# Examiners' Report
# Principal Examiner Feedback

## October 2024

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

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**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.

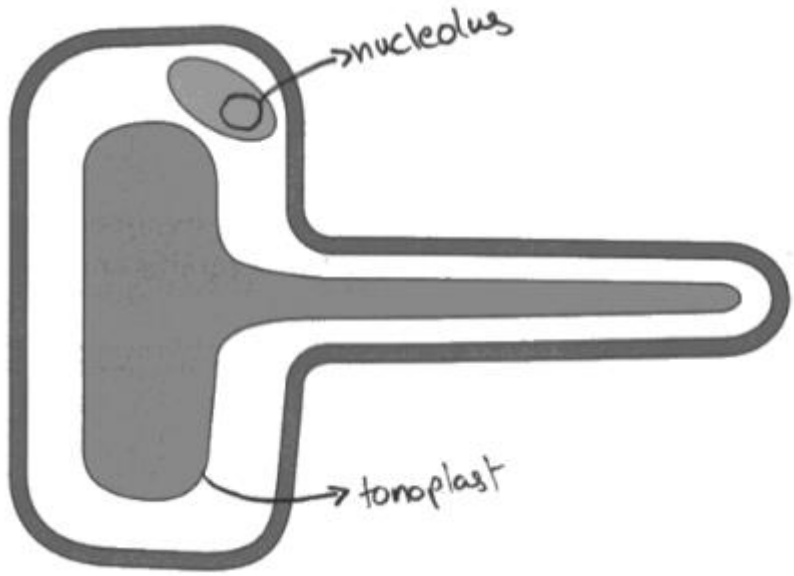
**Question 1(a)(i) and (ii)**

This question provided students with an incomplete plant cell. The vacuole and nucleus were drawn in to aid students.

Students were asked to label the tonoplast in (a)(i). Most students could do this correctly; however, care must be taken that label lines touch the intended structure(s). There was a significant number of lines that ended in the cytoplasm or inside the vacuole.

Fewer students were able to correctly draw and label a nucleolus in the right place.

This is an example of a response which was awarded both marking points:




**Question 1(b)**

This question asked students to complete the table to show which of the structures would be present in plant leaf cells.

A significant number of students did not think that the Golgi apparatus would be found in a plant leaf cell.

**Question 1(c)**

This question asked students to calculate the actual width of the lysosome.

Students needed to convert their measurement of the line XY into μm and then divide by the given magnification. Most candidates could do this correctly, although students who measured in cm sometimes did not perform the unit conversion correctly.

Some students did not take careful note of the instruction to give their answer to two decimal places.

This response did not give their answer in µm:

Calculate the actual width (X–Y) of this lysosome in µm.

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

(1)

3cm $\frac{3}{25000} = 1.2 \times 10^{-5}$

Answer $1.2 \times 10^{-5}$ µm

**Question 2(a)(i)**

Most students knew that the eukarya domain would contain organisms with a nucleus, mitochondria and chloroplasts.

The most common incorrect answer was plants.

**Question 2(a)(ii)**

This question required students to name two processes that take place in the nucleus of a diatom.

All possible answers were seen, with transcription and DNA replication being most common, followed by ribosome production.

A significant number of creditworthy responses such as translation or protein synthesis were seen.

This is an example of an answer which gained two marks.

(ii) The nucleus in a diatom contains DNA.

Name **two processes** that take place in the nucleus of a diatom.

(2)

1 Transcription

2 formation of ribosomes

**Question 2(b)**

This question asked students to describe how a decrease in biodiversity within an ocean habitat could be determined

A significant number of students failed to read the question correctly and instead of describing how biodiversity could be measured, went into detailed descriptions of the effect on biodiversity of a loss of diatoms, such as food chain collapse.

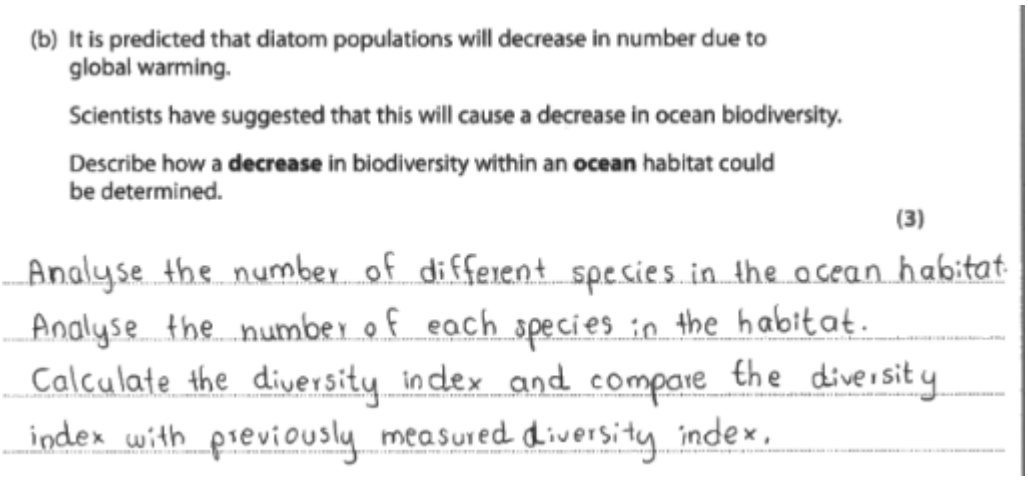
Those who did understand the question at times struggled to articulate what needed to be measured in order to calculate index of diversity, especially around species abundance.

