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Examiners' Report
June 2016

GCE Biology 8BN0 02

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Introduction

On this paper the best-answered questions tended to be the multiple choice, short-answer and AO1 questions; this is illustrated by the fact that the most mark-yielding of the extended written response questions was 7(b), which required a fairly straightforward description of the protein trafficking pathway without reference to data or an unfamiliar context. Candidates demonstrated a good grasp of some of the mathematical skills – for example calculating a percentage decrease in 3(b)(i) – but other mathematical skills were weaker, in particular the calculation of the magnification of a micrograph image as assessed in 2(a).

Some candidates appeared to be unsure of the meaning of some of the new command terms used, for example 'criticise', 'justify' and 'assess' in questions 5(c)(ii), 6(d) and 8(c) respectively. Questions using the command term 'explain' tended to be incompletely answered as candidates did not fully explain the biological processes involved in producing the relevant outcome; 4(b)(i) was a particular case in point.

Analysing unseen data was the greatest area of difficulty for candidates in general, and is an area that candidates are strongly advised to work on. The new AO2 is based around handling qualitative and quantitative data, while the new AO3 is about analysing, interpreting and evaluating scientific information, ideas and evidence; the weightings given to these assessment objectives dictate that more than half the marks on the new-style papers will involve some form of data analysis. These are really valuable skills that will be needed not only by those candidates who go on to be professional scientists but also by all citizens attempting to navigate the information age. Candidates learn a great deal from analysing their own data collected from Core Practicals (or other practical work carried out during the course) but they will also benefit from exposure to data sets that they have not collected themselves, which provide a greater level of cognitive demand.

Question 1 (b)(ii)

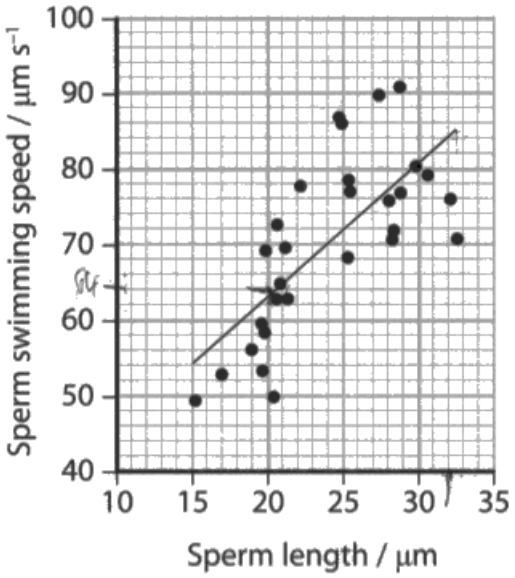
Most candidates were able to answer this question correctly by linking the release of ATP (or energy) from the mitochondria to the swimming of the sperm. Almost all responses started off in the right direction with a reference to energy, but some were not sufficiently precise to be awarded the mark. The examiners hoped that candidates would demonstrate their knowledge of the structure and function of the sperm cell by mentioning the flagellum; simple references to energy for the sperm to 'move' were not detailed enough at this level. Candidates should note that the idea of making, producing or creating energy was not credited, since it runs counter to the principle of the conservation of energy.

Question 1 (c)(i)

This question assessed candidates' ability to work with linear relationships of the form $y = mx + c$ (mathematical skill A.3.3). Many candidates answered successfully by finding the gradient of the line on the graph, which allowed them to extrapolate beyond the extent of the x-axis. However, some candidates extended the x-axis and the line on the graph and attempted to read the swimming speed directly from their extended graph. Although this was a creative approach, it usually did not yield a sufficiently accurate answer.
A disappointing number of candidates failed to achieve the second mark for use of correct units, even though these really could be taken directly from the graph. Some candidates omitted units entirely, while another surprisingly common mistake was for the 's' to become superscript which is biologically nonsensical.

(c) The relationship between the length of a sperm cell and the speed at which it can swim was investigated.

The data collected are shown in the graph.



20 = 64
30 = 80) +16
40

(i) Calculate the swimming speed of a sperm cell that is 40 μm long, as predicted by the line shown on the graph.

(2)

Answer 96

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Examiner Comments

The working (beside the graph) in this answer reflects a valid method of extrapolation. Unfortunately the candidate has not read the graph accurately enough so has not obtained the correct answer, and units are omitted, so neither of the two marks could be awarded.

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Examiner Tip

You are expected to read graphs as accurately as possible, even if the reading is in-between the grid lines. For example, at a length of 20μm the line is half-way between the grid lines for 62 and 64μm s^{-1}, so you should read off 63μm s^{-1}.

Question 1 (c)(ii)

Of course, linear extrapolation is not always appropriate in biological contexts. This question asked candidates to consider the limitations of the swimming speed they had predicted in part (i). Answers tended to focus on either the first or the second bullet point in the mark scheme, rarely considering both. Bullet point 1 was much more frequently seen by the examiners, probably because the variability of the data visible in the graph helped to point candidates in the right direction.

(ii) Explain the limitations of using the line on the graph to predict the swimming speed of sperm cells.

(2)

There will be some anomalies, such as long sperm that swim more slowly than the graph predicts. Also, only two pieces of data from the graph are on the line, so it is unlikely that any further data will match the line exactly.

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Examiner Comments

This answer correctly explains the first bullet point in the mark scheme, so was awarded 1 mark.

ResultsPlus
Examiner Tip

Look for signposts as to how many points to include in your answer. In this case the question refers to limitations (plural), and two marks were available, so the examiners were looking for two distinct points.

(ii) Explain the limitations of using the line on the graph to predict the swimming speed of sperm cells.

