



Examiners' Report

June 2023

GCSE Combined Science 1SC0 1BH

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June 2023

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Introduction

The Pearson Edexcel GCSE (9-1) Paper 1: Biology (Higher tier) paper is the first of two papers taken as part of the GCSE (9-1) Biology qualification. This is the sixth assessment of the GCSE (9-1) specification although it was not examined in Summer 2020 and 2021. There were autumn sittings in 2020 and 2021 but these had much lower entries. In 2022 to compensate for lost learning as a result of the Covid pandemic, candidates had access to an advanced information document for this paper which detailed some of the content that would be included in the exam and some that was not included. Candidates this year did not have this advanced information and had to prepare for questions from all the topics of the specification included in this paper.

The Biology specification and the qualification follows a linear assessment model whereby candidates must complete the two papers, worth 100 marks each, in the same single year of certification. Paper 1: Biology (Higher tier) is assessed by a variety of question types, including multiple-choice questions, short-answer questions, calculations and extended open-response questions. Candidates should answer all questions in a time period of 1 hour and 45 minutes. The extended open-response questions are identified by an asterisk (*) in the question paper to indicate that marks are also awarded for the ability to structure a response logically. There are two such questions in this paper. In addition, the GCSE (9-1) Biology qualification assesses practical knowledge and maths skills; the requirements of which are given in the specification. Furthermore, there are 8 mandatory core practicals which candidates must complete prior to the examination, as aspects of working scientifically are also assessed in questions throughout the paper. Paper 1: Biology (Higher tier) contains questions assessing the content from Topics 1 to 5, as identified in the specification.

In this examination series, candidates were required to respond to questions that tested their knowledge and understanding of the role of mitosis in asexual reproduction, the role of stem cells in growth and medicine, the role of natural selection, non-communicable diseases with reference to BMI and waist : hip ratio and reflex arcs. Questions designed to assess practical skills included writing a plan to determine the effect of pH on the rate of reaction of amylase, and the effect of salt concentrations on the movement of water by osmosis in potatoes, this included questions on accuracy and improving an investigation. The maths skills assessed in this paper related to applying the idea of doubling to calculate a population size in bacteria, calculating magnification as well as using percentages and calculating a percentage increase.

There are now five past papers with mark schemes and examiners reports as well as sample assessment material, a year 10 mock and practical support booklets available for this qualification and it is clear that these resources are being utilised as part of the revision process. The use of scientific terminology in responses has improved, particularly in higher ability candidates. Most candidates were able to access both of the extended writing responses, although answers for the reflex arc were presented with a better structure and more specific detail.

Most candidates showed good knowledge on the use of stem cells. Natural selection is a core concept but on this paper candidates had to apply their understanding of the process to extinction and this was something that candidates of all ability managed to show. This question linked to determining sex in birds through inheritance of chromosomes and again this application was something that candidates of all abilities achieved. Most candidates showed a good knowledge of the process of osmosis although they found the link to practical aspects of accuracy and improvements of methods more challenging. Candidates were provided with data and guidance related to BMI, waist : hip ratio, alcohol and smoking and all candidates were able to analyse the data and present conclusions with the higher ability candidates including detailed evaluations of the data. Candidates were assessed on their knowledge of enzymes through both theory and practical aspects. The method was based on the core practical and it showed that many candidates had done this practical, or slight variations on the method and had a good understanding of the techniques involved. Across the paper there was a general improvement in answering practical and maths questions, possibly reflecting teachers increased awareness of its importance.

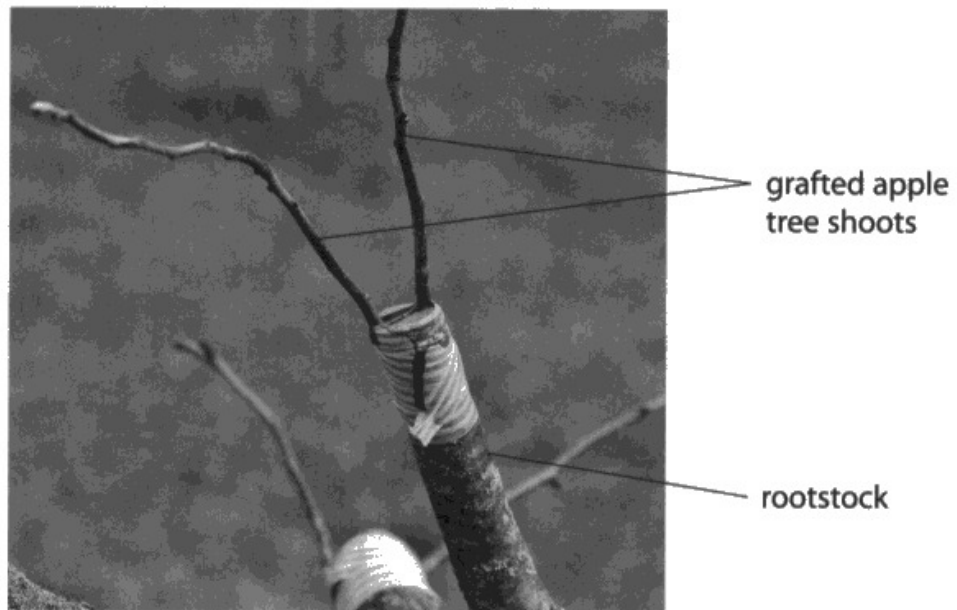
The paper included a number of questions targeting specific higher specification points which are topics that candidates tend to find more challenging. These included sex linked inheritance. These questions showed more differentiation across the candidates entered for the paper, with higher ability candidates showing a better understanding of these difficult concepts.

Question 1 (b)

This question required the application of the knowledge of mitosis which produces genetically identical cells and how this can be an advantage and disadvantage. Most candidates recognised that genetically identical plants are susceptible to the same disease and many recognised the advantage of the grafting technique allowed production of apples with desired characteristics. Some candidates repeated information given in the question that they were genetically identical and therefore the same, without elaborating.

(b) Grafting is a technique used to grow some varieties of apple tree.

Figure 1 shows apple tree shoots grafted on to a rootstock.



(Source: © ATTILA Barsan/Shutterstock)

Figure 1

Grafting can be used to produce apple trees that are genetically identical.

Give **one** advantage and **one** disadvantage of growing genetically identical apple trees.

