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# Examiners' Report
# June 2016

# GCE Biology 8BI0 01

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# Introduction

This was the first sitting of the AS paper 8BI0/01: Core Cellular Biology and Microbiology designed to assess Biological Molecules, Cells, Viruses and Reproduction of Living Things.

It was very pleasing that every mark on the paper was accessible to candidates and all questions achieved every mark possible. The level of demand was significantly higher than previous AS papers with far fewer 'easy' marks and it was significantly more demanding to achieve full marks for the longer questions and many of the shorter 'explain' questions because of the much tighter mark scheme where candidates are no longer able to score full marks on a question without answering the question fully. Where able candidates were able to respond appropriately to each question few did it consistently across the paper so relatively few candidates scored highly across the whole paper. As a result the mean mark for the paper was lower than AS exams in recent years, although it was the same mean mark achieved for the first AS papers at the time of introducing the last significant change of specification and there were no re-sit candidates.

Questions that demanded recall tended to score very well, e.g. when asked to describe the process of translation. However, when asked to analyse and explain data and apply their knowledge in unfamiliar contexts (e.g. density gradient centrifugation) many candidates found the marks harder to obtain.

Many candidates did very well with the questions testing their understanding and ability to apply mathematical skills. Unfortunately a significant number of candidates struggled with the calculation questions and many were left blank. These are higher demand than past mathematical questions and this is an important part of the new specifications. Did those candidates who left these blank forget their calculators or suffer from a lack of numerical confidence?

Some candidates lost marks through not reading the question carefully or poor literacy; others through carelessness, for example by not making a clear comparative statement or only making one clear statement when a question carries two or more marks.

## *Question 1*

These four multiple choice questions discriminated well, with most having just over 50% of candidates getting each one correct.

a: most candidates correctly identified A the anther as the part where pollen grains are made.

b: less than 50% of candidates identified the correct chromosome numbers for the nuclei. The most common incorrect response was C (7, 14)

c: 50% of candidates identified nucleus Q dividing by mitosis as the correct answer. The most common incorrect response was B with nucleus P dividing by mitosis.

d: 54% of candidates identified that there was only one correct statement. The most common incorrect answer was to state C that there were two correct statements.

## *Question 2 (a)(i)*

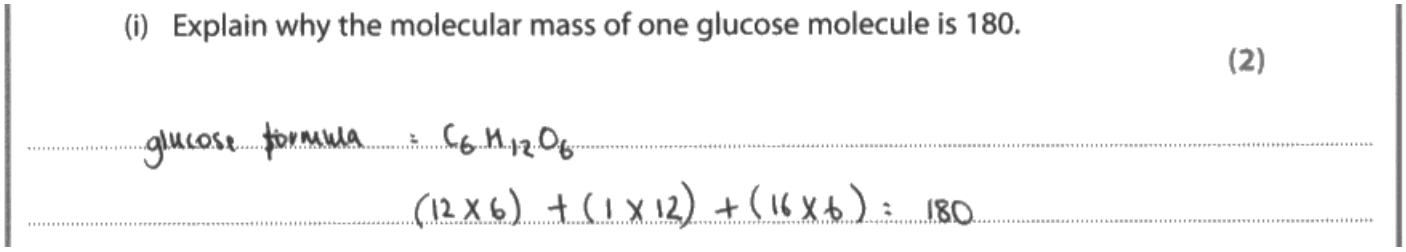
Question 2(a) was designed to test the specification point 1.1ii "know the structure of the hexose glucose" and 1.1iii "….condensation reactions forming glycosidic bonds …." in an applied manner that tests some simple mathematical skills.

Candidates needed to recall the biological knowledge that the formula for glucose is C6H12O6 and that maltose is formed from a condensation reaction between two glucose molecules. They were provided with the molecular mass of each element and the molecular mass of one glucose molecule so no additional chemical knowledge beyond the specification (where they also need to know the structure and properties of water 1.7) and the information provided was required. Please note that the Maths guidance says at the top of each page 'assessment is not limited to the examples given below'.

2(a)(i) was extremely well answered by the vast majority of candidates, with both marks being awarded. Many of the responses were very clear and laid the answer and working out logically.

A few candidates left this blank, perhaps showing a fear of chemistry or numeracy. Other candidates failed to recall the molecular formula for glucose so struggled to get the totals to add up to 180.

This response gained both marks available.


(i) Explain why the molecular mass of one glucose molecule is 180.

(2)

glucose formula = $C_6H_{12}O_6$

$(12 \times 6) + (1 \times 12) + (16 \times 6) = 180$

**ResultsPlus**
**Examiner Comments**

This is a typical example of the majority of clear logical correct responses for the question.

This response gained both available marks.

(i) Explain why the molecular mass of one glucose molecule is 180.

**(2)**

Glucose is made up of 6 Carbons (12x6=72), 6 oxygen (16x6 =96) and 12 Hydrogens (12x1=12). Addin up the molecular mass for each elements total will equal: 96+12+72 = 180

**ResultsPlus**
**Examiner Comments**

Although the candidate has not clearly stated the formula for glucose they have demonstrated it through a clear description of how many of each element makes up a molecule of glucose and how the total adds up to 180.

This response gained one mark.

(i) Explain why the molecular mass of one glucose molecule is 180.

**(2)**

Because glucose has the formula $C_6H_{12}O_6$ $C_5H_8O_4$ therefore the sum of molecular mass must adds to 180 hence the figure of 180

**ResultsPlus**
**Examiner Comments**

This response is typical of those that recalled the formula for glucose, but did not go on to show how the formula gives rise to the molecular mass of 180. They have avoided the information given and made no attempt at the calculation so do not gain the second mark available.

**ResultsPlus**
**Examiner Tip**

Always show your working for calculations – even if your answer is wrong you may show your understanding in stages of the calculation and get awarded some of the marks available.

This response gained no marks.

(i) Explain why the molecular mass of one glucose molecule is 180.

**(2)**

A glucose molecule is made up of carbon hydrogen and oxygen and sums to 180.

**ResultsPlus**
**Examiner Comments**

This response is typical of those who did not recall the formula for glucose and therefore could not use the information provided effectively.

This response scored no marks.

(i) Explain why the molecular mass of one glucose molecule is 180.

**(2)**

glucose is a carbohydrate which contains all 3 of the elements

In glucose there is bound 6 carbon molecules more than one of the 3 molecules each of the 3 molecules. 8 carbons, 5 oxygens, 4 hydrogens

**ResultsPlus**
**Examiner Comments**

This candidate did not recall the correct formula for glucose. They have however, made an attempt to deduce the formula from the information given about the molecular masses and their collection would add up to 180, but they haven't shown how it was calculated.

## *Question 2 (a)(ii)*

The majority of candidates clearly understood that maltose is made of two glucose molecules by showing the molecular mass for two glucose molecules added together correctly. Some candidates left this as their final answer, but the many responses showed a clear subtraction of the mass of a water molecule from this result to gain both marks.

This response gained both marks available.

(ii) Calculate the molecular mass of maltose.

(2)

180 + 180 = 360

360 - 16 - 2 = 342

Answer 342

**ResultsPlus**
**Examiner Comments**

This response is typical of the logical way many candidates tackled this question.

**ResultsPlus**
**Examiner Tip**

Please note – take care of your handwriting so that numbers and letters are clear and unambiguous. For example in this example the initial calculated response would not have received the second mark because it looks like 343, but the response on the answer line was interpreted as 342 so given both marks because of the clear differences between the 3 and the 2.

This response gained both marks available.

(ii) Calculate the molecular mass of maltose.

(2)

$C_6H_{10}$ $C_{12}H_{22}O_{11}$ = maltose

$(12 \times 12) + (22 \times 1) + (11 \times 16)$ Answer 342

= ~~348~~ 342

**ResultsPlus**
**Examiner Comments**

This candidate went the long way for calculating the answer, by working out the formula for maltose and then calculating the mass correctly.

This response gained one of the two marks available.

(ii) Calculate the molecular mass of maltose.

(2)

180 * 180 =

Answer 360

**ResultsPlus**
**Examiner Comments**

This is typical of the many responses that correctly identified maltose as being made up of two glucose molecules so added them together for one mark. However, they did not recognise that water is removed in a condensation reaction so did not subtract the mass of one water molecule that would have been needed for the second mark.

This response gained no marks.

(ii) Calculate the molecular mass of maltose. (2)

$C_{12}H_{24}O_{12}$

Maltose = glucose + glucose

$C_6H_{12}O_6 + C_6H_{12}O_6 = C_{12}H_{24}O_{12} - H_2O$ =

Answer $C_{12}H_{22}O_{11}$

**ResultsPlus**
**Examiner Comments**

This candidate successfully calculated the molecular formula of maltose. Unfortunately, they did not read the question carefully enough and did not provide a molecular mass so could not gain either of the marks available.

**ResultsPlus**
**Examiner Tip**

Always read the question carefully.

This response gained no marks.

(ii) Calculate the molecular mass of maltose. (2)

$180 \times 2 = 260$

Answer 260

**ResultsPlus**
**Examiner Comments**

Although this candidate recognised that maltose is made of two glucose molecules 180+180 does not add up to 360 so they did not gain the 1st mark available.

**ResultsPlus**
**Examiner Tip**

When making calculations it is worth doing a quick check to make sure the magnitude of the number makes sense to avoid simple errors like this one.

## *Question 2 (b)*

The majority of candidates were able to distinguish the 6C sugar from the 5C sugar, often with reference to hexose and pentose.

Some candidates were able to gain the second mark usually for correctly stating both the molecular formula of glucose and ribose, with a small number stating that ribose had two less hydrogens and one less oxygen than glucose.

A few candidates lost the mark by referring to carbon, oxygen or hydrogen molecules.

Some candidates gave differences between the uses of the sugars rather than structural differences as commanded in the question.

Several candidates referred to having isomers as a structural difference.

However, both glucose and ribose have isomers.

This response gained both marks available.

(b) Give **two** differences between the structure of a ribose molecule and the structure of a glucose molecule.

**(2)**

Ribose only has 5 ~~6~~ carbons whereas glucose has 6. Ribose also has two hydrogens and one oxygen less than glucose.

**ResultsPlus**
**Examiner Comments**

This response compares the number of carbon, hydrogen and oxygen atoms in each molecule for both marks.

This response gained both marks available.

(b) Give **two** differences between the structure of a ribose molecule and the structure of a glucose molecule.