(2)

It does not allow for any limiting factor that may cause the sperm to reach a certain speed and stop increasing. The sperm length may reach a length that is considered too long and therefore the speed at which it travels may decrease.

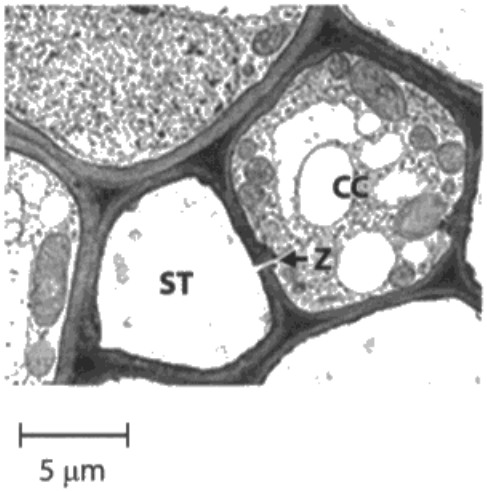
ResultsPlus
Examiner Comments

This answer correctly explains the second bullet point in the mark scheme, so was awarded 1 mark.

Question 2 (a)

When the paper was written this was intended as quite an accessible question, since the labelled scale bar was provided below the micrograph. However, very many candidates seemed completely confused as to how to tackle the question – perhaps because they had not previously practised working with a scale bar. Various different features of the image were measured (unnecessarily) and diverse erroneous calculations led to answers ranging over 20 orders of magnitude. Answers less than 1 were frequently seen; in these cases a sense-check should have suggested a mistake, since it is fairly clear that the image has been magnified rather than reduced. Candidates are advised to practice magnification calculations of a variety of different types.

2 The electron micrograph shows a cross-section through part of a vascular bundle, containing phloem tissue.



A sieve tube element is labelled '**ST**'. A cell called a companion cell is labelled '**CC**'.

(a) Calculate the magnification of this image.

(1)

mag = picture image / real image.

= 1.4 / 5 = 0.28

Answer: × 0.28

ResultsPlus
Examiner Comments

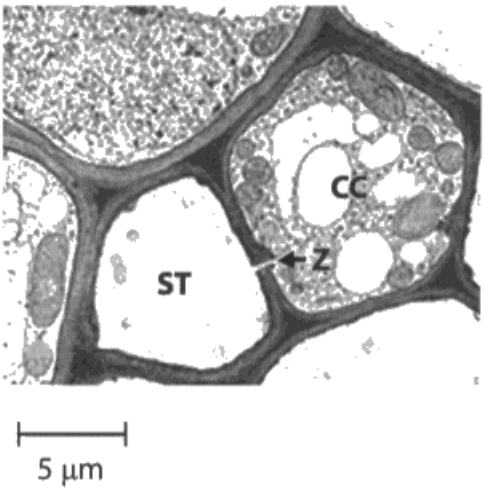
This candidate has correctly measured the scale bar below the micrograph, but unfortunately did not convert the value of 1.4cm into 14000µm – so the answer is 1000 times too small.

This was just a 1-mark question so there was no mark available for working, therefore this answer scored 0 marks.

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Examiner Tip

When carrying out a calculation, be sure to take account of the units of measurement.

2 The electron micrograph shows a cross-section through part of a vascular bundle, containing phloem tissue.



A sieve tube element is labelled '**ST**'. A cell called a companion cell is labelled '**CC**'.

(a) Calculate the magnification of this image.

(1)

5 µm = 0.005 mm

The line is 14 mm

magnification = $\frac{14}{0.005}$

× 2800

Answer: × 2800

ResultsPlus
Examiner Comments

In this example the candidate has converted 5µm to 0.005mm before carrying out the division. This is an equivalent, valid method and the answer is correct, gaining 1 mark. The candidate has set out extremely clear working, allowing the examiner to follow exactly what has been done.

Question 2 (c)

Candidates usually had the right idea here: that the sieve tube element would not be making proteins. However, marks were frequently lost through a lack of detail. Answers did not tend to specify that no **mRNA** would be available in the absence of a nucleus or that transcription would not take place, and reference to the **role** of the rER in relation to protein synthesis tended to be omitted.

(c) There is no nucleus in a mature sieve tube element.

Give **two** reasons why a sieve tube element does not require rough endoplasmic reticulum and ribosomes.

(2)

Because the ribosomes and rough endoplasmic reticulum are used for the production of proteins and without the nucleus they cannot be made therefore the rER and riboromes are not needed

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Examiner Comments

This answer was too vague so could not be awarded any marks.

It states that ribosomes and rER are used for the production of proteins, but does not give their roles. It also says that proteins cannot be made without the nucleus, but does not give the reason. Therefore this answer did not fully address either of the bullet points in the mark scheme.

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Examiner Tip

Give details in your answer and ensure that reasons are specific.

Question 2 (d)(i)

The majority of candidates were able to identify the structure correctly as a pit or plasmodesma (either of these was acceptable, and the plural term plasmodesmata was also allowed on this occasion). However, many struggled to describe the structure in any further detail for the second mark. There also appeared to be widespread conflation of these two structures, with plasmodesmata frequently described as pits or vice versa.

(d) Companion cells are found next to sieve tube elements.

(i) Describe the structure labelled **Z** that connects the cytoplasm of the companion cell to the sieve tube element.

(2)

Z is a plasmodesmata – a hole in the cell wall that connects the two cells membranes to speed up the transfer of molecules between the two cells.

