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June 2024

IAL Biology WBI15 01

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June 2024

Publications Code WBI15_01_2406_ER

Introduction

This paper tests the knowledge, understanding and application of material from the following topics:

- Respiration, Muscles and the Internal Environment
- Coordination, Response and Gene Technology

The range of questions provided ample opportunity for candidates to demonstrate their grasp of these topics and apply their knowledge to novel contexts. This paper yielded a wide range of responses and some very good answers were seen.

Question 1 (a)(ii)

This question asks candidates to describe how MRI can show damage to the anterior cruciate ligament.

Most candidates could describe the use of radio waves/magnetic fields. However many did not qualify the image produced. Pictures and photos gained no credit.

(ii) Damage to anterior cruciate ligaments can be detected using magnetic resonance imaging (MRI).

Describe how MRI can show damage to the anterior cruciate ligament.

(2)

By sending radiowaves from the MRI machine, a 2D image is formed, showing the structure of the joint; and consequently showing the break / gap in the anterior cruciate ligament

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Examiner Comments

2 marks: the use of radio waves and a 2D image.

(ii) Damage to anterior cruciate ligaments can be detected using magnetic resonance imaging (MRI).

Describe how MRI can show damage to the anterior cruciate ligament.

(2)

MRI use magnetic fields to the nonactive area absorb magnetic fields and emit so this

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Examiner Comments

1 mark: There is no reference to a qualified image.

Question 1 (a)(iii)

This question asks candidates to calculate how many anterior cruciate repairs were carried out on males. They are given data and the population with the percentage of females in that population.

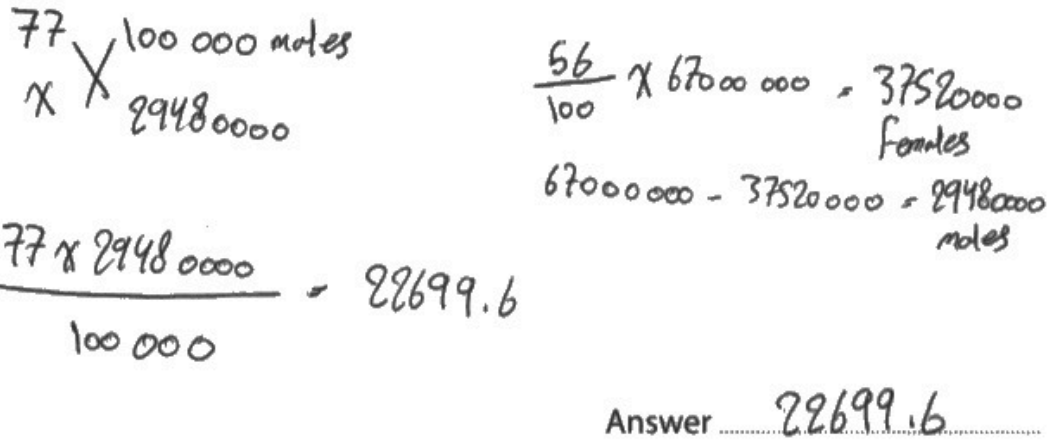
A majority of candidates were able to calculate the number of males who needed repairs to their cruciate ligaments. However several used the female data and gained no credit. Also seen quite often was 22699.6. This only gained 1 mark as it is impossible to have .6 of a male.

(iii) In one country, there were 77 anterior cruciate ligament repairs for every 100 000 males in one year.

The population of this country in that year was 67 000 000 and 56% of the population were female.

Calculate the number of anterior cruciate ligament repairs in males that year.

(2)



ResultsPlus
Examiner Comments

Correct calculation but answer given as 22699.6 which only gains 1 mark.

(iii) In one country, there were 77 anterior cruciate ligament repairs for every 100 000 males in one year.

The population of this country in that year was 67 000 000 and 56% of the population were female.

Calculate the number of anterior cruciate ligament repairs in males that year.

(2)

$\frac{56 \times 67\,000\,000}{100} = 37520000$

$67\,000\,000 - 37520000$

$= 29480000$ males

100,000	77
29480000	x

Answer 22700

$x = \frac{29480000 \times 77}{100,000}$

$= 22699.6$

22700

ResultsPlus
Examiner Comments

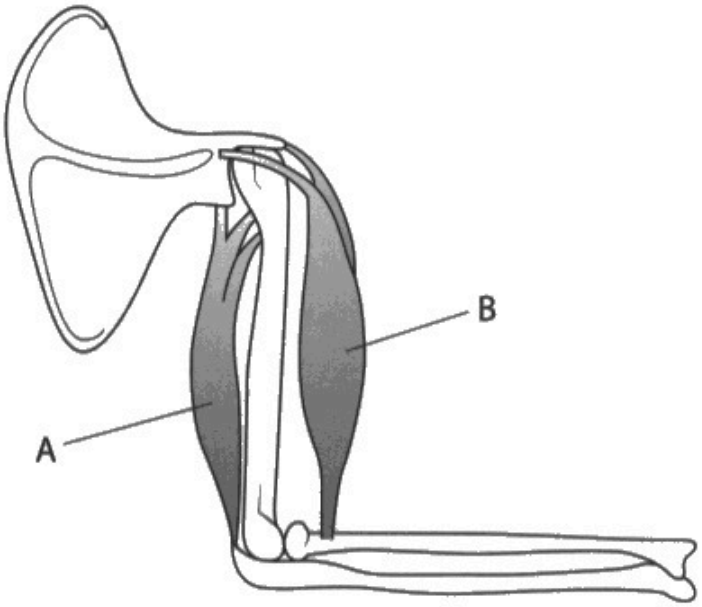
Correct calculation of the percentage of males and the number of anterior cruciate ligament repairs given as a whole number.

Question 1 (b)(i)

In this question candidates have to name the two types of skeletal muscle that are contracted when the arm is held in the bent position.

The majority of candidates gave the expected response of flexor and extensor. Naming the muscles biceps and triceps was accepted as was the hybrid answer of flexor and triceps. A few candidates only gave one type of muscle.

(b) The diagram shows some muscles in an arm.



(i) Name the **two** types of skeletal muscle that are contracted when the arm is held in this position.

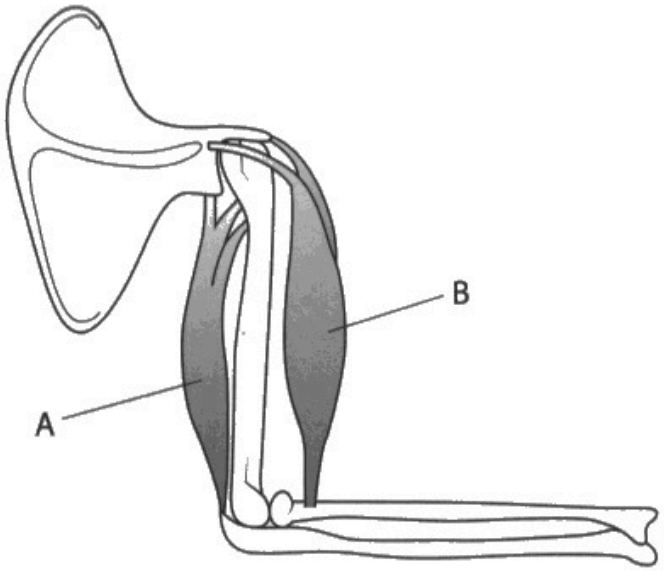
(1)

bicep

ResultsPlus
Examiner Comments

Only one muscle named so 0 marks.

(b) The diagram shows some muscles in an arm.



(i) Name the **two** types of skeletal muscle that are contracted when the arm is held in this position.

(1)

They're antagonistic ~~pair~~ muscles, B is an flexor and A is an extensor

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Examiner Comments

Both types of muscle correctly named.

Question 1 (b)(ii)

In this question candidates are asked to describe how the arm could be straightened using the named muscle types in Q01(b)(i).

The majority of candidates correctly described the contraction of muscle A and the relaxation of muscle B. A few got the labels A and B the wrong way round. As 'straightened' was in the stem of the question this did not get the second mark. Most knew that the muscles A and B were antagonistic.

(ii) Describe how the arm could be straightened by the muscles labelled A and B.

(2)

Arm is straightened when A which is the extensor muscle contracts while B being flexor muscle relaxes for the arm to extend.

A and B are antagonistic muscles.

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Examiner Comments

Two correct points to gain both marks.

(ii) Describe how the arm could be straightened by the muscles labelled A and B.

(2)

A ~~can~~ relaxes and B ~~flexe~~ contracts

pw

A acts as an extensor

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Examiner Comments

An example where the candidate gets the muscles the wrong way round.