**(2)**

Ribose molecule is a ~~hexose~~ pentose sugar with the formula $C_5H_{10}O_5$ whereas a glucose sugar is a ~~pentose~~ hexose sugar with the formula $C_6H_{12}O_6$. So ribose has 1 less carbon and one less oxygen than a glucose molecule. Glucose has 2 ~~forms~~ isomers (α & β) whereas ~~glucose~~ ribose only has one.

**ResultsPlus**
**Examiner Comments**

This response gains marks for comparing pentose and hexose and using the correct formulas. However, they would not have got a mark for the comment on isomers as ribose also has isomers.

This response gained one of the two marks available.

(b) Give **two** differences between the structure of a ribose molecule and the structure of a glucose molecule.

**(2)**

A ribose molecule is a pentose sugar molecule which only contains 5 carbon atoms, whilst a glucose molecule contains 6 carbon atoms. A ribose molecule only has 10 atoms of hydrogen, whilst a glucose molecule has 12.

**ResultsPlus**
**Examiner Comments**

This response gained a mark for comparing the number of carbon atoms. They would have received the second mark if they had compared the oxygen as well as the number of hydrogen atoms in the molecules.

This response gained no marks.

(b) Give **two** differences between the structure of a ribose molecule and the structure of a glucose molecule.

**(2)**

A ribose molecule, has oxygen and hydrogen attached to each carbon molecule, along with this, a glucose molecule has 5 carbon molecules, and also carbon, carbon double bonds.

**ResultsPlus**
**Examiner Comments**

This response is not worthy of any credit. There are no clear correct comparisons and illustrates a couple of common mistakes: reference to carbon molecules and reference to carbon double bonds.

## *Question 3 (a)*

In order to gain full marks for this question, candidates had to refer to the polarity of the water molecule. Otherwise a maximum of two marks would be awarded in this case.

The question was well answered by the majority of candidates usually gaining two or three marks. Descriptions of polarity, included the dipolar nature of water and in a very few cases, the description of slightly positive H's and a slightly negative O. There were even some good descriptions of unequal electron sharing. However a few candidates lost this mark due to describing full ionic charges. Many candidates included hydrogen bonding and/or cohesive properties in their descriptions. With some excellent responses clearly explaining the connection between polarity and hydrogen bonding. A few described adhesion instead of/ in addition to cohesion which was not relevant to the question asked. As were the frequent references to other properties of water such as the specific heat capacity.

Some candidates were able to explain how the net inward force was created at the surface. They were able to express themselves well, using appropriate terminology, in demonstrating an understanding of why water has a high surface tension.

This response gained all three marks available.

(a) Explain how the properties of water molecules result in surface tension.

(3)

water molecules have hydrogen bonds between them. This means that water is very cohesive and holds together strongly. Hydrogen bonds form because water is a polar molecule and the $\delta^+$ hydrogens of one molecule are attracted to the $\delta^-$ oxygen of another. The hydrogen bonds are strong enough that the weight of the pond water does not produce enough force to overcome these hydrogen bonds.

**ResultsPlus**
**Examiner Comments**

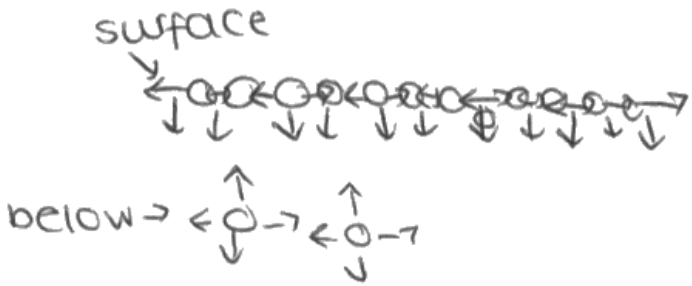
This response gained marks for the hydrogen bonding, cohesion and polarity of the water.

This response gained all three marks available.

(a) Explain how the properties of water molecules result in surface tension.

(3)

water ~~molecules are~~ is liquid in ~~their~~ its standard state. The ~~adhesion~~ cohesion of water molecules mean they stick together, and on the surface of the water there is only 1 layer, meaning the dipolar molecules only have downward and sideways forces, meaning there is tension created at the surface. (see below)




**ResultsPlus**
**Examiner Comments**

This response gained marks for cohesion and the dipolar nature of water. It also provided a good example of a response that shows how surface tension is created.

**ResultsPlus**
**Examiner Tip**

Don't forget that simple diagrams like this can be included in answers and can often add clarity to your explanations.

This response gained two of the three marks available.

(a) Explain how the properties of water molecules result in surface tension.

(3)

Water molecules are polar therefor they are able to form hydrogen bonds so can be closely attracted togehe at an air-water interface ~~Also,~~ resulting in adhesion. Also, water molecules have a high specific heat capacity so a large amount of energy is required to raise the temperature of water. Water is also virtually incompressible and has a maximum density at 4°C.

**ResultsPlus**
**Examiner Comments**

This response gained marks for the polarity of the water and the ability to form hydrogen bonds. They have confused adhesion and cohesion and the rest of the properties given in this example, although true, are not relevant to the question asked so are not worthy of credit.

**ResultsPlus**
**Examiner Tip**

When selecting properties of molecules/structures, etc pick those that are relevant to the context of the question – in this case surface tension.

This response gained just one of the marks available.

(a) Explain how the properties of water molecules result in surface tension.

**(3)**

Water is two hydrogen atoms bonded to one oxygen, forming a V shape. The oxygen is slightly negative and the hydrogens are slightly positive, and at the surface of the water the molecules line up so that the negative end of one molecule is attracted to the positive of another, so the molecules at the surface are held together more strongly, resulting in surface tension.

**ResultsPlus**
**Examiner Comments**

This response gained one mark for the description of the polarity of the water molecule. Please note if they had not already included the description of 'slightly' in relation to the charges they would not have got the mark for the later description of the negative end being attracted to the positive end as that could be easily interpreted as a full ionic charge and a description of an ionic bond.

To gain full marks the candidate should have mentioned hydrogen bonds and cohesion and not just that they are held together strongly.

## *Question 3 (b)*

This question demonstrates the increase in emphasis and expectations with respect to maths in this specification. Many candidates coped well with the maths and appropriate units in (i) and gained two or all three marks. Some, however, became confused about decimal points, number of zeros, standard form and units. There was a minority a candidates who barely attempted the calculation.

In the first part of this question, many candidates were able to calculate the force correctly and show how they did it. Many also divided by 20 to get the correct figure for the answer. However, a significant number of candidates lost a mark for failing to note the units involved, or for giving incorrect units.

A significant number of candidates just left their answer at the initial calculation of the force.

A consequential error was allowed in part (ii) for the incorrect answer being carried forward from part (i), so that the comparison of forces could still be made in the second part of the question. Most candidates used a suitable figure for surface tension from the graph. With the majority then going on to describe the surface tension force being greater than that of the force exerted by the pond skater, thus partly answering the question. The more able candidates realised that to fully answer the question, one had to extrapolate the figures and explain that beyond 15°C the force of surface tension would still be greater than the force exerted by the pond skater. Some really good answers included an extrapolated estimated value for surface tension which indicated a warm day.

This response gained all six marks available in total for b(i) and b(ii).

(i) Calculate the force exerted by the pond skater for each millimetre length of contact with the surface of the water.

Give your answer in standard form.

**(3)**

weight of pond skater = $2 \times 10^{-5}$ kg $\times$ 9.8

$= 1.96 \times 10^{-4}$ N

$\frac{1.96 \times 10^{-4} \text{ N}}{0.02 \text{ m}} = 9.8 \times 10^{-3}$ $Nm^{-1}$

Answer $9.8 \times 10^{-3}$ $Nm^{-1}$

(ii) This pond skater can stay on the surface of water even on a hot day in summer.

Use your calculated value and the graph to explain why this pond skater can stay on the surface of water.

(3)

$9.8 \times 10^{-3}\ Nm^{-1} = 0.0098\ Nm^{-1}$

According to the graph at 15°C, the surface tension of water is $0.0735\ Nm^{-1}$ which is 7.5 times bigger than the force exerted by the pond skater.

The graph has a shallow gradient which means as temperature increases by a large amount, the surface tension of water doesn't decrease by a large amount so even at high temperatures the surface tension of the water won't be smaller than the amount of force the pond skater is exerting on the surface.

**(Total for Question 3 = 9 marks)**

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**Examiner Comments**

This response calculated the force exerted per mm correctly and used suitable units in the answer. They also compared this calculated value with suitable figures from the graph, recognising the scale of the effect of temperature on the surface tension of the water to gain all three marks for the second part of the question.

This response gained five of the six marks available.

(i) Calculate the force exerted by the pond skater for each millimetre length of contact with the surface of the water.

Give your answer in standard form.

**(3)**

$0.02 \times 9.8 = 0.196$

$0.196 \div 20 = 9.8 \times 10^{-3}$

Answer $9.8 \times 10^{-3}$ N

(ii) This pond skater can stay on the surface of water even on a hot day in summer.

Use your calculated value and the graph to explain why this pond skater can stay on the surface of water.

**(3)**

Whilst the surface tension of water decreases as temperature increases, the pond skater always exerts less force on the surface of the water than the minimum surface tension of 0.070Nm$^{-1}$. Therefore even if the temperature increases past 15°C the pond skater is able to stay on the waters surface.

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**Examiner Comments**

The calculation was completed correctly for a force per metre. However, because the complete unit was not included it could not be awarded the third mark.

The use of the graph for the explanation was good and gained all three marks available.

**ResultsPlus**
**Examiner Tip**

Do take care to try and write legibly to help the examiners and ensure they can read exactly what you meant to say.

This response gained just one of the six marks available.

(i) Calculate the force exerted by the pond skater for each millimetre length of contact with the surface of the water.

Give your answer in standard form.

**(3)**

① 0.02g → kg

② $\frac{0.02}{1000} = 0.00002\ kg$

③ $0.00002 \times 98 = 0.000196$

0.000196

$10^{-4} \times 1.96$

0.0001.96

Answer $1.96 \times 10^{-4}$

(ii) This pond skater can stay on the surface of water even on a hot day in summer.

Use your calculated value and the graph to explain why this pond skater can stay on the surface of water.

**(3)**

the pond skater can stay on the surface because the force in newtons on the water decreases as temperature increases therefore allowing pond skater to be on surface of the water.

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**Examiner Comments**

For (b)(i) the candidate calculated the force of the pond skater for one mark, but did not go on to take into consideration the size of the pond skater as instructed in the question. They also neglected to provide any units.

