Pearson Edexcel

Examiners' Report
Principal Examiner's Feedback

January 2022

Pearson Edexcel International Subsidiary/Advanced 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) This question required students to draw and label a chloroplast, amyloplast and a tonoplast onto the supplied diagram of a plant cell. The students were assessed on the location, relative size and labelling of these three structures.

A small number of students did not attempt this question and went straight onto part (b). Students need to read given information carefully to ensure they do not miss out questions without answer lines.

Nearly all students knew that an amyloplast and a chloroplast would be smaller than the nucleus and that the tonoplast would be larger than the nucleus. A minority of students did not know either the amyloplast or tonoplast relative size to the given nucleus.

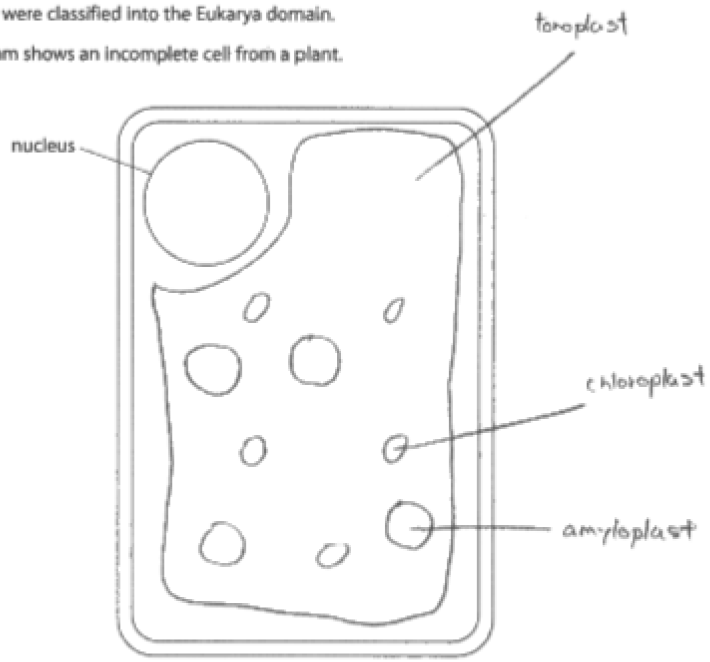
Most students knew that the amyloplast and chloroplast would be found in the cytoplasm of the plant cell, however a small number of responses were seen which had structures drawn in the nucleus, vacuole or outside the cell membrane.

Students need to be careful with their label lines to ensure they touch the structures that they are labelling. Some label lines ended up labelling the cytoplasm or the inside of the vacuole and were therefore not creditworthy.
This response did not gain the tonoplast mark as they had labelled the vacuole. Although the chloroplast and amyloplast were of a suitable size they were in the wrong location:

1 Woese classified organisms into a three-domain system.

Plant cells were classified into the Eukarya domain.

The diagram shows an incomplete cell from a plant.

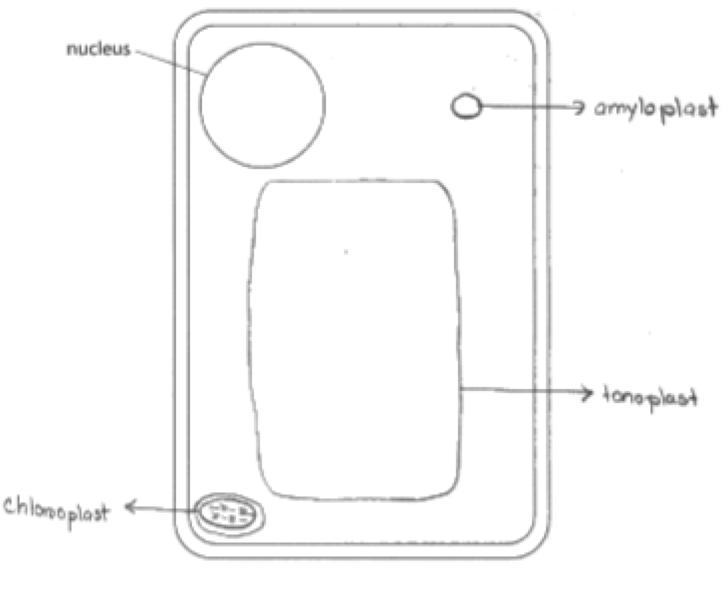


(a) Complete the diagram by drawing an amyloplast, a chloroplast and the tonoplast to show their location and relative size in this cell.

Label these three structures.

(3)

This is an example of a response which gained full marks



(b) This question gave the students a photograph of a Golgi apparatus taken using an electron microscope.

Students were expected to identify the organelle from the photograph and state its function.

Most candidates were able to identify the organelle and give a correct function. The most common answer was that it modifies proteins before packaging them.

A small number of students misidentified the organelle as either rough or smooth endoplasmic reticulum.

(c) These four multiple choice questions tested students' knowledge of the three domains and were generally answered well by students.

Question 2

(a) This question gave students a photograph of xylem vessels that had been stained. The rings of lignin were clearly visible on the photograph. Students needed to use this to identify that staining helped to identify structures within the specimen. Identification of the 'specimen' through staining was not credit worthy.

It was pleasing to see that students knew that DNA/chromosomes and organelles would be able to be identified more clearly if they were stained, as shown in this response:

A stain was added to the xylem before viewing using a microscope.

Give a reason why it is usual to stain specimens in microscopy.

(1)

Stains are absorbed making some organelles visible ~~fo~~ that aren't normally to be observable under a microscope.

(b) Students were asked to explain how the arrangement of cellulose molecules and secondary thickening in xylem vessels contributes to the physical properties of the cell wall.

