



Examiners' Report June 2024

IAL Biology WBI14 01

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Introduction

The standard of responses was noticeably higher than in previous series. Centres are now much more familiar with the content of the specification and the demands of the exam paper. Candidates are clearly better prepared as a result. Knowledge is good, expression is improved and there is definitely a difference in the mathematical ability of the candidates. There were also fewer blank responses.

Question 1 (b)(i)

'Compare and contrast' is a command word that centres and their candidates are now very familiar with. The majority of candidates are giving both similarities and differences and not simply writing two separate descriptions, thereby accessing all the marks.

- (i) Compare and contrast the types of chloroplast pigment found in the seaweeds with those found in the spinach.

Use the information in the diagram to support your answer.

(3)

All plants contain β -carotene. All plants contain chlorophyll a. Only spinach contains chlorophyll b. Pigment P and Q are only found in brown seaweed. All plants contain the same pigment from a xanthophyll. Spinach contains 2 more xanthophylls ~~two~~ types than seaweed.



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Examiner Comments

This is one example of an excellent response which illustrates a number of the possible mark points.



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Examiner Tip

Always give at least one similarity and one difference when answering questions with the 'compare and contrast' command word. Then check the number of marks allocated to the question to add some more statements if necessary.

Question 1 (b)(ii)

Candidates who read the question and understood its expectations generally picked up the first two mark points. Fewer candidates appreciated or wrote about the need to use the same solvent when comparing R_f values. Some candidates misinterpreted the question and described how this chromatogram would have been set up, which has been asked in previous series.

(ii) Describe how the student could identify pigment P using this method.

(3)

By calculating the R_f value. Measure the distance from origin to solvent front (distance moved by solvent), and measure the distance ~~from~~ moved by pigment P from origin. Substitute values into equation:

$$R_f = \frac{\text{Distance moved by pigment from origin}}{\text{Distance moved by solvent from origin}}$$

Once the R_f value is calculated compare it with ~~the~~ data booklet of R_f values for the same solvent that was used. And identify pigment P by finding the same R_f value in the data booklet.



ResultsPlus
Examiner Comments

This response illustrates all three of the mark points.



ResultsPlus
Examiner Tip

It is imperative that the same solvent is used if R_f values are to be compared. As it is so important, there is very likely to be a mark for stating this.

Question 1 (c)(ii)

This question was very low scoring with many responses simply putting the diagram into words; describing the different depths that the different light penetrated to.

(ii) Explain the positions of the brown and red seaweeds on the submerged rock.

(2)

The brown seaweed is located above the red seaweed as it absorbs green light and red light, whereas red seaweed absorbs blue light the most. These positions prevent competition for light allowing both organisms to grow increasing biodiversity. The locations could also be due to the ~~fast~~ amount of oxygen they need.



This candidate has picked up on the idea of avoiding competition and been awarded the second mark point. However, they have failed to state the obvious which is that this would result in the seaweeds being able to absorb as much light as possible.

Question 2 (a)(i)

This question has been asked in previous series and candidates who have used past papers and mark schemes to prepare, scored well. A common error was to not state what or who was being contaminated.

(a) Both students used aseptic techniques to culture the bacteria.

(i) Explain the importance of using aseptic techniques to culture bacteria.

(2)

It prevents contamination, no foreign bacteria will be cultured accidentally in the liquid medium. It also prevents students from getting infected by a harmful bacteria.



This response starts by describing contamination of the cultures but does not describe a possible consequence. They then describe a consequence of contaminating the student so can be awarded the 2 marks in the second set of possibilities.

(a) Both students used aseptic techniques to culture the bacteria.

(i) Explain the importance of using aseptic techniques to culture bacteria.

(2)

~~So that outside do~~ So that outside microorganisms do not contaminate the culture. ~~The contamination~~ By contamination, pathogenic microorganism bacteria may form.



This response illustrates the first pair of possible mark points.

Question 2 (a)(ii)

This question has also been asked in previous series and examiners saw some excellent responses. One thing that did stand out was the increase in the number of candidates who could explain why working beside a bunsen burner is significant. This has previously not really been understood by many candidates.

(ii) Explain **one** aseptic technique that should be used when culturing bacteria.

(2)

The inoculating loop should be heated by using a bunsen burner or it should be autoclaved so that any other pathogenic bacteria is killed and does not grow.



This response illustrates the pair of mark points that relate to using sterile equipment.

(ii) Explain **one** aseptic technique that should be used when culturing bacteria.

(2)

Leaving a bunsen burner switched on near a culture.
The convection current prevents any airborne bacteria from falling on the culture & ruining it.



This response illustrates the use of the bunsen burner.

Question 2 (b)

As commented earlier, the mathematical ability of candidates overall has noticeably improved since 2020. The last time a question involving logs was asked, the number of candidates scoring full marks was limited. However, this year, question on logs was completed properly.

- (b) Calculate the growth rate constant (k) of these bacteria between 2 hours and 6 hours of culture.

