Pearson
Edexcel

Examiners' Report
June 2025

GCE Biology A 9BN0 03

ResultsPlus

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications come from Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at https://www.edexcel.com or https://www.btec.co.uk.

Alternatively, you can get in touch with us using the details on our contact us page.

ResultsPlus

Giving you insight to inform next steps

ResultsPlus is Pearson's free online service giving instant and detailed analysis of your students' exam results.

- See students' scores for every exam question.
- Understand how your students' performance compares with class and national averages.
- Identify potential topics, skills and types of question where students may need to develop their learning further.

For more information on ResultsPlus, or to log in, visit https://www.edexcel.com/resultsplus. Your exams officer will be able to set up your ResultsPlus account in minutes via Edexcel Online.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: https://www.pearson.com/uk.

June 2025

Publications Code 9BN0_03_2506_ER

All the material in this publication is copyright

© Pearson Education Ltd 2025

Introduction

The 9BN0_03 paper gave candidates the opportunity to display their knowledge and understanding across the whole specification. Questions allowed candidates to make connections between topics on the specification and apply their knowledge to novel scenarios.

There were multiple opportunities for candidates to apply their knowledge of core practicals from the course. This included practical 18 (investigating habituation to a stimulus) and practical 15 (investigate the effect of different antibiotics on bacteria). Elements of practical 10 (carry out a study on the ecology of a habitat) and practical 14 (use gel electrophoresis to separate DNA fragments of different length) were also examined.

The level-based response question gave candidates the opportunity to discuss knowledge from many topics in the specification, which many candidates did successfully.

The most successful candidates could link information from different topics across the specification and had a concrete understanding of the overarching 'big ideas' in biology. They were able to use key terms confidently and link ideas in their responses. As a result, these candidates could confidently apply their knowledge to unfamiliar contexts.

Successful candidates:

- Gave answers appropriate for the command word in the question.
- Followed all instructions in the question.
- Answered questions in the context set, using the information given.
- Used terminology appropriate at A Level for example, 'impulse' and 'not signal'.
- Did not leave any ambiguity in their responses.
- Provided relevant detail in their responses.
- Had studied the pre-released scientific article and made connections to the specification.

Less successful candidates:

- Gave answers that were not appropriate for the command word in the question.
- Re-wrote information that was in the question, wasting time.
- Did not answer the question in the context set.
- Provided ambiguous answers.
- Used terminology that is not appropriate at A Level.
- Could not recall key definitions or processes.
- Made errors in calculations.
- Did not write legibly.
- Wrote answers that were not linked and not in a logical order.

Question 1(a)(i)

This question required candidates to recall the definition of succession. The majority of candidates achieved both marks. However, some candidates did not gain full marks because they described changes in abiotic and biotic factors, which are consequences of succession rather than part of its definition. Others referred to the development of species or communities but did not clearly state that this involves a change in species composition or community.

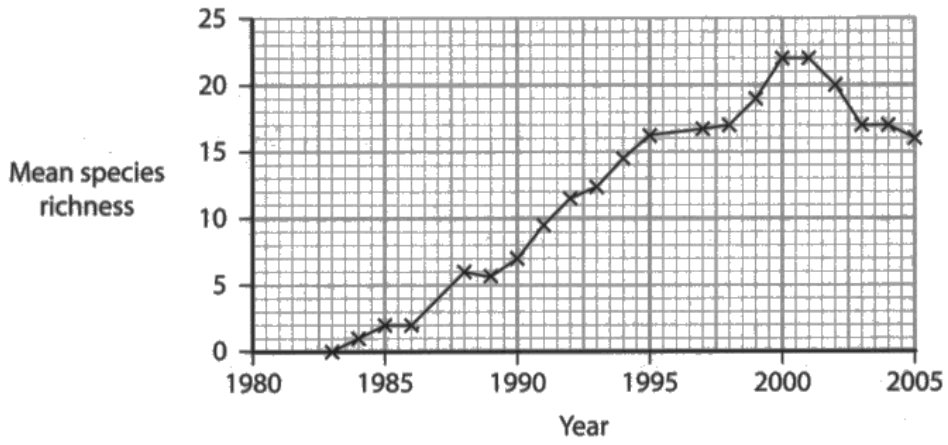
1 In 1980, a volcano erupted in Washington State, USA.

Ash from the volcano covered surrounding vegetation, killing all the plants.

Succession has been investigated on one of the sides of the volcano.

(a) In one study, species richness on the side of the volcano was measured.

The graph shows the change in mean species richness from 1983 to 2005.



(i) State what is meant by the term **succession**.

(2)

The change in communities occupying an environment over time. Starts with pioneer species and ends with climax community.

ResultsPlus
Examiner Comments

This response achieved two marks for MP2 and MP3.

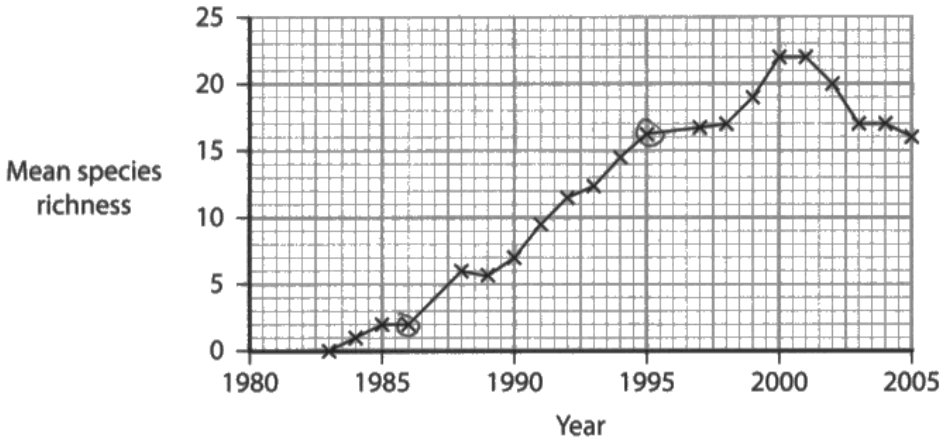
1 In 1980, a volcano erupted in Washington State, USA.

Ash from the volcano covered surrounding vegetation, killing all the plants.

Succession has been investigated on one of the sides of the volcano.

(a) In one study, species richness on the side of the volcano was measured.

The graph shows the change in mean species richness from 1983 to 2005.



(i) State what is meant by the term **succession**.

(2)

Plants colonising the ground and growing and reproducing and dying in it. The growth of plant roots stabilises the soil and the decomposition of plants ~~enou~~ provides nutrients for other species.

ResultsPlus
Examiner Comments

This candidate gave a description of the consequence of succession rather than the definition, so this answer scored zero marks.

Question 1(a)(ii)

This question required candidates to calculate the rate of increase in the mean number of species between 1986 and 1995. To do this, candidates needed to read the values of 16 and 2 from the graph, calculate the difference, and determine the rate of increase per year. The answer also had to be expressed to two significant figures. Many candidates did not gain any marks. Those who achieved only one mark either did not use two significant figures or failed to include a unit. In some cases, candidates used an incorrect unit, such as the unit for concentration.

(ii) Calculate the rate of increase in the mean number of species from 1986 to 1995.

Give your answer to two significant figures and include units.

(2)

$\frac{16.5 - 2}{2}$

Answer 7.30

ResultsPlus
Examiner Comments

This candidate did not calculate the correct number of years therefore they did not achieve MP1. This response was not awarded any marks.

(ii) Calculate the rate of increase in the mean number of species from 1986 to 1995.

Give your answer to two significant figures and include units.

(2)

$$\frac{16-2}{1995-1986}$$

$$= 1.6$$

Answer 1.6

ResultsPlus
Examiner Comments

This candidate performed the correct calculation but did not include a unit. Therefore the response was given one mark.

Question 1(a)(iii)

This question, which asked candidates to recall the term used for the first species to colonise an area, was accessible to most candidates. However, some did not attempt an answer. Targeted revision should focus on the recall of key biological terms.

(iii) Following the eruption, one of the first plant species to be observed was *Lupinus lepidus*.

Give the term used to describe the first species to appear at a location.

(1)

pioneer species

ResultsPlus
Examiner Comments

This response was awarded one mark.

(iii) Following the eruption, one of the first plant species to be observed was *Lupinus lepidus*. ??

Give the term used to describe the first species to appear at a location.

(1)

colonising species

ResultsPlus
Examiner Comments

This response was awarded one mark.

Question 1(b)(i)

This question required candidates to state the meaning of the term 'organ'. It proved challenging for some candidates. A number of responses incorrectly gave the definition of a tissue, describing an organ as made of different cells working together. Others referred to 'similar' tissues, which did not gain credit.

(b) Species of *Lupinus* have organs called root nodules that contain bacteria.

Sugars and nutrients are exchanged between the plant and the bacteria in the root nodules.

(i) State what is meant by the term **organ**.

(1)

Similar &
o a group of ~~tissues~~ specialised tissues working together to complete & carry out the same function.

ResultsPlus
Examiner Comments

This response was not awarded the mark.

(b) Species of *Lupinus* have organs called root nodules that contain bacteria.

Sugars and nutrients are exchanged between the plant and the bacteria in the root nodules.

(i) State what is meant by the term **organ**.

(1)

group of different tissues that work together to carry out a particular function

ResultsPlus
Examiner Comments

This response was awarded one mark.

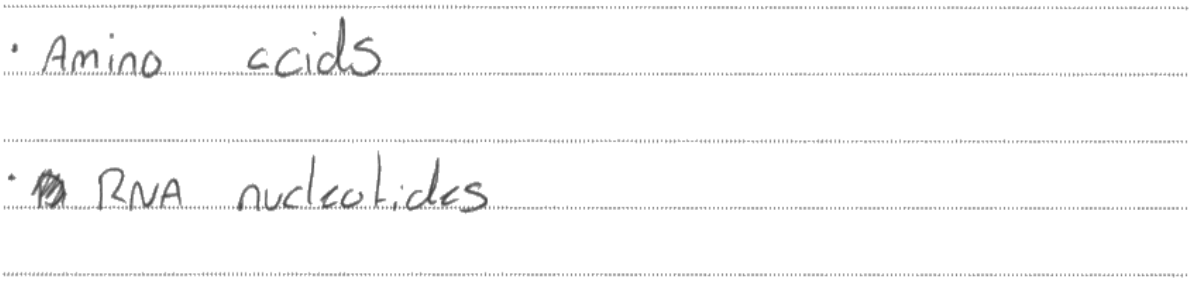
Question 1(b)(ii)

The majority of candidates achieved both marks, with many successfully recalling organic molecules needed to synthesise proteins that contain nitrogen. However, those who gained only one mark often gave two molecules from the same marking point. Some candidates lost marks for not recalling amino acids.

(ii) Bacteria in root nodules are able to fix nitrogen gas (N_2) into ammonium compounds that the plant can use.

Name two organic molecules, containing nitrogen, needed to synthesise proteins.

