Examiners' Report

Principal Examiner Feedback

October 2023

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

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 multiple-choice question was answered correctly by most students.

Question 1(b)

This question asked students to explain why it is possible for chromatid A to be genetically different from chromatid B.

Most students knew that crossing over was involved, but fewer students gave a full explanation.

The students needed to correctly explain that crossing over had occurred between chromatids B and D, but chromatid A did not undergo crossing over.

This is an example of a response which scored 2 marks:

(b) Explain why it is possible for chromatid A to be genetically different from chromatid B.

(2)

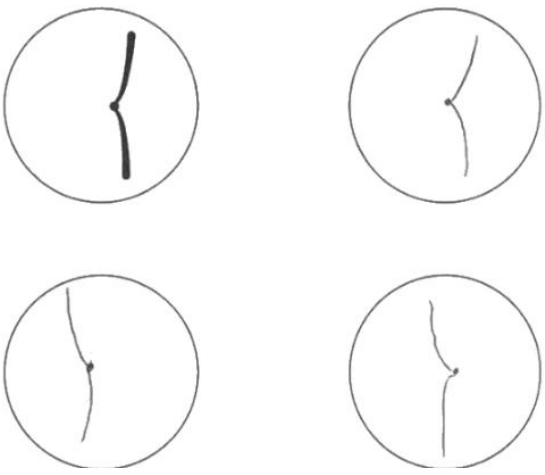
Due to crossing over of ~~[illegible]~~ non sister chromatids forming recombinant alleles. Crossing ~~[illegible]~~ Swapping over of section of chromatid between chromatid B and D, so sister chromatids A and B are no longer genetically identical.

Question 1(c)

This question asked students to complete the drawings to show the four haploid cells that would be produced after meiosis, from the cell on the previous page.

Nearly all students knew what the term haploid meant as most drawings were haploid. Correct haploid drawings after either meiosis I or meioisis II were creditworthy.

Unfortunately, a significant number of students did not use the given drawing and therefore drew haploid cell contents that were not creditworthy, for example:



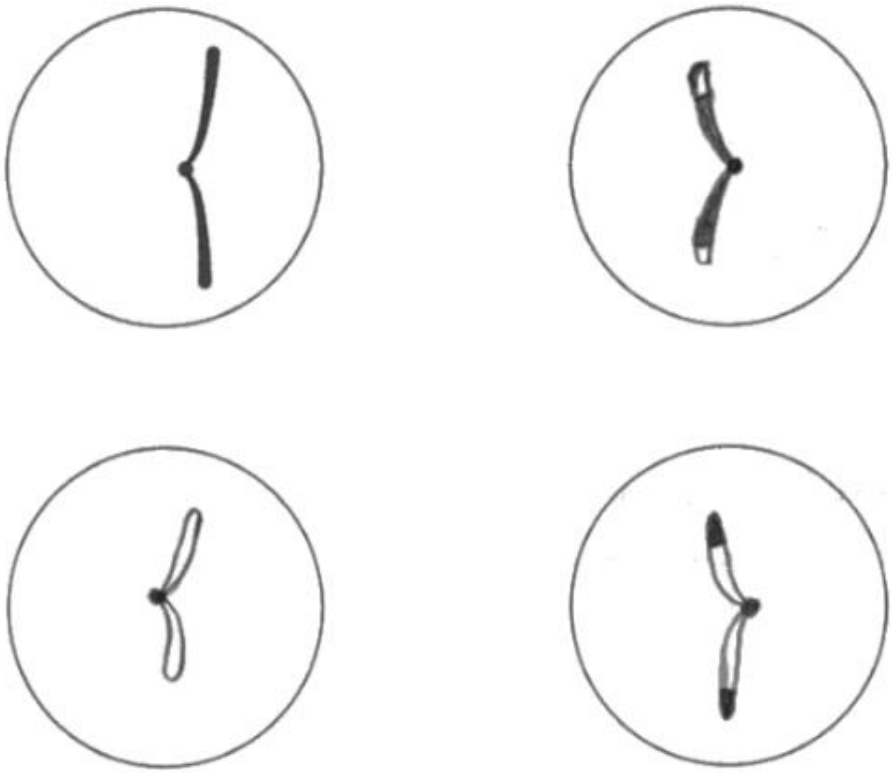
This is an example of a response that scored both marks:

(c) A student was asked to draw the four haploid cells produced by this cell in metaphase I of meiosis.

The diagram shows the incomplete drawings produced by this student.

Complete the drawings to show the **four haploid** cells produced.

(2)



(Total for Question 1 = 5 marks)

Question 2(a)

This question required students to calculate the magnification of the provided photograph.

The most common correct method involved measuring the scale bar, converting the units and then dividing by 20.

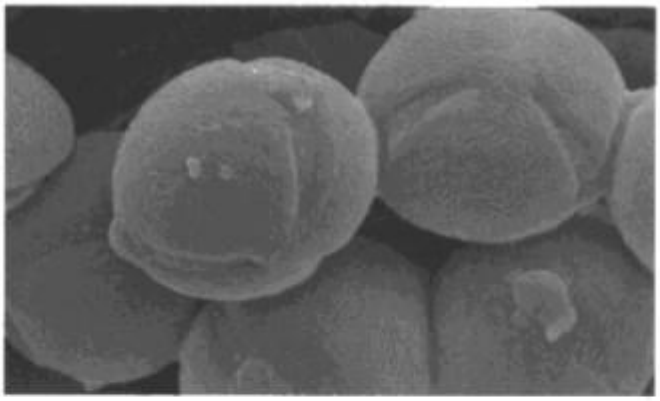
The majority of students gave the correct answer.