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

It was clear that many had learned the structure of a cell wall thoroughly and many good descriptions were seen. However, students needed to take careful note of the command word 'explain' in order to gain marks.

Most students could link one aspect of marking point 3 to the property of strength. A significant number of responses also gained marking points 1 and 2 for describing the different orientations of the cellulose microfibril layers. Some students explained why xylem vessel cell walls were impermeable to water.

The most detailed responses picked up on the rings of lignin in the photograph or described the role of pectate as shown in this 4-mark response:

(b) Explain how the arrangement of cellulose molecules and secondary thickening in xylem vessels contributes to the physical properties of the cell wall.

(4)

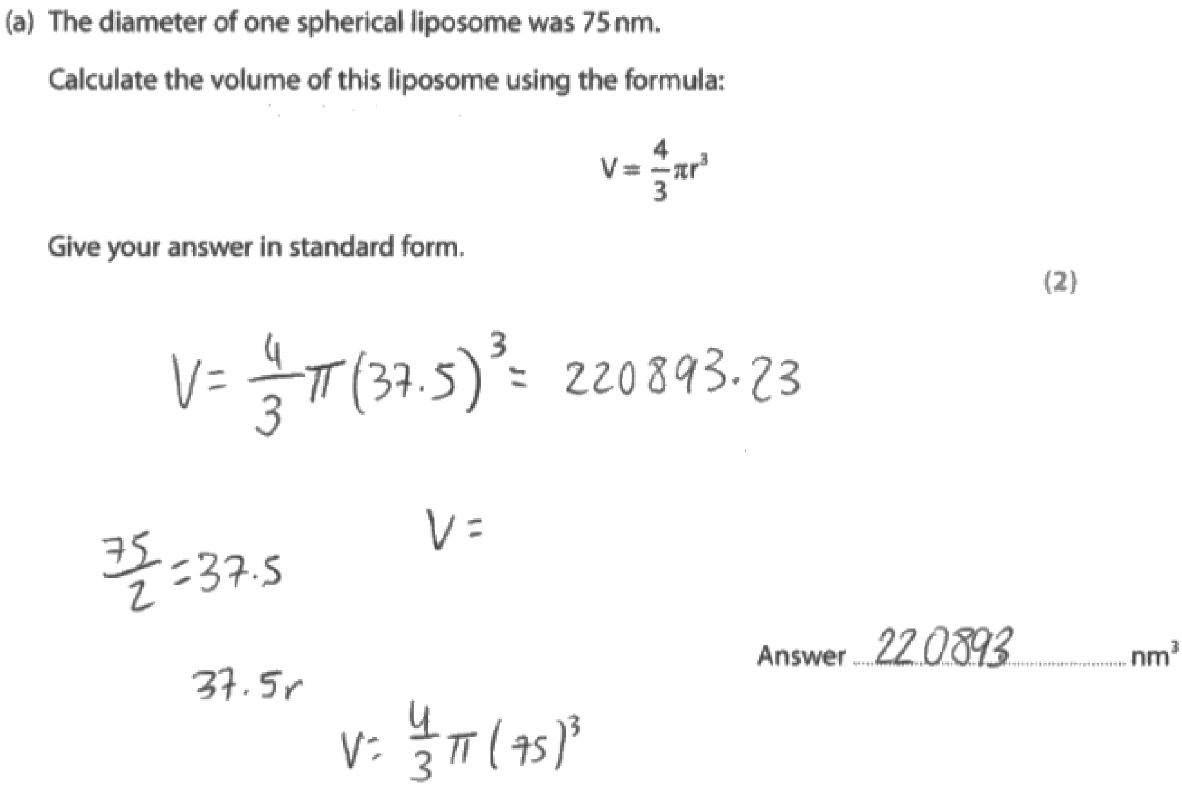
Xylem vessels contains lignins that are in spiral shape around the inner walls of xylem this provides mechanical support and flexibility to cell wall. Cellulose molecules are parallel to one another and forms hydrogen between each molecule making microfibrils. Microfibrils are ~~long~~ arranged in criss cross manner in primary cell wall. ~~and embedded in matrix of~~ In secondary cell wall microfibrills are arranged in same direction in a layer and different layer microfibril are positioned at a different angle. This increases the strength of cell wall and can ~~with ss~~ withstand high tension.

Question 3

(a) This question asked students to use the given formula and diameter to calculate the volume of the liposome. The students were expected to give their answer in standard from.

It was clear to see an improvement to past exam series in the number of students who took careful note of the requirement to give their answer in standard form.

The most common mistakes made by students were to not take note of the standard form requirement, to insert the diameter into the equation or giving their answer to too many decimal places compared to the given data.
This response calculated the volume correctly to gain one mark:


(a) The diameter of one spherical liposome was 75 nm.

Calculate the volume of this liposome using the formula:

$$V = \frac{4}{3}\pi r^3$$

Give your answer in standard form.

(2)

$V = \frac{4}{3}\pi(37.5)^3 = 220893.23$

$\frac{75}{2} = 37.5$

$V =$

$37.5r$

$V = \frac{4}{3}\pi(75)^3$

Answer 220893 nm³

This response was awarded two marks and demonstrates clear working and good exam technique by the student:

Give your answer in standard form.

(2)

$r = 37.5$

$V = \frac{4}{3} \times \pi \times (37.5)^3 = 220893.2335$

2.2×10^5

Answer 2.2×10^5 nm^3

(b) This question asked students to compare and contrast the structures of pre-mRNA and active mRNA.

It was disappointing that significant numbers of students did not take notice of the command ‘compare and contrast’. Answers which gave a paragraph of information about pre-mRNA formation, structure or function followed by a paragraph of information about active RNA were not creditworthy.

