Examiners’ Report
Principal Examiner Feedback

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Introduction

This was the first paper of the examination for the modular Biology specification.

This paper examined content from Unit 1 of the specification. The paper carried 90 marks and consisted of eight questions in various styles similar to those of the questions on the linear paper. Three of the questions were the same as three on the linear paper.

The examining team were pleased with the knowledge and understanding shown by many of the students taking this examination. Many students were able to apply their knowledge and understanding of the relevant biology topics to novel contexts. Many students were also able to apply their knowledge to unfamiliar practical protocols. Most could analyse and evaluate data and information. The responses of many students indicated that centres had worked hard to prepare their students. Most students attempted all questions and finished the paper.

Question 1 was about microorganisms and cell structure. Students were given a diagram of *Euglena* showing detail that would be seen with an electron microscope. Many could correctly show, in (a) (i) that *Euglena* is in the group protoctists, although a significant few opted for bacteria or viruses. For question (a) (ii) nearly all students chose a response indicating that mitochondria are the site of respiration. For (a) (iii) most indicated that the nucleus houses the chromosomes and for (a) (iv) most could indicate the position of the cell membrane. In part (b) students were asked which labelled structures in *Euglena* are found in plant cells and most students correctly chose the chloroplasts. In part (c) students were asked to state the meaning of organelle. This was not so well answered as many thought it was a small organ or gave the answer as 'a particle inside a cell'. Some students correctly said that it was a part of a cell that has a specific function and many also gave an example to support their answer. Part (d) was answered correctly by many students who identified R /flagellum for swimming and U/mitochondria for providing energy. Some lost a mark by referring to producing energy and a few seemed to be guessing. This question was also on the linear paper.

Question 2 was about respiration, energy and the Benedict's test for glucose. Students were given some data about the results of a Benedict's test for four different flavoured waters. For (a) (i) students were asked to give one variable that the teacher controls and most gave time, temperature or volume of one of the solutions. For (a) (ii) most students said that a water bath, or a description of a water bath, would be used to safely heat the boiling tube at 70 ^{o}C. A few incorrectly gave the response 'use a thermometer'. For part (b) many students scored highly. Most identified water B because it went brick red during the Benedict's test and therefore contained the most glucose so would gain more energy from respiration for muscle contraction and the athlete could run for longer. A few incorrectly identified water C because it had no glucose and would not make the athlete fat. Candidates who gave an incorrect water could still gain some marks if they referred to respiration and energy. In part (c) most students referred to people with diabetes benefitting from drinking a flavoured water that does not contain glucose, or that it would contain less energy and help prevent people becoming overweight. This question was also on the linear paper.

Question 3 was also in common with the linear paper. The question was about nutrition in plants. In part (a) students were asked to give the energy conversion that happens during photosynthesis. Many students did not answer this well and instead of giving light energy to chemical energy they referred to heat energy or kinetic energy. In part (b) students were asked how to destarch a leaf. Many said to put the leaf or plant in the dark but failed to state for how long. Some students may have missed the command word did not explain why this would destarch the plant and many referred to the plant not being able to photosynthesise but the required answer was a reference to starch being broken down or used up. Some students confused this with the test for starch and referred to killing the leaf, decolorising it and then adding iodine solution. Some students did not attempt part (b) (ii) where they were shown an experimental set up where part of a leaf had access to carbon dioxide and light and part of the same leaf with access to light but not to carbon dioxide. Students were then asked to indicate the results of a starch test on the whole leaf after 24 hours but many indicated correctly that the part of the leaf that had been outside the jar with access to carbon dioxide would have become black indicating the presence of starch and the part of the leaf without access to carbon dioxide would stain yellow/brown because there was no starch. Most students answered part (c) well – give the functions of two named mineral ions - and the most frequent responses were about nitrate ions and magnesium ions. A few students lost a mark by referring to nitrogen rather than nitrate ions, as did those students who gave phosphorus instead of phosphate for nucleic acids/ATP or cell membranes. They gained the function mark but not the mark for the name of the ion. Part (d) was the most challenging part of the question and there were some good responses indicating that waterlogged soil contains no air so no oxygen, therefore no or less (aerobic) respiration and not enough ATP for active transport of mineral ions into the roots.

