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Examiners' report

A LEVEL

BIOLOGY A

OCR Level 3 Advanced GCE in Biology A

H420

For first teaching in 2023

H420/03 Summer 2025 series

Version 1

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate responses is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from Teach Cambridge.

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Paper 3 series overview

H420/03 is one of the three examination components for GCE Biology A. This component assesses content from across all areas of Biology and links these topics within practical, familiar and novel contexts. To do well on this paper, candidates need to be comfortable applying their knowledge and understanding to unfamiliar contexts and be familiar with a range of practical techniques.

Some candidates got high marks on this component because of the opportunities to display knowledge from a wide range of topics. Others found this paper challenging because of its synoptic nature and because of the skills they were assessed on. Candidates were assessed on their ability to interpret and evaluate ideas, and to provide the evidence leading them to conclusions, as well as on their ability to develop and refine practical methodology.

All questions were accessible to candidates, and there seemed to be no time issues with completing the examination. The examination produced a good spread of marks, and most candidates attempted all the questions.

Many candidates used the additional answer spaces provided in the paper rather than writing around the provided lines. This is excellent practice, and we encourage all centres to advise their candidates to take this approach.

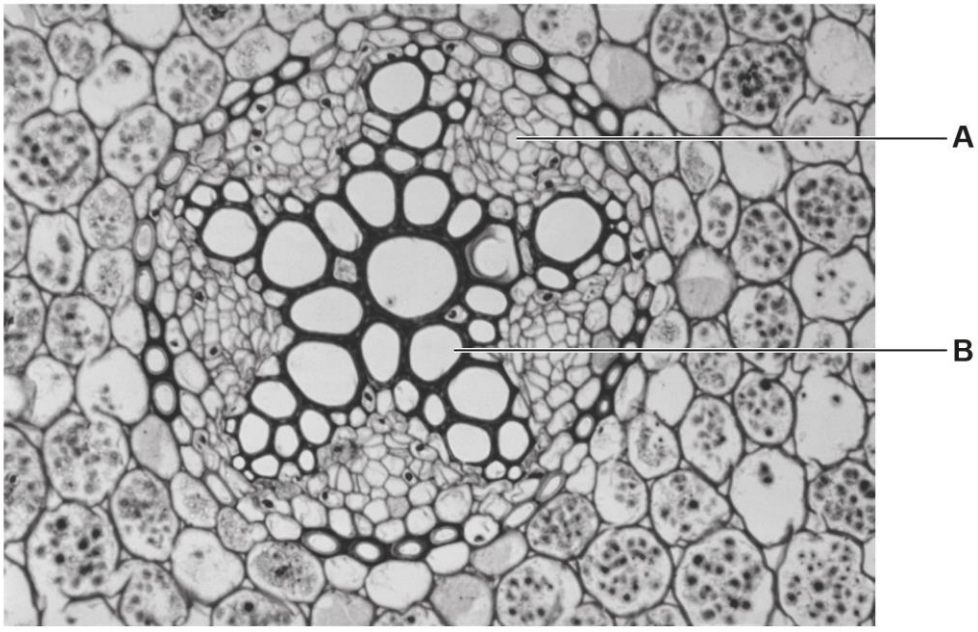
Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• showed mathematical fluency and were able to interpret graphs • were able to interpret and evaluate data and results • provided full and detailed explanations • demonstrated excellent knowledge of practical procedures, including ideas such as resolution and standardised variables • were able to discuss ethical issues while avoiding irrelevant information • read questions carefully and paid attention to the information provided • produced clear, organised and concise responses to questions.	• had difficulties with aspects of their mathematical skills, such as extrapolation and the choice of units • were unable to recall particular mechanisms and processes, such as active loading and the action of adrenaline • wrote responses that lacked depth, particularly to practical-based questions • found it difficult to interpret and use the images and information supplied in the question paper to answer related questions • left answers unfinished or blank.

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Question 1 (a)

1 The roots of plants contain a variety of cells and tissues.

(a) The photomicrograph shows a transverse section through the root of a herbaceous dicotyledonous plant.



Name the cells labelled **A** and **B** in the photomicrograph.

A .....

B .....

[2]

Few candidates gained both marks. Most candidates identified A as 'phloem'. Phloem is the correct **tissue**, but the question asks for the names of the **cells**. Therefore 'sieve tube element' would have been the appropriate answer (see 3.1.3 (b) (i) in the specification). Similarly, the cell indicated by B is a 'xylem vessel'. However, candidates who wrote 'xylem' (i.e., as in 'xylem cell' – the word 'cell' was already stated in the question) were given a mark, because B is a cell within the xylem tissue.

Assessment for learning

Make sure that candidates understand the difference between the tissues and the cells of a plant's vascular tissue. Phloem tissue comprises several types of cells, including sieve tube elements and companion cells. Xylem tissue also includes several types of cells, such as xylem vessels.

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Question 1 (b) (i)

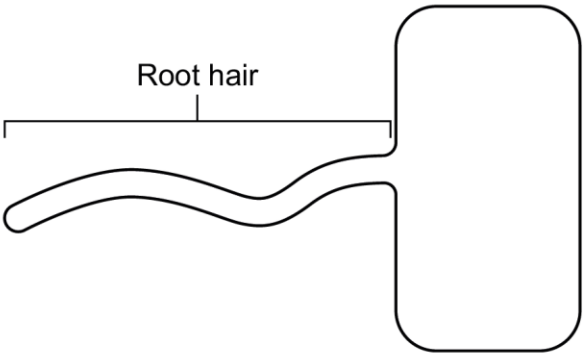
(b) The outer surface of a root is made up of root epidermal cells.

A root hair cell is a type of root epidermal cell that has a hair-like extension called a root hair.

A typical root epidermal cell has a surface area to volume ratio (SA : V) of 0.3 : 1.

A root hair cell has a higher SA : V than a typical root epidermal cell.

The diagram shows a root hair cell. The diagram is not to scale.



The root hair has:
- a diameter of 10 μm
- a length of 800 μm.

(i) Calculate the SA : V of the root hair.

Assume the root hair is cylindrical.

