

Principal examiner reports for teachers

Principal examiner reports for teachers summarise what candidates did well and what candidates needed to improve for this examination series only.

This report is to be used in conjunction with the question paper and mark scheme.

For guidance on teaching and learning we provide resources for many of our syllabuses.

Resource	Where to find it
Grade descriptions – Grade descriptions describe the level of performance typically demonstrated by candidates achieving the different grades awarded for a qualification.	School support hub Select: Subject > Resource finder > Syllabus and specimen materials
Schemes of work – Schemes of work are designed to support you in your teaching and lesson planning.	School support hub Select: Subject > Resource finder > Teaching and learning
Lesson planning – Guidance on how to plan a lesson.	Lesson planning
Resource plus – There may be additional resources such as teaching packs containing lesson plans, resources and worksheets and videos for aspects of your syllabus.	School support hub Select: Subject > Resource finder > Teaching and learning
Teaching tools	Teaching Tools
Exemplar candidate responses	School support hub Select: Subject > Resource finder > Teaching and learning
Learner guide – A guide for students to help them understand what the course involves.	School support hub Select: Subject > Resource finder > Teaching and learning
Community forums – Do you have a question or something to share? Our online forums are great way to keep up to date with your subject and the global Cambridge community.	Community forum on the school support hub
Access to scripts for this series.	Access to scripts service
Results analysis is available for some syllabuses.	Results analysis
Test maker is available for some subjects.	Test maker

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BIOLOGY

Paper 9700/12
Multiple choice

Key messages

Candidates performed well on **Questions 3, 5, 6, 7, 9, 11, 16, 23, 28 and 31.**

Candidates performed less well on **Questions 13, 14, 15, 18, 27, 30, 36, 37 and 38.**

There was no clear pattern in terms of which topics were challenging. Many of the questions where candidates performed less well required particularly careful reading of both the question, and the options. Other challenging questions relied on interpreting graphical data.

Comments on specific questions

Question 13

- Option **C** was a common incorrect answer.
- Although option **A** and option **C** both show lowest water solubility for the region at the centre of the cell surface membrane, only option **A** shows a sudden change to high water solubility at a fixed distance away from the centre in the correct option. This reflects the hydrophobic nature of the fatty acid tails in the centre of a phospholipid bilayer, and the hydrophilic nature of the phosphate heads.

Question 14

- Option **B** was a common incorrect answer.
- Option **B** contains familiar terms for the secondary structure of proteins, such as β -pleated sheets and α -helices. β -pleated sheets are not coils of amino acids. Furthermore, the polypeptides in a quaternary structure do not necessarily need to be different.

Question 15

- Option **B** was a common incorrect answer.
- Candidates who opted for **B** decided that statements 1 and 2 about ribozymes and enzymes were correct. Statement 1 is incorrect because, for enzymes, it is the active site and substrate, rather than the R-groups, that are complementary.
- Statement 3 is also correct. To check the validity of this statement, candidates needed to consider that there are only 4 different bases in a polynucleotide and 20 different amino acids in a polypeptide. This will mean that for a polymer made up of the same number of monomers, there are many more possible combinations in a polypeptide.

Question 18

- Option **B** was a common incorrect answer.
- Candidates selecting option **B** had not noted that region Q consists only of the fatty acid hydrocarbon tails. It does not include the region of a phospholipid molecule where the fatty acid tails are joined to glycerol.

Question 27

- All options were popular.
- This question relied on an understanding that in eukaryotes, a primary transcript is modified by the removal of introns and joining together of exons to form mRNA. This does not occur in bacteria. This means that statements 1 and 2 are correct.
- Statement 3 is incorrect because the genetic code is universal.

Question 30

- Option **A** was a common incorrect answer.
- Those candidates who opted for **A**, rather than the correct option, **B**, had misidentified the muscular and elastic arteries. The many dark wavy lines in the central photomicrograph shows the layers of recoiled elastic fibres.

Question 36

- Option **A** and option **B** were common incorrect answers.
- The roles of the substances involved in the transport of oxygen and carbon dioxide in blood are often confused by candidates. Candidates who opted for **A** or **B** incorrectly thought that carbaminohaemoglobin is found in blood plasma.

Question 37

- Option **D** was a common incorrect answer.
- Option **D** is incorrect because the rings of cartilage in the trachea are not complete.

Question 38

- Option **C** was a common incorrect answer.
- Option **C** is a correct description of the pathogen that causes TB. It does not explain why antibiotic treatment for TB takes a long time.

BIOLOGY

Paper 9700/22 AS Level Structured Questions
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Key messages

What candidates did well

- Some candidates gave clear sequential responses to questions requiring step-by-step accounts, such as when describing mass flow in plants and outlining how an anti-RSV monoclonal antibody is produced by the hybridoma method.
- Many candidates were careful to spell scientific terms correctly. Examples of this were carboxyhaemoglobin, prosthetic group, capsid, lysosome and cholesterol.
- Some candidates were able to deal with unfamiliar, challenging material, such as in the question about the therapeutic drug etoposide. The high standard of response from these candidates reflected an understanding of syllabus knowledge to help them make valid deductions and suggestions.

