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June 2022

GCE Biology B 9BI0 02

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Introduction

The examiners were impressed with the high standard of many exam papers. The general standard was higher than previous sessions and candidates and centres should be commended for their hard work in preparing for these exams despite the disruption to their education caused by the government response to a viral pandemic. It was clear that many candidates had prepared very thoroughly for these examinations and had developed an excellent grasp of all the topic areas covered. Factual knowledge was generally very strong, although some candidates occasionally did not use accurate, scientific terminology. As a general rule, candidates should always try to use technical language and when doing so, they should ensure that they use it accurately. Mathematical skills were generally very good, although some candidates found using the Hardy-Weinberg equation to determine the number of heterozygotes in a population very challenging. The examiners felt that there was an improvement in the quality of answers to data analysis questions and candidates seem to understand that they often need to apply their knowledge to unfamiliar situations. A minority of candidates still find it difficult to appreciate what certain command words mean. 'Discuss' requires a full exploration of all aspects of a question and 'evaluate' requires both sides of an argument to be considered before drawing a conclusion. The Advance Information clearly helped candidates to prepare certain topic areas as many scored highly on topics that were listed, such as the function of the retina.

Question 1 (b)

This question asked candidates to name three enzymes involved in DNA replication and describe their functions. Strong answers listed DNA helicase, DNA polymerase and DNA ligase and went on to give an accurate description of the function of each. Many candidates gave insufficient detail when describing the function of DNA polymerase, simply stating that it adds nucleotides or forms hydrogen bonds – a reference to the formation of phosphodiester bonds between neighbouring nucleotides was required. Descriptions of the function of DNA ligase were also often slightly vague with many referring joining nucleotides rather than joining fragments of DNA. Most candidates gained at least one mark with many going on to gain all three. A few candidates confused DNA replication with the process of transcription and referred to RNA polymerase and RNA formation.

(b) Describe the roles of three named enzymes involved in DNA replication.

(3)

DNA helicase catalyses the formation of hydrogen bonds between complementary bases (Adenine and thymine, cytosine and guanine). DNA polymerase catalyses the formation of phosphodiester bonds between phosphate group and ribose sugar. DNA ligase lines up ~~catalyses~~ the nucleotides

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Examiner Comments

This answer scored one mark for the role of DNA polymerase forming phosphodiester bonds. All three enzymes are listed but the functions of DNA helicase and DNA ligase are not correct.

ResultsPlus
Examiner Tip

Take care to give descriptions with A level standard detail and use accurate language. Sometimes an answer can be correct but does not have the required detail expected at A level.

(b) Describe the roles of three named enzymes involved in DNA replication.

(3)

- DNA helicase breaks down the hydrogen bonds thus seperating the DNA strands
- DNA polymerase helps link adjacent nucleotides together via phosphodiester bonds
- DNA ligase helps link gaps of DNA sections along the phosphodiester backbone together.

ResultsPlus
Examiner Comments

This is a good answer that gained all three marks. The candidate has given a correct function for each of the enzymes.

(b) Describe the roles of three named enzymes involved in DNA replication.

(3)

- DNA Helicase – unwinds and unzips the ~~part~~ double helix in parts
- DNA ~~Pol~~ Polymerase – attaches the complementary bases to template strand
- DNA ligase – 'glues' the okazaki fragments together – fills in gaps

ResultsPlus
Examiner Comments

This answer gained two marks. Correct functions are given for DNA helicase and DNA ligase. The function of DNA polymerase lacks sufficient detail.

Question 1 (c)

This question assessed candidates understanding of the base pair rules and also mathematical skills. Most candidates gained at least one mark. Some candidates calculated that 15% of the nucleotides would be cytosine but did not then use this to determine the actual number of nucleotides.

Question 2 (a)(ii)

This question assessed candidates' understanding of the action of steroid hormones. Although most candidates are not familiar with how auxin exerts its effects, the question stated that auxin acts in the same way as oestrogen. Strong answers explained how auxin would bind to a receptor protein, that the receptor protein would then change shape and act as a transcription factor binding to DNA and stimulating RNA production. Many candidates scored one mark but only a few went on to gain all three. A significant number of candidates confused the action of steroid hormones with hormones that work via a second messenger.

(ii) Some types of auxin affect the activity of cells in the same way as hormones such as oestrogen affect human cells.

These auxins pass through the cell membrane and affect the synthesis of enzymes.

Explain how these auxins affect the synthesis of enzymes.

(3)

auxins promote cell elongation. auxin binds to transcription factors involved in gene activation. This triggers promoter regions and therefore synthesis of enzymes by transcription

ResultsPlus
Examiner Comments

This answer gained one mark for the binding of the auxin to the transcription factor. The candidate has used a lot of key vocabulary in their answer but there is either a lack of detail (eg promoter region is not linked to DNA) or slight inaccuracies (enzymes are synthesised by transcription).

ResultsPlus
Examiner Tip

When using scientific vocabulary, it is important to use it accurately. It is not enough to have all the correct words if they are in the wrong places.

(ii) Some types of auxin affect the activity of cells in the same way as hormones such as oestrogen affect human cells.

These auxins pass through the cell membrane and affect the synthesis of enzymes.

Explain how these auxins affect the synthesis of enzymes.

(3)

Auxins bind to receptors which ~~cause~~ allows hydrogen ions into the cell. This makes the inside of the cell more acidic- so H^+ ions interact with R groups of ~~an~~ ~~met~~ amino acids and ~~y~~ change the bonding within polypeptide chains which changes the protein produced during translation so the enzyme is not formed.

ResultsPlus
Examiner Comments

This answer gained no marks. Although the candidate has stated that the auxin binds to a receptor, it is not clear that the receptor is within the cell. The rest of the answer is incorrect.

Question 2 (b)

This question discriminated well. Many excellent answers were seen that identified key data patterns including the increased germination rate if the last colour of light was red, although few candidates recognised that the number of exposures had no effect. Stronger answers referred to the overlapping or non-overlapping of the standard deviations and explained what this meant in terms of difference in means. Stronger answers also went on to state that for germination to occur, P_R form of phytochrome needs to be converted to the P_{FR} form. Some candidates gave vague answers, for example, many stated that 'red light had more effect' rather than stating that the last colour being red increased germination rates. A significant number of candidates did not mention the role of phytochrome. Although the role of phytochrome in seed germination is not listed in the specification, candidates should be able to apply their knowledge of phytochrome in flowering of plants to other situations.

Analyse the data to comment on the effect of red (R) and far-red (FR) light on the germination of lettuce seeds.

(4)

When far red light was ~~exposed~~ present independently or as the last light source, the mean number of seeds germinating was significantly greater. The overall mean for red light exposure, under the terms above, was 4.3 compare to only 1.5 when far red light was present as last light source. This indicates how red light stimulates germination as converts P_r into active P_{fr}, able to act as transcription factor, turning genes on. The final light source presented to the seeds has the effect on seed germination. The standard deviation is again greater ~~with~~ red light indicating how the spread of data is more varied; this could limit the overall conclusion

ResultsPlus
Examiner Comments

This is a good answer that gains two marks. The candidate clearly states that germination rates are higher when the last light colour is red and explains how this affects phytochrome. Although the standard deviations are mentioned, the significance of the overlaps is not explained.

ResultsPlus
Examiner Tip

If standard deviations are shown, always look for overlaps.

Analyse the data to comment on the effect of red (R) and far-red (FR) light on the germination of lettuce seeds.

(4)

When red light is the last light received, the mean number of seeds that germinate is higher than when far-red light is the last light received. This is because ~~the~~ red light causes the conversion of R ~~to~~ the inactive phytochrome Pr to the active phytochrome Pfr which stimulates germination. ~~The~~ The more minutes of far red ~~light~~ light that plants with red light as the last light were exposed to, the less germination. For example, in a sequence of R, FR, R, FR, R, ~~only~~ 5 less seeds germinated compared to a sequence of R, FR, R. This is because less Pfr was present.

ResultsPlus
Examiner Comments

This is a strong answer that gains three marks. The candidate clearly states that red being the last light colour increases the germination rate and then goes on to explain that P_R is converted to P_{FR} and then explains that it is the high level of P_{FR} that stimulates germination.

Analyse the data to comment on the effect of red (R) and far-red (FR) light on the germination of lettuce seeds.

