Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2021

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

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Introduction

This was the sixth WBI11 paper of the new specification in what has been recognised as being a very difficult year for many students and centres. A range of responses were seen on all questions, including the multiple-choice questions, with the paper yielding a wide spread of marks. There were some very good responses to many questions, including the levels-based questions, and centres are using the materials and advice given to prepare students for the exam.

Question 1

This was mostly multiple-choice questions focused on nucleic acids and protein synthesis. Many students showed a secure knowledge of the structure of the different components, but there was more confusion around the antisense strand and the mRNA strand synthesised from this template.

Question 2(a)

Almost all students could calculate the volume of blood passing through the heart in 24 hours, but some did not convert this to standard form as required in the question, losing the second mark.

Question 2(b)

Compare and contrast questions require statements of clear similarity (e.g. they both have collagen fibres) and of difference; in this case, one of each was needed.

Many students gave a list of differences but no similarities. The question asked for a comparison of the **structure** of the two blood vessels, but a large number of students wrote about the function of the blood vessels e.g. where the blood was being carried to, the type of blood transported, the relative pressures involved, so did not gain credit. A number of students appeared to be comparing the arteries to veins.

Question 2(c)

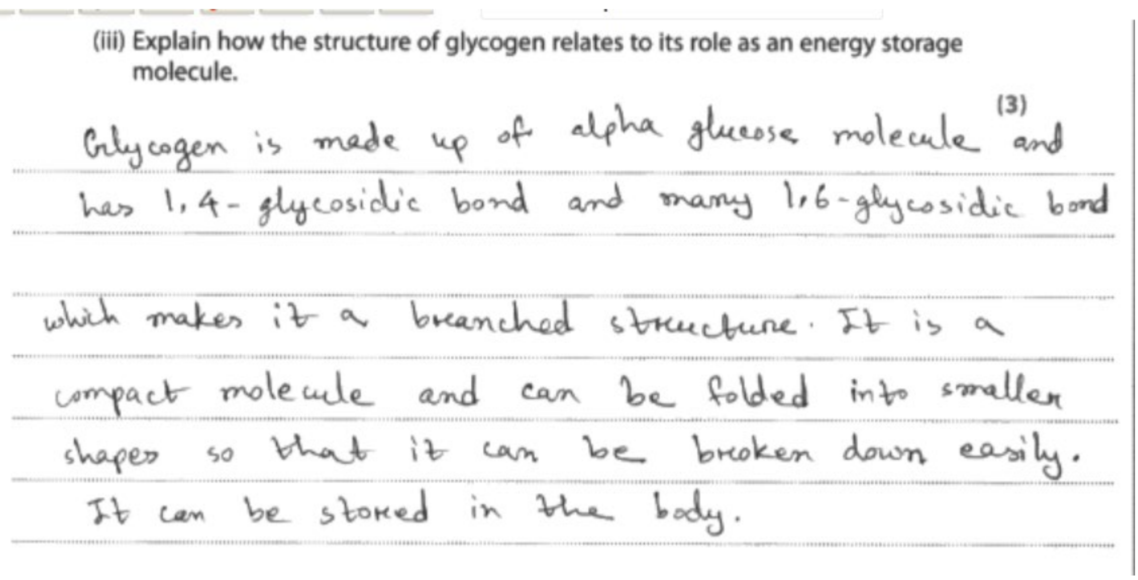
A large number of students knew the structure of the vein and although they found it challenging to add components to the outline diagram, they were able to gain full marks. The most common structures added were valves, which had to be drawn opening in the right direction to gain credit. A smaller number of students added inner layers to the wall. Where students did not add structures to the outline, they were unable to achieve full marks. Labelling was generally very good.

Question 3(a)(i) &(ii)

Almost all students knew that α glucose molecules were joined by condensation reactions and that glycosidic bonds were involved.

Question 3(a)(iii)

Whilst many students knew a lot about the structure of glycogen, this had to be linked to its role as an energy storage molecule to gain credit. Many students gave a list of correct facts about the structure of glycogen but did not link these to energy storage.