(2)

Use the equation: $k = \frac{\log_{10}N_t - \log_{10}N_0}{0.301 \times t}$

where:

$\log_{10}N_t$ = \log_{10} number of cells at 6 hours

$\log_{10}N_0$ = \log_{10} number of cells at 2 hours.

$$\frac{\log_{10}5.2 - \log_{10}2}{0.301 \times 4} = 0.345$$

Answer 0.345



ResultsPlus
Examiner Comments

This response is an example of a common error made by those candidates who do not really understand logs. It achieves 1 mark and is treated as a consequential error.



ResultsPlus
Examiner Tip

Don't take log of logs.

(b) Calculate the growth rate constant (k) of these bacteria between 2 hours and 6 hours of culture.

(2)

Use the equation: $k = \frac{\log_{10} N_t - \log_{10} N_0}{0.301 \times t}$

where:

$\log_{10} N_t = \log_{10}$ number of cells at 6 hours

$\log_{10} N_0 = \log_{10}$ number of cells at 2 hours.

$$k = \frac{5.2 - 2}{0.301 \times 4}$$

$$k = 2.66 \quad \square$$

Answer2.66.....



ResultsPlus
Examiner Comments

This is an example of a well-laid out calculation that has an answer expressed to an appropriate number of decimal places.



ResultsPlus
Examiner Tip

If the question does not specify how to express the final answer, you need to decide on an appropriate number of decimal places/significant figures.

Question 2 (c)(i)

Marks for ratio questions were up this year partly because the mathematical ability of candidates appears to have improved and partly because of added scaffolding to the answer line, indicating how a ratio should be expressed.

(c) The number of bacteria in the samples taken after 10 hours were:

398 107 171 in the culture of student P

6309573 in the culture of student Q.

(i) Calculate the ratio of the number of bacteria in these two cultures.

(1)

$$\frac{398\,107\,171}{6309573} = 63.1$$

Answer 63 :1



ResultsPlus
Examiner Comments

An example of a clearly laid out answer.

Question 2 (c)(ii)

There were some very good attempts to answer this question, with many candidates scoring both marks.

- (ii) Student P and student Q used different methods for determining the number of bacteria.

State which method each student used.

Give a reason for your answer.

(2)

Student P Turbidity measurement. Colorimeter is used.
Because both ~~as~~ dead and alive bacteria are counted
so the number in the culture after 10 hours is very large.

Student Q Dilution plating. Only living bacteria are
counted so less number in the culture after 10 hours.



ResultsPlus
Examiner Comments

A cross-section of methods were seen. The candidate who wrote this response has referred to two of these correctly.

- (ii) Student P and student Q used different methods for determining the number of bacteria.

State which method each student used.

Give a reason for your answer.

(2)

Student P Turbidimetry

Since the population kept increasing, it is because both dead and living cells were considered here. Turbidimetry considers the absorbance of light by the sample, and since both the dead and living cells absorb light, both get considered in the ^{count} ~~count~~.

Student Q Serial dilution, plating and cell count

In this method, the cells are observed with dyes, like trypan blue, which help to differentiate between the dead and living cells and so only the living cells are considered, which is why the cell count also decreases when the cells die, ^{more} ~~more~~.



ResultsPlus
Examiner Comments

There were some very good responses that described the use of haemocytometers in conjunction with exclusion dyes. One such response is illustrated here.

Question 3 (a)

Most candidates made the correct calculation but lost the mark for not expressing their answer in correct standard form. However, it was felt that the number of candidates doing this was probably down from recent series.

In 2022, it was estimated that 92 million tonnes of textile waste was produced in the world.

Textile waste is either burned or buried underground in landfill sites.

(a) It is estimated that by 2030, there will be 134 million tonnes of textile waste produced each year.

Calculate this increase in textile waste.

Give your answer in standard form.

$$\begin{array}{r} 134000000 - 92000000 \\ \hline = 4.2 \times 10^7 \end{array} \quad \text{(1)}$$

Answer 4.2×10^7 tonnes



ResultsPlus
Examiner Comments

A well laid-out calculation with the answer given in standard form correctly.



ResultsPlus
Examiner Tip

Make sure that you know how to express a value in standard form correctly.

Question 3 (c)(i)

The meaning of the term sustainable is frequently asked in paper 2 and many candidates have clearly learnt the definition using past paper mark schemes. However, the question asks for the meaning as applied to the context of the question, which cost a number of candidates their mark.

- (c) There are companies in Scandinavia that are producing sustainable textiles for clothing.

One company is recycling textile waste. It is removing dyes and making new fibres that can be woven.

Another company is using waste from the wood industry, wheat straw and leather scraps to make fibres.

- (i) Give the meaning of the term **sustainable**, as used in this context.

(1)

Sustainable is producing clothes producing
~~from~~ clothes from textile waste
or wood waste without causing harm to
the environment - not renewable but recycling



This is an example of the type of response that examiners are hoping to see.

- (c) There are companies in Scandinavia that are producing sustainable textiles for clothing.

One company is recycling textile waste. It is removing dyes and making new fibres that can be woven.

Another company is using waste from the wood industry, wheat straw and leather scraps to make fibres.

- (i) Give the meaning of the term **sustainable**, as used in this context.

(1)

It can be defined as renewable or reusable.



This example is more typical of a response from a candidate who has not followed the instructions carefully enough.



