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June 2017

GCE Biology 9BN0 01

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Introduction

This was the first paper of the revised GCE Biology 2017 specification A (SNAB). It tested the knowledge and understanding of six topics as well as the ability of candidates to use information provided in the context of these topics. The topics forming the basis of the assessment in this paper are:

- Lifestyle, Health and Risk
- Genes and Health
- Voice of the Genome
- Biodiversity and Natural Resources
- On the Wild Side
- Immunity, Infection and Forensics

There are significant differences between this paper and papers set in the previous specification. These include new command words, changes to the assessment objectives, increased mathematical demand and a longer examination paper. On the whole, candidates coped well with this paper, finding most of the questions accessible; indeed, there were very few examples of questions not being attempted at all, with all questions achieving the full spread of marks. The range of questions provided plenty of opportunity for candidates to demonstrate their grasp of these topics and their ability to process biological information.

It was pleasing to see how well many candidates could recall several areas of the specification in a good level of detail. Many candidates produced clear answers, set out in a logical style and used key biological terms appropriately.

Some candidates let themselves down by not reading the questions carefully enough, or by providing a response without the detail required at this level. Lack of clarity of expression was also a problem for a number of candidates.

Another change is to the philosophy behind the mark schemes. These have moved away from marking points which depend on spotting a word or phrase to a more holistic idea of what is required for a mark.

Question 1 (b)

Many candidates were able to produce a reasonable answer to this question. The main reasons for not gaining marks were poor expression and lack of clarity. For the second marking point, it had to be clear that it was the contents of the cortical granules that were released. Statements such as 'cortical granules are released into the zona pellucida' were not enough and did not gain this mark. Similarly, for marking point four candidates needed to make it clear that the the nuclei fuse or that they join to form a diploid nucleus. Statements such as 'sperm and egg nuclei join together' were not sufficiently clear to gain the mark. Numerous incorrect references to lysozyme, lysosomes and vesicles containing cortical granules were seen.

(b) Describe the events of fertilisation that occur after the acrosome reaction.

(3)

The cortical reaction occurs where the sperm cell [illegible] head fuses with secondary oocyte membrane triggering it to release cortical granules from vesicles. This causes the zona pellucida to thicken, preventing other sperm cells from entering/penetrating the ~~own~~ goes on allowing membrane. The head of the sperm cell ~~and the head of~~ and the nuclei of the sperm cell and the ovum to fuse.

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Examiner Comments

For this response the candidate gained all three available marks. Bullet point one was given in lines 1 and 2, bullet point 3 in lines 3 and 4, and bullet point 4 in the last line.

Note that 'release of cortical granules' line 3 was not sufficient for bullet point 2.

Question 2 (a)

Many candidates produced complete answers that gained all three marking points. However, a number did not answer the question: it asks candidates to explain how phospholipids form a membrane. Many simply described the arrangement of phospholipids in the membrane, only gaining marking point three. To gain marking points one and two candidates need to describe how the hydrophilic heads associate with water and how the hydrophilic tails avoid/repel water. Terms such as 'water loving' and 'water hating' were ignored and statements such as 'phospholipids have a hydrophilic head and a hydrophobic tail' were not considered sufficient for bullet points 1 and 2.

2 All cells have a cell surface membrane.

(a) Explain how phospholipids form a cell surface membrane.

(3)

- phospholipids have a hydrophillic phosphate head which is 'water loving'
- they have 2 hydrophillic fatty acid tails which are 'water hating'
- phosphate heads are organised by on the facing the outside and inside of the cell where water is
- a bilayer of phospholipids is formed so hydrophillic tails are not in contact with the water.

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Examiner Comments

This response gained one mark, bullet point 3 (BP3).

The candidate has not explained how the phospholipids form a bilayer. Lines 1 to 4 describe the structure of the phospholipids but do not explain the role of the structures in forming a bilayer. Lines 5 – 8 describe the arrangement of phospholipids in the bilayer and gain BP3.

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Examiner Tip

Pay attention to command words, especially when a question is on a familiar topic. It is very easy to answer a different question from the one asked. Many candidates answered this question by describing the structure of membranes in great detail – rather than **explain how** phospholipids form a cell membrane.

Question 2 (c) (i)

Many candidates gained full marks for this question. However, some appeared not to read the question carefully and provided detailed accounts that included everything they knew about mutations in the CFTR gene and cystic fibrosis. For example, references to the effects of CFTR mutations were frequently seen but were not relevant to the question so gained no marks. A number of candidates confused the mechanism by which chloride ions enter cells with the role of the CFTR protein in allowing chloride ions to diffuse out of the cells. Descriptions of chloride ions being pumped out of cells or chloride ions moving in and out of cells via the CFTR protein were not accepted.

(i) Describe the role of the CFTR protein in ensuring that the mucus produced in the lungs has the right consistency.

(3)

Chloride ions are transported across the membrane

Sodium ions are pumped ~~out~~ into the cell down the concentration gradient.

This draws more water into the mucus, preventing it from being 'too sticky'

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Examiner Comments

This response gained no marks. The first statement makes no reference to the role of the CFTR protein. It is also a little ambiguous, implying that movement of the chloride ions is an active process. So, BP1 could not be awarded. Lines 3 and 4 describe the transport of sodium ions into the cell and do not gain BP2. Lines 5 onwards describe the movement of water but do not make reference to osmosis and do not gain BP4.

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Examiner Tip

Make sure that you provide clear and complete responses. These should include appropriate reference to key terms used in the question, e.g. CFTR protein, and use appropriate technical words, e.g. osmosis.

CFTR protein allows Cl^- ions to move out of epithelial cells and into the mucus. This means that if there is too little water in the mucus (too sticky) Cl^- move from epithelial cell into the epithelial cell and into the mucus, this charge difference cause Na^+ to move into the mucus by diffusion from epithelial. High concentration of Na^+ draw water out of cell by osmosis into the mucus. Without CFTR protein the chain to get more water into the mucus would not happen.

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Examiner Comments

This is an example of a good response that gained a maximum of three available marks. Bullet point one (line 1), bullet point 2 (lines 5 and 6), bullet point 3 (lines 6 and 7) and bullet point 4 (line 7).

Question 2 (c) (ii)

Many candidates gained one or two marks for this question. Most often, bullet points 1 and 3. The question asks candidates to explain how information provided demonstrates the nature of the genetic code. Bullet point 1 was awarded for a simple statement such as 'three bases code for each amino acid'. However, to gain bullet points two and three candidates needed to use information from the table. While a number of candidates did this to gain bullet point 3, few managed to gain bullet point 2. Many candidates did not gain marks because they made reference to codons without giving any clear idea that they were describing three bases.