ResultsPlus
Examiner Comments

This answer is mixing up plasmodesmata and pits. It scored 1 mark for correctly identifying Z as a plasmodesma, but the subsequent description is of a pit so the second mark could not be awarded because the two parts of the answer do not match.

ResultsPlus
Examiner Tip

Remember that 'plasmodesmata' is a plural. The singular is one **plasmodesma**; use the term plasmodesmata to refer to more than one.

Question 2 (d)(ii)

This question produced a good spread of marks: almost all candidates were able to interpret the micrograph to identify the difference in the number of mitochondria, many went on to link this to the role of the companion cell in providing ATP to the sieve tube element or actively loading solutes, but relatively few completed the explanation with reference to the role of the sieve tube (bullet point 2).

(ii) The electron micrograph shows a difference in the number of mitochondria in the sieve tube element and in the companion cell.

Explain the difference in the number of mitochondria.

(3)

The companion cell will have many mitochond-ria in comparison The to the sieve tube because the companion cell provides the sieve tube element with the energy, ATP, for its functions, therefore does not require mitochondria.

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Examiner Comments

This answer scored 2 marks, correctly addressing the first and last bullet points in the mark scheme.

However, a fuller explanation (making reference to the role of the mitochondria or the sieve tube element) was needed for the award of the third mark.

ResultsPlus
Examiner Tip

When answering an 'explain' question, try to explain yourself as fully as possible.

Question 3 (b)(i)

Most candidates were able to carry out this calculation correctly, but serious weaknesses in mathematical skills were exposed in some cases. Some candidates did not perform a subtraction to find the difference in the concentrations, and another common mistake was to divide by 250 rather than 2100. The latter error produced an answer greater than 100%, again highlighting the need for candidates to check if their answer is logical: a decrease of more than 100% would mean a negative ion concentration in the leaf, which does not make biological sense.

(b) The concentrations of some inorganic ions were measured in soil and in plants.

The table shows the concentration of nitrate ions in the soil and in different parts of a plant.

Site	Nitrate ion concentration / ppm
leaf	250
leaf stalk	990
stem	1200
root	2100
soil	29

(i) Calculate the percentage decrease in nitrate ion concentration from the root to the leaf.

(2)

2100 − 250 = 1850

$\frac{2100 - 250}{250} =$

$\frac{1850}{250} = 7.4 \times 100 = 740\%$

Answer 740%

ResultsPlus
Examiner Comments

This candidate has correctly found the difference in concentration between the root and the leaf, scoring 1 mark. However they have then divided by the final, rather than initial, concentration, so their percentage decrease is not correct.

Obtaining an answer of more than 100% could have given a clue that a mistake had been made: a decrease of more than 100% would mean a concentration less than 0, which doesn't make sense.

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Examiner Tip

When you have done a calculation, check that your answer makes biological sense.

(b) The concentrations of some inorganic ions were measured in soil and in plants.

The table shows the concentration of nitrate ions in the soil and in different parts of a plant.

Site	Nitrate ion concentration / ppm
leaf	250
leaf stalk	990
stem	1200
root	2100
soil	29

(i) Calculate the percentage decrease in nitrate ion concentration from the root to the leaf.

(2)

$\frac{250}{2100} \times 100 = 11.9\%$

$100 - 11.9 = 88.1$

Answer 88%

ResultsPlus
Examiner Comments

This answer uses a different method from that shown in the mark scheme, but it is still valid and obtains the correct answer for 2 marks. The candidate has calculated the concentration in the leaf as a percentage of the concentration in the root, then subtracted this from 100 to find the percentage decrease.

Question 3 (b)(ii)

This was a straightforward question which was well answered in more than half of the responses seen. The common errors are likely to come as no surprise to teachers: some candidates mixed up the xylem with the phloem, and some were unsure as to which form of transport was involved – diffusion and active transport were fairly frequent suggestions. Reference to the data could have guided candidates away from active transport, since the table shows that the concentration is higher in the root than in the leaves.

(ii) Describe how nitrate ions are transported from the root to the leaves.

(2)

Nitrate ions are drawn in to the roots and once there, transported by the phloem to the leaves via active transpat, ATP is required as the movement is against gravity and often a concentration gradient as the plant tries to gain the maximum nutrients required

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Examiner Comments

This answer did not score any marks. The wrong vessel is described (phloem rather than xylem), and the method of transport is incorrect. The candidate could have spotted their mistake by checking the data provided: the table shows that transport from the root to the leaf is with (not against) the concentration gradient.

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Examiner Tip

Make sure you know the difference between the roles of xylem and phloem vessels: candidates often mix these up.

(ii) Describe how nitrate ions are transported from the root to the leaves.

(2)

Nitrate ions are transported from the root to the leaves by ~~translocation~~ the transpiration stream in the xylem. The nitrate ions are dissolved in water, which moves from the root to the leaves due to the hydrostatic pressure created by the transpiration stream.

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Examiner Comments

This answer gained 2 marks for a correct description of the method of transport and the vessel involved.

Question 3 (b)(iii)

The great majority of candidates scored at least 1 mark here by giving the correct symptoms of a shortage of magnesium. Many were able to offer a partial explanation in terms of a shortage of chlorophyll, gaining 2 marks, but relatively few gave a full explanation making reference to a lack of glucose (or carbohydrate) for growth due to limited photosynthesis. A fairly common error was to suggest that the plant would wilt, which is not the same as stunted growth and is a consequence of low turgor pressure due to water shortage.

(iii) The concentration of magnesium ions in the soil was found to be very low.

Explain the effects of a shortage of magnesium ions on a plant.

(3)

stunted growth, yellowed leaves, ~~less~~ poor root growth

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Examiner Comments

This candidate has correctly stated the effects of a shortage of magnesium, but has not given any explanation as to why these effects occur, so could only score 1 mark.

