to replication of DNA were seen which was not creditworthy. It was important for candidates to recognise cell growth can occur in two ways (in size or in number) and thus, qualify which was appropriate here. Descriptions of prophase were also seen, suggesting candidates had not studied the diagram provided carefully to recognise they were being asked about interphase rather than stages of mitosis.

3 The cell cycle allows cells to divide and produce new cells for growth and repair.

(a) The diagram shows the stages of the cell cycle.



(i) Describe what happens in the G_1 phase of the cell cycle.

(2)

Cell ~~grows on~~ synthesises new organelles like mitochondria, ribosomes, golgi apparatus.
Cell grows in size.

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Examiner Comments

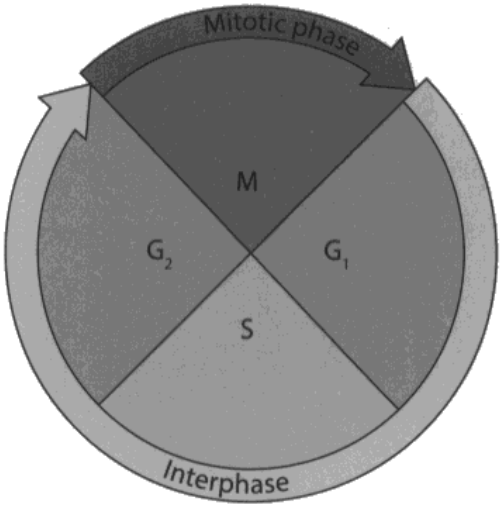
This is an example of a response that achieves both available marks. Synthesis of new organelles and cell growing in size are both on the mark scheme.

ResultsPlus
Examiner Tip

When talking about cell growth, be clear about whether you are referring to increase in number or size. Both of these happen in the cell cycle.

3 The cell cycle allows cells to divide and produce new cells for growth and repair.

(a) The diagram shows the stages of the cell cycle.



(i) Describe what happens in the G_1 phase of the cell cycle.

(2)

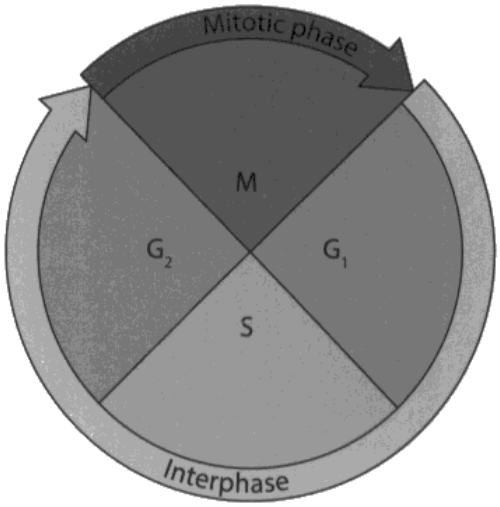
In the G1 phase the cell grows, organelles are made and proteins are made.

ResultsPlus
Examiner Comments

This response achieves both available mark points but for the references to organelles and proteins being made. The reference to the cell growing did not score as it is not qualified with size.

3 The cell cycle allows cells to divide and produce new cells for growth and repair.

(a) The diagram shows the stages of the cell cycle.



(i) Describe what happens in the G_1 phase of the cell cycle.

(2)

cell continues to grow, and prepares for DNA replication by synthesising proteins and mRNA

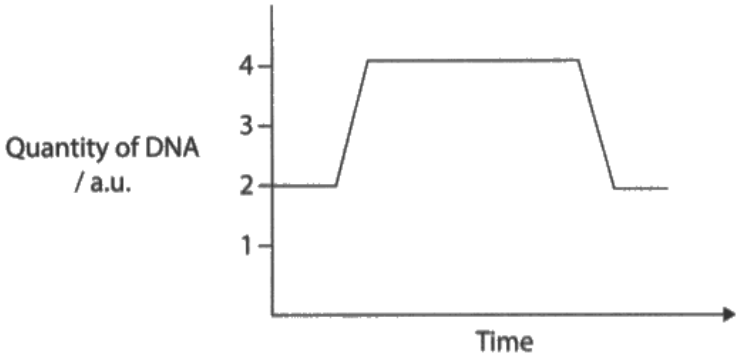
ResultsPlus
Examiner Comments

This response achieved a mark for the synthesis of proteins. The reference to cell continues to grow was not creditworthy.

Question 3(a)(ii)

This question required candidates to **explain** changes in DNA quantity as a cell went through the cell cycle. Careful attention to use of terminology was essential here; there were frequent references to chromosome numbers doubling, which is not the case. Many candidates were able to recognise that the quantity of DNA increases because it replicates although this was not always explicitly stated as doubling. Equally, candidates often simply quoted the values from the diagram provided without doing the interpretation. At the other end, when the DNA is reducing, it was often not recognised as halving. Additionally, it was often linked to completion of mitosis/telophase, rather than cytokinesis.

(ii) The graph shows the change in DNA content of a cell during the cell cycle.



Explain the changes in the quantity of DNA in a cell during the cell cycle.

(3)

During interphase, DNA is replicated so doubles from 2 to 4.
It is maintained during prophase, metaphase, anaphase, telophase.
In cytokinesis the cell split halving DNA content so each cell
has 2 a.u DNA forming two genetically identical daughter cells

ResultsPlus
Examiner Comments

A clear response that has linked the changes in DNA quantity to stages of the cell cycle, referring to doubling and halving. All three mark points achieved.

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Examiner Tip

Don't leave the interpretation of data to the examiner!

Explain the changes in the quantity of DNA in a cell during the cell cycle.

(3)

Quantity of DNA increases from 2 to 4 au. during interphase as the chromosomes are visible and formed, and DNA is formed, the ~~nucleus~~ nuclear envelope is also formed, nucleolus is formed.
Quantity of DNA decreases from 4 to 2 au. during mitosis as the chromosomes condense and are pulled to the opposite ends of the cell, the ~~nucleus~~ nuclear envelope and the nucleolus break down, so quantity of DNA is lower.

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Examiner Comments

This response scored zero marks.

Question 3(c)(ii)

Candidates found this question challenging although most candidates were able to achieve one of the two available marks. Candidates frequently described a globular protein as having tertiary structure without giving details on what this is. Attempts at mp1 often did not go quite far enough; descriptions of spherical were seen but not linked to a polypeptide or chain of amino acids being folded into this. Candidates often lost marks when attempting mp4; they referred to hydrophilic/hydrophobic regions rather than giving the required level of detail in terms of R groups. The most commonly seen marks were references to the bonds between R groups (mp2 and mp3).

(ii) Red blood cells contain haemoglobin, a globular protein.

Describe the structure of a **globular protein**.

(2)

Globular proteins are round and compact. They have hydrophilic groups outside the protein and hydrophobic groups on the inside so globular proteins are soluble.

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Examiner Comments

This response almost achieved mp4 - missed the reference to R groups.

ResultsPlus
Examiner Tip

Be really detailed when talking about structure of the biological molecules.

(ii) Red blood cells contain haemoglobin, a globular protein.

Describe the structure of a **globular protein**.

(2)

Globular protein haemoglobin is in a sphere shaped structure with the outside being hydrophilic - which is water loving - and the inside being hydrophobic - which is water repelling -. This makes globular proteins good transport proteins as they are soluble.
Tertiary structure of protein with bonds like ionic interaction, hydrogen and disulfide bridges between the R groups on the polypeptide chains.

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Examiner Comments

This response achieved the maximum two marks for the last two lines (mp2 and mp3). The first part was missing details such as reference to chain of amino acids and R groups for mp1 and mp4 to be awarded.

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Examiner Tip

Be consistent with your level of detail through your response.

Question 4(a)(ii)

This question was well answered with the majority of candidates achieving maximum marks, showing constructive use of past papers and learning of the method from carrying out the core practical. Candidates were able to give a lot of relevant detail of the method of gel electrophoresis. Common errors seen were reference to agar gel, rather than agarose. However, this usually did not restrict marks as there was often something else creditworthy in the response for mp1. There was a lot of reference to PCR which is not required; the question asked about how gel electrophoresis can be used and so this should be the starting point. Candidates should be reminded to explicitly state they are using DNA from two different sources for comparison if this is the context of the question and not expect the examiner to pick up on any inference. Comparison of fragments was seen from time to time which is not acceptable as we do not see the fragments.

(ii) There are two populations of cheetah: the Asian cheetah and the African cheetah.

Describe how gel electrophoresis can be used to determine that these two populations of cheetah are closely related.

(3)

- From gel electrophoresis, the more strands aligned on the same row means the more closely related the two populations are.
- Add a drop of DNA sample into the gel electrophoresis, the positive and negative charged electron from the machine would generate the results into different strands on one column.
- Putting the two columns together then compare allow us to see ~~th~~ how similar the two samples are.

ResultsPlus
Examiner Comments

This response did not achieve any marks. Strands are not considered to be the same as bands in gel electrophoresis. If detail about wells had been added in the second point, this would have been sufficient for mp1 to be awarded. We also do not know what the 'two populations' or 'two samples' are; had a reference to cheetahs been added, we may have been able to award other mark points.

ResultsPlus
Examiner Tip

Use terminology correctly and use the context of the question.

(ii) There are two populations of cheetah: the Asian cheetah and the African cheetah.

Describe how gel electrophoresis can be used to determine that these two populations of cheetah are closely related.

(3)

~~DNA~~ Restriction enzymes are added to both samples of amplified DNA. Then samples are added in prepared wells in agarose gel. Electrical current is passed through the gel and stopped after 5 hours. Fluorescent ~~dye~~ die which was added to DNA samples is identified using a UV light. Compare the positions and sizes of the DNA fragement of the two species. Any similarities show interbreeding.

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Examiner Comments

This response includes a lot of detail about the process of gel electrophoresis for mp1; use of fluorescent tags was seen frequently. Comparison of fragments is not correct and so cannot be awarded. The reference to two species is also incorrect; the context of the question is two populations of the same species.