The majority of students could state that species richness needed to be counted and were awarded marking point one.

It was pleasing to see that many students could remember the equation from the specification correctly, resulting in this being the most commonly awarded mark. Some candidates did not gain marking point three because they referred to biodiversity index instead of index of diversity.

Some students struggled to articulate themselves with respect to MP5 and their answers failed to mention time or make a comparison, both of which were needed to gain credit.

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



(b) It is predicted that diatom populations will decrease in number due to global warming.

Scientists have suggested that this will cause a decrease in ocean biodiversity.

Describe how a **decrease** in biodiversity within an **ocean** habitat could be determined.

**(3)**

Analyse the number of different species in the ocean habitat.
Analyse the number of each species in the habitat.
Calculate the diversity index and compare the diversity index with previously measured diversity index.

**Question 3(a)**

This response required students to state what is meant by the term endemic.
Most students could demonstrate their understanding of this term correctly.

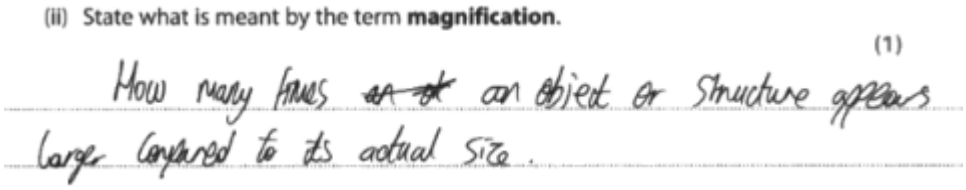
**Question 3(b)(i)**

It was pleasing to see that most students could use the provided information to correctly calculate the length of the pollen grain

**Question 3(b)(ii)**

This question required students to state the definition of the specification term magnification. This proved to be challenging for some students, with some just giving the equation for magnification.

This is an example of an answer which was awarded the mark:


(ii) State what is meant by the term **magnification**.

(1)

How many times ~~as of~~ an object or structure appears larger compared to its actual size.

**Question 3(c)**

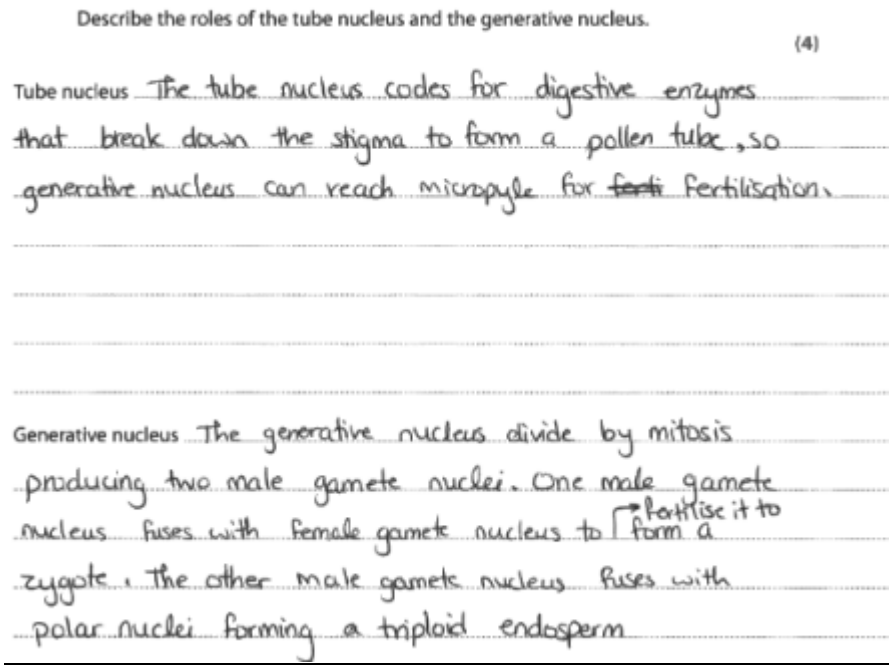
This question gave a diagram of a germinating pollen grain and asked students to describe the roles of the tube nucleus and the generative nucleus.

It was generally understood by students that the tube nucleus was involved in the production of the pollen tube. They also knew that enzymes were involved but few mentioned that the tube nucleus controlled their production. Some incorrectly stated that the tube nucleus made the digestive enzymes.

Most students gained the third marking point; for correctly describing something travelling down the pollen tube to a named female structure or cell.

The most common reason why students did not gain marking point four was due to describing the division into 2 male sperm cells or 2 generative nuclei. More students correctly described the fusion of a male haploid nucleus with the polar nuclei than with the egg cell nucleus.

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



Describe the roles of the tube nucleus and the generative nucleus.

(4)

Tube nucleus The tube nucleus codes for digestive enzymes that break down the stigma to form a pollen tube, so generative nucleus can reach micropyle for ~~ferti~~ fertilisation.

Generative nucleus The generative nucleus divide by mitosis producing two male gamete nuclei. One male gamete nucleus fuses with female gamete nucleus to fertilise it to form a zygote. The other male gamete nucleus fuses with polar nuclei forming a triploid endosperm

**Question 4(a)**

The majority of students answered this question correctly, but some students may have misread statement three.

