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June 2019

GCE Biology 9BN0 02

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Introduction

This 9BN0/02 paper allowed candidates to showcase their knowledge and understanding of, as well as to display connections between, topics 1 to 4, and topics 7 and 8.

It was most pleasing to see candidates delivering a range of excellent responses across a diverse array of questions that demonstrated their good grasp of the material being tested. Much thanks should go to both the candidates for this, and to their teachers.

Whilst most candidates offered clear and unambiguous answers, it should be noted that there were a number of cases where the quality of expression meant that marks could not be awarded.

Question 1 (b)

This question item required candidates to not only explain the orientation of a phospholipid in terms of exposure to an aqueous solution, but also why the phospholipids aline as a bilayer required in a cell surface membrane.

Whilst most candidates were able to link the polar and non-polar regions of the phospholipid to water, only a minority explained why two layers were needed.

The following answer suitably refers to the aqueous medium on either side of the cell membrane and then linked this to the hydrophilic heads of the phospholipids.

(b) Explain why the phospholipids are arranged in two layers in a cell surface membrane.

(3)

Due to hydrophilic heads pointing towards the inside of the cell and towards the outside of the cell, this is where water is located.
The hydrophobic tails of the Phospholipids point into the middle of the bilayer, this is where water is not present.

This also provides strength and allows Proteins and glycolipids to sit in the membrane.

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Examiner Comments

A clear and accurate answer that fully targeted the question. All 3 marks awarded.

ResultsPlus
Examiner Tip

Always check to make sure that the answer fully matches the question.

The following answer was typical of many responses seen.

(b) Explain why the phospholipids are arranged in two layers in a cell surface membrane.
(3)

The hydrophobic tail faces away from the water molecules and the hydrophilic head is water loving so it faces towards water molecule and is attracted to it, forming hydrogen bonds. The hydrophobic tail repels the water molecules, leading to the two layer formation in a cell surface membrane.

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Examiner Comments

The response initially gives a clear explanation for why the fatty acid chains orientate away from the water. It then refers to the water loving nature of the hydrophilic head which is not credit worthy in this instance but they then go on to gain the second marking point by refering to it facing the water. However, the final sentence does not identify that there is an aqueous solution either side of the cell surface membrane. Therefore 2 marks were awarded.

Question 2 (a) (i)

This 'complete the table' item required candidates to identify which of the two types of named scans can detect the size and location of a large tumour.

This is a clear and unambiguous answer.

2 There are various ways to scan the brain.

(a) (i) Brain tumours are dense masses of cells. The presence of brain tumours can be detected using several types of scanning method.

The table shows two types of scan. Place a tick [✓] in the box if the scan can identify the size and location of a large brain tumour or a cross [✖] in the box if the scan cannot identify the size and location of a large brain tumour.

(2)

Type of scan	Can be used to identify the tumour
CT	✓
MRI	✓

ResultsPlus
Examiner Comments

Two obvious ticks are provided and the response gains both marks.

ResultsPlus
Examiner Tip

Make sure that in questions that ask for a tick or cross, that these are unambiguous as some answers offered cross-tick hybrids that cannot be awarded marks.

Please note that a blank is not considered equivalent to a cross.

This response was typical of those that did not gain both marks.

2 There are various ways to scan the brain.

(a) (i) Brain tumours are dense masses of cells. The presence of brain tumours can be detected using several types of scanning method.

The table shows two types of scan. Place a tick [✓] in the box if the scan can identify the size and location of a large brain tumour or a cross [✗] in the box if the scan cannot identify the size and location of a large brain tumour.

(2)

Type of scan	Can be used to identify the tumour
CT	✗
MRI	✓

ResultsPlus
Examiner Comments

Like answers from a number of candidates, this one only achieved the second row. It may have been that candidates did not fully take note that question stem referred specifically to large brain tumours.

ResultsPlus
Examiner Tip

Always check the detail given in the question stem as it can give context to the question.

Question 2 (b)

The question related to how PET scans can be used to study the structure of the brain. Many candidates appeared to be unfamiliar with this form of scan.

This example is typical of the most common form of response seen.

(b) Describe how positron emission tomography (PET) scans can be used to investigate brain structure.

(2)

PET scans use radioactive tracers injected or put into the body
Can then see which areas of the brain are most active

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Examiner Comments

An encouraging number of candidates appreciated that a radioactive tracer was required, as is in the case here. However, it was not uncommon to see references to radiowaves being described. Only a minority were able to successfully expand on their answer to state what was being detected or that the scan could produce a 3D image.

This response gained 1 mark.

Question 3 (a)

In this question, candidates needed to apply their understanding of the Hardy-Weinberg equation to the data provided. It was encouraging to find a good number of candidates who had a clear understanding of this topic area and were able to offer complete answers that elicited full marks. A minority appeared to ignore the reference to using the Hardy-Weinberg equation and proceeded to give an example of a monohybrid cross for cystic fibrosis.

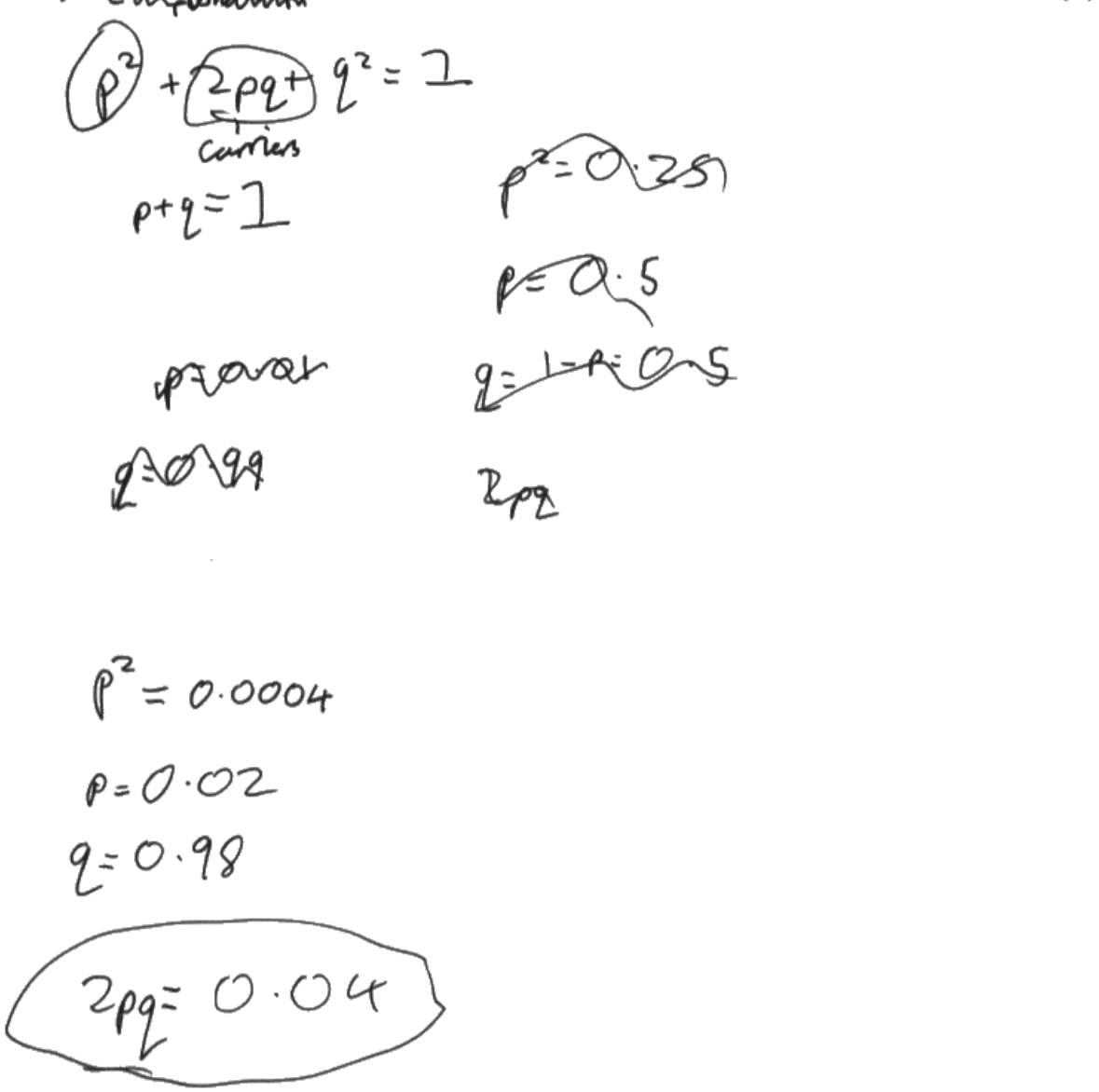
In the following response, the correct equation has been identified.