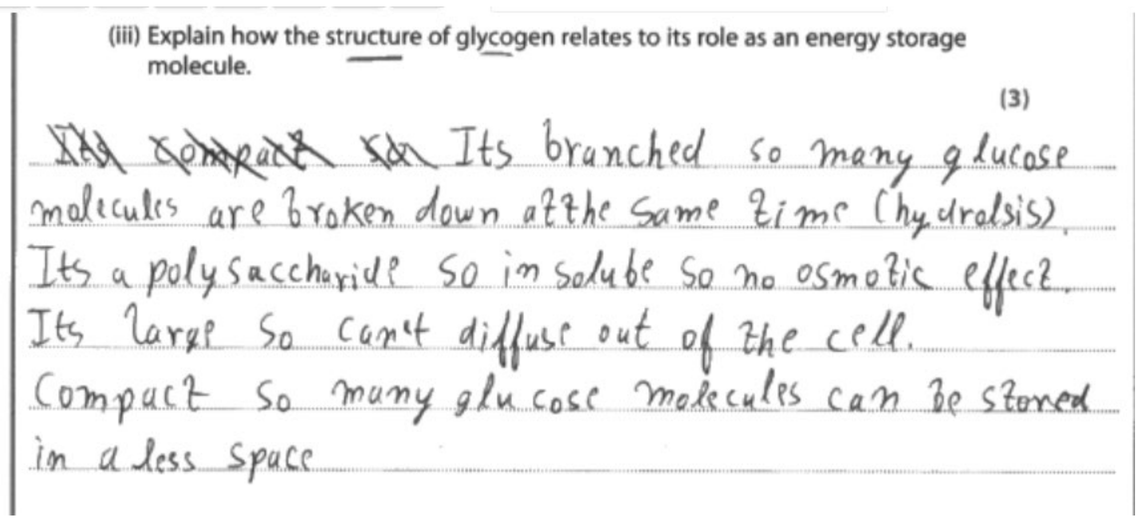


(iii) Explain how the structure of glycogen relates to its role as an energy storage molecule.

(3)

Glycogen is made up of alpha glucose molecule and has 1,4-glycosidic bond and many 1,6-glycosidic bond which makes it a branched structure. It is a compact molecule and can be folded into smaller shapes so that it can be broken down easily. It can be stored in the body.

The most common statement gaining credit explained the way the branched structure led to rapid hydrolysis – no credit was given for "easier hydrolysis" which was seen a lot. While many answers included a reference to glycogen being insoluble or having no osmotic effect, very few students explained this was because it was a polysaccharide / large. Despite this, there were some excellent answers gaining full marks.



(iii) Explain how the structure of glycogen relates to its role as an energy storage molecule.

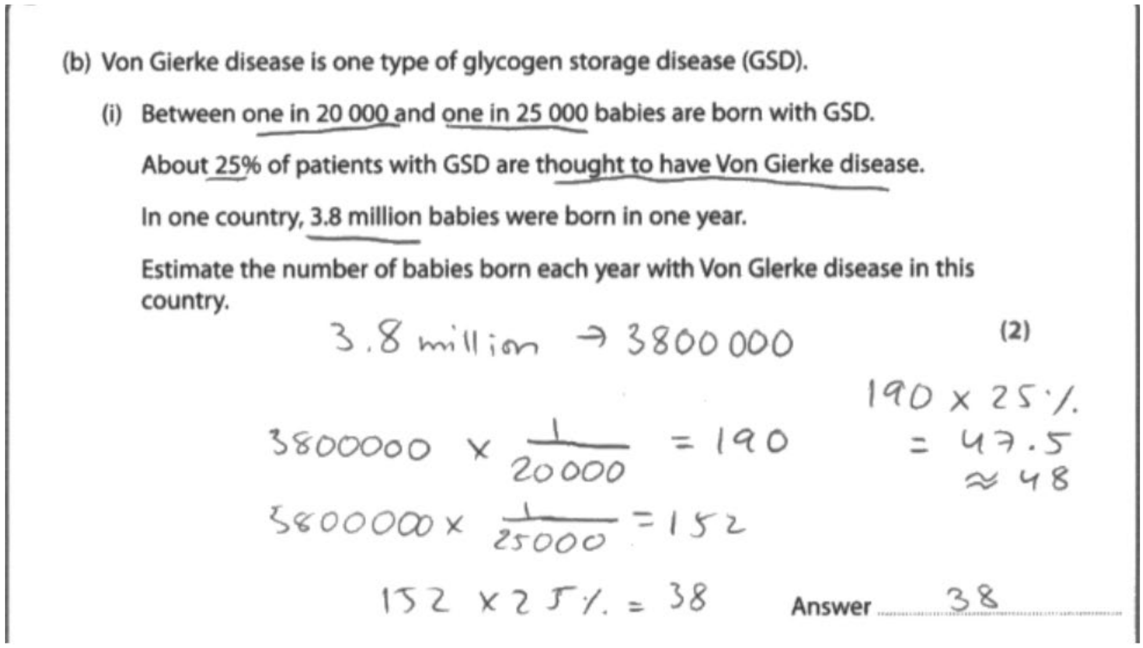
(3)