(4)

The number of seeds that germinated depended on the last type of light shone on the seeds. When the last light shone was Red light and the mean number of seeds was around 43. All had the same as their standard deviation overlaps so the results aren't different from each other. This is due to Pr being converted to Pfr in red light and Pfr is the active form of phytochrome. When far red was shone last less seeds germinated as only 6 germinated in the 3rd second seaverce and 10 in the 4th seaverce. The standard deviation averages slightly. ~~His shows~~ As pfr is coverted into Pr (inactive) it implies pr inhibits germination and pfr stimulates germinatin

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Examiner Comments

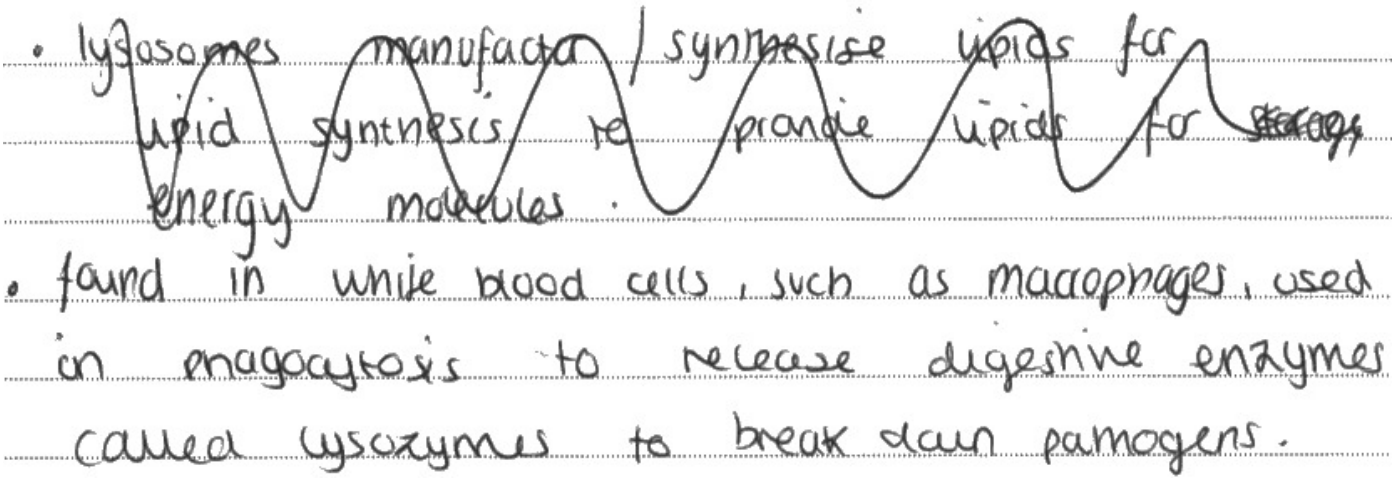
This is an excellent answer that gained all four marks. The significance of the final colour of light is discussed, a correct statement about the overlapping standard deviations is given and the conversion and P_R to P_{FR} is explained along with how P_R must inhibit germination.

Question 3 (a)(iii)

This was well answered by many candidates although a significant number did not give enough detail to gain both marks. The question asked candidates to explain the function of lysosomes so that a reference to lysosomes containing enzymes along with a role of these hydrolytic enzymes was needed. Candidates should try to use scientific vocabulary such as hydrolysis rather than referring to 'breaking down.'

(iii) Explain one function of lysosomes.

(2)



ResultsPlus
Examiner Comments

This answer gains two marks for the idea that lysosomes contain digestive enzymes and that these enzymes digest pathogens.

ResultsPlus
Examiner Tip

Do not use the term 'break down', use terms such as digestion or hydrolysis.

Question 3 (b)(i)

This question was a mathematical calculation that required candidates to read from the graph, rearrange the equation and give the answer to two significant figures. Many candidates were able to correctly read from the graph although fewer were able to rearrange the equation. Most candidates are now confident in using significant figures and were able to gain a mark for use of significant figures in this question. Candidates should show all their working so that they may still gain some credit even if the final answer is incorrect.

(i) The ratio shown in the graph can be calculated using the formula

$$\text{ratio} = \frac{\text{volume of nucleus}}{\text{total volume of cell} - \text{volume of nucleus}}$$

On day 2, the volume of the cell nucleus was 900 μm^3.

Calculate the total volume of this cell on day 2.

Give your answer to two significant figures.

(3)

ratio = 16 $\quad 16 = \frac{900}{x - 900}$

$16(x - 900) = 900$

$x - 900 = \frac{900}{16}$

$x = 900 + \frac{900}{16} = 956.25$

Answer 960 μm^3

ResultsPlus
Examiner Comments

This is an excellent answer that gains all three marks. The candidate has shown all their working so that even if their final answer was incorrect, marks would be gained for other correct stages.

ResultsPlus
Examiner Tip

Always show all working.

(i) The ratio shown in the graph can be calculated using the formula

$$\text{ratio} = \frac{\text{volume of nucleus}}{\text{total volume of cell} - \text{volume of nucleus}}$$

On day 2, the volume of the cell nucleus was 900 μm^3.

Calculate the total volume of this cell on day 2.

Give your answer to two significant figures.

(3)

total volume − volume of nucleus = 900 μm^3 / 16

16 = 900 μm^3 / (total volume − volume of nucleus)

total volume = 56.25 + 900 = 956.25

Answer 956.25 μm^3

ResultsPlus
Examiner Comments

This answer gained two marks. The final answer was not given to two significant figures but the other steps were correct.

(i) The ratio shown in the graph can be calculated using the formula

$$\text{ratio} = \frac{\text{volume of nucleus}}{\text{total volume of cell} - \text{volume of nucleus}}$$

On day 2, the volume of the cell nucleus was 900 μm^3.

Calculate the total volume of this cell on day 2.

Give your answer to two significant figures.

(3)

1900

900 x 16 = 14400

Answer 14000 μm^3

ResultsPlus
Examiner Comments

This answer gained one mark for a correct reading from the graph.

Question 3 (b)(ii)

This question presented candidates with the changes in nucleocytoplasmic ratio of cells as early development proceeds. Candidates were asked to comment on the change in the ratios as time progressed. Most were able to gain at least one mark but only a few, very strong answers gained all three. Many candidates correctly stated that the ratio for all cells steadily increased up to three days. Many candidates then went on to state the ratio for trophectoderm cells then levelled off whilst the inner cell mass cells ratio decreased. Some candidates recognised that the reducing ratio was due to cells becoming smaller after divisions and some went on to explain that the two different cell types had differentiated and the ICM cells were then decreasing in size. Some candidates gave imprecise answers that did not refer to times, instead just giving vague statements about the lines going up and then levelling off.

(ii) Comment on the changes in the ratios as the zygote develops into a blastocyst.

(3)

as the number of cells increase, the ~~ratio~~ nucleocytoplasmic ratio also increase. ~~and~~ the ratio begins to have a ~~the~~ greater ~~go~~ gradient ~~at~~ on day 4 where the cells have developed, ~~and~~ however, the ~~ratio~~ trophectoderm ~~levels~~ begins to levels off on day 4 on a lower ratio of 2:6 compared to the cell ratio of 4:6. ~~and~~ inner cell mass

ResultsPlus
Examiner Comments

This answer gains two marks for the idea of an increase in ratio of all cells up to day 4 and then a levelling off for the trophectoderm cells.

(ii) Comment on the changes in the ratios as the zygote develops into a blastocyst.

(3)

- there is a higher ratio of cells (volume) in the inner cell mass than in the trophectoderm as the zygote develops
- this ratio is equal until day 3, when there are 8 cells
- after day 3, the ~~number~~ amount of cells (volume) in inner cell mass increases sharply, whereas the volume in the trophectoderm plateaus
- this is because the genetic material is contained within the volume of the nucleus (inner cell mass) which must be replicated to code for the baby.

(Total for Question 3 = 10 marks)

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Examiner Comments

This answer also gains two marks for identifying the increase up to day 3 and then the different growth of the two cell types after day 3.

Question 4 (b)(i)

Many candidates found this calculation challenging. Candidates had to use the graph to identify the pressure at the point when the atrioventricular valve closed (when the ventricle pressure increases above the atrial pressure). Many candidates selected the wrong point but were still able to gain marks due to error carried forward. After finding the pressure, candidates had to convert the area of the valve from cm^2 to m^2 and then rearrange the formula. A significant number of candidates were unable to convert the units correctly with many incorrectly assuming that there are 100 cm^2 in 1 m^2. Candidates should be careful when converting units.

(i) An atrioventricular valve in the healthy heart has a surface area of 3.5 cm^2.

Determine the force that is applied to this atrioventricular valve when it closes.

Use the formula

$$\text{Pressure in kPa} = \frac{\text{Force in newtons}}{\text{Area in } m^2}$$

$0.8\ kpa = \frac{x}{350}$ (3)

$\times 350 \qquad \times 350$

$0.8 \times 350 = 280$

3.5 cm
× 100
350 m

Answer 280 newtons

ResultsPlus
Examiner Comments

This answer gained two marks. The pressure has been correctly identified on the graph and the candidate has used the formula correctly. The unit conversion is, however, incorrect.

(i) An atrioventricular valve in the healthy heart has a surface area of 3.5 cm^2.

Determine the force that is applied to this atrioventricular valve when it closes.

Use the formula

$$\text{Pressure in kPa} = \frac{\text{Force in newtons}}{\text{Area in } m^2}$$

~~16 = F / 3.5~~

~~F = 56 kPa ms^2~~

$3.5cm^2 = 3.5 \times 10^{-4}$

16 = F / 3.5×10^{-4}

$F = 5.6 \times 10^{-3}$

(3)

Answer 5.6×10^{-3} newtons

ResultsPlus
Examiner Comments

This answer gained two marks. The unit conversion is correct and the formula has been used correctly. The initial reading from the graph is, however, incorrect.

(i) An atrioventricular valve in the healthy heart has a surface area of 3.5 cm^2.

Determine the force that is applied to this atrioventricular valve when it closes.

Use the formula

$$\text{Pressure in kPa} = \frac{\text{Force in newtons}}{\text{Area in } m^2}$$

cm^2 $\times 100$ $\rightarrow$ m^2

3.5 350

pressure = force / area

force = pressure in kPa x Area in m^2

1.4 x 350

= 490

(3)

Answer 490 newtons

ResultsPlus
Examiner Comments

This answer gained one mark. The reading from the graph and unit conversion are both incorrect but the formula has been rearranged correctly.

Question 4 (b)(ii)

This question required candidates to compare the pressure differences in the atrium, ventricle, and aorta of a heart with a damaged valve with a healthy heart. The question discriminated well with most candidates gaining at least one mark for the idea of reduced oxygen transport to muscles. Many candidates also correctly referred to the backflow of blood into the atrium and recognised that the aortic pressure was lower. Some candidates did not gain full credit as their answers were vague. For example, the statement 'the damaged valve allows backflow of blood' gained no marks but the statement ' the damaged valve allows the backflow of blood from ventricle to atrium' would gain a mark. Candidates should always try to give precise answers that give as much detail as possible.

