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June 2023

International Advanced Level Biology WBI15 01

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Introduction

This is the sixth time that the paper has contained only one level based question, based on the new specification. Candidates were provided with extensive stimulus material and they are beginning to understand what is required and how to respond. There were fewer blank scores seen throughout the paper.

The level based question showed far greater Level 3's than previously. Some candidates are still just describing the data that they have been provided with and this will only achieve a Level 1.

The mathematical element to this paper continues to present problems to candidates, whether it is extracting data from a graph or table, interconverting units or following the instructions in the rubric.

The article was demanding both in terms of science and the language used. It really does need to be studied before the examination.

Question 1 (a)

The majority of candidates had no problem with this calculation. It was expected that candidates did the calculation to no more than two decimal places. A few used in excess of 4 decimal places. The most common error was using the wrong denominator. It is advisable in all calculation questions to show working as even if the final answer is incorrect, some credit may be gained within the workings.

1 The human eye responds to different light intensities.

(a) The table shows the mean pupil diameter in different light intensities.

Light intensity	Pupil diameter / mm
bright light	3.35
normal room light	3.86
darkness	6.41

Calculate the percentage increase in the mean diameter of the pupil when a person moves from bright light into darkness.

(1)

$6.41 - 3.35 = 3.16$

$\frac{3.16}{6.41} \times 100 = 49.29$

$= 49.3$

Answer 49.3 %

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Examiner Comments

A few candidates selected the correct data to calculate the percentage change in pupil size when moving from bright light to darkness but used the wrong denominator to calculate the percentage.

ResultsPlus
Examiner Tip

Always include the workings in any calculation as even if the answer on the answer line is incorrect some credit may be gained through the working.

1 The human eye responds to different light intensities.

(a) The table shows the mean pupil diameter in different light intensities.

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bright light	3.35
normal room light	3.86
darkness	6.41

Calculate the percentage increase in the mean diameter of the pupil when a person moves from bright light into darkness.

(1)

$$6.41 - 3.35 = \frac{3.06}{3.35} \times 100$$

$$= 91.34$$

Answer 91.34%

ResultsPlus
Examiner Comments

Clear working shown with the correct subtraction and division by the correct denominator. The correct answer to two decimal places is on the answer line.

Question 1 (b)(ii)

Many candidates did not appreciate that the question focus was adrenaline. Consequently they gave the story about how the radial and circular muscles changed as light intensities changed. Most candidates correctly suggested that radial muscles contract and circular muscles relax. Candidates need to learn to read the question carefully and adapt their answer to the focus of the question. Few candidates achieved full marks here.

(ii) Describe how this change in diameter is brought about by the muscles of the iris.

(3)

→ Adrenaline hormone is secreted from adrenal glands → transported / moves in the blood.
→ It binds to the iris cells → Acts as a transcription factor → forming secondary messenger → which form a cascade of reactions that forms TIC
→ transcription of a gene occurs → Translation of mRNA occurs.
→ radial muscles contract → Dilator of pupil
→ circular muscles relax → More entry of light
→ More rods & cones stimulated

ResultsPlus
Examiner Comments

This is a very clear response in the context of the question ie adrenaline. The action of the radial and circular muscles is correct. This response gained full marks.

ResultsPlus
Examiner Tip

Candidates should not use the terms signals, messages or information as alternatives to impulses.

(ii) Describe how this change in diameter is brought about by the muscles of the iris.

(3)

An impulse sent by control centres in the brain through the ~~para~~sympathetic nerves to the iris which will stimulate the effectors, in this case the muscles. The ~~ext~~ circular muscles will relax and the radial will contract which will cause the pupil to widen to allow as much light into the retina.

ResultsPlus
Examiner Comments

Although this candidate did not refer to adrenaline the response does explain how the contraction or relaxation of the muscles of the iris is controlled. This response gained full marks.

Question 2 (a)(iii)

Candidates answered this question well showing knowledge about reduced NAD. The focus was on it providing / carrying hydrogen (atoms) to the electron transfer chain. This resulted in the release of energy or ATP production in the ETC. Candidates were stating 'the production of energy', which is not creditworthy. If candidates referred to the movement of protons to the intermembrane space it was expected that they referred to 'pumping'. Unfortunately several candidates referred to diffusion or just movement unqualified.

(iii) Describe the role of reduced NAD in aerobic respiration.

(2)

reduced NAD provides electrons in the electron transport chain, reduced NAD also provides H^+ ions, which are used in the formation of ATP. (chemiosmosis)

ResultsPlus
Examiner Comments

Correct reference to reduced NAD providing electrons to the ETC linked to the production of ATP.

(iii) Describe the role of reduced NAD in aerobic respiration.

(2)

NAD gets reduced in the respiration process to become NADH, an electron carrier. allows the electrons to be transported in the electron transport chain. allows water to be produced as a byproduct.

ResultsPlus
Examiner Comments

This response had the idea of reduced NAD providing electrons but was not clear about what this resulted in, namely ATP. Water was not a creditworthy response.

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Examiner Tip

Some answers to this question began with 'It'. As reduced NAD is in the stem of the question it was clear that the candidate is referring to the NAD. Candidates, as a general rule, must make it clear as to what they are referring. It should not be left up to the examiner to decide.

Question 2 (b)(i)

Nearly every candidate correctly stated that there would be less ATP produced and that the carbon monoxide prevents the oxygen binding to the haemoglobin. However as a result of less oxygen being carried by the haemoglobin few candidates could refer to cells having less final electron acceptors.

(b) Carbon monoxide and cyanide affect the production of ATP.

(i) Carbon monoxide binds to the haem group of haemoglobin.

Explain how carbon monoxide will affect the production of ATP.

(3)

carbon monoxide takes the place of oxygen in the RBC, on in the haemoglobin, so less aerobic respiration, as oxygen is the last electron acceptor, so less ATP production. with no oxygen, regeneration of oxidised NAD and oxidised FAD is not possible.

ResultsPlus
Examiner Comments

A clear response which gains all available marks. Clear reference to carbon monoxide taking the place of oxygen on the haem molecule, with a statement about oxygen being the final electron acceptor. The decrease in ATP can be stated at the start or the end of the response.

(b) Carbon monoxide and cyanide affect the production of ATP.

(i) Carbon monoxide binds to the haem group of haemoglobin.

Explain how carbon monoxide will affect the production of ATP.

(3)

- The production of ATP will decrease
- If carbon monoxide binds to the haem group of haemoglobin this will affect the substrate phosphorilation of glucose in the krebis cycle

ResultsPlus
Examiner Comments

Reference to a decrease in the production of ATP but there is no reference to oxygen being the final electron acceptor or that carbon monoxide displaces oxygen in the haemoglobin.

ResultsPlus
Examiner Tip

Candidates should refer to an actual change eg increase or decrease, rather than that something has an affect or causes an effect.

Question 2 (b)(ii)

(ii) Cyanide stops the transfer of electrons along the electron transport chain.

Explain why cyanide does not affect the production of ATP from anaerobic respiration.

(2)

Anaerobic respiration does not involve any electron transport chains so cyanid will not have an effect.

ResultsPlus
Examiner Comments

Initial statement about anaerobic respiration not involving the electron transport chain but no additional comment about glycolysis.

(ii) Cyanide stops the transfer of electrons along the electron transport chain.

Explain why cyanide does not affect the production of ATP from anaerobic respiration.

(2)

As anaerobic respiration is limited to glycolysis which occurs in the cytoplasm & there's no ~~cyan~~ ETC for the cyanide to inhibit.

ResultsPlus
Examiner Comments

Clear succinct response gaining both marks.

Question 3 (a)

Surprisingly, this question caused a few issues. Some candidates failed to appreciate what was meant by 'conditions'. As a result answers included temperature, lung volume and surface area of alveoli which did not gain credit. A wide range of answers were acceptable and some were obviously within the personal experience of candidates. It needs to be remembered that when the question asks for two conditions then providing a list of three or more may result in only the first two answers being taken.

3 The ventilation rate of animals will depend on many factors.

(a) State **two** lung conditions that affect the ventilation rate of a human.

(2)

. surface area of alveoli / S.A to volume ratio.

. lung capacity

ResultsPlus
Examiner Comments

The response here does not give lung conditions but rather gives the properties of the lungs.

ResultsPlus
Examiner Tip

When the question asks for **two** conditions and gives space for two conditions, only adding one will only gain half of the available marks.

Likewise when the question asks for two conditions and the candidates lists three or more then generally only the first two answers in the list will be taken. It is not up to the examiner to choose the responses from a list given by the candidate.

3 The ventilation rate of animals will depend on many factors.

(a) State **two** lung conditions that affect the ventilation rate of a human.

(2)

Pneumonia, tuberculosis

ResultsPlus
Examiner Comments

A clear answer gaining full marks. Phonetic spelling is acceptable, within limits, and as long as it doesn't look like a hybrid between two biological terms.

Question 3 (b)(i)

The majority of candidates were able to correctly state the relationship between body mass and ventilation rate. Inverse relationship or negative correlation were acceptable alternatives providing body mass and ventilation rate was stated. Inverse correlation was not creditworthy. Very few candidates noted the small number of species used in the study or that correlation doesn't imply causation. Standard deviations continue to cause problems. Generic statements of overlapping / not overlapping standard deviations are not significant / significant did not gain credit. It needed to be focused on the standard deviations between specific animals from the table. A few candidates used the standard deviations but stated that the wrong animals standard deviations were or were not overlapping.

(b) The table shows the mean resting ventilation rate of five species of animal.

