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Examiners' Report June 2024

GCE Biology 9BN0 03

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June 2024

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Introduction

The 9BN0/03 Biology paper focused on the general and practical application of the Pearson Edexcel GCE Biology Specification A. Aspects of all topic areas were considered and the paper included a series of question items linked to a pre-released scientific article. The paper included questions that targeted the conceptual and theoretical understanding of experimental methods, including mathematical analysis of experimental data.

The summer 2024 paper offered a wide diversity of question styles that gave candidates many opportunities to display their knowledge and understanding of material from across the whole specification. It allowed candidates to make connections from throughout the specification.

It was most pleasing to see candidates offering a host of encouraging responses that showed their good understanding of the material and much thanks should go to those who have taught them, as well as to the candidates themselves.

Whilst there were many clear and unambiguous responses, there were some candidates who could not be awarded marks due to the quality of their expression.

Successful candidates:

- demonstrated a familiarity with practical work and could devise investigations based on procedures they had carried out themselves;
- had studied the pre-released scientific article and read up on the aspects of biology within the article that they had encountered in their A-level Biology course;
- answered questions in the context set, showing that they had read the question;
- had learnt how to interpret the newly introduced command words – such as 'assess' and ‘determine’;
- provided specific, relevant details to their answers;

Less successful candidates:

- had a poor understanding of the principles behind core practicals;
- re-wrote information from the question, using up time and space;
- did not answer questions in context, missing both the command word and the context;
- did not understand how to interpret the command words and therefore misinterpreted questions;
- left out vital details or wrote vague answers lacking relevant facts;
- did not attempt some questions – some answer spaces were left blank;
- made errors in calculations by not checking significant figures or the numbers in the data already provided;
- did not write legibly or wrote answers with poor grammatical construction that resulted in ambiguous answers.

Implications for future teaching, learning and exam preparation – ensure that candidates carry out all of the core practicals and are involved in planning the procedures where there are variables that can be controlled or taken into account as well as evaluation of the results. Statistical analysis of data collected will allow candidates to become familiar with the reasons for selecting and using particular tests and how the results can be interpreted. The pre-released scientific article has to be studied well, in advance of the examination – however, regular reading of articles from scientific journals and magazines will help candidates become familiar with how the style of writing differs from that in textbooks or revision guides.

Question 1 (a)

Many candidates struggled to provide an answer that gained credit. Answers often showed an element of succession. For example, candidates frequently gave answers in terms of the pioneer species or even the climax or dominant species.

1 One of the first plant species to colonise some habitats is thale cress (*Arabidopsis thaliana*).

The plant hormone IAA (auxin) is produced in the growing tips of plants such as thale cress.



(Source: Nigel Cattlin / Alamy Stock Photo)

(a) State what is meant by the term **colonisation of a habitat**.

(1)

Succession that leads to a climax community

ResultsPlus
Examiner Comments

Students often fail to read the question.

ResultsPlus
Examiner Tip

Take time to read the question carefully. This is a correct statement about succession, but it does not answer the question asked.

1 One of the first plant species to colonise some habitats is thale cress (*Arabidopsis thaliana*).

The plant hormone IAA (auxin) is produced in the growing tips of plants such as thale cress.



(Source: Nigel Cattlin / Alamy Stock Photo)

(a) State what is meant by the term **colonisation of a habitat**.

(1)

The colonisation of a habitat is the settling of a new plant species into the habitat.

ResultsPlus
Examiner Comments

Although 'settling' is perhaps not the best word to use – 'Settling of a new plant species into the habitat' was allowed.

Question 1 (b)

This question was accessible to most candidates. Comprehensive answers were frequently seen. A number of students did not use allowed terms to described plants bending towards the light and did not gain MP3 eg plants pointing towards the light or moving towards the light were not accepted. A small number of students confused IAA (auxin) with phytochromes.

(b) One role of IAA is to stimulate the phototropic response of shoots.

Describe how IAA causes a phototropic response in the shoots of a plant.

(3)

IAA is a plant hormone. It is released from the tip of the so shoots. IAA accumulates to shaded side causing plant cell to elongate. The plant will bend towards the light which increases light absorption so more photosynthesis can take place.

ResultsPlus
Examiner Comments

This is an example of a response that gained all three available marks (MP1, 2 and 4).

(b) One role of IAA is to stimulate the phototropic response of shoots.

Describe how IAA causes a phototropic response in the shoots of a plant.

(3)

-IAA increases cell elongation in ~~plants~~ shoots.
-IAA moves to the shaded parts of the shoots which causes that side to elongate and therefore grow towards light. This is positive phototropism.
-IAA affects rate of transcription of ~~genes~~ genes that are responsible for cell elongation resulting in increased transcription of that gene.

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Examiner Comments

This response gained a maximum of three marks. All four available marking points are covered in the response.

ResultsPlus
Examiner Tip

If you are a student, a useful activity is marking someone else's answers. This will not only improve your understanding of the biology, but it will also show you the importance of producing answers that are clear and unambiguous, like this one.

(b) One role of IAA is to stimulate the phototropic response of shoots.

Describe how IAA causes a phototropic response in the shoots of a plant.

(3)

IAA is produced in the tips of plants and promotes cell elongation in the shoots by travelling down the plant via diffusion. A higher concentration of IAA on one side of the shoot promotes cell elongation in that direction and the plant shoot grows towards it.

ResultsPlus
Examiner Comments

Students can improve their exam technique by marking answers produced by other students.

ResultsPlus
Examiner Tip

How many marks should this response get?

We gave it one mark. Do you agree?

Question 1 (c)(i)

Many candidates provided simple explanations such as 'to make the results valid' . These types of response were accepted for MP1. Some candidates also gained MP2 for suggesting that heterozygotes would carry a copy of the normal and the mutated allele (MP2). Marking points 3 and 4 were seen less frequently.

One type of receptor for IAA is coded for by the tir1 gene.

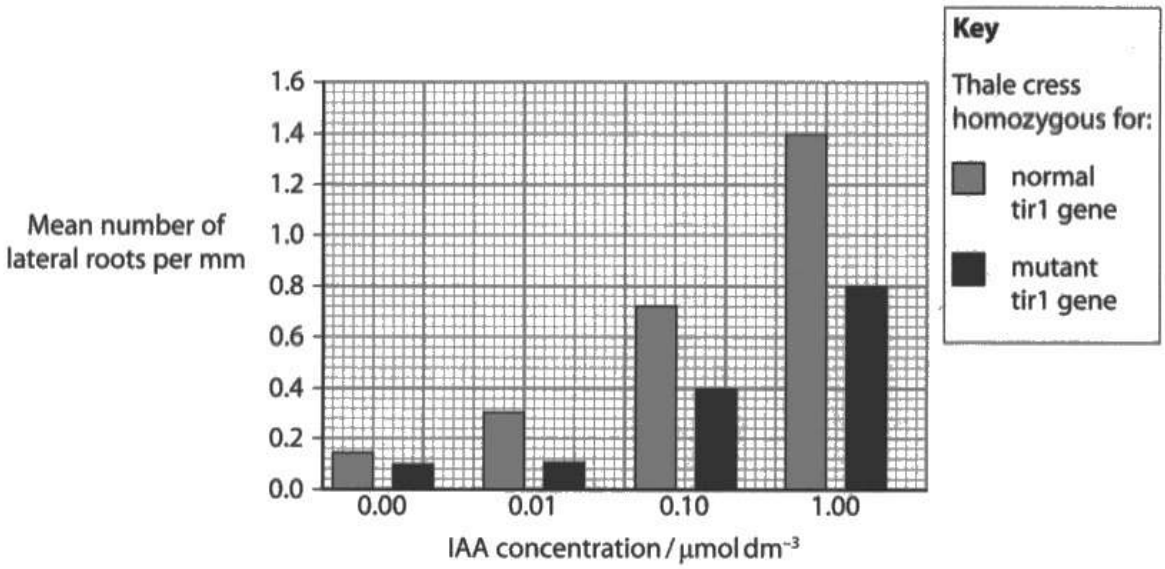
Scientists have investigated the effect of IAA on the growth of lateral roots in thale cress.

Plants homozygous for a normal tir1 gene and plants homozygous for a mutation in the tir1 gene were used in this investigation.

The plants were treated with different concentrations of IAA.

The mean number of lateral roots produced per mm of main root was recorded.

The graph shows the results of this investigation.



(i) Explain why the scientists used plants homozygous for the normal and the mutant tir1 gene in this investigation.

(2)

The mutant tir1 gene is caused by homozygous recessive alleles so the plant needs 2 copies for it to be expressed in the phenotype. Using homozyga for normal acts as a control to ensure that the mutation is definately caused by 2 recessive alleles and not heterozygous - carriers

ResultsPlus
Examiner Comments

This response gained two marks. MP3 was awarded for the first three lines and MP1 for the last three lines.

ResultsPlus
Examiner Tip

Compare the comments about control in the two examples of this question. Can you see why MP1 was given in this example and not in the other example?

One type of receptor for IAA is coded for by the tir1 gene.

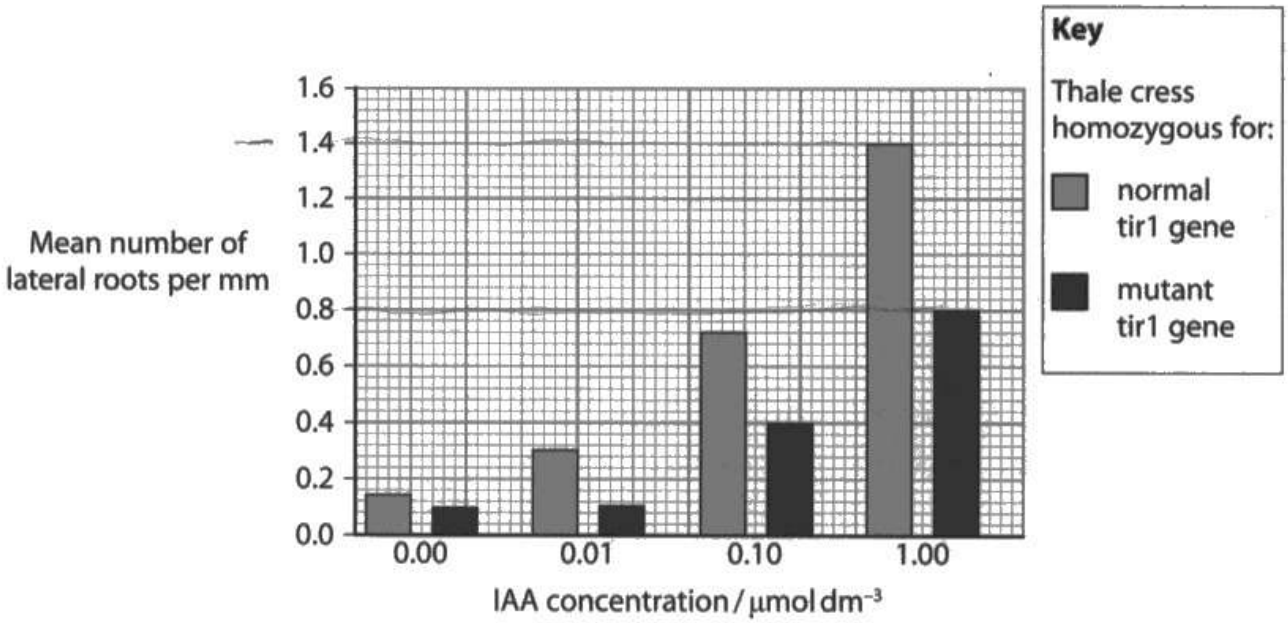
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The graph shows the results of this investigation.



(i) Explain why the scientists used plants homozygous for the normal and the mutant tir1 gene in this investigation.

(2)

To act as a control. Also to compare the differences and deduce the effect a mutation has.

ResultsPlus
Examiner Comments

This response did not gain any marks. The statement 'To act as a control' was not sufficient for MP1 additional guidance. To gain this mark it needed to be a clear expression of the idea that homozygosity is a controlled variable.

Question 1 (c)(ii)

This calculation proved to be straightforward for most candidates. Correctly rounded answers derived from 42.8571 were accepted. A small number of candidates ignored the instruction to calculate the decrease and instead calculated an increase.

(ii) Calculate the percentage decrease in mean number of lateral roots for thale cress with the mutant tir1 gene compared to thale cress with the normal tir1 gene at 1.00 µmol dm^{-3} of IAA.

(1)

1.4 - 0.8 = 0.6

$\frac{0.6}{0.8} \times 100 = 75$

Answer 75 %

ResultsPlus
Examiner Comments

Careful reading of questions is likely to result in fewer marks being lost for a correct statement that does not answer the question.

ResultsPlus
Examiner Tip

Take time to read questions carefully. In this question candidates are asked to calculate the percentage decrease. This candidate has found the percentage increase and did not gain the mark.

Question 1 (c)(iii)

Many candidates gave clear responses that gained both marks. Some candidates described the effect of IAA concentration on thale cress response without mentioning lateral roots and some did not describe the effect of the mutation on the response.

(iii) Deduce the effect of the mutation in the tir1 gene on the response of thale cress to IAA.

(2)

- the lower the concentration, the less the effect the lower the mean number of lateral Roots. there the mean number of lateral roots had decreased with decreasing concentration of IAA in both normal tir1 gene and mutant tir1 gene. However the rate mutant tir1 gene was less.

ResultsPlus
Examiner Comments

When using data provided in a question candidates often describe the data without addressing the question that was asked. In the first four lines of this response the candidate described the effect of concentration of IAA on lateral root production and not the effect of the mutation on IAA response. In the last sentence the candidate attempts to address the effect of the mutation. However, from the candidate's statement it is not clear what is less. It could be less of the tir1 gene or less of a response to IAA. The examiner has no way of knowing what the candidate means, so no mark can be awarded.

