Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

October 2020

Pearson Edexcel Advanced Level
In Biology A Salters Nuffield (9BN0)
Paper 02: Energy, Exercise and Coordination

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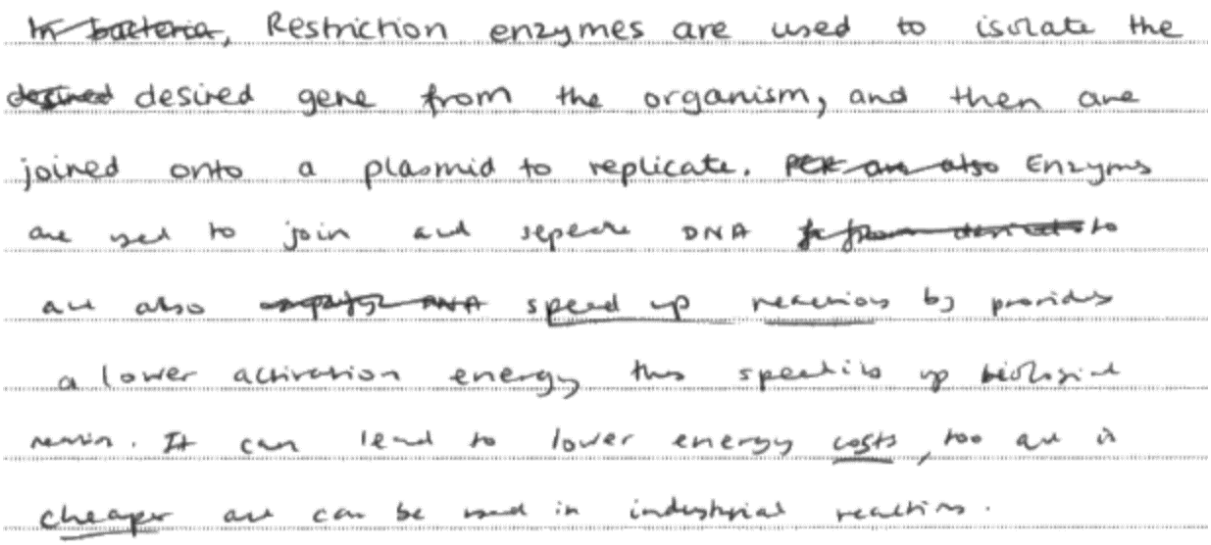
Question 1

(a)(i)
This was a multiple-choice item designed to test candidate knowledge of the term genome. It was encouraging to see that many has a pleasing grasp of this material and appreciated that it included both introns and exons.

(a)(ii)
This multiple-choice item explored which of three types of organism (animal, bacterium and plant) could both supply a gene to be used in genetic modification and could also be genetically modified themselves. Whilst a good number recognised that all three types could be both gene donors and recipients, a range of choices were seen.

(b)
The question related to the production of personalised protein using genetically modified organisms. Whilst there were a number of clear answers, with reference being made to the role of DNA helicase and RNA polymerase, some candidates focused on the genetic modification process.

Examiner Comments
This example was typical of a number of responses where candidates chose to discuss the role of restriction enzymes and ligases in the process of genetic modification, rather than the synthesis of personalised proteins. There is also a general discussion of enzyme action, but not relating to the specific enzymes involved in producing these proteins. No marks could be awarded for this answer.


In bacteria, Restriction enzymes are used to isolate the desired gene from the organism, and then are joined onto a plasmid to replicate. Enzyms are used to join and seperate DNA to and also speed up reactions by providing a lower activation energy this speeds up biological reactions. It can lead to lower energy costs, too as it cheaper are can be used in industrial reactions.

Examiner Tips
Always look to read the question carefully. This one was for a description of protein synthesis rather than genetic modification.

Examiner Comments
This is a clear answer targeting both the enzymes involved and their roles. The first marking point is achieved in the first sentence. The second marking point is found by considering the second and third sentences, whilst the third marking point can be awarded in the third sentence. Three marks given.

The enzyme DNA helicase splits the DNA molecule into two strands by seperating the hydrogen bonds between the bases. RNA polymerase lines up free nucleotides that are complementary to the bases on the template strand. It joins the nucleotides together in condensation reaction to form mRNA molecules which are used for deciding the order of amino acids in the protein produced.

Question 2

(a)
This question item required candidates to recall how to use a spirometer trace to calculate both the respiratory minute volume and oxygen consumption per minute. Some candidates were able to showcase a clear understanding of how to analyse the trace, but a number of answers either did not describe how to do the calculations or did not consider using the trace.

Examiner Comments
This candidate answer starts with a clear description of how to calculate the respiratory ventilation by multiplying tidal volume and the rate of ventilation, so scored the third marking point. However, no mark could be given for stating what the breathing rate was as the question required the candidates to describe how this could be gleaned from the spirometer trace.

In the oxygen consumption component, the candidate has not described how to find the oxygen volume difference from the trace. No reference was made to how to produce a value per minute. Therefore, this response was awarded a total of one mark.

respiratory minute ventilation

respiratory minute ventilation = tidal volume x breathing rate.
Tidal volume - the amount of ~~breath~~ air taken in
Breathing rate - number of breaths per minute.

oxygen consumption per minute

Oxygen consumption can be calculated as a rate of the amount of oxygen used by the body.

(b)
Candidates were required to state two variables that needed to be controlled to enable a valid comparison to be made between two spirometer traces, one from each of a pair of genetically identical twins.

Many gave suitable responses to gain both marks.

Examiner Comments
This candidate considered aspects of the exercise that needed to be maintained as well as offering an environmental variable, so gained both marks.

- length of time exercise lasted
- temperature of the room
- type of exercise done e.g. running on treadmill

(Total for Question 2 = 6 marks)

Examiner Comments

This response only made reference to exercise so could only be awarded one mark.