(ii) The table shows part of the gene that codes for the CFTR protein and the corresponding amino acid sequence. Each amino acid is represented by a single letter.

Part of the CFTR gene	ATT	AAA	GAA	AAT	ATC	ATC	TTT	GGT	GTT	TCC	TAT
Amino acid sequence	I	K	E	N	I	I	F	G	V	S	Y

Explain how the information in the table demonstrates the nature of the genetic code.

(3)

The table shows that the genetic code is non-overlapping. Each triplet codon in the gene codes for only one amino acid.
The table also shows that the genetic code is degenerate. One amino acid can be coded for by more than one triplet codon. Amino acid 'I' can be coded for by ATT or by ATC.

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Examiner Comments

This response gained one mark (bullet point 3).

In lines 1 and 2, the candidate did not use the information provided to demonstrate the non-overlapping nature of the code so bullet point 2 could not be awarded.

Reference to 'each triplet codon in the gene' was not sufficient so bullet point 1 was not awarded for lines 2 to 3. It needed to be clear that three bases are required to code for each amino acid.

The penultimate sentence was ignored and bullet point 3 was awarded for lines 4 to 7.

Genetic code is a triplet code so 3 bases code for an amino acid, for example here ATT codes for the amino acid I. Genetic code is non overlapping so one base is not in two codons at one time, they are read adjacent to eachother e.g. ATT, AAA codes for I then K. Genetic code is degenerate so more than one codon can code for the same amino acid. Here ATT and ATC both code for I.

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Examiner Comments

This is an example of a good response that gained all three available marks. Bullet point 1 (lines 1 to 3), bullet point 2 (lines 3 to 5) and bullet point 3 (lines 6 to 8). Notice that the candidate has followed the instructions in the question to explain how the information demonstrates the nature of the genetic code.

ResultsPlus
Examiner Tip

Make sure you understand what you are being asked to do before answering a question. This means you need to read the question carefully paying attention to any instructions and to the command words.

Question 3 (a)

Most candidates made a reasonable attempt at this question. Common mistakes included descriptions of loops and coils which were not accepted for bullet point 1. Statements such as 'bacteria contain plasmids made from circular DNA' were only awarded bullet point 3. To gain bullet point 1, it has to be clear that the circular DNA being described is different to plasmids. So 'bacteria contain circular DNA' with no mention of plasmids would be awarded one mark, and 'bacteria contain circular DNA as well as plasmids' would gain two marks. However, 'bacteria contain plasmids made from circular DNA' would only gain one mark. A number of candidates described bacterial DNA as being 'single stranded in contrast to animal DNA which is double stranded' – a misconception.

3 DNA synthesis in bacterial cell cultures has been investigated.

(a) Describe how DNA is organised in a bacterial cell.

(3)

Bacterial DNA is circular. The main circle of DNA is bundled together within the bacterial cell (not in a nucleus as in animal cells). Further DNA is organised into plasmids (small circles of bacterial DNA).

ResultsPlus
Examiner Comments

This response gained all three available marks. Bullet point 1 (lines 1 and 2), bullet point 4 (lines 3 and 4) and bullet point 3 (lines 5 and 6).

Question 3 (b) (i)

Candidates generally coped well with this calculation of a rate. The main reason for not gaining both marks was for the omission of units with the final answer.

Because candidates needed to judge where to draw a gradient, answers between 1.6 and 2 au min^{-1} were accepted.

(i) Calculate the fastest rate of uptake of bases by these bacteria.

(2)

30 62

62 − 30

85 − 65

Answer 1·6

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Examiner Comments

This response gained one mark. The numerical value calculated was correct but the candidate did not include any units.

ResultsPlus
Examiner Tip

Always provide suitable units with the answers to a calculation.

Question 3 (b) (ii)

Candidates thinking about this question and part (b)(iii) realised that thymine is incorporated into DNA and not RNA so gained bullet point 1. Some went on to explain why this would improve the experiment. Many candidates did not appreciate the significance of thymine. Some candidates produced answers focussing on determining the ratios of thymine to adenine while others made statements about improved specificity or accuracy.

(ii) Deduce how many times the bacteria in the culture have divided during this experiment.

(2)

Divided twice, once between 10-30 minutes and again between 65 and 85 minutes.

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Examiner Comments

In this response, the candidate correctly suggests the bacteria divided twice and gains one mark (BP1). However, instead of then explaining why this was the case they describe when the bacteria were dividing. To gain the second mark they need to explain why they could say the bacteria were dividing twice, e.g. because there were two periods of increase in base uptake.

Two times because there has been 2 significant increases in the amount of radioactive bases incorporated into the DNA, meaning that the DNA has been replicated 2 times, so have therefore divided 2 times.

ResultsPlus
Examiner Comments

This response gained both available marks.

Question 3 (b) (iii)

Candidates thinking about the question realised that thymine is incorporated into DNA and not RNA so gained bullet point 1. Some went on to explain why this would improve the experiment. Many candidates did not appreciate the significance of thymine. Some candidates produced answers focussing on determining the ratios of thymine to adenine while others made statements about improved specificity or accuracy.

(iii) Explain why the experiment would be improved if all the bases were provided but only the thymine was radioactive.

(2)

Thymine is only present in DNA and not in [redacted] RNA as RNA contains Uracil instead. It would also us to distinguish between DNA and RNA