3 Cystic fibrosis is a genetically inherited condition.

A couple who are both carriers for the condition have a 25% chance of having a baby with cystic fibrosis. In the UK, 1 in 2500 babies born have cystic fibrosis.

(a) Use the Hardy-Weinberg equation to calculate the probability of babies born in the UK being carriers for cystic fibrosis.

(3)



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Examiner Comments

The equation has been correctly used to calculate the two allele frequences 'p' and 'q'. However, it appears that 2pq was only partially applied, perhaps just 2p, so the answer could not be awarded the third marking point. 2 marks given.

ResultsPlus
Examiner Tip

Always check through answers at the end of the exam if there is sufficient time, in case of missing out an element.

Whilst this response does not offer the correct equation, the calculation has been clearly applied and the right answer is given as a percentage.

3 Cystic fibrosis is a genetically inherited condition.

A couple who are both carriers for the condition have a 25% chance of having a baby with cystic fibrosis. In the UK, 1 in 2500 babies born have cystic fibrosis.

(a) Use the Hardy-Weinberg equation to calculate the probability of babies born in the UK being carriers for cystic fibrosis.

↳ heterozygous

(3)

Cystic fibrosis recessive

1 in 2500 have cystic fibrosis.

$\frac{1}{2500} = 4 \times 10^{-4}$

↳ q^2

$\sqrt{4 \times 10^{-4}}$

$= 0.02$

$1 - 0.02 = 0.98$

↳ 0.98^2

$= 0.9604$

↳ p^2

$4 \times 10^{-4} + 0.9604 = 0.9608$

$1 - 0.9608 = 0.0392$

↳ 3.92%

Answer 3.92%

ResultsPlus
Examiner Comments

As the correct answer has been provided, all 3 marks are awarded.

Question 3 (b) (ii)

This question required candidates to consider how different mutations in the gene that lead to cystic fibrosis could elicit different severities of the condition. It was pleasing to note that many candidates were able to give an explanation targeted to the slant of the question. A minority, however, offered a general description of how the mucus comes to be very sticky.

This answer illustrates an example of a credit worthy description for the first marking point.

(ii) Explain why different mutations in the CFTR gene can lead to differences in the severity of the symptoms of cystic fibrosis.

(2)

As different mutations mean different seqances expressed meaning the severity would be different due to the different expression due to the mutation meaning mutation may cause a partial function CftR protein which means symptoms are not that bad compared to no CftR proteins.

ResultsPlus
Examiner Comments

The latter part of the sentence gained the first marking point, so 1 mark awarded.

ResultsPlus
Examiner Tip

Try to read through an answer to make sure it is clear and unambiguous.

This type of response was quite regularly seen, but gains no marks.

(ii) Explain why different mutations in the CFTR gene can lead to differences in the severity of the symptoms of cystic fibrosis.

(2)

There are several types of mutation, e.g. deletion, addition and substitution. Substitution will be least devastating as only 1 base pair is affected, whereas addition or deletion shifts the base sequence which increases the severity of cystic fibrosis as the gene coded may be faulty or may not be coded.

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Examiner Comments

A number of answers gave sound descriptions of different mutations, as did this one. However, the response did not follow it through to explain how this affected the severity of CF.

ResultsPlus
Examiner Tip

Be careful not to just repeat the question as it appears at the end of this response.

Question 4 (a) (i)

This item required candidates to apply their knowledge of the role of the brain in controlling heart rate. The majority of the candidates were able to display a good grasp of the material and pleasingly, were able to adapt it to this context of reducing heart rate after exercise.

This response is a sound explanation that gains two thirds of the available marks.

4 A moderate amount of exercise is considered good for the human body.

(a) A student carried out 20 minutes of physical exercise. During this time, her heart rate and level of sweating increased.

Shortly after completing the exercise, the student noted that her heart rate and level of sweating decreased.

(i) Explain the role of the brain in reducing the student's heart rate after the exercise.

(2)

The cardiovascular control centre in the medulla oblongata will send an inhibitory impulse down the vagus nerve to the SAN which will slow down its rate of depolarisation and therefore heart rate. So the brain, after being sent impulses from chemoreceptors, controls the rate at which the heart beats.

ResultsPlus
Examiner Comments

This answer suitably targets the second and third marking points for 2 marks.

Question 4 (a) (ii)

This item required candidates to describe how the brain is involved in reducing sweating after a period of exercise.

Whilst a number of candidates displayed a good understanding of this item, many did not offer the detail and precision needed to elicit the marks.

This is a typical response that did not quite offer sufficient precision to gain the marks that were available.

(ii) Describe how the brain reduces the activity of the sweat glands after the exercise.

(2)

The hypothalamous ~~detects~~ in the brain is responsible for the ~~thermo regulating~~ thermoregulatory control. The body no longer needs to cool down after exercise so the hypothalamous alerts the sweat glands to stop producing sweat.

ResultsPlus
Examiner Comments

Whilst there is a reference to the hypothalamus, there is no link to how information is sent to the sweat glands to reduce their activity. No marks scored.

ResultsPlus
Examiner Tip

Think about the information coming into and then the information coming out of the brain to the sweat glands. Also consider the specific region of the brain involved in thermoregulation.

Question 4 (b)

This item required candidates to explain how excessive exercise can be harmful. It delivered a good spread of mark outcomes. It was a pleasure to read a good number of answers that showcased candidates' knowledge and understanding of this material.

A number of answers, such as this one, gave one or more reasons why too much exercise can be harmful, but did not then follow through to explain how each exercise has a negative impact on the body.

(b) Explain why too much exercise could be harmful to the human body.

(3)

If you exercise too much it means your muscles, joints and ligaments are more succeptible to wear and tear. This means injuries can be picked up easier. It also means a weaker performance may be given due to fatigue. Too much exercise can also result in immune suppression, making the immune system weaker.

ResultsPlus
Examiner Comments

This response gained 2 marks for referring to two negative outcomes of excessive exercise. However, the answer was not developed to explain why these examples were harmful. As a consequence, only 2 marks were awarded.

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Examiner Tip

Always consider carefully what is meant by an explain question.

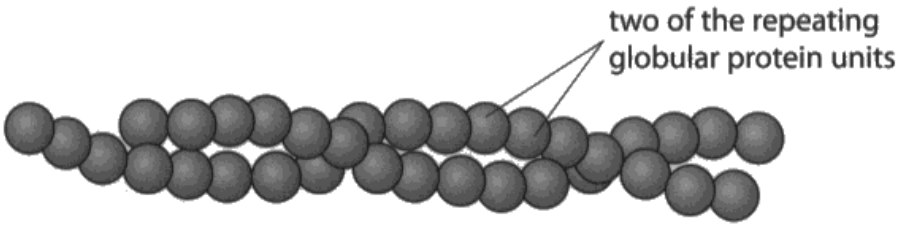
Question 5 (b)

This item expected candidates to offer similarities and differences between collagen and an actin filament. Whilst there were some excellent answers, a significant number of candidates did not answer the question being asked.

This is a sound answer that gained 2 marks.

(b) Actin and collagen are both proteins.

The diagram shows two filaments of actin from a muscle fibre. Each filament is a polymer of repeating globular protein units.



Compare and contrast the structures of an actin filament and collagen.

(3)

Both have peptide bonds between amino acids. Both are polypeptides - made of a long chain of amino acids. The actin filament has a tertiary structure, whereas collagen has a quaternary structure. Actin filament is globular, whereas collagen is fibrous, so Actin is spherical whereas collagen is in straight chains.