ResultsPlus
Examiner Tip

We compare bands, not fragments! Also remember to include what it is about the bands we

compare – this will depend on the context but is often their position.

(ii) There are two populations of cheetah: the Asian cheetah and the African cheetah.

Describe how gel electrophoresis can be used to determine that these two populations of cheetah are closely related.

(3)

Extract DNA samples from both the Asian cheetah and African cheetah and amplify them using ~~gel electrophoresis~~ PCR. Add restriction enzymes to cut up the DNA into fragments. Add a marker so the DNA can be viewed under UV light. Gel electrophoresis - load the DNA samples into wells and run an electrical current through, this will cause the DNA to become negatively charged and move towards the anode, seperating the DNA fragments by lengths*. Compare the pattern / size / location of the DNA bands of Asian and African cheetah. The more similarities in pattern of bands, the closer related the cheetahs are.

* the shorter fragments move further

ResultsPlus
Examiner Comments

A good response that has all of the mark points. Time was wasted giving details about PCR at the start which was ignored.



Start at the point the question tells you to.

Question 4(b)(i)

Candidates found this question challenging with most being able to say that there would be an increase in genetic diversity. There were a lot of other topic-related key terms used but these were not appropriate for the context; candidates need to be clear on the subtle differences between them. There were lots of references to use of stud books suggesting there are misconceptions about what national parks and game reserves are. Since these are animals in the wild, we cannot prevent inbreeding depression but can reduce the likelihood of it. There were a lot of good responses explaining why the different populations would have different gene pools, ie different selection pressures within their own environments meaning different alleles were favourable demonstrating a good understanding of this aspect of the course.

(b) Cheetahs from Africa are being reintroduced into a national park in India.

They are being taken from game reserves in Namibia and South Africa.

(i) Explain the advantages of introducing cheetahs from these two populations. (3)

It will introduce a unique genetic diversity to the cheetah population in the national park because there will be a unique variation of alleles if the two populations are introduced rather than one. This decrease the chance of genetic drift and inbreeding depression and increases the risk of survival of the cheetah's. This is because if there was a disease to suddenly hit, there's more alleles so a higher chance that one is advantages for natural selection to occur.

ResultsPlus
Examiner Comments

An example of a response that achieved the maximum three marks (mp2, mp4, mp3). Correct terminology has been used appropriately throughout. Reducing the chance of inbreeding depression is the correct explanation rather than preventing it; the context of the question is in the wild and so it would not be possible to prevent this happening but the chances can be reduced by the mixing of two distinct populations.

ResultsPlus
Examiner Tip

Use the context of the question given to structure your answer.

(b) Cheetahs from Africa are being reintroduced into a national park in India.

They are being taken from game reserves in Namibia and South Africa.

(i) Explain the advantages of introducing cheetahs from these two populations. **(3)**

- increases genetic diversity ~~and gene po~~ and increases biodiversity / species diversity in the national park.
- allows to ~~interbreeding to occur~~ breeding between the different cheetahs to occour.
- prevents inbreeding
- prevents extinction of cheetah species as they mate more.

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Examiner Comments

Mp2 only awarded here. This response includes a lot of key terms but they are not appropriate for the context of the question. Reference to preventing inbreeding is not creditworthy; it cannot be prevented.

Question 4(b)(ii)

Candidates found this question challenging and details on competition were frequently seen. Other answers included very generic responses referring to behavioural, anatomical or physiological adaptations, sometimes mixed in with inheritance of favourable alleles, without going further. Developing the aspect of behavioural adaptation and giving the specific idea of being able to obtain food would yield mp1. Candidates were then expected to go a little further and deduce why this specific adaptation would increase the survival chance with the idea that they would, therefore, not starve for mp2. Candidates also tended to paraphrase the question with statements such as 'they will know how to hunt for food and so can survive'. Given the survival idea is in the question, this will not yield any credit and so only one point has been made here.

(ii) The animals chosen were all born in the wild alongside other predators.

Deduce why this may increase the survival chances of the cheetahs when they are relocated to the national park in India.

(2)

They are able to effectively hunt food sources so won't die of starvation. They also know how to defend themselves against other predators as they grew up with other predators, so are more likely to survive interaction with other predators compared to cheetahs who weren't born in the wild.

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Examiner Comments

A response that achieved maximum marks in the first sentence. A good example of how writing concisely can be productive, saving time for other questions whilst still gaining all the available marks.

ResultsPlus
Examiner Tip

Ensure you don't paraphrase the question but extend your response so you have answered it.

(ii) The animals chosen were all born in the wild alongside other predators.

Deduce why this may increase the survival chances of the cheetahs when they are relocated to the national park in India.

(2)

they may already have developed survival instincts and mechanisms for example they may have behavioural adaptations ~~such as~~ physiological adaptations or anatomical adaptations which increases their survival chances. They may know how to hunt for prey and hav to camouflage and hide from predators so the cheetahs will know how to protect themselves and developed advantageous alleles through natural selection

(Total for Question 4 = 9 marks)

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Examiner Comments

The first four lines of this response is an example of several responses seen. This response does then give the idea of being able to hunt for mp1 but does not develop this far enough for further marks.

Question 5(a)

Many candidates tended to interpret this question as 'what is meant by the fluid mosaic model of the membrane?' which is not what the question was asking. It is clear candidates are not considering the difference between structure, function and properties. A large number of answers gave excellent descriptions of the phospholipids based on their properties but failed to refer to the term 'phospholipid bilayer' thus missed out on mp1. For mp2, it was necessary to describe the location of the proteins in the membrane rather than their functional aspects, ie carrier or channel proteins were not credited as this does not describe their position within the membrane. Lots of alternative descriptions were accepted here. A simple reference to one of glycoproteins, glycolipids or cholesterol being present was sufficient for mp3. A well annotated diagram was seen in a number of responses but the correct annotations had to be present for marks to be awarded; an unlabelled diagram was not sufficient.

5 All cells are surrounded by a cell surface membrane.

This membrane controls the movement of substances in and out of the cell.

(a) Describe the fluid mosaic structure of a cell surface membrane.

(3)

The fluid mosaic structure ~~involves~~ describes a phospholipid bilayer, which consists of two rows of ~~w~~ phospholipids (each of which has a hydrophobic "head" and hydrophic "tail" or chain of amino acids), through which small, non charged soluble particles can pass through. This model also includes protein channels and protein carriers, which allow larger or charged particles to pass through. The phospholipids are arranged head to head with the rows being parallel to each other

ResultsPlus
Examiner Comments

Only mp1 was awarded here for reference to the phospholipid bilayer. No credit is given for reference to proteins channels or carriers as these are functional rather than structural.

ResultsPlus
Examiner Tip

If you are asked about structure, don't write about properties or function. It won't achieve any credit and costs you valuable time.

5 All cells are surrounded by a cell surface membrane.

This membrane controls the movement of substances in and out of the cell.

(a) Describe the fluid mosaic structure of a cell surface membrane.

(3)

The fluid mosaic model suggests that the cell membrane is permeable to small non-polar substances. It contains both intrinsic proteins (ie carrier/channel proteins) and extrinsic proteins. It ~~so~~ is made up of a phospholipid bilayer, which has a polar hydrophilic phosphate head, and a non-polar hydrophobic fatty acid tail. It contains cholesterol embedded in the membrane.

ResultsPlus
Examiner Comments

This response initally discusses properties of the membrane which is not relevant to the question and so ignored. The candidate then achieves mp2, mp1 and then mp3 at the end.

ResultsPlus
Examiner Tip

Look how many marks there are and match this to the number of ideas you need. This will help guide how much you need to write about each part of the membrane. Giving details about hydrophobic and hydrophilic parts of the bilayer is properties, not structure and so

does not gain credit.

Question 5(b)(i)

The majority of candidates were able to achieve both marks available for this question. There were a minority that referred to water being taken up by active transport, perhaps mixing it with the uptake of mineral ions which creates the lower water potential in the cells, allowing the movement of water in by osmosis. Similarly, there were a handful of candidates that gave two possible answers, eg active transport and osmosis; the examiner will not choose which one to mark and so this is not creditworthy if they contradict each other. The phrasing we were looking for was movement from a higher **water** concentration to a lower **water** concentration / lower **solute** concentration to a higher **solute** concentration. It was necessary to have the reference to wither water or solute in the response for mp2 as the descriptor (higher or lower) is dependent on which is being referred to. Thus, a number of candidates missed this mark point for simply stating movement from a higher concentration to a lower concentration. Generally, those candidates that achieved mp3 did so using the term partially permeable to describe the membrane. There were some references to semi-permeable which were not credited. We accepted a correct reference to water potential as many candidates will have been taught this and phrased their explanation in this context, even though consideration of water potential is not on the specification.

(b) Water and mineral ions enter a plant through the root hair cells.

(i) Explain how water enters these cells.

(2)

water enter through diffusion, the moremnt of ~~water~~ water particles from an area of high concentrat-ion to an area of low concentration, ~~to~~ going down the concentration gradient. large molecules are taken in by ~~channel~~/carrier protein and taken into the cell.

ResultsPlus
Examiner Comments

An example of a response that did not achieve any marks due to missing key terms. Diffusion was not sufficient here as the question was specifically about water and there is no qualification of water or solute for the concentrations.

ResultsPlus
Examiner Tip

Remember, water movement into or out of cells is by osmosis and be clear whether you are referring to water or solute concentrations.

(b) Water and mineral ions enter a plant through the root hair cells.

(i) Explain how water enters these cells.

(2)

Water enters cells by osmosis from a high water concentration to a low water concentration through a partially permeable membrane.

ResultsPlus
Examiner Comments

A response that clearly illustrates all three of the mark points.

ResultsPlus
Examiner Tip

Aim for conciseness by using correct terminology.

(b) Water and mineral ions enter a plant through the root hair cells.

(i) Explain how water enters these cells.