ResultsPlus
Examiner Tip

Take note of the command word used in the question and answer accordingly.

(iii) The concentration of magnesium ions in the soil was found to be very low.

Explain the effects of a shortage of magnesium ions on a plant.

(3)

A shortage of magnesium ions means that less chlorophyll will be produced by the plant. This will result in less photosynthesis within the plant, causing stunted growth. The lack of chlorophyll will also result in a yellowing of the leaves of the plant.

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Examiner Comments

This answer scored 2 marks for the first and third bullet points in the mark scheme. It approaches the second bullet point as well, but does not quite get there because there is no reference to the production of glucose in photosynthesis. This means that the explanation is not quite complete: it is the shortage of glucose that accounts for the stunted growth of the plant.

Question 3 (c)

In this experimental design question the investigative context related to the tolerance of tomato plants to toxic lead ions. Generally the responses showed a good understanding of the importance of controlling variables and of repeats, and sensible practical set-ups were described involving tomato plants grown with different concentrations of lead. In many cases the method involved growing the plants in soil, but use of mineral ion solutions (a Core Practical technique) would allow for tighter control of variables and aid the measurement of the dependent variable (DV). In many cases a specific and measureable DV was not identified, perhaps because candidates were unsure how to measure whether the plant was alive; the examiners were willing to accept any reasonable measurements suggested by candidates, length or mass being typical examples (with a decrease taken to indicate the death of the plant). Most answers focused on the control of variables and the practical details of the method, placing most candidates at level 2.

Many candidates lost sight of the fact that the objective of the investigation was very specific: to determine the tolerance category of the tomato plants. Numerical data regarding lead concentrations was provided so it was expected that these be taken into account, firstly in the experimental method devised and secondly in the clear description of how the results would be used to determine the tolerance category. Those who attempted to refer to the lead concentrations given did not always do so successfully: methods involving four lead concentrations of "<300, 300-999, 1000-2000 and >2000" were frequently seen, with candidates failing to specify which precise concentration within these ranges should be used. Few candidates produced level 3 answers in which they recognised that testing the boundary concentrations (300, 999 and 2000) was necessary to determine the category. It was also rare to see a clear and specific explanation of how the experimental results would be used to determine the category.

Devise a laboratory investigation to determine the tolerance category of tomato plants to lead ions.

(6)

Firstly, use of same source of tomato plant. Prepare 5 different concentration of lead ion, also, a control group of concentration which there is no lead ion. Make sure the plt of soil for all plant is constant, also maintain the same temperature, humidity and the amount of light provided. Allow the plant to grow for 6 weeks, measure the growth of root and leaves every week, and note down any changes in the appearance of the plant. Repeat experiment to calculate the mean.

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Examiner Comments

This is a level 1 answer, scoring 2 marks. The candidate makes sensible use of tomato plants and lead ions, showing consideration of the context of the question. There is also an appreciation of the need to control variables and the role of repeats. However, there is no clear practical technique described, no indication of appropriate concentrations of lead to be used, and no specific dependent variable identified (measuring 'growth' is not clearly defined). Inclusion of at least one of these features would have helped this answer move to level 2.

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Examiner Tip

In an experimental design question, ensure that you give a clear method and identify a measurable dependent variable.

The Core Practicals you carry out during the course allow you to build up a 'toolkit' of practical techniques that you should be able to apply and adapt to new situations.

Devise a laboratory investigation to determine the tolerance category of tomato plants to lead ions.

(6)

Collect 4 samples of tomato plants, all seedlings from the same species and all the same age. Place each seedling in soil with the necessary mineral ions i.e. nitrates, magnesium and calcium as well as enough/the same amount of sunlight and volume of water as each other. Then, added to the soil would be different concentrations of toxic lead (~~200~~ 300, ~~500~~ 999, ~~1500~~ 2000, ~~2500~~ 2500 ppm); ~~for~~

Observe for 2 weeks and record ~~time~~ initial and final length as well as if they even survived. Then

repeat for each concentration 3 times to calculate an average and then categorise.

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Examiner Comments

This was a level 3 answer, scoring 5 marks. Tomato plants and lead ions are used appropriately and several variables are controlled. There is an appreciation that an adequate concentration of other necessary ions should be provided, although this would be better controlled by growing the plants in solution rather than in soil. The length of the plant is identified as a measurable dependent variable. Most importantly, the candidate has analysed the data provided and recognised that the concentrations at the **boundaries** between the tolerance categories (ie. 300, 999 and 2000 ppm) are important in classifying the plant. This is a key feature that identifies this as a level 3 answer, albeit at the weaker end of level 3.

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Examiner Tip

Remember that you are expected to be able to analyse and interpret scientific information: you must make good use of data provided.

Question 4 (a)

Almost all candidates described sensible safety precautions that should be taken when working with bacteria. Unfortunately these did not always yield marks, usually either because they were not aseptic or because the practical technique was not described in sufficient detail. Examples of responses that were frequently seen but were not credit-worthy include: incubation of bacteria at low temperatures to avoid promoting growth of pathogens (not aseptic) and use of sterile equipment (not a technique).

(a) Describe **two** aseptic techniques that should be used when working safely with bacteria.

(2)

Keep experiment ~~pac~~ + equipment near a flame (on blue) as this creates a ~~draught~~ draft which draws bacteria upwards + away from equipment. Sterilise equipment first eg use ethanol to wipe table clean and heat test tubes on blue flame to kill pathogenic bacteria.