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Examiner Comments

The candidate has appreciated that both are proteins and therefore has described that both have a primary structure (third marking point).

The reference to actin filament having a tertiary structure and the collagen a quaternary structure is sufficient to gain the first marking point. However, it implies that the actin filament does not have a quaternary structure so the fourth marking point cannot be awarded.

A total of 2 marks were awarded for this answer.

ResultsPlus
Examiner Tip

When comparing and contrasting, remember to give similarities as well as differences.

This response was typical of many seen for this item.

Compare and contrast the structures of an actin filament and collagen.

(3)

Actin is made out of many globular protein ~~filaments~~ units bound together to create a long chain. whereas collagen is ~~to~~ ~~fibrous~~ ~~protein~~ ~~which~~ made of many fibrous protein units wound together. This makes collagen fibres very strong with a higher tensile strength than actin filaments. Due to the globular structure of the protein in an actin filament this makes it soluble in water whereas collagen is not soluble in water due to it's fibrous structure.

ResultsPlus
Examiner Comments

This response considers collagen and actin, rather than an actin filament.

Further, it includes information on function when the question asked about structure.

This answer is awarded 0 marks.

ResultsPlus
Examiner Tip

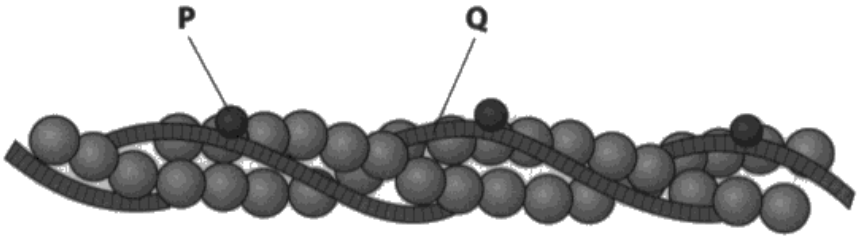
Always make sure the answer matches the question.

Question 5 (c) (i)

An item that required candidates to recognise the components of a thin filament in a myofibril and then describe their interactions. A good portion of the candidates were able to identify the two labelled components and then describe how they interacted.

This was a fairly typical response that lacked the level of detail required to elicit the 2 marks.

(c) The diagram shows actin and other components (P and Q) of a thin filament in a myofibril.



(i) Describe the interaction between P and Q that allows muscle contraction.

(2)

Upon ATP addition to structure Q, it extends and exposes the myosin binding sites on Q for the formation of cross bridges.

ResultsPlus
Examiner Comments

No marks could be awarded for this answer.

Question 5 (c) (ii)

This question allowed candidates to apply their understanding of how the structure of proteins is related to their function in the context of ATPase in the myosin head. Many candidates rose to the challenge and delivered excellent answers. Having said this, there was an even spread of marks from 0 to 3.

This answer was on the correct lines but was not tailored to the context of the question.

(ii) The thick filament in a myofibril contains myosin. The myosin head contains the enzyme ATPase.

Explain the importance of the primary structure for the functioning of this enzyme.

(3)

Primary structure is the straight chain of amino acids linked only by peptide bonds. This gives it its structure and determines shape of active site. Active site is the part of the enzyme that substrate binds to to be broken down.

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Examiner Comments

Whilst a suitable link between primary structure and active site has been made (third marking point), the reference to the substrate unqualified was not sufficient to contextualise the response for the fourth marking point.

As a consequence, only 1 mark was achieved.

ResultsPlus
Examiner Tip

Look to consider the context of the question when constructing an answer.

This is a clear and strong answer that achieves all 3 marks but offers all four marking points.

(ii) The thick filament in a myofibril contains myosin. The myosin head contains the enzyme ATPase.

Explain the importance of the primary structure for the functioning of this enzyme.

(3)

The primary structure of this enzyme determines how it will be folded into its secondary and then tertiary structure as bonds are formed between its R groups on each amino acid. This will determine whether its active site of ATPase will be able to bond with its substrate of ATP so that it can be broken down to ADP + Pi. With a different primary structure folding into a tertiary structure will be different so its active site will change shape so it can no longer bond with its substrate.

(Total for Question 5 = 9 marks)

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Examiner Comments

The answer initially gains the second marking point and then the first. It then delivers the fourth marking point. The reference to a different tertiary structure leading to a different active site shape was the third marking point.

Question 6 (a) (ii)

This question tested both candidates' understanding of the root tip squash and their ability to apply this knowledge to the hypothesis proposed. As a consequence, a suitable statistical test was expected so that the hypothesis could be rejected or accepted. Many candidates clearly had an excellent appreciation of the root tip squash core practical as well as a good understanding of the need to justify, or not, the hypothesis.

The following is a rather general answer that did not gain any marks.

(ii) Devise an investigation to test this hypothesis.

(5)

The plant root tips should be collected and then squashed in order to expose the cells. These should then be placed under a microscope and observed (maybe pichres or drawings) to see the activity of mitosis. Each cell showing stages of mitosis (including interphase) should be recorded at each point of the tip (should be divided into 5 points). The cell root tip being used should be kept the same however the points of the tip being observed should be changed. The difference in mitotic activity should be recorded.

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Examiner Comments

Whilst it was clear in this response that a root tip squash was being described, a lack of detail such as the strain used or a reference to maceration meant that no marks could be awarded. Likewise, the general reference to mitosis occuring, or considering the various stages of mitosis did not sufficiently target the focus of the question to elicit marks.

Overall, this answer did not achieve any marks.

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Examiner Tip

Make sure that practical details for the core practicals are fully appreciated.

Below is a clear answer that focused on delivering appropriate detail of the root tip squash.

(ii) Devise an investigation to test this hypothesis. at least 5 points from tip to start of zone 2. (5)

Use a plant and collect cells from both zone 1 and zone 2, from using aseptic technique. Collect a plant sample, soak in hydrochloric acid to split middle lamella, macerate and put sample onto slide. Then squash coverslip on top of slide and view under microscope. Use a stain of toluidine blue so you can effectively see the cells undergoing mitosis under the microscope. You can then use the mitotic index for both zones to compare the results.

Repeat the experiment at least 5 times, to increase reliability and validity. Make sure to control variables eg temp, pH buffer, species / age of plant.

Conduct a statistical test to find the significance of this test eg standard deviations from the mean.

work out a mean average.

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Examiner Comments

A pleasing decription of how to carry out a root tip squash was given. Also at the top of the page, it has linked it to the hypothesis in terms of zone 1 to zone 2. The marking points given that relate to the practical are the first, then the second, then the third and finally the fourth.

Whilst a reference to using a statistical test has been offered, a suitably named one would be expected for the fifth marking point.

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Examiner Tip

If a hypothesis is given, consider whether the answer should include how it can be rejected or accepted.

This is a comprehensive answer that gains all 5 marks.

(ii) Devise an investigation to test this hypothesis.

(5)

Cut off the bottom 2 mm of zone 1 from 5 roots of the same plant. Add HCl to them to soften them and dissolve the middle lamella. Stain the root tip cells with toluidine blue and heat to intensify the stain. Place the cells on a microscope slide and squash with a cover slip between thumb and forefinger. Look at cells using a microscope on high power and calculate the mitotic index. Calculate a mean mitotic index for all 5 roots. Repeat the experiment from a sample of cells taken from the edge of zone 1 and zone 2 for each of the 5 roots and calculate another mean mitotic index. Compare the two results, plot on a graph and use a students t-test to see if they are statistically significantly different. Make sure the concentration of HCl and the degree to which the cells are heated are kept constant at all times

ResultsPlus
Examiner Comments

This response initially delivers a clear decription of the root tip squash. It then links it to the two zones.

Here, reference to two means and then a student's t test, which would be an appropriate statisitcal test, have been supplied. Whilst there is no reference to the calculated value being compared to the critical value, the first five marking points have already been gained.

ResultsPlus
Examiner Tip

In longer prose questions such as this 5-mark one, offering an answer that follows a logical sequence is more likely to hit the various marking points that are available.

Question 6 (b) (i)

Approximately half of the candidate cohort were able to state the correct hexose in cellulose and in amylopectin.

This answer is probably the second most common incorrect response.

