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Examiners' report

AS LEVEL

BIOLOGY A

OCR Level 3 Advanced Subsidiary GCE in Biology A

H020

For first teaching in 2023

H020/01 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 1 series overview

H020/01 Breadth in Biology is one of two examined components of AS Level Biology A. The component tests content from four modules.

Module 1: Development of practical skills in biology

Module 2: Foundations in biology

Module 3: Exchange and transport

Module 4: Biodiversity, evolution, and disease

Candidates should expect a range of questions testing their knowledge and skills, including mathematical and practical skills. To do well in this component, candidates need to have a good level of knowledge and understanding of the basic concepts underlying biology. These include cell biology, biological chemistry, exchange structures, transport systems, biodiversity and evolution.

It is important that candidates practice working with past paper and exam style questions, discuss the need to read questions carefully, look at how to interpret questions (such as working on the meaning/requirement of command words like state, describe, and explain) and practice writing in clear concise language. All these points will allow them to improve their exam technique, become more confident in their responses and ultimately should allow them to receive the maximum marks possible for their ability.

OCR support

ExamBuilder provided by OCR is an excellent resource to quickly build effective tests for internal assessment and in class activities. It can be filtered by topic/year/style of question/practical skills/math skills and key terms can also be searched such as 'DNA' or 'eukaryotic cells'. It will also build the MS for assessments produced (including comments from the associated Examiners Reports) and has save features to store or share your produced materials.

In this paper, all questions were accessible to candidates, although some of the more challenging questions were only answered well by more successful candidates, showing the exam discriminated well among candidates.

There seemed to be no time issues with completing the examination as most candidates were able to provide responses throughout the whole paper. Most candidates attempted all the questions.

Centres are advised to continue to encourage candidates to spend time reading the question and make sure that they supply information that relates to and answers the question posed to improve candidates' performance. It is also suggested that centres access the growing bank of resources available from OCR (some of which are highlighted in this report) to continue to push candidate attainment.

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Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• recalled the meaning and definitions of terms accurately • showed mathematical fluency in calculations and interpreted graphs correctly • produced clear, well organised and concise responses to questions • did not repeat too much material from the question stem in their responses • read the question carefully and paid attention to the information and data provided • had a good practical knowledge of variables and controls and the ability to understand and apply the information given to the questions being asked • were able to appreciate the application of different statistical tests • showed firsthand experience of practical activities such as using and interpreting results from colorimeters and staining and preparing a range of slides with a light microscope.	• found it difficult to answer mathematical based calculations • left answers unfinished or blank • found it difficult to apply what they had learned to unfamiliar situations • produced responses which lacked depth, particularly in practical based questions • produced responses which were very wordy and often simply repeated information provided in the stem of the question • found it difficult to interpret and use images and information supplied in the exam paper to answer related questions • did not collect data accurately for use in calculations • did not use the command words in the question to help guide and shape the detail of their responses.

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Section A overview

There were many successful responses in this multiple-choice section. Examiners were pleased to see very few hybrid letters in MCQ responses, with candidates generally clearly crossing out unwanted responses instead of writing letters of the MCQ choices over each other risking losing a mark as hybrid letters are not given credit.

Many candidates were also seen to be working through the MCQ options for questions in a logical way: annotating and crossing out correct/incorrect options to limit the remaining choices bringing them closer to the correct response. This helps make sure candidates have read all the possible answers fully and helps them remove incorrect distractors bringing them closer to the correct response.

There were also hardly any blank responses for the MCQ questions showing that candidates are aware it's good practice to attempt all of these questions even if they are not sure of the correct response.

Candidates who performed well were also able to read data/information from graphs or tables accurately and were able to process and/or interpret it if needed, in the correct way. This was apparent in Questions 5, 12, and 18. Similarly, Questions 6,7,10,14 and 15 highlighted the benefit in using visual aids and diagrams in teaching and the production of learning materials as higher scoring candidates were able to engage with the pictures provided well and therefore get marks where appropriate.

Question 1

1 Which statement correctly describes microscopes?

A Light microscopes can produce higher resolution images than electron microscopes.

B Scanning electron microscopes produce higher resolution images than transmission electron microscopes.

C Transmission electron microscopes can achieve higher magnifications than scanning electron microscopes.

D Transmission electron microscopes can be used to view living tissues.

Your answer ☐ **[1]**

Most candidates answered correctly with C. This question highlighted that candidates need to be clear on the comparative magnifications and resolutions possible with the three main types of microscopes (light, SEM and TEM). Transmission Electron Microscopes (TEM) offer the highest levels of both magnification and resolution. Scanning Electron Microscopes (SEM) also provide high magnification and resolution, although not as high as TEM. In comparison, light microscopes have much lower magnification and resolution capabilities. There was confusion between TEM and SEM and this was shown by a lot of candidates choosing B.

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Question 2

2 Which statement correctly describes phosphorylated nucleotides?

A ADP can be hydrolysed to produce ATP.

B ADP can be phosphorylated to produce ATP.

C All phosphorylated nucleotides have three phosphate groups.

D Energy is released when ATP undergoes a condensation reaction to form ADP and P_i.

Your answer ☐ **[1]**

There was a clear split of knowledge in this question which showed good discrimination. More successful candidates gave the correct response of B, but a full range of answers were seen. Many candidates incorrectly believed all phosphorylated nucleotides contain three phosphates, showing the importance of knowing structural features of this and all the other biological molecules on the specification. Other candidates did not read each statement carefully and gave A or D as an answer confusing hydrolysis with condensation, so a clear knowledge of these reactions is also key.

Question 3

3 Which type of stem cell can become specialised into more than one cell type but is limited to a range of cell types?

A Embryonic

B Multipotent

C Pluripotent

D Totipotent

Your answer ☐ **[1]**

The question asks which type of stem cell can differentiate into more than one cell type but is limited to a range of cell types. Pluripotent cells can differentiate into any cell type within the body, whereas multipotent can differentiate into a limited range of cell types within a specific tissue, making B the correct answer. This question was well-answered by candidates, who had learned the definitions of all of the types of stem cell listed on the specification. The most common incorrect response was C, pluripotent, showing that some candidates knew these stem cells can differentiate into different cells but have wider range than multipotent.

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Question 4

4 A student carries out a non-reducing sugar test on a sample of fruit juice.

What is the correct reason for heating the sample with hydrochloric acid?

A It breaks the ester bond between glucose and fructose

B It breaks the ester bond between glucose and sucrose

C It breaks the glycosidic bond between glucose and fructose

D It breaks the glycosidic bond between glucose and sucrose

Your answer ☐ **[1]**

Many candidates identified the correct answer of C. Even if candidates had not been able to recall the correct reason for heating the sample with acid, they could have obtained the right answer by knowing 'fruit juice' contains 'fructose' sugars and having a good knowledge of bonding names in biological molecules.