Question 2 (b)(ii)

In this question candidates are asked to explain how SSRIs can be used to treat depression.

A majority of candidates could tell the complete story. Most correctly explained the involvement of the pre and post synaptic membranes in the correct place. Several candidates wrote about dopamine throughout their entire response; this gained no credit.

(ii) Drugs called selective serotonin re-uptake inhibitors (SSRIs) affect the reabsorption of serotonin at synapses in the brain.

This may help to reduce depression.

Explain why SSRIs can be used to treat depression.

(3)

~~SSRIs~~ As depression is caused by low serotonin levels, SSRIs work as they block the re-uptake of serotonin neurotransmitter (NT) in the ~~synapse~~ pre synaptic membrane. The reduced reuptake of the NT means the synapse / ~~with the~~ synaptic cleft will have higher levels of the NT with which allows for it to bind more often to the post synaptic receptors, thus firing more Action Potentials and increasing usage of serotonin, effectively reducing symptoms by increasing serotonin availability

(Total for Question 2 = 7 marks)

ResultsPlus
Examiner Comments

A complete story gaining full marks.

(ii) Drugs called selective serotonin re-uptake inhibitors (SSRIs) affect the reabsorption of serotonin at synapses in the brain.

This may help to reduce depression.

Explain why SSRIs can be used to treat depression.

(3)

→ SSRIs decrease the uptake of serotonin back to pre-synaptic neurone.
→ so higher concentration of serotonin will be present in the synapse in synaptic cleft.
→ so more serotonin will bind to serotonin receptors on post synaptic membrane.
→ initiating voltage gated sodium ion channels to open → resulting in an action potential in the next neurone

(Total for Question 2 = 7 marks)

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Examiner Comments

Details about SSRIs decreasing serotonin uptake in pre synaptic neurone.

More serotonin will bind to serotonin receptors on post synaptic membrane initiating action potentials.

3 marks.

Question 3 (a)(i)

In this question candidates have to calculate the number of rod cells in the section of squirrel monkey retina. In the introduction candidates are provided with data on photoreceptors in the grey bellied monkey and squirrel monkey.

Candidates need to use the data to calculate the percentage or proportion of rod cells in the squirrel monkey and then use that calculation to find the correct number of rod cells. Answers could be in standard form. However 41.67.8 or 4167.833 gained no credit as you cannot have 0.6 of a rod cell.

(i) A section of squirrel monkey retinal tissue contained a total of 5 000 photoreceptors.

Calculate how many of these photoreceptors would be rod cells.

Assume an even distribution of rod cells and cone cells in the retina.

(2)

$\frac{5000}{2} = 2500$

$\frac{5000 \times 3.5 \times 10^7}{4.2 \times 10^7} = 4166.7$

~~5660~~

$7 \times 10^6 + 3.5 \times 10^7 = 4.2 \times 10^7$

Answer 4.2×10^3

ResultsPlus
Examiner Comments

Answer correctly calculated and round up and put in standard form.
Full marks.

(i) A section of squirrel monkey retinal tissue contained a total of 5 000 photoreceptors.

Calculate how many of these photoreceptors would be rod cells.

Assume an even distribution of rod cells and cone cells in the retina.

(2)

$$\frac{3.5 \times 10^7}{(3.5 \times 10^7) + (7 \times 10^6)} \times 5000$$

$$= 4166.7$$

Answer 4166.7

ResultsPlus
Examiner Comments

The calculation of proportion of rod cells is correct but the final answer is given as 4166.7.

1 mark as .7 of a rod cell gains no credit.

(i) A section of squirrel monkey retinal tissue contained a total of 5 000 photoreceptors.

Calculate how many of these photoreceptors would be rod cells.

Assume an even distribution of rod cells and cone cells in the retina.

(2)

$5000 \times \frac{5}{6} = 4167$

Answer 4167.

ResultsPlus
Examiner Comments

A correct response with both fraction of rod cells calculated and the number of rod cells given to a whole number. Both marks attained.

Question 3 (a)(ii)

This question expects candidates to explain why there is a difference in the numbers of rod and cone cells in the retinas of the grey bellied night monkeys and the squirrel monkeys.

Generally candidates performed well on this question. Most were able to state that squirrel monkeys had more cone cells as they were active during the day or when there is more light. Conversely the grey bellied monkey was active at night and needed more rod cells. Seldom seen was the response that both monkeys needed to see colour to find food so had a similar order of magnitude of cone cells.

(ii) Explain why there is a difference in the numbers of rod cells and cone cells in the retinas of the grey-bellied night monkey and the squirrel monkey.

(3)

- night monkey active at night therefore have more rod cells than cones.
- day monkey active at day ~~therefore it~~ but it has more rod cells than cone cell but rod cell lower compared to night monkey. because
- Rod cells are bleached when light is sensed.
- cis-retinal converted to trans-retinal breaking rhodopsin to retinal and opsin. Opsin binds to the cell membrane blocking Na^+ channel therefore depolarised ~~neuron~~ neurotransmitter glutamate not released

ResultsPlus
Examiner Comments

1 mark: There is no credit in the mark scheme for explaining the biochemistry behind rod and cone cells.

(ii) Explain why there is a difference in the numbers of rod cells and cone cells in the retinas of the grey-bellied night monkey and the squirrel monkey.

(3)

Grey-bellied night monkey is active at night so it needs more rod cells to detect low light intensities. Squirrel monkey is active during day so it has more cone cells ~~then~~ ~~gre~~ to detect higher light intensities. Rod cells gives black & white vision while cone cells give colour vision.

ResultsPlus
Examiner Comments

3 marks: A complete answer comparing grey bellied monkey and squirrel monkey.

Question 3 (b)

In this question candidates are expected to use the information given in the pre-amble about the effect of auxins and gibberellins on a shoot. As it is a 'deduce' question, candidates have to draw/reach conclusions using the data in the introduction.

Candidates showed a good understanding of how auxin caused growth towards the light rough cell elongation. Many went into great detail about the biochemical mechanisms behind cell wall expansion, often though at the expense of other comments about auxin and gibberellin.

Few candidates referred to auxin inhibiting lateral bud growth. Clearly auxins are better understood than gibberellins.

Deduce the effect of each treatment on seedlings that have had their apical buds removed.

Use the information in the table to support your answer.

(3)

Seedling 1 had apical bud removed and ~~nothing~~ nothing was applied to it. Side shoots or ~~branches~~ grew. ~~Seedling 2 had an auxin~~ (no auxin to prev.) (no auxin to cause) apical dominance - prevention of side shoots growth) Seedling 2 had apical bud removed and auxin applied to the cut top of the seedling which ~~bends~~ led to shoot bending towards the sun, this is called positive phototropisim. Seedling 3 had gibberellins applied to ~~top of~~ cut top of seedling which enhanced the stem dormancy and cell elongation so the plant grew taller and more branched.

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Examiner Comments

3 marks: Causing apical dominance is an acceptable alternative to the mark point.

Deduce the effect of each treatment on seedlings that have had their apical buds removed.

Use the information in the table to support your answer.

(3)

Removal of the apical bud with no further treatment resulted in the increased growth of lateral buds / minimal growth in stem as auxin removed with apical bud means no apical dominance so lateral buds grew more. Auxin applied to cut top resulted in positive phototropism / ~~growth in~~ bending towards direction of light by stem and suppresion of growth at lateral buds so auxin helps identify direction of light and does apical dominance. Gibberllins increased growth / activated protein synthesis as plant grew larger and increased growth at stem and lateral bud so is growth regulator no phototropism.

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Examiner Comments

3 marks: A clear response.

Question 4 (a)(ii)

In this question candidates have been given a diagram of a sarcomere, which is drawn to the same scale, has a length of 50mm when contracted. Candidates have to work out the ratio of relaxed sarcomere to contracted sarcomere.

A tolerance of +/ – 1mm is permitted in the measuring of the sarcomere. As a general rule the ratio should be xxx:xxx and in this case relaxed sarcomere to contracted sarcomere, and not to more than 2 decimal places. Fractions in the ratio gain no credit so 9/5:1 was not deemed to be acceptable.

(ii) A diagram of this sarcomere, drawn to the same scale, has a length of 50 mm when contracted.

Give the ratio of the lengths of the relaxed sarcomere to the contracted sarcomere.

(1)

91mm → relaxed

$\frac{91}{50} = 1.82$

Answer 1.82 :1

ResultsPlus
Examiner Comments

Full marks: response within the acceptable range 1.78 – 1.82 :1

(ii) A diagram of this sarcomere, drawn to the same scale, has a length of 50 mm when contracted.