Learning generic definitions is important but if a question asks you for a definition in a particular context, you need to modify what you write to fit that context.

Question 3 (c)(ii)

Candidates find questions using the command word 'discuss' quite difficult to answer. Generally speaking, responses tend to lack sufficient reasoning and do not look at both sides of an argument.

Responses from less able candidates generally named one or two advantages of recycling the clothing, restricting them to a level 1 response. The more able candidates could take the advantage a step further by giving a reason, thus accessing the level 2 marks. Only a few candidates looked at both the advantages and limitations of the recycling to access the top mark.

* (ii) Discuss the extent to which these companies are reducing the conflict between human needs, climate change and conservation.

Use the information in the question, the photographs and your own knowledge to support your answer.

(6)

these companies are making sure human needs are met, by making new fibres which can be used for clothing, materials. They are reducing climate change as there is less waste produced. On the other hand, the process of removing dyes and recycling, may produce more CO_2 than just making new ones. CO_2 is produced from the transport of goods, as well as the factories which recycle. CO_2 is a greenhouse gas which can cause global warming and increase climate change. Additionally, using waste such as wood ~~and~~, wheat straw ~~and~~, and leather scraps may increase conservation, as less land must be taken for crops and cattle. So less forests are cut down, and less carbon sinks are destroyed and less habitats destroyed. cattle release methane; so, using leather waste is good, as less cattle will be used. methane is also a greenhouse gas, causing global warming.

(Total for Question 3 = 9 marks)



This response is awarded a level 3 mark.



Make sure you understand what is required in an answer for each of the command words.

- * (ii) Discuss the extent to which these companies are reducing the conflict between human needs, climate change and conservation.

Use the information in the question, the photographs and your own knowledge to support your answer.

(6)

Companies may provide new job, as they need people to help to remove dyes, make new fibres, ~~economy~~ economy may ~~be~~ boost. The product made from recycle material serve the same function ~~as~~ & may be even cheaper. However, farmers that ~~sell~~ sell cotton, wools, leather may be affected as lesser buyer. Other than that, it may help to reduce in climate change, as textile waste is not burn but reuse, lesser CO₂ produced, ^{as} CO₂ is a green house gas. However, more fuels may be used to transport waste textile or waste from the wood and also factory needed to remove dyes and make new fibre. This may cause more CO₂ to released, causing climate change. However, using waste from wood to make fibres or textile means lesser animal is being killed ~~to~~ for their skin to make leather or other fabric. Animal with beautiful fur that's endangered is not killed, conserve the ~~the~~ number of animal. However, trees may still be chopped, as more need of wood fibre. Habitat of animals still being destroyed.



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Examiner Comments

Another example of a level 3 response.

Question 4 (b)(i)

There were some good responses to this 'suggest' question, mostly involving the idea that the water content would vary, either between leaves or at different times of the day.

Some candidates wrote that the wet mass would vary but it was not felt that this was quite sufficient enough.

- (i) Decomposition was measured as a decrease in dry mass of the leaves.

Suggest why dry mass was measured and not wet mass.

(1)

Wet mass is inaccurate as it also considers the mass of water in the leaves, which can be different at different times of day.



This is one example of a reasonable suggestion.

- (i) Decomposition was measured as a decrease in dry mass of the leaves.

Suggest why dry mass was measured and not wet mass.

(1)

Dry mass is equal to biomass of the leaves and is equal to organic matter of leaves. Also, dry mass does not increase but wet mass can depend on amount of water.



Fewer candidates referred to the biomass being the organic matter.

Question 4 (b)(ii)

A wide range of responses were seen for this question. Units were not asked for and were not needed for both marks to be awarded. It was encouraging however that a number of candidates did give the correct units.

Some candidates did not give their answer to two significant figures, as instructed. The other reason for lost marks was because candidates tried to work out the percentage decrease instead of the rate of decrease.

- (ii) Calculate the rate of decrease in percentage dry mass between 30 days and 120 days for the sugar maple leaves.

Give your answer to **two** significant figures.

$$80 - 63\% = 17\% \quad 8\% \quad (2)$$

$$\frac{63 - 8}{90} = 0.61\% \text{ per day decrease } //$$

Answer



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Examiner Comments

A clearly laid out response.

Question 4 (b)(iii)

The most frequently awarded mark points were the additional guidance mark point two and the third mark point. Very few candidates looked at the data carefully enough and gave conclusions that referred to specific days.

(iii) Describe **two** conclusions that can be made about the decomposition of sugar maple leaves compared with the white oak leaves.

(2)

The decrease in percentage of dry mass is greater for sugar maple than oak leaves. The decomposition rate for sugar maple leaves is greater than for oak leaves.