(2)

advantage

The apples will become riper as more are grown

disadvantage

Reduces variation

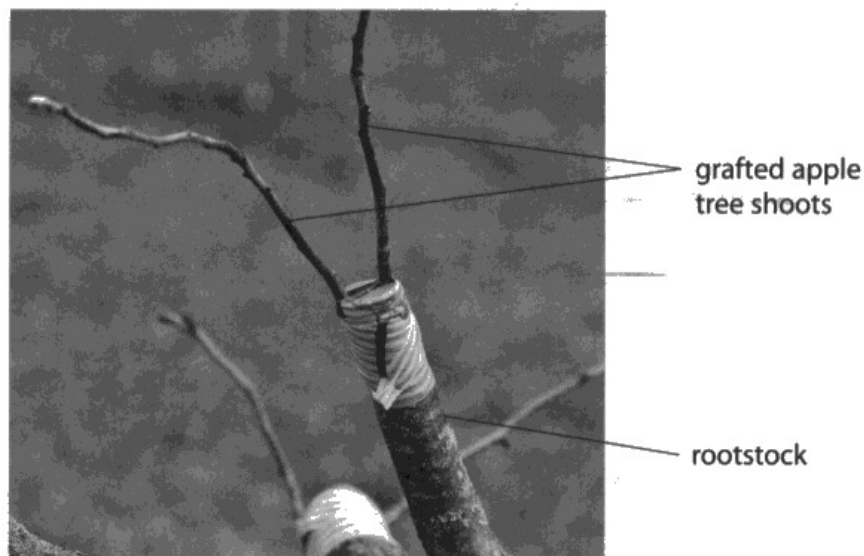


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Examiner Comments

The apples will not become riper is not a correct advantage, so no mark can be awarded here. 0 marks.

(b) Grafting is a technique used to grow some varieties of apple tree.

Figure 1 shows apple tree shoots grafted on to a rootstock.



(Source: © ATTILA Barsan/Shutterstock)

Figure 1

Grafting can be used to produce apple trees that are genetically identical.

Give **one** advantage and **one** disadvantage of growing genetically identical apple trees.

(2)

advantage

If the trees have desired characteristics like high apple produce than having them identical means a good source of apples.

disadvantage

~~No differentiation~~ The trees may have a mutation that is prone to disease which will be inherited through population.



Trees will have the desired characteristics is mark point 1 and all the trees may have a disease is enough for mark point 2 even though the mutation mark is incorrect. 2 marks awarded.

Question 1 (c)

Overall this question was answered well and showed that many candidates had completed the practical activity. Many candidates had used a spotting tile for continuous sampling but some showed that they had incubated the enzyme and starch at a specific pH before adding iodine after a set time and observing the colour. Many candidates across a range of abilities included the idea of controlling variables and the repetition of the investigation at different pH values and the expected outcome for results and scored full marks. Some candidates confused the positive and negative results for starch using iodine or confused it with other food tests and referred to incorrect colours. Some candidates had not fully read the introduction to the question and included the idea of adding an apple to the investigation.

(c) As apples ripen, enzymes convert starch into sugars.

Devise a method to find the optimum pH of an enzyme that breaks down starch.

You may use standard laboratory equipment and the solutions listed in the box.

starch solution	enzyme solution	iodine solution
a range of pH solutions		

(4)

First get your starch solution and mix with the enzyme solution and range of pH's. Add a range of pH's in different test tubes. Get a spotting tile and add a drop of your iodine solution to each tile. With a pipette place a drop of each different pH solution on each tile. The colour should ~~also~~ change from an orange to a blue-black colour. When the enzymes have all been catalysed the colour will stop changing and stay as black.



This response can be awarded 3 marks. Mark Point 1 mixing the three solutions together. We can award add a range of pH's as they are putting them into different test tubes for Mark Point 5. We can accept they are using iodine Mark Point 2 in the accept column as they are adding it to a spotting tile.

(c) As apples ripen, enzymes convert starch into sugars.

Devise a method to find the optimum pH of an enzyme that breaks down starch.

You may use standard laboratory equipment and the solutions listed in the box.

starch solution enzyme solution iodine solution
a range of pH solutions

(4)

= Add starch solution to the enzyme solution

- Also add iodine solution

- Start timer for every 10 seconds

- Measure ~~each~~ Add a range

of pH buffer at each interval.



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Examiner Comments

Mark Point 1 can be awarded for mixing enzyme, starch and pH buffer. The control cannot be awarded as they are just setting a timer not timing anything.



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Examiner Tip

When asked to devise a plan, always include controlling relevant variables.

(c) As apples ripen, enzymes convert starch into sugars. iodine test

Devise a method to find the optimum pH of an enzyme that breaks down starch.

You may use standard laboratory equipment and the solutions listed in the box.

① prepare a
spotting tile

✓ starch solution	amylase enzyme solution	✓ iodine solution
a range of pH solutions ~ repeat		

(4)

- mix enzyme solution with starch solution to convert starch into simple sugars.

② - prepare your starch solution by filtering out any insoluble parts.

- using a pipette, ~~drop~~ release one drop of iodine solution into each well of the spotting tile.

- pour the filtered starch solution and enzyme solution into a test tube and mix them together.

- ~~set up~~ mix starch solution with one of chosen pH solutions and begin dropping it into each ~~setting~~ well in spotting tile.

- ~~the~~ - repeat investigation with a different range of pH solutions.

- iodine is a 'brownish' colour, if starch is present it will turn a blue black, if not will remain a brown.



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Examiner Comments

If you read the whole response, you will see that the three solutions are mixed together. They are using iodine to test for starch and correctly identify the colour change in the presence of starch so Mark Point 1, Mark Point 2 and Mark Point 3 can be awarded. I can also award Mark Point 5 for repeat with a different range of pH solutions. Mark Point 4 cannot be awarded as a control variable is not the volume of iodine. 4 marks.

Question 1 (d)

Candidates of all abilities answered this question well, with most gaining full marks for linking the idea of denaturing to the active site. Candidates who scored one mark repeated the question, referring to the enzyme denaturing so it would not work.

(d) The optimum pH of an enzyme is pH 6.

Explain why this enzyme would not work at pH 10.

(2)

The conditions are too strong for the enzyme to work, deforming ^{and changing} its active site making it unable to breakdown substances



Deforming the active site is enough for Mark Point 2. Note the candidate does not have to refer to the enzyme as this is in the question.

(d) The optimum pH of an enzyme is pH 6.

Explain why this enzyme would not work at pH 10.

(2)

As a pH moves away from the optimum, either too acidic or alkaline, the enzyme's active site begins to denature in extreme pH levels, so the specific substrate cannot bond with it.

