# Examiners' Report
# Principal Examiner Feedback

## January 2021

Pearson Edexcel International Advanced
Subsidiary Level
In Biology (WBI12)
Paper 01 Cells, Development, Biodiversity and
Conservation

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Publications Code WBI12_01_2101_ER

## Introduction:

This paper tested the knowledge, understanding and application of material from the topics ‘Cell structure, Reproduction and Development’ and ‘Plant Structure and Function, Biodiversity and Conservation.

The range of questions provided ample opportunity for students to demonstrate their grasp of these topics and apply their knowledge to novel contexts.

The questions on this paper yielded a wide range of responses and some very good answers were seen. The paper appears to have worked very well with all questions achieving the full spread of marks.

**Question 1(a)(i-ii)**

These were multiple choice questions on starch and cellulose. More students answered the starch question correctly than the cellulose question.

**Question 1(b)(i)**

This question asked students to name two structures found in bacterial cells that are in involved in the synthesis of decomposition enzymes. Most students were able to correctly name ribosomes.

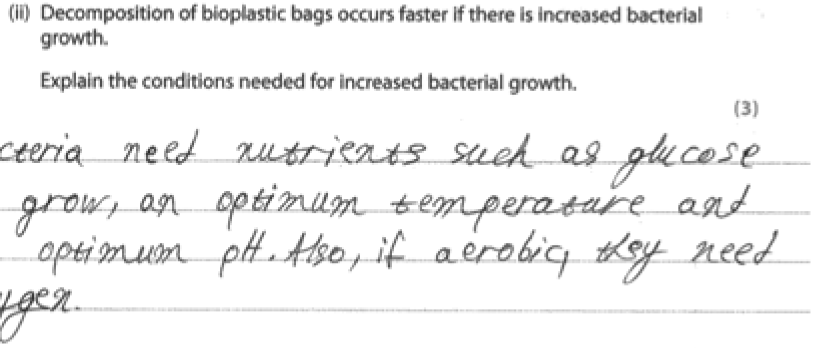
However, many students were not able to correctly name a second structure involved in protein synthesis in prokaryotic cells. Instead, they named structures from eukaryotic cells. The most common incorrect answers were nucleus, rough endoplasmic reticulum, or Golgi apparatus.

**Question 1(b)(ii)**

The students were asked to explain the conditions needed for increased bacterial growth. A similar question had been asked in the previous exam series and there was some improvement in the quality of answers seen.

It was clear that many students knew some conditions needed for the growth of bacteria as many correct conditions were stated. However, the most common mistake was to not take note of the command word 'explain' and therefore a significant number of students lost marks.

This is an example of where a student did not explain the stated conditions:



(ii) Decomposition of bioplastic bags occurs faster if there is increased bacterial growth.

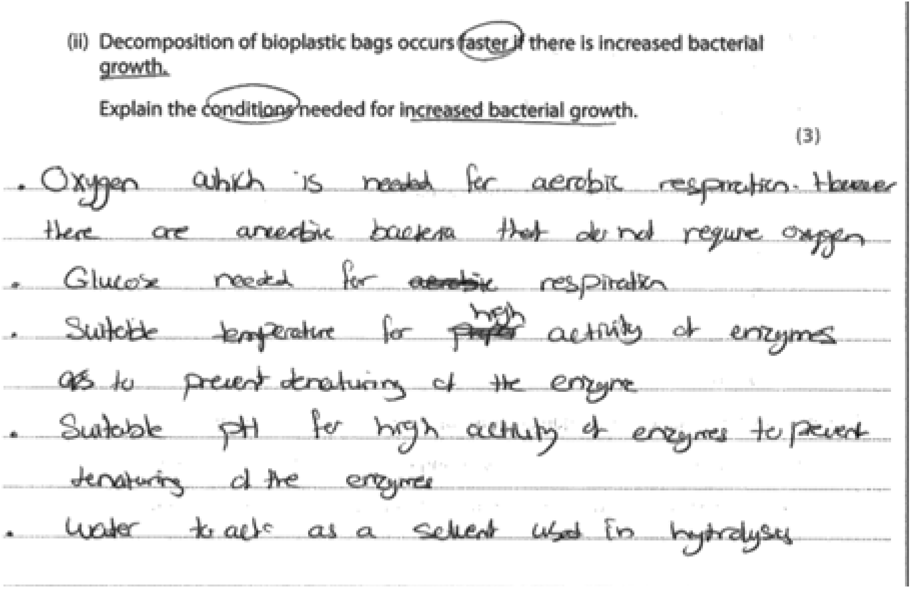
Explain the conditions needed for increased bacterial growth.

(3)

Bacteria need nutrients such as glucose to grow, an optimum temperature and an optimum pH. Also, if aerobic, they need oxygen.

Where students did explain the conditions needed for increased growth of bacteria, the more commonly awarded marks were for mp1 and mp3. Some answers were seen explaining why bacteria would need water. A common mistake by students which prevented the awarding of mp3 and mp4 was to say higher temperatures / pH would denature the bacteria (instead of referring to enzymes).

This is an example of a response which gained every marking point:



(ii) Decomposition of bioplastic bags occurs faster if there is increased bacterial growth.

Explain the conditions needed for increased bacterial growth.

(3)

- Oxygen which is needed for aerobic respiration. However there are anaerobic bacteria that do not require oxygen
- Glucose needed for ~~aerobic~~ respiration
- Suitable temperature for ~~proper~~ high activity of enzymes as to prevent denaturing of the enzyme
- Suitable pH for high activity of enzymes to prevent denaturing of the enzymes
- Water to acts as a solvent used in hydrolysis

**Question 2(a)**

This question gave the students a photo of a moth caterpillar that looked like a pit viper snake. The students were asked to complete the table to show the type of adaptations shown by the caterpillar. The majority of students were able to correctly name both adaptations and fill in the table correctly to gain both marks.

**Question 2(b)(i)**

The majority of students recognised the significance of the magnification given under the mitochondria photograph and gave the correct answer.

**Question 2(b)(ii)**

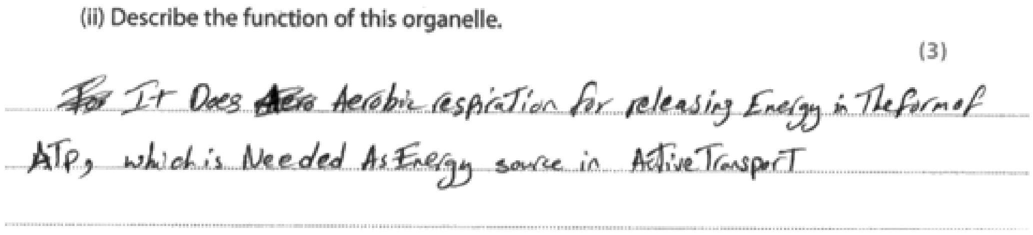
This question required students to recognise that the image in the photograph was a mitochondrion. Most students were able to do this, however a minority thought it was a lysosome.