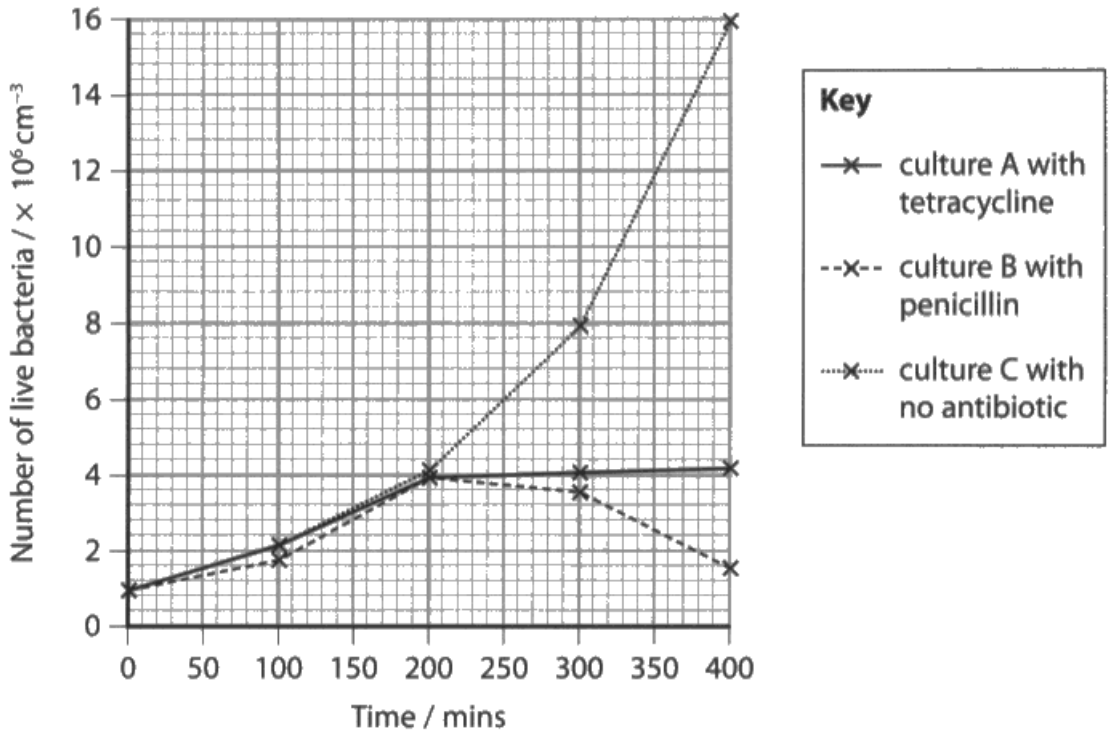
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Examiner Comments

This response gained both marks. The second sentence was accepted for bullet point 3.

Question 3 (c)

This question proved straightforward for many candidates and both marks were frequently awarded.

The results of the experiment are shown in the graph.



Deduce the effects of these antibiotics on the growth of the bacterial cultures.

(2)

- Antibiotic tetracycline inhibited growth/ reproduction of bacteria (Bacteriostatic)
- Antibiotic penicillin killed/destroyed bacteria (perhaps by disrupting bacterial membranes) = Bactericidal

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Examiner Comments

In this response, the candidate has clearly identified tetracycline as a bacteriostatic antibiotic and penicillin as a bactericidal antibiotic, and gains both marks. The description of penicillin killing bacteria would also have been accepted for bullet point 2. However, the description of tetracycline inhibiting growth of bacteria, would by itself not have been sufficient for bullet point 1.

Question 4 (a)

The majority of candidates found this question straight forward and produced complete answers gaining 4 or 5 marks. Many candidates included detailed descriptions of chemiosmosis which was not required. A number of candidates described hydrogen or hydrogen atoms, rather than hydrogen ions, as a product of photolysis and there was some confusion between the role of hydrogen ions and electrons.

4 Photosynthesis is a two-stage process by which plants fix carbon dioxide.

(a) Describe the light-dependent reactions of photosynthesis.

(5)

Energy from light excites two electrons in each of the photosystems PSI and PSII to a higher energy wave level. This leaves the photosystems in an excited state. Electrons from PSI move from one electron carrier to the other in a series of oxidation and reduction reactions, losing energy in the process. This energy is used in the synthesis of ATP. Electrons lost from PSI are replaced by electrons from PSII. Electrons in PSII must be replaced to keep the flow of electrons going. within the thylakoid space an enzyme catalyses the splitting of water into electrons, H^+ and oxygen. These electrons replace those lost in PSI so it is no longer positively charged. The H^+ combines with the co-enzyme NADP to form reduced NADP. ATP and reduced NADP formed in the light dependent reaction are both used in the light independent reaction.

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Examiner Comments

In this response the candidate has provided a reasonably complete description of the light dependent reactions gaining all five marks. BP1 (line 1), BP3 (lines 3 to 5), BP4 (lines 5 and 6), BP2 (lines 9 and 10) and BP5 (line 11).

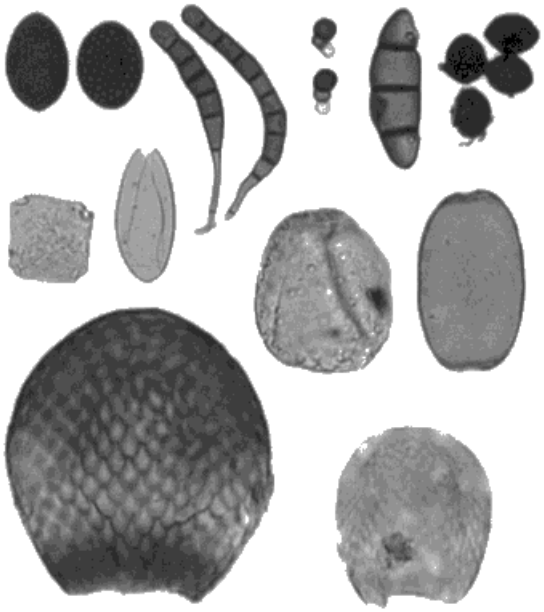
Question 5 (a)

This question proved challenging for many candidates. Bullet point one was frequently awarded. However, the other bullet points were less easy to achieve; this was mostly due to a lack of clarity in the answers.

To gain bullet point two, it needed to be clear that pollen present in peat bogs could be used to identify plant species. 'The sort of plants present can be identified from the pollen' was not enough. Similarly, for bullet point 2 candidates had to clearly link climate to the type/ species of plants growing. The question asks about climate change, so linking the type of plants growing to the weather or abiotic factors was not enough. Many candidates provided no idea about how depth correlates to time since the pollen was deposited (bullet point four) – often simply describing pollen being found in layers of peat. Although a number of candidates made statements such as 'the pollen present indicates the climate' they failed to express the idea that a change in pollen shows a change in climate, so did not gain the last bullet point.

5 Climate change has been correlated with changing atmospheric carbon dioxide levels.

(a) Scientists studying climate change have examined peat bogs to observe pollen grains such as those shown in the photograph.



Explain how studying pollen grains in peat bogs can provide evidence of climate change.