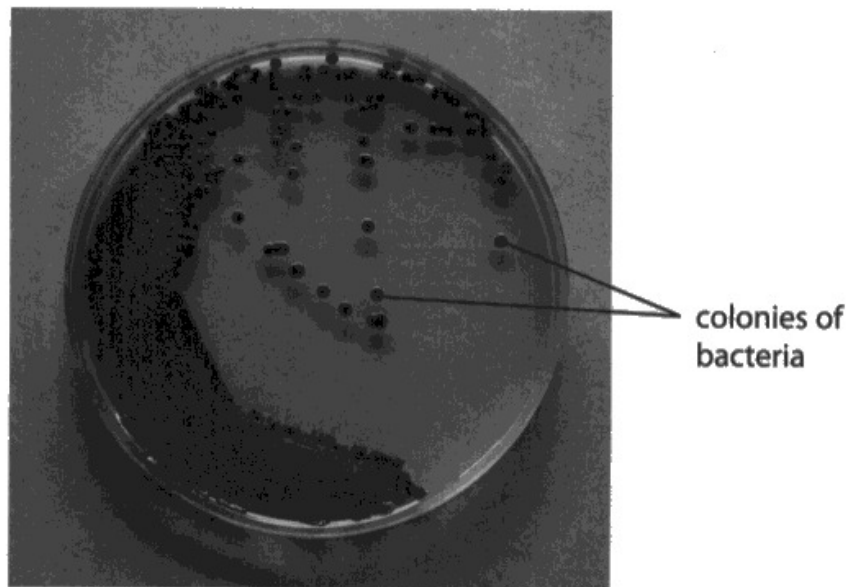


The active site denatures is 2 marks. A mark could also be awarded for substrate cannot bind to the enzyme. 2 marks awarded.

Question 2 (a)

This question required candidates to recognise that there are 10 doublings within a five hour period. 2^{10} results in a population size of 1024 but many candidates did not access it using that method and worked out each individual population numbers for 10 doublings. Some candidates did not count the first 30 minutes as a doubling point and calculated 512. Answers of 512 and those that showed 10 in the working obtained one mark.

2 Figure 2 shows colonies of bacteria growing on an agar plate.



(Source: © Chatchouliya/Shutterstock)

Figure 2

Each colony starts as one bacterium.

Every time bacteria reproduce, the number of bacteria in each colony doubles.

(a) Calculate the number of bacteria in a colony after five hours, if each bacterium reproduces every 30 minutes.

$$5 \text{ h} = 300 \text{ minutes}$$

$$\frac{300}{30} = 10$$

(2)

$$\begin{array}{r} 60 \\ \times 5 \\ \hline 300 \end{array}$$

$$10 \times 2 = 20$$

..... 20 bacteria



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Examiner Comments

300 divided by 30 and coming up with 10 shows that there are 10 divisions so Mark Point 1 can be awarded. Incorrect answer so only 1 mark. We can also accept just the calculation 300 divided by 30 for 1 mark.

Question 2 (b)(i)

Pathogen is a key scientific term from the specification but many candidates were not able to give the meaning. The mark was awarded for causing disease, illness or infection. Responses that didn't obtain the mark indicated that pathogens spread disease rather than causing it, or just gave examples of pathogens not the meaning.

(b) Some bacteria are pathogens.

(i) State the meaning of the term pathogen.

(1)

harmful micro-organisms that can spread
infectious diseases .



In this case we cannot accept spread disease, it must cause the disease. 0 marks.

(b) Some bacteria are pathogens.

(i) State the meaning of the term pathogen.

(1)

Foreign particles that enter the body usually carrying diseases



We need the term organism, particles is not enough for the mark. 0 marks.

(b) Some bacteria are pathogens.

(i) State the meaning of the term pathogen.

(1)

A pathogen is an organism that attacks the immune system, causing sickness.



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Examiner Comments

Causing sickness is the equivalent of causing disease so we can award 1 mark.

Question 2 (b)(ii)

Most candidates recognised that antibiotics kill bacteria or inhibit reproduction for one mark but the mechanisms were not fully explained with many candidates linking it to the production of antibodies or the role of the immune system. Higher ability candidates scored full marks for linking their explanation to the inhibition of process in the bacterial cells, frequently referencing the cell wall in their answers.

(ii) Explain why antibiotics can be used to treat bacterial infections.

(2)

Antibiotics target bacterial infections as they aim
are aimed to kill pathogens, and bacterial infections
are the results of pathogens entering the body.



In this case we can accept kill pathogens as killing the bacteria because of the context of the answer. 1 mark.

(ii) Explain why antibiotics can be used to treat bacterial infections.

(2)

Because antibiotics have antibodies that destroy
the bacterial infection that is in our body.



Destroy the bacterial infection is just enough for the mark point. 1 mark.

(ii) Explain why antibiotics can be used to treat bacterial infections.

Antibiotics can be used to ~~change~~ ^{treat} (2)
bacterial infections as they weaken the
bacteria by attaching themselves onto
them



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Examiner Comments

Weaken the bacteria is not enough for Mark Point 2 and there is no further creditworthy content. 0 marks.

Question 2 (b)(iii)

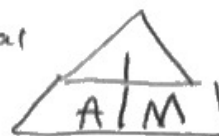
Candidates were given the image length and the actual length of a bacterium and asked to calculate the magnification. Most candidates of all ability scored full marks. Incorrect responses multiplied the two numbers or inverted the division calculation resulting in too small a number for a magnification.

(iii) A rod-shaped bacterium is 0.005 mm long. *actual*

A student draws the rod-shaped bacterium.

The bacterium in the drawing is 80 mm long.

Calculate the magnification of this image drawing.



(2)

$$\underline{80 \div 0.005 = 79.995}$$

$$\frac{80}{0.005} = 16000$$
$$= \times 1000$$

magnification = x 1000



ResultsPlus
Examiner Comments

This can be awarded 1 mark as 80 divided by 0.005 is Mark Point 1 but although they have calculated this correctly the answer on the answer line is incorrect so only one mark can be awarded. 1 mark.

- (iii) A rod-shaped bacterium is 0.005 mm long.
A student draws the rod-shaped bacterium.
The bacterium in the drawing is 80 mm long.
Calculate the magnification of this drawing.

(2)

$$\text{Magnification} = \frac{\text{image size}}{\text{length}}$$

$$\frac{80}{0.005} = 16000$$

$$\text{magnification} = 16000$$



ResultsPlus
Examiner Comments

This candidate has completed the calculation successfully and has the correct answer on the answer line for 2 marks.

- (iii) A rod-shaped bacterium is 0.005 mm long.
A student draws the rod-shaped bacterium.
The bacterium in the drawing is 80 mm long.
Calculate the magnification of this drawing.

(2)

$$m = \frac{I}{R}$$
$$\frac{80}{0.005} = 16000$$

magnification =



ResultsPlus
Examiner Comments

This candidate has completed the calculation correctly and got the correct answer. There is no answer on the answer line so we can mark what is in the white space. There is no ambiguity as there is only one calculation so we can award 2 marks.

Question 3 (b)(ii)

This question asked candidates to describe how stem cells produce the cells of an embryo. Some candidates described the properties of stem cells rather than answering the question asked. Most candidates scored one mark for the idea of differentiating or forming specialised cells but did not recognise that the cells of an embryo need to divide by mitosis to enable growth to occur.

Question 3 (c)(i)

Many candidates recognised that a transplant between siblings reduced the chance of rejection and gained the mark. Some candidates understood that this was linked to similar genetics. Marks were not awarded for the same DNA as they are not identical twins, nor for the same blood group as this doesn't ensure compatibility.