(iii) Deduce the effect of the mutation in the tir1 gene on the response of thale cress to IAA.

(2)

The mutation in the tir1 gene decreases the response of thale cress to IAA, regardless of the concentration. At all IAA concentrations, the plant homozygous for the mutant tir1 gene had a lower mean number of lateral roots. This may be because the mutated gene changed the shape of the IAA receptor, meaning IAA could not bind and so not cause more growth of lateral roots.

ResultsPlus
Examiner Comments

This response covered all three marking points and gained both available marks. MP1 in the first two lines, MP2 in lines 3 to 5 and MP3 lines 5 and 6.

Question 2 (a)

The majority of candidates gained both available marks. When asked to complete a table with numerical values candidates are expected to follow the format in the rest of the table. In this example the areas for zones of inhibition were all given as whole numbers. Candidates were expected to provide their calculated value as a whole number. The value recorded for the diameter was 19 mm. Values of 18.5 and 19.5 were accepted. Intermediate values were not accepted. On this occasion we accepted either 19 or 19.0.

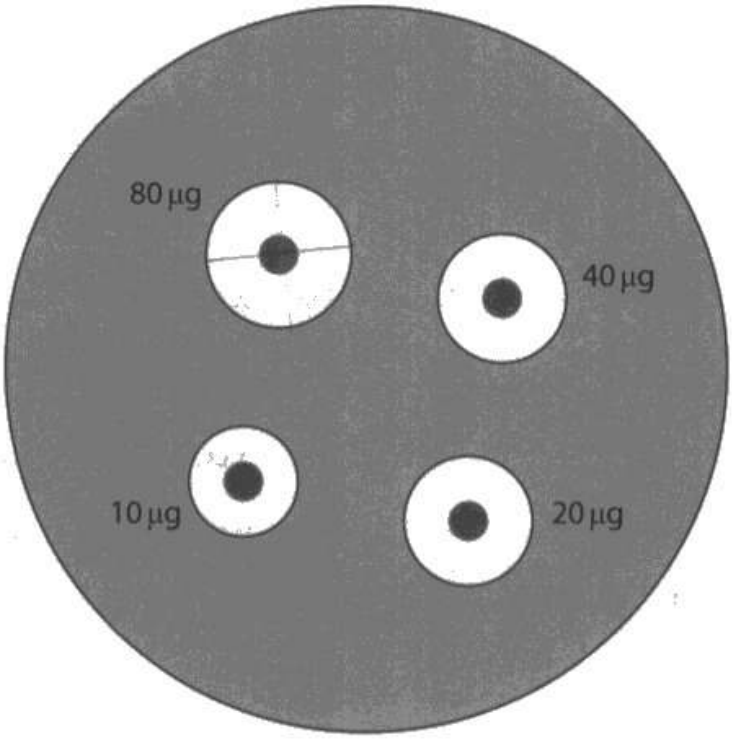
2 Pathogenic bacteria can become resistant to antibiotics.

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a bacterial pathogen that is resistant to many antibiotics.

Licochalcone A is a chemical isolated from the liquorice plant.

The antibacterial properties of licochalcone A have been investigated.

The diagram shows the effect of licochalcone A on a bacterial lawn prepared using MRSA.



Magnification ×1

(a) Complete the table using information from the diagram.

(2)

Mass of licochalcone A /µg	Diameter of clear zone /mm	Area of clear zone /mm²
10	14.5	165
20	16.5	214
40	16.5	214
80	19.0	284

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Examiner Comments

Giving the answers to calculations to an appropriate number of significant figures or decimal places is an important skill.

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Examiner Tip

When asked to complete a table with numerical data make sure you give your answers in the same style as the rest of the table. In this case the diameter should be given to one decimal place and the area as a whole number.

Question 2 (b)

This question required candidates to describe how a procedure could be caried out safely. Many candidates ignored the question and simply described using aseptic techniques.

To gain marking point 2, 4 or MP1 (additional guidance) the candidate response needed to indicate that the step was being carried out after transferring the antibiotic disks.

(b) The bacteria used in this investigation are pathogenic.

Describe how filter paper discs containing licochalcone A can be safely placed on the bacterial lawn.

(3)

firstly using a bunsen burner flame the ends of a pair of forceps, in order to sterilise it. place a filter paper disc in a solution of licochalcone A using the forceps. open the lid of the bacterial lawn slightly and place the filter paper disc on the bacterial lawn. before flaming the forceps wash hands thoroughly with antibacterial soap, and sterilise the work surface using a solvent

ResultsPlus
Examiner Comments

This candidate has gained all three available marks from, MP3 line 5, and MP 1,2 and 3 in the last three lines.

(b) The bacteria used in this investigation are pathogenic.

Describe how filter paper discs containing licochalcone A can be safely placed on the bacterial lawn.

(3)

Autoclave forceps to sterilise them. Working in the updraught of a Bunsen burner flame, use the forceps to carefully place the filter paper discs on the lawn.

ResultsPlus
Examiner Comments

This candidate described some aspects of aseptic technique but did not link any of these to carrying out the procedure safely.

ResultsPlus
Examiner Tip

Working safely is a key element of practical work. Make sure you understand how the procedures you use in your practical work allow you to work safely.

Question 2 (c)

The mark scheme allowed candidates to take one of two different approaches to identifying anomalous results. Many candidates chose to repeat the experiment approach and gained one mark for suggesting repeating the experiment. Some then gained a second mark for using the standard deviation to identify anomalous results.

A smaller number of candidates suggested graphing the results. However, those that chose this approach usually gained a second mark for describing the use of a line of best fit or identifying values that did not fit the trend. Candidates gained credit from the approach that gave the highest score but could not gain marks by mixing the two approaches.

(c) Explain how an anomalous result could be identified for this investigation.

(2)

Repeat investigation multiple time's and calculate mean - In addition use statistical tests such as finding out Standard deviation

ResultsPlus
Examiner Comments

This response gained one mark MP3 for repeating the investigation.
Using a statistical test was not sufficient for MP4.

(c) Explain how an anomalous result could be identified for this investigation.

(2)

Place the data on a graph and draw a line of best fit and whatever data doesn't match the general trend could be the anomalous result and ~~remove from the~~ ignored

ResultsPlus
Examiner Comments

This response gained two marks. MP1 (line 1) and MP2 (lines 2 to 4).

(c) Explain how an anomalous result could be identified for this investigation.

(2)

carry out repeats : At least 5 to calculate mean and standard deviation of data . Anomalous results are 2 or 3 standard deviations outside of the mean. results too large or too small will be obvious to identify

ResultsPlus
Examiner Comments

This response gained both marks, MP3 (line 1) and MP4 (lines 2 to 4).

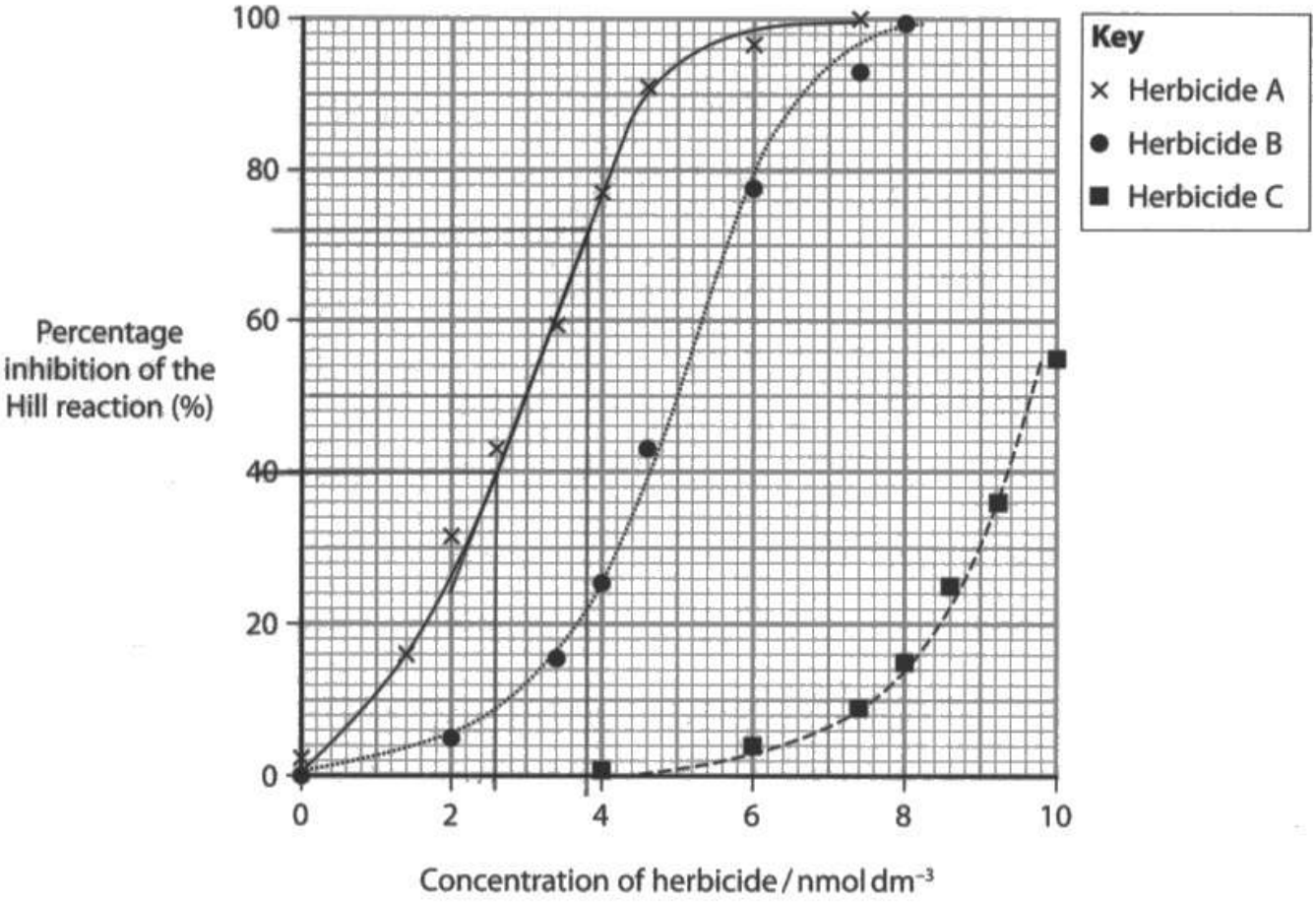
Question 3 (a)(i)

This question was answered correctly by the majority of candidates. A small number suggested the 'thylakoid space' and did not gain the mark.

3 Photosynthesis takes place in chloroplasts.

(a) The light-dependent processes in photosynthesis can be investigated using the Hill reaction. LDR

The graph shows the effect of three different herbicides, A, B and C, on inhibition of the Hill reaction in isolated chloroplasts.



(i) State the location of the light-dependent reactions in chloroplasts.

(1)

Thylakoid membranes in grana.

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Examiner Comments

This response gives a good description of the location.

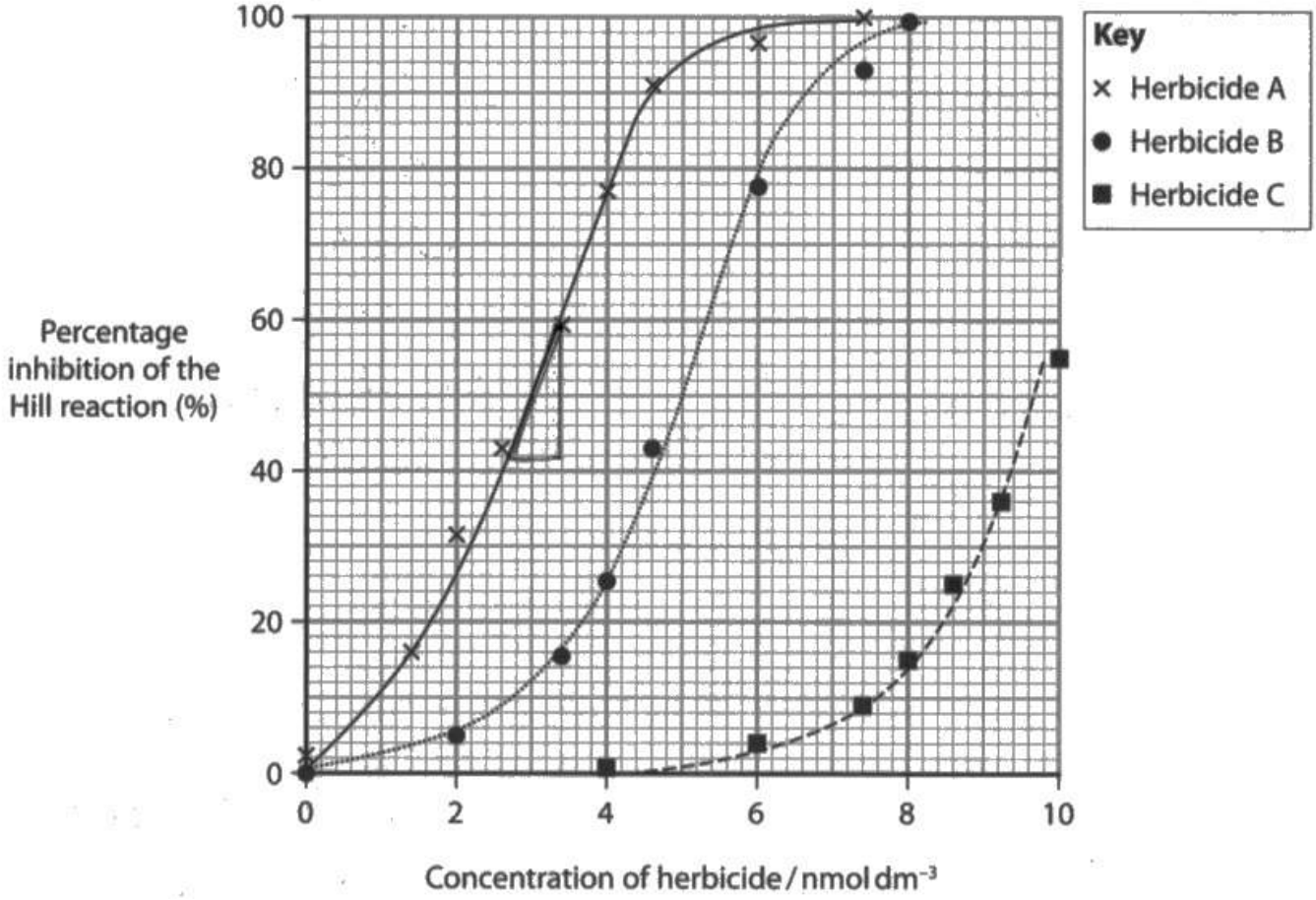
Question 3 (a)(ii)

Many candidates were able to calculate the gradient and provide a final answer to two significant figures. Some candidates confused y and x axis and some ignored the instruction to provide the final answer to two significant figures.