A significant minority of students described the structure of the mitochondrion, which was not credit worthy.

Where students knew it was a mitochondrion, the most commonly awarded mark point was for ATP production. A significant minority of students stated that mitochondria carried out respiration without being specific about it being aerobic respiration. Some referred to energy being produced, instead of released which is incorrect.

It was pleasing to see that many candidates described a process that required the ATP. The most common processes were active transport, muscle contraction and ATP being required for respiration.

This is an example of a response which gained all three marking points:



(ii) Describe the function of this organelle.

(3)

~~For~~ It Does ~~Aero~~ Aerobic respiration for releasing Energy in The form of ATP, which is Needed As Energy source in Active Transport

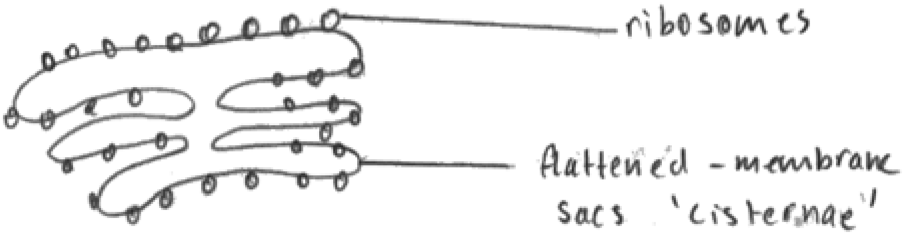
**Question 2(c)**

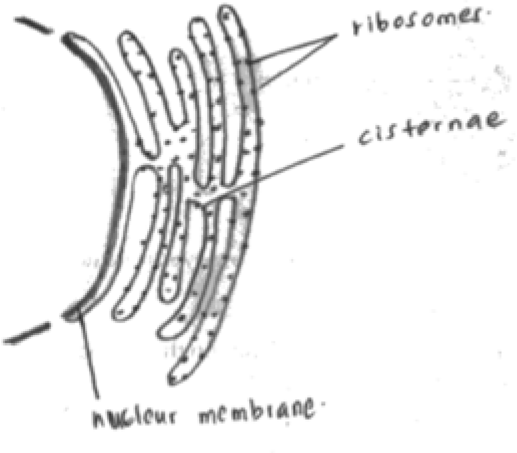
This question asked students to draw a labelled diagram of rough endoplasmic reticulum. Most students were able to draw a diagram which showed some resemblance to rough endoplasmic reticulum.

It is important to note that label lines must touch the parts of the structure being labelled.

Most drawings had ribosomes correctly labelled. However, few students were able to label the cisternae / membrane correctly. The most common mistakes were to use the labels cell membrane or cristae.

These are examples of responses which gained 3 marks:





## Question 3(a)

This question gave students a picture showing a pollen tube growing down from the tip of the style to the nuclei in the ovule. The students were asked to describe the events that occur from the time a pollen grain lands on the stigma to the production of a triploid endosperm nucleus and a zygote.

Most students were able to correctly describe the tube growing down to the ovule due the information provided in the diagram. The majority of students were able to link the release of digestive enzymes to this to gain the second marking point.

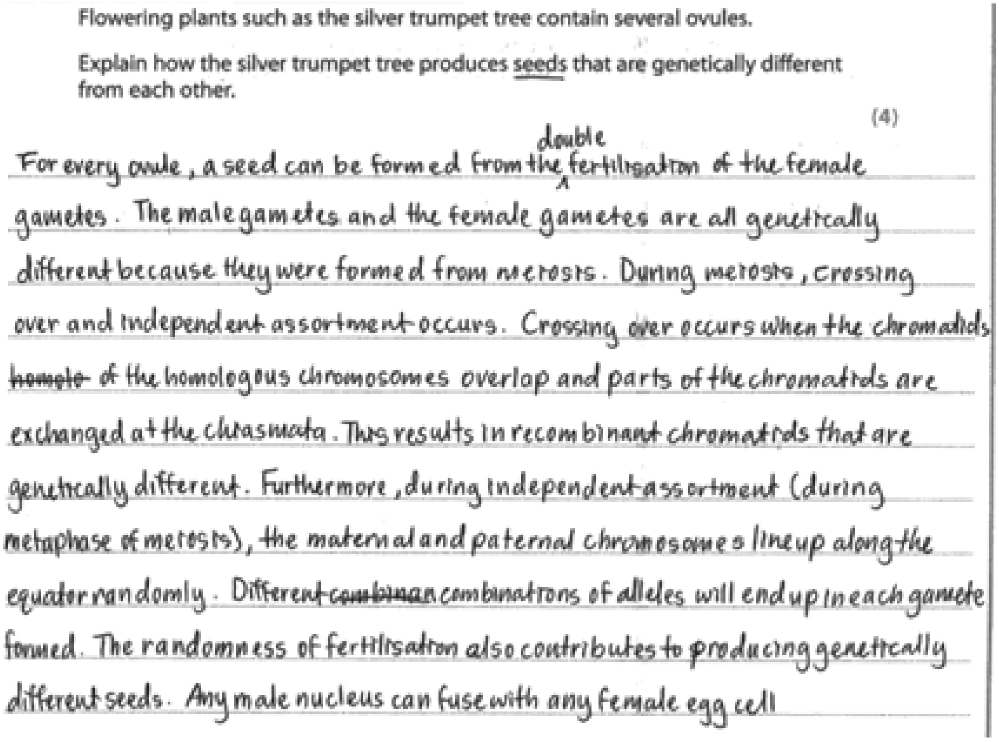
Marking points 3 and 4 were rarely seen which was disappointing. A significant minority of students referred to a ‘degenerative’ nucleus.
The most common errors which prevented the awarding of marking of marking points 5 and 6 were the descriptions of the generative nucleus fertilising the egg cell nucleus, or the omission of the polar nuclei.

## Question 3(b)

Students were asked to explain why the silver trumpet tree produces seeds that are genetically different from each other.
Most candidates were able to recognise that the gametes were formed in meiosis and that there was independent assortment of chromosomes. Some students were not able to explain how crossing over ensured genetic variation and therefore were not awarded marking point 2.

The higher-level responses recognised that meiosis produced the male and female gametes, but that it was the fertilisation of genetically different male and female gametes that also contributed to the genetic variation of the seeds. A small number of students recognised that the pollen may have come from more than one source.

This is an example of a response which met all four marking points.



Flowering plants such as the silver trumpet tree contain several ovules.

Explain how the silver trumpet tree produces seeds that are genetically different from each other.