Use the equations:

Surface area of cylinder = $2\pi r(r + l)$

Volume of cylinder = $\pi r^2 l$

SA : V of root hair = ... **[3]**

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Most candidates were able to use the values provided to calculate the surface area and volume of the root hair. In some cases, the final ratio was not presented in the standard format. A ratio should ideally be reported in the format x:1 (see page 13 of the OCR Mathematical Skills Handbook). Answers that reported the ratio as '1:2.5' or '2:5', for example, got 2 of the 3 marks. A ratio of 0.3:1 was provided in the introduction to the question. Therefore, an answer of 0.4:1 was expected. Answers that included additional significant figures (e.g. 0.4025:1) were also given 2 marks.

Calculation:

surface area of the root hair = 2 x π x 5 x (5 + 800) = 25,289.8208614

volume of the root hair = π x 52 x 800 = 62,831.8530718

SA:V of root hair = 25,289.82 / 62,831.853 = 0.4025 = 0.4 : 1

OCR support

Please read page 13 of the OCR Mathematical Skills Handbook for information on how to present ratios.

Question 1 (b) (ii)

(ii) State how a high SA:V helps a root hair cell perform its function.

.....

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

This question proved challenging because it required three elements to be included in the answer: an idea of 'increased' or 'greater', a named, relevant substance that could be transported and an indication of the direction of movement. For example, 'more water absorbed' was an acceptable answer because the context of the question is plant roots, therefore we can assume absorption must be into the roots. Many other wordings were acceptable, including 'greater uptake of minerals' and 'increased nitrate transport into roots'. Answers that contained the suggestion that a high SA:V reduced the diffusion pathway or diffusion distance were not credited.

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Question 1 (c)

(c) Carbohydrates produced in palisade cells are transported in phloem to sinks, such as roots.

Describe how carbohydrates move from palisade cells into companion cells in phloem.

.....

.....

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.....

.....

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

Excellent responses considered three aspects: the name of the carbohydrate (sucrose) that is typically transported in phloem tissue, how the carbohydrate travels to the phloem tissue (either through the apoplast pathway or the symplast pathway) and the mechanism by which sucrose enters companion cells. References to 'active transport of sucrose' rather than 'active loading' were not credited. Active loading includes the active transport of protons and the subsequent cotransport of the protons and sucrose.

Most candidates were able to get at least 1 mark, with some candidates being given all 3 marks.

Some candidates described the transport of sucrose into phloem sieve tubes and subsequent translocation, which was irrelevant to the question.

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Question 2 (a) (i)

2 Adrenaline is a hormone that increases heart rate when it binds to receptors on heart cells.

Beta blockers are drugs that bind to adrenaline receptors on heart cells.

Beta blockers are used to treat tachycardia (fast heart rate) and high blood pressure. They reduce the risk of a heart attack or stroke, which are two examples of cardiovascular diseases.

(a) The conversion of ATP to cyclic AMP (cAMP) in a heart cell is prevented when beta blockers bind to adrenaline receptors on the cell surface membrane.

(i) Describe **one** difference between the structure of ATP and the structure of ADP.

.....

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

Most candidates got a mark for this question. A few candidates stated 'ATP has three phosphates' without providing a comparison to ADP.

Assessment for learning



When responding to questions that require differences to be identified, candidates should adopt a comparative tone, using language such as 'more' or 'less' to demonstrate clear contrasts.

Question 2 (a) (ii)

(ii) Suggest how the binding of beta blockers to adrenaline receptors prevents the conversion of ATP to cAMP.

.....

.....

.....

.....

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

Most candidates realised that beta blockers stop adrenaline from binding to their receptors. Many candidates also described how the role of adenylyl cyclase would be affected, with some mentioning the role of G-proteins, in addition. An error that was seen occasionally was the suggestion that ATP, rather than adrenaline, binds to the adrenaline receptors.

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Question 2 (b)

(b) A scientist studied the health outcomes of people with high blood pressure that were treated with either:

- a new beta blocker treatment

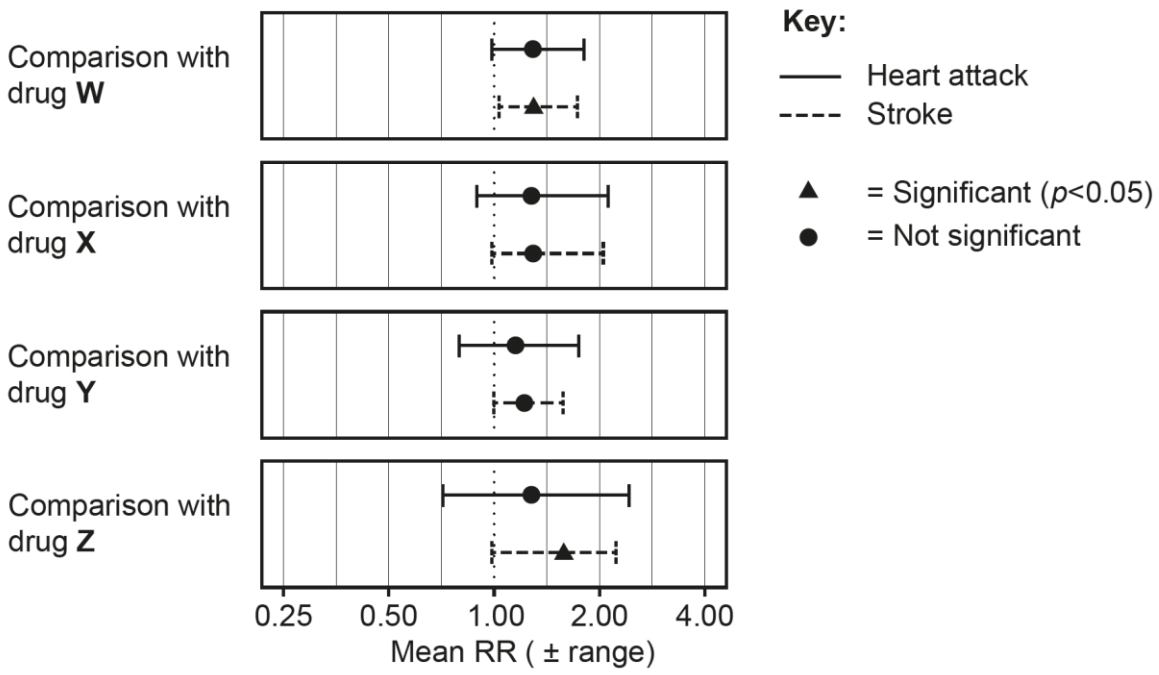
or

- one of four established treatments (drug **W**, **X**, **Y** or **Z**).

The scientist assessed the relative risk of a person in the study having a heart attack or having a stroke.

