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Examiners' Report
June 2016

GCE Biology B 8BI0 02

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June 2016

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Introduction

This was the first AS paper 2 examination of the new linear specification. There was a wide range in quality of answers with many excellent, well thought through and detailed answers. The new styles of AS papers place more emphasis on data analysis and interpretation, more questions in a practical context, an increased mathematical content and less scaffolding (resulting in fewer one or two mark questions). There are generally fewer mark points available for each question so that it is no longer possible to gain full marks for a question without giving a direct, correct answer.

Many candidates demonstrated that they were able to interpret data and use their knowledge of the specification to draw appropriate conclusions. Calculations were generally carried out well, although very few candidates made reference to standard deviations in question 5(a) and many struggled to use percentages in question 7(b)(ii). Most candidates showed good factual knowledge of areas of the specification such as speciation and blood clotting but some found applying their knowledge to situations that they had not encountered previously difficult. Candidates who scored well were confident in the use of key scientific vocabulary and wrote answers that were often precise and well structured. There is a tendency for some candidates to think that they need to fill every line in an answer, a better guide to how much detail is required is the number of marks allocated to a question. A brief, carefully constructed answer, using key scientific vocabulary, is often more desirable than a poorly organised verbose one.

Question 1 (a)

The majority of candidates gained both marks. Most correctly stated that active transport is the movement of substances against a concentration gradient and requires energy. A few confused active transport with diffusion or stated that it could operate both up and down a gradient.

(a) The photograph shows part of one epithelial cell from the wall of the small intestine.

This cell is adapted to absorb substances by active transport.

State what is meant by the term **active transport**.

(2)

The active (requires energy) uptake of a substance via special carrier proteins from a region of low concentration to a region of high concentration. The energy comes from ATP.

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Examiner Comments

This is a well structured answer that gains both mark points and clearly states the direction of the transport and the need for energy.

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Examiner Tip

The number of marks allocated to a question should help you to structure your answer. This candidate clearly gets both mark points: movement against a gradient and the need for energy without using all the allocated lines.

Question 1 (b)

Many candidates found this question demanding although there were several excellent answers. Most understood that there would be an accumulation of chloride ions outside the cells (or in the intestine) but fewer went on to explain how this would lead to water loss by osmosis due to a lowering of water potential outside the cell. Many candidates referred to concentrations of water rather than water potential. At AS and A level, it is expected that candidates should refer to water potential rather than concentration.

Question 1 (c)

The majority of candidates were able to gain one mark on this question for the idea of a reduced diffusion of oxygen into the blood through the alveoli. Fewer appreciated that the mucus would block the airways leading to a reduced diffusion gradient. Although a knowledge of cystic fibrosis is not required for the specification, all the information needed to answer the question was given to the candidates. Some candidates failed to score due to poor quality of language, an example of a low quality answer would be: "less oxygen enters the lungs". This could easily be improved to: "less air carrying oxygen is able to be drawn through the bronchi into the alveoli".

Question 1 (d)

Many candidates were able to correctly recognise that the mutated allele leads to less water loss, but only more able candidates went on to explain how this would be an advantage in surviving cholera and enabling people to pass on this allele to their offspring. Some candidates tended to confuse the terms gene and allele and some do not quite understand the distinction between the command words *describe* and *explain,* often simply describing the data.

(d) There is a high frequency of mutated CFTR alleles in some human populations.

In an experiment, three groups of genetically modified mice were infected with cholera bacteria.

The relative volume of water in their faeces was measured.

The results are shown in the table.

Group	Relative volume of water in faeces
Mice with two normal CFTR alleles	1.0
Mice with one normal and one mutated CFTR allele	0.5
Mice with two mutated CFTR alleles	0.1

Use the information in the table to explain why the mutated CFTR allele has a high frequency in some human populations.

(3)

Some human populations have more recent common ancestors, so their DNA are more similar so there is less genetic variation ~~This means~~ The populations which are less closely related have had more time to have mutations which causes ~~their~~ their DNA ~~to~~ be more different, ~~which means~~ The mutated allele has become more frequent in populations which it is an advantage for them to retain more water, ~~due to selective~~ due to natural selection. **(Total for Question 1 = 10 marks)**

the frequency of the allele has increased due to selective pressure from the environment - people with the mutated gene have lived longer and reproduced, passing the allele down generations.

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Examiner Comments

This answer explains how the allele reduces water loss and then points out that it is passed on to future generations. It almost gains a third mark point for the idea of survival but did not put this into the context of the question and imply that people were surviving cholera or the infection.

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Examiner Tip

Always include the context of the question in your answers. It is not possible to gain full marks by giving a generic answer without relating it to the question.

Question 2 (a) (i)

Many candidates gained both marks, although this seemed to depend upon whether candidates had experienced using photometers. Some candidates gave vague answers such as "allowing the experiment to work" and others seemed unaware that air bubbles would break the transpiration stream.

2 The rate of transpiration in plants can be measured using a potometer.

(a) (i) Explain why the stem of a plant should be cut under water before it is inserted into a potometer.

(2)

This is so that no additional air can enter the stem thereby affecting the results that the potometer produces.

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Examiner Comments

This answer gains one mark for the idea of preventing air bubbles entering the stem. The second mark is for an idea of the air bubbles breaking the water column; this answer gives an explanation that is too vague.

ResultsPlus
Examiner Tip

Give full details rather than vague answers. If it will "stop an experiment working" explain exactly why this is so.

2 The rate of transpiration in plants can be measured using a potometer.

(a) (i) Explain why the stem of a plant should be cut under water before it is inserted into a potometer.

(2)

To ensure no air has entered the xylem which would block the transpiration stream.