Question 3 (c)(ii)

Many candidates obtained the mark for this with linking the idea of the embryonic stem cells being linked to the potential for life. Some candidates stated that stem cells could continue to divide and cause tumours which did not gain credit as it is not linked to the isolation aspect.

Question 3 (c)(iii)

This question required application of knowledge on stem cells to their use in medicine. Marks were mainly awarded for the idea of not needing to find a donor or the use of embryonic stem cells, that the cells would not be rejected and that these cells could not differentiate into any cell. Some candidates gave the idea of not needing to take immunosuppressant's which was accepted or that the damaged cells could be replaced. The idea of repairing damaged cells was not accepted nor the idea that the stem cells could differentiate into anything.

- (iii) Stem cells, with the properties of embryonic stem cells, can be produced from a patient's own skin cells.

Discuss the benefits of using these stem cells to treat the patient.

(3)

There is a very high chance the body will not reject the stem cells. Embryonic stem cells can differentiate into any cell. Embryonic stem cells can repair damaged tissues and replace damaged cells. These skin cells don't have to be specifically extracted from the embryo making it easier to acquire them. (Total for Question 3 = 10 marks)



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Examiner Comments

Body will not reject the stem cells Mark Point 4. Stem cells can differentiate into any cell Mark Point 2. Repair damaged tissue/replace damaged cells is Mark Point 3. Do not need to use embryos is Mark Point 1. 3 Marks awarded.

- (iii) Stem cells, with the properties of embryonic stem cells, can be produced from a patient's own skin cells.

Discuss the benefits of using these stem cells to treat the patient.

(3)

Embryonic stem cells can differentiate into any specialised cell, stem cells can replace any damaged cells and repair any damaged tissue.



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Examiner Comments

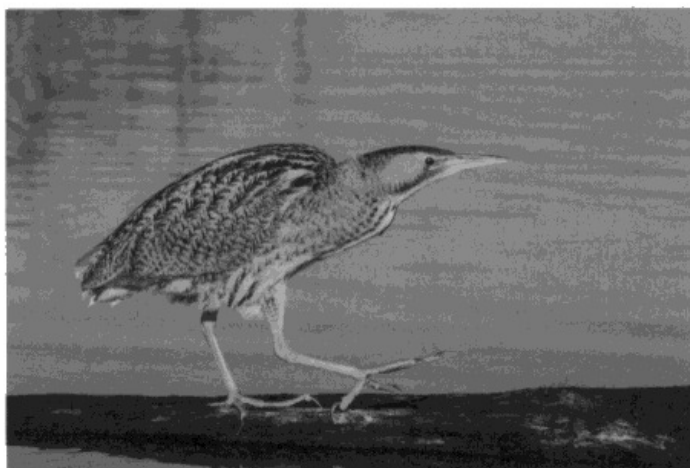
Stem cells can differentiate into any cell Mark Point 2. Replace damaged cells / repair damaged tissue is Mark Point 3. 2 marks.

Question 4 (a)(i)

Calculating a percentage increase is more challenging than a straightforward calculation but was performed more successfully than previous series. The first mark was awarded for calculating the difference in the population size, the second mark is for the idea of dividing by the starting population size and then obtaining the correct answer. Candidates who didn't calculate the difference in population size but divided by the starting population gained two marks. Full marks are awarded for the correct answer, irrespective of whether working is shown. Some candidates lost marks by not rounding their calculation correctly or for using recurring numbers incorrectly.

- 4 (a) In the 19th century the destruction of wetland habitats caused the extinction of the bittern in the UK.

Figure 5 shows a bittern.



(Source: © Ildiko Laskay/Shutterstock)

Figure 5

Restoration of the habitats has led to the birds returning to the UK.

Male bitterns make a loud booming sound.

This allows the numbers of male bitterns to be counted.

In 1997, 11 males were counted and this increased to 221 males in 2021.

- (i) Calculate the percentage increase in the number of males from 1997 to 2021.

(3)

$$\frac{221-11}{11}$$

$$\frac{210}{11}$$

$$\frac{221-11}{11} = \frac{210}{11} = 19\%$$

$$221-11 = \frac{210}{221} = 0.95 \times 100 = 95\%$$

..... 95 %



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Examiner Comments

One mark can be awarded for 210, the remainder of the calculation is incorrect so no further marks can be awarded. 1 mark.

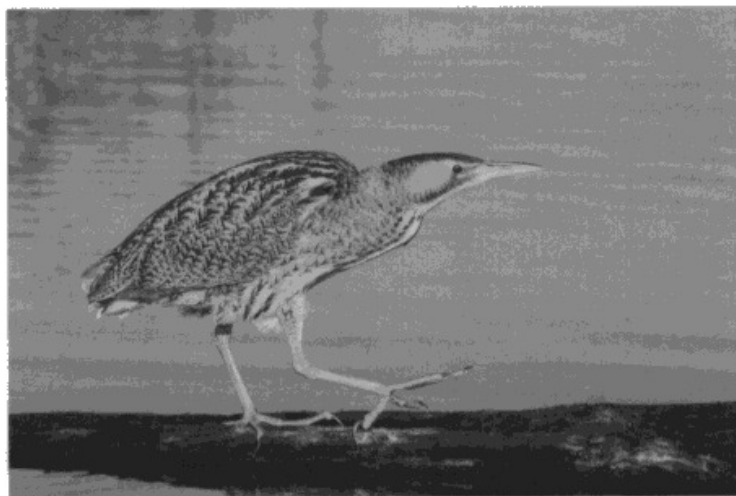


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Examiner Tip

Always show your working when answering mathematical questions.

- 4 (a) In the 19th century the destruction of wetland habitats caused the extinction of the bittern in the UK.

Figure 5 shows a bittern.



(Source: © Ildiko Laskay/Shutterstock)

Figure 5

Restoration of the habitats has led to the birds returning to the UK.

Male bitterns make a loud booming sound:

This allows the numbers of male bitterns to be counted.

In 1997, 11 males were counted and this increased to 221 males in 2021.

- (i) Calculate the percentage increase in the number of males from 1997 to 2021.

(3)

$$\frac{\text{change}}{\text{original}} \times 100$$

$$\begin{aligned} \frac{221 - 11}{11} &= \frac{210}{11} \\ &= 19.0909\overline{09} \\ &= 1909.09\overline{09} \end{aligned}$$

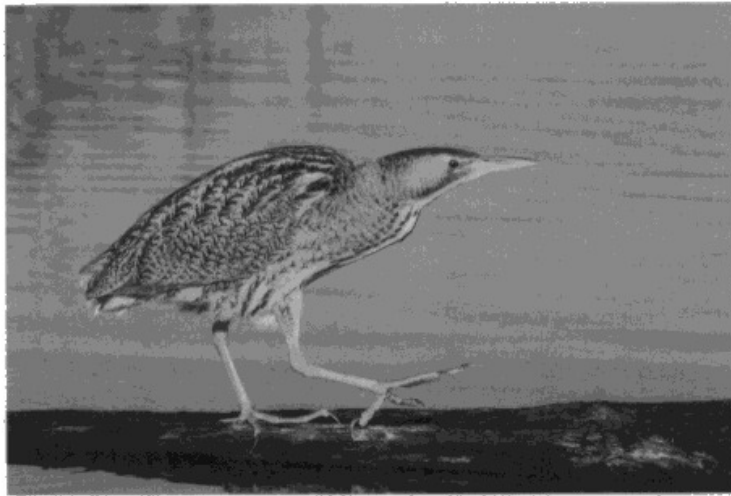
..... 1909.091%



3 marks can be awarded for the correct answer on the answer line, this can be given correct to any number of decimal places. 3 marks.

