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June 2024

GCE Biology A 9BN0 02

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June 2024

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Introduction

This paper offered a wide variety of different question styles for candidates to consider. Many appeared to relish this opportunity and displayed excellent knowledge, understanding and an ability to apply these in both theoretical and practical components. Likewise, many demonstrated most encouraging data interpretation and calculation skills.

My congratulations should go to candidates, as well as to all those who have helped enable them to show their biological knowledge in paper 2.

Question 1 (b)(i)

This question required candidates to consider the advantages of both PET and fRMI scans for investigating brain tumours over the use of MRI. Many candidates demonstrated an excellent grasp of the advantages. However, some chose to describe how each works.

This answer does not quite provide sufficient detail to gain marks.

(b) PET, MRI and fMRI are methods for scanning the brain.

PET uses labelled glucose. This glucose can be detected so that PET can be used to identify brain tumours.

*

(i) Describe the advantages of using PET and fMRI rather than MRI scans to investigate a possible tumour in the brain.

(2)

~~PET and fMRI scans both show function of areas of the brain~~ PET and fMRI scans show a more detailed and clear image than an MRI. Also fMRI scans can show the function of areas of the brain so the impact that the tumor will have on brain can be investigated/seen.

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Examiner Comments

The candidate has correctly appreciated that a PET scan assesses brain fuction, but does not also consider fMRI, so the first marking point cannot be awarded.

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Examiner Tip

As this item refers to both PET and fMRI, then both scan types should be considered.

A strong response that gains both marks.

(b) PET, MRI and fMRI are methods for scanning the brain.

PET uses labelled glucose. This glucose can be detected so that PET can be used to identify brain tumours.

(i) Describe the advantages of using PET and fMRI rather than MRI scans to investigate a possible tumour in the brain.

(2)

PET and fMRI show activity ~~for~~ of the brain in real time ~~the~~ and so can be used to study the activity of the brain and how it's being affected by the tumour, as opposed to MRI which only show its size and location. PET scans also show differences in tissue types better.

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Examiner Comments

The candidate has appreciated the advantages common to both PET and fMRI in terms of their role in investigating brain tumours. These can be seen in the first line and a half for both marks.

An answer that focuses on one aspect of the question.

(b) PET, MRI and fMRI are methods for scanning the brain.

PET uses labelled glucose. This glucose can be detected so that PET can be used to identify brain tumours.

(i) Describe the advantages of using PET and fMRI rather than MRI scans to investigate a possible tumour in the brain.

(2)

-PET and fMRI scans tell you more about the function of the brain eg. PET uses a radioactive metabolite to show areas of rapid cell division, and so show a tumour

-an MRI scan tells you more about the structure of the brain instead of the function

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Examiner Comments

This candidate has suitably considered the role of PET and fMRI scans in terms of brain function for the first marking point, but does not discuss their ability to deliver information in real time, hence one mark.

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Examiner Tip

Always take note of the mark allocation to help suggest the number of points required to elicit the marks.

Question 1 (b)(ii)

In this item, candidates were asked to view scan images and then state why image 1 is from CT and image 2 is produced from MRI. It was pleasing to note that the majority of the cohort were able to offer a creditworthy response.

This response initially discusses how the two scan types function rather than considering the images.

(ii) The images show brain scans produced from two imaging techniques other than PET.

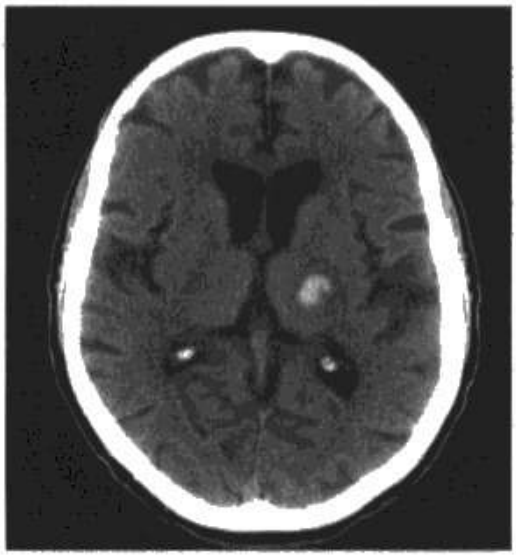


Image 1

(Source: ZEPHYR/SCIENCE PHOTO LIBRARY)

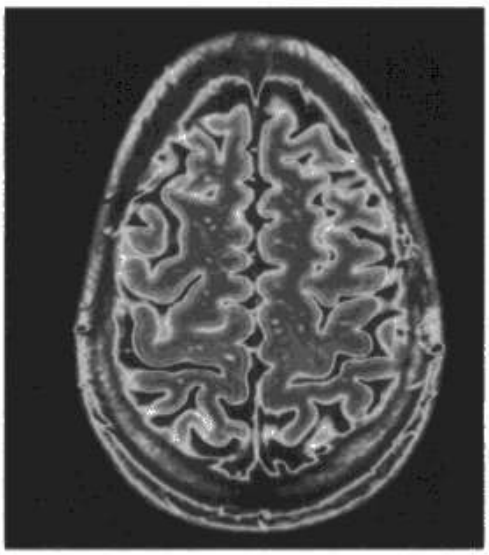


Image 2

(Source: ALFRED PASIEKA/SCIENCE PHOTO LIBRARY)

State how image 1 can be identified as being produced by CT and image 2 by MRI.