What candidates needed to improve

- Some candidates needed to understand that water movement caused by an increase in sucrose in phloem sap is more accurately described in terms of water potential rather than in terms of sucrose concentration.
- Some candidates stated more than two different ways in which carbon dioxide is transported in blood, when the question only asked for two ways.
- In the 9700 AS syllabus, ATP and DNA are examples where only the abbreviations appear in the relevant learning outcome. Candidates are not expected to write these out in full. Terms such as red blood cell, haemoglobin and rough endoplasmic reticulum, should not be abbreviated by candidates the first time they appear, for example rbc, Hb, RER. These abbreviations can be given in brackets after the term has been written out in full and then used thereafter.

Comments on specific questions

Question 1

(a) Comprehensive responses

- Most candidates completed the table of differences between animal and plant cells correctly.

Limited responses

- Some candidates did not follow the instruction to put a tick or a cross in every box in the table of differences.
- Some candidates thought that the cell wall of plants was made of peptidoglycan instead of cellulose.

(b)(i) Comprehensive responses

- Some candidates gave comprehensive responses by relating structure to function of all the relevant structures visible in the diagram of phloem tissue and the diagram of part of the cell membrane.
- Clear responses used one statement or one bullet point for each structure to be discussed.
- For structures involved in the movement of substances, complete statements included the correct direction of movement of the substance, either by referring in some way to leaving or entering cell **A** (companion cell) or entering the phloem sieve tube element.
- Many candidates knew that mitochondria produce ATP and gave further detail of how this provided energy for an activity related to sucrose transport.

Limited responses

- Some candidates needed a greater understanding of the differences in movement of protons and sucrose through the cotransporter protein, incorrectly describing sucrose as entering by facilitated diffusion, rather than against the concentration gradient.
- Some candidates described proton pumping and/or cotransport in terms of the phloem sieve tube instead of cell **A**.
- Candidates could generally identify the cell structures involved in sucrose transport and should have linked all of these to the function related to sucrose transport.

(ii) Comprehensive responses

- Responses usually included a correct reference to mass flow as the mechanism for sucrose transport to the sink.
- Many candidates stayed on task, focusing the response to the events in mass flow and avoiding writing about events occurring in the companion cell.
- Comprehensive answers considered the events occurring in the sink that allowed hydrostatic pressure of phloem sap at the sink to be lower than the hydrostatic pressure of phloem sap at the source.

Limited responses

- Many candidates knew that pressure was involved in mass flow of phloem sap and responses should have been more detailed by describing this as hydrostatic pressure.
- Some candidates needed to explain the cause of the increase in hydrostatic pressure occurring after sucrose entry into the phloem sieve tube.
- Some candidates incorrectly assumed that a reference to movement of sucrose to a sink is the equivalent of stating that sucrose moves from the top of a plant to the bottom of a plant.

Question 2

(a) Comprehensive responses

- Some candidates were sufficiently familiar with the properties of water that related to its role in transport in mammals to give a complete account of its solvent action and high specific heat capacity.
- Many responses included correct examples of solutes that would be transported in blood that helped to explain why water is a universal solvent.
- Some candidates gave clear explanations of a high specific heat capacity of water and related this to the ability of blood to maintain a constant temperature.

Limited responses

- Some candidates wrote about the specific heat capacity of water rather than the high specific heat capacity.
- Some candidates muddled the properties of water and attempted to write about the latent heat capacity of water.
- Some candidates incorrectly wrote about water or blood having a high latent heat of vaporisation and thought that this meant that blood would not evaporate.

(b) Comprehensive responses

- Many candidates could give two different ways in which carbon dioxide is transported in blood, with a good proportion of these showing an understanding as to whether this was in blood plasma or involving haemoglobin (within a red blood cell).
- Many candidates were able to give a correct spelling of carbaminohaemoglobin.

Limited responses

- Some candidates did not follow the instructions and gave more than two different ways in which carbon dioxide is transported in blood, with some continuing the list below the answer lines and some continuing across the lines.
- Some candidates incorrectly stated carboxyhaemoglobin instead of carbaminohaemoglobin.

(c) (i) Comprehensive responses

- Many responses were well organised, with the side headings 'similarities' and 'differences' and with each similarity and difference stated as a separate sentence or bullet point.

- Some candidates realised the importance of writing comparatively when describing differences and made it clear whether they were referring to myoglobin or haemoglobin.
- Many candidates knew that the prosthetic group in the diagram of myoglobin should be included as part of protein structure and so remembered to include this feature in their response.
- With only a single NH_2 group and a single COOH group labelled in the figure, some candidates noted that myoglobin is a single polypeptide protein and could highlight the difference with haemoglobin, which has a quaternary structure of four polypeptides.

Limited responses

- Some candidates wrote at length about haemoglobin and should have used the figure showing myoglobin to highlight those features that were shared with haemoglobin and those that were different.
- Some candidates needed to write about structural differences between the two molecules rather than about the functional similarities and differences.
- Some candidates gave points about myoglobin that were not visible in Figure 2.1, such as the presence of peptide bonds and the bonds involved in R-group interactions of tertiary structure.

(c) (ii) Comprehensive responses

- Some candidates realised that myoglobin would be able to take up oxygen from haemoglobin and deduced that the molecule could act as an oxygen store.
- A few candidates went into more depth in their response and explained the relationship between myoglobin and respiration in muscle cells.

Limited responses

- Many candidates only repeated information given to them in the question text and should have continued the response to show an understanding of the importance of the higher affinity of myoglobin to oxygen.

Question 3

(a) (i) Comprehensive responses

- A good number of candidates correctly drew around the middle residue (monomer) of the diagram of raffinose and were careful to avoid straying into any part of the other two residues.