For (b)(ii) No relevant figures from the graph have been used to make a comparison with the calculated value and the statement implies that it is the force of the pond skater that goes down with increasing temperature.

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**Examiner Tip**

Always include relevant units in calculations and check (and use) data carefully when it is provided in questions, especially check what the data is measuring.

## *Question 4 (b)(i)*

4(a) The majority of candidates recognised the fatty acid would be joined to glycerol during a condensation reaction forming an ester bond. The most common mistake was to think that a glycosidic bond would be formed.

4(b)(i) In this question the vast majority of candidates gained a mark for stating (or describing) the positive correlation between temperature and membrane fluidity clearly.

Many candidates recognised the more dramatic change in fluidity between the solid-like state and the liquid-like state and so gained the second mark. This mark could be gained by referring to the greater gradient. Often, however, the mark was not gained as candidates referred to an increase rate, which cannot be the case as there is no information given about time.

This response gained both marks available.

(i) Describe the relationship between membrane fluidity and temperature as shown by this graph.

(2)

As the temperature increases the membrane fluidity also increase. The increase is not linear. The greaterts rise in membrane fluidity is inbetween the solid like state and the liquid like state.

**ResultsPlus**
**Examiner Comments**

An example of a clear concise description of the trend with clarity of when the greatest rise in fluidity occurred.

This response gained one of the two marks available.

(i) Describe the relationship between membrane fluidity and temperature as shown by this graph.

(2)

As the temperature increases, the membrane fluidity increases. The rate of membrane fluidity is highest around the middle temperature.

**ResultsPlus**
**Examiner Comments**

This response is typical of the many responses that recognised the trend, but did not gain the second mark because of inappropriate use of the word 'rate' and/or being too vague about the point where the gradient changes.

## *Question 4 (b)(ii)*

The majority of candidates were able to use the data from the graphs to spot the effect of the differences in fatty acid type or structure on melting points and thus managed to score 2 or 3 marks for this question. However, a disappointing number of candidates failed to recognise the trends clearly.

Some responses referred to the effect of temperature on the fatty acids.

Some candidates were able to use the information about the melting points to make deductions about how the composition of membranes could affect the fluidity of the membrane.

There were extremely few instances where candidates commented about the lack of temperature values on the sketched graph and the effect that could have on any conclusion made.

This response gained three of the four marks available.

The student stated that membrane fluidity depends on the fatty acids present.

Analyse the data in these two graphs and the sketched graph to comment on this statement.

(4)

In graph 1 unsaturated fatty acids have a lower melting point than saturated fatty acids. The number of double bonds also seems to have an effect as n.o of ~~[illegible]~~ the double bonds in unsaturated fatty acids increases melting point decreases, so more unsaturated fatty acids in a membrane would lead to a more fluid membrane. It is hard to tell if chain length has any effect on membrane fluidity

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**Examiner Comments**

This candidate correctly identified two of the trends from the graphs provided, i.e. the comparison between the melting points of saturated and unsaturated fatty acids and the effect of the number of double bonds. They went on to make an inference about how this would affect membrane fluidity.

They just missed the clear trend for saturated fatty acids about chain length and melting point by considering all of the data on the graph together.

This response gained two of the four marks available.

The student stated that membrane fluidity depends on the fatty acids present.

Analyse the data in these two graphs and the sketched graph to comment on this statement.

**(4)**

From my graph you can conclude that the more saturated the fatty acid is the higher its melting point as you can see as the chain length increases so does the melting point ie at 20 chain length the melting point was at 75°C & at 12 chain length the melting point was 45°C. However when there is a unsaturated fatty acid the melting points are much lower i.e majority of them are below 0. On the previous graph as temperate increased the membere became more fluid which supports it becau

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**Examiner Comments**

The most common mark for this question was two and this is a typical example of a response that has correctly identified two trends from the graphs provided (comparison between saturated and unsaturated and the chain length) for two marks. However, they did not use all of the data available or linked the trends back to the original sketched graph to address the student's statement.

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**Examiner Tip**

It is important to learn to evaluate and analyse the information presented on graphs or in tables in order to answer the question which is actually asked or comment effectively on the data.

This is an important skill for this specification.

This response did not gain any marks.

The student stated that membrane fluidity depends on the fatty acids present.

Analyse the data in these two graphs and the sketched graph to comment on this statement.

**(4)**

In the first graph it shows that for saturated fatty acids, the higher the temperature, the more fluid the membrane is. However for the unsaturated fats, the lower the ~~the~~ temperature, the more fluid the membrane is. This shows it does depend on the fatty acids present.

However for the number of double bonds, even though there was only one, the melting points were very different even though they are all unsaturated.

The longer the carbon chain, the more energy you need to break the ~~hydrogen~~ bonds which also ~~proves~~ supports the students claim.

**(Total for Question 4 = 7 marks)**

In the sketched graph, it isn't clear which type of fatty acid she was using or if she used many so we can't conclude wing that.

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**Examiner Comments**

This response is a typical example of the responses of candidates who did not refer to the axis of the graphs carefully and therefore often produced ambiguous or incorrect statements about the data presented.

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**Examiner Tip**

When presented with a graph carefully check what is measured on each axis.

## *Question 5 (a)*

5(a) Many candidates were able to gain one mark for naming an appropriate solute. A number of responses referred to cytoplasm or a named organelle and so did not gain this mark.

Only a very few candidates were able to explain why what they suggested would be found in this component W, as they were less dense than 1.09 $gcm^{-3}$. Most responses did not attempt and explanation or merely stated that they were light or not dense, not using the information presented to them in the diagram.

5(b) The vast majority of candidates correctly identified lysosome and Golgi apparatus as being found in X and Y respectively. The most common mistake was to get those two organelles the wrong way round, choosing B instead of C.

This response gained both marks available.

(a) Component **W** was present after centrifugation.

Explain what might be present in component **W** other than water and salt.

**(2)**

None of the organelles would be present as seen from the tube's high density.

Enzymes may be present in component W because they have a lower density than 1.09. Component W has to be less dense than 1.09 $gcm^{-3}$.

**ResultsPlus**

**Examiner Comments**

This candidate correctly identified that no organelles would be present and gave an enzyme as something credible that could have been present in the layer. This is a relatively rare example of a candidate who went on to explain why it would be present.

This response gained one of the two marks available.

(a) Component **W** was present after centrifugation.

Explain what might be present in component **W** other than water and salt.

**(2)**

that were
sugars, dissolved in the cytoplasm of the cells, as well as other solutes such as urea.

**ResultsPlus**
**Examiner Comments**

The candidate has correctly identified that solutes from the cytoplasm are likely to be in component W. They would have gained the mark for solutes or urea. However, we did not credit sugars because it was a sucrose column and sucrose is a sugar, although specific named sugars like glucose were credited.

This response is typical of the vast majority who did not explain why it would be found in this layer, i.e. it is less dense than 1.09 $gcm^{-3}$.

**ResultsPlus**
**Examiner Tip**

Just naming something is never going to be sufficient to gain two marks for an 'explain' question.

This response gained no marks.

(a) Component **W** was present after centrifugation.

Explain what might be present in component **W** other than water and salt.

**(2)**

The cytoplasm as cell with have been separated as well. As it is simply a watery medium, it makes sense that it would rise to the top as component W.

**ResultsPlus**
**Examiner Comments**

Several candidates recognised that the cytoplasm rather than any organelles would be found in this top layer. Unfortunately once the cell has been disrupted the cytoplasm is not kept together as an identifiable component so only substances from the cytoplasm were deemed worthy of credit.

This response gained no marks.

(a) Component **W** was present after centrifugation.

Explain what might be present in component **W** other than water and salt.

**(2)**

the rest of the cytoplasm, including the nucleus and genetic material because DNA (and ∴ chromosomes) aren't very dense.

**ResultsPlus**
**Examiner Comments**

This is an example of a typical in correct response that names an organelle that would not be present in the top layer. Some candidates even named organelles that had their densities stated in the table provided.

## *Question 5 (c)*

Many candidates correctly identified the nucleus or the ribosomes as being present in component Z, thus scoring one mark.

However, a surprising number of candidates stated that the organelle present in Z might be mitochondria, lysosomes, ER or Golgi Apparatus, despite these being given in the accompanying table as present in other fractions of intermediate densities, therefore failing to effectively use the information presented to them.

A number of candidates realised that ribosomes were also extremely dense and may be found in this component of the gradient.

A small number of responses referred to plant cell organelles, despite the fact that the question stem told them that this density gradient separated the components of animal cells.

The majority of candidates gained the second mark for stating that the nucleus was the largest organelle or that it was the organelle which was most dense. Some also referred to it containing very dense material to gain this mark.

Some candidates referred to these being more dense than 1.22 or more dense than mitochondria, thus using the information given in the question effectively.

This response gained both marks available.

(c) Explain which other organelle would be present in component **Z**.

**(2)**

The nucleus would be present in component Z because it is the largest organelle & ~~contains~~ contains heterochromatin, which is very dense as area of DNA & protein

**ResultsPlus**

**Examiner Comments**

This response gained a mark for suggesting a suitable organelle – the nucleus, and explaining why it would be there (largest and contains dense DNA and protein).

This response gained no marks.

(c) Explain which other organelle would be present in component **Z**.

**(2)**

~~Ribosome~~ ~~Golgi ap~~ mitochondria because it is the most dense, so it may be lower down the solution with the other organelles

**ResultsPlus**
**Examiner Comments**

This response is typical of many which gave mitochondria as their answer despite the information telling them the density of the mitochondria in the table.

**ResultsPlus**
**Examiner Tip**

Read and refer to all of the information provided in the entire question and not just that in a specific item to help you construct your answers.

## *Question 5 (d)*

The vast majority of candidates gained a mark for recognising that the presence of ribosomes on rough ER contributed to a higher density.

Fewer candidates managed to explain how the two ERs could be separated through the idea of using smaller intervals of density and even fewer stated that a density range between 1.15 and 1.19 should be used for this.

Some candidates suggested repeating the experiment at a density of 1.16gcm□3, which would not have separated the two ER's.

Some responses gave details of the functions of rough and smooth ER, instead of answering the question asked.

This response gained no marks.

(d) Explain how rough endoplasmic reticulum can be separated from smooth endoplasmic reticulum using density gradient centrifugation.

**(2)**

The smooth endoplasmic reticulum would separate after being spun in a centrifuge because it has a different density to the Rough endoplasmic reticulum.

**ResultsPlus**
**Examiner Comments**

This candidate has not stated what would cause the different densities or which would be most dense, or suggested how they could be separated.