(1)

- CT uses x-rays whereas MRI uses magnets (CT is cross sectional and shows denser regions, MRI lights up more)

ResultsPlus
Examiner Comments

There were no marks given for this response.

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Examiner Tip

Make sure the answer fully targets the question being asked.

A short but effective answer.

(ii) The images show brain scans produced from two imaging techniques other than PET.

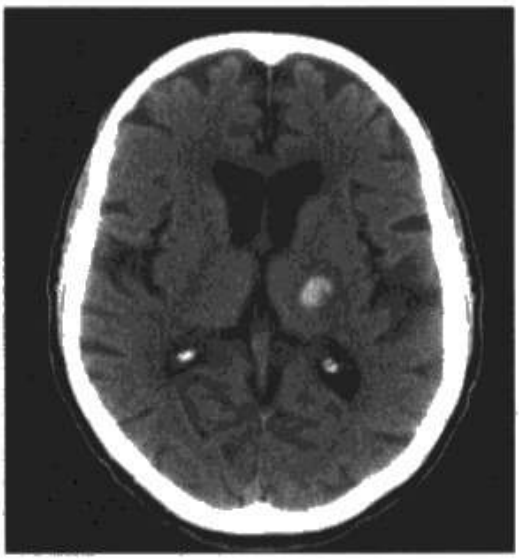


Image 1

(Source: ZEPHYR/SCIENCE PHOTO LIBRARY)

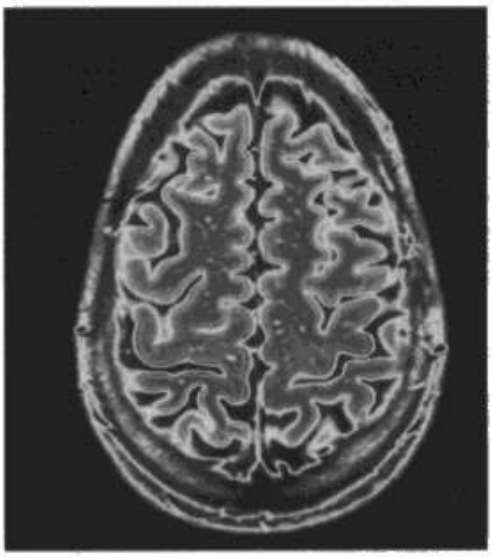


Image 2

(Source: ALFRED PASIEKA/SCIENCE PHOTO LIBRARY)

State how image 1 can be identified as being produced by CT and image 2 by MRI.

(1)

Image 1 has lower resolution than image 2.

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Examiner Comments

The student has correctly identified that image 2 displays more detail, given by the term 'resolution'.

A slightly different, but precise, response that elicits the mark.

(ii) The images show brain scans produced from two imaging techniques other than PET.

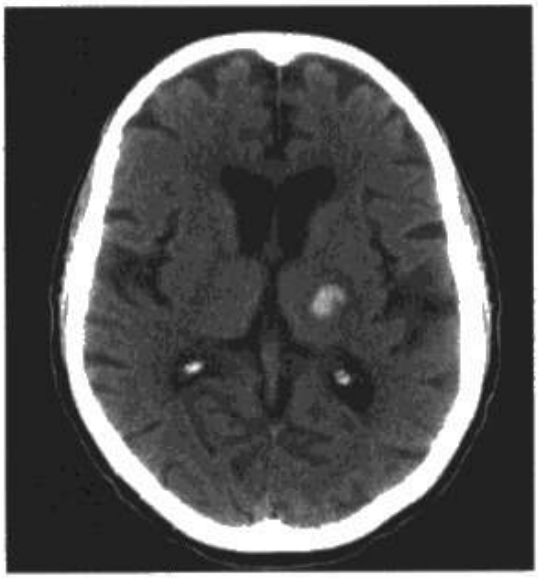


Image 1

(Source: ZEPHYR/SCIENCE PHOTO LIBRARY)

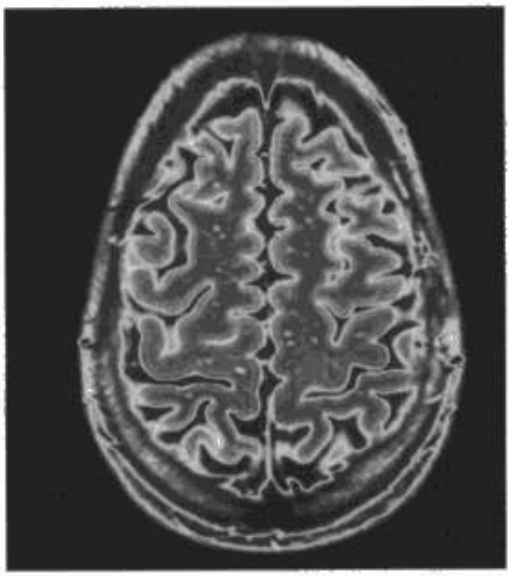


Image 2

(Source: ALFRED PASIEKA/SCIENCE PHOTO LIBRARY)

State how image 1 can be identified as being produced by CT and image 2 by MRI.