3 Photosynthesis takes place in chloroplasts.

(a) The light-dependent processes in photosynthesis can be investigated using the Hill reaction.

The graph shows the effect of three different herbicides, A, B and C, on inhibition of the Hill reaction in isolated chloroplasts.



(ii) **Calculate the gradient of the slope for herbicide A at 50% inhibition of the Hill reaction.**

Give your answer to two significant figures.

(2)

$\frac{18}{7} = 2.57$

Answer 2.57 $mol\ dm^{-3}$

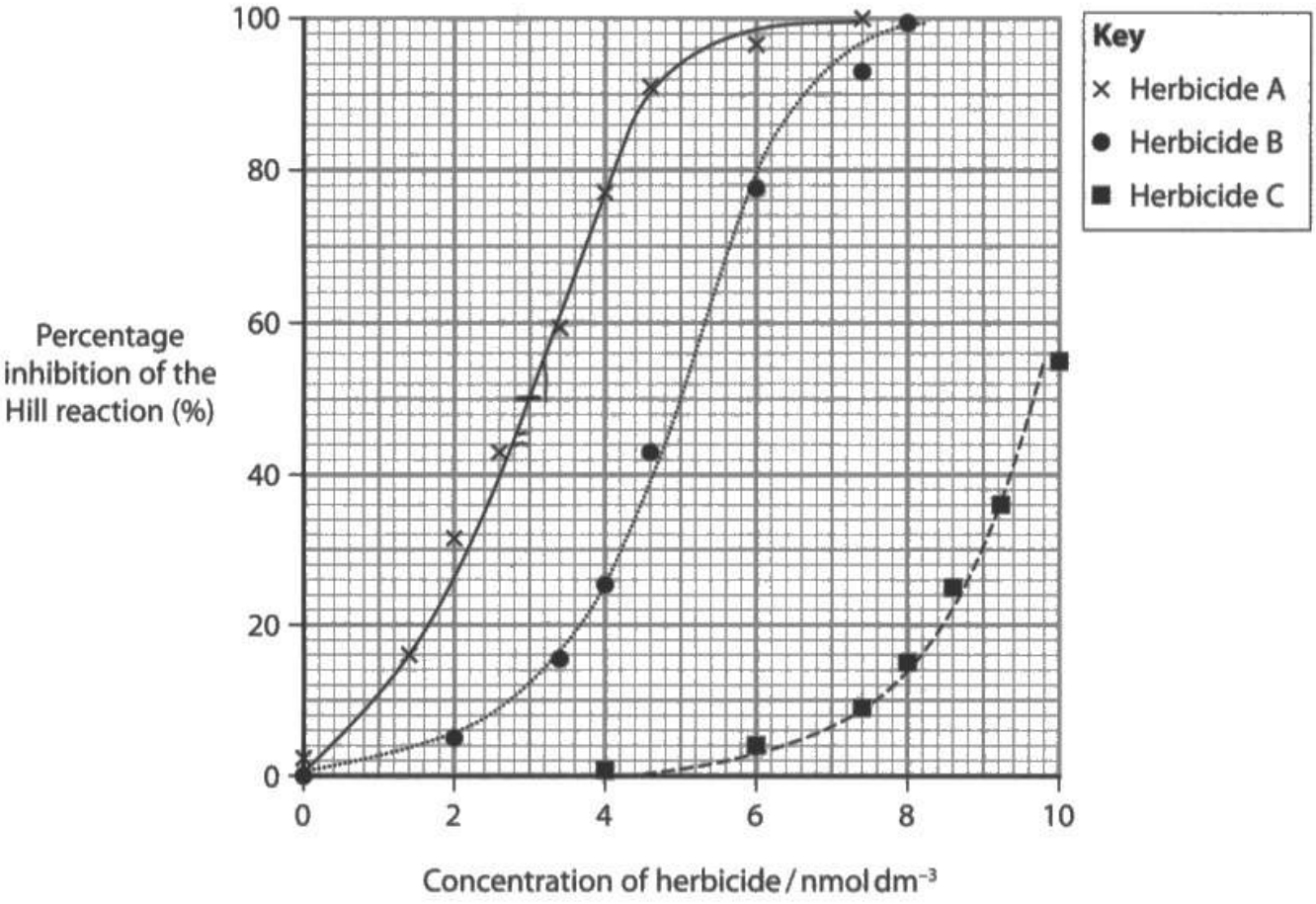
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Examiner Comments

This candidate made at least two mistakes and gained no marks. The gradient is incorrect, and the answer was given to two decimal places rather than two significant figures. Note, in this question the second mark was dependent on the first. An incorrect gradient given to two significant figures did not gain credit.

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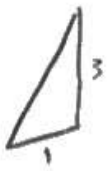


(ii) Calculate the gradient of the slope for herbicide A at 50% inhibition of the Hill reaction.

Give your answer to two significant figures.

(2)

$\frac{3}{1} =$



Answer 3.16

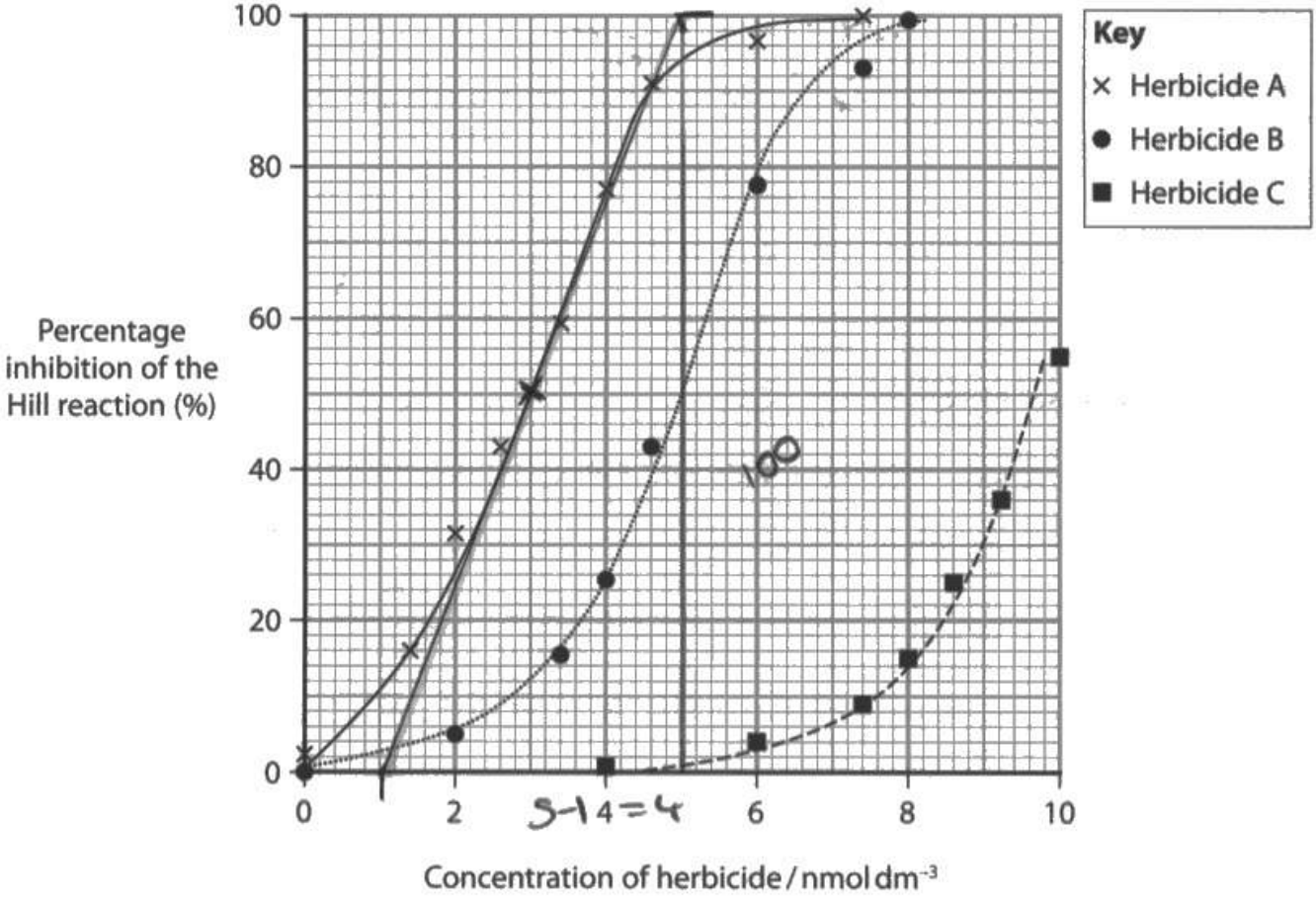
ResultsPlus
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(a) The light-dependent processes in photosynthesis can be investigated using the Hill reaction.

The graph shows the effect of three different herbicides, A, B and C, on inhibition of the Hill reaction in isolated chloroplasts.



(ii) Calculate the gradient of the slope for herbicide A at 50% inhibition of the Hill reaction.

Give your answer to two significant figures.

(2)

$\frac{100}{4} = 25$

Answer 25

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Examiner Comments

Correct answer to two significant figures gained both marks.

Question 3 (a)(iii)

Many candidates identified that chlorophyll absorbed light (MP1) and used the light energy to excite electrons (MP2). Fewer candidates went as far as describing the provision of high energy or excited electrons to the electron transport chain (MP3). A small number of candidates confused chlorophyll with chloroplast and described the role of chloroplasts.

(iii) Describe the role of chlorophyll in the light-dependent reactions of photosynthesis.

(2)

Chlorophyll contains Pigments needed for photosynthesis it contains Pigment at which light is absorbed at this is because it absorbs light at a specific wavelength and the light energy absorbed will pass onto the light dependant Stage.

ResultsPlus
Examiner Comments

This response gained one mark for MP1.

(iii) Describe the role of chlorophyll in the light-dependent reactions of photosynthesis.

(2)

The ~~ete~~ chlorophyll is a light absorbing pigment in photosynthesis. light energy excites the electrons within the ~~chloropl~~ thylakoid membrane to produce NADPH and Pi

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Examiner Comments

This response gained both available marks. MP1 in the first two lines and MP2 in lines 2 and 3.

Question 3 (b)

This question was accessible to the majority of candidates and complete answers were provided by many. A number of candidates went beyond the role of RUBISCO and described the whole of the Calvin cycle. Some candidates struggled with marking point 2, suggesting that carbon dioxide was combined with a six carbon molecule to form RuBP. If candidates did not gain MP2 for a description of the reaction, we did allow the mark for RUBISCO fixes carbon. However, it did need to be about fixing carbon and not fixing carbon dioxide.

(b) Describe the role of RUBISCO in the light-independent reactions of photosynthesis.

(3)

Rubisco is an enzyme that catalyses the fixation of RuBP to a 6 carbon unstable. This then becomes unstable and converts into RGP that is reduced into 12 GALP, 2 out of the 12 GALP are used to make hexose/glucose. The RUBISCO fixes carbon from the atmosphere

ResultsPlus Examiner Comments

Candidates often confuse biochemical details in respiration and photosynthesis.

ResultsPlus Examiner Tip

This response was given two marks. Which mark was not awarded and why?

(b) Describe the role of RUBISCO in the light-independent reactions of photosynthesis.

(3)

RuBISCO is an enzyme that catalyses the combining of RuBP and CO_2 to form ~~an~~ unstable 6C compounds. ~~These then convert~~ This process is carbon fixation. The 6x6C compounds split into 12x3C compounds, GP. GP is then reduced into GALP using hydrogen from $NADH+H^+$ and ATP from light dependent reactions. ~~This pro~~ The whole process is called the Calvin cycle.

ResultsPlus
Examiner Comments

This is an example of a good response. MP1 line 1, MP2 line 2 and MP3 lines 4 and 5.

Question 4 (a)

Many candidates recognised that the difference in trophic levels was important and gained MP1 for an appropriate comparison. Often candidates went on to describe the loss of energy at each trophic level for MP2 and some gained MP3 for the idea that there is less energy available to convert to biomass (MP3). Candidates sometimes failed to explain that there is less energy available to convert to biomass for MP3. A number of candidates described the transfer of biomass without reference to energy and did not gain MP2 or 3.

(a) Explain why an area of ocean can support a greater biomass of humpback whales than of great white sharks.

(3)

Both are at the end of their food chains but the trophic levels of humpback ~~wale~~ whales ~~or~~ is smaller than that of the great white shark. This means that there is less food avaliable for sharks compared to whales so there is more competition for food for sharks compared to whales which means that less sharks are ~~avaliable~~ able to survive compared to whales.

