

Examiners' Report

June 2025

Int Advanced Level Biology WBI14 01

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Introduction

This paper generated a range of responses with some excellent ones from our more able candidates. There was only one levels-based question this series and it performed similarly to recent series' levels-based questions, with centres clearly schooling their candidates on how to approach this style of questions. The MCQs did not cause candidates any problems with the exception of 4(b)(ii) and 6(b)(i); ratios always cause problems for many candidates and 6(b)(i) needed the question to be read very carefully. There seemed to be very few blank responses.

Question 1(c)

Candidates coped well with this opening question, using the information in the photograph to give their reasons. A few went into far more detail than was necessary but we ignored this, picked out the relevant statements corresponding to the mark scheme and hoped that they would not have wasted too much time.

(c) Suggest how the rats and goats destroyed the wildlife.

Use the information in the photographs to support your answer.

(2)

Goats ate all the grass and small plants
~~reducing~~ reducing ~~its population~~ the plant population
rats ate the eggs of animals not allowing the
animals to reproduce ~~eggs~~



This is an example of a typical response where the candidate has used the information in the photograph to answer the question.

Question 1(d)

A range of responses were seen for this question. A common mistake was to state what information would be needed without actually telling us how it would be obtained, thus not really answering the question. The mark point that was seen least frequently was the last one, which is the one that completes the story of the question.

(d) Describe how to determine the biodiversity of Redonda to show the effectiveness of the conservation project.

(3)

Biodiversity index can be measured by counting the number of different species of both plants and animals found on the island and see how they change over time. The number of organisms in a species can also be counted and change can be observed. If conservation successful, both number of organisms and species should rise.

(Total for Question 1 = 7 marks)



This is an example of a very clear and concise response which makes it very clear that both the number of different species and how many of each species that there are would be needed to determine the biodiversity index.

Question 2(a)

We have asked for a definition of a pathogen in previous series. There were some very accurate definitions which we have listed before in previous mark schemes.

2 Treatment of patients with antibiotics can affect the composition of their gut flora.

(a) Gut flora are important as they help protect the body from pathogens.

State the meaning of the term **pathogen**.

(1)

Microorganisms, mostly bad bacteria or viruses that cause diseases, and harm the body



From this particular response, we could pick out one of the acceptable definitions: a microorganism that causes disease. The reference to 'bad bacteria' is not wrong but too colloquial to be accepted at A level and 'harm' is too vague.



We can ask for definitions of any of the terms used in the specification. It is a good idea to produce a glossary of these terms, using past paper mark schemes where possible.

Question 2(b)

Asking a candidate to give a definition of an antibiotic is a question that has appeared many times and it was clear that some candidates had learnt textbook definitions verbatim.

We did still see some of the common errors that we have seen in the past such as confusion between antibiotics and antibodies, the idea that antibiotics can kill viruses and omitting to tell us that they are some sort of chemical.

(b) State the meaning of the term **antibiotic**.

(1)

it is a chemical that destroys or inhibits the growth of bacteria



This is an example of an acceptable definition.



Make sure that you are clear about the differences between an antibiotic and an antibody and check both the question and your answer to make sure you are writing about the correct one.

Question 2(c)i

Although we put the word 'variety' into bold, some candidates either missed this or else did not appreciate its significance and only focussed on one or two of the types of bacteria shown.

- (i) State **one** conclusion about the effect of the control on the **variety** of bacteria in the gut flora.

(1)

the variety of bacteria have not changed, the same 3 types of bacteria remained (C, E, A), however the proportion of bacteria A increase, bacteria C decrease, E remained the same



This response illustrates both our possible acceptable answers.



Read the question carefully, looking out for a word or words that we have put into bold as these will be directing you to a specific requirement of the question and therefore in the answer.

Question 2(c)ii

This question saw a large range of responses many of which were unfortunately incorrect or not appropriate. We did allow quite a generous range of values in our mark scheme as it was designed to be an estimate made without the use of an angle measuring tool. We did feel that an estimate given as a percentage could not be to anything other than a whole number.

- (ii) Estimate the decrease in the proportion of bacteria type C in the group given the antibiotic.

(1)

Answer 83 %



This candidate selected to give their answer as a whole number which was appropriate in this scenario.



One of the maths skills is selecting the appropriate number of decimal places or significant figures that an answer should be expressed to. If we have not specified how many of either of these in the question, it is up to you to decide what is appropriate.

Question 2(c)iii

Candidates clearly know that antibiotics do not discriminate between different types of bacteria. Many can explain why but did not apply this to the context of the question: the gut bacteria.

(iii) Explain how treatment with antibiotics can affect the gut flora.

(2)

- * As the antibiotic is a chemical that kills or inhibits growth of ^{any} Bacteria and doesn't differentiate between gut flora bacteria or pathogenic bacteria
- * Antibiotic may bind to the cell wall (peptidoglycan) and cause lysis of Bacteria and gut flora has the same peptidoglycan cell wall

(Total for Question 2 = 6 marks)



Like the candidate who wrote this response, most candidates picked up the first mark point but they did not use the information in the diagram to help them to extend their answers.

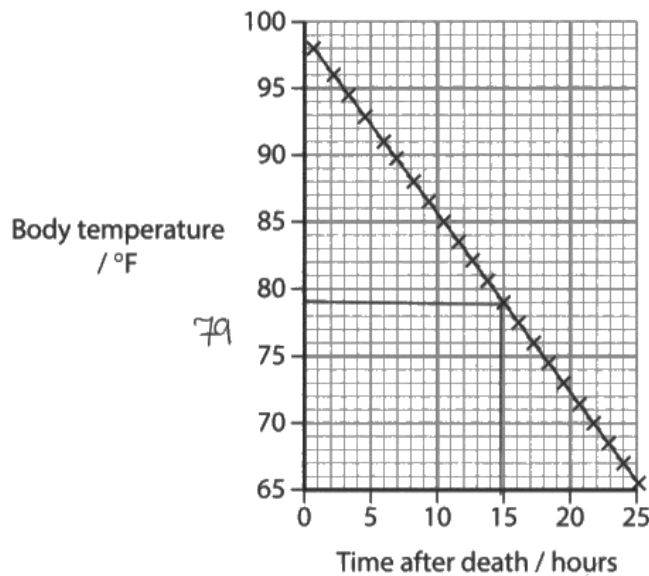


If a question is asked in the context of some data and is asking you to explain something, then you need to explain that data in your response.

Question 3(b)i

This was a straightforward calculation which scored highly except by the candidates who had not appreciated that their answer had to be given to one decimal place. Very few candidates expressed their answer as a recurring value which was encouraging to see, as this is something that we have commented on in previous series' reports.

- (b) The graph shows a cooling curve that can be used to determine the time of death of a mammal.



- (i) A mammal had been dead for 15 hours.

Calculate the body temperature of this mammal in °C.