**Question 4(b)**

Students were asked to describe how the nucleus of a sperm cell enters an egg cell.

Some students gave detailed descriptions about how the sperm got to the egg, which was not what they had been asked.

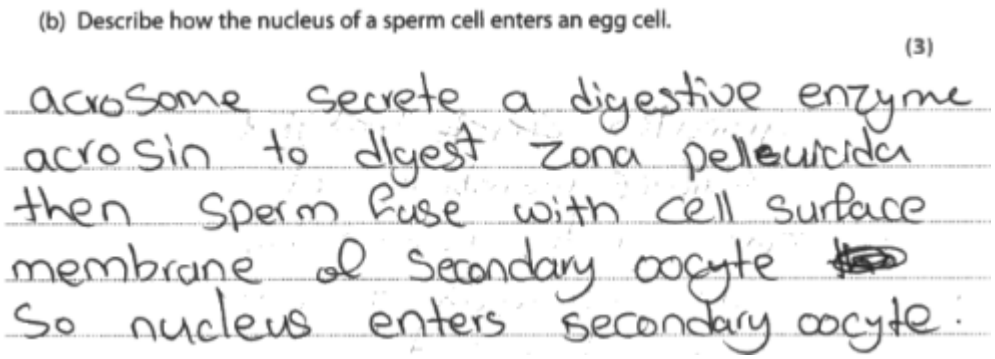
Most students understand the sequence of events before and after fertilisation, but a significant number needed to be more precise about the details and their use of appropriate terminology.

Some students described enzymes being present in the {acrosome/head} of the sperm cell but did not describe their release. Some students named the acrosomal reaction and also described it in detail.

The most commonly awarded marking point was marking point two. Those students who mentioned enzymes {breaking down/penetrating} the ZP without reference to digestion or digestive/hydrolytic (enzymes) were not awarded this marking point.

Some did not read the question carefully enough and wasted time describing events after the sperm nucleus enters the egg cell. Higher level responses described the fusion of the sperm cell membrane with the egg cell membrane, resulting in the entry of the sperm cell nucleus.

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


(b) Describe how the nucleus of a sperm cell enters an egg cell.

(3)

acrosome secrete a digestive enzyme acrosin to digest zona pellucida then sperm fuse with cell surface membrane of secondary oocyte so nucleus enters secondary oocyte.

**Question 4(c)(i)**

Students were asked to describe the role of the rough endoplasmic reticulum and the Golgi apparatus in the production of cortical granule enzymes.

It is very important that students read the question carefully and tailor their knowledge appropriately. They were asked about the production and not secretion of these enzymes. Students who described the release of the enzymes by exocytosis were not answering the question. It is important not to try and give a stock answer from a previous question and mark scheme.

Most candidates were able to demonstrate some knowledge of the process.

Many students could describe translation occurring at the ribosome, but some students referred to the primary structure as being an enzyme at this point of the process.

Few students described the role of the rough endoplasmic reticulum in the folding or modification of the polypeptide chain.

Most students understood that the protein/polypeptide was transported to the Golgi apparatus for modification. Higher level responses were able to describe some modifications.

**Question 4(c)(ii)**

This question asked students to suggest how the cortical granule enzymes will prevent more than one sperm nucleus entering the cell.

Most students understood that these enzymes would harden the zona pellucida, but few students could describe in sufficient detail how these enzymes would get from a cortical granule into the zona pellucida.

Marking point three was aimed at a high grade and proved to be a very good differentiator. Few students could demonstrate knowledge as to why sperm could no longer penetrate the zona pellucida after it had hardened.

A small number of responses included the changes to the sperm binding sites, for example:

(ii) Suggest how these enzymes will prevent more than one sperm nucleus entering the egg cell.

(3)

The cortical granules fuse with the cell surface membrane once the sperm enters the egg. The cortical granules release enzymes which hardens the outer layer of the zona pellucida. This then destroys sperm binding sites and prevents other sperm cells from entering the egg. The jelly of the zona pellucida hardens.

**Question 5(a)(i)**

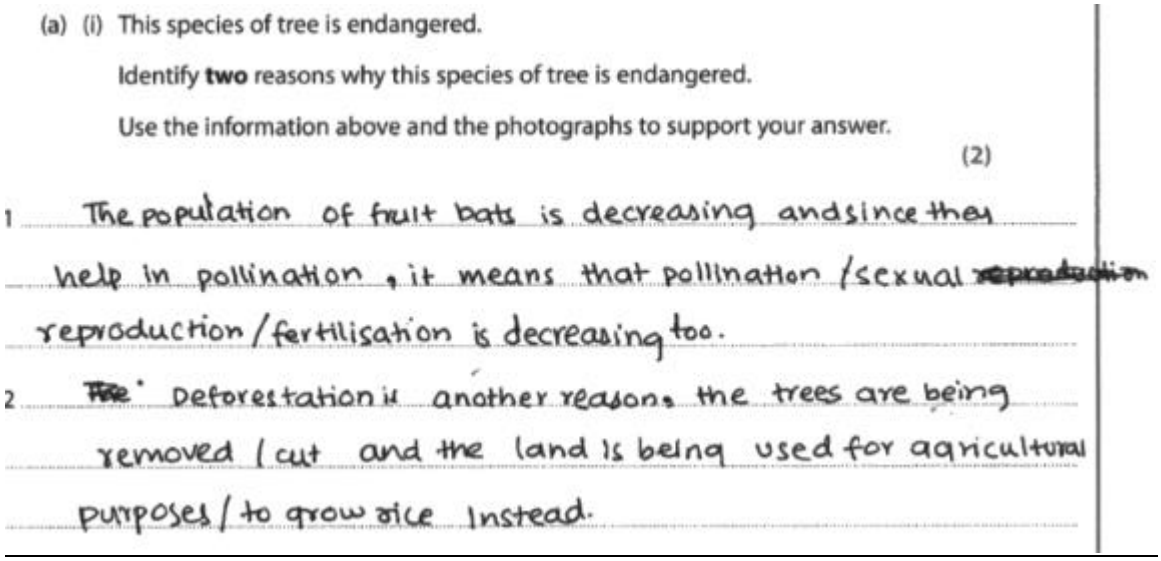
This question asked students to use the information and the photographs to identity two reasons why the Grandidier's Boabab is endangered.

