Examiners' Report

Principal Examiner Feedback

November 2021

Pearson Edexcel GCE

In Biology A Salters Nuffiled (9BN0)

Paper 3: General and Practical Applications in Biology

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The 9BN0/03 Biology paper focused on the general and practical application of the Pearson Edexcel GCE Biology Specification A. Aspects of all topics area were considered and the paper included a series of question items linked to a pre-release scientific article. The paper included questions that targeted the conceptual and theoretical understanding of experimental methods, including mathematical analysis of experimental data.

The paper offered a wide diversity of question styles that gave students many opportunities to display their knowledge and understanding of material from across the whole specification. It allowed students to make connections from across the specification.

Incorrect interpretation of the wording of some questions and poor expression in many responses often resulted in students not gaining credit for responses. A number of students appeared to struggle to apply their knowledge to the unfamiliar scenarios that were presented. In some cases, students produce detailed answers that do not address the question in the context in which it is set. Often gaining little credit.

However, overall, it was most pleasing to see students offering a host of encouraging responses that showed a good understanding of the specification.

Successful students:

- demonstrated a familiarity with practical work and could devise investigations based on procedures they had carried out themselves;
- had studied the pre-released scientific article and read up on the aspects of biology within the article that they had encountered in their A-level Biology course;
- answered questions in the context set, showing that they had read the question;
- had learnt how to interpret the newly introduced command words – such as ‘determine’, ‘devise’ and ‘evaluate’;
- provided specific, relevant details to their answers;
- attempted every question;
- worked through calculations in a logical sequence, showing their working.

Less successful students:

- re-wrote information from the question, using up time and space;
- did not answer questions in context, missing both the command word and the context;
- did not understand how to interpret the command words and therefore misinterpreted questions;
- left out vital details or wrote vague answers lacking relevant facts;
- did not attempt some questions;
- made errors in calculations by not checking significant figures or the numbers in the data already provided;
- did not write clearly or legibly: there were occasions where marks may have been lost due to indecipherable handwriting;
- wrote answers with poor grammatical construction that lost marks where the meaning was ambiguous.

Implications for future teaching, learning and exam preparation – ensure that students carry out all of the core practicals and are involved in planning the procedures where there are variables that can

be controlled or taken into account as well as evaluation of the results. Statistical analysis of data collected will allow students to become familiar with the reasons for selecting and using particular tests and how the results can be interpreted. The pre-released scientific article has to be studied well, in advance of the examination – however, regular reading of articles from scientific journals and magazines will help students become familiar with how the style of writing differs from that in textbooks or revision guides.

1(a)

Many students made the link between magnesium ions, chlorophyll and photosynthesis and gained both marks. However, a significant number of students made simple suggestions such as 'magnesium is required for growth' and did not gain either mark.

1(b)

A number of reasonably complete answers were seen, and many students gained all four available marks. Marking point one was seen infrequently and marking point three was often poorly expressed. To gain marking point three students needed to refer to cells not the plant elongating Comments such as 'the side of the plant elongates' did not gain this marking point.

2(a)(i)

Students who recognised that this question was about post-transcriptional modification often gained both marks. A number of students gained no marks for an answer that described the role of the primary structure in determining the three-dimensional structure of a protein.

2(a)(ii)

Many students struggled with this question. When students produced credit worthy responses the most frequently observed marking points were MP2 and MP3. Very few students picked up on the idea of tissue specific expression and tried to address MP1. The question is about differential expression and so marking point 4 is about the turning on or off of transcription. Answers describing

the turning on or off of genes did not gain this mark.

The response below did not get MP4. The student has referred to genes and not transcription, being turned on or off.

(ii) Explain how the acetylcholinesterase gene can be expressed in some tissues but not others.

(3)

Some genes will be ~~are~~ turned on by activators

Some genes will be turned off meaning they are unactivated and will not be expressed.

2(b)

A number of good responses to this question were seen. MP 1, 2 and 3 were frequently observed. Relatively few students addressed MP4.

2(b)(ii)

This question was answered well by many students with all three marks being awarded.

3(a)(i)

Many students carried out the calculation correctly and gained both marks.

3(a)(ii)

A significant number of students did not read the question carefully. Instead of answering the question asked they answered a different question about the consequences of a lack of blood being delivered to muscles. These students often gained one mark (MP3). Those students answering the question asked often gained MP1 and 3. Many also gained MP2. Very few students commented on the difference between males and females MP4. Some students did not provide a complete comparison required for MP1. A statement such as 'beta-blockers reduced the heart rate' was not sufficient. Students needed to express the idea that as the dose of beta-blockers increased the heart rate decreased.

3(b)

This question was answered well by the majority of students.