(b) In zone 2, the plant cells elongate due to a change in their cellulose cell walls.

(i) Cellulose and amylopectin are polymers of hexose sugars.

State one difference between the hexose in cellulose and the hexose in amylopectin.

(1)

Hexose in cellulose is not branched whereas hexose in amylopectin is branched.

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Examiner Comments

This answer, like many, focused on the polysaccharides rather than the hexoses that make up the two named polysaccharides.

This response was typical of the most common answer that did not gain the mark.

(b) In zone 2, the plant cells elongate due to a change in their cellulose cell walls.

(i) Cellulose and amylopectin are polymers of hexose sugars.

State one difference between the hexose in cellulose and the hexose in amylopectin.

(1)

In amylopectin there's 1,6 glycosidic links as well as 1,4 but in cellulose there's only 1,4.

ResultsPlus
Examiner Comments

In this answer, reference has been made to the bonds between the hexoses rather than the hexoses themselves.

ResultsPlus
Examiner Tip

Look to carefully identify the focus of the question.

Question 6 (b) (ii)

About two thirds of the cohort appropriately named the bonds between adjacent cellulose molecules in a cellulose microfibril. Of those that did not achieve the mark, glycosidic and ester bonds were the most common incorrect alternatives encountered.

Question 6 (c) (i)

This item required candidates to explain the process of differentiation that occured in the zone of differentiation in the root given in the question. Whilst many made reference to stem cells, a significant minority did not follow this through to explain how different tissues arose. The full mark range, from 0 to 3 was seen, with a near even spread.

An answer that initially focused on the question but then became a little general.

(c) In zone 3, some of the cells differentiate to give rise to phloem sieve tube elements and others differentiate into phloem companion cells.

(i) Explain how genetically identical cells in zone 3 can differentiate to give rise to different tissues.

(3)

They can switch on and off genes. transcription factors could bind to promotor region and allow RNA to bind. This can initiate the gene for that specific tissue to be turned on and mRNA can be made due to the transcription initiation complex.

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Examiner Comments

The first line of this answer gained the second marking point. The rest of the response did not link to the question's focus which was the formation of different tissues. This answer, therefore, gained 1 mark.

This answer illustrates the typical responses seen that started to tackle the question but did not then offer the necessary detail.

(c) In zone 3, some of the cells differentiate to give rise to phloem sieve tube elements and others differentiate into phloem companion cells.

(i) Explain how genetically identical cells in zone 3 can differentiate to give rise to different tissues.

(3)

These cells can differentiate into specialised cells. They are multipotent which allows them to differentiate into different cells, needed throughout plant

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Examiner Comments

No marks were awarded for this answer.

Question 6 (c) (ii)

This item required candidates to explain how they could compare the size of cells in the tip of a root to the xylem vessels found further up the root. Whilst there were a number of splendid answers, a sizeable portion offered rather general responses.

The following is a sound answer that gains 2 marks.

(ii) The student also hypothesised that the cells in zone 1 would be smaller in size than the cells that had differentiated into xylem vessels in zone 3.

The student prepared microscope slides of sections from zones 1 and 3.

Explain how the student could compare the sizes of cells in zone 1 with the sizes of xylem vessels in zone 3.

I
A M

(3)

The student should take a picture of the slide under a microscope at a certain known magnification, and count the size of the width and length of the cell in the image. Divide this number by the magnification, to obtain the actual size / area of the cell. Repeat, ~~taking~~ after taking a picture of the slide under a microscope of the other cell, eg the xylem vessels cells, and after finding the size and width, whilst knowing the magnification, calculate the actual size / area of the xylem cells. Compare the sizes of both cells, to determine which cells are bigger.

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Examiner Comments

Initially the response refers to measuring the width of a cell and then towards the end, the width of a xylem vessel is found. It was not necessary to state that the cell was from zone 1 as this is in the question, likewise for the xylem vessel. Therefore the third marking point can be pieced together.

About a third of the way through the answer, the fourth marking point is gained.

Question 7 (a) (ii)

An encouraging number of candidates offered comprehensive answers to this item that required them to deduce the fate of lactate in liver cells. There was a near even spread of marks across the full mark range.

A short, but clear, statement that partially targets the answer:

(ii) Cells produce lactate during anaerobic respiration. Lactate travels in the blood to the liver.

Liver cells can absorb lactate from the blood.

Deduce what happens to the lactate in these cells.

(2)

- converted into pyruvate and then broken back down to produce NAD.

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Examiner Comments

This response was awarded the first marking point.

A targeted answer that gained both marks:

(ii) Cells produce lactate during anaerobic respiration. Lactate travels in the blood to the liver.

Liver cells can absorb lactate from the blood.

Deduce what happens to the lactate in these cells.

(2)

lactate is converted in to glucogen
or it is oxisised and converted to pyruvate molecule for aerobic respiration

ResultsPlus
Examiner Comments

This response achieved the second and then the first marking points.

Question 7 (a) (iii)

It was pleasing to see that many candidates appear to have a thorough appreciation of how a dipeptide is formed.

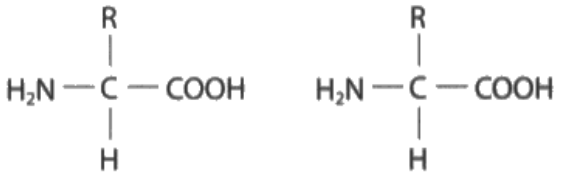
This answer illustrates the importance of being careful when delivering a response.

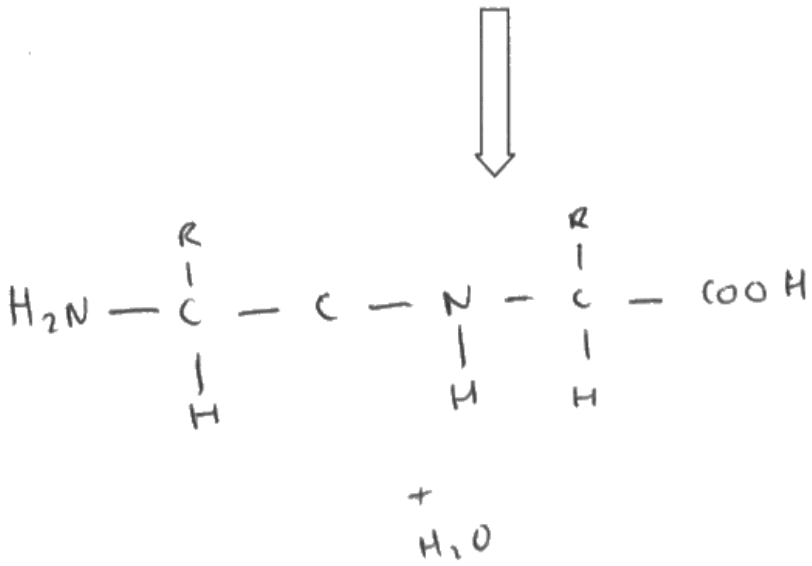
(iii) During protein synthesis, two amino acids are joined together to form a dipeptide.

The diagram shows two identical amino acids.

Complete the diagram to show how the dipeptide is formed from these two amino acids.

(2)





ResultsPlus
Examiner Comments

The answer was awarded the water releasing mark but, due to missing out an oxygen in the dipeptide, it did not gain the first marking point.

ResultsPlus
Examiner Tip

Always check carefully any diagrams drawn for accuracy.

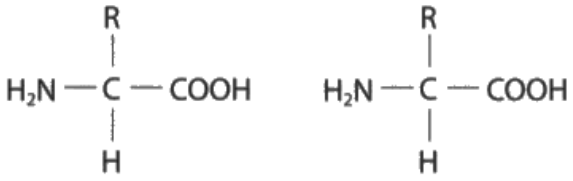
A clear answer that gains both marks.