(2)

Water enters by osmosis - water moves from a high water potential in the soil to a low water potential in the root hair cell through a partially permeable root hair cell membrane.

ResultsPlus
Examiner Comments

An example of all three mark points using the option of referring to the water potential.

Question 5(c)

This is another question where candidates did not use the term 'structure' in the question to formulate their response, often referring to the properties of the lining in their explanations, permitting hydrogen bonding and allowing cohesion/adhesion to occur. There was also some confusion between xylem and phloem being responsible for water transport. All mark points were seen with mp1 being the most commonly achieved. Some candidates missed mp2 as they referred to lignin but not its location within the xylem, ie the walls. There were also frequent references to schlerenchyma which was not relevant to this question.

(c) Explain how the structure of tissues in the stem enables water to be transported from the roots to the leaves.

(4)

Water is transported from the roots to the leaves via xylem tissue. Xylem tissue cell walls are lignified which makes the walls impermeable, preventing water from leaking and also provides structure to enable the tissue to withstand the pressure of the water column. Furthermore, xylem tissues do not contain any end walls and don't have any cells in their cytoplasm as it is dead tissue. This means the flow of water from roots to leaves is not disrupted. Lastly, xylem vessels contain pits which enable the lateral movement of water between xylem vessels.

ResultsPlus
Examiner Comments

This was a good response that uses key terminology correctly and achieves three of the four available marks. It is clearly stated that water is transported in the xylem (mp1), the cell **walls** are lignified (mp2), making the walls impermeable, preventing water leakage and withstanding water pressure (either of these achieved mp3) and then the last sentence achieves mp5. Disrupted was not quite enough for mp4 - we needed the idea of less resistance to water movement.

(c) Explain how the structure of tissues in the stem enables water to be transported from the roots to the leaves.

(4)

Xylem tissue is dead, hollow tubing allowing for the movement of water up the stem via cohesion-tension. This is due to the xy

-Sclerenchyma tissue gives strength and stability to the plant stem. Strengthened by lignin.

ResultsPlus
Examiner Comments

A typical response where only mp1 was achieved for the reference to xylem tissue. There is no link between lack of resistance to water movement with the idea that the xylem is hollow and so cannot be awarded mp4. The part about schlerenchyma at the end is irrelevant to the question as it does not transport water.

ResultsPlus
Examiner Tip

Read the question carefully - this one was about transport of water in plant stems so should direct you towards the xylem. This will help avoiding writing material that is not relevant to the question.

Question 6(b)

Candidates performed well on this question with most achieving both of the available marks. Marks were lost through not being careful enough with language, eg referring to washing bedding rather than disinfecting it.

(b) Describe **two** practices used in hospitals to prevent the spread of infection.

(2)

1 hospitals ensure that patient and staff/doctors wash hands regularly / use hand sanitiser to kill pathogens - hygiene. to reduce the spread of infection.

2 Hospitals ~~dead~~ regularly screen and isolate suspected infected patients to reduce the spread of infection.

ResultsPlus
Examiner Comments

An example of a typical response that achieved both of the available mark points. In the second point, the reference to screening on its own would not achieve the mark but they have gone onto give the action that would be taken, ie isolation which is mp4.

(b) Describe **two** practices used in hospitals to prevent the spread of infection.

(2)

1 increased ↓ Washing of surfaces and bed clothes

2 Regular check for patients with antibiotic resistant bacteria

ResultsPlus
Examiner Comments

An example of a response that did not quite go far enough to achieve marks. In the first point, we needed the idea of disinfecting rather than simply washing. In the second point, this does not quite answer the question as checking on its own will not prevent the spread – we need to know that patients would be isolated.

ResultsPlus
Examiner Tip

Check what you have written – does it answer the question being asked?

Question 6(c)(i)

A large proportion of candidates were able to achieve maximum marks on this question, demonstrating a clear understanding of this core practical. Some candidates missed mp1 because they added bacteria to a petri dish with no mention of agar or used agarose instead. Candidates should refer to what dimension they are measuring and comparing in a zone of inhibition. A number of candidates simply stated they would measure/compare the zone of inhibition which was not sufficient for mp4.

(c) Antibiotics are used to control bacterial infections.

Many organisms produce substances with antibiotic properties.

The table shows some information about two of these substances.

Antibiotic substance	Potential use
Seraticin	Effective against MRSA, *C. difficile*, *E. coli*
Reutericyclin	Effective against MRSA

Some of these antibiotics may be effective against resistant bacteria such as MRSA.

(i) Devise an investigation to compare the effectiveness of these two antibiotic substances.

(4)

- Set up two petri dishes gently spreading bacteria over the agar using an inoculating loop. Then, prepare solutions containing seratcin and reutericyclin which are the same concentration. Dip paper discs into each solution, then place them on the agar, in the petri dish. Use a disc soaked in distilled water as a control. Gently tape on the lid of the petri dishes and store them upside down at 37°C for 24hours. Then measure the diameter of the zone of inhibition. Repeat the procedure to find a mean diameter for each antibiotic, and find the area of the zone of inhibition. Compare these for the antibiotics. A larger area means the antibiotic is more effective.
Use a t-test to see if the results are statistically significant.

ResultsPlus
Examiner Comments

A clear response, written in a logical sequence, that illustrates all mark points. Reference to agar with bacteria (mp1), same concentrations of both antibiotics (mp2), use of paper discs for the antibiotics (mp3), incubation at a suitable temperature/time (either of these are acceptable for mp4), measuring and then comparing the diameter of the zone of inhibition (mp5).

ResultsPlus
Examiner Tip

Aim to write investigation methods in a logical manner - this will help you ensure you don't miss anything!

(c) Antibiotics are used to control bacterial infections.

Many organisms produce substances with antibiotic properties.

The table shows some information about two of these substances.

Antibiotic substance	Potential use
Seraticin	Effective against MRSA, *C. difficile*, *E. coli*
Reutericyclin	Effective against MRSA

Some of these antibiotics may be effective against resistant bacteria such as MRSA.

(i) Devise an investigation to compare the effectiveness of these two antibiotic substances.

(4)

① First ~~prepare~~ prepare two petri dishes.

② In a petri dish pour the molten agar and let it set, close the ~~the~~ the lid.

③ Once its set place the antibiotics in each petri dish and close the lid immediately. Label the petri dishes.

④ Let it set for 24 hours.

⑤ After 24 hours, measure the zone of inhibition occupied by the antibiotics in their respective petri dish.

ResultsPlus
Examiner Comments

This response illustrates typical errors/omissions seen that have resulted in missed marks. There is agar but no bacteria (missed mp1), no reference to same concentrations of antibiotics (missed mp2), there is a reference to adding antibiotics to the petri dishes but not how this was going to be done, eg wells/paper discs (missed mp3) and measurement of the zone of inhibition without reference to which dimension or a comparison (missed mp5). A mark was achieved for incubation for 24 hours (mp4).

ResultsPlus
Examiner Tip

Remember those details!

Question 6(c)(ii)

All possible scores were seen in equal measure for this question. Candidates were required to use the information provided about the structure of peptidoglycan and their own knowledge about cellulose to carry out a compare and contrast. Again, responses containing information on properties or function were seen which does not achieve any credit. A small number of candidates wrote a paragraph on cellulose and then a paragraph on peptidoglycan which is not compare and contrast and so not creditworthy. An organised approach would be to construct a paragraph on similarities and then another on differences. Use of 'both have...' or 'x has this, whilst y has that' should be extensive through responses to these questions. A number of candidates muddled cellulose with collagen or their general carbohydrate structure knowledge with that of proteins.

(ii) Some antibiotics destroy the bacterial cell wall.

Bacteria have cell walls made of peptidoglycan.

Peptidoglycan is a polymer of sugars with amino acids attached. The sugars are joined by glycosidic bonds. Cross links form between the amino acids in adjacent chains.

Compare and contrast the structures of peptidoglycan and cellulose.

(3)

Peptidoglycan is made of sugars and amino acids whereas cellulose is made by β-glucose. [redacted] In peptidoglycan, cross links form between the amino acids and adjacent chains. [redacted] Whereas cellulose is a triple helix structure with every other β-glucose molecule flipped. Peptidoglycan uses glycosidic bonds which is the same as cellulose.

ResultsPlus
Examiner Comments

This response achieved mp1 for the last sentence. It was not possible to award mp3 as it is not clear that cellulose does not contain the amino acids. There is evidence here of the muddling between cellulose and collagen with the reference to triple helix structure.

ResultsPlus Examiner Tip

When asked to compare and contrast, be clear whether something is present or not, eg peptidoglycan has amino acids but cellulose does not. Don't leave it to the examiner to guess what you mean!

(ii) Some antibiotics destroy the bacterial cell wall.

Bacteria have cell walls made of peptidoglycan.

Peptidoglycan is a polymer of sugars with amino acids attached. The sugars are joined by glycosidic bonds. Cross links form between the amino acids in adjacent chains.

Compare and contrast the structures of peptidoglycan and cellulose.

(3)

cellulose is a polysaccaride it is made from glucose molecules in a 1,4 bond it is called and mainly used for storage and insolation and structure. peptidoglycan is found in bacterial cells and its found in the cell cwall it contains both amino acids and glucose meaning it has both glycosicle and peptide bonds whilst cellulose only contains peptide bonds. Peptidoglycan also provides structure and affects the turgidy of the bacterial cell wall which the cellulose also does but in plants.

ResultsPlus Examiner Comments

This response did not achieve any of the mark points as there is no compare and contrast; there are sections of writing about cellulose and then separate parts about peptidoglycan. There is also reference to function and location which is not creditworthy as the question is about structure.

ResultsPlus
Examiner Tip

When asked to compare and contrast, write a paragraph on similarities and then a separate paragraph on differences. Avoid writing a paragraph about, eg cellulose and then a separate one on, eg peptidoglycan.

(ii) Some antibiotics destroy the bacterial cell wall.

Bacteria have cell walls made of peptidoglycan.