- A relative risk (RR) value of 1 means that the risk for people taking beta blockers is the same as the risk for people taking another drug.
- RR <1 means that there is a lower risk for people taking beta blockers.
- RR >1 means that there is a higher risk for people taking beta blockers.

The graph shows the results of the scientist's analysis. The error bars show ± 2 standard deviations.



A student looked at the results and concluded:

'the beta blocker does not seem to be an effective treatment for cardiovascular diseases'.

Evaluate whether the evidence in the graph supports this conclusion.

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

This was a challenging question that was intended to test candidates' ability to interpret relatively complex data and evaluate a conclusion. Despite the difficulty of the question, almost half of the candidates were able to get at least 2 marks, and most got at least 1 mark.

One challenge of the question was to realise that the wording of the conclusion ('not… an effective treatment') was the equivalent of suggesting that taking beta blockers raises the risk of a stroke or heart attack in comparison to taking other available drugs. Some candidates were therefore able to describe the data, but not in the correct context of supporting or not supporting the conclusion. Other candidates muddled the mean RR values and the SD values when describing the data.

A relatively straightforward way to get marks was to outline additional information that would be required to support the conclusion (e.g. sample sizes, aspects such as gender and age, and, crucially, a comparison between the risks when taking beta blockers and the risks when taking no medication).

Many candidates included the term 'correlation does not mean causation', which was irrelevant for these data because they were comparisons between groups rather than analysis of correlation.

Assessment for learning

Practise evaluating experimental results by considering aspects of validity, such as sample sizes, potential confounding variables (variables that should have been standardised) and the use of control groups.

ExamBuilder has a filter function that allows selecting 'Evaluation' questions. Past paper questions from Biology B specification can also be used for practising these types of questions. The two qualifications share approximately 60% of common content.

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Exemplar 1

The groups comparisons did all show that the relative risks are above 1 (excluding grand error bars), so people are more at risk really beta blockers. However, they only had a sample of people with (number) high blood pressure so there is no representation of tachycardia or other cardiovascular diseases. There are only 2 differences that are significant, the comparison with drug 2 for strokes and the comparison with drug W for stroke, so other than more there is no statistically difference between results. On drug 2 heart attack the error bars are large (0.75 - 2.5) so there is a chance they could be beneficial. Unclear on sample size, small sample sizes aren't representative. [4]

This is an exemplar of a successful response. The candidate has identified the principal point that supports the conclusion (i.e. in all cases, beta blockers present more risk and therefore RR is above one). However, the answer then recognises that only two of the differences are significant, which does not support the conclusion. The candidate also includes information that is missing from the data (i.e. comparisons for other cardiovascular conditions and the sample size in the study).

Question 2 (c)

(c) Heart rate is lowered when the heart receives stimulation from the vagus nerve.

Explain why the vagus nerve is considered part of the peripheral nervous system **and** part of the autonomic nervous system.

.....

.....

.....

.....

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

Many candidates were able to explain that the vagus nerve is part of the autonomic nervous system because it is involved in involuntary or unconscious control. Fewer candidates could explain why it is part of the peripheral nervous system, with some mentioning involuntary control in this context as well.

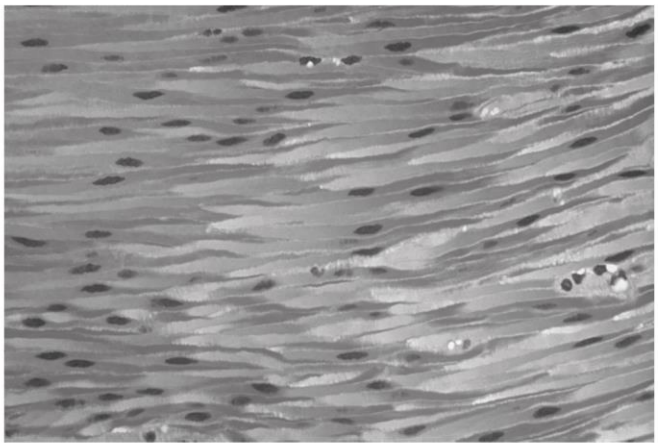
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Question 3 (a)*

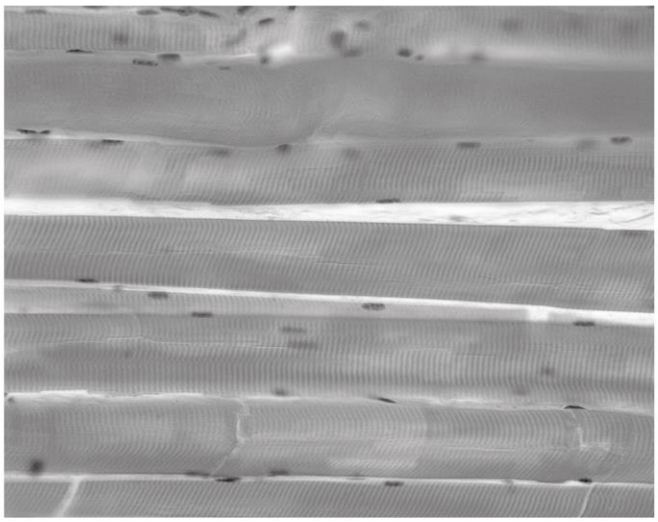
3

(a)* The three photomicrographs, **D**, **E** and **F**, show three different types of muscle tissue.

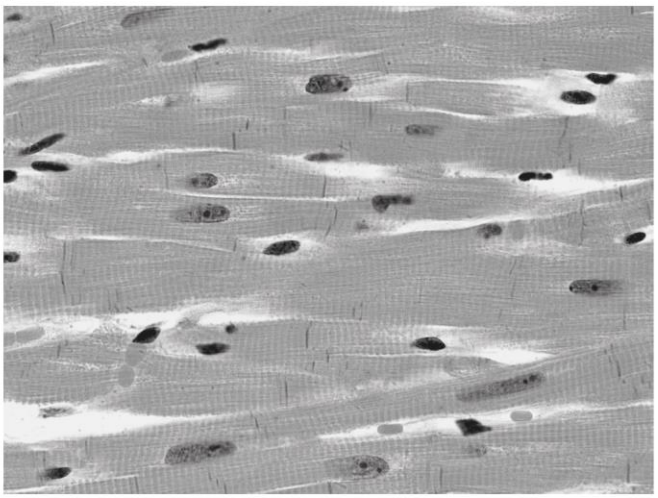
D



E



F



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State which photomicrograph shows cardiac muscle, which shows involuntary (smooth) muscle and which shows skeletal muscle.