Some students measured the pollen grain instead of the scale bar. Others made an error in unit conversion.

Students must read the question carefully and take careful note of any instructions regarding the format of their answer. Some students did not give their answer to two significant figures.

This is an example of the correct answer.

2 The photograph shows some pollen grains, as seen using an electron microscope.



(Source: BSIP SA / Alamy Stock Photo)

Scale bar ——— 20 µm

(a) Calculate the magnification of this photograph.

Give your answer to **two** significant figures.

(2)

2.9cm = 29mm = 29000µm

$\frac{29000}{20} = 1450$

2 x 1500

Answer × 1500

Question 2(b)

This question asked students to describe how the generative nucleus results in the production of an embryo and endosperm tissue in a seed.

The use of the correct language and terminology was very important in this question.

Most students gained mp1 and 4.

The omission of nucleus was the most common reason for mp3 to not be awarded. Fertilisation involves the fusion of nuclei and not just gametes.

Some students referred to the generative nucleus fertilising the polar nuclei or egg cell nucleus.

A small minority of students correctly referred to double fertilisation.

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

Describe how the generative nucleus results in the production of an embryo and endosperm tissue in a seed.

(3)

The pollen tube nucleus creates a pathway for the male generative nucleus to the micropyle, so the male generative nucleus undergoes mitosis to produce two haploid male nuclei for double fertilisation to occur, as one male haploid nucleus fuses with female egg cell haploid nucleus forming the diploid zygote, and the other haploid male nucleus fuses with the two polar nuclei forming a triploid endosperm.

Question 2(c)(i)

This question asked students to state what is meant by the term linkage with reference to the two genes in the question.

It was disappointing that many students gave an incorrect answer, especially as a similar question was asked on a recent exam paper.

This is an example of a response which gained the mark:

(c) Flower colour and pollen grain size are genetically determined in foxglove plants.

The linkage of the genes for flower colour and pollen grain size has been investigated.

(i) State what is meant by the term **linkage** with reference to these two genes.

(1)

2 genes coding for ~~1~~ two different characteristics found on same chromosom close two each other more likely to be inherited together as one unit

Question 2(c)(i)

Most students knew which statistical test would be used.

Question 3(a)

This response required students to give three differences between a cell wall with secondary thickening and a cell wall without secondary thickening.
Although the students were told to use the information in the diagrams to support their answer, many students did not and therefore mark point one was the least commonly awarded..
The most commonly awarded marking point was for cell walls with secondary thickening containing lignin, with most responses relating this to either mark point three or four.
This is an example of a response which gained full marks:

Give **three** differences between a cell wall with secondary thickening and a cell wall without secondary thickening.

Use the information in the diagrams to support your answer.

(3)

1 cell wall with secondary thickening is thicker than ~~without~~ cell wall without secondary thickening.

2 Tensile strength of cell wall with secondary thickening is stronger than cell wall without it.

3 secondary thickening cell wall contain lignin, cell wall without secondary thickening don't.

Question 3(b)(ii)

This question required students to explain how secondary thickening contributes to the physical properties of sclerenchyma fibres.

Nearly all students stated that the fibres would contain lignin.

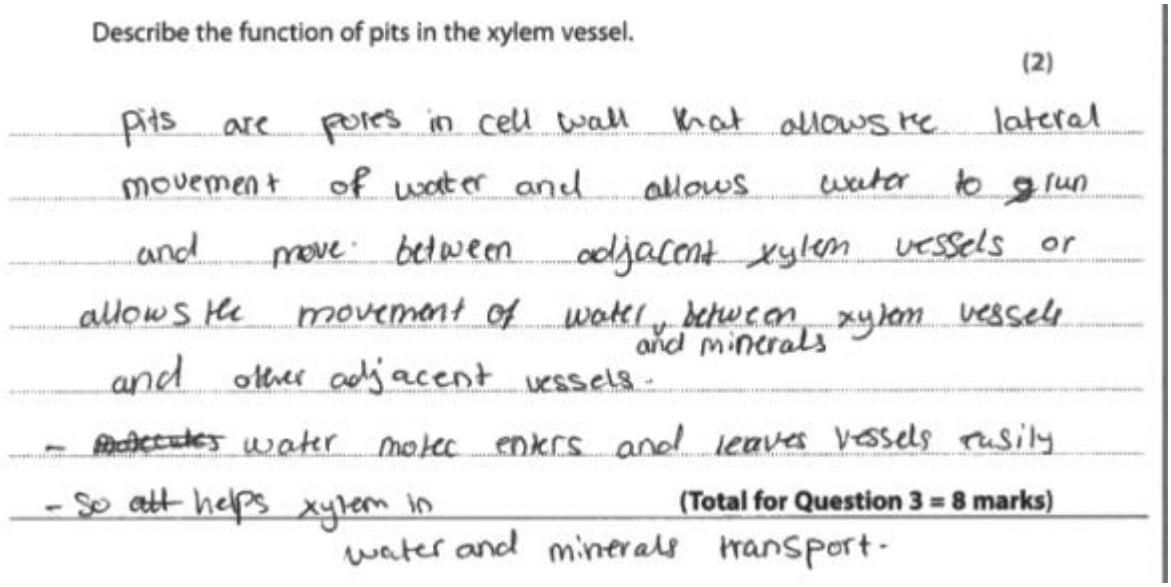
'Physical properties' is the phrasing from the specification, so it was surprising that a significant minority of students referred to function instead.