3)(c)

Many students struggled with this question and ignored the information provided in the stem of the question. Often these students produced responses that started with receptors in the blood detecting changes in pH etc and then went on to describe the role of the cardiovascular centre and they frequently ignored adrenaline completely. The most frequently observed marking point was MP4. Often for a statement such as 'adrenaline is the fight or flight hormone and increases heart rate'.

The response below gained three marks, MP2, 3 and 4. The first two lines were ignored as not relevant to the question. Adrenaline binds to receptors on the SAN (MP2), increasing the rate of impulses (MP3) and increasing heart rate(MP4).

(c) Beta-blockers work by blocking the effects of a hormone called adrenaline.

Adrenaline is produced by the adrenal glands located on top of each kidney.

Adrenaline acts on the heart to cause changes in heart rate.

Deduce how adrenaline can cause a change in heart rate.

(4)

An impulse from the cardiovascular control centre travels along sympathetic neurones to the sino-atrial node (SAN), causing adrenaline to be released and to bind to receptors on the SAN, causing the SAN to ~~be~~ also increase the rate of impulses being produced, resulting in increased heart rate.

4(a)

All four marking points were frequently seen. However, in general students provided detailed descriptions of the data without trying to link the information and answer the question.

4(b)(i) and (ii)

Very few students appeared to know what is meant by the term Q_{10} temperature coefficient (core practical 12). This meant they failed to gain a mark for 4(b)(i) and struggled to gain marks for 4(b)(ii).

The response below was a good example of a response produced by a student who understands what Q10 is. This response gained MP1 (lines 1 and 6) for control of two suitable temperatures; MP3 for control of lipase concentration (stated concentration in line 4); MP4 for measurement of the triglyceride / fatty acid concentration at stated times (lines 8 to 10); The equation given on lines 14 and 15 was allowed for MP6. Although the equation should have referred to rates of reaction marking point 5 was for calculating or finding the rate of reaction. This response does not gain MP5 but it was felt that activity could be accepted in place of rate allowing MP6.

(ii) Devise an investigation to determine Q_{10} for an extract of lipoprotein lipase enzyme.

Q04bii

Have 2 temperatures, 5°C and 15°C. Take a 9cm³ sample of lipid (constant concentration) (e.g cholestrol) and places in 2 test tubes. Take a lipoprotein lipase solution (of 0.5mol dm⁻³) and drop 3 pipette drops into each. Place 1st test tube in an incubator at 5°C and the 2nd test tube in an incubator at 15°C. Record the triglyceride concentration and fatty acid concentration before and after 30 minutes in the incubator. The enzyme activity can be determined by the amount of triglyceride and fatty acid broken down in that 30 minutes. The

$Q_{10} =$ 15°C enzyme activity / 5°C enzyme activity

A higher enzyme activity will mean more lipid has been broken down in the time as lipid → 3 fatty acids + glycerol

(Total for Question 4 = 9 marks)

Q04_Tot

5(a)(i)

The question was answered well by most students. Some students confused abiotic and biotic and some appeared not to read the question and gave one example of each.

5(a)(ii)

Only a very small number of students were able to carry out the chi squared test correctly.

The starting point for the calculation is to find an expected value. Rather than find the mean of 16 and 10 most students selected either 16 or 10 as their expected value. On this occasion, If they then completed the calculation, they were allowed 1 mark.

The response below shows the correct calculation and gained all three marks.

(ii) Some of the results of the investigation are shown in the table.

Forest	Number of bird species in areas of the forest where no trees are cut down	Number of bird species in areas of the forest where some trees are cut down
A	35	19
B	16	10

Calculate the Chi-squared value (χ^2) for forest B using the formula shown.

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

(3) Q05a

$\frac{(16-13)^2}{13} = \frac{9}{13}$ $\frac{9}{13}$

Answer 1.38

$\frac{(10-13)^2}{13} = \frac{9}{13}$ $\frac{9}{13} + \frac{9}{13} = 1.38$ (35.6).

The response below shows the incorrect selection of an expected value. However, the calculation method was correct, and one mark was awarded.

(ii) Some of the results of the investigation are shown in the table.

Forest	Number of bird species in areas of the forest where no trees are cut down	Number of bird species in areas of the forest where some trees are cut down
A	35	19
B	16	10

Calculate the Chi-squared value (χ^2) for forest B using the formula shown.

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

(3)

$\frac{(16-10)^2}{10} = 3.6$

Answer 3.6

5(a)(iii)

Many students ignored the instruction to deduce the effect for both forests, 'in these two forests'. As a consequence, they often failed to gain any marks. Those students who answered the question in terms of both forests often gained two marks, generally MP2 and 3.

5(b(i)

The first response below, did not gain MP1. Marking point 1 is about replacing trees cut down and not simply planting more trees. Frequently, poor English skills can make it difficult to award marks. The second response below, was awarded MP1. Obviously replanting the trees that have been cut down will not work. However, on this occasion replanting was taken to mean plant new trees to replace those cut down allowing the award of the mark.