Peptidoglycan is a polymer of sugars with amino acids attached. The sugars are joined by glycosidic bonds. Cross links form between the amino acids in adjacent chains. ↑ hydrogen bonds

Compare and contrast the structures of peptidoglycan and cellulose.

(3)

Both are polymers of sugars. However, peptidoglycan has amino acids attached whilst cellulose does not. They ~~are~~ both have their sugars joined by glycosidic bonds. Cross links form between amino acids in adjacent chains in peptidoglycan, but hydrogen bonds form between OH groups in adjacent chains in cellulose.

ResultsPlus
Examiner Comments

This response makes clear use of 'both have...' and peptidoglycan has... but cellulose does not' which will allow the candidate to access the marks – this is compare and contrast. This response achieves mp1, mp2 and mp3. This is maximum marks although the addition of peptide bonds when referring to the cross links between amino acids would have demonstrated the final mark point.

(ii) Some antibiotics destroy the bacterial cell wall.

Bacteria have cell walls made of peptidoglycan.

Peptidoglycan is a polymer of sugars with amino acids attached. The sugars are joined by glycosidic bonds. Cross links form between the amino acids in adjacent chains.

Compare and contrast the structures of peptidoglycan and cellulose.

(3)

Both peptidoglycan and cellulose have glycosidic bonds joining sugars together. They also both contain Cross links between adjacent chains. Peptidoglycan contains both sugars and amino acids while Cellulose only contains sugars but being β glucose.

ResultsPlus
Examiner Comments

A concise response that clearly contrasts and compares the two molecules, achieving maximum marks. It is possible to award mp3 as the candidate has said 'peptidoglycan contains both sugars and amino acids while cellulose only contains sugars...' indicating the amino acids are not there.

Question 7(a)(i)

Candidates generally understand the sequence of events during mammalian fertilisation. However, lack of reading the question correctly or using key terminology appropriately cost some candidates marks. There were a lot of references to release of cortical granules; it's the release of the contents of these that leads to the sequence of events and so this was ignored.

Stoats mate once a year and can produce, on average, 12 offspring.

(a) Before fertilisation, the cell membrane of a sperm cell fuses with the egg cell membrane.

(i) Describe the events **after** the fusion of these membranes.

(3)

The acrosome vesicles within the sperm cell will release digestive enzymes via exocytosis into the egg membrane to break down the zona pellucida of the egg cell, to allow the sperm cell to fertilised the egg.

ResultsPlus
Examiner Comments

This response is describing the acrosome reaction which comes before the starting point given in the question and so is not creditworthy.

ResultsPlus
Examiner Tip

Pay attention to the start point given in the question and start from there, not the step before or the step after!

Stoats mate once a year and can produce, on average, 12 offspring.

(a) Before fertilisation, the cell membrane of a sperm cell fuses with the egg cell membrane.

(i) Describe the events **after** the fusion of these membranes.

(3)

- The nucleus of the egg fuses with the nucleus of sperm.
- Enzymes are released that thicken the membrane of the egg preventing entry of further sperm cells.
- The cell undergoes mitosis to give rise to more identical cells.

ResultsPlus
Examiner Comments

This response achieves mp4 for the fusion of the two nuclei on the first line. The remainder lacks use of correct terminology to be creditworthy.

ResultsPlus
Examiner Tip

Use correct terminology for the context given.

Stoats mate once a year and can produce, on average, 12 offspring.

(a) Before fertilisation, the cell membrane of a sperm cell fuses with the egg cell membrane.

(i) Describe the events **after** the fusion of these membranes.

(3)

the zona pellucida immediately hardens so no more sperm can enter the egg cell. Only the head fuses with the egg so all the mitochondria produced comes from the egg, the fertilisation now produces a diploid zygote. The egg is protected when the zona pellucida hardens, cytoplasm provides the zygote with minerals and nutrients to allow growth + development.

ResultsPlus
Examiner Comments

This response achieves mp2 for hardening of the zona pellucida but the remainder of the response does not refer to any events that are happening as asked in the question.

ResultsPlus
Examiner Tip

Refer back to the question frequently to make sure you stay on track.

Stoats mate once a year and can produce, on average, 12 offspring.

(a) Before fertilisation, the cell membrane of a sperm cell fuses with the egg cell membrane.

(i) Describe the events **after** the fusion of these membranes.

(3)

•after membranes fuses a cortical reaction occurs where chemicals are released from cortical granules and it thickens zona pellicuda to stop other sperm from penetrating (polyspermy)
•then the nucleus of sperm cell enters the egg leaving its body and the nucleus of the egg and sperm fuse together to make a zygote
•zygote forms (~~it~~ diploid) and fertilisation has occured

ResultsPlus
Examiner Comments

A response that illustrates all of the mark points, written in a logical manner.

ResultsPlus
Examiner Tip

When asked to write about (a sequence of) events, try to keep them in a logical order. Preparing flowcharts on this as part of your study strategies will help!

Question 7(a)(ii)

Despite similar questions having been asked in previous series, candidates found this question challenging. It was often lack of detail that cost marks. A frequent response was reference to meiosis producing genetically different cells, suggesting candidates did not fully appreciate what a blastocyst is. Other incorrect responses referred to totipotency, but this does not describe how the cells differentiate. Some candidates missed mp3 as they paraphrased the question; reference to allowing cells to differentiate in the response will not be creditworthy as it is information given. It was necessary to be clear what this means, ie the proteins produced determine the structure and function of the cell.

(ii) After fertilisation, cell division leads to the formation of a blastocyst.

Cells of the blastocyst differentiate to form an embryo.

Describe how cells of the blastocyst differentiate.

(2)

Different conditions activate or repress different genes. Specific genes that are activated in the blastocyst are transcribed into mRNA & the proteins are translated. These then cause changes inside the cells causing them to differentiate to form an embryo.

ResultsPlus
Examiner Comments

Whilst this candidate appears to understand that there is some differential gene activation happening, they have not been explicit about the conditions that cause this to occur; different conditions is not sufficient for mp1. It was possible to award mp2 as it has been stated that actived genes are transcribed to produce mRNA. Paraphrasing the question in the final sentence is not sufficient for mp3.

ResultsPlus
Examiner Tip

Avoid paraphrasing the question.

(ii) After fertilisation, cell division leads to the formation of a blastocyst.

Cells of the blastocyst differentiate to form an embryo.

Describe how cells of the blastocyst differentiate.

(2)

Certain genes are switched on and off, switched on genes produce mRNA which determines the amino acid produced + therefore differentiate into its specialised function.

ResultsPlus
Examiner Comments

Another response that only achieves mp2. Determining which amino acid is produced is not quite correct (needs to be translation into a protein) and then using terms from the stem is not creditworthy; tell us what they mean, ie determining structure/function of the cell.

(ii) After fertilisation, cell division leads to the formation of a blastocyst.

Cells of the blastocyst differentiate to form an embryo.

Describe how cells of the blastocyst differentiate.

(2)

Cells of the blastocyst can differentiate into any type of specialised cell - including extra embryonic cells like the placenta and umbilical cord. They are totipotent. Chemical signals active certain genes - these genes are transcribed to produce mRNA, mRNA translated to produce proteins. These proteins modify the cell - changing its function and processes. The cell has differentiated. It is an irreversible process.

ResultsPlus
Examiner Comments

A good response that illustrates all three mark points. The first two lines are not necessary

as it is essentially repeating the question.

ResultsPlus
Examiner Tip

Avoid repeating the question as part of your response.

Question 7(b)(i)

The vast majority of candidates were able to achieve both marks on this question. Those that achieved just one mark typically lost a mark through not completing the maths in the first box.

(b) Female stoats can produce offspring in the first year of life.

The table shows the predicted increase in population, assuming 12 offspring are produced each year and that half the offspring are female and all of the offspring survive.

Year	Number of breeding females	Number of female offspring	Total number of offspring
1	1	6	12
2	1 + 6 = 7	42	84
3	7 + 42 = 49	294	588
4	49+294=343	2058	4116

(i) Complete the table to show the number of breeding females, number of female offspring and total number of offspring produced in year 4.

(2)

ResultsPlus
Examiner Comments

A clear response that achieves both marks. It was not necessary to write the calculation in the first box - 343 on its own would have been sufficient.

(b) Female stoats can produce offspring in the first year of life.

The table shows the predicted increase in population, assuming 12 offspring are produced each year and that half the offspring are female and all of the offspring survive.

Year	Number of breeding females	Number of female offspring	Total number of offspring
1	1	6	12
2	1 + 6 = 7	42	84
3	7 + 42 = 49	294	588
4	49+294	2058	4116

(i) Complete the table to show the number of breeding females, number of female offspring and total number of offspring produced in year 4.

(2)

49 + 294 = 343
× 12

49 × 12 = 588
588 / 2 = 294



An example where the calculation in the first box was not completed, losing a mark. Whilst 343 has been written in the space underneath, the candidate has then indicated a multiplication by 12. The answer in the box is taken as the final answer.



Don't leave calculations uncompleted expecting the examiner to know what you intended to do.

Question 7(b)(ii)

Most candidates gave a response that is a generic natural selection answer resulting in an increase in allele frequency without use of the context provided. This tended to restrict them to one mark (mp5). Other candidates hedged their bets and gave two variants with one suggesting an increase and another suggesting a decrease. Since this is a contradiction, it cannot be given credit. Consideration to careful use of language was essential in this question; many candidates used the phrase '...reproduce earlier' when referring to the females with the mutation; this could simply mean earlier in the year rather than earlier in their life/at a younger age. Qualification of statements is essential. Those candidates that did heed the context of the question and qualified their statements appropriately did achieve maximum marks.

(ii) A mutation causing females to mature rapidly allows stoats to reproduce in their first year.

Explain how the frequency of an allele leading to early maturity may change ↑ or ↓ over time.