A compare and contrast question requires both similarities and differences. Therefore, full marks could only be awarded if the answer contained both similarities and differences. More candidates identified differences than similarities.

Centres are advised to teach students the importance of comparative language in these types of questions, for example the use of the conjunctives ‘whereas’ or ‘but’.

The most common similarities given by students were that the two molecules were both single-stranded and that they both contain the base uracil. Few students made a clear statement that they both contained exons.

The most common difference marking point awarded was marking point 4. A number of excellent responses considered the different order of exons in active mRNA than pre-mRNA.

This response shows good exam technique by clearly identifying similarities and differences in the structure of the two molecules. Here the student gained marking points 2,3,4 and 5.

The structure of pre-mRNA produced from transcription is different from the structure of active mRNA.

Compare and contrast the structures of pre-mRNA and active mRNA.

(4)

Similarities:

Both are made of RNA nucleotides.

Both Contain exons.

differences:

pre-mRNA ~~contain~~ has introns but active RNA ~~doesn't~~ does not.

The RNA sequence of pre-mRNA is exactly Complementary to the DNA base sequence, but in active ~~R~~ mRNA introns are removed and exons are rearranged.

This response also scored full marks and demonstrates how to use comparative language in these types of questions:

(b) Active mRNA is formed after post-transcriptional modification of pre-mRNA.

The structure of pre-mRNA produced from transcription is different from the structure of active mRNA.

Compare and contrast the structures of pre-mRNA and active mRNA.

(4)

Both the pre-MRNA and the active MRNA consist of ~~A~~ Bases A, U, C and G, Both active and pre-mRNA are single stranded. The ~~pos~~ active m-RNA doesn't have introns whereas the pre-MRNA has introns, in some cases the ~~Rx~~ active-MRNA could also lack some of the exons present in the pre-mRNA*. The pre-mRNA could also have a different order of exons than the active mRNA, as splicing could result in a change in the arrangement of the exons.

* This is due to the process referred to as splicing carried out by spliceosomes.

(Total for Question 3 = 6 marks)

Question 4

(b)(i) This question asked students to name the stage of mitosis when the spindle fibres begin to form.

Most students knew that this would occur in prophase, however a small number of students did not take note of the context of mitosis in the question. Answers that identified a stage in meiosis were not creditworthy.
A minority of students though that spindle fibres begin to form in metaphase.

(b)(ii) This question asked students to explain the role of the spindle in mitosis.

It was clear to see that students understood the role of the spindle in mitosis and many excellent responses were seen which gained marking points 1 and 2.

Fewer candidates explicitly identified marking point 3, that the spindle would result in identical genetic material for the two daughter cells.

(b)(iii) This question asked students to draw a plant cell undergoing cell division, after mitosis had just finished.

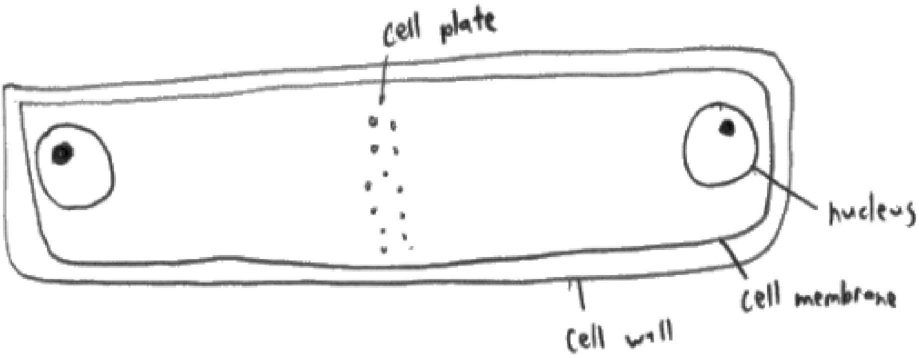
Unfortunately, similar to Q1(a), there were a number of students who did not attempt this question.

It was clear to see that many students understood that at this point in the cell cycle, there would be one cell with two nuclei. However, a significant number of students did not understand that the cell that they were drawing needed to be a plant cell and therefore a cell wall needed to be present.

Students needed to recall that plant cells divide after a cell plate has formed, and it was pleasing to see many responses showing a part formed cell plate. This is an example of a response which gained full marks:

(iii) Draw a plant cell undergoing cell division, after mitosis has just finished.

(2)

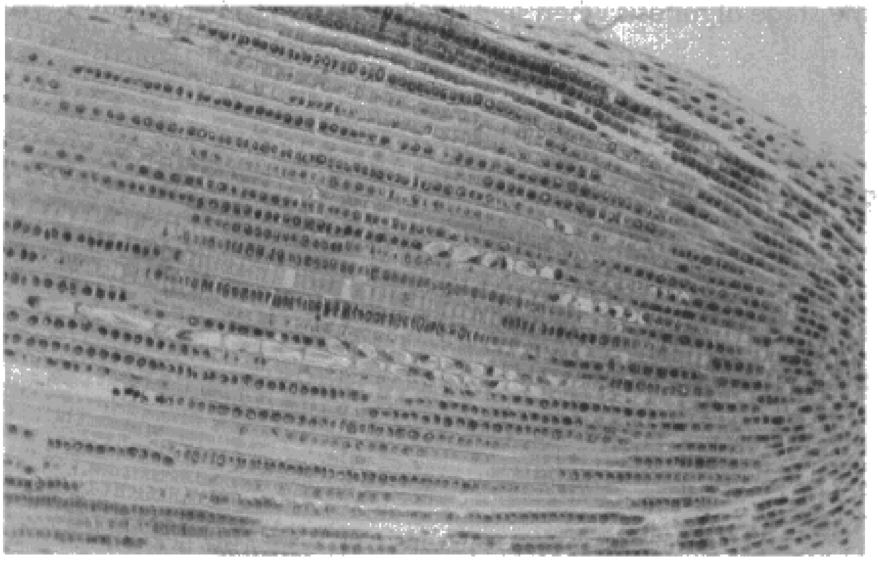


(c) This question gave the students a photograph of cells in a root tip. The specimen had been stained.