Most candidates could use the written information to help them identify that the decrease in bat population would reduce the pollination of the baobab, resulting in a decrease in population.

However, fewer students could link a vague response regarding deforestation to the photograph / information. Therefore marking point one was awarded less frequently than marking point two.

Some students believed the Boabab was endangered because the species is endemic to Madagascar.

This response scored full marks:



(a) (i) This species of tree is endangered.

Identify **two** reasons why this species of tree is endangered.

Use the information above and the photographs to support your answer.

(2)

1 The population of fruit bats is decreasing and since they help in pollination, it means that pollination / sexual reproduction / fertilisation is decreasing too.

2 ~~Fee~~ Deforestation is another reason, the trees are being removed / cut and the land is being used for agricultural purposes / to grow rice instead.

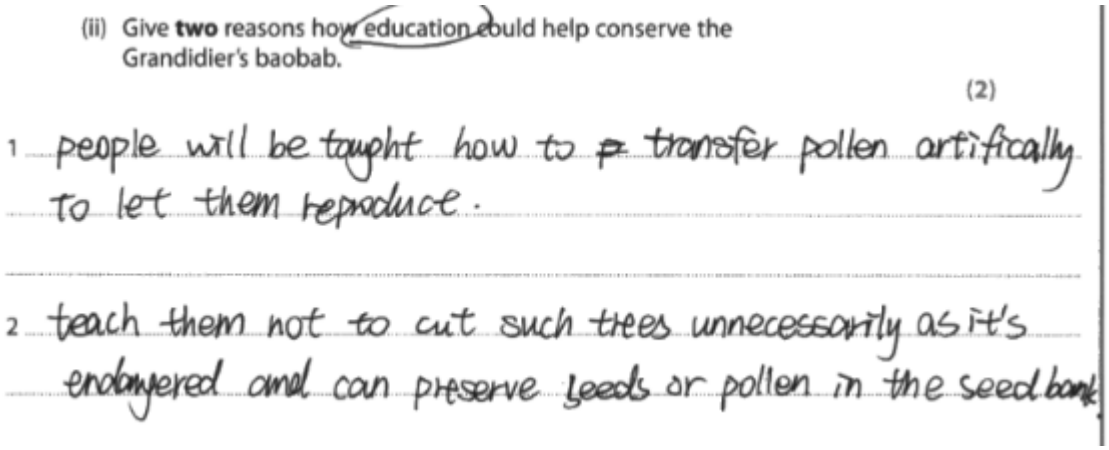
**Question 5(a)(ii)**

This question asked students to give two reasons how education could help conserve the Grandidier's Boabab.

It required students to identify a way that education would reduce loss of the Baobab trees (marking point one) and a way of promoting their population increase (marking point two).

There were a significant number of very vague responses, often with incorrect language. Many referred generally about how education can raise awareness of the importance of the trees, and the importance of conservation strategies in general.

It was surprising that few students could articulate that a way of increasing the number of trees would be to plant/grow more seeds/plants, although some excellent comments referring to artificially pollinating the Boabab trees were seen, for example:


(ii) Give **two** reasons how education could help conserve the Grandidier's baobab.

(2)

1 people will be taught how to ~~p~~ transfer pollen artifically to let them reproduce.

2 teach them not to cut such trees unnecessarily as it's endangered and can preserve seeds or pollen in the seed bank.

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

Students were asked to explain the role of one named molecule that uses calcium ions.

Nearly all students demonstrated their good understanding of this aspect of the specification, with many two-mark responses seen.

Most responses centred around the role of calcium pectate in forming the middle lamella.

**Question 5(b)(ii)**

Most students knew that phloem would translocate organic solutes in water and therefore selected the correct response.

However, a significant number of students selected xylem.

**Question 5(c)**

This question required students to analyse the provided graphical information in order to give two conclusions.

This question was particularly well answered with most students recognising that the fields with magnesium ions had more pods and that there were more pods per plant in 2020 than 2019.

The most common reason for only gaining 1 mark was giving one correct conclusion but then stating that a conclusion could not be made due to overlapping error bars.

**Question 5(d)**

This question required students to analyse the provided graphical information and comment on the results from the investigation.

It is important that students take careful note of the variables given on the axes and use these in their answers. A number of responses were seen which did not refer to magnesium ions.