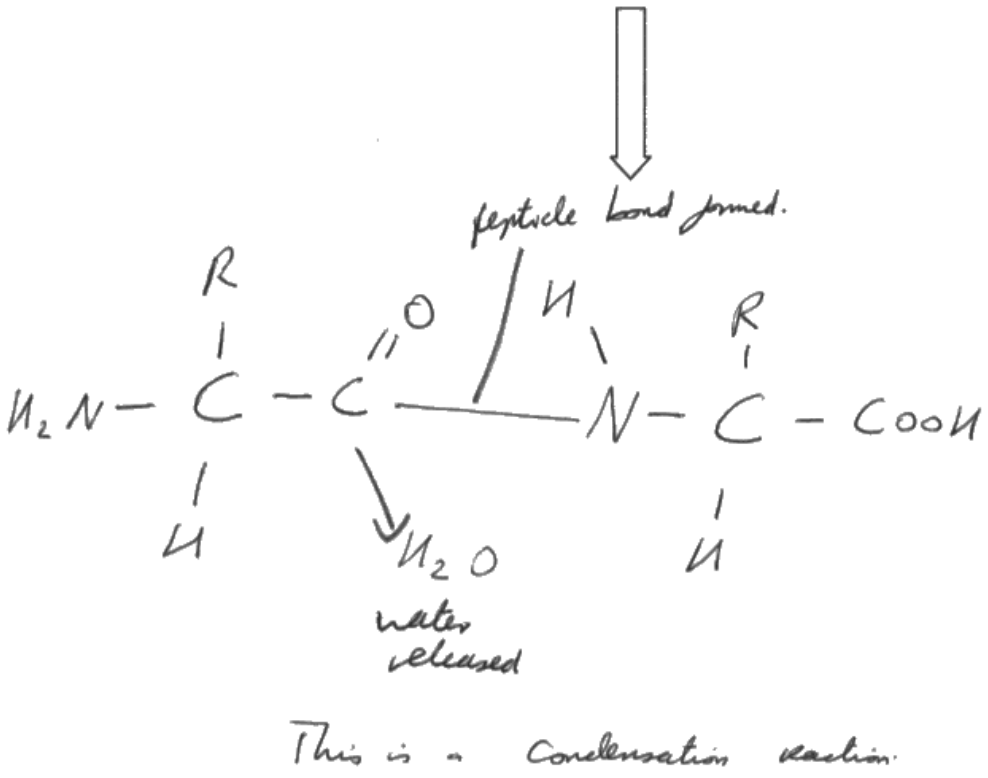
(iii) During protein synthesis, two amino acids are joined together to form a dipeptide.

The diagram shows two identical amino acids.

Complete the diagram to show how the dipeptide is formed from these two amino acids.

(2)





ResultsPlus
Examiner Comments

The dipeptide is drawn accurately and the production of water is shown, hence both marks given.

Question 7 (b)

This item required candidates to explain why the liver is considered an organ. There were many excellent answers supplied by candidates.

A short, and to the point, clear answer.

(b) Explain why the liver is an organ and not a tissue.

(2)

Liver is made up of many different type of tissues, forming a organ. as the different tissues have different functions

ResultsPlus
Examiner Comments

This response gained both marks.

Question 7 (c) (ii)

Candidates were required to explain why ATP is broken down during the process of glycolysis. An encouraging number of candidates had a splendid appreciation of this aspect of respiration.

This answer illustrates the most common type of response that did not elicit marks.

(ii) Explain why some ATP is broken down during glycolysis.

(2)

ATP is broken into Adp and an inorganic phosphate.

ResultsPlus
Examiner Comments

No marks awarded.

This answer tackles one aspect of the question.

(ii) Explain why some ATP is broken down during glycolysis.

(2)

To cause glucose to produce 2 x 3 carbon compands which have been phosphorylated from the Pi from ATP → ADP + Pi

ResultsPlus
Examiner Comments

The explanation is sufficiently clear to be awarded the third marking point.

This response suitably refers to glucose phosphorylation for the first marking point. It then offers the second marking point as identified in the additional guidance.

(ii) Explain why some ATP is broken down during glycolysis.

(2)

Some is broken down to phosphorylate the glucose to make it more reactive and unstable so it can then be converted into pyruvate

ResultsPlus
Examiner Comments

Both marks are awarded for this answer.

ResultsPlus
Examiner Tip

Use the mark allocation as a guide to the level of content required in the answer.

Question 7 (c) (iii)

This item asked candidates to explain the role of the carrier proteins that are part of the electron transport chain. Whilst a majority of candidates were able to explain one or two roles of these molecules, only a minority gained all the marks that were available.

The following answer hit one of the marking points but required a little more precision to gain further marks.

(iii) The electron transport chain occurs in the cristae of mitochondria. The electron transport chain involves a number of carrier molecules.

Explain the role of these carrier molecules in the electron transport chain.

(3)

✱ the carrier molecules 'carry' electrons across the electron transport chain. Allow electrons to move along ETC and release energy.
✱ This energy is then used by carrier molecules to pump protons from the matrix into the intermembrane space.
(✱ The last electron carrier is oxygen).

ResultsPlus
Examiner Comments

The initial description did not refer to how the various carriers were reduced and oxidised due to the passage of electrons for the third marking point.

The second paragraph was a clear description of the fourth marking point.

ResultsPlus
Examiner Tip

For the fourth marking point, both the idea that the protons were being actively pumped, as well as where they were going to, was required. In the latter case, make sure that the destination is clear and unambiguous. It was not uncommon to see descriptions that implied that the protons were pumped into the inside of the inner membrane rather than the space between the two membranes.

Question 8 (a)

Many candidates tackled this item that required them to comment on some graphical data very well.

Question 8 (b)

It was pleasing to note that many candidates appreciated how to manipulate the data relating to sugar intake and prostate cancer.

A clearly laid out calculation that delivered the correct answer of 343 men:

(b) In another investigation, the effect of diet on the development of prostate cancer was studied.

Data were collected on prostate cancer death rates and the intake of sugar. Some of the data are shown in the table.

Daily sugar intake per person / kJ	Prostate cancer death rate / 100 000 of the male population
420	5.0
840	8.5
1260	12.0
1680	16.0
2100	20.0

The male population size of Denmark is 2.86 million.

Calculate the number of men likely to die from prostate cancer if their daily sugar intake was 1260 kJ.

(2)

12 per 100000

$\frac{2860000}{100000} \times 12 = 343.2$

Answer 343

ResultsPlus
Examiner Comments

Both marks awarded.

Question 8 (c) (i)

Whilst there were a number of splendid answers to this item that required candidates to explain why identical twins were included in a study about developing prostate cancer, it was not uncommon to see many general answers.

This response is typical of many that were not sufficiently precise to gain the first marking point.

(c) In a third investigation, prostate cancer in identical and non-identical male twins was studied.

Data were collected on the probability of one male twin developing prostate cancer if his twin brother had prostate cancer.

(i) Explain why identical twins were included in this investigation.

(2)

Identical twins have the same ~~same~~ genetics so if one male twin ~~the~~ develops prostate cancer, there is a ~~high~~ chance that the other twin will also develop cancer because he also has the same genes which caused the other twin to develop prostate cancer.

ResultsPlus
Examiner Comments

Many answers, such as this one, did not differentiate between alleles and genes. No marks could be awarded.

ResultsPlus
Examiner Tip

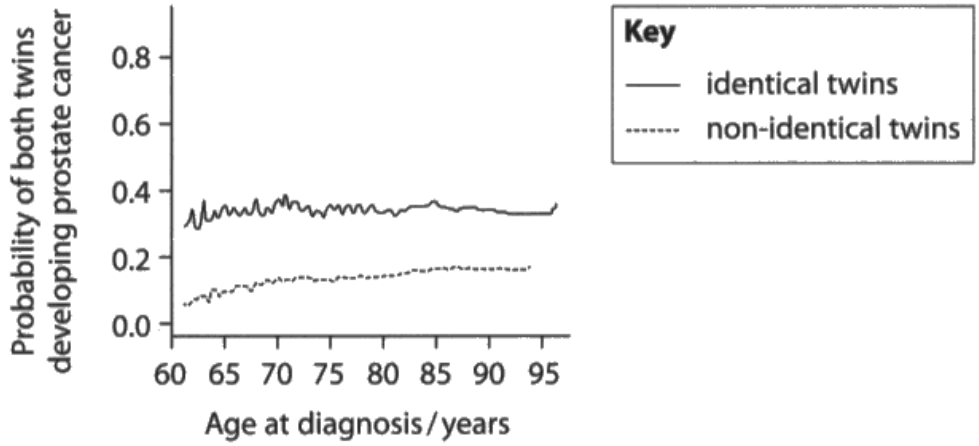
Make sure that genetic terms are fully understood.