(1)

MRI has higher resolution compared to CT

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Examiner Comments

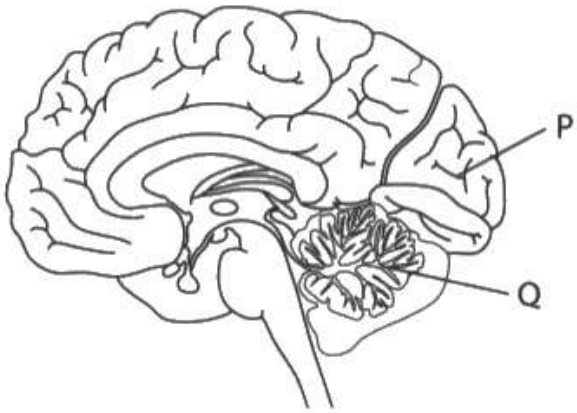
As the question identifies image 1 as being from CT and image 2 from an MRI, this candidate's answer gains the mark.

Question 1 (c)

This question component tested candidates' knowledge of both location and function of two brain regions. Most were able to do so for at least one of the two regions, with a function of the cerebellum (Q) being more commonly correctly offered.

An answer that clearly demonstrates that the candidate has identified the visual cortex and cerebellum and knows the functions of each.

(c) The diagram shows a human brain.



Brain tumours can change brain function.
Describe the possible effects of brain tumours in parts P and Q.

(2)

P Effects ~~balance~~ Movement and ~~balance~~. To Reduces Vision.

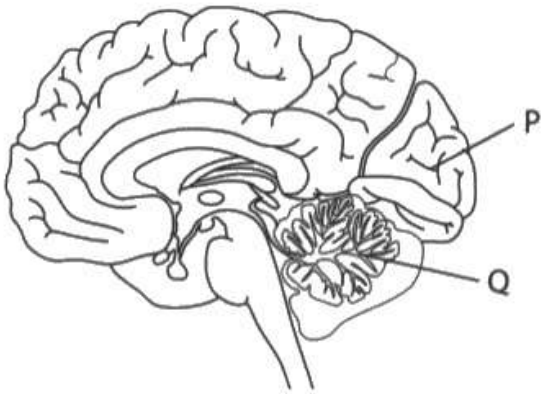
Q Effects Movement and balance

ResultsPlus
Examiner Comments

Both marks awarded for this clear answer.

An answer that does not gain either mark.

(c) The diagram shows a human brain.



Brain tumours can change brain function.
Describe the possible effects of brain tumours in parts P and Q.

(2)

P cerebellum controls ~~involuntary responses~~ high brain activity
Tumor would result in loss of speech and vision
Q medulla oblongata controls unconscious processes such
as breathing rate and heart rate. ~~Tumor~~ Tumor could
make it hard to breath and be fatal

(Total for Question 1 = 7 marks)

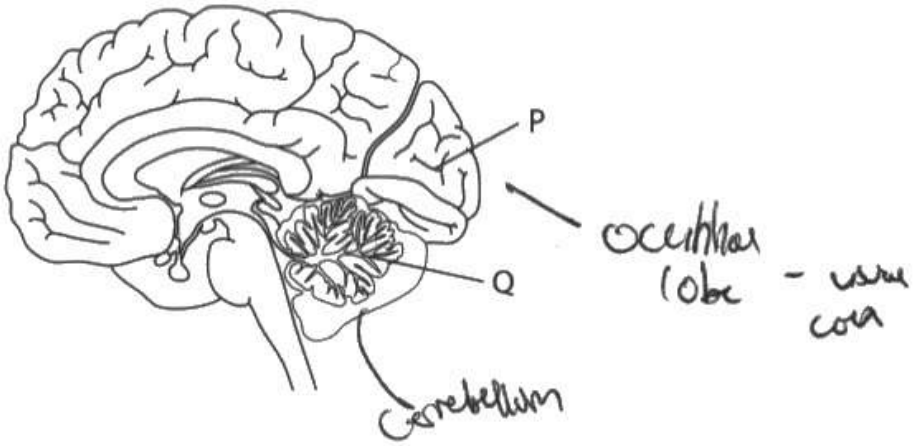
ResultsPlus
Examiner Comments

Whilst there is a correct element in the first two lines, by identifying P incorrectly and also referring to speech means that the low vision statement cannot be given.

Unfortunately Q is misidentified, so the incorrect function was offered.

A creditworthy response.

(c) The diagram shows a human brain.



Brain tumours can change brain function.
Describe the possible effects of brain tumours in parts P and Q.

(2)

P decreased vision, blindness.

Q poor balance and motor coordination.

ResultsPlus
Examiner Comments

The candidate has supplied a correct function for each region for the two marks. They have also chosen to offer a correct name for each of the two regions on the diagram.

Question 2 (b)

This question expected candidates to offer an explanation as to why muscle cells sometimes produce lactate from pyruvate. There were four marks available and many candidates were able to gain at least two.

A short answer that targets one of the four marking points.

(b) Explain why human muscle cells sometimes convert pyruvate to lactate.

(4)

- When there is a lack of oxygen
- Pyruvate is used in anerobic respiration
- Pyruvate a 3C ~~gives~~ releases CO_2 and become reduced to form lactate.
- NADH is used to reduce Pyruvate.