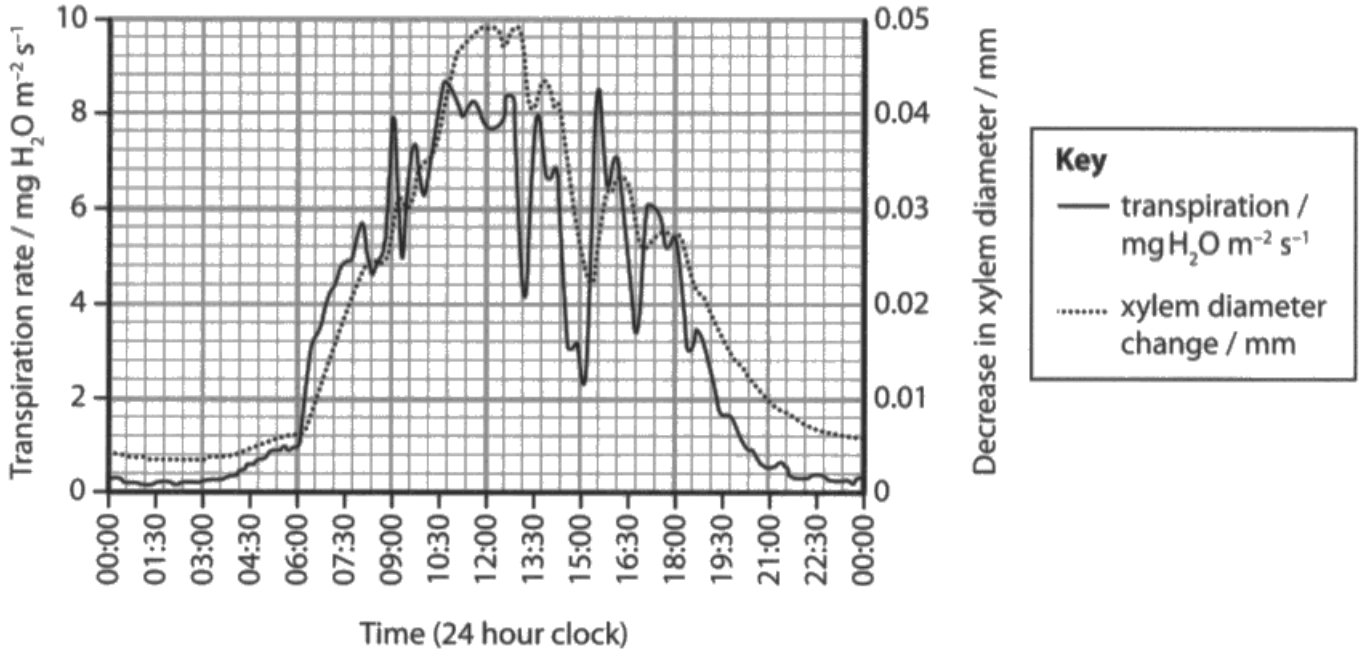
ResultsPlus
Examiner Comments

This answer gains both marks. The candidate has explained that it is important to prevent air bubbles entering the stem and then explained how this would affect the experiment.

Question 2 (c)

This question generated a very good range of answers and many excellent explanations were seen that gained five or six marks. Each AS paper will carry one six mark question that is marked by using a level based mark scheme. The level based mark scheme has indicative content rather than defined statements. Candidates that gained high marks gave thorough descriptions of how transpiration rate and xylem diameter changed, linked this to changes in abiotic factors such as light intensity, explained how the changes would alter transpiration and linked this to cohesion - tension theory. Less able answers tended to simply describe the patterns with a limited explanation in terms of how abiotic factors would change and affect the rate of transpiration. Many candidates understood the cohesion - tension theory but only more able ones referred to details such as the hydrogen bonding of water molecules. Most were able to suggest one or two abiotic factors such as light intensity or wind speed but fewer actually gave a detailed explanation in terms of stomatal opening and diffusion gradients. There is a tendency for some candidates to revert to the security of GCSE knowledge when encountering an extended answer question.

*(c) Scientists investigated the transpiration of pine trees over a 24-hour period.
The mass of water lost per second and the total area of the leaves were measured.
The decrease in diameter of xylem vessels was also measured over the same 24 hours.
The results are shown in the graph.



Using your knowledge of cohesion-tension theory, explain the changes in xylem diameter and transpiration rate over the 24-hour period.

(6)

The transpiration rate is highest during the ~~sunrise~~ warmest time of the day because high temperatures increase water evaporation. During this time the diameter of the xylem is the widest because ~~the time~~ it ~~was~~ is the time of day where the largest amount of water is being pulled through the xylem. # Water has the ability to form hydrogen bonds with other water molecules so the stream does not break. It can also form hydrogen bonds with the walls of the xylem so it is pulled through easily. Since there is less water in the leaves the stream travels up.

(Total for Question 2 = 10 marks)

ResultsPlus
Examiner Comments

This is a good level 2 answer. The candidate gives the basic pattern of transpiration and links this to environmental changes and cohesion tension. There is only a limited explanation of why transpiration rate changes and they have not correctly stated that the xylem diameter reduces at mid-day.

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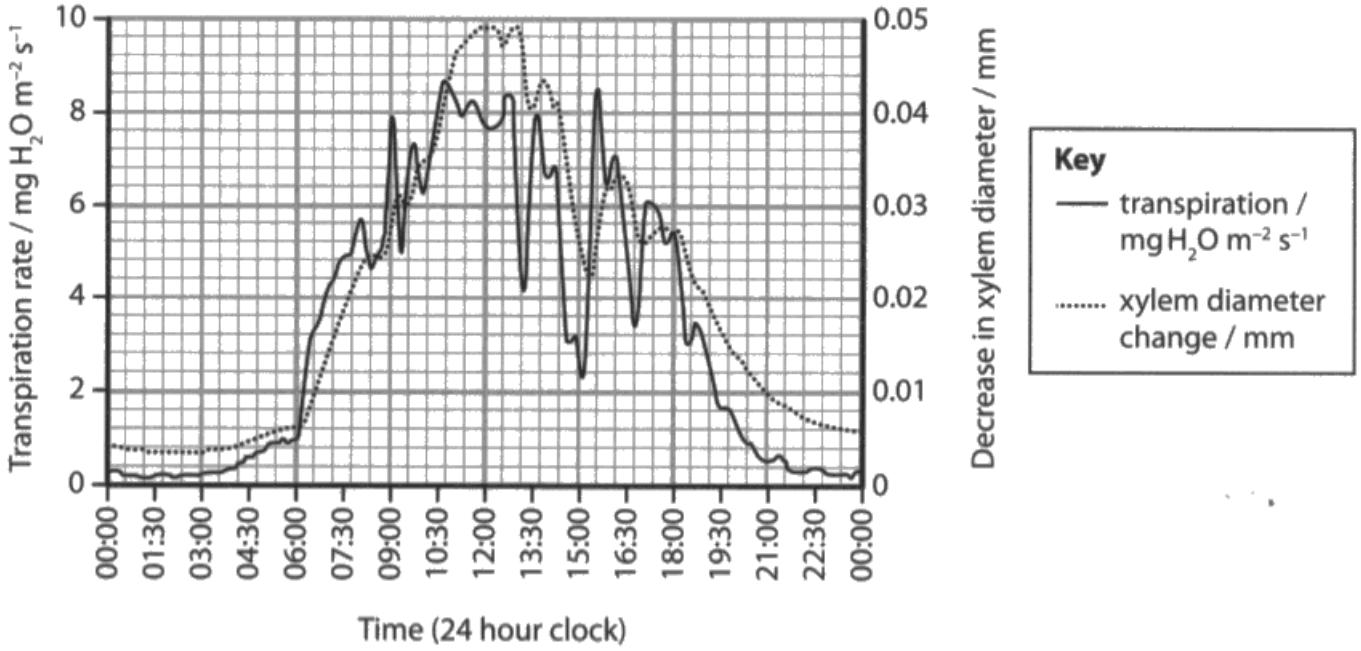

Using your knowledge of cohesion-tension theory, explain the changes in xylem diameter and transpiration rate over the 24-hour period.

(6)

The transpiration rate increases till mid-day as the sun rises causes evaporation from the leaves. This reduces the water potential in leaves so the water is transported down it's gradient by diffusion from the xylem to the leaves. This causes the xylem to suck water up which is under tension. The hydrogen bonds cause water to stick together (cohesion) and also stick to the inside of the xylem vessels (adhesion) to maintain a continuous water column. This causes the xylem vessel to constrict and the diameter decreases. As the time moves on from 12:00 the sun's energy decreases and less transpiration takes place due to less evaporation hence the diameter increases of the xylem vessel.