(2)



ResultsPlus
Examiner Comments

This response was awarded two marks.

(ii) Bacteria in root nodules are able to fix nitrogen gas (N_2) into ammonium compounds that the plant can use.

Name two organic molecules, containing nitrogen, needed to synthesise proteins.

(2)

- RNA
- DNA

ResultsPlus
Examiner Comments

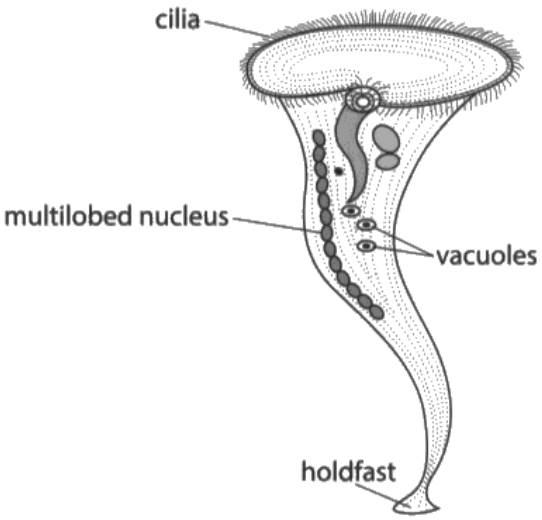
This response was awarded one mark.

Question 2(a)(i)

The majority of candidates successfully achieved both marks. Candidates were required to use the provided equation to calculate the volume of a cone by correctly substituting values from the question. The height and diameter of the Stentor were given in millimeters. However, some candidates did not correctly halve the diameter of 0.4 mm to find the radius, some failed to express their final answer to three decimal places, and others did not square the radius as required.

2 *Stentor coeruleus* is a unicellular organism.

The drawing shows the structure of a *Stentor coeruleus*.



(a) This *Stentor* has a height of 1 mm and a diameter of 0.4 mm at the top.

(i) Calculate the volume of this cone-shaped *Stentor*.

Use the equation for the volume of a cone:

$$V = \pi r^2 \frac{h}{3}$$

Give your answer to three decimal places.

(2)

$\pi \times 0.2 \times \frac{1}{3} = 0.20943...$

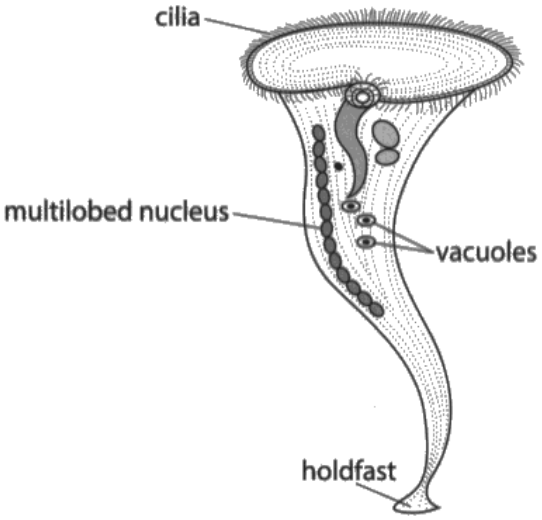
~~0.20~~ 0.210 mm³

ResultsPlus
Examiner Comments

This candidate did not square the radius therefore did not achieve MP1. The response was not awarded any marks.

2 *Stentor coeruleus* is a unicellular organism.

The drawing shows the structure of a *Stentor coeruleus*.



(a) This *Stentor* has a height of 1 mm and a diameter of 0.4 mm at the top.

(i) Calculate the volume of this cone-shaped *Stentor*.

Use the equation for the volume of a cone:

$$V = \pi r^2 \frac{h}{3}$$

Give your answer to three decimal places.

(2)

$V = \pi \times 0.2\text{mm}^2 \frac{1}{3}$

$= 0.0419$

0.0419 mm³

ResultsPlus
Examiner Comments

This candidate did not express the answer to three decimal places therefore scoring one mark.

Question 2(a)(ii)

This question proved challenging for many candidates, with the majority not gaining the mark. Candidates were expected to use the diagram to identify the domain to which *Stentor coeruleus* belongs. Some candidates incorrectly suggested bacteria, despite the diagram indicating the presence of a nucleus and vacuoles, both of which are membrane-bound organelles.

(ii) Give the domain to which *Stentor coeruleus* belongs.

(1)

Eukaryota

ResultsPlus
Examiner Comments

This candidate stated the correct domain and achieved the mark.

Question 2(b)(i)

The majority of candidates achieved the mark; however, some found this question challenging. Many candidates lost marks because their responses referred to control variables unrelated to the tapping stimulus.

(b) *Stentors* are found in fresh water attached to pebbles.

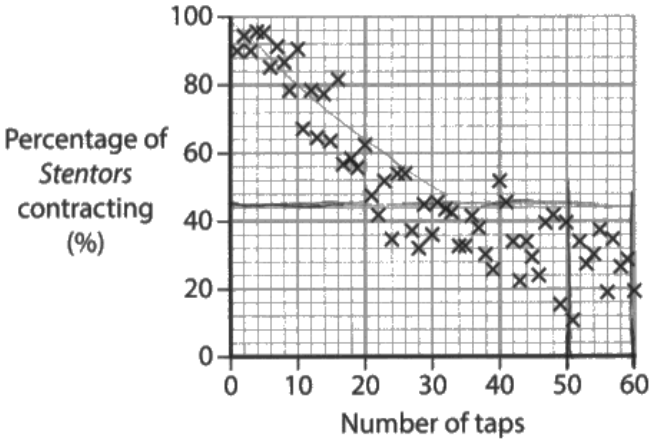
The response of *Stentors* to a stimulus was investigated.

A sample of 150 *Stentors* was allowed to attach to the bottom of a Petri dish filled with stream water. The *Stentors* were then given two hours to acclimatise.

The Petri dish was then tapped with a ruler once every minute.

After each tap, the percentage of *Stentors* that contracted was recorded.

The results are shown in the graph.



(i) The frequency of tapping the Petri dish was controlled.

Give **one other** variable of the tapping stimulus that should be controlled.

(1)

The amount of force used when tapping.

ResultsPlus
Examiner Comments

This candidate gave a variable that referred to tapping stimulus and was awarded the mark.

(b) *Stentors* are found in fresh water attached to pebbles.

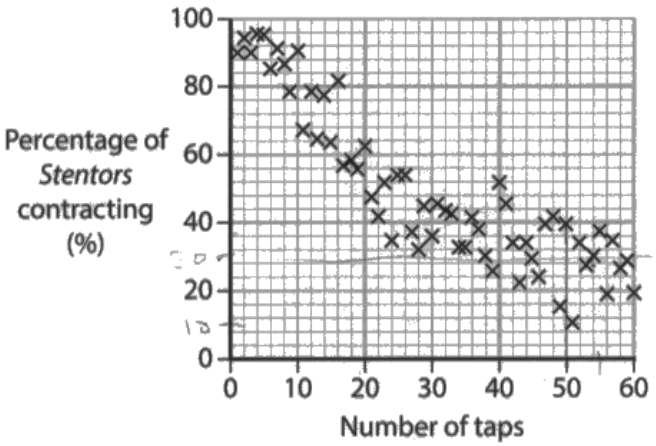
The response of *Stentors* to a stimulus was investigated.

A sample of 150 *Stentors* was allowed to attach to the bottom of a Petri dish filled with stream water. The *Stentors* were then given two hours to acclimatise.

The Petri dish was then tapped with a ruler once every minute.

After each tap, the percentage of *Stentors* that contracted was recorded.

The results are shown in the graph.



(i) The frequency of tapping the Petri dish was controlled.

Give **one other** variable of the tapping stimulus that should be controlled.

(1)

The temperature of the Petri dish.

ResultsPlus
Examiner Comments

This candidate did not state a variable that referred to the tapping stimulus and therefore did not achieve the mark.

ResultsPlus
Examiner Tip

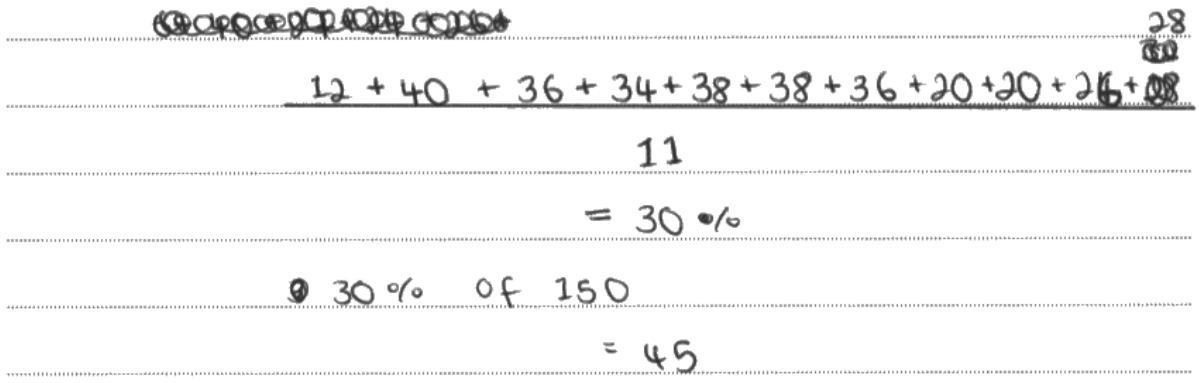
Make sure you read all of the question.

Question 2(b)(ii)

This question was challenging for candidates, with most failing to score any marks. Candidates were required to demonstrate that the mean number of Stentors contracting between 50 and 60 taps is approximately 45. This involved calculating the mean percentage of Stentors contracting using the data points between 50 and 60 taps, then showing that this mean percentage fell within the range of 37 to 53. Many candidates did not achieve MP1 as they did not attempt to use the relevant data points to calculate a mean. The command word 'show' required candidates to use data from the graph in their response.

(ii) Show that the mean number of *Stentors* contracting between 50 and 60 taps is approximately 45.

(2)



ResultsPlus
Examiner Comments

The candidate has used the points on the graph (between 50 - 60 taps) to calculate a mean with the range of 25 - 35 % to achieve MP1 and then showed how this mean percentage is approximately 45. This response scored two marks.

Question 2(b)(iii)

The majority of candidates achieved one mark. Many were able to gain MP1, but fewer candidates stated that the Stentors were becoming habituated.

(iii) Give **two** conclusions that can be drawn from the results of this investigation.

(2)

1 As the number of taps increase, the percentage of stentors contracting decrease as they become habituated

2 The repeated stimulus causes less than 50% of stentors to contract after 50 minutes, as threshold potentials are no longer reached.

ResultsPlus
Examiner Comments

This response gets MP1 and MP2 in lines 1-3.

Question 2(b)(iv)

The majority of candidates achieved one mark. Candidates were asked to explain why the Stentors contract less as the number of taps increases. While many candidates gained MP1, fewer achieved MP2. Several candidates noted that the stimulus is non-threatening but did not explain that this results in less energy being wasted due to reduced contraction.

