Examiners' Report

Principal Examiner Feedback

Summer 2022

Pearson GCE In Biology (8BN0) Paper 01
Lifestyle, Transport, Genes and Health

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Summer 2022
Publications Code 8BN0_01_pef_20220818*

Introduction:

This paper tested the knowledge, understanding and application of material from the topics 'Lifestyle, health and risk' and 'Genes and health'.

The range of questions provided ample opportunity for students to demonstrate their grasp of these topics and apply their knowledge to novel contexts.

The questions on this paper yielded a wide range of responses and some very good answers were seen. The paper appears to have worked very well with all questions achieving the full spread of marks..

There were some straightforward questions that yielded high marks across the ability range and some more challenging questions that discriminated well. It as clear that centres have been working hard to ensure their students read the command words more carefully and tailor their answers appropriately. The 'compare and contrast' type answers in particular showed a significant increase in the quality of comparative answers as opposed to separate paragraphs about each. More students utilised the data they were provided with in some of the questions.

As previously, questions that demanded recall were generally well answered, as were the majority of the calculation questions.

However, when asked to analyse and explain data and apply their knowledge to unfamiliar contexts, many students found the marks harder to obtain. The application of knowledge regarding codominance for example proved more challenging for some students.

Question 1(a)(i)

This question required students to give the sequence of the first 6 bases of the DNA. Most student swere able to do this correctly.

Question 1(a)(ii)

This question was very well answered by the students, with only a small number multiplying the number of bases by three.

Question 1(a)(iii)

This question asked students to give the maximum number of different tRNA molecules that would be needed to produce the polypeptide chain produced from the provided base sequence. This proved more challenging for students than the previous question. Few students recognised that ACG and GGC were repeated in the mRNA sequence.

Question 1(b)

This question asked students to describe the role of mRNA in protein synthesis. It was clear that some students did not fully understand the word 'role' and therefore lost a mark by not including either mp1 or mp4. Instead the most common responses gained mp2 and 3 for describing transcription and translation in general terms, for example:

(b) Describe the role of mRNA in protein synthesis.

(3)

mRNA leaves the nucleus through the nuclear pores ~~& align to~~ attach to the ribosomes for translation to begin.
Complementary base pairing takes place between the anti-codons of tRNA & the codons of mRNA.

This is an example of a response which gained 3 marks:

(b) Describe the role of mRNA in protein synthesis. (3)

mRNA is synthesised through transcription and translation. The DNA double helix unwinds at the site of the gene to be transcribed. The hydrogen bonds between the bases break. This is catalysed by DNA helicase. One strand the antisense strand acts as a template. Free RNA mononucleotides enter the nucleus through the nuclear pore and complementary base pairing occurs on the template strand. Hydrogen bonds form between the bases and phosphodiester bonds form between the adjacent RNA mononucleotide. mRNA detaches from the nucleus and attaches itself on a ribosome. TRNA carries specific amino acids to mRNA Complementary ~~Complements~~ base pairing occurs on the codon on the mRNA and anticodon on the tRNA. Amino acids are held at two at a time. This is catalysed by the enzyme peptidyl transferase

(Total for Question 1 = 6 marks)

Question 2(a)(i)

Nearly all of the students could calculate the percentage change of vitamin C content. The most common error was an incorrect denominator.

Question 2(a)(ii)

This was the first time graph plotting skills had been tested on this specification.

It was pleasing that the majority of students recognised that they should draw a bar chart.

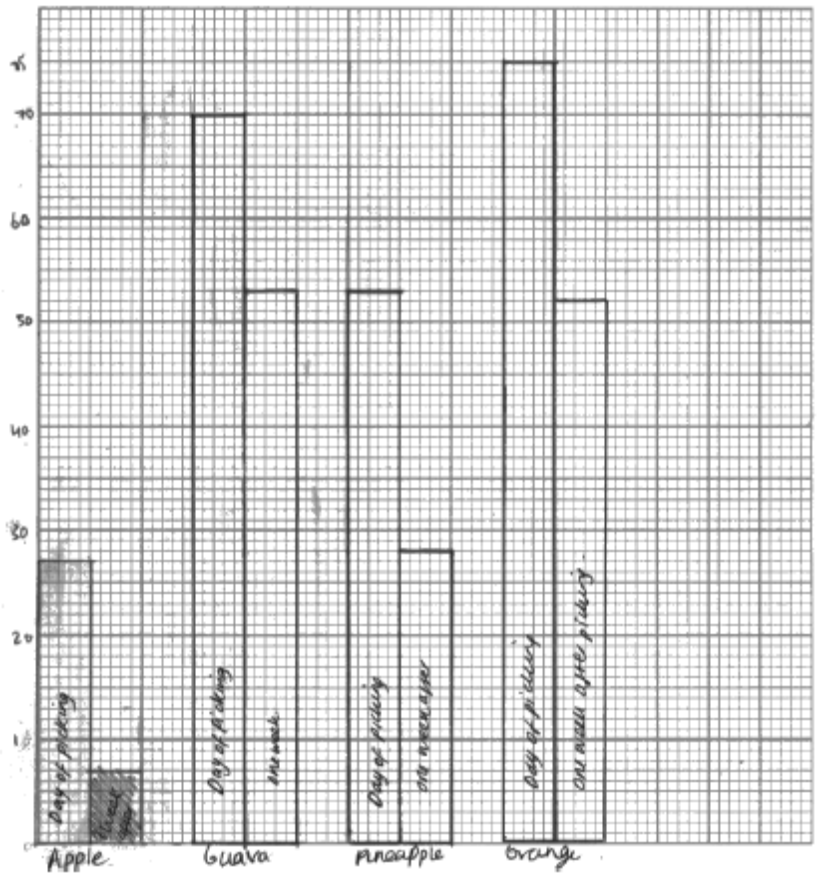
Most students recognised that should label their axes using the headings from the table of data and give a key.