Limited responses

- In most responses, the monomer on the left of the diagram was incorrectly circled. Candidates circling this monomer had not considered the orientation of the $-\text{OH}$ and $-\text{H}$ on carbon 4.

(ii) Comprehensive responses

- Most candidates gave alpha or α to show knowledge of the difference between alpha glucose and beta glucose.

Limited responses

- Some candidates gave an alphabet letter α rather than clearly showing the Greek letter for alpha, while a few gave beta or β .

(iii) Comprehensive responses

- Many candidates were able to complete the table correctly to show features of the three sugars listed.
- Most candidates knew that a glucose molecule had no glycosidic bonds and that glucose is a reducing sugar.

Limited responses

- A few candidates incorrectly thought that maltose is a non-reducing sugar.
- Some candidates thought that raffinose is a reducing sugar. These candidates may not have noted the information provided at the start of the question that raffinose produces the same results as sucrose when tested with Benedict's solution.

(b) Comprehensive responses

- Many were able to use the data given in the graph and gave the correct Michaelis-Menten constant (K_m) for α -gal, together with the correct units taken from the graph.

Limited responses

- Some candidates forgot to include the units for their correct K_m value.
- Some candidates knew that the first step in deriving the K_m value was to determine $\frac{1}{2} V_{max}$ and wrote this value down instead of continuing to find a substrate concentration.

(c) (i) Comprehensive responses

- Most candidates could identify the molecule shown in the figure as a fatty acid or carboxylic acid.

Limited responses

- Some candidates were not familiar with the structure of the molecule shown in the figure and assumed that the reference to raffinose meant that its breakdown product would also be a carbohydrate. Hence, 'carbohydrate', 'glucose' and 'monosaccharide' were stated.
- Some candidates gave lipids as their response, which was not sufficiently specific.
- Some candidates did not give the type of molecule and stated that the molecule was unsaturated, having noticed that there were no carbon-carbon double bonds in the figure.

(ii) Comprehensive responses

- Many candidates were able to describe how a fatty acid can become part of a triglyceride and gave well-expressed points containing all or most of the expected points.
- Many candidates knew that the reaction involved condensation or described the formation of water.

Limited responses

- Some candidates incorrectly named a bond type other than an ester bond, mostly stating hydrogen bond and some giving glycosidic bond.
- A proportion of candidates incorrectly stated glyceride or glycerine for glycerol.
- Some candidates incorrectly stated that three glycerols attached to a fatty acid; in these instances, some were able to correctly name the type of bond formed and explain the formation of water.

Question 4

(a) Comprehensive responses

- Many candidates knew infectious diseases are transmissible and are caused by pathogens.
- Some candidates used RSV to show an understanding of how the pathogen is passed from an infected person to an uninfected person, which was an acceptable way of explaining the term transmissible.

Limited responses

- Some responses given by candidates omitted to state that an infectious disease is caused by a pathogen.
- Some candidates who tried to describe modes of transmission should have shown an understanding that a pathogen passes from an infected organism to an uninfected organism.
- There was a proportion of candidates who described a mode of transmission in such a way that it was implied that this was the only way that a pathogen is transmitted.

(b) Comprehensive responses

- Some candidates correctly identified the envelope and the capsid in the diagram of RSV, and most of these gave correct spellings of the terms.

Limited responses

- The outer layer labelled **Q** was sometimes recognised as a phospholipid bilayer, which is not as accurate an answer as 'envelope', particularly as the diagram includes glycoproteins in this layer.

- In the diagram of RSV, the label 'protein subunits' should have been a clue to candidates that the structure was the capsid. Some appeared to think that the question was asking for the structure inside this capsid and gave RNA or nucleic acid as their answer.
- Some candidates gave caspid as their answer, which was not accepted, instead of capsid.

(c) (i) Comprehensive responses

- There were many candidates who were familiar with images of the bronchus and who recognised the spindle-shaped cells in the image as forming smooth muscle tissue.

Limited responses

- Some candidates gave smooth muscle cell as their answer for label **X**, despite being asked to name the tissue.
- Incorrect responses included elastic tissue and cartilage.

(ii) Comprehensive responses

- Most candidates recognised the cilia on the surface of the cell labelled **Y**, showed an understanding that cilia move mucus, and could give an acceptable description of the direction in which the mucus should move. A proportion of these also explained that the mucus contained pathogens.

Limited responses

- Some candidates described mucus as being moved out of the body, which was not precise enough.
- A few candidates described the role of cell **Y** as moving pathogens and did not note the presence of cilia and/or mucus.

(d) (i) Comprehensive responses

- Many knew that injection with a monoclonal antibody and vaccination provided artificial immunity. Most of these correctly linked the monoclonal antibody with passive immunity and vaccination with active immunity.

Limited responses

- All incorrect combinations of natural, artificial, passive and active were seen as responses and for a proportion of these, natural and artificial were paired together, despite being obviously contradictory.

(ii) Comprehensive responses

- Most of the candidates noted that an immune response needed to occur in a small mammal before a hybridoma could be formed.
- Some responses were of a high quality, with all the main points included in a step-by-step approach. These showed an understanding that an antigen specific to the antibody was required to elicit the immune response, and that the cells produced are harvested from the spleen.

Limited responses

- Many candidates thought that RSV needed to be injected into the small mammal rather than a specific antigen. These candidates had not realised that this approach would cause the activation of many different B-lymphocytes to cover the range of antigens presented by the virus.
- A common error was to explain that an antibody was extracted from the spleen and fused with a myeloma or cancer cell.
- Some candidates confused a myeloma cell for a melanoma cell, which should not be used for the creation of a hybridoma cell.