(ii) Explain why people with an atrioventricular valve that leaks find exercise difficult.

(4)

→ After the atrioventricular valves (AV) close, people with AV valve leaks, still have a much higher pressure in their left atrium compared to normal people - not all the blood has passed into the ventrical.

→ With AV valve leak, a lower maximum pressure is reached. → Oxygenated blood is sent to the body under a lower hydrostatic pressure.

→ The rate of delivering oxygen to respiring tissues is lowered.

→ Rate of respiration lowered, during less ATP for muscle contraction.

(Total for Question 4 = 9 marks)

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Examiner Comments

This answer gained three marks. The candidate correctly states that the ventricle pressure is lower and goes on to explain that there is a slower flow of blood to muscles and less ATP generated. A mark would not be awarded for transport of oxygen to tissues on line 11 but the candidate refers to muscles later in their answer.

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Examiner Tip

Always give precise detail in answers. For example, do not just say that the AV valve stops backflow, say where it stops the blood flowing to.

(ii) Explain why people with an atrioventricular valve that leaks find exercise difficult.

(4)

Having an atrioventricular valve that leaks would cause there to be some backflow of blood when it is moving from the atrium to the ventricles. This would decrease the blood pressure and amount of blood in the ventricles ~~causing~~ causing less blood to be pumped through the aorta to the rest of the body. The decreased blood pressure also means that the contraction will have less force, meaning that blood will not reach the muscle groups used during exercise as efficiently. ~~These~~ This means that ~~there will be a decrease in the rate of respiration respiration~~ with oxygen will not be provided to the muscles as quickly and efficiently and cause a decreased rate of respiration, which means the muscles will not have as much energy to work.

(Total for Question 4 = 9 marks)

ResultsPlus
Examiner Comments

This excellent answer gained four marks. The candidate clearly explains that there is backflow into the atria and then goes on to explain how pressure differences lead to reduced oxygen transport to muscles and respiration.

(ii) Explain why people with an atrioventricular valve that leaks find exercise difficult.

(4)

As there may be backflow of blood or leaks as a result of faulty valves, the constant flow of blood is irregular. There will not be the same amount of blood being pumped around the body and to ~~an~~ warm muscles as there would be in a working valve present body. The body ~~must~~ and heart must work harder and pump more to ~~more~~ maintain a required level of blood flow to reach the same level work as another would.

ResultsPlus
Examiner Comments

This answer gained no marks. The candidate correctly refers to the backflow of blood but does not state where the blood flows back to.

(ii) Explain why people with an atrioventricular valve that leaks find exercise difficult.

(4)

Having a leaky atrioventricular valve results in blood flow back into the atria from the ventricles. This causes the atria pressure to increase during ventricular systole, seen in the graph. As less oxygenated blood is in the left ventricles, a small volume will be forced out into the aorta to be transported around the body. Reduced oxygenated blood is unable to provide sufficient oxygen to respiring muscles resulting in them respiring anaerobically, producing toxic lactic. When doing exercise, energy demand increases in order for the muscle to keep contracting, less oxygen circulating prevents this energy production in the form of ATP leaving the individual fatigued and with muscle pain.

ResultsPlus
Examiner Comments

This excellent answer gained four marks. The candidate describes the effect of the damaged valve on the pressures in the heart and goes on to explain the consequences of this. The answer is also written in a logical way – candidates should be encouraged to think through their answers in logical steps.

Question 5 (b)

Many excellent, detailed, accurate answers were seen to this question. The retina was listed on the Advance Information and it was clear that many candidates and centres had prepared this topic well. Most were able to explain the breakdown of rhodopsin into opsin and retinal and many candidates gave impressive detail regarding the change between cis and trans retinal. Some candidates incorrectly suggested that opsin causes an increase in sodium ion diffusion into the rod cells, depolarisation, and neurotransmitter release. The examiners were impressed with the detailed knowledge shown by many candidates. Candidates should be careful to use correct symbols, for example, they should refer to Na^+ rather than Na.

(b) Explain the role of rhodopsin in the generation of a nerve impulse in cell X when light falls on the retina.

(3)

Rhodopsin is the photopigment found in rod cells which detect dim light. When light falls on the retina, rhodopsin in rod cells is bleached and broken down into opsin and retinal. opsin blocks Na^+ channels so no glutamate (inhibitory neurotransmitter) is released between the rod cell and bipolar cell but a neurotransmitter allowing the action potential to be triggered in cell x which is a bipolar cell. Due to summation and retinal convergence, the threshold is met faster for rod cells so an action potential can occur in the bipolar and travel across the synaptic cleft to the optic nerve.

ResultsPlus
Examiner Comments

This excellent answer gained three marks. The candidate describes how light splits rhodopsin into retinal and opsin and then goes on to describe the closure of sodium channels and reduction in release of glutamate.

ResultsPlus
Examiner Tip

If candidates use the symbol for sodium ions, they should use Na^+ not Na by itself.

(b) Explain the role of rhodopsin in the generation of a nerve impulse in cell X when light falls on the retina.

(3)

- As light falls on retina rod cells have bleaching occurring inside, meaning rhodopsin is broken down into retinal (~~and~~) and opsin.
- Opsin causes cation Na^+ ion channels to close
- Na^{2+} is still transported into rod cells
- ~~this slightly~~ - glutamate is released - inhibitory effect.
- ganglion cells become depolarised

ResultsPlus
Examiner Comments

This answer gained two marks. The candidate correctly states that rhodopsin is broken down into opsin and retinal and goes on to refer to the closure of cation channels. The reference to increased diffusion of sodium and increased release of neurotransmitter is, however, incorrect.

(b) Explain the role of rhodopsin in the generation of a nerve impulse in cell X when light falls on the retina.

(3)

enough
When light hits the rhodopsin visual pigment, it the converts the cis-retinal into trans-retinal. This conversion breaks down the rhodopsin into retinal and opsin these in a reaction called bleaching. The opsin bind to the cell surface membrane and blocks the Na^+ channels. The Na^+ pump works at the same rate and triggers hyperpolarisation. If enough bleaching occurs, it will become so more negative, it reaches the threshold and triggers glutamate neurotransmitters to release to the bipolar neurone - this results in an action potential and thus a nerve impulse.

ResultsPlus
Examiner Comments

This answer gained three marks and illustrates the excellent use of technical terminology. The candidate correctly refers to the hyperpolarisation of the membrane and reduction in glutamate release.

(b) Explain the role of rhodopsin in the generation of a nerve impulse in cell X when light falls on the retina.

(make)

(3)

- Splits into opsin and retinal due to light on the retina
- ~~Due to rod cells being bleached~~
- Rod cells are bleached
- Sodium channels

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Examiner Comments

This answer gained one mark. The candidate understood that rhodopsin splits into opsin and retinal but does not provide any further detail.

Question 5 (c)

This level-based question discriminated well. Candidates were presented with the details of an experiment carried out to investigate the effect of different lengths of time spent in the dark on sensitivity of the retina. The experiment also used two colours of light, one of which stimulates cones and rods, the other only cones. Level three answers discussed the data, recognised that light with a wavelength of 620 nm does not stimulate rods cells but 500 nm does, explained why rod cells are more sensitive and explained why time in the dark increased rhodopsin resynthesis. Level two answers focussed on the data and either the effect of summation or the resynthesis of rhodopsin. Level 1 answers often ignored the data and gave generic descriptions of retinal function or presented answers with no explanation.

Some outstanding answers were seen that fully explained why rods are more sensitive than cones and why time in the dark increased sensitivity. To get level 2 or 3 marks, candidates had to relate the theory to the data. Some candidates only discussed one aspect of the experiment or gave no explanations.

* Analyse the graphs to explain the results of this investigation.

(6)

The results show that the eye is much more receptive to the ~~620~~ 500 nm light than the ~~500~~ 620 nm light. As the minimum amount of light intensity was plateued for 620 at a much higher intensity than the 500. This can be explained by the ~~frequency~~ wavelength of the light. The higher wavelength of the light, the ~~eye~~ ~~be a~~ will have to do more to become more receptive to it. Also, after spending an extended amount of time in dark, the photosensitive pigments within the eye such as rhodopsin must be fully reformed, meaning a ~~stronger~~ dark colour (such as 500nm light), will be easier to detect as rhodopsin is very receptive to darker colours. As shown on the graph the rods are very receptive to 500 nm of high wavelength, whereas cones, which are much more receptive to bright coloured light ~~is~~ ~~re~~ most receptive to high wavelength light e.g. 620nm.

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Examiner Comments

This is a good answer that discusses the data. There is some explanation of why time in the dark increases the amount of rhodopsin and this is related to the data. Level 2, 4 marks were awarded.

Analyse the graphs to explain the results of this investigation.

(6)

The shortest time spent in darkness gave for both wavelengths a greater minimum light intensity at which LED was seen. This is due to less time being available for rhodopsin to resynthesise from opsin + retinal and convert trans-retinal back to cis-retinal following exposure to the white light. Rhodopsin is less able to direct the light as less in its active form. There is a similar trend for low time in darkness for both 620nm and 500nm light due to rhodopsin having low sensitivity to all light.
As time in darkness increases, rhodopsin has been able to resynthesise, increasing its sensitivity, allowing a ~~a~~ lower minimum light intensity to ~~just~~ be detected. 500nm light continues to show this trend as this wavelength is the optimum for rod cells relative sensitivity compared to 620nm. This high wavelength plateaus with minimum light intensity due to ~~less~~ rhodopsin having low sensitivity, seen in the bottom graph. The minimum light intensity for ~~500~~ 500nm light reached a low value due to rod cells having high sensitivity through retinal convergence. Many rod cells can detect the 500nm light at small intensities, joining to one bipolar neurone which provides enough combined stimuli to generate an action potential, allowing light detection.