Give the ratio of the lengths of the relaxed sarcomere to the contracted sarcomere.

(1)

Relaxed : Contracted
90mm : 50mm.

1.8 : 1

Answer 1.8 :1

ResultsPlus
Examiner Comments

Correct response after accurate measuring of sarcomere.

Question 4 (a)(iii)

Most candidates successfully named the protein as myosin. A few listed more than one protein – in that case only the first response was taken.

Question 4 (b)

In this question candidates have to describe the role of troponin molecules in the contraction of a sarcomere.

As muscle contraction has been a focus in several of the recent exam sessions candidates did well on this question. The key issues are to get the events in the correct order and the right molecule having the right effect. Candidates are still missing out the reference to myosin **head** when forming the crossbridge.

(b) Describe the role of troponin molecules in the contraction of a sarcomere.

(4)

Upon contraction, Calcium ions are ~~returned~~ released into sarcomere.
Troponin is attached to tropomyosin.
Calcium ions bind to troponin, change shape of the molecule, which also causes tropomyosin to ~~move~~ expose active ~~site~~ site on actin.
As actin active site is exposed, this allows ~~attached~~ myosin with altered shape to bind to actin, causing actin chain to move, contracting the muscle, ~~with~~ with actin-myosin cross bridge formed. Shortly after, cross bridges broken with hydrolysis of ATP.

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Examiner Comments

2 marks: For calcium ions binding to the troponin and changing its shape. The tropomyosin does not expose the actin binding site and there is no reference to myosin head.

(b) Describe the role of troponin molecules in the contraction of a sarcomere.

(4)

When calcium ions are released from the ~~sar~~ sarcoplasmic reticulum, it binds to troponin causing it to change shape, which causes the tropomyosin to move exposing myosin head binding sites, allowing the myosin head to bind to the actin filament, forming acto myosin cross-bridges. Then the myosin head tilt changing angle to pull the actin filament across the myosin towards the centre of sarcomere so that the sarcomere is ~~shorted~~ shortened. Then ATP binds to the myosin head breaking the cross bridges, and then is hydrolysed releasing energy for the myosin head to return to it's original position

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Examiner Comments

A complete response attaining all 4 marks.

Question 4 (c)(i-ii)

In this question candidates have to compete appropriate x and y axis scales on the graph and draw a line of best fit. Then using the graph, calculate the gradient of the line of best fit.

Generally this was done very well. Candidates have a great deal of experience within the specification of drawing graphs. There were however some very odd scales which gained no credit. Furthermore a line of best fit with these points should not go through the origin 0,0.

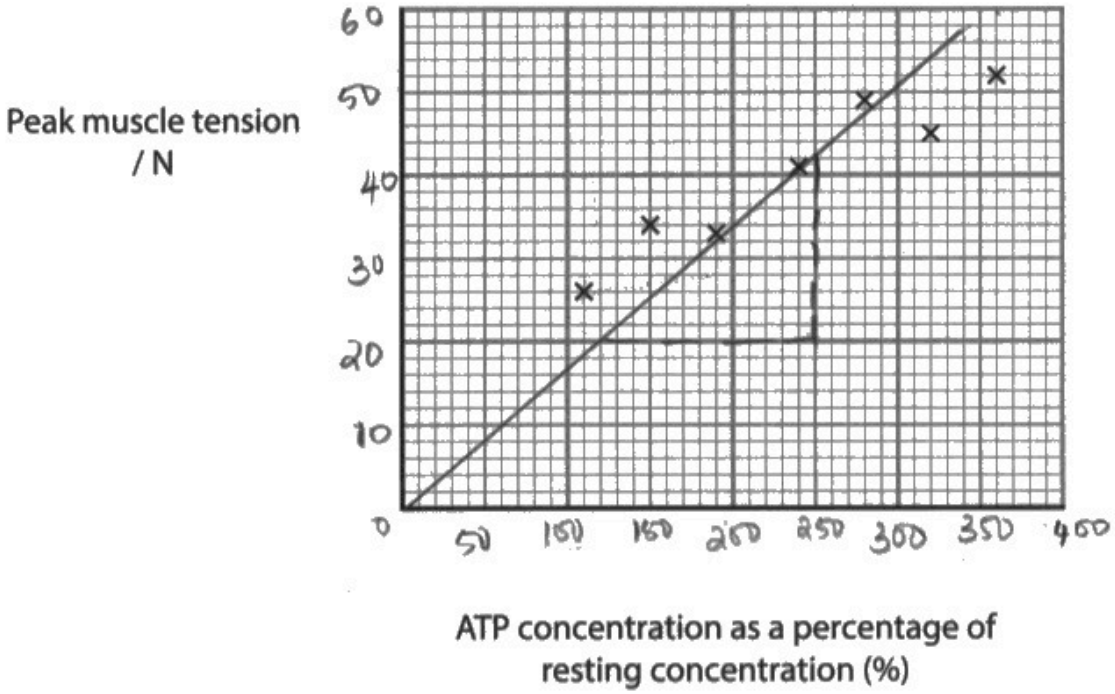
(c) Muscle contraction increases muscle tension.

The relationship between increasing ATP concentration and peak muscle tension was investigated.

The results are shown in the table.

ATP concentration as a percentage of resting concentration (%)	Peak muscle tension / N
110	26
150	34
190	33
240	41
280	49
320	45
360	52

The incomplete graph shows the results of this investigation.



(i) Add an appropriate scale to the axes of the graph and draw a line of best fit.

(2)

(ii) Calculate the gradient of the line of best fit.

(1)

$$\frac{42 - 20}{250 - 120} = \frac{22}{130} = 0.17$$

Answer 0.17 N per percentage increase

(Total for Question 4 = 10 marks)

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Scales are acceptable but the line of best fit going through the origin does not gain any credit.

The line of best fit going through the origin would lead to a gradient outside of the acceptable range.

Question 5 (a)

In this question candidates have to calculate the percentage in BMAA per gram from the seeds of the cycad trees to the flying foxes. The answer has to given to two significant figures.

The calculation was relatively easy and most candidates got the working correct. The only issue was giving the answer to two significant figures. 9510.8% was occasionally seen rather than 9500%.

Question 5 (b)(i)

In this second question on the flying squirrels candidates are given a three axis graph showing the results of an investigation where scientists looked at the flying fox population and the number of men diagnosed with ALS. Candidates have to explain the results of this investigation and are expected to use the information given in the question to support their answer.

Many candidates described the data rather than explaining it. This is a good example where candidates must fully comprehend the meaning of the key command word. Few candidates achieved high marks as they merely described the patterns shown in the graphs. The most frequently seen statement was that the population of flying foxes decreased.

(i) **Explain the results of this investigation.**

Use information from the question to support your answer.

(4)

- This investigation proves there is a ~~bet~~ relation between eating flying fox & developing ALS
- AS the population of flying foxes goes down So does ALS because there ~~a~~ are less flying foxes to eat and therefore less BMAA is consumed
- There is a delay in the graph as it takes time ~~MEA~~ for mens nervous system to degenerate and show symptoms
- Its relatively a low chance to get ALS from eating flying foxes because even at its peak ~~that~~ the ratio of getting it was 1:723.6 (1dp)

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4 marks for a full response.

(i) Explain the results of this investigation.

Use information from the question to support your answer.