(iv) **Explain the results of this investigation.**

(2)

The number of Stentors contracting decreased due to repeated stimuli. This resulted in them becoming habituated and not longer reacting to the stimuli as a result of an inhibitory synapse.

ResultsPlus
Examiner Comments

This response achieves MP1 only.

(iv) Explain the results of this investigation.

(2)

Habituation occurs meaning stentors become less ~~sensi~~ responsive over time to the stimulus to prevent energy wastage to a non-threatening stimulus.
less Ca^{2+} diffuses into Pre Synaptic membrane, less neurotransmitter released and so less depolarisation and no action potential

(Total for Question 2 = 10 marks)

ResultsPlus
Examiner Comments

This response achieved MP1 for 'habituation occurs'. The candidate would also achieve MP1 for 'stentors become less responsive over time to the stimulus'. MP2 achieved on line 3 and 4.

Question 3(a)

This question was accessible to the majority of candidates, with many providing complete answers. Candidates were asked to describe the role of fibrinogen in blood clotting. Several candidates included all four marking points in their responses, and many used the correct terminology for MP4. Candidates who found this question more demanding were often able to recall the names of the molecules involved but gave incorrect descriptions of their functions.

3 Fibrinogen is involved in blood clotting.

A variety of conditions affect the blood clotting process. These include atherosclerosis and dysfibrinogenemia.

(a) Describe the role of fibrinogen in blood clotting.

(3)

fibrinogen is insoluable and converts prothrombin within the blood to thrombin thrombin will combine with platelers within the blooce to form a plug that blocks any damage to the endothelium preventing ~~Pathogens~~ ldl Cholesterol entering.

ResultsPlus
Examiner Comments

This response did not gain any marks. Although fibrinogen, insoluble and thrombin are mentioned, the terms are not used in the correct context.

ResultsPlus
Examiner Tip

Make sure to include recall in your revision plan. It will help you to learn processes like the clotting cascade.

3 Fibrinogen is involved in blood clotting.

A variety of conditions affect the blood clotting process. These include atherosclerosis and dysfibrinogenemia.

(a) Describe the role of fibrinogen in blood clotting.

(3)

- fibrinogen is soluble.
- Thrombin converts fibrinogen into fibrin.
- fibrin is insoluble.
- fibrin forms an insoluble mesh which allows red blood cells and platelets to get trapped, forming a blood clot.

ResultsPlus
Examiner Comments

All MPs achieved in this response.

Question 3(b)(i)

This question was accessible to the majority of candidates. Candidates were provided with a family tree showing individuals' phenotypes, including one deceased male whose phenotype was unknown. They were also informed that individual T was heterozygous and had the condition. Candidates were then asked to determine whether the mutation is dominant or recessive. Most candidates correctly identified the mutation as dominant.

(i) Individual T was heterozygous for this mutation.

State whether this mutation is dominant or recessive.

(1)

dominant

ResultsPlus
Examiner Comments

This candidate correctly identified that the mutation is dominant. They annotated the question as a reminder that heterozygous individuals possess two different alleles.

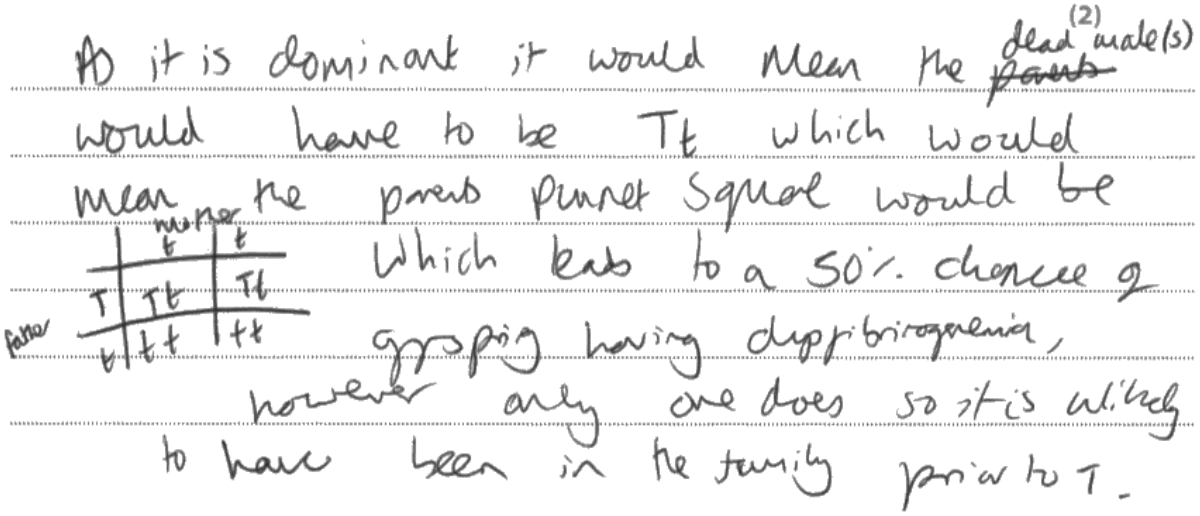
Question 3(b)(ii)

The majority of candidates achieved one mark. Candidates were asked to explain why the mutation causing the disease originated in the genome of individual T, using the family tree in their explanation. Those who did not achieve any marks often suggested that both of individual T's parents were unaffected, overlooking the information provided about the deceased male's unknown phenotype.

(ii) Scientists suggested this was a new mutation in this family originating in the genome of individual T.

Explain why the scientists suggested this.

(2)



ResultsPlus
Examiner Comments

Candidate achieved MP2 and MP3 for identifying that if the dead male possessed the mutation and was heterozygous, there would be a 50% chance of the offspring having the condition. However, only one of the offspring had the condition.

(ii) Scientists suggested this was a new mutation in this family originating in the genome of individual T.

Explain why the scientists suggested this.

(2)

Because individual T's parents didnt have the allele for ~~disease~~ condition. This means it's not a genetic condition passed down and a mutation must have occurred.

ResultsPlus
Examiner Comments

This candidate has incorrectly stated that neither of individual T's parents have the allele for the condition. However, the family tree states that the father's phenotype is unknown and therefore that statement cannot be made. This response was awarded zero marks.

ResultsPlus
Examiner Tip

Make sure you use all of the information provided in a question like this. It is a good idea to label family trees with the genotypes of individuals. For example, some candidates labelled the family tree to show that the mother is homozygous recessive.

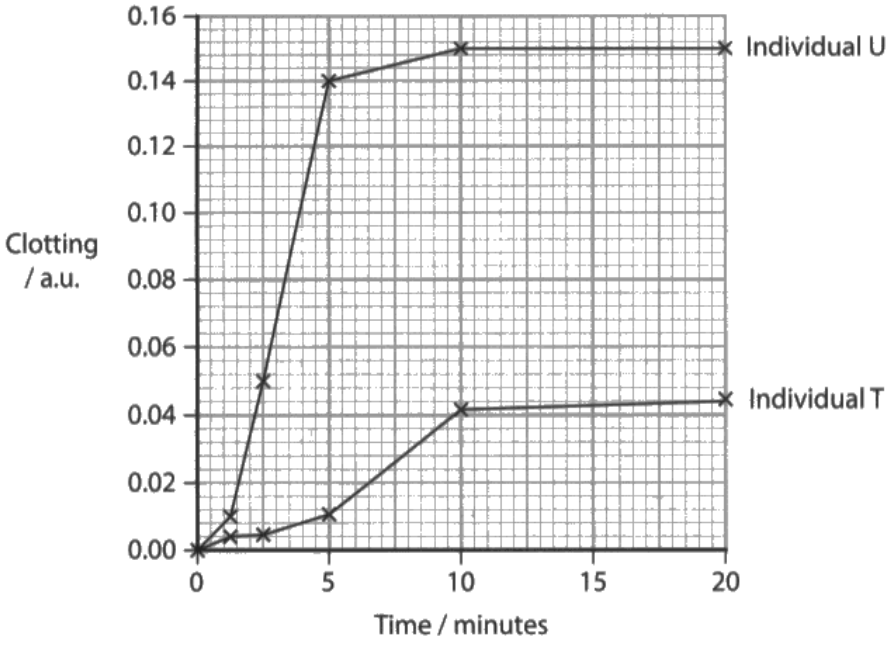
Question 3(b)(iii)

The majority of candidates achieved one mark. Some candidates did not use comparative language such as 'slower' or 'faster'. Others described the data without drawing conclusions from the graph. Some candidates wrote phrases like 'clots better' instead of 'increased ability to clot'. These candidates did not achieve MP1 because the term 'better' is subjective. Additionally, some candidates stated that the condition 'affects clotting ability' without specifying whether it increases or decreases the ability to clot.

(iii) Blood samples were taken from individuals T and U.

The ability of these blood samples to clot was investigated.

The results are shown in the graph.



Give **two** conclusions that can be drawn from these results.

(2)

1 Individual T takes longer to form a blood clot than individual U.

2 Individual T clots less ~~than~~ than individual U.



This response gained two marks. MP2 (line 1) and MP1 (line 4).



When a question asks you to draw conclusions from data shown on a graph, don't just describe what you see. Instead, infer conclusions from the data.

Question 3(c)

The majority of candidates achieved full marks. Candidates were asked to explain how blood clots can lead to the death of heart muscle. Some candidates focused extensively on the process of clot formation rather than explaining how a clot causes heart muscle death. Those who did not achieve MP1 failed to mention the 'lumen' or 'coronary artery'. Additionally, some candidates did not achieve MP4 because they did not refer to **aerobic** respiration.

(c) Atherosclerosis can increase the risk of blood clots forming.

Explain how blood clotting in atherosclerosis can result in the death of heart muscle.

(3)

Blood clotting in atherosclerosis will narrow ~~the coronary~~ ~~other~~ arteries, specifically it will narrow the coronary artery. Therefore, there is reduced oxygenated blood flow to the cardiac muscle from the coronary artery. Therefore, less oxygen means the cardiac muscle carries out less aerobic respiration. As a result, ATP and glucose cannot be produced so the heart muscle will die.

ResultsPlus
Examiner Comments

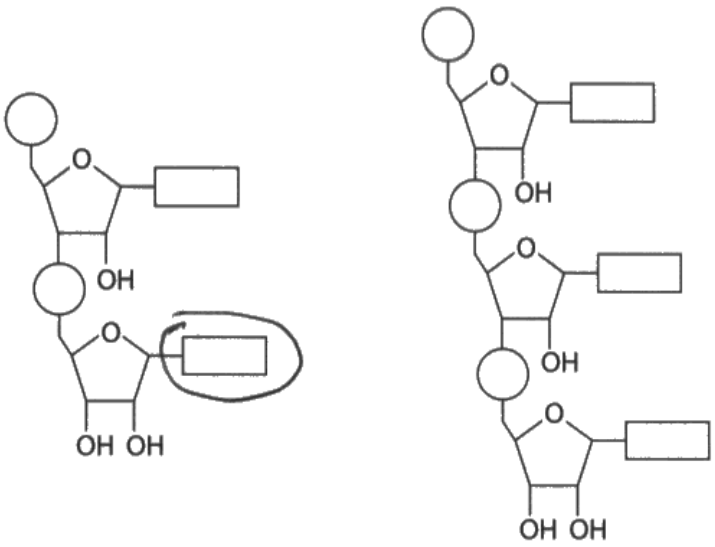
This response gained three marks. MP2 and MP3 on lines 3-4 and MP4 on lines 6-7. It did not achieve MP1 as the candidate did not mention **lumen**.

