

Moderators' Report/ Principal Moderator Feedback

Summer 2016

Pearson Edexcel GCE
in Biology (6BI02)
Development, Plants and the
Environment

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Paper Introduction

As this was the penultimate paper for the 2008 specification, the majority of candidates were those re-sitting this paper. As such many did use biological concepts they had learnt in the course of studying the A2 topics when tackling some of the questions on this paper.

Questions tackled well included those on the cell walls, the structure of sperm cells, ultrastructure of cells, sustainable resources and the process of natural selection. Those questions where the context was less familiar were less well answered. It is important that students learn how to apply their knowledge. Too often do we see answers learnt from previous mark schemes being regurgitated, regardless of the context. Students often fall into the trap of thinking that they have seen a question before, failing to read it carefully and note the difference in context - that often results in completely different answers.

In this paper, the question on the effect of environmental factors on gene expression was one that proved challenging for some students, although it was essentially quite straightforward. Another issue that did prevent many students scoring higher marks, was not using the data provided and failing to add enough specific details to answers given.

Those who had learnt the terminology well and were prepared to analyse the data provided with care and who were not daunted by the unfamiliar contexts – after all, who has heard of olms before? – did well. There was plenty of opportunity for those who had a good grasp of the concepts covered in Topics 3 and 4 to demonstrate their understanding and to score highly.

At the end of the day, knowledge is of limited use unless it can be applied.

Question 1

1a: It was pleasing to see that the majority of students correctly identified the two plant tissues from the image. A few did change their answer - more frequently from a correct to an incorrect answer.

1c: Although the question asked for a description of the **cell wall** of a xylem vessel, many ignored the wording of the question and went on to describe the structure of a xylem vessel. When this happens, what the student writes may be perfectly accurate, but is not the answer the question being asked and often fails to score any marks. Many saw 'cell wall' in the question and wrote down everything they knew about cell walls, rather than specifically trying to select knowledge to answer the actual question asked. This was a common issue, and not just on this question.

As a QWC question, spelling was penalised infrequently, most commonly for misspelling the word 'microfibril'. Many gave extra detail about structure of cellulose molecule but most then went on to gain marks for cell wall structure. Some mistakenly described cellulose molecules being bound by pectin or hydrogen bonds holding microfibrils together. There was some confusion between the terms 'rigidity' and 'turgidity', with some referring to lignin making the vessel more turgid. Fewer students mentioned the arrangement of lignin in the cell wall, but 'spirals' and 'rings' were seen. Pores were described instead of pits - few of which were bordered.

In summary, those who did attempt to describe the cell wall of a xylem vessel, usually mentioned the lignin and some also mentioned pits. There were many descriptions of cellulose molecules, rather than the arrangement of cellulose microfibrils within the cell wall. Credit was given for reference to pectin or hemicelluloses when described in the context of these molecules being part of the matrix in which the cellulose is embedded, even if the term matrix was not used.

Question 2

2a: This was a very straightforward question. Students are expected to know the structure of a sperm cell and the fact that the parts were given in the question should have helped. However, there were a great variety of drawings provided in answers. Common errors that lost marks were drawing the flagellum as a single line, having the acrosome and the nucleus in the wrong positions, having mitochondria within the flagellum or labelling the mid-section as the mitochondria instead of drawing them in as separate structures.

2bi: This question asked for the function of the flagellum in a sperm cell - not just the function of a flagellum. Therefore, the best answer was that it propels the sperm cell towards the egg cell. However, there were some responses that seemed confused as to where the sperm was headed or just didn't mention it.

2bii: This question asked about the function of mitochondria in sperm cells. One mark was available for referring to respiration and the other mark for explaining that the ATP or energy provided is used to move the sperm cell or its flagellum. Many students did correctly refer to the fact that mitochondria provide energy, but fewer mentioned respiration.

2biii: This question asked about the function of the acrosome in a sperm cell. Marks were awarded for describing the presence of enzymes inside the acrosome and then for the purpose of those enzymes. Many answers mentioned digestive enzymes or acrosin in the acrosome, although some incorrectly suggested that the acrosome itself was an enzyme. Many correctly described the digestion of the zona pellucida, with only a few referring to it as the 'jelly layer'. Credit was given for the idea that the enzymes created a pathway through the follicle cells, but not for stating that the enzymes digest these cells. Other incorrect answers described the enzyme as digesting the cell membrane of the egg cell.