- 4 (a) In the 19th century the destruction of wetland habitats caused the extinction of the bittern in the UK.

Figure 5 shows a bittern.



(Source: © Ildiko Laskay/Shutterstock)

Figure 5

Restoration of the habitats has led to the birds returning to the UK.

Male bitterns make a loud booming sound.

This allows the numbers of male bitterns to be counted.

In 1997, 11 males were counted and this increased to 221 males in 2021.

- (i) Calculate the percentage increase in the number of males from 1997 to 2021.

(3)

$$\frac{221 - 11}{232} \times 100 = 90.517\dots$$

.....90.5.....%

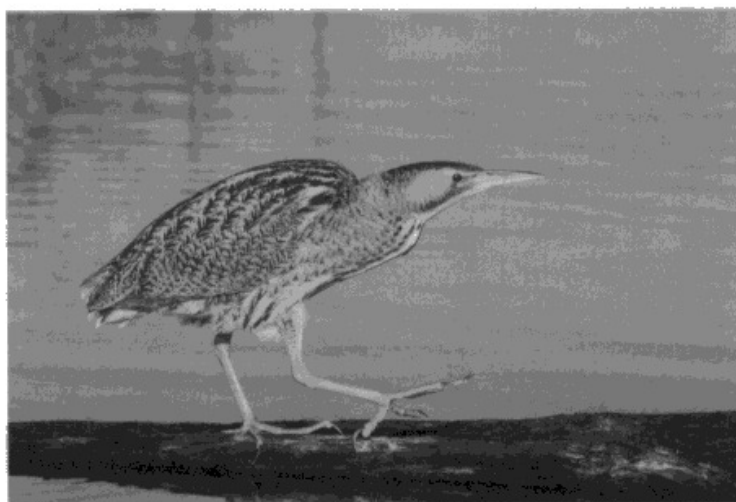


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Examiner Comments

The calculation is incorrect. Within the calculation is 221 - 11 so Mark Point 1 can be awarded. There are no further points that can be awarded as they have divided by 232.

- 4 (a) In the 19th century the destruction of wetland habitats caused the extinction of the bittern in the UK.

Figure 5 shows a bittern.



(Source: © Ildiko Laskay/Shutterstock)

Figure 5

Restoration of the habitats has led to the birds returning to the UK.

Male bitterns make a loud booming sound.

This allows the numbers of male bitterns to be counted. In 1997, 11 males were counted and this increased to 221 males in 2021.

- (i) Calculate the percentage increase in the number of males from 1997 to 2021.

$$\frac{221 - 11}{11} \times 100 = \frac{210}{11} \times 100 = 1909 \dots \%$$

$$\frac{221 - 11}{221} \times 100 = \frac{210}{221} \times 100 = 95 \dots \%$$

$$\frac{221 - 11}{11} \times 100 = \frac{210}{11} \times 100 = 1909 \dots \%$$

$$\frac{221 - 11}{11} \times 100 = \frac{210}{11} \times 100 = 1909 \dots \%$$



This candidate has completed the calculation correctly and then crossed out the correct answer and then placed an incorrect answer on the answer line. Mark Point 1 can be awarded for 221-11 and Mark Point 2 for the correct substitution. 2 marks awarded.

Question 4 (a)(ii)

Candidates of all abilities answered this question well, with most linking their answer to being hidden from predators or being camouflaged. Many candidates also linked this to the idea of increased survival.

The bitterns are difficult to see in the reeds of the wetland habitat.

(ii) Give **one** benefit of this to the bittern.

(1)

It ~~can~~ ^{can} camouflage which allows it to hide from it's predators and survive.



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Examiner Comments

Any idea of camouflage and blending in with the environment can be credited for 1 mark.

The bitterns are difficult to see in the reeds of the wetland habitat.

(ii) Give **one** benefit of this to the bittern.

(1)

Blending ~~it~~ helps them to blend into the environment when catching food as it makes them less visible.



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Examiner Comments

Blend in with the environment, making them less visible. Either of these would be creditworthy. 1 mark.

Question 4 (a)(iii)

This question asked candidates to explain why having animals that were closely related made the species susceptible to extinction, utilising their knowledge of natural selection. Most candidates scored at least two marks for recognising that closely related animals were all susceptible to the same disease or changes in the environment which would decrease the population size. Higher ability candidates made the connection between being closely related and a lack of genetic variation.

- (iii) There is some concern that the bitterns in the UK are all closely related. This could make them susceptible to extinction.

Explain, using your knowledge of natural selection, why being closely related could make the bitterns susceptible to extinction.

(3)

Because if they are all closely related ~~they won't be able~~ they wouldn't have much genetic variation making them more vulnerable as if they had to adapt via natural selection they wouldn't be able to survive because of their little variation amongst one another.



Not much genetic variation is Mark Point 1 less variation. The answer does not go on to mention a selection pressure so Mark Point 2 and 3 cannot be awarded. It also does not mention being unable to reproduce or lack of evolution so only 1 mark awarded.

- (iii) There is some concern that the bitterns in the UK are all closely related. This could make them susceptible to extinction.

Explain, using your knowledge of natural selection, why being closely related could make the bitterns susceptible to extinction.

(3)

Being closely related ^{could} make the bitterns susceptible to extinction because of a ~~due to a lack~~ lack of genetic variation. ~~If there is a lack of genetic variation~~ lack of genetic variation means that ~~it would be the~~ bitterns may not be able to adapt to ~~other~~ changes such as in weather, because they all have the same ~~etc~~ qualities. They may not survive if there was such a drastic change in conditions: e.g. wetland habitats dry up due to global warming or freezing in winter.



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Examiner Comments

Lack of genetic variation is Mark Point 1. Weather is a selection pressure (weak but acceptable) Mark Point 2. They also go on to elaborate with global warming. They all have the same qualities so they may not survive is Mark Point 3. 3 marks awarded.

- (iii) There is some concern that the bitterns in the UK are all closely related. This could make them susceptible to extinction.

Explain, using your knowledge of natural selection, why being closely related could make the bitterns susceptible to extinction.