~~Its compact its~~ Its branched so many glucose molecules are broken down at the same time (hydrolsis). Its a polysaccharide so insolube so no osmotic effect. Its large so can't diffuse out of the cell. Compact so many glucose molecules can be stored in a less space

Question 3(b)(i)

Students were asked to estimate the number of babies with Von Gierke Disease, based on the number of babies born each year, numbers with GSD and the information that about 25% of these have Von Gierke Disease. This proved very challenging for many, even though a large range of answers was acceptable.

Put simply: about 4 million babies are born each year. If one in 20,000 has GSD this is equivalent to 200 in 4 million. If 25% of these have Von Gierke Disease the answer is roughly 50. Answers in the range 38 to 50 were accepted. This student sets out their thinking clearly.



(b) Von Gierke disease is one type of glycogen storage disease (GSD).

(i) Between one in 20 000 and one in 25 000 babies are born with GSD.

About 25% of patients with GSD are thought to have Von Gierke disease.

In one country, 3.8 million babies were born in one year.

Estimate the number of babies born each year with Von Gierke disease in this country.

(2)

3.8 million → 3800 000

$3800000 \times \frac{1}{20000} = 190$

$190 \times 25\% = 47.5 \approx 48$

$3800000 \times \frac{1}{25000} = 152$

$152 \times 25\% = 38$

Answer 38

Question 3(b)(ii)

Most students realised that the parents must be carriers (heterozygous) to have an affected child without being affected themselves. Many gave the correct explanation that the allele causing the disease was recessive or that to be affected the child must be homozygous recessive, but a significant number referred to Von Gierke Disease as a recessive disease. A few students continue to confuse the terms gene and allele.

Question 4(a)(i)

Most students correctly identified that P would bind to oxygen. Credit was given for a number of ways of expressing this, but the idea of storing oxygen was not acceptable.

Question 4(a)(ii)

This was not answered so well; some students simply wrote everything they knew about amino acids e.g. that they are held together by peptide bonds, with detailed descriptions of the primary, secondary and tertiary structure of proteins. While a number correctly stated that amino acids on the outer surface would be hydrophilic, not all students went on to explain that this made the haemoglobin soluble in water.

Question 4(b)(i)

This question was answered well, with many students able to describe the relative positions of the curves for adult and fetal haemoglobin and explain that the fetal haemoglobin has a higher affinity for oxygen. Not many gained mp2, as they did not refer to diffusion of oxygen, and generally there was some confusion about the meaning of partial pressure.

Question 4(b)(ii)

This percentage difference calculation proved difficult for many students, with a wide variety of answers seen. Using this equation gave the correct answer:

$$\frac{\text{Number of amino acids which are different}}{\text{Total number of amino acids}} \times 100$$

Question 5(a)

Some students treated this question about cell membrane structure as a recall question and wrote at length about the arrangement of phospholipids, ignoring the information in the stem of the question and the requirement to explain how it provided evidence for the structure. Almost all got mp1 for identifying the structure as a bilayer. Those who did use the information given about the relative sizes of phosphate heads and fatty acid tails usually gained mp2 and 3 by explaining that the length of one phosphate head and fatty acid tail was 2.05 to 2.65nm and that the range of values given was roughly the width of half of the membrane so a bilayer would measure around 5nm. There were some very clear explanations gaining full marks, like this one.

