Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2025

Pearson Edexcel International Advanced Level In Biology (WBI15)
Paper 01 Respiration, Internal Environment, Coordination, and Gene Technology

Introduction

The paper was the eleventh incarnation of the new specification and tested Respiration, Internal Environment, Coordination, and Gene Technology.
The scope of the questions provided a good opportunity for students to demonstrate their knowledge and understanding of these topics.
There was an equal balance between topics 7 and 8.
The questions on this paper yielded a very wide range of responses with some excellent answers given. This resulted in an excellent spread of marks, across the full range (range 15 – 78)

There were few questions that were left blank showing that the paper was accessible. Many students made an attempt at questions on the article which was the final question. However, there were fewer blank questions for the article possibly indicating that time had been allocated for detailed analysis and research of the article. There is clear evidence that some students now are studying the article in detail while others only have a brief experience of it.

There were some straightforward questions demanding recall that yielded high marks across the cohort and some more demanding questions that discriminated well. Multi choice questions were well answered and proved to be a good source of marks particularly for grade E students. Diagrams that needed labelling e.g. 2a were well answered. There were many responses which were well articulated showing excellent use of biological vocabulary in context.

However, it is still evident that some students do not pay sufficient attention to the command word used in the question. This is particularly true of 'describe', 'explain' and 'assess' questions. Appendix 7 in the specification does detail the demands of each command word. This was particularly true og Q8g where many candidates attempted to explain how the energy drinks would lead to irregular heart rhythms.

Graphs relating to novel situations continue to be problematic for students. Many students did not refer to the data provided in the graphs and often failed to appreciate the units for axes of the graph (e.g. insulin question). Responses needing calculations were very varied. However there does seem to be an area that is improving as students become more aware of the nature and demands of this type of question. Clearly this has been a focus of both teaching and practice. Unit conversion and conversion to standard form still present problems to many students. Students need to be careful to follow the instructions in the stem of the question eg. the number of significant figures, or the number of decimal places.

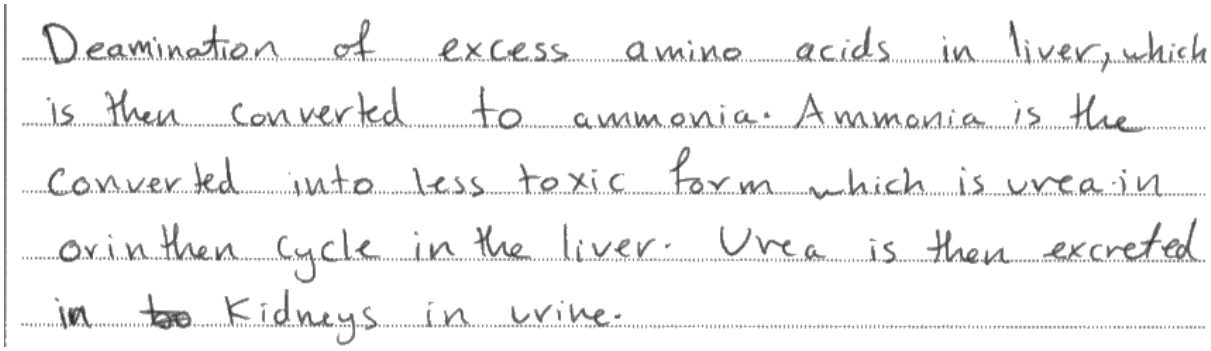
'Suggest' questions offered students the opportunity to show their knowledge and understanding from across the specification.
Questions which demanded analysis, explanation, and application of knowledge to unfamiliar contexts were seen to be more challenging to students and proved to be excellent for discrimination.
A large number of centres are clearly using our mark schemes and examiner reports to prepare students. This is particularly evident where similar mark points have appeared on previous papers. eg. Q2c 'effect of ADH' and 5c 'genetic modification of bacteria'. However,

care must be taken not to just use the points from previous mark schemes without relating it to the context of the current question.

Q1(a)(i) Many candidates struggled with structural formula and consequently did not show the dipedtide with a correct peptide bond. Many who did show a correct structural formula for the peptide bond did not show that water was also a product of this reaction. Candidates should read the question carefully as it did say to draw the 'molecules' formed so this should have been the hint needed to draw the water that is removed.

Q1(b) Candidates showed a clear knowledge of what happens to amino acids that result form the breakdown of excess proteins. The majority of candidates scored full marks here. It was pleasing to see that many candidates referred to the ornithine cycle even though details of the cycle are not required in the specification.
Many students again didn't read the question and talked about the digestion of protein to amino acids, rather than the breakdown of the amino acids themselves. Some went on to talk about transcription, translation and even protein modification.

This is an example of a response that gained full marks.

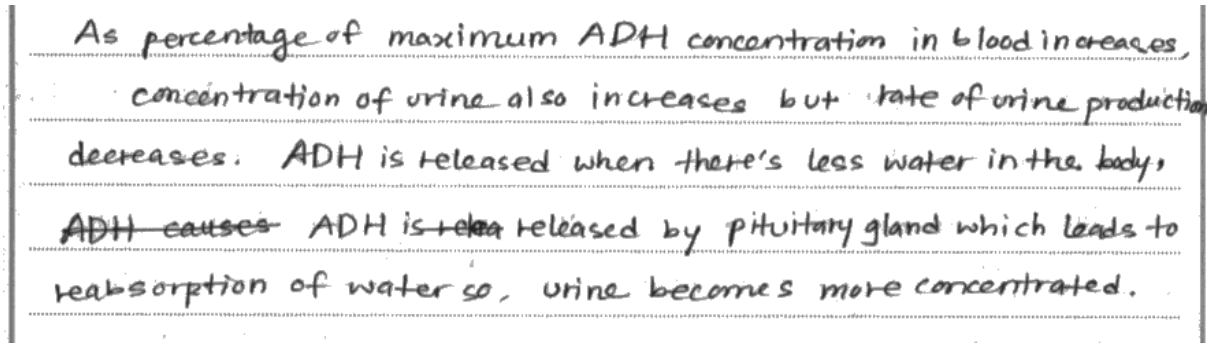

Deamination of excess amino acids in liver, which is then converted to ammonia. Ammonia is the converted into less toxic form which is urea in ornithen cycle in the liver. Urea is then excreted in ~~to~~ Kidneys in urine.

Q2(a) There were a very wide range of responses here. Although the majority of candidates were able to place the pituitary gland and cerebellum correctly the positioning of the hypothalamus was often incorrect. A degree of tolerance was allowed for the positioning of the hypothalamus. Initials for the locations were acceptable (providing they were the correct labels).