(3)

Being ~~not~~ ~~very~~ ~~related~~ ~~could~~ ~~make~~ them susceptible to extinction because natural selection proves that ~~am~~ animals which adapt are more likely to survive through adaption like survival of the ~~fittest~~ fittest. If bitterns are closely ~~fit~~ related then if one catches a disease they are likely to all catch a disease and without breeding with other birds they are unable to expand their characteristics for survival.



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Examiner Comments

Mark Point 2 can be awarded for disease (as this is a selection pressure), Mark Point 3 can be awarded for if one catches a disease they are all likely to catch a disease. Mark Point 4 cannot be awarded as they have not said fewer birds will be able to reproduce. 2 marks.

Question 4 (b)

Candidates found this question challenging and often just repeated information from the question or gave a generic answer to a question on selective breeding without applying it to the context. Candidates needed to recognise that the selected animals needed to be genetically different or have different characteristics, not just the idea of not being related. Some candidates recognised that this could be achieved by breeding animals from different locations. The second mark was for the idea that this process must be repeated over many generations, not just the idea of repeated.

(b) Describe how selective breeding can be used to produce a large population of animals that are not closely related.

(2)

Selective breeding is when you pick out the animals that have the genes you are looking for and you breed them. For not closely related animals you can breed animals that are not similar in genes producing an offspring different to the parents. This means they will not be closely related.



Breed animals not similar in genes is the same as breeding animals that are genetically different for Mark Point 1 for 1 mark.

(b) Describe how selective breeding can be used to produce a large population of animals that are not closely related.

(2)

Selective breeding can be used, as they can check their DNA and see if they are identical, if they are not, you can breed the 2 bitterns. The offspring will be identical however different to all others.



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Examiner Comments

Selective breeding does not usually involve checking the DNA so no mark awarded there. Breed two bitterns the offspring will be identical is not what the question is asking so no rewardable content. 0 marks.

Question 4 (c)

Sex determination in birds is different to humans. Candidates were given the chromosome combinations of homozygous Z for males and heterozygous ZW for females and asked to show the sex determination of offspring in a Punnett square. This was answered well by most candidates, showing that they understood the genetic terms and were able to relate their knowledge of sex determination in humans to birds.

(c) Sex determination in birds is different from humans.

Males are homozygous Z and females are heterozygous ZW.

Complete the Punnett square to show how sex is determined in birds.

(2)

		male	
		Z	Z
female	Z	Z	Z
	W	ZW	ZW



The parental gametes are correct but the completed Punnett square is not correct so only 1 mark can be awarded here.

(c) Sex determination in birds is different from humans.

Males are homozygous Z and females are heterozygous ZW.

Complete the Punnett square to show how sex is determined in birds.

(2)

		male	
		Z	Z
female	ZW	ZW	ZW
	zw	zw	zw



ResultsPlus
Examiner Comments

Neither the parental gametes nor the offspring gametes are correct here so no marks can be awarded. 0 marks.

(c) Sex determination in birds is different from humans.

Males are homozygous Z and females are heterozygous ZW.

Complete the Punnett square to show how sex is determined in birds.

(2)

		male	
		Z	Z
female	Z	ZZ	ZZ
	W	ZW	ZW



ResultsPlus
Examiner Comments

Both parental genotypes and offspring genotypes are correct for 2 marks.

Question 5 (a)(i)

Candidates were asked to calculate the volume of a cube and include the unit. Most candidates were able to calculate volume but many did not include the unit or incorrectly gave this as mm^2 , cm^2 or cm^3 . This highlights the importance of reading the questions carefully.

5 A student investigated the movement of water in potatoes.

The student used three identical cubes of potato.

The size of a cube is shown in Figure 6.

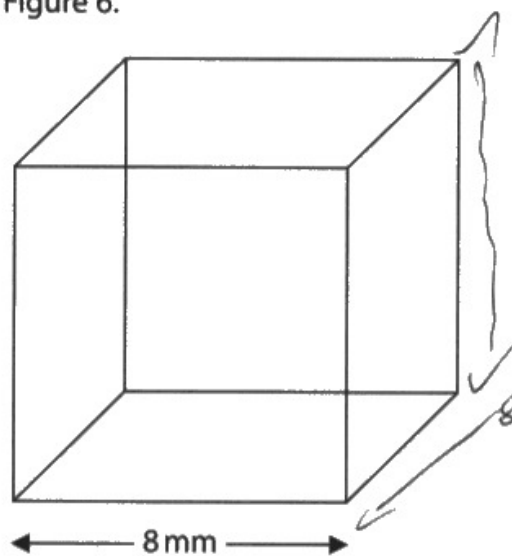


Figure 6

(a) (i) Calculate the volume of this cube.

Include the units in your answer.

$$L \times W \times h$$

(2)

$$8 \times 8 \times 8 = 512$$

$$512 \text{ mm}^3$$



ResultsPlus
Examiner Comments

The number is correct, working does not need to be shown for 1 mark and the units are correct for 1 mark. 2 marks awarded in total.



ResultsPlus
Examiner Tip

Always remember to include units in mathematical calculations.

- 5 A student investigated the movement of water in potatoes.
The student used three identical cubes of potato.
The size of a cube is shown in Figure 6.

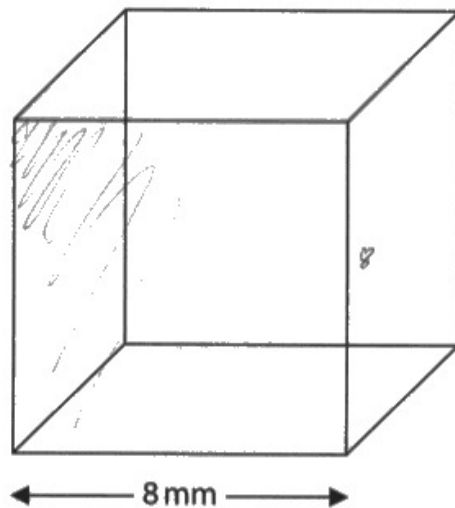


Figure 6

- (a) (i) Calculate the volume of this cube.

Include the units in your answer.

(2)

$$8 \times 8 \times 8 = 512$$

512 mm



ResultsPlus
Examiner Comments

The calculated number is correct at 512 but the unit is not correct so 1 mark awarded.

Question 5 (a)(ii)

This was a practical skills question which asked how the accuracy of a measurement could be improved. Accuracy is about how close the measured value is to the true value. The mark was awarded for drying the cube before its mass was measured or measuring using a balance that measured to a 1000th gram. Some candidates gave the idea of using a balance or repeating the measurement which does not address accuracy.

Question 5 (a)(iii)

Candidates were asked to explain the mass change of a cube placed in concentrated salt water. This was well answered showing a good understanding of osmosis. Marks were awarded for the decrease in mass, water leaving the cube by osmosis, across a partially permeable membrane and a description of the gradient. Some candidates referred to water potential gradient although a high water concentration to a low water concentration was credited. When making a comparison between the concentrations of two solutions, candidates should make sure they use comparative terms such as lower/higher.

