Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International Subsidiary / Advanced Level
In Biology (WBI11)
Paper 01 Molecules, Diet, Transport and Health

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Introduction
This is the third exam of the new specification and centres have worked hard to prepare their students. There was a wide range of question types and students were able to demonstrate their knowledge by applying it in a variety of contexts. Some excellent answers were seen and, overall, students coped well with the demands of the paper leaving very few questions unanswered.

Question 1
Many candidates scored full marks on this question which tested their knowledge of components of DNA and mRNA. Marks were lost usually because students used abbreviations for the names of bases (e.g. A for adenine) or included types of bonds in their answer.

Question 2
Parts (a), (b) and (c) were multiple choice questions on the cardiac cycle. The majority of students did well, however, the section on diastole was not well understood.

2(d)
This asked how the events of the cardiac cycle changed when the demand for oxygen increased and required a comparative answer: the cycle would be **shorter / faster** and that the ventricles would contract **harder**. Many students lost marks here because they referred to changes in heart rate (rather than the events of the cardiac cycle) or they suggested that the heart would contract harder. A few gave a detailed account of the cardiac cycle, which had already been tested in parts (a) to (c).

Question 3
This question tested knowledge of enzymes through multiple choice, explanation, and calculation. The two multiple choice questions were well answered.

3(c)(i)
Students were asked to explain the relationship between substrate concentration and rate of reaction shown in the graph. This required an explanation of the first part of the graph, where the substrate was the limiting factor, and the plateau part of the graph, where the enzyme was the limiting factor, but it was rare for students to include both. Where students did attempt the first marking point, they often referred to more substrate rather than more substrate molecules. Some students who understood the process and explained it well missed marks because they did not explain which part of the graph they were referring to.
Many students outlined that an increase in substrate caused an increased rate of reaction but did not explain this in terms of a **greater chance / greater frequency** of collisions between substrate and enzyme; instead stating that there would be more collisions or more enzyme-substrate complexes formed.

A few thought that the graph settled because the substrate had been completely used or described this as the rate decreasing.

This answer achieved full marks, covering all marking points clearly.

> - By increasing substrate concentration, rate of reaction increases, where more substrate molecules available, higher frequency of successful collisions and greater number of enzyme-substrate complexes.
> - The graph levels off, where no change in the rate of reaction with substrate concentration 6.5 a.u., as no more active site available, enzyme concentration is now a limiting factor.

3(c)(ii)
Students were asked to use information in the graph to calculate reaction rate using the formula they were given. This proved challenging for some, as they did not read the correct value from the graph; a common error was to assume V_{max} was 41. If they made an error here they could still achieve one mark for correctly substituting figures into the formula. Some students made simple errors, e.g. multiplying by 4 rather than adding 4 or rounded incorrectly when giving their final answer.

4(a)(i)
Although many students were able to recognise the trends shown in the graph, some did not score well because they did not answer in the form of "compare and contrast the effect of temperature on the solubilities…"
To achieve high marks, the answer should be structured as clear similarities and differences and relate to the effect of temperature, not simply state the relative solubilities of glucose and sodium chloride. As there were three marks available, more able students realised that they were required to give three separate comments. Most realised that the solubility of both materials increased with increasing temperature and many stated that temperature had a greater effect on solubility of glucose than solubility of sodium chloride. A smaller number recognised the linear relationship for sodium chloride and non-linear relationship for glucose.
Providing half of a comparative statement without the second part, e.g. there is a linear increase in solubility of sodium chloride as temperature increases; quoting figures from the graph without manipulating them, e.g. the solubility of glucose **increases to** 300g per 100cm^3 water rather than saying it **increases by** 225g per 100cm^3 water; giving contradictory statements in different parts of the answer, e.g. to say that solubility of glucose increases with increasing temperature but solubility of sodium chloride does not change, and later saying that solubility of sodium chloride increases slightly were common errors.

4(a)(ii)
This required students to know the formula for glucose and use it to calculate the molecular mass. Many did this without difficulty. Those who gave an incorrect formula were given credit when they used it in the calculation, reinforcing the importance of showing your working.

4(a)(iii)
This calculation was answered correctly by the majority of students. The most common error was subtracting the value for sodium chloride, rather than dividing by it.

4(a)(iv)
This question proved more challenging for many students. Some were able to recall that glucose had more polar groups than sodium chloride or were able to name these as hydroxyl groups and knew that these could make hydrogen bonds with water. Common errors included stating that glucose was a polar molecule or that the larger size of glucose molecules would be a barrier to dissolving.

4(b)
Students found it easier to explain the relative solubilities of glucose and fatty acids, with most able to recall that fatty acids have hydrophobic or non-polar tails. Many continued go on to say that these repel water or cannot form hydrogen bonds. A few also remembered that water is dipolar.