Question 3(c)

This question required students to describe the function of pits in the xylem vessel.

Most students knew that they would allow the movement of water, but some referred to vertical movement which was not creditworthy in this context.

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



Describe the function of pits in the xylem vessel.

(2)

pits are pores in cell wall that allows the lateral movement of water and allows water to ~~g~~run and move between adjacent xylem vessels or allows the movement of water and minerals between xylem vessels and other adjacent vessels.

- ~~Molecules~~ water molec enters and leaves vessels easily
- So ~~att~~ helps xylem in water and minerals transport.

(Total for Question 3 = 8 marks)

Question 4(a)(i)

This question asked the students to give the names of the other two domains.

The majority of students answered this question correctly, albeit with variations for eukarya.

However, it was disappointing to see a significant minority of students could not name one correct domain, with plants being a common incorrect response.

Question 4(a)(ii)

This question gave the students measurements of two different types of bacteria. The measurements were in different units.

It was pleasing to see many students took careful note of the different units and converted one correctly. Some students struggled with converting nm into mm.

Most took note of the order of the bacteria in the question as well as the instruction to give their answer in standard form.

However, it was disappointing that there were a large number of students who did not give their correctly calculated answer in standard form.

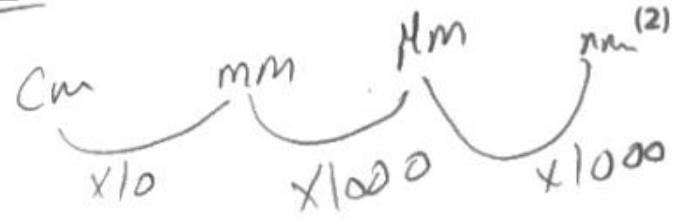
This is an example of a response which gained full marks:

(ii) Calculate how many times larger *T. magnifica* is than *M. genitalium*.

Give your answer in standard form.

(2)

20 X1000 X1000
= 20 000 000 nm



$\frac{20000000}{300} = 66666.6$

Answer 6.7×10^4

Question 4(b)

Students were provided with information about pepins in the cytoplasm of the given bacteria.

This question required students to apply their knowledge about these structures to this unfamiliar context.

Most students knew how DNA would contribute to the pepin function of protein synthesis and gained mark point 1.

Many students just repeated the given information about protein synthesis and therefore did not gain mark point 2.

The more able candidates knew the difference between an organelle membrane and the cell surface membrane. Weaker responses did not make this distinction, and this was the most common reason why mark point three was not awarded. For example:

Membrane ~~Contro~~ controls what enters and exits the cell, for exocytosis of proteins or enzymes.

Question 4(c)(i)

Students were asked to explain why an optimum temperature and water are needed for bacterial growth. This tested specification point 4.10.

It was pleasing to see nearly all responses linked optimum temperature to enzyme activity. Most candidates knew that the optimum temperature would have the highest enzyme activity. However, a small number of candidates discussed the effect of temperature on the bacteria rather than the enzymes.

The most common response for water centred around being required for hydrolysis reactions.

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

(i) Explain why an optimum temperature and water are needed for bacterial growth.

(2)

Optimum temperature Optimum temperature is needed for enzyme controlled reactions ~~to~~ to occur at the highest rate or at the best rate.

Water water is needed by the bacteria for hydration and for ~~hydrolysis~~ hydrolysis reactions to take place.

Question 4(c)(ii)

This question asked students to explain the results for the two types of bacteria in the graph.

It is important to take careful note of the command word.

Responses which described the graph, instead of explaining, could only access mark point one.

Most students gained mark point one.

Higher quality responses could give a more detailed explanation, which tended to centre around the type of respiration performed by the two types of bacteria, for example:

(ii) Explain the results for these two types of bacteria shown in the graph.

(3)

Bacteria A decreases growth rate as oxygen increases due to ~~be~~ this bacteria depending on ~~aer~~ anaerobic respiration.

Bacteria B positive correlation of growth rate to oxygen percentage due to it needing aerobic respiration

Question 5(a)(i)

Most students answered this question correctly

Question 5(a)(ii)

This question asked students to explain how a lack of magnesium ions could result in yellow leaves and reduced growth.

Students must ensure they fully answer all parts of the question, as a significant minority did not explain why there would be reduced growth.

Nearly all students knew that magnesium ions were needed for chlorophyll formation and gained mark point one.

Most students could explain how a lack of magnesium ions resulted in yellow leaves.

Higher quality responses clearly explained why this would then result in reduced growth. Correct terminology was important however, as a number of students referred to reduced production of food which is not sufficient at this level.

This response gained full marks:

(ii) Explain how a lack of magnesium ions could result in yellow leaves and reduced growth.