Question 4 was about water movement into and out of an amoeba. Students were given a photomicrograph of an amoeba with a contractile vacuole and also given some information about water continually entering the amoeba, water being produced inside the amoeba and excess water being expelled via the contractile vacuole that is moved to the cell membrane. In (a) (i) students were told that the diameter of the contractile vacuole in the image is 9 mm and that its actual diameter is 75 μm and were asked to calculate the magnification. Most students scored 2 marks here and some scored 1 for being out by a factor of 10, or for just carrying out one correct conversion of either mm to μm or vice versa. Most students correctly stated for (a) (ii) that water enters the amoeba by osmosis. Part (a) (iii) was slightly more challenging, but many said that water is produced by respiration but those that said anaerobic respiration lost the mark. Most students correctly stated active transport for (a) (iv) and in part (b) many students deduced that the many mitochondria are for movement of the contractile vacuole. A few gave an incorrect answer for anaerobic respiration, and some opted for other incorrect options such as for osmosis or for diffusion of oxygen. In part (d) students were given a table of data and asked to plot a graph. Many responses showed good graph skills and axes were the correct way around, the scale was suitable, axes were labelled and points plotted correctly and joined dot to dot with ruled straight lines. However, some students lost marks by plotting three lines instead of one line for the mean values; some did not label the axes, and some got the axes the wrong way round. Part (b) (ii) was very challenging and only the very best students answered this well. Many described the trend rather than explaining it but some deduced that as the concentration of salt solution in which the amoeba is immersed increases, less water enters the amoeba as there is less difference in concentration/water potential gradients, so there is less water to be expelled from the amoeba. In part (d) students were asked how reducing the temperature to 5^{o}C would affect the results. Many realised the rate of emptying would be slower/less frequent and tried to give an explanation in terms of molecules having less kinetic energy but they then switched to referring to collision theory of enzyme reactions. However, some students referred to kinetic energy of the water molecules or of less activity of the enzymes involved in respiration so less water made in the amoeba.

Question 5 presented students with an unfamiliar fungus, *A. niger* that may infect maize and peanut plants. They were also told that an unfamiliar bacterium, *Bacillus amyloliquefaciens* is a pathogen of some eukaryotic organisms. Students were given some data about yields of peanuts of uninfected plants, plants infected with the fungus and plants infected with the fungus but then treated with the pathogenic bacterium. Most students carried out the calculation correctly although some lost a mark by not giving the answer to one decimal place as instructed. In (a) (ii) students were asked how adding the bacteria to plants infected with *A. niger* increased the yield and this was challenging for all but the very best students. Many said that the bacteria would add mass to the peanuts. However, a good proportion of answers showed that students had deduced that because the bacterium was a pathogen of eukaryotic organisms it would harm/kill the fungus and so they gained at least one mark. Some went on to say that with the fungus removed the plant could carry out more photosynthesis and use the glucose produced to produce more seeds. Part (a) (iii) was a little easier and many students answered with two correct differences between fungi and bacteria, but some lost a mark by being too vague and not indicating which organism they were referring to, or by getting the differences the wrong way round. In part (b) most students devised two correct safety precautions, mainly referring to masks and gloves or sterilising the peanuts or not touching the peanuts. The final part of this question was the CORMS question and students were asked to design an experiment to find if humidity increased infection of peanut plants with the fungus. Many students scored highly stating the condition to be changed, referring to the same species/type of the peanut plants (or the fungus), carrying out repeats (at each humidity), stating a suitable time and a method of measuring infection such as measuring how many stems or seed pods were rotted, and giving two control variables – light intensity and another such as temperature. Some students lost marks by not clearly stating that the repeats were for each humidity level, or by giving a vague answer about how to measure infection. Some knew what the acronym CORMS represented but then said 'leave for a suitable stated time' instead of actually stating a suitable time.

