

Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International A Level
in Biology (WBI01) Paper 01

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Overall Impressions

This paper tested the knowledge and understanding of the two AS topics: 'Lifestyle, health and risk' and 'Genes and health', together with elements of How Science Works. The range of questions provided plenty of opportunity for students to demonstrate their grasp of these AS topics. On the whole, students coped extremely well with this paper, finding most of the questions straightforward to tackle; indeed there were very few examples of questions not being attempted at all, with all questions achieving the full spread of marks.

It was good to see how well many students could recall several areas of the specification in a good level of detail, including the core practical for measuring the heart rate in *Daphnia*. It was also very pleasing to see few students losing marks for poor quality of written communication (QWC) with answers often set out in a logical style with key biological terms spelt correctly.

Some students let themselves down by not reading the questions carefully enough, or by providing a response without the precision required at this level. Many students have clearly made good use of past papers and mark schemes, but it is important for students to understand the scientific principles covered in the specification so they can apply them to new contexts and not write a rehearsed answer to a question that has been asked in the past.

Individual Questions

Question 1(b)i

Students are asked to explain the meaning of the term, semiconservative replication. One mark was available for an explanation of semiconservative and a second for replication. Many students expressed the idea of semiconservative gaining mp2. However, a large number struggled to explain the idea of replication, often simply repeating the term.

(b) Meselson and Stahl carried out an experiment that demonstrated the semiconservative replication of DNA.

(i) Explain the meaning of the term **semiconservative replication**.

(2)

Semiconservative replication is a replication where there is one original strand of DNA and a new strand of DNA which is complementary to the original strand. Adenine pairs with thymine and cytosine pairs with guanine.

(b) Meselson and Stahl carried out an experiment that demonstrated the semiconservative replication of DNA.

(i) Explain the meaning of the term **semiconservative replication**.

(2)

This is the type of replication where each of the new DNA molecules produced contains one strand from the original DNA and one from the new strand. This means half of the new DNA is from the original DNA.

Students are asked to compare the structure of saturated and unsaturated lipids. Many students correctly ascribed carbon double bonds to unsaturated lipids (MP1). A large number of students attempted mp2 and mp3. However, they often failed to gain credit due to a lack of precision in their answers. In particular, simply stating saturated lipids have more hydrogen or are kinked is not sufficient. Students needed to clearly express that the ratio of hydrogen to carbon is higher in a saturated lipid for mp2 and that it is the fatty acid chains that are kinked in an unsaturated lipid.

Question 2(a)ii

In the next example, the student did not gain either mp1 or mp2. In order to gain mp1, the student needed to identify the double bond as being a carbon double bond. To gain mp2, the student needed to make it clear that the hydrogen to carbon ratio is higher in saturated lipids.

(ii) Describe how the structure of a saturated lipid differs from that of an unsaturated lipid.

(2) Q02aii

A saturated lipid does not have double bond whereas an unsaturated lipid has double bonds. A saturated lipid has more hydrogen atoms (H) than an unsaturated lipid.

Question 2(b)

Many students scored well in this question, often addressing all four available mark points and gaining the maximum mark of 3. Some students confused glycogen with starch. This sometimes restricted the award of marks as mark points could not be awarded if information was provided with inappropriate reference to amylase and amylopectin.

In the first example, one mark was awarded for the statement that it's made from glucose (mp1). The rest of the response refers to amylase and amylopectin so no further marks could be awarded.

(b) Describe the structure of glycogen.

(3) Q02b

~~made up of compact Amylo~~

made up of glucose monomers. Contains both

Amylose (1,4) glycosidic links, straight chain that

Spirals = compact and also Amylopectin which is

a branched chain of glucose monomers, with (1,4)

glycosidic and (1,6) glycosidic bonds

It's compact.

The second example addressed all four mark points and gained the maximum of 3 marks.

(b) Describe the structure of glycogen.