Use the formula:

$$\text{Temperature in } ^\circ\text{C} = \frac{5 \times (\text{temperature in } ^\circ\text{F} - 32)}{9}$$

Give your answer to **one** decimal place.

(2)

$$\frac{5 \times (79 - 32)}{9} = 26.111 \quad \text{Answer } \underline{26.1} \text{ } ^\circ\text{C}$$



This is a clearly laid out calculation which gives the correct answer.



Do not express your answer as a recurring value; always round the value up or down as appropriate.

Question 3(b)ii

The majority of candidates scored highly on this question; there is a good understanding of the effect of body fat on body cooling.

- (ii) Explain how this cooling curve would change if the mammal had more body fat.

(3)

will be less steep because fats act as heat insulator so less heat radiates out of body so less cooling rate



This response is particularly succinct

Question 3(b)iii

As with many calculations where values must be read from a graph and used, there was quite a degree of flexibility on the values allowed, provided they were expressed to an acceptable number of decimal places. We also had to allow for the different methods candidates could use to calculate or read off their intercepts and gradients.

- (iii) The equation for the cooling curve shown in the graph can be used to determine the time of death.

Write the equation for this cooling curve, using the format:

$$\frac{65.5 - 98}{25 - 0.5} = -1.32 \quad y = mx + c \quad (3)$$
$$C = 99$$
$$y = -1.32x + 99$$

Answer $y = -1.32x + 99$

(Total for Question 3 = 9 marks)

$$\frac{67 - 96}{24 - 2}$$

$$\frac{-1.31818}{65.5 - 98} \quad 25 - 0.5$$



This response has been laid out carefully and the candidate has expressed their equation appropriately, using probably the most frequently used values.



It always pays to show your working, especially in calculations worth more than 1 mark.

- (iii) The equation for the cooling curve shown in the graph can be used to determine the time of death.

Write the equation for this cooling curve, using the format:

$y = mx + c$

$m = \frac{79 - 67}{15 - 24} = -\frac{4}{3}$

$79 = -\frac{4}{3}(15) + c$ $c = 79 + 20 = 99$

Answer $y = -\frac{4}{3}x + 99$

(3)

(Total for Question 3 = 9 marks)



As a rule of thumb, we expect candidates to evaluate their answers and not leave them as a fraction. However, we felt that this was an exception to the rule and that a value of $-4/3$ for the gradient was appropriate.



Calculations should rarely be left as a fraction; the actual answer should be worked out and

expressed to a certain number of decimal places or significant figures.

Question 4(a)i

Percentage calculations seem to score better now than they used to do. Presumably centres and candidates are more prepared for the 10% of marks that we must assign to maths skills and know that this frequently includes a percentage calculation.

Generally, we feel that a percentage should be expressed to a maximum of two decimal places unless we have instructed otherwise.

4 Tigers are on the verge of extinction, despite a recent increase in numbers.

In 2010 there were 3 200 tigers and in 2023 there were an estimated 5 574 tigers in the world.

The Bengal tiger is the most abundant with approximately 3 100 animals in India and its neighbouring countries in 2023.

The photograph shows a Bengal tiger.



(Source: © Zoonar GmbH / Alamy Stock Photo)

- (a) (i) Calculate the percentage increase in the total number of tigers in the world from 2010 to 2023.

(1)

$$\begin{aligned} \uparrow \% &= \frac{5574 - 3200}{3200} \times 100 \\ &= 74.1875 \\ &\approx 74.2\% \end{aligned}$$

Answer 74.2 %



This candidate selected to express their answer to one decimal place which was appropriate.



When preparing for exams, ensure that you know how to carry out the maths skills listed in the appendix of the specification.

Question 4(b)i

Very few blank responses were seen for this question but responses by the less-able candidates tended to repeat the question without giving reasons for the importance of looking for tigers in the mountains.

- (i) Before the Tiger Action Plan was started, conservation groups had to prove that tigers were present in Bhutan, especially in the mountain regions shown in the second map.

Give **two** reasons why this was important.

(2)

So that no money is wasted on the Action plan.
~~To show that the mountain~~ If tigers are present in mountain regions; this indicates that tigers use the ~~mountain~~ mountains as a habitat for food, shelter & reproduction. So that it is suitable for living and to reproduce to increase population.



This candidate has started their response like many others did, writing about the waste of money if no tigers were in the mountains. The weaker candidates tended to go no further than that. However, this candidate has extended their response by explaining that the presence of tigers would indicate that the habitat in the mountains was suitable for tigers to survive.



If a question asks for 'two reasons' then two different reasons need to be given. Try and write two reasons which are clearly different in case you have really only put forward one idea.

Question 4(b)ii

We saw some excellent responses to this question with many candidates referring to the map as instructed.

Q17 Deduce the importance of establishing a tiger corridor in Bhutan for a greater increase in the number and diversity of tigers.

Use the information in the first map to support your answer.

(4)

AS there is a geographical barrier so, more inbreeding
so, less genetic diversity or reproduction isolation so,
less biodiversity so, linking the number and diversity of tigers would
increase the gene flow and more chance of favourable allele and more
allele to be found and reproduce offspring having that characteristics
so, higher genetic diversity so, more biodiversity of tigers
but due to long reproduction isolation they may have change
in behaviour so, less chance of fertilization or anatomical
adaptation are different. AS india tiger population are
spread over india and small area in Nepal, shreds of area
are not connected together. and establishing tiger corridor
in Bhutan would prevent tigers going extinct and Bhutan have large
area where tigers can found and so inbreeding or less genetic diversity or reproduction isolation
and can reproduce giving unfertile offspring (Total for Question 4 = 8 marks)



This is one example of a high-scoring response.

- (ii) Deduce the importance of establishing a tiger corridor in Bhutan for a greater increase in the number and diversity of tigers.

Use the information in the first map to support your answer.

(4)

- Prevent inbreeding, increasing genetic diversity, so higher Biodiversity of Tigers reducing risk of extinction.
- To prevent reduction in gene-flow and to increase the gene pool, forming new allele combinations.
- Prevents occurrence of Allopatric speciation, due to a selection pressure, reducing risk of reproductive isolation or reproductive isolation only occurs during Speciation when they can no longer produce fertile offspring
- Prevents species becoming endemics, reducing risk of Extinction
- Reduced risk of the tiger species ^{being} taken out easily ~~example~~, by a disease

(Total for Question 4 = 8 marks)



This is another example of a high-scoring response, but this one is slightly more succinct.

Question 5(b)i

Candidates seemed to struggle a bit more with this question, even though it was essentially testing them on antibody-antigen specificity; a topic we have tested many times in the past.

A common error was to state that a new antibody was needed to bind to both the cancer cell and the T killer cell. This has already been stated in the stem of the question.

Another error was to not use the appropriate terminology; a number of responses did not mention antigens.

