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Examiners' Report
June 2018

GCE Biology B 9BI0 03

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Introduction

This is the second year in which the new A level has been examined and it pleasing to note that candidates show signs of improved understanding of the tighter mark schemes and command words. The mathematical questions do pose difficulties for some and this is an area that needs to be practised.

This paper contains all the questions directed at practical skills, either describing elements of a practical or devising or modifying an investigation. This paper also contains some higher demand command words such as 'discuss' and 'criticise' and it is clear that some candidates find the interpretation of these command words a challenge.

The more able candidates demonstrate that they can address the following:

- analyse unfamiliar information or data;
- perform well with mathematical skills;
- explain an answer clearly and with requisite detail;
- understand the reasons for using certain practical techniques;
- suggest modifications to practical procedures and explain them;
- devise a practical procedure themselves, even when the context is unfamiliar.

Less able candidates tend to rely more on their revision to enable them to answer and find 'describe' questions easier to deal with. They tend to find A01 questions more straightforward than the other two assessment objectives, A02 and A03. There were fewer gaps in their papers than last year suggesting that the questions were more accessible.

The assessment of the new A levels places less emphasis on recall and rote learning and it would help students if the teaching reflected this change. Students need to be comfortable in applying biological principles they learn from the specification to novel situations and unfamiliar data. The more practice they get during their course the better prospect they will have of success in the examination. Some teachers have been using some of the old material for revision purposes but students would benefit from spending more time on last year's paper, the specimen papers and the Sample Assessment Materials in order to appreciate what is required in this new specification.

There is evidence to suggest that the demand of the long level-based question is better understood and almost all candidates were able to make an attempt at an answer.

Compared to the previous specification, the new A levels have greater emphasis on the assessment of analytical skills which some find more difficult. On the positive side, there were few signs of time pressure as the more challenging questions were attempted by most candidates, and it was clear that some very able students were entered for this assessment. These candidates tended to have few problems with analysing unfamiliar information, were good at mathematics, and understood what was required by the command words. They are also familiar with the practical skills and techniques used in the core practicals from the specification.

The emphasis of the 9BI0_03 paper is to examine knowledge and understanding of practical work. The core practicals within the specification provide a guide to the level of understanding required, but they are not the only source of material used in the examination. The paper contains questions

that test the indirect practical skills as outlined in the specification, as well as theory throughout the specification.

Question analysis shows that practical questions are not done as well as the other questions. It is essential that candidates do not follow the practical worksheets 'recipe style' and are encouraged to think about the reasons for certain techniques and the principles of the scientific method. Any opportunities for investigative work are to be encouraged as this will assist with tackling the A03 (ii) questions that are unique to this paper.

The examiners sense that students do not have sound knowledge of all the core practicals. It is also apparent that many students are capable of recalling the 'recipes' of the core practicals but struggle to appreciate why certain procedures are carried out. These students would benefit from being made to think about what they do rather than just follow instructions.

Question 1 (a)

This question challenged candidates to know which part of the brain controls heart rate and then to identify the part on the diagram. The correct answer E was evident in many scripts, but a variety of other letters was equally evident.

Question 1 (b)

This question asked candidates to explain how age might affect the structure of a neurone and the speed of transmission of an impulse, based on information provided by the graph. Most candidates appreciated that the transmission speed would be slower and many discussed the lack of myelination and the effect of this on saltatory conduction. Credit was also given to those who appreciated that the membrane structure would also be affected and this would have an effect on ion movement across the membrane.

Explain how age might affect the structure of a neurone and the speed of transmission of an impulse.

(3)

As shown in the graph, as people get older, they have less phospholipid in their membranes. This therefore means that the structure of the membrane isn't as stable / good as it used to be. As a result, the transmission of impulses along the neurone are slower because the sodium gates in the membrane aren't as stable and don't carry / pass impulses as effectively.

ResultsPlus
Examiner Comments

This answer gains mp1 but fails to give any detailed explanation. Sodium gates are mentioned but not linked to the movement of ions.

ResultsPlus
Examiner Tip

Look carefully at the number of marks available and try to give that number of different ideas in your answer.

Explain how age might affect the structure of a neurone and the speed of transmission of an impulse.

(3)

As age increases, the concentration of phospholipid in neurones decreases. This means that older people have less myelinated neurones. This will reduce the speed of ~~neurones~~ nervous transmission as less electrical insulation is provided to the neurones. The effect of saltatory conduction will also have been reduced with a decrease in myelination, which again will reduce the speed of nervous transmission. Older people will likely have less myelination due to having fewer Schwann cells.

ResultsPlus
Examiner Comments

This response gains full marks because mp1 is evident and an explanation is given which mentions the lack of myelination and the effect on saltatory conduction. It also mentions Schwann cells but this is the same marking point, mp2.

Question 1 (c)

This question tested understanding of the effects of a neurotoxin on the function of a neurone. Credit was given for recognising that the neurone treated with tetrodotoxin was in resting potential and that depolarisation could not take place because the toxin blocks voltage gated sodium ion channels were preventing the movement of sodium ions into the axon. Answers that discussed prevention of synaptic transmission could still gain credit providing the ideas in the mark scheme were described.

Many students simply described the data in the table and offered no explanation.

Analyse the data to explain the effect of tetrodotoxin on the neurone.

(4)

The ~~control gp~~ tetrodotoxin group have maintained the resting potential at -70mV following stimulation unlike the 110mV seen in the control group. This suggests ~~the~~ due to the stimulation the tetrodotoxin inhibited ~~the~~ ~~the~~ ~~Na+~~ ~~gated~~ ~~channel~~ from opening, (possibly by ~~attaching~~ binding to the protein and altering the hydrogen and ionic bonding within it changing the gate's shape). So no Na^+ can move across the membrane and depolarisation cannot even to the threshold potential of -55mV occur, so no action potential is generated. Because the initial Na^+ channel doesn't open, the Na^+ voltage gated ~~gate~~ and the K^+ voltage gated don't open either and so resting potential is maintained by the sodium ion pumps pumping in 2 K^+ ions and 3 Na^+ ions.

(Total for Question 1 = 8 marks)

ResultsPlus
Examiner Comments

This response gains full marks.

Analyse the data to explain the effect of tetrodotoxin on the neurone.

(4)

The data shows that the potential difference of the neurone in tetrodotoxin remained at -70mv, which is the resting potential. This shows that an action potential has not been generated As a result the impulse does not travel down the neurone and stimulate contraction of the muscles, so they do not contract (muscle paralysis)

ResultsPlus
Examiner Comments

This candidate is aware of the fact that exposure to tetrodotoxin means that a neurone will be in resting potential and that it cannot produce an action potential. However, there is no information in the answer that offers an explanation for these observations.

The effect of tetrodotoxin on muscle contraction is irrelevant to the question.

ResultsPlus
Examiner Tip

Answer the question asked. Irrelevance gains no credit and uses up time that could be used elsewhere, particularly when deciphering complex data in tables or graphs.

Analyse the data to explain the effect of tetrodotoxin on the neurone.

(4)

Tetrodotoxin blocks the synapse so that the impulse can't pass from neurone to neurone. The potential difference after stimulation is still -70mV - the same as the resting potential which suggests an action potential was not induced. This could suggest the toxin blocks Na^+ voltage channels. The control is 40mV which is expected after stimulation. or opens Cl^- channels.

(Total for Question 1 = 8 marks)

ResultsPlus
Examiner Comments

This response still gained 3 marks despite describing the effects of tetrodotoxin at a synapse. The only marking point missing is mp3.

Analyse the data to explain the effect of tetrodotoxin on the neurone.

(4)

Tetrodotoxin causes a potential diference of -70 so ~~it~~ triggers an action potential. The muscles were paralysed as ~~the~~ potential diference decreased to -70 from +40 so no impulse travelled.

ResultsPlus
Examiner Comments

This answer merely describes the data in the table and offers no explanation, so gained no marks.



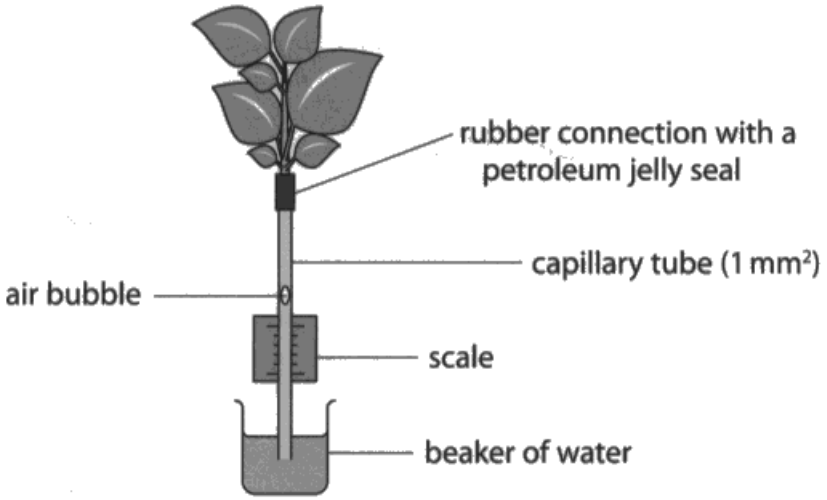
Describing data in a question that is asking for an explanation is unlikely to be rewarded.

Question 2 (a)

This question examined the ability of candidates to modify a described procedure in order to produce accurate readings. To gain full marks, candidates needed to give a sensible modification and then give a biological reason to explain why it would improve accuracy. There were three different modifications that were accepted, each linked to its own biological reason. The first option involved drying the leaves because wet leaves would reduce diffusion. The second option involved using a stem thickness that made a good fit into the rubber connection to prevent water loss from the apparatus. The final option involved making sure the shoot was cut underwater to prevent air blocking the xylem. Many lost credit with the second option by making reference to preventing air getting into the apparatus.

2 A student investigated the effect of moving air on transpiration in a leafy shoot.

The diagram shows the potometer used by the student.



(a) In this investigation, a leafy shoot was cut from a plant.

The leafy shoot was then put under water and the stem inserted into the rubber connection.

Explain how this procedure should be modified to produce accurate readings.

(2)

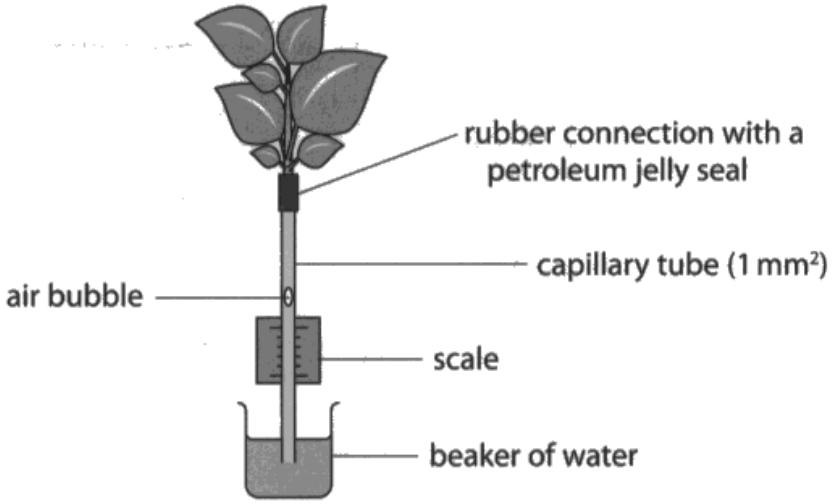
The leafy shoot should be cut underwater to prevent any air bubbles entering the xylem. And the leaf should be kept underwater with a funnel to catch all the bubbles produced.

ResultsPlus
Examiner Comments

This answer gained two marks for appreciating that the stem should be cut under water and that this prevents the possibility of air blocking the xylem.

2 A student investigated the effect of moving air on transpiration in a leafy shoot.

The diagram shows the potometer used by the student.



(a) In this investigation, a leafy shoot was cut from a plant.

The leafy shoot was then put under water and the stem inserted into the rubber connection.

Explain how this procedure should be modified to produce accurate readings.

(2)

Cut the stem under water. Remove any bubbles ~~with~~

Stuck on the stem with fingers.

ResultsPlus
Examiner Comments

This answer appreciates that the stem should be cut underwater but fails to provide a biological reason for this modification to the procedure.

ResultsPlus
Examiner Tip

When asked to explain you will not get full marks unless you offer a biological reason in your answer.

Question 2 (b)

Most candidates appreciated that the use of a reservoir to reset the bubble would allow repeat readings. Another popular response appreciated that a longer scale would allow the bubble movement to be measured for a longer time which facilitates repeat readings. Candidates need to be precise with their language as the use of the term 'larger' scale was not credited.

(b) During the investigation, the air bubble moved off the scale very quickly.

Explain how this potometer could be modified to obtain repeat readings.

(2)

There could be mutliple air bubbles that pass along the capillary tube allowing for many more results to be recorded.

ResultsPlus
Examiner Comments

This answer gained no marks.

(b) During the investigation, the air bubble moved off the scale very quickly.

Explain how this potometer could be modified to obtain repeat readings.

(2)

~~Reset the~~ The potometer can be used ~~re~~ could be a syringe to reset the position of the air bubble to original place to do repeats

ResultsPlus
Examiner Comments

This answer gained full marks because the use of a syringe was also accepted and the idea of resetting the bubble is clearly expressed.