(3) Q02b

Glycogen contains both 1-4, glycosidic bond and 1-6, glycosidic bond. They are made up of monomers of glucose. They are branched.

Question 2(c)

Most students gained mp1 and mp2 for a description of the trend in utilisation of carbohydrate and fat as intensity of exercise increased. The third mark point proved more difficult to award. Students were required to use the data to compare percentage energy obtained from both lipid and carbohydrate.

Using the information in the table, describe the effect of the intensity of exercise on the percentage of energy obtained from lipids and carbohydrates.

(3)

As the intensity of exercise increases, the percentage of energy obtained from lipids decreases while the percentage of energy obtained from carbohydrates increases. There is a higher energy obtained percentage from carbohydrates, in general, than from lipids.

Using the information in the table, describe the effect of the intensity of exercise on the percentage of energy obtained from lipids and carbohydrates.

(3)

As the intensity of exercise increases the energy obtained from lipids decrease and energy from carbohydrates increase, from 40% carbohydrates used at 20 arbitrary unity to 100% used carbohydrates at 100 arbitrary units increasing by 60% while in lipids it decreased from 60% to 0%. This indicates that carbohydrates are easily and quickly broken down to provide energy, but lipids for respiration, but lipids are slower to break down but provide more energy for respiration.

Question 3(b)ii

Many students struggled to express their ideas clearly and did not gain credit for their responses. Few students were able to suggest that the risk of death from CHD was greater at each cholesterol concentration in Asia (mp1). The second mark point was more accessible, however students needed to compare the two.

- (ii) Describe how this relationship differs from that shown for people living in Australia and New Zealand.

(2)

Generally, the risk for death from CHD is lower for the people living in Australia and New Zealand for the same quantity of mean cholesterol level. While for the people living in Asia, the risk of death increases continuously with increasing blood cholesterol, for the people living in Australia it decreases between $4.95 - 5.4 \text{ mmol dl}^{-3}$ of mean blood cholesterol.

Question 3(b)iii

Students are asked to suggest an explanation for the difference in the data. Many students were able to suggest an appropriate risk factor other than cholesterol in the diet. However, a disappointing number of students suggested different lifestyle or differences in the amount of cholesterol consumed, neither of which was accepted.

In the first response, the mark was awarded for reference to different diets. It could also have been given for different amounts of exercise. It would not have been given for different lifestyle.

- (iii) Suggest **one** explanation for the difference in the relationship for these two groups of people.

(1) Q03biii

The two groups of people will have a different lifestyle such as their diet and how much they exercise.

- (iii) Suggest **one** explanation for the difference in the relationship for these two groups of people.

(1) Q03biii

They are from 2 different continents, therefore their lifestyle and culture is different, which affects the death rate.

Question 3(b)iv

To gain the mark for this question, students needed to explain how the graph could be used to improve health. Simple suggestions, for example, that people in Asia could exercise more, were not accepted.

In this example, the student has identified that there is a greater risk in Asia and has suggested a change, therefore was awarded a mark.

(iv) Suggest how the information in the graph could be used to improve the health of people living in Asia.

(1)

The graph shows that the risk of death is higher in Asia. Using this information, the health care & Medical arrangements in Asia could be improved, in order to improve health.

Question 4(a)

A surprising number of students could not draw an amino acid.

Question 4(b)

In this question, students were required to describe the role of RNA in protein synthesis. Many students produced excellent answers that succinctly and accurately described the role of mRNA and tRNA in protein synthesis. However, a large number of students gave excessive details about mRNA synthesis or described t post-translational events, neither of which were required. Few students clearly expressed the idea that mRNA carries the code for a protein, for mp2.

*(b) Describe how RNA is involved in the synthesis of proteins.