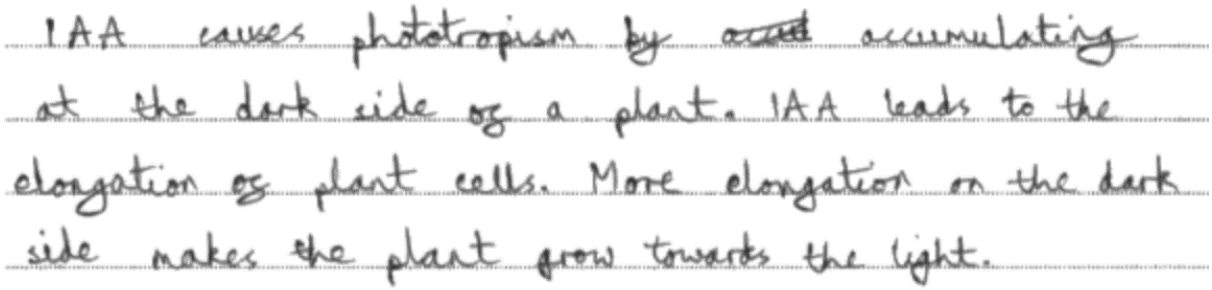
The length of time they exercise for and the type of exercise they're doing.

Question 3

(a)
In this item, candidates had to explain how IAA affected the growth of an oat coleoptile. It was most gratifying to see a number of thorough and detailed responses that displayed pleasing candidate knowledge and understanding.

Examiner Comments
This answer gained two marks. The initial statement refers to phototropism but not that it was a positive response. It was not uncommon to read answers, such as this, that gave their explanation in the context of light from one side.

The second sentence correctly identifies that IAA causes cell elongation for one mark, whilst the final sentence correctly refers to the direction of coleoptile growth in response to light, hence the second mark.

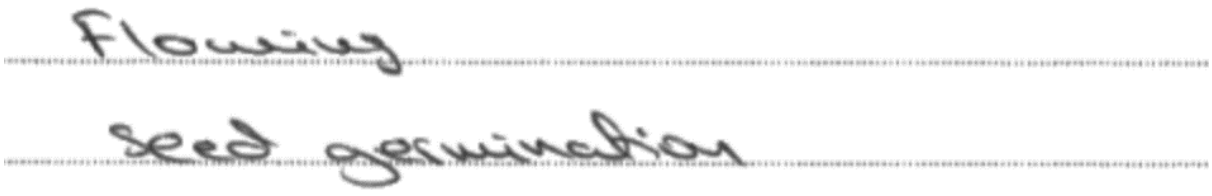


(b)(i)
A good number of candidates knew both the change in phytochrome form and speed of change in the presence of sunlight, so achieved the mark for this multiple-choice item.

(b)(ii)
The majority of candidates knew that phytochrome was a photosensitive pigment.

(b)(iii)
This item asked for an example of a response that was affected by phytochrome. Many clearly knew this, but a number of candidates offered a response relating to IAA.

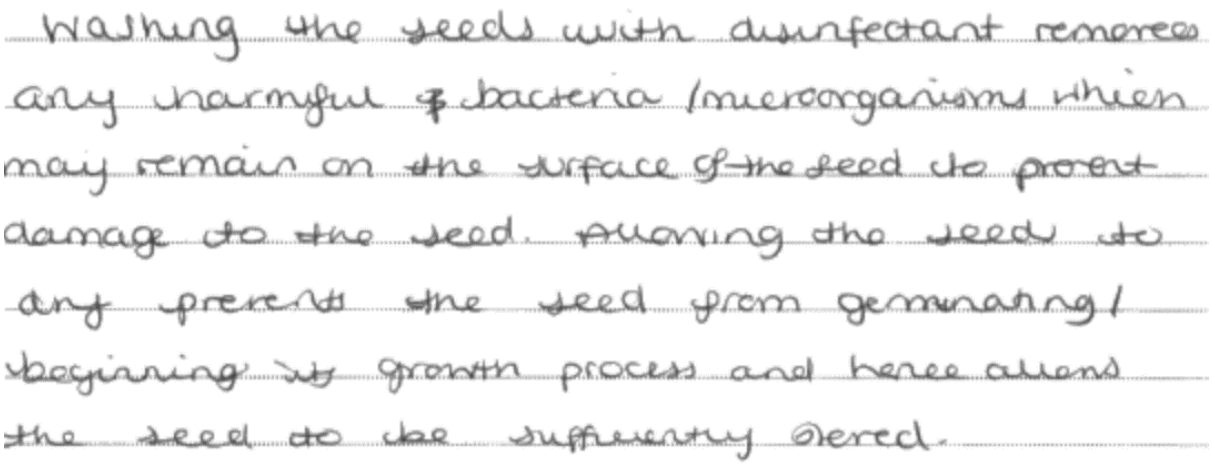
Examiner Comments
This candidate offered two answers, either of which would have been credit worthy on its own. One mark awarded.



Question 4

(a)
Candidates were asked to explain the advantages of two stages in preparing seeds for seed bank storage: washing seeds in disinfectant and allowing the seeds to dry. Many were able to demonstrate a secure appreciation of the roles of these two stages. However, some candidates focused on washing without taking into account that the washing was with disinfectant.

Examiner Comments
This response initially considers the washing stage but does not give an explanation in relation to the disinfectant. However, the latter part of the first sentence can be awarded the third marking point, whilst the second sentence achieves the second marking point, hence two marks awarded.



Examiner Tips
Always make sure that the whole of the question is considered when giving an answer.

(b)
This multiple-choice question required candidates to display a clear grasp of the definition of an organ, which many were able to successfully do.

(c)
This item required candidates to ascertain whether seeds remaining in a container where still viable or not using the data provided. It was most impressive to see many candidates using the data appropriately to determine that they were indeed viable.

Examiner Comments
This candidate response has been set out in a clear manner and gained all three marks.

1g = 20 seeds $\frac{48}{60} \times 100 = 80\%$ (3)
3g = 60 seeds

(1g) $\frac{1000}{50} = 20$ $20 \times 3 = 60$ (3g)

Yes, the remaining seeds in the container are viable as 80% of the seeds in the sample germinated - 5% more than the minimum percentage.

Examiner Tips
Showing your working in calculations may allow some marks to be awarded even if the final answer is incorrect.