ResultsPlus
Examiner Tip

This question uses the command word 'explain' and therefore full credit will only be given if an acceptable reason is provided for using the given modification.

(b) During the investigation, the air bubble moved off the scale very quickly.

Explain how this potometer could be modified to obtain repeat readings.

(2)

Dry the leaves. Instead of beaker of water, ~~add~~ a tube so less air will be able to get inside the capillary tube. The scale should be longer with possibly smaller intervals.

ResultsPlus
Examiner Comments

This answer gives two acceptable modifications but only one mark is available for this. The second mark was given for providing an explanation for the modification which is not evident in this answer.

Question 2 (c) (i)

This question tested understanding of the units used when measuring the rate of transpiration. The question discriminated well with only the better candidates gaining all three marks. The idea of dividing by the total area of leaves posed greatest difficulty.

(c) The student measured the distance in millimetres that the air bubble moved during a five-minute period in moving air and in still air.

(i) Explain how the student could convert these readings into a transpiration rate using the units $mm^3\ cm^{-2}\ min^{-1}$.

(3)

The student should calculate the area of a cross section of the capillary tube (πr^2) and multiply it by the distance moved by the bubble. They should then divide this by the five minutes taken. They should then find the area of the plants leaves in cm^2 and divide their value by that to give a transpiration rate.

ResultsPlus
Examiner Comments

This answer gained all three marks. The use of the plural for leaves allowed the examiner to give mp2.

(c) The student measured the distance in millimetres that the air bubble moved during a five-minute period in moving air and in still air.

(i) Explain how the student could convert these readings into a transpiration rate using the units $mm^3\ cm^{-2}\ min^{-1}$.

(3)

The student would take the distanced moved by the air bubble in cm and divide it by the time in minutes which would be 5. This would produce $mm^3\ cm^{-2}\ min^{-1}$.

ResultsPlus
Examiner Comments

This answer only gains one mark for dividing by 5.

ResultsPlus
Examiner Tip

Look at the total number of marks available. In this case there were three marks available so writing only one idea will not achieve all the marks available.

Question 2 (c) (ii)

This question asked candidates to explain the results of the investigation. Many candidates wasted time by describing the results in detail before starting to offer an explanation. The examiners rewarded answers that explained that moving air removes water or water droplets away from leaves which increases the concentration gradient. Credit was also available for making reference to the fact that the difference in the mean rate of transpiration is significant as the SD bars do not overlap.

(ii) The table shows the mean results and standard deviations of this investigation.

Mean rate of transpiration / $mm^3\ cm^{-2}\ min^{-1}$	
In moving air	In still air
3.2 ± 0.3	0.8 ± 0.2

Explain the results of this investigation.

(2)

In moving air, the mean rate of transpiration was higher (3.2±0.3) than that in still air (0.8±0.2). This is because wind ~~affects~~ increases transpiration as it removes water droplets from leaves much quicker than when there is no wind. Also, the uncertainty is slightly higher for rate in moving air so this reading may be more inaccurate.

ResultsPlus
Examiner Comments

This answer shows how many candidates tended to describe the data before starting to answer the question. One mark was given for the idea that water droplets are removed but the explanation is not detailed enough. The reference to the SD bars is also not acceptable.

ResultsPlus
Examiner Tip

When asked to explain results there is no need to describe them.

(ii) The table shows the mean results and standard deviations of this investigation.

Mean rate of transpiration / $mm^3\ cm^{-2}\ min^{-1}$	
In moving air	In still air
3.2 ± 0.3	0.8 ± 0.2

Explain the results of this investigation.

(2)

The table shows that in moving air, the transpiration rate is higher by on average than in still air. This is shown since in moving air, the mean rate of transpiration rate is 3.2 ± 0.3, whereas in still air it is 0.8 ± 0.2. This is because in moving air, evaporated water around the plant moves away, increasing the concentration gradient.

ResultsPlus
Examiner Comments

This answer gains full marks for stating that water is moved away and that this increases the concentration gradient.

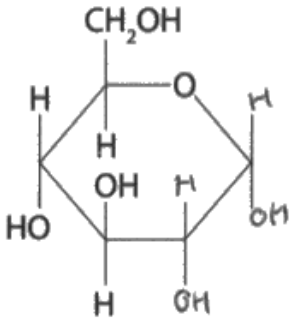
Question 3 (a)

This question asked candidates to complete a diagram to show the structure of alpha glucose. The most common error was to give the structure of beta glucose.

3 Glucose and fructose are monosaccharides.

(a) Complete the diagram to show the structure of alpha glucose.

(1)



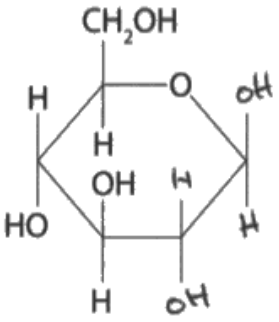
ResultsPlus
Examiner Comments

This diagram is correct and gains one mark.

3 Glucose and fructose are monosaccharides.

(a) Complete the diagram to show the structure of alpha glucose.

(1)



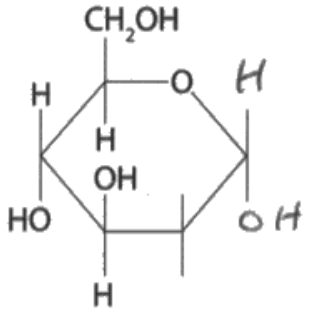
ResultsPlus
Examiner Comments

This diagram shows beta glucose and is therefore incorrect, scoring no mark.

3 Glucose and fructose are monosaccharides.

(a) Complete the diagram to show the structure of alpha glucose.

(1)



ResultsPlus
Examiner Comments

This diagram is incomplete and therefore gains no mark.

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Examiner Tip

Read questions carefully.

Question 3 (b) (i)

This question challenged candidates to appreciate that less fructose needs to be used to achieve the same level of sweetness and that this means less calories would be taken in. The final idea rewarded candidates for naming a health benefit such as reduced risk of obesity or heart disease. Many candidates discussed ideas of being less fat, but the examiners only rewarded answers that used technical terms for health problems.

(b) The makers of sweet tasting drinks use the enzyme glucose isomerase to convert glucose into fructose.

Fructose is a monosaccharide that tastes much sweeter than glucose.

(i) Explain a possible health benefit of converting glucose into fructose for use in sweet tasting drinks.

(2)

the fructose is made of two glucose sweet so fructose is more sweet and we can get the fructose from glucose by covalent bond transition

ResultsPlus
Examiner Comments

This answer repeats information in the stem of the question about fructose being sweeter and this is not credited. Also, there is no reference to energy intake or the idea of less risk of a named health benefit. So, this answer scores no marks.

ResultsPlus
Examiner Tip

Repeating information from the stem of the question will not gain credit.

(b) The makers of sweet tasting drinks use the enzyme glucose isomerase to convert glucose into fructose.

Fructose is a monosaccharide that tastes much sweeter than glucose.

(i) Explain a possible health benefit of converting glucose into fructose for use in sweet tasting drinks.

(2)

If fructose is sweeter you can add much less of it to food to provide the same sweetness as a large volume of glucose. ∴ this means that less sugar will be consumed but the same sweetness provided

ResultsPlus
Examiner Comments

This answer demonstrates understanding that less fructose is needed to provide the same sweetness but there is no explanation about calorie intake or a named health benefit. Scores 1 mark.

(b) The makers of sweet tasting drinks use the enzyme glucose isomerase to convert glucose into fructose.

Fructose is a monosaccharide that tastes much sweeter than glucose.

(i) Explain a possible health benefit of converting glucose into fructose for use in sweet tasting drinks.

(2)

Fructose tastes much sweeter than glucose, therefore less sugar is needed to achieve the required sweetness of the sweet tasting drink. Therefore converting glucose to fructose means less sugar is needed in the sweet tasting drinks. This has health benefits as less sugar means a reduced risk for type two diabetes and less chance of obesity and heart disease.

ResultsPlus
Examiner Comments

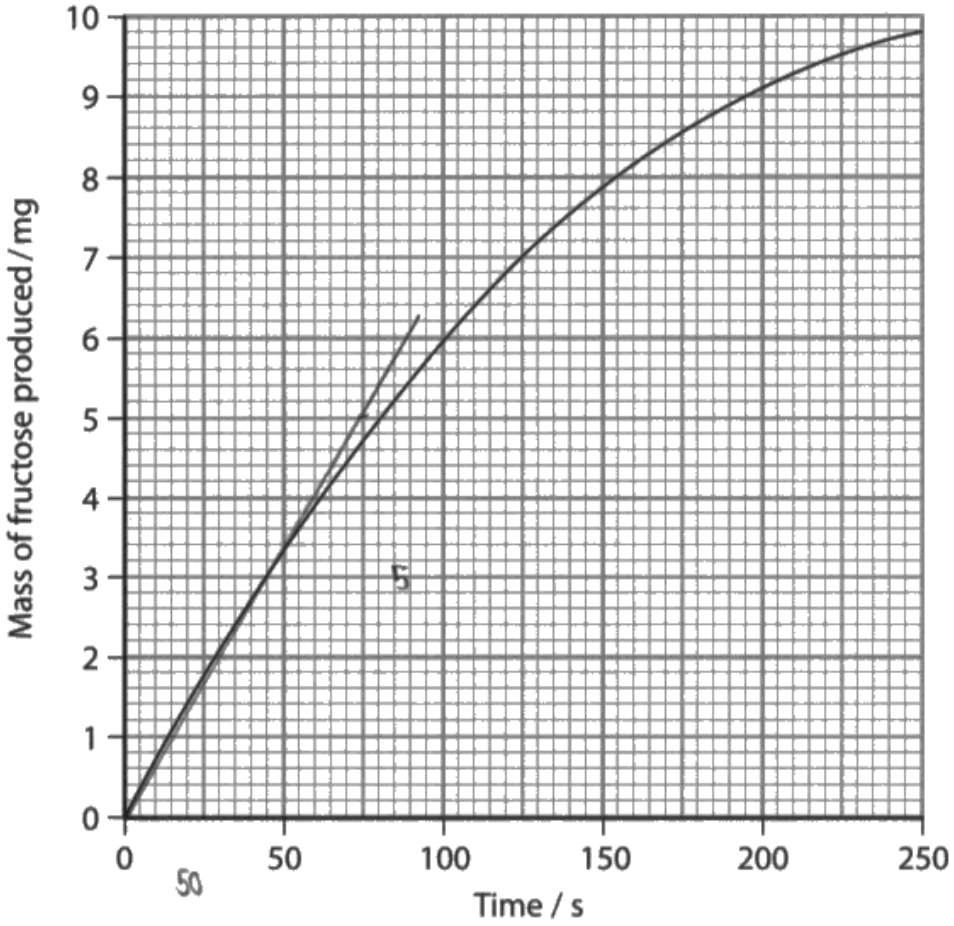
This answer shows understanding that less fructose is needed to provide the same sweetness and it also names several health benefits, so scores full marks.

Question 3 (b) (ii)

To gain the mark in this question the answer needed to be within the range 0.066 to 0.074. Many candidates were successful, but it was clear that some candidates did not know how to determine the initial rate of a reaction from a graph. Units were not essential in order to gain credit.

(ii) A student investigated the activity of glucose isomerase.

The graph shows the results of this investigation.



Determine the initial rate of the reaction.

(1)

$5/50 = \frac{1}{10} = 0.1\ mg\ s^{-1}$

Answer $0.1\ mg\ s^{-1}$

ResultsPlus
Examiner Comments

This is an example of an incorrect response.

Question 3 (b) (iii)

This question challenged candidates to devise an experiment to investigate the effect of magnesium ions on the initial rate of the reaction catalysed by glucose isomerase. Candidates need to be encouraged to write detailed responses, as if a fellow student was asked to follow their instructions. Unclear, imprecise accounts that lack detail will score poorly.

(iii) Cofactors are non-protein molecules that help enzymes to function.

Magnesium ions act as cofactors for some enzymes.

Devise an experiment to investigate the effect of magnesium ions on the initial rate of this reaction.

(5)

The dependent variable is the rate of reaction. To measure the initial rate of reaction you can time how long it takes for each concentration of magnesium ions to produce a set mass of fructose or you can continuously monitour the reaction and work out the initial rate for each reaction by drawing a graph and puting a tangent to the curve to work out the initial rate for each different concentration of magnesium ions and compare the graphs and initial rates. The independent variable is the concentration of magnesium ions so you need to test 5 different concentrations of magnesium ions (one could be with no magnesium ions). The control variables are the factors you need to keep the same for each test these include the volume and concentration of glucose because concentration affects rate of reaction. You also need to keep the temperature and pH the same because these affect enzyme activity and can cause enzymes to denature. In the investigation you will have 5 volumes of glucose which are the same and have the same concentration. To each volume of glucose you will add different concentrations of magnesium ions and measure the initial rate of reaction by timing how long it takes to produce a set mass or continuous monitoring so you will record the mass at 5–10 second intervals because the reaction will be fast. You then plot a graph for each test and work out the initial rate of reaction by drawing a tangent to the curve. Repeats should also be done (at least 3) to work out a mean for each conc of magnesium ions.