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Examiner Comments

The first two bullet points gain the first marking point, for one mark.

A clear, and logical, answer that can be awarded all four marks.

(b) Explain why human muscle cells sometimes convert pyruvate to lactate.

(4)

When there is not enough oxygen for aerobic respiration, pyruvate is converted to lactate so anaerobic respiration can take place. This is done so that small amounts of ATP can still be produced in absence of oxygen as NADH can donate H^+ ions to pyruvate causing it to convert to lactate so that the NAD can be reused in glycolysis. This does result in a build up of lactic acid, resulting in fatigue

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Examiner Comments

The first sentence delivers the first marking point, whilst the second sentence states the final mark point.

The second sentence then explains how the conversion to lactate enables NAD to be re-synthesised from reduced NAD for the second marking point, and then the reason for this as the third marking point at the end of the sentence.

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Examiner Tip

It is always worth considering whether answering a higher mark value question in a logical manner is appropriate, as this approach is more likely to reduce the chance of missing out an important aspect.

This example offers the two most commonly achieved marking points.

(b) Explain why human muscle cells sometimes convert pyruvate to lactate.

(4)

Pyruvate is converted to lactate during anaerobic respiration; when the cells do not have enough ~~energy~~ oxygen to carry out aerobic respiration. It does not release as much ~~E~~nergy / produce as much ATP as aerobic respiration, but is much faster. Lactate can ~~,~~ harm muscle cramps as it lowers the pH inside cells.

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Examiner Comments

The first marking point can be awarded over the first line and a half. The fourth marking point is achieved in the middle of the second sentence.

Question 2 (c)

This question tested candidates' appreciation of the vitamin C/DCPIP practical in a novel situation. Whilst the question set the starting point of providing two vitamin C solutions (extracted from fresh/frozen cow liver), a number of candidates described a method to produce each solution. Many responses illustrated that candidates had a good understanding of this core practical.

A detailed response that illustrates a clear knowledge of the practical.

(c) Many mammals such as cows can synthesise vitamin C from glucose in the liver.

Vitamin C solutions can be prepared from fresh or frozen cow liver.

Devise an investigation to compare the vitamin C content of these solutions.

(4)

① Collect/prepare vitamin C solutions from fresh and frozen cow liver from the same cow.
② Add 5cm^3 of 0.1% DCPIP solution into a glass beaker. (blue)
③ Add the fresh Vit C solution into a burette and record the starting measurement.
④ Carefully add a few drops of fresh Vit C solution to the DCPIP, giving it a little mix each time.
⑤ continue adding drops until the DCPIP decolourises.
⑥ Record the volume of Vit C (fresh) solution was used, to work out volume needed to decolourise DCPIP.
⑦ Repeat 3 times and repeat with frozen Vit C.
⑧ Compare the volumes needed at calculate Vit C content.

(Total for Question 2 = 9 marks)

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Examiner Comments

The second point given by the candidate can be awarded the first marking point. The candidate's fourth point correctly refers to the addition of the solution to the DCPIP for the second marking point, whilst their fifth point gains the colour change mark.

Linking the candidate's sixth and eighth points elicited the fourth marking point.

All four marks were achieved.

ResultsPlus
Examiner Tip

A clear step-by-step response which is a good approach to this practical question.

This example illustrates a common error when adding DCPIP to a vitamin C solution.

(c) Many mammals such as cows can synthesise vitamin C from glucose in the liver.

Vitamin C solutions can be prepared from fresh or frozen cow liver.

Devise an investigation to compare the vitamin C content of these solutions.

(4)

Take multiple samples of fresh and frozen liver and ~~grind them up into a liquid~~ prepare Vitamin C solutions from each. Place a known volume, such as 25cm³ of the Vitamin C solution from the frozen liver into a conical flask. Add DCPIP to a burette and note the starting volume in the burette. Titrate the vitamin C solution with the DCPIP, stopping when the blue-black ~~DCPIP~~ solution turns colourless. Note the final volume of DCPIP in the burette and calculate the volume needed to neutralise the Vitamin C. This can be used to calculate the concentration of Vitamin C in the 25cm³ sample. Repeat using a sample of Vitamin C solution from fresh cow liver, using the same volume. Calculate the concentration of Vitamin C solution in the sample from the fresh liver and compare with the value from the frozen liver. Repeat at least 4 more times for each type of liver. Make sure the concentration of DCPIP is the same and use the same volume of Vitamin C solution each time. DCPIP is an irritant, so wear eye protection and wash any skin it comes into contact with.

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Examiner Comments

The second sentence refers to a known volume of vit C solution made from frozen liver solution. Linked to this, the ninth and tenth lines refer to the same volume for the vit C solution from fresh liver for the first marking point. This is also reaffirmed in the penultimate sentence.

The fourth sentence refers to titrating a vit C solution with the DCPIP which can be awarded for the second marking point, but unfortunately the colour change subsequently described in this sentence cannot be given the third marking point.

To gain the fourth marking point, the volumes required needed to be compared so the sentence on the tenth and eleventh line cannot be given this mark. In consequence, this answer gained two marks.