(Total for Question 5 = 10 marks)

ResultsPlus
Examiner Comments

This is an excellent answer. The data is discussed and related to the explanation. The different sensitivity of rod and cone cells and the resynthesis of rhodopsin are discussed and related to the data. Six marks were awarded.

✱ Analyse the graphs to explain the results of this investigation.

(6)

After exposure to bright light, rhodopsin is bleached so the rod cells cannot detect light until rhodopsin is reformed. However when 500nm light is used, it takes less time for eventually the light can be detected at a much lower intensity than the 620nm light. This is because eventually the rhodopsin reforms and 500nm is the wavelength that rod cells are most sensitive to so they can easily detect it. The minimum light intensity that 620 nm can be seen at is higher than for 500nm. 620 nm is the wavelength that can be picked up by red cones but not rods. Cones are less sensitive to light because only one cone is attached to each bipolar cell. However, many rod cells are connected to one bipolar cell so several sub threshold generator potentials can add up to one threshold potential in the bipolar cell neuron by summation so rod cells are more sensitive to light. This investigation may not

ResultsPlus
Examiner Comments

Although all the lines are not completed, this is an excellent answer that gained six marks. Summation and rhodopsin synthesis are explained and the explanations are linked to the data. This illustrates the concept that precise, accurate answers will often gain credit.

ResultsPlus
Examiner Tip

Do not think that you always have to fill all the space. A shorter answer that is precise, accurate and answers the question will gain credit.

Analyse the graphs to explain the results of this investigation.

(6)

For the 500 nm light, as the time spent in darkness ~~after~~ increases, the lesser the light intensity which LED was seen.

500 nm light falls within ~~the wavelengths of~~ high sensitivity of mainly RODS, and little sensitivity of green cones and very ~~little~~ Red cones and blue cones.

For the 620 nm light at first ~~the~~ when the time spent in darkness increased the minimum light intensity which LED was seen was lesser however after a short time in darkness, the time spent in darkness did not affect the minimum light intensity at which LED was seen.

The 620 nm light falls within ~~mainly~~ high sensitivity with red cones and very little sensitivity with rods and green cones.

For the 500 nm light, the reason why with increased time the less light intensity is needed for led to be seen is because since it falls mainly within rods and green cones, ~~rods~~ for rod cells, ~~the gen~~ for a generator potential threshold to be reached, many rod cells can synapse with one bipolar cell hence the longer time in the dark, more ~~different light~~ range of light intensities can be seen hence lesser light is needed.

while for the 620 nm light, increased time ~~d~~ barely affects and ~~doe sno~~ does not affect the minimum light intensity needed to see the LED is because the light ~~falls mainly~~ is highly sensitive towards the red cones rather than the rods hence since one cone synapses with one bipolar cell, the stimulus which is the light intensity, needs to be bright enough for the cones to generate ~~a~~ an action potential to occur

generator potential for each the threshold for a

(Total for Question 5 = 10 marks)

ResultsPlus
Examiner Comments

This is a very good answer that gained four marks. The data is discussed and the effect of summation explained but there is no real mention of the resynthesis of rhodopsin so the highest level that could be awarded was level 2.

Analyse the graphs to explain the results of this investigation.

(6)

- The independent variable was the ~~type of light~~ type of light wavelength + time in darkness
- control variable = time in total darkness
- The lower wavelength light (500nm) was seen at a lower light intensity than the higher WL LED (620nm)
- At higher wavelengths of light (620nm), the blue cones, rods, green cones + Red cones are all sensitive to light so that's why the volunteer was able to see the 620nm ~~light at~~ LED at a higher light intensity + time in darkness didn't affect this (much).
- At lower wavelengths (500nm), ~~blue~~ cones, rods, green cones + the rods were the most sensitive to light + they have a lower visual acuity ∴ the min light intensity LED they seen at was very low.
- Red cones were the most sensitive to light at ~~500~~ 620nm + they have a high visual acuity.

ResultsPlus
Examiner Comments

This answer gained two marks. The majority of the answer is descriptive with little explanation.

Question 6 (b)(i)

Many candidates found this question challenging. Few referred to oncotic pressure or explained that the oncotic pressure of the plasma is due to plasma proteins that are unable to leave the capillary. Oncotic pressure is the term listed in the specification and so candidates should refer to it. Many candidates did, however, correctly explain that tissue fluid enters due to the net effect of the oncotic and hydrostatic pressures. Many candidates also referred to the movement of water rather than tissue fluid.

(b) Oedema is an accumulation of tissue fluid. This is due to less tissue fluid being returned to the blood capillaries.

(i) Explain how tissue fluid is returned to capillaries.

(3)

→ After tissue fluid ~~leaves~~ is forced out @ the arteriole end @ the capillaries due to the high hydrostatic pressure by the ventricles, and erythrocytes

→ Albumins ~~and~~ (plasma proteins) remain in the capillaries,

→ ∴ oncotic pressure stays constent while hydrostatic pressure drops below it, and @

→ water moves from a high water potential outside the capillary to an area @ low water potential inside,

→ so fluid is returned at the ~~ve~~ venous end.

ResultsPlus
Examiner Comments

This is a good answer that gained two marks. The candidate correctly explains how the difference between hydrostatic and oncotic pressure causes tissue fluid to enter and states that there are more plasma proteins in the plasma compared with the tissue fluid.

(b) Oedema is an accumulation of tissue fluid. This is due to less tissue fluid being returned to the blood capillaries.

(i) Explain how tissue fluid is returned to capillaries.

(3)

Tissue fluid is returned to the capillaries via the lymph glands

ResultsPlus
Examiner Comments

This is an example of an answer that gained no credit. The candidate has misread the question and refers to the movement of tissue fluid into the lymphatic system rather than the capillaries. The candidate may have read the first few words of the question: 'Explain how tissue fluid is returned' and then immediately started their answer.

ResultsPlus
Examiner Tip

Make sure that you read all the words in each question.

(b) Oedema is an accumulation of tissue fluid. This is due to less tissue fluid being returned to the blood capillaries.

(i) Explain how tissue fluid is returned to capillaries.

(3)

Due to high hydrostatic pressure at the arteriole
As the blood vessels increase in distance from the heart
, hydrostatic pressure drops at the venulous end of the
capillary bed. oncotic pressure however is higher
however so the tissue fluid containing nutrients and dissolved
like CO_2 so water diffuses back into capillaries.

ResultsPlus
Examiner Comments

This is an example of a common answer for this question. The candidate correctly explains how the combined effects of oncotic and hydrostatic pressures cause the return of tissue fluid but gives no further detail.

Question 6 (b)(ii)

This question generated answers with a wide spread of quality. Strong answers used detailed, accurate terminology, referring to reduce pumping of sodium ions out of the ascending limb, reduced removal of water by osmosis from the descending limb due to the higher water potential of the medullary fluid and reduced removal of water from the collecting duct. Weaker answers often did not refer to the ascending and descending limbs giving vague statements such as lower water uptake or less salt movement. Candidates also need to be careful when describing water potentials – many referred to lower salt concentration lowering the water potential.

(ii) Furosemides are drugs that are used to reduce oedema. They are diuretics that increase urine production.

Furosemides reduce the active transport of sodium ions by the loop of Henle.

Explain how furosemides cause an increase in urine production.

(4)

☆ less Na^+ ions enter the medulla tissue in the kidney

☆ As less / Active transport occurs and Na^+ ions cannot move by themselves.

☆ so less accumulation / lower salt concentration in the medulla tissue.

☆ ~~if~~ Making medulla have a higher water potential than normal, as less concentrated salts present.

☆ So a The difference in water potential ~~of the~~ between the collecting duct and medulla is lower,

☆ So ~~less~~ there is less tendency for water to move into medulla by osmosis ☆ as lower concentration gradient of water, ☆ so more water is lost via collecting duct.

ResultsPlus
Examiner Comments

This answer gained one mark. There is a lot of information given about sodium ion movement but key details are missing. One mark was awarded for the increased water potential of the medullary fluid.

(ii) Furosemides are drugs that are used to reduce oedema. They are diuretics that increase urine production.

Furosemides reduce the active transport of sodium ions by the loop of Henle.

Explain how furosemides cause an increase in urine production.

(4)

If there is less active transport of sodium ions, which would occur in the ascending loop of Henle then there would be less ions outside of the loop meaning less water would leave the descending loop via osmosis and more ions would be left in the loop, if there is more of both water and ion in the loop this would mean that more urine would be produced as there is more content in the loop to be passed onto the urinary tract.

ResultsPlus
Examiner Comments

This answer gained two marks for the idea of fewer sodium ions being pumped out of the ascending limb and less water absorption by the descending limb.

Question 7 (a)(i)

Many candidates were able to give a definition of a dominant allele although a significant number found the question very challenging. Strong answers stated that dominant alleles will affect the phenotype or area expressed when only one copy is present. Many candidates gave imprecise definitions such as, 'alleles that overpower other alleles' or 'alleles which affect a phenotype.' Candidates should make sure that they know formal definitions for genetics terms.