This response gained one of the two marks available.

(d) Explain how rough endoplasmic reticulum can be separated from smooth endoplasmic reticulum using density gradient centrifugation.

**(2)**

The rough endoplasmic reticulum has ribosomes attached and therefore has a higher density * than the smooth endoplasmic reticulum. Using density gradient centrifugation, the rough endoplasmic reticulum would be present lower in the column than the smooth endoplasmic reticulum.

**(Total for Question 5 = 7 marks)**

* greater than $1.16\ g\ cm^{-3}$.

**ResultsPlus**
**Examiner Comments**

The response gained a mark for explaining why RER is more dense, but did not explain how they could be separated using density gradient centrifugation.

This response gained both marks available.

(d) Explain how rough endoplasmic reticulum can be separated from smooth endoplasmic reticulum using density gradient centrifugation.

(2)

rough endoplasmic reticulum is slightly more dense so make a new sucrose column with solutions between 1.15 and 1.17 $gcm^{-3}$ and very small differences in density between them until the smooth and rough endoplasmic reticulum are in different positions.

**ResultsPlus**
**Examiner Comments**

This candidate correctly identified that RER would be more dense and correctly suggested using smaller intervals of sucrose density in order to separate the two components.

This response gained both marks available.

(d) Explain how rough endoplasmic reticulum can be separated from smooth endoplasmic reticulum using density gradient centrifugation.

(2)

Rough endoplasmic reticulum contains many ribosomes, which are very dense, but smooth endoplasmic reticulum contains no ribosomes, so would be less dense. They could be spun in a centrifuge with sucrose solutions eg more precise concentrations e.g. ~~1.155~~ $gcm^{-3}$ and 1.165 $gcm^{-3}$ so that they could be separated. SER might be found at about 1.55 $gcm^{-3}$ and RER at about 1.165 $gcm^{-3}$

(Total for Question 5 = 7 marks)

**ResultsPlus**
**Examiner Comments**

Another example of a response that explains how they can be separated and why it would work.

## *Question 6 (a)*

The majority of candidates gained a mark for recognising that mitosis is needed for growth, repair or asexual reproduction.

However a relatively common mistake was to refer to growth of cells or repair of damaged cells, instead of replacing cells, or growth of tissues or the organism.

Significantly fewer candidates gained the second mark by making reference to producing genetically identical cells, or did not gain this mark as they did not qualify their statement with the word "genetically" or to say that they had the same genetic information.

Only a few responses referred to "clones" or to "cells with the same number of chromosomes" being produced.

This response gained both marks available.

(a) Explain why cells carry out mitosis.

(2)

Cells carry out mitosis to produce genetically identical cells for growth, repair and replacement.

**ResultsPlus**
**Examiner Comments**

Marks were scored for producing genetically identical cells and for growth, etc.

This response gained one of the two marks available.

(a) Explain why cells carry out mitosis.

(2)

for ~~cell growth repair~~ repair of damaged cells and asexual reproduction

**ResultsPlus**
**Examiner Comments**

This response gained a mark for recognising that mitosis is needed for asexual reproduction.

**ResultsPlus**
**Examiner Tip**

In addition to the correct point, this response also demonstrates a relatively common mistake/ misconception. Mitosis does not repair cells (so this alone would not have gained a mark.) Mitosis may replace damaged cells to repair tissues, it is not used to repair individual cells.

## *Question 6 (b)*

The majority of candidates recognised that this was a synthesis stage and most of them easily picked up 2 marks for reference to DNA synthesis or for DNA replication and the DNA content doubling.

A significant number of candidates included details describing the process of replication that was not needed for this question.

Few candidates referred to the formation of chromatids with the majority of candidates mistakenly stating that the number of chromosomes doubled.

This may be a natural assumption due to the process of replication, but demonstrates a lack of understanding of the nature and behaviour of chromosomes during mitosis.

This response gained all four marks available.

(b) Explain what happens to the DNA content and the number of chromosomes in the stage labelled **K**.

**(4)**

In stage K, the DNA and histones are replicated for mitosis; so the DNA content will have doubled. This ensures the cells formed from mitosis are diploid (2n). The number of chromosomes will have remained the same however, only now being in an 'X' shape (consisting of 2 chromatids) joined by a centromere, so that they can be separated and pulled to opposite poles of the cell, so that each resulting cell is diploid.

**ResultsPlus**
**Examiner Comments**

This response gained marks for:

- DNA replication;
- DNA doubles;
- number of chromosomes stays the same;
- because each chromosome is now two chromatids joined by a centromere.

This response gained just one of the four marks available.

(b) Explain what happens to the DNA content and the number of chromosomes in the stage labelled **K**.

(4)

The number of chromosomes double as DNA is replicated in preperation for Mitosis. The DNA content does not change as introns are not removed during mitosis.

**ResultsPlus**
**Examiner Comments**

This response gained a mark for recognising that DNA replicates. However, they then state that DNA content does not change – the sequence of the DNA should not change but the content would double (unlike the number of chromosomes).

This response gained two of the four marks available.

(b) Explain what happens to the DNA content and the number of chromosomes in the stage labelled **K**.

This phase is called S-phase (Synthesis). (4)

DNA replication occurs. DNA helicase "unzips" the DNA double helix, breaking the hydrogen bonds between complementary bases. New bases come in and match up to their complementary pairs (A with T & C with G). DNA polymerase catalyses the formation of phosphodiester bonds between adjacent bases to make a new strand of DNA, working in a 5'–3' direction. This is called semiconservative replication because the new DNA contains 1 old strand and 1 new strand. The result is that the amount of DNA doubles & so does the number of chromosomes. There are 2 genetically identical copies of each chromosome.

**ResultsPlus**
**Examiner Comments**

Marks were gained by this response for recognising DNA replication takes place and it results in the amount of DNA doubling.

This response is typical of those that interpret the question as 'describe the process of replication'.

**ResultsPlus**
**Examiner Tip**

It is also typical in thinking that the number of chromosomes double, rather than each chromosome becoming two joined identical sister chromatids.

This response gained one of the four marks available.

(b) Explain what happens to the DNA content and the number of chromosomes in the stage labelled **K**.

**(4)**

The DNA is replicated during interphase so the chromosome number doubles. The chromosome number must double so homologous pairs are formed

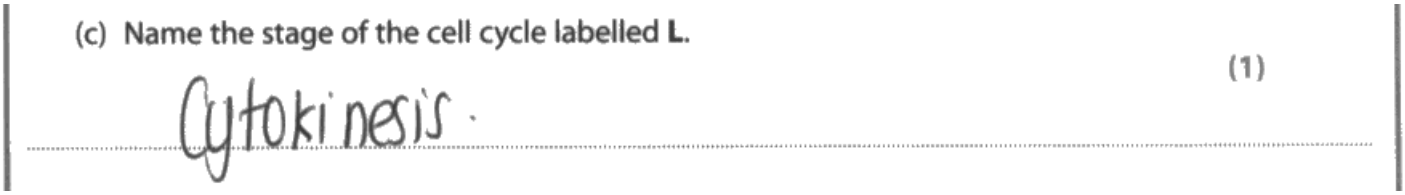
**ResultsPlus**
**Examiner Comments**

This response recognised that DNA replicates for one mark, but did not go on to state that the DNA content doubles.

## *Question 6 (c)*

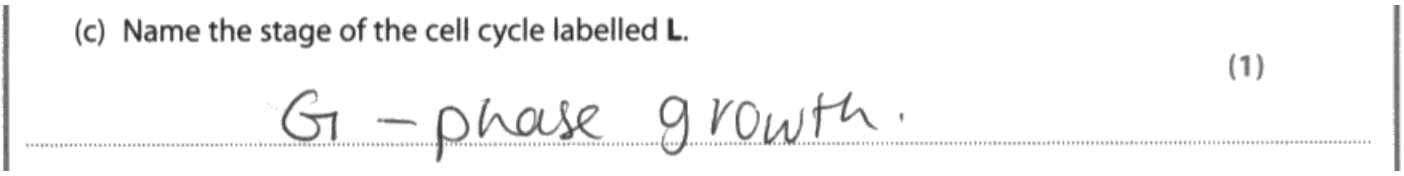
The vast majority of candidates correctly identified the stage of the cell cycle labelled on the diagram.

This gained the mark available.




**ResultsPlus**
**Examiner Comments**
An example of the correct response.

This response did not gain the mark.




**ResultsPlus**
**Examiner Comments**
This is an example of one of the more common incorrect responses given for this question.

## *Question 6 (d)(iii)*

The majority of candidates gained one mark for this question, usually for identifying that there may be differences in the material selected.

A few candidates suggested that the plants were different species despite it being stated that the second root tip was from another plant of the same species.

Some candidates responses implied that the cells in a particular region of root tip would all be in the same stage of mitosis, not that one sample of root tip would have cells in all different stages.

Only a few candidates were able to describe the difficulty of identifying the correct stage of mitosis, or that because there are so few cells in anaphase at any given time, any error in counting would be magnified.

We would have expected more candidates to consider these aspects if they had carried out and evaluated the practical technique.

This response gained one of the two marks available.

(iii) Explain why these two calculated values are not identical.

(2)

The two samples were from different plants which were likely in different conditions. This causes them to have different rates of mitosis (mitotic index) and a different proportions of time spent in different stages.

**ResultsPlus**
**Examiner Comments**

This is a typical example of the many responses that correctly identified differences in the samples selected that could have caused the difference.

This response gained one of the two marks available.

(iii) Explain why these two calculated values are not identical.

(2)

In this ~~This~~ experiment ~~was~~ students only see the cell for that snapshot in time, many cells could be on the verge of the next stage. Also one student could have identified a stage incorrectly due to the fact that they can look similar

**ResultsPlus**
**Examiner Comments**

This is a much rarer example of a response that showed awareness of the technique and the difficulty of identifying the correct stages.

## *Question 6 (d)(i–ii)*

Many candidates gained the full four marks available for these linked calculations with many showing clear working. Some candidates lost a mark for including too many decimal places in the final answer. Answers were allowed rounded to 1 or 2 decimal places at the most. A few candidates also lost marks through incorrect rounding of their numbers.

Some responses did not manage to find the correct answer in part (i), but the error was allowed to be carried forward using their answer as written, so that they were able to gain both points in part (ii) if the method used was correct.

In some cases for part (ii), the 8% value was calculated, but the candidate neglected to subtract this value from the answer calculated in part (i), thus failing to answer the question asked.

