Examiners' Report
Principal Examiner Feedback

January 2023

Pearson Edexcel International 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)(i)

This question asked students to complete the diagram by showing the position of the phloem, sclerenchyma and xylem vessels.

Nearly all students knew the position of the xylem. Some students got the sclerenchyma and phloem positions the wrong way round.

Question 1(a)(ii)

This multiple-choice question proved to be challenging for most students.

Question 1(b)(i)

This question asked students to name a structural molecule in a plant cell wall and a prokaryotic cell wall.

Students should be careful of how many answers they give. Where students wrote more than one molecule, only the first one was marked.

Most students knew that cellulose was a structural molecule found in plant cells walls. There were some responses which gave a different credit worthy response for plant cells.

Fewer students could correctly name a structural molecule in prokaryotic cell walls. Chitin was the most common incorrect answer.

Question 1(b)(ii)

This question asked students to explain how the arrangement of molecules contributes to the physical properties of cell walls of sclerenchyma fibres.

It was pleasing to see that most students knew what the physical properties of sclerenchyma fibres were.

Most students could correctly describe the arrangement of cellulose molecules in the cell walls of the sclerenchyma. The most common responses referred to the hydrogen bonds between cellulose molecules or that cellulose molecules would be in a mesh.

However, there was a significant minority of students who just stated lignin without considering the arrangement of the molecule in the cell wall.

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

(ii) Explain how the arrangement of molecules contributes to the physical properties of the cell walls of sclerenchyma fibres.

(3)

cell walls ~~of~~ have cellulose ~~of~~ molecules that has hydrogen bonds between them and can form microfibrils. microfibrils are arranged in a criss-cross arrangement forming sheets. sheets are held together by pectin, this gives the sclerenchyma fibres strength which is needed to do its function which is support. Also cell walls have lignin which are helical in structure and is a secondary thickening for the cell wall increasing its strength for supporting the stem of the plant

(Total for Question 1 = 9 marks)

Question 2(a)(i)

This question asked students to complete the diagram to show the numbers of chromosomes in the female and male gametes.

Most students were able to recognise that each gamete would have 32 chromosomes in order to fuse to form a diploid zygote with 64 chromosomes.

Question 2(a)(ii)

This question asked students to label the part of the diagram where meiosis would have occurred.

This question proved to be more challenging than the previous question, but there was still a significant number of students who gained the mark.

Question 2(b)(iv)

This question asked students to describe the function of the tube nucleus.

This question proved to be a very good differentiator, with 2 marks being gained by the majority of students. This was usually for mp1 and mp2.

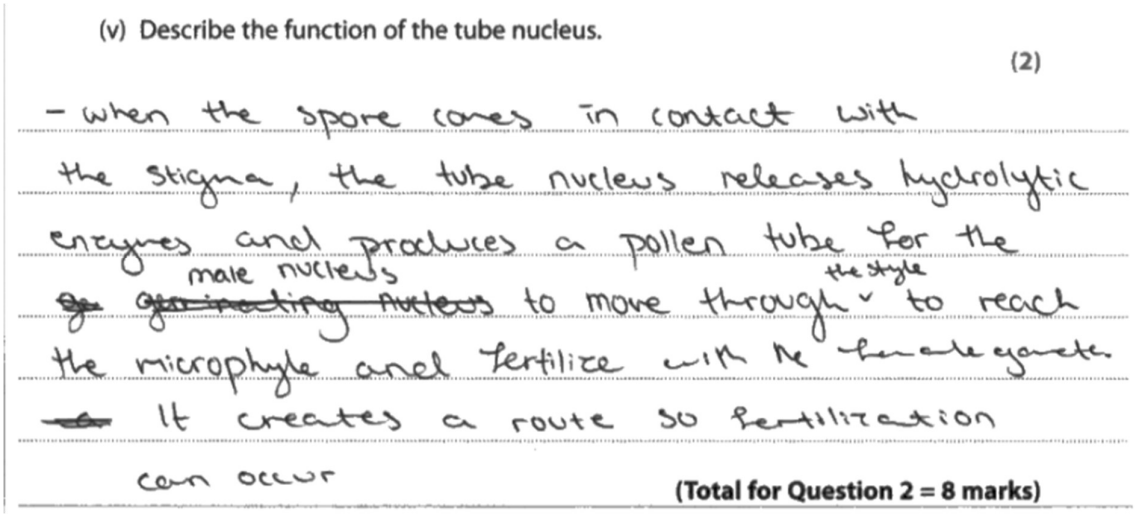
Some students confused the tube nucleus with a male nucleus and therefore could not be awarded mp3, for example:

(v) Describe the function of the tube nucleus.

(2)

To fuse with female gametes nuclei.

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



(v) Describe the function of the tube nucleus.

(2)

- when the spore comes in contact with the stigma, the tube nucleus releases hydrolytic enzymes and produces a pollen tube for the ~~the~~ ~~pro-inacting nucleus~~ male nucleus to move through the style to reach the microphyle and fertilize with the female gamete. ~~It~~ It creates a route so fertilization can occur

(Total for Question 2 = 8 marks)

Question 3(a)

This question asked students to name the domain which would contain the organism in photograph A. Students were expected to recognise that the organism contained the membrane bound organelle chloroplast.

It was surprising that a significant number of students gave the incorrect answers 'Archaea' or 'plantae'.

Question 3(b)(i)

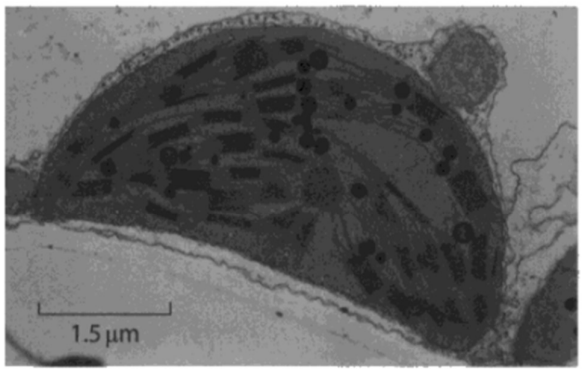
This question asked students to calculate the magnification of the chloroplast shown in photograph B and give their answer to two significant figures.

Most students were able to measure the length of the provided scale bar, perform a correct unit conversion and calculate the magnification. Some students did not perform a correct unit conversion. Some students lost a mark by giving their answers to two decimal places instead of two significant figures. A small number of students lost a mark as they gave a unit after their magnification.

Unfortunately, a significant number of students did not realise the significance of the scale bar or lack of information regarding the actual size of the organism in the question stem.

This response shows the importance of students' showing their working. If they had no working out, they would have scored 0. However, their working allowed the awarding of one mark for performing the correct unit conversion / calculation, even though they had not given the answer to two significant figures:

(b) Photograph B shows a chloroplast as seen using a different type of microscope.



(Source: © Science History Images/Alamy Stock Photo)

Photograph B

(i) Calculate the magnification of the chloroplast shown in photograph B.

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

2.2 cm = 2.2 × 10000 = 22000 µm

1.5 µm – 2.2 cm

$\frac{22000}{1.5} = 14666.67$ (2)

Answer 14667

Question 3(b)(ii)

This question required students to explain why the microscope used for photograph B shows more detail than the microscope used for photograph A.

Most students knew that photograph B would have been taken by an electron microscope and therefore gained mp1.

It was expected that students would analyse the two photographs carefully in order to discern that structures inside the chloroplasts could be seen in photograph B and not in photograph A. They then needed to explain why. Generalised references to higher magnification and higher resolution unqualified were not sufficient.

Question 3(c)

This question gave students a photograph of a structure found in the algal cell that was characteristic of animal cells.