(a) The scientists concluded that feather colour in owls is controlled by a single genetic locus. The brown allele is dominant to the grey allele.

(i) State what is meant by a dominant allele.

(1)

A dominant allele is what influences the phenotype

ResultsPlus
Examiner Comments

This answer scored no marks. The answer is far too vague.

(a) The scientists concluded that feather colour in owls is controlled by a single genetic locus. The brown allele is dominant to the grey allele.

(i) State what is meant by a dominant allele.

(1)

Dominant alleles ~~are the~~ cause the phenotype to be displayed on the individual ~~and is~~

ResultsPlus
Examiner Comments

This answer scored no marks. It is too vague as two recessive alleles would affect a phenotype.

(a) The scientists concluded that feather colour in owls is controlled by a single genetic locus. The brown allele is dominant to the grey allele.

(i) State what is meant by a dominant allele.

(1)

An allele always expressed to phenotype if present, even if another recessive allele is present.

ResultsPlus
Examiner Comments

This answer gained one mark. The candidate makes it clear that only one copy of the allele is needed to affect the phenotype.

Question 7 (a)(ii)

Many candidates found this question challenging. Candidates were asked to explain the range of phenotypes of feather colour after being told that feather colour is not a polygenic trait. Few answers recognised that the two peaks represented a peak for owls with two grey alleles and peak for owls with two brown alleles or a grey and a brown allele. Few also recognised that the variation around the peaks would be due to environmental factors or subjective scoring of the colours. A few more candidates recognised that the higher peak for grey owls may have suggested some form of natural selection. Many candidates suggested that disruptive selection would have occurred. Many other candidates also simply gave descriptions rather than giving an explanation.

(ii) Explain the range of feather colours, shown in the graph, in this population of owls.

(2)

Owls with a colour score of 2 had the highest percentage of all owls. They are the most grey owls.

ResultsPlus
Examiner Comments

This answer gained no marks. There is no explanation given for the range of phenotypes.

(ii) Explain the range of feather colours, shown in the graph, in this population of owls.

(2)

The wide range of feather colours shows genetic diversity within tawny owls. Grey owls with a colour score of 2 ~~were~~ had the highest penentage, suggesting the allele for these grey feathers is advantageous and passed on to the next generations by natural selection.

ResultsPlus
Examiner Comments

This answer gained one mark for the idea that the grey allele is advantageous and so has increased in frequency.

(ii) Explain the range of feather colours, shown in the graph, in this population of owls.

(2)

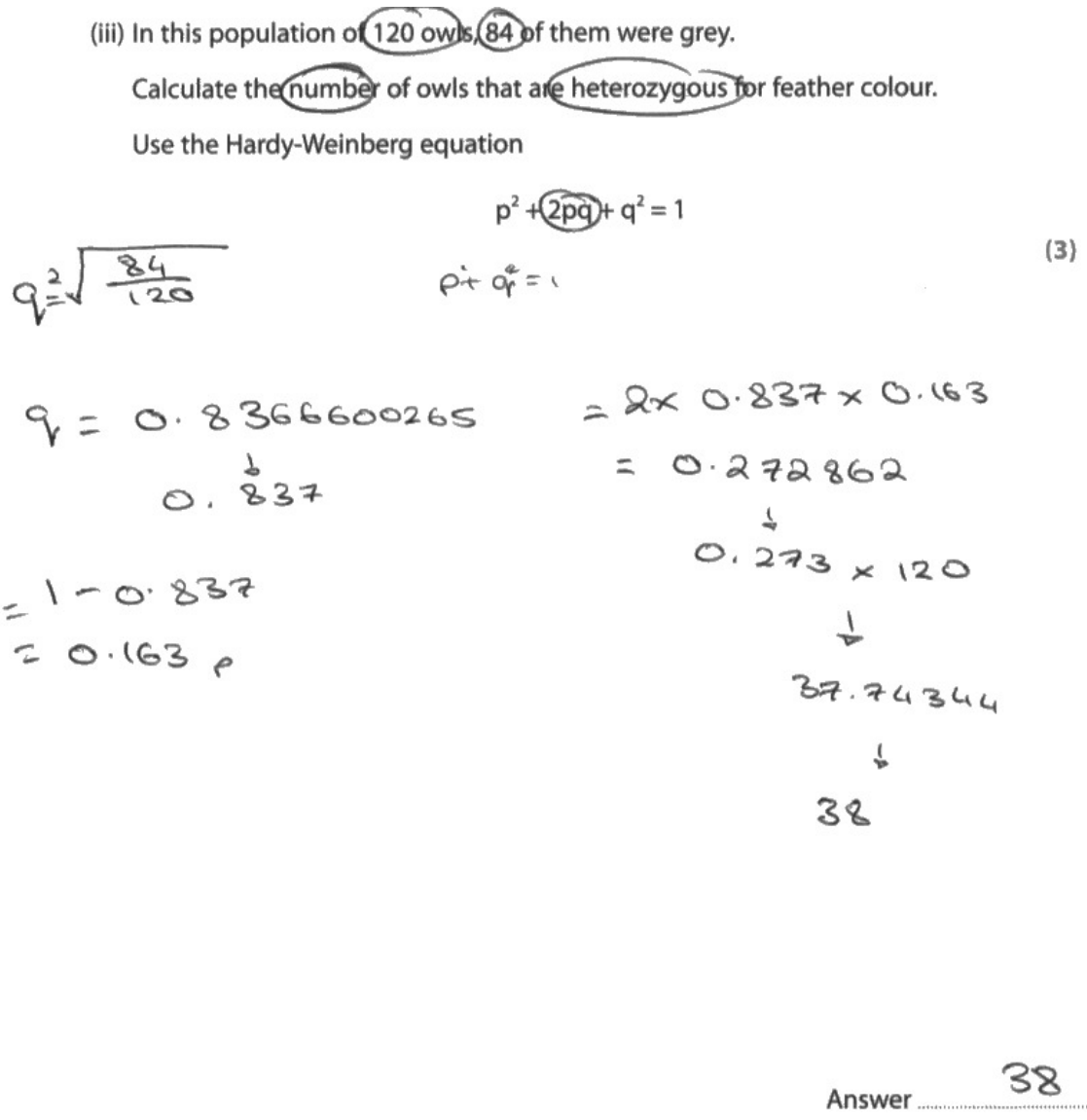
-30% of owls where grey because it is an advantageous allele that allows them to camoflague in areas close to the artic circle. This allows them to survive from predators and hunt prey withat being seen. The percaltage of owls with strong brow feathers are low (17.) as this is ~~no~~ a trait ~~allele~~ with no benefit,

ResultsPlus
Examiner Comments

This answer gained one mark for explaining how the grey allele may have given the owls an advantage

Question 7 (a)(iii)

This question generated a very mixed range of answers. Many candidates are now well versed in completing Hardy-Weinberg calculations, but some candidates found the calculation very challenging. Some candidates were unable to calculate the frequency of the recessive, grey, allele (q). Determining 'q' should always be the first step of a Hardy-Weinberg calculation. Some candidates were able to correctly calculate q and p but were then unable to determine the proportion of heterozygotes.


(iii) In this population of 120 owls, 84 of them were grey.

Calculate the number of owls that are heterozygous for feather colour.

Use the Hardy-Weinberg equation

$p^2 + 2pq + q^2 = 1$

(3)

$q = \sqrt{\frac{84}{120}}$

$p + q = 1$

$q = 0.836660026$

0.837

$= 1 - 0.837$

$= 0.163$ p

$= 2 \times 0.837 \times 0.163$

$= 0.272862$

0.273×120

37.74344

38

Answer 38

ResultsPlus
Examiner Comments

This answer gained two marks for correct calculations of p and q. The candidate unfortunately made an error when calculating the number of heterozygotes.

(iii) In this population of 120 owls, 84 of them were grey.

Calculate the number of owls that are heterozygous for feather colour.

Use the Hardy-Weinberg equation

$$p^2 + 2pq + q^2 = 1$$

(3)

$q^2 = \frac{84}{120} = 0.7$

$q = 0.84$

$p = 1 - q$

$= 1 - 0.84$

$= 0.16$

$2pq = 2 \times (0.84 \times 0.16)$

$= 2 \times 0.1344$

$= 0.2688$

120×0.2688

$= 32.256$

Answer 32

ResultsPlus
Examiner Comments

This answer gained all three marks. The candidate shows all the working well and shows how they reach the final answer.

(iii) In this population of 120 owls, 84 of them were grey.

Calculate the number of owls that are heterozygous for feather colour.

Use the Hardy-Weinberg equation

$p^2 + 2pq + q^2 = 1$

2pq

84/120 = 0.7 = dominant = p

(3)

0.3 = recessive (brown) = q.

$0.3^2 = 0.09$ } + ⇒ 0.58

$0.7^2 = 0.49$ }

2pq = 1 − 0.58 = 0.42.

Answer 0.42.

ResultsPlus
Examiner Comments

This answer gained no marks. The candidate has not calculated the values of p and q correctly.

Question 7 (b)

This question presented candidates with data on brown and grey owl populations along with the depths of snow over time. Candidates were asked to evaluate whether the data showed that human activity was causing a change in allele frequency of the owls. Strong answers discussed all aspects of the data, gave explanations for how human activity would have an effect and also gave reasons why the conclusion was not correct. As the question asked candidates to evaluate the evidence, both sides of the argument had to be considered to reach level 3. Most candidates were able to describe the data patterns and give some explanation for them to gain three or four marks. Only the strongest candidates explained why the data may not support the conclusion and went on to score five or six marks. When asked to evaluate, candidates should always give both sides of an argument.