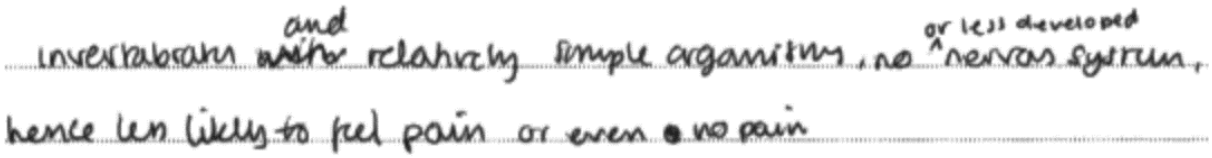
(d)
A multiple-choice question in which candidates had to recall a product of glycolysis. It was pleasing to see that most were able to do so.

Question 5

(a)
In this item, candidates had to offer one reason why some people believe there are fewer ethical issues when using the invertebrate *Daphnia* rather than using a mammal to study the effect of alcohol concentration on heart rate.

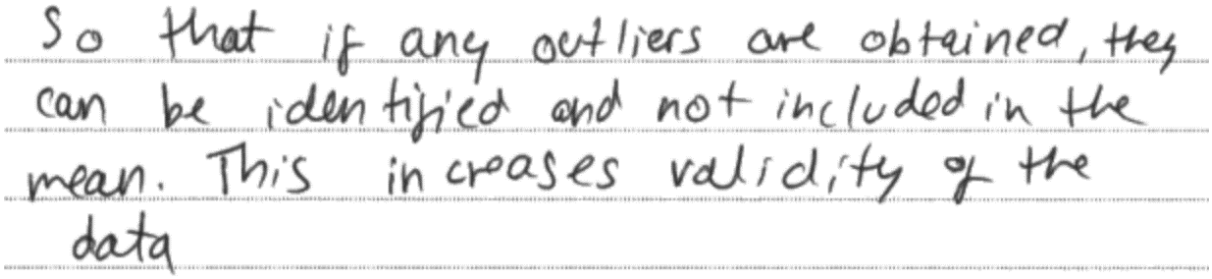
It was apparent that the majority of the candidature had a clear understanding of this ethical issue.

Examiner Comments
This response achieved the mark.



(b)(i)
In the context of the investigation described, candidates had to give a reason why 10 *Daphnia* were used at each alcohol concentration. It was most encouraging to note that many had a good grasp of why the heart rate of multiple *Daphnia* were taken.

Examiner Comments
This candidate answer linked the idea of identifying that any outlier present in the data would be removed before a mean was calculated. A good answer that gained the mark.



(b)(ii)
Candidates had to demonstrate their understanding of why the *Daphnia* had to be left in each alcohol concentration for five minutes prior to heart rate data collection. The majority of the candidature offered a response that gained at least one mark.

Examiner Comments
The reference to the alcohol being absorbed into the *Daphnia* was sufficient for the first marking point in this response. Towards the end of this answer, the candidate gained the second marking point, so two marks can be awarded.

allows sufficient time for alcohol to be absorbed into Daphnias blood stream. (2)
The Daphnias were left for 5 minutes in the alcohol before the heart rate was recorded to ensure that stress was not a factor increasing heart rate and to allow the Daphnia to acclimatise.

(c)
This devise item allowed candidates to produce an investigation to find the lowest alcohol concentration that had an effect on *Daphnia* heart rate.

Many were able to most effectively deliver a clear and accurate answer, a number did not, however, consider how the data table could inform them of the alcohol concentration range to be used.

Examiner Comments
This response makes a clear statement about maintaining one biotic factor in relation to the *Daphnia* so gained the second marking point. However, their second sentence offers an alcohol range that would not enable them to identify the lowest concentration needed so the first marking point was not given. No further mark points were found, so the answer gained one mark.

1) Obtain 50 Daphnias of the same age and split them up into 5 groups of 10

2) Then get 5 different alcohol ~~concentration~~ sample ~~that range~~ with concentrations of 0.00 (control), 0.17, 0.34, 0.51 and 0.68.

3) Suck pieces of cotton wool in each concentration. Then put the Daphnia on ~~them~~ cotton wool with their groups concentration for 5 minutes.

4) After 5 minutes, take them of the cotton wool and record their heart rate every 15 seconds for 1 minute

(Total for Question 5 = 9 marks)

5) ~~Now the~~ After gaining results, calculate the mean for each concentration and put them in a table

6) You should notice that as alcohol concentration increases, ~~so does~~ heart rate decreases. So 0.17 mol dm^{-3} should have the highest heart rate.

Question 6

(a)
Candidates were asked to complete a table by giving the adaptation type for two adaptation descriptions in the context of a wasp species.

Whilst many candidates gained both marks, it was not uncommon to see responses that did not gain the marks available.

Examiner Comments
This example illustrates an answer in which no marks were achieved.

Description of adaptation	Type of adaptation shown by the wasp
knocking its body to signal food	Physical
the stinger	biological & physical

Examiner Comments
This answer gained both marks.

Description of adaptation	Type of adaptation shown by the wasp
knocking its body to signal food	behavioral
the stinger	anatomical

(b)
In this question item, candidates were expected to describe how the structure of an unfamiliar enzyme enabled it to hydrolyse phospholipids.

It was most gratifying to note that many candidates offered considered and suitable descriptions and all the mark points were seen.

Examiner Comments
The first half of the first sentence gains the third marking point. However, as no reference is made to the tertiary shape of the enzyme, the second mark point cannot be given. No further marks were found within this answer.

phospholipase contains an active site complementary to the shape of Phospholipids, allowing it to break it down by hydrolysing it. It contains a water molecule or hydrogen group that can be used to hydrolyse phospholipids. Made up of hydrophobic layer repelling water on inside and hydrophilic layer attracting water on the outside hence creating a bilayer that forms its enzyme structure

(c)(i)
This item requested candidates to offer two functions of the Golgi apparatus. Whilst a minority appeared to confuse the Golgi with another organelle, most were able to successfully offer at least one correct function.

Examiner Comments
This candidate answer offered the first mark point in the first sentence and then gained the second mark point in the second sentence. Both marks given.

- To modify proteins as they pass through the flattened membrane bound sacs.
- To package the proteins into vesicles so they can exit the cell membrane through exocytosis.

Examiner Comments
In this response, it appears as though vesicles and cells have been confused so no mark can be awarded.

- Packages Cells to make them Compact and transports them through the Cell membrane.

Examiner Comments
As there is no reference to protein modification, then only the second mark point is present, so only one mark is achieved.