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Examiner Tip

Make sure you know how the colour changes in this practical. For example, in this answer, the end point would be the volume of DCPIP added to the vit C solution made from frozen liver for the DCPIP colour to not change.

This answer could not be awarded any marks.

(c) Many mammals such as cows can synthesise vitamin C from glucose in the liver.

Vitamin C solutions can be prepared from fresh or frozen cow liver.

Devise an investigation to compare the vitamin C content of these solutions.

(4)

- Set up 4 solutions of vitamin C extracted from cow liver

- Keep the volume, age of cow & gender of cow the same as ~~control~~ control variable.

- The dependant variable is the vitamin C content of the solution

- The independant variable is the breed of cow

- Place in boiling tube and check for colour once DCPIP added

- The darker, the higher the vit C content

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Examiner Comments

Whilst there is a reference to volume in the second bullet point, this would need to have been in the context of either DCPIP or the vitamin C solutions.

Question 3 (a)(i)

This question component required candidates to explain why carbon dioxide poisoning raised breathing rate. Whilst many were able to deliver clear and detailed answers, a number of candidates discussed a raised heart rate.

This answer offers good detail initially and gains three marks out of four.

3 In 2021, there was an accident at a nuclear power station in Spain. There was no radiation leak but carbon dioxide was released.

Some people were taken to hospital showing symptoms of carbon dioxide poisoning after inhaling carbon dioxide.

Their symptoms included rapid breathing and an increased heart rate.

(a) (i) Explain why rapid breathing is a symptom of carbon dioxide poisoning.

(4)

- an increase in concentration of CO_2 in the body and the blood is detected by chemoreceptors in blood vessels
- impulse is sent to ventilation centre in the medulla oblongata (this coordinates a response to decrease CO_2 concentration in a process of negative feedback).
- impulses are sent to ~~diagra~~ the intercostal muscles and diaphragm in order to increase breathing rate more frequent
- so CO_2 concentration decreases in the blood due to faster gas exchange occurring in the alveoli in the lungs

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Examiner Comments

The first bullet point gains the first marking point for the blood reference, not the body one. It also achieves the second marking point.

The candidate's second bullet point correctly links impulse direction to the location in the brain for the third marking point.

The third bullet point suitably refers to more impulses but not the pathway, so the fourth marking point cannot be awarded.

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Examiner Tip

As the context of the question is about a raised breathing rate, the reference to 'more' in the fourth and fifth marking points is significant.

This response also gains three marks by following a sequential approach, despite missing some elements.

3 In 2021, there was an accident at a nuclear power station in Spain. There was no radiation leak but carbon dioxide was released.

Some people were taken to hospital showing symptoms of carbon dioxide poisoning after inhaling carbon dioxide.

Their symptoms included rapid breathing and an increased heart rate.

(a) (i) Explain why rapid breathing is a symptom of carbon dioxide poisoning.

(4)

More CO_2 in lungs / alveoli - less gas exchange it enters the blood stream. CO_2 dissolves into carbonic acid which lowers the pH of the blood. chemoreceptors in hypothalamus detect a fall in H^+ in blood. Sends nerves impulses via sympathetic nerve to the muscles of the lungs (intercostal muscles / diaphragm) to contract more frequently. This ensures that breathing rate is faster and CO_2 is removed faster from the lungs.

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Examiner Comments

The reference to carbon dioxide, via carbonic acid, lowering the blood pH in the second sentence gains the first marking point.

The chemoreceptor statement in the second sentence gains the second marking point. However, there is no discussion in relation to the medulla.

The candidate suitably comments on the change in diaphragm/intercostal muscle contraction rate for the final marking point.

Likewise, this response achieves 75% of the available marks.

3 In 2021, there was an accident at a nuclear power station in Spain. There was no radiation leak but carbon dioxide was released.

Some people were taken to hospital showing symptoms of carbon dioxide poisoning after inhaling carbon dioxide.

Their symptoms included rapid breathing and an increased heart rate.

(a) (i) Explain why rapid breathing is a symptom of carbon dioxide poisoning.

(4)

When inhaling a lot of Co_2, pH of the blood decreases. Chemoreceptors detect the decrease in pH and send electrical signals to the ventilation control centre in the motor cortex and stretch receptors, which then send more frequent electrical impulses to the diaphragm and the intercostal muscles increasing the rate at which they contract. This increases breathing depth and breathing rate, hence why rapid breathing is a symptom of Co_2 poisoning. This is to increase oxygen concentration in the blood to increase the pH back to neutral

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Examiner Comments

The first two sentences gain the first two marking points respectively. However, the reference to signals rather than impulses stops the awarding of the third marking point.

In addition, in this sentence, the lack of a reference to the route taken by the more frequent impulses to the intercostal muscles means that the fourth marking point cannot be credited. Subsequently, the candidate correctly explains that the raised breathing rate is due to an increased intercostal muscle contraction rate for the final marking point.

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Examiner Tip

Consider using the term impulses rather than signals or messages.