(5)

~~RNA polymerase~~ DNA double helix unwinds and hydrogen bonds between bases break. Free nucleotides from the nucleus pair up according to the base pairing rule. RNA polymerase helps to catalyse the reaction. This process is called transcription and produces mRNA. Transcription stops at the stop codon. When transcription stops, the mRNA detaches and leaves the nucleus through pores. The mRNA moves to the cytoplasm where it attaches with a ribosome. tRNA binds with the ribosome and mRNA. Each tRNA carries 1 amino acid, which codes for the anticodons on each tRNA. The ribosome moves along the mRNA to produce proteins by joining the amino acids from the tRNA molecules with peptide bonds. This process is called translation, where polypeptide chains are formed. Each polypeptide chain according to the sequence of amino acids it has forms a protein.

Question 4(c)

Many students gave a detailed explanation gaining all 3 marks available. All four mark points were frequently observed. The descriptions in terms of lock and key for mp4 was accepted. However, descriptions in terms of, no formation of enzyme-substrate complex, or, absence of an induced fit would be preferred.

In the example below, all four mark points are addressed and the student was awarded the maximum of three marks.

(c) Explain how a change in the DNA sequence of the PAH gene might lead to a loss of enzyme activity.

(3)

Mutation causes change in nucleotide sequence. So mRNA with wrong sequence of ^{triplet} triplet codons is synthesized. Wrong primary structure of the protein is synthesized. So folding in tertiary structure is different which changes the shape of the active site of the enzyme. Enzyme active site is no longer complementary to substrate. No enzyme-substrate complex form so enzyme is inactive.

In the example below, a change in 3D structure was accepted for mp2. However, the description of a change in active site was not sufficient for mp3.

(c) Explain how a change in the DNA sequence of the PAH gene might lead to a loss of enzyme activity.

(3)

If a mutation occurs, there could be a change in the ^{final} 3D structure of the enzyme and it's not able to work properly. Or may be there is a change on the active site, or the properties have change like being soluble.

Question 4(d)

This question assessed the students' ability to link phenotype to genotype. Few students scored both marks. Many simply restated that the parents must be carriers to have a child that is affected and gained no marks.

In the example below, the student correctly identifies the affected child as being homozygous recessive. However, they then fail to make the same type of link for the parents, i.e. identify that because they are not affected they must be heterozygous for the trait.

Explain why this pedigree diagram shows that individuals 5 and 6 are carriers of the PKU disorder.

(2) Q04d

Because individual 8 is affected by PKU meaning she/he is diseased. Individual 8 is homozygous recessive for PKU. In order for individual 8 to be homozygous recessive, both parents (individuals 5 and 6) have to be carriers ~~or diseased~~

In the example below, the student has linked phenotype to genotype for parents and the affected child, gaining both marks. ____

Explain why this pedigree diagram shows that individuals 5 and 6 are carriers of the PKU disorder.

(2) Q04d

If the disease is in the recessive allele then for the disease to be present the person should have homozygous recessive. Since 5 and 6 do not have the disease and 8 has the disease 5 and 6 must be heterozygous. Since the dominant allele ~~is~~ is normal they appear normal.

Q04 Total

Question 5(a)

This question addressed a familiar topic and was answered well by many students. A number of students failed to be clear enough in their descriptions to gain some of the marks. In particular, many students insist that alveoli and capillaries are one cell thick. This was not accepted for mp4. Thin walls, or walls that are one cell thick, would be accepted. At this level we require a better description, e.g. the walls of the alveoli are thin, comprising a single layer of flattened epithelial cells. Numerous students described the breathing system in detail, which was not required, and gained no credit.

In the example below, the student has addressed mp2, 3, 4 and 5. Throughout the explanation, the student has tried to link structural features with increased diffusion of gases. The reference to small air sacs called alveoli was not sufficient for mp1.

5 Living organisms exchange gases with their environment.

(a) Describe how the structure of the human lungs is adapted for efficient gas exchange.