Q2(b) Most candidates knew this well and gained all 3 marks. The weak spot was the function of the medulla oblongata, as this was the one they most often got wrong. For the pituitary gland a correctly named hormone was required. As is customary when candidates gave a list of answers the first answer was taken.

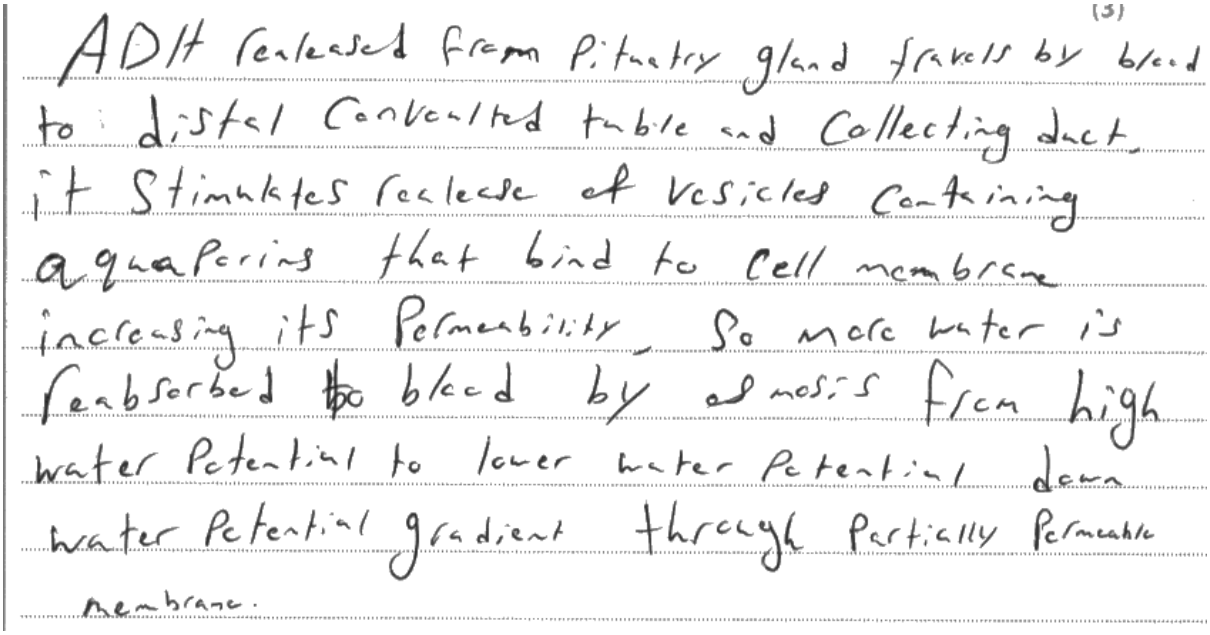
Q3(b)(i) This was a calculation where the total volume of urine produced in one day needed to be calculated using the data in the table. Answers needed to be in standard form. The majority of candidates correctly calculated the volume and gave the answer in standard form. Credit was given for the calculation of urine volume 2160cm^3 . Surprisingly a good number of candidates got the suffix for standard form incorrect eg. 2.16 x 10^{-3} .

Q3(b)(ii) The majority of candidates scored full marks in this question. They showed that they fully understood what the table showed and could accurately represent the relationships. Candidates who did not score highly did not show an appreciation of the difference in the command words 'describe' and 'explain'. It was not a requirement of this question to explain how ADH works.
This is an example of a response that achieved full marks.


As percentage of maximum ADH concentration in blood increases, concentration of urine also increases but rate of urine production decreases. ADH is released when there's less water in the body, ~~ADH causes~~ ADH is ~~rele~~ released by pituitary gland which leads to reabsorption of water so, urine becomes more concentrated.

Q3(c) This question was answered well, and it was clear that candidates had learned this in detail. Most were also able to describe the effect of ADH on aquaporins in the collecting duct and the subsequent impact on the movement of water. As this was an 'explain' question candidates needed to give information and biological detail about the processes involved.

This is an example of a response that achieved full marks.