(4)

pollen grain get preserved in peat bogs. Peat bogs accumulate in layers so the age of the preserved pollen increases with depth. Scientists can take cores of peat bogs, extract the pollen grains from each aged layer, and identify the plant species came from. Doing this they can

identify which plants were successful at the time because only mature plants produce pollen. Scientists know what ~~them~~ climate plant species live in now, so by identifying similar plant species in the peat bog they can conclude that those plants lived in similar climates. An increasing trend of plant species that are successful in warmer climates shows a trend of increasing temperatures. This shows evidence for global warming which is a type of climate change.

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Examiner Comments

This is an example of a complete response that gained the maximum of four marks but provided evidence for all five bullet points. BP1 (line 1), BP4 (lines 2 and 3), BP2 (lines 4 and 5), BP3 (lines 8 to 10) and BP5 (lines 10 to 13).

Question 5 (b) (i)

Many candidates realised they need to determine the values for respiration and then completed the percentage increase calculation correctly. A number calculated a percentage decrease rather than the percentage increase. Candidates calculating a percentage decrease without showing their workings often failed to gain any marks.

Type of forest	Mean NPP / gC m^{-2} y^{-1}	Mean GPP / gC m^{-2} y^{-1}	Ratio of NPP to GPP
Boreal	322	1013	0.32
Temperate deciduous	1301	2165	0.60

(i) Calculate the percentage increase in mass of carbon released due to respiration by temperate deciduous forests compared with that by boreal forests.

(3)

NPP = GPP − R
NPP − GPP = R
322 −
1013 − 322 = 691
1301 − 2165 = 864
R = GPP − NPP
NPP = GPP − R
864 − 691
= 173
173 / 691 × 100 =
25 %

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Examiner Comments

In this response, the candidate gained all three marks for the correct answer. If the final answer had been incorrect both working marks could have been awarded as the candidate has clearly shown the calculation of respiration for both forests (BP1) and correct values selected for the percentage calculation (BP2).

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Examiner Tip

Make sure you complete calculations in an organised way and always show your workings.

Question 5 (b) (ii)

A large number of candidates were awarded two marks (BP1 and 2). Few candidates went on to gain the third mark (BP3). To gain the first bullet point candidates had to refer to the difference in ratio. Responses in which candidates simply quoted values from the table without making a comparison did not gain this mark.

(ii) The ratio of net primary productivity to gross primary productivity is a measure of the ability of forests to transfer carbon from the atmosphere into biomass.

Scientists concluded that temperate deciduous forests would reduce levels of carbon dioxide in the atmosphere more than boreal forests.

Justify this conclusion.

(3)

This conclusion is correct because the ratio of NPP to GPP is higher in Temperate Deciduous forests than Boreal forests which means temperate deciduous forests are faster/more efficient at transferring carbon from the atmosphere into biomass. This results in a reduction of CO_2 levels in the atmosphere as the CO_2 is taken in and the carbon is incorporated into plant tissue. The ratio of NPP to GPP of temperate deciduous is almost double that of boreal forests showing that they will reduce CO_2 levels in the atmosphere more than boreal forests.

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Examiner Comments

In this response the candidate has gained two marks (BP1 and 2).

Question 6 (a) (iii)

Many candidates tried to link this question to the shape of the graph in part (i) and (ii), often producing descriptions of changes in substrate concentration as the reaction proceeds. Those candidates that answered the question asked generally gained one mark (BP1). Some candidates then went on to gain BP2. Since no particular direction to the change in initial rate is given in the question, a particular change in initial rate of reaction needed to be linked to an effect on rate. A number did not gain the second mark if they did not refer to a reduced rate of production of fibrin. For example 'less fibrin is produced' was not accepted.

(iii) Explain the effect of changes in the initial rate of reaction on the time taken for a blood clot to form.

(2)

~~the more fast~~ it would take a longer time for the blood clot to form as it would take longer for the mesh of insoluble fibrinogen to form

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Examiner Comments

This response gained no marks. The candidate has not linked time taken for a blood clot to form to the initial rate of reaction so bullet point one cannot be awarded.

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Examiner Tip

Make sure your answers are complete and that they cannot be interpreted in different ways.

~~Reduction~~ Reducing the initial rate of reaction will ~~decrease the time for~~ increase the time taken for a blood clot to form. Fibrin is insoluble, forms a mesh that traps blood cells & forms a clot. Slow initial rate, the slower the conversion of fibrinogen to fibrin, the less fibrin, so less mesh to trap blood & form a clot, so ~~clot~~ blood will clot more slowly. Fibrinogen is soluble.

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Examiner Comments

This response gained both marks.

Question 6 (a) (i) – (ii)

This question included a calculation and drawing a line on a graph.

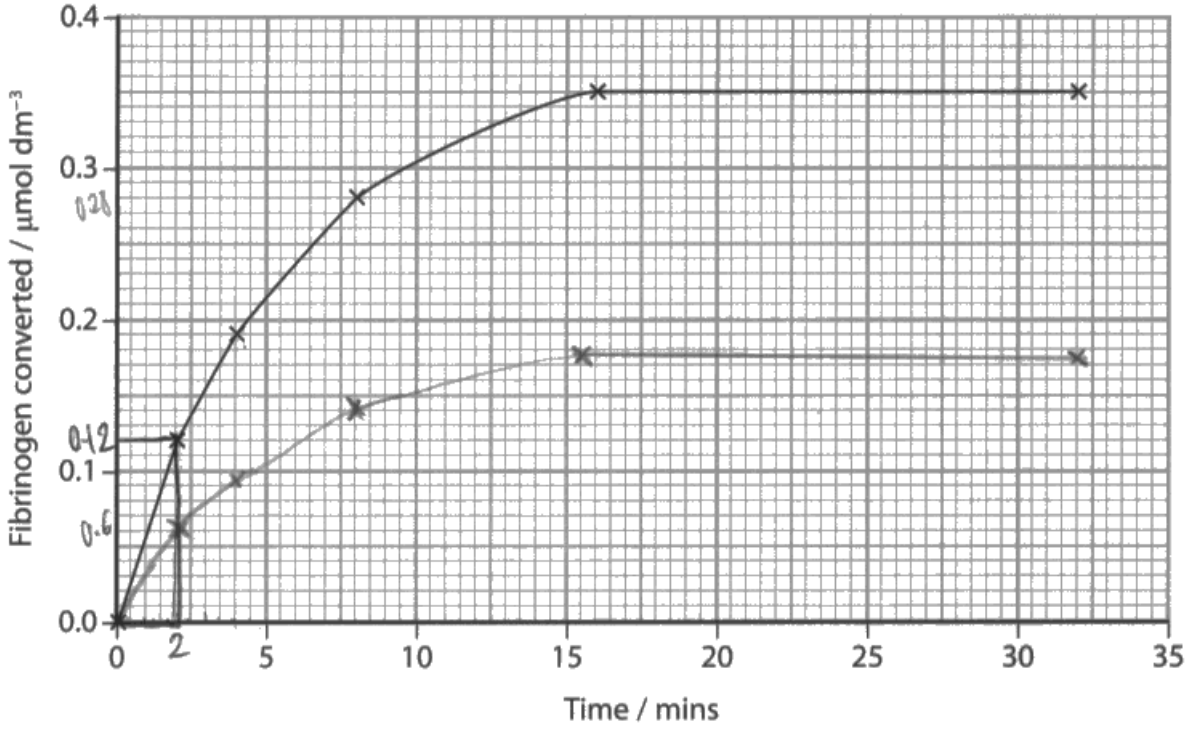
The calculation proved straightforward for candidates who knew the initial rate is determined by measuring the gradient at the start of the reaction. Obtaining the values from the graph was straight forward and no margin of error was allowed.