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Examiner Comments

This answer scored 2 marks, 1 for working in the up draught of a flame and 1 for wiping the bench with ethanol.

(a) Describe **two** aseptic techniques that should be used when working safely with bacteria.

(2)

Incubate bacterium at 25 °c to ensure that there no harmful pathogens are encouraged to grow above these temperatures. Also use sterile equipment and sterilize after each experiment to ensure no harmful bacteria is passed on.

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Examiner Comments

This answer did not gain any marks. Firstly, incubating at a temperature well away from human body temperature is of course safe practice, but is not an aseptic technique. Secondly, the examiners did not credit references to 'sterilising' without further details because this was not a description of a technique.

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Examiner Tip

Make sure your answer addresses exactly what the question asks for. In this case the two key words 'aseptic' and 'technique' were both important.

Question 4 (b)(i)

The examiners were interested and surprised to find that this was the least mark-yielding question on the paper. Many answers referred to relevant conditions in skin wounds that promote bacterial growth, such as warm temperatures and availability of oxygen. However, few candidates successfully addressed the command term used in the question by explaining why these conditions would help bacteria to grow rapidly.

(b) The salve was also tested on mice.

These mice had skin wounds infected with *S. aureus*. The salve was very effective in treating these infections.

(i) Explain why some bacteria can grow rapidly in skin wounds.

(3)

Because bacteria thrive and grow rapidly in areas that are dark and damp, such as a skin wound. Also, skin wounds will be a similar temperature to internal body temperature (around 37 °C), and bacteria grow very quickly at such temperature.

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Examiner Comments

This answer did not score any marks. It makes some reference to relevant features of a wound (the temperature and the damp conditions), but it does not **explain** how or why these would promote the growth of bacteria.

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Examiner Tip

When answering an 'explain' question, you must give details of the biological processes that lead to the outcome.

(b) The salve was also tested on mice.

These mice had skin wounds infected with *S. aureus*. The salve was very effective in treating these infections.

7 (i) Explain why some bacteria can grow rapidly in skin wounds.

(3)

Because bacteria require a source of nutrients to grow - provided by the glucose within the skin cells. Human body temperature is 37°C - which is high enough for rapid bacterial growth (increased rate of enzyme activity)

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Examiner Comments

This answer scored 2 marks, firstly for the availability of glucose and secondly for the idea that the warm temperature increases the rate of enzyme activity. The candidate has given a clear explanation of why each of these helps to promote growth.

Question 4 (b)(ii)

In response to this question, many candidates gave very detailed descriptions of all the phases involved in the testing of a drug – sometimes rather more detail than required. Candidates could have saved time by focusing on the question: how to test whether the salve is an appropriate treatment. It was overwhelmingly common for candidates to describe comparing the salve to a placebo, but of course this is not ethical when there is already an existing treatment! Candidates also typically referred to a double blind trial but did not describe what this involves. Therefore the most frequently awarded score was 2 marks, usually for the ideas of testing first on healthy volunteers and checking for side effects.

(ii) *S. aureus* can cause infections which are difficult to treat in humans.

Describe how scientists, after testing the salve on mice, could test whether the salve is an appropriate treatment for humans with wounds infected with *S. aureus*.

(4)

First it could be tested on a smaller group of volunteers, around 100-300, these should be healthy volunteers that can be monitered for any side effects and to see if it is safe. Then it could be tested on a larger group 1000-3000, of patients. The patients would be given either a placebo or the salve and this can be done in a single-blind a a double-blind test. After that if successful, the salve can be approved for distribution.

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Examiner Comments

This answer scored 2 marks; bullet points 1 and 4 from the mark scheme (healthy volunteers and side effects). The answer contains two features that very frequently prevented candidates from gaining more marks: use of a placebo rather than an existing treatment, and use of the term 'double blind' without further description.

Question 5 (a)

Q5 – general

Question 5 was based around a set of data which shows a negative correlation between the mass of the adult of various species and the diameter of its egg cell. Of course this negative correlation does not hold true more widely across the animal kingdom, it just happens to be the case for the five species selected; the reproductive strategies of these organisms have a much greater influence on the sizes of their eggs cells, so information about the sites of fertilisation and offspring development was also given.

5(a) Many candidates carried out this multi-step calculation successfully – well done. However, others found a number of potential pitfalls. The most common were: to get in a muddle with units, since the eel egg diameter was given in mm while the volume of the human egg was given in μm^3; to attempt to subtract the two volumes to find a difference, rather than dividing to find the multiplication factor; or simply being unable to use the formula for volume correctly, often squaring rather than cubing the radius.

(a) The human egg cell and the eel egg cell are approximately spherical.
The formula for the volume of a sphere is

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

where V is the volume and r is the radius of the sphere.

The volume of the human egg cell is $1.8 \times 10^6\ \mu m^3$.

Calculate how many times larger the volume of the eel egg cell is than the volume of the human egg cell.

(3)

$1.1 \times 1000 = 1100$

$\frac{4}{3} \pi \times 0.55^3$

$= 0.697\ \mu m^3$

$\frac{697000000}{1.8 \times 10^6} = 387.2$

$\frac{4}{3} \times \pi \times 550^3$

$= 696909970.3$

$\frac{697000000}{1.8 \times 10^6}$

1.8

Answer 387.2 times larger

ResultsPlus
Examiner Comments

This answer scored all 3 marks and clearly shows the three steps in the calculation. At the top we see the conversion of the eel data into μm (1.1 x 1000 = 1100). On the left-hand side the formula for volume is used correctly. On the right we then see a correct division to find how many times larger the eel egg is. Ideally the final answer should be rounded to two significant figures, since this was the degree of precision to which the data were given; however, on this occasion unrounded answers were accepted because the examiners did not want to penalise candidates who had carried out all the steps of the calculation correctly.