(iii) Comprehensive responses

- Many gave a correct advantage, either by stating that a vaccine would lead to the production of memory cells, or that it would provide longer-term immunity than a monoclonal antibody. Some gave a response that included both concepts in one concise sentence.

Limited responses

- Some answers were too vague, such as stating that vaccines are more efficient, or are faster.

(e) (i) Comprehensive responses

- Some candidates showed an understanding of chemotaxis in phagocytosis and began their response with this feature.
- Some candidates included detail of phagocyte receptor involvement in phagocytosis.
- Most candidates gave a good description of endocytosis rather than using the term.
- Some candidates completed their account by explaining how membrane fusion allowed the formation of the phagocytic vacuole.

Limited responses

- Some candidates gave a confused response, writing about phagocytes binding to a receptor or lysosomes acting before a phagocytic vacuole is formed.
- Some candidates did not notice that the response only required an outline of the events that lead to the formation of a phagocytic vacuole. These candidates gave an outline of the whole process ending in digestion by lysosomal enzymes or antigen presentation.
- Terminology needed to be improved in some responses, with terms such as 'swallowing up' not being acceptable alternatives to endocytosis.

(ii) Comprehensive responses

- Many knew that the lysosome was the required answer and spelled this correctly.

Limited responses

- A proportion did not spell lysosome correctly, with most of these stating lysosyme.

Question 5

(a) (i) Comprehensive responses

- Many candidates knew that DNA polymerase allowed the formation of phosphodiester bonds between adjacent nucleotides and reference to complementary nucleotides (or bases or strands) was made in an accurate context. A proportion of these continued their response to describe a DNA strand that was growing by the addition of phosphorylated nucleotides.
- Some candidates showed knowledge of the role of DNA polymerase in proofreading.

Limited responses

- Some candidates incorrectly thought that the primary role of DNA polymerase is to form hydrogen bonds between base pairs or hydrogen bonds between adjacent nucleotides and did not appear to be knowledgeable of phosphodiester bond formation between adjacent nucleotides.

(ii) Comprehensive responses

- Many were able to refer correctly to the leading and lagging strands that appear in DNA replication.

Limited responses

- The concept of DNA polymerase moving in only one direction on a DNA strand was not well understood by some candidates, so that attempts to describe this were muddled.

(b) Comprehensive responses

- Candidates were not expected to have knowledge of TOP2A or etoposide. Some made good use of the information provided to suggest sensible explanations about the therapeutic use of etoposide. They were able to visualise the time during the cell cycle when etoposide had its effect and explain the consequences, frequently making reference to cell cycle checkpoints.
- Some candidates, having read that etoposide can treat only some types of tumour, showed an understanding that the drug would be most useful on tumours where cells were dividing rapidly.

Limited responses

- Some responses indicated that candidates needed to read the information provided more carefully, so that they could understand when etoposide acts and formulate a response that related to events occurring in a cell cycle.
- Many candidates needed to make the distinction between tumour cells and tumours. Some responses stated the overall effect would be to stop tumours growing, without giving details at the cellular level.

- Many candidates referred to the drug stopping uncontrolled division, which was not enough to explain why only some tumours could be treated.

Question 6

Comprehensive responses

- Many were able to complete the cloze passage correctly, using correctly spelled scientific terms.

Limited responses

- Some responses contained one or more blanks.
- Some candidates, instead of giving channel or carrier for the proteins, gave a general feature such as 'intrinsic'.
- Some candidates did not know that cholesterol was involved in regulating membrane fluidity and suggested other molecules such as water and glycerol.
- Some candidates incorrectly gave hydrophilic as the type of interaction or began the word with 'hydro' and used an incorrect ending that was not recognisable as a scientific term. Others named a molecule or a different type of bond.
- Some candidates were unable to provide a spelling for cholesterol that was sufficiently close to the correct spelling.

BIOLOGY

Paper 9700/33 Advanced Practical Skills 1
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Key messages

What candidates did well

- Most candidates demonstrated a solid grasp of how to prepare a serial.
- Many candidates identified the dependent and independent variables and showed them with the appropriate units as headings for their results table.
- Most candidates understood how to state a trend in their results.
- Some candidates plotted and drew the graph precisely with the axes correctly labelled.
- Many candidates showed on their graph how they obtained their estimate of urease activity.
- Some candidates provided good explanations for change in urease activity after 35 °C by referring to the active site and the formation enzyme-substrate-complexes.
- Most candidates drew a clear and precise large plan diagram including the relevant layers of tissue layers in the leaf.
- Some candidates drew large drawings of cells with good observation of the shape of each cell in the epidermis.
- A few candidates demonstrated their skills of observation and were clearly able to identify observable differences between **P1** and Figure 2.2.
- Many candidates were able to accurately measure the lengths of the air spaces and then show their calculation of the mean length.
- A few candidates demonstrated that they could state the answer of their calculation to two significant figures.