The second part of the question proved more challenging with the majority of candidates incorrectly drawing a curve that plateaued below that of the original curve.

6 Fibrin is involved in the formation of blood clots.

Thrombin is an enzyme that converts fibrinogen to fibrin.

(a) The graph shows the effect of one concentration of thrombin on the conversion of fibrinogen to fibrin.



(i) Calculate the initial rate of reaction.

(2)

$\frac{y}{x}$ $\frac{0.12}{2} = 0.06$

Answer 0.06 μmol dm^{-3}/mins

(ii) On the graph, draw a line to show the effect of halving the concentration of thrombin.

$\frac{0.6}{2} =$ (1)

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Examiner Comments

A correct calculation for part (i) gains both marks. The curve drawn on the graph is incorrect so a mark was not awarded for part (ii).

Question 6 (b) (i)

Many students identified that those with CVD had a higher fibrinogen concentration than those without CVD (BP1). Some candidates then went on to gain a second mark (BP2). Relatively few candidates gained a third mark (BP3). To gain bullet point 2 some comparison to the values in the table needed to be made. To gain bullet point 3 it needed to be clear that it was the with and without CVD error bars that did not overlap.

(b) The table shows the results of an investigation into the fibrinogen concentrations in the blood of males and females with and without cardiovascular disease (CVD).

	Mean fibrinogen concentration / mg 100 cm^{-3}	
	With CVD	Without CVD
Males	333 ± 5.16	322 ± 2.00
Females	336 ± 7.25	319 ± 1.89

327·84 328·75 324 320·89.

(i) Explain how the results of this investigation could be used to identify individuals at risk of CVD.

(3)

The mean fibrinogen concentration is higher in both males and females who have CVD in comparison to those who don't. Blood samples could be taken from patients and ~~th~~ their readings ~~de~~ within these compared against this table. The standard deviations are quite large for people with CVD, however there is no overlap in the values with/without.

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Examiner Comments

The candidate was awarded three marks for this response: BP1 (lines 1 and 2), BP2 (lines 3 and 4) and BP3 (last two lines). The last two lines was considered just sufficient for bullet point 3. In the context of the sentence 'with/without' was read as with/without CVD. If the first part of the sentence, referring to CVD, had been missing then the mark would not have been awarded.

Question 6 (b) (ii)

Many candidates saw this question as an opportunity to write at length about cardiovascular disease – particularly atherosclerosis. The question asks about why a high concentration of fibrinogen in the blood might be a risk factor for CVD. Many candidates did gain one or two marks from bullet points 1, 2 and 3. For bullet point 4, it was necessary to identify that it was the blood supply to heart tissue, and not simply to the heart: this was less frequently seen.

(ii) Explain how changes in fibrinogen concentration might be a risk factor for CVD.

(3)

Increased concentrations of fibrinogen will relate to levels of fibrin and so the likelihood of blood clots forming within the blood.

Because CVD can be as a result of high cholesterol we are more likely to see cholesterol build up in the arteries of someone with CVD (atherosclerosis) which can break and trigger thrombosis which fixes the damaged epithelial cells of the artery.

Increased levels of fibrin in the blood can ~~external~~ increase the size of the blood clot within the artery and so decreasing lumen size. While decreased concentrations could mean that damaged epithelial cells can not be fixed as a result of a clot

Increasing blood pressure.

(Total for Question 6 = 11 marks)

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Examiner Comments

This response was given one mark (BP2).

Lines 1 to 3 did not gain any marks – the candidate has not said what high concentrations of fibrinogen will do.

Lines 4 to 9 describe events in atherosclerosis and are not relevant to this question and do not gain any marks.

Lines 10 to 12 gained one mark (BP2).

Decreased lumen was not accepted for bullet point 3. A decrease in lumen is a feature of plaques in atherosclerosis and is not relevant to this question.

Question 7 (a) (i)

The majority of candidates had little idea about the structure of collagen. Many gave generic descriptions of proteins or described the collagen layer in blood vessels.

7 In birds and mammals, gas exchange takes place between the blood in the capillaries and the air in the alveoli.

There are three layers between the blood and the air in the alveoli: the capillary wall, a layer of extracellular matrix and the alveolar wall. This is called the blood-gas barrier.

(a) The extracellular matrix contains collagen.

(i) Describe the structure of collagen.

(3)

Collagen is a fibrous protein. ~~this~~ ~~reads~~ This means the polypeptide chain has a secondary structure forming ~~a~~ single, strong, flexible strands ~~of~~ of protein. Collagen is insoluble and thus structural. Collagen can form bundles increasing its strength.

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Examiner Comments

This response did not gain any marks. The candidate has made some vague comments about the structure of collagen and has included some additional comments about the properties of collagen which are not relevant.

7 In birds and mammals, gas exchange takes place between the blood in the capillaries and the air in the alveoli.

There are three layers between the blood and the air in the alveoli: the capillary wall, a layer of extracellular matrix and the alveolar wall. This is called the blood-gas barrier.

(a) The extracellular matrix contains collagen.

(i) Describe the structure of collagen.

(3)

collagen is a type of fibrous protein, which means it remains long, linear, rather than compact + coiled. Each 3rd amino acid in collagen is glycine. It made from 3 polypeptide chains, meaning is a quaternary protein - more than one polypeptide chain. These form covalent cross-links with each other to ensure strength, and the 3 chains of polypeptide are coiled to right around one another. It is comprised of 2 alpha (α_1) helices, and 1 alpha α_2 helices, very strong and durable. Thus is a structural protein.