(4) Q05a

The human lungs are lined with small air sacs called alveoli. This increases the surface area of the lungs allowing maximum gaseous exchange. The alveoli are surrounded by a network of capillaries. This ensures fast diffusion of gases such as oxygen and carbon dioxide as it maintains a steep concentration gradient. Furthermore, both the capillary wall and wall of the alveoli are each only one cell thick. This reduces the distance in which the gases have to diffuse across ensuring the exchange is fast.

Question 5(b)

Most students gained at least one mark for this question, correctly identifying the relatively large surface area to volume ratio (mp1). A number of students also gained a second mark by suggesting that diffusion by itself was sufficient (mp2). A number of students failed to gain the second mark because they did not convey the idea that diffusion alone was sufficient. For example, 'so diffusion is rapid', is not enough for mp2.

In the example below, the first sentence gains both mp1 and mp2.

Suggest why *C. elegans* does not need a specialised gas exchange system.

(2)

C. elegans have a large surface area to volume ratio thus diffusion is sufficient to maintain life processes. Adult *C. elegans* only have about 1000 cells, which mean they are small. Short diffusion distances inside the body so a specialised gas exchange system is not required.

Question 6(a)

Most students gained two marks for this question (mp1 and mp2) and many of them, were able to gain the third mark point. When students did not gain the mp3, it was usually because their description of the arrangement of the phospholipids was ambiguous. Very few students drew a diagram, which would have allowed them to gain mp3. Very few students addressed mp4.

Question 6(b)

Many good answers were seen in which students made reference to lipids moving in the plane of the membrane (mp1) and the scattered appearance of proteins in the membrane (mp2). A number of students mentioned proteins in the membrane but did not convey the idea of the randomness of appearance and so did not gain mp2. Many students seemed to have little idea about the meaning of the term, fluid mosaic.

The response below gained both mp1 and mp2.

The majority of students made an attempt at the question and provided a confused description of the membrane structure. Others completed a description and provided a drawing of the membrane but did not address the question.

(b) The fluid mosaic model can be used to explain the properties of a cell membrane.

Explain what is meant by the term **fluid mosaic**.

(2)

Fluid ~~ref~~ refers to the flexibility and fluidity brought about by the phospholipids that can move to a certain extent. Mosaic refers to the random distribution of proteins (intrinsic and extrinsic) in ~~and on~~ the bilayer.

The response below gained one mark (mp1). However, the student used the term, mosaic to describe protein distribution rather than explaining what this meant, so the second mark (mp2) could not be awarded.

(b) The fluid mosaic model can be used to explain the properties of a cell membrane.

Explain what is meant by the term **fluid mosaic**.

(2)

It is called fluid mosaic because of the phospholipids' movement similar to a fluid and the proteins embedded inside the phospholipids like a mosaic.

Question 6(c)i

Students giving responses in terms of permeability often gained both marks, frequently gaining mp1 and 2 in a single sentence. Many students simply described the results in terms of intensity of colour and gained no marks.

In the example below, the first sentence gained mark point 2. Although not expressed as clearly as possible, the second sentence was accepted for mark point 3.

- (i) Using the information in the table, describe the effect of alcohol on the permeability of beetroot cell membranes.

[2] Q06ci

As the concentration of alcohol increases, the permeability of beetroot cell membranes increases. When alcohol concentration increases from 0% to 10%, the intensity of colour stays the same at 0.03 arbitrary units, same permeability.

Question 6(c)ii

Many students gained both marks (mp1 and mp2) for the effect of increased temperature on the experiment. Fewer students gained marks for the second part. Frequently, students failed to recognise that the question was about controlling cube size and that only one cube was involved. Those students often suggested that for a smaller cube, the surface area to volume ratio will increase so the intensity of the colour increases, gaining no marks. A number of students gave explanations without describing the effect on the results.

In the example below, the student gained one mark (mp 1) for the first part and two marks (mp3 and 4) for the second part.

(ii) The temperature of the solutions and the size of the beetroot cubes should be controlled in this investigation.