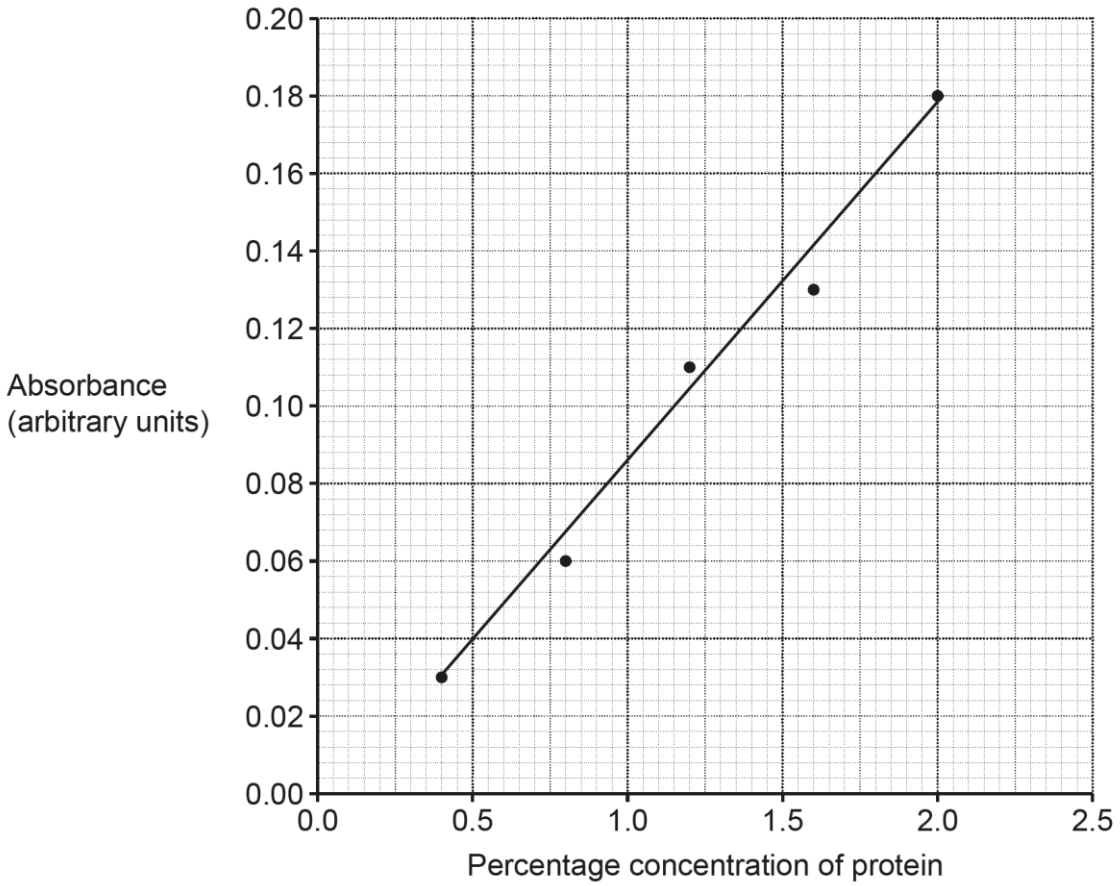
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Question 5

5 A student is finding out the concentration of a sample of protein.

- They set up five solutions that have a range of different protein concentrations.
- They carry out a chemical test on each solution that produces a colour change.
- They use a colorimeter to find out the absorbance of light through each solution.

The graph shows the calibration curve they plotted for each concentration of protein.



They carry out the same chemical test on the sample of protein with the unknown concentration and measure the absorbance as 0.16 arbitrary units.

Which statement correctly describes the results of the experiment?

A The concentration of protein in the sample tested is 1.6%.

B The concentration of protein in the sample tested is too low to read from the graph.

C The greater the concentration of protein, the less light is absorbed by the sample.

D The greater the concentration of protein, the less light is transmitted through the sample.

Your answer ☐ **[1]**

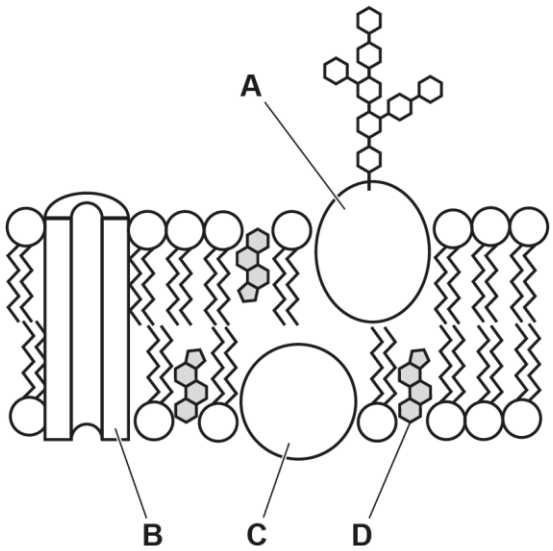
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This was generally well-answered by most candidates, but some did not interpret the graph correctly and gave the answer A or B instead of the correct answer D. Some others did not understand the difference between absorbance and transmission. This emphasises the importance of having a strong understanding of how to interpret graphs from various practical experiments, including colorimetry.

Question 6

The diagram shows the structure of a cell surface membrane.

Use the diagram to answer questions **6** and **7**.



6 Which component acts as a transport protein?

Your answer ☐ **[1]**

This question was correctly answered by most candidates with B, showing they had a clear understanding of membrane structure and function across most of the cohort.

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Question 7

7 Which component is made in the smooth endoplasmic reticulum?

Your answer ☐ **[1]**

This question proved more challenging than the previous question on membrane structure. Around half of the candidates were able to identify cholesterol in the membrane. In order to answer the question, candidates needed to know that it is a type of lipid and then link this to production in the smooth endoplasmic reticulum where lipids are made, giving D as the correct answer.

Question 8

8 Which option describes a role of membranes inside a cell?

A The cell surface membrane acts as a barrier between the cell and its environment.

B The inner membrane surrounding a mitochondrion allows the reactions of aerobic respiration to occur.

C The nuclear membrane has nuclear pores to allow DNA to move out of the nucleus.

D The outer surface of the plasma membrane has receptors for cell signalling.

