Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International Advanced Level In Biology (9BIO)
Paper 02: Advanced Physiology, Evolution and Ecology

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General Comments

There was a wide range in quality of answers seen by the examiners. Some students had clearly prepared very hard for the examination and presented answers that were detailed, had excellent vocabulary, and showed impressive understanding of all topic areas. Some students showed a degree of inconsistency in their understanding, often scoring well on some topics but leaving blank answers on others. A few students found the paper very challenging and demonstrated only a very basic level of knowledge, often giving GCSE standard answers.

Many students found data analysis questions challenging and also found questions that use command words such as 'discuss' and 'comment on' difficult. Students should try to think carefully about questions and data before rushing answers onto paper. A little bit of extra time spent looking for data patterns can help them to gain valuable extra marks.

Mathematics questions were generally done well, although only stronger students were able to complete the Hardy-Weinberg calculation.

Question 1

(a)(i) Many students were able to correctly identify that the atrioventricular valve will close when the pressure in the ventricle exceeds that in the atrium. A significant number of students, however, confused the atrioventricular valve with the semi-lunar valve.

(a)(ii) Many students were able to correctly identify the sequence of structures that an impulse passes through.

(b)(i) This question tested students' knowledge of how tissue fluid is formed. It also required reference to the information in the question. If a question asks students to 'use information in the question', they should ensure that reference is made to it in their answer. Only stronger students were able to explain that for tissue fluid to be formed, the hydrostatic pressure must be greater than the oncotic pressure. Good answers referred to the lack of plasma proteins in tissue fluid and the permeability of the capillary wall. Some, weaker, students confused the production of tissue fluid with osmosis in plant cells and referred to the movement of water across cell walls.

(b)(ii) This question was well answered by many students. Good answers explained that a lack of protein in the diet would lead to a reduction of plasma proteins and a change in oncotic pressure. Some students incorrectly stated that a low protein diet would lead to an increase in blood pressure, forcing more tissue fluid out.

Question 2

(a) (i) Many students were able to correctly identify that the karyotype was from a human with Turner's syndrome. Some students confused the karyotype with one from a person with Down's syndrome. Students should make sure that they have a thorough knowledge of all topics on the specification.

(a) (i) This question required students to identify how Turner's syndrome is produced. A few students confused the terms monosomy and polysomy.

(b)(i) This straightforward question tested students' knowledge of the terms haploid and diploid. Most were able to recognise that the ovum and secondary oocyte were haploid.

(b)(ii) This question required students to give a basic description of how different combinations of gametes are produced in meiosis. Many excellent answers were seen that fully explained how independent assortment and crossing over occur and many students used vocabulary confidently. Weaker students gave vague answers that often referred to different chromosomes rather than specifically stating homologous chromosomes. A few students referred to gene mutations – the question was focused on the production of different allele combinations. Students are encouraged to use full scientific vocabulary precisely and to add as much depth as possible to their answers.

Question 3

(a) (i) This was a relatively straightforward question that required students to identify the R group on an amino acid. Most were correctly able to identify the methyl group.

(a) (i) This question was found to be surprisingly challenging by a significant number of students. A wide range of incorrect peptide bonds were seen, and several students drew ester bonds. Students should be familiar with how condensation reactions produce polypeptides, polysaccharides, triglycerides, and nucleic acids.

(iii) Only stronger, well-prepared students gained more than one mark on this question. Some of the better answers gave excellent detail, describing the triple helical structure of collagen, and some even described the presence of named amino acids such as proline. Weaker students often left the question blank or described incorrect molecules, such as globular enzymes or cellulose.

(b)(i) Many students were able to rearrange this simple equation, but a surprisingly larger number did not recognise that the unit given for the measurement of the length was cm, whilst the unit for the elastic constant was $N\,mm^{-1}$. Students should be careful to check that units are consistent across all parts of a question.

(b)(ii) Some excellent, detailed answers were seen to this question. Many recognised that that the artery wall would be weaker in people with Ehlers-Danlos syndrome and also recognised the significance of the higher elastic constant. Most also recognised that the pressure in arteries is high so that they are under a high risk of damage when pressure surges.