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Examiner Comments

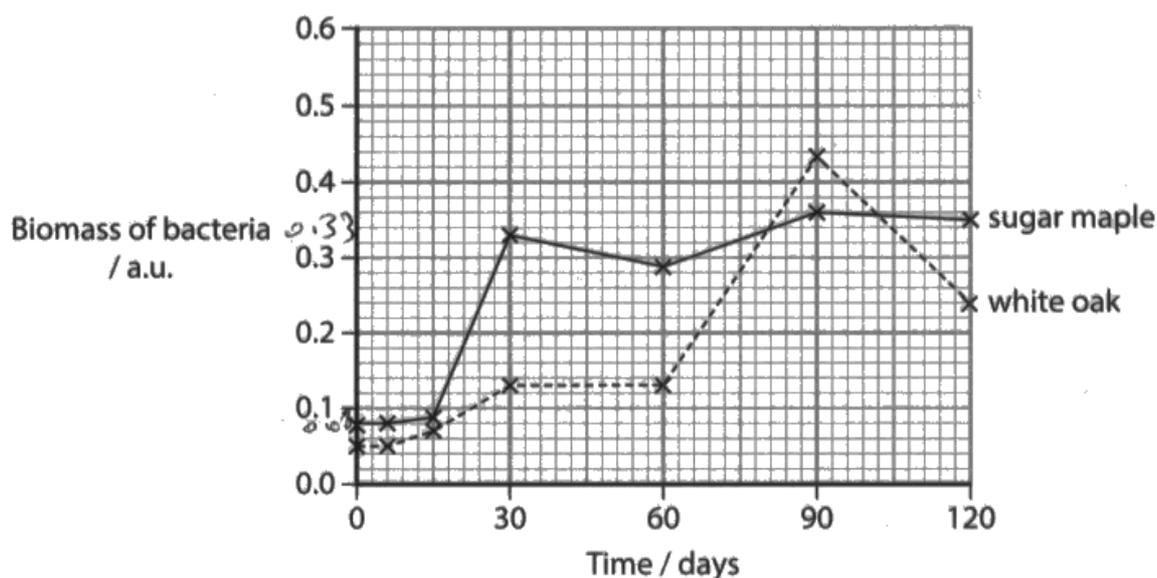
An example of a fairly typical response.

Question 4 (c)(i)

The majority of candidates found this calculation very straightforward, provided they read the values off from the graph accurately.

- (c) The biomass of bacteria on the two types of leaf during the 120-day period was determined.

The graph shows the changes in biomass of bacteria on these leaves.



- (i) Calculate how many times greater the biomass of bacteria on the sugar maple leaves is after 30 days compared with the biomass of bacteria at 0 days.

(1)

$$\frac{0.33}{0.08} = \frac{0.08}{0.08}$$

Answer 4.125



A typical, correct, response.

Question 4 (c)(ii)

There are two reasonable ideas that could explain the increase in biomass; the vast majority of candidates offered the second pair of responses. Marks did get lost by candidates who were too vague for mark point one of the second set and simply referred to 'food'.

- (ii) Suggest why the increase in biomass of bacteria after 30 days is greater on the sugar maple leaves than it is on the white oak leaves.

Give a reason for your answer.

(2)

The sugar maple leaves may provide more energy / glucose to be used by bacteria during decomposition than the white oak leaves. And so the replication of bacteria was faster at the sugar maple leaves as bacteria respired aerobically at a faster rate, increasing the rate of bacterial replication.



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Examiner Comments

A nice response that did go into a bit more detail than required for the 2 marks.

Question 4 (c)(iii)

For this question there are four possible pairs of responses. Probably the second pair was seen most frequently but again there were vague references to 'food'.

- (iii) Suggest why the biomass of bacteria on the white oak leaves decreased after 90 days.

Give a reason for your answer.

(2)

There was no glucose left for bacteria to respire in white oak leaves so they died. The bacteria population increased too much which caused accumulation of toxins ~~that~~ ^{which} caused the bacteria to die.



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Examiner Comments

An example of the second pair of responses – both the one in the actual mark scheme and the slightly different idea in the additional guidance.



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Examiner Tip

If you are writing about 'food' in a question, stop and think if you really mean food or if you should be slightly more specific.

Question 5 (a)

There were some excellent responses to this question, many giving far more detail than expected. Centres are clearly teaching this part of the specification in a degree of detail, which is presumably interesting the candidates as they are remembering it.

5 Herpes simplex is a virus that causes sores around the nose and mouth.

A modified form of this virus has been developed to infect and kill cancer cells in humans.

(a) Explain how a cell can become a cancer cell.

(2)

A mutation occurs in the tumour suppressor gene so cell multiplies uncontrollably as this gene is no longer active to limit cell replication.



This is a very good response which gives more detail than what is expected for this question.

5 Herpes simplex is a virus that causes sores around the nose and mouth.

A modified form of this virus has been developed to infect and kill cancer cells in humans.

(a) Explain how a cell can become a cancer cell.

(2)

Cancer cell undergoes mitosis uncontrollably uncontrollably. This can happen due to mutation in gene ^{DNA} of cell.



Although this response does not cover such detail as the previous one, it is more in line with what examiners were expecting.

Question 5 (b)(ii)

This is a straightforward question that was answered well. It was included to get the candidates to start thinking about how viruses get inside their host cells and the possible consequences.

(ii) State the function of the envelope proteins.

(1)

There are needed for attachment to host cells (eg.

bacteria or human cell) as they are antigens on

it that can complementary bind to cell receptors.



ResultsPlus
Examiner Comments

As expected, the vast majority of candidates wrote about the role of the envelope proteins in attachment of virus particles to their host cells.