To package proteins into vesicles and transport them to the cell surface membrane for exocytosis

(c)(ii)
This component required candidates to explain the purpose of each phase of the three-phase drug testing protocol in the development of a phospholipase inhibitor.

Whilst a number of candidates appeared to have a thorough understanding of the purpose of each phase, a minority tried to incorporate animal testing into one of the phases such that they did not necessarily link the correct phase with its purpose or purposes.

Examiner Comments
This response was insufficient to be awarded any marks.

First the drug will have to be tested on animals, mammals to be exact as they have similar functions and organs to humans. Once it is deemed safe for them, then it goes onto human trials.
The first stage of human trials, is testing healthy participant of various ages and genders, The trial will be double blind in order to avoid doctor bias. If it is safe for them and ~~theme~~ cons ~~don't~~ of the drugs don't outweigh the pros, then you move onto patient trials. The third phase is where they test it on patient who suffer from this allergy, they see if it's effects on those who have a phospholipase allergy and if it's safe enough to mass produce.

(Total for Question 6 = 11 marks)

Question 7

(a)(i)
In this item candidates had to deliver an explanation as to why there was no initial change in a person's fingertip temperature despite the person's feet being placed in hot water.

Only a minority of candidates considered the role of the blood and the circulation.

Examiner Comments
The idea of the time delay before the fingertip temperature starts to increase being due to the body adjusting was not an uncommon response but was not often developed, as in this answer. No marks were awarded.

There was no increase in fingertip temp, as her body was still adjusting to the change in core temperature

(a)(ii)
In this question, candidates had to calculate the greatest rate of increase in fingertip temperature.

A good number of candidates identified when the greatest temperature increase occurred using the graph and were then able to successfully calculate the rate.

Examiner Comments
This answer is clear and delivered with appropriate units. Both marks given.

(2)

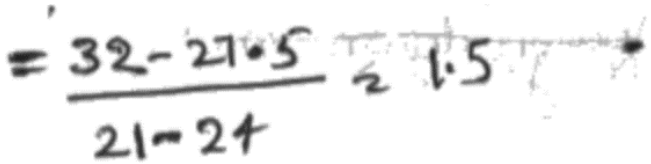
$32 - 27.4 = 4.6$

$\frac{4.6}{3} = 1.53$

Answer 1.53 °C per min

Examiner Comments

This answer showed working and gained the first mark, but the units were incorrect so only one mark was given.



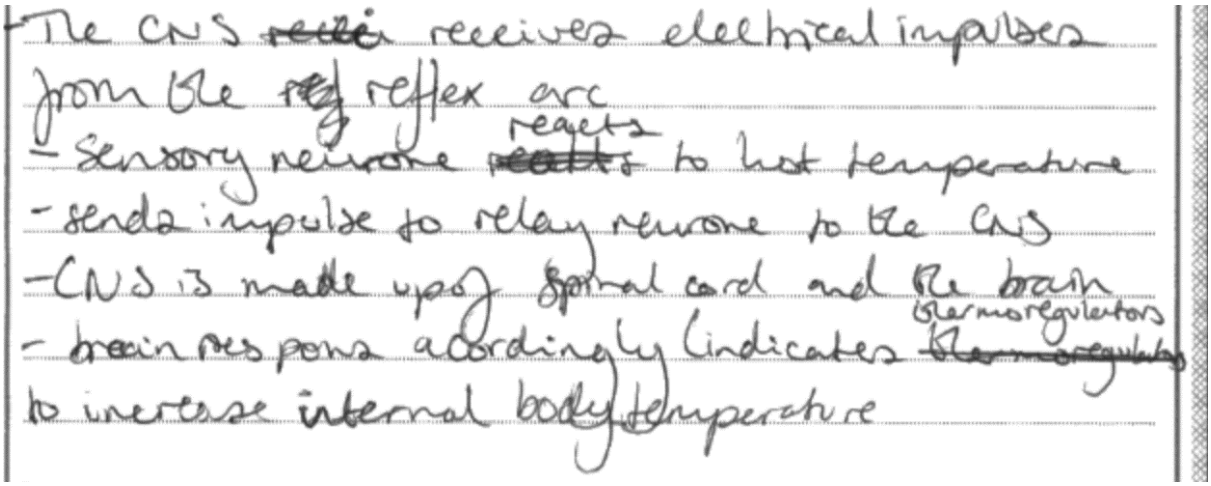
Answer 1·5 %

Examiner Tips
When doing a calculation, always consider the units.

(a)(iii)
The investigation showed that after a time delay, fingertip temperature increased, and candidates were asked to explain the role of the nervous system in bringing this about.

Whilst there were a number of clear and detailed explanations, it was not uncommon to see explanations that considered mechanisms that would have led to a temperature decrease.

Examiner Comments
This answer gives a general overview of a reflex arc and gains no marks.



(b)
Candidates had to justify a statement linking heat loss due to sweating with the dipole nature of water.

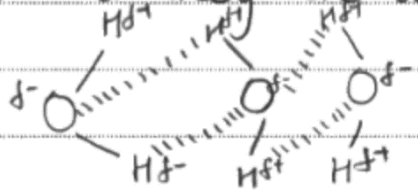
A good number of candidates correctly described the dipole nature of water but fewer were able to then apply this to the context of the question.

Examiner Comments
This response correctly refers to the role of hydrogen bonds between water molecules on the first and second lines so gains the second marking point. No other marks were found.

The dipole nature of water means it is cohesive and so water molecules stick together by hydrogen bonding, hence flow. Therefore sweat as is released in droplets. More sweat released means more heat lost, if released in molecules, there would be no effect.

Examiner Comments
This answer covered both of the first two marking points so gained two marks.

Water molecules are dipole due to the partially positive hydrogen and partially negative oxygen. Hydrogen from one molecule bonds to the oxygen from another molecule - creating a hydrogen bond. When sweating, more water is released as they are attracted to one another.