(3)

magnesium ion produce chlorophyll pigments chlorophyll pigments gives the green color of the plant as it ~~to~~ contain the green pigments responsible for this color so without chlorophyll the leaves become yellow chlorophyll # pigments trap light for photosynthesis so without chlorophyll ~~the~~ less photosynthesis ~~doesn't~~ occur occur so reduced growth

Question 5(b)

This 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 graphs for example would have limited the mark they could achieve.

Most responses gained level one by describing the effects of eggshells on the mean leaf area, mean shoot length and mean chlorophyll content.

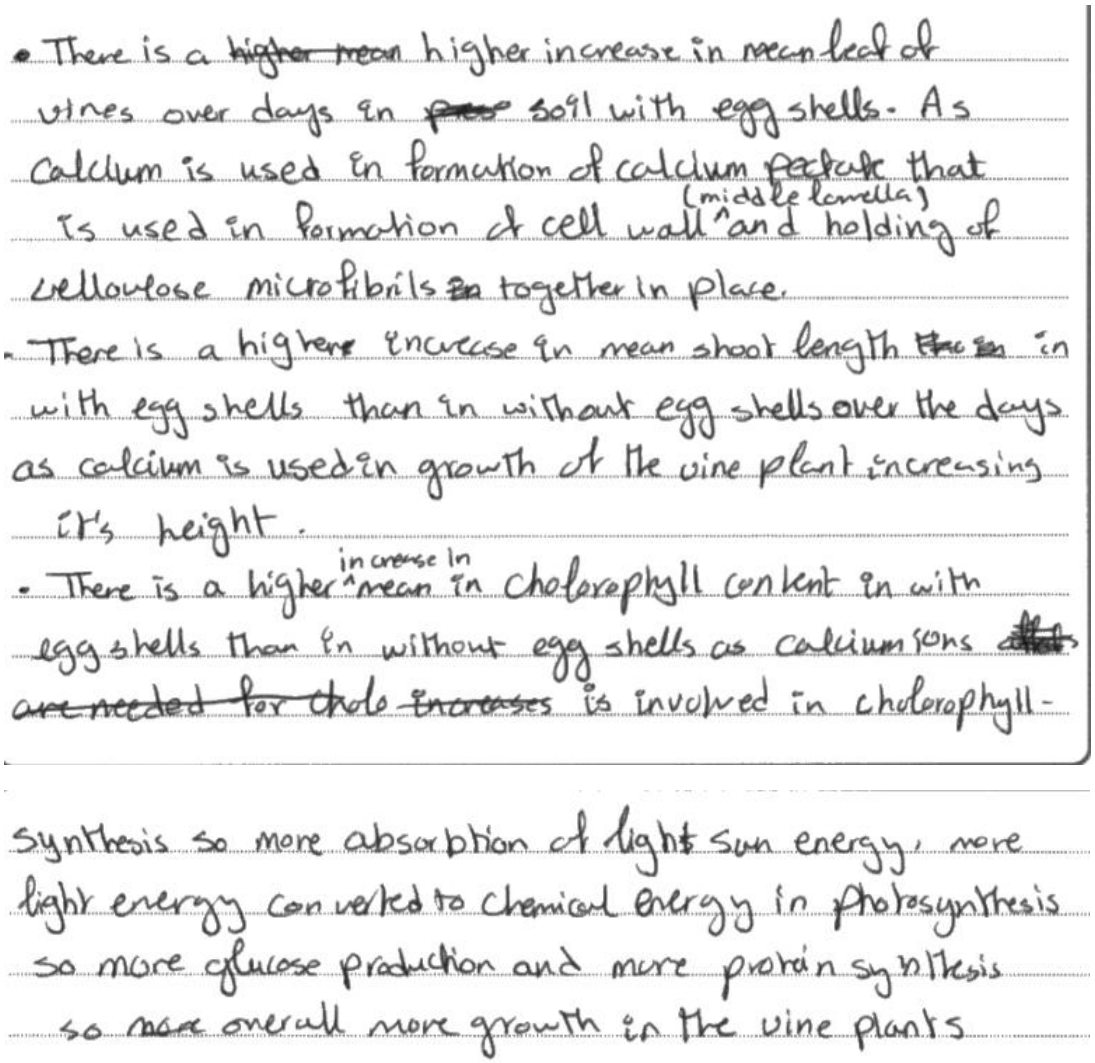
A lower level two was usually achieved by students linking the information about calcium ions to the given context. For example, they would explain that adding eggshells increased the calcium ion concentration and this would result in increased calcium pectate formation. Correct explanations linking an increased calcium pectate concentration to a greater mean shoot length often enabled the awarding of the higher mark in the level.

Higher level responses used all of the given information and their own biological knowledge in their answers.

Level three was usually achieved by students adding to their level two response by explaining than a larger leaf area / increased chlorophyll content would result in more photosynthesis. Many responses were seen explaining why increased glucose production could result increased plant growth. Some responses also considered the financial and environmental aspects of using eggshells.

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 candidates 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 particular graphs in front of them.