(4)

For every ovule, a seed can be formed from the double fertilisation of the female gametes. The male gametes and the female gametes are all genetically different because they were formed from meiosis. During meiosis, crossing over and independent assortment occurs. Crossing over occurs when the chromatids ~~homolo~~ of the homologous chromosomes overlap and parts of the chromatids are exchanged at the chiasmata. This results in recombinant chromatids that are genetically different. Furthermore, during independent assortment (during metaphase of meiosis), the maternal and paternal chromosomes line up along the equator randomly. Different ~~combinan~~ combinations of alleles will end up in each gamete formed. The randomness of fertilisation also contributes to producing genetically different seeds. Any male nucleus can fuse with any female egg cell

## Question 4(a)

Students were given information regarding two species of mice. They were asked to calculate the percentage difference in minimum total length of the Indian flat-haired mouse compared with the minimum total length of the harvest mouse and give their answer to two significant figures.
The main reason why students were not able to answer this question was not reading the question properly.

Some did not recognise that the given lengths were in different units and therefore did not perform unit conversions. Some did not recognise that they needed to add the minimum body and tail lengths together. Some did not recognise that they needed to give their answer to two significant figures. Annotation of the question before answering it might resolve some of these issues in future.

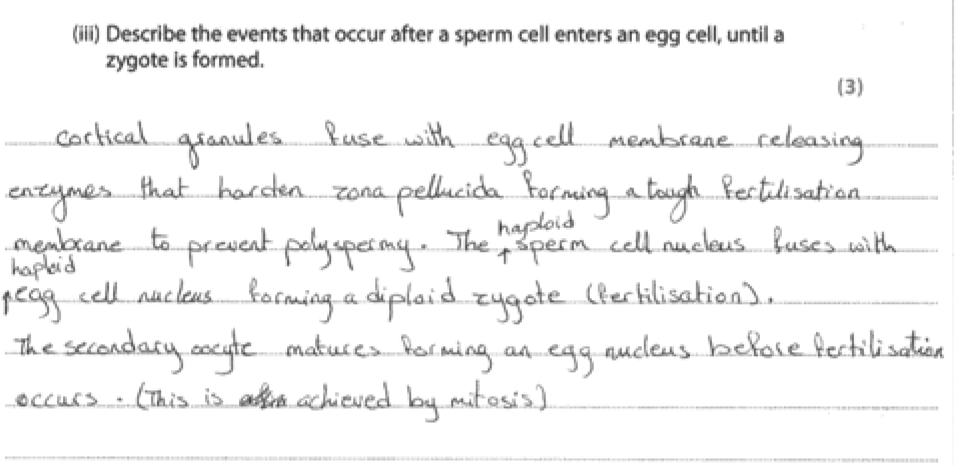
Students should always show their working in mathematical calculations, but there was a significant minority of students who did not and therefore gained 0 marks if their answer was incorrect.

## Question 4b(ii)

The majority of students were able to circle the mouse morula. The most common mistake was to circle the blastocyst.
A small minority of students chose to redraw a morula in the space at the bottom of the page instead of doing what the question asked.

## Question 4(b)(iii)

The students were asked to describe the events that occur after a sperm cell enters an egg cell, until a zygote is formed.
The majority of candidates could describe the hardening of the zona pellucida and the fusion of the haploid gametes, but few students were able to correctly describe the processes that led up to this. Some wasted time describing how the sperm cell would have entered the egg cell as they had not read the question correctly.



(iii) Describe the events that occur after a sperm cell enters an egg cell, until a zygote is formed.

(3)

cortical granules fuse with egg cell membrane releasing enzymes that harden zona pellucida forming a tough fertilisation membrane to prevent polyspermy. The haploid sperm cell nucleus fuses with haploid egg cell nucleus forming a diploid zygote (fertilisation).
The secondary oocyte matures forming an egg nucleus before fertilisation occurs. (This is achieved by mitosis)

**Question 4(c)**

The question requires students to suggest why mitochondria were located within 10nm of the lipid droplets.

Most students recognised that 10nm was a small distance and therefore the lipid droplets were located close to the mitochondria. It was rare to see an answer which could explain why the short distance would be beneficial.

Nearly all students could state the function of the mitochondria, but a significant number of students were not able to link this to the lipid droplets correctly and therefore did not gain marking point 3.

Common incorrect answers referred to lipids being used for insulation, or the production of lipids.

**Question 5(a)(i-iv)**

These were multiple choice questions relating to the plant stem section in the photograph. Few students could identify the structures in the diagram and therefore did not answer parts (i),(ii) or (iii) correctly. More students were able to answer (iv) correctly as this didn't relate to the diagram.

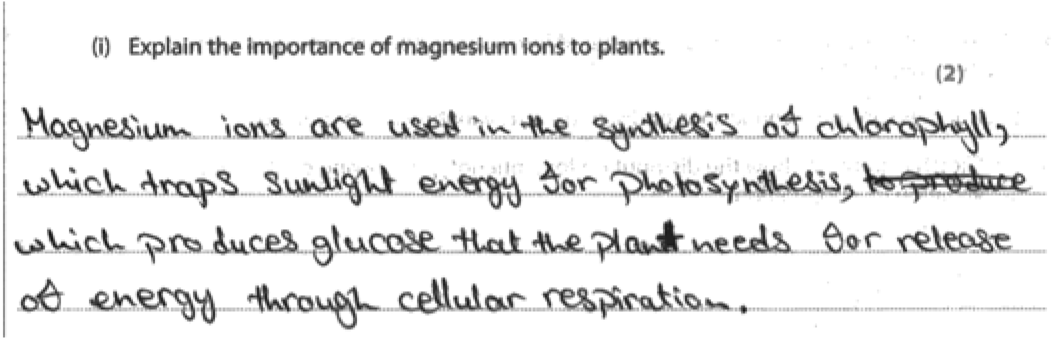
**Question 5(b)(i)**

Students were given information about an investigation.

Plants were watered with nutrient solutions containing different concentrations of magnesium ions. Students were asked to explain the importance of magnesium ions to plants.

Most students were able to explain that magnesium ions were need in the formation of chlorophyll, however fewer students were able to explain why plants needed chlorophyll beyond the GCSE answer of photosynthesis.

This is an example of a response which scored full marks:



(i) Explain the importance of magnesium ions to plants.

(2)

Magnesium ions are used in the synthesis of chlorophyll, which traps sunlight energy for photosynthesis, ~~to produce~~ which produces glucose that the plant needs for release of energy through cellular respiration.

### Question 5(b)(ii)

This question asked students to comment on the results of the investigation. It is important to take careful note of the command word used. ‘Comment on’ requires the synthesis of a number of factors from data/information to form a judgement.
A significant minority of students spent a long time writing out the data from the table into a description which did not gain any marks. They did not recognise that they needed to make a judgement.