Question 4(a)(i)

The majority of candidates were awarded the mark. Candidates were required to draw a circle around a base in the dinucleotide. Any nucleotide circled on the left dinucleotide was accepted for the mark. Some candidates circled the entire nucleotide instead of just the base.

4 The primary structure of a polypeptide, synthesised on a ribosome, is determined by the genetic code.

(a) The diagrams show an RNA dinucleotide formed from two RNA nucleotides and an RNA trinucleotide formed from three RNA nucleotides.



RNA dinucleotide RNA trinucleotide

(i) Draw a circle around **one** base in the dinucleotide.

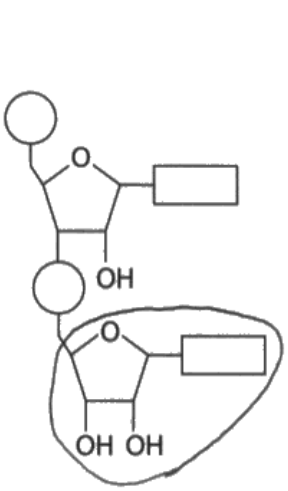
(1)

ResultsPlus
Examiner Comments

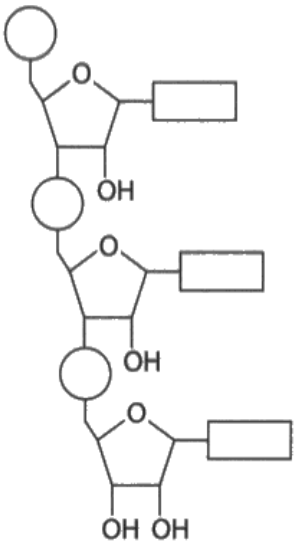
This response gained one mark for correctly identifying a base on the RNA dinucleotide.

4 The primary structure of a polypeptide, synthesised on a ribosome, is determined by the genetic code.

(a) The diagrams show an RNA dinucleotide formed from two RNA nucleotides and an RNA trinucleotide formed from three RNA nucleotides.



RNA dinucleotide



RNA trinucleotide

(i) Draw a circle around **one** base in the dinucleotide.

(1)

ResultsPlus
Examiner Comments

This response did not gain the mark because the candidate circled the sugar and base of an RNA dinucleotide.

Question 4(a)(ii)

The majority of candidates were awarded the mark. A small number of candidates referred to 'U' or 'oxyribose' and therefore did not achieve the mark.

(ii) State **one** difference between a nucleotide used to form RNA and a nucleotide used to form DNA.

(1)

RNA sugar is oxynbose and DNA sugar is deoxynbose-

ResultsPlus
Examiner Comments

This response did not gain a mark. The candidate stated the RNA sugar is oxyribose which is incorrect terminology.

ResultsPlus
Examiner Tip

Make sure you take time to revise names of molecules so you do not lose marks.

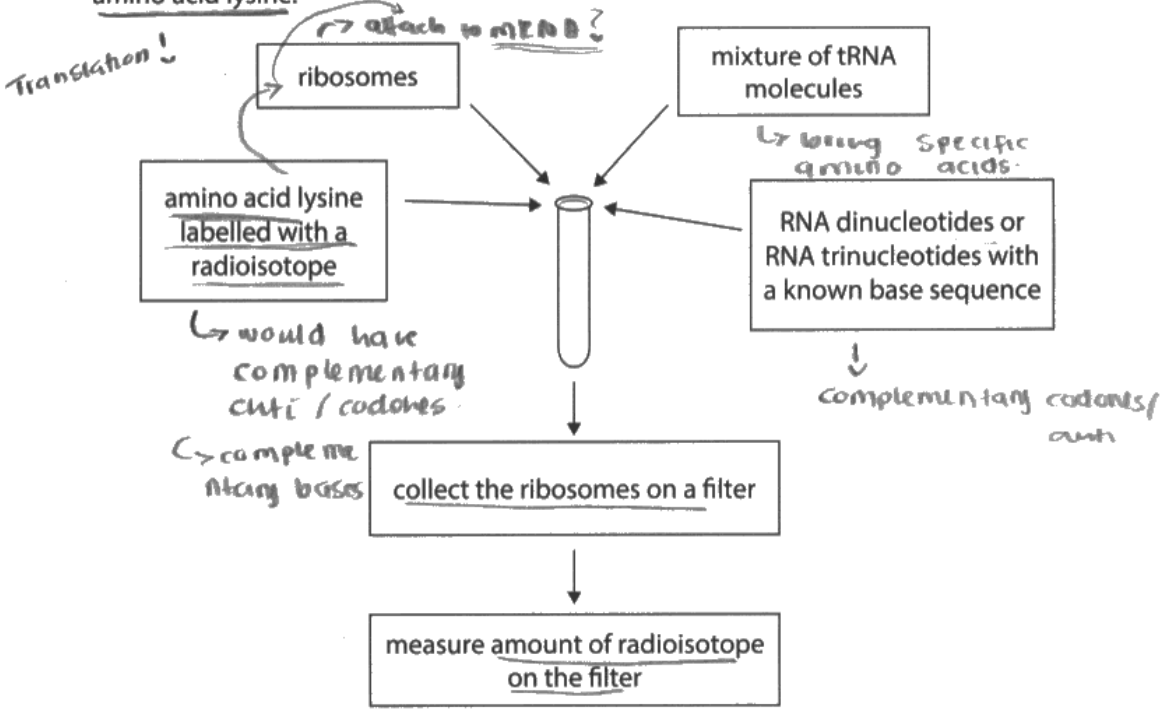
Question 4(b)(i)

In this question, candidates were expected to interpret details of an experiment investigating the genetic code of lysine and to describe the roles of components used. Many candidates gained MP3 by correctly recalling that tRNA brings amino acids to ribosomes. However, fewer achieved MP1, often failing to include terms such as 'binds' or 'attaches'. MP2 was less commonly awarded, as some candidates mentioned either 'anticodon' or 'codon' but did not refer to binding.

(b) An experiment to determine the genetic code used amino acids labelled with a radioisotope, RNA dinucleotides and trinucleotides, ribosomes and a mixture of tRNA molecules.

The small mRNA molecules used were dinucleotides and trinucleotides with a known base sequence.

The diagram shows the method used to determine the genetic code of the amino acid lysine.



(i) Describe the roles of the ribosomes, RNA dinucleotides and trinucleotides and the tRNA used in this experiment.

(3)

~~Ribosomes attach to m-RNA strand. t-RNA molecules~~

Ribosomes attach to the m-RNA dinucleotide or mRNA trinucleotide strands. t-RNA molecules bring specific amino acid lysine. Complementary codones and anticodones on the on the amino acid and RNA dinucleotides or RNA trinucleotides bind. This shows the base sequence of amino acid

ResultsPlus
Examiner Comments

This candidate achieved three marks. MP1 (lines 1-2), MP3 additional content (lines 2-3) and MP2 (lines 4-7).

ResultsPlus
Examiner Tip

Even if you are presented with a new experiment or method, there will be links to the specification and content you have learnt. For example, this experiment relates to the process of translation and the roles of mRNA, ribosomes and tRNA. When faced with a novel scenario, take the time to deduce which parts of the specification apply to the question.

Question 4(b)(ii)

This question required candidates to draw two conclusions from the results and explain them using the provided table. Conclusions corresponding to MP1 and MP3 were more commonly observed. MP2 was less frequently awarded, as candidates struggled to describe that no lysine was present on the filter when dinucleotides were used. Some candidates did not achieve MP4 because they failed to specify the codons AAA and AAG, instead stating generally that many base combinations code for lysine.

(ii) Some of the results for the amino acid lysine are shown in the table.

RNA dinucleotide or trinucleotide used		Presence of tRNA with radioactive lysine on the filter
Trinucleotide	AAA	Yes
	AAG	Yes
	GAA	No
Dinucleotide	AA	No
	AG	No
	GA	No
	GG	No

Explain **two** conclusions about the genetic code that can be drawn from the results of this experiment.

(4)

1 Genetic code is degenerate as lysine was present in both AAA and AAG base sequences. This ~~suggests that~~ shows that more than one triplet code can code for the same amino acid such as lysine.

2 The genetic code is also triplet code. This is displayed as lysine was only ever present in a triplet with three bases ~~like~~ such as AAA and AAG compared to AA or AG in dinucleotides.

ResultsPlus
Examiner Comments

This candidate achieved four marks. MP3 for saying the genetic code is degenerate and MP4 for the idea that lysine was present when both AAA and AAG trinucleotides were used. MP1 for stating the genetic code is a triplet code and MP2 for the idea that lysine was only present on the filter when trinucleotides were used.

Question 5(a)

The majority of candidates were awarded the mark. Some candidates stated that bacteriostatic antibiotics do not kill bacteria but did not mention that they inhibit bacterial replication. Others described the effect as stopping the growth of bacteria rather than stopping the growth in the 'number' of bacteria, and therefore did not achieve the mark.

5 Doxycycline (DOX) is a bacteriostatic antibiotic.

(a) State what is meant by the term **bacteriostatic antibiotic**.

(1)

a substance that prevents the growth of bacteria

ResultsPlus Examiner Comments

This response did not achieve the mark. The candidate stated 'prevents the growth' of bacteria without making a reference to the **number** of bacteria.

5 Doxycycline (DOX) is a bacteriostatic antibiotic.

(a) State what is meant by the term **bacteriostatic antibiotic**.

(1)

a substance that inhibits the replication / multiplication of bacteria

ResultsPlus Examiner Comments

This response achieved the mark. The candidate correctly stated that bacteriostatic antibiotics inhibit the replication of bacteria.

Question 5(b)(i)

Candidates found this question demanding. MP1 was observed in the majority of responses, with MP2 seen in some answers, while MP3 was rarely awarded. Many candidates described differences between the two conditions without attempting to explain, despite 'explain' being the command word. Some candidates did not achieve any marks because they described the effect of 60 cycles on E. coli rather than on DOX-resistant E. coli.