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


• There is a ~~higher mean~~ higher increase in mean leaf of vines over days in ~~pres~~ soil with egg shells. As calcium is used in formation of calcium ~~pectate~~ that is used in formation of cell wall (middle lamella) and holding of cellulose microfibrils ~~in~~ together in place.
• There is a higher increase in mean shoot length ~~Thro in~~ with egg shells than in without egg shells over the days as calcium is used in growth of the vine plant increasing it's height.
• There is a higher increase in mean in chlorophyll content in with egg shells than in without egg shells as calcium ions ~~effect are needed for chlo increases~~ is involved in chlorophyll-synthesis so more absorption of light sun energy, more light energy converted to chemical energy in photosynthesis so more glucose production and more protein synthesis so more overall more growth in the vine plants

Question 6(a)(i)

This question asked students to state what is meant by the term niche.

There was a wide range in the quality of responses to this question, with some responses showing that the students had a good understanding of this part of the specification.

Question 6(a)(ii)

This question asked students to make the type of adaptation shown by the mimic octopus.

Most students could correctly answer this question.

This is an example of a correct response:

(ii) The mimic octopus has the same banding pattern as the venomous sea snake.

Name this type of adaptation.

(1)

anatomical adaptation

Question 6(a)(iii)

Students were asked to suggest why the mimic octopus would change its appearance to look like two different animals.

It was pleasing to see so many creditworthy suggestions, with most focusing on the change to the predation risk or chances of successfully obtaining food, for example:

(iii) Suggest why the mimic octopus would change its appearance to look like a flat fish and a venomous sea snake.

(2)

Flat fish it could do this in order to attract smaller predators of this fish which would be prey for the octopus. It does this to lure prey.

Venomous sea snake It could mimic a venomous snake in order to decieve predators of the 'original looking' octopus to avoid trying to eat it.

Question 6(b)(ii)

This question continued the context of tetrodoxin and the stage II of the drug trial using a group of cancer patients. Students were asked to describe the processes that would have occurred before and after stage II in this tetrodoxin drug trial.

Centres are reminded of the importance of applying answers to the given context.

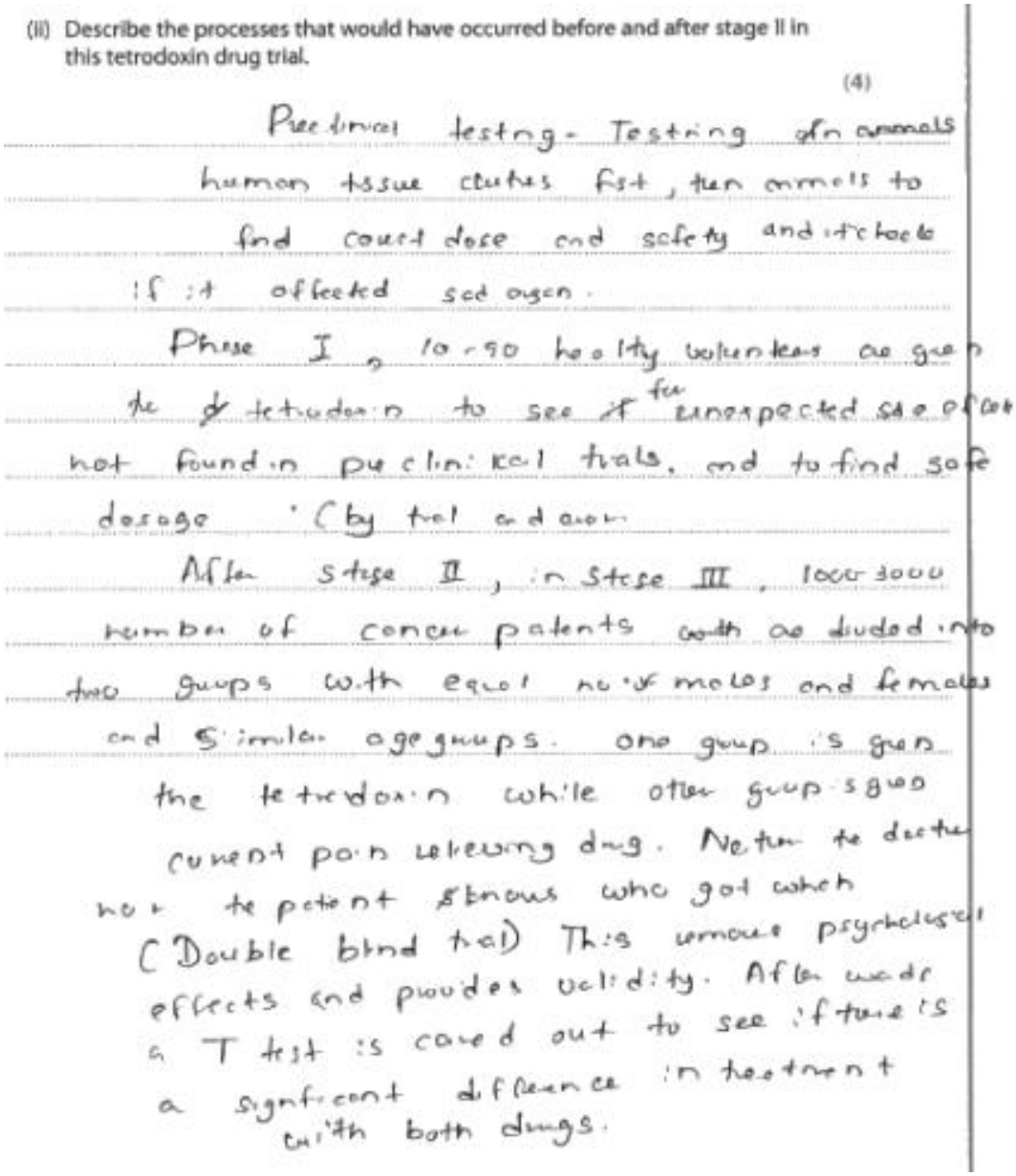
It was clear to see that most students knew the processes of drug trial, however fewer students could apply their knowledge to the given context. Generic answers will not gain full marks. As a result, many answers did not gain mark point two.