Question 5
This tested students' understanding of water potential, a new area of the specification. Although many attempted to explain the movement of water into paramecium in this context, there was some confusion over the correct terms.

5(a)(i)
Almost all students were able to recognise that osmosis was the explanation for water moving into the paramecium, and many correctly explained the water potential gradient between the cytoplasm and pond water. Where this mark was lost, it was often for not clearly stating that pond water had a higher water potential.

5(a)(ii)
Many students used the information in the stem of the question to consider what would happen if the contractile vacuole did not remove the water that was entering by osmosis, realising that the paramecium would swell and burst. Some students were able to deduce that the lack of a cell wall was a critical feature in this process. Some students incorrectly described the contractile vacuole as preventing the uptake of water or thought that the water entering by osmosis was bringing food and oxygen for the paramecium.

5(b)
This was the first of the levels-based questions and required students to use the information in three graphs to explain the results of an investigation. Almost all students used information from every graph in their answer and most achieved level 1 by describing the trend in each graph.

To achieve level 2, students needed to explain the uptake of water in terms of the relative water potential of solutions A and B, the pond water and the cytoplasm. Many were able to do this, but the most common mistake was to state that a solution was hypotonic without including a **comparative statements**. Most did not realise that the pond water graph was there as a baseline or control; some students described it as being the most suitable environment for the paramecium. Many incorrectly interpreted the constant rate of vacuole emptying in pond water as indicating that the pond water was an isotonic solution.

To achieve level 3 students had to include all components of the explanation: to describe the graphs for solutions A and B, deduce that more or less water was entering the paramecium and explain this by comparing the water potentials of solutions A and B with the cytoplasm.

Question 6
Although this question looked very straightforward, students lost marks because they did not use the correct terminology or recognise that human studies are complex and involve many factors which are difficult to control.

6(a)
Many students correctly recognised that high salt intake increased the hazard ratio for all diseases, and hazard ratio for coronary artery disease was the most affected. The most common errors were to give partial conclusions, e.g. high salt intake increases hazard ratio of coronary artery disease, and to answer in terms of the risk of contracting the disease rather than risk of death from it, e.g. high salt intake increases coronary artery disease the most.

6(b)(i)
Most students realised that smoking would increase risk of death and wrote detailed accounts of how this might happen. Although this allowed them to score one mark, it did not answer the question. To achieve full marks, they needed to say that both age and smoking increased the hazard ratio and that they should be controlled to make the investigation valid. It was relatively common for students to refer to the hazard ratio in terms of smoking and not age or mention hazard ratio. Validity was not mentioned often.

6(b)(ii)
Almost all students could give an example of other factors which should be controlled. Where marks were lost it was for imprecise answers, e.g. diet, rather than level of fat in diet; exercise, rather than level of exercise; or lifestyle.

6(c)
Only a small number of students realised that the hazard ratio for low salt intake had been standardised at 1.00 for each cause of death to act as a baseline for comparison with the effects of high salt intake.

6(d)(i)
This was a question for those who had a definition of correlation. The most common error was to use a phrase which implied causation, e.g. a change in one factor leads to a change in another. The most accurate answers were simple and clear, as demonstrated in the following example.

> the change in one variable is accompanied by a change in another.

6(d)(ii)
Two different ideas were given credit here. The first, that complex human studies are unreliable because it is impossible to control all the variables, was very rarely seen. Some students gave examples of variables which they suggested may not have been controlled e.g. gender, diet etc, but this was not given credit as we do not know this.

The idea that results are less reliable when people are asked to self-report, e.g. about the amount of salt they eat, or how much they smoke was seen more often.

The most common response speculated a small sample size or that the length of the study was too short. This information was not provided as facts in the question so could not be awarded marks.

Question 7
This question tested a new area of the specification and it proved challenging for many students.

7(a)(i)
Some students gave a full definition of partial pressure or stated that it was a measure of concentration of oxygen. Although it is a very common term when considering oxygen dissociation curves, a significant number were unable to explain it.

7(a)(ii)
This question required students to link the structure of haemoglobin to the shape of the oxygen dissociation curve. The most accurate answers started with key information about haemoglobin, e.g. that it has 4 subunits so could bind to 4 oxygen molecules, describing co-operative binding (that it is hard for the first oxygen molecule to bind, but progressively easier for later oxygen molecules) and explained this through the conformational change in the shape of the haemoglobin molecule. Some students correctly explained the plateau at high partial pressures of oxygen as being due to the saturation of the haemoglobin molecules.

