Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

Autumn 2020

Pearson Edexcel GCE
In Biology B (9BIO/02)
Paper 2: Advanced Physiology, Evolution and Ecology

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General Comments

The examiners were impressed by the high standard of understanding shown by many students. It was clear from the detail shown in answers to many questions that a significant number of students had prepared very thoroughly and carefully for this autumn series of examinations. There were some students who found many of the questions challenging and tended to underestimate the depth of understanding that is required at A-Level. Maths skills were generally very good although a surprising number of students were unable to complete a Hardy-Weinberg calculation. There was strong evidence that centres and students have come to terms with the new styles of questions that were introduced after the reforms and centres are preparing many students very thoroughly.

Question 1

(a)(i) Many students were correctly able to correctly identify that the genetic condition shown by the karyotype was Turner's syndrome, and recognised that it was due to polysomy.

(a)(ii) Many students were able to correctly recognise that the genetic condition would be caused by non-disjunction, although some students thought that it was caused by translocation.

(b)(i) This question tested students' knowledge of the stages of mitosis. Many students had a good understanding of the appearance of chromosomes during each stage although some confused telophase and prophase.

(b)(ii) This question required students to comment on the effects of colchicine on the number of cells in each phase of mitosis. Some excellent answers were seen that correctly referred to the overlapping of standard deviations, and many were able to conclude that mitosis must be blocked in prophase due to spindle fibres not forming. When referring to the standard deviations, a few students referred to the spread of data rather than looking for overlaps and some students did not refer to standard deviations at all. Students should be aware that if standard deviations are referred to in data, it is likely that they will need to use them in their answers. Some students also gave vague references to fewer cells in 'all stages' rather than giving specific examples of each stage.

Question 2

(a) Many excellent answers were seen to this question and it was clear that many students and centres had prepared this topic well. Some students erroneously discussed post synaptic potentials and others discussed the formation of an action potential – students should always read questions carefully before putting pen to paper. Common errors included: referring to sodium ions rather than calcium ions, giving the incorrect ionic symbol for calcium ions (Ca^{+} rather than Ca^{2+}), and referring to the fusion of neurotransmitters, rather than the vesicle membrane, with the cell membrane.

(b)(i) Good answers to this question recognised that DFP would cause the active site of acetylcholinesterase to change shape and thus inhibit the binding of acetylcholine. Some students did not recognise that DFP binds to the R group of an amino acid in the active site and incorrectly suggested that DFP is a competitive inhibitor.

(b)(ii) This question tested students understanding of the role of acetylcholine in the control of heart rate. Strong answers to this question recognised that acetylcholine would remain in the cleft if not broken down and so would keep binding to the SA node. Some students were very confused as to the role of the autonomic nervous system in regulating the heart rate and some confused the SA and AV nodes.

Question 3

(a) Many excellent answers were seen to this question and some students gave excellent explanations of the need for many mitochondria in producing ATP for the active uptake of substances such as glucose. Where students did not gain high scores, it was often for not recognising that the cell was from the proximal convoluted tubule and so would be involved in the uptake of specific substances. Many students were able to recognise that there were many mitochondria and a large surface area due to microvilli but did not go on to relate this to the specific role of this cell.

(b)(i) Many students were able to correctly recognise that facilitated diffusion involves membrane proteins, and substances pass down a gradient. Some students confused facilitated diffusion with active transport.

(b)(ii) Many students were able to correctly explain the role and effects of ADH although some confused the effect of ADH on the permeability of the collecting duct.

Question 4

(a) Where students scored full marks on this question, they gave the specific crosses that provide the evidence (1 v 2 or 3 v 4) and went on to explain what this showed. A common error was to refer to cross 6 v 7, which does not definitively prove that the allele for long fur is recessive. There was some surprising confusion as to the terms heterozygous and homozygous.

(b)(i) Many students were able to correctly deduce the possible genotypes of a male black cat with short fur. A surprising number of students gave the cats genotype as being XX and some gave only one copy of each allele.

(b)(ii) Many good answers were seen to this question that fully explained that only female cats can have two copies of fur colour genes and that male cats are XY.

(b)(iii) Answers to this question were very variable. Some excellent, well organised dihybrid crosses were seen, but many other students did not seem to understand

how to complete a dihybrid cross. Some students tried to do two separate crosses for both pairs of alleles and others did not appreciate that gametes have one copy of each chromosome (and gene.) When setting out genetic diagrams, students are advised to work neatly, to carefully label the phenotypes and genotypes of the parents and F_1, and to also label gametes.

Question 5

(a) Many students showed an excellent understanding of the hydrolysis of triglycerides and correctly drew glycerol and three fatty acids. Some students did not draw carboxylic acid groups and others included water on the right-hand side of the equation.

(b)(i) Students were able to answer this question by either drawing out possible structures of the fatty acids or using the general formulae for saturated and unsaturated acids. This was a difficult question, but many students were able to reach the correct final answer.

(b)(ii) This question required students to look at the effect of temperature on the melting of palm oil and cocoa butter. Many students gave excellent descriptions of the graph and were able to recognise the key differences between the profiles of the two lipids. Excellent answers referred to the effect of the double bonds of unsaturated fats causing the tails to not fit together easily, thus affecting the melting point. Some students confused the fatty acid tails with carbohydrates and discussed the effect of branched and unbranched polysaccharides on hydrogen bonds and melting points.