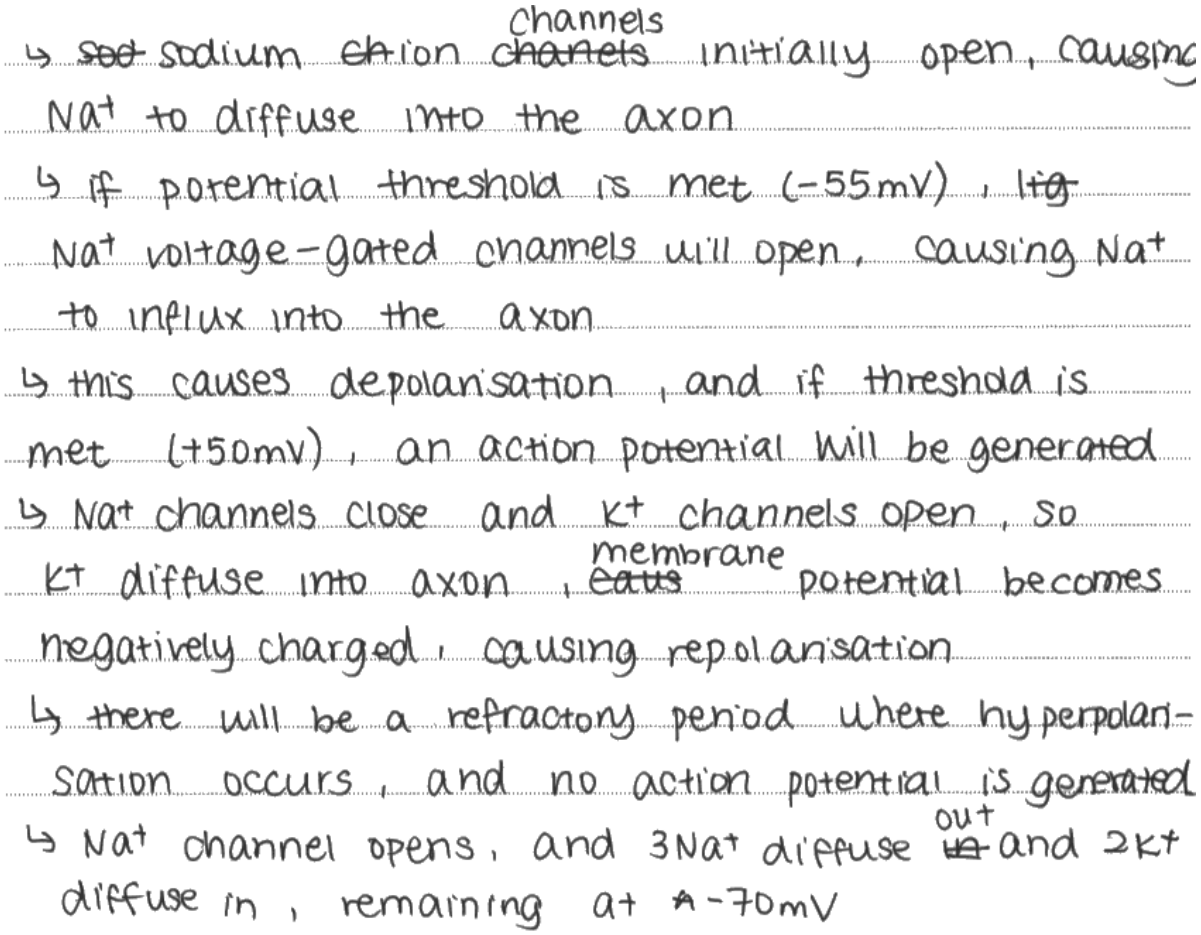

(3)
ADH released from Pituitary gland travels by blood to distal Convoluted tubule and Collecting duct it Stimulates release of vesicles Containing aquaPorins that bind to Cell membrane increasing its Permeability. So more water is reabsorbed to blood by osmosis from high water Potential to lower water Potential down water Potential gradient through Partially Permeable membrane.

Q4(a) There were some really good answers to this question. Candidates are very aware of how the action potential is generated.

MP2 sometimes wasn't credited as the word 'ion' wasn't included, although it invariably was for MP3. Few candidates noted that as a result of positive feedback more sodium ion channels opened. This question discriminated very well.

Candidates are reminded to carefully read the question, as it only asked for how the action potential is generated. Many responses had incredibly detailed descriptions of repolarisation and hyperpolarisation which was not required in the question and would have wasted a lot of time and gained no credit.

This is an example of a response that gained full marks.



Q4(b) This was a calculation where candidates had to calculate the maximum rate of increase in permeability to potassium ions. Essentially candidates need to work out the gradient of the upward part of the curve. The answer had to be given to two significant figures and with appropriate units. Many candidates struggled to calculate the gradient and even more did not use appropriate unit. There was an error carried forward mark, but candidates needed to show their working to obtain this. Too often in calculations candidates only put the answer down directly from their calculator without showing any working.

Q4di MP1 invariably achieved but candidates weren't always specific enough for MP2

Vague references to increased kinetic energy, or the impact of temperature on enzyme activity were frequently given but not credited. Candidates also said that impulse speed increased because the action potential was generated quicker or saltatory conduction happened faster without reference to ions.

This is an example of a response that gained full marks.

As temperature increases, the speed of nerve impulse increases, due to higher kinetic energy
So voltage gated channels open and close faster and ions move faster, and faster neurotransmitter release by exocytosis in the cleft. faster move of neurotransmiter in cleft and bind to receptors on post synaptic neurone

Q4(d)(ii) Candidates had no issues here. Most candidates scored 2 marks for MP1 and 2
The really good answers compared the effect of myelination vs axon diameter, securing MP3.

Q5(a) Candidates needed to state the meaning of the term homeostasis. The majority of candidates had no problem coming up with a definition which included maintaining, controlling or regulating. A few candidates only referred to specific examples where homeostasis occurs e.g. body temperature, osmoregulation. These did not gain credit.

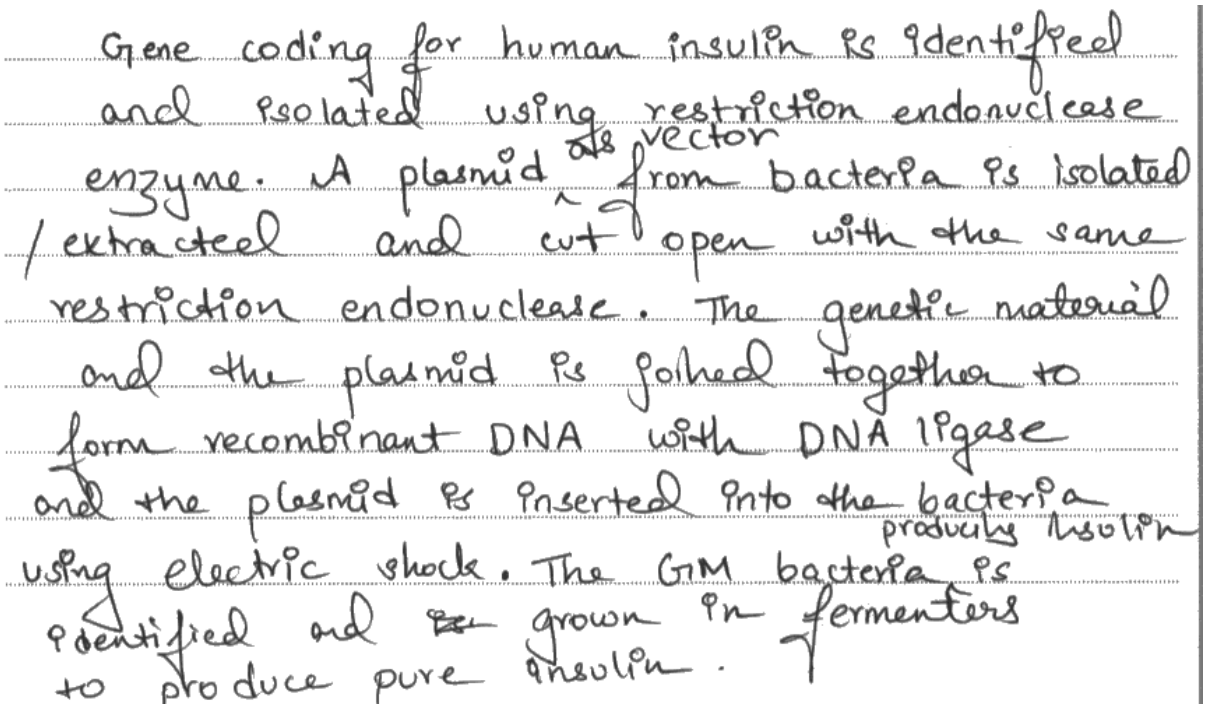
Q5(b) The majority of candidates correctly interpreted the graph and were able to come up with appropriate similarities and differences between the trained and untrained. Several candidates did not realise that the vertical scale was negative. Also, it was surprising to see candidates refer to times other than 50 minutes. 50 seconds were seen on several occasions. It pays to take heed of the unit for the axes on the graph.