(b) Many forests are exploited by humans.

(i) Describe how forests can be managed as a sustainable resource.

(2)

Extra trees can be planted in the forest.

(b) Many forests are exploited by humans.

(i) Describe how forests can be managed as a sustainable resource.

(2)

By replanting any trees cut down and rotating each area of the forest used to allow for it to Regrow and recover.

5(b)(ii)

A pleasing number of students were able to provide complete answers and gained 3 or 4 marks. Some students focussed on the burning or decomposition of felled trees increasing CO2 and ignored the idea of less photosynthesis. However, if they completed the story, they could still gain 3 marks.

6(a)

Students did not use the information provided about all versions of tau being produced from the same gene. These students could not gain MP1 or 2. MP3 was frequently seen. MP4 was awarded less often. Generally, this was because students mentioned ligase or vector but did not link the idea of inserting tau DNA into the vector, as required for the mark. Many students finished their answer with the idea of putting the vector into a fly. This was not allowed for MP5. To gain this MP students needed to describe putting the vector into a relevant structure e.g. fertilised egg.

6(b)

Many students gained two marks (MP2 and 3). Relatively few students noted the general effect of aging MP1. This is an important point as the effects of tau need to be interpreted against the general age related change.

6(c)

Very few students gave answers in terms of frequency as asked in the question. On this occasion the mark scheme was adjusted to accept responses in terms of length of time between impulses. Even with this adjustment students struggled to answer this question. The 'Determine' command word requires students use elements of mathematical skills in order to gain full marks. MP2 and 4 required the use of level 2 maths skills (either by converting length of time into frequency or correct interpretation of error bars). MP1 was the only marking point that was frequently seen.

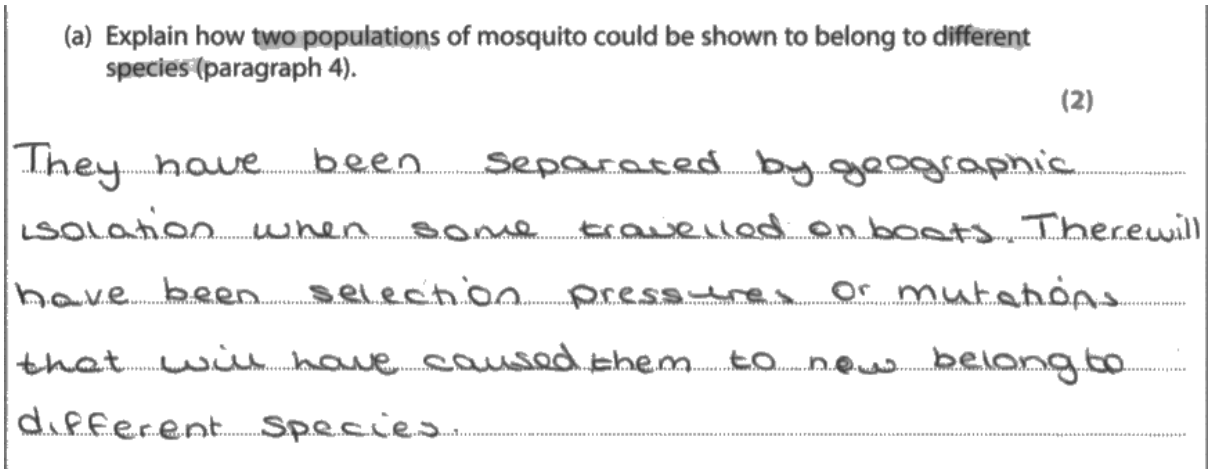
7 (levels based question).

Many students took information from the stimulus material provided but did not expand upon this information. These responses were restricted to level 1. A number of students successfully linked different examples from the stimulus material, their own biological knowledge and understanding to mitosis. However, they generally made little reference or made few links to meiosis. These responses were considered for level 2. A small number of students made good links between the resource information, their own biological knowledge and both mitosis and meiosis. These responses were considered for level 3.

8(a)

Many students gave an answer that gained both marking points. Some only gained MP2 because they did not explain i.e. they gave a definition with out actually doing a cross between two populations. For example 'different species cannot produce fertile offspring'.

Neither of the responses below answer the question. So both were awarded zero marks. The first response is about selection and speciation while the second response tells us why the two populations could be said to be from the same species.



(a) Explain how two populations of mosquito could be shown to belong to different species (paragraph 4).

(2)

They have been separated by geographic isolation when some travelled on boats. There will have been selection pressures or mutations that will have caused them to new belong to different species.

(a) Explain how two populations of mosquito could be shown to belong to different species (paragraph 4).

(2)

Through speciation.
If they can successfully reproduce with fertile offspring.