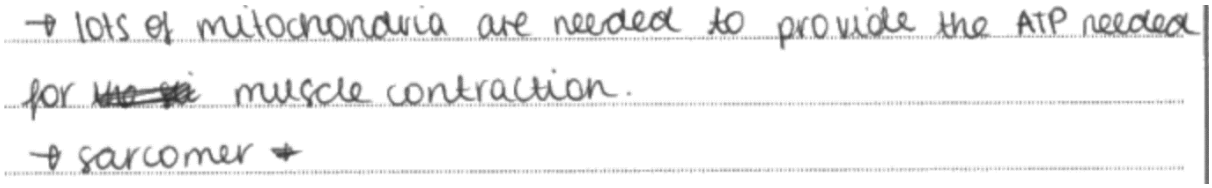
(Total for Question 7 = 12 marks)

Question 8

(a)
In this item, candidates were expected to give an explanation of how the structure of a muscle fibre is related to is function.

It was encouraging to note that candidates made links between structure and function, though few considered either the nature of the sarcolemma or the sarcoplasmic reticulum.

Examiner Comments
This response gained the second marking point in the first line. However, the reference to muscle contraction was not in the context of myofibrils or actin and myosin so only one mark was given.



(b)
A multiple-choice item that tested candidate knowledge of two different types of scan. Most knew this well.

(c)(i)
Candidates had to apply their knowledge of the Hardy-Weinberg equation to data provided on limb-girdle muscular dystrophy.

It was encouraging to see candidates effectively using Hardy-Weinberg to find the number of UK carriers for his rare type of muscular dystrophy.

Examiner Comments
This example delivered an answer within the range required so gained all three marks.

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

$6 \times 66.5 = 399$

$q^2 = \frac{399}{66500000}$

$q = \sqrt{\frac{399}{66500000}}$

$p = 1 - \sqrt{\frac{399}{66500000}}$

$2 \times p \times q = 4.89 \times 10^{-3}$ (3sf)

$4.89 \times 10^{-3} \times 66.5$ million $= 324984$ (nearest person)

Answer 324984

(c)(ii)
In this item candidates had to consider why the frequency of the allele for limb-girdle muscular dystrophy may change from one generation to another.

Examiner Comments
This response offers the most commonly seen correct answer: the first marking point. One mark was awarded.

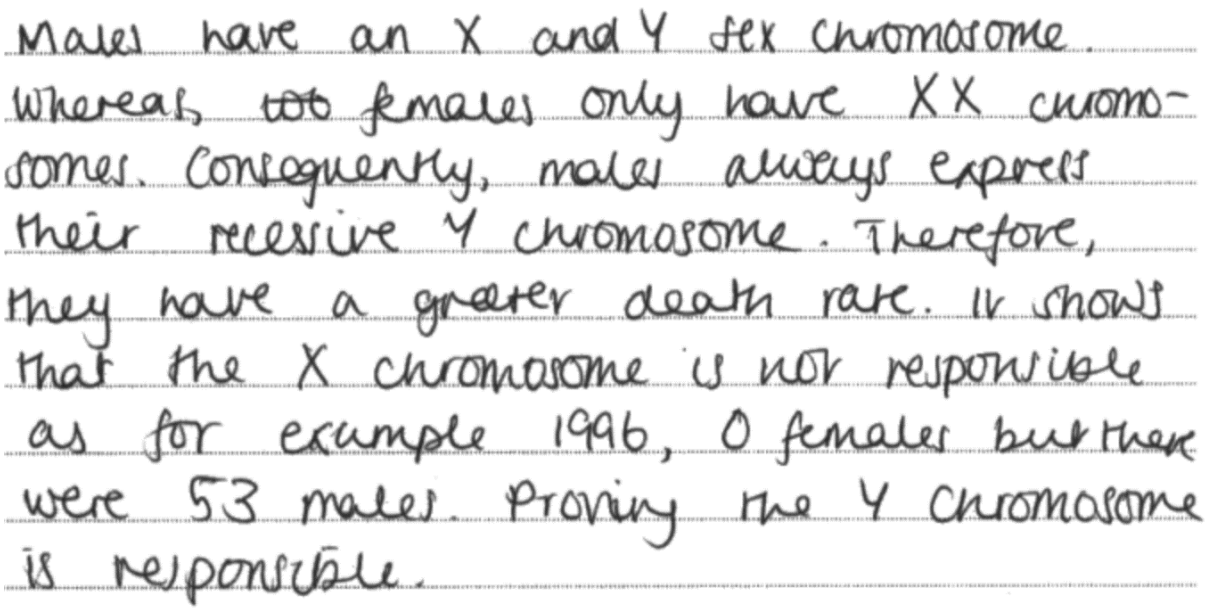
This is because mutations can occur which change the alleles in people. People pass this allele on to children which ... this allele on their children. Which can cause an increase in allele frequencies. So if the allele for LGMD2A is initial due to a mutation people pass this allele on which increases the frequency of the allele

(d)

In this question, candidates were provided with data about the number of deaths in males and females due to Duchenne muscular dystrophy.

In was most pleasing to see that many candidates offered an explanation that considered that the condition was sex-linked. It was rare to see the first marking point.

Examiner Comments
This response starts to consider the relevance of the sex chromosomes in this condition, but no marks could be given.


Males have an X and Y sex chromosome. Whereas, ~~too~~ females only have XX chromosomes. Consequently, males always express their recessive Y chromosome. Therefore, they have a greater death rate. It shows that the X chromosome is not responsible as for example 1996, 0 females but there were 53 males. Proving the Y chromosome is responsible.

Examiner Comments
The initial line described the data, a common starting point for much of the candidature. This response then goes on to explain that it is a sex-linked condition and that males only need one cope of the allele to express Duchenne muscular dystrophy so two marks could be awarded.

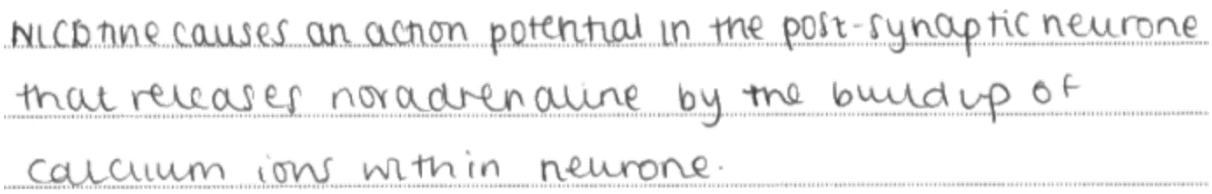
DMD has caused 351 deaths in males while only causing 4 deaths in females in 7 years. There ~~median~~ age is ~~20~~ so ~~they~~ ~~must be young and~~ This means it is a sex linked disease. The allelle is recessive and appears only on the x chromosome meaning women need two copies as they have two XC chromosomes for it to express itself. Men only need one copy for it to express itself as men have only one x chromosome. This means men are much more likely to get it.