(Total for Question 3 = 9 marks)

ResultsPlus
Examiner Comments

This answer gains one mark because the range of magnesium ions being used incorporates zero ions, one mark for controlling temperature or pH and one mark for repeating to obtain a mean. To gain a mark for glucose candidates needed to make it clear that an excess needed to be used which is not the case in this account. There is no mention of isomerase enzyme.

(iii) Cofactors are non-protein molecules that help enzymes to function.

Magnesium ions act as cofactors for some enzymes.

Devise an experiment to investigate the effect of magnesium ions on the initial rate of this reaction.

(5)

Create a hypothesis e.g the increased conc of cofactors ~~causes~~ of magnesium ions causes the initial rate of reaction to increase. use a colormeter to see the break down of a substance by different Concentrations of Magnesium ions. The clearer the substance the more that has been broken down. Calibrate the colourmeter. Use Make up stock Sollution + make dilution Concentrations by dilution method. Test each ~~concentration~~ absorbance for a set time, at several intervals using a stopwatch and ~~by~~ putting it in colourmeter. Control abiotic factors. Record data in a table and put in a graph to work out initial rate. to compare against control Do a statistical test

(Total for Question 3 = 9 marks)

ResultsPlus
Examiner Comments

This candidate fails to devise an experiment and scores zero. There are vague references to the independent variable but no mention of a treatment with no ions. Much of the account centres on a poor discussion of colourimetry.

COR MASSS

(iii) Cofactors are non-protein molecules that help enzymes to function.

Magnesium ions act as cofactors for some enzymes.

Devise an experiment to investigate the effect of magnesium ions on the initial rate of this reaction.

(5)

The student should produce 5 samples of equal glucose concentration. To each one, they should add the same volume of different concentrations of Magnesium ions. One should be a control with only water added. Temperature The student should then add the same volume of glucose isomerase to each sample and measure the mass of fructose produced per time ie. the rate of fructose production. This should be done at the same temperature for each sample. This should be repeated 3 times and average values calculated for each measurement. A graph of Mass of fructose produced against time should be plotted. The intial gradients of these graphs should be culculated using a tangent. the values of these gradients can be compared to the conc of Mg ions. A statistical test (Spearman's Rank) should be ~~for~~ performed to show whether or not there is correlation between enzyme function (as shown by initial rates) and Mg conc.

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Examiner Comments

This answer gains four out of five marks. The only idea missing is the use of the substrate glucose in excess.

Question 4 (a)

This question was based on Core Practical 11. The examiners credited answers that showed the need to draw a start line on which to spot the pigment. The method of concentrating the spot needed to be described and although many appreciated the need to repeat the spotting, only the best mentioned the need to dry after each spot. The name of a suitable solvent was hardly mentioned, and when it was most candidates chose water which was not accepted. Many appreciated that the pigment spots should not make contact with the solvent when the paper is dipped and that the procedure should be stopped when the solvent is near the top so a solvent front can be obtained.

4 Photosynthetic pigments are found in plant leaves.

(a) Describe how you could use chromatography to separate these pigments.

(3)

A concentrated solution containing pigments from a leaf should be produced using propanone and grinded leaves. ~~From~~ A line should be drawn on clean chromatography paper. A capillary tube should be used to place a dot of the solution on the line. Dot should be built up by drying it and adding more. Place end of paper in the propanone solvent and leave for 30 minutes. Measure solvent front. Calculate Rf values for pigments.

ResultsPlus
Examiner Comments

This answer has all four ideas in the mark scheme so gained a maximum of three marks.

ResultsPlus
Examiner Tip

When doing core practicals make sure to learn the methods used.

4 Photosynthetic pigments are found in plant leaves.

(a) Describe how you could use chromatography to separate these pigments.

(3)

using chromatography you dip the ~~dip~~ chloroplast (with chlorophyll) on the pencil drawn line and proceed to carry out the chromatography, the pigments will have diffent densities so will travel diffent distances along the paper and once dry you will be able to see the diffent pigments in that leaf of the plant.

ResultsPlus
Examiner Comments

This is a poor answer which only just gets a mark for the idea of placing the pigment on a line which is assumed to be on the chromatography paper. The account indicates poor recall of a simple procedure.

4 Photosynthetic pigments are found in plant leaves.

(a) Describe how you could use chromatography to separate these pigments.

(3)

chlorophyll a and b have different compositions. You mash a leaf in solution, making sure the green solution resulting is very concentrated, and ~~pick~~ put it on the paper. The different photosynthetic pigments have different RF values, so they ~~sto~~ will be carried different distances by the solvent, seperating them.

ResultsPlus
Examiner Comments

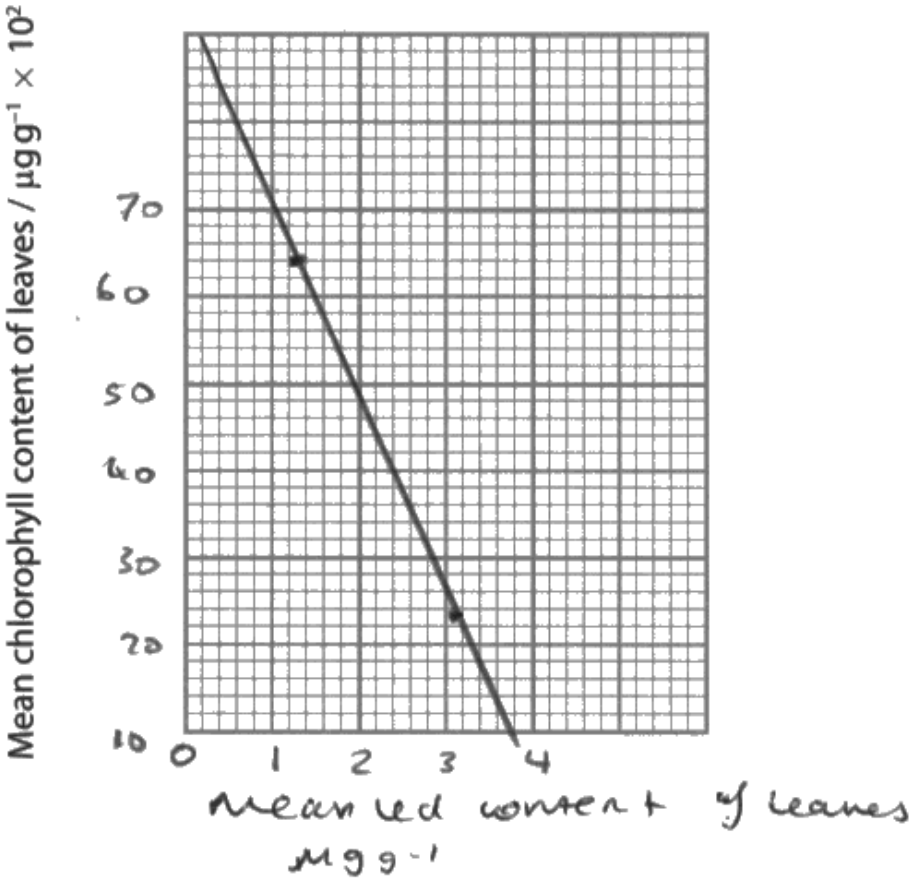
This account scores no marks because it lacks the detail needed at this level of assessment. The paper has no line drawn and although the need to concentrate the spot is mentioned, the method of doing this is not evident.

Question 4 (b) (i)

The specification requires candidates to be tested on their ability to plot graphs. Most candidates were able to gain one mark for producing an axis for chlorophyll content that was linear and allowed the subsequent plot to use at least half the available grid. However, the second mark proved more difficult to obtain as many failed to include the standard deviation bars. The examiners only considered these bars for the little traffic data.

(i) Plot a graph to show the data for mean chlorophyll content.

(2)

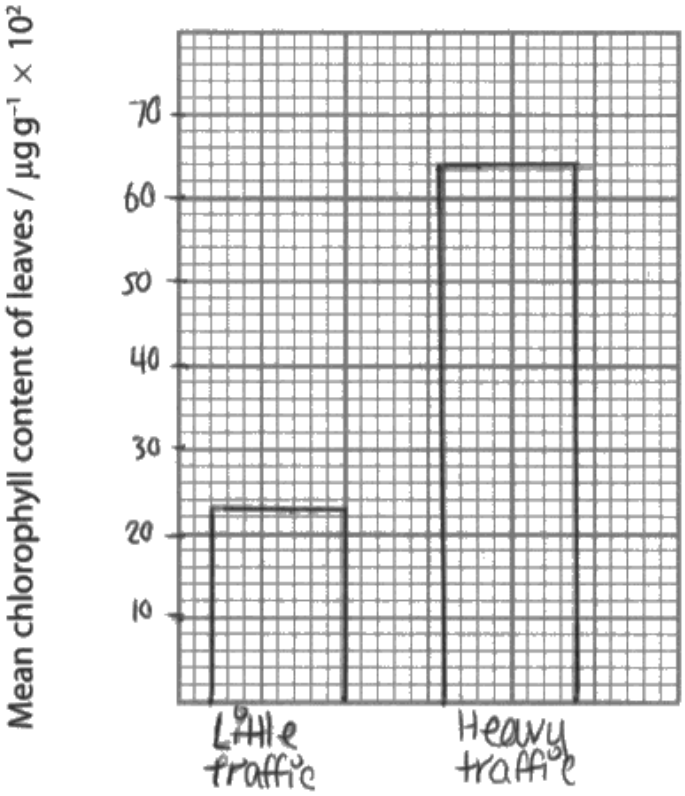


ResultsPlus
Examiner Comments

This graph gained one mark for a linear scale on the y axis and would also have been credited if the second mark if the correct standard deviation bars had been drawn for little traffic.

(i) Plot a graph to show the data for mean chlorophyll content.

(2)

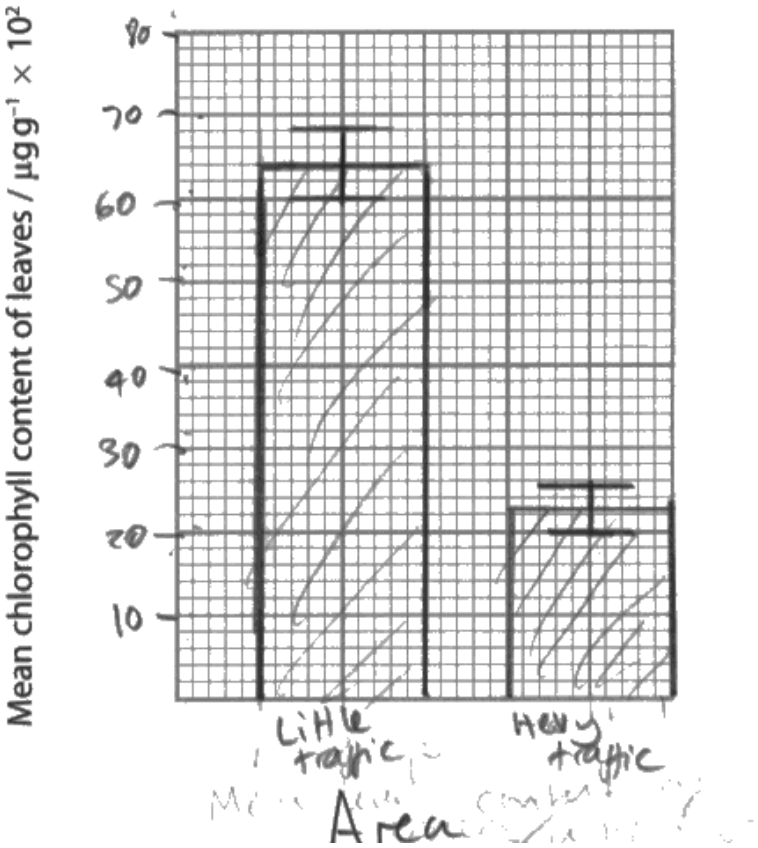


ResultsPlus
Examiner Comments

This graph gained one mark for an acceptable linear scale on the y axis. The bars for little traffic and heavy traffic are incorrectly labelled and no standard deviation bars have been drawn so the second mark was not given.

(i) Plot a graph to show the data for mean chlorophyll content.

(2)



ResultsPlus
Examiner Comments

This response shows a graph that is worthy of both marks.

Question 4 (b) (ii)

This question tested understanding of quadrat sampling. Marks were available for appreciating that the sampling should be randomised to avoid bias. Credit was available for suggesting a method of obtaining randomness such as a random number generator and also for appreciating that the location of the sampling should be at the same distance from the road where the traffic was monitored.

(ii) Explain how the quadrat sampling should have been carried out.

(3)

Quadrat sampling should've been thrown blindly to count the number of plant species available in areas where the lead pollution could then be measured.

ResultsPlus
Examiner Comments

This answer has none of the marking points in evidence and was awarded no marks. Throwing quadrats blindly was deemed not to be good enough for the idea of random sampling.

ResultsPlus
Examiner Tip

Remember that this is an A level assessment and that A level ideas and terminology are expected.

(ii) Explain how the quadrat sampling should have been carried out.

(3)

Quadrat sampling should have been carried out randomly within the area used. By turning the area into a grid and using a random number generator to produce co-ordinates to place quadrats. 5-10 quadrats should have been placed.

ResultsPlus
Examiner Comments

This answer gained 2 marks for making it clear that the sampling needed to be done at random and a method of generating randomness is also given.

(ii) Explain how the quadrat sampling should have been carried out.