Question 4

(a) (i) This multiple choice question required students to understand that sympatric speciation is the process that leads to the production of new species without geographical isolation. Some students confused this process with allopatric speciation.

(a) (ii) Many students recognised that it is hard to assign an extinct animal to a particular species as it is impossible to see if they can breed and produce fertile offspring. Some weaker students incorrectly referred to the difficulties in viewing the mosquito, or only referred to breeding, without mentioning the production of fertile offspring.

(a) (iii) Most students were correctly able to state that journals or scientific conferences are used to reach agreement. A few students gave simplistic answers such as 'repeat the work.'

(a) (iv) A significant number of students were able to gain both marks on this question. Many others, however, did not recognise that the genus needed a capital letter, or gave both the genus and species when asked for the genus.

(b)(i) This question tested students' ability to use the Hardy-Weinberg equation. Many strong answers were seen that had well organised working and correctly derived the final answer. A significant number of students did not understand how to use the equation. Students should follow simple steps such as: identify the recessive phenotype and find the frequency; use this frequency to find the value of q; once q has been found, use the equation p+q=1 to find p; then find 2pq and the number of heterozygous individuals.

(b)(ii) This question generated a wide range of answers. Only stronger students recognised that the question asked for the numbers of resistant / non-resistant mosquitoes to be related to the function of the ace-1 gene. Many students gave a correct description of natural selection but did not go on to explain how a change in the structure of acetylcholinesterase enzyme could result in resistance to pesticides. Some excellent answers made the link between the mutant recessive allele and the fact that it would enable acetylcholine to be digested in the nervous system even when pesticide is present. Pleasingly, a significant number of students recognised that the reduction in use of pesticides led to an increase in non-resistant mosquitoes suggesting that the mutation must carry a negative selective pressure when pesticide is not present.

Question 5

(a)(i) Many students understood that the nucleotides in DNA are joined by phosphodiester bonds. A few students confused these bonds with peptide bonds.

(a) (ii) This question required students to give a detailed description of the process of DNA replication. Many excellent answers were seen that described the roles of all

the enzymes, the role of complementary base pairing, and the formation of bonds. Weaker students often failed to name any of the enzymes involved and / or confused the roles of the different enzymes. Another common error was confusion of the role of hydrogen bonds with phosphodiester bonds.

(b)(i) This question required students to use the graph to identify that organisms with larger genomes generally have lower mutation rates. The graph also showed that single stranded nucleic acids have higher mutation rates. Strong answers identified patterns and gave suggestions for these patterns. Most students were able to gain at least one mark. 'Comment on' is a command that many students find challenging – when writing their answers, they should try to identify as many patterns in data as possible and try to make some interpretations.

Question 6

(a)(i) This question tested understanding of the action of neurotoxins. Many students were able to correctly recognise the different functions of cobra venom, nicotine, and lidocaine.

(a) (ii) This question tested students' understanding of the role of acetylcholine. Many were able to correctly identify that it is released by parasympathetic neurones and decreases the heart rate.

(a)(iii) Many students gave excellent descriptions of the events that lead to the release of acetylcholine from neurones. Students should be careful to give precision in their answers. For example, 'calcium ions diffuse into the neurone through voltage gated calcium channels' is a good answer; 'calcium moves in when an action potential arrives' lacks precision and detail. Some students referred to the post synaptic events rather than the release of neurotransmitter. Students should be careful to always read questions thoroughly.

(b)(i) This question was found to be challenging by many students although some excellent answers were seen. Students needed to recognise that increased amounts of capsaicin binding to receptors on the sensory cells would lead to increased release of neurotransmitter and a larger epsp in the sensory neurone. A high epsp would lead to a depolarisation that exceeded the threshold potential (by activating voltage gate sodium channels) and so an action potential is formed that moves along the neurone. Weaker students often gave very confused answers and did not use terms such as action potential, epsp, and depolarisation accurately. It is essential that students are confident when using scientific vocabulary and fully understand each term.