Mark points one and three were the most commonly awarded.

There were a number of responses which described the statistical analysis of the data.

It was pleasing to see many answers discussing the identification of side effects and effective dosages.

This response gained all of the available marking points:



(ii) Describe the processes that would have occurred before and after stage II in this tetrodoxin drug trial.

(4)

Pre clinical testing - Testing on animals human tissue cultures first, then animals to find correct dose and safety and it checks if it affected sed organ.

Phase I, 10-90 healthy volunteers are given the of tetrodoxin to see if for unexpected side effects not found in pre clinical trials, and to find safe dosage (by trial and error.

After stage II, in stage III, 1000-3000 number of cancer patents with are divided into two groups with equal no of males and females and similar age groups. one group is given the tetrodoxin while other group is given current pain relieving drug. Neither the doctor nor the patient knows who got which (Double blind trial) This removes psychological effects and provides validity. After words a T test is caved out to see if there is a significant difference in treatment with both drugs.

Question 6(c)

This question asked students to comment on the results of the stage II drug trial using both tetrodoxin and the current pain-relieving drug.

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

It was clear that most students were able to interpret what the data showed and therefore gained at least one mark from marking points one and two. However there was a significant minority of students who did not understand the graph.

It was pleasing to see a significant number of students considered at least one aspect from marking points three, four and five. Few students however commented on the small number of cancer patients involved in stage II.

Question 7(a)(ii)

This question asked students to suggest one function of the yolk in the fertilised fish egg cell.

Some excellent answers were seen, but it was disappointing that more students could not relate their knowledge of lipid droplets in a mammalian egg cell to this context.

This is an example of a creditworthy response:

(ii) Suggest **one** function of the yolk in the fertilised fish egg cell.

(1)

- Provide nutrients and glucose for the embryo for aerobic respiration and releasing energy for cell division + energy reserves for growing embryo.

Question 7(b)

This question asked students to explain how skeletal muscle cells can contain the same genes as the morula cells but be different in structure and function.

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

Nearly all students knew that the skeletal muscle cell had formed by differentiation, but centres are reminded that generic answers will not gain full marks. Students need to take careful note of the context of the question.

Nearly all students could explain how transcription and translation could only occur if the gene was switched on. Most students could explain how epigenetic modification would be involved in the process.

However fewer students could relate the proteins formed to the differentiation into a skeletal muscle cell.

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

Explain how these skeletal muscle cells can contain the same genes as the morula cells but be different in structure and function.

(5)

the cells in morula are totipotent stem cells which are undifferentiated stem cells that can form any of the cells types for an entire new organism including skeletal muscle cells. Skeletal muscle tissue has cells where the genes coding for the skeletal muscle function (such as contraction and relaxation) and elongated cells, is expressed/switched on by epigenetic modification. Chemical stimulus arrived at the cell e.g. DNA methylation, Histone acetylation, transcription factors where differential gene expressure took place as certain genes where switched on/activated. Genes coding for elongated skeletal cells where switched on in the skeletal cells and switch off in the cells of morula. Transcription is initiated where the mRNA is transcribed from activated genes. Translation of transcribed mRNA into polypeptides/proteins. Permanent modification of skeletal cell structure and function.

Question 7(c)(i)

This question provided a graph showing the results of an investigation. Students were expected to correctly read off the mitotic index for OVCAR8.

They were then expected to use this to calculate how many of the two thousand cells studied were in interphase.

Most students knew how to calculate the mitotic index and were able to correctly manipulate the equation to give a correct answer.

Centres are reminded of the importance of checking to see if the given answer makes sense for the data provided. There were a significant number of responses which gave an answer that was larger than the given number of cells studied.

Question 7(c)(iii)

This question asked students to explain why some people think that research into cancer treatments should not use embryonic stem cells.

Most students gained mark point two, for discussing the ethical, social, or religious aspects of the topic. However fewer students gave more detail in their explanation which covered aspects from marking point one.

Question 8(a)(i)

This question asked students to state the letter which shows the zona pellucida. Most students answered this question correctly.

Question 8(a)(ii)

This question asked students to name the structures involved in hardening the zona pellucida.

The majority of students could name the cortical granules, but a wide variety of spellings were seen.

Question 8(b)(ii)

This question asked students to calculate the acrosome to nucleus ratio for the reed bunting sperm cell shown in the table.

Most students could measure the structures in the diagram correctly, but fewer could give a correct ratio.

It is important to take careful note of the order given in the question. Some given ratios were the wrong way round or did not follow the correct format.