ResultsPlus
Examiner Tip

Think about the appropriate degree of precision for your answer. However, only round off when you have reached the end of the calculation, to ensure your answer is as accurate as possible.

Question 5 (b)

Candidates most frequently addressed the third bullet point on the mark scheme here, commenting on the increased likelihood of fertilisation. The examiners did not accept that a larger egg is 'easier' to fertilise, because this is not the case, but the larger egg provides a larger target for the sperm. Far fewer candidates integrated their own knowledge of the structure and function of the egg cell with the information provided, so the marks relating to lipid droplets and the energy content of the egg were not awarded so often.

(b) The eel egg cell is larger than the human egg cell, yet an adult eel is smaller than an adult human.

Analyse the data in the table to explain why it is advantageous for the eel to have a larger egg cell.

(2)

It is advantageous for an eel to have a larger egg cell as its site of fertilisation is in the sea and not in a uterus like a human. So having a larger ~~the~~ egg cell will increase the chances of fertilisation occuring.

ResultsPlus
Examiner Comments

This answer scored 1 mark for the final bullet point in the mark scheme, the idea of a greater chance of fertilisation.

Question 5 (c)(i)

Almost all candidates correctly identified the negative correlation and gained the mark.

Question 5 (c)(ii)

Some candidates appeared to misinterpret what the command term 'criticise' was asking them to do: some responses quoted the numerical data in great detail to provide evidence to support the existence of a negative correlation, but did not offer any criticism. However, the majority had their doubts that the correlation would hold true in general and most candidates were able to identify at least one problem with the data set. There was a tendency to focus on one particular flaw identified and discuss it at length, rather than going on to consider a range of different issues with the data set, so the full 4 marks were infrequently awarded.

(ii) Criticise this data set as evidence for a relationship between egg cell diameter and the mass of the adult.

(4)

The data given is not enough to conclude the relationship between egg diameter and mass of the adult as only 5 species data was collected. Also the species range as they belong to different taxonomies. Only 2 of the species were mammal and the rest were a a variety. Also the data collected was an egg taken from an individual not an average size found from many individuals. Also the site of fertilisation is not consistant with all the species as the eel was 'in the sea' and the rest were 'in the body'. There is too many uncontrolled variables to conclude this relationship.

ResultsPlus
Examiner Comments

This was a good answer that considered a range of weaknesses of the data set and scored 4 marks. The first four bullet points in the mark scheme are addressed, in the same order in which they appear in the mark scheme.

Question 6 (a)

A few candidates described suitable conditions for the **germination** of seeds, so did not score any marks. The rest of the responses were fairly evenly divided between 1 and 2 marks. A typical response scoring just 1 mark was "cool and dry", perhaps since this is a well-known phrase, but unfortunately these conditions are more suitable for storing cornflakes than seeds! The examiners did not accept 'cool' because seeds must be kept really cold, not just cool.

6 Svalbard Global Seed Vault (SGSV) is a seed bank. It keeps seeds from almost 4000 species of plants, focussing on food crops such as wheat, rice and maize.

(a) State suitable conditions for keeping seeds in a seed bank.

(2)

In a cool, dry place.

ResultsPlus
Examiner Comments

Dry is a good answer for 1 mark, but 'cool' is not right for the second mark.

ResultsPlus
Examiner Tip

Try to be as precise and specific as possible in your answers: if you mean 'cold', don't say 'cool'.

6 Svalbard Global Seed Vault (SGSV) is a seed bank. It keeps seeds from almost 4000 species of plants, focussing on food crops such as wheat, rice and maize.

(a) State suitable conditions for keeping seeds in a seed bank.

(2)

there must be moisture, heat, water, nutrients, availability of sun.

ResultsPlus
Examiner Comments

This answer appears to be stating suitable conditions for the seed to grow, rather than for storage in a seed bank – where, of course, germination of the seeds is **not** desirable.

Question 6 (b)(ii)

Candidates needed to take care to answer the question here, which was why starch must be broken down. There was rather a tendency to state factual information, such as "starch is a very large molecule that contains a lot of glucose", instead of actually explaining why the breakdown is necessary. The idea of releasing the glucose was key for the first bullet point in the mark scheme. A further element of explanation as to the utility of glucose was needed for the award of the second mark. The examiners did not credit comments on the size of the molecules (starch or glucose) since this is not the same as their behaviour or function and does not answer the question.

(ii) Explain why starch must be broken down before it can be used by the cells of the growing plant.

(2)

starch is a polymer so must be broken down by hydrolysis into glucose monomers before it can be used.

ResultsPlus
Examiner Comments

This is an example of an answer that scored 1 mark. The candidate has explained that starch must be broken down to release glucose, but has not explained why. This response could have gone on to score the second mark if the candidate had said what the glucose would be used for.

Question 6 (c)

Answers generally demonstrated good understanding of the key point, that different types of seed decline in viability at different rates. However, candidates were much less successful in addressing the question of how the seed vault could make use of this information. It was very frequently suggested that varieties A and B were not worth keeping because they would not last long enough, so SGSV should just keep variety C. Clearly this is not how decisions should be made about which seeds should be stored. A reasonable number of candidates made reference to regular germination testing to check for viability, but few explained that as viability begins to drop, the seeds should be grown into plants from which fresh seeds can be collected.

Explain how SGSV could make use of these results.