(4)

a selection pressure means

Random mutation leads to genetic variation and ✓ an advantageous allele for early maturation arises. This gives the selective advantage of being able to have more pregnancies and produce more offspring in one lifetime, and stoats are ~~indeed~~ dependent on parents for less time so require less resources to raise. This means female stoat are more likely to survive to adulthood and have time to produce more offspring when reproducing, passing this allele onto more offspring in natural selection than if the mutation was not present. So frequency of the allele leading to early maturity ~~de~~ increases over time ~~least~~ in evolution.

ResultsPlus
Examiner Comments

A response that has considered the context provided. It has achieved mp1, mp3, mp4, mp5.

ResultsPlus
Examiner Tip

It is important to consider the context in many questions but especially so in questions about natural selection.

(ii) A mutation causing females to mature rapidly allows stoats to reproduce in their first year.

Explain how the frequency of an allele leading to early maturity may change over time.

(4)

~~The trait introduced by the mutation~~

- Individuals with this mutation will mature and reproduce at a faster rate than individuals who do nd possess the allele
- Offspring will inherit this allele, allele frequency increases
- As this trait is advantageous, individuals with the allele reproduce at a faster rate therefore increasing the allele frequency in the population
- time acts as a selection pressure
- Those without trait may ~~be killed~~ die before they mature and reproduce

ResultsPlus
Examiner Comments

A response that achieves mp5 only. Reproducing at a faster rate is not the same as more offspring being produced and so not creditworthy. The response has then been repeated.



Don’t repeat yourself in your responses. A few seconds formulating your response before commiting pen to paper will save you time in the long run.

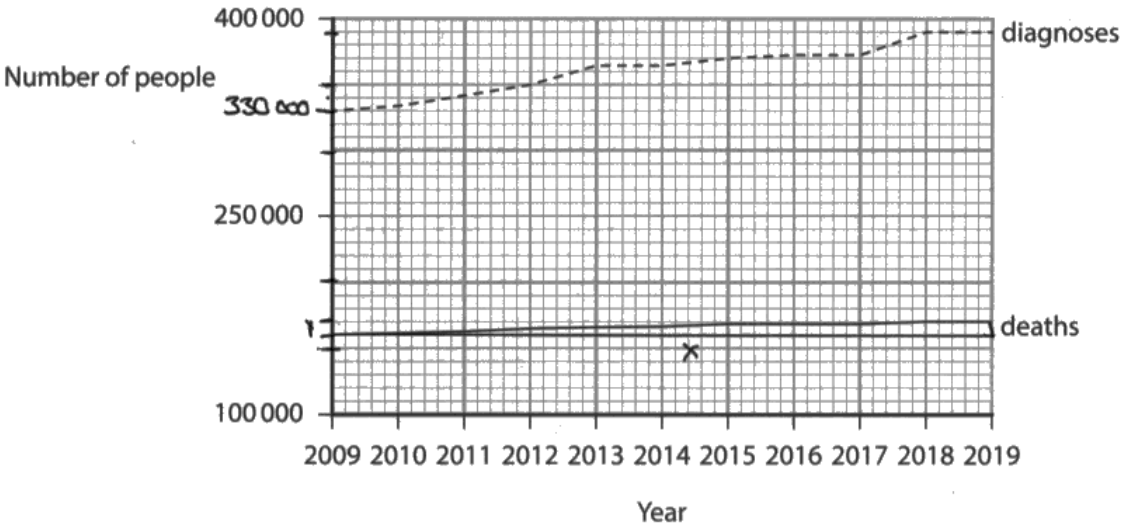
Question 8(a)(i)

The majority of candidates achieved both marks available in this question. Common errors were not heeding the instruction to give the answer to three significant figures or using the wrong denominator in the calculation.

8 Cancer affects many people in the UK.

Current treatments mean that many more people survive.

The graph shows the number of people diagnosed and dying from cancer within 10 years of diagnosis.



(a) (i) Calculate the percentage increase in cancer diagnoses from 2009 to 2019.

Give your answer to three significant figures.

(2)

2009 = 330,000
2019 = 390,000

390 000 − 330000 = 60,000

$\frac{60,000}{390,000} \times 100 = 15.384615$
$= 15.4 (3SF)$

15.4 %

ResultsPlus
Examiner Comments

An example of a response using the wrong denominator. The correct figures have been read from the graph and so mp1 can be awarded but not mp2.

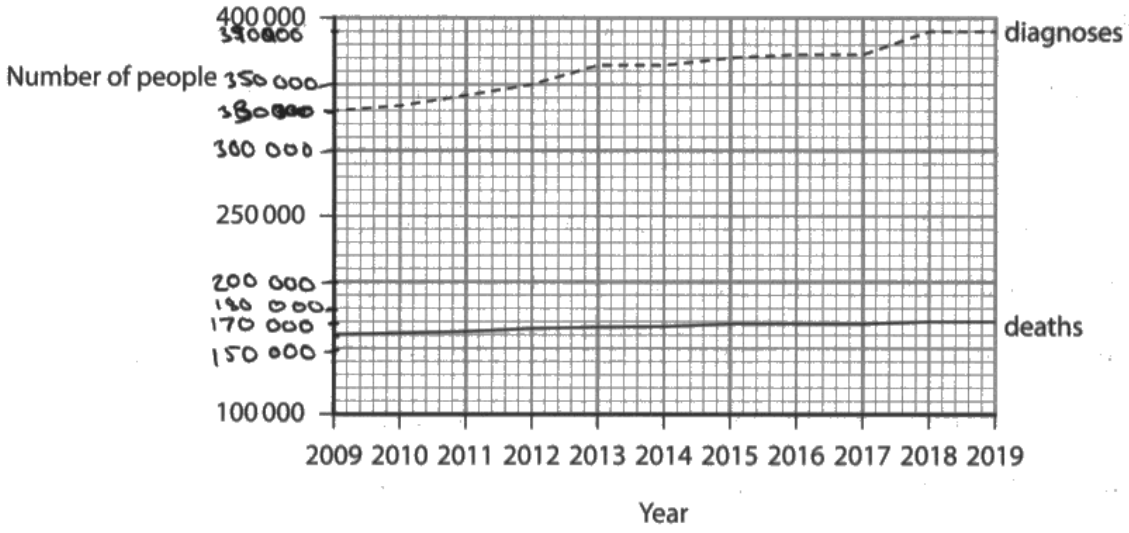
ResultsPlus
Examiner Tip

Make sure you know which figure to use as the denominator in percentage change/decrease/increase calculations.

8 Cancer affects many people in the UK.

Current treatments mean that many more people survive.

The graph shows the number of people diagnosed and dying from cancer within 10 years of diagnosis.



(a) (i) Calculate the percentage increase in cancer diagnoses from 2009 to 2019.

Give your answer to three significant figures.

(2)

2009 = 330,000

2019 = 390,000

% ↑ = $\left(\frac{390,000 - 330,000}{330,000}\right) \times 100$

= 18·18%.

18·18 %

ResultsPlus
Examiner Comments

The instruction to give the answer to three significant figures has not been considered, meaning mp2 cannot be awarded. The correct figures have been taken from the graph meaning mp1 can be awarded.

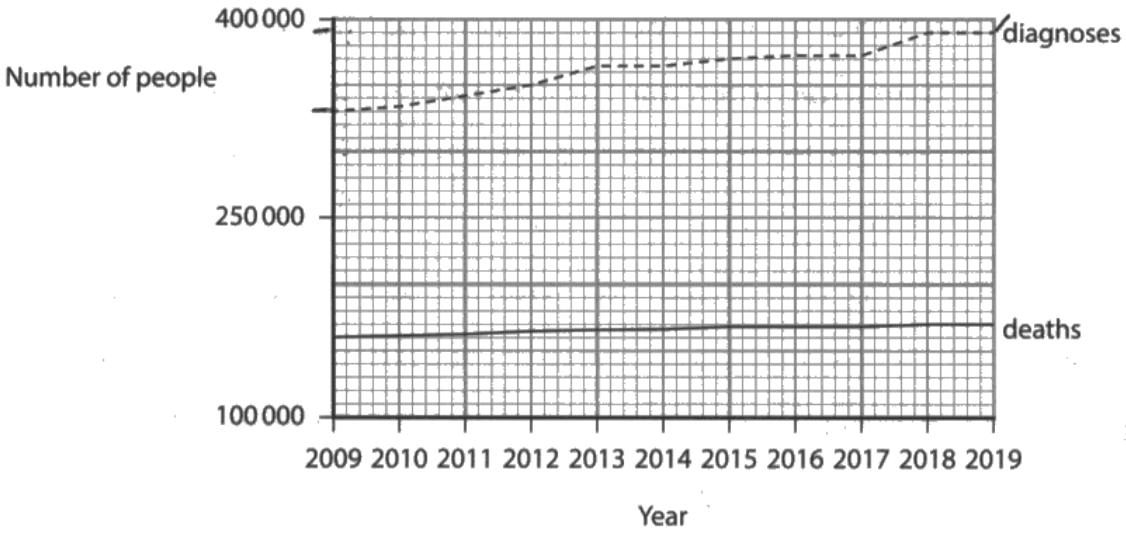
ResultsPlus
Examiner Tip

These responses are good examples why showing working is important - without that, this would have scored zero.

8 Cancer affects many people in the UK.

Current treatments mean that many more people survive.

The graph shows the number of people diagnosed and dying from cancer within 10 years of diagnosis.



(a) (i) Calculate the percentage increase in cancer diagnoses from 2009 to 2019.

Give your answer to three significant figures.

(2)

2009 = 330,000

2019 = 390,000

390,000 − 330,000 = 60000

$$\frac{60,000}{330,000} = 0.182 \times 100 = 18.2$$

18.2 %

ResultsPlus
Examiner Comments

A response that illustrates both mark points clearly.

ResultsPlus
Examiner Tip

Set working out in a logical manner so it is easy to follow.