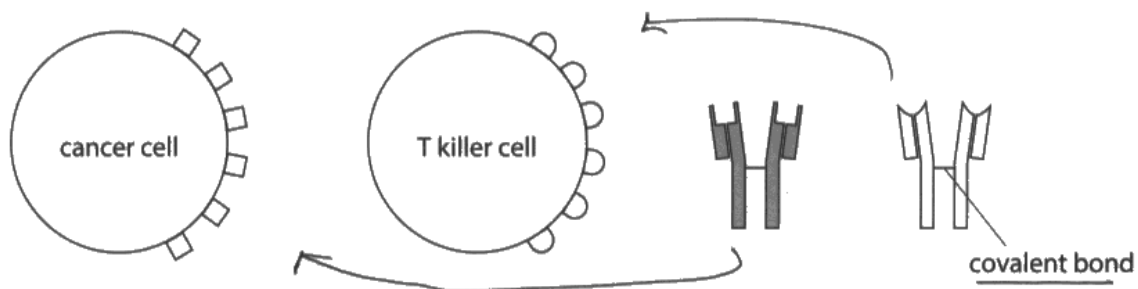
There was the expected confusion between antibodies and antibiotics, and antibodies being needed to kill both cells.

(b) Cells called T killer cells are involved in destroying cells infected with viruses.

These cells can also destroy cancer cells in a similar way.

Scientists have made a new single antibody that can bind to both cancer cells and T killer cells.

The diagrams show the antigens on a cancer cell, the antigens on a T killer cell and two different antibodies.



(i) Explain why a **single** antibody had to be made by the scientists.

Use the information in the diagrams to support your answer.

(2)

as antibodies are specific to one antigen as complementary to its antigen so can make antigen as it's have complementary binding site so can be attached to it as each cell have different shape of antigens as cancer cells have square antigens and T killer have circular antigens so each have different binding site



This response scores our first and our third mark point, both of which required a reference to 'antigen'.



Check that your answer does more than repeat the stem of the question - you will not be awarded marks for telling us exactly what we have told you. If you are writing about antibodies and what they bind to or what they are specific to, you must use the term 'antigen'.

Question 5(b)ii

Candidates who realised that they had to use the information in the diagram to guide their answer scored reasonably well. Several candidates tried to go down the production of monoclonal antibodies route, even though these are not actually on the specification, overlooking the fact that even antibodies produced by this method would still be specific to only one antigen.

(ii) Suggest how the scientists could make this single antibody.

Use the information in the diagram to support your answer.

(3)

By using enzymes to break the covalent bond between the two parts of the antibodies that are specific to cancer cells and antibodies specific to T Killer cells and use other enzymes to bind one part from each antibody together and form a new covalent bond so that the antibody is specific to T Killer cells and cancer cells.

x



This responses illustrates the first three of our mark points. The third mark point can be awarded as they have made it clear that the new antibody is made from one half of each of the original ones; marks could not be awarded to candidates who did not make this clear.

Question 5(b)iii

Candidates clearly know the role of T killer cells in destroying virus-infected cells and cancer cells. They also understand that antibodies play a role in phagocytosis.

(iii) Explain how this single antibody helps the body destroy cancer cells.

Extracted from
(2) body cells

The antibody ^{or attaches} binds to cancer cells' complementary antigens, causing opsonisation & aggregation of cancer cells for macrophages to engulf the cancer cells faster & destroy them. The T-Killer cells lyse the cancer cells by producing perforin.

(Total for Question 5 = 8 marks)



This response illustrates what we were looking for in mark points one and three; mark point two was barely seen. In mark point three we were specifically looking for the idea that phagocytosis would be enhanced, the reason being that phagocytosis occurs without antibodies opsonising the target cell.

Question 6(b)ii

We haven't asked this question before and were pleased with the attempts made by the majority of candidates, drawing on their knowledge of units 1, 2 and 4.

(ii) Suggest **two** reasons why this DNA contains more than 150 000 base pairs.

(2)

~~There~~ • The DNA includes non-coding regions, such as introns and regulatory sequences, which do not code for proteins.
• Some genes may be duplicated or present in multiple copies, increasing the total number of base pairs.



The most common two reasons given were non-coding regions and stop codons, which is what we expected. This particular candidate thought about the regulatory regions and the non-coding regions. A common error was to muddle up exons and introns.

Question 6(b)iii

Good responses were seen with many candidates working their way down the list of proteins, giving an answer for each one in turn.

(iii) Describe the roles of the proteins:

- RNA polymerase
- ribosomal protein
- RUBISCO
- ATP synthetase.

(4)

- RNA polymerase performs transcription of DNA sequence coding for proteins. RNA polymerase produces mRNA which could be translated to produce a polypeptide. So it is involved in protein synthesis (of DNA polymerase, eg)
- Ribosomal protein contributes to, supports the shape of the ribosomes (eg the attachment site of mRNA to hold it in place) which is necessary for a successful translation and polypeptide synthesis.
- RUBISCO is involved in the Calvin cycle.* It captures carbon dioxide and combines it with RUBP to produce GP, which is then to be converted to GALP, then glucose.
*in light-independent reactions of photosynthesis
- ATP synthetase performs phosphorylation of ADP, producing ATP (energy for, for example, protein synthesis)

(Total for Question 6 = 9 marks)



There were some very good answers from a large proportion of candidates, one of which is illustrated here. The function of ribosomal protein was probably the least known. Marks were lost by candidates who did not give enough specific A level detail eg RUBISCO - used in photosynthesis, ATP synthetase - make ATP.



When answering a question, consider if you have given enough specific A level detail.

(iii) Describe the roles of the proteins:

- RNA polymerase
- ribosomal protein
- RUBISCO
- ATP synthetase.

(4)

RNA polymerase ~~makes~~ forms phosphodiester bonds between the nucleotides of the mRNA during transcription. The ribosomal protein holds the mRNA to read it and holds the amino acids in place for peptide bonds to form ^{during translation.} RUBISCO enzyme catalyses carbon fixation in the calvin cycle by combining RuBP with carbon dioxide. ATP synthetase catalyses the phosphorylation of ADP to form ATP.

(Total for Question 6 = 9 marks)



This is another very good response, which reads as though the candidate wrote the mark scheme!

Question 7(a)i

A range of responses were seen to this question which depended on the candidate reading the question properly and whether or not they had revised the specification points covering practical work.

Although the core practicals are not tested on units 1, 2, 4 and 5, specification points 6.1 and 6.2 by their nature cover practical techniques and can therefore be tested on the two A2 theory papers, as well as paper 6.

7 Beta-carotene is a pigment produced by plants.

It can be harvested from plants and used as an antibacterial agent, as an antioxidant and as an ingredient in foods.