Describe the evidence that supports your identification of each type of muscle tissue.

.....

.....

.....

.....

.....

.....

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

Some candidates were unable to provide any relevant evidence to support their identifications. In contrast, it was obvious that quite a few candidates understood this topic to an excellent level and were able to match their correct identifications of each muscle tissue with several pieces of evidence.

Candidates were given marks for the logic of their evidence and could potentially access Level 2 without correct identifications of every muscle tissue. However, many were unable to access Level 1 because they did not incorporate any relevant evidence or appropriate terminology into their evidence. In many cases, candidates mentioned 'uninucleate' or 'multinucleate' without clarifying whether this referred to individual cells or the tissue as a whole. It was assumed these references were to individual cells, and therefore these points could be credited, despite a lack of specificity in some answers.

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Question 3 (b)

(b) The table lists events that occur during muscle contraction. Each event is represented by a letter.

Letter	Event
H	ATP binds to myosin, which causes myosin to detach from actin.
I	Troponin changes shape.
J	Myosin binds to actin.
K	ADP is released from myosin.
L	Hydrolysis of ATP causes the myosin head to regain its original position.
M	Ca^{2+} ions bind to troponin.
N	Tropomyosin moves position.

Give the sequence of letters that shows the correct order of events during muscle contraction.

The first letter has been done for you.

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

Most candidates were able to get at least 1 mark, and some were given three marks. The most common error was to place the steps involving ATP and ADP (K, H and L) in the wrong order.

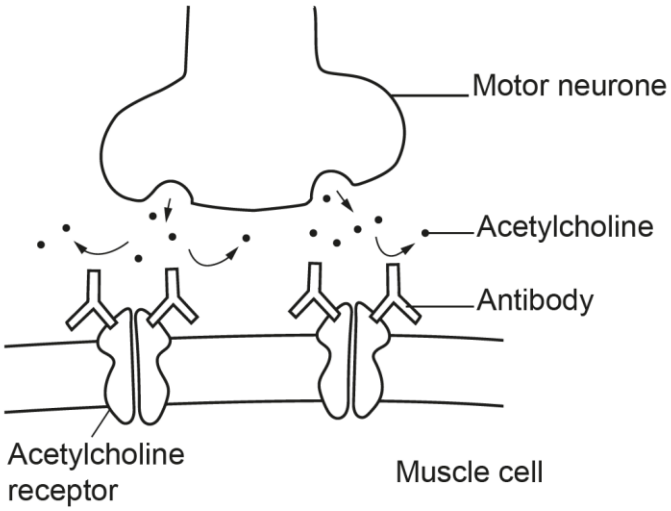
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Question 3 (c) (i)

(c) Myasthenia gravis (MG) is a disease that causes muscle weakness.

In MG, antibodies bind to acetylcholine receptors in neuromuscular junctions which prevents acetylcholine from binding to the receptors.

The diagram shows this process.



(i) State the name given to diseases such as MG.

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

Most candidates recognised that myasthenia gravis (MG) must be an example of an autoimmune disease because of the binding of antibodies to self-cells. Some stated that MG is a neuromuscular condition, which is true, but this information was provided in the question introduction. A few candidates mentioned specific diseases, such as motor neurone disease, despite the name of the disease being provided in the question.

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Question 3 (c) (ii)

(ii) Explain how the binding of antibodies to acetylcholine receptors in the neuromuscular junction reduces the rate at which Ca^{2+} ions bind to troponin.

.....

.....

.....

.....

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

This was a challenging question because candidates needed to interpret the novel information in the diagram and then apply appropriate technical terms in their response. Many candidates mentioned a lack of depolarisation or a reduction in the release of calcium ions, but marks were given only when specific locations in muscle cells were mentioned. For example, 'there would be less depolarisation of the muscle cell membrane, which would lead to fewer calcium ions being released from the sarcoplasmic reticulum' would be an answer that got both marks. Fewer than half of the cohort were able to get a mark.

Question 4 (a)

4 RNA and DNA are polynucleotides.

(a) Two types of RNA are messenger RNA and transfer RNA.

The table shows some properties of these two types of RNA.

Place ticks (✓) in the correct boxes to indicate which properties are true for each type of RNA.

Property	Messenger RNA	Transfer RNA
Anticodons are present.		
The nucleotide base sequence codes for a polypeptide.		
Uracil is bonded to adenine by hydrogen bonds within the molecule.		

[2]

Most candidates got at least 1 mark here, usually for knowing that an mRNA base sequence codes for a polypeptide. Candidates were not penalised for ticking the mRNA box to indicate the presence of hydrogen bonds. Although it is not required knowledge on the specification, hydrogen bonds can form between bases in different parts of an mRNA chain. Fewer candidates got a mark for identifying the correct features of tRNA.

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Question 4 (b)

(b) Outline how gene expression is regulated within cells at the post-transcriptional level.

.....

.....

.....

.....

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

A wide range of responses were seen, including incorrect references to the *lac* operon and histone modification. However, many of the candidates got at least 1 mark, most often for describing editing of primary mRNA and the removal of introns. Fewer mentioned the joining of exons. Candidates were also given marks for referencing the capping of mRNA, RNA editing and spliceosomes, despite this not being required knowledge in the specification.

Common errors included references to 'the removal from introns from DNA', 'extrons' and the use of 'splice' to mean 'remove' (although 'splice *out* introns' was accepted). Relatively few candidates muddled the meanings of introns and exons.

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Question 4 (c) (i)

(c) A student writes this method for extracting DNA from animal cells:

1. Grind the sample of cells using a mortar and pestle.
2. Mix the sample with detergent.
3. Add ethanol to precipitate the DNA from the solution.
4. Spool the DNA onto a glass rod.

(i) Another student suggests that step 1, grinding the sample of cells, is unnecessary.

Explain why step 1 is unnecessary.

.....

.....

.....

.....

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

Candidates, in general, performed well on this question, with most stating that animal cells lack a cell wall and recognising that the role of step one is to break down cell walls.

Question 4 (c) (ii)

(ii) State **one other** step that the student should include in the method **and** explain why this step is necessary.

Step .....

Explanation .....

.....