The most common mistakes made by students were not labelling the y axis correctly or having a non-linear or inappropriate scale.

This response lost mp1 as they had not labelled their axes correctly, but gained mp2,3 and 4.

(ii) Plot these data in a suitable graphical form.

(4)



Some students lost marks as a consequence of manipulating the data before plotting the change in vitamin C content rather than answering the question and just plotting the data.

Question 2(b)(i)

This question continued the context of the vitamin C investigation and asked students to give the reagent name and colour change that would be observed if vitamin C was present.

It was pleasing to see that most students could answer this correctly. Most responses centred around the use of DCPIP, although a few responses using starch/iodide solution were seen.

The most common incorrect reagent was phenolphthalein.

Question 2(b)(ii)

This question asked candidates to state and justify one variable that should have been controlled when the fruits were stored after picking.

Some students gave more than one variable.

Most students could state a suitable variable that should have been controlled, with the most common response being temperature.

The more detailed answers correctly justified their choice of variable, e.g. explaining how a different storage temperature would increase or decrease the vitamin C content of the fruits. Some answers related the control of their variable to an incease in the validity of the investigation and conclusions.

Incorrect answers referred to growing conditions for the plants – indicating that they had not read the question carefully.

A small number of students did not read the question carefully and did not justify their choice of variable.

Question 3(a)(i)

This question was answered correctly by most students, with only a few incorrect responses.

Question 3(a)(ii)

This question was answered correctly by most students.

Question 3(a)(iii)

This question was answered correctly by most students.

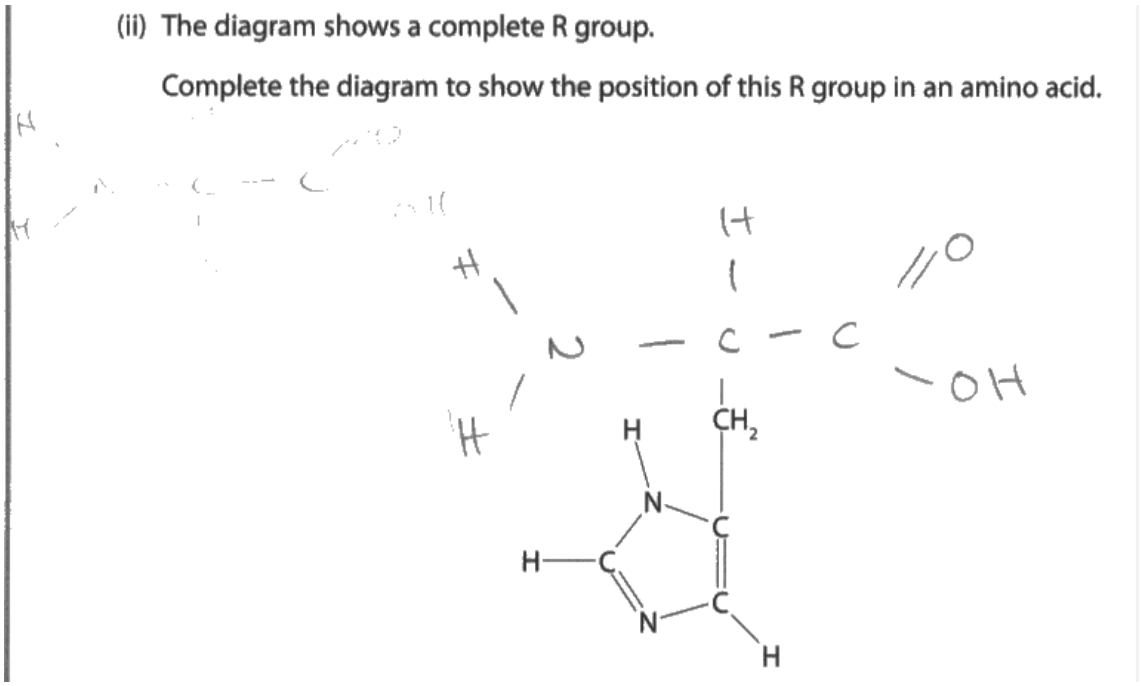
Question 3(b)(i)

This question proved to be more challenging for students.

Question 3(b)(ii)

This question gave the students the structure of a residual group and asked students to complete the diagram to show the position of this R group in an amino acid. It was clear that the question style was challenging for some students.