(Total for Question 2 = 10 marks)

ResultsPlus
Examiner Comments

This is a level 3 answer. There is a full explanation of how abiotic factors cause the changes in transpiration rate through the day and this is linked to the cohesion tension theory. It would require more depth in terms of the physiology behind the changes to gain six marks.

*(c) Scientists investigated the transpiration of pine trees over a 24-hour period.

The mass of water lost per second and the total area of the leaves were measured.

The decrease in diameter of xylem vessels was also measured over the same 24 hours.

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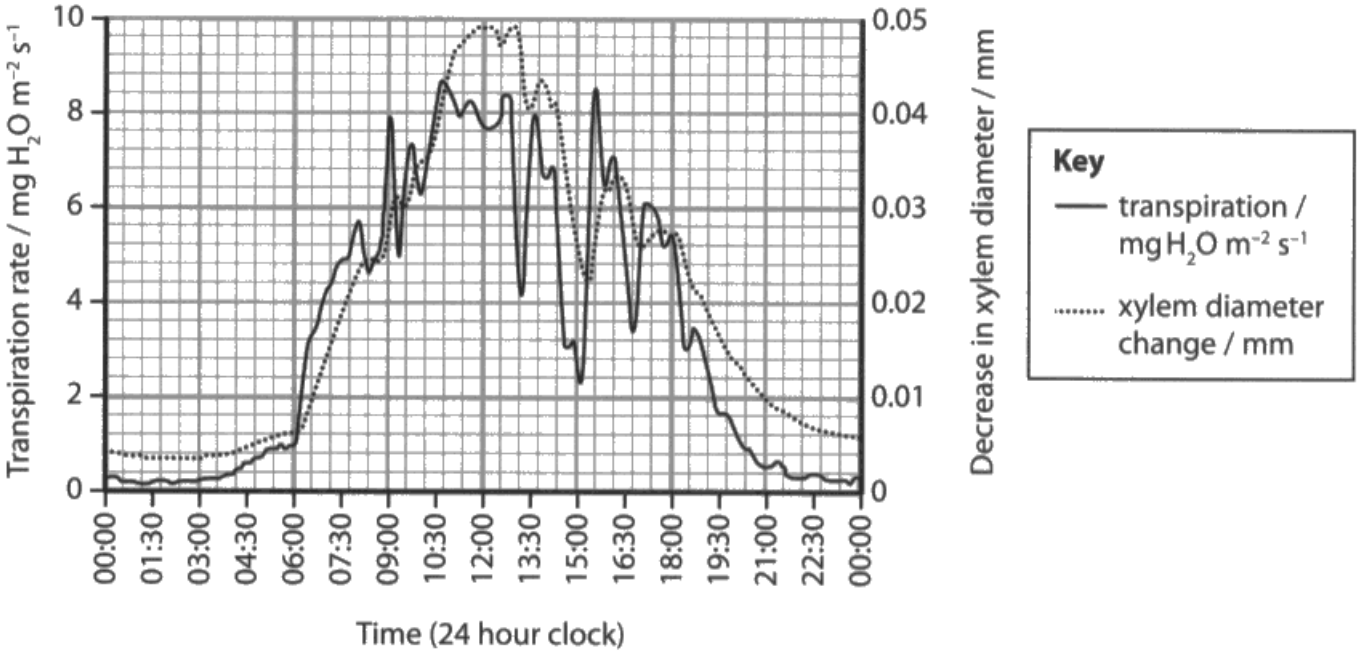

Using your knowledge of cohesion-tension theory, explain the changes in xylem diameter and transpiration rate over the 24-hour period.

(6)

From 00:00 to 06:00 when there is no sunlight, photosynthesis cannot occur so the stomata close and there is little transpiration as no water vapour is lost from the leaves. When the sun rises and the trees can photosynthesise, the water molecules are lost by diffusing from the spongy cells into the air spaces of the leaves, and then into the surrounding air (diffusing down a concentration gradient out of the leaf). When one water molecule is lost through evaporation, the hydrogen bonds between water molecules in the xylem (cohesive forces) are strong enough to 'pull' the column of water upwards, causing faster transpiration. The xylem increases in diameter when the pine trees photosynthesize to allow a greater volume of water to travel to the photosynthesising leaves, and to create a larger surface area for the adhesion of water molecules to the xylem walls for more efficient transpiration.

(Total for Question 2 = 10 marks)

ResultsPlus
Examiner Comments

This is a very strong, level 3 answer that gives very thorough and accurate explanations of the changes in transpiration and links them to the cohesion tension theory. It would be six marks but the candidate has mistaken a decrease in xylem diameter for an increase and so has not quite interpreted the data correctly.

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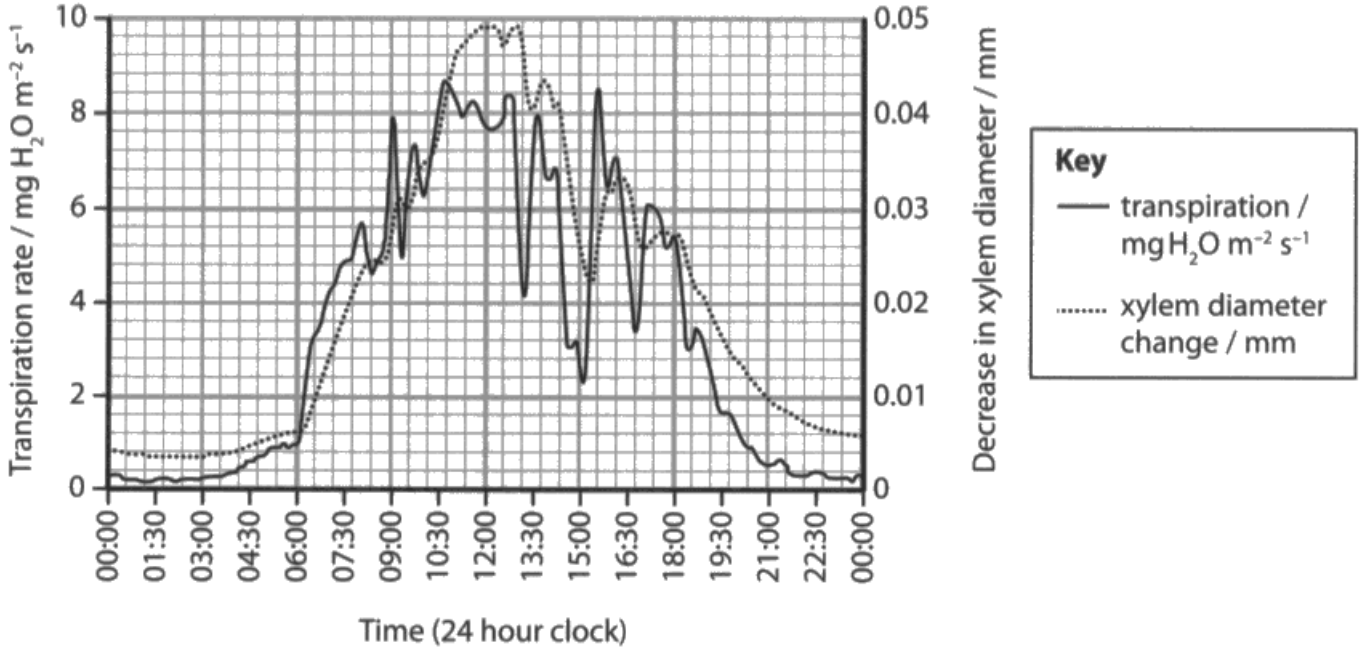

Using your knowledge of cohesion-tension theory, explain the changes in xylem diameter and transpiration rate over the 24-hour period.