ResultsPlus
Examiner Comments

In this response the candidate provides a good description of the structure of collagen that gains all three marks.

Question 7 (a) (ii)

Candidates who knew what collagen was were able to suggest that it provided strength or flexibility to the gas exchange surface. Many candidates provided incorrect suggestions: some confused collagen with elastic fibres and suggested its function was stretch and recoil; others suggested it provides a semi permeable exchange surface or that it stopped blood and air mixing.

(ii) Give a function for collagen in the blood-gas barrier.

(1)

for strength to hold to walls together.

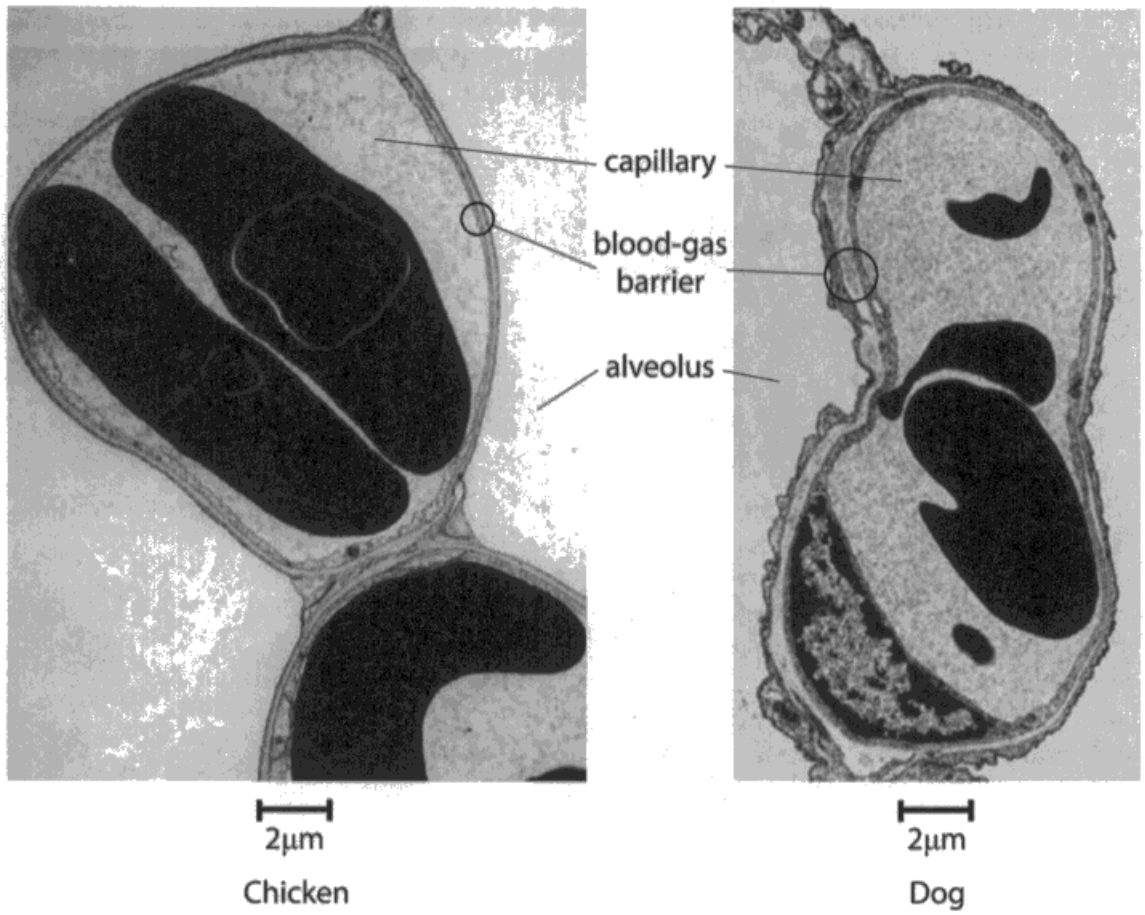
ResultsPlus
Examiner Comments

This response gained the mark for the first part of the response. The second part of the response 'to hold the walls together' would not have been quite enough by itself. Candidates needed to say which walls were being held together to gain the mark.

Question 7 (b)

This question was answered well by the majority of candidates. Reasons for not gaining full marks often involved poor expression: for example, 'smaller blood gas barrier' was not accepted for bullet point 1. Candidates had to express the idea of a faster rate of diffusion for bullet point 4. 'Resulting in more efficient gas exchange,' for example, was not accepted as it is in the stem of the question. Bullet point 2 was less frequently awarded than the others.

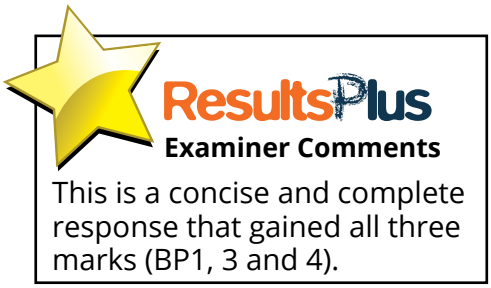
(b) The electron micrographs show the blood-gas barriers for a chicken and a dog.



Explain how the blood-gas barrier of the chicken is adapted to give more efficient gas exchange than the blood-gas barrier of the dog.

(3)

Blood-gas barrier of the chicken is a lot thinner than that of the dog's, giving the substances a much shorter diffusion pathway - increasing the rate of diffusion, and therefore, the rate of gaseous exchange.


ResultsPlus
Examiner Comments
This is a concise and complete response that gained all three marks (BP1, 3 and 4).

Question 8 (a) (i)

Most candidates scored either 0 or 2 marks for this question. Candidates who thought about the data generally gained two marks for BP1 and 2. A small number went on to gain a third mark for BP3 or 4.

Many candidates simply picked the data apart, describing each strain individually and gained no marks. There are very few marks available for simple descriptions of individual data points.

8 Human papilloma virus (HPV) is a DNA virus.

(a) Some strains of HPV are sexually transmitted and can cause cervical cancer or genital warts.

The table shows some information about the conditions associated with four strains of HPV.