Most students could identify the increase in mass for both maize and soybean with added magnesium ions and that the mass of 100 maize grains was greater than the mass of 100 soybeans. Higher level responses considered the difference in percentage increase.

The difference between validity and reliability was not understood by some students.

Very few students commented on methodology aspects.

When students analyse SD bars on a graph, it is not sufficient just to comment on either their size or the presence /absence of an overlap. It is important that they explain the significance of this. Many students did show that they understood that overlapping error bars reduce the validity of data but were not precise enough in stating exactly where this was/was not evident in the graph in front of them. It is important that students make it clear in their responses which error bars they are referring to. The data had some bars that overlapped and some that didn't. Therefore, marks could not be awarded for a vague statement referring to overlapping error bars showing no significant difference without stating which they were referring to.

**Question 6(a)(i)**

This question asked students to describe what happens to DNA in interphase.

Nearly all students knew that DNA replication occurs in interphase, but fewer students could give a second correct description. Where they did, the most common additional answer centred around transcription.

A significant number of responses described other interphase events which did not involve DNA, for example production of more organelles, increase in cell size or volume which did not answer the question asked.

Some high-level responses considered epigenetic modification.

**Question 6(a)(ii)**

This question asked students to name the stage of mitosis that follows prophase.

Most students gave the correct answer. However, a significant minority answered anaphase or interphase.

**Question 6(b)(i)**

Students were provided with a diagram showing what happened to chromosome 13 during the formation of the father's sperm cells. Students were expected to analyse this diagram and apply their knowledge of meiosis and gamete structure to this context.

This question was a very good differentiator. Numerous high-level responses were seen which gained all possible marking points, whereas low level responses tended to centre around gaining credit for describing sperm cell C or D in the diagram or for describing that the egg cell is haploid.

Mid-level responses added to these two marking points by considering that stage of meiosis that would be affected or that the chromatids had not split. Few candidates considered that the centromere had not divided.

Lack of precision in answers was a reason why some students failed to gain marks. For example, it is not sufficient at this level to say that the sperm cell enters the egg cell. The specification refers to the fusion of nuclei for example.

Some students did not take careful note that the diagram was referring to chromosome 13 and that there would be 22 other chromosomes in the nuclei. Responses referring to sperm D being diploid, without being specific that it was diploid for just chromosome 13, were ignored.

This is an example of a response which gained four marks (marking points 2,1,3,4,5):

(i) A zygote is formed at fertilisation.

Explain how an error in meiosis could result in the production of a zygote with three copies of chromosome 13.

(4)

In meiosis II, Spidle fibres were not able to contract and shorten so there was no breaking in the bond of the centromere ~~of the sister chro~~ so sister chromatids were not separated to the end poles in anaphase. When sperm D ~~has~~ with two copies of chromosome 13 fuses with a female nucleus with once copy of the chromosome it results in three copies of the chromosome 13.

**Question 6(b)(ii)**

Most students answered this correctly.

**Question 6(c)**

This question asked students to suggest why part of chromosome 13 can become attached to a different chromosome when a gamete is formed.

It was pleasing to see that a significant number of students were able to apply their knowledge of crossing over to this new context.

**Question 6(d)(i)**

This question asked students to explain how DNA methylation can alter the expression of some genes.

Some excellent responses were seen explaining where a methyl group would bind to the DNA molecule and the effect that this would have on gene expression.

Most students could explain that the genes would be 'switched off' or that RNA polymerase would not be able to bind, for example:

(d) Methylation of DNA can alter the expression of certain genes on chromosome 13.

Methylation of DNA can be passed on during mitotic cell division.

(i) Explain how DNA methylation can alter the expression of some genes.

(2)

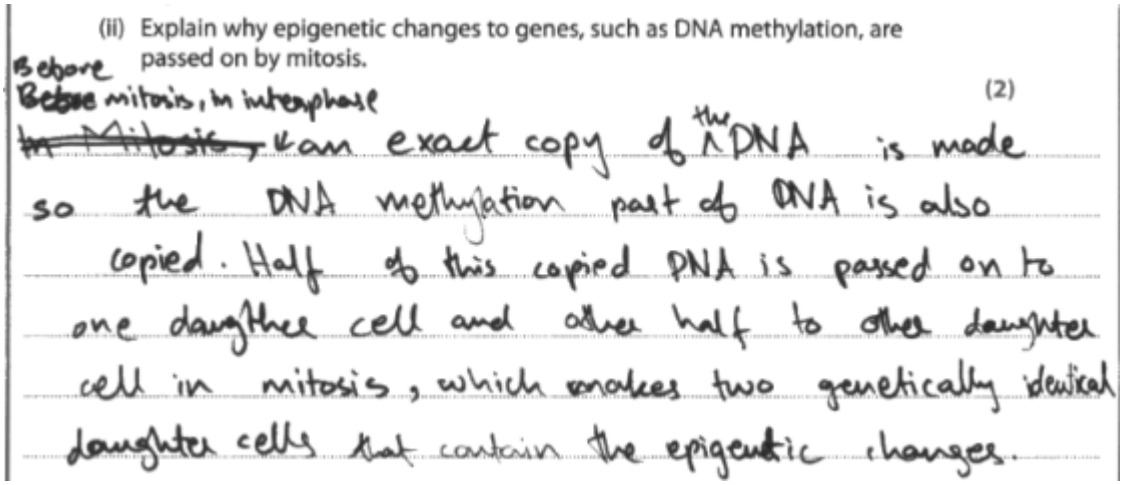
methyl group is added to cytosine base next to guanine in DNA chain by enzyme DNA methytransferase, change in arrangement of DNA molecule and physically block RNA polymerase and transcription factor

**Question 6(d)(ii)**

This question asked students to explain why epigenetic changes to genes, such as DNA methylation, are passed on by mitosis.