(6)

The diameter of the xylem increases until approximately 12:00 where it then decreases. At 12:00 the diameter of the xylem is approximately 0.05mm. Within the xylem vessel there is tension as water in the leaves evaporates creating a concentrated solution. Water and mineral ions travel up the xylem vessel. There is high tensile strength as there are hydrogen bonds between water molecules. The water moves up the xylem vessel and is actively transported into the leaf cells where water evaporates from the stomata

ResultsPlus
Examiner Comments

This is a level 2 answer. There is a limited explanation of the changes in transpiration rate linked to abiotic factors and an attempt at linking this to cohesion - tension theory. There is no explanation as to why abiotic factors would affect the rate and only basic consideration of what abiotic factors would cause changes.

Question 3 (a) (i)

The majority of candidates were able to gain at least one mark with many gaining both. This question tested candidates' ability to use the diversity index. Some less able candidates did not understand the meaning of the Σ (sum of) symbol.

The results are shown in the table.

Species of butterfly	Number of butterflies	
	Organic farm	Conventional
Cabbage white	22	44
Common blue	12	0
Large skipper	4	0
Monarch	3	0
Painted lady	11	0
Peacock	14	5
Red admiral	35	6
Small copper	2	0
Swallowtail	14	4
	117	59

(a) (i) The index of diversity for the conventional farm is 1.54.

Use the formula to calculate the index of diversity for the organic farm.

1954

$$D = \frac{N(N-1)}{\Sigma n(n-1)}$$

N = total number of organisms of all species
n = total number of organisms of a particular species

22 x 21 = 462
12 x 11 = 132
4 x 3 = 12
3 x 2 = 6
11 x 10 = 110
14 x 13 = 182
35 x 34 = 1190
2 x 1 = 2
14 x 13 = 182
2278

$D = \frac{117(116)}{2278} = 5.957\ldots$ (2)

Answer 5.96

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Examiner Comments

This answer gains both marks and is an example of a correct calculation.

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Examiner Tip

Always show all your working - you may get marks even if you don't get the correct final answer.

Question 3 (a) (ii)

The majority of candidates were able to gain at least one mark with many gaining two or three. Most were able to describe the increased number of butterfly species found on the organic field and many then went on to give an explanation of how chemicals such as herbicides and insecticides would affect the number of species. Surprisingly, only about half of the candidates made reference to the number of plant species and how this would affect the butterfly species. Candidates should try to include biological terms such as niche and habitat where appropriate.

Question 3 (a) (iii)

Most candidates were able to gain at least one mark on this question, with many going on to gain three or four. The majority recognised that abiotic factors, such as temperature, were not well controlled, and that the method of collection was not standardised. Typical examples of criticisms of the method included: not all butterflies being collected, the size of the sweep net and the method of sweeping. Fewer candidates recognised the lack of control of time and the need for more repeats to generate valid data. Now that there is no discrete "practical skills paper", candidates need to expect to be tested on experimental technique from both core and unfamiliar practicals.

(iii) Criticise the method used by the students to obtain these results.

(4)

The use of a sweep net will not give completely accurate results as it does not guarantee that all of the butterflys will be caught. When no more could be seen the sampling stopped but there could have been more butterflies that they did not catch which means their results are not totally reliable. The sampling was only carried out in specific conditions, there may have been more butterflys in the conventional form when the temperatre was lower and the wind speed higher. The experiment should have been carried out multiple times at different temperatres.

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Examiner Comments

This answer correctly criticises the experiment on the basis of the sweeping method, the abiotic factors not being controlled and the lack of repeats.

(iii) Criticise the method used by the students to obtain these results.

(4)

The butterflies were only caught and counted if the students could see them - cabbage white may be easier to spot than other, more camouflaged butterflies. This would make the number of some butterflies disproportionately higher than others, making the results unreliable. All butterflies were not sampled - the students collected them until no more were seen, meaning there could be more unaccounted for. The samples should be taken on exactly the same day in July to eliminate weather conditions of previous days as an extraneous variable. The samples should be ~~taken at a specific temperature~~ taken at a variety of specific temperatures - all noted - so some species are not favoured. The samples should be taken from both farms throughout the year, as some butterflies migrate.

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Examiner Comments

This answer gains three marks for:

- an understanding that the method is not standardised
- an understanding that factors such as temperature change
- an understanding that the time of year could affect the result.

Question 3 (b) (i)

Most candidates were able to correctly describe the changes in butterfly species number over the years although many did not notice the fact that the number levelled off or decreased in the final years. About half of candidates went on to correctly link the increased number of butterfly species with the increased number of plant species. Disappointingly, however, only a minority then explained this in terms of increased diversity of food. It is important to use precise language, and candidates should appreciate that "more food" is a different answer to "more variety of food sources".

(i) Butterflies and plant species were sampled from a range of farms that had used organic farming methods for different lengths of time.

The number of plant species and the number of butterfly species were recorded.

The results are shown in the table.

Years of organic farming	Number of plant species	Number of butterfly species
0	17	4
1 to 5	38	12
6 to 15	42	14
16 to 25	39	12

Explain how the number of years of organic farming affects the biodiversity of butterfly species.

(3)

as the years increase the number of plant species increase. This causes the number of butterfly species to increase as they feed off the nectar in the pollen of the plant. however no. of butterflies decrease by 2 in the years 16-25 which could be todo with the development of preferences or natural selection.

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Examiner Comments

This answer gained all three marks. The idea of an increase and a decrease in numbers of butterfly species is clear and this is linked to an increase in plant species. The candidate then points out that the butterflies feed on nectar; by itself this would not gain a mark, but as they have already explained that there are more plant species, the answer implies that there is more variety of food.

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Examiner Tip

Although no credit was awarded for it in this question, this candidate carries out a calculation to support their answer - this is "good practice".

(i) Butterflies and plant species were sampled from a range of farms that had used organic farming methods for different lengths of time.

The number of plant species and the number of butterfly species were recorded.

The results are shown in the table.

Years of organic farming	Number of plant species	Number of butterfly species
0	17	4
1 to 5	38	12
6 to 15	42	14
16 to 25	39	12

Explain how the number of years of organic farming affects the biodiversity of butterfly species.

(3)

The more years of organic farming, the less insecticides used and therefore the more butterfly species present. However, after 16 years there is a slight decrease which might be the cause of other organisms eating the plants that certain butterflies feed off.

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Examiner Comments

This answer gained two marks. There is a correct description of the change in butterfly species but no link to the increase in number of different plant species. The second mark is awarded for explaining the decrease in butterfly species.

Question 3 (b) (ii)

The majority of candidates gained at least one mark. Most were able to identify that the changes in the moth population matched those in the population of creeping thistle. Surprisingly only about half of candidates suggested a reason, or only gave a vague reason such as "the moths depend on the thistle." Candidates should try to give a specific reason in their explanations, such as a food source, or shelter from predators, rather than using imprecise terms.