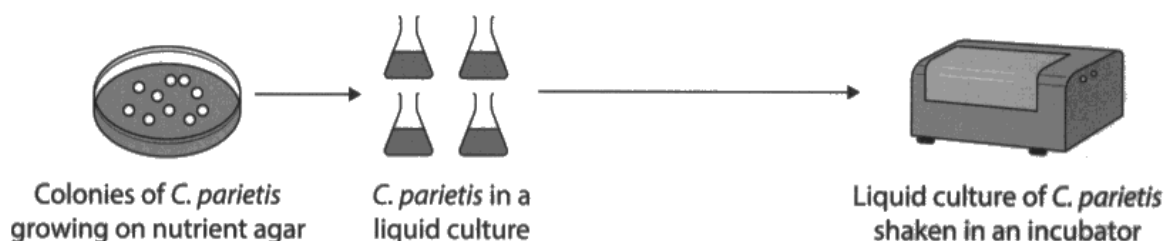
Bacteria called *C. parietis* produce beta-carotene.

Scientists experimented to find the culture conditions required for *C. parietis* to produce the maximum yield of beta-carotene.

(a) *C. parietis* growing on nutrient agar were used to inoculate a liquid broth.

The liquid cultures were then shaken in an incubator.

The diagram shows this procedure.



(i) Describe how to inoculate the liquid broth using the colonies growing on nutrient agar.

(3)

Aseptic conditions should be used where bunsen flame creates heat to destroy bacteria in the air. A liquid culture of nutrients of measured volume ^{and time} should be placed in flask and a sterilised inoculating loop should be swabbed on the colonies plate on nutrient agar and then it should be stirred into the flask ~~with~~ to transfer bacteria into it.



This is an example of one of the many good responses that we saw, although it would have been clearer if the candidate had stated that the bunsen burner was beside the work being carried out.

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(3)

o Start by making sure all windows are closed to decrease the chances of airborne bacteria entering the broth. Maintaining sterility conditions, you want to turn on a bunsen burner and have it nearby when opening the petri dish containing the bacteria. This is also to reduce the chances of airborne bacteria being added and waste them off. Using a clean, sterilized inoculation loop, with clean hands, you open the agar, swipe some on the loop and place it in the liquid culture. Seal the liquid culture, allowing for holes to prevent anaerobic conditions.



This is another example of a very good response.

Question 7(a)ii

A range of responses were seen, the ones scoring the highest were those where the candidate recognised that they had to write about the shaking and the incubator.

(ii) Suggest why these liquid cultures were shaken in an incubator.

(2)

The culture were shaken to increase oxygen availability for aerobic respiration and to keep the bacterial cells evenly distributed in the broth.



The most frequently seen mark point was our first one. Those who did give us two reasons tended to go for the third point, unlike the candidate who wrote this particular response. Some of the candidates who did attempt to give us the third point were not awarded the mark as they were not specific enough, stating that the cultures were put in an incubator at an appropriate temperature; we really thought at this level a candidate should tell us that the incubator was to maintain the temperature.



In a question like this, use the components of the question and the mark allocation to help work out how much to write. The question asks about shaking and an incubator. As there are two marks, one is probably allocated to the shaking and the other to the incubator. Any other mark points are a bonus.

Question 7(b)ii

Questions on chromatography have been asked before, but this one was coming from a slightly different angle as we wanted to know why chromatography would work to identify beta carotene.

(ii) Explain why chromatography can be used to identify beta-carotene.

(2)

β -carotene has a unique solubility in the ~~solvent~~ solvent, so it will have a unique R_f value which can be referenced and deduced from a data bank.



This response illustrates all three of our mark points. A fairly common error caused mark point 3 not to be awarded. Some candidates wrote that the Rf value could be used without describing how or that it could be compared without stating to what it should be compared.



Even if you think you know the answer to a question, always read through your answer and make sure you have written sufficient A level detail and that you have been specific enough. Don't rush over a response just because you feel confident with your answer.

Question 7(c)

A range of responses were seen to this question with most candidates appreciating that both graphs needed to be used in their response. Candidates are clearly being taught that overall statements are needed when describing conclusions.

Describe **three** conclusions that can be made from the data shown in these graphs.

(3)

As numbers of bacteria increase and decrease so does
numbers of pigments. pH of 8 is optimum for maximum
numbers of bacteria and concentration of pigment is at pH 8.
(pH 8 is optimum) Numbers of bacteria and concentration of
pigment keep increasing as temperature increases.



This is an excellent response that covers every aspect of our mark scheme very succinctly. The first mark point was the least frequently awarded. Those who attempted to, pointed out that they both increase together but omitted that they both decrease together as well.



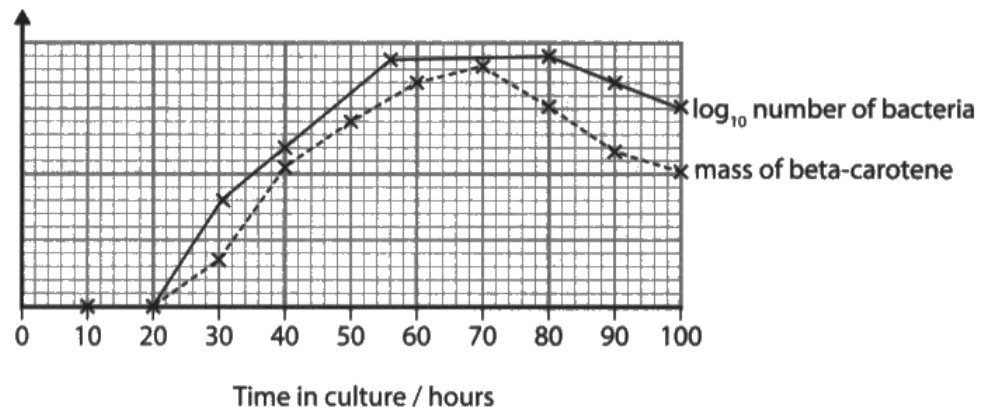
With three marks allocated to this question, three conclusions are very likely needed. The first two conclusions are obvious as we have given you two graphs with two different independent variables. As each graph contains two dependent variables, the third conclusion must therefore be for a pattern shared by these in both graphs.

Question 7(d)

A wide range of responses were seen for this question, with many candidates finding plenty to write about. Mark points 1, 3, 4 and 5 were frequently seen but rarely together so very few candidates scored the full 4 marks. Even a score of three was seen less frequently than expected.

The very weak candidates only described the changes in numbers of bacteria and only the more able thought about why the mass of beta-carotene should decrease.

- (d) The graph shows the mass of beta-carotene produced and the number of bacteria in the culture as determined by dilution plating.



Explain the changes in the mass of beta-carotene produced by this culture of bacteria.

Use the information in the graph to support your answer.

(4)

At 0-20 hours the number of bacteria is in its lag phase as it acclimatises to ^{liquid} sample culture so is not producing β carotene. At 20-56 hours is the log phase, as there is abundant nutrients (glucose) and space. bacteria is rapidly reproducing, those being born > those dying. At 56-80 hours we have the stationary phase where bacteria born = bacteria dying. β carotene mass starts to decrease at 70 hours as bacteria start to run out of nutrients to actually synthesise β carotene. Then 80 hours onwards is the death phase. bacteria born < dead bacteria mass keeps decreasing.