[1]

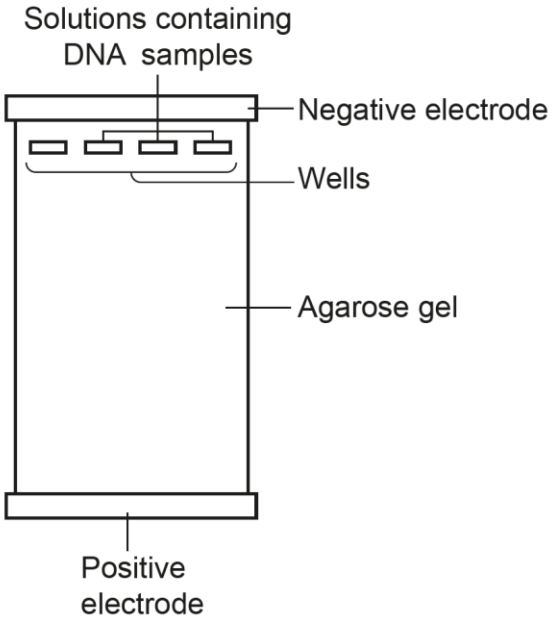
Only some candidates were able to get a mark for this question. The most common correct response was to state that protease should be added to break down histone proteins. A few candidates stated 'protease' but wrote 'to break down proteins' without specifying 'histones' or 'proteins associated with DNA'. Other responses that were given the mark included 'add salt to help precipitate DNA' and 'cool to stop damage to DNA'.

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Question 4 (d) (i)

(d) Electrophoresis is used to separate fragments of DNA so that the separated DNA fragments can be compared and analysed.

(i) The diagram shows an electrophoresis box. Solutions of DNA samples have been added to three of the wells in the box.



State **two other** solutions that should be added to the box before performing electrophoresis **and** explain the purpose of each solution.

Solution .....

Explanation .....

.....

Solution .....

Explanation .....

.....

[4]

This was a fairly challenging question that tested candidates' knowledge of how electrophoresis is carried out. Few candidates managed to get all 4 marks, but most got some marks. The most common correct responses were references to a buffer solution or a dye. Various terms (e.g. 'fluorescent markers') were accepted as alternative descriptions for dyes. In general, a candidate that got a mark for stating a relevant solution tended to also get a mark for a correct explanation. Fewer candidates mentioned the use of reference DNA fragments (DNA ladders).

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Question 4 (d) (ii)

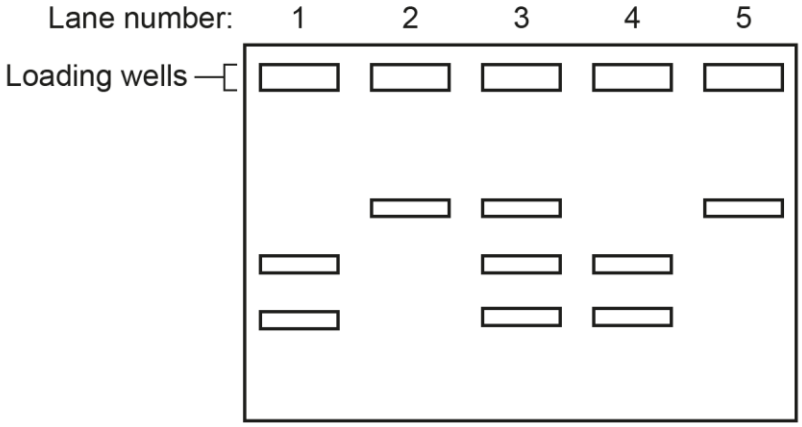
(ii) Electrophoresis can be used to detect disease-causing alleles, such as the mutant *HBB* allele that causes sickle cell disease.

Restriction enzymes are used to produce fragments of *HBB* alleles for analysis by electrophoresis.

These restriction enzymes:

- produce one fragment when the sickle cell *HBB* allele is present
- produce two smaller fragments when the normal *HBB* allele is present.

The diagram shows the results of electrophoresis of DNA samples from five people. It only shows DNA fragments from the *HBB* gene.



State the lane numbers that indicate:

- a genotype that is homozygous for the sickle cell *HBB* allele
- a genotype that is homozygous for the normal *HBB* allele
- a heterozygous genotype for the *HBB* gene.

Homozygous sickle cell .....

Homozygous normal .....

Heterozygous .....

[2]

Candidates performed very well in this question in general, despite the unknown context. Most were able to match the lane numbers with the correct genotypes.

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Question 4 (e) (i)

(e) Bacterial cells can be used for genetic engineering.

A donor gene is placed into a plasmid, which is taken up by a bacterial cell.

This process is inefficient. Not all plasmids form recombinant DNA with the donor gene, and only a small percentage of bacterial cells take up plasmids.

(i) A scientist estimates that 40% of their plasmids join to the donor gene to form recombinant DNA.

One in 2500 bacterial cells takes up a plasmid to form a transformed bacterial cell.

The scientist uses 1×10^9 bacterial cells.

Calculate the number of cells that take up a plasmid containing the donor gene.

Number of bacterial cells = ... **[2]**

Most of the cohort gained two marks for this calculation. A few candidates achieved one of the calculation steps (i.e. dividing 1 x 10^9 by 2500) without carrying out the second step. Even though this question did not require the use of standard form, many candidates used standard form correctly, which was excellent to observe.

Calculation:
Number of bacterial cells that take up the plasmid is 1 in 2500.
Therefore: 1 x 10^9 /2500 = 400,000
Out of the 400,000, 40% will take up the plasmid.
400,000 x 40% = 160,000

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Question 4 (e) (ii)

(ii) The percentage of plasmids that are taken up by bacterial cells is known as the transformation efficiency.

Suggest **one** factor that scientists could change to improve transformation efficiency.

.....

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

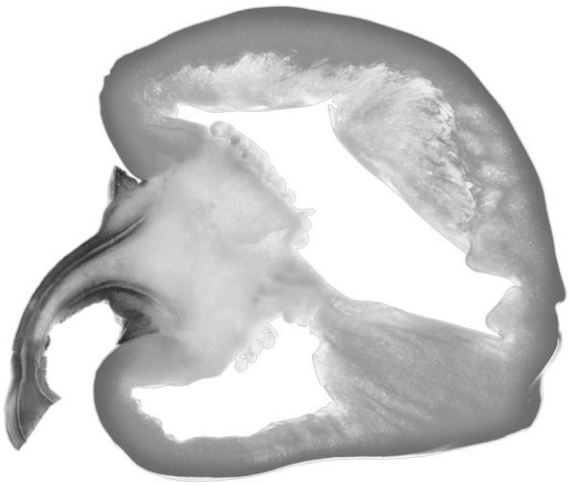
This was a challenging question. Despite this, most candidates were given the mark, usually for suggesting that temperature could be increased or that electroporation could be used.