(4)

the number of ~~fly~~ flying foxes decreases as people hunt these foxes for food and when the number of flying foxes decrease the men with ALS increase as they eat these foxes which have a high concentration of neurotoxin BMAA which causes the ~~men~~ ALS and when the number of foxes was too low people stopped feeding on them so the number of people with ALS decrease and the number of flying foxes starts to increase, there is a delay as the ALS needs time to be expressed and diagnosed

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Examiner Comments

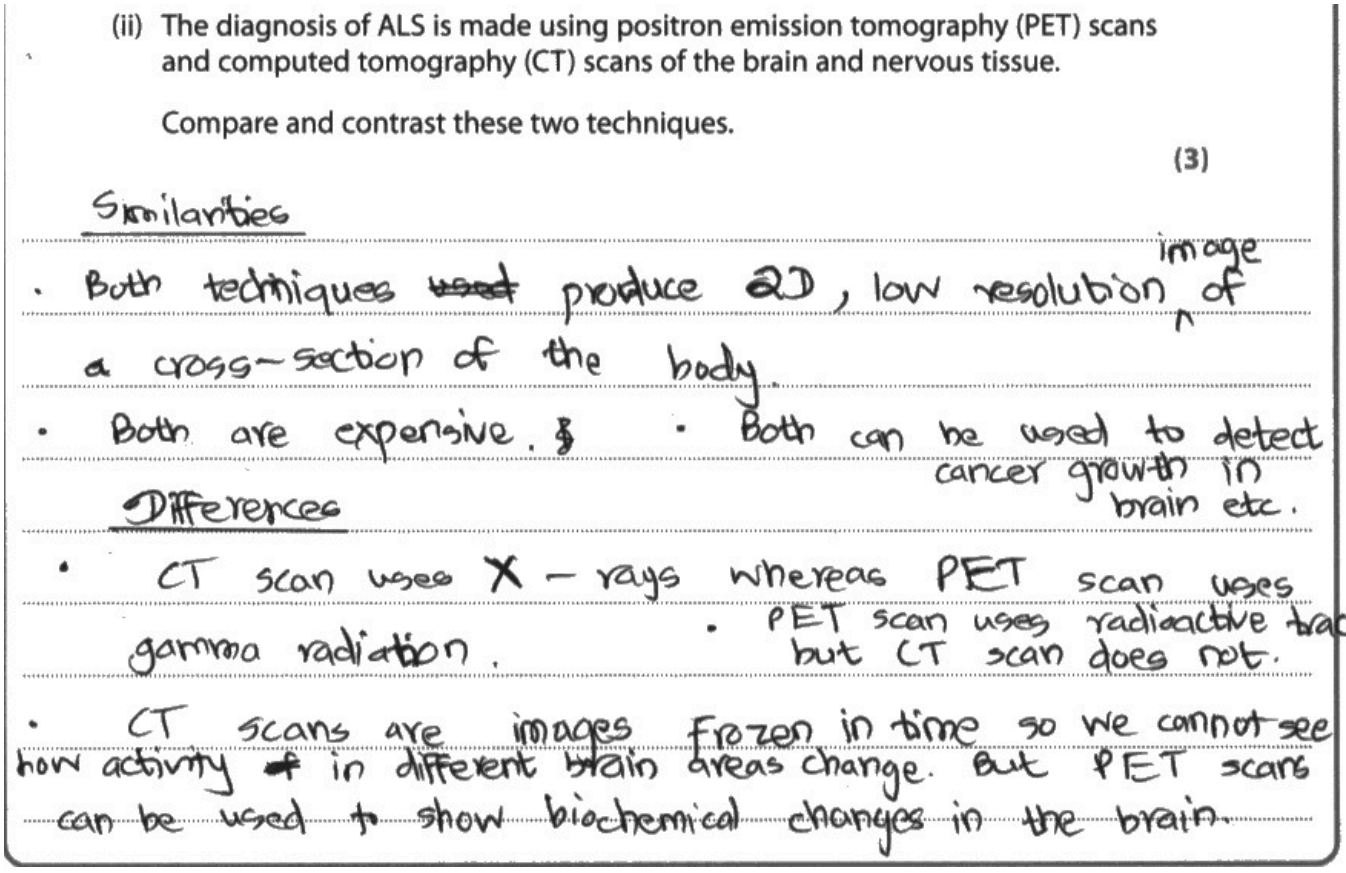
A very good response explaining the data rather than merely describing it.

Question 5 (b)(ii)

This question expects candidates to compare and contrast the use of positron emission tomography (PET) and computed tomography (CT) scans of the brain and nervous tissue to diagnose ALS.

The command words 'compare and contrast' are key here. There needs to be a clear comparison ideally in the same sentence. At a stretch, the next sentence may be acceptable. However when the comparison is in a separate paragraph this is not deemed to be in the nature of compare and contrast.

Many candidates struggled to find similarities apart from images formed. However, they found differences easier and often gave three or four differences – this can still only achieve a maximum of 2 marks for difference.



(ii) The diagnosis of ALS is made using positron emission tomography (PET) scans and computed tomography (CT) scans of the brain and nervous tissue.

Compare and contrast these two techniques.

(3)

Similarities

- Both techniques ~~used~~ produce 2D, low resolution image of a cross-section of the body.
- Both are expensive. §
- Both can be used to detect cancer growth in brain etc.

Differences

- CT scan uses X-rays whereas PET scan uses gamma radiation.
- PET scan uses radioactive tracer but CT scan does not.
- CT scans are images frozen in time so we cannot see how activity of in different brain areas change. But PET scans can be used to show biochemical changes in the brain.

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3 marks: A clear comparison about images and two clear differences.

(ii) The diagnosis of ALS is made using positron emission tomography (PET) scans and computed tomography (CT) scans of the brain and nervous tissue.

Compare and contrast these two techniques.

(3)

- PET and CT both build up 3d images of the brain
- CT uses X-rays, PET uses radioactive tracers and glucose
- CT only produces an image but PET can detect activity in the brain
- PET scans are more expensive

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Examiner Comments

3 marks: Clear reference to images and three differences for maximum 2 marks for differences.

(ii) The diagnosis of ALS is made using positron emission tomography (PET) scans and computed tomography (CT) scans of the brain and nervous tissue.

Compare and contrast these two techniques.

(3)

CT scans can only form 2-D ~~rays~~ images and not a clear image is formed and the X-ray radiations can also cause cancer whereas PET scans also form 2D images but can be changed to 3-D by the use of computer & PET scans can show ~~the before~~ all ~~th~~ of the results.

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Only 1 mark for imaging. Just about acceptable as in next sentence.

Question 5 (c)(i)

Candidates are tasked with drawing a myelinated neurone and labelling two features.

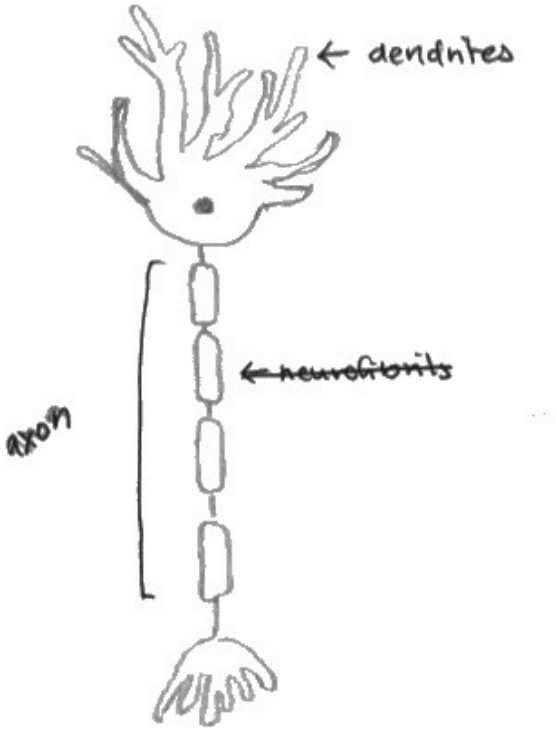
There were a range of drawing skills demonstrated. Many responses got the full 3 marks as they met the criteria of the mark scheme although some of the drawings were just about recognisable as a myelinated neurone.

Key elements are clearly cell body, myelin sheath with nodes of Ranvier with the synaptic terminal at the end. The labelling of two structures were often complicated by the labelling of additional structures which sometimes were incorrect. Label lines are expected to touch the part labelled.

(c) Neurotoxins can affect the potential differences generated across the membranes of motor neurones.

(i) Draw a myelinated motor neurone and label **two** structures.