Explain how each of the following would affect the results of this investigation.

(4) Q06cii

An increase in temperature = this would denature the proteins in the membrane and so the permeability would increase as there would be gaps in the membrane.

A decrease in size of the beetroot cube = this would have less cells → less ~~vacuoles~~ vacuoles and so less betalain → the color would appear lighter even if there was high permeability.

Question 7(b)

In this question, students could score two marks for a structure linked to a function. Students generally gained the marks for linking thin walls with more efficient diffusion or the presence of pores facilitating rapid exchange of materials between blood and tissue space. Again, capillaries were often described as being one cell thick which did not gain mp1, although it did allow access to mp2.

In the example below, the student gained one mark (mp2), linking increased diffusion to thickness of the wall. However, the wording of the first statement was not sufficient for mp1.

(b) Explain how the structure of a capillary is related to its function.

(2)

The capillary is one cell thick.

Therefore ^{oxygen} ~~gases~~ can efficiently diffuse across the capillary.

In the example below, both marks were awarded (mp2 and mp1).

(b) Explain how the structure of a capillary is related to its function.

(2)

Function of capillaries is exchange of materials (oxygen, glucose, carbondioxide waste) between blood and body cells. To ensure these substances diffuse at a quick rate walls of capillaries are extremely thin (one cell thick with no collagen muscle). They are also seen to form a wide network to increase surface area.

Question 7(c)

In this question, students were asked to describe the role of heart valves in the cardiac cycle. Many high-scoring responses were seen. In some of the responses, the description did not follow a logical cycle and the QWC mark was deducted.

A number of students described the heart valves in detail but did not describe their function with respect to the cardiac cycle. As a consequence, these responses often scored few marks. A small number of students simply stated that heart valves stop the back-flow of blood and gained no marks.

In the response below, the student gained mp 1, 2, 3, 4, 5, and 6. Mark point 5 was awarded as the student identified the location of the semilunar valves and the direction of flow of blood. Simply stating that 'semilunar valves open to pass blood to the lungs and the body' would not be sufficient by itself.

* (c) Describe the role of the heart valves in the cardiac cycle.

(6)

- In atrial systole both ventricle contracts opening the atrioventricular valve to pass blood to the relaxed ventricles (this takes 0.1 seconds)
- In ventricle systole, atrium relaxes and ventricle contracts closing the ^{cuspid} valve to prevent backflow of the blood to the atrium, and opens the semilunar valve in the arteries (pulmonary artery and aorta) to pass blood to the lungs and all body part. (This takes 0.3 seconds)
- In complete diastole, both atrium and ventricles are relaxed and the cuspid valves are open to refill the ventricles with blood. (this takes 0.4 seconds)

Question 7(d)

Many students gained both marks for this question. Generally this was for suggesting that oxygenated and oxygen-depleted blood will mix and so insufficient oxygen will be delivered to the body. Very few students made reference to reduced systemic blood pressure, mp3.

The example below gained both marks (mp1 and mp2).

(d) A small number of babies are born with a hole in the septum that separates the left and right ventricles. If the hole is not repaired these babies may not survive.

Suggest why these babies may not survive.

(2)

The oxygenated and deoxygenated blood will mix together, no longer kept separate. That means when the right ventricle contracts to pump blood, the muscle/body cells won't be getting enough oxygen to respire and survive. It will also cause breathing problems.

Question 8(a)ii

Many students were able to gain both marks by suggesting smaller increments in salt concentration between 4 and 4.5 g dm^{-3} .

Those students that suggested plotting a graph did not gain any credit, as the question asks for improvements to the experiment.

A typical response gaining both marks is shown below.

(ii) Suggest how the student would modify the experiment to find the concentration of salt solution that burst 50% of the cells.

(2)

The student can ~~test~~ use a greater range of salt concentrations between 4.5 g dm^{-3} and 4 g dm^{-3} . Experiment can be repeated at each concentration for reliability.