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Examiner Comments

This response was given MP1 (first two lines) but then nothing else.

(a) Explain why an area of ocean can support a greater biomass of humpback whales than of great white sharks.

(3)

- Humpback whales have greater mass than great white sharks (233 sharks have same mass of 1 Humpback whale)
- there are less trophic levels for humpback whale than great white shark so less energy is lost to respiration and other metabolic reactions so more energy for to be incorporated into Biomass
- less is also lost due to the parts not eaten as humpback whale will eat whole krill but shark wont eat bones of fish.

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Examiner Comments

This response gained all three marks in the middle bullet point (lines 5 to 10).

(a) Explain why an area of ocean can support a greater biomass of humpback whales than of great white sharks.

(3)

Because humpback whales are secondary consumers, compared to great whites which are tertiary consumers. This lower trophic level allows more energy to be transsered to humpback whales than to great whites. There is a greater availability of food for the humpback compared to the great white.

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Examiner Comments

This response gained MP1 (first two lines). 'lower trophic level allows more energy to be transferred to whales' was not sufficient for either MP2 or 3. For MP2 there needed to be a clear expression of the idea energy is lost at each trophic level. For MP3 it needed to be clear that more energy was available to convert into biomass.

Question 4 (b)(i)

The majority of candidates produced a correct answer for this question. Common errors were to use the incorrect sign or to use incomplete abbreviations eg GP rather than GPP.

(b) Phytoplankton are photosynthetic unicellular microorganisms.

Phytoplankton are primary producers in aquatic ecosystems.

(i) State the relationship between gross primary productivity and net primary productivity.

(1)

NPP = GPP − R

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Examiner Comments

Correct answer.

(b) Phytoplankton are photosynthetic unicellular microorganisms.

Phytoplankton are primary producers in aquatic ecosystems.

(i) State the relationship between gross primary productivity and net primary productivity.

(1)

GPP = NPP − R

ResultsPlus
Examiner Comments

Candidates often have a poor grasp of the small number of equations found in the specification. They should understand the principals behind the equation as well as be able to recall the equation.

ResultsPlus
Examiner Tip

There are not many equations in the specification. Where they do appear make sure you understand what the equation means. Then you are less likely to make the mistake that prevented this answer from gaining a mark.

Question 4 (b)(ii)

This question assessed candidates understanding of the relationship between GPP, NPP and respiration. Two marking points were available for identifying the independent variable as temperature (MP1) and an appropriate control variable (MP2). Two further marking points were available for the idea that excess oxygen produced in the light corresponds to NPP (MP3) and that oxygen consumed in the dark corresponds to respiration (MP4). Many candidates gained MP1 and 2 but failed to go on and provide the detail required for MP3 or 4.

(ii) The concentration of oxygen in water (dissolved oxygen) can be measured using an oxygen probe.

Explain how an oxygen probe could be used to estimate the effect of temperature on the gross primary productivity (GPP) of phytoplankton.

(4)

oxygen is produced from photosynthesis, from photolysis in the light dependent stage: $H_2O \rightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$

~~The equation~~ The equation for photosynthesis is $6H_2O + 6CO_2 \rightarrow C_6H_{12}O_6 + 6O_2$. Therefore the ~~rate~~ amount of oxygen produced in a minute, ~~represent~~ by calculating the increase in O_2 concentration in a minute, represents the rate of photosynthesis. Using waterbaths at a range of temperatures (5, 10, 15, 20, 25°C) the rate of photosynthesis can be compared. This represents GPP which is the rate that energy is incorporated into organic ~~mat~~ molecules in a plant. Repeats allow a mean to be calculated, which increases ~~validi~~ reliability. Test the O_2 concentration using distilled water ($50\ cm^3$) containing the same species and ~~volume~~ mass of phytoplankton. Control the light intensity.

ResultsPlus
Examiner Comments

This was a fairly typical response that gained two marks. The candidate has told us some relevant information about using different temperatures (line 8) and controlling some relevant factors (last line). However, the candidate has not explained how the oxygen probe can be used to estimate respiration (oxygen produced in the dark) or NPP (oxygen produced in the light).

(ii) The concentration of oxygen in water (dissolved oxygen) can be measured using an oxygen probe.

Explain how an oxygen probe could be used to estimate the effect of temperature on the gross primary productivity (GPP) of phytoplankton.

(4)

→ IV → the temperature of lawn (e.g 10°C, 20°C, 30°, 40°C, 50°C).

DV → the GPP via O2 % conc in oxygen probe.

to via NPP = GPP − R.

C.V. → pH of lawn, species of phytoplankton, age of phytoplankton.

to value of conc of lawn.

(1) Carve agreed the name of phytoplankton in ice cell culture on a petri dish

to make agar jelly + nutrient culture.

(2) Set up water baths at five different temperatures (listed above).

(3) Add a value of buffer lawn to each sample in agar jelly + then transfer the cells into a series of 5 different test tubes in a respirometer. 5 were being.

(4) Use a sodium lime (or another) way of removing CO2 + add to

(5) specific fixed intervals, e.g. every 30 seconds, measure % O2 % decrease in the water. (6) change in O2 concentration can be attributed to rate of respiration (O2 is used in respiration) (7) e.g. plot a graph + determine rate of decrease using tangent.

(8) Calculate NPP → change in mass of the phytoplankton (in grams) by weighing. to or perhaps change in length. (9) Calculate NPP + R = GPP at each temperature.

(10) Repeat the process again to determine if there is a significant correlation between temp + GPP.

ResultsPlus
Examiner Comments

In this response MP1 and 2 were given in the first few lines. MP3 (additional guidance) was awarded in bullet point 8.

The response did not gain MP4 (bullet point 5 and 6) as they did not measure oxygen consumption in the dark.

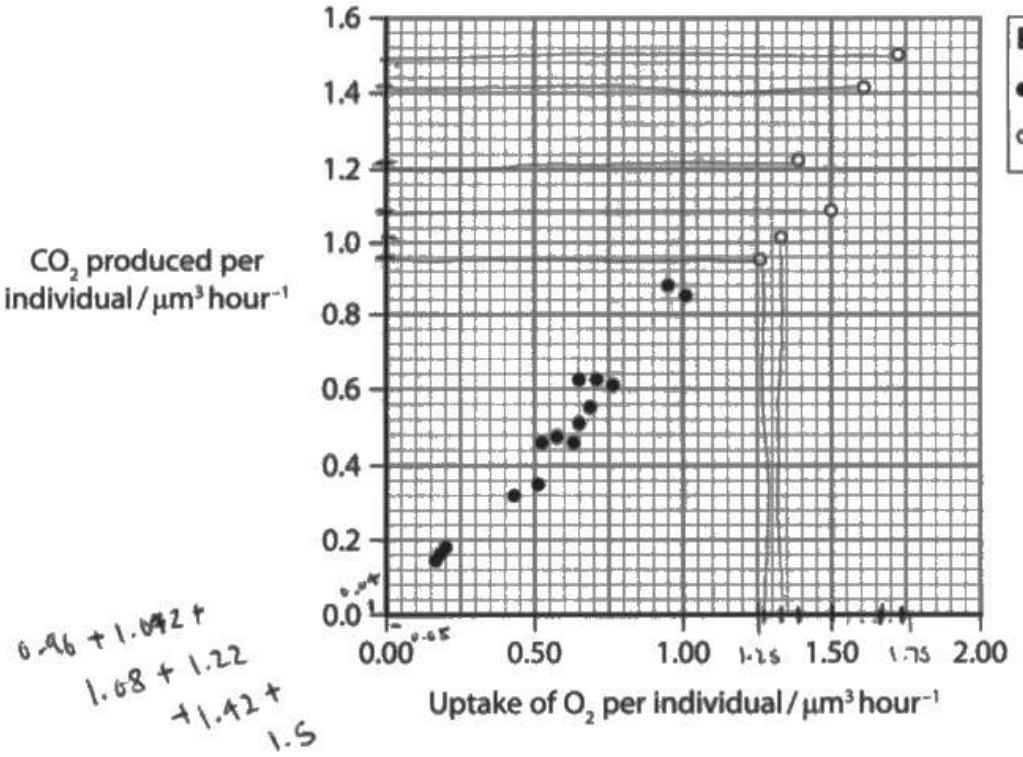
Question 4 (c)(i)

Most candidates provided a correct answer for this question. The main reasons for candidates not gaining the mark were to fail to give the ratio to 1 eg 0.6: 0.657 or giving the ratio the wrong way around eg 1: 0.86.

(c) Copepods are a group of zooplankton, small animals that feed on phytoplankton.

In an experiment, the production of carbon dioxide and the uptake of oxygen by copepods was measured at 14 °C and at 17 °C.

The results of the experiment are shown in the graph.



(i) Determine the mean ratio of carbon dioxide produced to oxygen consumed at 17 °C.

(1)

1.2 : 1.5

ResultsPlus
Examiner Comments

In biology we usually want ratio's written out in full and given either as a value to 1 eg 0.8: 1 or as 1 to something eg 1: 1.25.

In this response the candidate found some values to use but did not complete the calculation and did not gain a mark.

Question 4 (c)(ii)

In this question candidates were asked to deduce two conclusions. Deduce requires an answer that draws or reaches conclusions from the information provided. In other words, it requires candidates to go a step further than simply describing the data. One mark was available for candidates correctly describing the effect of temperature on oxygen uptake or carbon dioxide produced (MP1). Three marking points going a little further to gain credit: there is more respiration at the lower temperature (MP1), that the respiration taking place is aerobic (MP3) or making a reasonable suggestion about the respiratory substrate (MP4).

(ii) Deduce **two** conclusions from the results of this experiment.

(2)

- As the uptake of O_2 increases, the CO_2 produced per individual also increases

- At 14°C there is a higher level of CO_2 being produced compared to at 17°C.

ResultsPlus
Examiner Comments

This response gained one mark, MP1 – lines 4 and 5. MP1 could also be awarded for the additional guidance.

(ii) Deduce **two** conclusions from the results of this experiment.

(2)

At higher temperature of 17°C there is a lower oxygen uptake and carbon dioxide produced than at 14°C. At 14°C there is more CO_2 produced since there is a higher rate of respiration ~~which~~ which ~~provide~~ ~~warmth~~ keeps the zooplankton warm.

ResultsPlus
Examiner Comments

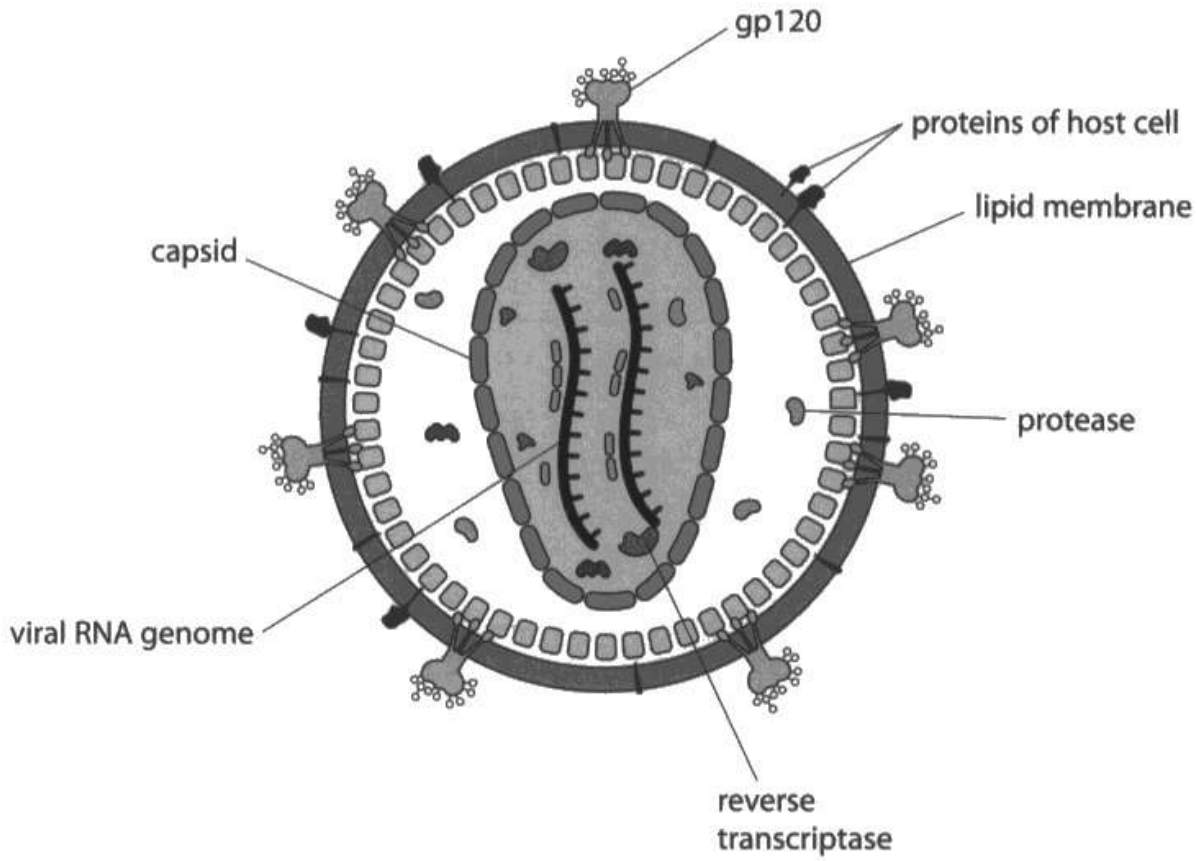
This response gained both available marks. MP1 (first two lines) and MP2 (lines 3 and 4).