Question 5 (b)(iii)

Many candidates took the hint from the previous question and wrote about the virus needing to be able to attach to the cancer cells and not to the non-cancerous cells.

- (iii) Explain why the herpes simplex virus has to be modified before it can be used to infect cancer cells.

(2)

If has to be modified so the envelope proteins are specific only to cancer cells to prevent it from attaching normal cells and causing sores around the nose and mouth.



A nice clear response.

Question 5 (b)(iv)

There were two possible approaches to this question that were viable and both were seen.

- (iv) Explain how the infection of a cancer cell with herpes simplex virus can result in the death of this cell.

(2)

Herpes simplex virus infect cancer cell. The virus replicates inside host cell which is the cancer cell and ~~can~~ cause damage to cancer cell. Cell burst and release the newly formed virus. Virus continues to attack other cancer cells. Infected cancer cell is damaged and recognise by T killer cells. T killer cells ~~destroy~~ destroy the infected cancer cell.



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Examiner Comments

This candidate has attempted to cover both ideas and is awarded both mark points for the first idea.

For the second mark point of the first set of answers, candidates have to clearly be talking about the lytic cycle if they are describing the viral replication.



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Examiner Tip

Not all viruses undergo latency like HIV does. Many only enter the lytic cycle and this is when the virus particles are replicated and burst out of the host cell. HIV only does this when it leaves latency and moves into the lytic phase.

Question 5 (c)

The immunology-based questions are generally poorly done but examiners did see some very good responses that covered both the humoral and cell mediated responses that would take place and result in the destruction of the cancer cells. There were noticeably fewer responses where candidates wrote that the B cells produced the antibody, which has been a common error in previous series.

Many candidates did not realise that they only needed to start their story after the immune response had been activated and there were many accounts about the role of macrophages in presenting antigen to T helper cells. This did not count against candidates but may have wasted a bit of time.

The first mark point was probably the one awarded the least, with only the more able candidates appreciating that the infected cancer cell was the actual antigen-presenting cell to the T killer cells.

- (c) Using a modified herpes simplex virus activates the immune system.

Explain why activation of the immune system would result in destruction of the cancer cells.

(4)

As it would allow macrophage to engulf cancer cells and ~~be~~ display it on MHC and so become ~~an~~ antigen presenting cell allowing T-Helper cell activation and so T-Helper cell secrete cytokines and so allow proliferation of T-Killer cells and B-cells to allow T-Killer cells to secrete perforin and destroy cancer cells. Also B-cells differentiated into plasma cells which secrete antibodies for opsonisation, agglutination and allow destruction of cancer cells by phagocytes. Also memory cells are produced for faster secondary immune response.

(Total for Question 5 = 12 marks)



ResultsPlus
Examiner Comments

This is a very good response that illustrates a number of the mark points.



ResultsPlus
Examiner Tip

Always specify if you are talking about T helper cells or T killer cells.

(c) Using a modified herpes simplex virus activates the immune system.

Explain why activation of the immune system would result in destruction of the cancer cells.

(4)

~~the~~ T-helper cells are activated with the antigens of virus. T-helper cell releases cytokines to activate B-cells. B-effector cells differentiate into plasma cells. Plasma cells produce antibodies. Antibodies mark cancer cells with virus this is called opsonisation. T-helper cells activate T-killer cells. T-killer cells opens pores on the cancer cell as virus is in it. The cell is burst. T-memory and B-memory cells are produced. So ~~more~~ faster reaction for another situation.



ResultsPlus
Examiner Comments

Another good response.



ResultsPlus
Examiner Tip

In a question such as this, the question itself tells you that the T killer cell is destroyed so you will not get a mark for stating this in your answer. You need to give a bit more detail on how it is destroyed.

Question 6 (b)(ii)

There were some good attempts at this question, which is actually asking candidates to make conclusions from less than straightforward data.

A large number of candidates started their response by stating that as the metal ion concentration increased the number of *Vibrio* samples surviving decreased. This was not specific enough for this data. The mark point most frequently awarded was the fourth one, which is not really surprising as this did not require candidates to look at specific concentrations of metal ions. The least frequently awarded was likely the third one.

Describe the conclusions that can be made about the effects of heavy metal ions on the survival of *Vibrio*.

(3)

- Heavy metal ions do not affect samples of surviving *Vibrio* at low concentrations, up to $100 \mu\text{g cm}^{-3}$
- Copper ions are most toxic/deadly to *Vibrio* as 0 *Vibrio* survive at $800 \mu\text{g cm}^{-3}$, whereas 18 survive at $800 \mu\text{g cm}^{-3}$ of nickel ions and 116 survive at $800 \mu\text{g cm}^{-3}$ of chromium ions
- Chromium ion is least deadly as it is the only ion where there are still surviving samples of *Vibrio* at $3200 \mu\text{g cm}^{-3}$
- High concentrations of all 3 metal ions reduce the survival of *Vibrio*.



ResultsPlus
Examiner Comments

This is an example of one of the better quality responses seen, demonstrating three of the mark points.



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Examiner Tip

When describing conclusions, start with any trends shown and then look at more specific conclusions, quoting relevant data points.