Animal	Body mass /kg	Resting ventilation rate /breaths per second
Talapoin monkey	1.3	0.45 0.54 ± 0.09 0.63
Ring-tailed lemur	2.9	0.44 0.53 ± 0.04 0.57
Crested porcupine	20.0	0.27 0.30 ± 0.03 0.33
Siberian tiger	134.0	0.21 0.27 ± 0.06 0.33
Hippopotamus	2210.0	0.12 ± 0.03

(i) Comment on the relationship between the mean resting ventilation rate and the body mass of animals.

(3)

As body mass of animals increase, resting ventilation rate decrease. Also, as body mass increases, Standard deviation of ventilation rate decrease. Standard deviation of ventilation rate for monkey and Ring-tailed lemum overlap, so results not significant. Also, age, gender of animals not clear that it have been controlled. Standard deviation ~~is~~ least reliable for Talapoin monkey as it is largest. Small sample size

ResultsPlus
Examiner Comments

A good response gaining full marks. The relationship was clearly stated and there is a reference to the standard deviations linked to correctly named animals with a statement about whether the results are significant or not. Here there is one of few examples where candidates mentioned the small sample size.

(b) The table shows the mean resting ventilation rate of five species of animal.

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Siberian tiger	134.0	0.27 ± 0.06
Hippopotamus	2210.0	0.12 ± 0.03

(i) Comment on the relationship between the mean resting ventilation rate and the body mass of animals.

(3)

As the table shows, the animal with the smallest body mass has the highest mean resting ventilation rate. Animals with higher body mass have lower resting ventilation rates. So, the larger the body mass, the ~~small~~ lower the ventilation rate. Although, the standard deviation/error margin of animals with high ventilation rate is also higher than those with lower ventilation rates.

ResultsPlus
Examiner Comments

Correct relationship stated but no clear statement about standard deviation linked to named species tested.

Question 3 (b)(ii)

Again a calculation that needed a conversion with an answer given to two significant figures. Most candidates calculated the number of breaths per minute correctly but did not convert to the correct unit or give it to two significant figures. Many responses gained 0 marks as they only put the answer on the answer line, which was incorrect, but showed no working. Furthermore a few candidates had the correct answer in their working but put a completely different answer on the answer line. The answer on the answer line is taken first.

(ii) **The tidal volume for a resting talapoin monkey was found to be 40 cm^3.**

The minute ventilation is the volume of gas inhaled or exhaled from the lungs in one minute.

Calculate the respiratory minute ventilation for a resting talapoin monkey.

Give your answer in dm^3 to two significant figures.

(2)

$40\ cm^1 = 0.04\ dm^3$

$0.04 \times 60 = 2.4\ dm^3$

$2.4 \times 0.54 = 1.296 = 1.3\ dm^3$

1.3 ..... dm^3

ResultsPlus
Examiner Comments

Clear calculation, with workings and correct conversion with the answer given to two significant figures on the answer line.

(ii) The tidal volume for a resting talapoin monkey was found to be 40 cm^3.

The minute ventilation is the volume of gas inhaled or exhaled from the lungs in one minute.

Calculate the respiratory minute ventilation for a resting talapoin monkey.

Give your answer in dm^3 to **two** significant figures.

(2)

$0.54 \times \frac{40}{1000} = 0.0216$

$\frac{1}{60} \times \frac{0.0216}{x}$

$x = 60 \times 0.0216$

1.30 dm^3

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Examiner Comments

Calculation and conversion correct but the answer on the answer line did not follow the instruction in the rubric, namely the answer given to two significant figures.

Question 3 (c)

This question was well answered with the majority of candidates gaining full marks. Crucial errors included using terms like signals, messages or information as alternatives to impulses. As in previous sessions this is not acceptable as alternatives. Careful reading of the question is needed to make sure that the answer corresponds to the question. Several times candidates ended their response by the impulse going to the SAN, leading to an increase in heart rate.

(c) An increase in activity level results in a change in the ventilation rate.

Describe why this change occurs and how it is controlled.

(4)

Increasing in activity level rate, increases respiration so there is more CO_2 in the blood. This is detected by chemoreceptors. So they send impulses to medulla oblengata, where the ventillation center is located, the medulla oblengata sends signals for both the external intercostal muscles and the diaphram to contract, this increases volume in the thorax and decreases pressure in lungs forcing air in. ~~until there is less combo~~ medula oblengata stops sending signals ~~until~~ when there is less CO_2 in the blood (reaches normal rates)

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Examiner Comments

This response gains 3 marks in the first 6 lines for increase in carbon dioxide in the blood, being detected by chemoreceptors which then send an impulse to the medulla. After that the candidate goes on about signals which is not an acceptable alternative for impulses.

(c) An increase in activity level results in a change in the ventilation rate.

Describe why this change occurs and how it is controlled.

(4)

an increase in activity level results in an increase of CO_2 in the body (so pH decreases) as body uses more O_2 than its being transported to cells for aerobic respiration. ~~Chemo~~ chemoreceptors detect this change in CO_2 concentration and send more frequent impulses to respiratory centre in the medulla (through sympathetic nervous system). The respiratory centre sends more (frequent) impulses through motor neurones (in sympathetic nervous system) to diaphragm and intercostal muscles (effector organs in lungs) to increase contractions causing an increase in ventilation rate (more breaths per minute) so more O_2 is exchanged and transported to cells

ResultsPlus
Examiner Comments

A very comprehensive answer gaining all available marks. The answer focuses on the ventilation rate and doesn't digress on to the sino atrial node and heart rate.

Question 4 (b)(ii)

As in similar questions involving both a calculation and a specific requirement on how to frame the answer, the candidate responses were very varied. Providing the measurement was within tolerance and the magnification correctly calculated it was necessary to convert the answer to standard form. This was frequently done incorrectly or not at all. 16000 was a common response. Several candidates also gave the answer units, which was also not creditworthy eg 1.6×10^4 mm.

Question 4 (b)(iii)

This question was particularly well done. Fast twitch and slow twitch muscle fibres have appeared in several recent examination papers. As a result candidates clearly have learnt the differences. The confusion here was that the question asked about structural differences rather than just differences or difference in their mode of action. Several candidates answered the question from a slow twitch view which was creditworthy. It was expected that candidate responses were comparative, ie fewer, larger etc. If they were not and only said large / few they could only get the mark if they referred to the other muscle fibre being small / many. Fast twitch muscle fibres having less blood supply was not creditworthy as it was deemed not to be structural.

(iii) **Describe how the structure of a fast twitch muscle fibre differs from a slow twitch muscle fibre.**

(4)

A fast ~~to~~ twitch muscle works better than a slow twitch muscle fibre. It is faster. The movements of the muscle in the fast twitch muscle are better and fast.

ResultsPlus
Examiner Comments

An answer focussing on the terms fast and slow with no biological content describing the structure of fast and slow twitch muscle fibres.

(iii) **Describe how the structure of a fast twitch muscle fibre differs from a slow twitch muscle fibre.**

(4)

- fast twitch muscle fibres have less number of mitochondria compared to slow twitch muscle fibres.
- So there is less aerobic and more anaerobic respiration happening in the fast twitch muscle fibres.
- fast twitch muscle fibres also have less number of myoglobin, so there is less oxygen absorption in the fast twitch muscle fibres.
- fast a twitch muscle fibres are used for short bursts of energy releasing movements.

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Examiner Comments

Correct reference to fewer mitochondria and less myoglobin. However there is no comment about there being fewer blood capillaries or blood vessels or a reference to the sarcoplasmic reticulum and relative size of fibres.

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Examiner Tip

In a comparative question it is expected that candidates either use the terms fewer / more / bigger or that they give details of both aspects eg fast twitch less mitochondria while slow twitch have more mitochondria.

(iii) Describe how the structure of a fast twitch muscle fibre differs from a slow twitch muscle fibre.

(4)

than slow twitch

Fast twitch muscle fibres contain less mitochondria, they have more glycogen, and more tightly packed fibres as they're adapted for short bursts of energy.

Fast twitch muscles contain less myoglobin than slow twitch muscles, and less blood capillaries making them appear very pale / white-ish.

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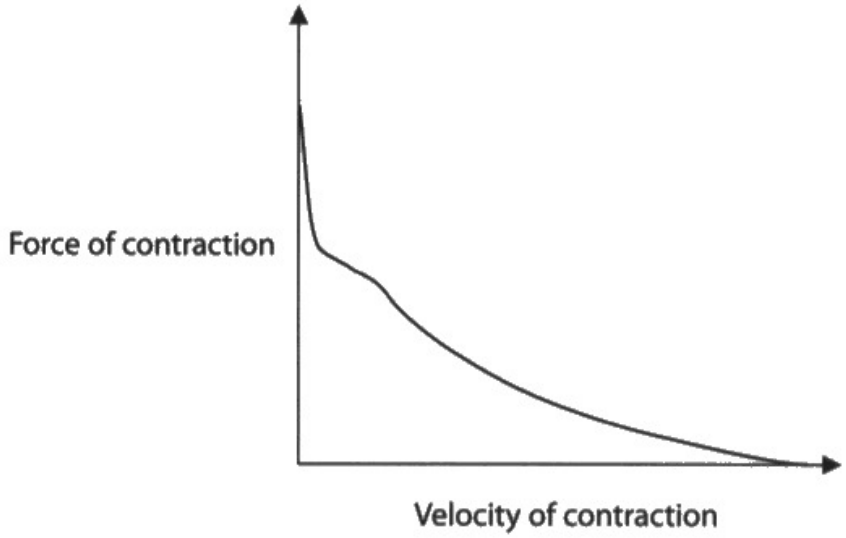
Examiner Comments

A clear response which gained all available marking points. Statements are clearly comparative and refer to structural difference not functional.