(3)



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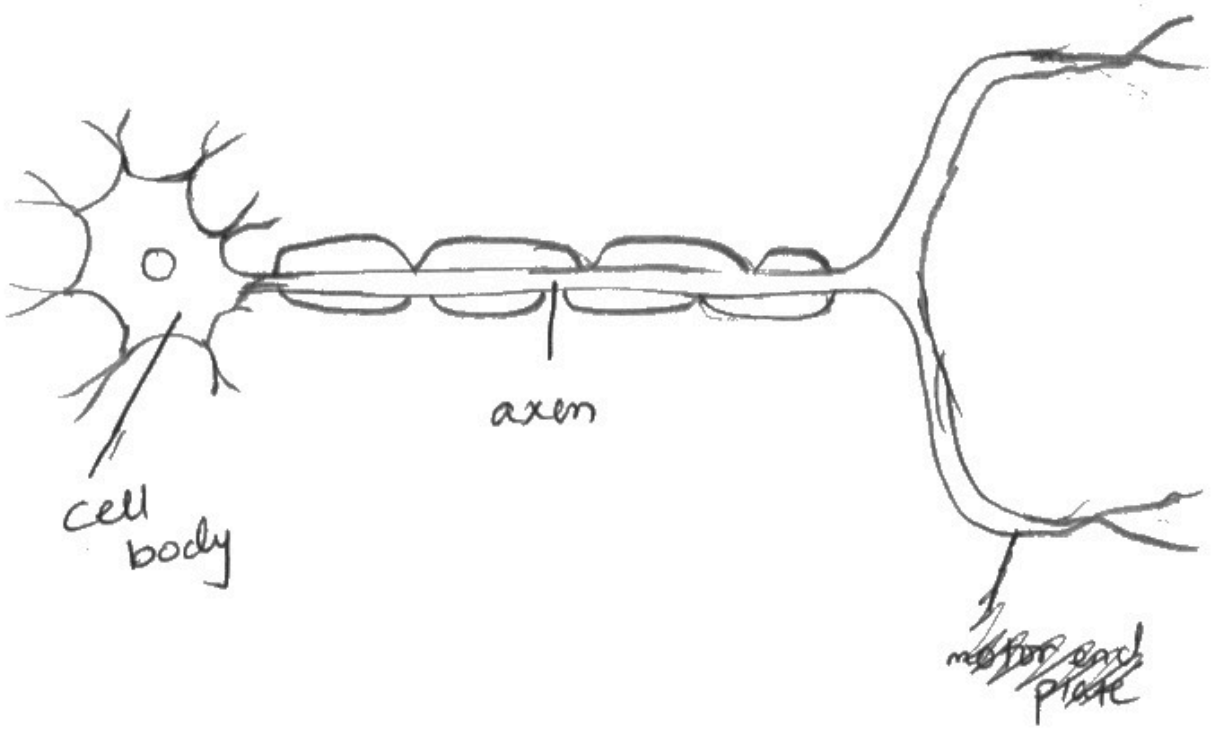
Nice neuron but let down by arrow not touching part. This has been referred to in recent past examiners' reports.

(c) Neurotoxins can affect the potential differences generated across the membranes of motor neurones.

(i) Draw a myelinated motor neurone and label **two** structures.

(3)



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A good attempt and well labelled. Full marks

Question 5 (c)(ii)

This question gives candidates data on the potential differences when a neurotoxin tetrodoxin is added to a nerve. Candidates are asked to explain how tetrodoxin inhibits the transmission of the nerve impulse along the axon. Key here is the command word 'explain'. Candidates who merely describe the pattern from the graphs cannot gain full marks.

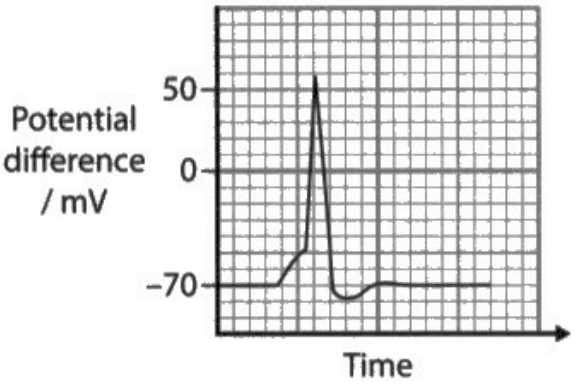
There were some very detailed explanations seen. It is a topic that comes up regularly; it was just a means of using the data in the context of TTX.

(ii) A different neurotoxin called tetrodotoxin inhibits the transmission of nerve impulses along axons.

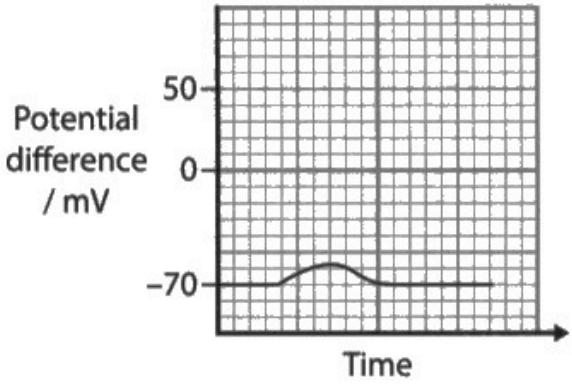
In an experiment, axons of motor neurones were stimulated in the absence of tetrodotoxin and in the presence of tetrodotoxin.

The graphs show the potential differences obtained in this experiment.

Absence of tetrodotoxin



Presence of tetrodotoxin



Explain how tetrodotoxin inhibits the transmission of a nerve impulse along the axon.

(3)

Tetrodotoxin binds to voltage-gated sodium ion channels so they cannot open, so less voltage-gated sodium ion channels open, and less sodium ion influx is caused, hence membrane potential increases but cannot increase above the threshold level, so no action potential is caused as it is an "all-or-nothing" response, hence no nerve impulses can be generated to be transmitted along the axon.

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Examiner Comments

A very clear response meeting all the required mark points.

Question 6 (a)(ii)

Candidates are provided with data on lactate concentration as the intensity of exercise increases and the stroke volume changing with heart rate. The data and graph compares an athlete and non athlete. Candidates are tasked with explaining the results of the investigation using the data provided and their own subject knowledge.

It is pleasing to see that candidates are at last coming to terms with the expectations of a level based question. Those who merely described the data from the graph or table were limited to level 1. To get to level 2 some degree of explanations is required, albeit simplistic, in biological detail. However the detail has to be accurate. Level 3 is where there is detailed biology used.

Explain the results of this investigation.
Use the information in the graph and the table and your own knowledge to support your answer.

(6)

Lactate concentration of a non athlete is higher than an athletes even at 240au which is the highest exercise intensity. This is because the athlete's body is trained and can clear oxygen debt from the muscles at faster rates. Athletes have fast twitch muscles fibres that have a high glycogen storage which is converted to glucose that can be used for respiration to produce ATP for muscle contraction. An athlete will have much less lactate entering the bloodstream as less of it is made even though athlete muscles respire anaerobically, the liver oxidizes lactate to pyruvate in order to be used in the link reaction to contribute to ATP production. An athlete's stroke volume is much higher at 200bpm than a non athletes. This is because after intense exercise, the heart muscle will release more oxygenated blood from the heart at the same amount of beats per minute

→

EXTRA PAPER

CONTINUE

ResultsPlus
Examiner Comments

A good top level 2 response.

Explain the results of this investigation.
Use the information in the graph and the table and your own knowledge to support your answer.

(6)

The difference in lactate conc in blood is very apparent between athletes and non Athletes even at 0 intensity (1.8 for Athlete & 1.5 for none) However it only seems to get more and more drastically different from start to end of experiment as 60 = 1.1 for A while 2.3 for B then jumped to 3.2 A and 6.2 B at 180 intensity this shows that the difference is by more than half furthermore the graph provides additional info: Stroke volume seems to be related to lactate conc the athlete has A increase in Stroke vol while the non Athlete has a stable stroke volume the Heart beat rates didn't affect non athletes like Athlete this is likely due to increase of lactate production / conc as a increase in lactate conc means more in NADH and if there a more in NADH there will be a more in electrons & H^+ ions in E.T.C resulting in more of Protons being pumped out of Matrix to the inner Mitochondrial membrane and so more electrochemical gain and so results in a quicker ATP Production and so lactate in body this is why more athletes do not have a great stamina and have more lactate due to them Producing these

Continued on back page →

ResultsPlus
Examiner Comments

This candidate has described graph and table with no real explanation.
Level 1

Explain the results of this investigation.
Use the information in the graph and the table and your own knowledge to support your answer.

(6)

As the intensity of the excercise increases the lactate concentration increases the non athelete has more production of lactate than the athelete. The most change in the lactate concentration between the 180 a.u and 240 a.u intesity of excercise with difference 3.2 mmol dm^{-3} in athelete and 3.8 mmol dm^{-3} in the non athelete. The atheletes have muscles structure contain higher stroke volume than the non athelete as they have stronger cardiacs muscle and stronger less heart rate. There is no calculation of mean and standered deviation so data has less reliebility. The atheletes have more slow twitch muscle fibre so the dependen the aerobic respiration as slow twitch contain many mitochondria and many myoglobin to transport the oxygen to all body cells and and mitochondria is site of aerobic respiration and production of ATP which it is the main source of energy but the non atheletes have more fast twitch that contain less mitochondria and has more glycogen & break glycogen to glucose to be used in glycolysis in anerobic respiration. the aerobic respiration in the slow twitch take place in atheletes so produce more ATP as more there oxydative phosphorilation so oxyge acts as final electron acceptor to regen produce wate molecules and regenerate nead and FAD that are needed in the electron transport chain. the
In teble as the intensity of excersise increases the lactate concentration increeses as the anerobic respiration starts to take place as there is no any oxy encuph oxygen.