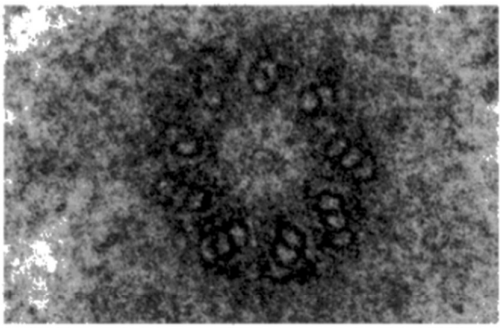
Students were asked to give the name and function of this structure.

It was surprising that many students could not identify this structure as a centriole. The most common incorrect answers were chloroplast, mitochondria and cell membrane.

Where it was correctly identified, nearly all students could give the correct function to score two marks.

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

centrioles



(Source: © DON W. FAWCETT/SCIENCE PHOTO LIBRARY)

The structure has the same function in the algal cell as in an animal cell.

Give the name and function of this structure.

(2)

Name

Centrioles

Function

For separation of chromatids during anaphase of mitosis, where centrioles split into spindle fibres which attach to centromeres for splitting of centromere for separation of chromosomes into chromatids.

Question 4(a)(i)

This question asked students to calculate the volume of an egg cell using the given diameter and formula.

Most students could calculate the volume correctly, but some failed to give their answer to one decimal place.

Some students used the diameter instead of the radius in their calculation.

It is important that students read the question carefully.

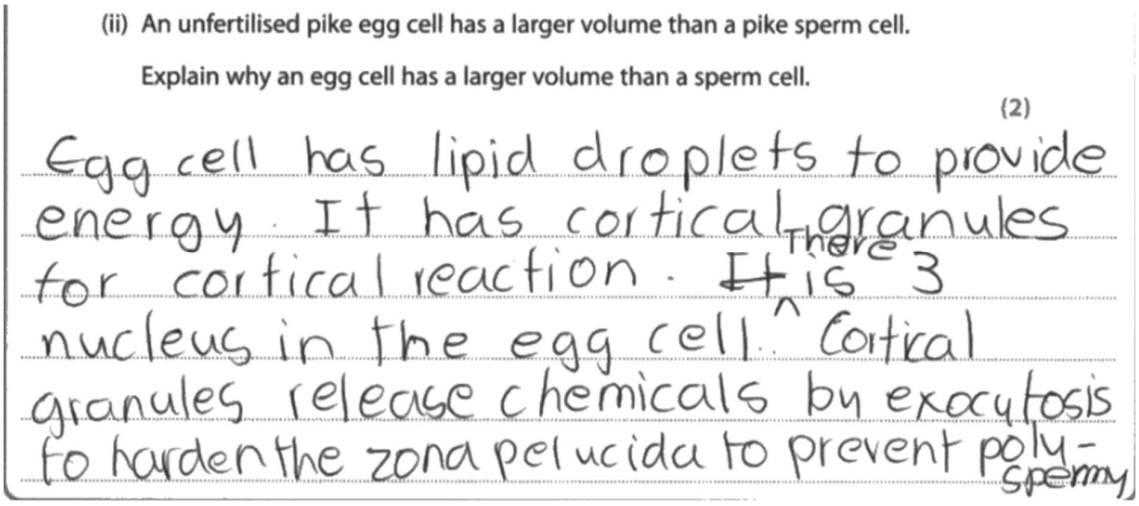
Question 4(a)(ii)

This question asked students to explain why an egg cell has a larger volume than a sperm cell.

Most students knew that an egg cell contained lipid droplets or cortical granules. Fewer students could extend their answer to explain why the egg cell contain lipid droplets.

Responses referring to the large size helping sperm cells to find or fertilise the egg cell were not credit worthy.

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


(ii) An unfertilised pike egg cell has a larger volume than a pike sperm cell.

Explain why an egg cell has a larger volume than a sperm cell.