Question 3

3a: This question asked students to use information from the electronmicrograph to explain how the organelle shown can be identified as a Golgi apparatus. There were many good answers to this, referring correctly to the stacks of curved or flattened, membrane bound sacs or cisternae and the absence of ribosomes. The presence of vesicles is not a key distinguishing feature - smooth and rough endoplasmic reticulum are also surrounded by vesicles; therefore, marks were not awarded for mentioning the vesicles. There were quite a few responses that referred to the function of the Golgi apparatus - which could not be discerned from the electronmicrograph! It is always a challenge to describe in words a structure, but many students did very well with this question.

3b: A straightforward question asking for a description of the role of the Golgi apparatus. However, it does appear that many students struggle with the phrase 'the role of'. There were also many answers that described the whole process of protein modification from the rER. Good answers referred to modification of protein, with details, and then the packaging of the protein in vesicles. Reference to lysosome production was also given credit. Many students incorrectly refer to the proteins becoming vesicles instead of being packaged inside vesicles.

Question 4

4ai: This question asked students to 'describe the **end result** of mitosis', not cell division. Many confused the two - not clearly recognising that mitosis is the division of the nucleus rather than division of the cell. Others identified telophase as the last stage of mitosis and correctly described the state of the cell at the **end** of telophase. Those that recognised that this was telophase often talked about nuclear membranes being reformed but not specifically nuclei. Descriptions of cytokinesis were not relevant to the question.

4aii: This question asked for a description of the end result of the S phase of the cell cycle. Credit was given for noting that the DNA had been replicated or copied and another mark was available for noting that the quantity of DNA or chromosomes had been doubled. These are not the same mark - as replication refers to the specific process of making identical copies of the DNA, whereas the doubling of DNA content or chromosome number is the consequence of that process in the cell cycle.

DNA synthesis was a common response, but many did refer to DNA replication though fewer recognised this would double the quantity of DNA. Most candidates achieved one mark and few obtained both. Many referred to replication of organelles or all cell contents.

4bii: This question asked students to use the information from the table, and their own knowledge, to suggest why the cells produced become smaller after each cell cycle. This proved particularly challenging, especially as few appeared to actually use the information in the table. Those that did refer to the table worked out that normally the cell would spend a lot of time in the G1 and G2 phases, during which proteins and organelles are produced; they then linked this to the cells becoming smaller after each cell division being a consequence of the cytoplasm and organelles having to be split between cells. Many referred to there being a lack of space of the cells as being a reason for them becoming smaller, perhaps referring to the diagram instead of the table. Some said that the chromosomes would become smaller so would need less space.

4c: The question asked students to describe the processes that takes place inside a cell during specialisation. This is a process that should be understood and one that happens in a particular sequence. There were many good answers describing the activation of genes, the transcription of these genes and the translation of the mRNA produced to result in proteins that determine cell structure and/or function. Switching of genes is acceptable, whereas 'turning on' of genes is not precise enough. Many incorrectly referred to the transcription of mRNA, rather than the transcription of the gene to produce mRNA. Reference to a chemical stimulus bringing about the activation of the gene was not relevant to this question as the context was 'processes ... inside a cell'.

Some students missed the point completely and discussed totipotent and multipotent stem cells and their ability to differentiate into different cells.

4d: This was, in essence, a simple question, asking for the difference between tissues and organs, there were many ways in which students expressed their answers. Although there were places to write the answers, to describe two differences, the answers were pieced together when marked to allow correct answers to be rewarded irrespective of the order in which the points were made.

For example, if a student had written '1- tissues are made of one type of cell', and '2-organs are made of different tissues' they would have gained full marks.

It was evident that many had learnt definitions, but many could not adapt these to fit the question. The main problem was the lack of comparison, so features of only one were mentioned, e.g. 'organs have many functions'. 'Tissues made of

one type of cell' and 'organs made of many types of cells' was quite common. Many also referred to organs being 'larger' or 'more complex' than tissues.

Question 5

5ai: This question asked for the meaning of the term 'sustainable' to be explained. Good answers did refer to renewable resources that would be available to future generations.