Students needed to describe that they would need to count both the numbers of cells in mitosis and the total number of cells visible on the photograph.

It was pleasing to see that most students knew how to calculate the mitotic index and could give the correct equation. However, some students did not describe how they would use the photograph in order to get the numbers of cells for the calculation, for example:

(c) The photograph shows a section through a root tip, as seen using a microscope.



(Source: © agefotostock / Alamy Stock Photo)

Describe how to determine the mitotic index of this tissue.

(2)

by dividing the number of cells undergoing mitoses with the total number of cells.

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

Describe how to determine the mitotic index of this tissue.

(2)

Count the number of Cells undergoing mitosis (have visible Chromosomes) and Count the total number of Cells, then divide the number of Cells in mitosis over the total number of cells and multiply the result by 100 to get ~~to get percentage~~

Question 5

(a)(i) This question required students to calculate the magnification of the image.

They were told that the bacterium labelled X is 0.5μm in length and it was pleasing to see that students recognised that they needed to measure its length.

The most common mistake was an incorrect unit conversion, which often resulted in an answer which should have alerted the student as to an error in their working.

(a)(ii) This question required students to recognise their calculated magnification from (i) would not be achievable using a light microscope.
Most students answered this question correctly. A small number of students gained ecf for a correct answer based on their incorrect magnification. However, it was surprising that a number of students who had calculated a magnification in (i) that would be achievable by a light microscope, gave a standard response that a light microscope would not have a high enough magnification. This inconsistency should have stimulated the student to check their answer to (i).

(b) This question required the application of knowledge of the advantages of plant-based products to the given context. One mark was available for a rote-learned response, and this was the most common mark awarded.

Higher level answers also addressed the advantages of the antimicrobial properties of the oregano oil, for example:

Oregano oil contains antimicrobial substances.

This oil can be used in the production of plastic used to package food.

Explain why this packaging may be chosen over traditional oil-based plastic packaging.

(2)

It prevents microbial growth in food which could cause disease to people who ate it. It is ~~renew~~ renewable so it is made available for future generations

(c)(i) Most students could interpret the provided data correctly to gain the mark.

(c)(ii) This question required students to calculate the maximum difference in the diameter of the largest and smallest zones of inhibition.
This required students to recognise the importance of the word 'maximum' in the question and use both the range and mean data provided in the table. Few students did this.

The most common mistake was to calculate the difference between the mean data, which was not credit worthy.

(d) This question informed students that three-phase testing can be used to check for the safety and effectiveness of these chemicals.
The students were then asked to describe the roles of phase I and phase II.
A small number of students repeated the given information about checking for safety and effectiveness without giving further detail and gained no credit.
A significant minority of students gave a standard answer describing three-phase testing without addressing the context of the question. For example, testing on animals / human cells, sample size, double-blind trials and use of placebos.

The most commonly awarded mark was for testing for side effects.
It was clear that many students had seen the paper on the previous series, which required students to suggest how a suitable dose for cancer treatment would be determined in human trials, as a large number of responses included the information about the role in determining the ideal dose.

The highest-level responses explained how the effectiveness of the chemicals could be determined, for example this response:

(d) Drugs containing these chemicals must be tested for safety before they can be approved and used to treat humans.

Three-phase testing can be used to check for the safety and effectiveness of these chemicals.

Describe the roles of phase I and phase II.

(3)

In phase I, the drug is tested on a small group of healthy volunteers to test for toxicity or ~~and~~ side effects of the drug and a minimum dose of the drug is decided by testing with a range of doses and selecting the lowest effective concentration of the drug. ~~Independent~~ review is then done by independent scientists to check the effectiveness of the drug. In phase II, the drug is ~~given~~ tested to on a small group of around 500 patient volunteers split into 2 groups with 1 group receiving the drug and the other receiving a placebo. This removes psychological factors and the effectiveness of the drug is tested by statistical analysis, to check for a significant difference in those treated with the drug compared with the placebo.

(Total for Question 5 = 9 marks)

Question 6

(a) This was the first of the level-based questions on the paper.

Students were supplied with both quantitative and qualitative information and were expected to use this information, and their own knowledge, to support their answer.

Students were expected to analyse the graph and the table of data to help them explain why there is such a large variation in the skin colour of the offspring produced from this cross.

Most students achieved level one by describing some information from the question/table and the graph, for example this response which scored level 1 and 2 marks:

There is a large variation because the
parental genotype are heterozygotes with many alleles,
and all these alleles can give very varied results
when combined with one another, and skin colour is polygenic
so more than 1 gene can code / contribute to the chorcteristic
/phenotype of skin, ~~All~~ both parents have all 3 genes
too ~~wht~~ which increases genetic variation, A B and C
are dominant alleles that code for darker skin, while a b and c
are recessive alleles that code for lighter skin, ~~as~~ and
the parental genotype both have ~~2~~ 1 of every recessive
and dominant allele, ~~Dark skin has highest propa~~ the
skin of the offspring being dark (containing atleast one
dominant allele) is way more likely (higher probability) as ~~it~~
only one dominant allele is needed to be observable phenotype (as it is dominant

0 and 6 dominant alleles being present has lowest probability as all alleles need to be either recessive or dominant which isn't likely due to parents containing half dominant half recessive. Individual having 3 dominant allele is highest probability as parental genotype are both like that. 2, 4 dominant alleles and 1, 5 dominant alleles being present have equal probability as they have either ~~recessive(2)~~ equal recessive and dominant alleles.