This proved to be a challenging question to many students, with many not understanding that epigenetic changes were replicated prior to mitosis.

This is an example of an answer which demonstrated the students understanding of this aspect of the specification:


(ii) Explain why epigenetic changes to genes, such as DNA methylation, are passed on by mitosis.

(2)

Before Before mitosis, in interphase ~~In Mitosis,~~ an exact copy of the DNA is made so the DNA methylation part of DNA is also copied. Half of this copied DNA is passed on to one daughter cell and other half to other daughter cell in mitosis, which makes two genetically identical daughter cells that contain the epigenetic changes.

**Question 7(a)(i)**

Most students could suggest a correct advantage of bacteria living on the skin surface having a capsule.

However, some students wasted time by given several responses, when they had been asked for one.

**Question 7(a)(ii)**

This question asked students to why this type of bacteria does not need a flagellum.

Many students were able to correctly apply their knowledge to this new context.

**Question 7(a)(ii)**

Most knew that bacterial cells would contain all three structures, but there was a significant minority who thought they would not contain either a ribosome or cell membrane.

**Question 7(b)(i)**

This question asked students to calculate the standard deviation for the given data.

This question was a very good differentiator, and the full range of marks were awarded.

Nearly all students gained the first marking point for calculating 6.5.

However, fewer students could give the correct denominator or remember to square root during the calculation.

There were some instances where a candidate lost the third mark due to incorrectly rounding to 1.802 instead of 1.803.

There were a small number of responses where students did not show their working. When the answer was incorrect, they lost the possibility of an error carried forward mark being awarded.

This is an example of a correct calculation:

$$s = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$$

The table shows some of the calculations done by the student.

| $x$ | $x-\bar{x}$ | $(x-\bar{x})^2$ |
|---|---|---|
| 11.0 | 2.0 | 4.0 |
| 7.5 | -1.5 | 2.25 |
| 8.5 | -0.5 | 0.25 |
| | | $\sum(x-\bar{x})^2 = 6.5$ |

(i) Calculate the standard deviation for this set of data.

Use the student's table and formula to help you.

(3)

$s = \sqrt{\frac{6.5}{3-1}}$

$\sqrt{\frac{6.5}{2}} = 1.803$

Answer 1.8 mm

**Question 7(b)(ii)**

This question proved challenging for many students, with many students selecting the answer that standard deviations would be calculated to see if there was a correlation between different concentrations and zone of inhibition diameter.

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

Most students demonstrated this maths skill correctly.

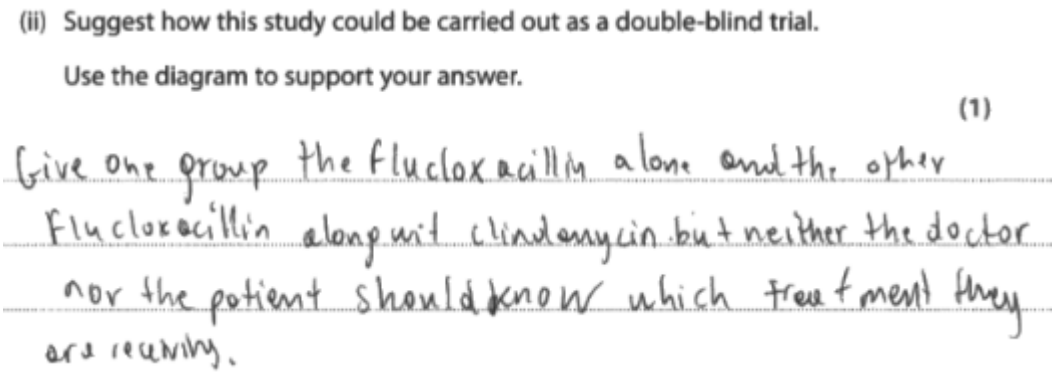
**Question 7(c)(ii)**

This question asked students to suggest how this study could be carried out as a double-blind trial. They were given the instruction to use the diagram to support their answer.

It was clear to see that most students knew the theory of a double-blind test in a generic drug trial, however fewer students could apply their knowledge to the given context.

Generic answers did not gain the mark, nor did answers referring to one of the groups receiving a placebo.

This is an example of a response which applied relevant knowledge correctly to the given context:



(ii) Suggest how this study could be carried out as a double-blind trial.

Use the diagram to support your answer.

(1)

Give one group the flucloxacillin alone and the other flucloxacillin along wit clindamycin but neither the doctor nor the patient should know which treatment they are receiving.

**Question 7(c)(iii)**

This question asked students to comment on the results of the investigation.

It is important that students take note of the command word.