There were a small number of blank responses found for this item and incomplete calculations that suggest that some candidates may not have had a calculator with them, or they had a fear of calculations.

This response gained all four marks available.

(d) The duration of each stage of the cell cycle is directly proportional to the number of cells in that stage.

A student made a squash preparation of a root tip and counted the number of cells in each stage of the cell cycle.

The results are shown in the table.

| Stage of cell cycle | Number of cells |
|---|---|
| Interphase | 169 |
| Prophase | 5 |
| Metaphase | 8 |
| Anaphase | 2 |
| Telophase | 62 |

(i) The cells in this root tip had a cell cycle time of 23 hours.

Calculate the time, in minutes, that these cells spent in anaphase.

(2)

$23 \times \frac{2}{246} \times 60$

0.18699 hours
x60
11.2 mins

Answer 11.2 mins

(ii) The student then used the same method to study mitosis in a root tip from another plant of the same species.

The student worked out that the cells spent 8% less time in anaphase.

Calculate the time, in minutes, that these cells spent in anaphase.

**(2)**

11.2 x 0.92

Answer 10.3 mins

**ResultsPlus**
**Examiner Comments**

Both calculations are correct and the answers were expressed suitably for the context of the question.

This response gained two of the four marks available.

(d) The duration of each stage of the cell cycle is directly proportional to the number of cells in that stage.

A student made a squash preparation of a root tip and counted the number of cells in each stage of the cell cycle.

The results are shown in the table.

| Stage of cell cycle | Number of cells |
|---|---|
| Interphase | 169 |
| Prophase | 5 |
| Metaphase | 8 |
| Anaphase | 2 |
| Telophase | 62 |

169 = 0.69
5 = 0.02
8 = 0.03
02 = 0.00813
62 = 0.25

(i) The cells in this root tip had a cell cycle time of 23 hours.

Calculate the time, in minutes, that these cells spent in anaphase.

(2)

169+5+8+2+62 = 246
246 mins
0.00813% of 1380 = 11.23
60+23 = 1380
2/246 ×100 = 81.3
246
0.81% of 246 mins
0.81% of 1380
=
11.3
380

Answer ..... mins

(ii) The student then used the same method to study mitosis in a root tip from another plant of the same species.

The student worked out that the cells spent 8% less time in anaphase.

Calculate the time, in minutes, that these cells spent in anaphase.

(2)

11.23 / 100 = 0.1123

11.23 − 0.8984

0.1123 × 8 = 0.8984

Answer 10.33 mins

**ResultsPlus**
**Examiner Comments**

This candidate demonstrated the correct mathematical techniques for both parts of the question and gained a mark for the method on each part. However, in part (i) the final answer is incorrect due to some poor rounding; in part (ii) they have used a different figure than that given as the answer to part (i) in their calculation so could not be credited for an error carried forward.

**ResultsPlus**
**Examiner Tip**

Check your rounding of numbers carefully.

This response gained two of the four marks available.

(d) The duration of each stage of the cell cycle is directly proportional to the number of cells in that stage.

A student made a squash preparation of a root tip and counted the number of cells in each stage of the cell cycle.

The results are shown in the table.

| Stage of cell cycle | Number of cells |
|---|---|
| Interphase | 169 |
| Prophase | 5 |
| Metaphase | 8 |
| Anaphase | 2 |
| Telophase | 62 |

(i) The cells in this root tip had a cell cycle time of 23 hours.

Calculate the time, in minutes, that these cells spent in anaphase.

(2)

Anaphase = 2 cells
therefore 2 hours
60×2
= 120 mins

Answer 120 mins

(ii) The student then used the same method to study mitosis in a root tip from another plant of the same species.

The student worked out that the cells spent 8% less time in anaphase.

Calculate the time, in minutes, that these cells spent in anaphase.

**(2)**

$\frac{8}{100} \times 120$

$= 9.6$

$120 - 9.6$

$= 110.4$

Answer 110.4 mins

**ResultsPlus**
**Examiner Comments**

The calculation for part (i) is wrong, so no marks were awarded. However, we allowed errors carried forward for these linked questions so this response gained two marks for part (ii) for correctly calculating a time that was 8% lower than the answer given in part (i).

**ResultsPlus**
**Examiner Tip**

Always show your working for calculation questions as you may be able to pick up marks, even if you have made a mistake.

Always check that your calculated values make sense given the information and context of the question.

This response gained just one of the four marks available.

(d) The duration of each stage of the cell cycle is directly proportional to the number of cells in that stage.

A student made a squash preparation of a root tip and counted the number of cells in each stage of the cell cycle.

The results are shown in the table.

| Stage of cell cycle | Number of cells |
|---|---|
| Interphase | 169 |
| Prophase | 5 |
| Metaphase | 8 |
| Anaphase | 2 |
| Telophase | 62 |

(i) The cells in this root tip had a cell cycle time of 23 hours.

Calculate the time, in minutes, that these cells spent in anaphase.

(2)

$\left(\frac{2}{246}\right) \times$

Answer ..... mins

(ii) The student then used the same method to study mitosis in a root tip from another plant of the same species.

The student worked out that the cells spent 8% less time in anaphase.

Calculate the time, in minutes, that these cells spent in anaphase.

(2)

Answer ..... mins

**ResultsPlus**
**Examiner Comments**

This candidate gained a mark for part (i) for showing the working for part of the calculation.

**ResultsPlus**
**Examiner Tip**

Always show your working – you may get some credit even if you can't complete the calculation.

Don't forget to bring a calculator with you into the exam!

## *Question 7 (a)*

This was a very discriminating question gaining an almost perfect spread of marks across the five possible outcomes (marks of 0 – 4).

Most candidates were able to state that conclusion 1 was justified by comparing the heights of the bars in the graph. It was pleasing to see some of the responses referring to the mean pollen tube length in their comparisons. Some good responses also included the idea that it may not be justified on the basis of the slight overlap between the range bars for the control and actinomycin D. Some candidates lost the mark by not actually stating what the difference was between the growth of the control and those with the inhibitors present, i.e. it was not clear if the inhibitors increased or reduced the length of the pollen tubes.

Only in the more able responses did candidates refer to the fact that there was no indication of time and therefore conclusion 2 could not be justified. A fair number referred to the fact that there was no information supplied about rate of growth, but only about pollen tube length. Many candidates thought the conclusion could be justified because it was the shortest.

Many candidates were also able to justify conclusion 3 on the basis of the larger error/range bar. The bars were deliberately unlabelled so that candidates were open to interpret them as range, error or standard deviation, etc. However, a significant minority of candidates stated that the control was the most repeatable, on the basis that the control is the easiest experiment to repeat as all the variables were (apparently) controlled. No candidates argued that it was possible to say that conclusion 3 was not justified as the range bar is shorter in proportion to the mean than some of the results with the inhibitors.

Some candidates also spotted that there was no indication of numbers of pollen grains used and so conclusion 4 could not be justified.

This response gained all four marks available.

(a) Analyse the results of this investigation to comment on each of these conclusions.

**(4)**

Conclusion 1: We can say that on average, yes all three inhibitors affected pollen tube growth as they all grew less, but the ranges bars of the control and act D overlap so act D may not inhibit pollen tube growth

Conclusion 2: This conclusion can't be made as we aren't measuring distance grown in a certain period of time, the inhibitor may act upon the pollen tube when it reaches a certain length. We want investigate speed, just measurements

Conclusion 3: Yes this conclusion is correct as the variance for control was 320 compared to 160, 160 and 40.

Conclusion 4: Wrong conclusion as we do not how many pollen tubes germinated, we only know the mean length of the tubes.

**ResultsPlus**

**Examiner Comments**

This response showed a clear understanding of just what the data is saying and how it relates to each of the stated conclusions, clearly identifying the limitations of the data provided and therefore which of the conclusions can't be supported.

This response gained none of the four marks available.

(a) Analyse the results of this investigation to comment on each of these conclusions.

(4)

for conclusion 1, it is accurate to say that the inhibitors affected the pollen growth as there is a large difference in the mean pollen growth. for conclusion 2, it is true that pollen in C13 grew the slowest for conclusion 3, the control was ~~the~~ least repeatable. firstly more pollens germinated as the mean pollen tube length was around 570 μm meaning they provided the furthest

**ResultsPlus**
**Examiner Comments**

For conclusion 1 they have identified that the inhibitors affect growth, but they did not stated what the difference is – are they longer or shorter?

For conclusion 2 they said that it grows the slowest, but there was no indication of time on the graph or in the method given.

For conclusion 3 they did not explain why it was most repeatable and ignored the bars provided on the graph.

For conclusion 4 they mistakenly equated length with the number of tubes germinated.

**ResultsPlus**
**Examiner Tip**

Read graphs carefully to make sure you are clear about what has been measured.

This response gained two of the four marks available.

(a) Analyse the results of this investigation to comment on each of these conclusions.

(4)

For conclusion 1, I agree as with each inhibitor the pollen tube length is different from the others and the control. I think conclusion 2 is correct because, with CB, the pollen tube only grew 40 µm so it grew the slowest. I agree with conclusion 3 because the control has the largest standard deviation of 320 µm. I disagree with conclusion D as just because the mean pollen tube length was the biggest, that doesn't mean that fertilisation occured and then germination.

**ResultsPlus**

**Examiner Comments**

This response gained credit for what was stated about the final two conclusions, but they have not stated what the difference is for conclusion 1 and ignored the lack of time for conclusion 2.

## *Question 7 (b)(i)*

This question was a good differentiator, effectively asking candidates to apply their knowledge of protein synthesis to the context of pollen tube growth. The majority of candidates did not gain a mark for this question. For example:

- A significant number of candidates did not attempt this question.
- A lot of responses suggested that proteins are not needed and therefore the tube can still grow.
- Many implied that a lot of mitosis was occurring and therefore growth could still happen.
- Many suggested that although transcription had been stopped, translation could still take place – highlighting a lack of understanding of the sequence of events in protein synthesis.
- Where candidates did gain marks it was through reference to competitive inhibitors, or that there was some mRNA left in the grain, or comments that there were still some proteins or enzymes in the grains to promote growth.

This response gained both marks available.

(b) (i) Actinomycin D (act D) inhibits transcription.

Explain why pollen tubes could still grow in the presence of act D.

(2)

Although act D inhibits transcription it does not completely prevent it from occurring, so although less transcription of occurring proteins can still be produced for growth. Alternatively, the pollen tubes may not need to produce new proteins for growth.