(3)

As variety A has the shortest age for 100% germination (10 years is the maximum for 100% germination), the SGSV will know to regularly re grow the seeds at around 20 years for variety A and then the new seeds can be stored. This would keep the embryos viable and thus the biodiversity can be maintained. For variety C they don't need to re grow the seeds as often as it remains at a high % of germination so they can save money and time by regrowing and maintaining the other varieties more than C. ~~Variety B has a longer age~~ Once the seeds are below 75% germination then new seeds should be collected and stored and the old can be disposed.

ResultsPlus
Examiner Comments

This is an example of a good answer that scored 3 marks. The candidate appreciates that the seeds need to be regrown to produce new seeds for storage, in order to maintain viability.

Question 6 (d)

The key idea underpinning this question was the value of genetic diversity within species, one of the biological principles of Topic 4. The information in the question stem refers to the storage of many varieties of the same crop; candidates needed to think about why this might be useful. Disappointingly few candidates referred to genetic diversity at all, and some of those who did suggested that the seed bank would be able to increase the genetic diversity, which would be quite impressive! There was very limited evidence that candidates understood the idea of genetic diversity being useful in the face of changing selection pressures in future. Many candidates appeared to forget that this was a seed bank focusing on food crops, so the examiners saw more references to possible future medicinal benefits of the plants than to food security. Medicinal benefits were not credited on the basis that wheat and rice are unlikely to be sources of novel drugs, and this is not generally used as a justification for keeping food crops in seed banks.

(d) SGSV keeps seeds from more than 865 000 varieties of plant, including 200 000 varieties of wheat and rice. Some of these varieties are rare or extinct in the wild.

Since 2004, more than 410 million dollars have been spent on SGSV and other seed banks around the world.

However, it is estimated that 75% of global crop diversity is not stored in international seed banks.

Critics argue that many crop varieties stored in SGSV are not actually used for food, and that the money would be better spent supporting farmers who are growing food crops.

Justify the continued funding of SGSV.

(3)

If there is a natural disaster which wipes out the seeds of farmers then seedbanks have spares so we can regrow the crop. Seedbanks also help maintain genetic divesity so if a disease wipes out all the current crops seedbanks may have a seed that is resistant to the disease. Without the seedbanks some species may have gone extinct, these plants may have a ~~ease~~ medical use in the future so it is important they are kept.

ResultsPlus
Examiner Comments

This answer scored 3 marks. In the first sentence there is the idea of protecting the seeds from natural disasters, then in the second sentence the key concept of maintaining genetic diversity and recognition that the seeds in the seed bank may contain useful traits (in this case resistance to disease). At the end is a reference to potential medicinal uses, but this was not credited.

Question 7 (b)

This question was generally well answered, with candidates demonstrating sound knowledge of the protein trafficking pathway. The modal mark was 3 rather than 4 because answers tended to be a little too vague to score the 3rd bullet point in the mark scheme: candidates tended to say that the protein would be 'modified' in the Golgi apparatus, but since the context of the question was specifically about a glycoprotein, the examiners were looking for a clear description of the addition of a carbohydrate group.

(b) Anti-freeze glycoprotein (AFGP) is one type of anti-freeze protein.

Messenger RNA coding for AFGP is translated at a ribosome to produce a polypeptide.

Describe how this polypeptide is then processed to make AFGP.

(4)

The polypepide chain enters the lumen of rough ER where it is modified and folded into its tertiary structure. Then the protein is packaged into ER vesicles that bud off the r.ER and fuse together ~~at the~~ to form the cis face of the golgi apparatus. Here, the chain is further modified, by adding carbohydrates to form the glycoprotein AFGP, before being packaged into golgi vesicles to be taken to ~~exterior~~ specific areas of the cell or to be released outside the cell by exocytosis.

ResultsPlus
Examiner Comments

This answer scored all 4 marks by correctly describing the modifications taking place in both the ER and Golgi apparatus, as well as transport around the cell in vesicles.

ResultsPlus
Examiner Tip

Be sure to read the question carefully: in this case, the question refers specifically to a **glyco**protein, so you should know that a carbohydrate group must be added.

Question 7 (c)

This question assessed candidates' understanding of gene switching and cell specialisation: if AFP II mRNA is present only in the liver, the AFP II gene must be transcribed only in the liver, so this gene must be activated in the liver and deactivated in other tissues. The question generated a good spread of marks: many candidates realised that the protein must be produced in the liver then transported to the rest of the body, so gained 1–2 marks; fewer candidates completed the explanation with reference to gene switching, but a significant number did so successfully to gain 3–4 marks.

Explain the distribution of the AFP II protein and AFP II mRNA.

(4)

- AFP II protein is all around the fish in all tissues to ensure all of the fishes tissues do not freeze.
- The AFP II mRNA however is only found in the liver tissue.
- This is because the gene coding for AFP II mRNA is only active in the DNA of the liver tissue cells.
- Therefore the protein is only transcribed ~~and~~ to into mRNA and translated into the protein in the liver.
- The protein then travells all around the body in vesicles through exocytosis.

ResultsPlus

Examiner Comments

This candidate shows good understanding of the biological processes involved here (with one mistake at the end).

The answer scored the full 4 marks, as follows:

- sentence 1 gains mark scheme bullet point 5

- sentence 2 gains no marks because it simply repeats the information in the table, although it helps the logical flow of the answer

- sentence 3 gains mark scheme bullet point 1

- sentence 4 gains mark scheme bullet points 2 and 3

- sentence 5 gains no marks because the biology is incorrect (transport around the body is not in vesicles).