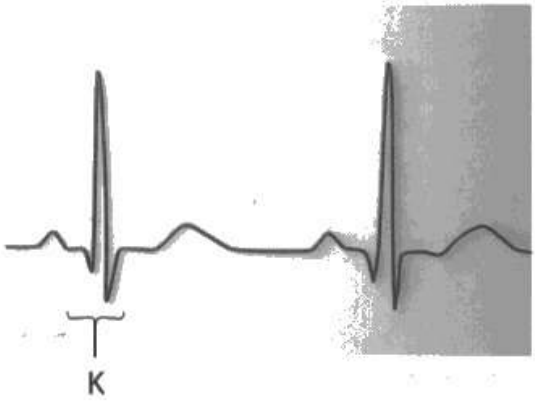
Question 3 (b)

In this item, candidates had to demonstrate their knowledge of an ECG trace and what it represents, in this case, the role of the atrioventricular node (AVN) at the QRS complex. Many candidates appreciated that ventricular systole occurred here and that the AVN transferred electrical activity to the bundle of His/Purkyne fibres. It was less common to be informed about picking up the electrical activity from the atria and delaying its transmission.

This candidate answer gains full marks.

(b) Electrocardiograms (ECGs) were also recorded for the people with carbon dioxide poisoning.

The diagram shows part of an ECG.



(Source: KATERYNA KON/SCIENCE PHOTO LIBRARY)

Explain the role of the atrioventricular node (AVN) in the events happening at K on the ECG.

(3)

K is the QRS complex where depolarisation of ventricles occurs. AVN has already received electrical impulse from SAN. The AVN then sends electrical impulses to the purkyne fibres (collectively bundle of His) which then branch off to conduct impulses to the muscle cells in apex of heart which then spreads upwards. This allows ventricles to contract from bottom up.

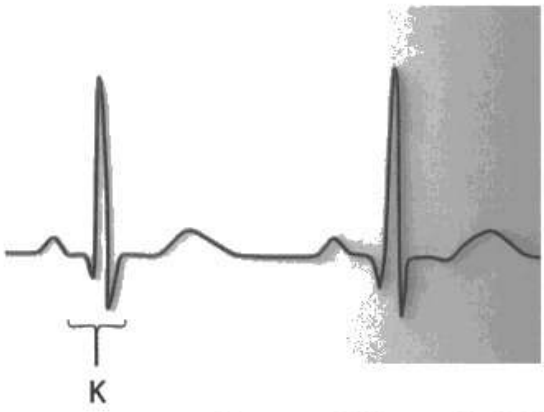
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Examiner Comments

The first three sentences can be given marking points 1, 2 and 4 respectively.

This is a most pleasing, and thorough answer which gains all three marks.

(b) Electrocardiograms (ECGs) were also recorded for the people with carbon dioxide poisoning.

The diagram shows part of an ECG.



(Source: KATERYNA KON/SCIENCE PHOTO LIBRARY)

Explain the role of the atrioventricular node (AVN) in the events happening at K on the ECG.

(3)

K is the ventricular systole. Once the AVN receives a nervous impulse from the SAN, there is a small delay. The AVN then carries this nervous impulse down the bundle of His to the apex of the heart and depolarises the ventricular cardiac muscle from the apex upwards. This causes the ventricles to contract (ventricular systole at K), pushing blood from the ventricles to the aorta or pulmonary artery.

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Examiner Comments

The short first sentence correctly informs us what is occurring at K. The use of the word 'impulse' was felt to be an acceptable alternative to electrical activity such that this sentence gains the second and third marking points.

Had three marks not already been achieved, the candidate's second sentence then offers the fourth marking point.

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Examiner Tip

Note that the question does not state what the events are that are happening at K, so consider whether it would be appropriate to offer this. In this case, either the QRS complex or ventricular systole.

Question 3 (c)

In this question, candidates were expected to give a reason why a woman may elect to have CVS rather than amniocentesis. Whilst many gained the mark, it was not uncommon for candidates to write about why amniocentesis may be chosen over CVS.

Perhaps the second most common incorrect response seen.

(c) Radiation has leaked from accidents at other nuclear power stations. This has led to mutations in the developing embryos of pregnant women.

Prenatal genetic screening can be offered to check for certain mutations.

Give a reason why some pregnant women may choose chorionic villus sampling rather than amniocentesis.

(1)

Chorionic villus sampling is less invasive

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Examiner Comments

No mark can be awarded for this answer.

This answer shows the most common incorrect answer offered by candidates.

(c) Radiation has leaked from accidents at other nuclear power stations. This has led to mutations in the developing embryos of pregnant women.

Prenatal genetic screening can be offered to check for certain mutations.

Give a reason why some pregnant women may choose chorionic villus sampling rather than amniocentesis.

(1)

lower risk of miscarriage.

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Examiner Comments

The mark cannot be awarded for this answer.

This candidate offers the first marking point.

(c) Radiation has leaked from accidents at other nuclear power stations. This has led to mutations in the developing embryos of pregnant women.

Prenatal genetic screening can be offered to check for certain mutations.

Give a reason why some pregnant women may choose chorionic villus sampling rather than amniocentesis.

(1)

Chorionic villus sampling can be done earlier in pregnancy than amniocentesis, reducing risk of miscarriage or complications in ~~testing~~ screening.

(Total for Question 3 = 9 marks)

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Examiner Comments

The first line and a half enables the mark to be awarded.

Question 4 (a)

In this maths question, candidates were provided with the number of base pairs is a typical body cell along with the mean mutation rate per base pair per cell cycle. They were then asked to calculate how many mutations could happen in a body cell in one cell cycle.