Although many had learnt a text book response and used it appropriately, there were many answers that discussed environmental issues, such as biodegradability or pollution. The idea of 'can be used again' seems to be a common misconception of 'renewable', it was also confused with 'recycling'. Many referred to 'sustainable' as meaning that something can be 'regrown' or 'replanted', pre-empting the next question.

5aii: This question asked students to explain why the use of packaging pellets made from starch are more sustainable than pellets made of polystyrene that comes from crude oil.

Many good answers were provided, although a common error was to describe the starch as being able to be replanted or regrown rather than the plants which are the source of the starch. Almost all students recognised that oil was non-renewable, but some missed the point that the plants producing starch could be regrown.

5bi: Most answers correctly referred to the conditions of pH 9.0 and a temperature of 30°C. However, some answers did not use the actual figures from the graph, and referred to 'alkali pH' and other temperatures other than those in the data provided.

5bii: This question asked for a description of the effect of temperature on the breakdown of the bioplastic.

Those that read the question properly gained at least two marks and many gained a third with a relevant manipulation of data, although some did just quote the data from the graph without working out the differences. Some candidates looked at the effect of pH or combined the effect of both pH and temperature into their responses.

5biii: This question was generally well answered, with many referring correctly to variables such as volume of enzyme or area of plastic sheet.

Common errors that were seen included references to 'amount' of enzyme and size of sheet - which are too imprecise. Also, references to mass, pH and temperature were not relevant in the context of the investigation that had been conducted, where temperature and pH were independent variables and the change in mass was the dependent variable.

5biv: This question asked why it would not be valid to use the data to predict what would happen at a temperature of 30 °C and a pH of 11.0. Students were expected to realise that as the only pH values tested were 7.5 and 9.0, pH 11 would be outside of the range tested and that with only two values tested it would not be possible to extrapolate.

Many did note that there were not enough sets of data to make an accurate prediction or that there was no pattern or trend. However, the most common incorrect answer was that there were no results for pH11, ignoring the fact that if there was a result for pH11 there would be no need to make a prediction. Others referred to the enzyme being denatured at pH11.

Question 6

6ai: This question asked students to explain what was meant by the term 'zone of inhibition'.

The majority of the responses showed an understanding of what the zone of inhibition was in the investigation. A few responses just stated that 'it was a clear zone', which was not enough to get a mark. Many said that it was a clear zone 'where the bacteria were sensitive', so really just repeating the question.

6aii: This question was misread by many students who just repeated the answer to the previous question with no reference to it being quantitative. Only the better answers referred to the sizes of the zones of inhibition being compared or that the larger the zone the fewer bacteria that were growing.

Vague statements about 'sensitivity' or 'inhibition' were made in many answers without being specific enough to gain credit.

6b: This was a straightforward data analysis question and the majority gained at least 2 out of a possible 3 marks. Most identified clove as the most effective and sage as the least effective. Many also noted that flower buds appeared to be more effective than leaves and stems. Fewer noted that basil was the same as rosemary and that lemon balm and thyme were also equally effective.

There was a tendency to quote figures, which is insufficient, on its own, to gain credit.

6c: This question asked for a suggestion on how the investigation could be improved. Many made suggestions for an extension of the investigation, rather than an improvement.

Many mentioned repeats in order to calculate mean values - which only gained one mark. In order to gain both marks, it was necessary to suggest repeats for each plant extract. Others correctly suggested controlling the variable of which part of the plant to use - this was phrased in many ways.

Students were confusing the terms 'reliability' and 'validity'. Controlling the variables would increase the validity of the investigation or any conclusions

drawn from the results, whereas repeats would increase the reliability of the results obtained. Many students used both terms, just in case!

6d: There were two ways in which the investigation described could be changed to make it safe for school laboratories - changing the incubation temperature and using non-pathogenic species of bacteria.

Many students picked up on the temperature that was quoted as 37°C in the question and suggested a lower temperature - however, the reasons given were not always creditworthy. Many still believe that bacteria become pathogenic when grown at higher temperatures, failing to note that human body temperature would encourage the growth of bacteria harmful to humans.

Some did suggest the use of non-harmful strains of bacteria.

Question 7

7a: Explaining polygenic inheritance continues to prove difficult for many students. However, there were many good answers referring to the fact that it involves more than one gene affecting a single characteristic and that these genes are on different loci. Credit was also given for reference to these genes interacting or resulting in continuous variation.