Level two was usually achieved by students building on this to consider some of the genetic causes of variation, for example crossing over and independent assortment in meiosis.

This response gained a higher level two, four marks as they fulfilled the level one criteria and considered how the variation could be caused by crossing over and independent assortment:

Use information from the question, and your own knowledge, to help support your answer.

(6)

there is large variation firstly, because skin colour is polygenic, so many combinations of genes will each produce a slightly different skin tone, as shown by the dihybrid cross diagram. Also, there's a large variation of skin tones because there are different probabilities of inheriting each skin tone. ~~The~~ Some are more likely than others ~~to~~ to be inherited. Also, meiosis produces 4 genetically different daughter cells due to crossing over during prophase 1, and independent assortment during meiosis which leads to genetic variation and therefore, variation in the phenotype.

Level three was usually achieved by students extending their answers to consider random fertilisation of gametes and how the environment/mutations affect variation in skin colour, for example:

*(a) Explain why there is a large variation in the skin colour of the offspring produced from this cross.

Use information from the question, and your own knowledge, to help support your answer.

(6)

Skin colour is a polygenic ~~inheritan~~ inhertance, controlled by three different genes A, B and C, both have a ~~domaint~~ dominant allele and a recessive allele, During fertilizing ~~~~ random gametes fuse with each other, and also there is cross-over that happened during meiosis where sections of DNA was exchanged. and also there is random independent assortment. Also of the results in variation and crossing-over results in new allele recombination. Any gamete can take any allele and ~~to~~ hence variation in skin colour. This is variation ~~~~ due to mutation. ~~The~~ Also the greater the number of dominant alleles, the darker the skin colour. The most ~~com~~ common skin colour is at 3 dominant alleles.

(b) This question asked students to suggest two reasons why some individuals may have darker skin than others with the same genotype.
It was clear to see which students had read the question carefully and taken note of the words ‘same genotype’. There were a significant number of students who did not do this and suggested the difference was down to a different genotype which was not creditworthy.

Many students did realise that exposure to sunlight might have been a factor, but did not explain whether it was more or less exposure to sunlight that would cause a darker skin colour for example:

(b) Suggest **two** reasons why individuals that have inherited the genotype AaBbCc, may have a darker skin colour than other individuals with the same genotype.

(2)

1 The environment might affect skin colour like the amount of sunlight at different locations

2 The amount of food or activities they do could affect the skin darkness

Credit worthy suggestions relating to diets interacting with the melanin pigment synthesis, mutation, gene expression and skin disease were also seen.

This response gained marking points 1 and 2 to gain full marks:

(b) Suggest **two** reasons why individuals that have inherited the genotype AaBbCc, may have a darker skin colour than other individuals with the same genotype.

(2)

1 These individuals may have a mutation that causes the to produce more skin colour pigment called melanin

2 These individuals ~~have~~ may have had greater exposure to UV light over the year, causing their skin color to appear darker

(Total for Question 6 = 8 marks)

Question 7

(a) This question asked students to state what is meant by the term species richness.

Many correct definitions were seen, demonstrating students understanding of this area of the specification.

This response did not gain the mark as they did not fully define the term:

> State what is meant by the term **species richness.**
>
> (1)
>
> Speciess richness means there are many different types of speciess in an area.

Whereas this is an example of a credit worthy response:

> State what is meant by the term **species richness.**
>
> (1)
>
> The number of species in a particular area.

(b) This question asked students to explain the advantages of drying seeds before storage.

This question was very well answered by the majority of students, demonstrating their knowledge of this aspect of the specification.

All marking points seemed to be equally awarded, with students using the question total as a guide to how many points should be made.

(c)(i) This question asked students to recall the heterozygosity index equation and many did so correctly. Students who read (ii) carefully may have picked up aspects to help their answer.

Some students were confused as to which equation they needed to give. A range of equation were seen, including index of diversity and Hardy-Weinberg.

(c)(ii) This question gave the students the number of individuals in the population and the heterozygosity index.
Students were required to use this data and calculate the number of heterozygotes in this population.
It was clear that many students knew how to rearrange the equation to make 'number of heterozygotes' the subject of the equation. Therefore, they gave the correct answer and gained the mark.

(c)(iii) This was the second of the level-based questions on the paper. Students were given pertinent information about the titan arum as well as four conservation suggestions. They were expected to use this information in their response.

Students seemed to find this question more challenging than Q6(a), although there was still a full spread of marks seen.

Students needed to address all four suggestions in order to access the higher marks on this question and it was surprising that a high proportion of students did not.

The first and fourth suggestions were discussed at a greater depth than the others. Many responses were seen that related asexual and sexual reproduction to the effect on genetic diversity. Points relating this genetic diversity to survival of the individuals were also frequently seen, possibly due to the level-based question on the previous series.

Of the four suggestions, the one that was least understood by students was creating a studbook for the species. Many students did not know what a studbook was, with descriptions of magazines and educational leaflets often given. Where the concept of studbooks was understood, the common point made was that one would prevent inbreeding.

There was confusion in some answers about storing pollen in a seedbank. Some answers referred to seeds instead of pollen which was not credit worthy. Few candidates were able to identify that collecting pollen would enable artificial pollination to take place during the short periods of time that flowers were open. Where candidates did talk about collecting pollen as an option, the most commonly given response related to pollen viability or storage costs of this.

The most common way students accessed level one was to make a basic comment about the effect of both asexual and sexual reproduction on the genetic diversity of the titan arum population, for example this response which gained two marks:

*(iii) Discuss the suggestions, proposed by these scientists, for conserving the titan arum.