Question 9

(a)(i)
Candidates were told, in a flow diagram, that nicotine binds to acetylcholine receptors on the post-synaptic membrane of a neurone. They had to explain how the bound nicotine would cause an action potential to occur in that neurone.

Whilst it was rare to see the first marking point, many candidates displayed an excellent understanding of this process and gained good marks.

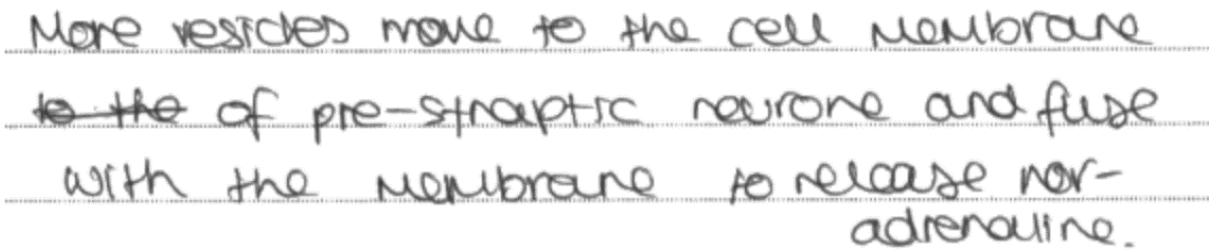
Examiner Comments
This response does not offer an explanation so no marks can be given.



Examiner Tips
Careful note should always be taken of the command word being used in a question.

(a)(ii)
Many candidates displayed a good understanding of the role of calcium ions in neurotransmitter release from the presynaptic membrane and gained the mark in this item.

Examiner Comments
This statement gains the mark.



(b)(i)
In this question, candidates had to determine the maximum rate of decrease in nicotine concentration in blood plasma per minute.

Whilst many did take into account the spread of the data provided in the table, a number did not.

Examiner Comments
This answer did not consider the range of data and then calculated a percentage change, so no marks could be awarded.

(2)

$\frac{\text{decrease}}{\text{original}} \times 100$

$\frac{35 - 24.1}{35} \times 100$

Answer 31.1% ng cm^{-3} min^{-1}

Examiner Comments
This answer sets out the maximum and minumum concentrations and then divides by the time to calculate the correct answer. Both marks given.

$\frac{44.3 - 18.5}{30} = 0.86$ ng cm^{-3} / min (2)

Answer 0.86 ng cm^{-3} min^{-1}

(b)(ii)
Data was provided in this item about the size of the lumen of an artery in response to two different nicotine concentrations. Candidates had to use this to determine the effect of the two concentrations on the percentage change in the first minute.

Some candidates gave clear responses that gained full marks. Many, however, did not consider the percentage change component of the question or that it was restricted to the first minute.

Examiner Comments
This example does not take into account the requirement to determine the percentage change. No marks awarded.

Longer. The higher the concentration the larger the lumen mean diameter after a minute for example Group A at 1.0 mg of nicotine had a mean diameter of 49 MM but Group B at 0.1 mg of nicotine had a mean diameter of 45MM.

(b)(iii)
This item required candidates to analyse all of the investigation data provided relating to rats and nicotine concentration to evaluation a statement. The statement was:

Nicotine gained from smoking cigarettes in humans causes an increase in blood pressure and a decrease in the lumen of arteries.

A wide range of responses were seen, from those that only considered one aspect of the investigation to detailed analyses of all the information given.

Examiner Comments
This response initially considers the effect of nicotine concentration on blood pressure in rats. It then goes onto consider the effect of artery lumen diameter. Whilst these two aspects are discussed, there is no link made between the lumen size due to vasoconstriction and blood pressure. Therefore, three marks were awarded in this instance.

The data for the blood pressure of the rats somewhat supports this statement, Group A which had 10 times the amount of nicotine of Group B, showed a rapid increase in mean blood pressure from 122 to 150 mmHg at 1 minute. Comparatively Group B jumped to only 135 mm Hg at the same time. However, the rest of the blood pressure data shows that after 2 minutes Group A had a lower mean blood pressure than Group B for the ~~remain~~ remaining 28 minutes. Group B showed a steady decline following 2 minutes and at

30 minutes has 122mmHg however, Group ~~B~~ A had a rapid decrease to 113mmHg at 5 minutes and began to steadily increase up to 120mmHg at 30 minutes. ~~The data~~

Alternatively the data for the lumen diameters of Groups A and B appear to totally ~~oppose this~~ oppose this statement. Group A and B both had an initial decrease in ~~the~~ lumen diameter at 0.5 minutes however the lumens of ~~Grou~~ Group A quickly increased. ~~Alt~~ At the same time the lumen diameter of Group B slowly increased to 48 μm which it remained at for the rest of the readings apart from a change at 5 minutes to 52 μm. Group A had ~~on~~ a ~~overall~~ generally higher lumen diameter than Group B, with a total average of 50.4 μm whereas the total average of B was 47.6 μm. Overall there is very little data to verify the statement