Describing the binding of the second and third oxygen molecules as easier without saying that the binding of the first molecule was difficult and or stating there was a change of shape rather than a conformational change or change in tertiary structure were the most common errors. A significant minority confused haemoglobin with red blood cells and described haemoglobin as biconcave in shape.

7(b)(i)
The most common answer to this question was to state that alveoli were very small and must, therefore, have a low partial pressure of oxygen. A few students realised that partial pressure would be lower if oxygen was being moved out of alveoli eg. into the blood or into cells for respiration, or if other gases eg. carbon dioxide or water vapour increased in concentration.

7(b)(ii)
Lack of understanding of partial pressure caused difficulties for some students in this question. The most common correct responses involved oxygen diffusing out of capillaries and into cells where it was used for respiration, although some lost a mark by referring to movement, not diffusion. Some realised that this was due to a difference in partial pressure of oxygen between the blood and the cells. A few students correctly stated that carbon dioxide entering the blood from the cells would also decrease the partial pressure of oxygen.
A number of students answered the wrong question here and wrote about why the blood pressure decreases as blood flows from arteries through capillaries to veins.

7(b)(iii)
The majority of candidates were able to correctly use the information in the two graphs to determine the percentage saturation of haemoglobin in the blood as it leaves the lungs; reading a ppO_2 of 6.2 kPa from the oxygen cascade graph and then a % saturation of 81% on the oxygen dissociation curve.

7(b)(iv)
This question referred to the oxygen cascade graph and required students to explain why the percentage saturation of haemoglobin was so much lower at high altitude than at sea level. Although most students knew that there is less oxygen available at high altitude, they did not go on to explain the consequences of this; that the partial pressure of oxygen in the alveoli will be lower, so the concentration gradient between the alveoli and the blood will be lower, and therefore the rate of diffusion of oxygen into the blood will be slower. Some achieved a mark for realising that if less oxygen is available, the haemoglobin will not be able to bind to as much oxygen. However, some repeated the information in the stem (that there is lower percentage saturation of haemoglobin) without linking this to less oxygen binding and did not get credit for this.
A lot of students gave irrelevant information about adaptations to life at high altitude (increased numbers of red blood cells, amount of haemoglobin and lung capacity) or explained the Bohr shift. A few students thought that sea level meant underwater and struggled to gain any marks by using this context.

8(a)(i)
Many students were able to correctly measure the diameter of the lumen in both diagrams and use these values to calculate percentage decrease. The most common errors were incorrect measurement (although it was still possible to score one mark for the calculation if workings were shown), errors in the formula used for calculating percentage decrease, and rounding errors.

8(a)(ii)
This was the second of the levels-based questions. Many students have a very good understanding of the causes and effects of cystic fibrosis and wrote about this at length. However, to achieve more than level one, students were required to answer the question that was set, which was to explain why cystic fibrosis caused the differences shown in the diagrams. The best answers identified the differences (inflamed muscle, increased mucus and narrowed lumen in the person with CF) and used their knowledge of cystic fibrosis to explain this. In general, students were more able to describe the processes leading to narrowing of the lumen than how sticky mucus led to bacterial infection and inflammation. Some students referred to the CFTR protein being mutated, not the gene, and a few referred to blockage of an artery with mucus, rather than the trachea; however, overall this question was answered well.

8(b)(i)
Students were asked to explain how identification of carriers through genetic screening could contribute to the reduction in number of babies born with cystic fibrosis. It was clear some students did not understand that the carriers were the potential parents and thought that the screening was pre-natal. The majority of students scored at least one mark on this question by suggesting that carriers may decide not to have children, to use IVF or PIGD techniques or to opt for termination

if embryos were identified as having cystic fibrosis. A minority incorrectly wrote that cystic fibrosis could be eliminated by gene therapy.

8(b)(ii)

Most students could identify and describe at least one ethical issue associated with genetic screening. Some students assumed that this question only involved pre-natal screening, e.g. amniocentesis or CVS, but issues associated with all forms of screening gained credit. The most common error was to state that screening increased the risk of miscarriage without linking this to amniocentesis or CVS. There were some thoughtful and well-articulated answers, showing that students were able to recognise the moral and social dilemmas involved with this technology.

Paper Summary

Teachers can help students to improve their performance on this paper by taking note of the following points:

- look carefully at the command words in the question and make sure that you are giving the right type of response.
- always show working in calculations as marks are often given for intermediate steps.
- in numerical questions ensure that the final answer is given to an appropriate number of decimal places. If rounding is necessary, make sure that this is done correctly.
- make sure that you are applying your knowledge to answer the question that has been set, rather than writing everything you know about that topic.
- answers often require comparative statements, particularly when describing graphs or changes, so make sure that you are using comparative words eg. faster, more slowly, less often etc.

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