Question 6 (c)(i)

Many candidates identified this question as testing them on the natural selection idea and there were many references to mutations and selection pressures. As seen in responses to similar questions in the past, the less able candidates either did not specify what the selection pressure was or else stated that it caused the mutations.

- (c) The samples of *Vibrio* taken from each pond were spread on agar containing different antibiotics.
- (i) The scientists expected the percentage of resistant bacteria to be higher in the samples of *Vibrio* taken from the ponds previously treated with antibiotics.

Explain why the scientists expected this difference.

(3)

This is as the ponds previously treated with antibiotics would have had *Vibrio* that were exposed to the selection pressure of the antibiotic. Due to this natural selection would occur and the *Vibrio* that had a mutation to be resistant to the antibiotic would be more likely to survive and reproduce (via binary fission), hence increasing the frequency of the allele for antibiotic resistance, hence most bacteria left in these ponds would have antibiotic resistance.



ResultsPlus
Examiner Comments

This response illustrates the mark points.



ResultsPlus
Examiner Tip

Selection pressures do not cause mutations. Mutations occur and the selection pressure results in the survival of the organism with the advantageous mutation.

Question 6 (c)(ii)

This question was very well answered with only a few candidates giving the difference the wrong way round.

(ii) Some of the antibiotics used were bacteriostatic and some were bactericidal.

State the difference between a bacteriostatic antibiotic and a bactericidal antibiotic.

(1)

Bacteriostatic antibiotic inhibit growth of bacteria while bactericidal antibiotic kill the bacteria



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Examiner Comments

A textbook response.

Question 6 (c)(iii)

This was one of the most challenging questions on the paper but still elicited very few blank responses and lots of good attempts. There were a number of ways that candidates could approach this question but most wrote about looking for changes in numbers of bacteria or zones of inhibition around antibiotic-soaked filter paper (sets five and eleven).

(iii) The method did not distinguish between bacteriostatic and bactericidal antibiotics because no colonies grew.

Suggest how the method would need to be modified to show which antibiotics were bacteriostatic and which were bactericidal.

Give a reason for your answer.

(2)

Count number of ~~sets~~ bacterial cells before and after antibiotic. Allow replication by adding equal ~~amount~~ volume of nutrients. Bacteriostatic antibiotic lead to same number of bacteria (no increase). Bactericidal leads to decrease in bacteria numbers.

(Total for Question 6 = 11 marks)

↳ bacteriostatic



ResultsPlus
Examiner Comments

This is an example of a response that matched set five pair of mark points.

- (iii) The method did not distinguish between bacteriostatic and bactericidal antibiotics because no colonies grew.

Suggest how the method would need to be modified to show which antibiotics were bacteriostatic and which were bactericidal.

Give a reason for your answer.

(2)

Spread ~~sample~~ the same volume of Vibrio cell suspension on nutrient agar plates
at 25°C

Incubate the plates for ~~to~~ 6 hours, to allow some bacterial growth.

Then add filter paper ~~to~~ discs with the same volume of each antibiotic to
the agar plates and incubate for 12 hrs at 25°C.

If clear zones formed, the antibiotic is bactericidal. If no clear zones are
formed, the ~~ant~~ antibiotic is ~~bacteriostat~~ bacteriostatic.



ResultsPlus
Examiner Comments

This is a very high-quality response which can be awarded both mark points from the set one pair of responses.

Question 7 (a)

There were some excellent responses to this question with many being awarded full marks. Candidates clearly know the light-independent reaction story very well.

Probably the last mark point was the one least frequently awarded as less-able candidates tended to end their responses with the formation of glucose, not extending their response quite far enough to answer the question fully.

- 7 Increased levels of atmospheric carbon dioxide can lead to an increased rate of photosynthesis. This is called the CO₂ fertilisation effect.

This effect varies depending on air and soil temperature, the availability of water, the availability of nutrients and the species of plant.

Plants that can take advantage of higher carbon dioxide levels will have a greater increase in biomass.

- (a) Describe how carbon becomes incorporated into plant biomass.

(3)

The carbon enters the cell in the form of CO₂ in the Calvin cycle in the light independent reaction to bind with the RUBP which will be catalysed by RUBISCO enzyme to give ^{unstable} 6C molecule. which will then further break into 2 GP molecules and with using of ^{the reduction} reduced NADP and energy from phosphorylation of ATP it will be converted into ^{2 molecules} GALP. The GALP will then $\frac{5}{6}$ of it be used to make RUBP ~~2 molecules~~ and $\frac{1}{6}$ of it will be used to make glucose. glucose that will be stored in the cells in the form of starch after transported in the form of sucrose.



ResultsPlus
Examiner Comments

This is an excellent account of the light-independent reaction, which does contain more detail than needed to achieve full marks.

7 Increased levels of atmospheric carbon dioxide can lead to an increased rate of photosynthesis. This is called the CO₂ fertilisation effect.

This effect varies depending on air and soil temperature, the availability of water, the availability of nutrients and the species of plant.

Plants that can take advantage of higher carbon dioxide levels will have a greater increase in biomass.

(a) Describe how carbon becomes incorporated into plant biomass.