Question 8(b)(iii)

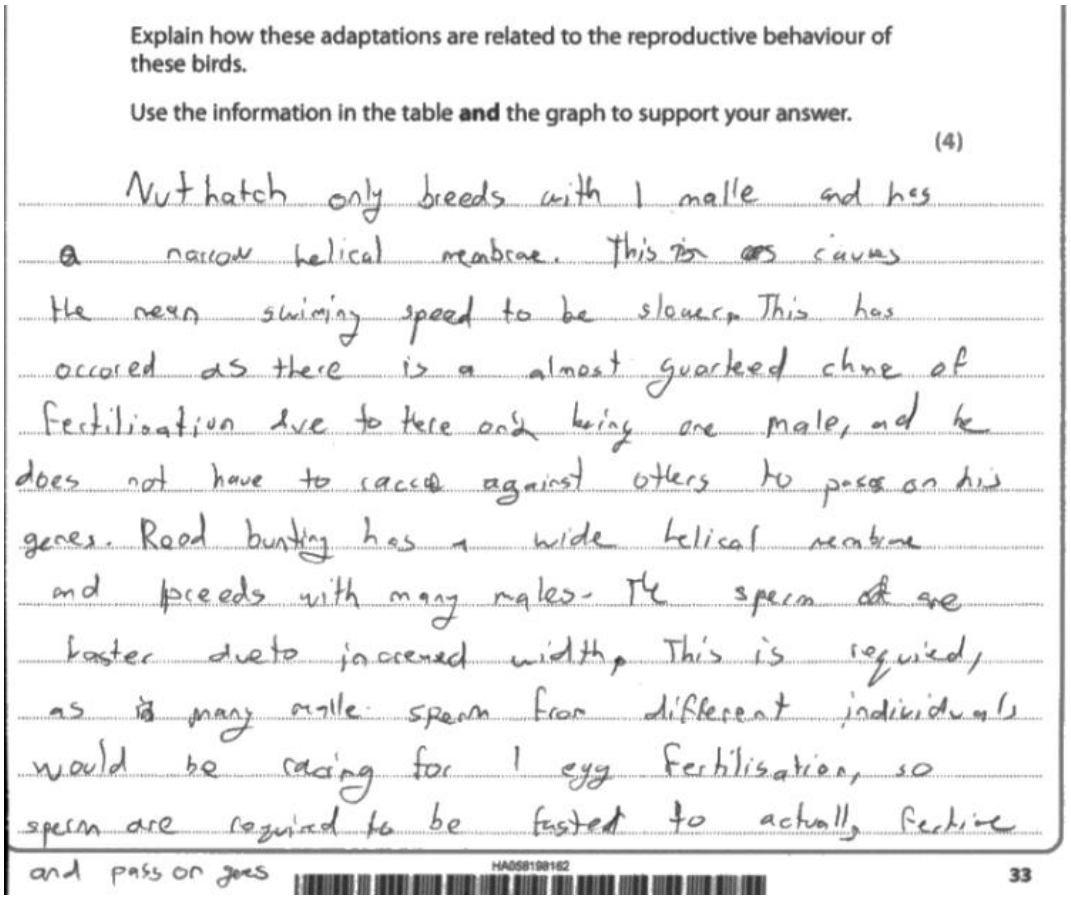
This question required students to analyse the given graph, table and accompanying information to explain how the acrosome to nucleus ratio and the width of the helical membrane affect the swimming speed of sperm cells.

Nearly all students could correctly describe the relationship between increasing width of the helical membrane and the mean swimming speed of the sperm cell. Most students could then relate this to either the reed bunting or the nuthatch sperm cells.

Most students attempted to explain how an increased swimming speed would be beneficial to a male reed bunting's reproductive success, but lack of precision in their answers often prevented the awarding of the third marking point. Some students related it to the reproductive success of the female which was not creditworthy.

A small number of students misinterpreted the information in the table and described how males mated with numerous partners in a short space of time which was not creditworthy in the context of this question.

This is an example of a response which gave a good explanation of why a faster sperm cell speed would be beneficial to a male reed bunting:



Explain how these adaptations are related to the reproductive behaviour of these birds.

Use the information in the table **and** the graph to support your answer.

(4)

Nuthatch only breeds with 1 malle and has a narrow helical membrane. This ~~as~~ causes the mean swiming speed to be slower. This has occured as there is a almost guarked chne of fertilisation due to here only being one male, and he does not have to raced against others to pass on his genes. Reed bunting has a wide helical membrane and breeds with many males. The sperm do are faster due to increased width. This is required, as is many malle sperm from different individuals would be racing for 1 egg fertilisation, so sperm are required to be fasted to actually fertilise and pass on genes