(3)

- Random sampling should have been done in each area (little traffic and heavy traffic)
- A grid should have been laid out using tape measures, and a random number generator used to generate random coordinates to place the quadrats to avoid investigator bias
- At least 10 samples should be done in each area to find a mean

ResultsPlus
Examiner Comments

This answer gained full marks. Random sampling is mentioned and a method to generate randomness. This answer also makes it clear that the sampling suggested will avoid bias.

Question 4 (b) (iii)

The command word criticise in this question demanded that candidates inspect the data and look at the merits and faults to support any judgement made. The merit in this question was that the heavy traffic did reduce the chlorophyll content and the mark scheme was structured to ensure that full marks could only be obtained if this idea was evident. The faults were more in number. The examiners accepted the idea that photosynthesis was not actually measured in the investigation. They also accepted the ideas that the lead could be from other sources or that another named factor could be responsible for the chlorophyll content and that only one species of plant had been studied.

(iii) The scientist concluded that lead pollution from cars reduces the photosynthesis of plants.

Criticise the validity of this conclusion.

(2)

There was no data collected on the rate of photosynthesis of plants in each area, so this statement is not valid. Many factors affect rate of photosynthesis alongside chlorophyll concentration meaning plants with low chlorophyll concentrations in polluted areas still may have high rates of photosynthesis. It is assumed that heavy traffic means more lead pollution, less chlorophyll conc. means less photosynthesis, and comes caused less chlorophyll conc, with the data only shows correlation.

(Total for Question 4 = 10 marks)

ResultsPlus
Examiner Comments

This answer makes it clear on the first two lines that there is no data about the rate of photosynthesis for one mark and then towards the end of the answer the idea that heavy traffic being linked to less chlorophyll is evident for the second mark.

ResultsPlus
Examiner Tip

Understand the meaning of command words and use your understanding to structure your answer.

(iii) The scientist concluded that lead pollution from cars reduces the photosynthesis of plants.

Criticise the validity of this conclusion.

(2)

The conclusion of the is not valid because many variable weren't controlled eg the concentration of other pollutants or temperature of sampled area. However the data does suggest that increasing lead concentration decreases the amount of chlorophyll. Further tests would need to be carried out to confirm its validity. He also hasn't measured the photosynthesis rate of the plant- cannot comment on it despite chlorophyll being used in photosynthesis

(Total for Question 4 = 10 marks)

ResultsPlus
Examiner Comments

This answer gains full marks because it is made evident that increasing lead concentration decreases the chlorophyll content which is the first marking point in the mark scheme. The answer also makes it clear that other pollutants may be responsible and that the rate of photosynthesis has not actually been measured. The structure of the mark scheme only allowed for one of these latter ideas to be credited.

(iii) The scientist concluded that lead pollution from cars reduces the photosynthesis of plants.

Criticise the validity of this conclusion.

(2)

This conclusion lacks validity because there is a very low lead content in both conditions and so there is not enough to prove that is it what's causing the lowered chlorophyll levels. as well as this, the maximum lead content for the little traffic is 1.92 $\mu g g^{-1}$ and the minimum for the heavy traffic is 2.8 $\mu g g^{-1}$. This is a difference of less than 1 $\mu g g^{-1}$ and so the evidence is not conclusive and the validity of this statement is low.

(Total for Question 4 = 10 marks)

max
1.92

min
2.8

ResultsPlus
Examiner Comments

This answer scored no marks because none of the ideas in the mark scheme are evident. It also shows what many weaker candidates tended to do which was to describe the data in the table in words, an exercise which wastes time and gains no credit.

ResultsPlus
Examiner Tip

Rewriting data that has already been provided is unlikely to gain any credit.

Question 5 (a)

This question challenged candidates to identify cells in anaphase and then to do a simple calculation of the percentage of these cells showing this stage of mitosis. Three cells are in anaphase out of total of sixteen, so the answer of 18.75 was given two marks. If this answer was rounded up to 18.8 or 19 the two marks were also given. Weaker answers failed to identify the correct number of cells showing anaphase and some failed to count the total number of cells correctly.

(a) Calculate the percentage of cells in this photomicrograph in anaphase.

(2)

16 cells.

$\frac{3}{16} \times 100 = 18.75$

Answer 18.75 %

ResultsPlus
Examiner Comments

This answer is acceptable for two marks.

(a) Calculate the percentage of cells in this photomicrograph in anaphase.

(2)

$\frac{3}{16} \times 100 = 18.75\%$

$= 18.8\%$

Answer 18.8%

ResultsPlus
Examiner Comments

This answer is acceptable for two marks.

(a) Calculate the percentage of cells in this photomicrograph in anaphase.

(2)

$\frac{3}{16} \times 100$

Answer 25%.

ResultsPlus
Examiner Comments

This answer shows the total number of cells calculated to be in anaphase as four which is incorrect. Three was no credit for calculating a percentage from incorrect numbers.

Question 5 (b)

This question was based on Core Practical 3 in the specification and answers varied considerably in terms of the quality of detail provided. Marks were available for using warm acid and then removing the acid with water before adding a named stain. Further credit was available for the ideas of macerating the tissues and using a cover slip to squash it flat.

The better answers made mention of acid but many failed to note that it should be warm. Rinsing the acid with water was the least recorded marking point. A surprising number of candidates named a cover slip incorrectly.

(b) Describe how to prepare a microscope slide of root tissue to show stages of mitosis.

(4)

Cut the root tips to about 0.5 mm to 1 cm thick. Then place the root tissue onto a slide and use a mountain needle to gently massarate it to exposed the cells and make it more visable. Then using acetic orcein. Stain the tissue before placing the cover slip on top. Then wrap the slide up with tissue and gently pressed the cover slip down to remove excess stain and to flatten the cells and make it thinner and easier to observe.

ResultsPlus
Examiner Comments

This answer gained three marks for macerating the tissue, albeit before adding the named stain, and then using a cover slip to squash the tissue. No mention is made of the use of acid.

ResultsPlus
Examiner Tip

Learn the methods described in each Core Practical in the specification.

(b) Describe how to prepare a microscope slide of root tissue to show stages of mitosis.

(4)

The student should first place the roots into hydrochloric acid for a few minutes, to hydrolyse bonds formed in plant cell walls + middle lamella, thus separating the plant cells. They should then remove the roots and rinse with water before cutting the final 1cm off the root tip. This root should be placed on a microscope slide and teased apart using a mounted needle - macerate the sample to reduce the thickness of the root. Add a drop of acetic orcein to stain your slide before adding a coverslip to further squash the sample. Place tissue over the cover slip and pass down slightly to further squash the sample so that it is as thin as possible. Use the microscope to now locate the region behind the root cap where the cells will be dividing.

ResultsPlus
Examiner Comments

This answer gains full marks. The only idea not evident is making sure that the acid in use is warmed.

(b) Describe how to prepare a microscope slide of root tissue to show stages of mitosis.

(4)

Cells from root tip should be cut from root, since this is where mitosis occurs. The root tip cells should the be ~~dada~~ stained treated with a dye so that they can be seen on microscope. Next these cells should be squashed. This causes the cells to spread out so that mitosi can be seen clearly. The cells should be pressed ~~present~~ between a microscope slide and a cover slip so that they can be viewed by a light microscope.

ResultsPlus
Examiner Comments

This answer is typical of those that do not provide sufficient detail. There is no mention of acid and the dye is not named. The only credit evident is the use of a cover slip to squash the cells.

ResultsPlus
Examiner Tip

General statements will not gain credit. You must use detail at this level of assessment.

Question 5 (c)

This question challenged candidates to devise a method to investigate the effect of waterlogged soil on mitosis in root cells. Candidates who planned their answer before putting pen to paper were able to write erudite accounts that gained the marking points. Those who rushed into answering the question produced more convoluted accounts.

The examiners credited answers that described using plants of the same species or age to grow in waterlogged soil and non-waterlogged soil for a stated time. Credit was also available for recognising the need to control the abiotic factors that affect growth and for looking at cells from the same part of the root tip.

tissue to remove excess dye.

(c) Devise a method the student should use to investigate the effect of waterlogged soil on mitosis in root cells.

(4)

Grow two plants of the same species and same age one in is soil which is not water logged and another in watterlogged soil and then cut 5mm of there root tips and view them under a microscope and count how many cells are in each stage of mitosis or if they are even going through mitosis (might be in interphase). When growing the two plants you have to make sure other vaibles that affect plant growth are controlled like temperature, pH and light intensity. In addition the ~~st~~student should do repeats and work out the mitotic index for both or do statistical testing like the student T test so see if ~~there~~ is a significant difference between means. The student should also test different plant species.

ResultsPlus
Examiner Comments

This answer gained full marks. The only idea not mentioned from the mark scheme was leaving the two plants for the same stated time.

(c) Devise a method the student should use to investigate the effect of waterlogged soil on mitosis in root cells.

(4)

The student should cut the same length of root tissue from onion roots growing in waterlogged soil and in normal soil. Then the student should prepare microscope slides for both root tissues and observe the number of cells in mitosis using a microscope. Also, the student should calculate the mitotic index of each root tissue and compare these results.

ResultsPlus
Examiner Comments

This answer gained one mark for the idea of waterlogged and non-waterlogged soil. Using the same length of root was not detailed enough to gain credit as the length of the root tip was required. The important message to appreciate is that if a friend had to use this answer to actually do the investigation they would not be able to do so because the information provided lacks detail and is inadequate.

ResultsPlus
Examiner Tip

Practice with a friend by writing answers to questions that ask you to devise a method to investigate and then swap with the friend and be critical by telling each other where you need more detail to be able to carry out the method.

Question 5 (d)

This question challenged candidates to explain why a lack of oxygen in soil could reduce the growth of a plant. Some credit was given to answers that mentioned aerobic respiration but the main focus of the question is inhibition of the electron transport chain. This inhibition would lead to less ATP production with a consequent effect on energy requiring processes for growth such as the ability to actively transport mineral ions into root cells. Equal credit was available to those candidates who discussed the role of anaerobic respiration and glycolysis in their answer.

(d) Waterlogged soil lacks oxygen.

Explain why a lack of oxygen in waterlogged soil could reduce the growth of a plant.

(4)

Lack of oxygen means there's less oxygen available for aerobic respiration, meaning less ATP produced. Meaning less energy availble for plant growth. e.g mitosis is active process. Anaerobic respiration produces less ATP/energy.

ResultsPlus
Examiner Comments

This answer gained two marks for mentioning aerobic respiration and that less ATP is produced.

(d) Waterlogged soil lacks oxygen.

Explain why a lack of oxygen in waterlogged soil could reduce the growth of a plant.

(4)

Mitosis is used for cell repair, replacement and growth. If a plant has a lack of oxygen then the plant can't respire and so mitosis doesn't happen as efficeitly. If mitosis can't happen then the plant won't grow. Reduced the uptake of nutrients minerals and oxygen from the soil. It might cause the plant to drown as the concentration gradient is too large so water is constantly diffusing into the roots

ResultsPlus
Examiner Comments

This answer gained no marks because it lacks the detail expected at this level of assessment. Respiration is mentioned but not prefixed by aerobic. Uptake of minerals is also mentioned but not linked to the idea that this is an active process requiring ATP.

ResultsPlus
Examiner Tip

Use A level terminology in your answers.

(d) Waterlogged soil lacks oxygen.

Explain why a lack of oxygen in waterlogged soil could reduce the growth of a plant.

(4)

Plants growing in waterlogged soils lack oxygen for cellular respiration. They resort to anaerobic respiration producing ethanol and carbon dioxide as a final product. Firstly, this form of respiration gains a very small amount of net ATP (2 ATP per molecule of glucose). This means less ATP for dividing cells to grow and also less ATP available for the light independent reaction to produce glyceraldehyde-3-phosphate needed for growth. If less ATP is gained from respiration, this means that active processes such as translocation of sucrose is also limited, hence growth is reduced.

(Total for Question 5 = 14 marks)

ResultsPlus
Examiner Comments

This answer gains full marks. The only idea not mentioned from the mark scheme is the idea of reduced active uptake of mineral ions.

Question 6 (a)

This question asked candidates how a microscope should be used to observe stomata using the high power lens. The examiners rewarded three ideas: use of the low power lens to locate the specimen; focussing with the low power lens or medium power lens before using the high power lens and then only using the fine focus knob when the high power lens is in place. These simple ideas were a challenge for some candidates.

(a) Describe how a microscope should be used to observe the stomata using the high power lens.

(3)

When wing a microscope you should start off yar obsevation mrough a law power lense you should then move up from more mrough the lense until the picture become clear. looking mrough the high powered lense the stomata can men be seen clear and crisp and it should then be eavy to identify mem and re adjust the light hav had on them.

ResultsPlus
Examiner Comments

This answer gained one mark for the idea of locating the specimen using the low power lens.

(a) Describe how a microscope should be used to observe the stomata using the high power lens.

(3)

First the low power verse should be used to identify where the stomata are then a medium power verse and then after finding the stomata again the high power verse can be used. This could use the fine detail mechanism to focus the stomata but only at high power as it may damage the slide.

ResultsPlus
Examiner Comments

This answer gained all 3 marks. The examiner allowed fine detail mechanism to focus as equivalent to fine focus.

Question 6 (b)

This calculation anticipated a whole number of 143 would be calculated for the number of stomata. Credit was available if the answer was not acceptable but elements of sensible working could be seen.