Use the information given to support your answer.

(3)

• phospho lipids form a bilayer, hydrophilic phosphate heads are facing outwards and inwards. hydrophobic fatty acid tails are facing each other in the center of the bilayer.

• so a combined width of 2 phosphate heads and two fatty acid tails form the bilayer. so the highest width would be (0.9 + 0.9 + 1.75 + 1.75) = 5.3 nm and the lowest width would be (0.8 + 0.8 + 1.25 + 1.25) = 4.1.

A range that the width of this cell membrane is within.

Question 5(b)

Although the question asked students to explain the location of cholesterol in cell membranes, a significant number wrote about the function of cholesterol, gaining no credit. Where students did attempt to explain the location, many lost marks for imprecise language eg describing the cholesterol as being in the phospholipid layer rather than between the fatty acid tails, or describing the fatty acid tails as hydrocarbon tails, which was not clear (since hydrocarbon tail was used as a label on part of the cholesterol molecule). The most commonly seen marking points were mp1 and 3.

This student gained mp1,2,3.

Cholesthol is present in fatty acid tails of the cell membrane. It allows cell membrane fluidity. The hydrocarbon tails in the diagram are hydrophobic and non-polar. The fatty acid tails are also hydrophobic and orient away from the aqueous environment.

Question 5(c)(i)

This was generally very well done with many students able to describe the weak positive charge on hydrogen atoms and weak negative charge on oxygen. Where marks were lost it was usually because the charges were not described as weak, or because the water molecule was described as being positively charged at one end and negatively charged at the other, without reference to hydrogen and oxygen.

Question 5(c)(ii)

A significant number of students simply repeated the information in the stem of the question, describing the relative permeability of cell membranes to the four chemicals without any attempt to explain this. Stronger students realised that the permeability of the membrane would depend on the size and charge of the material passing through it and realised that different transport mechanisms were needed for the different chemicals. The most commonly seen marking points were mp4 (active transport or facilitated diffusion to move sodium and chloride ions) and mp3 (facilitated diffusion to move glucose). Some students attempted to explain how steroids move but did not gain credit as they did not refer to diffusion. Many did not gain mp1 as although they knew that water moved by osmosis / diffusion, they did not refer to the small size of the molecule.

Question 6(a)(i)

Students were given a graph and told in the stem of the question that there is a correlation between smoking and death rate from lung cancer in men; they were asked to explain how the graph showed this correlation. About half did not achieve mp1 as they referred only to the increase in smoking being mirrored by an increase in death rates and did not refer to the decrease in either feature. The second marking point was less frequently attempted, but well expressed where it was.

- as number of ~~cigarre~~ cigarettes smoked increases death rate from lung cancer increases.
- increase in number of cigarettes happens first then increase in death rate happens after.
- the graphs mirror each other. ~~as~~ and they have the same overall pattern.

6(a)(ii)

Many students realised that fewer but larger alveoli would result in a smaller surface area for gas exchange, although a minority lost this mark because they did not specify that it was the surface area of alveoli / surface area for gas exchange which was smaller. The explanation of the effect on gas exchange was more variable, with a number of students simply saying that there was less gas exchange or that it was less efficient, rather then referring to the decrease in rate.

Question 6(b)

This was the first of the levels-based questions and answers at all three levels were commonly seen. Students were given relevant information in the diagram and stem of the question and asked to explain the factors determining the rate of diffusion of gases between the air and the tissues of the bird embryo.

There were some outstanding answers where students organised a logical account of each factor (e.g. diffusion distance), how it related to the structures in the egg (thickness of shell or membranes) and how it affected rate of diffusion (increasing thickness decreases the rate of diffusion).

The strongest answers explained three or four factors and had no trouble achieving level 3. Weaker answers did not follow through the explanation, e.g. they recognised that thickness of shell was important, but did not link it to diffusion distance or to the effect on rate; some students referred to less diffusion (rather than a lower rate of diffusion) or to less efficient diffusion.