(iii) Explain the mass change in the cube in the concentrated salt solution.

(3)

In concentrated salt solution it lost 0.06 g of mass. This is because water concentration outside of potato is much lower compared to water concentration inside of potato and so ^{potato} water molecules moved from a high water concentration to a lower ^{water} concentration.



ResultsPlus
Examiner Comments

The response can be awarded Mark Point 1 for losing mass and Mark Point 5 for moving from a high water concentration to a low water concentration. Note they must be specific for this mark about water, not just high to low and not down a concentration gradient. The candidate can also be awarded the water moves out for Mark Point 3, although they do not mention the cube this is implicit from their answer. 3 marks.

(iii) Explain the mass change in the cube in the concentrated salt solution.

(3)

- Osmosis is the movement of water molecules across a partially permeable membrane from an area of high water concentration to an area of low (dilute) water concentration.
- Osmosis tries to create equilibrium in the solution.
- Where the salt concentration was lower the potato absorbed some of this by osmosis to reach equilibrium.
- This is why the concentrated salt solution decreased by 0.06g → It moved into the potato sample via osmosis.



ResultsPlus
Examiner Comments

This candidate has not related the information at the top of the answer to the question but can still be awarded for osmosis Mark Point 3 and the mark for the partially permeable membrane Mark Point 4. They cannot be awarded the mark for high water concentration to low water concentration because they refer to low water concentration being dilute. The remainder of the response is incorrect. 2 marks.

(iii) Explain the mass change in the cube in the concentrated salt solution.

(3)

Through osmosis, the concentrated salt solution took water away from the cube.



ResultsPlus
Examiner Comments

The osmosis mark can be awarded Mark Point 3. Also the concentrated solution took water away from the cube is water moves out of the cube Mark Point 2. Although the language is a little clumsy, we can accept that the candidate is referring to water moving out of the cube by osmosis for Mark Point 2 and Mark Point 3. 2 marks awarded.

Question 5 (a)(iv)

Practical questions which require candidates to suggest improvements to methods have challenged candidates in the past. The question asked how the method used could determine the concentration of salt that led to no change in mass. A mark was awarded for repeating the investigation with more concentrations of salt solution which most candidates accessed. Some candidates gave the idea that other variables needed to be controlled and higher level responses recognised that the concentrations of salt should be between the dilute and the concentrated with some candidates referring to plotting a graph to predict the isotonic concentration point.

- (iv) The student wanted to find the concentration of salt solution where the potato cube did not change mass.

Describe how the student could modify this investigation to find this concentration.

(3)

Repeat the experiment slightly changing the salt concentration each time. Do this until the mass of the potato no longer changes.



Changing the salt concentration is enough for Mark Point 1. 1 mark.

Question 5 (b)

This question was challenging with many candidates not recognising that they needed to apply knowledge of plant cell structure to the practical situation. The marks were awarded for the idea of the cell wall providing structure or strength, the idea that the cells could become turgid or that they had a vacuole which can store water. Many incorrect responses referred to the partially permeable membrane allowing the movement of water into and out of the cells that can prevent bursting. Application questions are more challenging than direct recall of knowledge.

(b) Explain why potato cells do not burst when placed in water.

(2)

• They have a strong cell wall
• The cells absorb the water



ResultsPlus
Examiner Comments

Cell wall is Mark Point 1. Strong is acceptable for Mark Point 2 in the additional guidance column for Mark Point 2. 2 marks awarded.

Question 6 (a)

Most candidates were able to give two factors, other than genetics, that influence a person's mass with diet and exercise being the most frequent responses. Some linked the fact that these were lifestyle or environmental factors. Responses relating to age, sex or height were not credited as they do not address the idea of influence.

- 6 (a) A person's mass is partially influenced by the alleles they inherit from their parents.

Give **two** other factors that can influence a person's mass.

(2)

- Their diet and their environment.



The diet is Mark Point 2. Environment is Mark Point 1. 2 marks.

- 6 (a) A person's mass is partially influenced by the alleles they inherit from their parents.

Give **two** other factors that can influence a person's mass.

(2)

- Lifestyle - the way you live.

~~- environment~~

- environment - the things condition you live in



Lifestyle and environmental factors are the same marking point for 1 mark.

Question 6 (b)

Candidates were required to interpret the information in the table and comment on the data and health risks to the patient. Most candidates recognised the person was overweight with a healthy waist : hip ratio but many linked the overweight idea to increased risk of cardiovascular disease rather than recognising that the two measurements could be used to suggest the mass was due to muscle or at least that the fat was not around vital organs in the abdomen. Many candidates misinterpreted the waist : hip ratio indicating that they were either abdominally obese or nearly abdominally obese. A significant number of responses did not appreciate that the units of alcohol drunk were per day and the guidance was for a week. Other candidates calculated the weekly intake to be between 21 and 28 units and linked this to liver damage. Although some candidates linked lack of smoking to being healthy, they didn't gain the mark unless it was linked to a low risk of a disease associated with smoking.

(b) Figure 8 shows the data obtained from a patient by a doctor doing a health check.

The guidance used by the doctor is also listed in Figure 8.

measurement	data	guidance
BMI	28	18–25 healthy 26–30 overweight 30+ obese
waist : hip ratio	0.85	<0.9 healthy >0.9 abdominal obesity
alcohol units	3–4 units per day	<14 units per week
number of cigarettes smoked	0	do not smoke or vape

Figure 8

Comment on the data and the health risks to this patient.

(4)

The individual's BMI fits into the overweight category. High BMI can be associated with the development of type 2 diabetes and various cardiovascular diseases. Whilst the patient's waist:hip ratio is in the healthy range and their cigarette intake is none, the person appears to have a bad drinking habit consuming between 7 and 14 units a week, which is deemed healthy. Alcohol consumption is known to cause liver damage which impacts the metabolism in the body.



This response scores Mark Point 1 for recognising 28 is classified as overweight. There is no mark for linking overweight to diabetes or cardiovascular disease as their waist : hip ratio shows they are not abdominally obese. Mark Point 2 can be awarded for recognising the waist : hip ratio is in the healthy range. They have recognised that the patient is consuming more alcohol than recommended and linked this to liver damage for Mark Point 4. 3 marks are awarded.

(b) Figure 8 shows the data obtained from a patient by a doctor doing a health check.

The guidance used by the doctor is also listed in Figure 8.

measurement	data	guidance
BMI	28	18–25 healthy 26–30 overweight 30+ obese
waist : hip ratio	0.85	<0.9 healthy >0.9 abdominal obesity
alcohol units	3–4 units per day 21–28	<14 units per week
number of cigarettes smoked	0	do not smoke or vape

Figure 8

Comment on the data and the health risks to this patient.

(4)

her BMI shows that she is overweight meaning that she has a high chance to become obese and get things like diabetes or heart a cardiovascular disease. The data shows that she is drinking more than 21 units per week which means she is drinking more than the recommended amount. This could lead to many problems later on like an unhealthy ~~liver~~ liver due to alcohol poisoning.