However, the majority of students were able to state that as magnesium ion concentration increased, the mass increased. The most common error was to try and explain why the mass increased and many detailed responses were seen that linked increased chlorophyll to increased number of photosynthetic products and growth.

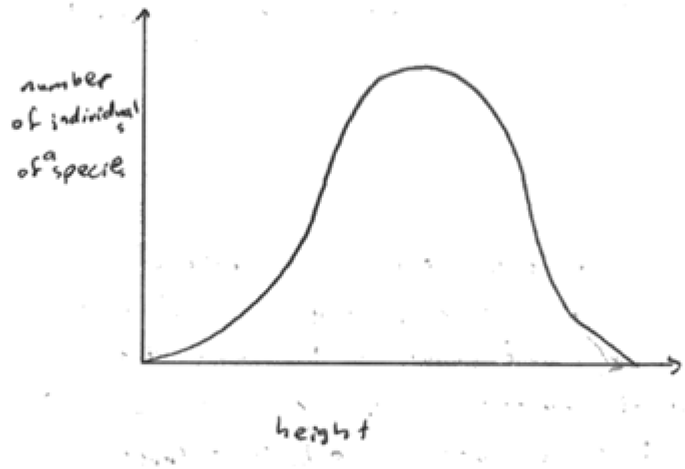
The majority of students did not look for more trends beyond the relationship between concentration and dry mass, therefore they did not achieve marking point 2.
More able students were able to analyse the data in more detail and recognised the significance of the size / non overlapping of the SD values.

### Question 6(a)

Students were asked to sketch a graph to show the distribution for a phenotype showing continuous variation in a population.
The majority of students were able to draw a graph (either bar or line) showing normal distribution. However, fewer students thought to label the axes. Where axes were labelled, a minority of students used the terminology of the question; ‘variation’ and ‘population’ which were not appropriate. Higher scoring answers used axes labels such as height and number of individuals.

Some students did not understand what was required and drew punnet squares or cladograms.
Centres are reminded that it is good practice for this type of graph to start and end at 0.

This is an example of a response which scored both marks.



**Question 6(b)**

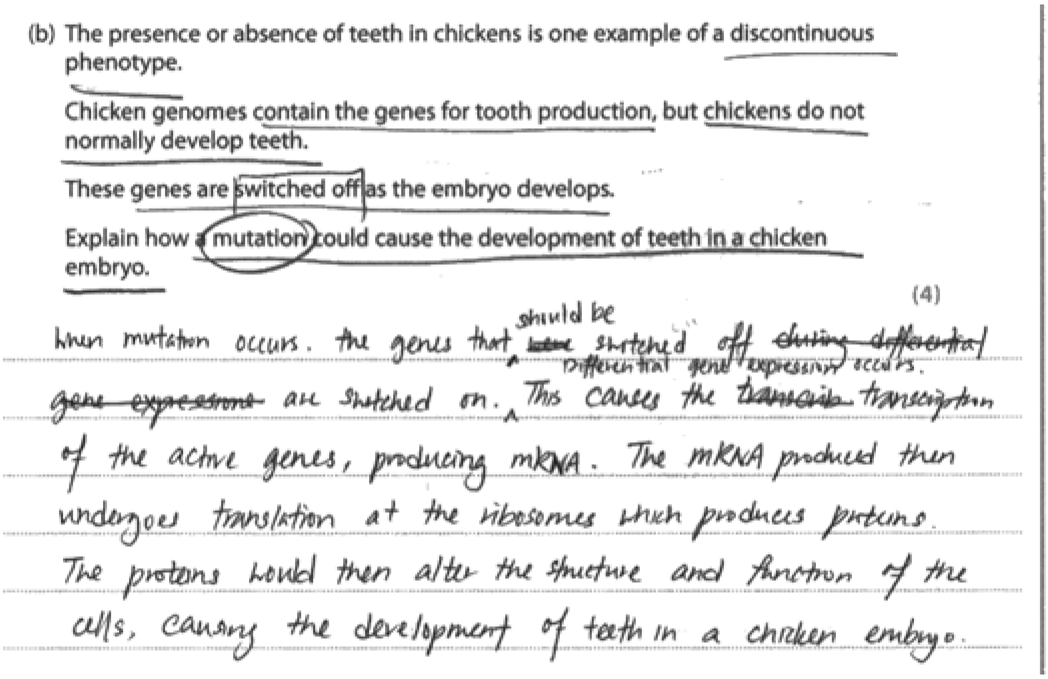
Students were given information about a type of discontinuous variation. They were told that genes for tooth production in chickens were switched off as the embryo develops. Students were asked to explain how a mutation could cause the development of teeth in a chicken embryo.

It was pleasing to see that most students recognised the importance of the word 'mutation' in the stem of the question. However, some students wasted time describing different types of mutation, or how they occur, which were not credit worthy. A significant minority latched onto 'mutation' to describe how different proteins could be formed as a result which was not what they were being asked. The most commonly awarded marking points were 2 and 3.

Marking point 4 was not commonly awarded as most students tended to just restate the question stem and say that the protein would cause the development of teeth in a chicken embryo, without explaining how.

This question differentiated very well with the higher-level responses referred to mutations resulting in the genes for tooth production being activated, explained how proteins would be formed as a result of transcription and translation, and then explained how the proteins would cause beak cells to differentiate into tooth cells.

This is an example of a response which scored full marks:



(b) The presence or absence of teeth in chickens is one example of a discontinuous phenotype.

Chicken genomes contain the genes for tooth production, but chickens do not normally develop teeth.

These genes are switched off as the embryo develops.

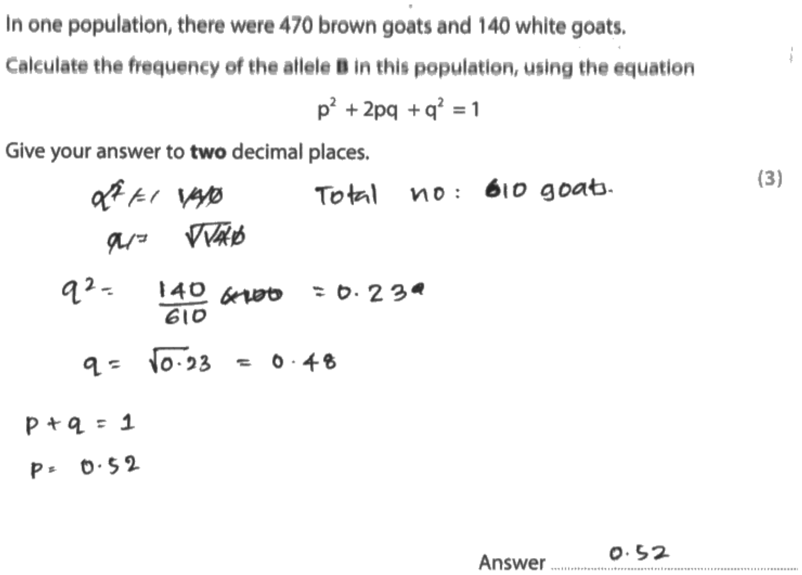
Explain how a mutation could cause the development of teeth in a chicken embryo.