**ResultsPlus**
**Examiner Comments**

Marks were awarded for recognising that transcription may not have been completely inhibited so that some proteins could still be made. Combining effectively a knowledge about inhibition and the process of protein synthesis.

This response gained one of the two marks available.

Because the pollen tubes still contain previously made mRNA strands which can be reused.

**ResultsPlus**
**Examiner Comments**

The candidate correctly identified that some mRNA may still be present and can be reused – unfortunately they did not go on to say that it could be used for translation/protein synthesis which would have given them the second mark.

This response gained one of the two available marks.

(2)

Inhibition of transcription means the ~~cells~~ cells won't be able to make mRNA and therefore hydrolytic enzymes. However they ~~would've~~ would've had a store of hydrolytic enzymes before being placed in the ~~acid~~ acid D. And they can still digest the style, towards the microphyll.

**ResultsPlus**
**Examiner Comments**

This is an example of another of the credit worthy ways of gaining marks for this question. The candidate suggested that things needed for the pollen tube growth are already present – in this case the enzymes needed to digest the style.

This response gained both marks available.

(b) (i) Actinomycin D (act D) inhibits transcription. pollen grains germinate would not effect the pollen tube length generally.

Explain why pollen tubes could still grow in the presence of act D. (2)

there are still mRNA molecules in the pollen tubes that could undergo translation, that have previously undergone transcription, so the inhibition to transcription will already present not affect these^ mRNA molecules being translated, allowing growth to occur.

**ResultsPlus**
**Examiner Comments**

An example of a good response that recognises that previously made mRNA may still be present and able to go through translation.

**ResultsPlus**
**Examiner Tip**

Please note the top of the clip. You can see the end of the answer to the previous question. If your answer extends beyond the space given clearly indicate this within the space available so that it is clear that additional space has been required and that the rest of the answer will be found elsewhere on the paper or on an additional answer sheet.

## *Question 7 (b)(ii)*

This was a straight-forward recall question of a key process and many candidates were able to construct clear and thorough responses.

Most candidates referred to mRNA attaching to the ribosome, or going into the ribosome. However, too many merely referred to mRNA going to the ribosome.

Most candidates recognised that tRNA is attached to a specific amino acid but a common error here was to give the impression that one tRNA attached to several amino acids.

Many candidates described the anticodon/codon binding and the formation of peptide bonds between amino acids.

However, these points were often lost through muddled responses and lack of clarity.

Some candidates wrote about transcription or even replication instead of translation.

This response gained all four marks available.

(ii) Cycloheximide inhibits translation.

Describe the process of translation.

(4)

An MRNA molecule attaches itself to a ribosome. tRNA molecules bind to their specific amino acids in the cytoplasm. Anticodons on the tRNA temporarily bind to codons on the MRNA via complementry base pairing. This allows amino acids on ~~eday~~ adjacent tRNA molecules to form peptide bonds between them. The ribosome moves along the MRNA to allow more tRNA's ~~###~~ to bind to it. This eventually forms a polypeptide chain. ~~Be~~ This process stops when the stop codon on the MRNA is reached.

**ResultsPlus**

**Examiner Comments**

This is a typical example of the many full and excellent descriptions candidates gave for this question. Marks were gained for:

mRNA attaches to the ribosome;

tRNA molecules bind to specific amino acids (Note: if it was implied that one tRNA binds to amino acid**s** the mark would not have been awarded);

complementary pairing of codon and anticodon;

formation of peptide bonds;

process stops at the stop codon.

This response gained no marks.

(ii) Cycloheximide inhibits translation.

Describe the process of translation.

(4)

A tRNA molecule ~~ass~~ attaches to the starting amino ~~group~~ with ~~an~~ ~~comp~~ an appropriate anti-codon in the ribosome, this is done by complementary base pairing. ~~phosphodiester~~ Strong covalent phosphodiester bonds form between the paired bases, this creates the phosphodiester backbone. The tRNA molecule leaves to pick another anti-codon sequence. ~~Anothe~~ ~~Thes~~ These processes repeat until a long DNA ~~molecule~~ strand is formed. The DNA strand coils as it distances itself from the ribosome. ~~Thes~~ Translation stops once the 'stop' amino acid sequence is reached.

**ResultsPlus**

**Examiner Comments**

This is an example of one of the less able responses that mixed several different processes up and in the process did not manage to make any clear enough correct statements worthy of any credit.

This response gained one of the four marks available.

(ii) Cycloheximide inhibits translation.

Describe the process of translation.

(4)

During translation, ~~m~~ ribosomes attach to mRNA. tRNA, with the corresponding anticodon, then fits into the ribosome. A peptide bond is then formed between the DNA and RNA. The tRNA and mRNA then move along one codon. The tRNA is then released back into the cytoplasm, as the bond has been broken and the order of amino acids is then established.

**ResultsPlus**

**Examiner Comments**

A mark was awarded for the ribosome attaching to the mRNA. The rest is confused about what is joining to what and is incorrect and not worth credit.

This response gained three of the four marks available.

(ii) Cycloheximide inhibits translation.

Describe the process of translation.

(4)

Once mRNA has left nuclear pores, it travels through the cytoplasm and into the small subunit of Ribosomes (made up of rRNA and proteins). tRNA have specific amino acids attached and are found in the big subunit. The anti-codon on the tRNA complimentary base pair with the codon on the mRNA in order to release the amino acid on the tRNA. This is then repeated in order to form polypeptide bonds between the amino and and until the STOP codon is reached.

**ResultsPlus**
**Examiner Comments**

Marks were awarded for:

- mRNA joining with the small subunit of the ribosome;
- anticodon binding to the codons;
- suitable reference to the stop codon.

Marks were not awarded for:

- tRNA have specific amino acid**s** – just one each;
- polypeptide bonds – instead of peptide bonds.

**ResultsPlus**
**Examiner Tip**

Do take care of your clarity of communication – if what you write can be interpreted in multiple ways (including clearly wrong answers) you will not gain credit as seen in this example with the 'tRNA have specific amino acids'.

This response gained no marks.

(ii) Cycloheximide inhibits translation.

Describe the process of translation.

(4)

The process of changing DNA in to another form. DNA to tRNA. DNA helicase unwinds the two strands of DNA breaking the hydrogen bonds between the strands. As DNA replicates 5' to 3 and chains run ↑↓ like so. The leading strand translates in one long piece swapping Thymine for uracil the lagging strand can only synthises in sections called ozwasici fragments, these are fused together & in the presents of DNA ligase, to complete the strand, hydrogen bonds ~~reform~~ form and two strands rewind.



**ResultsPlus**
**Examiner Comments**

This is an example of those candidates who described transcription or replication (or a bit of both) instead of describing translation and so gained no marks.

**ResultsPlus**
**Examiner Tip**

Make sure you know the difference between replication, transcription and translation.

## *Question 7 (b)(iii)*

The majority of candidates scored well on this question about how amino acids are bonded together. Marks were most commonly gained for naming the bond (peptide bonding) and for recognising it was a condensation reaction. Many candidates also provided the specific detail that the bond forms between the amino and carboxyl group.

However, there were a surprising number of candidates who did not attempt this item. Other candidates referred to hydrogen, glycosidic or phosphodiester bonds.

This response gained both marks available.

(iii) Cytochalasin B prevents the addition of monomers in the synthesis of the protein actin.

Describe how monomers are bonded to a polypeptide chain during the synthesis of actin.

**(2)**

In a condensation reaction, ~~the~~ a molecule of water is lost as hydrogen is lost from the amino group ($NH_2$) of one ~~amino~~ amino acid, and a hydroxyl group is lost from the carboxyl group of another amino acid, forming a ~~hydrogen~~ peptide bond between them

**ResultsPlus**
**Examiner Comments**

This candidate would have been credited for:

recognising it as a condensation reaction;

describing that it is formed between the amino group and carboxyl group;

naming the bond correctly.

For a maximum of two marks.

This response gained one of the two marks available.

(iii) Cytochalasin B prevents the addition of monomers in the synthesis of the protein actin.

Describe how monomers are bonded to a polypeptide chain during the synthesis of actin.

**(2)**

During condensation reactions an OH and an H group are removed from the two molecules and are joined through through a -O- bond. This produces a longer chain and a molecule of water

**ResultsPlus**
**Examiner Comments**

The candidate recognised that a condensation reaction was involved for one mark, but did not go onto name the bond made or describe the groups involved on the amino acids.

This response gained one of the two marks available.

(iii) Cytochalasin B prevents the addition of monomers in the synthesis of the protein actin.

Describe how monomers are bonded to a polypeptide chain during the synthesis of actin.

**(2)**

monomers are bonded through which are amino acids are bonded together via with peptide bonds in translation.

**ResultsPlus**
**Examiner Comments**

The candidate gained credit for correctly naming the bond produced in this response.

This response gained no marks.

(iii) Cytochalasin B prevents the addition of monomers in the synthesis of the protein actin.

Describe how monomers are bonded to a polypeptide chain during the synthesis of actin.

**(2)**

monomers chain by an ester bond after translation and transcription have occured.

**ResultsPlus**
**Examiner Comments**

This is a typical example of a response that gained no marks mainly through incorrect naming of the bond produced and providing no description of the reaction.

## *Question 8 (a)*

The majority of candidates failed to define an allele properly to gain the mark.

Many did refer to an allele being a different version of a gene however, very few referred to the fact that different alleles were found at the same locus on a chromosome.

Candidates often referred to an allele as being a trait or characteristic. Others tried to define it in terms of a description of dominant and recessive traits.

Many had alleles as being sections of a gene.

This response gained the mark.

**8** Genetic variation results from the recombination of alleles during meiosis.

(a) State what is meant by the term **allele**.

**(1)**

An allele is different forms of the same gene.

**ResultsPlus**
**Examiner Comments**

This is a typical example of the many correct responses seen.

This response gained no marks.

**8** Genetic variation results from the recombination of alleles during meiosis.

(a) State what is meant by the term **allele**.

**(1)**

a different type of gene.

**ResultsPlus**
**Examiner Comments**

"Different type of gene" was not allowed for this question as there are distinct different types of gene in the genome, e.g. homeotic genes, oncogenes, etc.

However, for those who clarified their answer by saying "alleles are different types of **a** gene" were allowed the mark as a much less ambiguous answer.

This response did not get the mark.

**8** Genetic variation results from the recombination of alleles during meiosis.

(a) State what is meant by the term **allele**.

**(1)**

A Specific characteristic that is coded for in the production of a organism

**ResultsPlus**
**Examiner Comments**

An example of a response describing alleles in terms of characteristics that did not get the mark.