Here is an example of a response which scored full marks. The student has drawn out an example amino acid to help them access the question.



Question 3(c)(i)

This question required students to use the provided information in order to calculate the mass of female 1 in kg.

It was pleasing to see that nearly all students could rearrange the equation correctly.

However a significant number of students did not convert the height of the female into metres or used height instead of height^2.

Question 3(c)(ii)

This question required students to explain what is likely to happen to the BMI values for the three females in this investigation.

Higher level answers considered not only the effect on the BMI for each female, but also explained what would cause the change, using calculated energy intake differences, for example this response:

(ii) Explain what is likely to happen to the BMI values for the females in this investigation.

(2)

The recommended daily energy intake for females is 8400 kJ a day, female 1 has a diet containing less (840 kJ)) so this female's BMI will decrease. Female 2 is given a diet containing the same energy intake as the recommended one so her BMI will likely stay constant. Female 3's energy intake is (840 kJ)) higher than the recommended energy intake so her BMI will increase.

(Total for Question 3 = 10 marks)

Question 4(a)(i)

This question was answered correctly by most students.

Question 4(a)(ii)

This question was answered correctly by most students.

Question 4(b)(i)

This question proved to be challenging for students.

Question 4(b)(ii)

This question required students to multiply the length of one pitch by the number of pitches. Students then needed to convert their answer into μm.

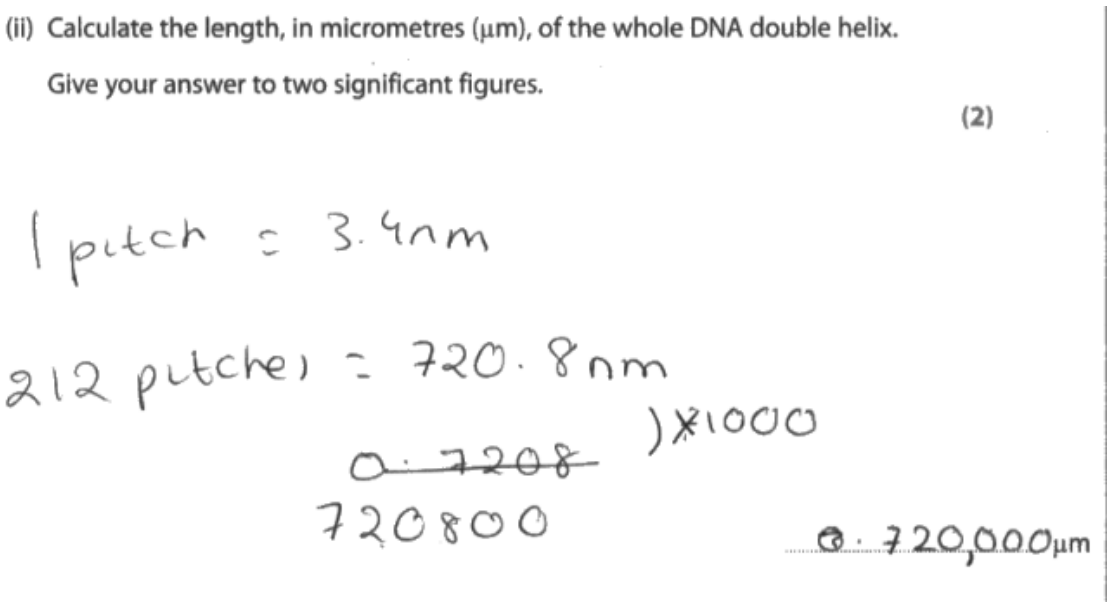
As in previous exam series, a significant number of students made errors in unit conversion. However the presence of their working out often meant that mp1 could still be awarded.

This is an example of a response with an incorrect unit conversion which gained 1 mark:

(ii) Calculate the length, in micrometres (μm), of the whole DNA double helix.

Give your answer to two significant figures.

(2)

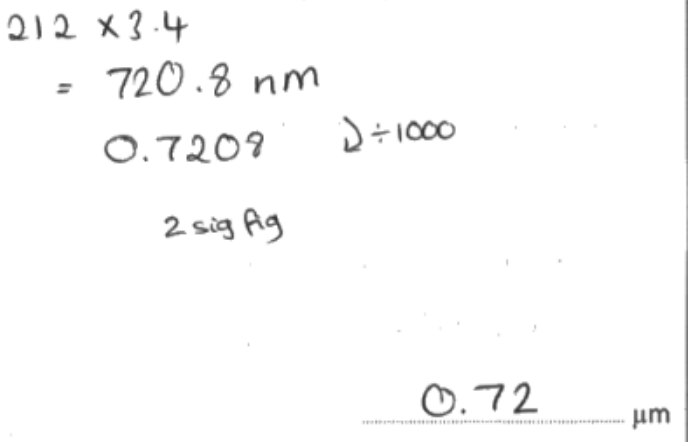


This response scored full marks:

(ii) Calculate the length, in micrometres (μm), of the whole DNA double helix.

Give your answer to two significant figures.