(4)

when mutation occurs. the genes that ~~were~~ should be switched off ~~during differential gene expressions~~ are switched on. Differential gene expression occurs. This causes the ~~[illegible]~~ transcription of the active genes, producing mRNA. The mRNA produced then undergoes translation at the ribosomes which produces proteins. The proteins would then alter the structure and function of the cells, causing the development of teeth in a chicken embryo.

**Question 6(c)**

This question proved to be challenging for the majority of students. It was clear that some students did not know how to use the given equation to calculate the frequency of B. A small minority of students who did know how to answer the question lost a mark as they did not give their answer to two decimal places.
This student correctly calculated the frequency of B to gain 3 marks:



In one population, there were 470 brown goats and 140 white goats.

Calculate the frequency of the allele **B** in this population, using the equation

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

Give your answer to **two** decimal places.

(3)

~~$q^2 = 140$~~ Total no: 610 goat.

~~$q = \sqrt{140}$~~

$q^2 = \frac{140}{610}$ ~~6100~~ $= 0.23$

$q = \sqrt{0.23} = 0.48$

$p + q = 1$

$p = 0.52$

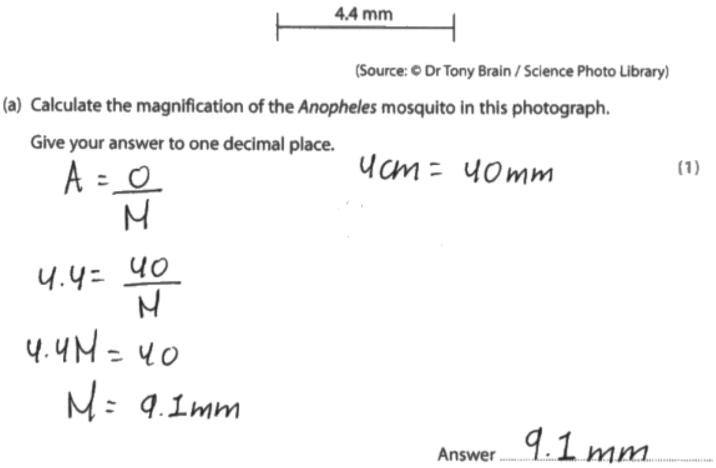
Answer 0.52

Unfortunately some students failed to show their working, so if their answer was incorrect they were not able to access any marks.

**Question 7(a)**

The students were provided with a photograph of a female Anopheles mosquito. A scale bar under the photograph gave the measurement of 4.4mm.
Students were expected to measure the scale bar in mm and divide their measurement by 4.4mm. They were then asked to give their answer to one decimal place.

A significant number of students made at least one error in this calculation and therefore did not gain the mark. Most common errors included measuring in cm and not converting the measurement, placing the numbers incorrectly into the equation, not giving answers to one decimal place or giving their answer with the unit mm. This response shows one of these errors:



(Source: © Dr Tony Brain / Science Photo Library)

(a) Calculate the magnification of the *Anopheles* mosquito in this photograph.

Give your answer to one decimal place.

(1)

$A = \frac{O}{M}$

4cm = 40mm

$4.4 = \frac{40}{M}$

4.4M = 40

M = 9.1mm

Answer 9.1 mm

**Question 7(b)**

This multiple-choice question asked students which percentage was the correct percentage of people who died from malaria from the given data. A significant number of students selected the surviving percentage option.

**Question 7(c)(i)**

This question asked students to state the function of a nucleolus. This question was not answered well by the majority of candidates as they confused nucleolus with nucleus.

**Question 7(c)(ii)**

This question asked students to compare the ultrastructure of the fungal cell in the diagram with the cell taken from the root of a plant and give three differences.

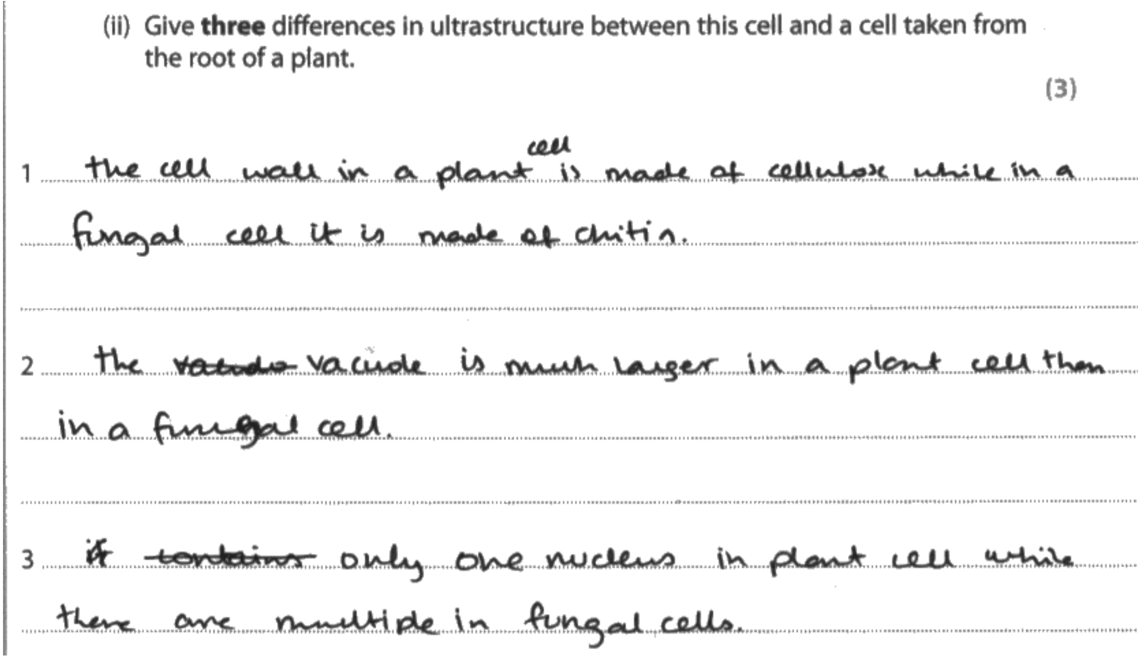
Reading the question carefully is good practice and it was surprising that many students did not understand the significance of the plant cell being a root cell. Reference to chloroplasts were therefore non-credit worthy.