ResultsPlus
Examiner Comments

A clear detailed account and explanation of the data using key relevant knowledge from the specification. Top level 3.

Question 6 (b)

In this question candidates are told that coyotes are often poisoned with cyanide by farmers to prevent them killing livestock. They are also told that cyanide inhibits cytochrome oxidase. Candidates have to explain how the action of cyanide would kill the coyote.

Most candidates grasped the idea that electrons are not passed along the ETC, so aerobic respiration stops and coyotes have to rely on anaerobic respiration. However for many candidates this is how far their explanation went. What is needed is that this leads to less ATP so no contraction of muscle/cardiac muscle. Few candidates went down the route of pyruvate being converted to lactate resulting in lowered pH and subsequent denaturing of enzymes.

(b) The photograph shows a coyote.

(Source: © Shaun Cunningham/Alamy Stock Photo)

Some coyotes have been poisoned with cyanide to prevent them from killing the livestock of farmers.

Cyanide inhibits cytochrome oxidase, the last carrier in the electron transport chain (ETC).

Explain how the action of cyanide would kill a coyote.

(4)

electron cannot pass along all electron transport chain,
less energy produced to allow ✗ hydrogen ions to be actively pumped accross ETC to the intermembrane space.
less hydrogen ions diffuse back to mitochondrial matrix across ATP synthase, therefore less energy produced for phosphorylation of ADP to ATP. (ADP + Pi → ATP)
Chemiosmosis is less likely to take place.
Incomplete aerobic respiration, less ATP produced
ATP is needed for muscle contraction, nerve impulses, growth. ✗ Anaerobic respiration might take place, lactate builds up in blood and cannot be broken down, blood pH decreases, enzymes denature and coyotes die

ResultsPlus
Examiner Comments

A very good response with the majority of mark points stated. Full marks attained.

(b) The photograph shows a coyote.

(Source: © Shaun Cunningham/Alamy Stock Photo)

Some coyotes have been poisoned with cyanide to prevent them from killing the livestock of farmers.

Cyanide inhibits cytochrome oxidase, the last carrier in the electron transport chain (ETC).

Explain how the action of cyanide would kill a coyote.

(4)

- as Cytochrome oxidase is the last carrier in ETC and Cyanide inhibits it so the ETC will be permenantly reduced so ETC won't accept electron from reduced NAD and FAD so they remain reduced so Krebs cycle and link reaction stops
- ~~so~~ ~~it~~ no ETC so Production of ATP decrease and coyote will relay more on anerobic respiration so more Production of lactic acid ~~so~~ and lactic acid decrease pH in the Muscle so ~~enzymatic~~ enzymes ~~activity~~ in muscles denature so coyote die

ResultsPlus
Examiner Comments

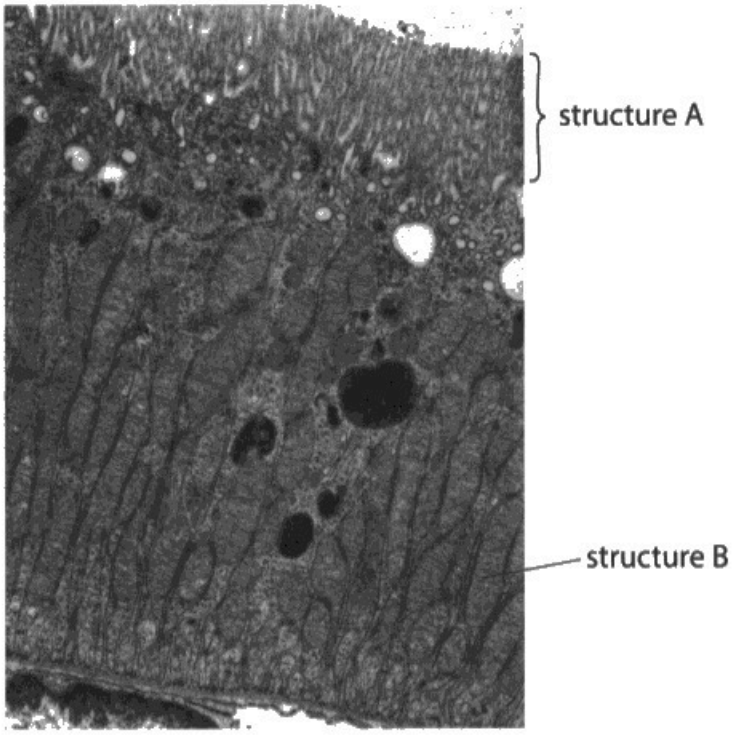
Although mp1 is repeated several times there are sufficient points here to achieve full marks.

Question 7 (a)(iii)

Candidates are provided with an electronmicrograph of a cell lining the proximal convoluted tubule with two structures labelled.

The majority of candidates were able to correctly identify structures A and B. However few could accurately describe the orientation of the labelled structures. For orientation the expectation is that structure A/brush border is in the lumen of the tubule, or that structure B is located at the base/basal side of the cell.

(iii) The electron micrograph shows part of a cell lining the proximal convoluted tubule.



(Source: © Jose Calvo/Science Photo Library)

Explain how structures A and B and their locations in the proximal convoluted tubule enable the reabsorption of solutes.

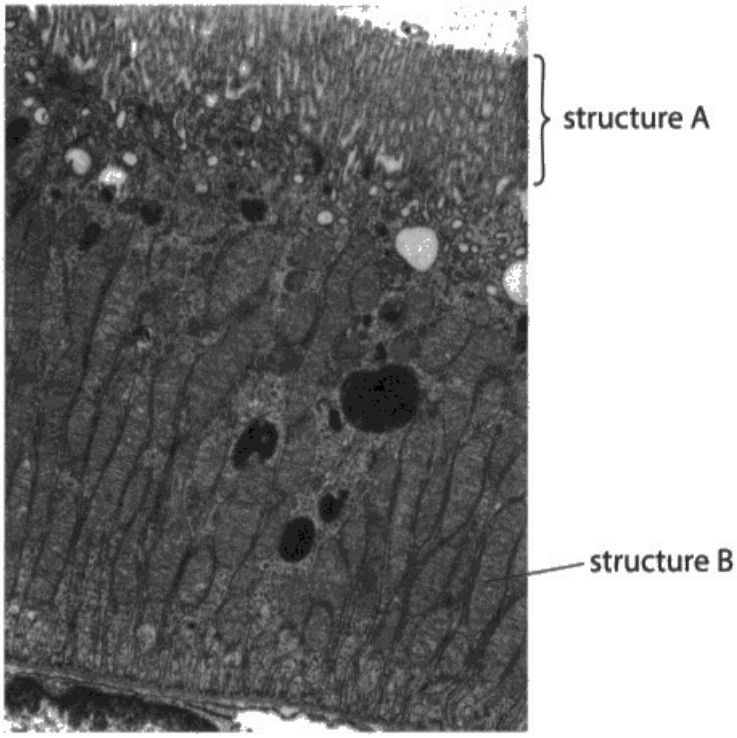
(3)

- Structure A, microvilli, increase surface area of proximal convoluted tubules to fit more sodium glucose/amino acid cotransporters on apical side
- Structure B, mitochondria, are the site of aerobic respiration to release energy for the active pumping of sodium ions into blood from cytoplasm against concentration gradient
- sodium diffuses into cytoplasm with glucose or amino acid against concentration gradient without using energy
- this is called secondary active transport

ResultsPlus
Examiner Comments

One of the few that stated apical side. Full marks.

(iii) The electron micrograph shows part of a cell lining the proximal convoluted tubule.



(Source: © Jose Calvo/Science Photo Library)

Explain how structures A and B and their locations in the proximal convoluted tubule enable the reabsorption of solutes.

(3)

Structure A is microvilli that increases the surface area for greater absorption rate. B structure looks like mitochondria which produces ATP for active transport. It is between the Inner layer which starts with microvilli. Microvilli is exposed to the filtrate.

ResultsPlus
Examiner Comments

Structures A and B correctly identified but no reference to the orientation. This was a very common response.

Question 7 (b)

In this question, data on urine volume, ion concentration and urea mass are provided to candidates. The graph and table show the changes over a 150 minute period. Candidates are asked to comment on the results of the investigation.

Once again key here is the command word 'comment'. Many candidates gave detailed explanations on how ADH caused the changes shown in the data. This failed to attain many marks. There was an expectation that candidates used the data on all three elements. Generally this question was well answered.

Comment on the results of this investigation.