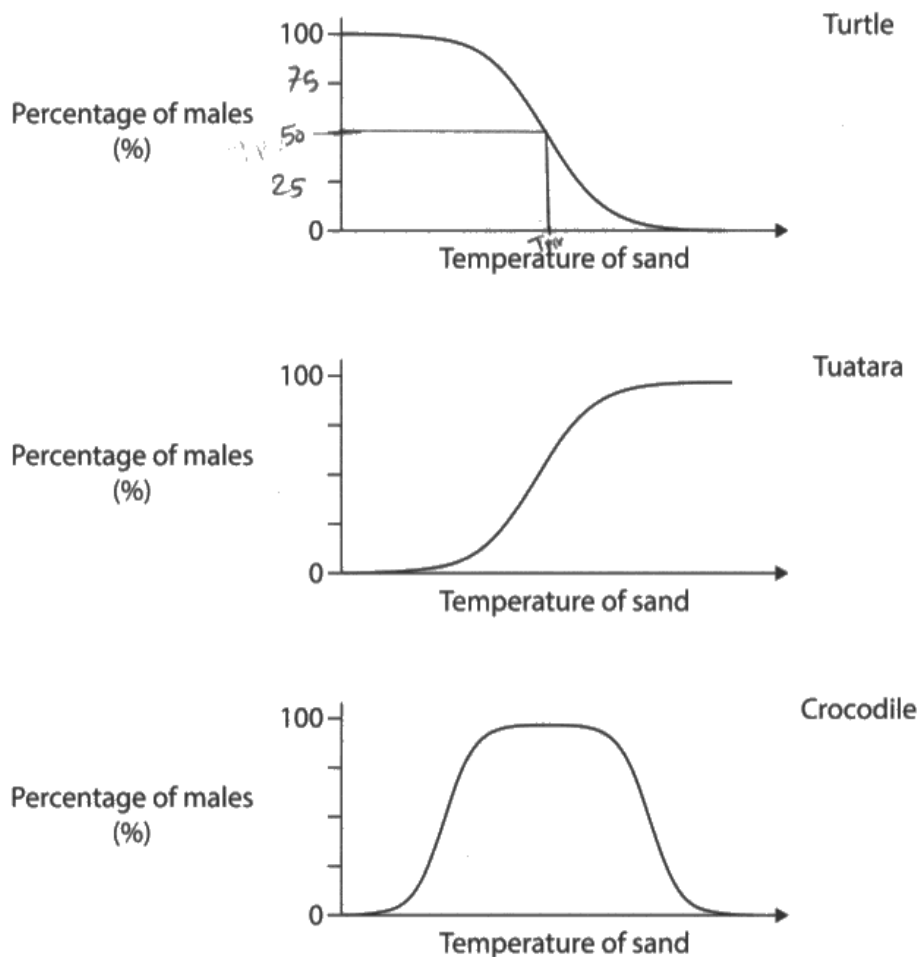
(Total for Question 7 = 15 marks)

This particular response did score three marks: mark points 1, 3 and 4.

Question 8(a)i

A T_{piv} is a new idea to many candidates but there were very few who did not attempt this question.

- (a) The graphs show the effect of temperature of the sand on the percentage of males that hatch, in three types of reptiles.



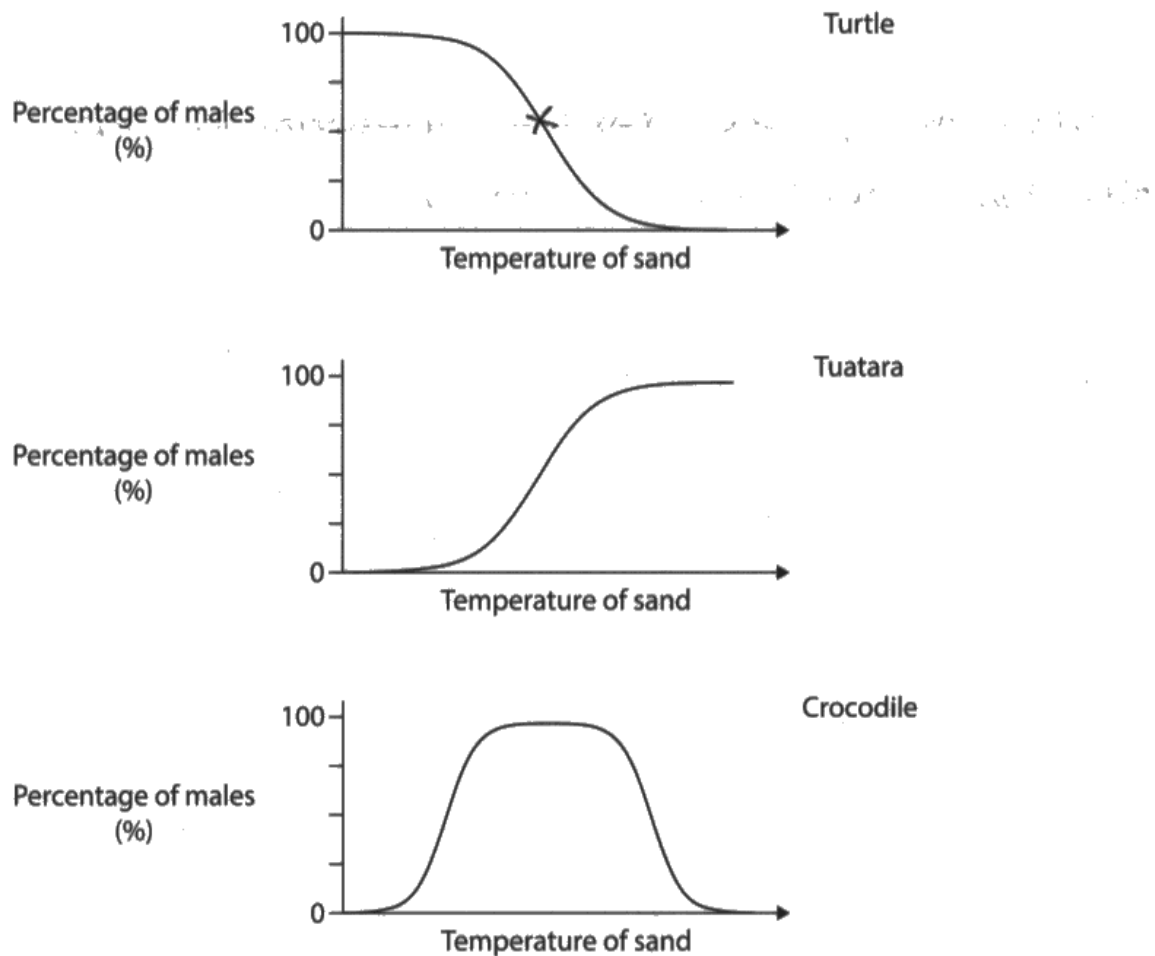
- (i) The pivotal temperature (T_{piv}) is the temperature at which equal numbers of males and females are produced.