Question 6 was about the effect of light intensity on gas exchange in a leaf. Students were shown a protocol involving a leaf in a sealed tube with some hydrogencarbonate indicator solution, which was moved to different distances from the lamp. Students were told that hydrogencarbonate indicator solution is red when neutral pH and purple when alkaline. The table of data gave times taken for the indicator solution to change from red to purple at different distances from the lamp. In part (a) most students gave two correct variables that should be kept constant, but some incorrectly gave distance from the lamp or light intensity, which was the independent variable. In part (b) students were asked to explain the results but many just described them. However, some students deduced that the further away the lamp the lower the light intensity and the lower the rate of photosynthesis so the longer it took for the indicator to become purple because the rate of uptake of carbon dioxide is slower. Many also deduced that at distances less than 13 cm light was no longer the limiting factor and these were excellent responses. Unfortunately, some students thought that the indicator change colour due to oxygen being added rather than because carbon dioxide is absorbed by the leaf. Some students also became confused and referred to the leaf producing carbon dioxide. In part (c) students were given a diagram of the internal structure of a leaf, as a prompt, and were asked to explain how a leaf is adapted for gas exchange. Some students may have misread the question or else simply trotted out a learnt response about how the leaf is adapted for photosynthesis, rather than for gas exchange. They still managed to gain a few marks for correct references to stomata and air spaces but their responses about transparent cuticles/epidermis and numbers of chloroplasts did not gain them any credit.

Question 7 was about the human respiratory system. Students were given a diagram of a human thorax and asked to name a structure that was the trachea. Many got this right, but a surprising number gave oesophagus as their response. Students were then asked to describe the role of intercostal muscles and the diaphragm in breathing out. Some did not read the question carefully and described breathing in and some lost marks by being rather vague and referring to volume and pressure changes but not linking them to the thorax / chest cavity. However, there were some good responses indicating good knowledge and understanding. Students were then given a diagram of an alveolus with a surrounding capillary. They were told the radius of the alveolus and asked to calculate the surface area, for which they were given the formula to use. Most students gained full marks here. Students were then told that there are about 700 million alveoli in a pair of human lungs and were asked to calculate the total surface area in m^2. They were told that there are 1×10^{12} μm^2 in 1 mm^2. Many students multiplied the value for surface area of one alveolus by 700×10^6 and then divided by 10^{12} and arrived at the correct answer. However, some students omitted one step or got their sums upside down. For the last part of this question students were asked how structures in the human lungs enable efficient diffusion and gas exchange. Many students sensibly used information from the earlier part of the question and explained that alveoli have a large surface area to volume ratio as they are small and having so many alveoli gives a very large surface area for gas exchange. They could also see from the diagram that alveoli are very close to capillaries, and they should recall that alveoli and capillaries both have very thin walls so giving a short diffusion distance. The diagram should also have prompted them to recall that the flow of blood in capillaries maintains a concentration gradient. Some candidates gave answers that showed excellent knowledge and application, and these responses were credited – such as moisture preventing alveoli sticking together, which would reduce the surface area, and some referred to the temperature inside the body giving molecules more kinetic energy so increasing the speed of diffusion. Some students lost a mark by referring to alveoli cells as having thin walls rather than alveoli walls being one cell thick.

Question 8 was about respiration. Students were asked to complete twoword equations for anaerobic respiration – one for plants and one for animals. Nearly all gave the correct response of lactic acid/lactate for animals but some were confused about anaerobic respiration in plants and gave either carbon dioxide and water or ethanol and water as their answer, but a good number gave ethanol and carbon dioxide. For part (b) students were asked to complete a table about features of anaerobic and aerobic respiration in human muscle cells. This required some application of their knowledge, particularly for row three which asked if gas exchange occurs. Good students realised that as there is no oxygen used, and no carbon dioxide produced in anaerobic respiration then there is no need for gas exchange, so gas exchange occurs only in aerobic respiration. Many students correctly stated that only aerobic respiration occurs in mitochondria and that anaerobic respiration produces an oxygen debt.

Summary

Based on their performance on this paper, students are offered the following advice:

- read each question carefully and note any special instructions such as giving a numerical answer to a certain number of decimal places
- always show your working for calculations as you may then score some marks for process even if you get an incorrect answer
- identify the command word and when asked for an explanation of the results of an investigation do not just describe the results
- study the meanings of the command words that may be used in an exam; these are given in the specification
- write in detail and use biological terminology such as trachea rather than windpipe
- avoid referring to 'producing energy'. It is fine to say that respiration produces ATP but when referring to energy say that respiration releases energy
- read through your answers and check that they make sense and that you have covered everything you have been asked to do
- look at the number of marks allocated to the question part and think about whether you have given enough information to gain that amount of marks
- for experimental design questions make sure you write about how to carry out an investigation
- always read the information given in the question stem; it may help you to answer the ensuing questions and help you recall information and apply your knowledge
- make sure you are familiar with the content of the specification and with the mathematical skills you may be expected to demonstrate.

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