(6)

Suggestion 1; growing more plants produced by asexual reproduction will ~~not~~ result in less genitic diversity. Suggestion 2; by collecting pollen when an individual plant flowers and store it in a seed bank will insure that incase this plant extinct the scientist will be able to replant it and save it. Suggestion 3; creating a studbook for this species will help in studying this ~~[illegible]~~ ~~it from~~ helps in conserving this plant. Suggestion 4; by artificially pollinating plants in the wild and in botanical gardens this will cause genetic variation this helps in conserving this plant

The most commonly awarded mark on this question was level 2, three marks. This was awarded in two different ways.

Either for a basic discussion of three suggestions, or for a more detailed discussion of two sections.

This response was awarded three marks for a more detailed consideration of the 1st and 4th suggestion. Their reference to seeds was not creditworthy for the 2nd suggestion and they didn't make a relevant point about studbooks.

*(iii) Discuss the suggestions, proposed by these scientists, for conserving the titan arum.

(6)

There are both advantages and disadvantages to the ideas proposed. Firstly, growing more plants by asexual reproduction could increase the population of the titan arum at a quick rate. Secondly, storing seeds in a seed bank will ensure that if all other methods fail that this species does not go extinct. Creating a studbook will inform more people on this plant speies are raise awarness. Artifically pollinating plants will increase sexual reproduction of these plants and increase genetic variety, it will also be more efficent then insects pollenating the plants. However, there are disadvantages. If only the asexual reproduction method is used this can lead to low genetic variation and may endanger plants. Also, the seeds in the seed bank may not be able to grow if conditions are not right, and pollinating plants artifically may not result in germination, since usually the plants are expecting to be pollinated as the plant only flowers once every 10 years, or the offspring may die.

Level 3 could only be awarded if creditworthy points had been made about all four suggestions.

The highest scoring responses used their own knowledge to discuss advantages and disadvantages of suggestions 1,2&4 and advantages of suggestion 3 as shown by the following 6-mark response.

Fist suggestion: Growing more plants produced by asexual reproduction will increase the population of titon orum plants rapidly, but as a result of asexual reproduction by mitosis, genetically identical offsprings are produced, therefore no change in genes between plants so no change of genetic diversity, and any change in environment like natural disaster or disease, will kill all of them. Second suggestion: Collecting pollen when plants flowers will be time consuming and takes long time to be produced. But as is stored in seed bank, it can be frozen so that it can be viable for long time and fertilise flowers of this plants when it comes to the flowering season, it also increases genetic diversity as pollen are genitically different by meiosis which when planted make different plants with different genotypes so more adapted to environment. Third suggestion: Studbooks will record the mating of species and their transfer to reduce inbreeding to make sure they select different mates and breed them, increasing genetic diversity. Fourth suggestion: Pollinate them artificially in wild and in garden will increase chance of fertilisation by putting pollen in ovary and randomly done to increase genetic diversity. But if it is not random, it may decrease genetic diversity. All suggestions are good to be made as advantages outweighs disadvantages

Students are advised to spend some time planning their answers. It was clear to see that students who made notes next to each suggestion on the question paper addressed each suggestion in their answer and generally scored higher marks as a result.

Question 8

(a) This question asked students to suggest how the sticky proteins holding the sperm bundle together would have been secreted.

This question was generally very well answered with the majority of candidates obtaining marks by talking about the packaging of the proteins by the Golgi apparatus into vesicles and the subsequent exocytosis from the cell.

(b) This question gave the students a graph showing the speed of individual sperm compared with bundles of sperm in liquids of different resistance.
Many weaker candidates who answered this question obtained just 1 mark for talking about any trend that was taken from the graph with comparative quantitative references. Marking point 1, that the individual sperms have slower speeds than the bundle sperms in all resistances, was most common second mark.

Fewer candidates noticed that there was an overlap in the error bars for 0.5 resistance.

The highest-level responses used their knowledge in order to make a judgement as to the reason why bundles of sperm would be able to maintain these greater speeds as shown by this response which gained full marks:

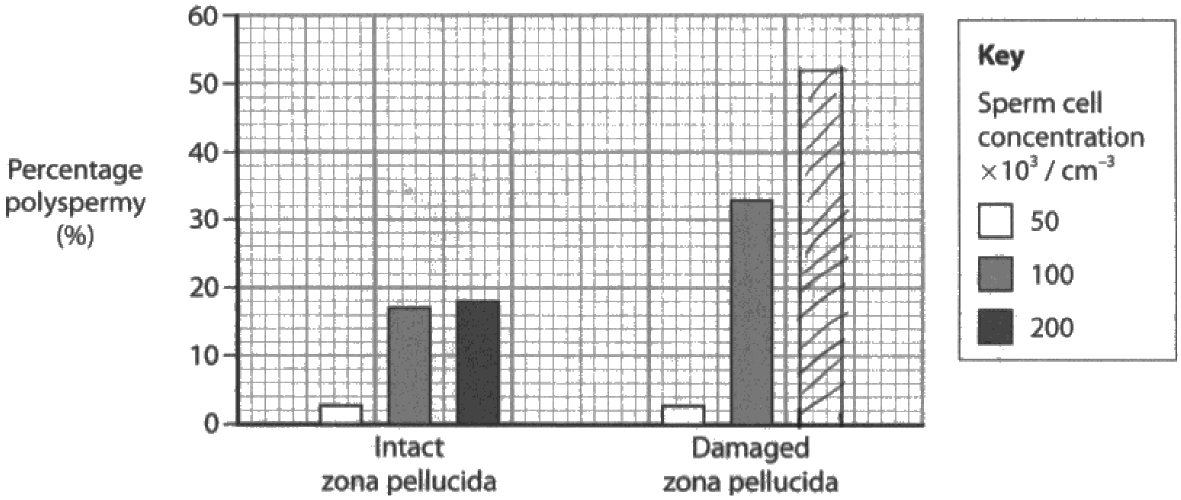
Comment on the results of this investigation.