(2)



Question 4(c)

This question asked students to compare and contrast the structure of a DNA double helix with the structure of the tRNA shown in the diagram.

It is important to take careful note of the command words used in questions. The command 'compare and contrast' means that students need to identify both similarities and differences between the structures in order to gain full marks.

It was pleasing to see an improvement in the use of comparative language in responses and this resulted in a higher performance.

The most common similarity was that they both contained the organic bases A, C and G.

The most common differences were that DNA is double stranded whereas tRNA was single stranded and that DNA contained thymine whereas tRNA contained uracil.

A small number of students stated that tRNA contained an amino acid binding site whereas DNA did not.

A significant number referred to a difference being RNA nucleotides and DNA nucleotides, failing to explain the differences between them.

This response gained 4 marks:

Compare and contrast the structure of a DNA double helix with the structure of tRNA.

(4)

tRNA is folded into a clover shape whereas the DNA double helix is in a coiled shape. tRNA has an amino acid binding site whereas DNA doesn't. tRNA has anticodons whereas DNA doesn't. Both have the bases adenine, guanine, cytosine but tRNA has uracil whereas DNA has thymine. Both have hydrogen bonding within its structure.

Question 5(a)

Students were told that mutations in the CFTR gene affected the CFTR protein channel in the epithelial cells of the respiratory system.

They were asked to name another organ system that would be affected by a CFTR mutation.

Most students correctly stated digestive system, but a number of responses stating reproductive system were also seen.

Unfortunately, a number of students did not read the question carefully and either stated respiratory system or they gave the name of an organ.

Question 5(b)(i)

This question asked the students to explain how chloride ions move through the two membranes labelled in the diagram.

It was clear that the majority of students studied the given diagram carefully.

The majority of students recognised that chloride ions moved through the basal membrane via active transport. However weaker responses just referred to the use of ATP, which was indicated on the diagram. More detailed answers explained why ATP was required to move the chloride ions and therefore gained the second marking point.

Most students recognised that there would be a higher concentration of chloride ions in the epithelial cell than in the mucus and linked this to the passive diffusion of the chloride ions.

Question 5(b)(ii)

This question gave the information that chloride ions were moving into the mucus. Students needed to use this information to explain which direction the water molecules would be moving as a result.

They were also provided with some scaffolding.

Most students correctly concluded that water molecules would move from a higher concentration in the epithelial cell to a lower concentration in the mucus by osmosis. Many also referred to water potential differences – although not on the specification this was given credit.

The higher level answers related this movement to the increased chloride ion concentration in the mucus, for example:

(ii) The movement of the chloride ions into the mucus would cause the movement of water molecules.

Explain the direction of movement of the water molecules.

(3)

The water molecules would move by osmosis from higher water potential in the cell to low water potential outside the cell in mucus due to high solute concentration of (Na^+ and Cl^- ions) in mucus.

Question 5(c)(i)

This question was answered correctly by most students, with only a small number of incorrect responses.

Question 5(c)(ii)

This question gave the students a diagram showing the inheritance of cystic fibrosis in a family.

They were asked to complete the Punnett square to show the possible genotypes of a child of individual 15 and a male who is heterozygous for the cystic fibrosis gene.

The diagram showed that individual 15 was an affected female and most students correctly deduced the resulting homozygous recessive genotype.

As a result, most students were able to complete the Punnett square correctly to gain the mark.

It was surprising however, to see some students choosing to use different allele letters than the ones provided in the question.

Question 5(c)(iii)

The majority of students knew that the chorionic villus sampling would be the genetic screening test carried out in the tenth week of pregnancy.

However, a number of students lost the mark due to incorrect spelling, for example:

(iii) Individual 12 is pregnant. She has been advised to have a genetic screening test for cystic fibrosis.

Give the name of the prenatal genetic screening test that would be carried out in her tenth week of pregnancy.

chronic villus sampling

Students who were not sure of the correct spelling often put CVS in brackets next to their answer, which allowed the mark to be awarded.

Question 5(c)(iv)

This question asked students to discuss the ethical issues relating to the use of genetic screening during pregnancy.

Most students gave an answer relating to the risk of miscarriage.

A high number of responses also discussed issues associated with false positive results.

Fewer students could discuss the ethical issues concerning the termination of a pregnancy due to a genetic condition. Most responses discussed the ethical issues surrounding abortion / terminations in general, which is not what the question was asking.

Question 6(a)

This question provided students with a graph showing the percentage of gases exchanged at two surfaces.

Students were asked to deduce why the skin and the lungs of this frog are involved in the transport of oxygen.

It was clear that many students found this question difficult.

Few students referred to the graph information in their answers. Numerous zero-mark responses were seen which incorrectly suggested that the frog would be able to get all of the oxygen it needed through the skin because of its large surface area: volume.

The most common mark to be awarded was for responses which had used the given data and recognised that more diffusion of oxygen occurs in lungs than in skin.

More detailed answers then explained why only 22% occurred via the skin, with references to skin surface area: volume or diffusion distance being the most common credit worthy points made.

Question 6(b)(i)

This question asked students to explain the function of the semilunar valve in the aorta.