Question 4 (c)

Candidates found this graph a challenge. Most correctly referred to the relationship between velocity of contraction and force of contraction, although it was stated in many ways. Inversely proportional and negative correlation were acceptable alternatives providing they referred to velocity of contraction and force of contraction. A surprisingly large number of candidates got the relationship the wrong way round. Many candidates found it a challenge to explain how velocity of contraction affected the number of cross bridges formed. Again, as the sliding filament theory is relatively common in papers several candidates merely gave an account of this theory gaining no credit. Many candidates often showed a slight knowledge of this theory but missed crucial elements. This was particularly true of the involvement of ATP, myosin head and tropomyosin.

(c) The graph shows the relationship between the force of muscle contraction and the velocity of muscle contraction.



The greater the number of cross bridges formed between actin and myosin the greater the force of contraction of a muscle.

Explain the relationship between the force and the velocity of contraction of a muscle.

(3)

As The velocity of Contraction increases, the force of attraction decreases It is a -ve Correlation. when the muscles Contract faster ; the force of Contraction decreases because more fast twitch muscles Contract ~~less energy~~ Faster & less time between Contraction & Relaxation & less energy Provided by Anaerobic Respiration So less force of Contraction

(Total for Question 4 = 11 marks)

Maybe accumulation of lactic acid due to increased Anaerobic Respiration causes Cramps & less force of Contraction occurs

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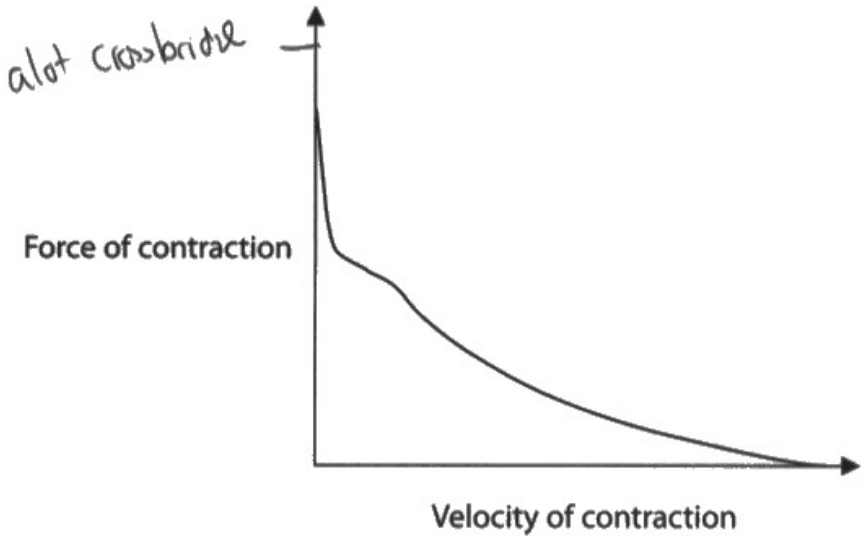
Examiner Comments

In this response there is a clear reference to the relationship shown in the graph, namely as there is an increase in velocity of contraction there is a decrease in the force of contraction. There is no reference to how actin-myosin cross bridges form or that when the velocity of contraction is high fewer cross bridges can form.

(c) The graph shows the relationship between the force of muscle contraction and the velocity of muscle contraction.



The greater the number of cross bridges formed between actin and myosin the greater the force of contraction of a muscle.

Explain the relationship between the force and the velocity of contraction of a muscle.

(3)

As velocity of contraction increase, force of contraction decrease>. This is because when velocity increase thee is fewer crossbridge form between actin and myosin. This may dive to fewer tropunin change shape so fewer ~~myos~~ tropomyosin change shape so fewer myosin binding site revealed so less myosin head is able to bind to actin.

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Examiner Comments

This response gains full marks with a correct reference to the relationship shown in the graph with a reference to their being fewer cross bridges formed and how cross bridges are formed.

Question 5 (b)

This question was either particularly well done or poorly done. Candidates find the kidney a difficult topic and the mechanism of the counter current mechanism even more of a challenge. There were some very good responses that gained full marks, usually for mark points 1, 2, 3 and 5. A lack of precision sometimes meant that mark point 1 could not be awarded eg referring to the tubes moving in opposite directions rather than the fluid or filtrate. Mark point 5 was often addressed in multiple ways in candidate responses. A few candidates are still referring to sodium rather than sodium ions which is not creditworthy. Mark point 4 was also regularly missed as candidates referred to there being a concentration gradient rather than the increased concentration gradient or a concentration gradient being formed.

✱ (b) Describe how the loop of Henlé acts as a countercurrent multiplier.

(4)

- filtrate moves in the opposite direction.
- loop of Henle consists of the ascending and descending limb.
- the descending limb is permeable to water and some ions.
- This allows water to move out causing it to be concentrated with ~~fffff~~ filtrate.
- In the ~~descending~~ ascending limb, selective reabsorption takes place.

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Examiner Comments

This response gets the first mark point referring to filtrate moving in opposite directions and the last mark point with reference to the descending limb being permeable to water.

ResultsPlus
Examiner Tip

Writing needs to legible. This response, even when magnified, was very difficult to read.

(b) Describe how the loop of Henlé acts as a countercurrent multiplier.

(4)

In the decending loop the medulla/surroundings
has higher concentration of salts/hyper tonic
condition so the water is diffused through
the limb/loop (as water is permiable for decending
loop) ~~to~~
while in ascending loop the membrane is only
permiable to salts, so Cl^- ions are actively
transported out of limb/loop which causes
Na^+ ions to move out due to concentration
gradient, it increase the salt in medulla thus
increasing the water removed in decending loop
so it acts as ~~carter~~ countercurrent multiplier

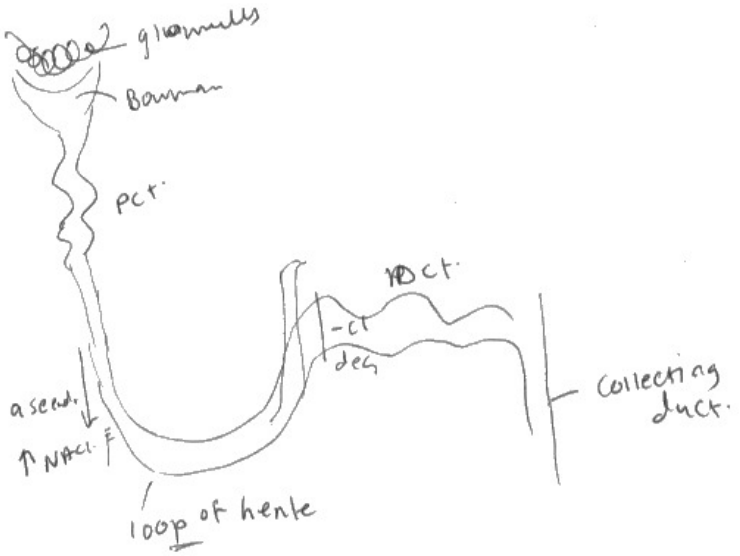
ResultsPlus
Examiner Comments

This response gained all mark points except the filtrate direction of movement mark. The order is a bit random but as mark points are standalone, credit was given.

(b) Describe how the loop of Henlé acts as a countercurrent multiplier.

(4)

- In the loop of henle there are ascending and descending limps.
- during the ascending the concentration of Na^+ and cl^- is higher as we are going down
- However during descending concentration of Na and cl^- is lower as we are going up.
- NO active transport is involved here and no water passes by only solutes such as Na and cl^-.
- loop of Henla's job is for reabsroption.



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Examiner Comments

The biologically correct words are used but they do not give a description of how the loop of Henle acts as a countercurrent multiplier. There is nothing to credit here.