This example incorrectly converted 2.5 x 10^{-8} from standard form, so calculated an incorrect answer.

4 Mutations are rare changes in the sequence of bases in DNA.

(a) Each body cell contains 6 billion base pairs.

The mutation rate for human cells has been estimated to be 2.5×10^{-8} mutations per base pair per cell cycle.

Calculate how many mutations could happen per body cell in one cell cycle.

6,000,000,000

(1)

0.00000025

6,000,000,000 x 0.00000025

= 1500 mutations

Answer 1500 mutations

ResultsPlus
Examiner Comments

The mark could not be given here.

ResultsPlus
Examiner Tip

Always double check when converting between standard form and numeric form.

An answer that shows both working and the correct answer.

4 Mutations are rare changes in the sequence of bases in DNA.

(a) Each body cell contains 6 billion base pairs.

The mutation rate for human cells has been estimated to be 2.5×10^{-8} mutations per base pair per cell cycle.

Calculate how many mutations could happen per body cell in one cell cycle.

(1)

$6 \times 10^{9} \times 2.5 \times 10^{-8} = 150$

Answer 150

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Examiner Comments

The mark was achieved for the answer of 150.

Question 4 (b)(i)

This question item expected candidates to determine why the anticodon base sequence provided was 83% the same as on the original DNA template strand. Whilst many candidates recognised that it was not identical due to thymine in DNA being replaced by uracil in tRNA, only a minority appeared to appreciate the significance of the 'determine' command word.

This candidate has not only stated that uracil has replaced thymine, but also appreciated that this accounts for 1/6th of the bases, so the remaining 5/6th or 83% are the same.

(b) Some mutations affect the phenotype of the organism.

(i) The DNA template strand is involved in the synthesis of mRNA.

The anticodons of the first four tRNA molecules that carry amino acids into a ribosome are shown.

UAC GGA UCG AAC

Determine why the sequence of bases in these anticodons is 83% the same as the sequence of bases on the DNA template strand.

(2)

because out of the 12 bases shown, 2 bases (the uracil) are not present in DNA. DNA has thymine replacing the uracil. so only 10 out of the 12 bases are present in DNA hence 83.3%.



ResultsPlus
Examiner Comments

This clear answer gains both marks.



ResultsPlus
Examiner Tip

Make sure that you know what each command word is asking you to do. In the case of 'determine', there has to be a mathematical component.

This answer tackles the calculation in reverse and is awarded both marks.

(b) Some mutations affect the phenotype of the organism.

(i) The DNA template strand is involved in the synthesis of mRNA.

The anticodons of the first four tRNA molecules that carry amino acids into a ribosome are shown.

AUGCCUAGCUUG

UAC GGA UCG AAC

Determine why the sequence of bases in these anticodons is 83% the same as the sequence of bases on the DNA template strand.

(2)

This is because ~~DNA has the bases adenine, cytosine, and guanine and thymine however RNA~~ there are 12 bases and the 2 uracil bases are not in DNA. The represent 16.6%, when you take away 16.6% that give 83.3%.

$\frac{2}{12} \times 100 = 16.6\%$

$100 - 16.6 = 83.3\%$

ResultsPlus
Examiner Comments

The first marking point can be given as stating that uracil is absent on DNA is an acceptable alternative answer.

The candidate then clearly sets out to prove that 83% of the bases are the same by showing that only 1/6th (100-83%) are different.

Question 4 (b)(ii)

In this component of question 4, candidates were expected to explain why a change in the DNA base sequence can change an organism's phenotype. Most were able to link the change in the base sequence to a change in protein structure, but it was rare to read an answer that explained why this alters the phenotype.

This response offers elements of two marking points but overall no marks can be credited.

(ii) Explain why a change in the DNA sequence can change the phenotype of an organism.

environmental influences on genotype

(3)

A change in the DNA sequence results a change in the 3D structure of an amino acid. Complementary basing cannot occur as the enzyme substrate complex will ~~not fit~~ change shape, therefore the enzyme won't fit.

~~The~~ The phenotype can change as ~~people will~~ people will experience different environmental changes.

ResultsPlus
Examiner Comments

The first sentence refers to the 3D shape of an amino acid being altered rather than the protein. The answer also touches on a change in overall shape but of the enzyme-substate complex.

This is a response in which the candidate has considered how the protein alteration affects the phenotype.

(ii) Explain why a change in the DNA sequence can change the phenotype of an organism.

(3)

A change in the sequence of DNA (mutation) results to a change on the primary structure of the protein, this results to incorrect foldings of the tertiary structure due to changes in R group bonds such as hydrogen bonds, this results into differently shaped active sites, so overall different enzymes are produced, resulting in different phenotypes.

ResultsPlus
Examiner Comments

The second line correctly refers to a change in primary structure for the first marking point. It then gains the second marking point on the third and fourth lines.

The fifth and sixth lines reference a change in the active site which can be awarded the fourth marking point for a total of three marks.

This answer also gains all three marks.

(ii) Explain why a change in the DNA sequence can change the phenotype of an organism.