Generic answers about the function of all semilunar valves were not credit worthy as the question was about the valve in the aorta.

Lower scoring responses tended to focus on the function of the closed valve.

However higher scoring responses considered the function of both the open and closed valve in the aorta, for example:

(b) The aorta of this frog contains a semilunar valve and elastic fibres.

(i) Explain the function of the semilunar valve in the aorta.

(2)

It prevents back wash of blood from the ~~aeorta~~ aorta into the ventricle when pressure in the aorta is higher. It also let pressure build in the ventricle until they open, allowing blood to be pumped into the aorta.

Question 6(b)(ii)

This question asked students to explain the function of the elastic fibres in the aorta.

Most students were able to include the aspect of elastic fibres allowing stretch and recoil in their answer. Higher level responses explained the benefit of this to the maintenance of blood pressure.

A few responses included incorrect information relating to contraction and relaxation of the elastic fibres.

Question 6(c)(i)

This question required students to explain the advantages of using *Nymphargus bejaranoi* in the investigation.

Only a small minority of students gave more than one advantage of using this type of frog, which meant that most responses scored a maximum of one mark.

A significant number of students incorrectly stated that the frog was an invertebrate.

The most common response related to the heart being visible and therefore the monitoring of the heart rate would be non-invasive.

More detailed responses considered more than one advantage.

This response gave two correct advantages:

(i) Explain the advantages of using this type of frog for this investigation.

(2)

Transparent ∴ heart can be seen without cutting through the frog.

· substances (caffeine) can diffuse directly through the skin.

Question 6(c)(ii)

This question required students to discuss the validity of the given conclusion.

It was clear to see that many students had studied all of the given information carefully and many high scoring responses were seen.

Most students recognised that the experiment had only been carried out on one individual frog and discussed that the results would not be representative of either this frog species or all frog species.

Fewer students discussed the concentration aspect of the conclusion. Where they did, responses tended to centre around intermediate concentrations or that 0.4 mg cm^{-3} concentration had not been tested.

Despite being asked to discuss the validity of the conclusion, there were some who referred to the reliability of the data instead and referred to conditions under which the investigation had been carried out.

This is an example of a response which scored four marks:

(ii) A student concluded that a caffeine concentration of 0.1 mg cm^{-3} would cause the largest increase in heart rate in every species of frog.

Discuss the validity of this conclusion.

(4)

This is not valid because only one frog has been tested meaning they could be an anomaly. Also only one species has been tested, other species could have different reactions to caffine - Small intervals of caffine concentration could be tested allowing greater accuracy than 0.1 could be 0.09, 0.08, 0.11, 0.12, 0.1.

Question 7(a)

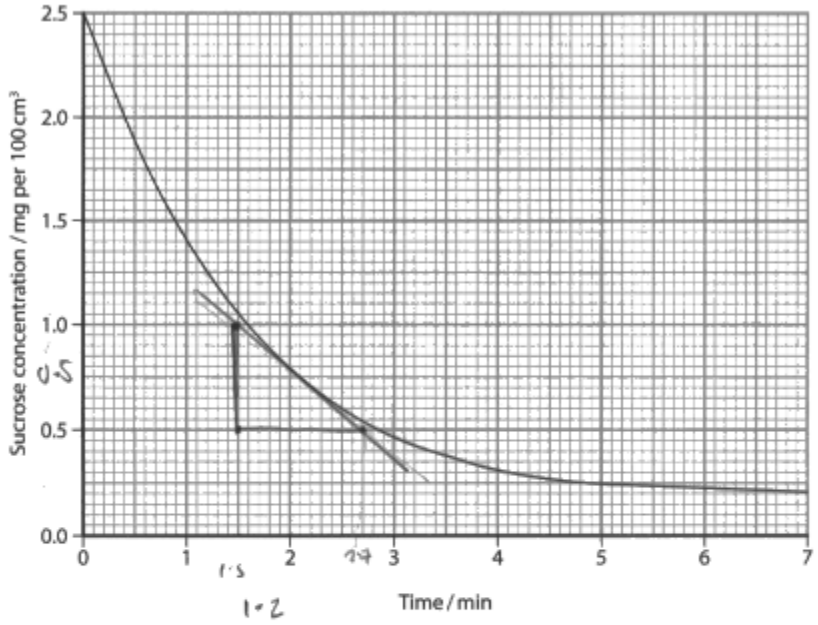
Students were provided with a graph showing the change in sucrose concentration in the presence of sucrase.

They were asked to calculate the initial rate of reaction from the graph.

Unfortunately, the majority of students did not seem to understand the difference between rate of reaction and initial rate of reaction. Numerous responses were seen dividing the total decrease in sucrose concentration by 7 minutes. Another common error was choosing to draw their tangent when the sucrose concentration may have become a limiting factor, for example:

7 The disaccharide sucrose is hydrolysed by the enzyme sucrase.

The graph shows the change in sucrose concentration in the presence of sucrase.



(a) Calculate the initial rate of reaction from this graph.

Give your answer to one decimal place.