Your answer ☐ **[1]**

Some of the candidates were able to correctly interpret the question carefully and identify that answers A and D are roles of cell surface membranes and so were incorrect. Those candidates also knew that DNA does not move out of the nucleus; this would be mRNA during transcription. This left B as the correct answer for them.

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Question 9

9 Which row of the table correctly compares the properties of glycogen and amylose?

	Glycogen	Amylose
A	Branched	Branched
B	Insoluble	Soluble
C	Insoluble	Insoluble
D	Unbranched	Unbranched

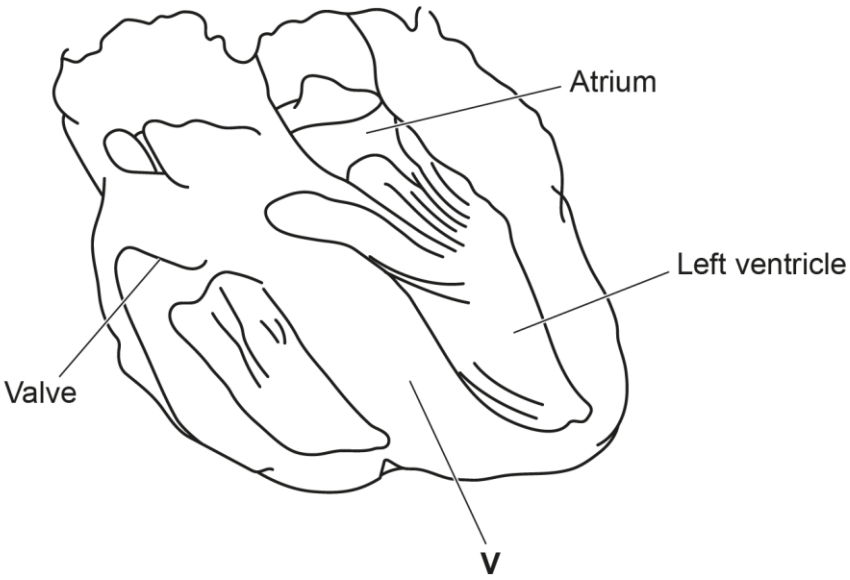
Your answer ☐ **[1]**

Only a few candidates answered this correctly (Option C). Many candidates gave the response B, believing that amylose is soluble. However, amylose is only soluble if heated up and added to boiling water to make a starch solution, which goes beyond the specification point of properties of polysaccharides in living organisms. It forms part of the structure of starch which is a storage polysaccharide in plants and is therefore insoluble.

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Question 10

10 The diagram is of a dissected lamb heart.



What is the name of the structure labelled **V**?

A Aorta

B Apex

C Septum

D Vena cava

Your answer [ ] **[1]**

Candidates showed good knowledge of the internal structure of the heart in this question with most candidates correctly identifying the septum (Option C).

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Question 11

11 Carbon dioxide is transported around the body either in the blood plasma or inside erythrocytes.

Which statement is true about the transport of carbon dioxide?

A Excess carbon dioxide causes blood pH to increase

B Hydrogencarbonate ions are exchanged for hydrogen ions in erythrocytes

C Most carbon dioxide is transported in the blood plasma in the form of hydrogen carbonate ions

D Some carbon dioxide reacts with hydrogen ions to form haemoglobinic acid

Your answer [ ] **[1]**

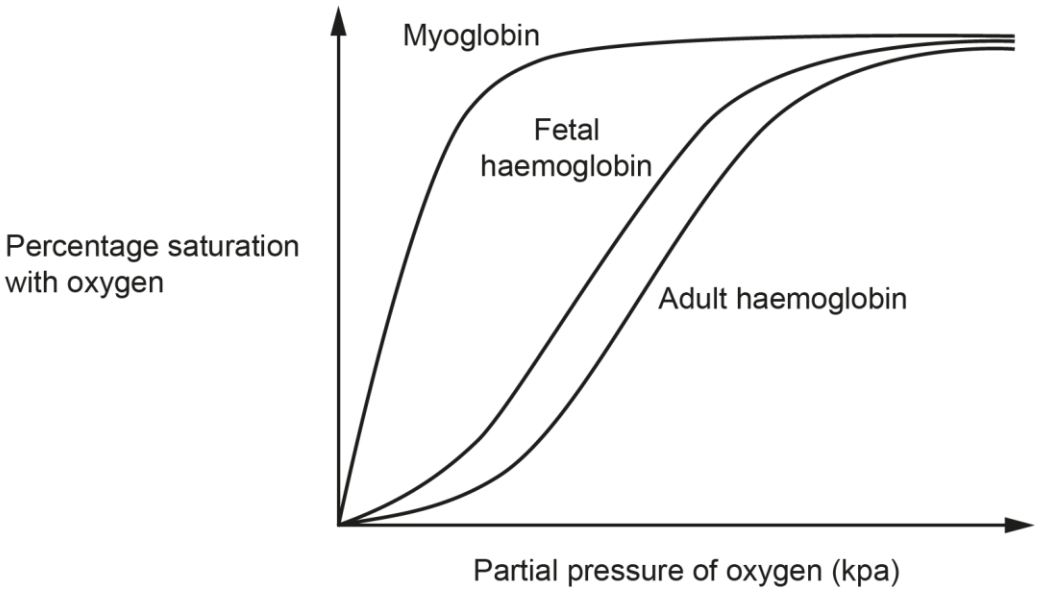
Although this was a challenging part of the content, most of the candidates were able to correctly answer this question with C. However, all choices for incorrect answers were commonly given, suggesting that this is an area candidates are unclear on. Many candidates confused higher acidity of the blood caused by excess carbon dioxide with an increase in pH. Candidates should be clear that higher pH is more alkali, whereas an acidic solution would have lower/decreased pH.

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Question 12

12 The graph shows oxygen dissociation curves for adult haemoglobin, fetal haemoglobin and myoglobin.

Myoglobin is a respiratory pigment found in muscle that acts as an oxygen store.



Which statement correctly compares the dissociation curves?

A Adult haemoglobin has a higher affinity for oxygen when compared to fetal haemoglobin at most partial pressures of oxygen.

B Fetal oxyhaemoglobin dissociates from oxygen molecules less easily than myoglobin at most partial pressures of oxygen.

C Myoglobin has the highest affinity for oxygen at all partial pressures of oxygen.

D Myoglobin has the lowest affinity for oxygen at most partial pressures of oxygen.

Your answer ☐ **[1]**

Although knowledge of myoglobin is not listed on the specification, most candidates either knew the answer to this question or were able to correctly interpret the graph and information given and apply their knowledge of oxygen dissociation curves, therefore correctly identifying the right answer of C.