Question 8(a)(ii)

This question was testing candidates' ability to observe trends and appreciate trends should be looked at over as long a period of time as possible. Two alternative answers were permitted; one for those candidates that looked at the whole timescale provided and noted that in 10 years, there had been an increase of 10,000 over this time period and made the conclusion that there would be the same increase again over another 10 year time period. The other alternative was for those candidates that noticed the plateau over the latter years and assumed it would remain a plateau. Other candidates attempted calculations using numbers from the diagnoses line rather than the deaths line.

(ii) Predict the number of deaths within ten years of diagnosis in 2029.

(1)

Answer 170000

ResultsPlus
Examiner Comments

An example where the candidate has noticed the plateau in the later years of the data given.

(ii) Predict the number of deaths within ten years of diagnosis in 2029.

(1)

2009 - 2019 = 10 years

160,000 → 170,000

10,000 gap → 10 years +10,000

Answer 180,000

ResultsPlus
Examiner Comments

An example where the candidate has used the whole time period provided. The working was

not required for this question but helps to understand the candidate's thought process.

Question 8(c)(i)

The majority of candidates were able to achieve at least one mark on this question. It required candidates to recognise that an antigen is simply a protein (this information was also in the table provided) and so apply their knowledge of translation to this context. The stem of the question asked how mRNA was used, indicating that detail on transcription was not required. A number of candidates referred to transcription happening in the nucleus and then being transported to the ribosome where translation would occur. Other responses included descriptions of alternative splicing or how the antigen/protein can initiate an immune response.

(c) New treatments for cancer involve types of immunotherapy.

The table shows examples of immunotherapy and the method of action.

Type of immunotherapy	Method of action
Monoclonal antibodies	The antibody attaches to the specific protein antigen on cancer cells
Checkpoint blockers	Blocks T cell inhibitors produced by cancer cells
mRNA vaccine	Engulfed by macrophages and used to synthesise the specific protein antigen

(i) Explain how mRNA can be used to produce a specific protein to act as an antigen.

(3)

mRNA is translated on the ribosome, where a specific amino acid sequence is formed. ~~This~~ The primary structure (sequence of amino acids) determines how the protein is shaped because it determines the bonds that will cause it to fold into its tertiary structure. This means that mRNA can code ~~coding~~ for a polypeptide that forms a protein in the same shape as an antigen. Immune cells recognise the protein as the antigen and engulf it, then synthesise the antigen which triggers a specific immune response that gives rise to antibodies in order to make the immune response faster.



A response that achieves mp3 only. There is lots of information but none of it is relevant to the question; the requirement was to give details on how mRNA can be used to **PRODUCE** a protein.



Start at the point the question tells you to and use all the information provided to apply your knowledge to the given context.

(c) New treatments for cancer involve types of immunotherapy.

The table shows examples of immunotherapy and the method of action.

Type of immunotherapy	Method of action
Monoclonal antibodies	The antibody attaches to the specific protein antigen on cancer cells
Checkpoint blockers	Blocks T cell inhibitors produced by cancer cells
mRNA vaccine	Engulfed by macrophages and used to synthesise the specific protein antigen

(i) Explain how mRNA can be used to produce a specific protein to act as an antigen.

(3)

~~• attach mRNA to specific coding region of DNA~~

° mRNA engulfed by macrophage

° macrophage presents mRNA particles to T-helper cells

°T-helper cells

° mRNA binds to ribosome, producing specific protein

° protein can be folded in rER

° protein packaged into vesicle to go to golgi, where it is modified to act as an antigen.

ResultsPlus
Examiner Comments

Only mp2 awarded. Again, there is no detail on how the protein is produced which is what the question is asking.

(c) New treatments for cancer involve types of immunotherapy.

The table shows examples of immunotherapy and the method of action.

Type of immunotherapy	Method of action
Monoclonal antibodies	The antibody attaches to the specific protein antigen on cancer cells
Checkpoint blockers	Blocks T cell inhibitors produced by cancer cells
mRNA vaccine	Engulfed by macrophages and used to synthesise the specific protein antigen

(i) Explain how mRNA can be used to produce a specific protein to act as an antigen.

(3)

- The mRNA is derived from the pathogen / cell you want to identify
- when engulfed by the macrophage it will attach to ribosomes and undergo translation, where the ribosome moves three bases (codon) at a time along the mRNA, where a complementary anticodon is brought by the tRNA attached to an amino acid. Then peptide bonds are formed between the amino acid forming a polypeptide chain.
- Then in the golgi apparatus it is folded into its specific 3D shape from bonds between R groups forming a protein. This protein is identical in shape to the pathogens antigen as the mRNA was derived from the pathogen. So it is able to act as a pathogen.

ResultsPlus
Examiner Comments

A response that achieves all three available marks (mp2, mp3 and mp5). It was not possible to award mp4 as we need the anticodon and codon binding and a **specific** amino acid on the tRNA.

Question 8(c)(ii)

This question asked candidates to apply their knowledge of the different aspects of the immune reponse in the context of different types of immunotherapy. The focus was on the events that would happen leading to the destruction of cancer cells. Many candidates spent time repeating information given in the question or gave detailed descriptions of the primary immune response and the formation of memory cells in preparation for a secondary response; much of this was not relevant to the question and so could not be credited. Candidates also tended to drift their responses towards an invading pathogen rather than the cancer cells. Breaking this down into mini questions and identifying the aspect of the immune response relevant to each immunotherapy would have allowed candidates to score higher marks, rather than just writing everything they could about the immune response. Candidates that took this approach tended to score higher marks than those that did not.

*(ii) Discuss how these types of immunotherapy can lead to the destruction of cancer cells.

Use your own knowledge and the information given in this question.

(6)

Checkpoint blockers work by blocking the T cell inhibitors produced by cancer cells meaning that ~~they~~ the T helper cells are then able to activate the B cells and stimmulate the immune response to kill whatever is causing the cancer. ~~Monoclonal cells This combined with~~ Monoclonal ~~cells~~ antibodies attach to the specific protein antigen on cancer cells meaning that the cancer cells cannot attach to the bodies natural proteins, meaning the rapid cell division caused by the cancer binding to lots of proteins cannot happen, surpressing the ~~pro~~ cancer cells.

mRNA vaccine engulfs ! macrophages and is used to synthesise the specific protein antigen meaning that the specific proteins produced will have special shapes to bind with enzymes that arent wanted and stop the cancer cells from growing.

ResultsPlus
Examiner Comments

There was a lot of content in this response that is taken from the information provided which cannot be credited. There is also some very muddled information but picking out

relevant parts meant we could credit the initiation of an immune response under use of checkpoint blockers and prevention of cell division under the use of antibodies for a level 1 response. This response was awarded two marks.



This is a question where it is possible to break it down into mini questions and 'write a little about a lot'. Ensure you keep targetting the question – destruction of cancer cells – so your response should stop at the point the cells have been destroyed. Continuing with details on formation of memory cells is not relevant to the question.

*(ii) Discuss how these types of immunotherapy can lead to the destruction of cancer cells.

Use your own knowledge and the information given in this question.

(6)

Monoclonal antibodies destroy cancer cells as they attach to antigen on cancer cells. ~~they prevent~~ They can lead to agglutination where cancer cells clump together so they can be engulfed all at once or opsonisation where cancer cells are marker for phagocytosis. Checkpoint blockers prevent T cell inhibitors this means T-cells can bind to APCs and produce cytokines so that B-cells can divide and differentiate into B-effector ~~and~~ so they can differentiate into plasma cells to produce antibodies which kill cancer cells. mRNA vaccine allows macrophages to have the specific protein antigen which can be use to bind onto cancer cells to prevent them ~~for~~ from binding to ~~other cells~~ destroy these cancer cells

ResultsPlus
Examiner Comments

This is a level 2 response for three marks. There is good information on the use of monoclonal antibodies that discusses how their use can lead to the destruction of cancer cells, ie agglutination leading to phagocytosis. The response has made a good start with the use of checkpoint blockers with the production of cytokines but then subsequent

information about antibodies killing cancer cells is incorrect and cannot be credited. The information on the use of mRNA vaccines does not offer any more than what is given in the table within the question and so no credit can be gained here.

*(ii) Discuss how these types of immunotherapy can lead to the destruction of cancer cells.

Use your own knowledge and the information given in this question.

(6)

• Monoclonal antibodies bind to specific protein antigen on cancer cells causing ~~them~~ them to opsonisation and they are clumped together by agglutination allowing for easier macrophage phagocytosis resulting in the cancer cell also being engulfed, inside the lysosome fuses with the phagosome ~~joining~~ breaking down and destroying ~~the~~ cancer cells and then presenting antigen onto the MHC complex being antigen presenting cells. (APC)

• Checkpoint blockers block T cell inhibitors made by the cancer cells, meaning T-helper cells are now able to be activated and release cytokines to activate T-killer cells. These can bind/and lyse cancer cells causing destruction of cancer cells and also allows for perforins to be released by T-killer to lyse cell creating pores in cancer cells.

The ~~m~~ mRNA vaccines ~~expose~~ is used to synthesize specific protein antigen which help to be presented onto the MHC complex, becoming an APC and allowing for memory cells produced, ~~memory~~ also especially T helper memory cells and other memory cells. when used in combination they can have greater effect in destruction of cancer cells, it provides active artificial immunity to person. Can cause ~~response~~ specific and non specific response

ResultsPlus
Examiner Comments

This is an organised response that covers relevant detail on the use of monoclonal antibodies and checkpoint blockers but the consistency is lost when discussing the use of mRNA vaccines although there is some relevant biology in this part. This allowed the response to access level 3 for five marks.

ResultsPlus
Examiner Tip

Remember to maintain consistency with your level of detail throughout the longer answers. A plan at the start may help with this and save time in the long run.

Question 9(a)

This is a question that has been asked many times in the past and most candidates were able to achieve maximum marks. There was some confusion with Krebs Cycle in respiration which was ignored and also exactly which reaction is catalysed by RUBISCO. Some candidates referred to carbon dioxide being needed for both the light-dependent AND the light-independent reactions. Since this is a contradiction, the examiner cannot select which one to credit and which to ignore.