This is an example of a response which scored 3 marks:

- both trained and untrained individuals have a decrease ~~(-)~~ in ~~% change~~ percentage change in insulin concentration as the exercise duration increases
- rate of percentage change of insulin concentration decreases for both individuals after 50 minutes of exercise
- ~~untrained~~ the untrained individual has a greater percentage change (decrease) in insulin concentration than the trained individual at all times during the exercise

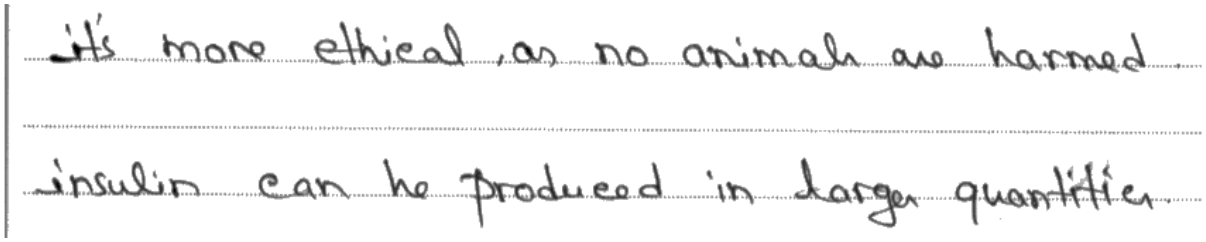
Q5(c)(i) Candidates had clearly benefited from studying previous mark schemes as this topic had been tested in recent exam sessions. However, it is important that candidates pay attention to the detail given in the question stem so that their answers are in context. MP1 was seldom seen as most referred to gene rather than genes / two genes. Most candidates obtained MPs 2,3 and 4.

This response gained 3 marks.


Gene coding for human insulin is identified and isolated using restriction endonuclease enzyme. A plasmid as vector from bacteria is isolated / extracted and cut open with the same restriction endonuclease. The genetic material and the plasmid is joined together to form recombinant DNA with DNA ligase and the plasmid is inserted into the bacteria producing insulin using electric shock. The GM bacteria is identified and grown in fermenters to produce pure insulin.

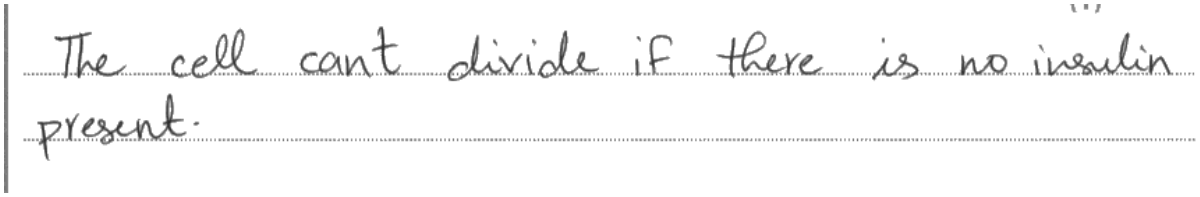
Q5(c)(ii) Candidates needed to suggest two advantages of producing human insulin using genetically modified bacteria. This was a very open question, but candidates did need to specific in their responses. It was surprising that full marks were not given more often. Too often specific terms were used e.g. ethical without any explanation or qualification. Merely stating the word gained no credit. The other issue many candidates referred to the bacteria rather than the insulin. There was no credit for bacteria grow faster, nor bacteria can be produced in larger quantities.

This response gained full marks.


it's more ethical, as no animals are harmed

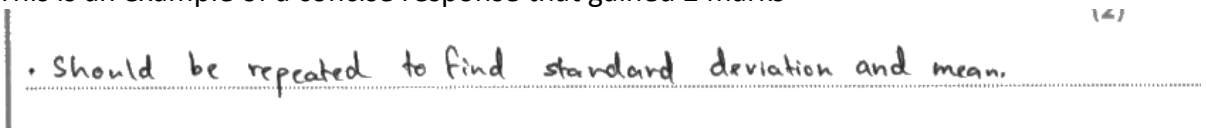
insulin can be produced in larger quantities

Q5(d)(i) Most candidates came up with a creditworthy response here e.g.


The cell can't divide if there is no insulin present.

Q5(d)(ii) Most candidates were able to state that the experiment / concentration would be repeated. Just about all students achieved MP1 but many stopped there, often getting the mark multiple times by saying repeats and then calculating a mean.
Quite a few talked about repeating the experiment and then finding the highest and lowest values in order to plot the error bars without reference to SD calculation
Some responses were very concise but obtained full marks.

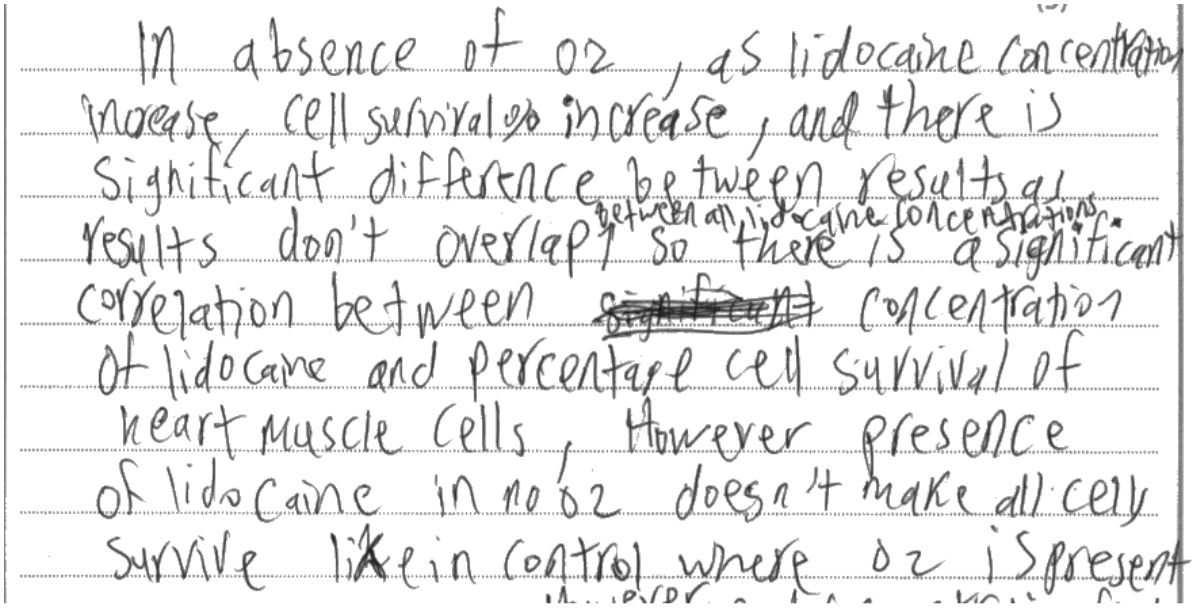
This is an example of a concise response that gained 2 marks



Q5(d)(iii) Candidates struggled to put over their ideas about how the error bars could be used to interpret the results of the investigation. There were hardly any responses comparing the size / overlap of the error bars. The majority had a go at commenting on overlapping / non overlapping error bars with an appropriate comment on significant difference. Several candidates omitted the difference / different which was required for the mark.