8(b)

Many students struggled with this question. Some were able to describe deletion of viral DNA, preventing virus replication and the slowing of destruction of white blood cells (MP3, 4 and 5). Most students did not think to tell us how the HIV gets its genome into human DNA and is therefore a target for CRISPR (MP1 and 2).

8(c)

This question was reasonably well done by many students. For MP3 the students had to suggest something reasonable to measure. Suggestions such as 'observing the effect of pests' did not gain MP3.

8(d)

Very few credit worthy response were observed. Students appeared to have little idea of what germ line refers to. This term is used in the pre-release article and it would be expected that students would find out what it means while studying the article.

8(e)

Some responses were seen that suggested students had an idea as to the role of an RNA guide. However, many students simply described the role of mRNA in translation.

8(f)

Many good responses to the question were seen with students gaining MP1 and 2. However, MP 3 was seen infrequently.

8(g)

The majority of students recognised that the virus might be transmitted by a different vector (MP4). Unfortunately, very few students tried to explain why a new vector might become available (MP1 to 3).

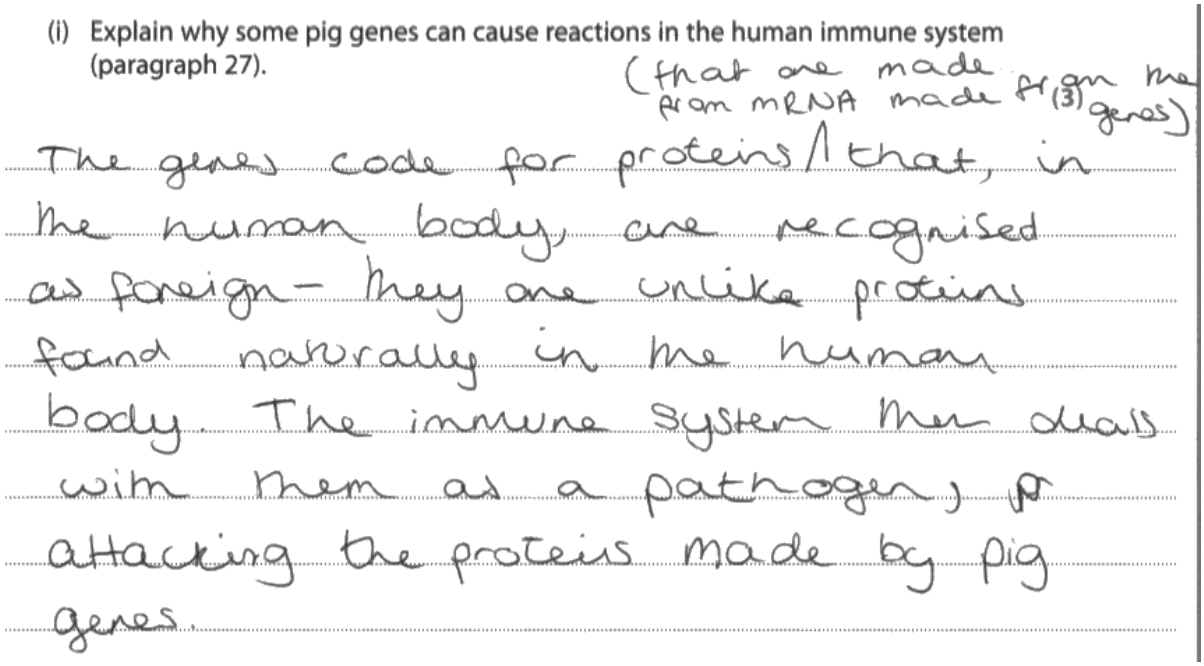
8(h)

A number of students gained both available marks for MP3 and 4. Very few students explained were the PERVS came from (MP1 and 2).

8(i)

Many students referred throughout their answer to the 'pig gene' as the antigen. These students were able to gain MP4 only. To gain MP1 to 3 students needed to recognise the genes need to be transcribed and translated (MP1) and that the proteins produced will be seen as foreign (MP2 and 3).

The response below is a good example that gained all three available marks.



(i) Explain why some pig genes can cause reactions in the human immune system (paragraph 27).

(that are made from mRNA made from pig genes) (3)

The genes code for proteins / that, in the human body, are recognised as foreign – they are unlike proteins found naturally in the human body. The immune system then deals with them as a pathogen, by attacking the proteins made by pig genes.

8(j)

A number of complete response were seen. Many students recognised that the two diseases were caused by the same organism (MP1) and that memory cells would provide life long immunity (MP4). Relatively few students explained how these memory cells were produced (MP2 and 3).

8(k)

The majority of students were able to state what the term endemic means.

8(l)

Many students were able to identify that the pattern of inheritance of Tay-Sachs disease was recessive.