Question 8 (c) (ii)

It was most encouraging to note that many candidates made a good attempt at this extended prose question. They were required to analyse the three different sets of data to evaluate the likely causes of prostate cancer in men. The full mark range from 0 to 6 was seen.

This is a sound response that gained half the available marks.

*(ii) The graph shows the results of this investigation.



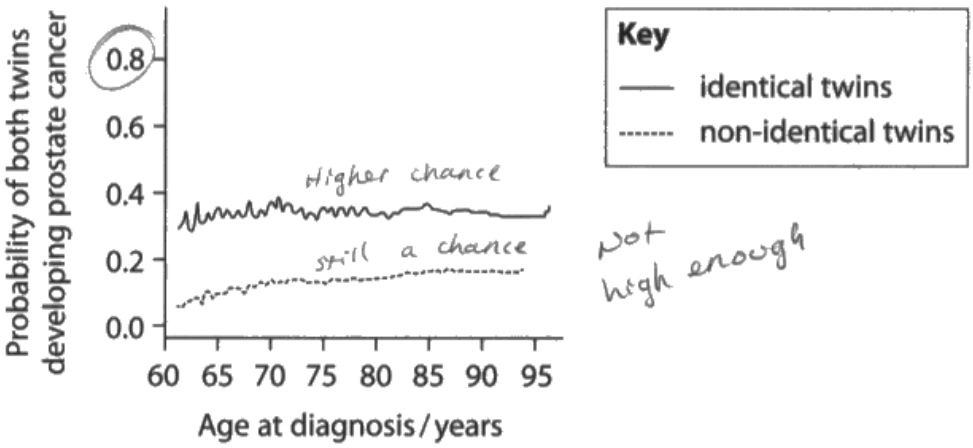
ResultsPlus
Examiner Comments

The initial part of the response considers the relationship between increasing age and developing prostate cancer. It also offers a basic conclusion. This covers both components required to gain 2 marks in level 1.

Subsequently, the answer describes the other two investigations. Finally, at the end, another basic conclusion is provided. As a clear discussion relating to more than one study has been included, the response has entered level 2. However, as the conclusions given remain basic, only one component of level 2 has been achieved, hence 3 marks.

An encouraging answer that made a number of links between biological knowledge and understanding that allowed good conclusions to be drawn.

*(ii) The graph shows the results of this investigation.



ResultsPlus
Examiner Comments

In this response, the discussion relating to identical twins and non-identical twins, for example, gained level 1. However, the answer not only considered all three investigations, but the conclusions considered the accumulation of mutations over time and that the causes of prostate cancer were likely to be multifactorial. This meant that it not only complied with all of level 2 but offered elements of level 3. As a consequence, it gained 5 marks.

Question 9 (a)

The majority of candidates were able to correctly calculate the BMI. However, a number then did not use the result to ascertain the mean weight category for men in 2017.

This was a typical response that only gained 1 mark.

9 Changes in diet are affecting the health of people in the UK.

(a) The table shows mean data for adult males in the UK in 1967 and 50 years later in 2017.

Year	Mean mass / kg	Mean height / cm	Mean BMI
1967	73	172	24.7
2017	84	178	26.5

The National Health Service (NHS) states that BMI can be used to assess the weight category of an adult male. The table shows these categories.

Category	BMI range
Underweight	⩽18.4
Healthy weight	18.5 – 24.9
Overweight	25.0 – 29.9
Obese	⩾30.0

The mean BMI for adult males in 1967 indicates that they were in the healthy weight category.

Use the BMI formula to determine the mean weight category for adult males in 2017.

$$\text{BMI} = \frac{\text{mass in kilograms}}{(\text{height in metres})^2}$$

(2)

$\frac{84}{178^2} = 2.651180407 \times 10^{-3}$

$\times 10$

$= 26.5$

ResultsPlus
Examiner Comments

The calculation has been tackled correctly, but the question required candidates to then use this information, which is not seen here. Hence only the first marking point was awarded.

ResultsPlus
Examiner Tip

Make sure that the 'determine' command word is fully understood.

A clearly laid out response that gains both marks.

9 Changes in diet are affecting the health of people in the UK.

(a) The table shows mean data for adult males in the UK in 1967 and 50 years later in 2017.

Year	Mean mass / kg	Mean height / cm	Mean BMI
1967	73	172	24.7
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Overweight	25.0 – 29.9
Obese	⩾30.0

The mean BMI for adult males in 1967 indicates that they were in the healthy weight category.

Use the BMI formula to determine the mean weight category for adult males in 2017.

$$\text{BMI} = \frac{\text{mass in kilograms}}{(\text{height in metres})^2}$$

(2)

$\frac{84}{(1.78)^2} = 26.5$

The mean weight category for adult males in 2017 is overweight, as one BMI for males in 2017 is 26.5.

ResultsPlus
Examiner Comments

In this answer, the calculation has been correctly tackled and then applied to elicit the mean weight category for men in 2017.

Question 9 (b) (i)

In this item, candidates were expected to use the data in the table to describe the effect of repeatedly being shown a cheeseburger on the production of saliva. Whilst there were a good number of excellent answers, many candidates found it challenging due to the form in which the data was provided.

(b) The effect of being shown a cheeseburger on saliva production in a child was studied.

The mass of saliva produced by this child was measured.

The child was then shown a cheeseburger and the new mass of saliva produced was measured. The change in the mass of saliva produced was recorded.

This was repeated with the child being shown a cheeseburger on eight occasions, at five minute intervals.

The results in the table show the change in mass of saliva produced compared with the mass of saliva produced before the child being shown a cheeseburger.

Occasion	Change in mass of saliva produced / g
1	+ 0.30
2	+ 0.18
3	+ 0.05
4	+ 0.02
5	+ 0.02
6	– 0.08
7	– 0.18
8	– 0.19

This is a strong response that gains both marks.

(i) Describe the effect on saliva production shown by these results.

(2)

Saliva production decreases as number of occasion shown cheeseburger increases. From 6 to 8 the saliva mass is lower than the initial mass. On the first occasion saliva mass is the highest.

ResultsPlus
Examiner Comments

Initially the overall trend is described for the second marking point. Then a clear description of what the negative values for the change in mass of saliva produced was given for the final marking point.

An answer that does not fully target the question being asked.

(b) The effect of being shown a cheeseburger on saliva production in a child was studied.

The mass of saliva produced by this child was measured.

The child was then shown a cheeseburger and the new mass of saliva produced was measured. The change in the mass of saliva produced was recorded.

This was repeated with the child being shown a cheeseburger on eight occasions, at five minute intervals.

The results in the table show the change in mass of saliva produced compared with the mass of saliva produced before the child being shown a cheeseburger.

Occasion	Change in mass of saliva produced / g
1	+ 0.30
2	+ 0.18
3	+ 0.05
4	+ 0.02
5	+ 0.02
6	– 0.08
7	– 0.18
8	– 0.19

(i) Describe the effect on saliva production shown by these results.

(2)

The child is become habituated to being shown pictures of hamburgers. The constant stimulation of the salivatory glands would mean the body will begin to ignore the stimulus and therefore caused a decrease in the saliva production.
The more times the picture is shown the less the child salivates.

ResultsPlus
Examiner Comments

The inital part of this answer appears to be trying to explain the data rather than describe it. The final sentence, despite refering to a photograph, does suitably offer the overall trend, which is the second marking point. 1 mark awarded.

ResultsPlus
Examiner Tip

Make sure that the difference between the 'describe' and 'explain' command words are fully understood.

A clear description of the overall trend in the data.

(b) The effect of being shown a cheeseburger on saliva production in a child was studied.

The mass of saliva produced by this child was measured.

The child was then shown a cheeseburger and the new mass of saliva produced was measured. The change in the mass of saliva produced was recorded.