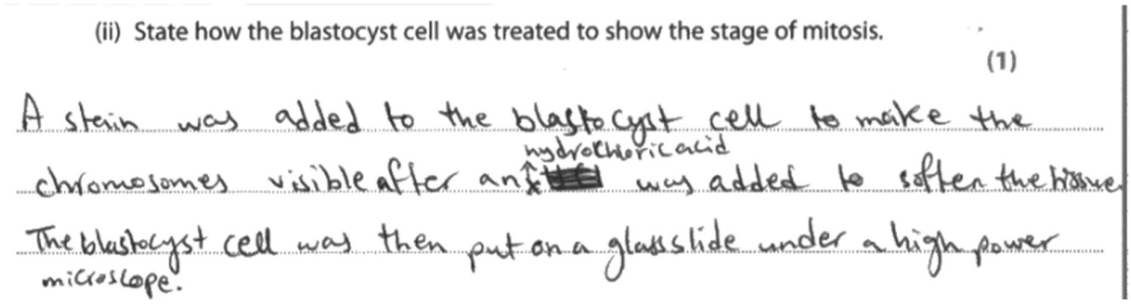
(2)

Egg cell has lipid droplets to provide energy. It has cortical granules for cortical reaction. ~~It~~ There is 3 nucleus in the egg cell. Cortical granules release chemicals by exocytosis to harden the zona pelucida to prevent poly-spermy

Question 4(b)(ii)

Students were asked to state how the blastocyst was treated to show the stage of mitosis.

It was pleasing to see that many students used the photograph to help their answer. They could see the chromosomes were visible and could link this to the application of a stain, for example:


(ii) State how the blastocyst cell was treated to show the stage of mitosis.

(1)

A stain was added to the blastocyst cell to make the chromosomes visible after an hydrochloric acid was added to soften the tissue. The blastocyst cell was then put on a glass slide under a high power microscope.

Question 4(b)(iii)

This question asked students to compare and contrast the structure of a morula with the structure of a blastocyst.

A compare and contrast question requires students to give both similarities and differences.

It is important for centres to note that a paragraph of information about the structure of a morula followed by a paragraph of information about the structure of a blastocyst is not the appropriate way to answer this type of question.

Students tended to focus more on the differences in the structures in their responses.

Most students identified that a morula contains totipotent cells whereas a blastocyst contains pluripotent cells. The most common statement that gained the second difference mark was that the blastocyst contained more cells than a morula. The difference of solid mass of cells compared to hollow ball of cells was also common.

Question 4(c)(i)

This question asked students to describe the adaptations of a sperm cell that allow movement.

It was clear that most students knew how a sperm cell was specialised for its function. However, some students did not take careful note of the context of the question, Answers referring to the haploid nucleus, for example, were not credit worthy.

Most students could describe a correct adaptation to gain one mark. The most common response described the rotation of the flagellum. Many students also correctly linked the release of energy / production of ATP by the mitochondria enabling the rotation of the flagella, which gained two marks.

Question 4(c)(ii)

The students were provided with a graph showing the results of an investigation. Students were asked to give two conclusions for this investigation.

Students are reminded to take careful note of how many conclusions they are asked to make.

Most students could give at least one correct conclusion and many students gave both.

A small number of students said that the speed of the sperm cells increased with increasing time which was incorrect.

Question 5(a)

This question provided information about a new type of bacteria that was discovered in Greenland.

Students were asked to describe how scientists could determine that this was a new type of bacteria.

Most students gained mp2 for describing molecular phylogeny. Fewer students described how the phenotype would be analysed.

Higher level responses described how identification of differences in either phenotype or in biological molecules could give evidence to it being a new type of bacteria.