HPV strain	Condition associated with the strain	Percentage of all cases caused by the strain (%)
6	cervical cancer	<1
	genital warts	67
11	cervical cancer	<1
	genital warts	22
16	cervical cancer	55
	genital warts	<1
18	cervical cancer	13
	genital warts	<1

(i) Comment on the relationship between HPV and these two conditions.

(3)

HPV strain 6 or 11 is much more likely to cause genital warts than cancer especially strain 6 as 67% of genital warts cases are caused by ~~the~~ & HPV strain 6. And HPV strains 16 and 18 are much more likely to cause ~~cervi~~ cervical cancer than genital warts.

overall HPV is more likely to cause ~~genet~~ genital warts than cervical cancer as roughly 89% of genital warts are caused by a strain of HPV but only 68% of cervical cancer cases are ~~cas~~ caused by an HPV strain

ResultsPlus

Examiner Comments

In this response, the candidate has addressed all four bullet points and gained the maximum of three marks: bullet point 2 (lines 1 and 2), bullet point 1 (lines 3 and 4) and bullet points 3 and 4 (lines 5 to 7).

Question 8 (a) (ii)

Candidates who understood what a vaccine was could access this question and gain two or three marks. A significant number of candidates described vaccines as treating cervical cancer or genital warts and did not gain marks for bullet points 2 to 4. Some candidates focussed on the composition of the vaccines (BP1) and the strains of virus they would protect against (BP2) and then failed to link this to the conditions the particular strains of HPV are linked to (BP3 and 4).

(ii) The table shows two vaccines developed from different combinations of HPV.

Vaccine	Strains of HPV used in development of the vaccine
Cervarix	16 and 18
Guardasil	6, 11, 16 and 18

Analyse all the data to explain why the Guardasil vaccine is preferred to the Cervarix vaccine.

(4)

Guardasil contains antigens from all 4 strains and so will provide immunity against all 4 strains. Cervoxil will only provide immunity against 16 & 18 and so will decreases ~~your~~ the chance of getting cervical cancer but will not protect you again HPV strain 6 or 11 which could cause genital warts. Whereas guardasil will decrease the chance of contracting cervical cancer & genital warts

ResultsPlus
Examiner Comments

This response gained all four available marks. Bullet point 1 (line 1), BP2 (line 2 or 3), BP3 and 4 (line 4 to 8).

ResultsPlus
Examiner Tip

Vocabulary matters when answering questions. Many candidates did not gain bullet point 3 or 4 because they described the effect of vaccination as 'curing genital warts' or 'curing cervical cancer'. Curing implies something very different to preventing or protecting from.

Question 8 (b)

This question asks specifically about the role of T cells in a person who has been immunised with a particular vaccine when they are subsequently infected with a particular strain of HPV. Most candidates instead produced as complete a description of the immune response as they could, often with no mention of HPV16 or even virus. Many references to HPV infecting white cells and to bacteria were seen. Many candidates described the role of macrophages as antigen presenting cells and of B cells in antibody production in detail.

(b) Cervarix and Guardasil have been used in national vaccination programs.

A person who has been vaccinated becomes infected with HPV-16. Explain the role of the T cells in the body of this person.

(3)

T-Cells will bind receptors to antigens on the antigen presenting cell, this ~~cell~~ forms a complementary complex which activates T- cells to make T- killer cells and T- memory cells. T-killer cells destroy cells which have been infected by HPV -16 to prevent further replication and spreading. T-Memory cells stay in the body for a secondary response if the body is infected by the virus for a second time. T-Helper cells are also produced which activate B- cells, B- cells bind to antigens to form antibodies which kill the virus.

ResultsPlus

Examiner Comments

The candidate gained three marks for this response. The question was about T cells and this response describes the role of each of the three main types of T cell: T memory cells (line 6 and 7), T helper cells (lines 8 to 10) and T killer cells (lines 4 to 6).

The description of the T cell recognising antigen on antigen presenting cell was not linked to HPV-16 so would not have gained bullet point 2.

Question 8 (c) (ii)

Many candidates had a reasonable understanding of the meaning of the term sex linkage. Bullet point 1 was most frequently awarded and a reasonable number of candidates then went on to gain bullet point 2. A number of candidates appeared unclear as to what sex linkage was, often suggesting it described the inheritance of two genes close together on a sex chromosome.

(ii) State what is meant by the term **sex-linkage**.

(2)

sex linkage is when a gene is found on a ~~the~~ locus on one of the sex chromosomes (XX, XY) so its phenotype is often determined by gender. Recessive phenotypes ~~from~~ are sex linked genes are more likely to be expressed by males.

ResultsPlus

Examiner Comments

This is an example of a response that gained both marks for a clear explanation of sex linkage: bullet point 1 (lines 1 and 2) and bullet point 2 (lines 3 to 5).

Question 9 (a)

The majority of candidates struggled to interpret the data provided in this question. The most frequently awarded mark was for bullet point 1. In the better responses, candidates commented on the change in carbon and nitrogen levels over the course of the 90 days, and some managed to reach an overall conclusion (bullet point 4).

Question 9 (b)

This was a levels-based question in which candidates were asked to devise an investigation to study succession in a compost heap. Very few candidates produced a realistic method for demonstrating succession.

Candidates struggled with this question from several perspectives such as:

- knowing how to carry out an ecological study;
- making the link between the compost heap and decomposers;
- understanding of the concept of succession.

Many candidates were setting up multiple compost heaps with different C:N ratios, using quadrats and counting the species and numbers of plants. Some were setting up experiments in beakers or test tubes. Very few candidates suggested a suitable method of demonstrating succession had taken place, e.g through use of a suitable statistical test, or kite diagrams.

There were many generic comments such as: set up five (compost heaps), control other variables, record results in a table and repeat three times. Statements needed to be tied into to the context of the question to move beyond level 1.

*(b) The changes in the compost heaps are due to the activity of decomposers and other organisms.

Devise an investigation to determine the effect of the carbon to nitrogen ratio on the succession of species in these compost heaps.

(6)

Independent Variable : Carbon to nitrogen ratio.

Dependent Variable : Succession of species.

First control other variables, compost heaps must have equal light exposure, temperature changes, climate etc so must all be in same place, and must be equal size.

Calculate the carbon to nitrogen ratios for each heap and ~~count~~ take a soil sample of 10 cm^3 from centre of heap and record number and species of decomposers

and any plants/fungae on surface. Take readings every week for 3 months and calculate an index of diversity for ~~the data~~ each heap, every week. Plot these on a graph with diversity index against carbon to nitrogen ratio.