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Question 13

13 Which option describes the Bohr effect?

A At the same partial pressure of oxygen, haemoglobin has a higher percentage saturation of oxygen.

B Oxygen dissociates from oxyhaemoglobin more readily during exercise.

C The Bohr effect ensures muscles have less oxygen for aerobic respiration.

D The oxygen dissociation curve for haemoglobin shifts to the right in a mammal that is at rest.

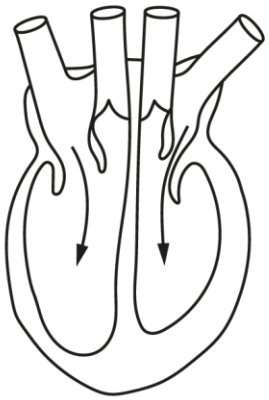
Your answer ☐ **[1]**

Some candidates correctly identified B as the correct answer, being able to link the Bohr effect to its effect. The most common incorrect answer was D, possibly due to candidates not reading the question carefully and noting the '*at rest*' at the end of the question.

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Question 14

14 The diagram shows a stage of the cardiac cycle.



What stage of the cardiac cycle is shown in the diagram **and** which valves are open?

A Atrial systole **and** atrioventricular valves

B Atrial systole **and** semilunar valves

C Ventricular systole **and** atrioventricular valves

D Ventricular systole **and** semilunar valves

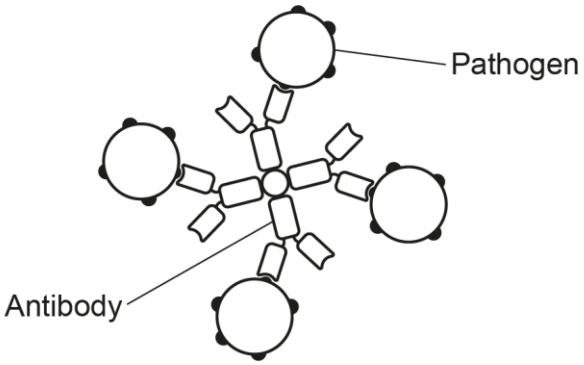
Your answer ☐ **[1]**

Most candidates were able to match the annotated diagram of the heart to the cardiac cycle and identify the open valves, giving A as the correct answer. Candidates should be aware of the cardiac cycle and which valves are open and closed at the different stages, as well as the associated pressure and electrical changes during the cardiac cycle.

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Question 15

15 The diagram shows an antibody attached to multiple pathogens.



What is the type of antibody shown?

A Agglutinin

B Antigen

C Anti-toxin

D Opsonin

Your answer [ ] **[1]**

Candidates needed to know how antibodies function as listed on the specification, which includes agglutinins, anti-toxins and opsonins. Most candidates recognised A as the correct answer, as the diagram shows multiple pathogens being held together by the antibody shown.

Question 16

16 Which of these descriptions is **not** a primary non-specific defence against pathogens?

A Blood clotting caused by a damaged blood vessel

B Expulsive reflexes caused by irritation of the lining of the airways

C Phagocytosis by neutrophils

D Wound repair to damaged skin

Your answer [ ] **[1]**

Candidates who had a clear understanding of primary non-specific response were able to identify that C was the correct answer as phagocytosis is a secondary non-specific defence against pathogens.

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Question 17

17 A pregnant woman is infected by a virus that causes the common cold.

She has an immune response and produces antibodies that are passed on to her fetus.

What type of immunity does her fetus have?

A Artificial active

B Artificial passive

C Natural active

D Natural passive

Your answer ☐ **[1]**

Most candidates gave the correct answer of D, knowing that pregnant women pass on a natural immunity which is passive, as the fetus does not have an immune response but receives antibodies from the mother via the placenta.

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Question 18

18 Scientists studied the genetic diversity of four different wolf populations in a national park in Canada.

The data are shown in the table.

Population	Number of genes studied	Number of polymorphic gene loci
A	8	1
B	14	7
C	4	1
D	19	9

Which population is the most vulnerable to environmental change?

Your answer ☐ **[1]**

Some candidates were able to recall the equation for calculating genetic diversity (number of polymorphic gene loci/total number of gene loci). They knew that the lower the genetic diversity the more vulnerable a population is to environmental change, so they gave A as the correct answer with a genetic diversity of 0.125, compared to 0.5 for B, 0.25 for C and 0.47 for D.

Question 19

19 What is the definition of species biodiversity?

A The distribution of different species in a habitat

B The number of different species in a population

C The species richness and species evenness in a habitat

D The variety of organisms in a habitat

Your answer ☐ **[1]**

Most candidates correctly identified C as the correct answer showing they were able to recall the definition of species biodiversity and link it to species richness and evenness. This point can be supported when teaching Simpsons diversity index.

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Question 20

20 Dachshunds are a breed of dogs which were bred for hunting badgers.

They have sharp front claws and a pointed snout to dig holes.

What term describes this type of adaptation?

A Anatomical

B Behavioural

C Environmental

D Physiological

Your answer ☐ **[1]**

Option A was the correct answer as anatomical adaptations are about the structural features of an organism. Many candidates answered this question correctly, but some did select D, suggesting there is some confusion around the meaning of physiological adaptations which are adaptations that ensures the correct functioning of internal cell processes.

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Section B overview

Candidates were able to demonstrate a wide range of knowledge and ability in this section. Many candidates were able to access all questions. There were relatively few candidates who did not respond to some questions, suggesting that timing was not an issue during the exam.

Additional answer space
Examiners were pleased to see that many candidates used the additional answer spaces provided in the paper, rather than continuing their answers outside the provided lines, and this is something we would encourage all centres to advise their candidates to do.

Questions 23 (b) and 25 (c) (i) highlight the need for candidates to pay close attention to diagrams and images, making sure they measure them carefully to support accurate responses. Questions 21 (b) (ii), 22 (b) (i), 23 (c) (i), 23 (c) (ii) and 24 (a) proved to be the most challenging for many candidates, while candidates were more successful with Questions 21 (a), 22 (a), 23 (b) (i) and 24 (b) (ii). Further discussion of these questions is found below.

Many candidates seemed to find it challenging to apply known content to an unknown situation or example and to link different topics together. An example of this would be Question 22 (b) (ii) where knowledge of DNA replication was needed as well as an understanding of competitive inhibitors. This was also seen in Question 23 (a) (iii) where a knowledge of cell organelles, protein synthesis and the role of plasma cells was needed.

Practical/experiment-based questions such as Questions 23 (c), 24 (b) and 26 (b) exemplified that candidates with firsthand experience and knowledge of practical investigations, data processing and analysis could get more marks on this type of questions. Some candidates were possibly disadvantaged by lack of practical experience.