The scientists concluded that increased greenhouse gases from human activity are resulting in an increase in the frequency of the brown allele.

Analyse the data to evaluate this conclusion.

(6)

The mean snow depth decreases between 1980 and 2007, starting at around 11cm and ending around 2cm. Since brown owls are more likely to survive in lower snow depths than higher ones, as the will stand out more to predators if there is more snow so it acts as a selection pressure against them, the percentage of ~~owls~~ brown owls surviving has likely increased over time as the snow depth has decreased. This is backed up by the increase in percentage of brown owls. As the snow depth decreases, the grey owls will become selected against as they will become more noticable than the brown owls to predators so they their population gets smaller and the grey alleles a ~~are~~ and homogenous recesive genotype is selected against. This would increase the frequency of the brown alleles as they become selected for which is shown in the increase in the percentage of brown owls in these years going from around 12% to around 45%. However no data is provided linking a decrease in snow depth to climate change and although it is unlikely there could be another factor decreasing the snow depth or a different selection pressure selecting for the brown feathers so the scientists cannot be sure.

(Total for Question 7 = 12 marks)



This is an excellent answer that was awarded five marks. The candidate discusses the data, gives explanations for the changes in owl populations and gives a reason why the data may not be supportive.



If the command word is 'evaluate' always give both sides of an argument.

The scientists concluded that increased greenhouse gases from human activity are resulting in an increase in the frequency of the brown allele.

Analyse the data to evaluate this conclusion.

(6)

Graph 1:

- as snow depth increases, the percentage of brown owls that survive decreases more than that of grey owls.
- This is because grey owls blend in more with white snow and are more adapted to it, whereas brown owls are more easily seen by predators against the snow hence have a lower survival percentage

Graph 2

- mean snow depth has been, on average, decreasing steadily from 1980 to 2007, from an average of 12 cm to an average of 3cm.
- this is due in part to global warming, which increases temperatures via the greenhouse effect throughout all seasons, hence decreasing the likelihood of snow.
- In 2007, there was no snow, a mean depth of 0, which is more favourable for brown owls than it is grey ones, since grey owls do not blend in against brown and green dirt vs white snow, hence grey owls are more visible to predators

* However, brown owl population % already increasing before 1980 a snow depth decrease. Brown allele is dominant to grey allele, which could are increase as owls breed. Other factors could be reducing numbers of grey owls.

Graph 3

- percentage of owls that are brown has been increasing since 1960, from 12% to 42%, a 30% increase
- However, there was already an increase in the percentage of brown owls from 1960 to 1980, where there is no data for mean snow depth. This suggests there are other factors during the increase in brown owls, and hence the number of owls surviving to pass on the brown allele.

therefore a reasonable conclusion but not complete picture of causes of % pop increase

(Total for Question 7 = 12 marks)

Conclusion:

- global warming decreasing snow levels due to increased temperatures
- decreased snow levels less favourable to grey owls *
- increase in population % of brown owls ∴ increase in brown allele frequency.

ResultsPlus
Examiner Comments

This excellent answer that gained five marks is a well organised answer. All the graphs are explained, counter arguments given and a conclusion reached.

The scientists concluded that increased greenhouse gases from human activity are resulting in an increase in the frequency of the brown allele.

Analyse the data to evaluate this conclusion.

(6)

• The population of the brown owls is increasing as a result of climate change.

• As the brown owls have a higher chance of survival in fewer snow depth, as a result of global warming the snow depth is decreasing. The population percentage of Brown owls increase, they are almost 50% percent of the owl population.

ResultsPlus
Examiner Comments

This answer is mainly a description of the data and so gained 1 mark.

The scientists concluded that increased greenhouse gases from human activity are resulting in an increase in the frequency of the brown allele.

Analyse the data to evaluate this conclusion.

(6)

While this is true it is due to Directional . Where grey tawny owls survive + thrive better in higher snow depth as opposed to the brown owls. This may be due to being able to better camoflage with the snowy environment from predators. than brown owls. The increasing rate of greenhouse gases emitted has caused a significant decrease in snow depth as per the graph indicating that by 2007 snow depth hit 0cm. The human activity of burning fossil fuels releasing locked up CO_2 carbon releases CO_2 into the environment, a known greenhouse gas, at which trap long wavelength radiation from the sun, this heat reduces snow depth melting it This leads to a higher number of surviving brown owls compared to grey as they are hunted easier. This higher survival rate means the dominant brown allele is more frequent as it is passed down

(Total for Question 7 = 12 marks)



This is a good quality answer that discusses the data and gives explanations. There is, however, no counter argument so is a level two answer gaining four marks.

Question 8 (b)

This question asked candidates to look at the changes in soil depth, mass of nitrate and mass of leaf litter of areas of ground exposed after a glacier has melted. Candidates were asked to explain the changes shown in the table. Many candidates gained at least one mark with many gaining three marks. Most candidates understood that primary succession had occurred. Many stated that pioneer species had arrived, microbial decomposition had increased the mass nitrates in the soil and more niches/soil depth was available for more plants to grow. Few candidates directly related the theory to the data in the table and did not identify the jump in nitrate content after 100 years or the decrease in leaf littering after 150 years. Candidates should always try to organise their answers around the data.

(b) Explain how succession brings about the changes in the soil during this period of time.

(5)

pioneer species, such as lichen, colonise area. Lichen grow on bare rock that is left after melting. pioneer species like lichen are highly adapted to withstand harsh environmental conditions. Eventually pioneer species break down rock and they die + decomposed by microorganisms. Produces humus → organic material in soil. Allows for more complex organisms to grow and they outcompete lichen as they have more ecological niche's. These then decompose and process repeats. As more plants/organisms decompose more nitrates are added to the soil which means larger more complex organisms can grow → more nitrates → more amino acids produced ∴ more plants so greater amount of leaf litter. Climax community created.

ResultsPlus
Examiner Comments

This answer gained three marks. Succession is explained correctly but there is no reference to timings or the subtle changes that occur.

(b) Explain how succession brings about the changes in the soil during this period of time.

(5)

Pioneer Coloniser Species arrive when abiotic factors are harsh and there isn't much nitates & nutrients in soil and occupy a ~~sp~~ highly specialised niche. Pioneer species break down rocks with roots to form more soil and then die & decompose ~~to~~ returning nitrates & nutrients into the soil so abiotic factors become less harsh. Coloniser species arrive & ~~out~~ out compete pioneer species, coloniser species usually larger plants with more niches so pioneer species die out. Coloniser species also dies & decomposes, forms more soil & returns nitrates & nutrients to soil. More species arrive and ~~g~~ soil becomes more fertile, eventually, stable climax community is reached.

ResultsPlus
Examiner Comments

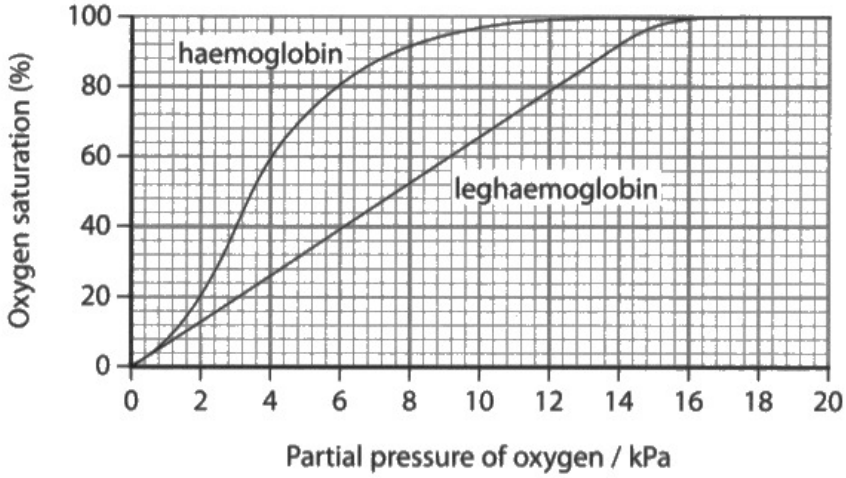
This answer also explains succession well but does not give any time frames or identify the more subtle features of the data.

Question 8 (c)(i)

This question presented candidates with the oxygen dissociation curve for leghaemoglobin and haemoglobin and asked candidates to explain how it shows that the structure of leghaemoglobin is more similar to myoglobin than haemoglobin. Many candidates incorrectly suggested that both myoglobin and leghaemoglobin has very high affinities for oxygen and that both are shifted to the right of haemoglobin. Strong answers that gained two or three marks explained leghaemoglobin does not have a sigmoidal curve and so no cooperative binding occurs.

(c) The roots of some of the plants growing around the glacier were found to contain an oxygen binding protein called leghaemoglobin.

The graph shows the oxygen dissociation curve for leghaemoglobin and the oxygen dissociation for haemoglobin.



(i) Leghaemoglobin is a protein that is similar in structure to myoglobin. Both of these proteins have one subunit.

Explain how the oxygen dissociation curve shows that the structure of leghaemoglobin is more similar to myoglobin than to haemoglobin.