What candidates needed to improve

- Some candidates incorrectly included units in the body of their table of results such as 'seconds' and '% concentration'.
- Few candidates suggested an acceptable modification to the method that would enable the concentration of **U** to be estimated more accurately as there was no reference to the value stated in their estimate in **1(a)(v)**.
- Some candidates did not refer the instruction in the question to 'show on your graph how you obtained your answer'.
- Some candidates drew large plan diagrams that were imprecise and needed to include more details of the internal tissues of the leaf.
- Some candidates drew large drawings of cells that were imprecise as each of the cells was identical, unlike the cells of the leaf.
- Some candidates needed to consider which observable features they selected as differences between **P1** and Figure 2.2 as there were some answers, such as the 'shape of the vascular bundle', which was not appropriate as a difference.
- Many candidates needed to understand how to state their answer to two significant figures.

3 Enzymes

3.1 Mode of action of enzymes

Learning outcomes

- Candidates should be able to explain the mode of action of enzymes in terms of an active site and enzyme substrate complexes.

What candidates did well

- Many candidates provided very good answers to the question explaining the change in urease activity at higher temperatures showing clear understanding of the resulting change in shape of the active site and the decrease in number of enzyme-substrate complexes.

What candidates needed to improve

- Some candidates needed to consider providing more details concerning the mode of action of enzymes.

Comments on specific questions

Question 1

(a) (i) Comprehensive responses

- Many candidates were able to identify the concentrations of urea when carrying out the serial dilution of the 5.0% urea solution. Many responses demonstrated knowledge of transferring the correct volumes of urea solution and the addition of the correct volumes of water.

Limited responses

- Some candidates needed to understand that transferring a smaller volume of urea would mean that too little of each concentration would be available to use.

(ii) Comprehensive responses

- Many candidates understood that the heading for the independent variable had to be to the left of the heading for the dependent variable and that a time should be recorded for each concentration of urea prepared.

Limited responses

- Candidates needed to understand that units such as 'percentage concentration' and 'seconds' should not be recorded in the body of their results table.

(iii) Comprehensive responses

- Many excellent responses expressed the trend shown by their results.

Limited responses

- Some candidates needed to describe the trend by referring to the increasing or decreasing urea concentration and the subsequent change in time for the litmus to change colour.

(iv) Comprehensive responses

- Most candidates understood that they were required to state the time, in seconds, for their result for the unknown concentration, **U**.

Limited responses

- Some candidates needed to understand that even if the whole surface of the litmus paper had not changed colour after 180 seconds, they should record the result as 'more than 180'.

(v) Comprehensive responses

- Many candidates demonstrated a good knowledge of how to estimate an unknown concentration using their results of known urea concentrations.

Limited responses

- Some responses needed to show that the estimated concentration could be stated as being between two known concentrations.

(vi) Comprehensive responses

- Many candidates were able to identify two errors and improvements.

Limited responses

- Some candidates needed to go into more detail when describing how to bring about the improvements that they were suggesting.

(vii) Comprehensive responses

- Some responses demonstrated knowledge of what is required to estimate the concentration of **U** more accurately such as by stating examples of known urea concentrations either side of their estimated concentration.

Limited responses

- Some candidates needed to go into more detail such as by stating examples of standard urea concentrations which were either side of the stated estimated concentration.

(b)(i) Comprehensive responses

- Many candidates were able to select appropriate scales for the x-axis and the y-axis, plot the 5 points and draw a line through these points.

Limited responses

- Some candidates omitted labels for the x-axis and y-axis.

(ii) Comprehensive responses

- Many candidates were able to draw a line on the x-axis at 25 °C to cross the line on the graph so that the estimated urease activity could be estimated.

Limited responses

- Many responses needed to show on the graph how the estimation of urease activity had been carried out.

(iii) Comprehensive responses

- Many candidates were able to explain the change in urease activity from 35 °C to 50 °C by referring to the altered shape of the active site on the urease enzyme. There were many excellent responses that included further references to the formation of fewer enzyme-substrate-complexes.

Limited responses

- Some responses needed to show greater depth of knowledge of how enzymes functioned at higher temperatures.

Question 2

(a)(i) Comprehensive responses

- Some candidates were able to show that they had used the microscope to identify the many layers of tissue, including the central vascular area and the layer of palisade tissue extending across the upper part of the leaf.

Limited responses

- Many responses needed to show that they had observed all the tissues of the leaf and taken into account the relative size and proportions of these layers.

(ii) Comprehensive responses

- Some candidates demonstrated good knowledge of what was required to make a large drawing of four cells.

Limited responses

- Some candidates need to develop their skills when observing and recording the fine details of cells. The shape and proportion of the different cells needed to be represented in the final drawings.

(b) Comprehensive responses

- Some excellent responses included detailed descriptions of observable differences between the section on **P1** and in Figure 2.2.

Limited responses

- Some candidates needed to be able to select observable differences between **P1** and Figure 2.2 that could be clearly described.

(c) (i) Comprehensive responses

- Many excellent responses included correct measurements of the lengths of the air spaces with the appropriate units.

Limited responses

- Candidates need to understand that these measurements needed to be recorded accompanied by the appropriate units and could not be recorded as micrometres.

(ii) Comprehensive responses

- Many responses demonstrated knowledge of what is required to calculate the mean length of the five air spaces.

Limited responses

- Some candidates need to understand that how the calculation was carried out needed to be shown in the answer.

(iii) Comprehensive responses

- Many responses demonstrated knowledge of what is required to calculate the actual mean length of the five air spaces. Some responses also demonstrated understanding of how to state the answer to two significant figures.

Limited responses

- Many responses needed to show greater understanding of giving the answer to two significant figures.

