Examiners' Report
Principal Examiner Feedback

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In Biology (5BI2F) Paper 01

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Paper Introduction

The range of responses given across this paper identified clear misconceptions and misunderstanding amongst students on several topics. Although common mistakes were made, those that are made year upon year, there were distinct areas in which student performance was poor, despite traditionally students showing an improvement in understanding. Interpreting trends in data, enzymes and cell structure and function, previously answered well by students, showed this time to prove challenging and consequently many candidates lost marks for giving incorrect, ambiguous or vague responses. Transport across cells membranes again proved to to be a problem area for candidates - few understood the principles of diffusion and even less were able to fully and correctly state how water is absorbed by plants. Although the term osmosis was often used, this was frequently in the wrong context where many candidates discussed how water moved up the stem by osmosis rather than into the roots/root hair cell from the soil. Many candidates lost marks in simple calculations, particularly for question 4 where students were unable to use the values given in the question to work out the diameter of the zygote. Application of knowledge and understanding was also an issue for a large number of candidates - the majority were challenged by the context given in question 6ci and 6cii and gave 'off the cuff' responses that failed to attract marks.

Student performance showed improvement on previous years in topics such as genetic modification and the heart and blood, although some candidates had difficulty in relating structure to function for question 4c. Quadrat sampling and the ratio calculation were also carried out well and a good understanding of base pairing was evident in a vast number of responses given. There were a large number of questions across the paper that were not attempted at all by students.

5BI2F_01_Q01ai

This was a well answered question, not often left blank, with a range of responses covering all marking points. Most students included 'photosynthesis' in their answer although there was occasional confusion between this and respiration where some candidates gave the correct reactants but linked these to the incorrect process. Some candidates were confused on where water entered the plant for photosynthesis with several quoting 'leaves' or 'stomata' and other responses named the roots as the site of photosynthesis. Many quoted 'oxygen' as a reactant and responses referred to the Sun or even 'energy from the Sun'. Several students gave the word equation for this reaction and, if fully correct, were awarded full marks.

Examiner Tip

When tackling questions involving biological processes such as photosynthesis, think carefully about writing equations to show the reactions rather than following the instructions given by the question. Some word equations used were incorrect or mixed words with incorrect formulae which did not gain marks. Always look at the mark allocation for a question and include the same number of key points in a response.

5BI2F_01_Q01b

Many candidates were unable to recall the function of the cell wall and vacuole. A common response by students linked the cell wall to the second option - controls how much oxygen leaves the plant - possibly misconceived into thinking that the cell wall had a role in controlling the entry and exit of substances (indicating confusion with the function of the cell membrane). Similarly, the variety of responses given for the function of the vacuole were vast and spanned most options which confirmed a significant lack of knowledge of the function of plant cell components.

Examiner Tip

There will always be some questions on an examination paper that are direct recall and this is an example. Find ways of revising information that help you to remember key facts that you can use to answer questions like this. Use strategies, such as pneumonics, that will help you to remember key facts.

5BI2F_01_Q01c

Many students struggled to use the correct language to describe the results which limited the marks that they obtained for this question. Many failed to recognise the peak at 25^{o}C and instead used the term 'middle temperature' which was vague and added extra ambiguity to some answers given. Good, clear, succinct answers were given by few candidates who were able to hit all three marking points in responses gaining full marks. Candidates gaining one mark provided responses that were often focussed on the peak at 25^{o}C stating that most bubbles were produced at this temperature although many of these failed to provide further detail for a second mark. Valuable time was often wasted by students attempting to explain the data rather than describe, including details mainly on enzyme action which often was not linked to the data given in the table but rather a recall of knowledge. The most common error included information such as 'The higher the temperature, the more bubbles produced' where many overlooked the peak and were either unable to interpret the pattern in the data or misunderstood what the data was showing. Although there were a good number of students that were able to answer this question correctly and succinctly there were too many that were unable to follow the pattern

in the table from 0 to 45°C, or identify the optimum temperature at which most bubbles were produced. A few students neglected to read the question and described what happened to the temperature rather than the number of bubbles.