(b)(ii) Many students gained at least three marks on this question. The question showed the effects of using different concentrations of capsaicin on the production of sweat. Strong answers described the data patterns and explained the significance of the overlapping error bars. If error bars are present on a graph, they should be referred to in the answer. Stronger answers also included references to the decline

in response when given a high dose and problems with validity such as small sample sizes and the lack of a control experiment. Good, detailed answers also explained that sweat production would lead to a cooling effect due to the evaporation of water. Weaker answers tended to focus on only one or two aspects, often simply giving descriptions of the data.

Q**uestion 7**

(a)(i) Many students completed this calculation well and understood how to determine the amount of energy transferred from the producers to the primary consumers.

(a) (ii) A significant number of students found this question challenging. Only stronger students recognised that energy is lost from the food chain due to a range of reasons such as movement, undigested or uneaten food, and heat loss. Very few noticed that the question was asking for an explanation for differences in efficiency and so required some idea of why some transfers are less efficient than others.

(b) This question presented students with data about the effect of the distance of a hedgerow on crop growth, wind speed and temperature. Strong answers described the patterns and gave explanations for the effects of the abiotic factors on crop growth. The best answers made links between different factors, for example the links between wind speed, temperature and transpiration rate, and competition for light and minerals close to the hedgerow. Weaker answers tended to give simplistic descriptions of the data without trying to explain the patterns.

Question 8

(a)(i) This question required students to interpret a pedigree diagram to determine the genotypes of the parents. Many students were able to correctly identify the correct genotypes.

(a)(ii) This question required students to determine the genotypes of two of the individuals and then go on to calculate the probability of the next child being a boy with haemophilia. Many students gained all three marks and drew well organised diagrams. Most knew how to use a genetic diagram, although some students gave incorrect genotypes for the parents.

(b) This question required students to look carefully at data for two different anti-clotting drugs and discuss their roles in preventing blood clots for people undergoing kidney dialysis. Most students were able to gain at least one mark for giving some descriptions of the data. Many recognised that both drugs increased the mean time taken to clot blood and that there were overlaps in ranges for the two drugs. Strong answers explained that although drug B had the highest maximum value, drug A was a better choice as there was no overlap with the control group. Many also correctly compared the variation in clotting times seen with the two drugs and the control.

Question 9

(a) Many students were correctly able to explain that auxin is produced in the shoot tip and inhibits lateral bud formation whilst cytokinin promotes lateral bud formation. Some weaker students confused the roles of the two hormones, and a few referred to phototropism.

(b) This question tested students' understanding of the nature of the cell surface membrane and how it allows non-polar molecules to diffuse between phospholipid fatty acid tails, whilst polar molecules need to move through channels by facilitated diffusion. Stronger students often gained both marks. Weaker students sometimes gained one mark for correctly stating that the uncharged auxin molecule will move into the cells by diffusion through the fatty acid tails.

(c)(i) Students needed to draw a tangent to the curve on the graph to calculate the maximum rate of elongation of the cell. Some excellent answers were seen that correctly used a tangent and went on to calculate the gradient. Some students calculated the average rate (by dividing the total elongation over the 60-minute period) rather than the fastest rate.

(c) (ii) This challenging question required students to recognise that the cell wall elongation increased as pH fell below 4.3. The change in pH would activate the expansin protein which would disrupt bonds between cell wall molecules such as calcium pectate and cellulose. The weaker cell wall allows the cell to elongate when water enters by osmosis. Some excellent answers were seen that gained all three marks. Many weaker answers gained one mark for recognising the increase in cell wall elongation when the pH fell.

Paper Summary

In future series, students should try to:

- ensure that scientific language and key terms are used accurately
- try to answer every question rather than leaving blanks
- understand what each comman word requires
- ensure that they have a knowledge of every topic area in the specification
- work through maths questions such as Hardy-Weinberg questions in a step-by-step, methodical way.

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