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1	+ 0.30
2	+ 0.18
3	+ 0.05
4	+ 0.02
5	+ 0.02
6	– 0.08
7	– 0.18
8	– 0.19

(i) Describe the effect on saliva production shown by these results.

(2)

As occasions increase, the more times the child is shown the cheeseburger, the less saliva is produced. At the 4th and 5th occasion, the change in mass is the same. Biggest decrease from 6th and 7th of -0.1g of saliva.

ResultsPlus
Examiner Comments

This response gains the second marking point for 1 mark.

Question 9 (b) (ii)

Candidates were expected to name the learned behaviour that was illustrated by a child producing less saliva upon repeated showings of a cheeseburger. The majority of the candidature recognised this was an example of habituation.

Question 9 (b) (iii)

In this item, candidates were expected to explain how habituation to being repeatedly shown the cheeseburger decreased saliva production comes about due to a change at the synapse. The majority of candidates recognised that there would be a decrease in the release of neurotransmitter, however, many only offered generalised accounts. Having said this, there were some splendid answers and a good spread of marks across the full mark range was seen.

The following is a rather general answer that lacked the detail required to elicit the various mark points.

(iii) Explain what happens at the synapse to cause a decrease in saliva production when the child was shown a cheeseburger on more than six occasions.

(4)

The signal for saliva production ~~after~~ causes less neurotransmitter to be released the more times the signal is sent across the synapse. This results in a weaker signal being transmitted out the other side which results in less saliva being produced.

ResultsPlus
Examiner Comments

No marks given.

The beginning of this answer offered sufficient detail to gain 1 mark. Towards the end it again delivered the necessary detail to gain a second mark.

(iii) Explain what happens at the synapse to cause a decrease in saliva production when the child was shown a cheeseburger on more than six occasions.

(4)

Repeated stimulation of a synapse results in a reduction of the permeability of the presynaptic membrane to Ca^+. As less Ca^+ is absorbed, less neurotransmitter is released into the synaptic cleft by the presynaptic membrane. After 6 occasions ~~Aint~~ the amount of neurotransmitter released becomes insufficient to overcome the threshold ~~page~~ that needs to be met to result in an action potential in the post synaptic membrane. This means that on the 6th ~~one~~ occasion no saliva is produced.

ResultsPlus
Examiner Comments

Initially, the answer suitably explains the reduction in presynaptic membrane permeability to calcium ions, which is the first marking point.

Subsequently, it refers to the release of less neurotransmitter but does not explain how or that it then binds to receptors on the post-synaptic membrane.

Finally, however, the response refers to a reduced likelihood of an action potential occuring at the post-synaptic membrane for the final marking point.

2 marks awarded.

Question 9 (c)

This question item required candidates to give a description of the role of sodium ions in the functioning of the eye. A good number of candidates demonstrated their thorough understanding of this material and built their answers in the context of the child observing the cheeseburger.

A sound answer that gains two thirds of the marks.

(c) When the child was shown the cheeseburger, information would have been sent from the eye to the brain.

Describe the role of sodium ions in the functioning of a mammalian rod cell.

(3)

Na^+ is moved out of the ~~cell~~ cell by active transport but it can then diffuse back in. When it is light, rhodopsin breaks down so Na^+ channels close. Na^+ continues to move out of the cell but cannot diffuse back in. The inside of the cell can become depolarised and ~~no~~ neurotransmitters are no longer sent to inhibit the bipolar neuron. The bipolar neuron becomes depolarised and sends an action potential to the brain.

ResultsPlus
Examiner Comments

The first sentence suitably describes the first marking point. It does not, however, gain the third marking point as it is not given in the context of being in the dark or not stimulated.

The second marking point can be awarded as the second and third sentences correctly refer to the sodium ions not being able to move back in when in the light.

A rather general response that could not be awarded any marks.

(c) When the child was shown the cheeseburger, information would have been sent from the eye to the brain.

Describe the role of sodium ions in the functioning of a mammalian rod cell.

(3)

Na^+ ions enter the mammalian rod cell at the retina, which sends an impulse down the optic nerve to the brain which then [illegible]. the brain would send signals to the salivary glands to produce more saliva.

ResultsPlus
Examiner Comments

The first part of the first sentence is not given in the context of the rod cell being in the dark or not being stimulated.

An encouraging answer that is written in the context of the question.

(c) When the child was shown the cheeseburger, information would have been sent from the eye to the brain.

Describe the role of sodium ions in the functioning of a mammalian rod cell.

(3)

The child would have seen the cheeseburger in the light. In the light rhodopsin is converted into retenal and opsin. No sodium ions enter the rod cell but they are continuously being transported out of cell actively by active transport. As a result of this, no sodium ions go down towards the bipolar cell and as there is no neurotransmitter (glutamate) released to bind to the bipolar cell, (to inhibit it) the bipolar cell can not pass the impulse on towards the ganglion cells.

ResultsPlus
Examiner Comments

As the first sentence refers to in the light, the third sentence can be awarded the second marking point. The reference to actively transporting the sodium ions out of the rod cell also in the third sentence, is a suitable alternative way of writing the third marking point.

2 marks were given for this response.

Question 10 (a) (i)

In this item, candidates were required to use the data to enable them to explain how the use of nandrolone could lead to atherosclerosis. Most candidates did refer to the data but a sizeable minority did not, which meant they could not gain full marks.

A clear answer that elicits 2 out of the 3 marks available.

The use of nandrolone has been linked to a variety of cardiovascular conditions.

Explain how the use of nandrolone could lead to atherosclerosis.

(3)

- Nandrolone decreases the elastic recoil of the aorta making it more prone to endothelial damage
- Damage in endothelial results in formation of an atheroma which can lead to atherosclerosis.

ResultsPlus
Examiner Comments

Initially the answer uses the data to gain the first marking point. It then refers to endothelial damage in the aorta for the second marking point. However, there is insufficient detail to gain the fourth marking point.

ResultsPlus
Examiner Tip

When data is provided, consider how it could be used.

An answer that does not quite offer sufficient detail to gain more than 1 mark.

The use of nandrolone has been linked to a variety of cardiovascular conditions.

Explain how the use of nandrolone could lead to atherosclerosis.

(3)

Nandrolone causes a decrease in percentage recoil meaning the aorta is less elastic. This causes higher blood pressure in the arteries (hypertension). A higher blood pressure means its more likely for damage to an artery wall to occur, which would then cause atherosclerosis (hardening of artery by plaque formation). A hard plaque would form to 'fix' the damaged artery.

ResultsPlus
Examiner Comments

The first sentence uses the data provided appropriately to gain the first marking point. However, the reference to damage to the artery wall was not sufficient for the second marking point.

Question 10 (a) (ii)

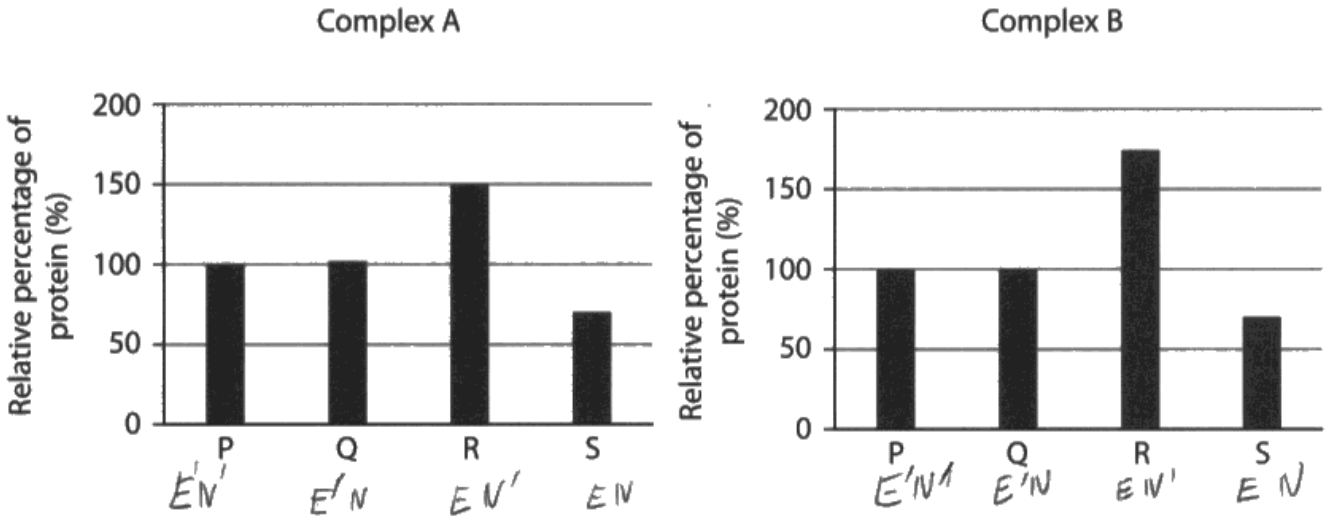
In this item, two graphs were presented that showed how exercise and nandrolone can affect the relative percentage of two protein complexes involved in the electron transport chain. Candidates were expected to comment on how nandrolone affected ATP production using this graphical data. The full range of marks was seen.