It is good practice to use comparative language and statements in these types of questions. Some students lost marks as they did not make it clear which cell they were referring to.

The most common mark awarded was for recognising that plant cells would contain starch grains whereas the fungal cell contained glycogen granules. Recognition that plant cell walls contained cellulose whereas fungal cell walls contained chitin was the second most awarded marking point.

Higher level responses identified the difference in vacuole size or the number of nuclei.

This is an example of a response which gained full marks:



(ii) Give **three** differences in ultrastructure between this cell and a cell taken from the root of a plant.

(3)

1 the cell wall in a plant cell is made of cellulose while in a fungal cell it is made of chitin.

2 the ~~vacuole~~ vacuole is much larger in a plant cell than in a fungal cell.

3 it ~~contains~~ only one nucleus in plant cell while there are multiple in fungal cells.

## Question 7(d)

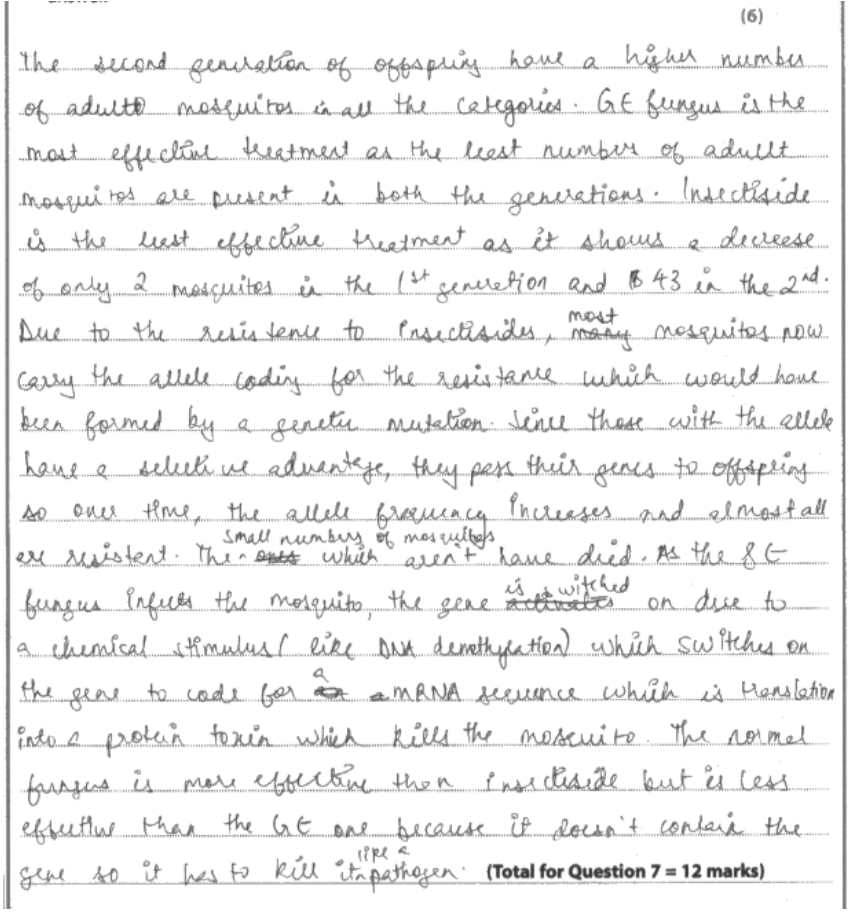
This was the first of the level-based questions on the paper.
Students were supplied with information about an investigation using different treatments in mosquito containing huts in West Africa. They were asked to use information in the question to help them evaluate the three treatments.

Students were expected to analyse the table of data to make a conclusion of which treatment was the most effective. They were also expected to draw on the provided information regarding insecticide resistance and the GE fungus. Few students considered the methodology of the investigation or the wider impact that the GE fungus could have on the ecosystem.
Most students achieved level one by describing the trends shown in the table and by giving the conclusion that the GE fungus was the most effective treatment.

Level two was usually achieved by students building on the level one criteria and using the information in the question above the table. They used the resistance to insecticide information and the activation of the gene when the mosquito was infected by the fungus information to explain the results in the table.
Level three was usually achieved by students building on the level two criteria to give an answer which showed greater depth and understanding. They often considered mutations, how the toxin would be produced for the gene and

relevant consideration of the methodology of the investigation. The highest quality answers also considered the wider impact of the GE fungus.

These are examples of level 3 responses:



(6)

The second generation of offspring have a higher number of adultt mosquitos in all the categories. GE fungus is the most effective treatment as the least number of adult mosquitos are present in both the generations. Insectiside is the least effective treatment as it shows a decreese of only 2 mosquitos in the 1st generation and ~~B~~ 43 in the 2nd. Due to the resistence to insectisides, most ~~many~~ mosquitos now carry the allele coding for the resistance which would have been formed by a genetic mutation. Since those with the allele have a selective advantage, they pass their genes to offspring so over time, the allele frequency increases and almost all are resistent. The small numbers of mosquitos ~~ones~~ which aren't have died. As the GE fungus infects the mosquito, the gene is switched ~~activates~~ on due to a chemical stimulus (like DNA demethylation) which switches on the gene to code for a ~~a~~ mRNA sequence which is translation into a protein toxin which kills the mosquito. The normal fungus is more effective than insectiside but is less effective than the GE one because it doesn't contain the gene so it has to kill it like a pathogen.

**(Total for Question 7 = 12 marks)**

(6)

~~The Ge Fungus Kills The Mo~~ All of The Treatments show ~~obvious~~ change Effect on Mosquitos Numbers, As ~~They Decrease~~ change The Number of Mosquitos, The Number of Mosquitos generation At first of Each TreatMent was Different from other TreatMents, & The second ~~Mo~~generation shows A Big Dicrease, in Control group The fungus is Not Dead so The ~~first 2generation~~ Number of Mosquitos is increasing, As it increased By 475 & in The insecticides TreatMent the Number of Mosquitos Also increase Because The Most of The ~~Most~~ Mosquitos Are resistant To insecticides That's Might Be Because of somehaving Advantageous Allele Due To Mutation ~~& They~~ Breed with Each other & survive Passing On Their favourable Allele To next generations so The Numbers increased, Those who weren't Able To survive DiDn't have The Advantageous Allele so They Died, causing The increase in Number of Mosquitos To Be lower Than that of No TreatMent By 84%. Normal fungus Also show a increases ~~show~~ in The Number of Mosquitos By 19, As some of The Mosquitos ~~Are~~ resistant To fungus ~~So~~ They Are Able To survive & Breed & reproduce. (G E) fungus The only shows a Decrease in Number of ~~A~~ Adult Mosquitos As it kills The Mosquitos By Toxin Activated By chemical stimulus Affecting the gene causing Activation (By Differential gene Expression). All of ~~3 Trea~~ Two Treatments of fungus show Effect on Decreasing in Number of Adult Mosquitos But (Ge) is The Most Effective. The Number of Mosquitos in The Beginning wasn't The same which ~~Doesn't show~~ Effects results. The ~~result~~ Treatments Effect Investigation should By repeated,

**(Total for Question 7 = 12 marks)**

Higher Number of Mosquitos should ~~Be~~ used. The insectisides have The lowest Effect on Mosquitos. The Number of Mosquitos increase Due To Breeding.