Examiner Tip

'Describe' questions that are linked to data usually expect students to identify trends and patterns and these need to come across clearly in written responses. When discussing trends in data from a table, try to structure your answer in a logical order, reading from the first piece of data given to the last. Always take adequate time to look at information in tables and graphs carefully. Don't attempt to answer the question until you are sure that you understand what the data is showing

5BI2F_01_Q02ai

On the whole this question was well answered. Candidates were able to pick out the correct two numbers from the graph and use them in a subtraction calculation to arrive at the correct mass difference. Some students were not always able to work out the difference although most were still awarded one mark for using the correct values from the graph. Other candidates attempted to calculate mean values, again scoring one mark for their use of 60 and 70, but added and then divided these numbers to obtain an incorrect final answer which was, most often, 65.

Examiner Tip

Read questions carefully, twice if there is time, to reduce the risk of misinterpreting what you are being asked to do. Showing working out will often gain a mark. Marks are never lost from showing how an answer is derived.

5BI2F_01_Q02aii

Many candidates found this question challenging. Students got caught up with explaining how men and women had different masses, how men stopped growing at the age of 19 and the importance of healthy eating and exercise. Puberty and mitosis were often mentioned with no relation to the question. Of those that were able to describe the method to calculate a mean, many lost marks because they were not specific enough in describing the addition of masses, often going straight into the division. Few students gave details about percentile charts or how to determine a median value and others provided details that were too vague to credit e.g. 'collect results and find an average' and therefore scored no marks.

Examiner Tip

Take care to add necessary detail to answers. The question will be quite clear on what a response should focus on and in this case, it was the mean of *19 year old males* that was wanted not all males.

5BI2F_01_Q02b

A large percentage of candidates were able to choose the correct words from the box to complete each of the sentences. Candidates scoring one out of the 2 marks.

5BI2F_01_Q02c

Two marks were not often awarded for responses to this question and many answers indicated a significant lack of understanding or were limited in their ability to express themselves scientifically. A large number of responses were vague e.g. 'they come from the same potato/plant' or gave a repeat of the question in their answer - 'new plants are clones'. Misconceptions were evident; 'potato plants are not able to reproduce' or 'unable to reproduce sexually', 'potato cells have 46 chromosomes' amongst others and there were a fair number of references to genetic modification. There were few references to asexual reproduction although a higher minority understood that mitosis was involved in producing clones. This term, however, was often used incorrectly implying a misunderstanding of its real meaning. Candidates that were able to score at least one mark were often still unable to express their understanding clearly or used terminology in their response that was the absolute minimum needed to score - 'produced cells with the same DNA' or 'they have the same chromosomes' or 'produced identical cells' were an acceptable alternative to 'genetically identical'. The latter was very rarely seen in answers. Many students chose to leave this question blank.

Examiner Tip

This is a tricky topic that includes key terminology that should be used in responses. Make sure that you learn definitions for these key words and that you are able to use them appropriately in sentences.

5BI2F_01_Q03aiii

Although 'valve' was a common marking point, candidates that failed to name structure Y invariably understood its function for one mark. 'Preventing backflow of blood' was the most frequently seen marking point. Many candidates misread what the arrow was pointing to and there were several answers that provided details on the atrium or ventricle which were not credited. Others linked the job of the valve to 'pumping blood' or

similar, confusing its role with the role of other parts of the heart and students who included details on 'opening and closing' often did so in the wrong context. For example, 'valves open to allow blood to pass through' was seen several times. Other incorrect answers mostly included an attempt at describing the function of the valves; oxygenating blood, separating oxygenated and deoxygenated blood and controlling blood flow were just some that were seen.

Examiner Tip

Learn the structure of the heart thoroughly as questions related to the various parts of the heart often appear in examination questions. Where a diagram is labelled with letters or numbers and a question is based around one or more of these labels, always name the part(s) that the question is referring to in your answer. The chances are it will be worth a mark.

5BI2F_01_Q03biii

Although the mark scheme allowed for a fair variety of answers, marks were still lost as candidates gave genetic diseases (mainly cystic fibrosis), anaemia including sickle cell, smoking, poor diet and, very often, diabetes as a reason for an increase in the number of white blood cells. A good number of students also came to the incorrect conclusion that the number of white blood cells were higher as their number needed to equal or balance with the number of red blood cells or stated an involvement in blood clotting. Some candidates linked the increase in the number of white blood cells with increased exercise and others confused their role with that of red blood cells. Candidates that gained marks for their response often understood that the patient was 'ill' or 'had an infection' and many of these went on to state that white blood cells were needed to 'fight infection'.