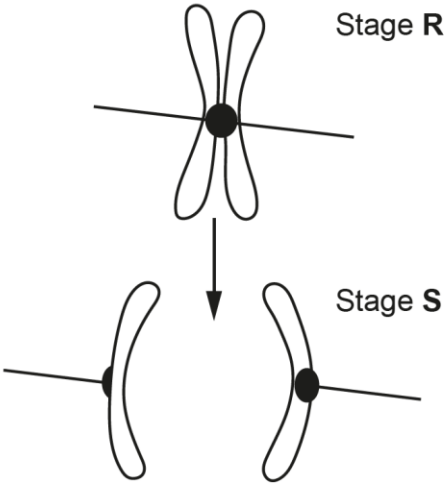
A few questions highlighted that candidates need to take more time to read the stem of the question carefully and make sure their response is targeted towards answering the questions posed to them. This is shown especially in Question 22 (b) (i), which, although being gridded at a lower level, was actually marked lower than expected as many candidates just repeated the stem of the question and therefore could not get credit.

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Question 21 (a) (i)

21

(a) The diagram below shows a chromosome going through two stages of meiosis 2.



(i) State the names of stages **R** and **S**.

Stage **R** .....

Stage **S** .....

[1]

Most candidates answered this correctly. A few candidates wrote metaphase I or anaphase I and so were not given the mark as the question stem clearly states the diagrams are for meiosis 2. Candidates should be able to recognise and describe diagrams for all stages of mitosis and meiosis.

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Question 21 (a) (ii)

(ii) Describe **two** features of homologous chromosomes.

1 .....

.....

2 .....

.....

[2]

More successful candidates were able to get 2 marks on this question, but it was clear there was confusion about homologous chromosomes. Many candidates referred to homologous chromosomes being *genetically identical* or having the *same alleles* as each other. Other common misconceptions included that the homologous chromosomes are permanently joined by a centromere and that this centromere is always in the middle of the chromosome length. Candidates who were given marks most commonly put MP1 and/or 6, often in the same sentence. Every marking point was given, but some of them, such as MP4 and 5, were very rarely given.

Misconception

There was a misconception about homologous chromosomes, with students stating that the homologous chromosomes are identical and that they have the same alleles rather than the same genes at the same loci but potentially different alleles. Also, some candidates thought that homologous chromosomes are permanently joined by a centromere and that the centromere is always in the middle, which reflects a misunderstanding of both the chromosome structure and behaviour during cell division.

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Question 21 (a) (iii)

(iii) Describe what is happening during stage **S**.

.....

.....

.....

.....

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

Most candidates got 1 mark with nearly half of candidates getting 2 marks. MP4 was most commonly seen as well as MP2, with 'shorten' being the most common description. The more technical term 'condense' was rarely seen. MP3 was given often, but many candidates did not get this because they didn't clearly mention that a separation/pulling apart was involved. Many candidates also got confused and talked about homologous chromosomes being split. Some candidates confused centromere and centrosome. Some candidates also seemed to interpret the question as 'Describe what is happening during stage S *of the cell cycle'*, highlighting the need for candidates to really make sure they understand the question before they start writing.

Question 21 (b) (i)

(b) Mitosis and meiosis are important processes in organisms.

Mitosis occurs to allow an organism to grow by making new cells and repair its tissues.

(i) State **one other** role of mitosis in organisms.

.....

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

Some candidates responded by saying asexual reproduction, and a few referred to clonal expansion. Many candidates referred to growth and repair despite it being in the stem of the question and the '**one other**' being in bold.

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Question 21 (b) (ii)

(ii) Meiosis allows organisms to make gametes.

Describe the **three** processes that occur during meiosis to cause genetic variation in gametes **and** state the stage in which each process occurs.

Process 1 .....

Stage .....

Process 2 .....

Stage .....

Process 3 .....

Stage .....

[3]

A few candidates were given 2/3 marks on this question, with the most common response being 'crossing over' in 'prophase 1'. Many candidates could not distinguish between the two different independent assortments, and they just put 'independent assortment' without further qualification. Descriptions were allowed in the mark scheme if direct terms were not used for independent assortment of chromosomes in metaphase 1 and independent assortment of chromosomes in metaphase 2. As the question asked specifically about processes that occur in meiosis, mutations was not given marks. As mutations do not directly link to a 'process' in meiosis.

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Question 22 (a)

22

(a) DNA is a molecule found in the nucleus of eukaryotic cells.

The passage below is about the structure and properties of DNA.

Complete the sentences using the most appropriate term(s).

A molecule of DNA is made from two polynucleotides twisted around each other in a shape known as a ..... . The two polynucleotides are held together by ..... between nitrogenous bases. Cytosine and guanine are more strongly bonded than adenine and thymine, as there are ..... bonds holding them together.

[3]

Most candidates were able to get all 3 marks here. The most common error seen was not knowing that three Hydrogen bonds are found between Adenine and Thymine. A few mentioned using ester/phosphodiester/peptide bonds/glycosidic bonds or just Hydrogen without bond and didn't get a mark. Some candidates did not refer to a 'double helix', just saying 'helix' or occasionally alpha helix.

Question 22 (b) (i)

(b) DNA replication occurs in eukaryotic cells.

(i) The DNA in the nucleus of a eukaryotic cell is associated with histone proteins.

State **one other** feature of DNA in a eukaryotic cell that is different from DNA in a prokaryotic cell.

.....

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

This question seemed to challenge candidates. It was evident that most candidates did not read the full question stem carefully, as the most common response was that the DNA is enclosed in a nucleus or similar statement. The stem clearly stated, 'The DNA in the nucleus…' and then asked for **one other** feature of DNA, etc. Giving candidates adequate interactions with past papers and questions is an excellent way of improving their exam technique and should be used frequently in teaching to help prepare them for examinations.

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OCR support

ExamBuilder provided by OCR is an excellent resource to quickly build effective tests for internal assessment and in class activities. It can be filtered by topic/year/style of question and key terms can also be searched such as 'DNA' or 'eukaryotic cells'. It will also build the MS for assessments produced (including comments from the associated Examiner's Reports) and has save features to store your produced materials and share with colleagues.

Question 22 (b) (ii)

(ii) Drugs that affect DNA replication are used to treat cancer.

Zelpolib is a drug that affects the enzyme DNA polymerase by binding to its active site.

Suggest explanations for how Zelpolib affects DNA replication.

.....

.....

.....

.....