This response did not get the mark.

**8** Genetic variation results from the recombination of alleles during meiosis.

(a) State what is meant by the term **allele**.

**(1)**

An allele is a gene that is expressed

**ResultsPlus**
**Examiner Comments**

Another example of a common error defining alleles as something expressed.

## *Question 8 (b)(ii)*

8(b)(i) Fewer than 50% of candidates correctly identified when independent assortment and crossing over took place. The most common incorrect answer was to suggest prophase I and anaphase I.

8(b)(ii) This question gained the full spread of marks. Many candidates referred to bivalents or to homologous pairs and to lining up, however, a number of candidates failed to refer to 'homologous' chromosomes, or made reference to sister chromatids or two pairs of homologous chromosomes lining up, thus failing to capture the mark.

Most candidates also referred to chiasmata or gave a good description of chromatids overlapping.

Although a number of good responses stated that there was a break in chromatids or chromosomes, this point was only gained in more able responses and by a minority of candidates.

A common omission was to fail to state that genetic information was exchanged between chromatids or chromosomes.

This response gained all three marks available.

(ii) Describe the process of crossing over that occurs during meiosis.

**(3)**

Homologous chromosomes ~~exchange~~ lie side by side and form a tetrad exchanging alleles with one another at points ~~called~~ of connection called chiasmata. ~~This occurs~~

**ResultsPlus**

**Examiner Comments**

Marks for this response were given for:

homologous chromosomes lining up;

exchange of alleles between chromosomes;

chiasmata.

## *Question 8 (c)*

Marks were readily gained by the vast majority of candidates for recognising and stating the trends between genome size and chromosome number and between genome size and recombination rate.

Marks were also frequently given for identifying anomalies in the trends.

The relationship between the chromosome number and recombination rate was not as readily stated. However, when it was given, there was usually a nice explanation of why this was the case.

Some candidates reversed the trend for recombination rate.

Many candidates described the evidence in detail to support their correlations and a number of candidates attempted to explain the reasons for the correlations rather than analyse the data.

This response gained three of the four marks available.

(c) The table shows some data on the genome size, haploid number of chromosomes and the recombination rate of several species of animals.

| Species | Genome size / Mb | Haploid number of chromosomes | Recombination rate / au |
|---|---|---|---|
| Dog | 2500 | 39 | 1.6 |
| Human | 3000 | 23 | 1.2 |
| Sheep | 3000 | 27 | 1.2 |
| Cow | 3000 | 30 | 1.1 |
| Macaque | 3100 | 21 | 0.7 |
| Baboon | 3100 | 21 | 0.6 |
| Opossum | 3500 | 11 | 0.2 |
| Wallaby | 3700 | 8 | 0.2 |

Analyse the data to comment on the relationship between genome size, haploid number of chromosomes and recombination rate.

**(4)**

Generally, the larger the size of the genome in Mb, the ~~smaller~~ less the number of haploid chromosomes and the smaller the recombination rate. This is with the exception of the sheep

and the cow species because whilst the genome size is the same as humans and lower than the Macaque, the haploid no. of chromosomes is higher than that of both humans and Macaque. Both the sheep and cow have 4/7 more chromosomes than a human and 6/9 more than a macaque, which doesn't fit with the relationship.

**ResultsPlus**
**Examiner Comments**

This response is typical of those that gained the most common three marks:

trend between genome size and haploid number;

trend between genome size and recombination rate;

spotting anomalies to the trend.

This response gained all four marks available.

Analyse the data to comment on the relationship between genome size, haploid number of chromosomes and recombination rate.

**(4)**

We can see that as the genome size increases - from 2500 Mb in dogs to 3700 Mb in wallabies - the haploid number of chromosomes decreases - from 39 in dogs to 8 in wallabies - and so does the recombination rate - 1.6 au to 0.2 au - This is the general trend, however ~~cows~~ although human sheeps and cows have the same genome size they do not have the same number of haploid chromosomes (higher in cows - 30, then sheep - 27, then humans - 23) or the same recombination rate (this is lower in cows (1.1au). This may be an error in the investigation, as for the rest, the higher the number of haploid chromosomes, the quicker the recombination rate will be.

**ResultsPlus**
**Examiner Comments**

All three trends requested are described in this response, together with some discussion of those species that do not all fit the trends for the full complement of four marks awarded.

This response gained no marks.

Analyse the data to comment on the relationship between genome size, haploid number of chromosomes and recombination rate.

(4)

- Humans, sheep and cows seem to have the same Genome Size
- wallaby has a high genome type by and haploid number of chromosomes whereas humans have 23 haploid chromosomes.
- the recombination rate for dogs is higher than it is for humans because dogs have 1.6 au whereas humans have 1.2 au.

**ResultsPlus**
**Examiner Comments**

This is an example of the type of response that did not gain any credit as none of the trends are clearly stated just some individual comparisons between species.

**ResultsPlus**
**Examiner Tip**

When asked to comment on the relationship between different variables make sure you clearly describe the trends shown by the data.

## *Question 9 (a)*

The majority of candidates gained one or two marks for this question.

There were plenty of references to the substrate having the correct shape to fit the active site. However, in some cases this mark was lost as there was no reference to shape. A good number of responses also referred to the concept of induced fit and/or gave some very good descriptions of this.

Many candidates referred to lowering of activation energy, but many responses gained this mark from describing the formation of an enzyme-substrate complex.

The final marking point which required some specific reference to the reaction being catalysed was seen less often, indicating that some candidates were again not using the information supplied in the question. However, a reasonably high number of responses did manage to gain this point.

This response gained one of the three marks available.

(a) Explain the role of the active site in the conversion of succinate to fumarate.

(3)

The role of the active site is to catalyse the reaction in which the products turn to the substrate.

- the active site binds to the oxygen molecules of the succinate.
- the active site creates a double bond between the $CH_2$ of the succinate by removing two hydrogens

**ResultsPlus**
**Examiner Comments**

This response gave detail of the specific change carried out in this reaction for one mark, but did not give details of the role of the active site beyond being a catalyst.

This response gained two of the three available marks.

(a) Explain the role of the active site in the conversion of succinate to fumarate.

(3)

The substrates (succinate) bind to the active site of the succinate dehydrogenase as the active site's shape is complentary to the shape of the substrate. This biding forms a temporarily an enzyme-substrate complex, this is unstable and thus breaks down to form the product being the fumarate and the unchanged enzyme.

**ResultsPlus**
**Examiner Comments**

Marks were awarded for the complementary shape and the formation of the enzyme-substrate complex.

This response gained all three marks available.

(a) Explain the role of the active site in the conversion of succinate to fumarate.

(3)

the active site creates a double bond between the $CH_2$ groups, resulting in a loss of hydrogen. The substrate binds to the enzyme forming the enzyme substrate complex, temporary bonds are formed between the active site and the substrate as they are a complimentary shape for the induced fit hypothesis

**ResultsPlus**
**Examiner Comments**

Marks were awarded for the specifics of the reaction; the formation of the enzyme substrate complex and the complementary shape between the active site and the substrate.

## *Question 9 (b)(i)*

This was very well answered with the majority of candidates scoring both marking points and most of the rest gaining at least one mark. There were some basic references to similar structure or shape of substrate and inhibitor and a few who recognised the similarity of having the two end COO- groups.

Most followed up this point by stating that the inhibitor could bind to the active site instead of the substrate.

It was pleasing to see statements about competitive inhibition as well as some clear descriptions of this type of inhibition.

This response gained one of the two marks available.

(i) Explain why malonate inhibits the activity of succinate dehydrogenase.

(2)

it binds to the active site of the enzyme and ~~blocks~~ prevents any succinate from binding to it

**ResultsPlus**
**Examiner Comments**

A mark was awarded for stating that it binds to the active site preventing the succinate from binding. However, they did not explain how or why it would bind to the active site.

This response did not gain any marks.

(i) Explain why malonate inhibits the activity of succinate dehydrogenase.

(2)

malonate is an enzyme which is able to inhibit the activity of succinate dehydrogenase as ~~that~~ its active site does not fit or match to that of succinate dehydrogenase thus not reacting together.

**ResultsPlus**
**Examiner Comments**

This is an example of the responses where candidates had muddled what was the enzyme and what was the substrate/ inhibitor and therefore was not able to gain any marks.

This response gained both marks available.

(i) Explain why malonate inhibits the activity of succinate dehydrogenase.

(2)

malonate inhibits the activity of succinate dehydrogenase because it has a very similar shape to ~~the~~ succinate i.e. ~~the~~ this will bind to the active site and prevent the formation of a succinate dehydrogenase and succinate complex, (enzyme substrate complex)

**ResultsPlus**
**Examiner Comments**

This candidate gained credit for recognising that the shape of the malonate and succinate are similar and that therefore the malonate could bind to the active site and prevent succinate binding.

This response gained both marks available.

(i) Explain why malonate inhibits the activity of succinate dehydrogenase.

(2)

Because has similar structure to succinate so binds with the active site of succinate dehydrogenase instead, preventing succinate from doing so - competitive inhibitor.

**ResultsPlus**
**Examiner Comments**

This is another example of a more able response, typical of the many who recognised this as a type of competitive inhibition.

## *Question 9 (b)(ii)*

9(b)(ii) Drawings were generally accurate with most candidates using the first diagram with succinate bound as a guide in order to gain the mark.

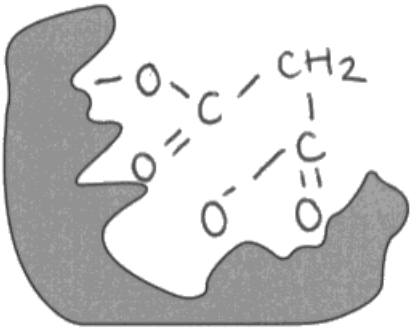
Nevertheless, a significant number of candidates failed to gain the mark, e.g. through having the O- and O (double bond) round the wrong way or having the O groups in the incorrect sections of the active site.

9(b)(iii): Approximately 50% of candidates correctly identified the relevant graph for this type of inhibition. The most common incorrect graph chosen was **C.**

This response gained no marks.

(ii) On the diagram, draw malonate binding to succinate dehydrogenase.

**(1)**

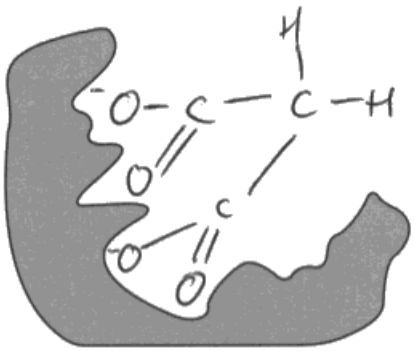



**ResultsPlus**
**Examiner Comments**

This is an example of a response that failed to gain the mark because they put the Os in to the wrong parts of the active site – not matching the diagram with succinate.