Label the T_{piv} for turtles on the graph.

(1)

Strictly speaking, candidates should have labelled the x axis to point out the T_{piv} , which is what this candidate has done.

- (a) The graphs show the effect of temperature of the sand on the percentage of males that hatch, in three types of reptiles.



- (i) The pivotal temperature (T_{piv}) is the temperature at which equal numbers of males and females are produced.

Label the T_{piv} for turtles on the graph.

(1)



We did allow them to indicate the point on the graph corresponding to the 50% males and the T_{piv}.

Question 8(a)ii

We were a little surprised at how few candidates actually referred to the shape of the curve being S shaped for the turtles and the tuatara. We had hoped that they would use their knowledge of the oxyhaemoglobin dissociation curve to describe these curves.

- (ii) Describe the effect of the temperature of the sand on the percentage of males produced in these three reptiles.

(3)

For turtle, the percentage of males produced will reduce in a S shape when temperature is raising.

For ~~sand~~ Tuatara, the percentage of male produced will increase in a S shape when temperature is rising, it will ~~no in~~ percentage will raise slowly then become faster in a critical point.

For ~~Crotodile~~ crocodile, the percentage of male produced will increase, then stay unchanged and reduce when temperature is rising.



This is a clear response illustrating all our mark points.



A question like this initially appears very straightforward. Three graphs, three descriptions. However, the graphs are all different shapes, so the shape of each needs commenting on in the descriptions as well.

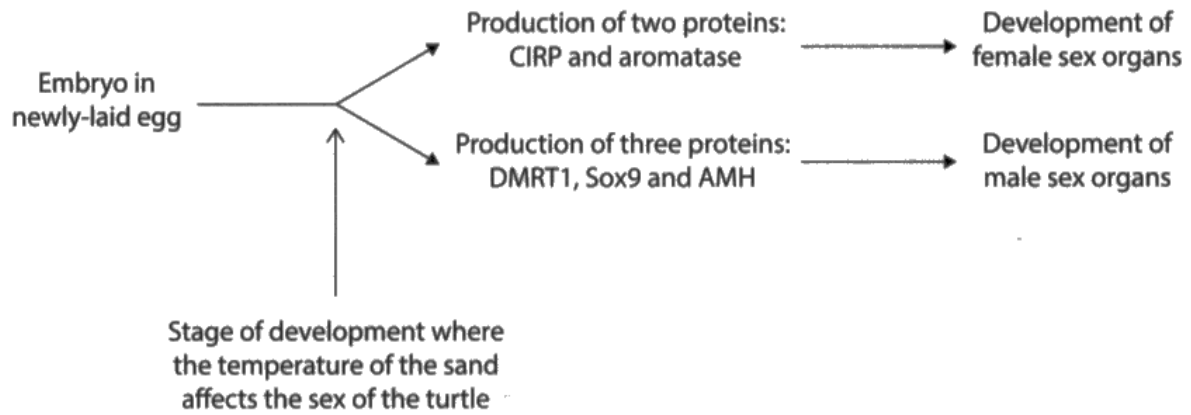
Question 8(b)

Candidates generally picked up mark points two and three or else four and five, rarely all four. The reference to the specification point, mark point one was rarely seen.

- (b) The embryos in newly-laid eggs have immature reproductive organs that can develop into either male reproductive organs or female reproductive organs.

In turtles, sex is determined by differential gene expression.

The diagram shows how the sex of a turtle is determined.



Explain how temperature determines the sex of turtles.

Use the information in the graph in part (a) and the diagram to support your answer.

(4)

Production of proteins require enzymes. When temperature is too high, enzyme that catalyzes for the formation of DMRT1, Sox9 and AMH denature so the development of the male sex organs cannot take place. ~~Temperature may act as a selection pressure and causing some genes to turn on or off.~~ The gene coding for the proteins needed for development of male sex organs may have been switched off. ~~Temperature change may cause epigenetic modification.~~ Enzymes have different optimum temperatures and enzyme for male sex organs may work ^{better} at lower temperature than that of female sex organs. The coding of sex of turtles is polygenic. Temperature change may cause epigenetic modification or DNA methylation causing some genes to not be able to be coded.

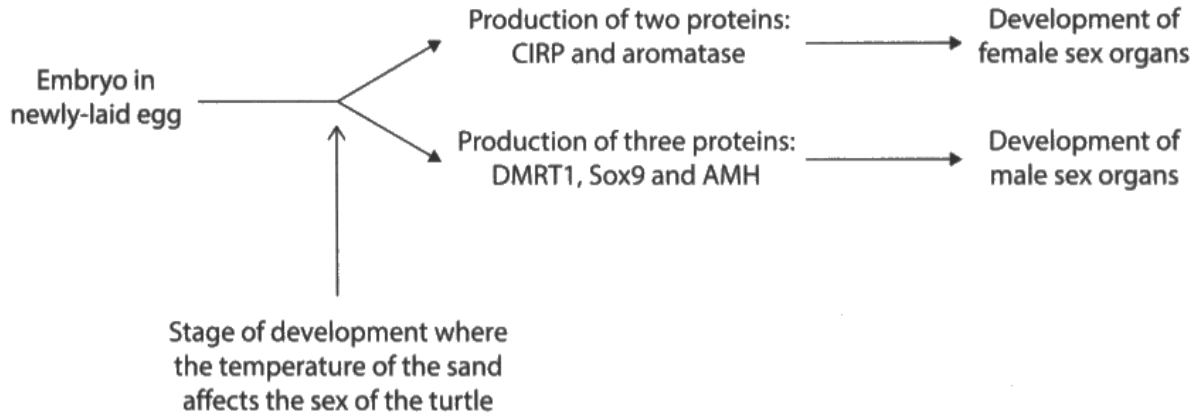


This response illustrates a common error made by a number of candidates: they linked the temperature in with whether or not the enzymes involved in the production of the proteins would become denatured or not. At the very end of this response the candidate has referenced our second and third mark points.

- (b) The embryos in newly-laid eggs have immature reproductive organs that can develop into either male reproductive organs or female reproductive organs.

In turtles, sex is determined by differential gene expression.

The diagram shows how the sex of a turtle is determined.



Explain how temperature determines the sex of turtles.

Use the information in the graph in part (a) and the diagram to support your answer.

(4)

When the temperature of sand is lower it cools the egg which leads to production of DMRT1, Sox9 and AMH, if the sand temperature increases these proteins will ~~denature~~ denature and will stop producing instead the other two proteins CIRP and Aromatase will be produced leading to the ~~development~~ development of female sex organs.



Ignoring the reference to proteins denaturing, which does not contradict anything creditworthy, we can award mark points four and five for this response. Many candidates who identified that this question was about epigenetics, demonstrated some very good knowledge and understanding about this part of the specification.

Question 8(c)i

By far the most common example of an anthropogenic activity given by candidates is shown by this candidate, the burning of fossil fuels.