(3)

Carbon dioxide from the atmosphere is taken into plant cells by diffusion through the stomata. where it is used in the (2nd) light independent phase Calvin cycle, where (it is) carbon fixation occurs. RuBP binds to CO₂ by Rubisco enzyme to produce 3-P. 3-P is then converted (into G3P) by products of light dependent stage NADPH and ATP into G3P. where G3P is converted into glucose and other types of molecules amino acids that become part of plant's biomass.



Another example of a very good response.

Question 7 (b)(i)

The majority of candidates realised that they had to write about enzymes in their response but not all were specific enough to the context of the question; they did not mention RUBISCO and tie the role of this enzyme in with the Calvin cycle.

The other mistake made by less-able candidates was not stating the direction of the effect i.e. if the activity increased or decreased, depending on the temperature change they had chosen to write about.

(b) (i) Explain why air temperature affects the CO₂ fertilisation effect.

(2)

Because higher temperature means increased energy of CO₂ so faster diffusion into plant also higher temperature increases enzyme activity RUBISCO increasing rate of calvin cycle and photosynthesis



ResultsPlus
Examiner Comments

This response illustrates the mark points nicely.



ResultsPlus
Examiner Tip

If the question asks you what an effect is, then you must state whether there is an increase, decrease or no change.

Question 7 (b)(ii)

This was another question where the candidates could approach their answer in a number of different ways.

Rather surprisingly there were an expectedly high number of candidates who wrote about the effect of temperature on RUBISCO.

(ii) Suggest why soil temperature affects the CO₂ fertilisation effect.

(2)

use ~~the~~ ^{faster} uptake of ions by
active transport ~~since~~ ^{because} since
more ice such as phosphate nitrate,
magnesium to make chlorophyll to
absorb more light.



ResultsPlus
Examiner Comments

This candidate took the first approach covered in the mark scheme. Few candidates, including this one, were awarded the first mark point in this set of mark points but could still be awarded full marks.



ResultsPlus
Examiner Tip

Read the question carefully and pause before launching into writing your response to make sure you don't make any silly mistakes.

Question 7 (c)

There were some good accounts of the role of water in the light-dependent reaction; another part of the specification that candidates know well.

(c) Explain why a lack of water availability in the leaves would decrease the CO_2 fertilisation effect.

(3)

- less photolysis of water into H^+ and electrons
- less H^+ ions for proton gradient so less ATP synthesized
- fewer electrons being replaced in chlorophyll.
- less reduced NADP produced.
- less light dependent reaction
- so less light independent reaction
- less glucose / GALP produced



ResultsPlus
Examiner Comments

A very clear response demonstrating all the mark points.



ResultsPlus
Examiner Tip

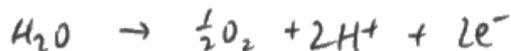
Extended bullet points such as used by this candidate are acceptable provided they include enough context. A list of words would not be considered acceptable.

(c) Explain why a lack of water availability in the leaves would decrease the CO₂ fertilisation effect.

(3)

Lack of water availability ~~effect~~ will decrease the amount of water available for the photolysis of water ~~is~~ the involved in the light dependent reaction. Hence, less ATP and NADPH are produced. Less ATP and NADPH to produce G3P in light-independent reaction, so there is decrease rate of photosynthesis, therefore CO₂ fertilisation effect decreases.

Photolysis of water is when water splits into H⁺ and O₂



H⁺ converts NADP to NADPH.



ResultsPlus
Examiner Comments

A clear and well-constructed response.

Question 7 (d)

A range of responses was seen to this question. The most common error was to state that the AM had a lower change in high nitrate soil than ECM without stating that the change was an increase. This unfortunately prevented the first mark point from being awarded.

The most frequently awarded mark points were the last two. The least frequently awarded was the second one.

Explain the results of this investigation.

(4)

~~A~~ A higher nitrate concentration leads to an increase in mean ~~percentage~~ change in plant biomass for both plants with AM fungi and plants with ECM fungi. This is because with more nitrates available there is more nitrogen for the synthesis of amino acids, which can form more proteins, which is stored in the plant as biomass. Plants with ECM fungi also have a higher mean percentage change in plant biomass compared to plants with AM fungi, as the ECM fungi can ~~release~~ provide the plants with more nitrate ions for the synthesis of proteins. The mean percentage change in plant biomass is negative for plants with AM fungi as it leads to less proteins being produced.

(Total for Question 7 = 14 marks)



This response illustrates four of the five mark points.

Question 8 (a)

There were some good responses with many candidates giving reasonable suggestions for the advantages to the seal for having a large spleen.

- (a) Animals, such as seals, that spend much of their time underwater have very large spleens.

Spleens store oxygenated red blood cells which are released into the bloodstream during a dive.

Explain why a large spleen would help the seal during its dive.

(4)

A large spleen stores more oxygenated red blood cells so having a large spleen means aerobic respiration can occur for longer during a dive as the red blood cells are released into the blood. This means the seal does not have to switch to anaerobic respiration which causes the buildup of lactic acid which can lead to muscle cramps and fatigue. So the seal has more energy ~~from~~ from aerobic respiration and can dive for longer and dive deeper as well. Also the seal can breathe easier at deeper depths because the oxygenated red blood cells allow it to use oxygen better as haemoglobin is already bound to oxygen molecules.