(4)

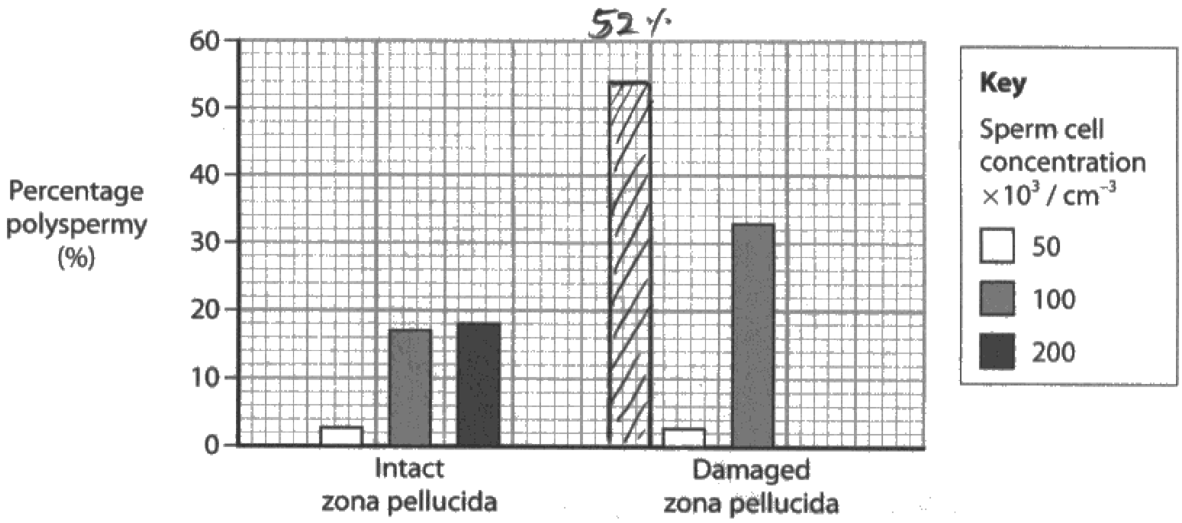
As resistance of liquid increases up to 0.5 a.u both types of sperm swim faster. However sperm bundles generally start and proceed at a higher speed than individual sperm. Individual sperm speed decreases directly after 0.5a.u. 0.5a.u is when both types swim the fastest. Error bars over lap indicating low reliability. Error bars at 0.5 a.u overlap significantly. As resistance increases, individual sperm speed decreases after 0.5a.u. Slight decrease in bundle speed in 18 $\mu m s^{-1}$ at 1.5 a.u but increases again. Bundle sperms have greater force of speed due to many sperms moving and swimming as compared to a single sperm.

(c)(i) This question asked candidates to plot the result for the 200 × 10^3 on the graph. Students were expected to use the key in order to decide the correct plotting location for the bar and that shading of the bar would be required.

Recognition of time constraints meant that any attempt of shading was accepted, for example:



The most common mistakes made by students were incorrect plotting, leaving the bar unshaded or plotting the bar in an incorrect location, for example:



(c)(ii) This question asked students to explain the results of the investigation. Students were expected to analyse the graph and identify two conclusions. Nearly all students were able to conclude that there was a higher percentage of polyspermy if the egg cells had a damaged zona pellucida. Comparative language was often important here.

It was clear that many students had a good understanding of the cortical reaction and could successfully apply this knowledge to this question.
Fewer students were able to conclude that that there was a higher percentage of polyspermy with a higher sperm cell concentration. Very few students were able to give an explanation as to why. This is an example of a 4-mark response which did explain why there was a higher percentage of polyspermy with a higher sperm cell concentration:

(ii) Explain the results of this investigation.

(4)

~~For both ovums, the~~ For both groups, as the sperm cell concentration increases, the percentage polyspermy increased. this is because there are more sperm per unit volume, more sperms around the ovum trying to fertilize it and hence more acrosin released and more jelly coat is dissolved, higher chance of polyspermy. Also the group with the damaged zona pellucida had a higher percentage polyspermy overall, because since the zona pellucida is damaged, there is place fore sperm to enter and fertilize the ovum and also even if the cortical reaction took place, there will still be empty space for the sperm to enter.

Question 9

(a) This question was answered correctly by most students.

(b)(i) This question asked students to complete the table to show the type of adaptations shown by the Hood Island tortoise.

It was clear that many students understood the difference between anatomical, physiological and behavioural adaptations and were able to gain two or more marks on this question.