(2)

$\frac{0.5}{1.2} = 0.416$

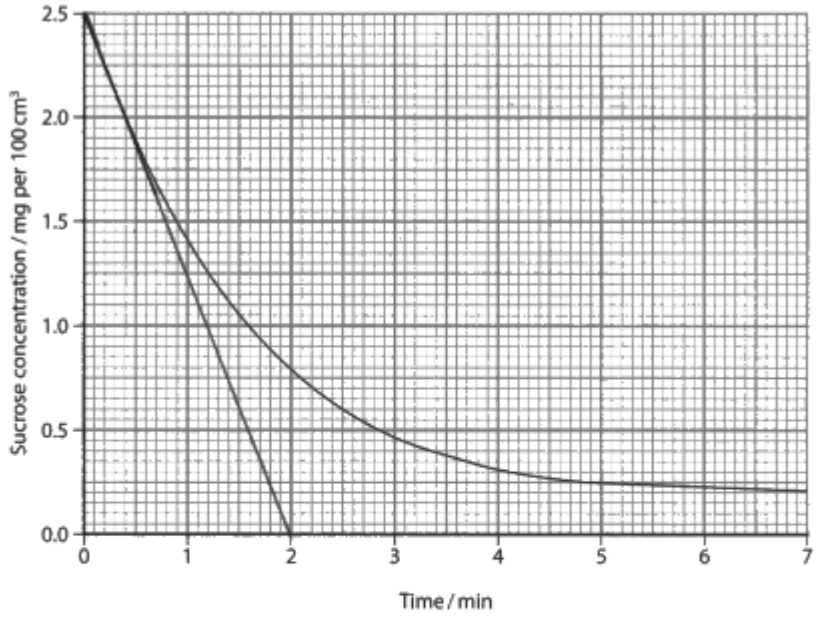
$\frac{1}{0.416}$

2.4 ..... mg per 100 cm³ min⁻¹

This is an example of a correct initial rate of reaction calculation:

7 The disaccharide sucrose is hydrolysed by the enzyme sucrase.

The graph shows the change in sucrose concentration in the presence of sucrase.



(a) Calculate the initial rate of reaction from this graph.

Give your answer to one decimal place.

(2)

2.5 ÷ 2 = 1.3

1.3 mg per 100 cm³ min⁻¹

Question 7(b)

This question required students to explain how to carry out a valid investigation to collect the data shown in the graph.

Therefore, students were expected to explain how to use the given sucrose concentrations in their experiment. It was disappointing that a significant number of students ignored this information and used concentrations such as 0%, 20%, 40% etc which were not creditworthy.

Most students could explain that the volumes of sucrose and sucrase could be controlled, with this being the most common marking point awarded.

A significant number of students could also explain how to control another variable in the investigation, the most common being temperature, concentration of enzyme or pH.

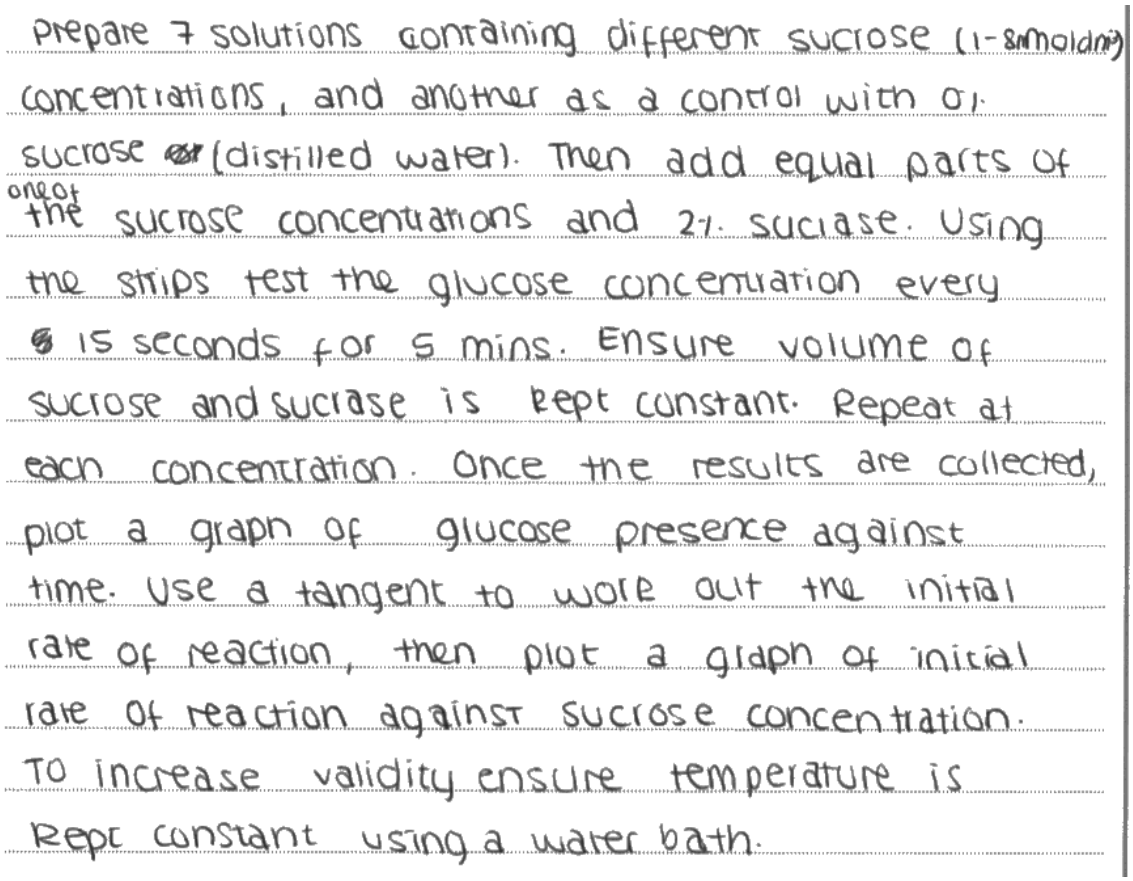
Many students failed to take into account the information provided in the question – such as the fact that sucrase breaks down sucrose or that indicator strips can be used to determine glucose concentration in a solution. As a consequence, many students