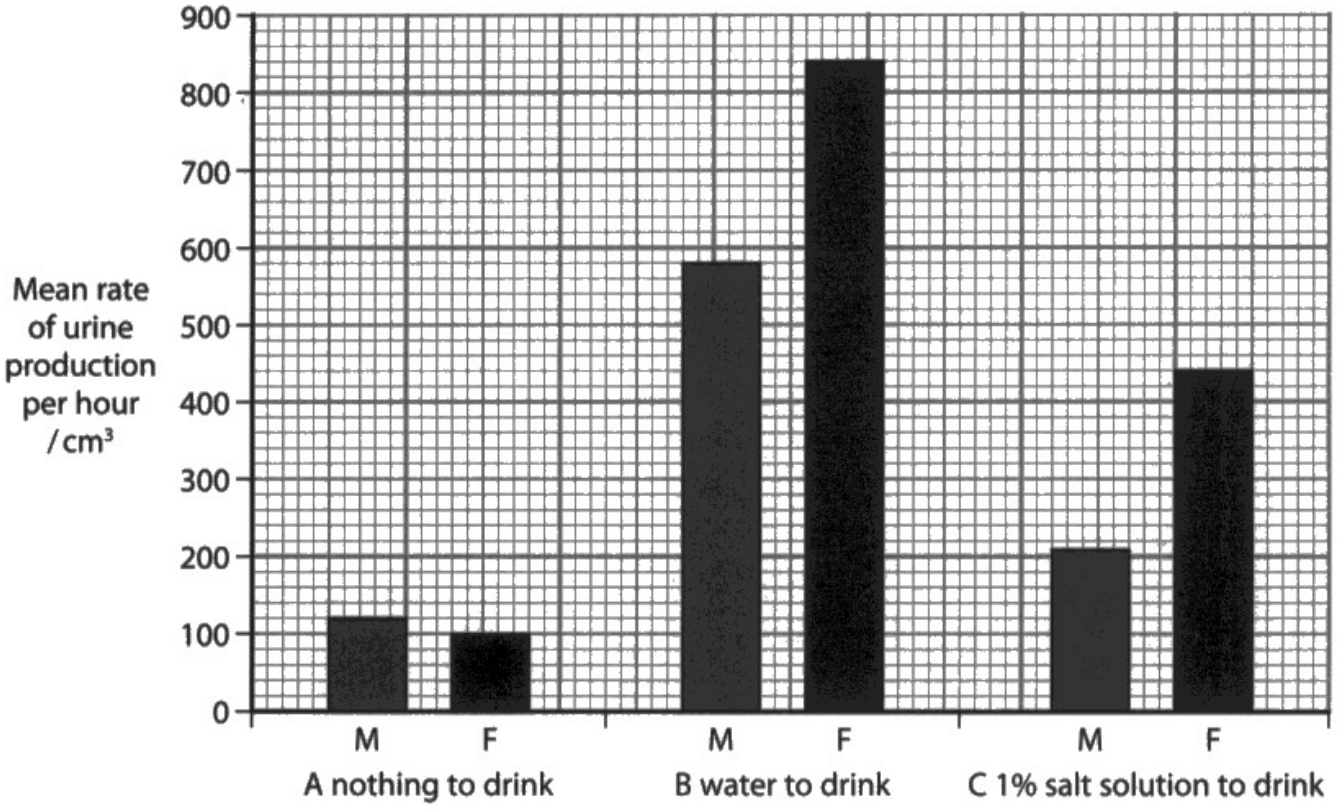
Question 5 (c)(i)

Again a calculation involving a specific format for the answer. In this case the answer was required to one significant figure, after correctly reading the data from the graph and calculating the ratio. A minority of candidates misread the reading from the graph. A significant number of candidates who correctly read the data from the graph gave the ratio to one decimal place. So 1:8.4:4.4 only got the mark for correctly reading from the graph.

(c) In an investigation, one group of people was given nothing to drink, a second group was given water and the third group was given 1% salt solution to drink.

The mean rate of urine production was recorded for the males and females in each group.

The graph shows the results of this investigation.



(i) Calculate the ratio of the mean rate of urine production for the females in the three groups.

Express your answer as nothing to drink : water to drink : salt solution to drink.

Give your answer to one significant figure.

(2)

100 : 840 : 440

1 : 8.4 : 4.4

Answer 1 : 8.4 : 4.4

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Correct reading from the graph and the ratio put in the right order as nothing to drink: water to drink: salt solution to drink. However the answer was requested to be to one significant figure not one decimal place.

(c) In an investigation, one group of people was given nothing to drink, a second group was given water and the third group was given 1% salt solution to drink.

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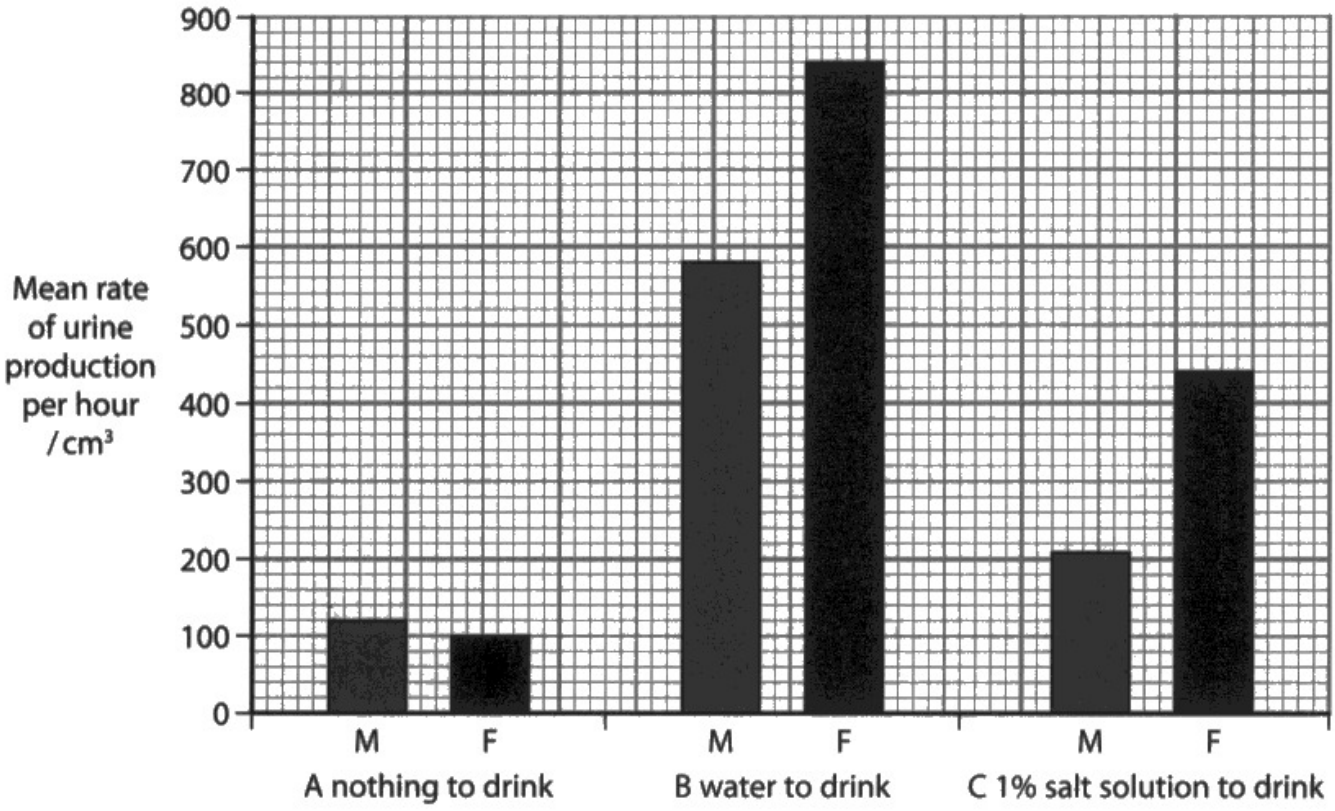

(i) Calculate the ratio of the mean rate of urine production for the females in the three groups.

Express your answer as nothing to drink : water to drink : salt solution to drink.

Give your answer to one significant figure.

(2)

$\frac{120}{120} : \frac{530}{120} : \frac{210}{120} = 1 : 5 : 2$

~~60 : 290 : 105~~

Answer 1 : 5 : 2

The readings taken from the graph were inaccurate so no credit was given, even though the ratio was in the correct format.

Always double check readings from a graph and take particular care over the scale.

(c) In an investigation, one group of people was given nothing to drink, a second group was given water and the third group was given 1% salt solution to drink.

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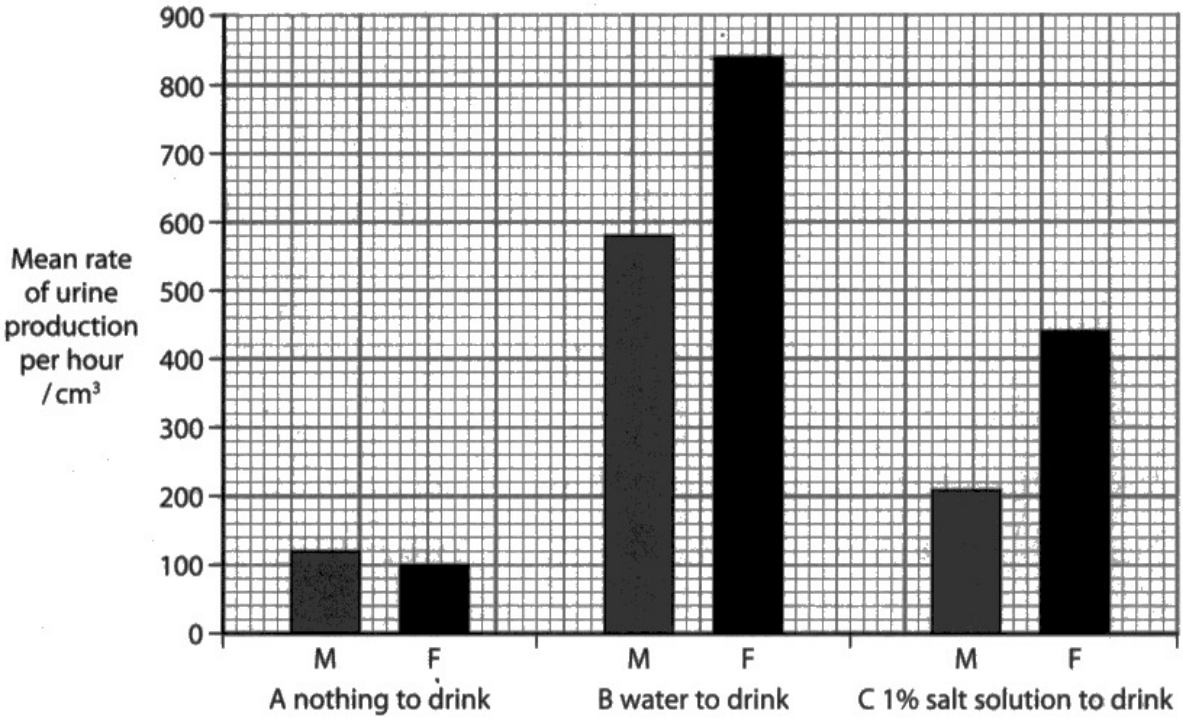


(i) Calculate the ratio of the mean rate of urine production for the females in the three groups.