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Question 5 (a)

5 A student investigates water potential in the cells of a bell pepper, *Capsicum annuum*.

A slice of bell pepper is shown in the image.



The student:

- prepares several concentrations of sucrose solution
- cuts pieces of pepper and records the mass of each piece
- places pieces of pepper in each sucrose solution
- removes the pieces after 30 minutes and dries them
- records the mass of each piece.

(a) The student makes sucrose solutions of different concentrations by diluting a stock solution.

State a piece of equipment, with a higher resolution than a measuring cylinder, that the student should use to transfer solutions during the dilution procedure.

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

A range of answers were accepted, including for equipment that could feasibly be used to hold and release the stock solution (e.g. a burette or volumetric flask) and equipment used for the transfers (e.g. graduated pipette). 'Pipette', unqualified, was not given the mark because some dropping pipettes have resolutions lower than a measuring cylinder.

OCR support

Please look at page 34 of the OCR Biology Practical Skills Handbook for more information on resolution and uncertainties.

The Language of measurement is also a useful resource for guidance on resolution and uncertainties.

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Question 5 (b)

(b) The student controls temperature and the time that the pepper pieces are in the sucrose solution.

State **one** other variable that the student should control during the experiment.

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

Many candidates got a mark for this question, most often for 'size' or 'area' or 'age' or 'type' of pepper.

Question 5 (c)

(c) The student calculates the change in mass of each piece of pepper during the experiment and converts these values to percentage change in mass.

Explain why the student converts the results to percentage change in mass.

.....

.....

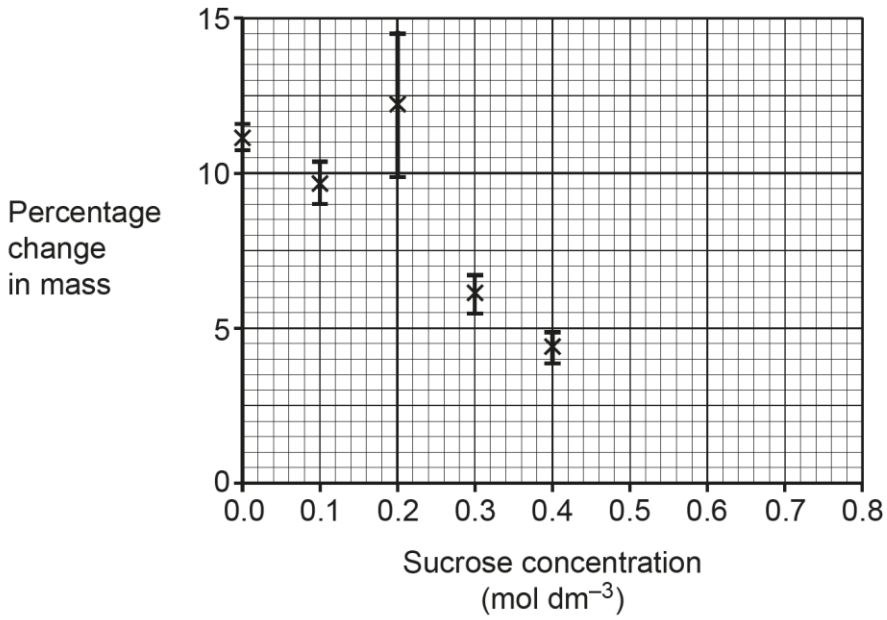
..... **[1]**

This was a challenging question as it required two elements to be included to gain the mark: the idea that initial masses may differ and the idea that the use of percentage change would allow comparisons. A full explanation was evident only when both elements were present in a response. Only some candidates were given the mark.

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Question 5 (d)

(d) The graph shows the results of the experiment.



Use the graph to estimate the concentration of sucrose solution that has the same water potential as the pepper tissue.

Concentration of sucrose solution = ... mol dm^{-3} **[2]**

Most candidates were given both marks. Most candidates were able to extrapolate a straight line to the x axis without including the anomalous data point.

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Question 6 (a) (i)

6 β-thalassemia is an inherited blood disorder in which the β-globin chain of haemoglobin is changed or absent in a person's red blood cells.

Many different DNA mutations in the β-globin gene can cause β-thalassemia, including these two mutations:

mutation 1: **C G G ⟶ C T G**

mutation 2: **G T C ⟶ A T C**

Each mutation occurs in a triplet in the template strand of DNA.

The transcribed mRNA is complementary to the template strand.

(a)
(i) The diagram on the opposite page is a representation of the genetic code. It shows the amino acid encoded by each mRNA codon.

The letters in the centre of the diagram represent the first base in each codon.

State the amino acids that are encoded by the original triplet and the mutated triplet in mutation 1.

Original amino acid .....

New amino acid .....
[1]

Many candidates got this mark by converting the two DNA triplets to the complementary mRNA codons and thereby producing an answer of 'alanine' and 'aspartic acid'. Many candidates did not convert to the complementary codons, and this resulted in an incorrect answer of 'arginine' and 'leucine'.

Question 6 (a) (ii)

(ii) State **and** explain the effect of mutation 2 on the structure of the β-chain of haemoglobin.

.....

.....