ResultsPlus
Examiner Comments

The response indicates that 28 is in the overweight range for BMI for Mark Point 1. They have recognised that the patient is drinking more than the recommended amount which damages the liver Mark Point 4. 2 marks.

(b) Figure 8 shows the data obtained from a patient by a doctor doing a health check.

The guidance used by the doctor is also listed in Figure 8.

measurement	data	guidance
BMI	28	18–25 healthy 26–30 overweight 30+ obese
waist : hip ratio	0.85	<0.9 healthy >0.9 abdominal obesity
alcohol units	3–4 units per day	<14 units per week
number of cigarettes smoked	0	do not smoke or vape

Figure 8

Comment on the data and the health risks to this patient.

(4)

From the BMI, we can tell the person is overweight*, the waist:hip ratio shows that they are healthy. However they consume 3-4 units of alcohol per day, which is 21-28 units per week, which is nearly double of what the guidance is, so the person has a very high chance of developing things like kidney failure which could lead to death. They would also build up a very slow reaction time which is dangerous if they drive. The patient doesn't smoke ~~so~~ meaning they have a minimal chance of developing lung problems.

* meaning there is a small chance of them developing type 2 diabetes.



A BMI of 28 is overweight for Mark Point 1. Waist : hip ratio is healthy for Mark Point 2. Alcohol consumption between 21 – 28 is too high linked to kidney disease Mark Point 4. Lung problems is enough for the link to smoking. There is no mark for linking BMI to type 2 diabetes as the waist : hip ratio does not back up that they are overweight.
4 marks.

Question 6 (c)

The second extended open-response question asked for a description of the structure and function of a reflex arc. The level of detail of the pathway taken by the electrical impulse was used to determine which level a response was given, with a linkage to the function of the reflex arc enabling the top of the mark band to be credited. Candidates of all abilities were able to access the question, with many making clear linkages between the components of a reflex arc, accessing Level 2 or Level 3. In Level 3 the function of the reflex arc needed to link the quick response to protection from danger to gain full marks.

* (c) The doctor also tested the reaction time of the patient.

Describe the structure and function of a reflex arc.

(6)

- The reflex arc allows the body to have an automatic response to a change in stimulus to protect the body from harm.
- The reflex arc ~~works like this~~ starts from the stimuli (touching a hot pan) to the receptor (skin) to the sensory neuron to the CNS to the relay neuron to the motor neuron to the effector (muscle in hand) to the reaction (move hand away.)
- An electrical impulse travels through all these components:
 - An electrical ^{impulse} travels across neurons.
 - An electrical impulse reaches the end of the relay neuron before the synapse, ~~etc~~ ^{this triggers} the release of electro-transmitters, which then diffuse across the synapse and bind onto the motor neuron causing the electrical impulse to continue.



ResultsPlus
Examiner Comments

This candidate has given a clear description of the reflex arc naming the neurones involved in the correct order. This is the driver for the mark scheme and places this into Level 3. To go to the top of Level 3 the candidate must link the reflex arc to its role to protect the body and the fact that it is a fast response. This response does refer to protecting the body from harm but does not give information on its speed, so 5 marks are awarded.

* (c) The doctor also tested the reaction time of the patient.

Describe the structure and function of a reflex arc.

(6)

- Reflex Arc is a rapid and automatic response that bypasses the brain to prevent us from harm.
- Reflex Arc contains axon, dendrons, myelin sheath
- The axon helps to travel impulses from neurone to neurone
- The dendron passes the impulse to the synapse where it then travels to another neurone.
- The myelin sheath insulates the axon speeding up the electrical impulses
- An example of the reflex arc in use is if you touch something hot you will pull your hand away
- Receptors, reflex arc, CNS, motor neurone, effectors this is pathway of the reflex response



This response refers to the CNS and the motor neurone so have part of the reflex arc linked together which puts the response into Level 2. To get to the top of Level 2 they need to link this to either its role in protecting the body or the fast speed of the response. The response states both of these so can be put to the top of band 2 for 4 marks.

*(c) The doctor also tested the reaction time of the patient.

Describe the structure and function of a reflex arc.

(6)

- Makes reaction time faster in certain situations
- makes you move quicker than your brain tells you to
- ~~A signal is sent~~
- If you burn your hand a signal is sent up your hand to a reflex centre it then sends the signal back to the hand to make it move away from the heat before it ~~can~~ ~~reach~~ to your brain process the information



ResultsPlus
Examiner Comments

There is no reference in this response to the neurones involved in the reflex arc but they have recognised that the reflex arc allows reactions to be faster so 1 mark can be awarded.

*c) The doctor also tested the reaction time of the patient.

Describe the structure and function of a reflex arc.

(6)

When you touch something it is detected by your skin which then sends an electrical impulse through a relay neurone across a synapse ~~then~~ to your CNS which is processed by your brain. When your body detects something that would hurt you, like pulling your hand on something hot it is detected by your skin then passed through ~~to~~ a motor neurone through the synapse then ~~to~~ instead of going to your brain it uses a reflex arc which then makes your body move your hand without thinking it.



ResultsPlus
Examiner Comments

This response gives part of the reflex arc including the relay neurone in the CNS and the motor neurone which is enough to put the response into Level 2. There is no information on the function of the reflex arc for protection or that the response is fast, so it cannot go to the top of the level. 3 marks are awarded.

Paper Summary

Based on their performance on this paper, candidates should:

- Ensure they answer the actual question in the paper. Written responses to a number of questions indicated that candidates used past papers as part of their revision process which is commendable but care must be taken to ensure that candidates answer the actual question in the paper, as although the knowledge may be similar the question is rarely identical.
- Recognise that the word 'explain' means additional scientific information is needed that is linked to the answer given. They should also understand that when they are required to make comparisons between two sets of data or two concepts the language used should be comparative – 'greater', 'faster', 'quicker' etc. When comparing two sets of apparatus ensure sufficiently different responses are given to match the number of marks and avoid just stating the reverse argument.
- Read the information given in the introduction to the question but avoid repeating it in the answer as it will not gain credit. Candidates should also read mathematical questions carefully to note whether an answer is required in standard form, to a specified number of significant figures or requires a unit to be included. They should ensure they consistently apply rules for rounding up numerical answers and understand recurring numbers.
- Ensure that methods for core practicals are understood, including the differences, accuracy and improvements to methods as well as controls and control variables. Be prepared to apply your knowledge of practical activities to unfamiliar practical investigations.
- Make sure that key scientific terms from the specification are understood including pathogen, diploid, haploid, genotype and phenotype.
- Always show the mathematical working when doing calculations as a mark can be awarded for errors carried forward. Check the number of marks given for the question and ensure that they have included enough facts to match the marks awarded.
- Consider the context of the question to ensure that they apply their scientific knowledge to the situation they are being asked about.

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>