(3)

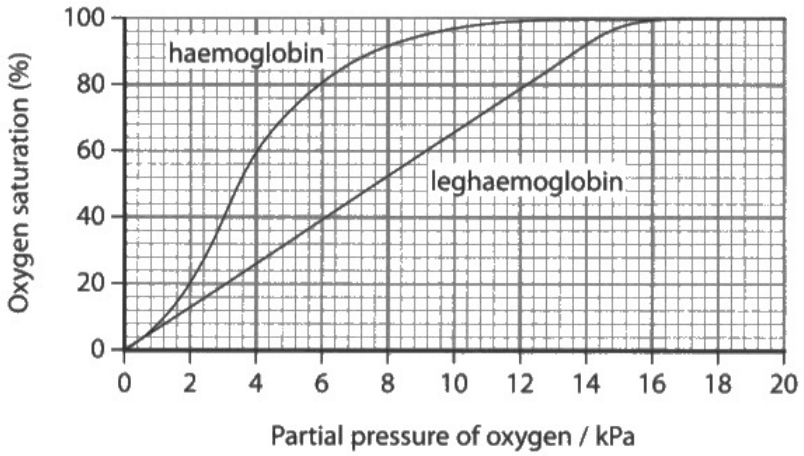
The leghaemoglobin graph isn't sigmoidal # like the haemoglobin curve, it is linear before levelling off after a 14kPa partial pressure of oxygen.
Oxygen dissociation curve for haemoglobin is s-shaped as it has 4 subunits for oxygen to bind to and each subunit has a different oxygen affinity. Leghaemoglobin is ~~has~~ linear up to 14kPa pp(O_2) as there is only one subunit for oxygen to bind to.

ResultsPlus
Examiner Comments

This good answer gained two marks. The candidate clearly explains that leghaemoglobin does not have a sigmoidal curve and has a constant affinity for oxygen.

(c) The roots of some of the plants growing around the glacier were found to contain an oxygen binding protein called leghaemoglobin.

The graph shows the oxygen dissociation curve for leghaemoglobin and the oxygen dissociation for haemoglobin.



(i) Leghaemoglobin is a protein that is similar in structure to myoglobin. Both of these proteins have one subunit.

Explain how the oxygen dissociation curve shows that the structure of leghaemoglobin is more similar to myoglobin than to haemoglobin.

(3)

haemoglobin produces a curved graph due to the conformational shape change that occurs changing the binding of oxygen to the other 3 subunits. whereas because leghaemoglobin and myoglobin only have one subunit, there is no shape change so each O_2 molecule binds in the same way, producing a straight graph.

ResultsPlus
Examiner Comments

This excellent answer gained all three marks. The candidate has stated that leghaemoglobin does not have a sigmoidal curve and that this is because cooperative binding does not occur.

Question 8 (c)(ii)

Most candidates gained at least one mark on this question, usually for correctly stating that the oxygen levels in compacted, water-logged soil is low. A significant number of candidates did not go on to gain further credit as they gave no reference to respiration or functions of the ATP that has been produced. Strong answers gave uses for the ATP such as the active uptake of nitrate ions which can be used to mark amino acids. Many candidates focused on the gaining of oxygen without extending their answer to explain how gaining oxygen would increase growth.

(ii) Explain how leghaemoglobin enables these plants to grow in waterlogged and compact soils.

(3)

In waterlogged soils, water fills up the air spaces which means less oxygen is available in the soil. Since leghaemoglobin has high affinity for oxygen, it acts a store for oxygen and releases it when needed so the plant has oxygen available for respiration

ResultsPlus
Examiner Comments

This answer gained two marks. The candidate explains that the waterlogged soil lacks oxygen and that the leghaemoglobin enables respiration to occur. There is no explanation of how respiration will increase growth.

(ii) Explain how leghaemoglobin enables these plants to grow in waterlogged and compact soils.

(3)

because leghaemoglobin doesn't have a high oxygen saturation it is therefore easier to be able work underground in waterlogged and compact soil because the soil wouldn't be able to have much oxygen entering and exiting out.

ResultsPlus
Examiner Comments

This answer gained one mark for the correct statement that waterlogged soil lacks oxygen.

(ii) Explain how leghaemoglobin enables these plants to grow in waterlogged and compact soils.

(3)

Oxygen usually enters roots by diffusion
Less enters by diffusion in waterlogged and compact soils.
Leghaemoglobin has an affinity for oxygen, increases diffusion of oxygen into the root cells.
Oxygen required for respiration, to produce ATP, for active transport of mineral ions in the soil into the roots, to be used to for growth for example nitrates for proteins.

ResultsPlus
Examiner Comments

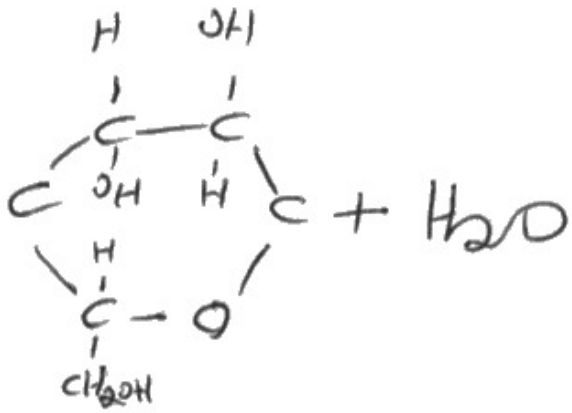
This excellent answer gained all three marks. The candidate clearly explains that waterlogged soil lacks oxygen and that the leghaemoglobin enables the plant to respire and release for nitrate uptake and protein synthesis.

Question 9 (a)(ii)

A significant number of candidates found this question challenging although many gained both marks. A few candidates drew α-glucose and others did not draw accurate ring structures. A minority of candidates also incorrectly drew water molecules.

(ii) Draw one of the products of the hydrolysis of this part of the cellulose molecule.

(2)

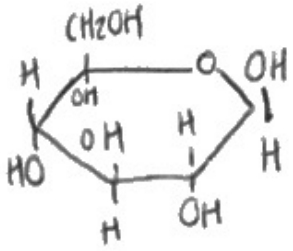


ResultsPlus
Examiner Comments

This answer gained no marks. The ring structure is not complete and the candidate has included water.

(ii) Draw one of the products of the hydrolysis of this part of the cellulose molecule.

(2)



ResultsPlus
Examiner Comments

This gained one mark. The OH group on carbon number one is correct but the candidate has made an error by adding an OH group to carbon number five.

Question 9 (a)(iii)

Most candidates were able to gain at least one mark on this question, but few went on to gain all three. Most were able to explain that cellulose is a straight chain molecule and is bonded to other cellulose molecules by hydrogen bonds. Few went on to explain how the structure of cellulose means that it strengthens cell walls so that cells do not burst when under pressure. Only a handful of candidates explained that the structure of cellulose means that it is permeable to water molecules. A small number of candidates suggested that cellulose has a branched or helical structure.

(iii) Explain how the structure of cellulose is adapted for its function in plant cell walls.

(3)

Cellulose is unbranched and forms β-1,4 glycosidic bonds in an alternating pattern forming straight chains. These chains form hydrogen bonds with each other to form strong microfibrils that protect the plant cell as they require a lot of energy to break.

ResultsPlus
Examiner Comments

This answer gained two marks. The candidate explains that cellulose molecules are straight chains and are joined by hydrogen bonds.

(iii) Explain how the structure of cellulose is adapted for its function in plant cell walls.

(3)

~~opposite~~ parallel strands of cellulose form Hydrogen bonds between each other creating cellulose microfibrils allowing for high tensile strength. Cellulose has many 1-4 glycosydic bands and is unbranched so its compact and a good energy store. Also insoluble due to it being non-polar ~~meaning~~ so its doesnt effect osmotic potential.

ResultsPlus
Examiner Comments

This answer gained just one mark for stating that hydrogen bonds hold molecules together.

(iii) Explain how the structure of cellulose is adapted for its function in plant cell walls.

(3)

• cellulose molecules react in a condensation reaction, to form straight-chain cellulose microfibrils. The straight chains provide a rigid structure cell wall, so cell can withstand turgor pressure.

• ~~cellulose is made of β glucose molecules~~

• Hydrogen bonds can form between cellulose microfibrils to make layers of microfibrils, which strengthen cell wall

• ~~cellulose molecules are arranged in a crossed~~

ResultsPlus
Examiner Comments

This is a strong answer that gained all three marks. The candidate states that cellulose molecules are straight chains that are hydrogen bonded to each other. They go on to state that the strength of cellulose means that it can withstand turgor pressure.

Question 9 (b)(i)

Around half of the candidates correctly answered this question. Some candidates gave confused answers that did not refer to the idea that an index of diversity takes into account the populations of each species as well as the number of different species.

(i) State why calculating an index of diversity is a better measure of biodiversity than counting the number of different species.

(1)

takes into accound number of species and number of individuals in each species.

ResultsPlus Examiner Comments

This answer correctly states that an index of diversity takes into account both populations and numbers of different species.

(i) State why calculating an index of diversity is a better measure of biodiversity than counting the number of different species.

(1)

more accurate and effective.

ResultsPlus Examiner Comments

This answer gained no marks. The candidate has given a vague reference to accuracy which does not answer the question.

(i) State why calculating an index of diversity is a better measure of biodiversity than counting the number of different species.

(1)

Because the index of diversity takes into account the ~~number~~ population of each species

ResultsPlus
Examiner Comments

This answer gained one mark. A correct reference to the index of diversity taking populations into account is given.

Question 9 (b)(ii)

This question assessed candidates' understanding of the benefits of in situ conservation compared with ex situ conservation. Most candidates were able to give at least one benefit although many simply gave a description of what in situ conservation is (animals remain in natural surroundings was often seen) rather than explaining the benefits. Common correct answers included behaviours not being affected, whole areas and food webs being conserved and reduced inbreeding. Some candidates still confuse inbreeding with interbreeding. A small number of candidates incorrectly stated that in situ conservation places organisms in zoos.

(ii) Give two advantages of in-situ conservation of elephants compared with ex-situ conservation of elephants.