Q6(b)(i) MP2 normally achieved so most students got at least 1 mark.
Candidates should be reminded what non-overlapping error bars mean. Some merely stated it meant result was significant rather than significantly different, and some linked to validity and reliability which was not creditworthy. It is also important to make it clear which parts of the data they are referring. This question was very good at discriminating between candidates.

This is an example of a response that got 3 marks.



(i) Assess the effects of lidocaine on cell survival.

the low oxygen concentration cause decrease in % of cell survival. (3)

By increasing Concentration of lidocaine, the Percentage cell Survival increases. 0.01 $mol\,dm^{-3}$ of lodocaine is most effective as it Caused highest number of cells to Survive similar to the control group. Also no overlapping of error bars, So it means there is significant difference between values. # lidocaine increases survival as it causes paralysis of Cell and it's unable to move due to preventing initiation of action potential in muscles. So no muscle contraction and cell will not need energy large amounts of ATP so it cope with low concentration of lidocaine oxygen.

Q6(b)(iii) Candidates used the information given in the question stem and graph to come up with some very valid responses. MP1 achieved by vast majority, often in association with MP2 where many students stopped without expanding on the impact less muscle contraction would have on oxygen/ATP demand.

This is an example of a response that obtained full marks.

Lidocaine blocks impulses by binding to receptors on the postsynaptic membrane. Through that, the sodium ions cannot be released and no impulse can be carried through the neurone. ~~The heart muscle cells therefore cannot~~

If oxygen is low, it cannot act as the final electron acceptor in the Electron transport chain. Therefore, the heart muscles contract slower, as the ATP is low as well.

Q6(c)* This was the level-based question. Candidates were provided with data on cardiovascular disease and heart rate of athletes and non-athletes during exercise. Candidates were asked to discuss how exercise reduces the risk of death from CVD. They had to use their own knowledge and the information in the question to support their answer.

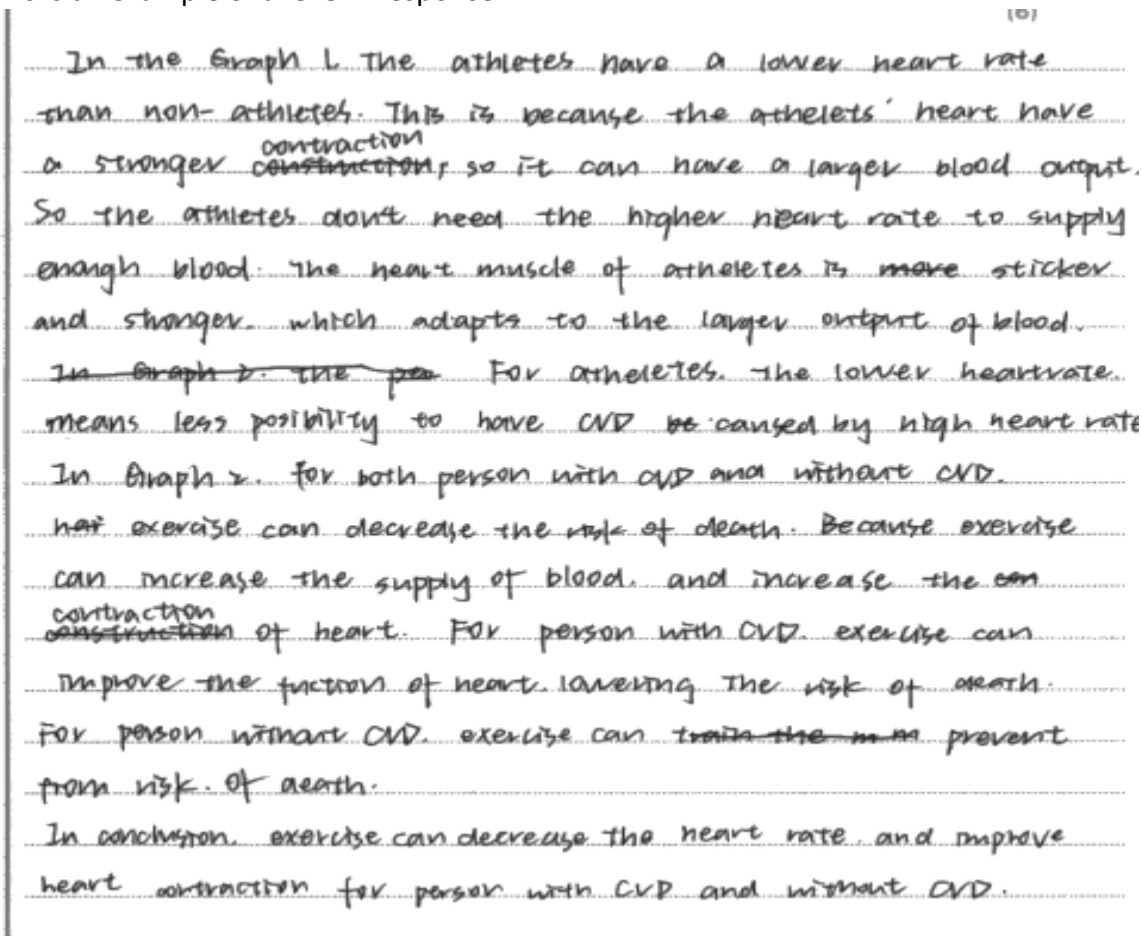
Candidates are becoming more experienced in the demands of this level-based question format. Responses are improving with many more level 3 responses. Care does need to be taken to ensure that the focus of the question is answered. Several responses made no reference to exercise. Level 1 responses really only described the data from the two graphs.

This is an example of a response which scored 6 marks:

Athletes have lower heart rate than non athletes As athletes have stronger cardiac muscle results from years of training this results in higher stroke volume and higher cardiac output. Increasing exercise, decreases risk of death from CVD as during exercise, heart rate increases leading to sufficient blood flow. So more oxygen and glucose reach heart leading to more aerobic respiration so more ATP produced. Moreover, exercise increases breakdown of fats so less accumulation of cholesterol occur so less atheroma which prevents narrowing of endothelium of blood vessels to which increases blood flow. Increasing exercise, reduces resting heart rate as athletes have lower heart rate than non athletes so this reduces hypertension so which prevents endothelial damage and inflammation. Exercise increases lung capacity. increasing exercise duration decreases risk of death for more in person with CVD

(Total for Question 6 = 13 marks)

This is an example of a level 2 response.