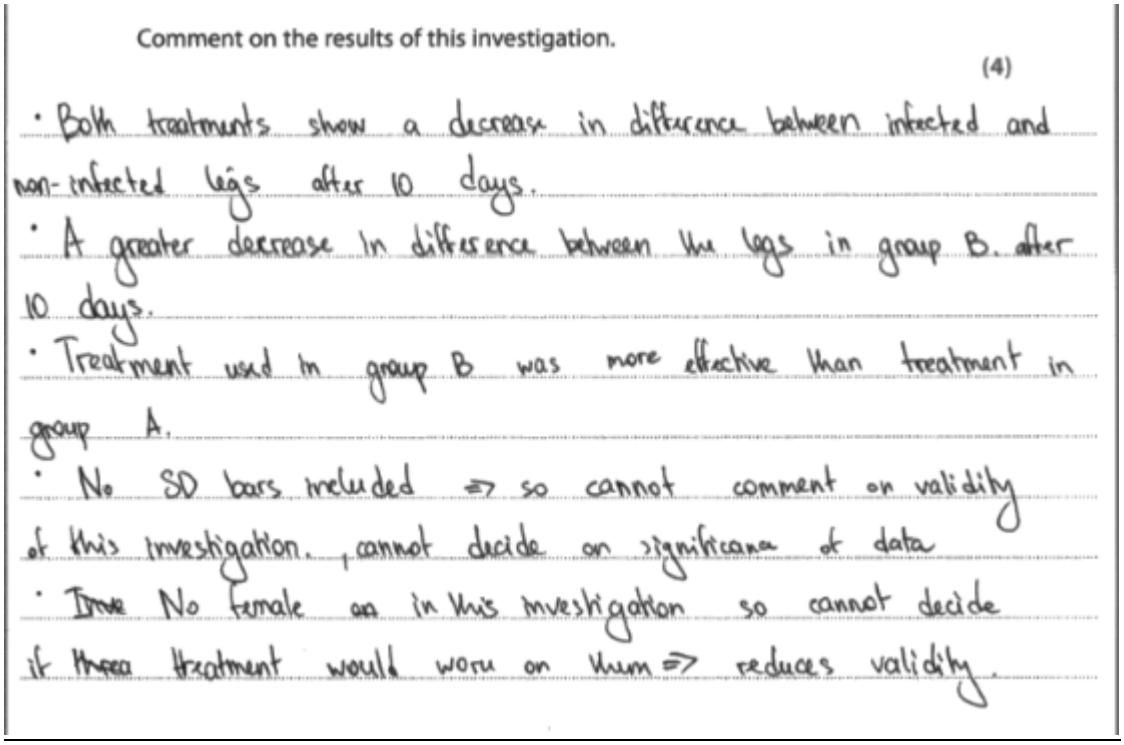
Some students struggled to understand the data and that a lower mean difference in circumference between the infected and non-infected leg would mean that the treatment was more effective. Perhaps they had not remembered the diagram of the leg at the start of question 7. Therefore, some students thought treatment A was more effective.

Where students did understand the data, most were able to spot that the circumference difference deceases with time or compared calculated decreases. Some higher-level responses formed the judgement that the treatment which group B received was more effective.

Very few students commented on the initial difference or decrease from day 0-5.

It was pleasing to see a variety of creditworthy comments regarding the study, the most common relating to sample size linked to validity, age of participants and that only male participants were used. Some commented that there were no standard deviations so they couldn't judge significance or validity of data / conclusions.

is an example of a response which gained marking points 1,2,3,5:


Comment on the results of this investigation.

(4)

• Both treatments show a decrease in difference between infected and non-infected legs after 10 days.

• A greater decrease in difference between the legs in group B. after 10 days.

• Treatment used in group B was more effective than treatment in group A.

• No SD bars included ⇒ so cannot comment on validity of this investigation. , cannot decide on significance of data

• Done No female as in this investigation so cannot decide if these treatment would work on them ⇒ reduces validity.

**Question 8(a)**

This question asked students to describe **one** piece of information that would need to be collected in order to determine if the scientist was correct and that the Akhal-Teke breed was the same as the older breed.

A small number of students suggested breeding them together to see if they produce fertile offspring, which was not creditworthy.

The majority of students correctly identified that they should analyse the DNA but they often failed to specify what aspect of the DNA would be analysed (the sequence) and therefore did not gain marking point one.

Most students knew that they were looking for similarities between the named molecules.

This is an example of a correct response:

(a) A scientist suggested that the Akhal-Teke breed is the same as an older breed known as the Turkoman horse.

Describe **one** piece of information that would need to be collected in order to determine if the scientist was correct.

Give a reason for your answer.

(2)

Information

Sequence of bases of DNA

Reason

as ~~the ma~~ if sequence of bases of DNA are the same then the scientist is correct.

**Question 8(b)**

Most students could recall the required equation from the specification and use it correctly.

**Question 8(c)(i)**

This question asked students to suggest a reason why the Caspian breed has small hooves in proportion to its mass, whereas the closely related Arabian breed has large hooves in proportion to its mass.

Unfortunately, many students did not take careful note of the provided written information or the photographs. Vague responses e.g. just stating 'mutation' were not creditworthy at this level, nor were answers referring to water storage:

The Caspian breed was thought to be extinct until a small population was discovered in mountainous regions in 1965.

The Arabian breed is found in sandy deserts.

(i) The Caspian breed has small hooves in proportion to its mass, whereas the closely-related Arabian breed has large hooves in proportion to its mass.

Suggest **one** reason for this difference.