(b) The diameter of the field of view is 0.4 mm.

Calculate the number of stomata per mm^2 on the leaf surface.

The area of a circle is πr^2, where π is 3.142.

(2)

diameter = 0.2 mm

$\pi \times 0.2^2$

$= 0.12568$

Answer 0.13 mm^{-2}

ResultsPlus
Examiner Comments

The answer is incorrect but the working shows 0.12568 which allows one mark to be given.

ResultsPlus
Examiner Tip

Always show your working.

(b) The diameter of the field of view is 0.4 mm.

Calculate the number of stomata per mm^2 on the leaf surface.

The area of a circle is πr^2, where π is 3.142.

(2)

18 stomata in

Area = ~~$\pi(0.2^2)$~~

$3.142 \times (0.2)^2 = 0.12568\ mm$

$\frac{18}{0.12568} = 143.22\ mm^{-2}$

$= 143$

Answer 143 mm^{-2}

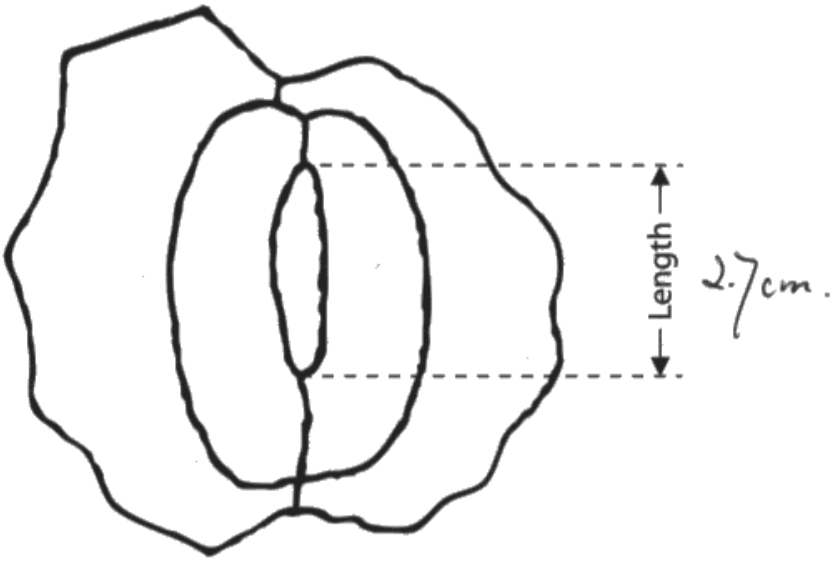
ResultsPlus
Examiner Comments

The answer is correct and the working shows excellent train of thought.

Question 6 (c)

This question provided the actual length in μm of the stoma and it was expected that candidates would measure the length on the diagram and convert it into μm before dividing by 20 to give the answer as ×1350. A mark was available to those who produced the wrong answer but showed in their working sensible conversion of their measured length into the correct units.

(c) The diagram shows one of the stomata drawn by the student.



The actual length of this stoma is 20 μm.

Calculate the magnification of this drawing.

(2)

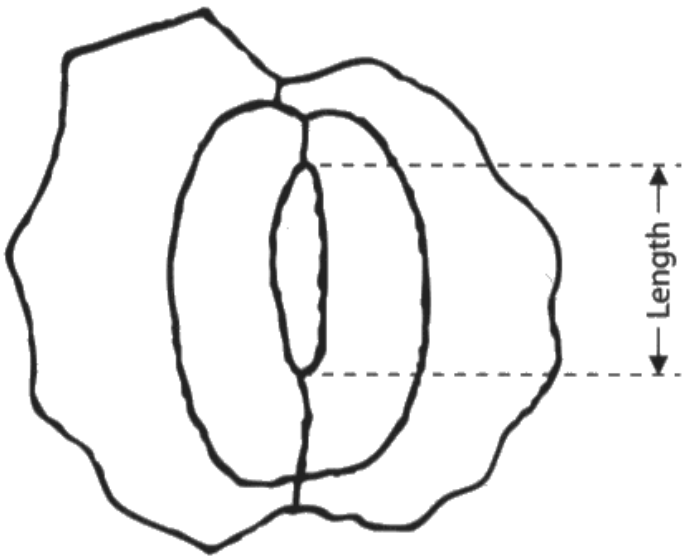
$$\frac{2.7 \times 10^{-2}}{20 \times 10^{-6}} = 1350$$

Answer 1350

ResultsPlus
Examiner Comments

The correct answer gains two marks regardless of any working on display. The × symbol was not insisted upon.

(c) The diagram shows one of the stomata drawn by the student.



The actual length of this stoma is 20 µm.

Calculate the magnification of this drawing.

27mm × 1000 = 27000 µm (2)

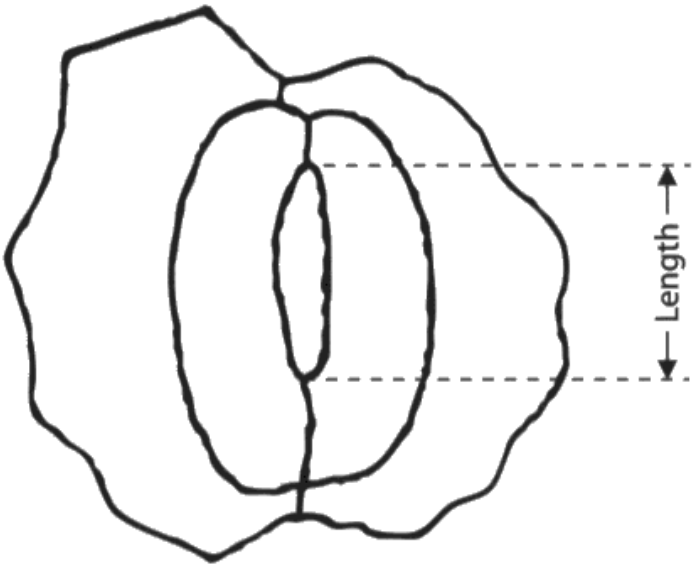
magnification = $\frac{27000}{20\ \mu m}$ = 1350

Answer .....

ResultsPlus
Examiner Comments

This candidate failed to write their answer in the correct place but it is clear in the working that the correct answer is 1350, so two marks were awarded.

(c) The diagram shows one of the stomata drawn by the student.



The actual length of this stoma is 20 µm.

Calculate the magnification of this drawing.

(2)

1 or 5mm

A M

5000µm

1 = 800µm

A = 20µm

Answer x 250

ResultsPlus
Examiner Comments

This answer is incorrect and the working gains no credit.

Question 6 (d) (i)

This question asked candidates to calculate the standard deviation for a set of data in a table. The formula to use was given. A surprising number of candidates struggled to give the correct answer but one mark was available for seeing 17.2 or 68.8 in the working.

(d) The results of this investigation are shown in the table.

Leaf sample	Number of stomata mm^{-2}	
	Leaves in bright light	Leaves in dim light
1	184	143
2	190	138
3	182	140
4	185	132
5	192	136
Mean ($\bar{x}$) and SD	186.6 ± 4.2	137.8

27.04
0.04
4.84
33.64
3.24

(i) Calculate the SD for the leaves in dim light.

Use the formula

$$SD = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$$

(2)

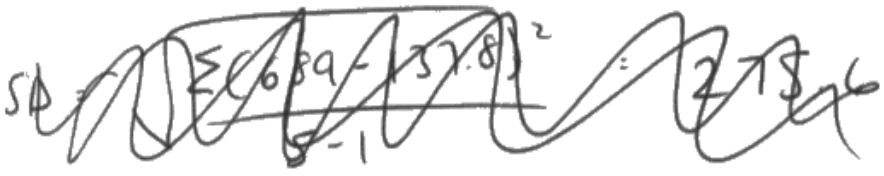
$\sqrt{\frac{68.8}{4}} = 4.147$

184 27.04

Answer 4.147

ResultsPlus
Examiner Comments

This answer is acceptable and gains both marks.



689

$$\sqrt{\frac{\Sigma(5-137.8)^2}{689-1}} = 5.063$$

$$: 5.1$$

$$\pm 5.1$$

Answer ± 5.1

ResultsPlus
Examiner Comments

This answer is not acceptable and the working does not gain credit. No marks were awarded.

$SD = \frac{\sqrt{27.04 + 0.04 + 4.84 + 33.64 + 3.24}}{4} = \frac{\sqrt{68.8}}{4}$

$SD = 2.07$

Answer 2.07

ResultsPlus
Examiner Comments

This answer is incorrect but 68.8 can be seen in the working so one mark was awarded.

ResultsPlus
Examiner Tip

Always show your working because credit is available if your final answer is incorrect.

Question 6 (d) (ii)

This question demanded that detail of the location on the plant and on the leaf be provided. Most answers used general terms such as same part or same place and these answers were not credited.

(ii) Describe how these nail varnish peel samples should be taken to allow a valid comparison between the mean numbers of stomata.

(2)

The peel should be the same depth on all leaves. The same nail varnish should be used on all leaves, covering the same area on the same part of the leaf. Eg, all from the middle of the underside of the leaf, more stomata are found there than the upside.

ResultsPlus
Examiner Comments

By making it clear that the sampling would be taken from the middle of the underside of the leaf this candidate gained two marks.

(ii) Describe how these nail varnish peel samples should be taken to allow a valid comparison between the mean numbers of stomata.

(2)

The layer of nail varnish used for each plant leaf should be the same thickness. The same nail vanish should also be used each time.

ResultsPlus
Examiner Comments

This candidate discusses the nail varnish but makes no mention of location on the plant or the leaf and so no marks were awarded.

(ii) Describe how these nail varnish peel samples should be taken to allow a valid comparison between the mean numbers of stomata.

(2)

They should be taken from the same area of the lower leaf epidermis from each plant (eg the bottom). Similarly sized leaves from the same part of each plant should be used (eg the third leaf from the top). The area of painted nail varnish should be the same for each leaf.

ResultsPlus
Examiner Comments

This candidate provides the detail needed to gain two marks. If (e.g. the bottom) and (e.g. third leaf from the top) had not been written the answer would have gained no marks.

ResultsPlus
Examiner Tip

Use detail in your answers and avoid general terms.

Question 6 (d) (iii)

This question asked candidates to explain how fewer stomata might affect the growth of coffee plants. Many discussed the effect on gas exchange and transpiration in ways that lacked the detail required. The examiners credited those who appreciated that less carbon dioxide would be absorbed and that this would impact on substances in the Calvin cycle and substances produced from the Calvin cycle. A mark was available for linking reduced transpiration to the availability of mineral ions.

(iii) Analyse the data to explain how fewer stomata might affect the growth of coffee plants.

(3)

fewer stomata means that less CO_2 is able to enter the cell as fewer stomata will be open to allow the diffusion of CO_2 into the leaves. This means less CO_2 is available for carbon fixation by RUBISCO in the calvin cycle. Thus less photosynthesis occurs, so less GALP is produced which goes on to form glucose for respiration or amino acids for protein synthesis which both increase growth. Fewer stomata decreases water loss which may help to increase growth.

ResultsPlus
Examiner Comments

This answer uses terminology expected at this level of assessment and was awarded full marks for the idea that less carbon dioxide is absorbed which results in less GALP which results in less amino acids for protein synthesis.

ResultsPlus
Examiner Tip

Use terminology suited to this level of assessment.

(iii) Analyse the data to explain how fewer stomata might affect the growth of coffee plants.

(3)

Leaves in dim light had fewer stomata than leaves in bright light, The mean stomata number in bright light was 48.8 mm^{-2} higher. Fewer stomata means there is less area for gases to diffuse in an out of, slowing the rate of diffusion and slowing the transpiration stream. This means, the plant will recieve smaller amounts of CO_2 for light dependent reactions, and the movement of xylem and phloem may be slower causing transport of growth factors and hormones to growing regions to be slower.

ResultsPlus
Examiner Comments

This answer gained one mark for the idea that less carbon dioxide will be received but elsewhere the prose lacks precision and detail.

Question 7 (a) (i)

This question credited candidates who appreciated that radiation attenuates the organism which means it is safe to administer as it will not be able to cause disease. Most candidates made reference to attenuation but failed to make the link to reducing the risk of malaria. A number of different ways of describing attenuation were accepted.

A number of candidates believe that *Plasmodium* is a virus or a bacterium, which lost them credit.

(a) (i) Explain why the samples of *Plasmodium* were exposed to radiation.

(2)

Radiation mutated their genes/proteins, preventing transcription/ translation so they died. So ~~as~~ they cannot cause malaria when they're used as a vaccine.

ResultsPlus
Examiner Comments

This answer gained full marks because the idea of killing was allowed as equivalent to attenuation and it is also clear that the risk of malaria is reduced.

ResultsPlus
Examiner Tip

Note that in a two mark question there will be a least two ideas that you need to address.

(a) (i) Explain why the samples of *Plasmodium* were exposed to radiation.

(2)

To kill the live bacteria so the vaccine wouldn't actually give the patients plasmodium. It weakens the virus to allow antibodies for plasmodium to be made for the ~~first~~ contact with the real virus so they have memory B≠ T cells to kill the pathogen.

ResultsPlus
Examiner Comments

This answer gained no marks because Plasmodium is described as a bacterium and then as a virus. Also, whilst it is stated that an immunity will kill the pathogen, it is not made clear that the risk of malaria is reduced. Examiners are not allowed to make deductions on the part of the candidate.