9 An increasing concentration of carbon dioxide in the atmosphere has been linked to climate change.

(a) Cells in the leaves of trees contain chloroplasts that absorb carbon dioxide.

Describe what happens to carbon dioxide when it enters a chloroplast.

(4)

- CO_2 binds with RuBP
- Produces two GP molecules
- ADP is converted to ATP and NADP is reduced to form NADPH
- Produces two GALP molecules which is decarboxylated
- Glucose produced

ResultsPlus
Examiner Comments

This response achieved mp2 and mp4 on the first two lines.

ResultsPlus
Examiner Tip

This is a frequently asked question – make good use of past papers to become familiar with the requirements.

9 An increasing concentration of carbon dioxide in the atmosphere has been linked to climate change.

(a) Cells in the leaves of trees contain chloroplasts that absorb carbon dioxide.

Describe what happens to carbon dioxide when it enters a chloroplast.

(4)

Carbon dioxide is fixed during the light-independent reaction. In the stroma, CO_2 combines with a 5 carbon compound RuBP, this reaction is catalysed by enzyme RUBISCO, producing an unstable 6 carbon compound. This then produces two molecules of GP. reduced NADP and ATP produced from the light-dependent reaction convert GP into GALP and two molecules of GALP produce glucose. ✓

✓ in the chloroplast

ResultsPlus
Examiner Comments

An example of a response that achieves all mark points.

ResultsPlus
Examiner Tip

Remember to refer to RUBISCO as an enzyme or catalysing the reaction between carbon dioxide and RuBP.

Question 9(b)

This question required candidates to make use of information given and a provided equation. Whilst most candidates were able to complete this successfully and derive the correct answer for maximum marks, common errors included not accounting for needing to divide the diameter provided by two for substitution into the given equation. Other common errors were not recognising that carbon was 50% of the biomass, requiring the calculated figure to be divided by two and not adhering to the requirement for one decimal place. A number of candidates rounded answers to intermediate calculations which meant they did not derive the correct final answer. It is advised that no rounding is done during calculations and this is left to the end of the calculation when the final answer is achieved.

(b) Trees are important carbon sinks.

A formula can be used to calculate the mass of carbon in the trunk of a tree:

Biomass = volume of trunk × density of the species

The mass of carbon stored in the trunk is 50% of the biomass.

Calculate the mass of carbon stored in the trunk of an oak tree with a height of 3.0 m and a diameter of 1.2 m.

The density of oak is 720 kg m^{-3}.

Volume of a cylinder = $\pi r^2 h$

Give your answer to one decimal place.

(3)

d = 1.2M
r = 0.6M
h = 3.0M

$\pi \times 0.6^2 \times 3 = 3.4$

Vol = 3.4

$3.4 \times 720 = 2442.9$ ~~kg~~

Answer 2442.9 kg

ResultsPlus
Examiner Comments

This response completed mp1 and mp2 successfully but forgot to do the final calculation that accounted for carbon only being 50% of the biomass.

ResultsPlus
Examiner Tip

Underline key parts of the information you are given and when you get to what you think is your final answer, check that you have considered it all in your calculation.

(b) Trees are important carbon sinks.

A formula can be used to calculate the mass of carbon in the trunk of a tree:

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The mass of carbon stored in the trunk is 50% of the biomass.

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The density of oak is 720 kg m^{-3}.

Volume of a cylinder = $\pi r^2 h$

Give your answer to one decimal place.

(3)

$r = \frac{1.2}{2} = 0.6$

vol

$= \pi \times (0.6)^2 \times 3 = 3.392920066$

biomass

$3.39... \times 720 = 2442.902447$

50% of 2442.90... = 1221.451224

Answer 1221.5 kg

ResultsPlus
Examiner Comments

A clearly laid out response to the question with the correct final answer to one decimal place for all three mark points.



Set your answer out in a logical and coherent manner. This means you may still achieve some marks if your final answer is incorrect.

Question 9(c)

This was a comparison question on environmental benefits of two different trees, using information provided. Many candidates missed mp2 as they were not comparative and simply referred to the oak trees taking carbon dioxide out of the atmosphere, failing to recognise that both species will do this but the oak will remove comparatively more. Most candidates were able to achieve mp1 although some missed it as they referred to a 'better' carbon sink without qualifying what they meant by 'better'. Candidates also mixed up their terms: species richness/biodiversity and carbon/carbon dioxide with frequent references to storage of carbon dioxide instead of carbon for mp1 or stating carbon rather than carbon dioxide for mp2.

(c) Scots pine is a species of conifer tree with a density of 420 kg m^{-3}.

Conifers have fewer species of plant growing underneath them than oak trees.

Deduce why planting oak trees may have more environmental benefits than planting Scots pine.

(3)

Oak trees provide area for more species of plants to grow. This increases species richness of the environment as there is greater biodiversity. More species of plant means that there is more food sources available so organisms have more food. This is environmentally beneficial as animals will have sustainable food sources. Additionally, density of Scots pine is lower meaning that it absorbs less CO_2 than oak trees, which means more CO_2 left in the atmosphere contributing to global

ResultsPlus Examiner Comments

A response that achieves three marks. Oak trees leading to greater biodiversity, meaning there are more food sources (mp4) and Scots pine removes less carbon dioxide meaning more is left in atmosphere is the acceptable converse for mp2.

ResultsPlus Examiner Tip

If you are asked to compare, ensure you use comparative statements consistently

throughout your response.

(c) Scots pine is a species of conifer tree with a density of 420 kg m^{-3}.

Conifers have fewer species of plant growing underneath them than oak trees.

Deduce why planting oak trees may have more environmental benefits than planting Scots pine.

(3)

Oak trees would be able to store more carbon within them than scots pine so would reduce the atmospheric CO2 more than the scots pine, the oak trees also have more species of plant growing under them so increase the biodiversity of the area they are in. Oak trees are better carbon sinks than scots pine

ResultsPlus
Examiner Comments

This response achieves mp1 on the first line and uses the context of both oak and Scots pine to lead into mp2. Oak trees leading to more biodiversity is mp3. The last sentence is an example of a statement that is ignored – 'better' unqualified is not sufficient for mp1 although it had already been achieved at the start of this response.

Question 9(d)

Many candidates were able to achieve mp3 although a large proportion referred to release of carbon dioxide but did not link it to the respiration of the microorganisms. For mp1, the idea of the microorganisms carrying out decomposition was required. If candidates could link this to breaking down organic molecules and using the carbon from those products in other ways, they were able to achieve both marks. However, candidates find the idea of decomposition at the molecular level a challenge.

(d) Soil also stores large quantities of carbon.

Discuss the role of microorganisms in carbon storage in forest soils.

(2)

Microorganisms digest and decompose organic matter in the soil and therefore take in carbon and store it. However, they also respire and therefore release carbon in the form of carbon dioxide.

ResultsPlus
Examiner Comments

A response that achieves mp1 and mp3. The candidate was almost there with mp2 when referring to taking in and storing the carbon but we needed the idea of the carbon being used in assimilation of synthesis of other organic molecules.

ResultsPlus
Examiner Tip

Remember, when microorganisms decompose material, they are breaking down the molecules and using the components to build other molecules they need.

(d) Soil also stores large quantities of carbon.

Discuss the role of microorganisms in carbon storage in forest soils.

(2)

microorganism will feed on dead matter releasing the CO_2

ResultsPlus
Examiner Comments

An example of a response that was almost there but missed key parts. We needed decomposing rather than feeding and the linking of the release of carbon dioxide to respiration. This response scored zero marks.

Question 10(b)(i)

Candidates were generally able to calculate both ratios but in some cases got the values the wrong way round in one of the calculations. This meant the correct value was obtained for one but not the other.

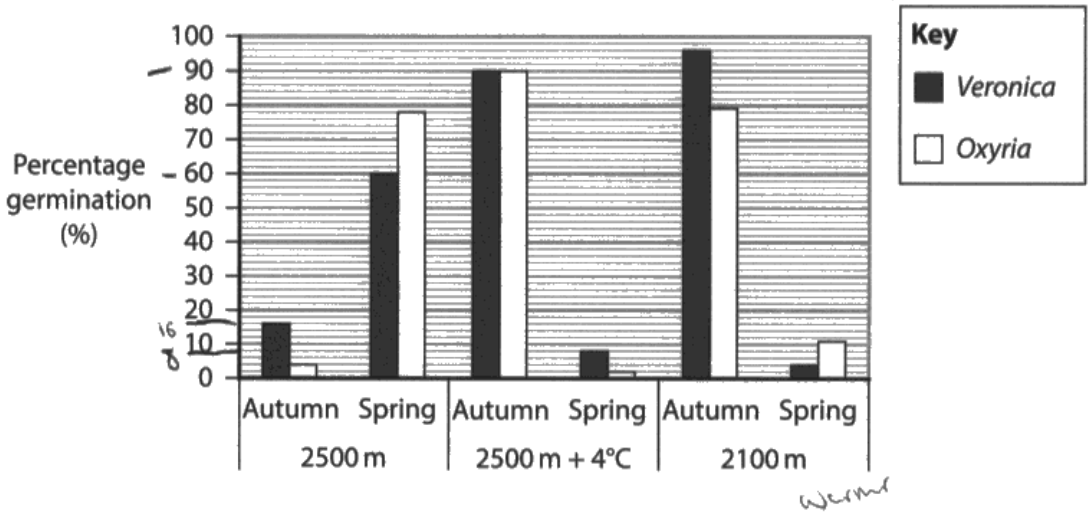
(b) An investigation was carried out to determine the effect of an increase in temperature on the timing of germination of alpine plants.

Two species of alpine plant that grow at an altitude of 2500 m are *Oxyria* and *Veronica*.