(2)

Remain in natural habitat so they arent being disturbed when move due to transport.
Help the local ecosystem maintenance and maintain food web.
Cheaper as no specialsed area is required to be built.

ResultsPlus
Examiner Comments

This answer gained two marks for the idea of no transportation and the maintenance of the whole ecosystem.

(ii) Give two advantages of in-situ conservation of elephants compared with ex-situ conservation of elephants.

(2)

- Breeding programmes can be set up with in-situ conservation of elephants
- Able to track the trade of elephants or moving of elephants for breeding from one place to another using log books.

ResultsPlus
Examiner Comments

This answer gained no marks – the candidate has confused in situ conservation with ex situ conservation.

(ii) Give two advantages of in-situ conservation of elephants compared with ex-situ conservation of elephants.

(2)

→ allows them to keep their natural instincts as elephants ~~confilit~~ kept in natural habitat
→ will not disrupt ecosystems as elephants kept in their natural habitat

ResultsPlus
Examiner Comments

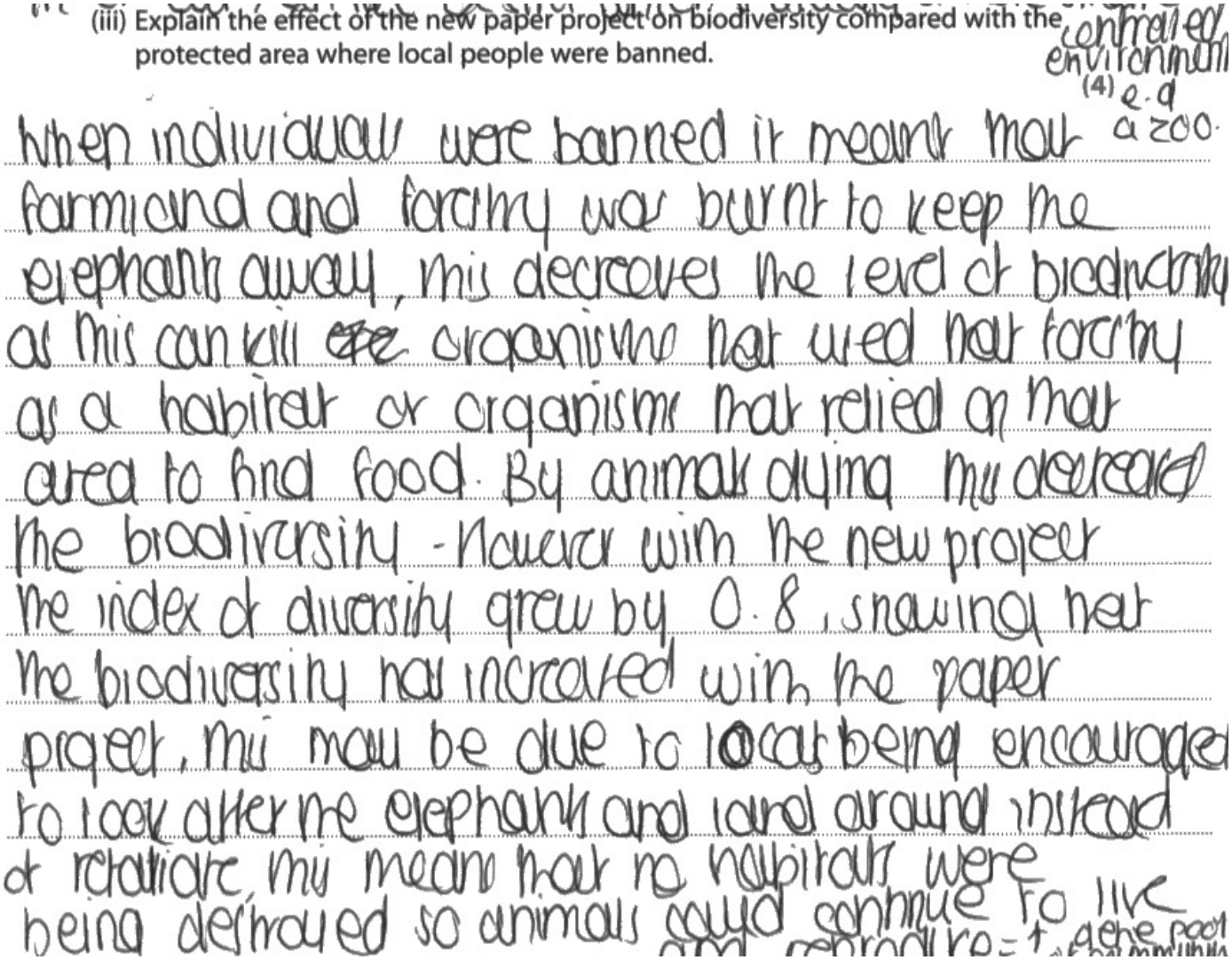
This is a good answer that gained two marks. The candidate clearly explains that in situ conservation keeps the natural behaviours of animals and maintains the whole ecosystem.

Question 9 (b)(iii)

This question generated a good range of answers. Most candidates gained at least one mark, often for describing the effect of the paper project on biodiversity compared with banning people from conservation areas. Stronger answers explained that the project was successful as it gave local people an income from the elephants and so there was less destruction of habitats, and the local people had an incentive to protect the elephants from poaching. Many candidates also stated that by protecting the elephants, the elephants would transfer seeds of plants and create other niches so that overall biodiversity increased.

(iii) Explain the effect of the new paper project on biodiversity compared with the protected area where local people were banned.

(4)



ResultsPlus
Examiner Comments

This is a very good answer that gained three marks. The candidate explains that the biodiversity is higher in the area with the paper project and then goes on to explain that this is due to the local people gaining a benefit and so maintaining the habitat.

(iii) Explain the effect of the new paper project on biodiversity compared with the protected area where local people were banned.

(4)

The new paper project after two years had an increase in biodiversity as it meant that not only where the elephants forest & grassland being maintained and gaurded. ~~It also meant that trees could continue to grow in that area as they were no longer being cut down to be used for paper. In the other hand, destroyed by farmers and~~ whilst also protecting the area people were banned from allowing biodiversity to spread naturally. On the contrary, the conservation area people were banned from had a decrease in biodiversity as they would burn or damage certain areas to prevent elephants from eating or destroying them. This could have ~~had~~ led to the loss of some species so biodiversity went down.

ResultsPlus
Examiner Comments

This answer gained two marks for describing the higher biodiversity in paper project area and explaining that there is less destruction of habitats.

(iii) Explain the effect of the new paper project on biodiversity compared with the protected area where local people were banned.

(4)

- human intervention in the paper project has lead to an increase in biodiversity - this is an example of ex-situ conservation. This projects allows people to actively get involved into protecting elephants from poaching whereas banning local people from entering is not doing enough.
- bannings may be legislated, does not necessarily mean they are in force. people could be illegally entering and continue to poach resulting in a decrease to biodiversity
- the paper project also has economic benefits, providing more incentive to get involved.

ResultsPlus
Examiner Comments

This answer gained three marks. The candidate has described the increased biodiversity and has gone on to explain that in the area where people are banned, poaching has continued and that the elephants now have value to the local people.

(iii) Explain the effect of the new paper project on biodiversity compared with the protected area where local people were banned.

(4)

There was an increase in the index of diversity in the area with paper projected, as because farmers were not burning the areas so biodiversity was able to thrive as habitats were not being destroyed. The fact that farmers were able to make money from the dung persuaded them not to burn the areas.

There was a decrease in index of diversity in the area locals were banned from as because farmers were still burning areas as there was no inticive incorse not to. Their crops were probably still being eaten/tramped but there was no plus side to having the elephants around.

ResultsPlus
Examiner Comments

This excellent answer gained all four marks. The candidate describes the increase in biodiversity and goes on to explain how making the elephants valuable to the local people has reduced habitat loss and prevented burning of the areas.

Question 9 (c)

Many candidates were able to gain one mark to explain the limitations of CITES but few went on to gain both. Some candidates simply stated the roles of CITES or stated that roles of conservation in general – candidates should read questions carefully to ascertain what the questions are looking for. Good answers discussed the non-voluntary nature of the treaty, the problem that many species have ranges that overlap over borders and the issues with preventing illegal activity.

(c) Describe the limitations of CITES in the conservation of organisms such as elephants.

(2)

→ Not all countries have signed up to be part of the conservation treaty,

→ hunting and trading elephants are still legal in some countries where they are found and the markets are in high demand.

ResultsPlus
Examiner Comments

This is a very good answer that gained two marks. The candidate clearly explains that CITES is not signed by all countries and that it is hard to prevent hunting within a country as CITES only concerns trade.

(c) Describe the limitations of CITES in the conservation of organisms such as elephants.

(2)

Not all countries have joined CITES and if someone goes against CITES, it isn't illegal.

ResultsPlus
Examiner Comments

This answer gained one mark for the idea that not all countries have signed up to CITES.

trade.

(c) Describe the limitations of CITES in the conservation of organisms such as elephants.

(2)

Preventing people from trading elephant and hunting of ~~ee~~ is difficult because they are large and suitable for poorer families in gaining income. Preventing the trade of elephants will lead to people becoming poorer and unable to provide for themselves.

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Examiner Comments

This answer gained one mark for the idea that it is difficult to prevent people from trading species when the rewards are high.

Paper Summary

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

- having a clear understanding of what each command word requires – these are listed in the specification
- showing all working for calculations
- using key scientific vocabulary accurately
- applying their knowledge confidently to unfamiliar contexts
- making sure that you consider mark allocations for each question before writing answers.

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

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