Question10

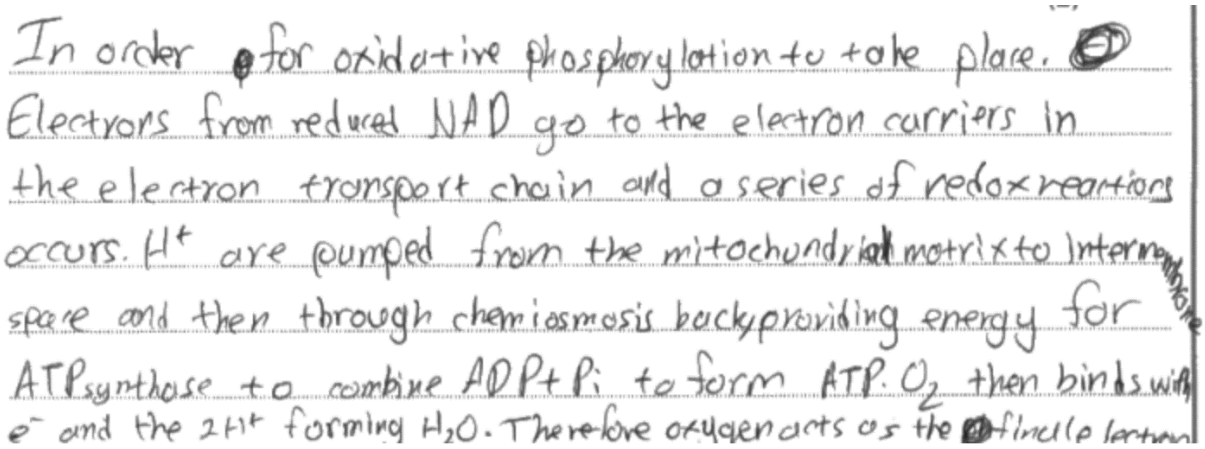
(a)(i)
A multiple-choice question that required candidates to analyse a diagram. Most were able to successfully gain the mark.

(a)(ii)
This multiple-choice item tested candidate recall of the Kreb's cycle. The majority of the candidature selected the correct answer.

(a)(iii)
In this item, candidates were asked to consider why reduced NAD needs to be oxidized within mitochondria.

Many knew what reduced NAD would deliver to the electron transport chain but only a minority considered that once oxidized it could be reused in the Kreb's cycle to keep that process going.

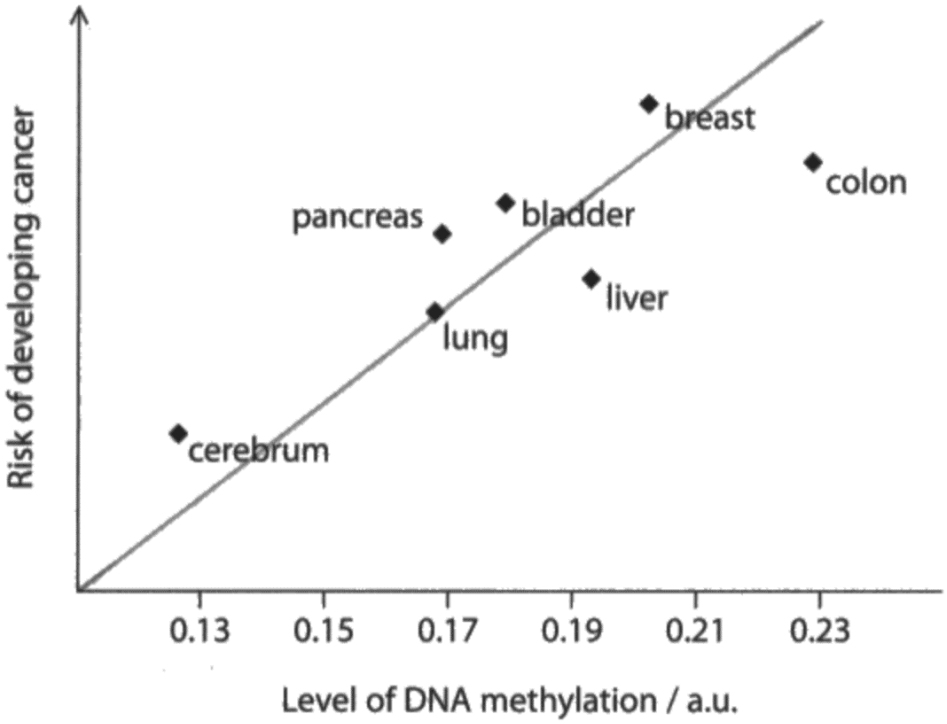
Examiner Comments
This example achieved both marks as it explains the role of the reduced NAD in supplying electrons to the electron transport chain for one mark, and hence the formation of ATP for the second mark.


In order for oxidative phosphorylation to take place. Electrons from reduced NAD go to the electron carriers in the electron transport chain and a series of redox reactions occurs. H^+ are pumped from the mitochondrial matrix to Intermembrane space and then through chemiosmosis back providing energy for ATPsynthase to combine ADP + Pi to form ATP. O_2 then binds with e^- and the $2H^+$ forming H_2O. Therefore oxygen acts as the final electron

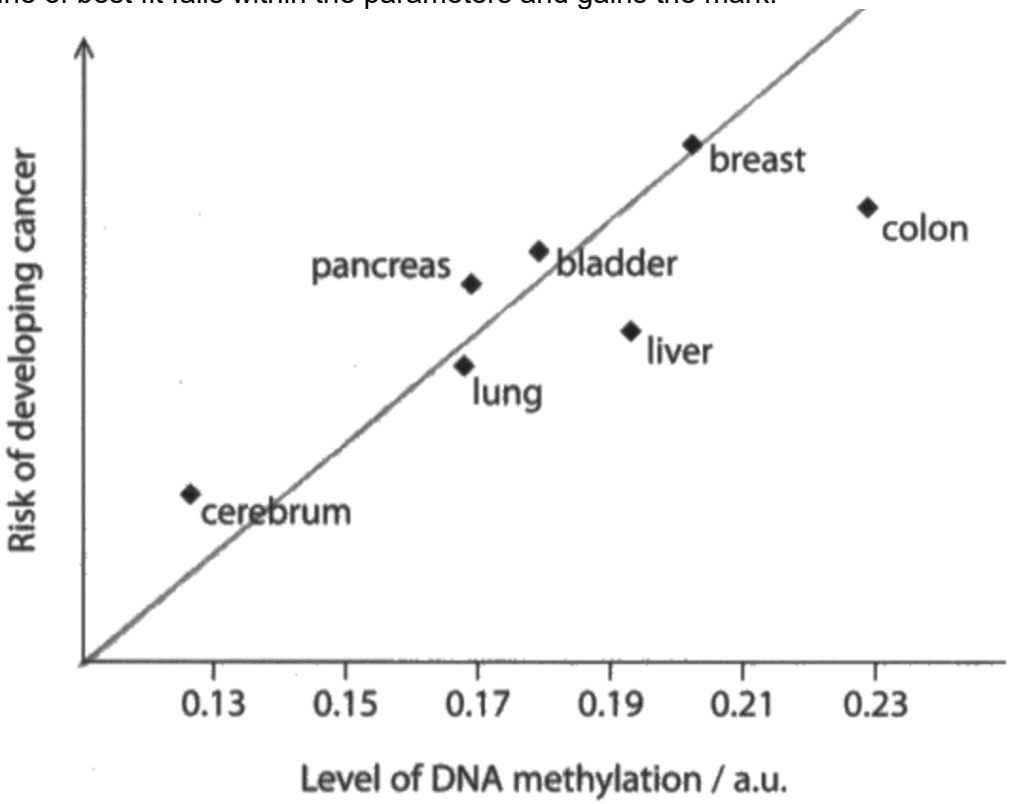
(a)(iv)
A multiple-choice question which required candidates to apply the fact about a mutation in succinate dehydrogenase that made it non-functional to the Kreb's cycle and electron transport chain diagram. A good number where able to apply the information correctly to gain the mark.