(ii) Creeping thistle is considered to be a weed.

Creeping thistle has a deep root system and takes many years to be completely removed by organic farming methods.

The moth population and the number of creeping thistle plants were counted.

The results are shown in the table.

Years of organic farming	Number of moth species	Number of creeping thistle plants
0	15	10
1 to 5	27	235
6 to 15	20	74
16 to 25	10	14

Explain the changes in the number of moth species.

(2)

The moth species fluctuated proportionally with the number of thistle plants. Moths will eat the plants, so if the plants decrease, as will the moths due to competition.

(Total for Question 3 = 14 marks)

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Examiner Comments

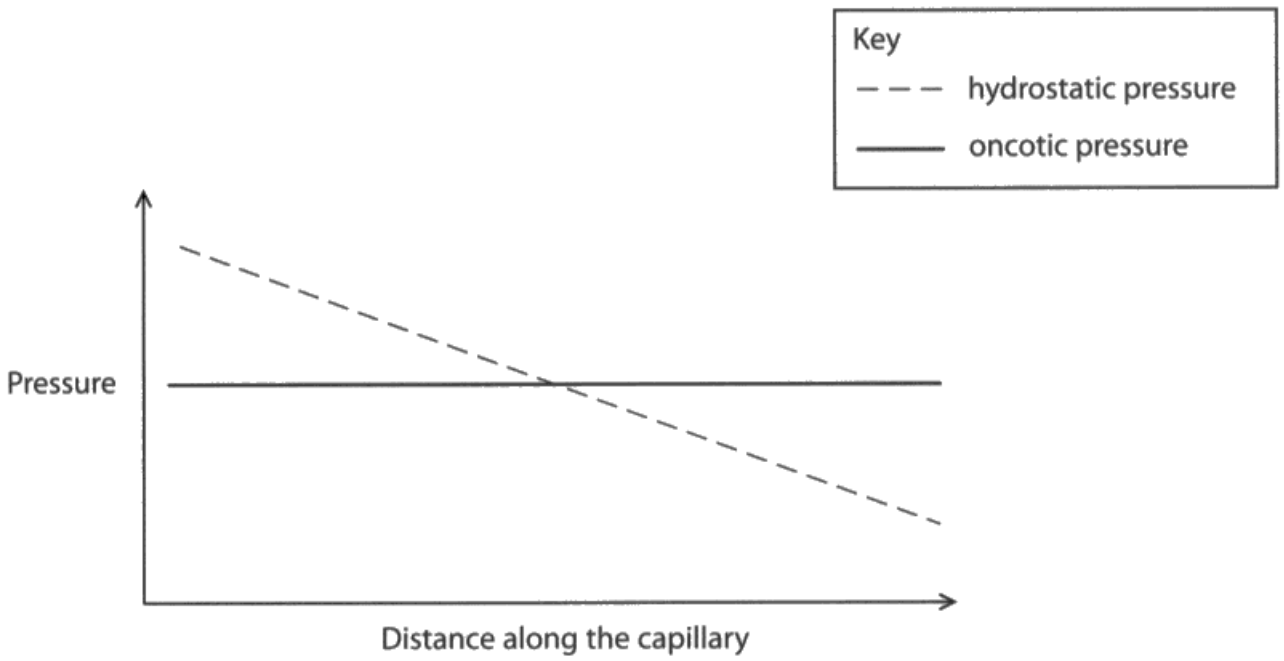
This answer gained both marks. The link between moths and thistles is clear and a reason is given for why changes in population of creeping thistle affects the moth population.

Question 4 (a) (i)

Only half of the candidates gained this mark. Many appreciated that blood is pumped to both the heart and lungs in a double circulatory system but the answer needed to imply that the blood is pumped to the heart and lungs **separately**, as blood is in fact pumped to both the heart and lungs in a single circulatory system. Many (incorrectly) suggested that the system prevented oxygenated and deoxygenated blood mixing, which although true, did not answer the question. A few candidates gave the converse answer and described a single circulatory system without stating why this did not deliver blood at high pressure.

Question 4 (b) (i)

This question generated a big range in the quality of responses. There were several very detailed explanations of the circulation of tissue fluid that used the information in the graph, along with candidates' own knowledge. There were also, however, many answers that suggested that some candidates were unaware of how tissue fluid is formed. This question also required candidates to compare the two different pressures and credit was not awarded where comparisons were not made. "Tissue fluid is released when the hydrostatic pressure is high**er**" would gain a mark. "Tissue fluid is released when the hydrostatic pressure is high" would not gain a mark. About half of candidates were able to correctly compare the pressure but far fewer went on to explain that hydrostatic pressure is generated by the contraction of heart muscle and that oncotic pressure is generated by plasma proteins.



(i) With reference to the diagram, explain how tissue fluid is produced and reabsorbed by the capillaries. (4)

At the arteriole end* the beginning of the graph. the hydrostatic pressure is greater than the osmotic effect causing fluid to leave the capillary - along with solutes such as ~~B~~ amino acids; towards the end of the graph is the venule end. the oncotic pressure is greater than the hydrostatic pressure (which has decreased) fluid re-enters the capillary however not as much re-enters, as left. The tissue fluid is the excess water and solutes which bathes the cells

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Examiner Comments

This answer gained two marks. The candidate makes a correct comparison of the hydrostatic and oncotic pressure and links this to the formation and reabsorption of tissue fluid. They do not explain how the pressures are generated.

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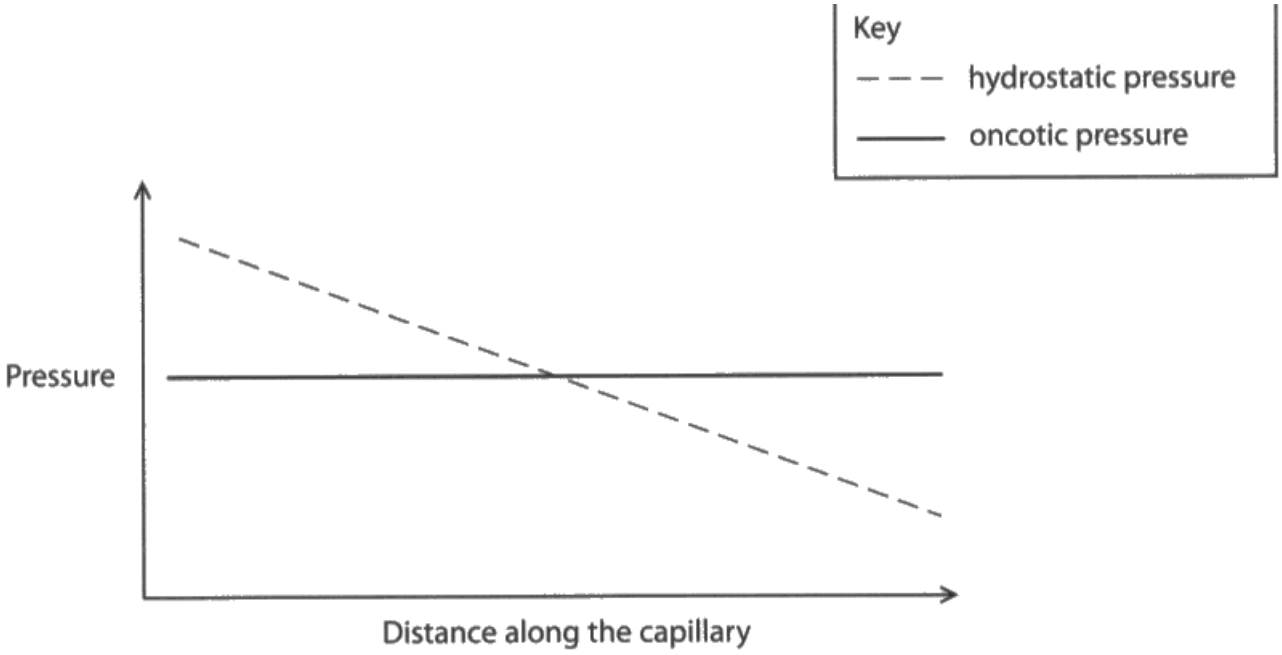
Examiner Tip