In the below response, the student gained one mark (mp 1).

(ii) Suggest how the student would modify the experiment to find the concentration of salt solution that burst 50% of the cells.

(2)

Use a smaller range between salt concentration
i.e. instead of 0.5 g dm⁻³ difference the student
could use a difference of 0.1 g dm⁻³ between
salt concentrations.

Question 8(a)iii

Many good responses were seen for this question, with students using solute concentrations to explain water movement by osmosis into the cells. Common mistakes included students confusing the direction of water movement or solute concentrations. A number of students did not refer to osmosis (mp2). Many students used the concept of water potential to explain the direction of water movement, which was pleasing.

In the example below, all three marks were awarded (mp1, 2 and 3).

(iii) Explain why the red blood cells swell when placed in solutions with a low salt concentration.

(3)

The concentration of salt is then higher in the cell than it is in the outside. It also means that the water potential outside the cell is higher. As the water potential outside is higher, water moves into the cell by osmosis causing the cell to swell up and burst.

In this next example, the student gained two marks (mp1 and 2). The student does not give sufficient information about the direction of the water concentration gradient to get the third mark (mp 3).

(iii) Explain why the red blood cells swell when placed in solutions with a low salt concentration.

(3)

If solution has low salt concentration water will move into the RBC by osmosis due to the concentration gradient ~~is~~ thus causing the cell to burst.

Question 8(b)i

Some students produced good answers for this question. Many, however, ignored the instruction to explain the effect and simply described what was happening. It is important that students read questions carefully.

- (i) Explain the effect four days storage at 4 °C has on the concentration of haemoglobin and potassium ions in the red blood cells.

(3) Q08bi

Haemoglobin concentration stayed the ~~to~~ same because Haemoglobin too big to diffuse out of red blood cell's cell membrane. The Potassium concentration however decrease because it uses active transport, so the ~~concentration goes for~~ potassium moves ^{at the Na⁺, K⁺ pump} from an area of high concentration to an area of low concentration up ~~an~~ concentration gradients. So 100% conc. of Potassium inside cell, therefore, Potassium moves outside of the cell.

Question 8(b)ii

To gain all the available marks for this question, students had to draw together information from different parts of the specification. A pleasing number of answers gaining all three available marks were seen.

The response below is an example of one in which the student has gained all three available marks (mp1, 3 and 4).

Using the information in the graph and table, explain the changes in potassium ion concentration in red blood cells.

(3)

By providing glucose the red blood cells can ~~respire, therefore~~ causing an increase in the concentration of Potassium ions, ~~from~~ to 100% and the control remains at 60%.

This occurs because ~~glucose~~ the RBCs can respire with the help of glucose and ATP is produced, through which RBCs can reabsorb potassium through active transport.

Paper Summary

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

- Read the whole question carefully, including the introduction, to help relate your answer to the context asked. You should read the question through carefully at least once and then write down your knowledge and understanding in a way that answers the question.
- Read your answers back carefully – do they answer the question, have you made at least as many clear points as marks are available?
- When asked to distinguish between two things, make sure your answer is comparative and mentions both things being compared.
- When asked to describe a trend, the question is asking for the overall changes and not a detailed description of individual points on a graph or in a table.
- Include a relevant calculation whenever you are asked to describe or compare numerical data in tables or graphs.
- Don't be afraid to include a sketch diagram or graph if it will help add clarity to your answer.
- When describing the measurement or control of variables, be specific about what is to be measured, e.g. volume or mass, and avoid vague terms such as amount.
- Pay particular attention to your spelling and the use of technical names and terms, as well as the organisation of your answer in QWC labelled extended writing questions.
- Explore and assess examples of student responses from this report. This will enable you to recognise what makes a good response to different types of questions, and allow you to exemplify the level of knowledge and understanding expected at AS level.

Grade Boundaries

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