Question 5 (a)(i)

Many candidates found this question straightforward and gained the mark. Most of those failing to gain the mark recognised that gp120 has a role in binding to host cells but did not identify the host cell as a T helper cell or that gp120 binds to CD4.

5 Human immune deficiency virus (HIV) can cause acquired immune deficiency syndrome (AIDS).

(a) The diagram shows an HIV virus particle.



(i) State the role of gp120 in the life cycle of the HIV virus.

(1)

attach to other cells and kill them.

ResultsPlus
Examiner Comments

This response did not gain a mark. To gain this mark candidates need to identify the role of gp120 as binding or attaching to CD4 molecules or to T helper cells.



Take care with scientific language. Although this answer did not gain a mark it also displays an important misconception. What does this response imply that is not correct?

Question 5 (a)(ii)

The majority of candidates did not gain this mark. Many of these candidates suggested the proteins were there to prevent immune recognition or else suggested a role in antigen presentation or phagocytosis.

(ii) Give a reason why there are proteins from the host cell in the lipid membrane surrounding the virus particle.

(1)

A virus's ~~cell~~ lipid membrane is made from the host cell it was synthesised within's membrane as they take a part of the membrane with them when they bud from the host cell.

ResultsPlus
Examiner Comments

This response was considered to match the idea expressed in the mark scheme and was given the marking point.

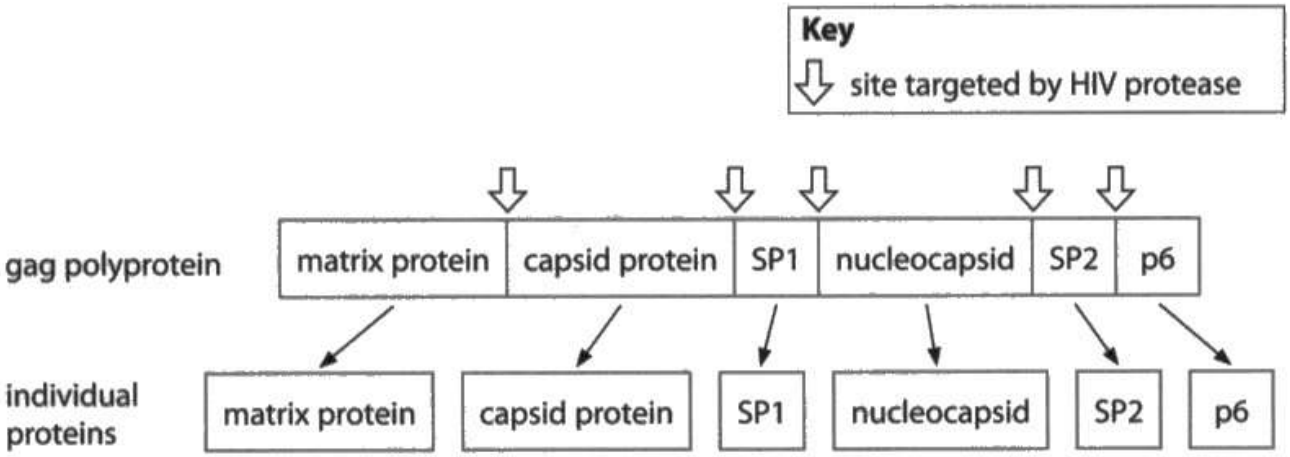
Question 5 (b)

Many candidates recognised from the stimulus material provided that the polyprotein needs to be cut into smaller proteins and that this would require hydrolysis (MP1) of peptide bonds (MP2) at specific sites recognised by the protease (MP3). A number of candidates tried to provide answers in terms of post-transcriptional processing of pre-RNA.

(b) During viral replication, virus mRNA molecules are translated into a virus polyprotein called gag. A polyprotein is a chain of smaller proteins.

This polyprotein is then split into individual proteins by the HIV protease.

The diagram shows the individual proteins produced from the polyprotein by HIV protease.



Deduce how HIV protease can split the gag polyprotein into individual proteins.

(3)

R HIV proteases breaks the bonds between gap polyprotein in hydrolysis reactions.

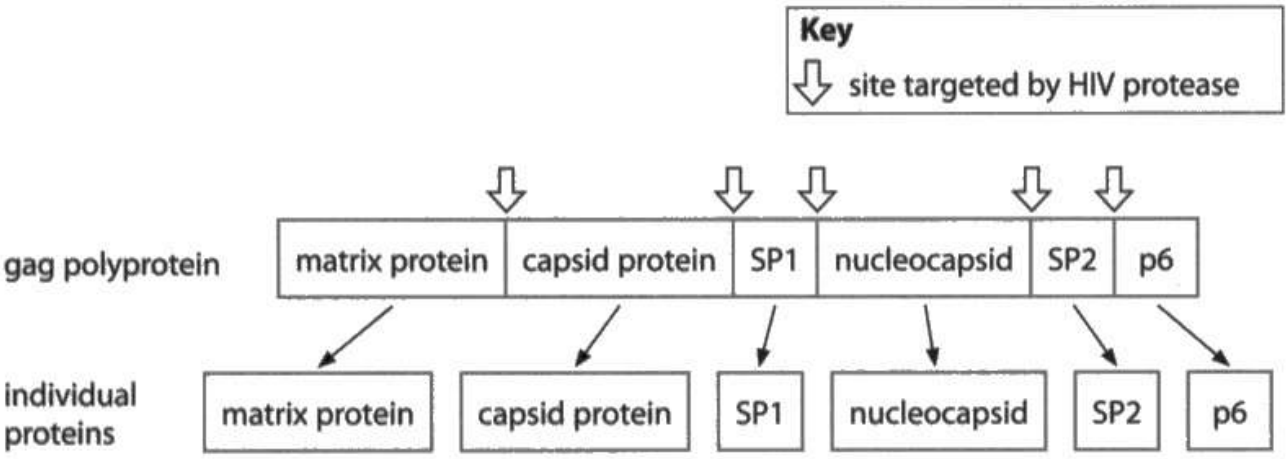
ResultsPlus
Examiner Comments

This response gained one mark, MP1.

(b) During viral replication, virus mRNA molecules are translated into a virus polyprotein called gag. A polyprotein is a chain of smaller proteins.

This polyprotein is then split into individual proteins by the HIV protease.

The diagram shows the individual proteins produced from the polyprotein by HIV protease.



Deduce how HIV protease can split the gag polyprotein into individual proteins.

(3)

The HIV protease targets a specific binding site on the poly protein. The HIV protease breaks the bonds between the proteins so that individual proteins are made, using hydrolysis to break the bonds

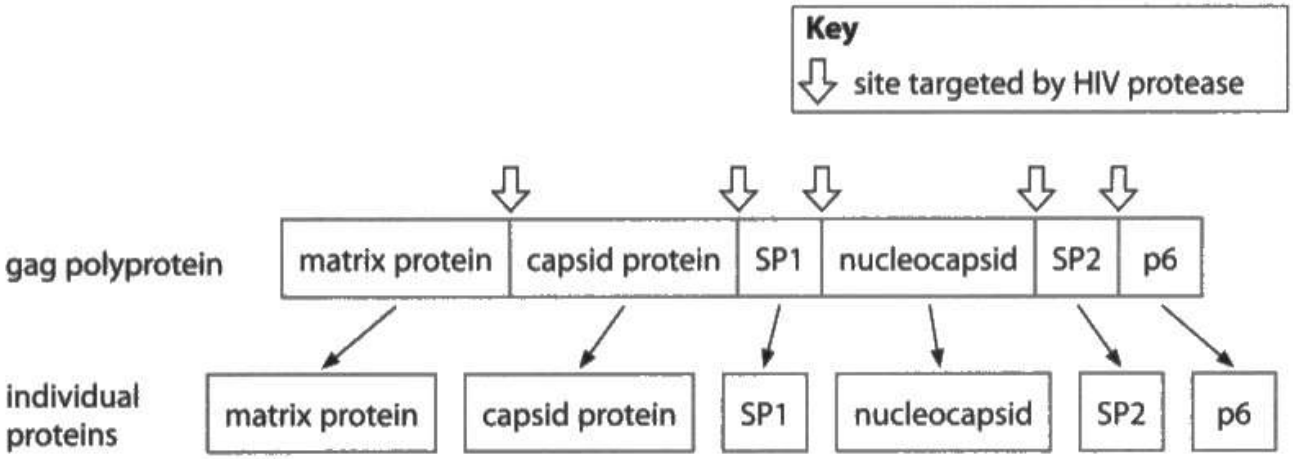
ResultsPlus
Examiner Comments

This response gained MP3 (lines 1 and 2) and MP1 (last line).

(b) During viral replication, virus mRNA molecules are translated into a virus polyprotein called gag. A polyprotein is a chain of smaller proteins.

This polyprotein is then split into individual proteins by the HIV protease.

The diagram shows the individual proteins produced from the polyprotein by HIV protease.



Deduce how HIV protease can split the gag polyprotein into individual proteins.

(3)

Protease is an enzyme. Its active site is complementary to the gag polyprotein so enzyme-substrate complexes form between them. At each site targeted by HIV protease, enzyme-substrate complexes form and the peptide bonds between the chain of amino acids is hydrolysed and breaks, forming individual proteins.

ResultsPlus
Examiner Comments

This response gained all three marks for a complete answer.

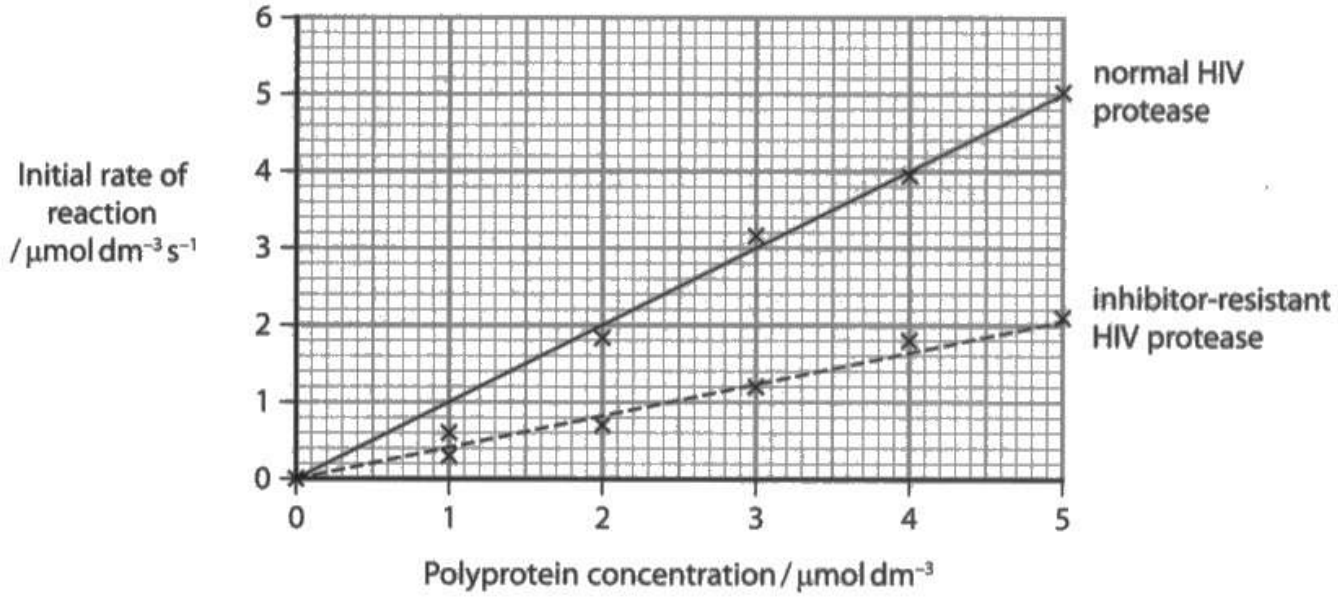
Question 5 (c)(i)

Many candidates recognised that they needed to find the slope of the graph and then use this to find the rate of reaction at a concentration of 7 μmol dm^{-3} s^{-1}. Some candidates came up with alternative methods that produced a correct answer and gained both marks. A number of candidates calculated the slope of the graph but went no further and gained one mark. Very few candidates provided suitable units. On this occasion units were ignored.

(c) HIV protease inhibitors are used in drugs to treat HIV infection.

In some individuals, the HIV has developed resistance to protease inhibitors.

The graph shows the effect of polyprotein concentration on the initial rate of reaction of normal HIV protease and inhibitor-resistant HIV protease.



(i) Calculate the initial rate of reaction in the inhibitor-resistant HIV protease for a polyprotein concentration of 7 μmol dm⁻³.

(2)

$\frac{2.1}{5} = 0.42$

0.42×7

$= 2.94$ μmol dm⁻³ s⁻¹

$\frac{2}{5} \times 7$

$= 2.8$

Answer 2.8 μmol dm⁻³ s⁻¹

ResultsPlus
Examiner Comments

Correct answer gained both marks.