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

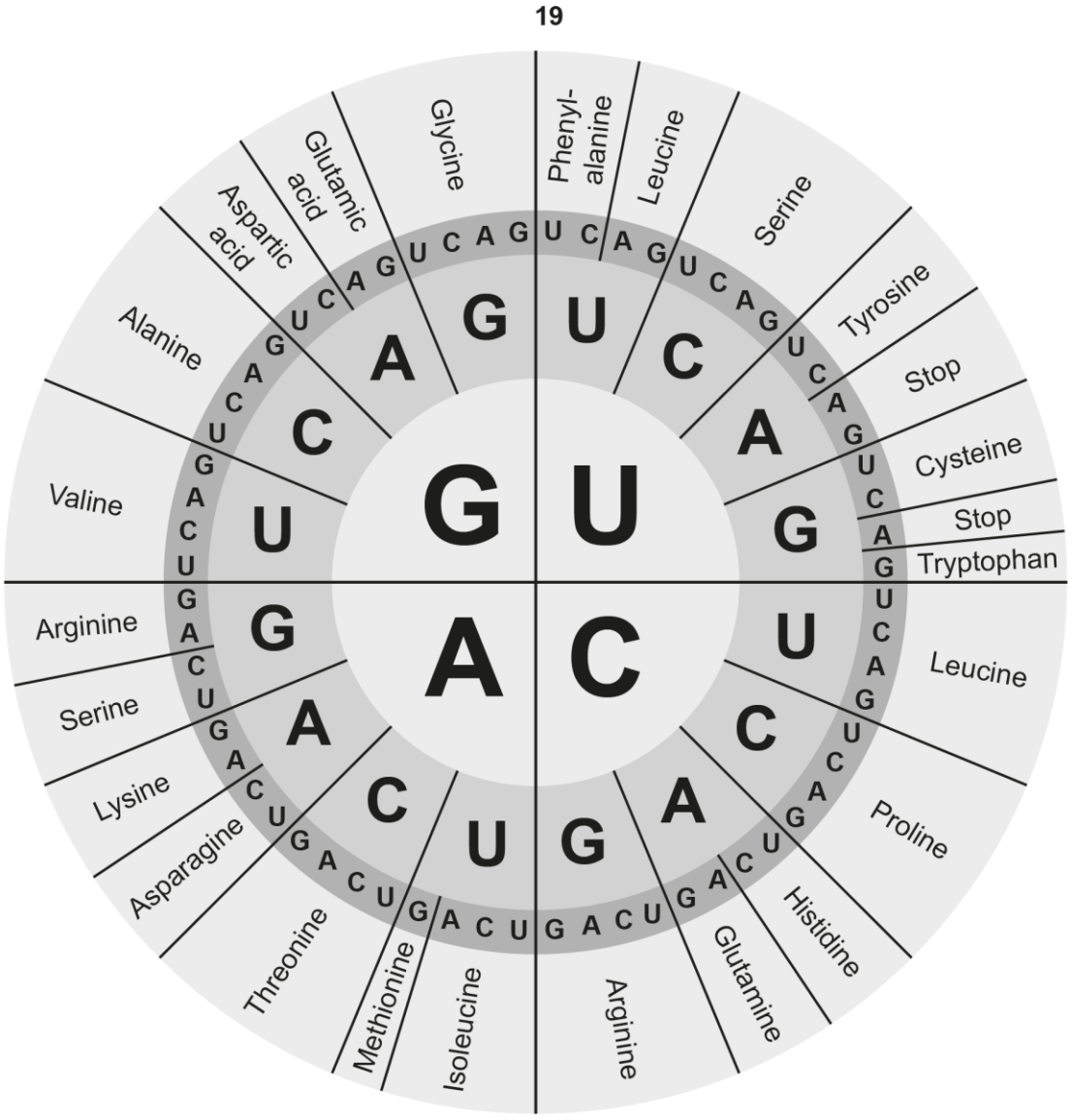
Candidates who did not convert the DNA triplets to complementary mRNA codons in part 6 (a) (i) usually made the same error in this question. This was a more challenging question, however, because even when the inclusion of a premature stop codon was mentioned, candidates still needed to explain the effect of the stop codon on the structure of the β-chain. Relatively common errors included references to a frameshift mutation or the early termination of transcription.

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Misconception

A stop codon stops translation **not** transcription.

Question 6 (b)*



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(b)* In 2023, a gene editing treatment for β-thalassemia was approved for use in the UK.

Gene editing is a form of gene therapy.

Standard gene therapy:
- uses a vector to deliver a functional, normal allele to cells in a person's body
- does not remove the faulty, disease-causing allele from the person's cells.

Gene editing:
- can correct the faulty, disease-causing allele so that only the functional, normal allele is present at that locus
- can be performed on stem cells that have been removed from a person's body; the stem cells are then transferred back into that person.

Discuss the advantages of gene editing compared to standard gene therapy **and** discuss the ethical issues shared by both forms of gene therapy.

.....

.....

.....

.....

.....

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

The information about gene editing may have been new to many candidates, unless they had read about it in articles, because it is not required knowledge in the specification. A successful response integrated this novel information on gene editing with a candidate's understanding of established gene therapy. Many candidates discussed the potential for gene editing to provide a more permanent treatment with fewer immune responses, and some candidates discussed the potential to treat genetic conditions that stem from dominant alleles. The most common ethical issues to be discussed were the potential risks of relatively new technologies, religious objections and the potential for cosmetic, non-disease use. Relatively few candidates discussed these issues in enough detail to warrant Level 3.

Many responses described the use of gene editing for germline therapy or taking stem cells from embryos, which was not directly relevant to this question. Many responses also discussed ethical issues that related to only one form of therapy rather than both forms. Responses that included this type of irrelevant information were often not given the communication mark.

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Exemplar 2

Advantages of gene editing rather than standard gene therapy include: no chance of the body's immune system rejecting the vector, and no chance of the vector failing to enter nucleus of persons cell to form recombinant DNA. As well as the person not still having the faulty, disease causing allele within their cells. Once the stem cells have been modified in gene editing, it is a permanent solution as the patients body will produce differenciated cells without the faulty allele, with the functional allele, while in traditional gene therapy, the patient may still procure cells in the future with the disease causing allele & without the functional allele. Ethical concerns involve the use of gene therapy for aesthetic purposes **[6]** like changing hair/skin colour rather than for medical purposes. Furthermore: it is difficult to reverse this procedure, so mistakes with editing a persons DNA can be life changing or lethal. Gene editing that occurs in embryos is unethical as the baby is unable to consent.

This is an exemplar of a detailed response that got Level 3. Three advantages of gene editing have been described (no chance of rejection, the suggestion of greater precision ('no chance of... failing to enter nucleus'), and 'permanent solution'). Two ethical points have been given (use for aesthetic purposes and 'mistakes... life changing or lethal'). This represents a detailed discussion for both advantages and ethics, which means Level 3 could be given. The communication mark was not given because the reference to the use of embryos is irrelevant and because the response included of a description of an ethical point relating to only one therapy. The answer scored 5 marks.

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Question 7 (a) (i)

7 Pathogens are transmitted to animals and plants by a variety of methods.

(a) A group of scientists collected and analysed data about climate change and the number of cases of diseases transmitted by animal vectors.

The scientists wanted to know whether the number of cases of each disease had increased as a result of climate change.

They found that the number of cases had increased for 103 different animal vector-transmitted diseases.