ResultsPlus
Examiner Comments

This is an example of one of the excellent responses seen and it illustrates most of the mark points.

(a) Animals, such as seals, that spend much of their time underwater have very large spleens.

Spleens store oxygenated red blood cells which are released into the bloodstream during a dive.

Explain why a large spleen would help the seal during its dive.

(4)

This is because the seal is unable to breathe underwater, so no oxygen is available to them when underwater, they must have large spleens that store ~~lots~~ ^{lots} oxygenated blood cells store lots of oxygenated blood cells as this allows them to respire aerobically in the water, so they can produce ATP ~~needed~~ ^{needed} to release energy to contract muscles for ~~swimming~~ ^{as} swimming ~~while~~ they hunt their prey (fish that live underwater). If they had small spleens, they would have less oxygen and then they would have to respire anaerobically, producing lactic acid and generating less ATP, so less energy released during for muscle contraction and swimming. The lactic acid ~~could~~ ^{could} would cause the seal to be in oxygen debt, so they would need to resurface for oxygen sooner and would spend less time underwater ~~if not~~ ^{if not} for the large spleen.



ResultsPlus
Examiner Comments

Another excellent response.

Question 8 (b)(ii)

Some good responses seen to this question. Most candidates scored the first mark point provided they referred to the median or middle size of spleen. The third mark point was seen relatively frequently but the less able candidates described the length of the error bars, rather than interpreting their meaning.

(ii) Describe **two** conclusions that can be made from this data.

(2)

Bajau People have a higher median volume of spleen than saluan people. Furthermore, Bajau people there is a wider range of spleen volumes amongst the Bajau people than saluan people.



ResultsPlus
Examiner Comments

This response achieves full marks.



ResultsPlus
Examiner Tip

Describing the length of error bars is not making a conclusion.
Interpreting what the length means is a conclusion.

Question 8 (c)

A wide range of responses were seen for this question with the vast majority of candidates realising that they had to write the natural selection story.

Less able candidates tended to write very superficial generic responses, limiting themselves to level 1 marks. The more able candidates wrote their response in the context of the question enabling them to access level 2 and 3 marks.

*(c) The study analysed the genomes of the Saluan people and the Bajau people to identify any genetic relationships that correlated with spleen volume.

The scientists concluded that the Bajau had become genetically-adapted to diving.

Explain how the Bajau could have become genetically-adapted to diving.

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

due to geographical isolation
(6)

Bajau people had no gene flow with Saluan. Bajau people had selection pressure which is need for fish for food while saluan didn't. So Bajau people had the mutation resulting in their spleens to be bigger so they ones with beneficial alleles hunter for more fish, survived, reproduced more, passed on beneficial alleles over generations to increase its frequency while others died so a population of people adapted to swim due to having large spleen and other features helping them to swim was made by natural selection. Also people who were able to provide more food had higher chances of finding mates increasing allele frequency for large spleen more. large spleen and other factors like high lung capacity allows higher storage of oxygen to be delivered to muscles so they can contract and rely less on anaerobic respiration and release energy from aerobic respiration to make ATP so no lactate so muscles take longer time to get fatigued and suffocation is prevented. They could also have stronger muscle allele to dive larger distances.

(Total for Question 8 = 13 marks)



This is a level 3 response as the whole story has been covered in the context of the question.

*(c) The study analysed the genomes of the Saluan people and the Bajau people to identify any genetic relationships that correlated with spleen volume.

The scientists concluded that the Bajau had become genetically-adapted to diving.

Explain how the Bajau could have become genetically-adapted to diving.

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

(6)

The Bajau people spend more time diving underwater than the Saluan.

So, ~~there are~~ ~~spleens~~ due to ^{this} selection pressure applied on them,

the Bajau have mutated genes that code for larger spleens to enable them to swim underwater for long periods of time.

As the Saluan people are a separate group of people, they may be living in a different environment (island).

So there is less chance of meeting and mating between the two groups of people, so no gene flow.

The selection pressure applied on Bajau people is the ability to live underwater for longer time.

To enable this mutations ^{causing gene coding} ~~code~~ for larger spleens arise.

These alleles are passed down the generations of Bajau people increasing the allele frequency of this advantageous alleles. So Bajau people have spleens with larger volume to store more oxygenated red blood cells.



ResultsPlus
Examiner Comments

This is another level 3 response and illustrates how little needs to be written, if the important points can be pin-pointed, to score highly.

Paper Summary

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

- In the maths questions, pay attention to how to express values – if you are given instructions on how to do this then these need following but if there are no instructions then look at the values given in the question and select a suitable format.
- In the maths questions, always show your working as you may be able to pick up method marks even if your final answer is incorrect.
- Appreciate the differences in the meanings of terms such as validity, repeatable, accurate etc and understand when each term should be used.
- You need to be able to describe what the significance of error bars in terms of the effect of one variable on another variable.
- When describing trends in data or describing conclusions shown in a graph or table, an overall description should be given as a starting point and then the individual trends described separately. Salient values should be included.
- In context-based questions you have to include aspects of the context in your response; a generic response will not score highly.

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>