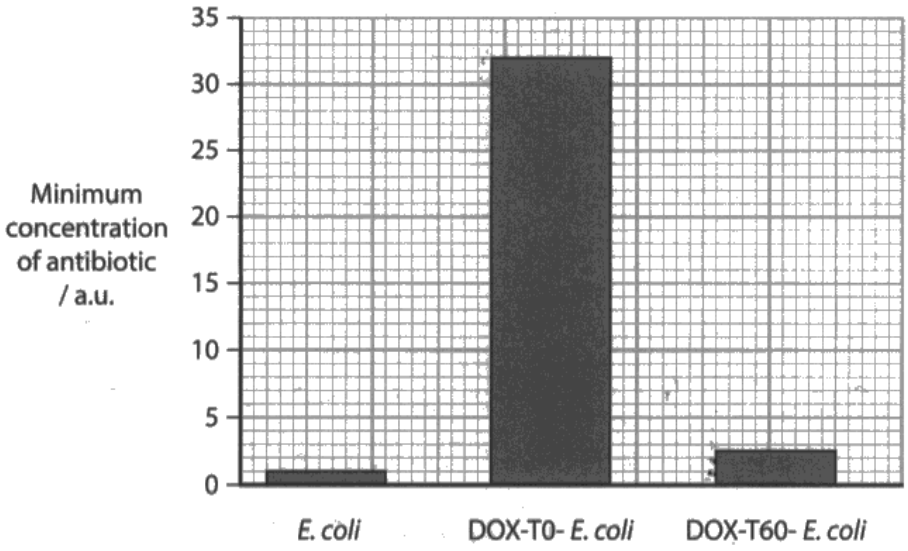
(b) Antibiotic resistance to DOX was investigated.

A culture of *E. coli* was treated with DOX and a resistant strain of *E. coli* called DOX-T0- *E. coli* was produced.

The DOX-T0- *E. coli* were then placed in antibiotic free conditions.

After 60 cycles of cell division, they became a different strain called DOX-T60- *E. coli*.

The graph shows the minimum concentration of DOX required to have a bacteriostatic effect on the bacteria.



(i) Explain the effect of 60 cycles of cell division on DOX resistant *E. coli* (DOX-T0- *E. coli*).

(2)

DOX-T0- E. coli has the ~~greatest~~ highest minimum concentration of antibiotic required to have a bacteriostatic effect on the bacteria. The difference between the highest concentration of DOX-T0- E. coli and the highest concentration of DOX-T60- E. coli is 32 - 28.5 which is 29.5 a.u.

ResultsPlus
Examiner Comments

This response was not awarded any mark point. The candidate has attempted to describe the data. However, the question asks candidates to **explain** the effect of 60 cycles of division on DOX resistant *E.Coli*.

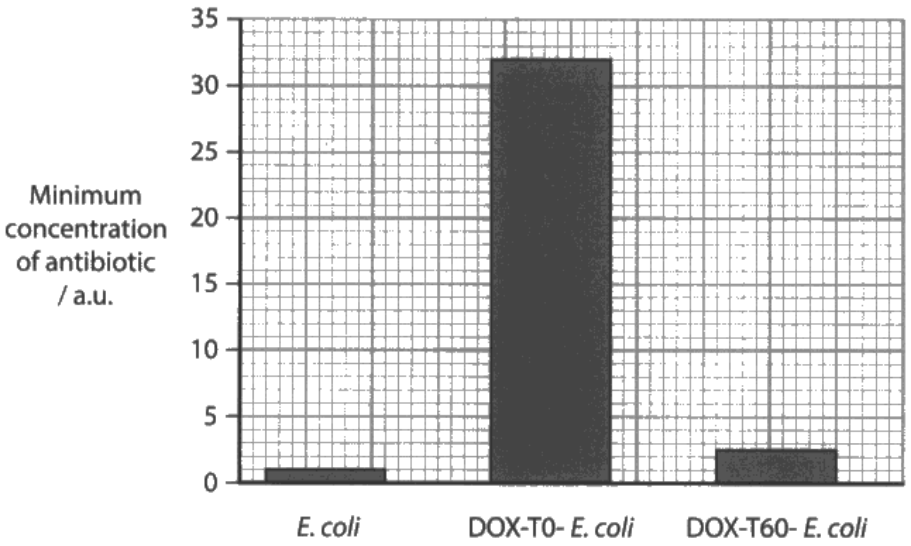
(b) Antibiotic resistance to DOX was investigated.

A culture of *E. coli* was treated with DOX and a resistant strain of *E. coli* called DOX-T0- *E. coli* was produced.

The DOX-T0- *E. coli* were then placed in antibiotic free conditions.

After 60 cycles of cell division, they became a different strain called DOX-T60- *E. coli*.

The graph shows the minimum concentration of DOX required to have a bacteriostatic effect on the bacteria.



(i) Explain the effect of 60 cycles of cell division on DOX resistant *E. coli* (DOX-T0- *E. coli*).

(2)

- their antibiotic resistance to DOX reduces. They have been grown in antibiotic free conditions meaning there is no selection pressure which would favour antibiotic resistant genes. Instead, other genes are naturally selected. The frequency of the antibiotic resistant gene reduces, meaning a lower dose antibiotic becomes more effective

ResultsPlus
Examiner Comments

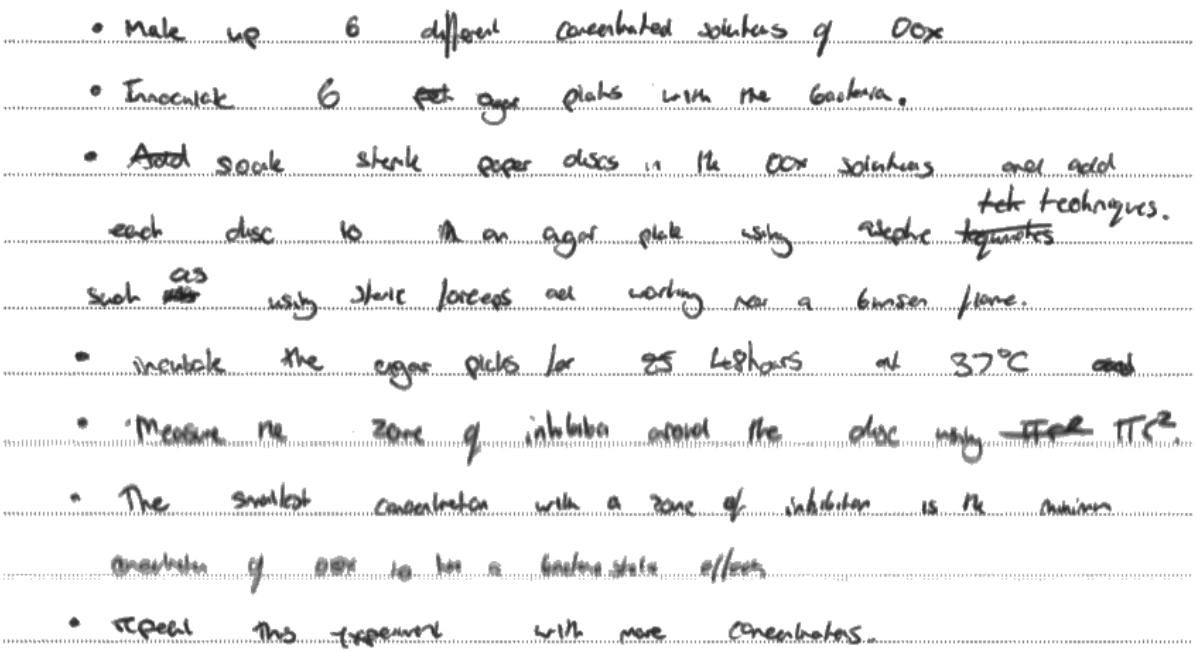
This response was awarded the two marks. MP1 on the first line and MP3 for 'grown in antibiotic free conditions meaning there is no selection pressure'. They also achieve MP1 again, later in the response for saying, 'the frequency of the antibiotic resistant allele reduces'.

Question 5(b)(ii)

Many candidates achieved full marks. MP1 to MP4 were present in a large number of responses. MP1 was sometimes not awarded because candidates referred to a petri dish rather than specifying **agar**. MP3 was often missed as candidates did not reference values taken from the graph. MP5 was rarely seen; where attempts were made, candidates mentioned zones of inhibition without qualifying how these would be used, such as identifying the lowest concentration disc that produces a zone of inhibition.

(ii) Devise a procedure to determine the minimum concentration of DOX required to have a bacteriostatic effect on the bacteria.

(4)



ResultsPlus
Examiner Comments

A comprehensive response which achieved MP1, MP2, MP4 and MP5. The candidate did not state an appropriate range of concentrations and therefore did not achieve MP3. However, this response shows a description adequate for MP5 which was not seen in many responses.

(ii) Devise a procedure to determine the minimum concentration of DOX required to have a bacteriostatic effect on the bacteria.

(4)

- Using petri dish of agar with ecoli populations
- ~~tift~~ tict place bunsen burner over petri dish
- open lid slightly and add small ↓ Concentration of DOX
- Close lid, tape shut to prevent unwanted bacteria entering agar. Then store dish upside down to prevent H_2O dripping onto agar.
- Repeat steps 2-5 with increasing concentrations of Dox leaving 1 dish with no DOx as a control.
- leave all dishes to incubate for 48 hours
- then study zone of inhabition. Calculating it by the formula => Area = πr^2
- use this to find the minimum Dox required to have an effect. by comparing zone of inhabitions

ResultsPlus
Examiner Comments

This response achieved MP1 for stating 'use agar with *E.Coli* populations' and MP4 for 'incubate for 48 hours'. The candidate made an attempt at MP3 suggesting a range of concentrations needed to be used but did not give an appropriate range. The candidate also attempted MP5 but did not state how the zone of inhibition would show the minimum antibiotic that has an effect on the growth on *E.Coli*; they simply stated 'comparing zone of inhibitions'.



If you are asked to devise a procedure based on data given to you, use information given in the table or graph to write your method.