The scientists concluded that climate change has increased the transmission of pathogens by animal vectors.

(i) Suggest **one** additional piece of information that is needed to assess the validity of the scientists' conclusion.

.....

.....

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

This proved to be a challenging question for candidates. A range of responses were given the mark, such as 'knowledge of the number of diseases analysed', 'population sizes of the animals', 'the time period over which the study was done', and 'whether a statistical test was significant'. Many responses were too vague to be given a mark or were missing a key element (e.g. 'stats test' rather than 'the significance of a stats test').

Question 7 (a) (ii)

(ii) Suggest why climate change might result in more cases of diseases caused by animal vector-transmitted pathogens.

.....

.....

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

Many candidates got this mark by suggesting that temperature increases could increase the geographical ranges of vectors or boost the population sizes of vectors and pathogens.

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Question 7 (b) (i)

(b) Neutrophils are white blood cells that contribute to the immune response against infection.

Neutrophils produce oxidative bursts as part of their response to infection.

An oxidative burst is the rapid production of highly reactive particles, including hydrogen peroxide (H_2O_2), inside the cell.

(i) State the location of the stem cells that differentiate into neutrophils.

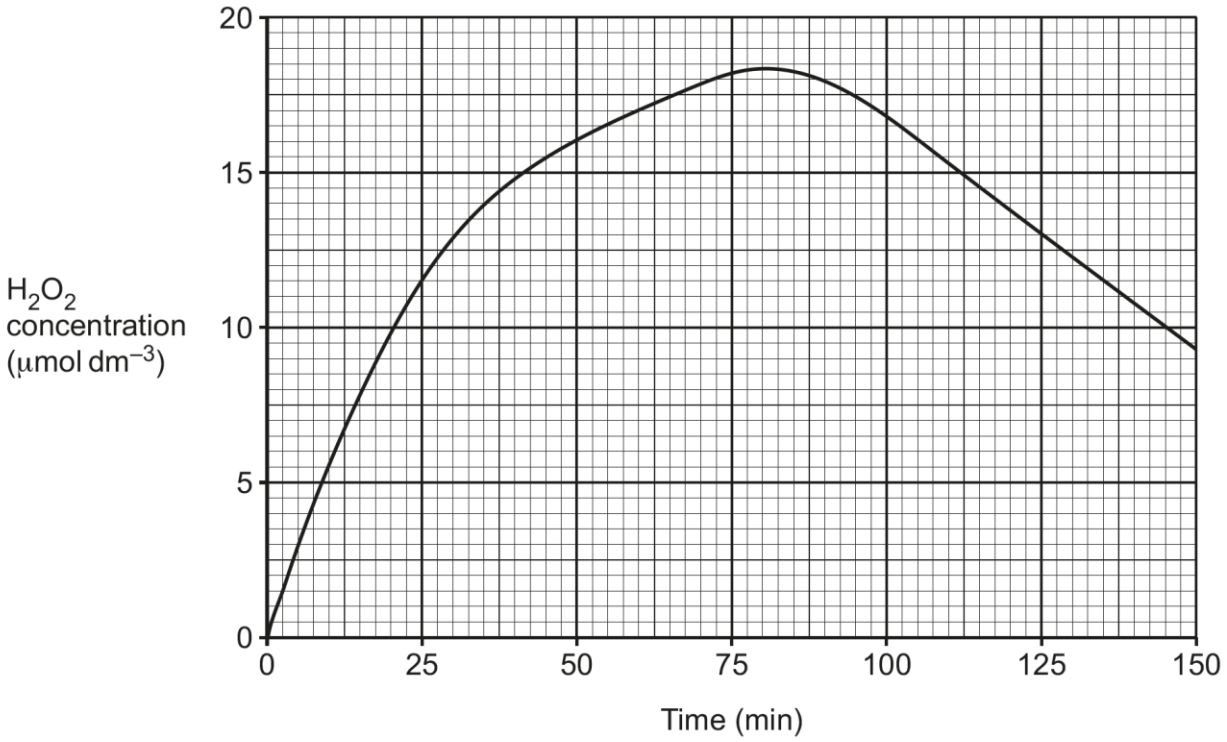
..... **[1]**

Most candidates remembered that the stem cells that differentiate into types of blood cell are located in the bone marrow.

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Question 7 (b) (ii)

(ii) The graph shows the change in hydrogen peroxide concentration in a neutrophil during an oxidative burst.



Use the graph to calculate the **initial rate** of increase of H_2O_2 concentration in the neutrophil during an oxidative burst.

Rate = ... Units ..... **[3]**

Overall, candidates performed very well on this question. Many were able to calculate a correct initial rate by using a tangent on the graph. A few candidates were not given a mark for their unit because it was presented as 'µmol dm^{-3}/min' rather than 'µmol dm^{-3} min^{-1}', which is the preferred format for compound units (see page eight of the OCR Maths Skills Handbook).

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Question 7 (b) (iii)

(iii) Suggest how an oxidative burst helps neutrophils to perform their function.

.....

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

Many candidates got the mark for suggesting that the reactive particles from the oxidative burst are likely to help a neutrophil destroy pathogens. A variety of wordings were given credit (e.g. 'break down bacteria' and 'digest microbes').

Question 7 (b) (iv)

(iv) Antibodies can bind to receptors on the cell surface membrane of a neutrophil.

The binding of an antibody to a receptor causes the neutrophil to engulf the pathogen that is bound to the antibody.

State the name given to antibodies that act in this way.

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

Many candidates recalled the term 'opsonin' and therefore got this mark.

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Question 7 (c)

(c) Plants lack immune cells, but they have other defences against pathogenic infection.

The sentences describe one form of plant defence against pathogens.

Complete the sentences using the most appropriate word or phrase.

When a pathogen is detected in plant tissue, a plant increases the production of a polysaccharide called ..... . This polysaccharide is deposited in channels called ....., which pass through cell walls. This deposition stops the pathogen moving between cells. The polysaccharide is also deposited in the small gaps between sieve tube elements. These gaps are known as ..... . This deposition stops the pathogen moving between different regions of the plant.

[3]

Most candidates scored at least 1 mark for this question, but very few were able to get all 3 marks. Most candidates remembered that the relevant polysaccharide is callose and realised that the channels through cell walls must be plasmodesmata. Very few candidates were able to name the gaps between sieve tube elements as 'sieve pores'. A lot of candidates answered 'sieve plates'.

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