It was apparent that many students recognised the link to Fick's Law (even if they did not name it) and listed the three factors which gave a framework to their answer.

It was pleasing to see clear explanations of the effects of temperature on diffusion rate being included by a number of students. The term "density of pores in the shell" caused confusion for some students, with a number thinking that a higher density would decrease the rate of diffusion.

Question 7(a)

This question asked for factors increasing the risk of CVD; it looked very straightforward, but some students lost marks by not correctly identifying which were lifestyle factors and which were non-lifestyle factors or by not looking carefully enough at the examples given in the diagram. For the lifestyle factors the two examples were inactivity (rather than level of exercise) and high blood pressure (rather than blood pressure); this should have reinforced the need for a factor which would **increase** the risk e.g. high BMI (not just BMI) or high salt intake (not just salt intake). Some students gave answers which were too vague at A-level e.g. poor diet.

Question 7(b)

Students were given a graph showing the effect of exercise on the relative risk of death from CVD and asked to describe the conclusions which could be drawn. The two obvious trends were:

- the more intense the exercise, the lower the risk of death from CVD
- the more energy used in exercise the lower the risk of death from CVD

Many students struggled to identify these broad conclusions and it was rare to see both marks achieved. Some drew vague conclusions e.g. the more exercise you do, the lower the risk, which did not follow any of the information given in the graph.

> Describe the conclusions that can be made from the information shown in this graph.
>
> (2)
>
> We can see from the graph that more exercise a person takes, the less relative risk of death from CVD he has.

This very concise answer gained two marks.

> Describe the conclusions that can be made from the information shown in this graph.
>
> (2)
>
> The more intense the exercise take, the lower the relative risk of death from CVD. The ~~risk~~ relative risk also decreases as the energy needed for exercise ~~is used increased~~ increases.

Question 7(c)(i)

This was a straightforward question asking students to explain how dietary antioxidants reduce the risk of CVD. Whilst there were some excellent answers, a significant number of students did not know the basic facts or wrote in vague terms about the benefits of antioxidants. Marking point 3 was most frequently seen where students described reduction in plaque or atheroma formation, but not for simply saying that it reduced CVD, as this was in the stem of the question.

Question 7(c)(ii)
Students were asked to devise a study to confirm that antioxidants reduce the risk of CVD. Many knew that they should have two groups of individuals, matched for risk factors e.g. age, and that one group should be given antioxidants and the other group not given antioxidants. It was rare to specify that they should be healthy / have no known heart condition. Some lost mp4 as they monitored for the risk of CVD rather than the incidence of CVD or chose inappropriate factors to monitor. There were some strong answers to this question gaining full marks.

Question 7(d)
This was the second of the levels-based questions, based around the effects of blockage of a coronary artery in people with CVD. Students were given a graph of energy released by heart muscle cells in the period of time after the blockage and some additional information about the time that contraction stopped and when the heart muscle cells began to die.

Indicative content was arranged into three areas

- immediate effects of the blockage
- the effects of anaerobic respiration on the heart muscle
- use of the graph and information from the stem of the question

It was clear that many knew a blockage would prevent blood carrying oxygen (and less commonly glucose) from reaching the heart muscle cells. Some said that this would reduce respiration, rather than reduce aerobic respiration. The vague term "nutrients" (used in place of glucose) did not gain credit.

Many knew that anaerobic respiration produces lactic acid, and that the decreased pH denatures enzymes. A few stated that anaerobic respiration produces less energy than aerobic respiration, or that glycogen reserves are used. Some realised that when muscle contraction stops, the heart no longer pumps blood around the body and could describe an effect of this e.g. no gas exchange in the lungs or tissues, organ failure etc. Some students did not include any information from this section.

Marking point 11 was commonly seen, but many students ignored the graph apart from this, and some simply repeated back the information in the stem about what was happening at 8 and 20 minutes without explaining the implications of this. The strongest answers realised that 8 minutes was a key milestone (when contraction stops), read the energy level of the graph at this point and deduced that there was not enough energy for contraction to continue. Similarly, at 20 minutes heart muscle cells begin to die; the stronger answers read the energy level off the graph at this point and recognised that there was not enough energy for cells to survive.