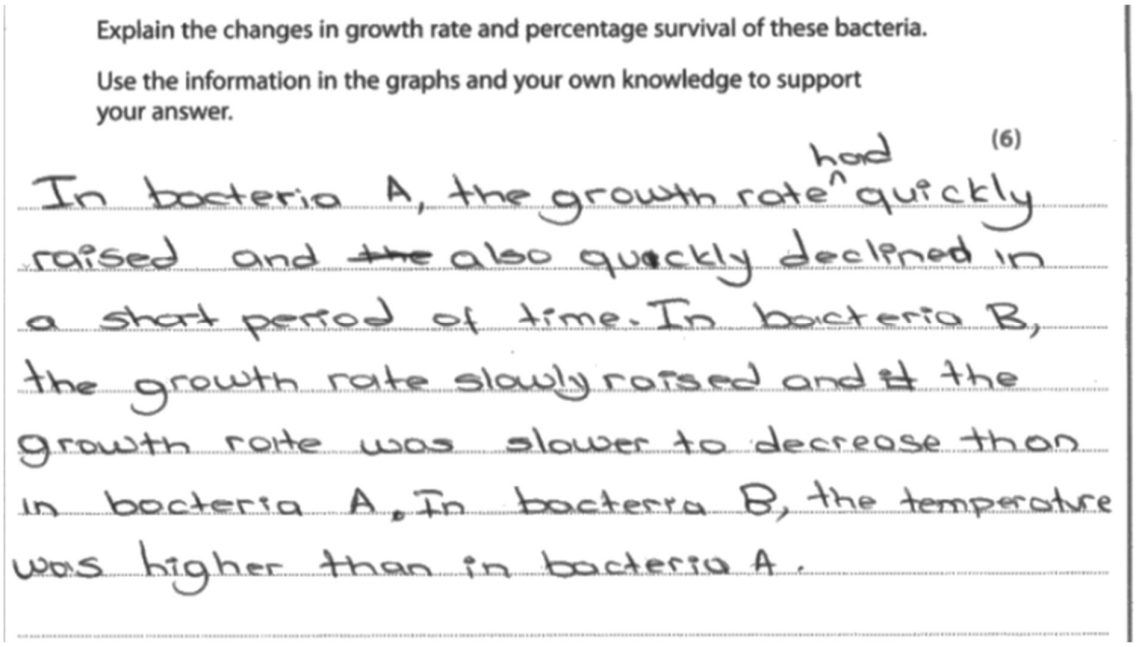
Question 5(b)

This was a level-based question.

Students were provided with a range of information to analyse, and they were expected to use this information to support their answer.

The most common way students gained level one was by giving a correct description of one or both graphs.

This response just described graph 1 and was therefore limited to the lower mark in level one:



Explain the changes in growth rate and percentage survival of these bacteria.

Use the information in the graphs and your own knowledge to support your answer.

(6)

In bacteria A, the growth rate had quickly raised and ~~the~~ also quickly declined in a short period of time. In bacteria B, the growth rate slowly raised and ~~it~~ the growth rate was slower to decrease than in bacteria A. In bacteria B, the temperature was higher than in bacteria A.

Students who provided correct explanations for the effect of temperature and desiccation on the different bacteria could access the higher levels.

The most common way to access level two was by explaining why the growth rate of bacteria changed as temperature changed. This was often by linking increasing temperatures (up to optimum) to increased enzyme activity, or by explaining that the decrease in growth rate was due to denaturation of enzymes, for example:

Graph 1:-
for Bacteria A:- the bacteria will start growing from -4°C. ~~The~~ temperature. After -4°C the growth rate of bacteria start increasing until the optimum 10°C. So the optimum temp for bacteria A is 10°C. After 10°C the growth rate decreases until 20°C then the bacteria stopedgrowing as the enzymes ~~ar~~ for the growth of bacteria are deratured. for bacteria B:- The bacteria will start growing from 74°C, unitil the optimum temperature of 94°C. The enzyme activity is greater in the optimum temperature. After 94°C the growth rate of bacteria decrease and ~~et grow~~ stop growing 105°C.
Grap 2:- for both mutated bacteria C and bacteria C the % survival decreases when the days after water was removed increases. for mutated bacteria. The % survival decreases until 6 days. Error bars don't overlap there is significant difference. for bacteria C. The error bars overlap so there is no significant difference.

(Total for Question 5 = 8 marks)

Some students extended their explanation of graph one to explain how this increased enzyme activity would increase bacterial growth rate and gained the higher mark. Some students gained level two by giving a basic explanation for both graphs.

To access the lower mark in level three students needed to give a detailed explanation for one graph and basic explanation for the other. A detailed explanation for both would gain the higher mark.

This is an example of a response which scored 6 marks:

Explain the changes in growth rate and percentage survival of these bacteria.