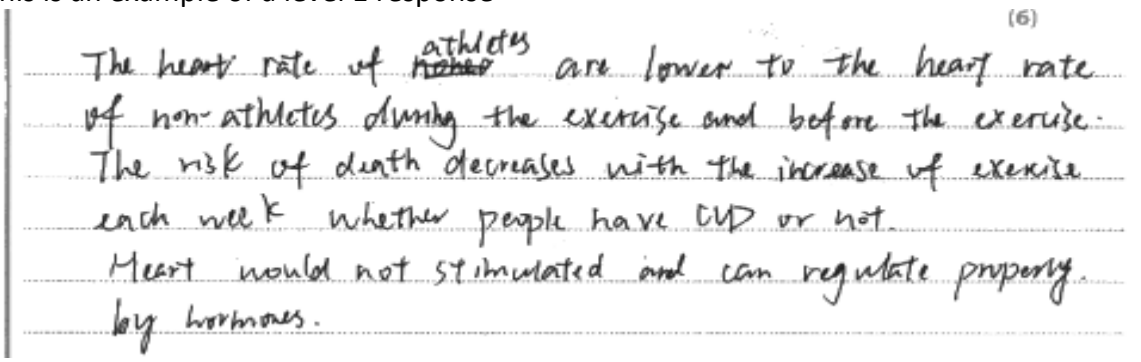


(6)

In the Graph 1 The athletes have a lower heart rate than non-athletes. This is because the athelets' heart have a stronger ~~construction~~ contraction, so it can have a larger blood output. So the athletes don't need the higher heart rate to supply enough blood. The heart muscle of athelctes is ~~more~~ stricker and stronger. which adapts to the larger output of blood. ~~In Graph 2. the pea~~ For athelctes. the lower heartrate means less positivity to have CVD ~~be~~ caused by high heart rate In Graph 2. for both person with CVD and without CVD. ~~not~~ exercise can decrease the ~~risk~~ of death. Because exercise can increase the supply of blood. and increase the ~~con~~ contraction ~~construction~~ of heart. For person with CVD. exercise can improve the fuction of heart. lowering The risk of death. For person without CVD. exercise can ~~train the m~~ prevent from risk. of death.

In conclusion. exercise can decrease the heart rate. and improve heart contraction for person with CVD and without CVD.

This is an example of a level 1 response



(6)

The heart rate of ~~none~~ athletes are lower to the heart rate of non-athletes during the exercise and before the exercise. The risk of death decreases with the increase of exercise each week whether people have CVD or not.

Heart would not stimulated and can regulate properly. by hormones.

<u>Q7(a)(i) and 7(a)(ii)</u> Candidates had no problem with identifying the type of microscope used to obtain the micrograph. A number did not gain credit as they stated electric, electronic, electrical or just E.

With the calculation of the width of the mitochondrion most candidates measured correctly (within the acceptable range). However, conversion from mm to µm continue to present problems. A few candidates did not follow the instruction in the question stem to give the answer to three significant figures even though it was emboldened in the question stem.

Q7(c) This question was very well answered. A few candidates lost credit for saying (reduced) NADP. As the question asked for three products of Krebs cycle the first three answers given by the candidate was taken.

Q7(d) Most candidates were able to obtain MPs 1 and 2 by describing the relationships from the graph. Very few made a comment linking increased demand for ATP to a named cell activity or cell process. Many candidates made an attempt at a suitable comment on the error bars. However, to gain credit the comment needed to be specific e.g. error bars for number of mitochondria do not overlap so results are significantly different or error bars for concentration of ATP overlap {1-3 days /5-7days/7-10 days} so results not significantly different. (although like in 6bi, some students struggled to articulate what overlapping/non-overlapping error bars meant).
There were some very appropriate comments on the lack of data. This question proved to discriminate extremely well.

These are examples of responses that gained full marks.

1. Positive correlation between days after cell division and number of mitochondria
2. Positive correlation between days after cell division and concentration of ATP.
3. Number of mitochondria increases more when days after cell division increases.
4. Great amount of mitochondria do not produce great amount of ATP.
5. Positive correlation between number of mitochondria and ATP concentration.
6. SD in the first graph do not overlap, so there are significant differences on number of mitochondria on different days.
7. SD in the second graph, between day 1 and 3, and in day 5 to day 10, overlap, so no significant ~~different~~ differences shown in ATP levels.

- The number of mitochondria slowly increased for the first 5 days, but increased by significantly higher numbers after the first 5 days
- The concentration of ATP increased steadily throughout the 10 days
- s.d. does not overlap for mitochondria, which means difference between results were significant
- s.d. overlaps for ATP, which means difference between results were significant.
- concentration of ATP ~~was~~ positively correlates to number of mitochondria
- ~~mito~~ increasing number of mitochondria is necessary for sustaining growing neurone and energy for impulse transmission (ATP production)
- ATP is regularly consumed by growing neurone for growth and energy for transmitting nerve impulses

Q8(a) The majority of candidates came up with an appropriate reason why 'optimal hydration' is beneficial. This question was very open, and some candidates came up with ingenious suggestions which did gain credit. However, a significant minority just added to prevent dehydration which was not sufficient to gain credit.

Q8(b) Candidates most frequently only gained MP3 and 4. They missed the first two-mark points as their explanation started in the brain. It was hoped that candidates would realise that caffeine would need to be ingested after drinking and then absorbed into the blood before crossing the blood-brain barrier.