Express your answer as nothing to drink : water to drink : salt solution to drink.

Give your answer to one significant figure.

(2)

100 : 840 : 420

10 : 84 : 42

1 : 8.4 : 4.2

Answer 1 : 8 : 4

ResultsPlus
Examiner Comments

Readings from graph are correct and the ratio calculated and given to one significant figure.

Question 5 (c)(ii)

Some responses were very unclear and it was a challenge to work out what part of the graph the candidate was referring to. A lack of comparative terminology often let candidates down eg female had high urine production when they had a drink. Candidates should be encouraged to consider all the different variables when writing their responses. In this case comparing males to females as well as comparing the effects of different drinks or no drinks.

(ii) Describe **two** conclusions that can be drawn from the results of this investigation.

(2)

The greater the volume of water drank, the greater the volume of urine production. When nothing to drink, male's ~~rate~~ mean rate of urine production is higher, however when ~~some~~ water or 1% salt solution is ~~drank~~ given to drink, mean rate of urine production is higher for women.

Also, when ~~the~~ the drink is pure water, rate of urine production is higher.

ResultsPlus
Examiner Comments

This response has a general comment about the drinking leading to the greater urine production together with a comment comparing females to males when they have had a drink. The second mark point needed to be clearly in the context when they had had a drink, as the relationship was not true when nothing had been drunk.

(ii) Describe **two** conclusions that can be drawn from the results of this investigation.

(2)

Females have ~~of~~ a higher mean rate of urine production than ~~males~~ males in water to drink and 1% salt solution to drink. ~~The~~ males have a higher mean rate of urine production than ~~females~~ Females in nothing to drink but by a small difference.

ResultsPlus
Examiner Comments

This response compared the urine production in males and females after they had had a drink (or didn't have a drink) but did not make a general comment about relative rate of urine production.

Question 5 (c)(iii)

This question was well answered by most candidates, showing a good understanding of the role of ADH and osmoreceptors. A few candidates went into great detail about the mechanism of water reabsorption including aquaporins, which is too much detail for a 2 mark question. However there was a significant minority of candidates that thought more ADH would be released or that water would be reabsorbed in the collecting duct.

(iii) Explain the effect on the mean urine output of the group drinking water.

(2)

The group that had to drink a lot of water had the highest urine output as more water is passed through the kidneys as it and excreted as urine as the body already contains enough water, therefore more urine is produced and less ADH is released.

(Total for Question 5 = 13 marks)

ResultsPlus
Examiner Comments

Clear reference to less ADH but no linkage to increase in water potential being detected by osmoreceptors.

(iii) Explain the effect on the mean urine output of the group drinking water.

(2)

The group drinking water have more water in their blood plasma, therefore it becomes diluted. In order to return the blood plasma concentration back to its normal level via negative feedback, less ADH is released from the pituitary gland and acts on the walls of the collecting duct and the proximal tubule. Less ADH decreases permeability to water, meaning that less water is reabsorbed into the bloodstream so more is lost in the form of urine.

(Total for Question 5 = 13 marks)

ResultsPlus
Examiner Comments

A good response that obtained full marks. The response was presented in a clear logical manner.

Question 6 (a)

There were some very succinct responses that gained full marks and some very long responses which went 'out of clip' gaining hardly any marks. Mark point 1 was given the least as candidates did not refer to the nature of ions and the nature of membranes. A few candidates lost mark point 2 as they failed to refer to proteins, ie channel proteins or carrier proteins. Most candidates referred to either active transport or facilitated transport (or both) and correctly referenced this to a concentration gradient.

6 The concentration of ions in the blood is controlled by homeostasis.

(a) Explain how ions can cross the cell membrane.

(3)

They can be transported by carrier ~~channel~~ proteins ~~embedded~~ in the cell membrane. More ions are transported out (exocytosis) if there's a lower concentration of ions at one end of the membrane. If concentration of ions are greater in blood they leave through urine or as sweat.

ResultsPlus
Examiner Comments

This response only gained one mark referring to ions being carried by carrier proteins.

6 The concentration of ions in the blood is controlled by homeostasis.

(a) Explain how ions can cross the cell membrane.

(3)

ions are polar molecules, they cannot diffuse across cell membrane as ~~it is~~ phospholipid bilayer is non polar. ions can pass through with the help of voltage-gated protein channels embedded in the bilayer, which are polar. they can pass through by ~~passive~~ facilitated diffusion.

ResultsPlus
Examiner Comments

A very concise response that gained three marks. Mark point 1 was often missed but here the response refers to ions being polar and as such cannot travel through the phospholipid bilayer.

ResultsPlus
Examiner Tip

Candidates need to be clear about the difference between diffusion, osmosis, facilitated diffusion and active transport in their responses.

Question 6 (b)

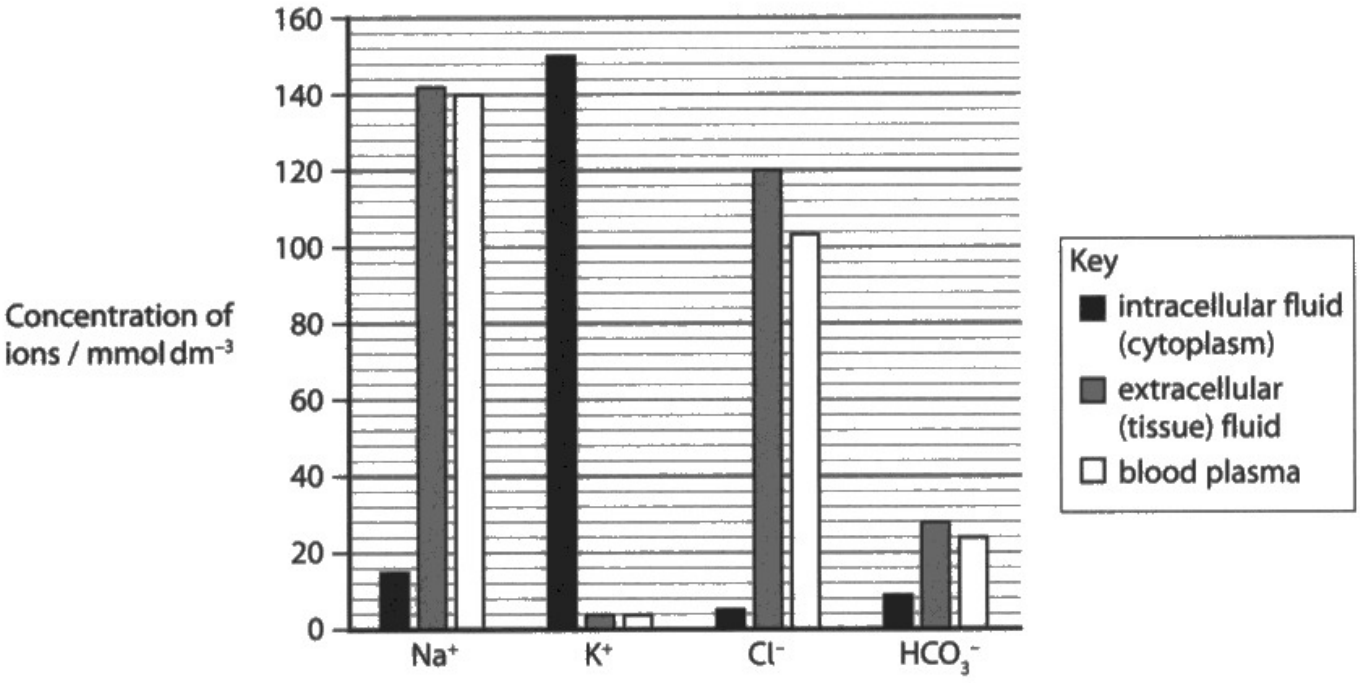
This was the only level base question. Candidates were provided with stimulus material, in this case a bar chart. They were expected to use this information to support their answer together with their own knowledge. The most common way candidates gained Level 1 was by giving the correct concentration / distribution of at least two ions from the graph comparing cytoplasm, tissue fluid and plasma. It was disappointing that some candidates spent all the available space describing the bar chart without explaining the roles of any of the ions.

Level 2 was usually awarded for the consideration of the role of sodium and potassium ions. This was usually in the context of nerve impulse.

Candidates who also considered the role of chlorine ions and hydrogen carbonate ions achieved Level 3.

*(b) Ions are found within fluids in the human body in different concentrations.

The graph shows the concentration of ions in intracellular fluid (cytoplasm), extracellular (tissue) fluid) and blood plasma.



The ions are used to perform vital functions within the metabolism of the cells.

Discuss how the distribution and concentrations of the ions shown in the graph contribute to their biological roles.

Use the information given in the graph and your own knowledge to support your answer.

(6)

* Na^+ ions are found is ~~very~~ high & very similar concentrations in the extracellular fluid & the blood plasma.

* K^+ ions are found in a very high concentration in the intracellular fluid, but are found in very low concentrations in the extracellular fluid & the blood plasma

* Chlorine has a very low concentration in intracellular fluid, but has a much higher concentration in the blood plasma & extracellular fluid.