Make sure that you make your answer comparative if you are comparing data. Use your own knowledge to explain and analyse data.



(i) With reference to the diagram, explain how tissue fluid is produced and reabsorbed by the capillaries.

(4)

- Tissue fluid is plasma that leaks out of the capillaries through pores – it lacks plasma proteins + red blood cells
- It bathes the tissues + provides a surface for gas exchange
- Tissue fluid is reabsorbed by the capillary when the hydrostatic pressure drops – the oncotic pressure is maintained with the capillary, but towards the end of the capillary the hydrost. pressure decreases.

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Examiner Comments

This answer unfortunately gained no credit. The candidate describes how the hydrostatic and oncotic pressures change along the length of the capillary but does not compare them.

Question 4 (b) (ii)

This question discriminated well between candidates. Many candidates made a good attempt to gain at least one mark. Many were able to recognise that the proteins would build up or accumulate in the tissues and some then went on to explain how this would affect oncotic pressure or water potential. Some candidates did not gain marks due to the use of imprecise language or restating the question stem. Marks were only awarded for a clear implication that the proteins would reduce tissue fluid uptake by the blood (or draw more tissue fluid out of blood). Candidates should be careful not to simply write down the question stem - no credit was awarded for stating that proteins are not removed.

(ii) Lymphatic ducts remove proteins that are secreted by cells.

Explain how a blockage of a lymphatic duct could lead to lymphoedema.

(2)

A blockage would mean lots of proteins would not be delivered to where they need to go and they would not be able to pass the blockage. The proteins would be stuck in the tissue fluid causing the water potential of the tissue fluid to be more negative than the capillary thus the plasma and water will not be reabsorbed.

(Total for Question 4 = 8 marks)

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This answer gained both marks. It is clear that the proteins remain, or are stuck, in the tissue fluid and there is an explanation as to how this affects the water potential.

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Examiner Tip

Make sure that you know whether increasing solute concentration will increase or lower water potential. Be careful not to restate the question stem in your answers.

Question 5 (a)

This question was generally well answered. The majority of candidates understand the events that occur during blood clotting and were able to apply their knowledge to the data. Most stated that smoking increased the levels of thrombin and fibrinogen and then explained how this would lead to clot formation. Only a handful recognised that standard deviations were stated in the data and that these indicated that there was no overlap. As a general rule, if standard deviations (or other statistical measures) are included in data, it is good practice to use them when answering the question.

This answer only gained one mark. The candidate describes the increase in fibrinogen but not the increase in thrombin. There is no explanation of the roles of thrombin and fibrinogen in clotting. The mark awarded is for the recognition that fibrin production leads to clot formation.

(a) Analyse the data to explain why smoking can increase the risk of blood clot formation.

(4)

Due to smoking more, Fibrinogen is produced more, which in the presence of calcium ions turns into a soluble protein called Fibrin. Fibrin can form spindles/bundles which can cause red blood cells and platteletes to form into a clot. So the more Fibrinogen, the ~~more~~ ~~more~~ increase of red blood cells and platelets will occur. This is due to an increase in smoking. Thrombin is made from Thromboplastin and prothrombin which are clotting factors. These increase the likelihood of blood clots because they are in the plasma ~~of red~~ and red blood cells which will be more likely to bunch up and form a clot due to the solute Fibrin molecules.

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Examiner Tip

Use standard deviations and carefully select the important data in your answers.

(a) Analyse the data to explain why smoking can increase the risk of blood clot formation.

(4)

Smoking can increase the risk of a blood clot forming because it increases the amount of thrombin and fibrinogen there is in the blood plasma. A non-smoker had a mean of 56 thrombin concentration whereas smokers had a mean of 121 thrombin concentration. By having more thrombin in the blood it means that there is more to catalyse the conversion of fibrinogen into fibrin to them make meshes to trap platelets causing a blood clot. This also means that the more cigarettes per day that smokers have, the higher their concentration of fibrinogen and thrombin in the blood.

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Examiner Comments

This is a high quality answer that gains three marks. There is a clear statement that both thrombin and fibrinogen increase and this is then linked to the clotting cascade. The answer is organised clearly and logically.

Question 5 (b) (ii)

Candidates generally scored highly on this question, with the majority gaining one mark, and many going on to gain a second mark. Most were aware that neutrophils ingest pathogens and many described the digestion of the pathogens. Some candidates confused neutrophils with lymphocytes and described antibody formation. There was evidence that some candidates clearly knew the function of neutrophils but frustratingly used very imprecise language: "eating / taking in" rather than "engulfing", and "destroying / killing" rather than "digesting" are examples of answers that would not gain credit.

(ii) Describe the function of a neutrophil in defence.

(2)

The neutrophil is part of the non-specific immune system. They engulf and digest pathogens by phagocytosis.

ResultsPlus
Examiner Comments

This answer clearly gains both marks. There are clear references to engulfing and the digestion of pathogens.

ResultsPlus
Examiner Tip

Always use scientific language. Remember that AS is a step up from GCSE and what may have been accepted at GCSE may not be accepted at A level.

(ii) Describe the function of a neutrophil in defence.

(2)

neutrophils aid spa non specific immune response by ingesting pathogens by phagocytosis

ResultsPlus
Examiner Comments

This answer would only gain one mark for the idea of phagocytosis.

ResultsPlus
Examiner Tip

Always "finish the story" when explaining something. This answer stops half way - the pathogens have been ingested, but what happens next?

Question 6 (a)

This question was found to be difficult by a surprising number of candidates. Many seemed to not be aware that blood and water flow in opposite directions in the gill lamellae of bony fish. A range of different directions were suggested by candidates.

Question 6 (c) (ii)

Most candidates were able to gain at least one mark, but only a small number went on to gain all three. Unfortunately, some candidates did not refer to the surface area : mass ratio when making the link between the gill surface area with activity levels. There is an important distinction between surface area and surface area : mass ratio. Despite this, many were able to correctly explain that higher activity requires more oxygen, but then did not complete the story by linking this to respiration for muscle contraction. It is important to relate the increased respiration rate to a function rather than simply stating increased respiration.