Seeds from these two species were placed in agar and kept for one year in the following conditions:

- a cycle of seasonal temperatures found at 2500 m
- a cycle of seasonal temperatures 4°C higher than those found at 2500 m
- a cycle of seasonal temperatures found at 2100 m.

The graph shows the results of this investigation.



(i) The ratio of spring to autumn germination for *Oxyria* grown in conditions found at 2500 m decreased from 19.5 : 1 to 0.02 : 1 when temperatures were increased by 4°C.

Calculate the ratios of spring to autumn germination for *Veronica*.

(2)

16:16 = 30:8 = 15:4 = 3.75:1

90:8 = 11.25

Ratio of spring to autumn germination for 2500 m 3.75 : 1

Ratio of spring to autumn germination for 2500 m plus 4°C 11.25 : 1

ResultsPlus
Examiner Comments

11.25 was a common incorrect answer caused by putting the larger number first rather than the value for spring as indicated in the question.

ResultsPlus
Examiner Tip

When calculating ratios, make sure you put the values in the correct order as dictated by the question.

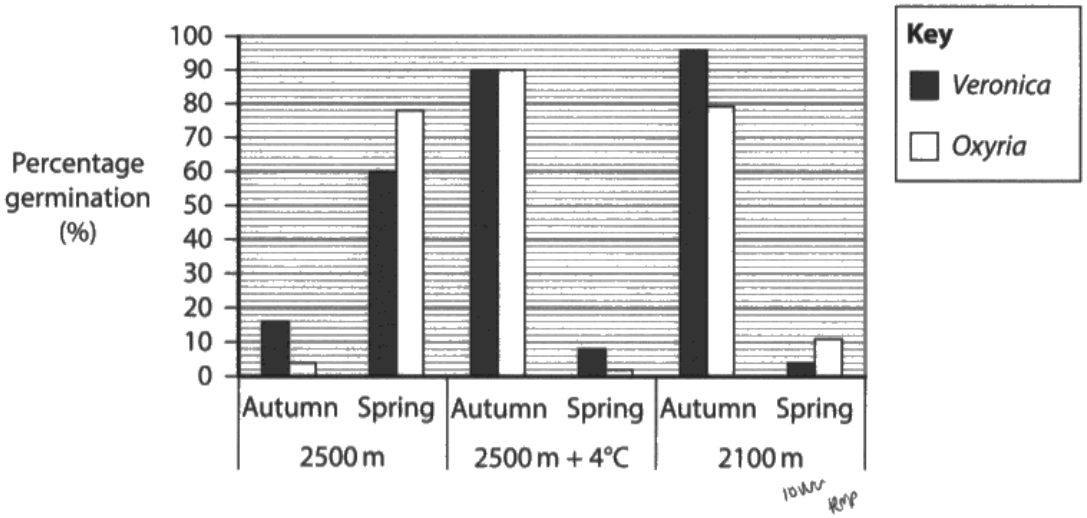
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The graph shows the results of this investigation.



(i) The ratio of spring to autumn germination for *Oxyria* grown in conditions found at 2500 m decreased from 19.5 : 1 to 0.02 : 1 when temperatures were increased by 4°C.

Calculate the ratios of spring to autumn germination for *Veronica*.

(2)

60 : 16

3·75 : 1

8 : 90

0·09 : 1

≈ 0·0888...9

Ratio of spring to autumn germination for 2500 m 3·75 : 1

Ratio of spring to autumn germination for 2500 m plus 4°C 0·09 : 1

ResultsPlus
Examiner Comments

An example where both ratios were calculated correctly for both marks.

Question 10(b)(ii)

The majority of candidates were able to achieve at least one mark on this question, usually mp1. There were some contradictions which meant credit could not be given, such as they may survive better in summer and less in winter – the overall survival was needed. Poor use of language was also an issue – growth was used instead of germination. Some candidates did not appear to understand what germination is, referring to the plants being able to photosynthesise.

(ii) During the winter months, the air and soil temperatures fall.

Deduce the effect of climate change on the survival of alpine plant species such as *Oxyria* and *Veronica*.

(2)

Climate change can cause an increase in temperature this can cause an increase in germination in autumn months and a decrease in spring months - causes a seasonal change to the flowering and germination which could alter their food resources and food chain meaning reduced survival rates.

ResultsPlus
Examiner Comments

An increase in germination in autumn achieves mp2 and reduced survival rates at the end achieves mp1.

(ii) During the winter months, the air and soil temperatures fall.

Deduce the effect of climate change on the survival of alpine plant species such as *Oxyria* and *Veronica*.

(2)

Due to increases in temperature due to climate ~~change~~ change, the survival of alpine plant species would reduce, since plants would ~~ger~~ be more ~~likely~~ likely to germinate in autumn than spring, thus would have to survive a winter (where they are more likely to die) first instead of a summer.

ResultsPlus
Examiner Comments

A good example of mp1, mp2 and mp3.

(ii) During the winter months, the air and soil temperatures fall.

inter - atc

Deduce the effect of climate change on the survival of alpine plant species such as *Oxyria* and *Veronica*.

(2)

Climate change increases the mean atmospheric temperature
This means there will be a significant decrease in alpine plants in spring but there will be an increase in autumn

ResultsPlus
Examiner Comments

Rushing has potentially cost a mark here: '...a significant decrease in alpine plants in spring....' but we do not know what the qualification of the decrease is – survival, growth, germination?

ResultsPlus
Examiner Tip

Check your answers back to make sure you have not missed out key parts. The examiner will not fill in the gaps for you.

Question 10(c)

This question was asking candidates to use information from different practical investigations they should have carried out over the course of their studies; these include the use of iodine to detect the breakdown of starch, the effect of temperature on enzyme activity, calculation of initial rate of reaction at each temperature and Q10. However, the majority of candidates did not take this approach. There was significant confusion surrounding how to measure the activity of amylase with suggestions including measuring the volume of gas produced with an upturned cylinder, use of a respirometer, use of DCPIP, use of Benedict's or Biuret reagent. Candidates often used hydrogen peroxide as a substrate rather than starch despite this being given in the stem of the question. Germinating seeds at different temperatures and measuring volume of amylase produced, and using the volumes in the Q10 equation was also seen. Candidates did not seem to be confident with how to express the equation for Q10.

***(c) The effect of temperature on germinating seeds can be demonstrated by measuring the Q_{10} value for enzyme activity.**

When seeds germinate, amylase is produced.

This enzyme can be extracted from the seeds and used to break down starch.

Devise an experiment to compare the Q_{10} of amylase from germinating seeds of *Veronica* and *Oxyria*.

(6)

- Q10 is the difference between amylase at 2 temperatures that are 10°C apart.
- select seeds from veronica and oxyria (same size / mass etc.)
- create several test tubes in water baths at different temperatures to see how much amylase is produced as seeds are in each temp
- calculate Q10 by comparing 2 temperatures 10°C apart (E.g 30 and 20°C) for each veronica and oxyria
- leave to germinate for equal time period

ResultsPlus
Examiner Comments

This response is not detailing a method that will allow calculation of Q10 of amylase. It has been given credit for the idea of needing germinating seeds and the use of water baths. This method of germinating seeds at different temperatures was commonly seen but not what the question was asking for.

ResultsPlus
Examiner Tip

When devising an investigation, think about the ones you have done in the lab throughout your studies. If what you are writing does not have any similarity to a practical you have done, it is probably not right. This response scored two marks.

*(c) The effect of temperature on germinating seeds can be demonstrated by measuring the Q_{10} value for enzyme activity.

lower rate of growth and photosynthesis as decreases further

When seeds germinate, amylase is produced.

This enzyme can be extracted from the seeds and used to break down starch.

Devise an experiment to compare the Q_{10} of amylase from germinating seeds of *Veronica* and *Oxyria*.

(6)

1. Extract the amylase enzyme from the seeds of Veronica
2. Ensure that the enzyme has a uniform concentration of 1 moldm^{-3} by dilution if necessary (control the concentration)
3. Use a measuring cylinder to measure 5cm^3 of the 1 moldm^{-3} amylase enzyme into a test tube (control volume)
4. Add 2cm^3 of pH7 buffer solution to the test tube (control pH)
5. Place the test tube in a 10°C water bath and leave to acclimatise for 10 minutes
6. Add 5cm^3 of 0.1 moldm^{-3} starch solution to the test tube, add 5 drops of iodine. Amylase breaks down starch to colour change from blue-black to colourless

7. Use a colorimeter to measure the absorbance of the test tube every 10 s for 5 minutes

8. Plot a graph of absorbance against time

9. Draw at tangent at t=0 and calculate the gradient which is the initial rate of reaction

10. Repeat steps 1-9 three times and calculate mean initial rate of reaction at 10 °C

11. Repeat steps 1-10 at different temperatures in 10°C intervals using water baths at 10°C, 20°C, 30°C, 40°C, 50°C

12. Measure Q_{10} for each temperature increase of 10°C

$$Q_{10} = \frac{\text{rate at temperature } (T+10)^{\circ}C}{\text{rate at temperature } T^{\circ}C}$$

13. Calculate mean Q_{10} up until optimum temperature is reached

14. Repeat steps 1-13 for other seeds

15. Compare Q_{10} values using student T- test to see if the difference is significant

ResultsPlus
Examiner Comments

This is a clearly written response, in a logical sequence. It can be followed step-by-step, with consideration of variables and how data will be processed. It scored six marks.

ResultsPlus
Examiner Tip

When asked to devise a practical, plan your response before you put pen to paper. Jot down

key points at the start to act as prompts for what you need to include.

Paper Summary

Based on their performance on this paper, candidates should:

- Spend a little more time analysing what questions are asking including the command words.
- Ensure they maintain consistency with use of key terminology through individual responses and the entire paper.
- Avoid paraphrasing the question and repetition of points within responses.
- Pay careful attention to instructions, particularly around decimal places and significant figures in maths-based questions.
- Ensure they include revision of the core practicals to the same level as the remainder of the content.

Much of this can be achieved through regular practice and habit-building throughout their course of study.

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link: https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

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