described experiments with other enzymes and products that they were familiar with – such as the use of trypsin on milk, referring to the use of colorimeters or gas syringes to measure the rate of reaction. Knowledge of core practicals has to be applied in the context the question.

It was disappointing that few students used the provided photograph. As a consequence, marking points 4 and 5 were rarely awarded.

As seen in the previous calculation, few students knew how to calculate initial rate of reaction, which is the purpose of the relevant core practical being assessed.

This is an example of a response which gained mp1,2,3,4 and 6:


Prepare 7 solutions containing different sucrose (1-8mol/dm³) concentrations, and another as a control with 0% sucrose (distilled water). Then add equal parts of one of the sucrose concentrations and 2% sucrase. Using the strips test the glucose concentration every 15 seconds for 5 mins. Ensure volume of sucrose and sucrase is kept constant. Repeat at each concentration. Once the results are collected, plot a graph of glucose presence against time. Use a tangent to work out the initial rate of reaction, then plot a graph of initial rate of reaction against sucrose concentration. To increase validity ensure temperature is kept constant using a water bath.

Question 7(c)

This question required application of knowledge to an unfamiliar situation. Students were provided with a diagram showing the effect of enzyme inhibition on the shape of the enzyme's active site. They were also provided with a graph showing the difference in rate of reaction when an enzyme inhibitor was added.

Nearly all responses explained that the enzyme active site was no longer complementary to the sucrose.

However, many students thought that this would result in no enzyme-substrate complexes being formed, which the graph clearly showed was not the case.

This student recognised that there were still some enzyme-substrate complexes being formed and gained both marking points:

Explain why the inhibitor has decreased the maximum rate of reaction.

(2)

The enzyme inhibitor decreased the maximum rate of reaction as it changes the shape of the enzyme. It changes the shape of the active site of the enzyme. The substrate and active site of the enzyme are no longer complementary to each other. Less collisions between the enzyme and substrate. Less enzyme substrate complex formed. Less product produced to calculate the rate of reaction. Enzyme concentration becomes a limiting factor as substrate concentration increase.

(Total for Question 7 = 10 marks)

Question 8(a)(i)

This question asked students to state what is meant by the term diastole.

Some students lost the mark by not being specific in their answers. They were expected to link relaxation to the atria and ventricles, although answers referring to relaxation of the heart were allowed. Answers referring to relaxation of muscles in general were not sufficient. Answers referring to the heart being at rest were also not sufficient.

Question 8(a)(ii)