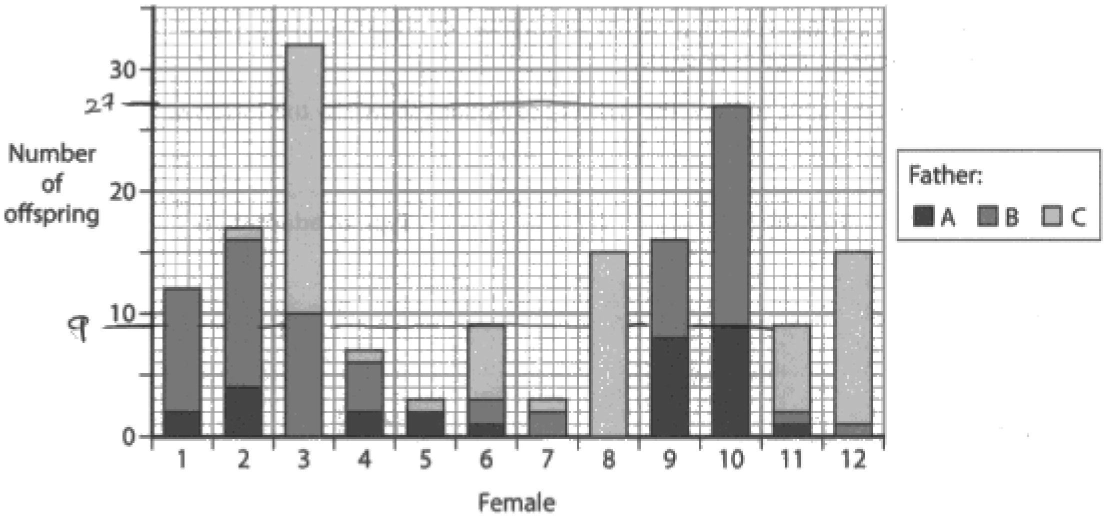
Where students lost a mark, it tended to be for the shell that arches above the neck.

(b)(ii) This question asked students to suggest one selection pressure that results in the development of one of the features in the table in Q9(b)(i).
Generally, this question was very well answered with the vast majority of candidates being able to identify a selection pressure that was suitable to the example given.

One of the most common answers was that long neck would enable the tortoise to reach food sources that were higher up. Other credit-worthy suggestions related to competition for mates or territory.
It is important that students take note of how many suggestions they are required to give. Further suggestions would not be marked and are not an effective use of time in an exam.

(c)(i) This question required students to extract data from the graph in order to calculate the percentage of female 10's offspring that were fathered by male B.

Unfortunately, a significant number of students calculated the percentage of female 10's offspring that were fathered by male A instead, which was not credit worthy as shown by this response:



(i) Calculate the percentage of female 10's offspring that were fathered by male B.

(1)

$\frac{9}{27} \times 100 = 33\%$

Answer 33% %

Students need to double check their working on these types of questions to ensure they have the correct data.

Another common error was incorrect rounding. A number of students rounded incorrectly to give the answer of 66.6%.

This is an example of how the correct answer would be achieved:

(i) Calculate the percentage of female 10's offspring that were fathered by male B.

(1)

$\frac{18}{27} \times 100$

$= 66.7$

Answer 66.7 %

(c)(ii) This question asked students to calculate the percentage increase in the wild population of *C. hoodensis* tortoises. Students had been told that there were only three males and 12 females left in the wild at the start of the breeding programme and this had risen to 1800 individuals.

There has been a gradual improvement in student performance in calculating percentage increases over the lifetime of this new specification.

(c)(iii) This question told students that a zoo tested its captive-bred giant tortoise and determined that it was a *C. hoodensis* tortoise. The students were asked to explain how the zoo determined that its giant tortoise was a *C. hoodensis* tortoise.

It was clear that many students understood that molecular phylogeny could be used to look for similarities (and differences) in molecular evidence, with many students describing analysis of DNA. Some students successfully explained how the zoo could have compared physical features to a *C. hoodensis* tortoise. Few responses were seen that addressed marking point 4.

Some excellent answers were seen which clearly understood how the zoo could determine the tortoise was *C. hoodensis* tortoise. Some students misread the question and explained how the zoo would determine it was a different species to *C. hoodensis*, which lost them marks.

The most common mistake made by students was to refer to analysing some form of molecular or physical evidence, but not fully explaining that this would need to be compared to a *C. hoodensis* tortoise.

This is an example of a response which gained marking points 1,2,and 3.

(iii) A zoo tested its captive-bred giant tortoise and determined that it was a *C. hoodensis* tortoise.

Morphology, anatomy, DNA.

Explain how the zoo determined that its giant tortoise was a *C. hoodensis* tortoise.

(3)

Firstly, the morphology of the captive bred giant tortice is compared to a known C. hoodensis tortoise. If the shape and size is the same as well as the anatomy, the tortoise is the same.

~~Nowadays, the advancement in technology has allowed for~~

The DNA of the captive-bred tortoise can be extracted, ~~and~~ examined and compared to the known DNA of a C. hoodensis tortoise. As the base sequence of the captive-bred giant tortoise's DNA is the same as C. hoodensis tortoise, the zoo is able to determine and confirm that it is.

(d) This question asked students to explain how a change in the frequency of a recessive allele in the tortoise population could be determined.

The majority of students found this question very challenging.

Generally weaker candidates simply talked about DNA analysis/ genetic screening/ gene mapping without specific reference to finding or comparing alleles.

Many students referred to calculations other than Hardy-Weinberg, for example heterozygosity index and index of diversity, which were not credit-worthy.

A significant number of students knew that the Hardy-Weinberg equation would be involved and this the most commonly awarded marking point.
The highest scoring answers successfully explained how the results from this calculation from different generations could be compared, for example:

(d) Scientists thought that a recessive allele was changing in frequency in the tortoise population.

Explain how the change in frequency of this allele could be determined.

(2)

The frequency of a recessive allele would be determined by firstly finding the number of homozygous recessive tortoises by looking ~~at~~ to analysing there ~~to~~ ~~[illegible]~~ alleles and traits through stud books. The frequency of the recessive allele can then be found by using the Hardy-weinberg equation, and comparing the current recessive allele frequency, to the old recessive allele frequency.

Paper summary

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

- Read the whole question carefully to ensure you do not miss questions.
- 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.
- 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 that are non emboldened in the specification.
- Make sure you include your working with all calculations. If rounding is necessary, make sure that this is done correctly. Check to see what format you are expected to present your answer in, e.g., standard form.

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