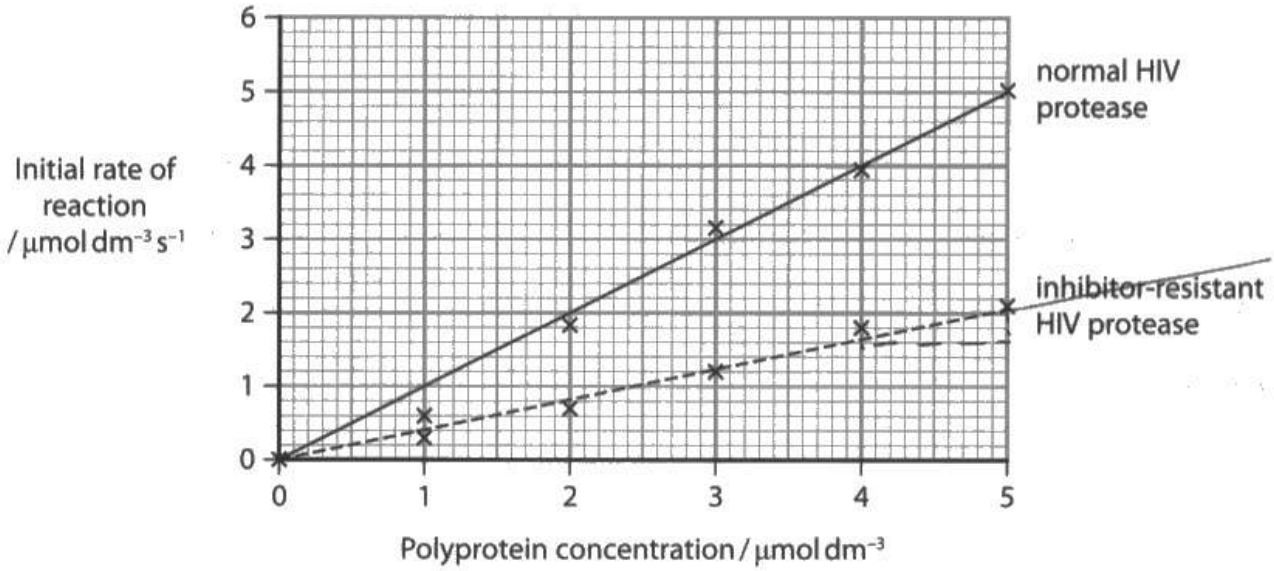
ResultsPlus
Examiner Tip

Notice the candidate provided clear workings. If the final answer had been wrong the intermediate mark for finding a gradient could have been awarded.

(c) HIV protease inhibitors are used in drugs to treat HIV infection.

In some individuals, the HIV has developed resistance to protease inhibitors.

The graph shows the effect of polyprotein concentration on the initial rate of reaction of normal HIV protease and inhibitor-resistant HIV protease.



(i) Calculate the initial rate of reaction in the inhibitor-resistant HIV protease for a polyprotein concentration of 7 μmol dm⁻³.

(2)

$\frac{2 - 1.6}{5 - 4} = \frac{0.4}{1} = 0.4$

Answer 0.4

ResultsPlus
Examiner Comments

In this response the candidate calculated the gradient but then did not use it to find the new rate. One mark was awarded.

Question 5 (c)(ii)

This question assessed candidates' understanding of the effect of enzyme and substrate concentration on the initial rate of reaction of an enzyme (core practical 4).

A small number of candidates gained all three available marks. The most frequently achieved mark was for the idea expressed in the additional guidance for MP3. Candidates were allowed to suggest keeping both enzyme and substrate concentration the same to allow comparison of the enzymes for this marking point. Few candidates suggested substrate concentration should be in excess (MP1) so that the enzyme works at its maximum rate (MP2).

(ii) Explain the importance of enzyme and substrate concentrations when comparing the initial rates of reaction of different enzymes.

(3)

Substrate concentration must be large so it does not become a limiting factor in the reaction. Substrate concentration should be same for every repeat of experiment. Concentration of enzymes should all be equal so you can compare data from each reaction, as a higher concentration would lead to a higher initial rate of reaction.

Substrate large so every enzymes form maximum number of enzyme substrate complexes

ResultsPlus
Examiner Comments

In this response MP1 was given in the first two lines. MP2 was awarded for the last two lines as the idea of allowing the enzyme to work at its maximum rate. MP3 was given in lines 4 to 6.

Question 6 (a)(i)

Many candidates provided complete answers that demonstrated a good understanding of this aspect of the specification. Candidates sometimes lost marks because they described events as taking place on the wrong side of the synapse eg suggesting MDMA binds to receptors on the post-synaptic membrane. A few candidates produced responses in which they suggested that MDMA was acting as the neurotransmitter and made no reference to serotonin.

6 The drug MDMA (ecstasy) can cause damage to the brain.

(a) This damage can cause changes in behaviour. This drug affects serotonin synapses.

(i) Explain how MDMA changes the rate of transmission of nerve impulses across serotonin synapses. Reduces reuptake,

(4)

MDMA reduces the reuptake of serotonin from the synaptic cleft. This means that the base level of neurotransmitter remaining in the cleft is higher than normal. This means that less neurotransmitter needs to be released from the presynaptic membrane to open up sodium channels on the post-synaptic membrane. More sodium can then rush in and open up the voltage gated channels to cause depolarisation of the ~~neb~~ membrane and cause an action potential. The presence of MDMA causes an increase in the rate of transmission of nerve impulses by reducing the level of neurotransmitter which needs to be released to open up sodium channels to allow the passage of an action potential.

ResultsPlus
Examiner Comments

In this response two marks were awarded. MP1 and MP4.

ResultsPlus
Examiner Tip

Try using the mark scheme to see if you can work out where marks should be given for this response.

6 The drug MDMA (ecstasy) can cause damage to the brain.

(a) This damage can cause changes in behaviour. This drug affects serotonin synapses.

(i) Explain how MDMA changes the rate of transmission of nerve impulses across serotonin synapses.

(4)

MDMA ~~p~~ binds to receptors on ~~pp~~ pre-synaptic membrane thereafore preventing the reuptake and breakdown of serotonin. This increases the concentration of neurotransmitter in the synaptic cleft so more neurotransmitter (serotonin) will fuse and bind with receptors on post-synaptic neurone, causing depolarisation of neurone as Na^+ influxes in. If the threshold is reached an Action Potential is produced and this increases the firing of the neuron, there for increases frequency of impulses and increases rate of transmission of impulse making it faster.

ResultsPlus
Examiner Comments

This is an example of a complete response that gained all four available marks. MP1 in line 1, MP2 in line 2, MP3 in lines 5 and 6 and MP4 in lines 8 to 10.

Question 6 (a)(ii)

Many candidates gained the two descriptive marks (MP1 and MP3). Some of these also gained at least one of the quantitative marks (MP2 and MP4).

The command word for this question was Determine. This means that to gain full marks the response needs an element that is quantitative. However, simply quoting figures is not sufficient, candidates need to use the data they have been provided with. This means they need to perform some element of calculation using the data. At the simplest level this might be a subtraction. However, percentage changes or fold increases are more likely to generate useful quantitative statements.

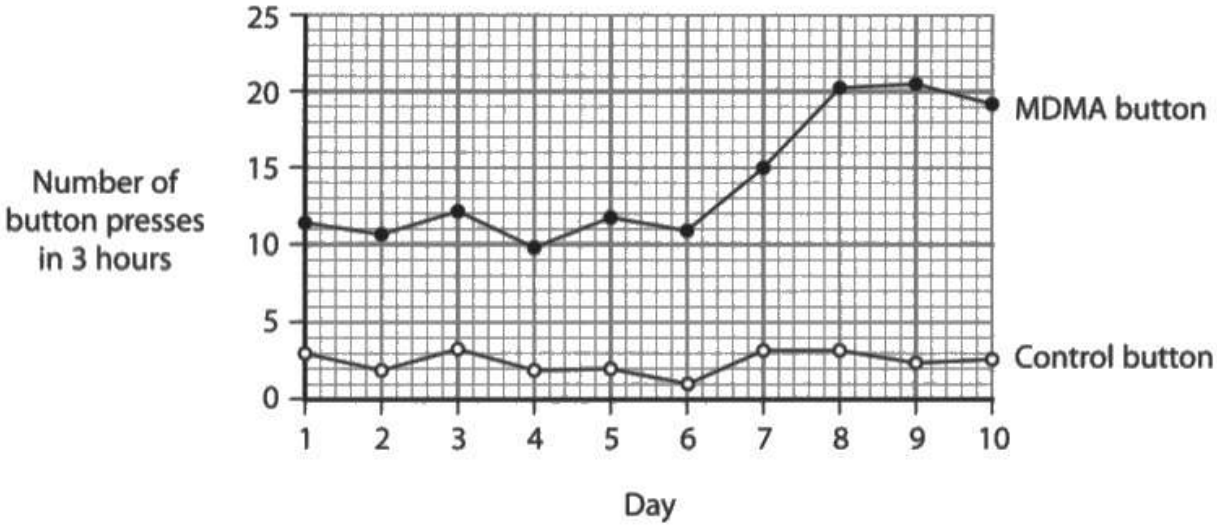
(ii) The effect of MDMA on the behaviour of mice has been investigated.

Mice were provided with access to two buttons, an MDMA button and a control button.

When they pressed the MDMA button they received a dose of MDMA.
When they pressed the control button they received a dose of salt solution.

The buttons were activated for one three-hour period each day.

The graph shows the results of this experiment.



Determine the effect of MDMA on the number of button presses made by these mice.

(3)

- MDMA increased the number of MDMA button pressed by mice after Day 6. The number increased from 11 to 20 from Day 6 to Day 8, and levels off around 20 after Day 8.
- MDMA increased the number of MDMA button pressed compared with the normal button. The number of MDMA button pressed everyday is 4 times of the number of normal button pressed everyday ~~from~~ before Day 1–6, and 8 times of normal button pressed at Day 8–10.

ResultsPlus
Examiner Comments

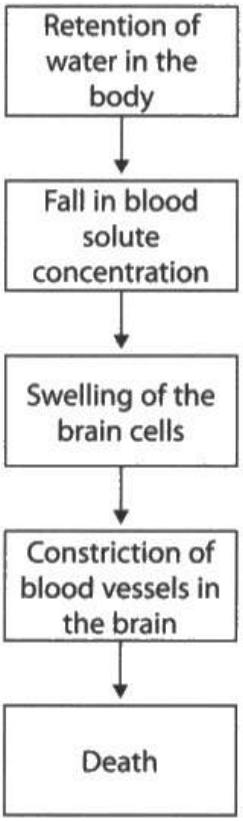
This response was given all three available marks. All four marking points were seen. MP3 was given in the first two lines. MP2 and 4 were given in the last three lines. MP1 was given in line 5.

Question 6 (b)(i)

The majority of candidates were able to provide a good description of active transport and gained both marks.

(b) MDMA is responsible for swelling of the brain resulting in death in some people.

The diagram shows how MDMA can cause brain swelling and death in some people.



Brain cells regulate their volume using active transport of sodium ions.

(i) State what is meant by **active transport**.

(2)

Transport of substances across a membrane, from low concentration to high concentration. Using energy.

ResultsPlus
Examiner Comments

This response gained both marks.

Question 6 (b)(ii)

Many candidates produced complete explanations in terms of sodium ions moving into the brain cells increasing solute concentration (MP1), water moving in by osmosis (MP2) and therefore cell volume increasing (MP3). Answers in terms of sodium ions moving out of the brain cells were also accepted. A number of candidates did not gain marks because they did not make a clear link between changes in solute concentration and the direction of movement of water. Some candidates attempted to give answers in terms of the sodium potassium ion pump and action potentials and gained no marks.

(ii) Explain how the active transport of sodium ions can regulate brain cell volume.

(3)

Sodium ions will be transported from low to high concentration when Sodium ion channels open. This will cause depolarisation and cause an increase in Potential difference. When Sodium ion channels open a threshold Potential is reached. When Sodium ion channels close ~~[illegible]~~ Wat leave which causes repolarisation.

ResultsPlus Examiner Comments

Many candidates appeared to hold the misconception that any movement of sodium ions is associated with generating action potentials and produced this type of response.

ResultsPlus Examiner Tip

Take time to understand the question. Do not rush to produce an answer based on the first thought that comes into your head. Always check your answer. Ask yourself 'does my response answer the question?'

(ii) Explain how the active transport of sodium ions can regulate brain cell volume.

(3)

The active transport of sodium ions out of the blood, from low sodium ion concentration to high sodium ion concentration in brain cells leads to an increased ion concentration in brain cells ^ overcome water moves into brain cells by osmosis leading to the swelling of brain cells as ^ cell volume is increased.

ResultsPlus
Examiner Comments

This response gained all three available marks. MP1 was given in line 4 and 5. Ion concentration was accepted for solute concentration. MP2 was given in line 6 and MP3 was awarded in the last two lines.

Question 6 (b)(iii)

Candidates often ignored the reference to vasoconstriction in the question. These candidates often produced answers in terms of swollen brain cells take up more of the available space, reducing the space available for blood vessels (MP2). Some candidates did consider vasoconstriction but often suggested that vasoconstriction narrows the lumen of arteries or capillaries and did not gain MP3.

(iii) Explain why swelling of the brain cells will result in vasoconstriction.

(2)

. Swelling of the brain cell, will cause vasoconstriction as arterials are constricted to decrease blood flow to the brain cell, to ~~lower~~ stop the swelling which will result in less oxygen to the brain.

ResultsPlus
Examiner Comments

This response gained both available marks. MP4 line 1 and 2 and MP3 line 2.

ResultsPlus
Examiner Tip

Note, MP3 could be awarded because the candidate described the vasoconstriction of arterioles. A number of candidates did not gain this mark because they described vasoconstriction of arteries or capillaries.

Question 6 (b)(iv)

The majority of candidates provided answers that gained both marks.

(iv) Explain why vasoconstriction will result in the death of brain cells.

(2)

Vasoconstriction is the narrowing of arteries, this leads to low supply of oxygen to the brain resulting in death of brain cells

ResultsPlus Examiner Comments

This response did not gain any marks. A 'low supply of oxygen to the brain' did not gain credit. MP1 needed to be about blood flow and MP2 needed to be about a lack of oxygen for respiration.

(iv) Explain why vasoconstriction will result in the death of brain cells.

(2)

Vasoconstriction would reduce or cut of the blood flow to the brain. therefore oxygenated blood cannot reach the cells. without oxygen the brain cells cannot respire can which causes cell death.

ResultsPlus Examiner Comments

This response gained both marks. MP1, line 2 and 3 and MP2, lines 4 and 5.