ResultsPlus
Examiner Tip

Produce answers that contain detail and are clear so that the examiner does not have to make deductions.

Question 7 (a) (ii)

This question required candidates to make it clear that the vaccine given to the control group would contain all the ingredients of the actual vaccine but lacking *Plasmodium*. A variety of ways in making this point were accepted. The examiners were also generous in accepting the term 'placebo'. It was common to see the phrase 'no vaccine' but this was not credited as lacked the detail required.

(ii) State the control treatment that was given to people in group C.

(1)

They weren't given any vaccine but maybe a placebo such as saline solution

ResultsPlus
Examiner Comments

This is typical of an answer that gained the mark.

(ii) State the control treatment that was given to people in group C.

(1)

An empty injection A placebo injection that did not contain any ~~Pl~~ Plasmodium.

ResultsPlus
Examiner Comments

Another example of an answer that gained the mark.

(ii) State the control treatment that was given to people in group C.

(1)

No vaccine present

ResultsPlus
Examiner Comments

This answer gained no mark and is typical of many that stated the idea of no vaccine.

Question 7 (a) (iii)

This question challenged candidates to criticise the validity of the claim that the vaccine was 100% effective. One mark was available for noting that it was 100% effective for the high dose because none were infected, or that it was not effective for the low dose as some were infected. Credit was given for appreciating that the results for the lose dose were very similar to those in the control casting doubt on the effectiveness of the vaccine at this dosage. Credit was also given for appreciating that the sample size was small. Oddly, many made reference to the different numbers of people in each group rather than noting that the sample sizes were too small. Credit was also available for making a sensible suggestion about the fact that there is no information about sample selection.

(iii) It was claimed that this vaccine was 100% effective.

Analyse the data to criticise the validity of this claim.

(3)

There is a small sample size for each group which decreases the validity ~~of the results~~ and reliability of the result. People who got injected with a low dose still contracted malaria (9L%) which ~~Stow~~ shows it is only effective in high doses.

ResultsPlus
Examiner Comments

This answer recognises that the sample size is small and also that the vaccine is not effective at low dose because some people became infected. The answer gained two marks as there is no comparison with the control and no mention of sample selection.

(iii) It was claimed that this vaccine was 100% effective.

Analyse the data to criticise the validity of this claim.

(3)

Although with the high dose, there were no patients with malaria, with the low dose 16 people had malaria with only 1 person not. This shows that it is not 100% effective as in the low dose, the vaccine was still given to the group. If it was 100% effective the vaccine would have had no cases of malaria with both the low and the high dose however this is not the case.

ResultsPlus
Examiner Comments

This candidate writes a lot but only about the low dose being ineffective because some people had malaria. The question is worth three marks so only writing about one idea is not going to gain all the marks available.

ResultsPlus
Examiner Tip

Look carefully at the number of marks available and make sure your answer has at least this number of different ideas.

Question 7 (a) (iv)

This question asked candidates to describe how vaccination produces active artificial immunity. The question required some significant detail at advanced level on how active immunity is achieved through vaccination. However, some answers tended to be a little superficial and still at GCSE level. Candidates are encouraged to use knowledge and understanding which reflects an advanced level of assessment.

The examiners credited the creation of antigen presenting cells which T cells bind to and are then activated to release cytokines which stimulate B cells. The role of plasma cells in producing antibody was credited as was the creation of T and B memory cells. Many believe that memory cells release antibody.

(iv) Describe how vaccination enabled the people in group B to have active artificial immunity against malaria.

(5)

The introduction of the pathogen ~~cells~~ triggers the (humoral) immune response to produce antibodies. ~~A macrophage~~ The pathogen contains specific antigens on its surface to which a macrophage binds to and injects it by phagocytosis. It then presents the antigens on its surface (↑ on MHC ↑) to become an APC & T helper cell then binds and becomes activated to produce clones of actve T helper & T memory cells. The activated T helper cells bind to a B APC (that presents the same antigen), releasing cytokines and activating it to undergo clonal selection to produce clones of B effector & B memory cells. Upon 2nd infection the B & T memory cells in the blood are able to rapidly produce antibodies PTO →

ResultsPlus
Examiner Comments

This was a good answer that gained full marks, even though it states that T memory cells produce antibodies.

(iv) Describe how vaccination enabled the people in group B to have active artificial immunity against malaria.

(5)

They were exposed to the antigen ^ pathogen so they were able to produce antibodies* ~~to beat the~~ against the pathogen. Also some ^ B cells involved in providing immunity ~~may turn~~ turn into memory cells that ~~will~~ allowed them to produce antibodies the next time the malarial microorganism entered the blood cell, the antibodies will be specific to the ~~pathogen~~ shape of * the antigen and bind to it then engulf the pathogen. This occurs through T-helper cells stimulating B cells.

ResultsPlus
Examiner Comments

This answer is disorganised. However, it recognises that T helper cells stimulate B cells and also that B memory cells are involved in the story. The answer was credited with two marks.



Know the facts for 'Describe' questions.

Question 7 (b)

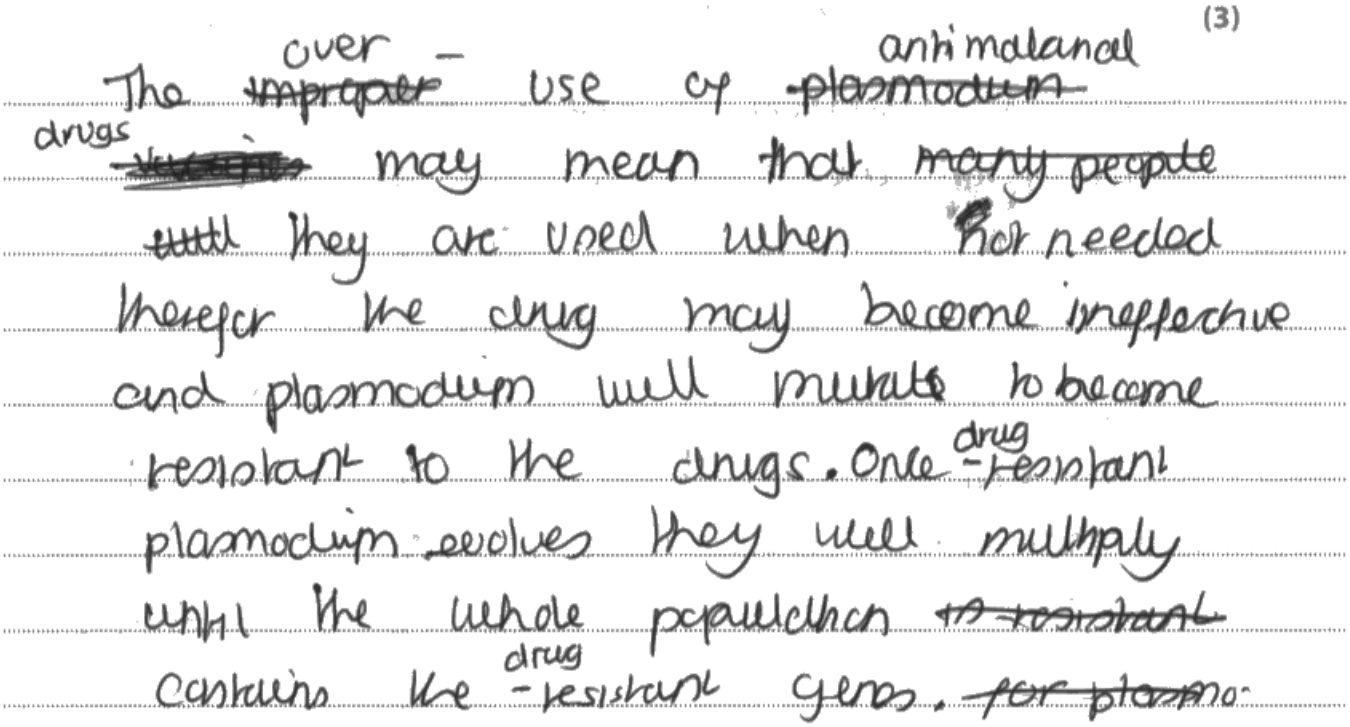
This question asked candidates to explain how drug-resistant *Plasmodium* may have evolved. Many were aware of the role of mutations but failed to qualify that they are random of chance events. The better answers showed appreciation that the drug was the selection pressure and that the mutation allowed *Plasmodium* to make enzymes that made the drug ineffective. The survival and reproduction of resistant organisms was not in the mark scheme but the fact that this enabled the allele to be passed on to offspring was credited. Many candidates lost credit by referring to the gene or the mutation or the resistance being passed on.

(b) Anti-malarial drugs can be used to protect people from malaria.

These drugs are not always effective because *Plasmodium* develop resistance.

Explain how drug-resistant *Plasmodium* may evolve.

(3)



ResultsPlus
Examiner Comments

This shows a response in which mutation is mentioned but not the idea of chance. The response lacks the detail shown in the mark scheme and scored no marks.

(b) Anti-malarial drugs can be used to protect people from malaria.

These drugs are not always effective because *Plasmodium* develop resistance.

Explain how drug-resistant *Plasmodium* may evolve.

(3)

A random mutation results in an advantageous allele that is resistant to the anti-malarial drugs. When reproduction occurs and the allele is passed on through plasmid transfer becoming more frequent. Therefore, more plasmodium become resistant due to the selection pressure and they are resistant to the drugs. This occurs as the allele

ResultsPlus
Examiner Comments

This answer gained full marks by recognising that random mutation is involved and that the allele is passed on. It also makes it clear that the drug is the selection pressure.

(b) Anti-malarial drugs can be used to protect people from malaria.

These drugs are not always effective because *Plasmodium* develop resistance.

Explain how drug-resistant *Plasmodium* may evolve.

(3)

A chance mutation could occur in an allele of the *Plasmodium* genome, allowing them to develop resistance to the drug. This could be through decreasing uptake of the drug, developing enzymes that can break down the drug or developing a metabolic pathway that bypasses the reaction that the drug affects. These resistant plasmodium survive as they have a selective advantage and then pass the advantageous resistance allele to their offspring.

ResultsPlus
Examiner Comments

This is another answer that gained full marks. This answer shows that chance mutations are involved and that the allele is passed on. It also makes it clear that the mutated DNA is producing an enzyme that makes the drug ineffective.

ResultsPlus
Examiner Tip

Use terminology and language that is expected at this level of assessment.

Question 8 (a) (i)

This question required candidates to determine from the graph the number of deaths caused by atherosclerosis and then to give the answer in standard form. Most were able to determine the number of deaths but only the better candidates gave the correct answer in acceptable standard form.

(a) The graph shows that atherosclerosis kills more people than any of the other disorders.

This is mainly due to its development in the coronary arteries.

(i) State the number of deaths caused by atherosclerosis.

Give your answer in standard form.

(1)

15.2 millions per year

Answer 15.2 millions per year

ResultsPlus
Examiner Comments

This answer is not in standard form and therefore gained no mark.

ResultsPlus
Examiner Tip

Read questions carefully.

(a) The graph shows that atherosclerosis kills more people than any of the other disorders.

This is mainly due to its development in the coronary arteries.

(i) State the number of deaths caused by atherosclerosis.

Give your answer in standard form.

(1)

15·2 million.

15 200 000

Answer $1 \cdot 52 \times 10^{7}$.

ResultsPlus
Examiner Comments

This answer is correct and in standard form so gained the mark.

Question 8 (a) (ii)

This question tested understanding of the events that lead to the development of atherosclerosis in an artery. There were four ideas credited for a maximum score of 3 marks. The first idea rewarded those who mentioned the endothelium being damaged by a stated factor such as high blood pressure or a toxin. The second idea rewarded those who discussed the role of the inflammatory response and white blood cells. The remaining ideas gave credit for the role of cholesterol or calcium deposits and the formation of an atheroma or a plaque. Many lost credit by making reference to damage to the wall of an artery and many answers lacked the detail needed to score all 3 marks.

(ii) Describe how atherosclerosis develops in the coronary arteries.

(3)

There is damage to the artery wall and collagen is exposed. Cholesterol then collects on the collagen. and there is an inflammatory response. White blood cells collect and absorb the cholesterol and become sponge cells and deposit their contents on the artery wall. this plaque then builds up and with the addition of sodium and calcium hardens to form an atheroma.

ResultsPlus
Examiner Comments

This answer gained full marks despite only referring to damage to the artery wall. The inflammatory response is mentioned along with white blood cells and the role of cholesterol deposits. Calcium deposits are mentioned but combined with sodium ions. Alone, this would have negated the mark. Plaque formation and atheroma formation are also mentioned.

(ii) Describe how atherosclerosis develops in the coronary arteries.

(3)

Fatty [redacted] deposits build up in the arteries which narrows the lumen. Blood pressure then increases due to the large volume of blood [redacted] trying to pass through the narrower lumen. As a result atherosclerosis develops and could lead to a heart attack.

ResultsPlus
Examiner Comments

This response fails to answer the question and lacks the detailed description expected at this level for a fairly straightforward process. No marks were awarded.

ResultsPlus
Examiner Tip

A level facts must be learnt to maximise scores on easy recall questions such as this one.