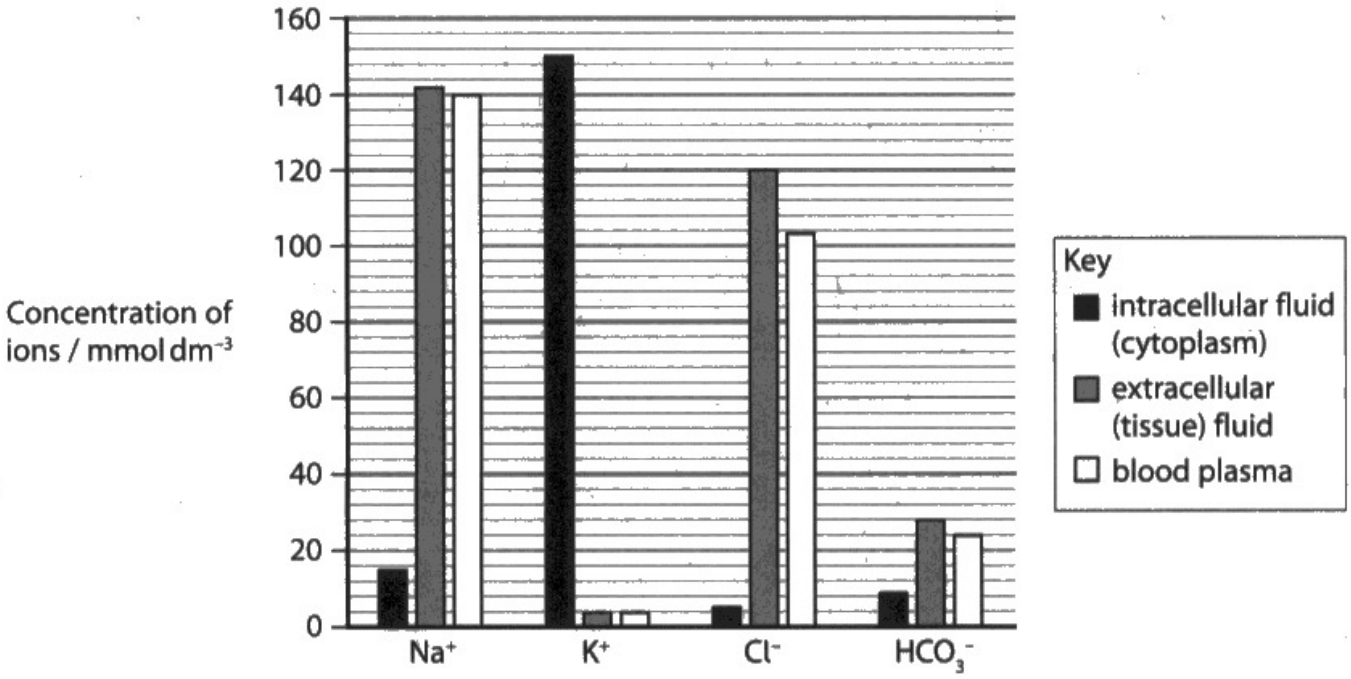
* HCO_3^- is found in the blood plasma & extracellular fluid in similar concentrations.

ResultsPlus
Examiner Comments

This response considers the distribution of the ions within tissue fluid, cytoplasm and blood plasma without giving detail about the function of the ions. As such it remains at a Level 1 response.

*(b) Ions are found within fluids in the human body in different concentrations.

The graph shows the concentration of ions in intracellular fluid (cytoplasm), extracellular (tissue) fluid and blood plasma.



The ions are used to perform vital functions within the metabolism of the cells.

Discuss how the distribution and concentrations of the ions shown in the graph contribute to their biological roles.

Use the information given in the graph and your own knowledge to support your answer.

(6)

Na^+ ions are in high concentration in the blood plasma and the tissue fluid (140 and ~~150~~ 142 mmol dm^{-3} respectively) and in low concentration in the cytoplasm (15 mmol dm^{-3}) as it is needed in neurones to generate action potentials by diffusion into the axon. At rest, they must be in greater concentration outside to maintain the resting potential. K^+ are in high concentration inside cells (150 mmol dm^{-3}) and in low concentration in the tissue fluid and plasma (4 mmol dm^{-3} each) as they

must be present inside neurones to keep a constant electrochemical gradients at the axon membrane. The concentrations of these 2 ions is maintained around neurones by the sodium-potassium pumps in axon membranes which actively pump sodium ions out and potassium ions into the axon against their concentration gradients. Cl^- ions are in high concentrations in the tissue fluid and plasma (120 mmol dm^{-3} and 103 mmol dm^{-3} respectively) and in low concentration inside cells (6 mmol dm^{-3}) as they are needed to balance the charge by Na^+ and maintain water potential gradients so mucus in various locations is not made too thick and sticky. HCO_3^- ions are in slightly higher concentration in the plasma and tissue fluid (24 mmol dm^{-3} and 28 mmol dm^{-3} respectively) than inside cells (10 mmol dm^{-3}) as they are needed to maintain blood pH and transport carbon dioxide from body cells (produced in aerobic respiration) to the lungs for exhalation.

(Total for Question 6 = 9 marks)

ResultsPlus
Examiner Comments

A very thorough response descripting the distribution of the ions and giving details about their specific role in the body. A Level 3 response.

Question 7 (b)

This question proved a challenge to many candidates. The best candidates obtained full marks here. Candidates had some idea of how genes were activated but often the specifics were absent, ie the chemical or transcription factor was absent. Few candidates referred to pre-RNA following transcription of these three named genes. Many candidates were clearer about post transcriptional modification, particularly what happens to the exons. Nearly all candidates got mark point 4, reference to translation. However mark point 5 was often missed as candidates referred to proteins, which was in the stem of the question.

(b) There are 14 different serotonin receptors found in the human nervous system.

Three different genes are used to produce these receptors.

Explain how three genes can produce 14 different receptors for serotonin.

(4)

The 3 genes are transcribed into pre-mature mRNA containing introns and exons. The pre-mature mRNA is converted to mature mRNA by a process called splicing done by the enzyme spliceosome; which removes introns and combines exons in different ways to make different primary sequences. Since spliceosome can join exons in different ways, it leads to different primary sequences which are then translated into different polypeptide chains thus producing different active sites of proteins due to different R-group interactions.

ResultsPlus
Examiner Comments

A clear response presented in a logical format that gave the full story explaining how three genes could produce 14 different receptors for serotonin. The only mark missing from the mark scheme was reference to the activation of the different genes by transcription factors.

(b) There are 14 different serotonin receptors found in the human nervous system.

Three different genes are used to produce these receptors.

Explain how three genes can produce 14 different receptors for serotonin.

(4)

- The 3 genes code for 14 different receptors for serotonin.
- Due to ~~transcription factors~~ different transcription factors binding to different promoter regions. (post-transcriptional modification or epigenetic modification such as DNA acetylation causing an acetyl group to combine unwinding DNA for transcription. - ~~Exons or~~ Specific introns ~~exons~~ are spliced out and entrons stay or spliced in.
- Causing transcription of these coding ~~or~~ exons or genes to mRNA.
- mRNA is then translated to produce proteins in ribosomes resulting in receptors.

ResultsPlus
Examiner Comments

This response gained credit for reference to post transcriptional modification and translation. However the comments about introns and exons were not clear. There was no reference in the response to pre-RNA.

Question 7 (c)(i)

The majority of candidates correctly gave the relationship between the dose of MDMA and serotonin. However a significant number of candidates merely stated 'MDMA caused an increase in the concentration of serotonin in the csf'. For mark point 1 an increase in MDMA dose was required together with the effect on the serotonin concentration. Mark point 2 was seldom achieved. As the command word in the question stem was 'determine' some element of mathematical analysis was required. Often this was the increase in serotonin concentration between two stated MDMA concentrations, eg between 0–15 MDMA there was an increase of 130mg/cm^{-3}. Candidates could use the line of best fit or the actual line for this analysis. However the figure had to be correct (within +/-5). No credit was given for just describing the graph.

(i) **Determine the effect of MDMA on the serotonin level in the cerebrospinal fluid.**

(2)

MDMA leads to an increase in serotonin concentration in cerebrospinal fluid. The larger the MDMA concentration, the greater the serotonin concentration in cerebrospinal fluid. At 24hrs later + 15 mg kg^{-1} MDMA, serotonin conc in fluid was 390 mg cm^{-3} (140 mg cm^{-3} increase).

ResultsPlus
Examiner Comments

Here there is a clear statement of the relationship between increasing the dose of MDMA and the increase in the level of serotonin. An attempt has been made to read data from the graph (390mg cm^{-3}). As the command word was determine some form of calculation was expected. Here a figure is given but it is not in the acceptable range for either the actual data or line of best fit. 40 mg cm^{-3} was out of the range which was 125+/-5.

(i) Determine the effect of MDMA on the serotonin level in the cerebrospinal fluid.

(2)

Overall, there ~~was~~ was an increase of 130 mg cm^{-3} in concentration of serotonin from a dose of 0 to 15 mg Kg^{-1} of MDMA, so the serotonin level increases with a greater dose of MDMA.

ResultsPlus
Examiner Comments

Statement of the relationship between serotonin and MDMA dose plus a calculation of the change in levels between two stated set points. The calculated figure is within the tolerance (+/-5 for either the actual line or the line of best fit).

Question 7 (c)(ii)

A relatively easy question providing the extrapolation from the graph was correct and within the limits allowed (+/-4). Then the candidates had to convert the answer to g / cm^{-3}. Again another conversion and ample opportunity for the candidate to miscalculate, which many did. In this case the units were not needed.