To achieve level 3, students were required to write a balanced answer with information from all three areas of content. A number of students wrote comprehensive, well-structured answers and achieved full marks on this question.

Question 8(a)(i)

The majority of students knew that galactose and glucose are the products of lactose digestion.

Question 8(a)(ii)

This question asked students to explain how the 3D structure of lactase affects its mechanism of action. There were two key points to note

- it is soluble, due to globular shape or external hydrophilic R groups (mp1) so can collide with lactose (mp2)
- it has an active site complementary to lactose (mp3) and when an enzyme-substrate complex forms this lowers the activation energy (mp4)

Mp1 and 2 were rarely attempted. Mp3 was commonly seen, but most students did not go on to explain how the activation energy is lowered for mp4.
This student gained mp3 and 4.

> The enzyme laCtase has a specific tertiary Structure with specific bonds between R groups So has a specific active sites which fits the substrate (lactose) catalysing the breakdown of glycosidic bonds forming the products and decreasing activation energy of the hydrolysis reaction.

Weaker answers included a lot of generic information about the primary, secondary and tertiary structure of proteins without reference to lactase, and some students confused lactose and lactase. A small number thought that the active site was on lactose.

Question 8(b)(i)

A lot of information was included in the stem of Q8(b) and students were asked to give one advantage of using immobilised lactase. Many students correctly stated that the enzyme could be re-used, that it would not contaminate the milk (or that free lactase would have to be removed before the milk could be drunk), or that the immobilised lactase would have a higher rate of activity. Weaker answers suggested that the enzyme was more efficient, that the lactose-free milk was somehow better / healthier or that the milk would be free of lactose.

Question 8(b)(ii)

Students were provided with a table of data comparing the activity of free and immobilised lactase at different pH values and asked to explain the effect of pH on the activity of the two enzymes. Almost all students realised that the optimum pH for both enzymes was 4-6, and some explained that extremes of pH affected the shape of the active site. However, it was rare to see an explanation of how this happens (by breaking bonds between R groups) or to see comments comparing the range of pH values over which free and immobilised lactase are active.

Weaker answers described each line of the table without attempting to explain it.

Question 8(b)(iii)

This short question proved to be very challenging for the majority; students were asked how the rate of activity of the lactase could be measured, and to give appropriate units.

No practical detail was required, and marks were awarded for measuring the decrease in concentration of lactose or increase in concentration of glucose or galactose over time. Units were therefore mass per volume per time e.g. mg ml^{-1} s^{-1}. Any units of mass, volume and time were accepted, and Mmol, mol, µmol were accepted in place of units of mass.

A lot of students did not realise that rate of activity must be measured over time, so did not include units of time, or resorted to using a.u.

Question 8(c)

Students were asked why a very rare congenital disorder was mostly found in people from one country. Many achieved mp2 by commenting that the people stayed in that country, married others from that country and so the disorder was passed on to their children. Those who realised that a mutation was involved often did not state that the gene / DNA was affected and therefore did not achieve mp1. Many of those who referred to mutation thought that it was caused by drinking milk or not drinking milk.

Paper Summary

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

- In compare and contrast questions ensure that both similarities and differences are given. Similarities should be clearly stated eg. they both have endothelial cells, while differences should refer to both components and be comparative e.g. A has a thicker wall than B, A has more elastic fibres than B.
- In numerical questions take note if you are asked to express the answer in standard form or to a particular number of significant figures. You will lose marks if you do not follow these instructions.
- Where information is given in the stem of the question it is important to use it but you will not gain credit for simply repeating it in the answer. Try to think about what it is telling you and use the information in your explanation.
- The term less efficient is usually too vague to gain any credit. Think about what you actually mean (often it is linked to lower rate) and use this term instead. Similarly, the term amount will not gain credit – mass or volume is usually more appropriate.
- If data is provided (in the form of a table or graph) and the command word is explain, simply describing the data will not gain full marks. You should identify the trends shown by the data and use your knowledge to explain why this is occurring.

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