Question 8 (b)

The 9-mark level-based question this series involved testing understanding of how the Hardy-Weinberg (HW) equation might be applied. Candidates were asked to discuss the validity of the claim that the HW equation could be used to predict the number of people who would need treatment for health disorders. The question was preceded by questions about a non-genetic disorder and it was hoped that this might clue candidates into appreciating that the HW equation is of no use in predicting disorders caused by the environment or lifestyle. This concept was only acknowledged in the better responses.

The indicative content was divided into three sections. Acknowledgement that disorders can be caused by lifestyle (L), knowledge of the HW formulae and its assumptions (A) and problems associated with the HW equations (P) such as giving examples of why the assumptions are not valid or making it clear that genetic testing has complications.

Level 3 could only be awarded if candidates mentioned at least one L and then at least six ideas from A and P. Most candidates mentioned lots of As and Ps but failure to give one L restricted them to level 2. Weak answers mentioned very few ideas that were acceptable as indicative and were restricted to level 1. These weaker answers included the genetics of sickle cell anaemia which is irrelevant to this question.

*(b) Some health disorders, such as sickle cell anaemia, have a genetic basis.

People who are at risk of these disorders can be identified using genetic tests.

Hospital managers need to predict the future cost of treating people with health disorders.

It has been claimed that the Hardy-Weinberg equation ($p + q = 1$ or $p^2 + 2pq + q^2 = 1$) could be used to predict the number of people who would need treatment for health disorders.

Discuss the validity of this claim. q^2 ~~would be the~~

(9)

this claim may not be valid as the Hardy-Weinburg equation has many assumptions such as mating is random, there is no mutation, no migration, the population is large, there are discretions between generations, male and females have the same allele frequencies, there is no inbreeding, no genetic drift and there is no change in selection pressure. However, in a population this is not always the case as many people migrate, mating may not be random as ~~females~~ parents can be tested for being carriers, so mating may not occur. Also, the Hardy Weinburg equation relies on probabilities / percentage of allele frequency. Therefore, due to random change anyway, the equation is less valid. Also, in areas such as Africa, being malaria has being a carrier gives people a selective advantage over malaria, meaning the Hardy-Weinburg equation would not work in this case as the allele frequencies would be 0.5.

However, realistically it may be valid as for large populations e.g. the UK (but not small islands) to give a rough estimate for predictions as it takes into account

the probability of inheriting the allele, so could still be used in the prediction as q^2 would be the population percentage in need of treatment.

In conclusion, the Hardy-Weinberg equation should not be used on its own, as the equation usually makes many assumptions.

ResultsPlus
Examiner Comments

This answer is level 2 and scores 6 marks. There is sufficient evidence of the HW equation and its assumptions but no mention of lifestyle diseases and their effect on hospital costs.

This claim is incorrect because some health disorders can be caused by diseases or the environment it is impossible to predict the exact number of people who will need treatment for health disorders.

ResultsPlus
Examiner Comments

This response gains one generous mark for the idea that the diseases mentioned could be due to non-genetic causes.

-Sickle cell anaemia is caused by a recessive homozygous allele which can be expressed by 'q' in the equation.

-The equation is only valid when there is random mating & no mutation in the population, given that no migration happens & However, using this as a future measure doesn't take in account of the potential selection pressures the population is about to face which can be hard to predict. If a population was struck by famine or a huge climate change, then there will a selection pressure to drive for mutation which makes the equation invalid. It is also harde to control the migration of the human population & to verify that their genetics haven't changed due to their migration. It is also difficult to control random mating because of the use of contraception etc. & to ensure that all mating is random. There are also other factors that cause more mutation which are hard to be control, e.g. the exposure to radiating sunlight which varies in exposure depending on where the people's environment is. There is also no guarantee that the population size will stay constant in the future, which makes the equation invalid. There might be a huge depletion in population due to war or limited resources which can't be predicted at the present time. It is also difficult to calculate or gain all the genetic information from a large sample size size.

Using the equation to predict the no. of people with health disorder is ~~however~~ inconsistent as some genetic disorder are not due to a recessive homozygous allele and can be influenced by other factor such as age & gender. Other health disorder such as AIDs & like atherosclerosis is not due to genetics which make the equation not relevant. The over-generalisation of having no control of the type of people in the sample & the specific disorder taken account makes this statement invalid. Some disorder such as injury is due to the exposure to different potential hazards & danger which is hard to control & varies person to person, therefore there ~~would~~ could be a way to accurately predict the no. of people who would have disorder in the future. There also could be other alleles that contribute to genetic condition & the equation doesn't account for codominance feature. Not ~~all alleles~~ ~~would~~ ~~add up to 1 in total~~, It would also be harder to repeat the experiment to prove that this hypothesis is correct, which decrease the validity.

ResultsPlus
Examiner Comments

This answer is level 3 and gains 9 marks. It fulfils the criteria of showing good knowledge and understanding of the HW equation and its limitations and also recognises that there are disorders such as AIDS and atherosclerosis which do not solely have a genetic basis.

*(b) Some health disorders, such as sickle cell anaemia, have a genetic basis.

People who are at risk of these disorders can be identified using genetic tests.

Hospital managers need to predict the future cost of treating people with health disorders.

It has been claimed that the Hardy-Weinberg equation ($p + q = 1$ or $p^2 + 2pq + q^2 = 1$) could be used to predict the number of people who would need treatment for health disorders.

Discuss the validity of this claim.

(9)

p^2 is the frequency of homozygous dominant alleles, ~~and~~ q^2 is the frequency of homozygous recessive alles and $2pq$ is the frequency of heterozygous alleles so if the ~~poor health~~ hospital managers can determine whether the health disorder is recessive or dominant, it could be possible to predict future costs. However, there are some assumptions with the Hardy-Weinberg equation and principle. The Hardy-weinberg principle is that the frequency of alleles will not change from generation to generation. ~~All assumptions~~ some assumptions are that there are no mutations, the population size is infinitely large, the population reproduces asexually and there is no movement in or out of the population. Not all of these assumptions will hold ~~true~~ true and so the predictions may not be entirely accurate. Although some disorders, such as sickle cell anaemia, have a genetic base, not all health disorders do. For example atherosclerosis is only partly influenced by genetics. For example men are more susceptible to atherosclerosis as

women have more oestrogen which helps prevent it. Race also affects the manner of atherosclerosis. However, atherosclerosis is primarily based on lifestyle such as smoking, drinking, no exercise and an unhealthy diet. All of the above increase the risk of atherosclerosis. As some of these ~~are genetic~~ have a genetic base, they cannot be predicted using the Hardy-Weinberg equation so it would not accurately predict corrs.

ResultsPlus
Examiner Comments

This answer gains level 3 and 9 marks as it is full of knowledge and understanding of the HW equation and offers a number of its limitations. It also makes it clear that lifestyle such as smoking or drinking can contribute to health disorders.

ResultsPlus
Examiner Tip

Read the 9 mark question very carefully and plan your answer before rushing to pen to paper.

Question 9 (a) (i)

This question expected candidates to be able to calculate the mean rate of growth from a set of data and carry out a simple subtraction. However, many candidates struggled to calculate the mean rate of growth without herbicide to be 22, and the mean rate of growth with herbicide to be 36. The subtraction to give the correct answer of 14 was only seen with the better candidates.

(a) (i) Calculate the difference between the mean rate of growth of these trees over the five years.

(2)

(da) $\frac{130-20}{5} = 22\ cm\ yr^{-1}$ $\frac{200-20}{5}$ $36\ cm\ yr^{-1}$

$36 - 22 = 14$

Answer 14 cm yr-1

ResultsPlus
Examiner Comments

This answer shows a clear train of thought and gives the correct answer. The units are also evident, though they were not insisted on in order to be awarded the marks.

(a) (i) Calculate the difference between the mean rate of growth of these trees over the five years.

(2)

~~470~~ $\frac{450}{5} = 90$ ~~670~~ $\frac{650}{5} = 130$

$130 - 90 = 40$

Answer 40cm

ResultsPlus
Examiner Comments

This candidate has not understood how to calculate the mean rate of growth by adding up the mean heights in a cumulative way. No marks were awarded for the correct subtraction from incorrect data.

Question 9 (a) (ii)

The command word 'explain' required candidates to give a biological reason for the difference in the mean height of the trees. Many candidates described the difference in great detail but gained no credit. Marks were given for appreciating that herbicide is more effective at removing weeds and as a consequence there would be reduced competition for a named resource that affects growth.

(ii) Analyse the data to explain the difference in the mean height of the trees at the end of the five-year period.

(2)

The data shows that the mean growth of trees using herbicide to deal with the weeds is 130cm whereas the mean growth of trees ~~using~~ when removing the weeds ~~with~~ by hand is 90cm. This can be explained because the herbicide inhibits the growth of the weeds, the trees have less competition for nutrients therefore can grow higher. When the trees have competition for nutrients ~~with~~ with the weeds, they cannot grow as high because they have less nutrients.

ResultsPlus
Examiner Comments

This answer simply states what a herbicide does but does not make any comparative statement about effectiveness of the two methods. The term 'nutrients' was not credited as the examiners insisted competition for a more detailed abiotic variable such as light, carbon dioxide, water or mineral ions.

ResultsPlus
Examiner Tip

Read questions carefully and pay attention to the command word being used.

(ii) Analyse the data to explain the difference in the mean height of the trees at the end of the five-year period.

(2)

At the end of the five years period mean height of trees by using the herbicide are more than the mean height of trees by removing by hands. 70 cm more herbicide than removing with hand.

ResultsPlus
Examiner Comments

This answer only describes the data and makes no attempt to answer the question.

(ii) Analyse the data to explain the difference in the mean height of the trees at the end of the five-year period.

(2)

Using herbicide to remove weeds is much more effective than removing by hand as shown by the ~~difference~~ mean growth of trees using herbicide being 180 and in the control being 110. More weeds die with herbicide. This reduces the interspecific competition ~~be~~ between weeds and trees for resources like water and minerals in the soil, so the tree with less weeds has more resources to use in the transpiration and

ResultsPlus
Examiner Comments

This answer makes it clear that the use of herbicide is more effective and therefore there will be less competition for water and minerals. The answer scores full marks.

Question 9 (a) (iii)

This question challenged candidates to name two biotic variables that need to be controlled if a valid comparison of the two methods of weed reduction could be made. The command 'explain' required each named variable to be linked to a biological reason. Most candidates named one biotic variable, some two, but only the better candidates offered an explanation.

(iii) Explain two biotic variables that need to be controlled to allow a valid comparison of the effect of each method on tree growth.

(2)

- Using the same geild with the same light intensity so that no tree has an advantage due to the soil or amount of light they are exposed to.
- Amount of water recieved needs to be Controlled so that the trees have access to the same nutrients or ions.

ResultsPlus
Examiner Comments

This candidate names two abiotic variables and so scored no marks.

ResultsPlus
Examiner Tip

Read questions carefully and learn the meaning of biological terms.

(iii) Explain two biotic variables that need to be controlled to allow a valid comparison of the effect of each method on tree growth.

(2)

Number of insects. Insects could eat the trees leaves, which would inhibit growth. The number of trees in the area. More trees means more competition between the species.

ResultsPlus
Examiner Comments

This answer notes that there is a need to control insects as they feed on the tress. It also mentions the need to control the number of trees and notes in converse the idea of controlling competition. The answer was awarded both marks.

Question 9 (b) (i)

This question was preceded by a description of a method used by a student to collect data that measures the absorbance of a chloroplast suspension in DCPIP. The question then asks candidates to explain how the described method is used by the student to collect valid data. The marks were awarded for appreciating that the light intensity should be the same as should the concentration of the chloroplast suspension or DCPIP solution. Credit was also given for recognising that a red filter should be used and that the tube should be in pristine condition and that a control tube containing water should be used for calibration.

(i) Explain how the student used this method to collect valid data.

(4)

The student used this method to compare the difference in the colour of the indicator with herbicide and without. As the electron transport chain is used, the DCPIP indicator is reduced and therefore turns colourless. The sample with herbicide should stay blue if the student is correct as the electron transport chain is inhibited. With no herbicide the tube should stay colourless.

ResultsPlus
Examiner Comments

This answer only concentrates on the DCPIP colour change which is an idea not credited in the mark scheme.

(i) Explain how the student used this method to collect valid data.

(4)

Variables would be controlled, such as the volume and concentration of DCPIP. The level of light they are exposed to would be measured using a light meter, to ensure that the same intensities are present at both tubes. The colourimeter would be used correctly in both instances, only holding the opaque sides of the cuvette and ensuring no liquid spills from the cuvette onto the transparent side. The absorbance reading would be callibrated by pure water before each reading is taken. The variable of temperature would also be controlled, by use of a water bath. The experiment would be repeated 5 times to calculate a mean and identify any anomolies.

ResultsPlus
Examiner Comments

This answer scored 4 marks. The only idea not mentioned is the colour of the filter that should be used.

(i) Explain how the student used this method to collect valid data.

(4)

kept the chloroplasts in the same conditions, along with they were both exposed to the same light source and coloured filter. They used a colorimeter to obtain accurate and valid results.

kept in the same conditions
Exposed to the same light source
Used colorimeter to gain accurate results
Repeated and measured more than one

ResultsPlus
Examiner Comments

This answer gained no marks. There is a reference to same light source but this wording does not make it clear to the examiner that the candidate knows the same light intensity is needed. Examiners are not allowed to interpret on behalf of the candidate.