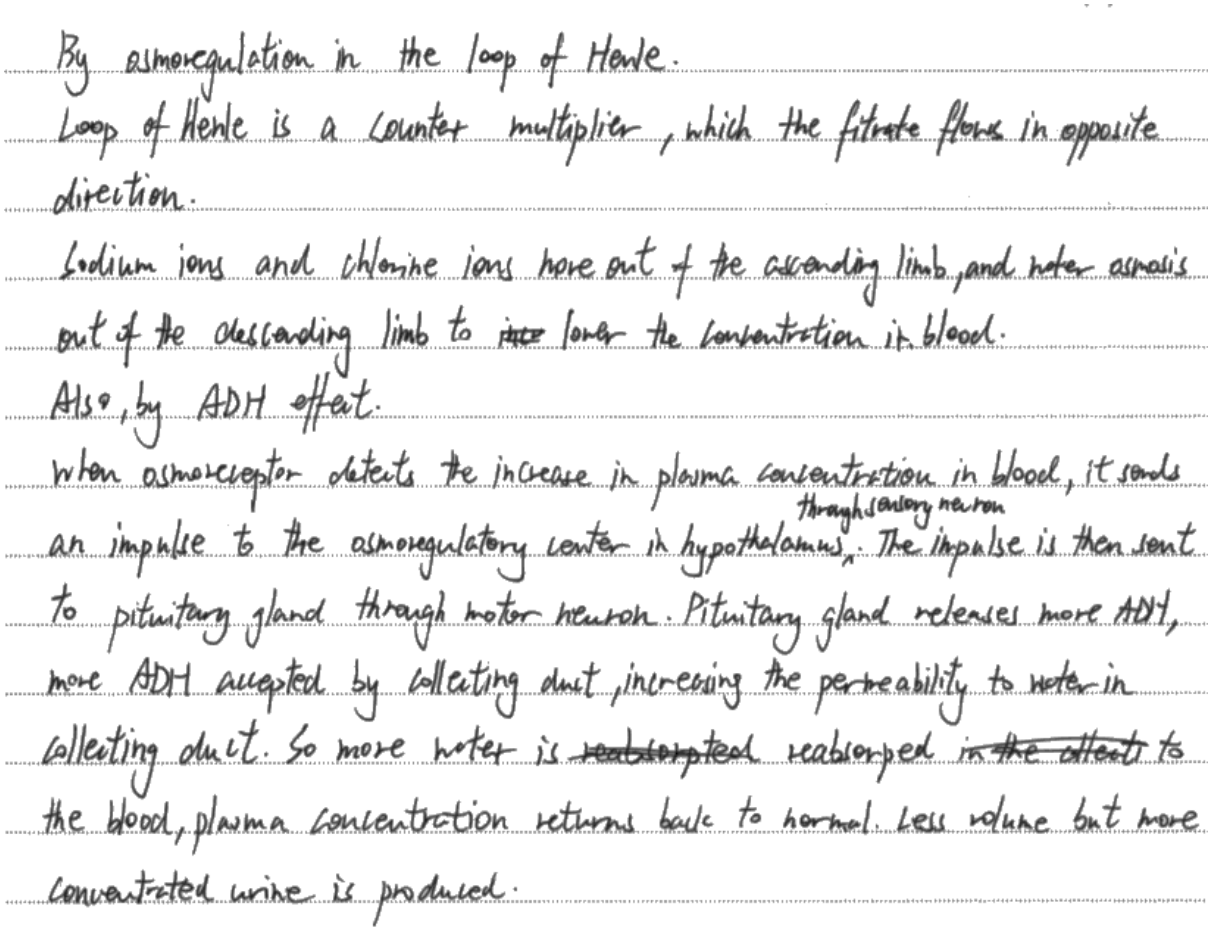
This is an example of a response that gained full marks.

- caffeine in energy drinks is similar to natural caffeine
- caffeine can pass blood brain barrier and go to brain and bind to caffeine receptors in brain opening Na^+ channels allowing Na^+ to diffuse into postsynaptic membrane leading to more depolarisations and action potentials in postsynaptic membrane so more nerve impulses going to parts of brain controling mood, consentration and sleepiness

Q8(c) This was another open-ended question where candidates had to give one reason why a 'typical man' has a larger daily requirement for water compared with a 'typical woman' and then explain why. Generally, this was done very well.

Q8(d) This question proved incredibly challenging to candidates and was low scoring in many cases. MP1 was often missed as instead of homeostasis or osmoregulation, they referred to negative feedback. MP2 was often not credited as, although they mentioned osmoreceptors in the hypothalamus, instead of making reference to water potential they spoke about concentration of Na^+/blood meaning they couldn't gain the mark. Some very in-depth responses about transport of ions out of the nephron in the PCT, and then counter-current multiplier in the loop of Henle.

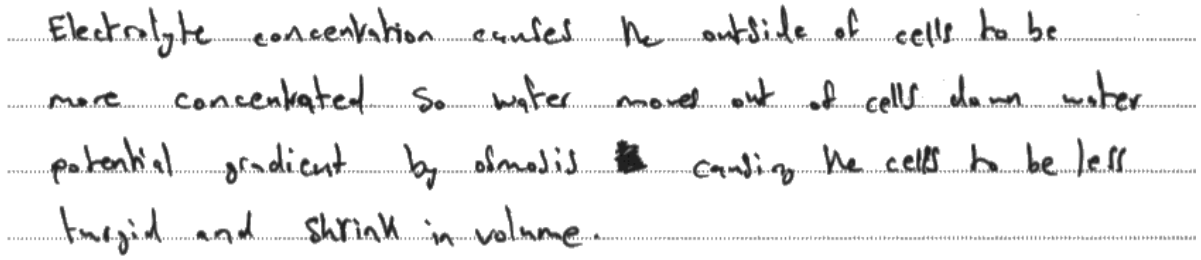
This is an example of a response that achieved 5 marks.


By osmoregulation in the loop of Henle.
Loop of Henle is a counter multiplier, which the filtrate flows in opposite direction.
Sodium ions and chlorine ions move out of the ascending limb, and water osmosis out of the descending limb to ~~into~~ lower the concentration in blood.
Also, by ADH effect.
When osmoreceptor detects the increase in plasma concentration in blood, it sends an impulse to the osmoregulatory center in hypothalamus through sensory neuron. The impulse is then sent to pituitary gland through motor neuron. Pituitary gland releases more ADH, more ADH accepted by collecting duct, increasing the permeability to water in collecting duct. So more water is ~~reabsorpted~~ reabsorped ~~in the effect~~ to the blood, plasma concentration returns back to normal. Less volume but more concentrated urine is produced.

Q8(e) MP2 was mainly given for the additional guidance, especially water moving down a water potential gradient.

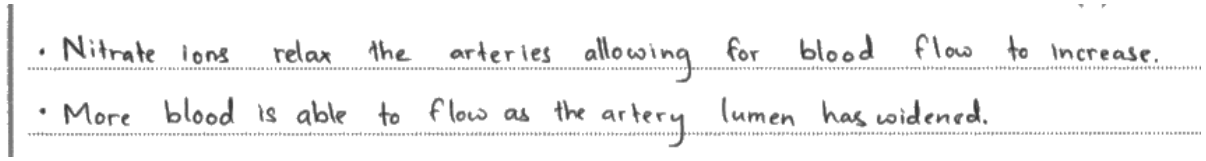
Candidates showed a good understanding of water movement and use of the word 'osmosis'. A number of candidates didn't get MP2 because they just said the increase in electrolytes decreased the water potential of the blood rather than making a comparative statement. Candidates must remember when talking about osmosis to refer to the water concentration gradient or water potential rather than just the concentration gradient.