This response gained the mark.

(ii) On the diagram, draw malonate binding to succinate dehydrogenase. (1)

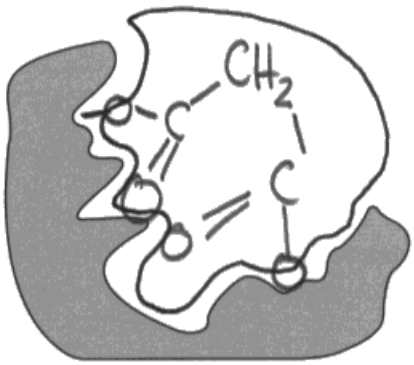


**ResultsPlus**
**Examiner Comments**

This response gained the mark by including the correct charges and positions of the Os in the active site.

This response did not gain the mark.

(ii) On the diagram, draw malonate binding to succinate dehydrogenase. (1)



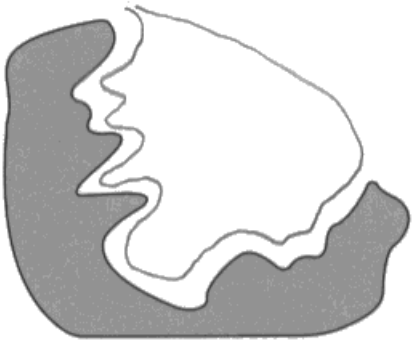
**ResultsPlus**
**Examiner Comments**

In this example the oxygen atoms with the double and single bonds are the wrong way round and the charge is missing from the oxygen at the bottom so it did not gain the mark.

This response did not gain the mark.

(ii) On the diagram, draw malonate binding to succinate dehydrogenase.

(1)



**ResultsPlus**
**Examiner Comments**

This is an example of the candidates who did not attempt to draw the functional groups of the malonate in the relevant position of the active site so did not gain the mark.

## *Question 9 (c)*

A majority of responses only achieved Level 1 for this question, containing only a few suggestions that could affect validity or on how to improve validity, but not related to issues identified. In some cases, one or two issues were identified and suggestions made on improvement of these, thus lifting the response into the upper band of Level 1 where they could gain two marks of the six available.

When reading the mark scheme it is important to realise that the indicative content is given as an example of what to look for and each point is not a separate mark, unlike the rest of the mark scheme.

Most candidates were able to identify problems with the method. The following were frequently referred to: Volumes not measured precisely, difficulty in seeing the end point, temperature/pH not controlled, not measuring the initial rate of reaction, various concentrations of malonate should be used or succinate and lack of repeats. The majority of candidates did not move in to Level 2 or 3 because they did not go on to suggest how the method could be improved or explain why these things were important, e.g. temperature could affect the number of collisions between the enzyme and the substrate and therefore increase/decrease the rate of reaction.

However, a significant number of candidates managed to identify at least three issues and suggest improvements on these issues to gain three or four marks as a Level 2 response.

Some candidates, were able to produce Level 3 responses for providing a range of specific issues, with suggestions on improvement on these issues and also demonstrating the impact of this by explaining the effects of the improvements. Responses at this level demonstrated good understanding of biological principals as well as experimental technique, and were well thought out and constructed.

Generally candidates that performed better here were able to consider points one at a time, identifying a problem with the procedure, suggesting a solution and explaining how it would improve the method. They also used a wider vocabulary, and were able to relate the practical work to the scientific theory.

There was a lot of scope here for candidates to demonstrate a range of skills: practical, organisational, scientific and analytical. However, some candidates appeared unable to criticise a method at all. Evaluating practical procedures and identifying why stages are needed in procedures should be incorporated into their practical work during the course.

Some candidates confused volume with concentration and others still used words such as amount which is too vague for AS level Biology and not possible to measure.

This is an example of a good Level 2 response which gained four of the six marks available.

*(c) The rate of reaction of succinate dehydrogenase can be measured using a methylene blue solution.

Methylene blue starts off blue but changes to colourless as succinate is converted to fumarate.

A student investigated the effect of malonate on the rate of reaction of succinate dehydrogenase.

The student used the following steps.

**Step 1.** Succinate solution was poured into a beaker up to the 25 $cm^3$ mark.

**Step 2.** Ten drops of succinate dehydrogenase solution and three drops of methylene blue solution were added.

**Step 3.** The beaker was left on the bench until the methylene blue became colourless and the time for this change was recorded.

**Step 4.** Steps 1 to 3 were repeated using two different concentrations of succinate solution.

The whole procedure was repeated with the addition of 15 $cm^3$ of malonate solution with the succinate solution in **Step 1**.

Criticise the method used in this investigation.

**(6)**

~~The whole procedure should've been repeated with at least 5 different volumes of methylene~~ Step 1: a pipette should've been used or a measuring cylinder to measure out 25$cm^3$ of succinate and not just poured straight into a beaker.

Step 2: drops shouldn't have been used, but volumes in ratio to the concentration. So if 10$cm^3$ was wanted - at 0·2% succinate, 2$cm^3$ of succinate should've been used and 8$cm^3$ distilled water. Much like for a concentration of 0·4% 4$cm^3$ of succinate should've been used and 6$cm^3$

of dishlled water. By keeping the same overall volume, the results are comparable.
Step 3: to measure initial rate of reaction, within a given time intervals should have been measured. So eg: every 5 minutes for 30 minutes, ~~at 3,6,9,12~~ at 5, 10, 15, 20, 25, 30. Also a calorimeter to measure absorbance would've been more reliable as you could see how much absorbance is occurring - so you don't have to wait for each concentration to go **(Total for Question 9 = 13 marks)**

completely colourless, **TOTAL FOR PAPER = 80 MARKS**
as undoubtably the lower concentrations will take much longer.
Step 4: at least 5 concentrations should've been used: 0.2%, 0.4%, 0.6%, 0.8%, 1% to ensure reliable data. Then each of these should've been repeated.

The whole procedure should've been repeated with one set concentration and ~~the~~ an equal volume of malonate.

**ResultsPlus**
**Examiner Comments**

This is a good example of a response that contains more than expanded criticisms of the experiment that was the requirement to get into a Level 3 response. In this example the pairs identified were:

- volume of succinate poured in a beaker + should have used a pipette;
- initial rate of reaction should have been measured + use of colorimeter;
- at least five concentrations should have been used + five concentrations suggested;
- drops for enzyme and indicator + measurements suggested to control concentration through keeping the same total volume.

With some explanation about how the lack of control, or the suggested improvements could have affected the results the response would have had access to Level 3 marks.

This response is an example of a Level 3 response that gained all six marks available.

The student did not use any repeats at each concentration. Repeats allow anomalies to be identified and allow a reliable mean to be calculated. It has not mention what other variables were controlled in this experiment, and the beaker was left on the bench, meaning the temperature was not constant. Temperature effects the rate of reaction of enzymes as an increase in temperature causes more successful collisions between sucrate and succinate dehydrogenase, so more ESC's and rate of reaction increases. In ~~ord~~ order to keep this constant, the ~~enzyme~~ beaker should be kept in a water bath. The initial rate of reaction was not measured, which is more valid, because as the succinate concentration decreases as it ~~is~~ ~~addition of~~ being turned into fumarate, this will slow down the rate of reaction. To measure initial rate of reaction, you could place the solution in a cuvette, and in a colorimeter and measure the % absorbance over the first 60 seconds, in 5 second intervals. When 15cm$^3$ of malonate is added, the volume does not stay constant, therefore reducing the concentration of enzymes and substrate. In order for this not to occur, when the inhibitor was not added, an equal volume of distilled water (15cm$^3$) must be added to the solution. ~~It is at~~ A beaker is also not a very precise measuring apparatus, so I would suggest using a pipette or measuring cylinder instead.

**ResultsPlus**
**Examiner Comments**

As well as spotting issues with the method, this response suggested solutions to improve the method and explained why the issues are important and would affect the results:

- lack of repeats + repeat to calculate mean + identify anomalies;
- temperature not controlled + use a waterbath + effect on collisions with the enzyme and rate of reaction;
- initial rate of reaction not measured + effect decreasing succinate concentration will have on reaction rate + use a colorimeter;
- volume not constant when you add malonate + reduces concentration of enzyme and substrate + use equal volume of water in others;
- beaker not good for measuring volume + use a pipette or measuring cylinder.

**ResultsPlus**
**Examiner Tip**

In an experimental context a candidate demonstrates biological understanding through identifying solutions and the consequence of errors/lack of control/ solutions. Not just through identifying issues in the method provided without any explanation.

This response gained no marks.

- The experiment does not have a control group which would have supported or contradicted the statement.
- Step 1 started with a fairly large amount of solution.

**ResultsPlus**
**Examiner Comments**

This is an example of a response that did not contain sufficient information linked to the method to gain any credit.

This response gained Level 1 and one mark of the six available.

The experiment lacked validity as the repeats (volume of) that did not contain the same or control of solution in Step 1. This also lacks reliability as different results may occur.

Different drops were used which were not controlled and lack validity as if the control had equal drops then the rate of reaction would be fair equally a fair test.

Other variables were not controlled like the temperature of light which may have either ran a faster lacks validity.

**ResultsPlus**
**Examiner Comments**

This is an example of a Level 1 response where a few issues with the method were identified, but there was no attempt made at suggesting suitable improvements or explanation of the impact of the issues on the results.

## Paper Summary

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

- read the whole question carefully, including the introduction, to help relate your answer to the context asked. In particular make sure you make note of the command word used in the question, especially 'explain';
- make sure you bring a calculator to the exam; show all your working and check that the magnitude of your answer makes sense in the context of the question;
- aim to evaluate practical procedures and identify why stages are needed in procedures during your practical work in the AS course;
- read your answers back carefully – do they answer the question, have you made at least as many clear points as marks are available, and have you made any silly mistakes (e.g. does your answer make sense);
- 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. When criticising a method given include ways to improve the experiment and explain how it will affect the results/reaction;
- use all of the information provided in the question to help you with your answer, e.g. diagrams, graphs and tables of data including the labelling of the axis;
- explore and assess examples of candidate responses from this report to help you understand what makes a good response to different types of question, and exemplify the level of knowledge and understanding expected at AS level in this new specification.

# Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx





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