It is important to calculate $D = \frac{N(N-1)}{\Sigma n(n-1)}$.

ResultsPlus

Examiner Comments

This is an example of a good level 3 response. The candidate describes how compost heaps should be set up and that the species of organism present should be observed over time (level 1). They give some details about the type of species that they would expect to be finding and state that both the species and number of each species would be recorded. Several variables to be controlled or monitored are also noted (level2). Some sensible details about sampling and a good description of how the results can be analysed/presented are also given (level 3).

Question 10 (a) (i)

The question was straightforward for most candidates. The most frequent reason for not gaining the mark was describing an allele as a different type of gene. Responses referring to a different 'version', 'form', 'variation' of a gene, were all accepted, but 'type' was considered to have a very different meaning and was not accepted.

(i) State what is meant by the term **allele**.

(1)

A specific type of gene.

ResultsPlus

Examiner Comments

This response did not get the mark. Reference to 'a different type of gene' was not accepted since 'type of gene' can be taken to mean something very different to 'version of a gene'.

Question 10 (a) (ii)

Many candidates completed this calculation correctly, although a number ignored the instruction to provide the final answer as a percentage. If the final answer was not correct the mark that candidates received depended on the workings they had provided. Most produced a Hardy-Weinberg equation (bullet point 1) but relatively few showed any intermediate values from the calculations (bullet point 2).

(ii) Use the Hardy-Weinberg equation to show that more than 50% of the forest elephant population are homozygous for the GBA gene.

(3)

$p + q = 1$

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

$0.43^2 + 2 \times 0.43 \times 0.57 + 0.57^2 = 1$

$2 \times 0.43 \times 0.57 = 0.4902.$

~~$2 \times 0.43 \times 0.57 = 0.50$~~

~~So 50% are heterozygous + 50% are homozygous.~~

So 49% are heterozygous + 51% are homozygous

Answer 51%.

ResultsPlus
Examiner Comments

This example shows a complete calculation that gained all three marks. The response is clearly laid out and if the final answer had been incorrect would have gained two marks for workings, bullet point 1 (second line) and bullet point 2 (line 4).

ResultsPlus
Examiner Tip

Always lay out your calculations clearly and show the complete workings for each step in the calculation.

Question 10 (b) (i)

This was the second levels based question on the paper. Candidates seemed to find this question more accessible than 9(b). Those candidates that used the information provided to support the statement were accessing level 2 (3 – 4 marks). If they only used selected data e.g simply discussed the allele data they were limited to level 1 (1 – 2 marks). Candidates using all the information as well as their own knowledge of how a species can be defined to reach a balanced judgment were accessing level 3 (5 – 6 marks). Some candidates ignored the question and described how a new species evolves – the answer to the next question.

(b) Scientists have concluded that the forest elephant and the savannah elephant are two different species.

*(i) Analyse the data and the information provided to comment on the validity of this conclusion.

(6)

The forest elephant does not possess GBA allele L at all however the savannah elephant has 95% of its population possessing that particular allele. However both species do possess GBA allele J which suggests that their ~~genes~~ genes are similar. This is also only one study which means it could possess anomalous data. There is no indication of how many elephants are in each population or how many were tested.

ResultsPlus

Examiner Comments

In this response the candidate has ignored most of the information provided and has not reached a judgment on the stated conclusion. This response was considered to be at level 2. The candidate has only considered information about allele frequency (lines 3 to 5) and has made some rather general statements about study design.

- There are significant morphological differences between the forest elephant and the savannah elephant: the forest elephant is much smaller and has a different appearance to its tusks and jaw. This suggests they are different species
- The two kinds of elephant are found in different habitats and occupy different ecological niches, as evidenced by their different feeding habits. This too suggests they are different species

- Their proportion of allele frequencies for the GRA gene are completely different: the vast majority of savannah elephants are homozygous for LL (90.3%), a genotype that does not exist in the forest elephant population. Similarly 57% of ~~savannah~~ forest elephants have the K allele which is not found in the savannah elephant population.

However, without further information, we cannot claim if these differences in alleles would mean that the two populations, if they interbred, could produce fertile offspring. Since this is the definition of a species, with this information alone a definitive conclusion cannot be reached on whether the two elephants are distinct species or not.

ResultsPlus

Examiner Comments

This is an example of a response that was judged to be level 3.

The candidate has considered morphological differences and behavioural differences (level 2) in the first paragraph. The allele data is then discussed in the second paragraph. The idea of a species being animals that can reproduce to produce fertile offspring is then introduced and a balanced conclusion is arrived at in the third paragraph (level 3).

Question 10 (b) (ii)

Many candidates found this question accessible, the most frequently awarded marks being bullet points 1 and 4. Many candidates also mentioned allopatric speciation (bullet point 3) but relatively few described reduced gene flow between the two populations (bullet point 2).

(ii) Explain how two species of African elephant could evolve from a common ancestor.
(3)

Two species of African elephants can evolve from a common ancestor due to the process of Speciation which results in reproductive isolation of the two species. This could be allopatric speciation where geographical isolation results in two species being reproductively isolated, or symptric speciation where the species are reproductively isolated but not geographically isolated. The two species experience different ~~th~~ selective pressures which means individuals with the ~~most~~ better genetic make up equipt to deal with the pressures are more likely to survive **(Total for Question 10 = 13 marks)**

and pass their genes on, creating two unique species from one common ancestor.

TOTAL FOR PAPER = 100 MARKS

ResultsPlus
Examiner Comments

This response gained all three available marks. Bullet point 1 (line 4), bullet point 2 (lines 3 and 4) and bullet point 4 (lines 7 and 8).

The candidate did not mention reduced gene flow between the isolated populations (bullet point 3) so this mark would not have been awarded.

Paper summary

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

- Make sure you are familiar with the command words used in this specification.
- Take a little time to scan the paper and plan the order in which to answer questions.
- Read the whole of each question carefully, including the introduction, to help relate your answer to the context used in the question and to ensure you provide your answers in the relevant place.
- Read your answers back carefully – do they answer the question? Are your answers clear and unambiguous? Have you made at least as many clear points as marks are available?
- Think carefully about the data provided in questions to help you answer the question – you should not be spending time simply describing in words the individual data points of a table or graph, rather you should be processing the information – look for trends, similarities or differences in the data.
- Include clear workings with any calculation: these may start with a suitable equation followed by the values determined at different steps in the calculation.
- Do include a sketch diagram or graph if it will help add clarity to your answer.

Grade Boundaries

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