(1)

Sandy desert is very hot and it does not have water in everyplace so Arabian horse have large hooves to store water for longer time.

This in an example of a response that gained the mark:

The Caspian breed was thought to be extinct until a small population was discovered in mountainous regions in 1965.

The Arabian breed is found in sandy deserts.

(i) The Caspian breed has small hooves in proportion to its mass, whereas the closely-related Arabian breed has large hooves in proportion to its mass.

Suggest **one** reason for this difference.

(1)

natural selection as Arabian horse need large hooves not to sink in sand so adapted individuals survived and passed alleles of desirable features to offspring

**Question 8(c)(ii)**

This question required students to complete the table to show how many horses would have the heterozygous genotype and how many would have the homozygous recessive genotype.

They were provided with one equation and that the population was 400 horses.

As in previous series, many students find this aspect of the specification difficult. However, there was a significant improvement in the number of responses which gained full marks.

It was disappointing that that some students gave answers in the table that were not sensible. Answers were seen which gave negative numbers, or numbers exceeding the given population.

Although many students could correctly calculate $q^2$, a significant number failed to perform the square root before subtracting their value from 1.

This is an example of a correct calculation:

| Genotype | two copies of the dominant allele | heterozygous | two copies of the recessive allele |
|---|---|---|---|
| Part of Hardy–Weinberg equation | $p^2$ | 2pq | $q^2$ |
| Number of individuals | 46 | 179 | 175 |

Complete the table to show how many horses would have the heterozygous genotype and how many would have the homozygous recessive genotype.

Use the equation:

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

$\frac{46}{400} = 0.115$

$p^2 = 0.115$

$p = \sqrt{0.115}$

$= 0.339116499_2$

$p + q = 1$

$q = 1 - p$

$q = 1 - (0.339116499_2)$

$= 0.660883500_8$

$q^2 = 0.436767_{00}16$

$0.436767_{00}16 \times 400$ (3)

$= 174.71$

$= 175$

Some students gained mp1 and mp2, but did not go on to calculate the number of horses with the two different genotypes, for example:

| | | | |
|---|---|---|---|
| **Number of individuals** | 46 | | |

Complete the table to show how many horses would have the heterozygous genotype and how many would have the homozygous recessive genotype.

Use the equation:

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

(3)

$p^2 = \frac{46}{400} = 0.115$

$p = \sqrt{0.115} = 0.34$

$\therefore q = (1 - 0.34) = 0.66$

$\therefore$

$p^2 = \frac{46}{400} = 0.115$

$p = 0.34$

$1 - 0.34 = q = 0.66$

$q = 0.34$

$2pq$

$2 \times 0.34 \times 0.66$

**Question 8(d)**

This question was the only level-based question on the paper.

Students were provided with a range of information to analyse, both qualitative and quantitative, and they were expected to use all this information to support their answer. Students who only used the table for example would have limited the mark they could achieve.

Many students laid their answers out very clearly, logically quoting the table and graph data and working through the related advantages and disadvantages.

Most responses gained level one by discussing either a basic disadvantage or a basic advantage linked to information in the table.

For example, many students were able to recognize that less sperm in frozen and thawed samples can swim and/or that frozen sperm have reduced survival time and increase in damaged DNA. Many were able to link these observations with reduced likelihood of successful fertilisation of an egg cell.

A level two response was usually achieved by students either linking both a basic advantage and disadvantage to the given table and graph, or for giving a detailed discussion of the advantages of using frozen sperm.

For example, students discussed the benefits of IVF, sperm storage, increasing numbers of offspring and the ability to use sperm from dead males to prevent the loss of alleles from the gene pool.

Higher level responses used all of the given information and their own biological knowledge in their detailed discussions of both advantages and disadvantages of using frozen sperm in breeding programmes for the endangered breeds of horses.

Few students mentioned the significance of the correlation coefficient.

This is an example of a response which achieved level 3:

Discuss the advantages and disadvantages of using frozen sperm in breeding programmes for these endangered breeds.

Use all of the information in Question 8 to support your answer.

(6)

Freezing Sperm prevents the population from going extinct as scientists can use IVF. This can also help maintain genetic diversity as scientists can analyse DNA and use a stud book to fertilise an egg with different alleles to increase the gene pool. However freezing and then thawing sperm cells causes a significant decrease in survival and may also damage DNA. This means the IVF would have to be done quickly and there would be a high chance that the sperm cells die before fertilising the egg. Damaged DNA could result in horses with deformities and possibly result in alleles coding for wrong characteristics putting the offspring at a disadvantage in their environment. Freezing also reduces the percentage of sperm that can swim meaning there will be a much lower chance of pregnancy. At 26.9% sperm cells that can swim, there will be around 75% successful pregnancies which is still a good chance suggesting freezing sperm cells could be effective. However freezing sperm cells alone may not be very effective if there are little to no females in the population. If something happens to the sperm samples there is no way to get new ones.

**Paper summary**

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

- 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.
- Information provided in the introduction to questions is provided for a specific reason. Read it carefully and analyse what information will be needed to provide a high-level response to the question being asked. If you have been provided with diagrams anlayse them carefully too.
- 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 all of the mathematical skills in the specification which could be tested at this level. Do not give your answers as fractions unless you are asked to.
- 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.
- Take careful note of instructions regarding the presentation of your calculated answer, e.g. give your answer to the correct number of significant figures.

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