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

(4)

• Mean volume of urine produced increased at first 60 minutes then ~~dropped~~ started to decrease and reached to its normal volume which is 100 cm after 150 minutes

• Mean Concentration of ions in urine decreased at first 60 minutes then increased again reaching to normal level of 6.0 a.u. after 150 minutes

• They show reverse effect indicating that as mean volume ~~increase~~ of urine produced increase ~~the~~ the mean Concentration of urine ions decreases.

• graph show that after drinking water mass of urea in urine keeps increases for 60 minutes then drop after till reaching same mean mass before drinking after 150 minutes which is 20.0.

• No indication of sample size used

• No mean or SD values ~~calculated~~ reducing validity. Calculated.

ResultsPlus
Examiner Comments

4 marks: A clear response making relevant comments on the data. One of the few that made comments about lack of statistical analysis or scientific method used.

Comment on the results of this investigation.

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

(4)

volume of urine produced is highest after 60 minutes after drinking. Mean (mechanical of ions) in urine is highest at start of experiment (0 minutes) and 150 minutes. The lowest at 60 minutes. At 60 minutes, (ADH) water is reabsorbed in collecting duct, water then produced in urine. giving (ADH) concentrated urine. (dilute urine)

For the graph, highest mass of urea in urine sample at 60 minutes after drinking. Water need, time t. g. for t. the kidney, then reabsorption of water until it is produced. Water need, 60 minutes t. produce. lowest urea mass at 0 and 150 minutes after drinking water. At 0 and 150 minutes, water ~~from~~ the body is normally produced so. (ADH) water/urine can be produced, hence mass of urea ~~lowest~~ and volume of urine lowest. Result in concentrated urine.

ResultsPlus
Examiner Comments

A good response achieving 4 marks.

Comment on the results of this investigation.

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

(4)

The Mean volume of urine produced ~~of ions in urine~~ increases by 225 cm^3 till 60 mins after Drinking

The Mean concentration of ions in urine Decrease from 6.0 a.u to 1.8 a.u till 60 minutes.

After 150 minutes after Drinking both Mean of urine Volume of urine produced and Mean Concentration of ions in urine are back to there normal values.

Mean Mass of urea in the urine Sample increases till 60 minutes after Drinking and Decreases back to 2.a.u after 150 minutes of Drinking water

ResultsPlus
Examiner Comments

A concise response giving all the elements for 4 marks.

Question 7 (c)

Candidates are provided with data about the sodium ion concentration of the blood with increasing hyponatraemia. Candidates are asked to explain how the excessive release of ADH causes the changes in blood sodium concentration shown in the table.

It was pleasing to see that many candidates have a detailed understanding of how ADH works. It has been a regular in recent exam sessions. There is an increasing knowledge of how aquaporins function. Some candidates did not gain credit as their responses were too vague eg referring to kidney rather than DCT or collecting duct. Still some candidates forget to put ion in their answer. Sodium on its own gets no credit.

(c) A person with hyponatraemia suffers from excessive production of antidiuretic hormone (ADH) from the pituitary gland.

This causes changes in the sodium ion concentration of the blood.

The table shows the sodium ion concentration of the blood in patients with hyponatraemia.

Condition	Sodium ion concentration of the blood / a.u.
normal	135 to 145
mild hyponatraemia	130 to 134
moderate hyponatraemia	125 to 129
severe hyponatraemia	<125

Explain how the excessive release of antidiuretic hormone (ADH) causes these changes in blood sodium concentrations.

(3)

- concentration of Na^+ in blood reduces with ↑ severity of hyponatraemia
- because excessive ADH causes ↑ water reabsorption into blood from ~~completed~~ the collecting duct
- because it causes vesicles with aquaporins to fuse with cell membranes

ResultsPlus
Examiner Comments

Full marks here, and good reference to aquaporins and membrane.

(c) A person with hyponatraemia suffers from excessive production of antidiuretic hormone (ADH) from the pituitary gland.

This causes changes in the sodium ion concentration of the blood.

The table shows the sodium ion concentration of the blood in patients with hyponatraemia.

Condition	Sodium ion concentration of the blood / a.u.
normal	135 to 145
mild hyponatraemia	130 to 134
moderate hyponatraemia	125 to 129
severe hyponatraemia	<125

Explain how the excessive release of antidiuretic hormone (ADH) causes these changes in blood sodium concentrations.

(3)

As release of ADH increases and becomes more excessive, sodium ion concentration of blood decreases. This is because increased release of ADH causes increased permeability of collecting duct to water as more aquaporins are incorporated into cell membranes (vesicles containing water channels are incorporated ~~into~~ within membrane as ADH binds to cell membrane to activate 2nd messenger cAMP). So more water moves into blood by osmosis at collecting duct, increasing water potential of blood and decreasing sodium ion concentration.

ResultsPlus
Examiner Comments

A very thorough response gaining full marks.

(c) A person with hyponatraemia suffers from excessive production of antidiuretic hormone (ADH) from the pituitary gland.

This causes changes in the sodium ion concentration of the blood.

The table shows the sodium ion concentration of the blood in patients with hyponatraemia.

Condition	Sodium ion concentration of the blood / a.u.
normal	135 to 145
mild hyponatraemia	130 to 134
moderate hyponatraemia	125 to 129
severe hyponatraemia	<125

Explain how the excessive release of antidiuretic hormone (ADH) causes these changes in blood sodium concentrations.

(3)

ADH from the pituitary gland when released in excess it can cause changes in the blood sodium concentrations and can interfere with blood Clotting. Which may prevent blood flow to the parts of the body

ResultsPlus
Examiner Comments

Unfortunately no marking points accessed. There is no explanation evident.

Question 8 (a)

Question 8 is based on the scientific article. It was clear that some candidates have had a greater opportunity to study the article than others.

In Q08(a) candidates need to explain how Ted Turlings could have identified that the BtPMaT1 gene that was found in the whitefly came originally from a plant. Candidates could answer this question either by going down the microarray/bioinformatics route or PCR and electrophoresis.

Many candidates had a good awareness of the procedures but could not sum it up by stating that the BtPMaT1 gene was only found in plants and no other species of whitefly.

8 The scientific document you have studied is adapted from articles in *New Scientist* and the *Journal of Consumer Protection and Food Safety*.

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

(a) Explain how Ted Turlings and colleagues could have identified that the *BtPMaT1* gene found in the whitefly was originally a plant gene (paragraph 2).

(3)

by using gel electrophoresis. The DNA fragments (gene) is loaded into agarose gel wells & electricity is turned, DNA fragment (gene) are negatively charged so moved towards +ve electrode. Southern blotting is used where gene is transfered into nitrocellulose membrane. Use radioactive probe, X rays to view the number, position & size of bands of gene. Compare the number, position & size of bands of gene obtained from whitefly to gene in plants. Both have the same bands using gene sequencing, comparing the full DNA Profile of the insect with full DNA profile of Plant.

ResultsPlus
Examiner Comments

Use of electrophoresis and comparing band pattern and sizes showing genomes of the whitefly and plants are the same.

8 The scientific document you have studied is adapted from articles in *New Scientist* and the *Journal of Consumer Protection and Food Safety*.

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

(a) Explain how Ted Turlings and colleagues could have identified that the *BtPMaT1* gene found in the whitefly was originally a plant gene (paragraph 2).

(3)

Sequence the genome of both whitefly & plant

Use of PCR, to amplify the genes.

Extract plant BtPMaT1 gene & amplify with PCR. Load both on to a gel & carry out gel electrophoresis. Banding patterns are produced. Band on same line means plant means that BtPMaT1 gene is present.

Use micro arrays techniques. mRNA collect use reverse transcriptase to produce cDNA from the mRNA. Fluorescent tags & Plant DNA containing the BtPMaT1 gene are added to the cDNA & allowed to hybridise on micro arrays. Analyse the microarray

ResultsPlus
Examiner Comments

3 marks: A mix of both methods. However this response has use of PCR, gel electrophoresis and comparing banding to be the same.

8 The scientific document you have studied is adapted from articles in *New Scientist* and the *Journal of Consumer Protection and Food Safety*.

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

(a) Explain how Ted Turlings and colleagues could have identified that the *BtPMaT1* gene found in the whitefly was originally a plant gene (paragraph 2).

(3)

Carry out PCR to amplify the whitefly gene. Follow this by gel electrophoresis with plant DNA as a ~~positive control~~ positive control to identify differences in the band patterns. If the whitefly ~~gene~~ DNA has band patterns that match with plants then it is from the plant genome.