(b)(i)
Candidates were requested to add a line of best fit to a graph. Most did so with the line being above the points relating to the risk of developing colon, liver and lung cancer but below the risk points for bladder, breast and pancreatic cancer.

Examiner Comments
This response just did not quite gain the mark as lung cancer risk can be seen to be above the line of best fit.



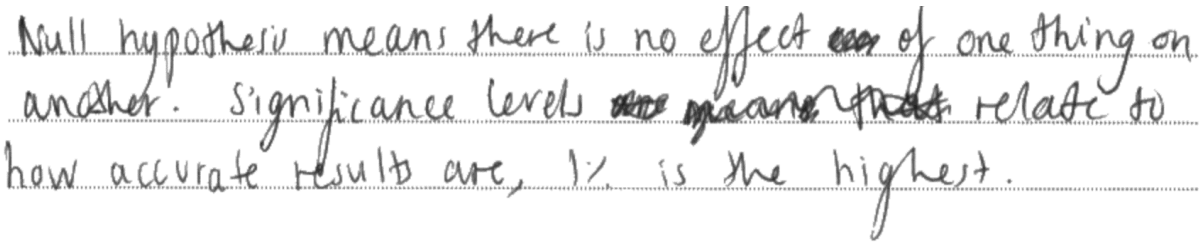
Examiner Comments
This line of best fit falls within the parameters and gains the mark.



(b)(ii)
Candidates had to explain a phrase relating to the rejection of a null hypothesis at the 5% significance level for an investigation studying the effect of age on the mean level of DNA methylation.

Only a minority of candidates demonstrated a thorough understanding of both the null hypothesis and 5% significance level.

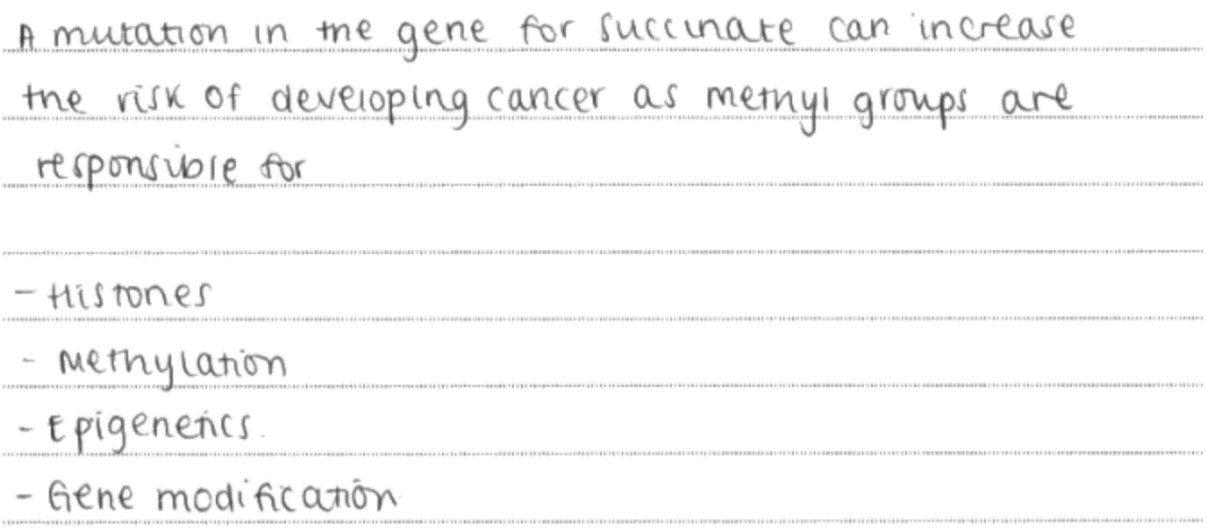
Examiner Comments
This response does not focus on the null hypothesis in terms of the investiation being considered. No marks were awarded.



(b)(iii)
In this question, candidates had to take all the data into account to provide a logical explanation of events to link the risk of developing cancer with a mutation in succinate dehydrogenase.

It was most pleasing to see that a number of candidates delivered considered and detailed responses that elicited the higher marks.

Examiner Comments
This response does not really tackle the question so no marks could be awarded.



Examiner Comments
This is a targeted explanation that was awarded full marks.

(6)

Dehydrogenase breaks down high levels of succinate. ~~Progenitor for TET is a tumour suppressor gene.~~ A mutation such as deletion or substitution can change the sequence of the enzyme's primary structure changing the folding/shape of its active site. ~~The~~ Enzyme cannot bind to succinate via complementary shape. Enzyme-substrate complex does not form. If succinate is not broken down by the enzyme, TET is inhibited and DNA coding for tumour suppressor genes can ~~retain~~ remain methylated, hence not expressed hence causing prolonged mitosis and an increase in ~~risk~~ ~~of~~ developing cancer.

Paper Summary

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

- Make sure you read the whole question thoroughly so that your answer is always targeted
- When data is provided in a question, consider it carefully
- When asked to provide a numerical answer through a calculation, show your working and also consider any units that should accompany it
- Take note of the mark allocation for each question as this can inform you of the level of detail required
- Make sure that you fully appreciate the command words so that each of your answers is suitably focused
- If you have time, read through your answers to check that they are clear and unambiguous
- Take care to make sure your answers are fully legible at all times

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