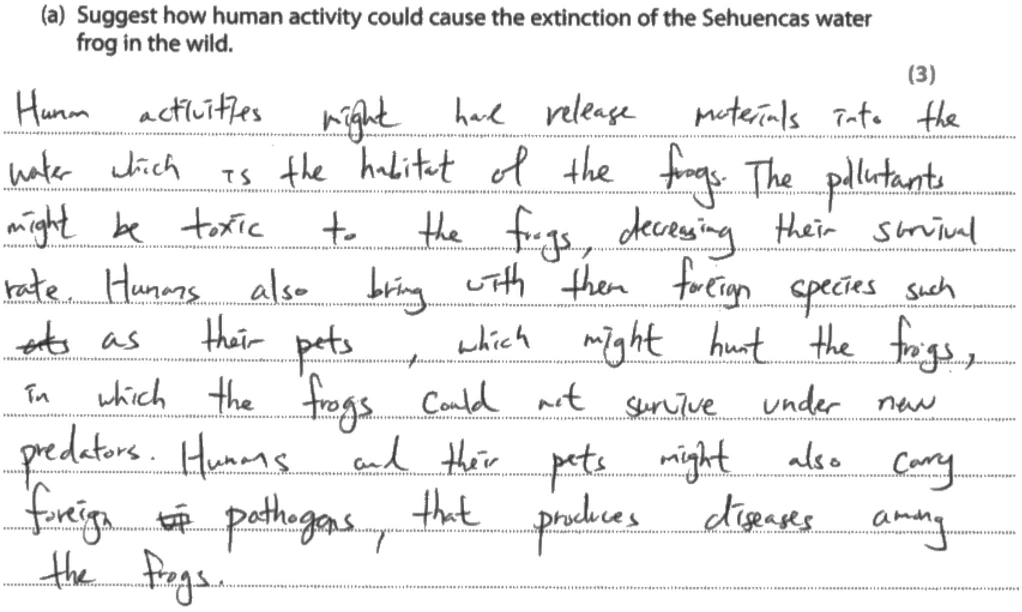
**Question 8(a)**

Students were asked to suggest how human activity could cause the extinction of the Bolivian Sehuencas water frog in the wild.
This question proved to be a good differentiator with most students giving at least one credit worthy suggestion.

A minority of students just referred to habitat loss without explaining how human activity could have caused the habitat loss. Some referred to overfishing which was not credit worthy.

The most common suggestions were pollution of water/deforestation and hunting. Some higher quality answers linked the habitat loss to increased competition for reduced resources with other organisms, or the introduction of new predators.

This 3 mark response demonstrates some of these ideas:



**(a) Suggest how human activity could cause the extinction of the Sehuencas water frog in the wild.**

**(3)**

Human activities might have release materials into the water which is the habitat of the frogs. The pollutants might be toxic to the frogs, decreasing their survival rate. Humans also bring with them foreign species such ~~ets~~ as their pets, which might hunt the frogs, in which the frogs could not survive under new predators. Humans and their pets might also carry foreign ~~tp~~ pathogens, that produces diseases among the frogs.

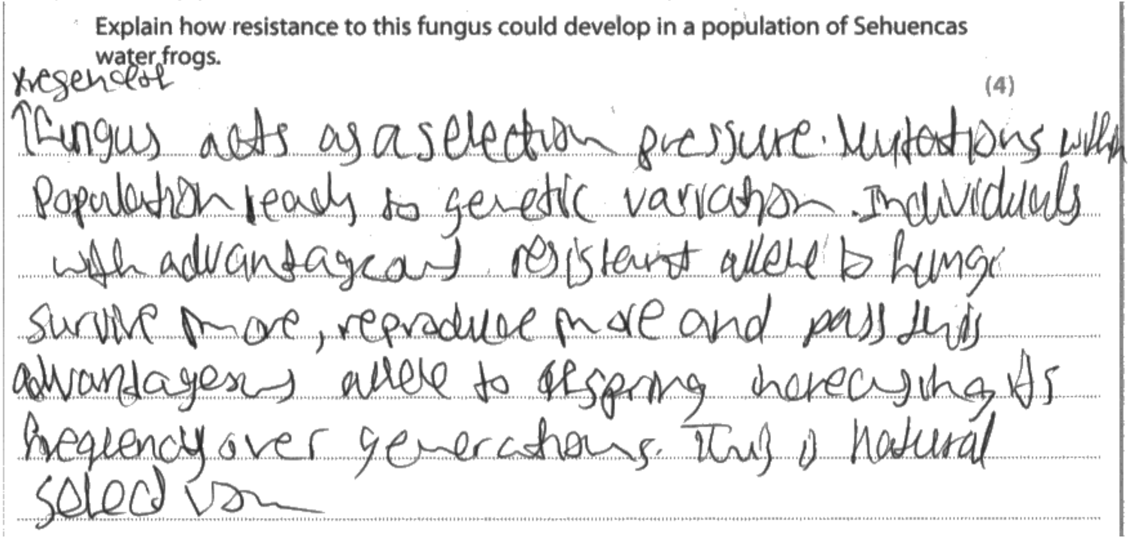
## Question 8(b)

This question asked students to explain how resistance the fungus could develop in a population of Sehuencas water frogs.

There was a wide range in the quality of responses seen, with many generic responses that were not able access all of the marking points.

It was pleasing to see that a majority of responses recognised that a mutation must have occurred. However, imprecise terminology limited awarding of marking points two and four as some students referred to genes instead of alleles. Some students failed to relate the resulting new allele to the context of resistance which limited the awarding of some marking points. Nearly all students recognised that some frogs would survive and reproduce.

Some students gave detailed answers related to the given context and covered every marking point to score full marks, for example:



Explain how resistance to this fungus could develop in a population of Sehuencas water frogs.

[illegible]

(4)

Fungus acts as a selection pressure. Mutations with population leads to genetic variation. Individuals with advantageous resistant allele to fungi survive more, reproduce more and pass this advantageous allele to offspring increasing its frequency over generations. This is natural selection

## Question 8(c)

This question was one of the most challenging on the paper for the majority of students. Many blank responses were seen, even though students went on to give lengthy responses to the next question in the paper.