Use the information in the graphs and your own knowledge to support your answer.

(6)

Graph 1 shows that bacteria A grows better in low temperatures (-4-20°C) while bacteria B grows better in higher temperatures (66-106°C). The optimum temperature for bacteria A is 10°C and the optimum for bacteria B is 94°C. Additionally, bacteria B reaches a higher growth rate than bacteria A. Enzymes of the bacteria work best at different temperature and denature at the extremes above and below the optimum. Denatured enzymes can't catalyze metabolic reactions so growth decreases. Graph 2 shows that both bacteria C and mutated bacteria C survive less as days after water was removed increases. This may be because without water, bacteria dehydrate and can't preform metabolic reactions. However, mutated bacteria C survives much less than normal bacteria C. This may be because the mutated bacteria doesn't have a capsule that protects from dehydration.

Question 6(a)

This question provided information about an investigation using an extract from a Hawaiian parakeet flower.

Students were provided with some information about the investigation, a diagram showing zones of inhibition and a table showing the results of the investigation.

Students were asked to comment on the antimicrobial properties of this extract.

Nearly all students correctly identified that a higher concentration of extract had more antimicrobial properties / had a larger zone of inhibition. Most students could also correctly state that the extract was most effective against bacteria A or that it was least effective against bacteria B.

Higher level of responses commented that the zone of inhibition was larger due to the bacteria being killed due to the antimicrobial properties of the extract.

Question 6(b)(i)

This question provided information about an investigation using two pain killing drugs, A and B.

Students were asked to evaluate the results of this investigation.

It was pleasing to see that most students understood the requirements for the command word 'evaluate'. Nearly all responses gave at least one correct conclusion.

The most commonly awarded mark was for correctly identifying the negative correlation between concentration and headache duration. Most students could also identify that drug A was more effective at reducing the duration of headaches.

Many responses also commented that there was no significant difference between the two drugs due to the overlapping of the {error/SD} bars.

Some students wrote relevant comments about sample size, controlled variables.

A small minority of students did not understand the lack of data for lower concentrations of drug B.

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

(i) Evaluate the results of this investigation.

(4)

As the concentration of both drugs increases, the mean duration of headaches decreases.

Between 200 and 400 mg/Kg, drug B seems to have higher duration of headaches, so drug A seems more effective.

However, error bars overlap, this decreases confidence in the significance of the difference.

No idea about results for drug B at concentrations 0, 50, and 100 mg/Kg.

No ideas about sample size or statistical analysis.

Question 6(b)(ii)

This question asked students to compare and contrast phases II and III in a contemporary drug trial using drug A.

As with the previous compare and contrast question on this paper, poor exam technique limited the marks that some students could achieve.

Most students could comment on the size of the groups used in the different phases and the inclusion of placebos/double blind trials.

Students who did not take careful note of the context of the question did not gain the first similarity marking point. References to using patients in both phases in the drug trial were not sufficient. Students were given information above the graph at the start of part (b) that drug A was a painkilling drug and was tested as a treatment for headaches. Question 6(b)(ii) was set in the context of the drug trial was using drug A. Therefore, references to patients unqualified was insufficient.

More detailed responses also considered that different concentrations of the drug would be used in phase II but not phase III.

Question 7(a)

This question gave students information regarding the mass of eggplants imported by four countries in 2020.

Students were asked to calculate the expected mass of eggplants imported by France in 2023 to the nearest whole number.

Most students were able to correctly calculate the expected mass, using a variety of methods. However, a small number of students did not give their answer to the nearest whole number and therefore lost a mark.

Question 7(b)(ii)

This question asked students to explain how seed banks would prepare, store and assess viability of seeds.

It was clear to see the good understanding that students had of this topic and many excellent answers were seen which addressed all three required aspects.

The most commonly awarded points were for drying the seeds and for an appropriate explanation of a suitable storage condition.

Higher level responses included the gathering of replacement seeds from plants grown from stored seeds.

A minority of students did not take careful note that there were three aspects in the question that they needed to address, or did not understand the term 'viability', which limited the marks that could be awarded.