(ii) Analyse the data to explain the difference in the activity levels of these fish species.

(3)

The higher the activity level, the greater the comparison of surface area to masses as well as surface area of gill lamellae.

This is because large organisms with a small surface area/volume ratio cannot obtain enough oxygen (O_2) to meet their needs by simple diffusion alone and this is why they require a mass transport system.

Fish species with a higher activity level, (mullet and mackerel), need more oxygen for respiring muscles and tissues.

ResultsPlus
Examiner Comments

This answer gained all three marks. There is a clear reference to the surface area : mass ratio increasing with activity which is then linked to oxygen and respiration in the muscles.

ResultsPlus
Examiner Tip

State why respiration is needed, for example, respiration linked to muscle activity.

(ii) Analyse the data to explain the difference in the activity levels of these fish species.

(3)

Mackrel has a high activity level, as it has the highest comparison of surface area to mass at $10.4\ cm^2g^{-1}$, this is because it will have a higher metabolic rate so will require a higher surface area of gill lamellae available for gas exchange. Toadfish has a low activity level, its surface area of lamellae is ~~20th~~ 80% smaller ~~as it~~ than the mackrel as it has a lower metabolic rate so requires less energy from aerobic respiration so less oxygen is required.

ResultsPlus

Examiner Comments

This gains two marks. There is a clear reference to surface area: mass ratio and this is linked to oxygen uptake. Respiration is mentioned but it is not put into the context of muscle activity.

Question 6 (d)

Candidates generally scored well on this question and were able to interpret the diagrams to explain why the gill damage would affect oxygen uptake or gas exchange. Most gave relevant descriptions of the effects of the heavy metal ions on the gill structure, usually implying a reduction of surface area, reduction in water flow or reduced contact of gills with the water.

Use the photographs to explain why fish die in water polluted with heavy metal ions.

(2)

The surface area of their lamalle is lower (due to the heavy metal ions). Lamallae is the prime site of gas exchange and by decreasing the surface area so much the fish will die as they won't have enough oxygen to respire.

(Total for Question 6 = 8 marks)

ResultsPlus
Examiner Comments

This answer gained both marks. There is a clear explanation of the effect of heavy metal ions in terms of loss of surface area and the candidate then links this with reduced uptake of oxygen.

Question 7 (a)

Most candidates were able to gain at least one mark. "Class" was usually correctly stated along with "Eukarya". There was, however, some confusion as to the genus and species with some candidates picking the wrong species of elephant, inappropriately using capital letters and / or swapping the genus and species names. Candidates should note that genera names begin with a capital letter and species names begin with a lower case letter.

Question 7 (b) (i)

The majority of candidates gained credit on this question with most making references to the similar appearances of the elephant species. Some gave inappropriate similarities such as large size (which could include other large animals) and some candidates gave a generic definition of different species rather than stating that the elephants had not been observed breeding together.

(i) Give one reason why scientists used to classify African elephants as a single species. (1)

They are anatomically similar, have very similar features, characteristics such as the ears and tail.

ResultsPlus
Examiner Comments

This answer clearly gains a mark for stating that the elephants are anatomically similar in appearance.

ResultsPlus
Examiner Tip

When making a comparison, make sure that you compare appropriate features. Stating that both have a backbone would not be appropriate as many other animals have backbones (but were not thought to be the same species).

Question 7 (b) (ii)

Most candidates were aware of the roles of conferences, peer review and scientific journals in presenting and validating research. A few incorrectly discussed how the DNA data itself could lead to a conclusion rather than explaining how the scientists would agree.

(ii) Scientists agreed to separate the African elephants into two species based on new evidence from DNA sequencing.

State how scientists reach agreement on new evidence.

(1)

Through peer review and Scientific Conferences whereby the validity of the evidence is decided. If the evidence is valid, Scientists can agree on a known theory for ...

ResultsPlus
Examiner Comments

This answer clearly gains a mark by correctly stating that peer review and scientific conferences are used to reach agreement on new evidence.

Question 7 (d) (iii)

This question was found to be difficult by many candidates. There were some excellent, very impressive answers showing that some candidates had looked at the data carefully and used their knowledge of haemoglobin dissociation curves to explain it. Many candidates did not appreciate that if the dissociation curve did not shift in either direction then this would mean that the affinity of haemoglobin for oxygen would not be affected by temperature. There was significant confusion as to whether shifting a curve to the left or right would make it more likely for oxygen to be released or to bind more tightly. Many candidates thought that the affinity of haemoglobin would remain high at cold temperatures enabling the mammoth to obtain oxygen from the air in colder weather. Where candidates appreciated that lowering the temperature increased the affinity of elephant haemoglobin for oxygen (so binding more tightly) they often attained two or three marks.

(iii) Scientists extracted the genes for mammoth haemoglobin and used them to produce mammoth haemoglobin.

The oxygen dissociation curve for mammoth haemoglobin at 38 °C was found to be the same as for the Asian elephant at 38 °C.

Lowering the temperature did not shift the oxygen dissociation curve.

Explain how these observations show that this haemoglobin enabled mammoths to be adapted for life in cold Arctic regions.

(3)

These observations show that that this haemoglobin enabled mammoths to be adapted for use in cold Artic regions because lowering the temperature did not shift the oxygen dissociation curve so no matter how cold it got the oxygen would still bind to the haemoglobin so the mammoth found it easier to live in cold artic regions

ResultsPlus
Examiner Comments

This answer shows a common mistake - suggesting that when the temperature is lowered, the haemoglobin is still able to bind oxygen which would maintain oxygen uptake. In the case of the elephants used for comparison, lowering the temperature increases the affinity so that in actual fact they would pick up more oxygen from the air.

ResultsPlus
Examiner Tip

Make sure that you know what moving the curve to the left and right do to the affinity of haemoglobin for oxygen.

(iii) Scientists extracted the genes for mammoth haemoglobin and used them to produce mammoth haemoglobin.

The oxygen dissociation curve for mammoth haemoglobin at 38 °C was found to be the same as for the Asian elephant at 38 °C.

Lowering the temperature did not shift the oxygen dissociation curve.

Explain how these observations show that this haemoglobin enabled mammoths to be adapted for life in cold Arctic regions.

(3)

Means that mammoth oxygen circulation systems were equally effective at any temperature. Mammoths fairly making little effect of oxygen demand because of movement, so no need for a change with temperatures.
If a mammoth became colder, it could release just as much oxygen from haemoglobin to its tissues

ResultsPlus
Examiner Comments

This answer gains one mark. There is no reference to oxygen affinity but the candidate does state that oxygen is still released to the tissues. They do not go on to explain why oxygen release to the tissues is beneficial to the mammoth.

ResultsPlus
Examiner Tip

Always finish off your answer. Explain why maintaining the release of oxygen to the tissues in the cold is beneficial to the mammoth.

Question 7 (d) (i)-ii

Most candidates were correctly able to read the haemoglobin dissociation curve and identify 10 % for part 7(d)(i). Some candidates did not take sufficient care and used the wrong curve.

Part 7(d)(ii) was found to be very challenging for many candidates, with only about one fifth gaining one or both marks. A large number of candidates thought that the answer was simply 10 % of 1.3 cm^3 and did not appreciate how to determine what percentage of oxygen would be unloaded. Some gave incorrect units such as grams. This is an example of a level two maths question that requires candidates to use their maths skills in a biological context.