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

Candidates were given a range of marks for this question. Many described how Zelpolib attaches to the active site, or described what DNA polymerase does, but did not use the term 'competitive inhibitor' or they didn't explain how the actions of DNA polymerase are halted, i.e. no phosphodiester bonds/no sugar phosphate backbones and no elongation of the polynucleotide chain. The most common error was confusing the function of the DNA polymerase with that of helicase (i.e., *unzipping the double helix)* and thinking that the polymerase is responsible for the *base pairing* between complementary nucleotides in the DNA chains of the double helix.

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Exemplar 1

The binding of the active site of DNA polymerase prevents the formation of a new phosphate sugar backbone which prevents the creation of a new strand of DNA

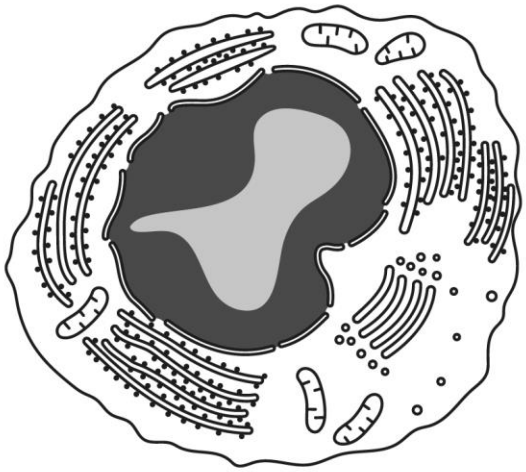
This candidate was able to get 2 marks for a clear and concise response showing their understanding well. They were credited with the alternative response for MP4 referring to the lack of formation of the sugar/phosphate backbone and used alternative wording (AW) to show they understood that if DNA polymerase was unable to bind to its active site, this would stop the elongation of the new polynucleotide chain.

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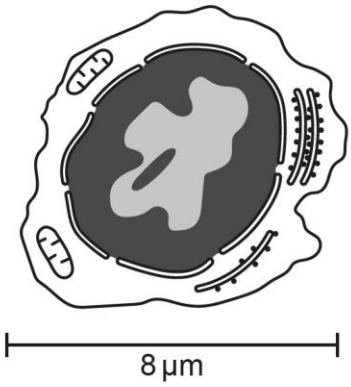
Question 23 (a) (i)

23

(a) The diagram below shows a drawing of a plasma cell and a B lymphocyte. The actual size of the diameter of each cell is shown with a scale bar.



Plasma cell



B lymphocyte

(i) Calculate the surface area to volume ratio (SA:V) of the plasma cell. Assume the plasma cell is spherical.

Use the formulas:

surface area of sphere = $4\pi r^2$

volume of sphere = $\frac{4}{3}\pi r^3$

SA:V = ... **[2]**

Most candidates were able to calculate the surface area and the volume correctly. Few candidates gained full credit; responses commonly lost one mark due to not reducing the ratio to N:1 and/or incorrect rounding.

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OCR support

The Mathematical Skills Handbook produced by OCR is intended as a resource for teachers, to clarify the nature of the mathematical skills required by the specifications and indicate how each skill is relevant to the subject content of the specifications.

There are also the Maths for Biology resources that can be shared with candidates to support them with their maths skills. These can be accessed on Teach Cambridge.

Question 23 (a) (ii)

(ii) Calculate the magnification of the B lymphocyte.

Give your answer to **2** significant figures.

Magnification = ... **[2]**

About half of the candidates got 1 mark, with some candidates getting 2 marks. Many did not pick up on the instruction to give the answer to two significant figures and so only got 1 mark. Some candidates could not convert units correctly and so were only able to gain 1 mark for the magnification calculation. Some candidates measured the wrong cell so frequent opportunities for accurate measurement should be provided to candidates in taught environments to improve these skills.

OCR support

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Question 23 (a) (iii)

(iii) Using the diagram and your own knowledge, explain why plasma cells are usually larger than B lymphocytes.

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.....

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

Many candidates got 2 or 3 marks for being able to link their knowledge of cell organelles, to protein synthesis and then a specific specialised cells function, in this case a plasma cell. The most commonly given mark points were MP2 and 5. Some candidates did not link antibodies and proteins to the organelles that they could see in the diagram, and others talked about the plasma of the blood rather than plasma cells. Other errors/misconceptions seen were that the difference in size was to do with the relative ease with which the cells could be transported in the blood and confusion regarding the terms 'organelles' and 'organisms'.

Exemplar 2

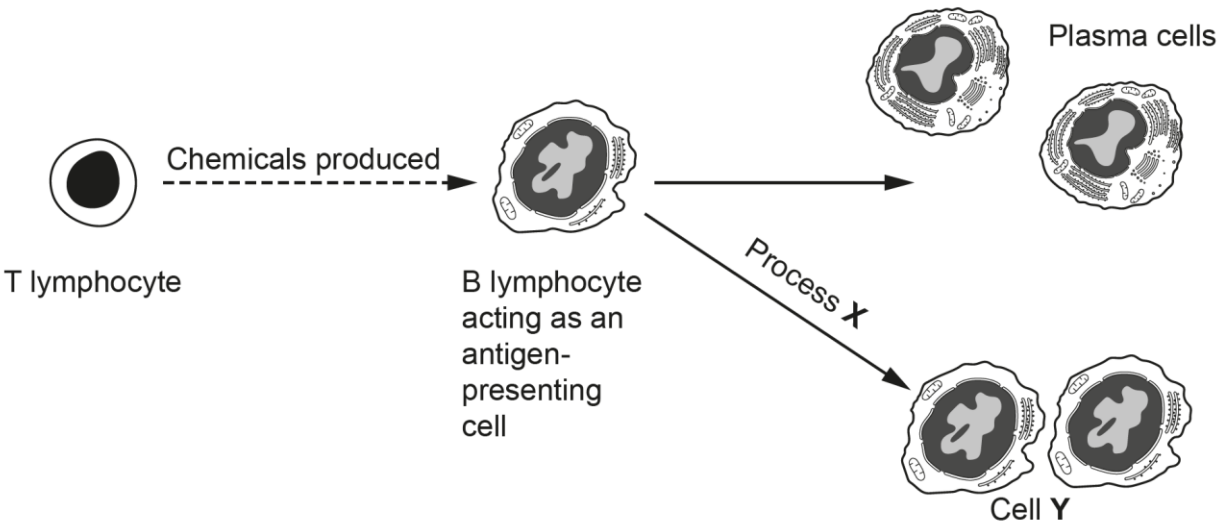
Because, plasma requires alot of protien, so it needs a bigger cell to have more Rough endoplasmic reticulum, to therefore have more ribosomes, which can make proteins. It uses proteins to help produce different antibodies. It also has more mitochondria for energy.