BIOLOGY

Paper 9700/42 A Level Structured Questions

Key messages

What candidates did well

- Many candidates demonstrated a secure understanding of key biological concepts across genetics, evolution, physiology and molecular biology.
- Definitions were often accurate, including continuous variation and fungal characteristics.
- Data handling was frequently effective, with many responses identifying trends and supporting statements with appropriate evidence.
- Many responses used precise biological terminology, particularly in questions on sarcomere structure, PCR analysis and homeostasis.
- Some candidates produced well-structured extended responses, especially in ethical and applied contexts.
- Application of knowledge to unfamiliar contexts was evident in several questions, including disease control and gene therapy.

What candidates needed to improve

- Responses needed to be more closely focused on the question context, avoiding inclusion of general or irrelevant material.
- Greater precision was required in terminology, including correct use of units, genotypes and named structures.
- Explanations often needed further development rather than brief or general statements.
- Clear distinction between related concepts was required, for example diffusion, osmosis and active transport, or endothelial and epithelial cells.
- Data interpretation needed more linkage between trends and underlying biological processes.
- Some responses included appropriate ideas without sufficient qualification or detail.
- Some candidates were able to apply knowledge to unfamiliar contexts or produce extended explanations.

Comments on specific questions

Question 1

(a) Comprehensive responses

- Most responses identified at least two valid reasons for *L. fallax* being critically endangered, with habitat loss and climate change being the most frequent.
- Some responses included three distinct, clearly expressed factors.

Limited responses

- Some responses referred to predation or competition without indicating an increase. Disease was included without identifying it as newly introduced. Some responses described bottleneck effects or consequences of small population size, which were not relevant.

(b) Comprehensive responses

- Many responses recognised the role of optimal temperature range and explained that maintaining conditions outside this range would reduce infection. Some included specific temperature values, monitoring strategies and antifungal treatments.

Limited responses

- Some responses were vague or described general conservation strategies, such as protected areas or captive breeding, which were not relevant.

(c) Comprehensive responses

- Many responses correctly described fungi as eukaryotic with chitin cell walls and spore production.
- Some included hyphae, saprotrophic nutrition and structural detail.

Limited responses

- Some responses described fungi as autotrophic, containing chlorophyll or as prokaryotic. Recognition that fungi may be unicellular or multicellular was often omitted.
- Some responses included incorrect spelling of technical terms.

Question 2

(a) (i) Comprehensive responses

- Most responses defined continuous variation as a range of phenotypes without distinct categories.

Limited responses

- Some responses described causes rather than defining the term.

(ii) Comprehensive responses

- Some responses included polygenic inheritance, environmental factors such as diet and exercise, and their interactions.

Limited responses

- Some responses treated genetic and environmental factors separately or did not indicate the extent of environmental influence.

(b) (i) Comprehensive responses

- Most responses correctly identified that the mutant allele increases body mass and supported this using data.
- Some responses included accurate figures and recognised overlapping error bars.

Limited responses

- Some responses omitted units, used imprecise language or did not specify genotype.

(ii) Comprehensive responses

- Most responses suggested valid explanations such as increased food intake or reduced activity.

Limited responses

- Some responses were vague or unrelated to the question.
- Some responses had the wrong idea incorrectly suggesting less food and more exercise.

Question 3

(a) Comprehensive responses

- Most responses correctly identified the HTT gene and protein.

Limited responses

- Some responses used incorrect terminology when distinguishing between the protein and the disease.

(b) (i) Comprehensive responses

- Most responses identified individuals with a family history.

Limited responses

- Some responses referred to individuals already known to have high CAG repeat numbers which is what the test was identifying.

(ii) Comprehensive responses

- Some responses included informed consent, psychological impact and adult-onset considerations.

Limited responses

- Some responses need sufficient explanation or incorrectly suggested that the genes would not have developed until later in life.

(c) Comprehensive responses

- Some responses accurately interpreted PCR and gel electrophoresis data, including use of CAG thresholds and fragment size comparison.

Limited responses

- Many responses simply described the results without linking the distance travelled to the number of repeats.
- Some responses also described methods without interpreting the results.

(d) Comprehensive responses

- Most responses recognised that Huntington's disease is dominant and explained why gene addition therapy is unsuitable.
- Some responses suggested gene editing would be necessary.

Limited responses

- Some responses did not fully explain why dominant alleles cannot be masked.

Question 4

(a) Comprehensive responses

- Many responses described evolution as change over time, including allele frequency and natural selection.
- Some responses referred to speciation.

Limited responses

- Fewer responses explicitly linked evolution to the formation of new species.

(b)(i) Comprehensive responses

- Some responses clearly compared evolutionary relationships and divergence points.

Limited responses

- Many responses described the diagram rather than evolutionary relationships.
- Many responses stated that both trees diverged into two groups without referring to the time of divergence.

(ii) Comprehensive responses

- Most responses recognised that DNA similarity indicates relatedness.

Limited responses

- Many responses referred to DNA which was not enough as a reference to nucleotide sequences was needed.
- Some responses only stated common ancestor which was too vague. A further qualification such as closest or more recent is needed.
- Some responses referred vaguely to databases without further qualification.

(iii) Comprehensive responses

- Most responses identified that including more species increases reliability.

Limited responses

- Some responses referred only to number of birds or sample size.

(c) Comprehensive responses

- Most responses recognised reduced genetic diversity in the absence of crossing over.

Limited responses

- Few responses explained mechanisms such as more recombination or linkage groups not broken.
- Some responses described crossing over in terms of an exchange of alleles between chromosomes instead of between non-sister chromatids of homologous pairs.