A significant number of students gave the equations for either index of diversity or mitotic index instead of heterozygosity index. Another common mistake was to refer to number of species.

However it was pleasing to see a number of excellent responses detailing how the number of heterozygotes in a population could be determined followed by a correct heterozygosity index equation.

**Question 8(d)**

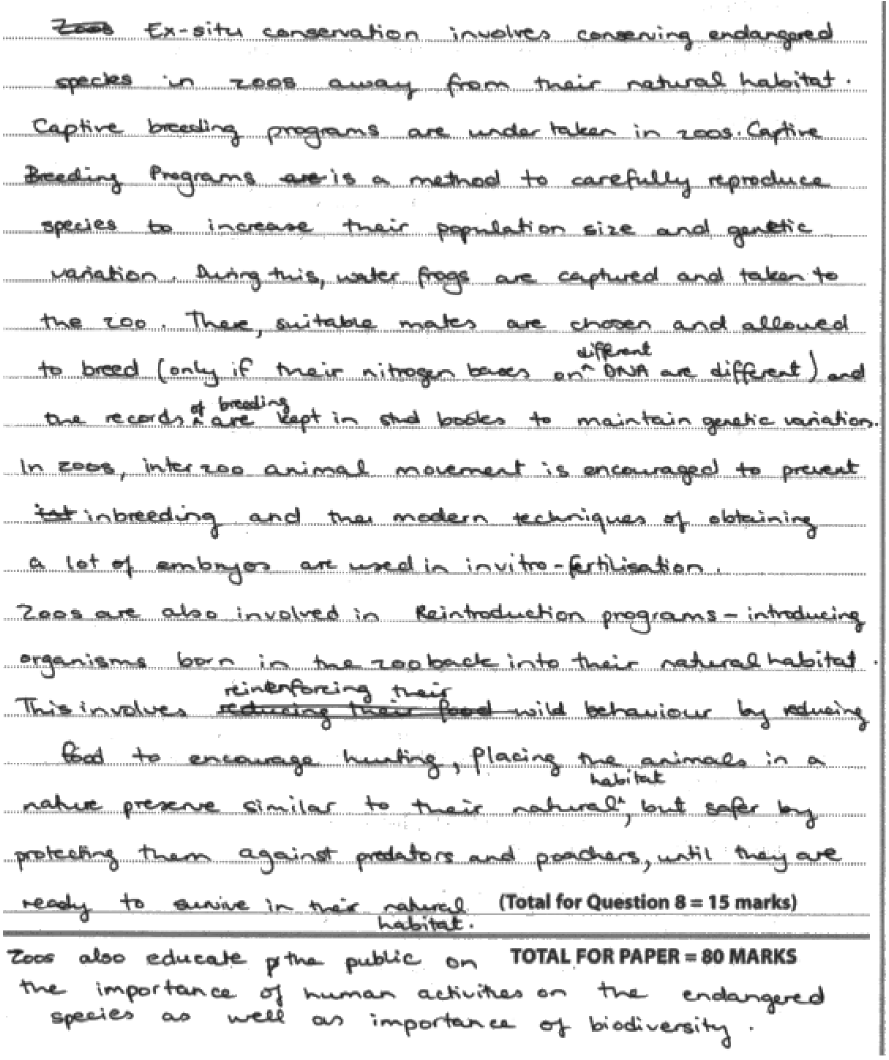
This was the second of the level-based questions on the paper.
Students were asked to describe the role of zoos in the conservation of endangered Sehuencas water frogs.

Students were expected to notice the command word ‘describe’ and know they were not expected to make justifications for any of the zoo roles they mentioned. Therefore they should have realised that they should describe as many different roles of zoos as they could, both ex-situ and in-situ. Students tended to be able describe ex-situ zoo roles well, with the most common descriptions including taking individuals to zoos to provide them with necessary resources and enabling them to breed in captivity. This was the most common way that students achieved level one.

Level two responses built on this foundation and described how zoos would be involved in maintaining genetic diversity and reintroduction of frogs.

Level three responses considered the wider role of zoos beyond those already mentioned. Students described the important role zoos play an in education and research. They also considered the role of zoos in-situ. For example, removal of predators and eradication of the fungal disease in the native habitat.

These are examples of level three responses:



~~Zoos~~ Ex-situ conservation involves conserving endangered species in zoos away from their natural habitat. Captive breeding programs are undertaken in zoos. Captive Breeding Programs ~~are~~ is a method to carefully reproduce species to increase their population size and genetic variation. During this, water frogs are captured and taken to the zoo. There, suitable mates are chosen and allowed to breed (only if their nitrogen bases on different DNA are different) and the records of breeding are kept in stud books to maintain genetic variation. In zoos, inter zoo animal movement is encouraged to prevent ~~tat~~ inbreeding and the modern techniques of obtaining a lot of embryos are used in invitro-fertilisation.

Zoos are also involved in Reintroduction programs – introducing organisms born in the zoo back into their natural habitat. This involves ~~reducing their food~~ reinforcing their wild behaviour by reducing food to encourage hunting, placing the animals in a nature preserve similar to their natural habitat, but safer by protecting them against predators and poachers, until they are ready to survive in their natural habitat.

**(Total for Question 8 = 15 marks)**

**TOTAL FOR PAPER = 80 MARKS**

Zoos also educate ~~p~~ the public on the importance of human activities on the endangered species as well as importance of biodiversity.

zoos can develop captive breeding programmes,
individuals are given food and suitable condition for mating and increasing population,
zoos can use stud books to keep track of who bred with whom,
use of IVF for transport gametes of different individuals in different zoos,
prevent interbreeding for less heterozygotes, send individuals from different zoos for breeding,
all these procedures maintain genetic diversity,
spread awareness of Sehuencas water frogs, ban hunting, modify habitat free of extinction factors,
introduce more individuals for more breeding options,
freeze and store gametes, incase individuals die out,

making Reintroduction programs,
introduce water frogs into the wild after teaching them how to become wild animals,
provide them food, remove predators,
prevent human activity in its habitat.

**Paper summary**

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

- Read the whole question carefully, including the introduction, to help relate your answer to the context asked.
- You should take into account the command words as well as the context given. Answers which do not match the command words or do not relate to the given context will not gain high marks.
- Some question specifically state ‘use information in the question to support your answer’. This refers to more than just quantitative data.
- Do not try and make a mark scheme you have learnt from a previous paper fit a different question with different context and command words.
- Study the mathematical skills which could be tested and make sure you include your working with all calculations. Give relevant units where applicable. If rounding is necessary, make sure that this is done correctly.
- Check to see if a certain number of decimal places or significant figures are required in mathematical calculations. Does the answer require you to convert to / from standard form?

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