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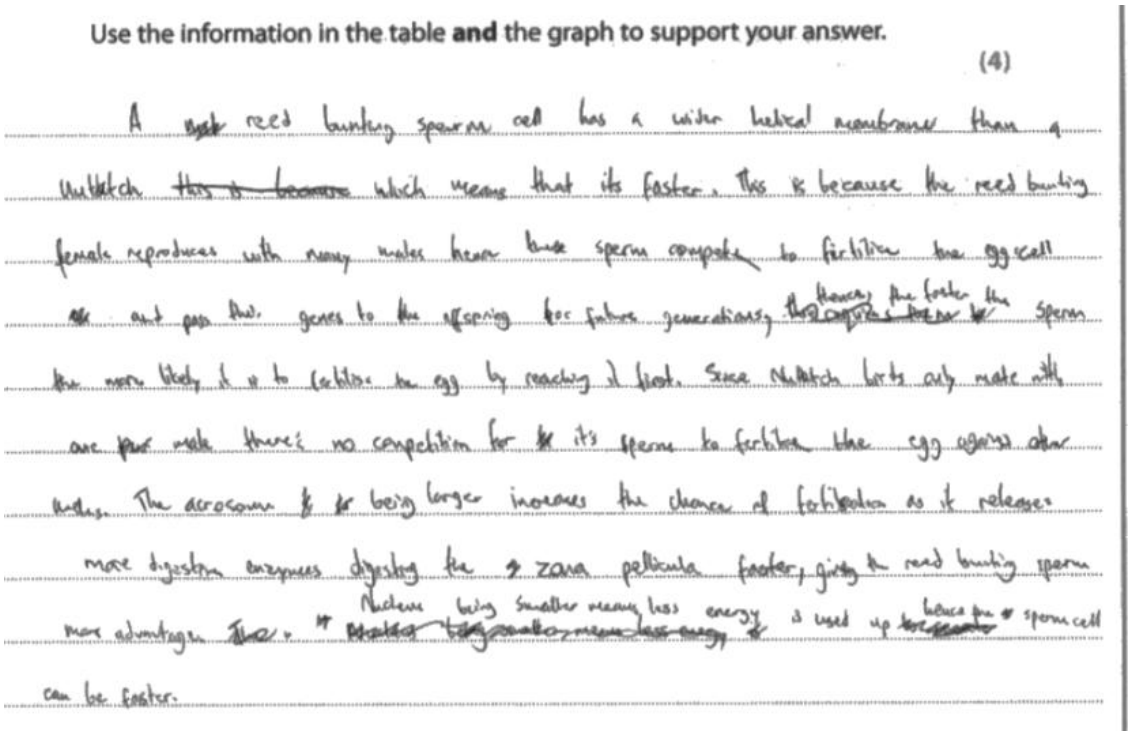
The highest quality responses also considered the importance of the larger acrosome to nucleus ratio.

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



Use the information in the table **and** the graph to support your answer.

(4)

A ~~nut~~ reed bunting sperm cell has a wider helical membrane than a nuthatch ~~this is because~~ which means that its faster. This is because the reed bunting female reproduces with many males hence have sperm compete to fertilise the egg cell ~~as~~ and pass the genes to the offspring for future generations, ~~the~~ however the faster the sperm the more likely it is to fertilise the egg by reaching it first. Since nuthatch birds only mate with one ~~per~~ male there's no competition for it's sperm to fertilise the egg against other males. The acrosome is ~~is~~ being longer increases the chances of fertilisation as it releases more digestion enzymes digesting the ~~s~~ zona pellicula faster, giving ~~a~~ reed bunting sperm more advantages. ~~The~~ ~~Nucleus~~ being smaller means less energy is used up ~~because~~ hence the ~~s~~ sperm cell can be faster.

Question 8(c)

This question provided students with information about blue dragons.

The students were asked to suggest why it might be advantageous for blue dragons to be hermaphrodites. Most students considered the effect on genetic diversity.

Most could recognise the advantage that this would have on reproductive success, but a significant minority wrote about the benefits of self-fertilisation which was not creditworthy.

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

Each individual can produce both egg cells and sperm cells for sexual reproduction with another blue dragon.

Their sperm cells cannot fertilise their own egg cells.

Suggest reasons why it may be advantageous for blue dragons to be hermaphrodites.

(3)

such that there will be no difference between the male & female populations as both are hermaphrodites so any two blue dragons can reproduce which increases the genetic diversity & reduces the risk of extinction & allows for adaptation to new environments & maintains the population, when the sperms can't fertilise its own eggs this increases the genetic diversity since a sperm from different blue dragon is needed to fertilise the eggs

Question 8(d)

This question asked students to use the given equation to calculate how many cats would have the homozygous dominant genotype and how many cats would have a heterozygous genotype.

It was clear that many students struggle with this type of calculation, but there were also a significant number of students that gained full marks.

The two most common mistakes made were not being able to convert 16 into 0.16, and then not calculating √0.16.

There were a small number of responses where the number of cats in the table did not add up to the given total in the question.

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

Colour of cat	 Black	 Black	 White
Genotype	BB	Bb	bb
Part of Hardy–Weinberg equation	p^2	2pq	q^2
Number of cats	36	48	16

Complete the table to show how many cats would have the homozygous dominant genotype and how many cats would have a heterozygous genotype.

Use the equation

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

(3)

$q^2 = 16 \quad q = \sqrt{16} = 4 \quad q^2 = 0.16 \quad q = \sqrt{0.16} = 0.4$

$p + 0.4 = 1$

$p = 0.6$

$p^2 = 0.36$

$= 36\%$

$2pq = 2(0.6)(0.4)$

$= 0.48$

$= 48\%$

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.
- Some questions 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 all of the mathematical skills in the specification which could be tested at this level.
- 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 in standard form.