Question 5

(a) Comprehensive responses

- Many responses demonstrated accurate knowledge of sarcomere structure.

Limited responses

- Some responses omitted key terminology such as bands, zones or lines, or put them in the wrong places.

(b) Comprehensive responses

- Some responses clearly described the role of calcium ions and the sequence of contraction, giving a logical sequence of events using accurate language.
- Some responses recognised that there was a low concentration of calcium ions, rather than no calcium ions, and correctly developed explanations based on fewer, less or reduced consequences rather than none.

Limited responses

- Some responses needed greater precision or included inaccuracies such as calcium ions binding to tropomyosin, not stating head for myosin head and sarcomeres contracting instead of shortening.

Question 6

(a) Comprehensive responses

- Few responses completed the table correctly.

Limited responses

- Fewer responses stated that lactose is hydrolysed into glucose and galactose even when the correct enzyme was stated.
- Few responses incorrectly identified lac Y.

(b) Comprehensive responses

- Most responses correctly explained a range of advantages, including those related to production methods.

Limited responses

- Vague responses often stated that recombinant insulin is cheaper without providing any further qualification or detail.

Question 7

(a) Comprehensive responses

- Many responses correctly stated the relevant structures and processes.

Limited responses

- Some responses confused endothelial and epithelial cells or mixed up **A** and **C**.
- Some responses stated basal, instead of basement, membrane.

(b) Comprehensive responses

- Many responses identified a range of different factors that are likely to decrease the GFR.

Limited responses

- Some responses needed specificity with unqualified references to pressure or comparing the diameters of the afferent and efferent arterioles.
- Some responses also included incorrect references to water potential and osmosis.

(c) Comprehensive responses

- Some responses started with an accurate definition, followed by a logical outline of the principles of homeostasis using appropriate terminology which was then related to an appropriate example.

Limited responses

- Some responses focused on a described example, often omitting any information regarding receptors and effectors and using vague language, for example glucose or water levels rather than blood glucose concentration or blood water potential.
- Some responses incorrectly referred to positive feedback.
- Few responses stated that a constant internal environment is maintained despite changes in the internal environment.

Question 8

(a) Comprehensive responses

- Most responses correctly identified the three energy-requiring processes.

Limited responses

- Some responses incorrectly stated photosynthesis for C.

(b) Comprehensive responses

- Many responses correctly described proton gradients and ATP synthase.

Limited responses

- Some responses were vague or included unnecessary detail such as the events leading up to chemiosmosis and the roles of reduced NAD and reduced FAD.

(c) Comprehensive responses

- Most responses calculated the answer correctly.

Limited responses

- Some responses included errors in ratios or rounding.

Question 9

(a) Comprehensive responses

- Many responses described the correct trend and linked the trend to a correct reference to respiration.

Limited responses

- Some responses needed to link trends to respiration.
- Several responses incorrectly stated that nitric oxide caused the decrease in oxygen concentration as it supplied oxygen or acted as a final electron acceptor.

(b) Comprehensive responses

- Many responses made explicit comments referring to differences, for example, the number of steps, reversibility, and additional products.

Limited responses

- Some responses were limited to a comparison of products without consideration of any other details.

(c) Comprehensive responses

- Some responses correctly described adaptations and linked these to relevant explanations.

Limited responses

- Many responses needed further development, for example, the locations of specific adaptations were often omitted.

Question 10

(a) (i) Comprehensive responses

- Most responses calculated the answer correctly.

Limited responses

- Few responses had miscalculations.

(ii) Comprehensive responses

- Most responses interpreted the different stomatal index values on upper versus lower leaf surfaces with an understanding of the need for water conservation.

Limited responses

- Some responses only made vague references to transpiration, photosynthesis or light intensity.
- Some responses made no reference to gaseous exchange.

(b) Comprehensive responses

- Some responses linked the correct limiting factors to specific times using the data.

Limited responses

- Many responses needed more accurate graph interpretation and clearer linkage to limiting factors. Just stating daytime, night-time or during the day or night was not sufficiently precise.
- Some responses incorrectly stated that higher carbon dioxide concentrations suggested higher rates of photosynthesis.
- Some responses referred to respiration which was not required.

(c) Comprehensive responses

- Most responses correctly identified the precise location in the chloroplast and described the roles of ATP and NADP.

Limited responses

- Some responses needed to describe the roles of ATP and reduced NADP more accurately.
- A few responses stated the grana more generally or stated the phase of photosynthesis instead of the physical location.

BIOLOGY

Paper 9700/52 Planning, Analysis and Evaluation
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Key messages

What candidates did well

- Most candidates demonstrated effective investigation planning skills, taking account of the independent, dependent and standardised variables.
- Most candidates demonstrated competent mathematical skills. Candidates were able to calculate standard error and percentage difference, giving their answer to the correct number of significant figures.
- Statistical analysis of unfamiliar data was completed competently by some candidates.
- Some candidates underlined sections of the question stem to highlight key ideas. This was a successful strategy for the evaluation questions as it helped these candidates to identify potential flaws in the investigation.

What candidates needed to improve

- When planning an investigation, it is important to set out the work in a logical way and for it to be detailed enough for another person to follow. Candidates should practice planning a range of different investigations, using a numbered list to express their ideas in a coherent and concise manner.
- Careful reading of each question before starting to write is important. Candidates should use the command word and the number of marks allocated to understand how to answer each question.
- Candidates take care to use the correct terminology when completing statistical analysis.