(c)(i) Many students were able to recognise that the small populations of orangutans would lead to inbreeding depression and a genetic bottleneck. Students should always try to use technical vocabulary, such as bottlenecks and gene pools, in their answers. Some students continue to confuse inbreeding with interbreeding.

(c)(ii) This question tested students' knowledge on how humans and conservation interact. Many students recognised that isolated orangutan populations would be able to interbreed with other populations due to the land bridges. Stronger answers also explained the idea that by giving local people payments they would become stakeholders and so keep maintaining the bridges and have an interest in the conservation.

(c)(iii) Strong answers referred to the role of CITES in regulating trade in species between countries that sign up to the treaties. Some students gave very vague answers that just referred to CITES encouraging conservation – students should be careful to give full detail in their answers.

Question 6

(a) This question tested understanding of the role of voltage gated sodium channels. Many students recognised that voltage-gated sodium channels are open during

depolarisation although some students thought that they were open during repolarisation.

(b)(i) This question required students to compare and contrast the effect of increasing neurone diameter on speed of impulse in myelinated and non-myelinated motor neurones. Some students gave excellent, detailed answers that explored both similarities and differences. A few students did not fully appreciate the command, 'compare and contrast' and only listed similarities or differences. Some students tried to give explanations rather than comparing the two types of neurone – students should make sure that they are fully conversant with the requirements of all command words.

(b)(ii) The examiners were impressed with the mathematical skills of many students who were able to use the equation of a straight line to correctly calculate the speed of an impulse. Where students did not gain full credit, they often gained partial credit for calculating the intercept or the gradient.

(b)(iii) Many students gave an excellent explanation of saltatory transmission linked to the presence of nodes of Ranvier. Most students were able to gain at least one mark and where they did not gain further credit it was typically because their answers gave vague, imprecise statements. Students should always try to use precise, accurate language in answers.

Question 7

(a) This question assessed the understanding of water transport across roots. Many students correctly recognised the path as the apoplast pathway although a few mistook it for the symplast pathway.

(b) Few full explanations of the mass-flow hypothesis were seen, and many students find this topic difficult. There were some excellent explanations that stated how sucrose transport into the phloem affects water potential, osmosis, and pressure. Some students did not appreciate that the question was asking for an explanation rather than a simple description and simply described the flow of sucrose from leaf to root.

(c) This question required students to analyse data about the effect of mistletoe on NPP, transpiration and mineral ion content of apple trees. A wide range of answers was seen and most students gained some credit. Some impressive explanations were seen that correctly explained how mistletoe reduced the transpiration rate of the apple trees and so reduced the transport of mineral ions to the leaves. High quality answers also went on to give examples of how reduced nitrate content would reduce amino acid synthesis and how reduced calcium would affect cell wall production. Weaker answers tended to give descriptions of the data without offering much of an explanation and did not link the transpiration and mineral ion data together.

Question 8

(a)(i) This maths question required students to use a haemoglobin dissociation curve to determine how much oxygen was carried by 100 cm^3 of blood. Many students were able to correctly use the graph, but a significant number found the final calculation difficult, particularly converting between dm^3 and cm^3.

(a)(ii) Many students were able to explain the shape of the haemoglobin dissociation curve, but only stronger students gave a full explanation for the differences between haemoglobin and myoglobin. Some excellent answers were seen that fully explained the biochemical and physiological reasons for the different shapes of the dissociation curves.

(b) This question required students to look carefully at the oxygen dissociation curves of haemoglobin for Tibetans and Europeans. Many students recognised that at low partial pressures of carbon dioxide, Tibetan haemoglobin has a higher affinity for oxygen. Stronger students also noticed that the Bohr shift for Tibetan haemoglobin is more significant and related this to reduced affinity of haemoglobin for oxygen.

(c)(i) The determination of allele frequencies by using the Hardy-Weinberg equation is an important A-Level skill. It was pleasing to see that many students set out their working clearly, showing all the steps of their calculations. Common errors included: not finding the square root of q^2 to determine the frequency of the recessive allele, correctly finding 2pq but not using it to find the number of people, and rounding numbers before the final answer. Numbers should be rounded to the correct number of significant figures at the final step of the calculation

(c)(ii) This question tested students' knowledge of the species concept. Many students correctly recognised that the presence of the allele in modern day Tibetan people and the Denisovans meant that modern humans and the Denisovans must be part of the same species.

Question 9

(a)(i) Many students were able to recognise that the nucleus and mitochondria both have a double membrane whilst the other labelled organelles have single membranes.

(a)(ii) This question tested understanding of the functioning of rod cells. Some students were able to recognise that rhodopsin breaks down when stimulated by light but many also incorrectly thought that this causes voltage-gated channels to then open.

(b) This data analysis question tested understanding of the sensitivity of rod and cone cells, the structure of the retina and the effect of light of different wavelengths on rods and cones. Weaker students gave very simple descriptions of the data and often gave inaccurate descriptions of the locations of rods and cones in the retina.

Stronger students recognised that rod cells are not simulated by red light of wavelength 670 nm but are stimulated by green light of wavelength 525 nm. Some students gave excellent detailed accounts that fully linked all the information given to explain the experimental results correctly.

Paper Summary

In future series, students should try to:

- set out all working for maths questions so that it is clear and structured
- organise genetic diagrams carefully and label them precisely
- be fully aware of what each command word requires
- use precise and accurate language
- ensure that depth and detail in answers is of an A-Level standard.

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