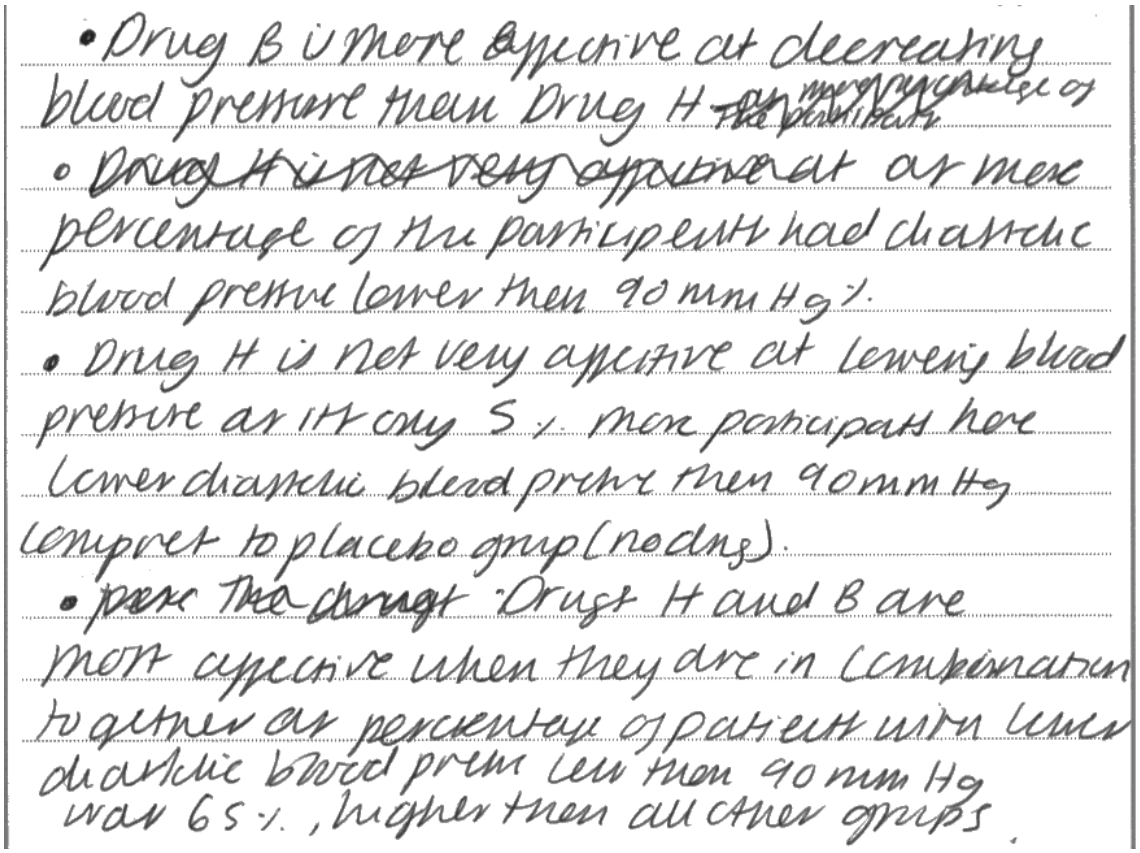
This question asked students to determine the effectiveness of the two drugs used in this investigation.

Some students misinterpreted the data and thought that the placebo was more effective than either of the drugs. It is important to study the axes labels carefully.

Nearly all students recognised that the combination of the two drugs was the most effective at reducing blood pressure, and this was the most commonly awarded marking point.

It was also pleasing to see that students had taken careful note of the command word and included relevant quantitative elements in their answers, although some lost marks here for not reading the scale on the graph carefully.

The most detailed responses also compared the drugs to the placebo, for example this response which scored three marks:


• Drug B is more effective at decreasing blood pressure than Drug H ~~as mentioned in the pamphlet~~.
• ~~Drug H is not very effective at~~ as more percentage of the participants had diastolic blood pressure lower than 90 mm Hg %.
• Drug H is not very effective at lowering blood pressure as it's only 5 % more participants here lower diastolic blood pressure than 90 mm Hg (compare to placebo group (no drug).
• ~~Here the data~~ Drug H and B are more effective when they are in combination together as percentage of patients with lower diastolic blood pressure than 90 mm Hg was 65 %, higher than all other groups.

Question 8(b)

Students were asked to discuss the benefits and risks of using antihypertensives, stains and anticoagulants to treat cardiovascular disease.

This question expected students to analyse graph A, graph B as well as the antihypertensive graph from Q8(a). Again, some students lost marks where they had failed to read the axis labels carefully, with some interpreting Graph B as indicating that the placebo was more effective than the anticoagulants at reducing the incidence of strokes.

Some students were confused about the actions of the three types of drug.

This question proved to be a very good differentiator with the full spread of marks awarded.

To achieve level one students needed to discuss some benefits and/or risks for at least one of the types of drug.

Most students achieved level one by discussing benefits and risks of statins.

To achieve level two, students needed to discuss some benefits and/or risks for at least two of the types of drug.

A number of students were limited to a lower level two as they only discussed benefits of the drugs.

Some students could not access level three as they did not discuss the benefits and risks of antihypertensives.

Where students discussed benefits and risks for all three drugs and made linkages between the mode of action of the drug and the benefits, they could access level three. It was pleasing to see a significant number of responses demonstrating evidence of these linkages for all three drugs.

This is an example of a level three response:

Discuss the benefits and risks of using antihypertensives, statins and anticoagulants to treat cardiovascular disease (CVD).

(6)

Antihypertensives lower blood pressure, this will reduce the risk of damage to the endothelium of the arteries and prevent the formation of an atheroma. However, antihypertensives can lead to drowsiness, nausea and migranes as side effects, it also needs to be taken over a long period of time. Statins lowers LDL cholesterol which reduces the risk of cardiovascular disease by increasing the amount of HDL present, this takes cholesterol to the liver where it will be broken down. However statins can cause neurological side effects, long term side effects such as excessive bleeding and brain damage. Anticoagulants reduce the formation of blood clots, this ensures blood containing oxygen and glucose can supply the heart and brain cells to lessen the risk of a heart attack and stroke. However, they cause excessive bleeding and need to be taken over a long period of time. It also causes side effects such as nausea and drowsiness.

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 take into account the command words as well as all of the context given. Answers which do not match the command words or do not relate to the given context will not gain high marks.
- Understand how to calulate initial rate of reaction, as well as other mathematical skills listed in the specification.
- When asked to compare and contrast, make sure you have included both similarities and differences in your answer.
- Ensure you use the correct technical names and terms in your answer.