Question 5(c)(i)

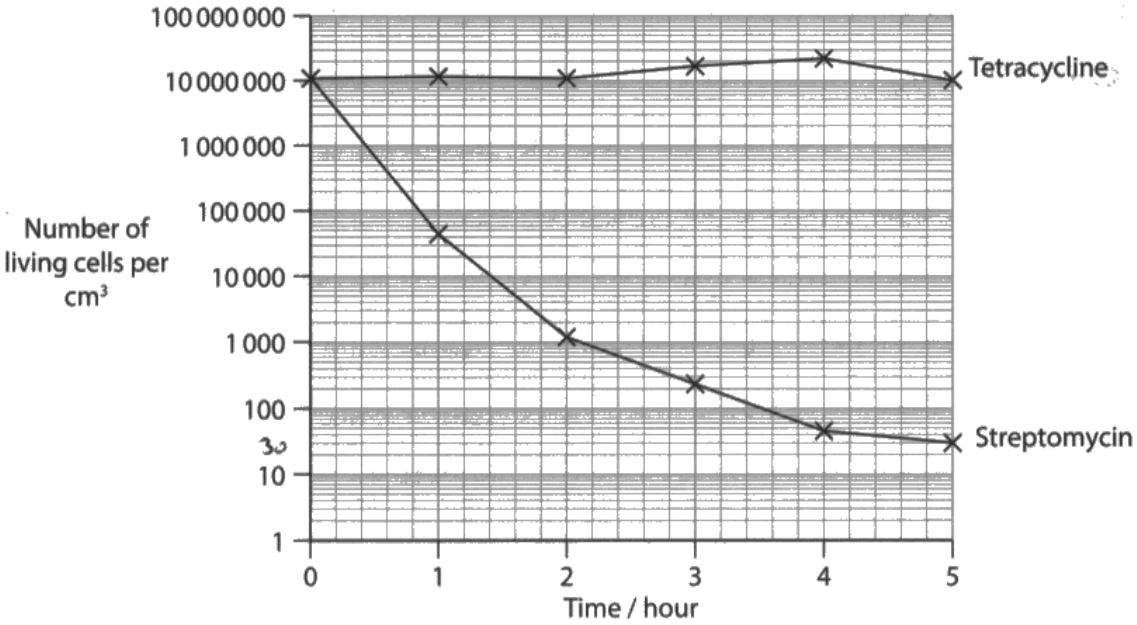
Candidates found this question demanding. Some achieved only one mark because they did not express their answer as a whole number. Many scored no marks due to providing an incorrect value for Streptomycin.

(c) In a different investigation the effects of two antibiotics, tetracycline and streptomycin, were compared on cultures of *E. coli*.

Each antibiotic was added to a culture containing 10 000 000 living *E. coli* bacteria at time 0.

Samples were removed from the cultures every hour and the number of living bacteria was determined.

The results are shown in the graph.



(i) Calculate the ratio of living bacteria in the tetracycline culture compared with the streptomycin culture at five hours.

(2)

tetracycline = 10,000,000 Streptomycin = 30

(÷ 30) ÷ 30

~~33333~~ 333333.3 : 1

Answer 333333.3 : 1

ResultsPlus
Examiner Comments

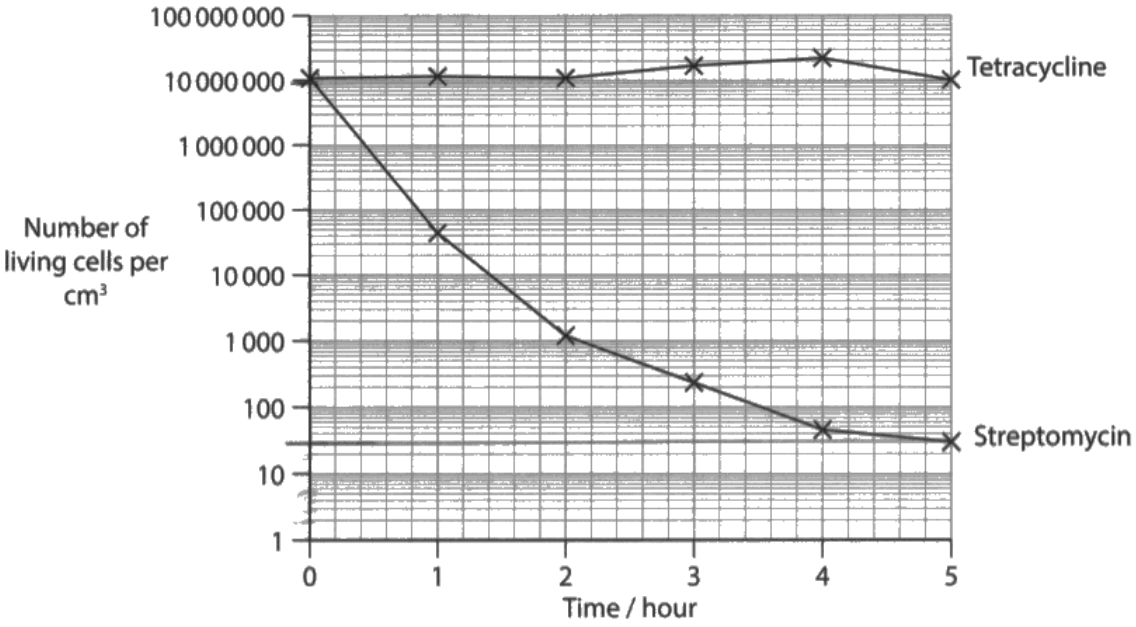
This candidate did not express their answer as a whole number. They achieved MP1 for getting the correct values from the graph.

(c) In a different investigation the effects of two antibiotics, tetracycline and streptomycin, were compared on cultures of *E. coli*.

Each antibiotic was added to a culture containing 10 000 000 living *E. coli* bacteria at time 0.

Samples were removed from the cultures every hour and the number of living bacteria was determined.

The results are shown in the graph.



(i) Calculate the ratio of living bacteria in the tetracycline culture compared with the streptomycin culture at five hours.

(2)

10 000 000 : 11.5

869565.2 : 1

870000 : 1

Answer 870 000 : 1

ResultsPlus
Examiner Comments

This candidate did not achieve any marks. They did not take the correct value for Streptomycin from the graph.

ResultsPlus
Examiner Tip

Make sure you familiarise yourself with the mathematical skill section in the specification. This question expected candidates to be comfortable using logarithmic scales.

Question 5(c)(ii)

This question was accessible to many candidates. Many achieved two marks by correctly stating that tetracycline is bacteriostatic and streptomycin is bactericidal. Some candidates did not achieve MP1 or MP2 because they quoted values instead of stating that tetracycline has 'no effect on the number of living cells' or that streptomycin 'decreases the number of living cells'.

(ii) Deduce the effects of these two antibiotics on *E. coli*.

(2)

Streptomycin is bacterialsidal ~~as~~ as the number of living cell decreases as it kills the bacteria. Tetracycline is bacteriastatic as the number of living cells stays the same but doesn't increase.

ResultsPlus
Examiner Comments

This response achieved both marks and gave both options for MP1 and MP2.

(ii) Deduce the effects of these two antibiotics on *E. coli*.

(2)

Tetracycline will have a very weak effect on the E. coli while Streptomycin will have a very strong and good effect on the E. coli. The E. coli will have a much higher chance at developing resistant strains to [redacted] Tetracycline [redacted] than with Streptomycin

ResultsPlus
Examiner Comments

The candidate did not achieve any marks. The statement 'tetracycline will have a weak effect on the *E.Coli*' does not achieve MP1 as there is no reference to the number of living cells. 'Streptomycin will have a very strong and good effect' does not achieve MP2. 'Weak', 'strong' and 'good' are subjective terms and should not be used in scientific explanations.

Question 6(a)(i)

This question was accessible to the majority of candidates. In many cases where the mark was not awarded, candidates did not specify **only** one geographical location.

6 The photograph shows a coastal tailed frog that is endemic to Western North America.



(Source: © Nature Picture Library/Alamy Stock Photo)

(a) Coastal tailed frogs live in streams. Coastal tailed frogs feed at night along the edges of streams. They eat invertebrates such as insects, spiders and snails.

(i) State what is meant by the term **endemic**.

(1)

The species is only found in one geographical location. Coastal tailed frogs are only found in North America

ResultsPlus
Examiner Comments

A good response, achieving the mark.

Question 6(a)(ii)

This question was accessible to the majority of candidates. Those who achieved only one mark often did not achieve MP2 because they failed to refer to the specific niche of the coastal tailed frog, despite this information being provided in the question stem.

(ii) Describe what is meant by the **niche** of the coastal tailed frog.

(2)

a niche is the role an organism plays in its habitat, it involves its interactions with biotic and abiotic factors, for example coastal tailed frogs eat at night

ResultsPlus
Examiner Comments

This response achieves both marks. MP1 for the general definition of niche and MP2 for referring to the specific niche of coastal tailed frog.

(ii) Describe what is meant by the **niche** of the coastal tailed frog.

(2)

the niche is the role of the frog within its ecosystem. this can be its behaviours or biological pattern for example the food it eats or when it sleeps.

ResultsPlus
Examiner Comments

This response achieved one mark only. Although an attempt was made at MP2, the candidate did not refer to the information provided.

ResultsPlus
Examiner Tip

Make sure you address all of the instruction in the question and make a note of how many marks it is worth. For example, this question was worth two marks therefore two statements needed to be made.

Question 6(b)(i)

Candidates found this question demanding. Candidates were required to determine the number of streams where frogs were not observed using the information in the first bullet point, then calculate the percentage of these streams where eDNA was detected. Many candidates scored zero marks because they did not use the first bullet point to identify that 36 streams had no frogs observed.

(b) The presence of coastal tailed frogs in streams is used as an indicator of the health of an ecosystem.

In the past, scientists observed frogs and recorded their locations.

Scientists can now use eDNA to study the locations of these frogs. This method detects frog DNA collected from the water and amplified by PCR.

In one investigation, the two methods were compared.

Observational studies and eDNA methods were used to determine if coastal tailed frogs were present or absent in 45 streams.

The results were:

- Observational studies found these frogs in 9 of the 45 streams.
- Frog eDNA was also detected in those 9 streams.
- Frog DNA was also found in 21 streams in which these frogs were not observed.

(i) Calculate the percentage probability of coastal tailed frog eDNA being detected in a stream in which the frogs were not observed.

Give your answer as a whole number.

(2)

~~45 ÷ 9 = 20%.~~

~~21 ÷ 5 = 4.2 × 20%~~

58

~~20~~ %

~~45 - 2~~

45 − 9 = 36.

$\frac{21}{36} \times 100 = 58.3\%$.

ResultsPlus
Examiner Comments

This candidate correctly worked out that there were 36 streams where no frogs were observed. They then correctly worked out that 21 is 58.3% of 36 and achieved two marks for expressing this as a whole number.

Question 6(b)(ii)

Many candidates achieved MP2 and MP3, but MP1 and MP4 were rarely seen. The strongest responses referenced the context of the question, for example, noting that the frogs are nocturnal and therefore difficult to observe at night. This highlights the importance of using all information provided in the question.

(ii) Comment on the advantages and disadvantages of using eDNA methods to identify streams with frogs that are active at night.

(3)

Advantages are that a scientist does not have to have the time consuming job of watching a stream or 45 streams.
It is more accurate than human observation because humans could misidentify the organism or totally miss the organism due to the dark conditions.
Disadvantages, the DNA may be transfered by flowing water into streams which they have not visited or the DNA could be transfered by predators which have used the stream after hunting the frog so it is misleading.

ResultsPlus
Examiner Comments

This was a typical response. The candidate achieved MP1 for suggesting the frog is difficult to see in dark conditions and MP2 for stating the DNA can by travel in the stream. The candidate was awarded two marks.

ResultsPlus
Examiner Tip

Make sure that you give both advantages **and** disadvantages if asked to. Subheadings or a table can guide your response to make sure you are following the instruction in the question.