However, a common error was to state 'using fossil fuels' which we felt lacked specificity at this level.

- (c) Anthropogenic activities such as the use of microplastic can affect the temperature of the sand.

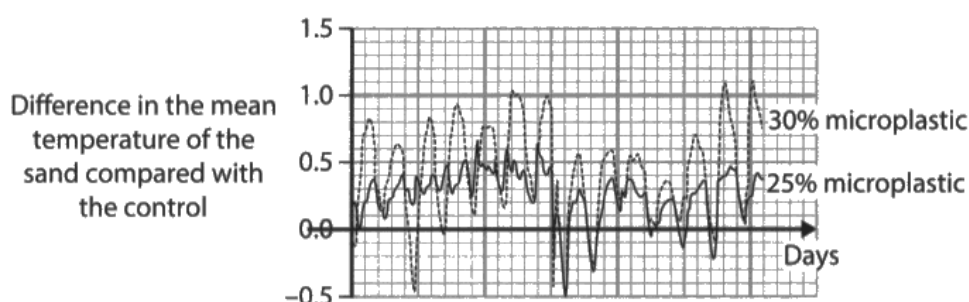
The effect of microplastic on the temperature of the sand was investigated during the breeding time of the turtles.

Several tubs were filled with sand containing two different percentages of microplastic.

Tubs containing sand only were used as controls.

The graph shows the differences in the mean temperatures of the sand containing 25% and 30% microplastic compared with the control.

The table shows the mean temperature of the sand during this investigation.



Content of tubs	Mean temperature / °C	Standard deviation / °C
Control	30.047 ✓	3.088 ✓
25% microplastic	30.294 ✓	3.095 ✓
30% microplastic	30.473 ✓	3.017 ✓

- (i) Name **one other** anthropogenic activity that could affect the temperature of the sand.

The burning of fossil fuels ^{from humans} resulting ~~at~~ in the release of CO₂ contributing to the greenhouse effect to warm up the planet (1)



This candidate gave us slightly more detail than was expected from the question but this did not count against them.

Question 8(c)ii

This was our only levels-based question on this paper. A wide range of responses were seen with very few responses left blank.

The less-able candidates had no problem in describing a piece of data from either the graph or the table and were therefore able to score at least one mark. Other candidates could explain the consequences of having disproportionate numbers of male and female turtles which accessed them a level two mark. The more-able candidates could use the T_{piv} values to assess the effects that a rise in temperature would have on each species of turtle.

*(ii) The T_{piv} for flatback turtles is 29.4°C.

A temperature of 27.7°C will result in all males and a temperature of 31.1°C will result in all females being produced.

The T_{piv} for green sea turtles is 30.0°C.

Discuss whether or not scientists should be concerned that the use of microplastics could be endangering turtles.

Use all of the information in the question and your own knowledge to support your answer.

(6)

①. The use of microplastics should be concerned.

Because the presence of microplastics increases the sand temperature.

The proportion of microplastics is higher, the increasing is greater.

At temperature is higher than 29.4°C and 30°C, there are more females than males in the ~~the~~ flatback turtle and green sea turtle population.

~~Some~~ Some male turtles cannot mate and breed so there is decreasing in offspring amount. The number of turtles decreases. Some alleles ~~contained~~ carried by males are lost so there is decreasing in genetic diversity of turtles. The ^{number of} animals that eat turtle decreases since they lack food.

It damages to food chain.

The production of microplastics may use fossil fuels which lead to greenhouse effect and global warming.

②. The use ~~it~~ needn't be concerned.

Because the control group has temperature greater than 29.4°C and 30°C.



This is a good example of a level 2 response. This candidate has referred to the T_{piv} of each species of turtle but then discussed what would happen to both of the species and not what the different effects would be in each species.

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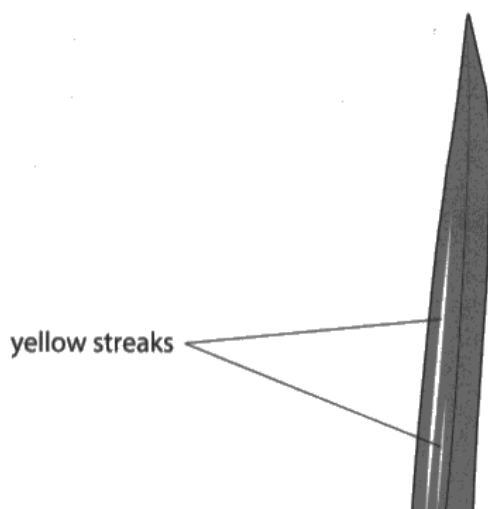


This response achieved a level 3 score as this candidate discussed the effects of the microplastics on each species separately, pointing out the differences as a result of the different T_{piv}s.

Question 9(a)i

The actual calculation did not cause candidates too many problems. Those who failed to score the mark generally did not express their answer in standard form or correct standard form.

- 9 The rice yellow mottle virus (RYMV) infects species of rice plants grown in Africa.
The leaves of infected rice plants become discoloured with yellow or orange streaks.
The diagram shows a leaf of a rice plant infected with RYMV.



- (a) One country in Africa can produce 1.7 million tonnes of rice per year.
Between 20% and 100% of the harvest may be lost due to infection with RYMV.

- (i) Calculate how many tonnes of rice are lost if 20% of the harvest is lost.

Give your answer in standard form.

(1)

$$\left(\frac{20}{100}\right)(1.7 \times 10^6) =$$

Answer 3.4×10^5 tonnes



A clearly laid out calculation.



We frequently ask for an answer to be expressed in standard form so ensure you know how to do this before the first exam.

Question 9(a)ii

Good responses were seen to this question.

- (ii) Explain why it is important to identify rice plants infected with RYMV as early as possible.

(2)

to remove the ^{infected} rice plants from the field to prevent the virus from infecting other rice plants. As the virus will reduce the amount of harvest collected ~~left~~ for the farmers as it reduces the yield of rice



This response illustrates both alternatives for mark point one, as well as what we were after in mark point two.