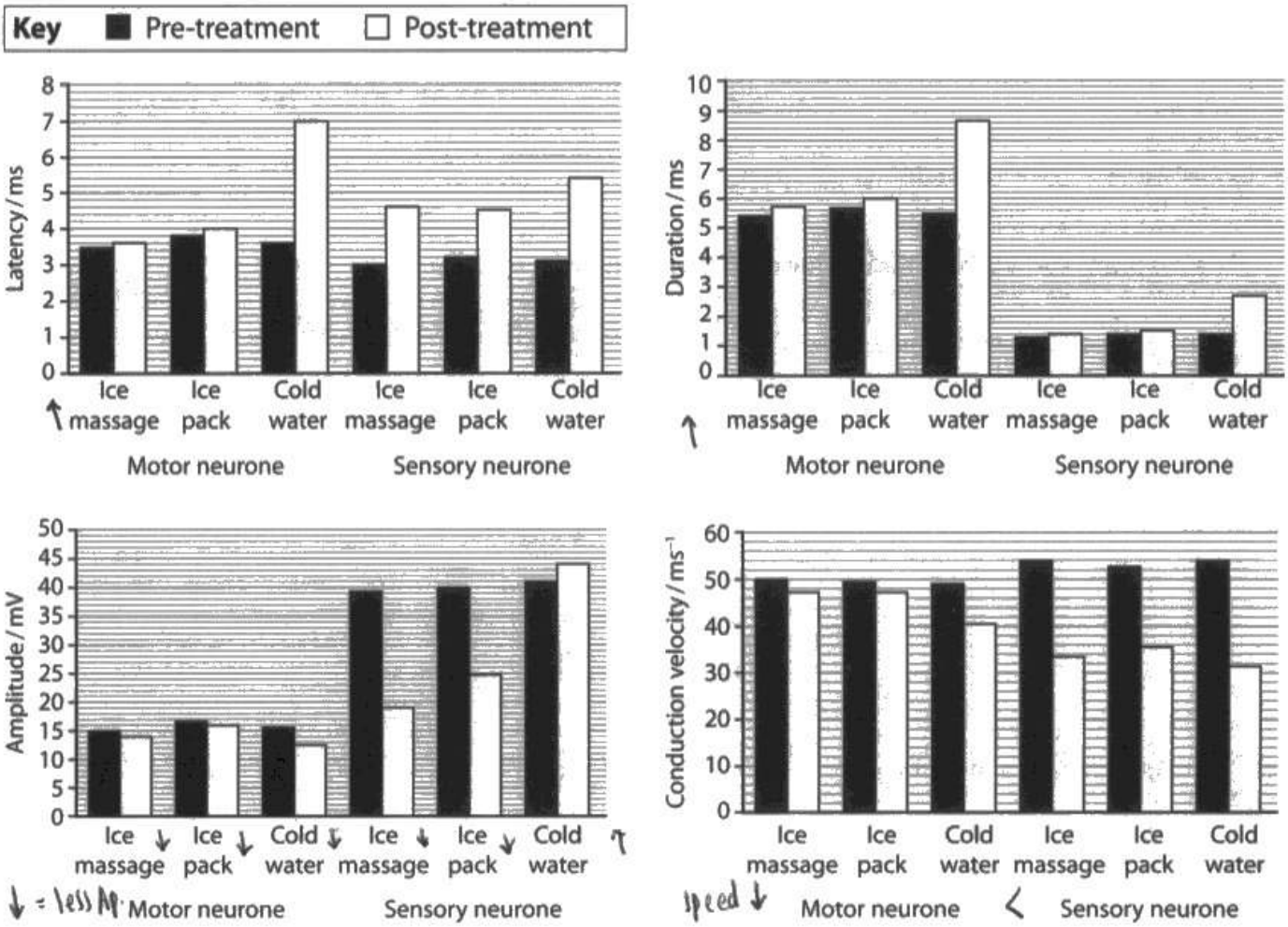
Question 7

The command word for the levels-based question was assess.

To answer the question candidates needed to make judgements on the information provided, demonstrate linkages to biological knowledge and reach conclusions.

Many candidates simply described the data from the graphs. The absence of linkage to their own biological knowledge and understanding limited this type of response to level 1. A number of candidates attempted to explain judgments made from the graph and these responses were generally considered to match level 2. Few candidates made a substantial conclusion, but those that did and had made a good attempt at explaining the results from the graphs were considered to match the requirement for level 3.

The effects of the different treatments on the CAP for motor and sensory neurones are shown in the graphs.



Assess the effect of different cold treatments on nerve conduction and the reduction of pain caused by muscle cramp.

Use all the information provided in the question as well as your own knowledge and understanding.

(9)

There are 3 different types of treatment, all involving cold or ice.
Ideally to stop or reduce pain caused by muscle cramps, the latency period, and the duration of the CAP should be increased and the amplitude and conduction velocity of the CAP should be reduced.
The latency period was increased post treatment for all 3 treatments and for both motor and sensory neurones, cold water had the highest increase in the latency period for both neurones which would be beneficial as it delays the time taken to feel pain

The duration was also increased by all 3 treatments post treatment and once again cold water had the highest increase for both motor and sensory neurones. Interestingly motor neurones had a larger duration when compared to sensory neurones, but this would be expected given the length of these neurones. An increase in duration would be beneficial as it delays pain.

The Amplitude for motor neurones post treatment was reduced for all 3 treatments with the most reduction coming from cold water, whereas post treatment the sensory neurones showed a drastic reduction with ice, noting approximatly half with ice massage compared to an increase in amplitude with cold water. The amplitude overall was higher for sensory neurones compared to motor neurones which would be expected as they would detect the pain from the sensor, reducing the amplitude would reduce the cap depol which would mean reduced pain.

for conduction velocity there was a reduction post treatment for all 3 treatments however sensory neurones showed the most reduction with ice massage whereas motor neurones showed the most reduction with cold water, reducing conduction velocity reduces the speed at which the CAP travels meaning the pain will be delayed.

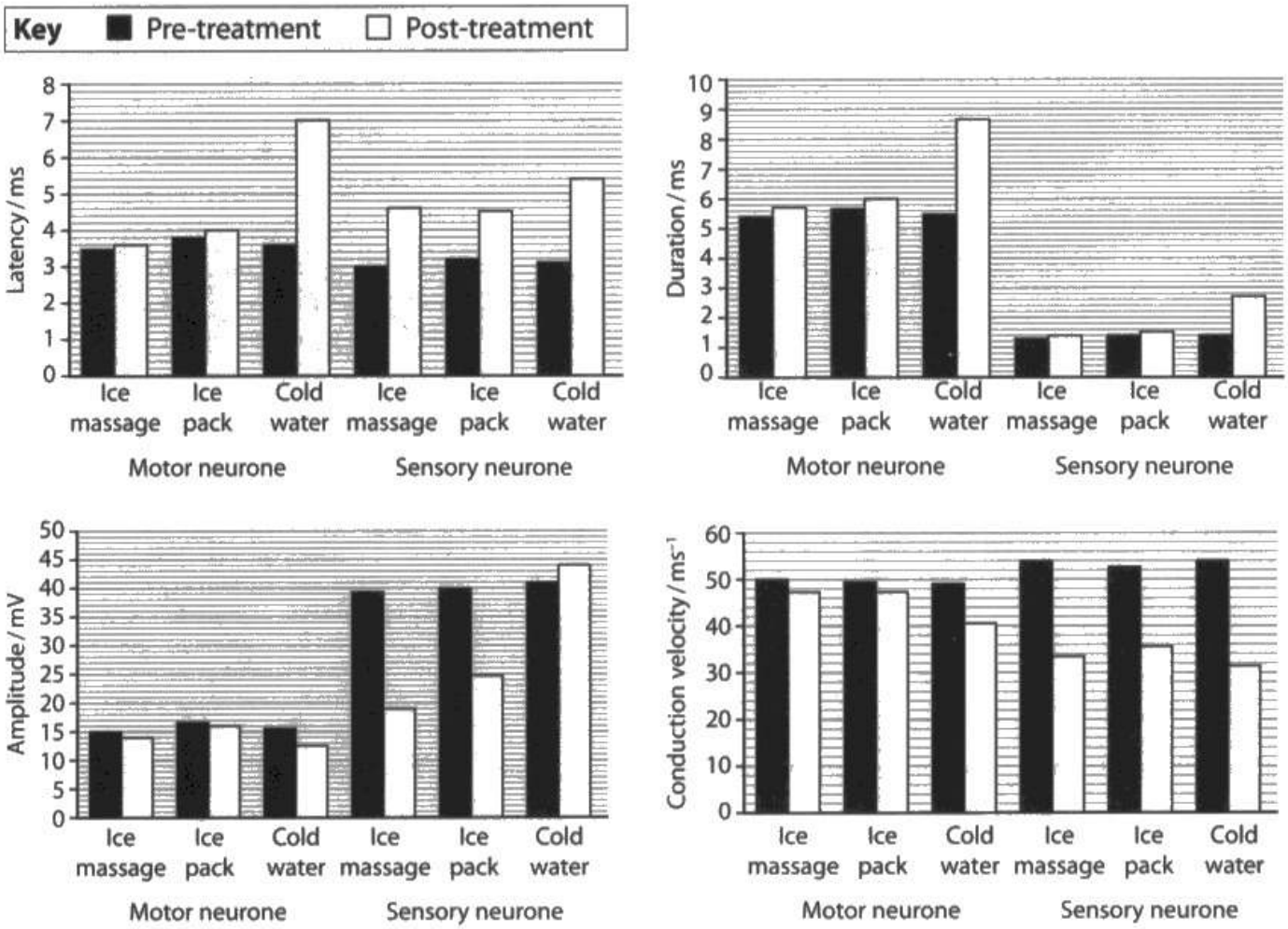
Overall it seems that cold and ice treatments can be used to delay and reduce different components of the CAP to delay or reduce pain caused from muscle cramps, although further rigorous investigations would be needed, it seems beneficial to use treatments combined, although cold water works well for motor neurones it can work poorly or exacerbate tinnings for sensory neurones, combining treatments may help overcome this, but it can be taken as a positive if pain can be reduced by muscle cramps using these methods.

(Total for Question 7 = 9 marks)

ResultsPlus
Examiner Comments

In this response the candidate has made judgments from all of the data provided. Throughout the response the candidate has made links from the data to their own biological knowledge and understanding. At the end of the response the candidate has produced a good summary conclusion. This response was considered a good level 3 response and was awarded nine marks.

The effects of the different treatments on the CAP for motor and sensory neurones are shown in the graphs.



Assess the effect of different cold treatments on nerve conduction and the reduction of pain caused by muscle cramp.

Use all the information provided in the question as well as your own knowledge and understanding.

(9)

The latency is higher post treatment than pre for both neurones. The amplitude is lower post treatment than pre treatment in both neurons except for sensory neurone in cold water where it is higher post treatment

The duration is higher post treatment than pretreatment for both neurones.
the conduction velocity is higher pre treatment in both neurones. This is because the synapse is opened so nerve impulses don't get to brain so it doesn't respond to the stimuli

ResultsPlus
Examiner Comments

In this response the candidate has attempted to make judgments from the data provided. Some judgments are correct, but others lack detail or are difficult to interpret. This was considered to be a level 1 response and was awarded 2 marks.

Question 8 (a)

Many candidates explained how differences in sequences could be used to determine how closely related the sloths were MP4. Some candidates linked this to the idea that amino acid sequence is determined by the DNA base sequence (MP2). Some then went on to explain that mutation accumulates over time resulting in altered amino acid sequences (MP3). Very few made any suggestion about why the eye lens protein was used (MP1).

8 The scientific article you have studied was adapted from the *New Scientist* and the *Brazilian Journal of Medical and Biological Research*.

Use the information from the scientific articles and your own knowledge to answer the following questions.

(a) Explain why analysis of the amino acid sequence of the eye lens proteins can be used to determine the phylogenetic relationship of different sloths (Box 1).

(3)

Mutations in DNA lead to a different sequence of amino acids being coded for in the proteins that make up an organism. The greater the number of different mutations observed between organisms ~~for~~ from different species, the longer ago they shared a common ancestor. The more recently they shared a common ancestor the more closely related they are and the more similarities there would be between amino acid sequences, and vice versa.

ResultsPlus
Examiner Comments

This response gained two marks for MP3 (first two lines) and MP4 (lines 3 to 9). Although the candidate implies the amino acid sequence is determined by the gene or DNA sequence they do not actually tell us that in the response, so MP2 could not be awarded.

Question 8 (b)

Candidates approached this question in three different ways.

Some candidates took the PCR – gel electrophoresis route. These candidates often gained all four available marks.

A number of candidates attempted the protein – DNA sequencing route. These candidates frequently failed to identify a gene or protein to sequence (MP1). Some of these candidates also simply described sequencing without telling us what was being sequenced (MP2).

A small number of candidates took a third approach and described using colour to identify the different phyla. Many of these candidates made statements such as 'the colour of the algae identify its phyla' (MP3) but told us little else.

(b) Describe how the algae living on the hair of sloths can be shown to belong to one of four phyla (Box 2).

(4)

The algae's DNA can be gathered and can be enhanced using PCR to produce more copies of the DNA. A florecent tag is added to the DNA and it the goes through gel electrophoresis. The bands produced will be compared to the bands produced by the 4 phyla. The phyla with the ~~most similarities to the~~ algae with largest number of bands at the same positions will be the phyla the algae belongs in. The bands can be viewed under UV light because of the florescent tag

ResultsPlus
Examiner Comments

This response was given four marks. The phrase 'the algae's DNA was gathered' was accepted for MP1 (line 1). The phrase 'using PCR to produce more copies' was accepted for MP2 (line 2 and 3). Use of electrophoresis to analyse the DNA bands was credited with MP4 (lines 4 to 6). MP5 was awarded for a description of how to allocate algae to a particular phylum (lines 7 to 10).