This candidate received full marks, getting MP2a, 3 and 5. It is clear they know the function of the cell organelles they are discussing and how that links to the production of antibodies in a plasma cell. They are also able to recognise that the number/amount of an organelle present is an indication of the function of that cell. However, they could not receive MP4 as they did not clearly state that mitochondria 'release' energy or produce ATP.

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Question 23 (b) (i)

(b) The diagram below shows some of the processes involved in the activation of B lymphocytes.



(i) Name the type of T lymphocyte shown in the diagram.

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

Most candidates got this mark, with the most common incorrect answer being 'killer T cell'. This suggested some confusion about the role of the different types of T cell in the immune response among candidates.

Question 23 (b) (ii)

(ii) Describe the role of process **X** in producing cell **Y** to fight future infections by the same pathogen.

.....

.....

.....

.....

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

Some candidates were able to correctly link the role of memory cells with a faster secondary immune response with many of those candidates being able to use alternative wording (AW) to explain this point. Some of the more successful candidates were able to correctly identify process X as differentiation, but overall candidates showed confusion with the sequence of the specific immune response with many stating it was mitosis or clonal expansion.

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Question 23 (c) (i)

(c) Plasma cells can be a target for treating autoimmune diseases such as systemic lupus erythematosus (SLE).

SLE causes widespread inflammation in the body and particularly affects the skin, joints, and internal organs.

Scientists investigated the effects of two drugs on reducing the numbers of plasma cells in humans. The two drugs used were:

- mycophenolate mofetil (MMF)
- cyclophosphamide (CYC)

SLE patients were given either MMF, CYC or no drug for a period of 10 weeks.

The table shows the results of the investigation.

Drug treatment	Number of patients	Median plasma cell number (mm^{-3})
MMF	25	55.6
CYC	20	31.2
No drug	22	103.0

(i) Some students choose to carry out a Student's *t*-test to analyse the data for the drug treatment.

With reference to the data, suggest whether a Student's *t*-test is an appropriate choice of statistical test.

.....

.....

.....

.....

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

Some candidates were confident with the *t*-test and were able to discuss its suitability for the data presented. Although many candidates stated that it was a suitable test, they were not able to give appropriate justification as to why and didn't get the marks. The Mathematical Skills Handbook referenced below contains all the statistical test candidates should be aware of and gives reasoning and examples of when and why they should be applied.

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OCR support

As well as The Mathematical Skills Handbook previously highlighted in this report, there is a Mathematical skills statistics booklet and the statistical tests quiz, both of which are great resources to support teaching and for highlighting gaps in knowledge on statistical tests, they could be useful for setting as transition work for new Year 12 students, teaching activities and/or homework, or for intervention with specific students or groups.

Question 23 (c) (ii)

(ii) The students conclude that CYC is the most effective drug in reducing plasma cell numbers.

Identify **two** reasons why the conclusion might **not** be supported.

1 .....

.....

2 .....

.....

[2]

Only some candidates gave suitable reasons to support the conclusion, with many not evaluating the investigation outlined in the main starting stem of the question and only focusing on the data they were presented with. For evaluation-type questions, candidates need to think about how the data they are presented with is sourced, considering control of variables such as sex, age and overall health. Some candidates did pick up on this with MP2, 3 and 4 being the most commonly given marking points.

Misconception

Many candidates seemed to hold the misconception that the number of samples must be the same in every group, rather than picking up on the fact that the study as a whole only had a small number of patients, i.e. a small sample sizes across all three groups. Class discussions around drug trials and testing can be a good way of introducing these ideas during teaching of communicable diseases – 'Would you take a new drug that had been tested on 20 people?' 'Why do drugs trails need controls?'

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Question 24 (a)

24

(a) The cell surface membrane of companion cells has a key role in the loading of sucrose into phloem sieve tubes.

A student wrote three incorrect statements as a part of their revision notes on this topic.

For each statement, state the error **and** write a correction.

Statement 1: The cell surface membrane of the companion cell contains channel proteins for pumping protons.

Error .....

Correction .....

Statement 2: The cell surface membrane of the companion cell contains cotransporter proteins for protons and glucose.

Error .....

Correction .....

Statement 3: Cotransporter proteins in the companion cell surface membrane use ATP to change shape to transport sugar molecules against their concentration gradient.

Error .....

Correction .....

[3]

More successful candidates showed a clear understanding of how sucrose is loaded into phloem sieve tubes via companion cells. The most common correct responses were for statement 1, where candidates knew protons are pumped out of the companion cell using 'carrier proteins' to set up a proton gradient. Many thought the proton pump was a cotransporter protein which was incorrect. Statement 2 was also answered correctly by more successful candidates who realised it is sucrose, not glucose, which is transported into the companion cell. Statement 3 was rarely correctly answered, with few candidates realising it is the flow of protons back into the cell by facilitated diffusion using a cotransporter protein that also brings sucrose into the cell with it.

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Question 24 (b) (i)

(b) A group of students use beetroot to investigate the effects of the solvent ethanol on the permeability of the cell surface membrane.

This is the method they use:

1. Set up six test tubes of ethanol of different concentrations (0%, 20%, 40%, 60%, 80% and 100%).
2. Add a piece of beetroot to each test tube.
3. After 10 minutes, remove the beetroot from the test tube. If membrane damage has occurred the solution in the test tube is a purple colour.
4. Use a green filter in a colorimeter to measure the absorbance of the ethanol solution. The absorbance is proportional to the level of membrane damage.
5. Repeat the experiment.

(i) State **two** variables that were **not** controlled in this experiment.

1 .....

2 .....

[2]

This question was generally well-answered, with many candidates getting both marks. The most common responses were volume of ethanol, size of beetroot and temperature. Some mentioned using the same variety of beetroot, but few mentioned blotting technique or using the same age of beetroot. Candidates were not given marks for saying to use the same 'mass' or 'amount' of beetroot as these are not appropriate measurements for this investigation.

Question 24 (b) (ii)

(ii) One of the students suggests using a red filter in the colorimeter because this is what they had used for a Benedict's test.

Suggest why the student is **incorrect** to suggest using a red filter.

.....

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

This question was answered well by more successful candidates. This was a challenging question assessing candidates' knowledge of how a colorimeter works. Many candidates' responses were vague, only referring to red filter/light being similar to purple pigment from beetroot, or that a red filter is used in a Benedict's test for sugar or that a red filter would affect the absorbance without explaining how. Those that were given a mark related the idea that red light would be reflected through the purple solution and so would lower absorbance readings. Centres should try to provide multiple opportunities to candidates to use colorimetry outside of the common Benedict's test and candidates should be aware of how a colorimeter works.