Question 7(b)(iii)

This question asked students to explain how scientists could breed new high-yielding varieties of eggplants which are resistant to *R. solanacearum* bacteria.

It was pleasing to see that nearly all students followed the instruction to use the information in the tables to support their answer, with most students being able

to explain why variety A and variety D should be used in a breeding programme. Some students only focused on the resistant characteristic without considering the high-yielding characteristic which limited the marks they could be awarded.

Higher level answers also considered the benefits to scientists checking to see which offspring had inherited the required characteristics and using only those offspring in further crosses.

Question 8(a)(i)

Students were provided with some information about arginase deficiency (AD).

They were asked to suggest how a recessive mutant allele could be produced in prophase I.

Many students knew that crossing over occurred in prophase I.

Answers referring to independent assortment were not credit worthy.

Question 8(a)(ii)

This question expected students to use the given equation to calculate how many people do not have a mutant allele for ARD1.

There were a significant number of responses which gained full marks.

Most students could work out that q^2 was either 1÷300 000 or 26 000÷7 800 000 000. A minority of students failed to square root this answer to get q.

It was pleasing to see that most students remembered that p+q=1 and used this to calculate the value of p. A number of students did not square this answer to get p^2.

A small number of students gave a number that was larger than the given population.

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

(ii) If the incidence of AD was 1 in 300 000, and the population was 7 800 000 000, then 26 000 people would have AD.

Calculate how many people do not have a mutant allele for ARD1.

Use the equation:

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

(3)

$q = \sqrt{\frac{26000}{7,800,000,000}}$

$p+q=1$

$q = 1.823 \times 10^{-3}$

$p = 1 - 1.823 \times 10^{-3}$

$p = 0.998$

$p^2 = 0.996$ Answer 7771 544 427

0.996×7800000000

$= 7771544427$

Question 8(b)

This question asked students to give two differences between active mRNA and pre-mRNA.

Students are reminded to take careful note of how many answers they are asked to make, as further answers will not be marked.

It was clear to see that most students knew the structure of both active mRNA and pre-mRNA, with most students gaining mark point 1.

Fewer students knew that the exon order/number could differ in active mRNA.

Question 8(c)(i)

Students were given information about human induced pluripotent stem cells (hiPSC).

They were asked to explain how a pluripotent stem cell could become a cell that synthesises arginase.

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

Many good explanations were seen which addressed marking points 1,2,4 and 5. Students understood what was meant by the term pluripotent stem cell and could explain differential gene expression and epigenetic modification.

However, marking point 3 could only be awarded if they referred to the arginase gene being switched on or active. Answers needed to apply to the context of the question. Vague statements regarding genes unqualified were not creditworthy.

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

(i) Explain how a pluripotent stem cell could become a cell that synthesises arginase.

(5)

the pluripotent stem cell is capable of differenciating into most cells. this occurs due to differencial gene expression and some genes are turned off (by DNA methilation) and some genes such as the gene that allows synthesis of arginase are tured on (histone modification) and the ~~nucleus~~ ~~mRNA~~ ~~undergoes~~ ~~trans~~ mRNA for the gene is transcripted and then translated forming the polypeptides which has a different tertiary and quardenary structures required to make the pluripotent stem cell a cell that synthesises arginase. meaning the pluripotent stem cell has been specialised

Question 8(c)(ii)

This question asked students to explain why society may support the use of hiPSC stem cells to treat patients with AD.

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

Most students could explain the ethical issues regarding the use of embryonic stem cells to gain marking point 2.

Fewer students looked back at the information they were given about AD to give further detail to their answers. Those that did recognise that hiPSC stem cells came from adult skin, although some thought that they came from the patient's own body. Few students used the information that AD can be fatal or that arginase production occurred in liver (somatic) cells.

Paper summary

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

- Read the whole question carefully, including the introduction, to help relate your answer to the context asked.
- You should take into account the command words as well as the context given. Answers which do not match the command words or do not relate to the given context will not gain high marks.
- 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.

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