Question 8 (c)

Many candidates were able to describe how to use a spirometer trace to obtain the rate of oxygen consumption (MP3 and 4) and often also stated the need to use a carbon dioxide absorber (MP1). Some candidates also mentioned controlling the temperature (MP2). Few candidates appeared to have taken account of the units for metabolic activity used in the article 185 kJ/day/kg. As a result, these candidates did not suggest calculating a rate (part of MP4), using the mass of the sloth (MP5) or converting volume of oxygen used into a kJ value (MP6). Some candidates described experiments using a respirometer. Marking points 1, 2, 5 and 6 were still available to these candidates.

(c) Describe how a spirometer could be used to estimate the metabolic rate of a sloth (paragraph 5).

(4)

Allow sloth to breath in and out of spirometer from a mouthpiece. CO_2 exhaled are absorbed by soda lime. A spirometer trace is produced. Oxygen consumption can be ~~calculated~~ found by calculating difference in volume of O_2 between 2 peaks on the trace. Calculate rate oxygen consumption = $\frac{\text{oxygen consumption}}{\text{time taken}}$

Metabolic rate = oxygen consumption rate.

Breathing rate can be found by counting number of peaks in a given time.

Breathing rate = $\frac{\text{number of peaks (breaths)}}{\text{time taken}}$ Find tidal volume by subtracting ① volume of O_2 at ~~one~~ peak the adjacent peak. Minute ventilation = tidal volume x breathing rate

① volume of O_2 at one trough from

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Examiner Comments

This response gained three marks. MP1 (line 2), MP3 (line 2) and MP4 (equation in line 4).

Question 8 (d)

Many candidates appeared to understand the principle involved in using antibodies to identify different viruses. However, they often only gave half the story. Some were telling us that different viruses have unique antigens, and these are recognised by specific antibodies (MP1 and 2) and others telling us how to distinguish between specific and incidental viruses (MP3 and 4). A number of candidates confused specific and incidental in their answers.

(d) Explain how the presence of different antibodies can be used to show that some viruses are specific to sloths and some are incidental (Box 3).

(3)

antibodies are unique to the target antigens. therefore the prescence of different antibodies indicates ~~prescence of~~ immunity against a range of pathogens with varied antigens. Further, if an antibody is unique to the sloths it can be determined that the pathogen presenting the antigen is complementary to is specific to the sloths while antibodies found in other organisms indicate sytence of incidental viruses.

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In this response the idea that antibodies are specific was credited in line 1. The idea that if antibodies to viruses are only found in sloths then the virus is specific to sloths (MP3) was credited in lines 7 to 8. And the idea that if antibodies to a virus are found in other species, then the virus is incidental to sloths (MP4) was credited in lines 8 to 10.

Question 8 (e)

This question was accessible to many candidates, and they often suggested that plant material was difficult to breakdown MP1 and the slow digestive process ensured maximum absorption of nutrients (MP3). Many candidates did not include the idea of time for digestive enzymes to work (MP2) instead making statements such as 'allows longer to break down food' which were not considered sufficient for MP2. Many candidates provided answers in terms of conserving energy which did not gain any credit.

(e) Sloths have 'the longest digestive process on record for a plant-eating mammal' (paragraph 7).

Deduce the advantage to the sloth of a slow digestive process.

(2)

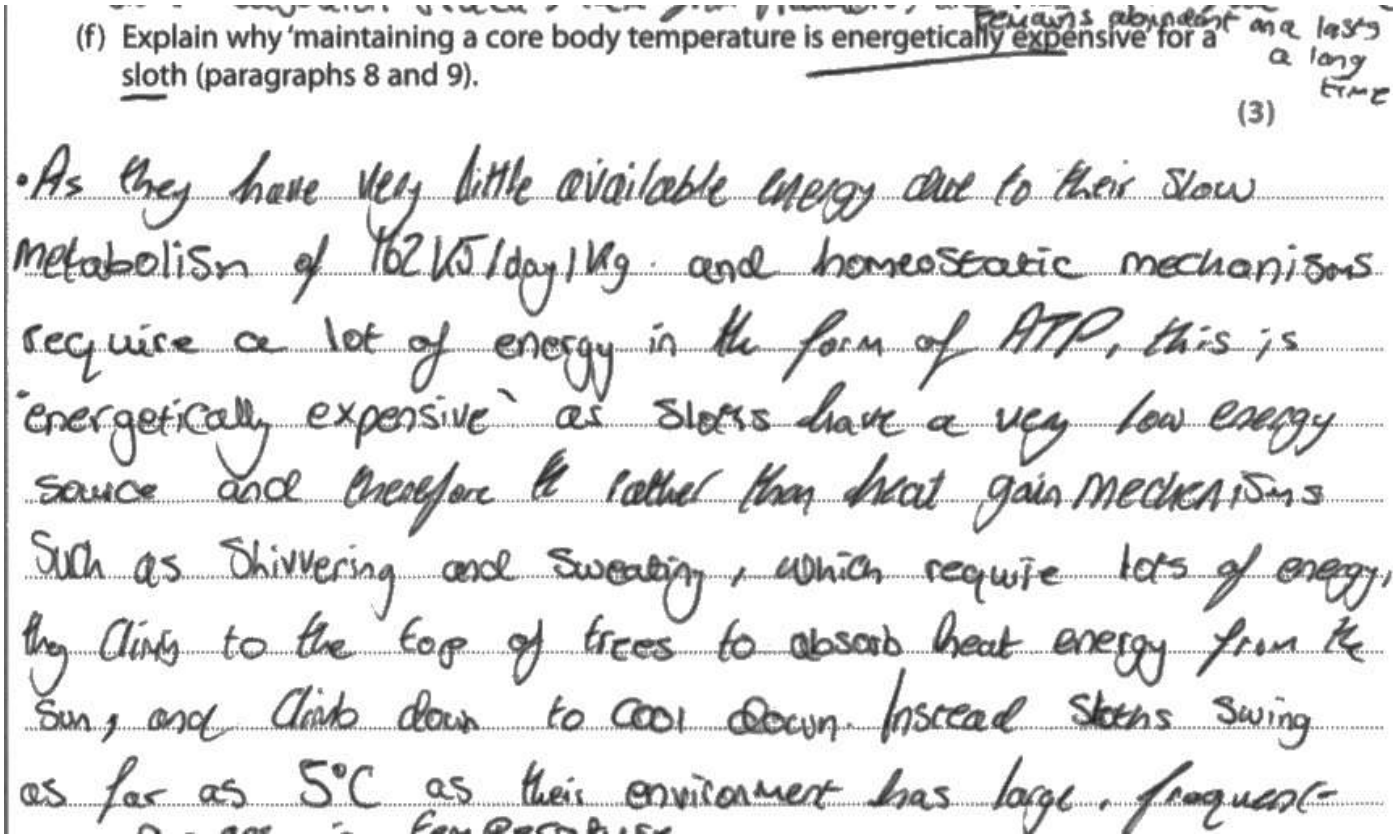
The slow digestive process allows enough time for the sloth's digestive system to break down all molecules like cellulose which are difficult to digest, which allows the sloth to extract all the nutrition and all the minerals from the food it has eaten instead of having to constantly move to find more food in abundance which expends energy.

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This response gained both available marks. MP1 (line 2) and MP3 (line 3).

Question 8 (f)

Many candidates produced answers that gained all three available marking points. Most frequently for marking points 2, 3 and 4.



(f) Explain why 'maintaining a core body temperature is energetically expensive for a sloth (paragraphs 8 and 9).

(3)

• As they have very little available energy due to their slow metabolism of 162 kJ/day/kg and homeostatic mechanisms require a lot of energy in the form of ATP, this is 'energetically expensive' as sloths have a very low energy source and therefore it rather than heat gain mechanisms such as shivvering and sweating, which require lots of energy, they climb to the top of trees to absorb heat energy from the sun, and climb down to cool down. Instead sloths swing as far as 5°C as their environment has large, frequent

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This is a fairly typical response that was awarded MP3 (line 2 and 3), MP4 (line 6) and MP2 (last 2 lines).

Question 8 (g)

The majority of candidates answered this question correctly.

Question 8 (h)

Candidates were able to provide complete answers that gained a maximum of three marks. All four marking points being frequently seen.

(h) Sloths spend a lot of time hanging upside down – 'constant grip is made possible by a lattice of tendons in the hands and feet that draw the digits closed' (paragraph 10).

Explain the advantage of using a lattice of tendons to draw the digits closed.

(3)

tendons are tensed at rest and have an ability to resist fatigue and many tendons ## together can muscle to have connections strong so that the sloths digits stay closed

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Examiner Comments

This response was given one mark for MP4.

(h) Sloths spend a lot of time hanging upside down – 'constant grip is made possible by a lattice of tendons in the hands and feet that draw the digits closed' (paragraph 10).

Explain the advantage of using a lattice of tendons to draw the digits closed.

(3)

tendons are non-elastic connective tissues that connect bones to muscles presence of lattice of tendons make it easier for bone to be pulled without lots of muscle contraction) minimising amount of ATP used for ~~contracting~~ Contracting muscles. and allowing energy saved. (tendon helps movement of muscles as it pulls the bone)

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Examiner Comments

This response gained all three available marks. MP1 was given in line 1, MP2 in lines 3 and 4 and MP3 in lines 5 and 6.

Question 8 (i)

Many candidates suggested that the enzymes are more resistant to low pH (MP3), and some suggested this was because the enzymes will have a different primary structure (MP1) or that they will have different bonding between R-groups (MP2).

(i) Sloth muscles 'contain a unique set of enzymes that confers tolerance to heavy accumulations of lactic acid' (paragraph 12).

Deduce how the enzymes in sloth muscles will differ from those in human muscles.

(2)

Enzymes will have a different sequence of ammino acids and a different tertiary structure and different R group bonding interactions so diffrent structure and function.

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Examiner Comments

Many students produced a response like this one. MP1 in line 1 and MP2 in line 2 to 3.

(i) Sloth muscles 'contain a unique set of enzymes that confers tolerance to heavy accumulations of lactic acid' (paragraph 12).

Deduce how the enzymes in sloth muscles will differ from those in human muscles.

(2)

Enzymes may contain different amino acid sequences and thus tertiary structure such as different bonding between R groups which allows it to be more stable when pH levels fall due to lactic acid increase, allowing the enzyme to function properly despite this.

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Examiner Comments

Learning how to use mark schemes to check answers to exam questions can help improve student perfomance.

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Examiner Tip

Sometimes there are more marking points than marks available. When accessing your learning compare your answer to the mark scheme rather than focus on the score you get for a question.

Question 8 (j)

Many candidates were able to explain the term community (MP1) with most of these also giving a reasonable explanation of the term commensal (MP2). Sometimes it was not clear the candidate was describing a community and not a population and MP1 could not be awarded. Some students confused commensalism with mutualism suggesting both the organisms living on the sloth and the sloth benefit from the relationship and MP2 could not be awarded.

(j) Sloths carry a 'community of commensal beetles, mites and moths'.

Explain what is meant by this phrase (Box 4).

(2)

Commensal is a type of symbiosis. Symbiosis is the biological relationship between organisms of different species, in this case ~~the it~~, between the sloth and the beetles, mites and moths. A commensal relationship means that one organism is helping the other organism without receiving anything in return - in this case, the beetles, mites and moths are receiving protection without benefit to the sloth. "Community" refers to ~~a~~ different populations of different species occupying the same area/habitat: the sloth's skin/fur.

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Examiner Comments

Commensal is not a specification term. However, it is in the pre-release article and therefore candidates might be expected to find out what the term means.

This candidate has provided a good answer explaining both the terms community and commensal.

Question 8 (k)

Candidates often produced answers that gained all three available marks. Some candidates simply described the process of evolution and did not address sympatric speciation.

(k) Describe how sympatric speciation could have occurred in the moths living on sloths (Box 4).

(3)

variation is naturally occuring within a population, caused by mutations etc.* One of these mutations will be considered an advantageous allele, allowing the moths to ~~repro~~ survive and breed. This passes the alleles on to the next generation and overtime, causes two populations to become genetically distinct that they are no-longer able to breed to produce fertile offspring

*& or selection pressures, such as the algae that there is available and the ability to digest it

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This response is the answer to how a selection pressure drives evolution. The candidate gained one mark, MP2 (lines 5 to 7).

(k) Describe how sympatric speciation could have occurred in the moths living on sloths (Box 4).

(3)

The moths of a cetain species may have had diffferent mating rituals, diffferent markings or diffferent breeding times due to random genetic mutations in the population. This would cause the two groups to become reproductively isolated, so there would be no exchange of alleles between the populations. Gene mutations would accumulate between two populations until they were genetically diffferent enough from each other that they could no longer reproduce to give fertile offspring, so are two diffferent species.

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This response provides a complete answer to the question. MP1 (first two lines), MP2 (line 3), MP3 (lines 4 and 5) and MP4 (last three lines).

Paper Summary

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

- make sure you understand the principles behind a core practical and be prepared to apply what you have learnt from core practicals to answer questions in the exam;
- read all the information provided – especially where practical procedures are being described in unfamiliar contexts;
- learn the command words and the types of answers expected;
- read the whole question, identify the command word and the context;
- set out calculations carefully – show each stage of your working, in case a mistake is made at the final step;
- attempt every question – time permitting, always at least make an educated guess and read the stem of the question carefully as there is often information in there that might help;
- add specific, precise details – do not expect the examiners to fill in the gaps for you!
- use bullet points if it helps you organise your answers to questions requiring longer responses – but make sure the statements contain details and are not too brief.

Grade boundaries

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