ResultsPlus
Examiner Comments

3 marks: Again, use of PCR to amplify, use of electrophoresis and same banding patterns. It should be noted that similar is not an acceptable alternative to same/match.

Question 8 (b)

In this question candidates are asked to explain why the frequency of the BtPMaT1 gene increases in the whitefly population.

Many candidates struggled with this. It is clear that some have had the opportunity to study the article in more depth. However the question did lead candidates to the relevant paragraphs. Several candidate responses failed to mention 'gene' or 'allele' at all. Consequently they did not score highly. The mark scheme wants a clear distinction between surviving and then going on to reproduce, passing the advantageous allele to the offspring.

(b) Explain why the frequency of the *BtPMaT1* gene increases in the whitefly population (paragraphs 3 and 6).

(4)

Since plants generate deadly toxins, this creates a survival pressure for insect species such as the whitefly who feed on these plants. Therefor, incorporating the BtPMaT1 gene into the whiteflies genome would provide an advantage to the whiteflies as this gene will help them avoid being poisoned by this toxin as in plants. They are able to store this toxin in a harmless way. Therefore, by borrowing this genetic information from the plants, the whiteflies who had this gene were able to survive whilst others died from consuming the plant. Those who survived were able to pass on the BtPMaT1 gene to their offspring and this continued for generations, which is why the frequency of this gene increased in whitefly population.

ResultsPlus
Examiner Comments

4 marks: A very clear and thorough response. The story is correct and in order.

(b) Explain why the frequency of the *BtPMaT1* gene increases in the whitefly population (paragraphs 3 and 6).

(4)

The prescence of the BtPMaT1 gene allowed whiteflies to eat plant material without the risk of death from toxins. This caused food availability to act as a selection pressure. Whiteflies with the BtPMaT1 gene were able to have a greater no. of food sources than those who ~~dida~~ did not, increasing their chances of survival and reproducing, passing the gene to future generations and therefore increasing it's frequency. Where as whiteflies without the gene die either due to ingestion of toxins or lack of food sources.

ResultsPlus
Examiner Comments

Another clear response with the story in the right order.

(b) Explain why the frequency of the *BtPMaT1* gene increases in the whitefly population (paragraphs 3 and 6).

(4)

There is a selection pressure for the whiteflies to survive ~~close to~~ the gene toxins. The whitefly borrows the BtPMaT1 gene and manages to survive the plant toxins. Whiteflies ~~without the~~ without the gene do not survive. Whiteflies with the gene pass on the advantage to their offsprings, which then increases the genetic frequency of BtPMaT1 amongst whiteflies

ResultsPlus
Examiner Comments

2 marks: Here the example is where the whiteflies survive and pass the advantageous gene to their offspring. No reference to reproduction.

Question 8 (c)

In this question candidates explain how populations of fluorescent red zebrafish could be produced for breeding.

Questions like this appear in most sessions. However key here is the context. The relevant Dred gene has to be isolated from the coral. Not other named species. The gene is inserted into a vector. The vector is inserted into the zebrafish, although cell or embryo would be preferable. The final part of the story is about how these fluorescent zebrafish can be identified and left to breed. These final two parts were often missing.

(c) Explain how populations of fluorescent red zebrafish could be produced for breeding (paragraphs 9 and 15).

(4)

They are transgenic so they take gene from different species. desired gene from the seacoral is isolated and cut by restriction endonuclease, harmless virus or a liposore is also cut by the same restriction endonuclease to produce sticky ends (Vector) gene is inserted by the vector by a gene gun and then they are stick together by the enzyme DNA ligase. harmless virus is then inserted into the zebrafish and it will accumulate in its chromosomes, when they reproduce, it will be fluorescent under UV light.

ResultsPlus
Examiner Comments

Not quite the full story as there is no reference to how the zebrafish are selected for breeding and the consequent outcomes.

Question 8 (d)

In this question candidates have to suggest the risks and benefits of genetically modifying zebrafish. Again, candidates were given the relevant paragraphs in the article.

There is maximum 2 marks for either risks or benefits. This question is very open ended but some responses were very vague and did not gain credit. Some degree of specificity is required eg study tissue regeneration is acceptable while study regeneration is not.

The most common responses were for the risks. There were some very carefully thought out answers here.

(d) **Suggest the risks and benefits of genetically modifying zebrafish (paragraphs 9, 14 and 20).**

(3)

These genetically modified zebrafish allows us to image cell dynamics in a live animal and learn more about how tissue regeneration occur. More about skin biology can be learned through tracking individual cells as they develop, move and regenerating by giving them a dye. However there may be adverse health effects on people after eating genetically modified zebrafish accidentally that are not known now. Leaving genetically engineered materials in the environment may also affect ecosystem.

ResultsPlus
Examiner Comments

Clear two benefits and one risk at least.

(d) Suggest the risks and benefits of genetically modifying zebrafish (paragraphs 9, 14 and 20).

(3)

Risks are leaking into nature and interbreed with fish in wild and when other wise animal eat it, then GM zebrafish might be harmful to them may cause decrease in biodiversity. ✓

Benefits, For research purpose like skin regeneration ✓ medical advancement.

For money not sell for more as it is pretty common. ✓

ResultsPlus
Examiner Comments

Just sufficient for 3 marks.

Question 8 (e)

Candidates are expected to explain how the skin cells doubled to cover the area of damage.

They could come either from increase in cell size or cell number. Most only got the increase in cell number mark through mitosis. Few got the way in which cells increase in cell volume.

(e) Suggest how the skin cells 'doubled in size to cover the area of the damage' (paragraph 19).

(3)

skin cells undergoed mitotis by ~~[illegible]~~ doubling the amount of cytoplasm and cell organelles
this is due to the release of histamine causing inflamation, to increase blood flow to damaged area and cause pain to alert injury

ResultsPlus
Examiner Comments

Full marks attained by reference to mitosis, doubling in amount of cytoplasm, inflammation and increased blood flow. This covers 5 out of the 6 marking points.

(e) Suggest how the skin cells 'doubled in size to cover the area of the damage' (paragraph 19).

(3)

It happen by mitosis, it will keep on producing identical cell so that they could recover. Also with the help of Transcription factor, it active gene to recover from damage to do transcription of active gene and to translate to RNA and finally protein.

ResultsPlus
Examiner Comments

1 mark: Only increase in cell number through mitosis.

Question 8 (f)

For the last question on the paper, candidates have to explain how a single celled embryo of a zebrafish, injected with the colour producing gene, could develop into an adult with red skin cells.

More candidates here showed an understanding of the events post mitosis leading to the production of the red pigment/protein. There were many very good responses seen.

(f) Explain how a single-celled embryo of a zebrafish, injected with the colour producing gene, could develop into an adult with red skin cells (paragraphs 14, 15 and 17).

(3)

under certain transcription ~~factors and~~ or epigenetic modifications, RNA polymerase binds to promotor region of the gene the gene coding for red protein is activated. So the gene is transcribed to produce mRNA which is translated at ribosomes into red proteins. Hence the phenotype seen is red skin cells.

ResultsPlus
Examiner Comments

3 marks: Gene switched on, then translated forming the red protein.

(f) Explain how a single-celled embryo of a zebrafish, injected with the colour producing gene, could develop into an adult with red skin cells (paragraphs 14, 15 and 17).

(3)

Embryonic cells are totipotent so they can divide to give any type of cells. The cells diviide and differentiate to form tissues then organs ~~to make~~ (each with specific functions) to form the adult fish. The colour producing gene has sections that are switched on and others that are switched off due to genetic or environmental factors resulting in their red colour. Transcription factors or epigenetic modification can cause the switching on or off of genes.

ResultsPlus
Examiner Comments

3 marks: Cells divide, then differentiate and colour gene switched on.

Paper Summary

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

- Read the whole question carefully, including the introduction, to help relate the answers to the context asked.
- Take into account the command words as well as the context given. Answers which do not match the command words or do not relate to the given context will not gain high marks. Appendix 7 in the specification lists all the command words and their meaning.
- In the level based question all the introductory information eg graphs and tables need to be used as well as relevant knowledge and understanding.
- In calculations it is better to show workings as well as the answer as incorrect answers may gain some credit for correct working.
- Greater care needs to be taken in the interconversion of units eg cm^3 to dm^3 and mm to µm.
- Furthermore 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.
- Make sure that your response is legible. There was a significant increase in responses that were very difficult to read.
- If you put part of the answer somewhere else on the paper it is vital that you clearly indicate where this is.
- Many 'suggest' questions refer to novel situations. You need to use knowledge from the specification and apply it to this situation in specific terms rather than in generalisations.

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

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