Many answers referred to 'phenotype' instead of 'characteristic' or 'trait'. This was incorrect, as the phenotype refers to the way in which the genotype is expressed - a trait would be fur colour, whereas the phenotype may be brown or black fur. There were also many answers referring to alleles instead of genes.

7bi: Many students have difficulty differentiating between a 'control' and a 'controlled variable'. Hence, there were many references to the age, gender or condition of the rabbit, along with a range of environmental variables.

Whilst some did refer to the removal of the icepack, these answers did not gain credit unless they also mentioned that the rabbit had to be shaved.

7bii: Although the answer expected was relatively simple - many students failed to gain marks as they did not refer to the results of the experiment, and how these supported the hypothesis provided.

There were many vague references to environmental factors affecting gene expression without reference to this example. Many referred to the presence of the ice pack rather than the environmental factor of 'cold' or 'lower temperatures.' There were also vague references to changes in temperature causing a change to a characteristic and genes being 'affected' rather than being activated or genes being activated by changes in the environment. Many also made reference to the life of these rabbits in the Himalayan Mountains and how the black fur would reduce heat loss - which was very perceptive, but not the answer to the question being asked!

Many students gained the marks for the fur growing back black where the ice pack had been and the body was cold and for referring to the fur growing white where the body was warm. Only the better answers correctly referred to the gene being expressed at low temperatures.

7c: There were some good answers to this question with many gaining full marks referring to the fact that the fur grew back black where the ice pack had been because the enzyme had been activated. However, there were many that did not mention the enzyme or re-stated the fact that the enzyme was inactive above 25°C. There were also some that referred to the enzyme being inactive at temps lower than 25°C.

Yet again, many students failed to link their answer to the evidence provided. Some thought that white was the fur colour produced by the enzyme and that temperatures below 25°C inactivated the enzyme.

Question 8

8ai: The vast majority of students referred to Bulgaria as the country with the lowest biodiversity - a straightforward question requiring careful reading of the graph in the question.

8aiii: Most answers referred to the fact that there was a greater biodiversity of troglobites in Slovenia than in Greece, although some just quoted the figures from the graph directly with no attempt at manipulation.

8b: The concept of niche appears to be understood well, with many answers referring to the role of the organism or species, usually in the context of its habitat, ecosystem or community. 'Environment' was considered to be too imprecise to describe the concept of niche. Some answers also referred to how an organism or species interacts or how it exploits resources in its habitat, although these were infrequent.

8ci: Most answers correctly described endemic with reference to the caves of Slovenia and Croatia, as required by the question.

8ciii: This question required answers that explained how the olms could have evolved, in the context of being geographically isolated and with reference to adaptations previously described. In order to gain full marks, it was necessary to do more than simply relate the sequence of events involved in natural selection, students were expected to pick up on the adaptations that would have been beneficial in a cave ecosystem and to tell the story with that in mind.

The starting point of genetic variation within the population of amphibians was not seen as often as expected. However, many answers did reference selection pressures and geographical / reproductive isolation. The beneficial characteristics that would have aided survival were rarely described despite them having been listed earlier in the question. Most candidates still a mark for

the idea of a beneficial characteristic or allele – though a significant number lost the mark for describing a 'beneficial gene'.

Not all answers referred to both 'survive' and 'reproduce' which resulted in the mark being lost. Many referred to the passing on of genes to offspring, even though they would then follow this up with the idea of a change in allele frequency over time. In order to gain the mark for a change in allele frequency, it was necessary to put this in the context of time, or over a number of generations.

Paper Summary

In order to improve their performance students should:-

- Read all of the details in the questions carefully and double check the context of the question.
- Do not 'skim read' - make sure to read every word, e.g. 'this' and 'these' are easily overlooked and can define the whole nature of the question.
- Answer the question being asked, with reference to the actual context and not the question you wished the examiner had asked!
- Develop a familiarity with the terminology encountered at this level and learn how to define key phrases accurately.
- Try for shorter, more precise sentences. Rambling can lead to contradictions which can lose marks.
- When underlining key words in a question, try to refer to them when writing the response.
- Review all of the recommended core practicals with particular reference to the process of practical investigations.
- Gain practice at interpreting information presented graphically and in tables.
- Practice basic mathematical calculations – subtractions, and % differences.