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Question 24 (b) (iii)

(iii) Explain how the students can process their data to assess repeatability.

.....

.....

.....

.....

.....

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

Some candidates got all 3 marks, but other candidates did not show an understanding of the term 'repeatability', confusing it with 'precise' and 'accurate'. Also, the question asked candidates how they would **process the data** to assess repeatability and many incorrectly talked about doing repeats and comparing the results to others, presumably not realising that although these methods can increase repeatability, they are not to do with processing the data obtained. Many described how to plot the data as a calibration curve and draw a line of best fit, which shows the pattern of data but does not show the repeatability of the experiment. Many candidates got 1 mark for (carrying out repeats and) calculating a mean, and then some went on to work out the SD. A few candidates also described either plotting them as error bars or comparing the SD to see if a small error bar/SD indicates good repeatability, suggesting they have covered these points in their taught environment.

OCR support

Language of Measurement in Context produced by OCR exemplifies the use of terms such as repeatability, resolution and uncertainty in the specific context of a biology investigation and defines them in accessible ways backed up by practical examples.

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Question 25 (a)

25

(a) The Asian elephant, *Elephas maximus*, is the largest land mammal in Asia. It is an endangered species.

Asian elephants need a transport system because they are a very large mammal and diffusion distances are too long.

Explain **two other** reasons why an Asian elephant has a transport system.

.....

.....

.....

.....

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

This question was answered well, with most candidates being given 2 marks. Some candidates were confused about Surface Area: Volume ratio and stated that large organisms had a large/er Surface Area: Volume ratio, so were not given this marking point.

Question 25 (b)

(b) Name an international agreement that might use data about the changing numbers of the Asian elephant to monitor its conservation status.

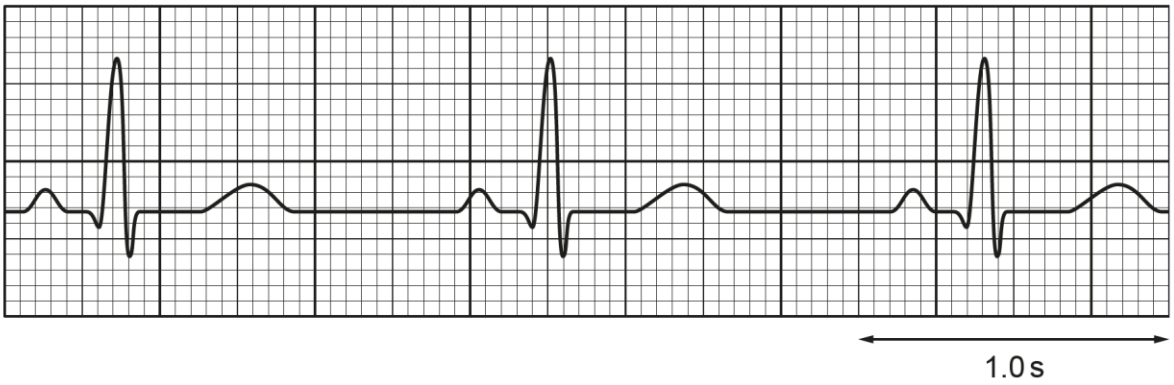
..... **[1]**

Most candidates were able to give a response to this question with about half the candidates getting the mark, with most giving CITES. Many gave examples such as CPPS, the Red List and IUCN which are not 'international agreements'. Some candidates stated the *Rio convention* alone – this was not given marks as this international convention/conference was responsible for several international agreements. The (Rio) Convention on Biological Diversity was the one focused on biodiversity, so this was needed to obtain the mark.

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Question 25 (c) (i)

(c) This is an electrocardiogram (ECG) trace of an Asian elephant.



(i) Calculate the heart rate of the Asian elephant.

Give your answer to the nearest whole number.

Heart rate = ... beats per minute **[2]**

This questioned assessed graph reading skills as well as heart rate calculations. It proved challenging for candidates, as only a few were able to measure the ECG correctly and recognise that the 0.1s scale bar did not cover the whole of one heartbeat. However, candidates that did not recognise that the scale bar was not covering the whole heartbeat were still credited with a correct calculation of heart rate based on the measurement they had taken off the ECG and were able to get 1 mark.

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Question 25 (c) (ii)

(ii) Describe how the ECG trace would appear differently if the elephant had tachycardia.

.....

.....

.....

.....

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

More successful candidates were able to interpret the question correctly and describe how the trace would look different rather than giving a description of what tachycardia is. Some candidates were familiar enough with the ECG wave to describe this in terms of the correct ECG annotations of P, QRS and T where appropriate for the different marking points.

Question 26 (a)

26

(a) Bone marrow contains stem cells which can only differentiate into blood cell types including erythrocytes and neutrophils.

Complete the table to show which statements about both erythrocytes and neutrophils are true and which are false.

Tick (✓) **one** box in each row.

Statement	True	False
They both contain mitochondria		
They both contain enzymes		
They can both undergo mitosis		

[2]

This question was a good discriminator with most candidates being given 1 mark for one or two correct statements and others getting 2 marks for all three correct responses.

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Question 26 (b)

(b) A student is studying erythrocytes and neutrophils in a blood sample.

They smear a drop of the blood sample across a microscope slide and place it under a light microscope.

They focus the microscope using a high power but cannot see any white blood cells.

Suggest **and** explain why the student cannot see any white blood cells on the slide.

.....

.....

.....

.....

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

Many candidates showed a familiarity with using microscopes to view blood smears and were able to get 1 mark for recognising that no stain had been added but fewer went on to explain its use by relating the addition of a stain to improving contrast. Many talked about white blood cells being too small to be seen in a light microscope and needing an EM to see them. This highlights the need for hands on practical work dealing with stains, slide preparation and the need for the opportunity to revisit these skills at different points in the specification, in this case possibly during the teaching of specialised cells and transport in animals. Some candidates correctly linked their response to 'few' white blood cells in the blood but were not given marks for saying 'none' as some white blood cells would be present in a normal blood smear even if the sample is obtained from an uninfected individual.

Question 26 (c)

(c) One area of potential use for stem cells is in medicine, for example, to repair damaged tissues and to treat neurological conditions.

State **one other** potential use of stem cells.

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

A wide range of responses were given, with many candidates able to get one of the points on the mark scheme. The most common correct answers were research, growing new organs or developing/testing new drugs. However, candidate responses which were vague statements such as 'to replace cells' or 'clone new plants' were not given the mark.

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