ResultsPlus
Examiner Tip

Be precise with the words you choose so the meaning of what you want to convey leaves no doubt for the examiner.

Question 9 (b) (ii)

This question provided a table of data and asked candidates to explain the effect of herbicide on the growth of weeds. The candidates gained credit for appreciating that DCPIP stays blue because herbicide reduces electron availability which in turn reduces NADPH and ATP. Credit was also given for recognition that the light independent stage or the Calvin cycle are affected.

(ii) Analyse the data to explain the effect of this herbicide on the growth of weeds.

(4)

As time increases ~~from~~ 0 to 20 minutes, ~~0.3~~ absorbance without the herbicide decreases and absorbance with the herbicide stays relatively constant. This ~~at~~ is because without the herbicide the electron transport chain reaction occurs ~~from~~ and NADPH is synthesised and the NADPH can reduce ~~the~~ DCPIP so turning the colour from blue to colourless. ~~There~~ As time goes on, the absorbance of ~~the solution~~ decreases as the colourless state means more light is being reflected. ~~Therefore NADPH can be used~~

(Total for Question 9 = 14 marks)

Therefore, by herbicides preventing the synthesis of NADPH, there is no NADPH to ~~reduce~~ help convert ribulose biphosphate into carbohydrates which contribute to growth of ~~organisms~~ plants.

→ RUBP

ResultsPlus
Examiner Comments

This answer illustrates how credit was available in the converse if candidates described events without the use of herbicide. In this case electron transport occurs, NADPH is made and DCPIP is changed from blue to colourless gained 3 marks. Reference to RuBP would have been credited if the Calvin cycle had been named.

(ii) Analyse the data to explain the effect of this herbicide on the growth of weeds.

(4)

With herbicide the absorbance value for 0-20 minutes remained roughly constant, didn't fluctuate a lot compared to without herbicide, -ve correlation (as time increased, absorbance value decreased steadily), with herbicide, absorbance value constant because electron transport chain inhibited therefore NADPH can't be produced because no electrons are passed along ETC to pump H^+ across the membrane to create an electrochemical gradient therefore NADP doesn't become reduced which is why the indicator DCPIP remains blue and doesn't become colourless so there is an increase in chloroplast pigment which doesn't scatter light so there's a higher reading as it's more turbid even without herbicide

(Total for Question 9 = 14 marks)

ResultsPlus
Examiner Comments

This answer was awarded three marks because it mentions the inhibition of electron transport with the consequent reduction in NADPH. It also mentions that the DCPIP remains blue.

Question 10 (a) (i)

The correct answer to this question was benzylpenicillin and most candidates clearly understand that Gram positive bacteria have peptidoglycan in their walls.

Question 10 (a) (ii)

This question was well answered, with most candidates appreciating that antibiotics do not affect eukaryotic cells.

(ii) Give one reason why these antibiotics will not affect human cells.

(1)

Humans have eukaryotic cells

ResultsPlus
Examiner Comments

Full marks awarded.

(ii) Give one reason why these antibiotics will not affect human cells.

(1)

Human cells do not have a peptidoglycan structure.

ResultsPlus
Examiner Comments

Reference to human cells lacking a cell wall or peptidoglycan were also credited with the mark.

(ii) Give one reason why these antibiotics will not affect human cells.

(1)

The mode of action of these antibiotics do not affect the human cell machine.

ResultsPlus
Examiner Comments

This answer gained no mark because it lacks the required detail.

Question 10 (b)

This question challenged candidates to explain why rifamycin prevents the growth of bacteria. The table provided a clue by stating that rifamycin inhibits prokaryotic RNA polymerase. As such, the examiners credited answers that made it clear that the antibiotic binds to RNA polymerase preventing transcription and the synthesis of proteins. Very few candidates scored full marks.

(b) Explain how rifamycin prevents the growth of bacteria.

(3)

Virus replicate by invading host cells and use their cell body mechanisms to produce viral proteins. However for protein synthesis RNA polymerase is vital. Rifamycin blocks the the enzymes meaning viral protein cannot be transcribed and translated, hence

- Bacteria would not be able to produce proteins
- This is because rifamycin blocks RNA polymerase.
- This means the growth of bacteria will also be stopped.

ResultsPlus
Examiner Comments

This answer gained one mark for the idea that proteins would not be produced, but the term 'block' was not accepted as equivalent to 'bind' to RNA polymerase.

(b) Explain how rifamycin prevents the growth of bacteria.

(3)

rifamycin is a bacteriostatic drug. By ~~preventing~~ inhibiting RNA polymerase, ~~[illegible]~~ new RNA strands cannot be formed as the ~~[illegible]~~ nucleotide complementary, preventing new RNA from being formed and therefore further bacteria.

ResultsPlus
Examiner Comments

This answer repeats the information in the table and fails to mention that the RNA strands that cannot be made are those of messenger RNA. For these reasons no marks were awarded.

ResultsPlus
Examiner Tip

Avoid being careless by giving the general term RNA as opposed to the actual type of RNA which is affected.

(b) Explain how rifamycin prevents the growth of bacteria.

(3)

It inhibits RNA polymerase so an RNA strand can't be formed in translation. This prevents growth as no proteins can be formed as amino acid chains aren't formed as transcription can't take place due to translation not being completed.

ResultsPlus
Examiner Comments

This answer gains two marks for stating that proteins cannot be made and that transcription cannot take place.

Question 10 (c) (i)

This was a challenging calculation but many candidates gave the correct answer of 2000.

(c) Mutations in the DNA of bacteria can enable them to be resistant to antibiotics.

(i) A single bacterium can produce 2×10^{10} new cells per day by cell division.

The mean mutation rate in one day is 1 in 10 million new cells produced.

Calculate the mean number of bacteria with mutations that could be produced in one day from a single bacterium.

(2)

20,000,000,000 ÷ 1

2 x 10^{10} ÷ 10 million = 2000

Answer 2000

ResultsPlus
Examiner Comments

The correct answer gains both marks.

20000000000 ÷ 10000000

= 2000 = 20

Answer 20

ResultsPlus
Examiner Comments

The answer is incorrect but one mark is given for seeing 20 000 000 000 or dividing by 10 000 000 in the working.

Question 10 (c) (ii)

This question tested understanding of the effects a mutation would have on the structure of a protein. Candidates gained credit for appreciating the role of R groups and various bonds in the structure and shape of proteins, and for recognising that a change in the shape of the 70s ribosomes would mean that streptomycin can no longer bind.

(ii) Explain how bacteria may become resistant to streptomycin if a mutation changes the primary structure of a protein.

(3)

- change to the primary structure means the sequence of amino acids change
- different R group on amino acid and different peptide bond so the tertiary structure of the protein is changed, with is the 3D folding of α helix / β-pleated sheets
- therefore, ~~bat~~ antibody not specific to antigen on protein, so streptomycin cannot bind to 70s ribosomes
- mutation is a random change to the sequence of base pairs

ResultsPlus
Examiner Comments

The odd reference to antibody and antigen was ignored in this answer. Full marks were awarded for appreciating that the R groups would be different which would affect the tertiary structure and prevent streptomycin binding.

(ii) Explain how bacteria may become resistant to streptomycin if a mutation changes the primary structure of a protein.

(3)

Primary structure is sequence of amino acids joined by peptide bonds. Proteins are synthesised at the ribosome. Streptomycin binds to ribosomes. A mutation changing the primary structure of a protein at the ribosome could stop the antibiotic from binding, thus becoming resistant.

ResultsPlus
Examiner Comments

This answer contains irrelevant information but does at least mention that the antibiotic would not be able to bind, so one mark was credited.

ResultsPlus
Examiner Tip

Irrelevant information wastes your time and does not score any credit.

Question 10 (d)

This final question in the paper challenged candidates to devise a method to compare the effectiveness of the four antibiotics. Credit was given for using the same species of bacteria and for mentioning a growth medium. Credit was also given for using the same concentration of each antibiotic and for mentioning an acceptable way to measure growth, such as the zone of inhibition. Finally, credit was available for stating an acceptable time and temperature for incubation and for describing an acceptable method of aseptic technique. This question discriminated well and it was pleasing that most candidates made an attempt suggesting they had reached the end of the paper with time to spare.

(d) A student compared the effectiveness of these four antibiotics on the growth of bacteria.

Devise a method that the student could use to obtain valid results.

(5)

The Student could prepare to dipped a nutrient agar plate and perform Spread plating* onto this agar Store plate. This would need to be done using aseptic techniques e.g. wiping the work surface down with ethanol and leaving it for 5 minutes. Then create user create a Solution with the antibiotics in and make Sure all the antibiotics are the same concentration. Then on each plate ~~the + concentrated dots of antibiotic onto~~ treat each antibiotic Solution onto the different parts of the agar plate. Make Sure each are equal distanced apart. Then put the tied lid on the agar plate and Secure the lid. However do not block off the oxygen supply to the to prevent anaerobic bacteria growing then leave for 2 to 2 days and ~~to~~ using a ~~ge~~ rule measure the diameter of the where the bacteria has not grown to of each antibiotic. This diameter can be compared to Show to which was more useful. Then repeat this experiment 3 times & calculate a mean.

For each of these repeats obtain variables that need to be controlled are the temperature at which every plate is incubated, this can be done by using a thermometer. Also the same bacteria needs to be used each time along with the Same concentration and volume of Solution with each antibiotic.

(Total for Question 10 = 15 marks)

TOTAL FOR PAPER = 120 MARKS

The independent variable in this is the bacteria ~~antibiotic~~ with the dependent being the antibiotic used.

* With a specific another bacteria that all antibiotics are useful against,

ResultsPlus
Examiner Comments

This answer gained full marks. The only marking point missing is the one which required a stated time and temperature. A stated time is given (2 days) but there is no mention of an acceptable incubation temperature.

(d) A student compared the effectiveness of these four antibiotics on the growth of bacteria.

Devise a method that the student could use to obtain valid results.

(5)

Use the same strain of bacteria (for each repeat) to make an agar plate containing a bacterial lawn. Use aseptic techniques throughout to avoid contamination. Place each antibiotic in the 4 corners of the agar plate in a well, opening the agar plate minimally whilst doing so. Incubate at 25°C for 2 days to allow the antibiotics to work. See if there are any inhibition zones around any of the antibiotics. If so, measure the length or area of these to allow you to create a bar chart of inhibition zone length against antibiotic. Use the same conc of each antibiotic so results are valid. Inhibition zones show that the antibiotic is killing the bacteria growing around it. A large inhibition zone shows that the antibiotic is effective in small concentrations. Repeat the experiment 3 times and calculate a mean length of inhibition zone for each antibiotic. Control abiotic factors such as light or temperature. Use a control group, without adding any antibiotics.

ResultsPlus
Examiner Comments

This is another answer that gains all five marks. The only idea not credited is aseptic technique because to gain credit an example had to be described.

(d) A student compared the effectiveness of these four antibiotics on the growth of bacteria.

Devise a method that the student could use to obtain valid results.

(5)

Put culture of bacteria on an agar plate. Put 4 filter paper disks each containing ~~can~~ an antibiotic at ever distance from each other on the agar plate. Wait a week. When looking at the agar plates now, if there are clear disks around the filter paper disks where bacteria have not grown, then the antibiotic was ~~successful~~ effective. Measure the ~~are~~ diameter ~~to~~ of ~~the~~ each area ~~that the~~ around the filter paper disks where the bacteria has not grown and work out the area of each using πr^2. The one with the largest area is most effective. Temperature should be kept constant. Place agar plate in incubator.



This answer shows the standard of many others. It lacks organisation and detail. The marks were given for the use of agar and measuring the clear zones.



When asked to 'devise' a method, make sure what you write could easily be followed by someone else without having to ask you a question about what you mean. For example, stating that the temperature should remain constant is inadequate because the actual temperature wanted is not clear.

Paper Summary

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

- Read the question carefully because there may be an unfamiliar command word that needs a little extra thought.
- Write concise answers that include the detail and terminology expected at A level. Candidates are encouraged to use scientific language worthy of this level of assessment. As such, a term such as 'amount' when referring to volume or concentration is unlikely to gain credit. Similarly, the term nutrient should not be used when glucose or any other named substance is being referred to.
- Try to understand the command words used in the examination paper and make sure that any answer addresses the meaning of each command word. For example, if a question has the command word 'explain' it will not be possible to gain full marks if only a description is offered. Similarly, when asked to criticise they need to provide positive as well as negative evidence for what they are asked to do.
- Always show working in any mathematics question as credit is always available should the final answer be incorrect.
- Avoid the use of numbers that have too many significant figures in them as this is unlikely to gain credit. As a guide, use the same number of significant figures as in the actual data shown in the question and read the question carefully in case there are clues given.
- Make sure you understand all the core practicals listed in the specification. When carrying out the practicals, try to discuss the reasons for carrying out certain techniques with your partner, if working together, or with your teacher. This is the practical paper, and it is apparent that many candidates seem unable to answer questions that require basic recall of procedures, such as using a microscope or preparing a microscope slide.
- Practise mathematics questions.
- Look at the number of marks available in each question and try to ensure that the answer contains at least that number of themes or ideas.
- Do not waste time by repeating the stem of the question before starting the answer. This time is lost and is unavailable for questions that require unravelling of information in graphs or tables.

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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