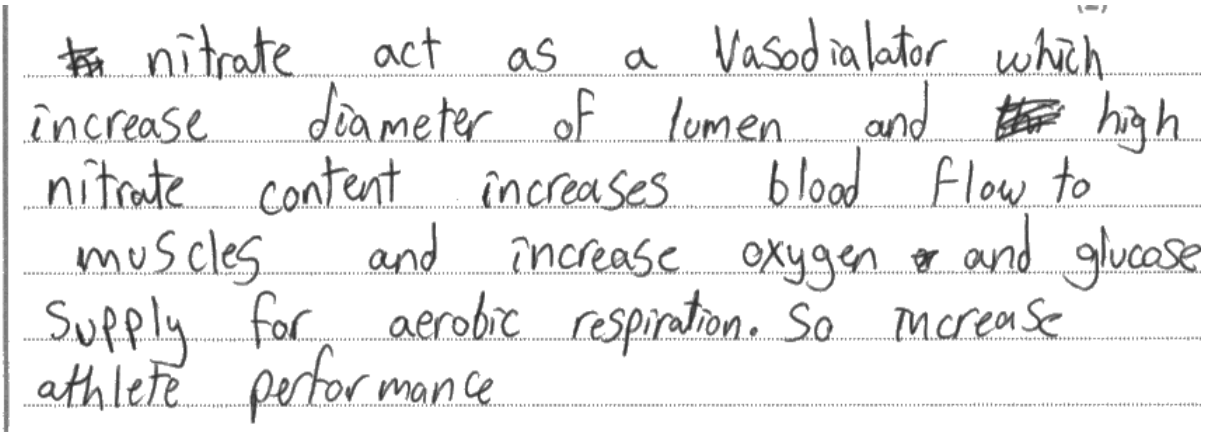
This is an example of a response that achieved full marks.



Q8(f) Candidates did not score highly here. The most common answer was vasodilation (MP3). Some candidates talked about the nitrate being used to make more amino acids/proteins and thus muscle thereby contributing to muscle growth. This was then linked to increased flow of blood to the muscle, in order to provide oxygen and glucose for respiration (for contraction/growth of muscles).

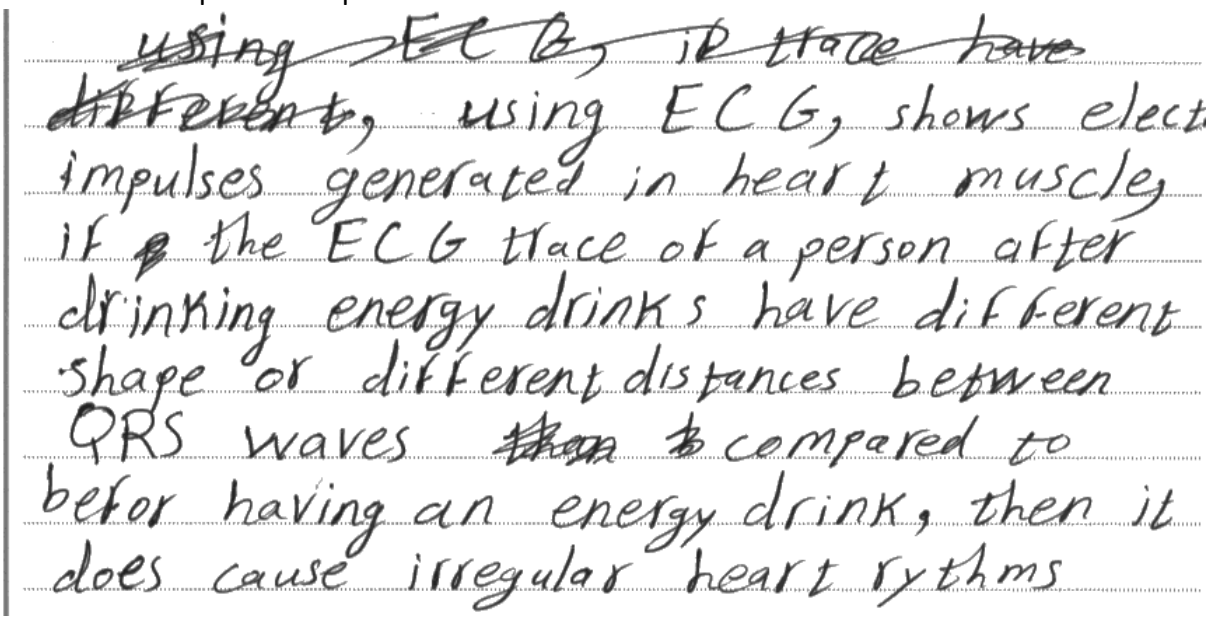
These responses gained full marks.





Q8(g) Many candidates did not read the stem of the question carefully enough nor take heed of the command word 'describe'. A significant number of candidates spent their whole response explaining the effect energy drinks and how it caused irregular heart rhythms. The candidates that did read carefully often achieved full marks. This question was more about experimental design.

This is an example of a response that achieved full marks.


using ECG, it trace have different, using ECG, shows elect impulses generated in heart muscle, if the ECG trace of a person after drinking energy drinks have different shape or different distances between QRS waves to compared to befor having an energy drink, then it does cause irregular heart rythms

Q8(h) In this question candidates had to give one reason why some people are not able to tolerate cow's milk and then explain why. This question was well answered. It was pleasing to see that many candidates linked an inability to breakdown lactose to an absence of a gene that codes for lactase.

Summary

A few suggestions for improving candidate performance are given below:

- candidates need to have time study the article and give sufficient time to answering these questions in an exam.
- candidates need to refer to the command word used in the question and focus their answer in an appropriate manner. Appendix 7 in the specification lists all the command words and their meaning. This is particularly true for explain, describe, and comment on as command words. There were several instances in this paper where the command word was 'describe' yet the candidate response gave an 'explain' answer.
- in level-based questions both graphs need to be used as well as relevant knowledge and understanding.
- in calculations it is better to show the workings as well as an answer. If the answer is incorrect, students may gain some credit for correct working.
- care needs to be taken in the interconversion of units – eg cm^3 to dm^3, and mm to µm.

- also, in calculations care needs to be taken to ensure that the answer is in the required format eg. two significant figures, standard form and the number of decimal places.
- candidates must ensure that their responses are legible. There was a clear increase in writing that was very difficult to read.
- If a candidate puts part of an answer in a place somewhere else on the paper it is vital that the candidate indicates this. A correct page reference would be helpful.
- many 'suggest' questions refer to novel situations. Candidates need to use knowledge from the specification and apply it to this situation in specific terms rather than in generalisations.
- It is good to see that centres are using previous mark schemes to inform candidates. However, it is very important that the candidate answers the question in the context given in the stem of the question.