Question 8 (b) (i)

Many candidates were able to correctly calculate the rate of sucrose transport. A significant number, however, only calculated the mean time and did not use this to then calculate the rate of transport.

Question 8 (b) (ii)

This question discriminated well between candidates. It required candidates to consider the combined effects of two independent variables on the rate of translocation of sucrose. Encouragingly, most candidates gained some credit and were able to analyse the data to some extent. Many candidates recognised that the inclusion of oxygen increased the rate of transport and also that increasing the temperature in the presence of oxygen increased the rate of transport but did not in the absence of oxygen. Many candidates also made correct references to active processes and the effect of temperature on kinetic energy. Where candidates scored less credit, it was typically due to the use of imprecise language. Many simply stated that increasing the temperature increased the rate when this was in fact only true when oxygen was present. Some candidates correctly described the effects of oxygen and temperature but did not go on to give an explanation as to why this would affect transport of sucrose.

(ii) Analyse the data in the table to explain the effect of temperature and oxygen on sucrose transport.

(4)

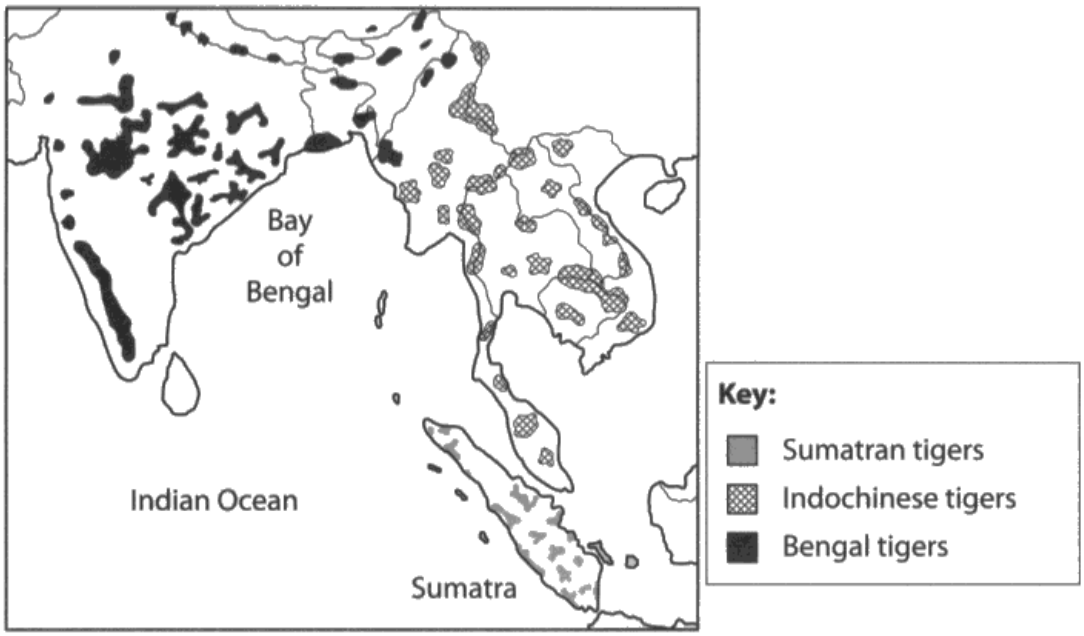
The data shows that an increase in the availibility of Oxygen increases the rate of Sucrose transport, shown by a decrease in time taken for sucrose to travel 200m/hr in a glass chamber containing air rather than Oxygen. This is because sucrose transport happens in the phloem. The phloem uses energy which is why companion cell contain large amounts of mitochondria, for respiration. So more Oxygen meant a higher rate of respiration so the cells had more energy and the sucrose transport is increased. Temperature increase also increases rate of sucrose transport because the particles have more kinetic energy so are more likely to collide so respiration rate is likely to increase.

ResultsPlus
Examiner Comments

This is a good, well explained answer that describes the effect of oxygen and temperature on the rate of transport and gives an explanation for both.

Question 9 (a)

This question generated a good spread of results with many candidates gaining three or four marks. Candidates are clearly very familiar with the process of allopatric speciation. Most were able to describe the role of geographical separation and a large number specifically used the term allopatric speciation (although there was some confusion with sympatric speciation). There was some confusion over the role of reproductive isolation and candidates need to be careful with the wording of their answers. It needs to be clear that reproductive isolation separates populations within a species and that this will lead to speciation rather than simply stating that different species cannot breed together. More able answers made reference to different selective pressure and the accumulation of genetic differences. Again, care needs to be taken to not suggest that geographical separation causes mutations to occur.



(a) Use the map to explain how the different varieties of tiger may eventually become separate species.

(4)

Sumatran tigers could have become reproductively isolated due to the ocean as a physical barrier. (allopatric speciation) The indochinese and bengal could have become separate due to habitat prefernce as they are better suited to the selection pressures of different areas (sympatric speciation) over time, due to differentiation selection pressures and random mutation, allele frequencies change and the tigers become reproductively isolated forming separate species.

ResultsPlus
Examiner Comments

This is a very thorough answer that correctly describes the geographical separation, reproductive isolation, allopatric speciation, different selective pressures and a change in allele frequencies. The candidate does incorrectly mention sympatric speciation but has already gained maximum marks.

ResultsPlus
Examiner Tip

Be careful with the wording of your answers. Reproductive isolation in this context should be something that helps to cause speciation and not a consequence.

Question 9 (b)

The majority of candidates gained at least one mark although there was some confusion as to whether there would be an increase or decrease of genetic disorders in the tiger populations. More able answers described a fall in frequency of genetic disorders and explained this by referring to tigers from different populations breeding together or having wider gene pools. Some candidates thought that the tiger populations would breed with each other and this would cause harmful alleles to spread and increase the frequency of disorders. Candidates should be careful when using the terms inbreeding and interbreeding - they mean very different things.

(b) The development of palm oil plantations in Sumatra has removed areas of forest that provided the natural habitat for these tigers.

Many tigers in Sumatra suffer from inherited disorders.

Explain why planting strips of trees to link the remaining patches of forest would have an effect on the frequency of genetic disorders in these tigers.

(2)

The individuals would be linked so the gene pool will be greater and less chance of developing inherited disorders. If they were completely isolated then the gene pool would be smaller and the frequency would be greater.

ResultsPlus
Examiner Comments

This answer gains both marks. The candidate correctly states that the frequency of disorders will fall and that this is linked to a larger gene pool.

ResultsPlus
Examiner Tip

Use technical vocabulary such as "gene pool" where appropriate but be careful to use the correct terms. Inbreeding and interbreeding are often confused and do not mean the same thing.

Paper Summary

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

- be prepared to analyse unfamiliar data. Gain as much practice as possible
- use scientific knowledge and understanding when giving explanations
- use accurate, scientific vocabulary in answers
- plan answers carefully so that they are precise and not over verbose
- be familiar with all the necessary maths skills that are listed in the specification
- be familiar with the core practicals and have full understanding of how to plan and criticise experiments.

Grade Boundaries

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

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

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