Examiner Tip

Be sure to learn the role of blood components thoroughly. This is an area of biology that students often lose marks on. Responses that lack clarity or are ambiguous are very unlikely to be awarded marks. Make sure that sentences are structured clearly.

5BI2F_01_Q03biv

Most candidates attempted this question and the full range of marks was seen in the responses given. Many candidates had issues with naming a feature of the red blood cell and linking this feature to a correct description of how it helped to increase the amount of oxygen carried and this inevitably led to a vast number of students gaining one out of the two marks available. Candidates lost marks for describing a biconcave shape in a way that was just not suitable e.g. 'it has dimples/dents' or 'like a doughnut' were frequently given and others failed to gain marks for

'increases the amount of oxygen they carry' which was basically a repeat of the question. Rather than biconcave, some student stated 'concave' - an unacceptable alternative. Most often, candidates would give two correct features, although were awarded only one mark, and failed to give a correct description of how this feature helped to increase oxygen transport. A fair number of students gaining one mark understood that the red blood cells had a 'large surface area' but omitted to mention the feature that gave this. There was little mention of haemoglobin and the idea of 'more space for oxygen carriage' was infrequently seen. Overall, a good number of students were able to score one mark, many for recognising that the red blood cells do not have a nucleus or that they have a large surface area but it appears that two marks was reserved only for the best candidates.

Examiner Tip

There will be times when questions are asked that links oxygen transport with exercise. This wasn't one of them! Read questions carefully and then structure a response around what the question is actually asking. Think carefully about adaptations of cells. Firstly, name a feature and then describe how this particular feature helps the cell to carry out its function.

5BI2F_01_Q04bi

There was a common misconception that the cell membrane had a 'protective' role in the cell and this lost many candidates a mark. However, 'nucleus' was a common response for the first part of the question where candidates were asked to identify structure Y. Very few lost this mark although unfortunate spelling in some cases e.g. nucleolus failed to gain a mark.

Examiner Tip

Learn the function of the different parts of animal and plant cells thoroughly. These are likely to come up often in examinations. One common misconception amongst students is that the cell membrane protects the cell in some way. You need to justify 'protect' by stating clearly what the cell membrane is protecting the cell from.

5BI2F_01_Q04bii

Many candidates failed to score any marks as they used the incorrect mathematical function in their work. A large percentage of students were aware that 5000 and 35 had to be manipulated in some way but many chose to multiply these values to arrive at an incorrect final answer of 175 000. Few candidates failed to score as a result of not showing their working out despite a final answer being given, albeit incorrect.

Examiner Tip

Be sure to understand orders of magnitude in calculations such as this. All cells are extremely small and arriving at an unrealistic value of 175 000 mm should tell you that this is far too big for any type of cell. Always show working out to questions that are expecting a calculation to be carried out. Always use a calculator to carry out calculations in a science exam and don't try to express the figure shown on the calculator in a different form if you don't feel confident in doing so or unless the question asks you to.

5BI2F_01_Q04biii

This question was answered well by the majority of candidates who were able to demonstrate a good understanding of complementary base pairs. Most marks were gained by responses that gave examples of base pairing i.e. AT and CG. Few responses lost marks but of these, the most common were giving an example of only one of the base pairs e.g. either AT or CG rather than both or just simply muddling up the base pairs e.g. AC or GT. Other incorrect responses including details that attempted to describe the action of enzymes, giving information about the lock and key hypothesis or just listed the bases rather than illustrating how they were paired. Some candidates gave information on general DNA structure by providing details of the 'double helix' rather than base pairing as stated in the question. Few responses mentioned the hydrogen bond between pairs of bases but those that did generally gained two marks as they also gave correct details on how the bases were paired.

Examiner Tip

The hydrogen bonds are found between the base pairs i.e. A------T and G------C and it is these bonds that keep the two strands of the double helix together. Make sure you understand what the question is asking. In this case, the word 'how' seems to have been overlooked by some candidates who omitted key information about base pairing in their response.