Comments on specific questions

Question 1

(a) Comprehensive responses

- Some candidates standardised aspects of the exercise programme such as the time of day or speed of running.

Limited responses

- Many candidates incorrectly focused their attention on standardising the people carrying out the exercise programme.

(b)(i) Comprehensive responses

- Many candidates extracted information from the question to correctly identify the independent variable.

Limited responses

- A few candidates gave lots of additional information before correctly identifying exercise as the independent variable.
- A few candidates incorrectly identified the dependent variable.

(ii) Comprehensive responses

- Many candidates used Figure 1.3 to correctly describe the effect of the exercise programme on the difference in systolic blood pressure and gave correct data quotes.
- Some candidates gave detailed answers that considered the difference in both systolic and diastolic blood pressure.
- A few candidates understood Figure 1.2 and were able to explain the changes in blood pressure before and after the walking test.

Limited responses

- Some candidates did not pay attention to the y-axis label on Figure 1.3 and therefore did not refer to the 'difference' in blood pressure.
- A few candidates gave incorrect data quotes from Figure 1.3 or did not include units with their data quotes.

(c) (i) Comprehensive responses

- Most candidates correctly calculated the standard error.

Limited responses

- None seen.

(ii) Comprehensive responses

- Some candidates took note of the question stem and responded using phrases such as 'to calculate', 'to see if' rather than stating conclusions.
- Some candidates used the correct terminology such as the calculated mean or the true mean. Candidates should be aware that the standard error helps to identify if the means are significantly different.

Limited responses

- Some candidates did not use the correct terminology, often referring to the data, the results or the values, rather than to the means.
- A few candidates did not include any detail, often referring only to reliability or accuracy.

Question 2

(a) Comprehensive responses

- Most candidates correctly calculated the time taken for one cardiac cycle.

Limited responses

- A few candidates incorrectly divided the number of cardiac cycles by 60 seconds.

(b) (i) Comprehensive responses

- Most candidates described a correct method to obtain a 0.3 per cent solution of caffeine.

Limited responses

- Most candidates used water as the diluent.
- A few candidates used 12 cm³ of water and 8 cm³ of stock solution (reversing the numbers), gave volumes that would not produce 20 cm³, or attempted a serial dilution.

(ii) Comprehensive responses

- Some candidates were able to describe a suitable method, giving enough detail for another person to be able to follow their method.
- Many candidates stated an appropriate range of five concentrations for the independent variable.
- Some candidates considered the investigation carefully and explained how several variables should be standardised.
- Many candidates described how the dependent variable should be measured and included the need for replicates to be taken. These candidates stated clearly that measurements should be taken 'at each caffeine concentration'.
- A few candidates suggested the use of a video camera or clicker to allow accurate counting of the number of cardiac cycles.

Limited responses

- A few candidates did not state the caffeine concentrations to be used, gave concentrations that were higher than 0.5 per cent (the concentration of the stock solution of caffeine) or did not include units.
- Some candidates did not state that a microscope should be used to observe *D. magna*.
- Some candidates suggested methods to standardise variables that were not appropriate to this investigation. To maintain a constant temperature, a temperature-controlled room is

appropriate, and the microscope light should be turned off when not in use. A water bath would not be suitable.

- Most candidates suggested the use of replicates. At least three replicates should be carried out for 'each concentration'.
- Some candidates included a risk assessment. For this question, a risk assessment was not required.

Question 3

(a) Comprehensive responses

- Most candidates correctly completed all aspects of the sketch graph in Figure 3.3.

Limited responses

- A few candidates did not use the question stem to add correct axes labels. A straight line should be drawn as Pearson's linear correlation coefficient, r , was significant.

(b)(i) Comprehensive responses

- Some candidates described the method in sufficient detail for another person to follow it.

Limited responses

- Some candidates correctly suggested the use of a random number generator. For this method, the random number generator should not be linked to coordinates or to the use of quadrats.

(ii) Comprehensive responses

- Most candidates correctly calculated the percentage difference.

Limited responses

- The calculated difference should be divided by the mean area covered by water hyacinth in treatment 3. A few candidates incorrectly used the mean area in treatment 2 as the denominator.

(iii) Comprehensive responses

- Some candidates correctly explained why a t -test should be chosen.

Limited responses

- A few candidates correctly chose the t -test without giving a correct explanation for their choice.
- Some candidates did not use the correct terminology; the t -test is used to compare the difference between two means. The t -test does not compare data, results or values.
- A few candidates stated an incorrect statistical test, such as the chi-squared test.

(iv) Comprehensive responses

- Some candidates suggested a risk, the hazard associated with that risk and suggested a suitable precaution.

Limited responses

- Some candidates did not include sufficient detail when identifying the risk or the hazard.
- A few candidates suggested gloves as a precaution when this was already stated in the risk assessment.

(v) Comprehensive responses

- Some candidates gave detailed responses that evaluated the data shown in Figure 3.6 and identified several flaws in the overall investigation.
- Some candidates compared the data for treatments 1 and 2 to treatment 3 (the control) and stated whether the error bars overlapped or did not overlap. Candidates should refer to a significant difference if appropriate.

Limited responses

- Some candidates only evaluated the data shown in Figure 3.6. These candidates did not consider the shortcomings of the investigation.
- Some candidates gave several data quotes without stating whether the error bars overlapped or did not overlap.
- A few candidates compared treatments 1 and 2 without making a comparison to treatment 3 (the control).