(ii) Predict the concentration of serotonin for a dose of 17.5 mg kg^{-1} of MDMA.

Use the line of best fit.

Give your answer in g cm^{-3}.

(2)

430 mg cm^{-3}

430 x 100 = 43000

43000 g cm^{-3}

ResultsPlus Examiner Comments

Extrapolation from graph and conversion from mg cm^{-3} to g cm^{-3} inaccurate. No credit awarded here.

(ii) Predict the concentration of serotonin for a dose of 17.5 mg kg^{-1} of MDMA.

Use the line of best fit.

Give your answer in g cm^{-3}.

(2)

400 mg cm^{-3}

= 0.4 g $/cm^3$

0.4 g cm^{-3}

ResultsPlus Examiner Comments

Correct extrapolation and conversion.

(ii) Predict the concentration of serotonin for a dose of 17.5 mg kg^{-1} of MDMA.

Use the line of best fit.

Give your answer in g cm^{-3}.

(2)

395 mg 1 cm^3

0.395 g 1 cm^3

0.395 g cm^{-3}

ResultsPlus
Examiner Comments

Unfortunately the extrapolated figure from the graph was just out of tolerance (+/-4).

Question 7 (c)(iii)

This question proved a challenge to many candidates, most likely as they did not read the question carefully. Several candidates compared taking MDMA orally and via injection to how quick the response to the drug would be, which is an interesting response but not to this question. Many candidates were awarded mark point 1 as they referred to MDMA (or digested derivatives) being absorbed in the blood either in the mouth or intestinal tract. The second mark point wanted some description of the MDMA getting to the brain and crossing the blood brain barrier. Few candidates achieved mark point 3 as many referred to serotonin binding to receptors.

(iii) Explain how the MDMA taken **by mouth** could affect the level of serotonin in the brain.

Use the information in the question to support your answer.

(3)

Taking MDMA by mouth, ~~my~~ MDMA be broken down by enzymes in ~~the~~ stomach and small intestine so when it is absorbed into the blood stream ~~this~~ it will be less effective MDMA so less effect on serotonin level. Digested MDMA components can pass blood brain barrier hence binds to ~~serotonin~~ receptors (such as calcium ion Ca^{2+} receptors) which stimulates release of serotonin.

ResultsPlus
Examiner Comments

A good answer stating that MDMA is absorbed into the blood. It was acceptable to be absorbed into the blood in the mouth or gut. Then the MDMA crosses the blood brain barrier where it stimulates the release of serotonin.

ResultsPlus
Examiner Tip

Candidates need to make it clear that they are referring to the MDMA or serotonin.

(iii) Explain how the MDMA taken **by mouth** could affect the level of serotonin in the brain.

Use the information in the question to support your answer.

(3)

diffused into blood after it enters the stomach

taken to the brain by the cerebrospinal fluid

diffuses into the brain from the fluid

ResultsPlus
Examiner Comments

This response only just got mark point 1 referring to diffused into the blood after it enters the stomach. It didn't refer to MDMA but it was thought as MDMA is in the stem of the question that this was the base line.

Question 8 (a)

This was surprisingly poorly answered by many candidates. Candidates are reminded that simply repeating the given information will not gain marks. Few answers addressed mark point 1. Mark point 2 was the most commonly awarded mark. Some responses considered what would happen to the digested molecules but not as frequently as was expected. Where responses did try to address these aspects, inaccurate or incorrect terminology let them down eg to produce energy.

8 The scientific document you have studied is adapted from the article *'Microbiota-gut-brain axis and the central nervous system'* by Xiqun Zhu, Yong Han, Jing Du, Renzhong Liu, Ketao Jin and Wei Yi in *Oncotarget* (2017).

Use the information from the article and your own knowledge to answer the following questions.

(a) "Gut microorganisms play an important role… affecting human metabolic functions by decomposing the complex polysaccharides in food".

Explain the role of gut microorganisms in decomposing complex polysaccharides (paragraph 2).

(3)

- microorganisms release extracellular enzymes (such as amylase)
- These enzymes break down ∃ polysaccharides (such as starch) releases it's α glucose monomers by breaking down bonds (∃ α 1-4, glycosidic bonds)
- products are then reabsorbed by the [redacted] microorganisms

ResultsPlus
Examiner Comments

This response only was awarded the second mark point for microorganisms releasing enzymes that break down the glycosidic bond.

8 The scientific document you have studied is adapted from the article *'Microbiota-gut-brain axis and the central nervous system'* by Xiqun Zhu, Yong Han, Jing Du, Renzhong Liu, Ketao Jin and Wei Yi in *Oncotarget* (2017).

Use the information from the article and your own knowledge to answer the following questions.

(a) "Gut microorganisms play an important role… affecting human metabolic functions by decomposing the complex polysaccharides in food".

Explain the role of gut microorganisms in decomposing complex polysaccharides (paragraph 2).

(3)

- it can produce enzymes that digests breaks down cellulose, hemicellulose or pectin in food into simple sugars which can be fermented into fatty acids and can be used to as a respiratory substrate
- humans cannot produce enzymes that digest these type of polysaccharides

ResultsPlus
Examiner Comments

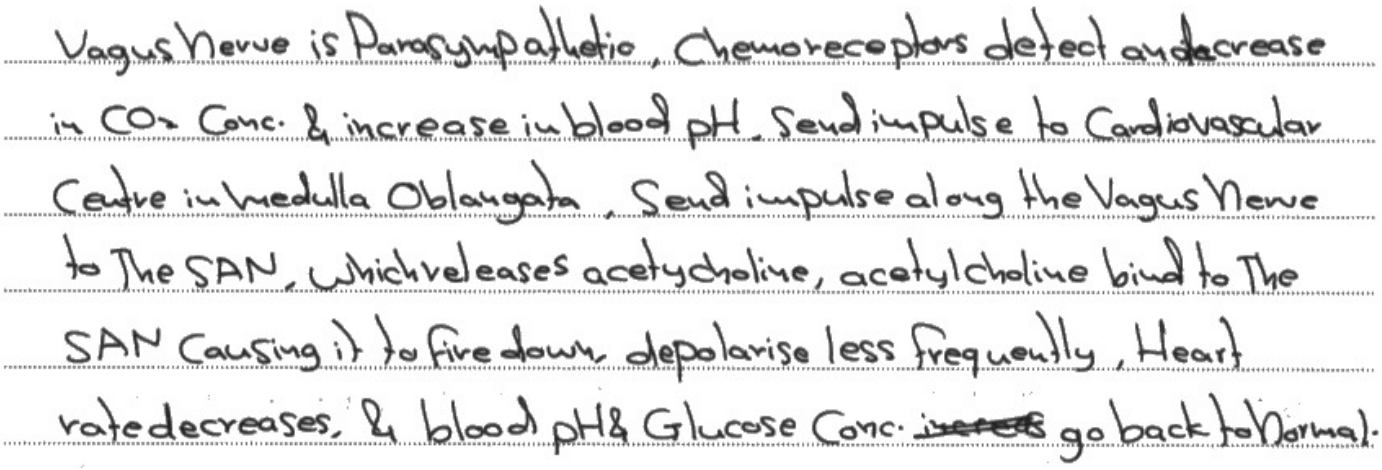
A concise but productive response. A clear comment that enzymes produced by microorganisms (it) which ferment the substrate into simple sugars which can then be used as a respiratory substrate. A final sentence saying that humans cannot digest these polysaccharides.

Question 8 (b)

This question was either done well or poorly. There were few intermediates. Like recent sessions the terms signal, message or information are not acceptable alternative for impulse. In most cases candidates either got mark points 1 and 2 referring to correct function of receptors sending impulses to the CVC or medulla or mark points 3 and 4 referring to brain or medulla sending impulses to the SAN via the vagus or parasympathetic nervous system which slows the rate of depolarisation of the SAN. A key error in mark point 3 was candidates inferring that the vagus nerve sends impulses to the SAN. Many candidates mixed up the sensory and motor nerves of the vagus as well as the correct function of the sympathetic and parasympathetic nervous systems. It should not be left up to the examiner to decide which nerve controls what action.

(b) Describe how the vagus nerve is involved in the control of heart rate (paragraph 6).

(4)



ResultsPlus
Examiner Comments

A good response gaining full marks. The initial comments about the receptors sending impulses to the cardiovascular centre and the subsequent actions with the medulla sending impulses along the vagus nerve to the SAN causing a reduction in the rate of depolarisation. Both halves of the story are here – receptors and response.

(b) Describe how the vagus nerve is involved in the control of heart rate (paragraph 6).

If there is an increase in the heart rate (4)
The vagas nerve sends impulses to the cardiovascular control centre in the brain and ~~cause~~, which sends impulses through the parasympathetic ~~or sympathetic nervous system~~ nervous system, to the SAN, causing it to depolarise less and ~~therefore the heart rate decrea~~ send less waves of depolarisation of to the AVN. and therefore the heart rate decreases.

ResultsPlus
Examiner Comments

Here there is only the second half of the story – impulses from the CVC to the SAN via the parasympathetic system and subsequent less waves of depolarisation, causing the heart rate to decrease.

Question 8 (c)

Candidates are usually quite good at the specific immune response and immune system, but here they struggled with the novel context. T helper cells releasing cytokines to activate T killer cells were the most commonly awarded aspects. Many candidates stated that T killer cells would destroy the tumour cells without giving the details of how, to get the mark. Lots of irrelevant information was seen regarding B cells / antibodies / APCs etc and lots of repeating words from the stem of the question eg accumulation.