5BI2F_01_Q05b

Many candidates scored one mark for showing understanding that the roots were involved in the absorption of water. There was little use of the term 'root hair cells'. There were numerous candidates that included the term 'osmosis' but this was more often mentioned in the wrong context e.g. 'water moves up the stem by osmosis' with very little linkage given to osmosis and water movement into the roots. A significant minority of candidates that did use the term 'osmosis' also failed to relate this to water transport from a high to a low concentration into the roots. Some candidates referred to respiration in their answers and others discussed adaptation of roots. Neither type of response gained credit.

Examiner Tip

Osmosis is a key term in science and questions related to this process often crop up in examinations. Make sure you are able to apply your understanding of this process to describe or explain how water movement occurs in plants. Learn the difference between the different methods of transport across cell membranes.

5BI2F_01_Q05c

Although many candidates demonstrated a good understanding of the reasons for genetic modification there were some unnecessarily vague answers that could have been awarded marks if a little more thought had been given to answers. Ideas about increased yield, faster growth rate, and pesticide and herbicide resistance were commonly seen although answers such as 'taste' as opposed to 'improved taste' or 'growth' rather than 'faster growth' were not awarded. Some candidates misread the question and attempted to give details about how genetic modification is carried out and others lost marks by giving the conditions needed for growth such as more sunlight or water and 'adding fertiliser' seemed to be a favourite for a fair number of students. Some candidates chose not to attempt this question at all and a fair number of answer spaces remained blank. 'Immunity' was used incorrectly at times with reference to pesticides and herbicides and some stated 'Golden Rice' seemingly without understanding that this was the term used to just describe a genetically modified variety.

Examiner Tip

Answers to questions need to be absolutely clear to gain a mark. An examiner will not make assumptions or interpret what you mean even if the intention by the candidate is correct. A list rule applies in questions that specify how many points you need to make. This question asks for two points - if a third is given that is incorrect it is likely to negate a mark.

5BI2F_01_Q05d

Although a good number of candidates were able to gain 4 marks for their response the omission of key information to move answers from a level 2 to a level 3 was too often omitted. Many failed to include details that implied repeats needed to be carried out and a mean calculated, inclusion of which would have moved many responses into the top band. Some answers were poorly structured and use of non-scientific terms such as 'grid' or 'square' as alternatives to quadrat were often incorporated into answers. Use of a 'Punnett' square was seen quite often. Some candidates were unable to name or describe a quadrat at all and instead gave details on how a small area would be selected, most often stating $1m^2$ or $10m^2$, either of which contributed to the overall mark given for the answer. Some sampling areas given, however, were unrealistically large e.g. 100 m^2 and were not

considered for credit. The idea of 'random' sampling did not come across often in responses and some attempts at how the number of plants needed to multiplied in some way to take into account the size of the field were confused and incorrect. There were numerous responses that referred to planting seeds and then counting them and others that attempted to describe transect sampling which often lacked clarity and were not awarded.

Examiner Tip

Make sure you understand how to calculate a mean as this is a mathematical process that often crops up in examinations. Any type of sampling technique should be repeated so that a mean value can be calculated. This mean value should discard any anomalies in the data obtained.

5BI2F_01_Q06b

Students that performed poorly on this question failed to use key terminology in their response. Some were confused between the roles of the small and large intestine and others implied a lack of understanding of the structure of the digestive system in general. For example, several candidates mentioned how food was transported from the small intestine to the stomach. Some described peristalsis without using the term itself to discuss how the small intestine pushed food towards the large intestine. Many, less articulate responses used terms such as 'passes', 'transports' or 'takes' food to the large intestine and were not credited. Numerous responses focussed on the large intestine rather than the small intestine and included detail about the formation of 'poo' or irrelevant detail about excretion.

There were many candidates that did show some understanding of the role of the small intestine. A good percentage of students were able to recall that the small intestine had a role in 'breaking down' food although some failed to gain marks for their misunderstanding of the small intestine 'absorbing' nutrients. The correct function or presence of enzyme action in the small intestine were rarely seen in responses and it wasn't uncommon to see details such as the 'small intestine breaks down enzymes/amylase' which was obviously not credited. Similarly, the role of villi was infrequently mentioned.