This is a sound response that focused on one of the two groups of mice provided with nandrolone.

(ii) In investigation 2, some of the cells from the middle layer of the aortas of the mice were removed.

Two protein complexes, A and B, are found in the cells of the middle layer. These protein complexes are involved in the electron transport chain.

The graphs show the relative percentage of these two protein complexes in each group of mice.



Comment on the effects of nandrolone on the production of ATP.

(3)

Groups P and Q both have no change in both ~~the~~ proteins, however ~~however~~ during exercise nandrolone inhibits the production of both proteins which means it slows down the production of ATP at the electron transport chain, so less ~~ETP~~ ATP is produce aerobically.

ResultsPlus
Examiner Comments

In this answer, the emphasis was limited to considering mice that had been given nandrolone and did exercise. However, within this context, the first and fourth marking points were credit worthy.

2 marks were achieved.

Question 10 (a) (iii)

Candidates were provided with a table of data about the quantity of mRNA found per cell taken from the middle layer of the aorta wall of mice belonging to the four groups that were subject to difference treatments. The candidates had to consider why a conclusion made about this data was not valid for all the mice.

The majority of candidates recognised that there was some overlap in the data but often only considered one of the two relevant pairs of overlapping data.

Below is an answer that did not make use of the data provided.

(iii) The transcription factor Tfam is involved in the production of mitochondria.

In investigation 3, some of the cells from the middle layer of the aortas of the mice were removed. The quantity of mRNA per cell coding for Tfam was measured.

The results are shown in the table.

Group	Quantity of mRNA per cell coding for Tfam / a.u.
P	100 ± 20
Q	75 ± 10
R	170 ± 25
S	85 ± 15

A student concluded that nandrolone affects the quantity of mRNA per cell coding for Tfam.

Explain why this conclusion is not valid for all the mice.

(2)

Because all of the mice are different and may have different factors which affect the quantity of mRNA despite nandrolone. These differences could include age and gender.

ResultsPlus
Examiner Comments

No marks could be awarded for this response.

ResultsPlus
Examiner Tip

When data is provided, it is likely to be necessary for a complete answer.

A clear answer that tackled one pair of overlapping data:

(iii) The transcription factor Tfam is involved in the production of mitochondria.

In investigation 3, some of the cells from the middle layer of the aortas of the mice were removed. The quantity of mRNA per cell coding for Tfam was measured.

The results are shown in the table.

Group	Quantity of mRNA per cell coding for Tfam / a.u.
P	100 ± 20
Q	75 ± 10
R	170 ± 25
S	85 ± 15

less mitochondria

A student concluded that nandrolone affects the quantity of mRNA per cell coding for Tfam.

Explain why this conclusion is not valid for all the mice.

(2)

Some of the standard deviations overlap, such as for group Q and group P so ~~these~~ without exercise there is no significant difference between mRNA quantity per cell for those taking nandrolone and those not.

ResultsPlus
Examiner Comments

Whilst the variation in the quantity of mRNA per cell was not given as a standard deviation, it was considered that this was a suitable assumption for candidates to make.

In this case, the credit worthy comparison was between non-exercing mice that were given nandrolone or not given nandrolone.

1 mark was awarded.

Question 10 (b)

In this extended prose item, candidates were asked to discuss the advantages of an exercise programme without nandrolone. Many candidates tackled it carefully, offering considered and logical answers, and there was a good spread of marks across the full range.

This answer limited itself to one element of the three that were available to discuss.

*(b) Analyse the data from these three investigations to discuss the advantages of an exercise programme without nandrolone.

(6)

An exercise programme without nandrolone would allow investigators to isolate and directly identify the impact of exercise on the structure and function of the aorta, production of ATP and quality of mRNA per cell coding for Elastin. The presence of the performance enhancing drug would show unnatural changes in these variables.

An exercise programme without nandrolone will keep elasticity of the aorta high and not damage elastic fibres. This is shown by the fact that in investigation 1, group P and R both had higher mean max. elastic recoil of the aorta with 57% and 80% despite P not ever exercising, because they weren't given nandrolone. However the groups who were given nandrolone had much worse elastic recoil percentages (Q: 38%, S: 53%) illustrating that the groups given nandrolone had weaker, damaged, less elastic aortas. The results also show that in both cases, exercise increased elasticity of the aorta.

ResultsPlus
Examiner Comments

The thrust of this response relates to the amount of elastic recoil in the aorta. As this was relevant, the answer falls within level 1. However, there is no link to why this is an advantage, e.g. a reduced risk of atherosclerosis, so only 1 mark could be awarded.

A strong answer that gains almost all the marks available.

*(b) Analyse the data from these three investigations to discuss the advantages of an exercise programme without nandrolone.

(6)

An exercise programme without nandrolone is beneficial as this is modelled by group R which shows the highest mean maximum recoil in the male aorta which shows that the arteries are elastic and functioning properly so there is a reduced risk of atherosclerosis as a lower blood pressure will mean damage to the endothelial lining is less likely and so atheromas are less likely to form and therefore reduced risks of CHD coronary heart disease and stroke. It is also shown that group R has the highest percentage of Complex A and B proteins found in the aorta by almost 50% more than the groups with nandrolone or without exercise. Having more of these protein complexes as a result of exercise programmes without nandrolone will mean that more ATP can be generated and so people can have more energy and be able to carry out strenuous tasks more easily. Furthermore exercise has the advantage of increasing the sensitivity of muscle cells to insulin which reduces the risk of type 2 diabetes and keeps the HDL : LDL ratio high. Furthermore group R produces the highest quantity of mRNA per cell coding for TFam which is statistically significant as there is no overlap in the standard deviations by at least 25a.u of the other groups tested showing that exercise and no nandrolone has the benefit of producing more mRNA which codes for the transcription factor TFam which can ensure the production of more or more efficient mitochondria which will result in more efficient aerobic respiration so less lactate build up and allows the person to carry out aerobic activity for longer. Investigation 1 shows that the arteries are far more elastic with a maximum recoil of 23% higher than the second compared with exercise and no added nandrolone with the second highest recoil shows that there will be more efficient transport of blood around the body as the arteries can recoil to push the blood to the body cells resulting in more oxygenated blood reaching the respiring cells and so more aerobic respiration and more ATP and so increased athletic performance compared to other groups. **(Total for Question 10 = 14 marks)**

ResultsPlus
Examiner Comments

Initially the response refers to the level of elastic recoil due to exercise and an advantage in this context. Therefore 2 marks can be awarded from level 1 here.

Subsequently, the discussion not only refers to all three studies, but makes sustained links between these studies and the advantages of exercise in terms of respiration and the effect on athletic performance. This moves it through level 2 and into level 3. As such, this answer was given 5 marks.

Paper Summary

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

- make sure you fully appreciate the command word for each question item so that your answers are suitably targeted;
- read the question carefully so you thoroughly understand the context of the question;
- when a question contains information, such as in a table, graph or a diagram, make sure you consider it carefully;
- the mark allocation can be used as a guide to the level of content needed in your response;
- if an answer to a calculation is incorrect, showing your working may enable you to gain some credit;
- time permitting, read through your answers to make sure they are clear;
- make sure your writing is legible at all times.

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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