Question 6(c)

This question was accessible to most candidates. Candidates were asked to devise a method using eDNA to identify which species of frog is present in a stream. Comprehensive answers were frequently seen. However, candidates were less likely to achieve MP6, as many attempts did not refer to the **position** or **location** of bands. Additionally, many candidates did not achieve MP1 because they failed to state that DNA samples should be taken from **both** species of frog.

(c) The Rocky Mountain tailed frog is closely related to the coastal tailed frog.

Devise an eDNA method that could be used to identify which of these species of frog is present in streams.

(4)

collect DNA from the streams, Rocky Mountain tailed frog and coastal tailed frog. Amplify the samples using PCR. Add restriction enzymes and flouresecent tag to the samples. Load the sample into the wells of agar jelly covered in buffer solution. Pass a current through the tank and observe the bands produced in the gel electrophoresis. Compare the size and position of bands between the three samples. Similarities in band position and size indicate closer genetic relations. The more closley matched species is likely to be found ~~in~~ to be present in the stream

ResultsPlus
Examiner Comments

This response achieves MP1, MP2, MP3, MP5 and MP6. This candidate gave a good example for MP6 stating that you need to compare the **position** of bands to identify the species present. The candidate was awarded maximum four marks.

Question 7

The command word for this level-based question was 'discuss'. This question gave candidates a wide range of specification areas to discuss and required them to refer to details of complementary shapes in biological molecules and discuss their importance. Comprehensive answers were frequently seen, with many responses reaching the level 3 category. However, some candidates limited their responses to level 2 by providing only two examples of complementary shapes. Candidates should ensure they follow all instructions for level-based questions to avoid limiting the marks awarded. Those who listed molecules before writing their response generally achieved higher marks.

*7 The word 'complementary' is often used when describing the shapes of biological molecules that interact with each other.

Discuss the importance of complementary shapes in **three** types of biological molecule found in living organisms.

(9)

~~Proteins~~ Enzymes

Enzymes has active site of specific shape, thus they only catalyst certain reactions that the substrates shape are complementary to the active sites. Changes in the shape of enzymes due to mutation or denaturation cause the shape of the active site to no longer be complementary to the substrates, thus the enzymes cannot catalyse a reaction.

DNA and RNA

DNA and RNA base sequences are complementary to produce the correct molecules. Template strand is complementary to the coding strand. mRNA is complementary to the template strand on DNA, tRNA anticodons are ~~comple~~ complementary to the codon codes on mRNA to produce protein.

Receptors

Receptors shape must be complementary to the its chemical ~~signa~~ signaling for the signal to bind to the receptor and initiate the response. Although molecules with similar shapes might also be able to bind, like Dopamine agonist that can bind to dopamine receptor instead of neurotransmitter Dopamine.

ResultsPlus
Examiner Comments

This candidate has referred to three examples and given some correct biological details about these examples. The candidate attempts to link consequences to two of the examples. The third example of receptors is vague and an attempt at giving neurotransmitters as an example is given at the end. This response was indicative of a level 2 response and was awarded five marks.

ResultsPlus
Examiner Tip

Make a plan to ensure that you are addressing all of the instruction/s in the question. If you do not follow the instruction/s, you limit the level of your response. For example, this question asked candidates to discuss the importance of complementary shapes in **three** types of biological molecule.

***7** The word 'complementary' is often used when describing the shapes of biological molecules that interact with each other. enzymes antigens/antibodies

Discuss the importance of complementary shapes in **three** types of biological molecule found in living organisms. DNA/RNA

(9)

Enzymes

The active site of enzymes is specifically determined by bonding and folding that occurs whilst the enzyme is processed in the rough endoplasmic reticulum. It is determined by the interaction of R groups e.g. ionic bonding. This important since it produces active sites that complementary to the enzymes substrate. This means that if there are successful collisions, enzyme-substrate complexes can form - allowing enzymes to perform their role of biological catalysts. It also means only specific substrates can bind to the enzyme. Enzymes are key to ~~many~~ nearly all body processes and metabolism e.g. production of ATP by ATP synthase. ~~Therefore complementary DNA~~ Nucleic acids

complementary shapes in nucleic acids are key to their formation and structure. In DNA, the organic bases adenine and thymine are complementary (form two hydrogen bonds), as well as guanine and cytosine (3 hydrogen bonds). This allows DNA to form a double helix structure - due to bonds forming between.

parallel strands. Furthermore, complementary base pairing allows the formation of mRNA - since free RNA nucleotides line up to their complementary bases on DNA - allowing for transcription. similarly, complementary base pairing occurs between mRNA codons and tRNA anticodons - so that the specific amino acid is transported to the polypeptide chain. This allows translation to occurs. Therefore complementary base pairing allows for protein synthesis.

Antigens and antibodies

Antigens are ~~pa~~ molecules on the outside of cells or viruses that allow the immune system to recognise them as non-self or self. Non-self pathogens are engulfed and destroyed by phagocytosis - which phagocytes becoming antigen presenting cells. T cells with complementary receptors bind to APCs, which triggers the specific immune response. In which, B cells are activated and differentiate into plasma cells which produce antibodies. Antibodies are the complementary shape to antigens - forming antibody-antigen complexes. Antibodies ~~also~~ cause agglutination of pathogens, produce antitoxins or bind to pathogen receptors - so antibodies are crucial in allowing the immune system to destroy pathogens. Overall complementary shapes are crucial to the function of biological molecules - such as enzymes

(Total for Question 7 = 9 marks)

ResultsPlus
Examiner Comments

This candidate made a quick plan to make sure they included three examples in their response. This comprehensive response included three examples of complementary molecules with many correct biological facts given. The candidate has given a consequence / importance for each of the complementary molecules linked to the biological facts stated. This response was awarded full marks.

Question 8(a)

Candidates found this question demanding. MP1 was observed in more responses than MP2. Some candidates attempted MP1 but did not clearly infer that 'many' mammals hibernate. Most attempts at MP2 merely stated that hibernation must be inherited from a common ancestor, rather than referring to genes or alleles associated with hibernation.

8 The scientific article you have studied is adapted from New Scientist.

Use the information from the scientific article and your own knowledge to answer the following questions.

(a) Explain why 'the distribution of hibernating species on the tree of mammals' suggests that the common ancestor of all mammals was a hibernator (paragraph 3).

(2)

In order for there to be multiple species of mamal that hibernates there needs to be an ancestor for them to have recieved the gene from. As there are multiple species it suggests it was not just mutations and that the common ancestor hibernated.

ResultsPlus
Examiner Comments

This response achieved MP1 for stating that there are multiple species of mammal that hibernate and MP2 for suggesting that these mammals must have received the gene from a common ancestor.

8 The scientific article you have studied is adapted from New Scientist.

Use the information from the scientific article and your own knowledge to answer the following questions.

(a) Explain why 'the distribution of hibernating species on the tree of mammals' suggests that the common ancestor of all mammals was a hibernator (paragraph 3).

(2)

All mammals share a comon ancester as suggested by the 'tree of mamals' and as so many animals do have the ~~ability~~ ability to hybernate, it suggests that this trait was inherited by a comon ~~ancestor~~ ancestor.

ResultsPlus
Examiner Comments

This response achieved one mark for MP1. The candidate did not achieve MP2 because they did not refer to either allele, gene or adaptation.

Question 8(b)

Some candidates did not fully read the question and answered from a thermoregulatory approach. However, the question specifically asked why a reduction in physiological activity can reduce body temperature. MP2 and MP4 were commonly seen in responses awarded marks. Some candidates referred only to 'energy' without specifying 'heat energy'. Few candidates made the link between reduced physiological activity, a decreased metabolic rate, and consequently, a reduction in respiration.

(b) Explain how a reduction in physiological activity can result in a reduction in body temperature (paragraph 6).

(3)

A reduction in physiological activity means that less metabolic reactions are taking place as well as less respiration. This leads to less heat energy being generated at the muscles by either aerobic or anaerobic respiration so therefore less heat energy generated means that the core body temperature also decreases.

ResultsPlus
Examiner Comments

This response achieves MP1, MP3 and MP4 in that order. The candidate wrote their response in a logical order and was awarded three marks.

(b) Explain how a reduction in physiological activity can result in a reduction in body temperature (paragraph 6).

(3)

decreasing physiological activity means the rate of respiration is reduced as there's less demand for energy. Respiration is an exothermic reaction it gives out heat so reducing rate of respiration means less heat is produced so body temperature is lower and there's less heat produced from movement

ResultsPlus
Examiner Comments

This response achieves MP3 for stating 'rate of respiration is reduced' but does not achieve MP2 as they do not refer to ATP, instead saying there is 'less demand for energy'. MP4 achieved for saying less heat produced. MP1 was not seen in the response. The response achieved two marks.

Question 8(c)

The majority of candidates found this question challenging. Many candidates achieved MP6 by describing how a named mechanism leads to heat loss or gain. MP1 and MP3 were commonly awarded, but many candidates did not achieve MP4 and MP5. This was often due to candidates referring to 'signals' instead of 'impulses', therefore not achieving MP4 and MP5.

(c) Hibernating mammals, such as the black bear, can maintain a lower core temperature. 'The black bear (*Ursus americanus*), for example, lowers its core temperature by about 6 °C' (paragraph 8).

Describe the processes that would maintain the core body temperature of the black bear at a temperature 6 °C lower than normal.

(5)

Temperature drops of 6°C will be detected by thermoreceptors on the skin. Thermoreceptors will send impulses to the thermoregulatory centre in the hypothalmus. The thermoregulatory centre will then send fewer impulses to sweat glands to reduce heat loss from secretion and evaporation of sweat. Impulses will also be sent to cause vasoconstriction of arterioles to reduce blood flow to capillaries near the surface of skin to reduce heat loss. Impulses will also be sent to erector pili to ~~reg~~ erect hairs in order to trap air and for an insulation layer to reduce heat loss and maintain core temperature.

ResultsPlus
Examiner Comments

This response achieved MP3, MP4, MP5 and MP6 in that order. Many mechanisms were described that achieve MP6. The candidate correctly stated that **impulses** are sent from the thermoreceptors to the hypothalamus for MP4 and **impulses** are sent from hypothalamus to a named effector for MP5. The candidate achieved four marks.

Question 8(d)

Candidates found this question challenging. The most commonly awarded marking point was MP2, with candidates stating that genes can be identified from proteins present. Few candidates achieved MP1, as they did not specify that tissue samples needed to come from both hibernating and non-hibernating mammals. MP3 and MP4 were uncommon, with candidates often failing to explain how the base sequence of mRNA or the amino acid sequence of proteins can be used to identify the active gene.

(d) Tissue samples were collected from different mammals during hibernation. These were analysed to identify which genes were controlling hibernation (paragraphs 10 and 11).

Explain how scientists could use tissue samples to find out which genes were activated.

(3)

In tissue samples. There will be mRNA and proteins synthesised from the mRNA. mRNA will only be synthesised from active genes. Tissue samples can be collected before, during and after hibernation. Electrophoresis can be used to create proiles for mRNA. If mRNA is produced during hibernation and not before hibernation. ~~It is likely to be involved~~ The gene the mRNA is produced from is likely to be involved in hibernation.