Examiner Tip

The number of marks available for a response reflects the number of points that should be included in an answer. Peristalsis is a process that occurs throughout the digestive system. As this process requires muscle contraction, energy is needed, which means that it is an active process. Terms used to describe an active process need to be chosen carefully as terms such as 'transports' or 'passes' are unlikely to adequately

describe an active process. It is important that scientific terminology is used correctly. Its inclusion in a sentence or paragraph must make sense!

5BI2F_01_Q06ci

Many candidates were challenged by the context of this question and failed to understand that applying simplistic understanding of basic enzyme action would have been sufficient in gaining a level 3 response. Instead, a large percentage of students included details about how enzymes would make the clothes smell nice or, very frequently, that enzymes would destroy or kill bacteria. Few candidates used the prompt given by the diagrams to include details about complementary shapes (enzyme and substrate) although some did make an attempt at this, mostly unsuccessful, by discussing how the enzymes (protease and lipase) would join together to break down stains. References to the lock and key hypothesis were mostly vague, sometimes just randomly mentioned with no further detail to express the meaning of this term. There were also numerous, irrelevant references to pH and temperature and enzymes denaturing and other responses often conveyed misconceptions regarding active sites and stated that these were actually on the food molecules. Candidates gaining a level one response were aware that the enzymes played a role in removing stains in some way and although this was the minimum that was acceptable, this was the most common answer that got students into the lowest mark band. Few students added further correct detail to discuss how protease enzymes broke down proteins or that lipase enzymes worked to break down lipids. Very rarely were the products of these digestive reactions mentioned.

Examiner Tip

Be aware that food stains on clothes are made up of the food molecules that are broken down by our digestive system. They are broken down in exactly same way on clothes as they are in our body. When discussing enzymes and their substrates, always provide full details of the whole reaction i.e. naming the enzyme, its substrate and the products of the reaction that is catalysed.

5BI2F_01_Q06cii

Although a fair number of candidates were aware that temperatures higher than optimum would cause the enzymes to denature for one mark the information given in addition to this for many responses was often far from what was expected. Information including 'clothes would burn' or 'high temperatures would cause explosions'/fires' were surprisingly common. Other responses stated that high temperatures would cause 'holes in clothes' or 'cause the colour in clothes to run' or that 'clothes would melt/shrink'. Consequently, most answers either gained the 'denature' mark or nothing.

Examiner Tip

Remember that most enzymes you will need to learn about work best at 37^{o}C which is body temperature. Temperatures above this will cause the enzyme to denature. Be sure to understand what effect denaturing will have on the chemical reaction catalysed by the enzyme. Remember that enzymes are not living organisms and therefore cannot be killed. They are chemicals that change shape if they are placed in conditions outside of their optimum.

Paper Summary

Most of the marks lost by candidates in this paper were due to an inability to recall information, to express answers clearly using scientific terminology correctly, or to apply knowledge and understanding to a context. Candidates seemed unaware that the information needed to answer contextualised questions successfully was based on the underlying scientific principles taught in class and, for some questions, gave random answers that were sometimes far detached from the topic being tested. Other candidates were unable to clearly follow patterns in data and although attempts were made to describe these, they were often so poorly structured that they could not be awarded.

Candidates should be encouraged to attempt all questions in the paper, regardless of whether they lack confidence in the topic area. Marks can often gained for the use of key terminology or for showing working out to a calculation and it was likely there were several cases where students denied themselves of several marks as result of failing to provide some form of an answer. Many candidates, particularly those targeting lower grades, would benefit from practice in structuring answers to certain types of questions. In describing trends or patterns in data, for example, many less able students struggled to express their answers in a clear and unambiguous way which cost many marks. Mistakes were made in questions requiring some form of mathematical calculation, particularly for question 4bii where many students carried out a multiplication calculation rather than a division.

In contrast, there were several topic areas that were clearly a strength for the range of abilities. Candidates answered questions related to DNA structure, the function of white blood cells and photosynthesis very well, where previously performance may have been less favourable. As mentioned, one of the biggest downfalls was applying knowledge and understanding to questions placed in a less familiar context and this is clearly an aspect of the examination that let many students down.

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