Question 7 (d)(ii)

This question provided candidates with two sets of data and they needed to integrate the information from the table and the diagram in order to answer the question. Many of the candidates who did this successfully shaded the diagram to illustrate when the ice ages occurred during the evolutionary history of the fishes. They could then see that the earlier two ice ages occurred before the origins of the ray-fin fishes, leaving either the Karoo or Quaternary as the ice age that provided the selection pressure making anti-freeze proteins favourable. Research suggests that these proteins are actually a relatively recent innovation (in evolutionary time) and have arisen during the Quaternary, but of course candidates could not be expected to know this, and the examiners were happy to accept either the Karoo or the Quaternary as a logical answer. Unfortunately many candidates suggested dates that were not during an ice age at all, failing to demonstrate understanding of the biological principle of adaptation to prevailing conditions.

(ii) Many different types of anti-freeze protein are produced by ray-fin fishes.

Analyse the data to explain when these ray-fin fish are likely to have evolved the ability to produce anti-freeze proteins.

(3)

- Selection pressure and change in the environment.
- Mutation of alleles in the population
- Individuals with beneficial ~~[illegible]~~ features i.e. produce anti freeze protein survive and breed
- Pass on advantageous alleles to next generation
- Change in the frequency allele over generation

ResultsPlus
Examiner Comments

This answer did not score any marks. The candidate has given a very formulaic answer with one brief reference to anti-freeze protein but no reference to the data. Also the candidate has not attempted to answer the question set, which is a 'when' question.

(ii) Many different types of anti-freeze protein are produced by ray-fin fishes.

Analyse the data to explain when these ray-fin fish are likely to have evolved the ability to produce anti-freeze proteins.

(3)

260 to 360 million years during the Karoo ice age. This is the time where they began to increase in population after losing a ~~large~~ majority of the families. This shows that the protein was made because they were no longer dying when the ice age hit so must have evolved to be able to produce this protein in order to survive.

ResultsPlus
Examiner Comments

This answer scored 2 marks, firstly for identifying a correct time period (260–360 million years ago, during the Karoo ice age) and secondly for explaining that the protein would have helped the fish to survive during the ice age.

ResultsPlus
Examiner Tip

If you are given more than one set of data, try to see how they fit together to help you answer the question.

Question 8 (b)

It seems that many candidates, when faced with a question relating to meiosis, turn immediately to the two stock answers of independent assortment and crossing over. In this case neither of these were relevant so, unfortunately, many candidates did not score any marks here. Another approach taken by some was to state that gametes are haploid and/or contain only 23 chromosomes so must only contain one allele of each gene; however, a very specific set of 23 chromosomes is needed if only one allele of each gene is to be present! The separation of the homologues and then of the sister chromatids ensures that the gamete contains the right set of 23 chromosomes. This level of detail is key to understanding the process of meiosis, although it should be noted that further detail of the stages of meiosis is not required in this specification.

haploid

(b) This man produces gametes. Each gamete contains only one allele of each gene.

Describe how each gamete receives only one allele of each gene.

(2)

Through meiosis. ~~First~~ At the first division the homologous chromosomes divide at the second division, the sister chromatids divide this means only one allele or one gene is passed on to each gamete.

ResultsPlus

Examiner Comments

This answer scored 2 marks with a clear description of the separation of the homologous chromosomes then the sister chromatids. However, this answer goes above and beyond the level of detail expected in this specification with reference to the first and second division, since details of the stages of meiosis are **not** required.

Question 8 (c)

This question uncovered some fairly fundamental misunderstandings of the way alleles are inherited and of the process of crossing over. The most common and serious misconceptions were:

- that dominant alleles are more likely to be passed on than recessive alleles

- that crossing over is more likely to occur than not (e.g. that e+K would be more likely to occur than E+K, since e+K would be produced through crossing over)

- that crossing over is more likely to occur between loci that are closer together (e.g. that H+i would be a more likely recombinant than e+K).

Another relatively common mistake made in the approach to the question was to talk in general terms about loci and crossing over without making reference to the specific context of the question. It was important for candidates to look at the particular combinations of alleles listed, with reference to the diagram, and ultimately to arrange them into a rank order of likelihood (relative chances). Many candidates were able to score some marks for a partial assessment, particularly bullet points 2 and 3 on the mark scheme, but few went so far as to give the complete rank order.

Assess the relative chances of this man's gametes containing these combinations of alleles.

(4)

E and K are linked, and h and i are linked, as they are on the same chromosomes as are another. This means that they will be passed on together unless crossing over occurs between them. This is unlikely in h and i as they are adjacent, but likely in E and K as they are far apart. This means that the combination of e and K is more likely than H and i. The most likely combination is h and i, and the least likely is H and i.

ResultsPlus
Examiner Comments

This answer scored 3 marks – and nearly managed to score all 4.Bullet point 1 is met from a combination of the first part of the answer and the last sentence.In lines 5-6 it is stated that h and i are closer together than E and K for the third bullet point on the mark scheme.This leads to the idea that e and K is more likely than H and i for the fourth bullet point on the mark scheme.

The candidate did not clearly state that e+K or H+i can result from crossing over, and did not conclude by giving the overall relative chances, which would have allowed this answer to score the full 4 marks.

Paper Summary

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

- Learn the meanings of the command terms for the new specification and make sure your answer matches the command term used in the question.
- Go through the mathematical appendix (found at the back of the specification document) and check that you remember how to carry out all of these calculations.
- When data are provided in a question, make sure you read them carefully and use them to inform your answer.
- If more than one set of data is provided, look for connections between the sets: you are likely to need to combine the information to give the best possible answer to the question.
- For an 'explain' question, explain your answer fully: at the end of each sentence, try asking yourself 'why?' and see if you could explain further.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx





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