ResultsPlus
Examiner Comments

This response achieved MP2 and MP1 in lines 1-3. MP1 was given for 'tissue samples can be collected before, during and after hibernation' which is allowed in the additional guidance. MP3 and MP4 were not seen in the response. It was awarded two marks.

(d) Tissue samples were collected from different mammals during hibernation. These were analysed to identify which genes were controlling hibernation (paragraphs 10 and 11).

7. Explain how scientists could use tissue samples to find out which genes were activated.

(3)

Tissues contain many of the same type of specialised cell, MRNA is only made by transcription from active genes and then translated to produce a protein. Scientists could see which genes / sections of DNA are accessible for transcription initiation complexes to bind and see what proteins are produced.

ResultsPlus
Examiner Comments

This response was awarded MP2 for the idea that active genes are transcribed to make mRNA. The response also achieves MP2 for 'see what proteins are produced'. It was awarded one mark.

Question 8(e)

This question required candidates to explain what happens to the blood pressure of a mammal as it comes out of hibernation. Some candidates did not refer to increased blood flow, oxygen, or respiration and therefore lost marks. MP3 was rarely awarded, with most marks coming from MP1 and MP2. Many candidates spent time explaining why blood pressure is low during hibernation, which was not asked for in the question.

(e) Explain why there will be changes in blood pressure when a mammal comes out of hibernation (paragraph 13).

(2)

activated

mammal will have increased metabolic rate for process such as moving and respiration, ~~mamm~~ mammal also needs energy for movement ~~for more~~ blood ~~pressure~~ pressure will increase so more oxygenated blood reaches respiring cells so muscles can do aerobic respiration for movement

ResultsPlus
Examiner Comments

This response achieves MP1, MP2 and MP3 at the end of the response for 'more oxygenated blood reaches respiring cells so muscles can do aerobic respiration for movement'.

(e) Explain why there will be changes in blood pressure when a mammal comes out of hibernation (paragraph 13).

(2)

Less metabolic reactions and processes are occuring during hibernation. As it comes out of it, nutrients must be supplied for reactions and processes to occur. Blood pressure will ~~change~~ increase as more nutrients are demanded than originally. This will cause changes in blood pressure.

ResultsPlus
Examiner Comments

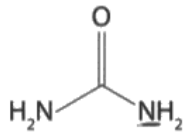
This response achieved no marks. The candidate referred to 'nutrients' and 'reactions' without mentioning 'oxygen' and 'respiration'.

Question 8(f)

Candidates were provided with a diagram of urea and asked to explain why recycling urea is important for a hibernating mammal. Candidates were expected to recognise the amine groups. Many candidates achieved only one mark by stating two molecules from the same marking point, for example mentioning both amino acids and nucleotides but not DNA or proteins. The additional guidance for MP3 was frequently seen, with many candidates noting that hibernating mammals do not eat during hibernation.

(f) Urea is a waste product that is usually excreted in the urine of mammals.

The diagram shows a molecule of urea.



During hibernation 'the thirteen-lined ground squirrel recycles its urea' (paragraph 13).

Deduce why it is important for a hibernating mammal to recycle urea.

(2)

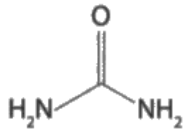
Urea contains nitrogen that is used in the synthesis of amino acids, used to create polypeptide chains, modified into proteins to allow for normal cell function e.g. receptors. Oxygen can be used for aerobic respiration

ResultsPlus
Examiner Comments

This response achieves MP2 and MP3. It does not achieve MP1 as the candidate does not refer to the amine group. It was awarded two marks.

(f) Urea is a waste product that is usually excreted in the urine of mammals.

The diagram shows a molecule of urea.



During hibernation 'the thirteen-lined ground squirrel recycles its urea' (paragraph 13).

Deduce why it is important for a hibernating mammal to recycle urea.

(2)

It preserves nutrients, and urea contains hydrogen and oxygen which are both critical components for aerobic respiration. Recycling this allows for continued aerobic respiration.

ResultsPlus
Examiner Comments

This candidate recognised that urea contains hydrogen and oxygen but did not refer to the importance of nitrogen. This response achieved no marks.

Question 8(g)

The majority of candidates did not achieve more than one mark. MP3 was commonly awarded for responses mentioning cosmic radiation and lack of calcium leading to bone loss. Many candidates did not achieve MP1 as they stated that muscles are not used at all in space, rather than muscles not working as hard. MP2 was rarely seen in candidate responses.

(g) Explain why the bones and muscles of astronauts on long missions will waste away (Box "To blearily go" paragraph B).

(2)

Muscles will not have to contract as much

ResultsPlus
Examiner Comments

This response achieved the additional guidance for MP1.

(g) Explain why the bones and muscles of astronauts on long missions will waste away (Box "To blearily go" paragraph B).

(2)

extended periods of
minimal food causes muscles and bones to
waste away since the astronauts don't
receive enough nutrients and protein to
maintain muscle ~~matt~~ss. lack of calcium
in their diet will lead to bone
wasting away.

ResultsPlus
Examiner Comments

This response achieved the additional guidance for MP3.

Question 8(h)

The majority of candidates achieved full marks. Many comprehensive responses recognised that a reduction in temperature lowers enzyme activity and that metabolic reactions are catalysed by enzymes. Some candidates incorrectly referred to denaturing. Others lost marks for not mentioning kinetic energy or for stating 'there will be more collisions' without specifying substrates and enzymes.

(h) Explain why reducing body temperature from 37.5 °C to 32 °C would reduce metabolic activity (Box "To blearily go", paragraph C).

(3)

Metabolic activity is reactions in the body. Reducing temperature reduces enzyme activity. This is because there is less kinetic energy and therefore less collisions between enzyme at substrate. This slows down reactions such as ~~metabolism~~ respiration.

ResultsPlus
Examiner Comments

This response achieved all three mark points. This candidate gave both options for MP2 and gave a named metabolic reaction for MP3.

Question 8(i)

Many comprehensive responses were seen, and the majority of candidates found this question accessible. Some candidates did not achieve MP1 because they did not specify **presynaptic membrane** when stating that neurotransmitters are released by neurones. MP2 was not achieved by some candidates who described a 'signal' being transmitted from one neurone to another. Some candidates scored no marks because they focused on the role of specific neurotransmitters rather than the general function of neurotransmitters.

(i) Describe the role of a neurotransmitter (paragraph 15).

(2)

A NT is released into the synaptic cleft to bind to the receptors on the post synaptic membrane which causes an action potential to be generated by sodium ions channels opening.

ResultsPlus
Examiner Comments

This response achieved all three mark points and was awarded two marks.

(i) Describe the role of a neurotransmitter (paragraph 15).

(2)

A chemical messenger that transmits nerve impulses between ~~across~~ neurone by diffusing across synaptic cleft to stimulate depolarisation/action potential in post synaptic neurone.

ResultsPlus
Examiner Comments

This was a typical response. The candidate achieved MP2 and MP3.

Question 8(j)

Many candidates found this question accessible. Many comprehensive answers were seen, with MP3 and MP4 commonly awarded. Some candidates did not achieve MP1 and MP2 because they failed to mention the hippocampus. Many responses referred to adenosine inhibiting neurotransmitter binding on the post-synaptic membrane, while fewer candidates suggested that adenosine inhibits the release of neurotransmitters from the pre-synaptic neurone.

(j) Explain how adenosine affects neural activity in the hippocampus (paragraph 15).

(3)

Adenosine is an inhibitory neurotransmitter that promotes sleep. It binds to post synaptic neurones in the hippocampus preventing non-inhibitory neurotransmitters from binding. As a result, less ~~of~~ Na^+ channels open in the post synaptic neurone, A threshold potential isn't ~~reach~~ reached and less action potentials are generated in the post synaptic neurone leading to a sleepy feeling.

ResultsPlus
Examiner Comments

This response achieved all four mark points. The candidate offered both the mark point and additional guidance for MP3 and MP4.

(j) Explain how adenosine affects neural activity in the hippocampus (paragraph 15).

(3)

Adenosine is an inhibitory neurotransmitter. When it diffuses across the synaptic cleft and binds to receptors (within hippocampus) on the post synaptic membrane it will cause Na^+ channels to close / Cl^- channels open and Cl^- ions diffuse in K^+ ions diffuse out leading to post-synaptic neuron becoming hyperpolarised. This ~~post~~ results in less or no action potentials being generated and transmitted from the hippocampus. Can prevent junctions leading to less drowsiness / ~~to~~ sleepiness

ResultsPlus
Examiner Comments

This candidate took a different approach which was less common. They achieved MP1, MP2 and MP4 for explaining how the post synaptic neurone becomes hyperpolarised.

Question 8(k)

Candidates found this question demanding. Many attempted MP1 but incorrectly stated that adenosine binds to receptors in the hippocampus rather than the hypothalamus, which contains the thermoregulatory centre. Some candidates made attempts at MP3 but used the term 'signals' instead of 'impulses'. Additionally, some candidates tried to achieve MP4 but did not state that there would be less or no contraction of skeletal muscle responsible for shivering. Many candidates overlooked the final part of the question and provided a general explanation of how mammals reduce core temperature.

(k) Explain how boosting the uptake of adenosine in the brains of the rats could lower the core body temperature of rats without triggering shivering (paragraph 16).

(3)

The adenosine could inhibit the thermoregulatory centre of the brain by preventing it from sending signals to the muscles. This is because it decreases neural activity by acting as an inhibitor so the electrical impulses never reach the muscles so they don't contract.

ResultsPlus
Examiner Comments

This response does not achieve MP1 as it does not refer to adenosine binding to the thermoreceptors. Although the candidate refers to 'signals', they then gain MP1, MP2 and MP3 for the last sentence.

(k) Explain how boosting the uptake of adenosine in the brains of the rats could lower the core body temperature of rats without triggering shivering (paragraph 16).

(3)

It would slow ~~[illegible]~~ a neural activity so metabolism would decrease ~~[illegible]~~ so the heart rate would be reduced so ~~the~~ muscles. The brain would therefore not send the impulses to the muscles ~~[illegible]~~ as the adenosine would have binded to the receptors so shivering wouldn't occur.

ResultsPlus
Examiner Comments

This response achieved MP1 for the idea that neural activity is reduced and MP3 for impulses are not sent to the muscle. It does not quite achieve MP1 as there is no reference to hypothalamus or thermoreceptors.

Paper Summary

Based on performance on 9BN0/03, candidates should:

- Read questions carefully, taking note of the command word.
- Use all information in the question, even if it is on a previous page.
- Learn key terms and processes.
- Pay careful attention to instructions.
- Take time to construct an answer that follows a clear, logical order.
- Make sure that handwriting is sufficiently clear.
- Ensure that revision is thorough and covers all areas of the specification.
- Learn the methods in the core practicals paying attention to why the steps are needed.

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

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London WC2R 0RL.