Question 9(b)i

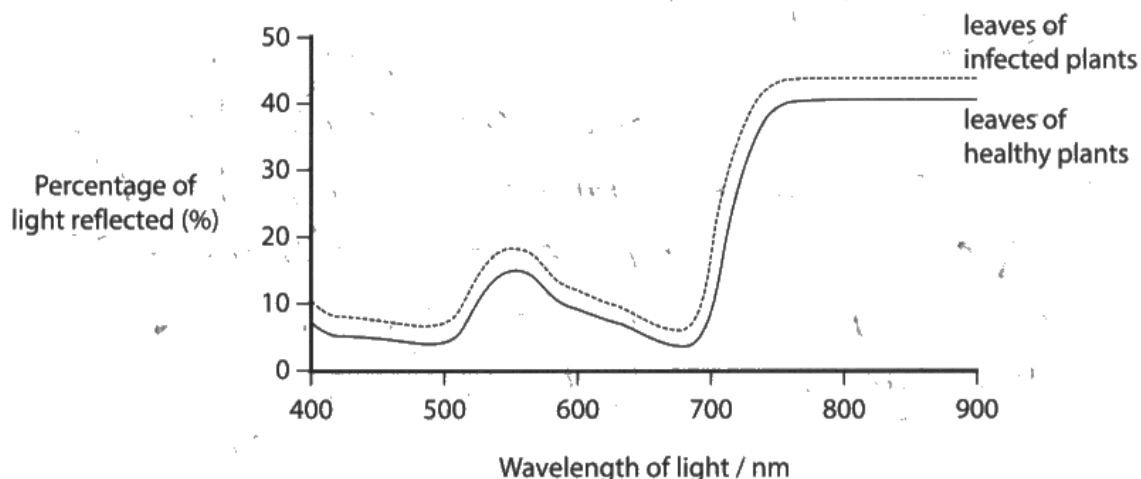
There were a number of acceptable answers to this question. We did not think we could accept visible light as this would be incorrect, however we felt it would be unfair to candidates to negate the mark, so we ignored any reference to visible light.

- (b) Scientists are trying to develop ways to identify rice plants recently infected with RYMV.

One investigation measured the reflection spectrum of the leaves of infected rice plants and compared this with healthy plants.

Different wavelengths of light were shone onto the leaves of rice plants and the percentage of light reflected at each wavelength was measured.

The graph shows the results of this investigation for healthy plants and plants that had been infected for two days with RYMV.



- (i) Suggest why wavelengths of light between 400 nm and 900 nm were used in this investigation.

(1)

Because it's the range of wavelengths present in ~~sun~~ sunlight and ~~it's~~ it's the range that ~~can~~ can be absorbed by photosystems in chlorophyll of rice.



This response illustrates two of our possible mark points.

Question 9(b)ii

This question was more challenging. We saw mark points one and three, but only the more able candidates gave us both points; candidates tended to focus on one aspect or the other.

The second mark point was rarely seen even from the more able candidates.

- (ii) Explain why the scientists thought that there would be a difference in the reflection spectra for healthy leaves and leaves infected with RYMV.

(2)

Leaves infected with RYMV change colour
so might have different ~~compos~~ compositions of
the different types of chlorophyll which will
absorb and reflect different wavelengths of
light.



This response illustrates mark point one.

- (ii) Explain why the scientists thought that there would be a difference in the reflection spectra for healthy leaves and leaves infected with RYMV.

(2)

As ~~the~~ plants infected with RYMV have discoloured yellow streaks, so they contain less pigments, so less absorption of light and more reflection of light.



This response illustrates mark point three.

Question 9(b)iii

A question like this requires both useful and non-useful aspects to be discussed. Many candidates recognised that this would be necessary to score the marks.

(iii) Discuss the extent to which the results shown in the graph could be useful to farmers in identifying infected plants.

Points against:

(3)

- The differences in the percentage reflection of light at different wavelengths by the leaves of infected plants and healthy plants is very small.
- Therefore, very advanced technology may be required to detect such a small difference and farmers may not have that technology.
- Also, this may require time and technical knowledge and skills which farmers ~~don't possess~~ may not possess.

Points for:

- There is however, a difference in the percentage reflection of light by infected plants and healthy plants, so this method can be used to identify infected plants.



This candidate has made it very clear which aspects of their response link to the results being useful and which aspects relate to not being useful.



If you are asked to discuss whether something is useful or not, you need to specify which aspects you are writing about are useful and which aspects are not useful; the examiner is not going to interpret your answer for you.

- (iii) Discuss the extent to which the results shown in the graph could be useful to farmers in identifying infected plants.

(3)

By seeing the graph, we notice that leaves of infected plants always have a higher percentage of light reflected compared to normal leaves. So it can be useful for farmers to know which are infected as they have different reflection of light. But their difference in reflection is very small, so farmers might not be able to know. for infected and healthy
No standard deviation of the graph is provided so we do not know will there be overlapping of data.



This candidate has made it clear what they think makes these results useful and what makes them not so useful, scoring mark points one and four. Although they have mentioned the lack of error bars they have not been specific in how this affects the interpretation of the data; we wanted to know about the differences not the overlap of the error bars.



Although we quite often have a mark for commenting on error bars in this type of question, we do expect a response to show an understanding of what is being shown or not shown. Simply writing about overlap or lack of overlap is too vague.

Question 9(c)

We have asked questions testing this same specification point in the past but this particular question was quite challenging for some candidates.

Marks were lost for poor wording and common misconceptions: confusion between genes and alleles, incorrect use of the term immunity for resistance, the idea that the selection pressure causes the mutation.

- (c) The types of rice plants most susceptible to infection with RYMV are those imported from Asia into Africa.

Explain why rice plants from Africa are less susceptible to the virus than those imported from Asia.

those in Africa

(4)

- As ~~they~~ *they* would have developed resistance to virus by Natural selection.
- Mutations would've occurred, giving some plants to be resistant, these plants would photosynthesize ~~and more~~, and thus survive more. Relative to the selection pressure that is the virus.
- Thus they'd reproduce more, passing on their advantageous resistance alleles, increasing allele frequency of resistance, until all population have it.
- Smaller number would be resistant from Asia, as they hadn't been exposed to the selection pressure (virus).

(Total for Question 9 = 13 marks)

TOTAL FOR PAPER = 90 MARKS



This was a good response which gained full marks.

- (c) The types of rice plants most susceptible to infection with RYMV are those imported from Asia into Africa.

Explain why rice plants from Africa are less susceptible to the virus than those imported from Asia.

(4)

^{most} Rice plants in Africa have developed resistance to the virus as the virus acts as a selection pressure. A mutation in the African rice plants would have caused an advantageous allele resistant to the virus to be produced. The ^{rice} plant would grow and survive and reproduce, passing the allele onto the offspring. As those plants with the allele have the advantage they would outcompete the plants without resistance that would die from RYMV. Therefore more the allele frequency within the African rice plants would increase. Asian rice plants however are not resistant to the virus, resulting in them being more susceptible.

(Total for Question 9 = 13 marks)

TOTAL FOR PAPER = 90 MARKS



This is another example of a clear response to this question.

Paper Summary

Based on the performance of this paper, candidates are given the following advice:

- Candidates should write their responses in the context of the question, avoiding generic responses.
- Candidates should use the mark allocation as a guide on how much to write: too few points will not access full marks and too much detail may result in running short of time at the end of the examination.
- Candidates should practice the maths skills listed in the appendix, especially the ones that come up frequently in these papers such as percentages, ratios, expressing answers in standard form, selecting and giving appropriate numbers of significant figures and decimal places in their answers.
- Candidates should use all the information available in the question: text, tables, graphs or diagrams as it is there for a reason.
- Candidates should read through their answer once they have completed it to check the terminology they have used and to check that they have written something that makes sense in the context of the question.

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
<https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html>