(c) "Microorganisms can also enhance the anti-tumor immune effect of drugs by promoting T cell accumulation and transformation."

Explain how microorganisms promote the accumulation of mature T-killer cells that enhance the anti-tumour effects of drugs (paragraph 7).

(3)

The triggering of the immune system can cause the formation of T - helper cell which then activate the T - killer cells. When these T- killer cell accumulate they can easily attack the tumour and stop it from growing any bigger.

ResultsPlus
Examiner Comments

There is no reference to microorganisms in this response which is a focus of the question. The only mark point is the activation of T killer cells. There is no detail in how the T killer cells attack / destroy the tumour.

(c) "Microorganisms can also enhance the anti-tumor immune effect of drugs by promoting T cell accumulation and transformation."

Explain how microorganisms promote the accumulation of mature T-killer cells that enhance the anti-tumour effects of drugs (paragraph 7).

(3)

Microorganisms secrete chemicals that act as transcription factors. They bind to receptors on mature T-killer cells causing formation of TIC (secondary messenger) in the cytoplasm. TIC binds to promoter regions of certain genes responsible for cell division by mitosis activating them. This allows binding of RNA polymerase which stimulates mRNA synthesis and transcription in addition to translation. Proteins are produced which increase the rate of cell division by mitosis. Proliferation of T-killer cells causes more perforin to be produced which attacks tumour increasing anti tumour effect. Microorganisms also affect lymphoid tissue

ResultsPlus
Examiner Comments

Even though this response was 'out of clip' it was in pulled papers and the whole response was viewed. This response achieved three marks.

Question 8 (d)

Considering fMRI is a common topic, this question was not well done because candidates either went into great detail about the techniques and challenges of doing an fMRI or about how probiotics affected the brain. Keeping both aspects separate could only achieve either mark point 1 or mark point 2.

(d) Describe how fMRI scans could be used to show the activity of the regions of the brain controlling memory and sensation when probiotics are consumed (paragraph 11).

(2)

- fMRI shows brain activity, so it can be used when probiotics are being consumed.
- More active areas will respire more, so ~~more~~ it will use more oxyhaemoglobin and so reflect more radio waves. Active areas should appear lighter.

ResultsPlus
Examiner Comments

Here both aspects of the question stem was answered. The use of fMRI when consuming probiotics with details of how more active areas would be seen in the fMRI. The answers could be in terms of two groups or the same individual.

(d) Describe how fMRI scans could be used to show the activity of the regions of the brain controlling memory and sensation when probiotics are consumed (paragraph 11).

(2)

- ~~FMRI~~ fMRI controls the activity of brain regions by monitoring O_2 uptake
- Individual ~~take~~ taking probiotics ~~must be~~ put to doing activities which stimulate memory and sensations whilst monitoring O_2 uptake to se concentrations consumed at each of these regions and determine if there is a normal functioning

ResultsPlus
Examiner Comments

There is no comparing of fMRI scan results or details of how the activity of the regions of the brain could be seen. Credit was given for an individual taking probiotics.

Question 8 (e)

As in most of the article based questions candidates either did well or poorly, probably indicating the amount of time devoted to the study of the article. The majority of candidates were able to work out that a changed diet would change the gut flora so achieved mark point 1. A few candidates used the term 'affect' which did not gain any marks. Relatively few candidates related the change in gut flora to a change in chemicals released in the gut which would travel in the blood and pass the blood brain barrier for mark points 2 and 3. Many candidates got the overall effect of stimulating the release of serotonin or other named neurotransmitters eg dopamine.

(e) Suggest how changes in diet could affect the composition of the gut flora causing imbalances in the naturally occurring chemicals in the brain (paragraph 10).

(3)

changing the diet means different chemicals / nutrients will be available for the bacteria that form gut flora, which means certain molecules may inhibit or promote the growth of certain types of bacteria as some will reproduce more favourably / faster / will outcompete others in certain conditions, resulting in different chemicals / endo and exotoxins released by these bacteria which can affect the naturally occurring chemicals in the brain as these may be changed / inhibited in some way, crossing the blood-brain barrier by diffusion

ResultsPlus
Examiner Comments

This response gained three marks. Clear reference to promoting growth of certain types of bacteria (ie change has happened) which result in different chemicals being released, which cross the blood brain barrier. Affect the naturally occurring chemical is not enough as there needs to be some indication of increase / decrease.

(e) Suggest how changes in diet could affect the composition of the gut flora causing imbalances in the naturally occurring chemicals in the brain (paragraph 10).

(3)

New diet may convert ~~g~~ food that contains a new and unique flora

If unique flora introduced into gut, it may lead to anxiety when cortisol means less serotonin or dopamine is released

Impulses sent from vagus nerve to brain signalling a harmful or new organism / bacteria in body leading to chemical being produced to kill these organisms

Gut flora could affect release of neurotransmitters which result in anxious behaviour

ResultsPlus
Examiner Comments

Three marks here. Unique flora leading to less neurotransmitter released. This reduction being caused by impulses going to the brain via the vagus nerve. Serotonin or dopamine are named neurotransmitters in the specification.

Question 8 (f)

A relatively well done question with most candidates able to state the loss of the myelin insulation layer which leads to a slowing in the rate of conduction of nerve impulses. No nerve impulses transmitted was not deemed creditworthy given the information provided to candidates in the stem.

(f) "Multiple sclerosis (MS) is a… demyelinating disease of the nervous system" (paragraph 14).

Symptoms of MS include poor coordination and loss of vision.

Explain how demyelination could result in these symptoms.

(2)

It could result in these symptoms as unmyelinated neurones would transmit the impulses much slower to the brain (no saltatory conduction). And so causes poor coordination and loss of vision as less impulses arrive per time.

ResultsPlus
Examiner Comments

Mark point 1 was not given here as there is no clear explanation of what demyelination is. Unmyelinated is not quite enough as it is merely repeating the stem. No saltatory conduction leading to slower transmission of the impulse was creditworthy.

ResultsPlus
Examiner Tip

Candidates need to careful how they phrase their response. Fewer impulse is acceptable but no impulses in not creditworthy.

(f) "Multiple sclerosis (MS) is a… demyelinating disease of the nervous system" (paragraph 14).

Symptoms of MS include poor coordination and loss of vision.

Explain how demyelination could result in these symptoms.

(2)

demylination means breakdown of mylin sheath which decreases speed of electrical impulses. So slower coordination.

ResultsPlus
Examiner Comments

Full marks here for a statement explaining that demyelination means loss / breakdown of the myelin sheath which resulted in a decreased speed of electrical conduction.

Question 8 (g)

Candidates had two routes of answering this question. Route 1 through extraction of the LPS gene from the wbc linked to use of a microarray followed by collection of results from multiple microarray analysis and then use of bioinformatics to analyse the data. Several candidates did not achieve the final marks as they merely suggested that bioinformatics could find the gene involved.

Route 2 was through the production of cDNA followed by the use of PCR followed by gel electrophoresis. Many candidates suggested use of fluorescence rather than fluorescent tags or dyes for the mark point.

Routes 1 and 2 were completely separate and could not be 'pick and mixed'.

(g) Gut microorganisms produce LPS (paragraphs 15 and 17).

White blood cells have receptors for LPS on their cell surface.

Describe the techniques that could be used to identify the LPS receptor gene found in white blood cells.

(3)

The sample should be taken and PCR should be used to make more copies of the gene. Then gel electrophoresis should be used. The receptor gene should be compared to the LPS receptor gene to identify it.

ResultsPlus
Examiner Comments

Candidates had two possible routes to answer the question. They could not however mix and match.

Here the response refers to the use of PCR and gel electrophoresis which are both creditworthy.

(g) Gut microorganisms produce LPS (paragraphs 15 and 17).

White blood cells have receptors for LPS on their cell surface.

Describe the techniques that could be used to identify the LPS receptor gene found in white blood cells.

(3)

- DNA Profiling could be used. Reverse endonucleases could be used to cut the required gene after it has been extracted. ~~The gene~~ A cDNA strand is made by DNA ligase and DNA polymerase if two strands are needed. The sample is then cut by endonucleases and placed in a PCR machine to be amplified. The amplified sample is then placed on a gel electrophoresis plate (agar gel) and an electric current passed through. LPS receptor gene could be put as a control in one of the wells and any segment that travels the same distance in a given period of time contains the same gene.
(PCR machine at 90°C then 55°C then 72°C to seperate strands, anneal primer, copy / transcribe DNA at optimal conditions for polymerase)

(Total for Question 8 = 20 marks)

TOTAL FOR PAPER = 90 MARKS

ResultsPlus
Examiner Comments

A comprehensive response involving cDNA, PCR and gel electrophoresis that was awarded three marks. Candidates could have also extracted the LPS gene from the white blood cells and referred to specific microarray. Data could then be collected from many arrays followed by the analysis of the data using bioinformatics.

Paper Summary

Based on their performance on this paper, candidates should:

- Have time to study the article.
- 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 distinct meaning. This is particularly true for 'explain, describe, determine and comment on' command words.
- Take greater care to check the axes, labels and units on graphs.
- Remember that in level based questions all the relevant information needs to be used including the candidates own knowledge. Simply describing the data will not achieve more than a Level 1.
- Show workings as well as the answer in calculations, as if the answer is incorrect candidates may gain some credit for the correct working.
- Take greater care in interconversion of units and do what the calculation asks for, eg to two significant figures.

Grade boundaries

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