(3)

DNA sequences code for amino acid sequences, which determines the folding of polypeptide chains. A change in the DNA base sequence means that when the DNA is converted into mRNA, it is translated to a different amino acid sequence as different anticodons from tRNA will now be complementary. This alternative amino acid sequence affects the tertiary structure of protein that it will fold into, as certain amino acids have different R groups, so different interactions will occur and thus a differently shaped protein will form (i.e enzyme w/ differently shaped active site). This can affect things such as muscle mass.

ResultsPlus
Examiner Comments

The candidate's second sentence can be awarded the first marking point. The reference to affecting the tertiary structure would not quite elicit the second marking point, the candidate then suitably qualifies 'affect' to a 'differently shaped protein'. They then achieve the final marking point in their bracketed statement.

ResultsPlus
Examiner Tip

Whilst the first sentence is factually correct, it is not quite answering the question. In this case, the focus of the question relates to a change in the DNA sequence.

Question 4 (c)

Many candidates were able to demonstrate a thorough understanding of why fast twitch muscle fibres contain more glycogen than slow touch muscle fibres. Having said this, the final mark point was only occasionally seen.

An answer which has a general focus on fast twitch muscle fibres, and gains one mark.

(c) Mutations can affect the metabolism of glycogen in fast twitch muscle fibres.

Explain why fast twitch muscle fibres contain more glycogen than slow twitch muscle fibres.

(3)

· fast twitch fibres are used in ~~fast~~ short bursts of powerful exercise like sprinting
· anaerobic respiration is used in fast twitch muscle fibres
· glycogen is important in anaerobic respiration
· slow twitch fibres respire aerobically so do not need the same amount of glycogen
· more energy is needed for fast twitch muscle fibres - glycogen stores energy

ResultsPlus
Examiner Comments

The final statement in this response can be awarded the first marking point.

Question 5 (a)

To tackle this calculation, the data was supplied, but candidates also needed to know what is meant by the cardiac cycle. Most candidates were able to achieve at least 50% of the available marks.

A clear candidate response that included showing the working out of the answer.

5 The resting heart rate varies between individuals for a variety of reasons.

(a) An adult male had a resting heart rate of 90 beats per minute. The systole stage was found to be 30% of his cardiac cycle.

Calculate the length of time for a single systole stage for this person.

(2)



0.2 seconds

ResultsPlus
Examiner Comments

As the answer is correct, both marks can be awarded.

Whilst this response was incorrect, the error carried forward rule can be applied.

5 The resting heart rate varies between individuals for a variety of reasons.

(a) An adult male had a resting heart rate of 90 beats per minute. The systole stage was found to be 30% of his cardiac cycle.

Calculate the length of time for a single systole stage for this person.

(2)

90 / 100 × 30 = 27 bpm. 60 = 0.45

1.5

0.45 seconds

ResultsPlus
Examiner Comments

The candidate has correctly multiplied by 0.3 and achieved a correct answer based on this, so can be credited with the second marking point.

ResultsPlus
Examiner Tip

It can be a good idea to show your working. In this case, the answer is incorrect and would have gained no marks if no working had been shown. However, since they did display some appropriate correct working and their answer was commensurate with this, they were awarded with 50% of the available marks.

Question 5 (b)(i)

This question asked candidates to state what is meant by having a 100% increased risk, in this case in the context of developing cardiovascular disease. Whilst many candidates gave a creditworthy answer, many did not seem to fully grasp this concept.

This response shows the most common incorrect answer.

(b) Some people with high blood pressure have a 100% increased risk of developing CVD.

(i) State what is meant by a 100% increased risk.

(1)

They will develop a CVD.

ResultsPlus
Examiner Comments

No mark can be supplied for this answer.

A slightly less definite outcome for a 100% increased risk, but still not creditworthy.

(b) Some people with high blood pressure have a 100% increased risk of developing CVD.

(i) State what is meant by a 100% increased risk.

(1)

They are most likely to develop CVD.

ResultsPlus
Examiner Comments

No mark given.

This answer shows one way to gain the mark.

(b) Some people with high blood pressure have a 100% increased risk of developing CVD.

(i) State what is meant by a 100% increased risk.

(1)

They are twice as likely to develop CVD as someone with regular BP.

ResultsPlus Examiner Comments

The reference to 'twice as likely' is a good alternative to doubling the risk.

A clear and complete answer that shows another way to achieve the mark.

(b) Some people with high blood pressure have a 100% increased risk of developing CVD.

(i) State what is meant by a 100% increased risk.

(1)

They have double the risk (chance) of developing CVD compared to the average person.

ResultsPlus Examiner Comments

The mark was awarded for this response.

Question 5 (b)(ii)

Candidates were invited to offer two risks associated with taking antihypertensives.

A short but entirely appropriate answer.

(ii) This person could be treated with antihypertensives.

Give **two** risks of this treatment.

(2)

1 Headaches

2 Fainting due to reduced blood pressure

ResultsPlus
Examiner Comments

Both marks were given for this response.

Question 5 (b)(iii)

Candidates were asked to explain how hypertensives reduced the risk of developing cardiovascular disease. Many had a thorough understanding of this topic area which was most gratifying to see.

This answer was written in a logical sequence and gained all four marks.

(iii) Explain how antihypertensives can reduce the risk of developing CVD.

(4)

- antihypertensives work by reducing your blood pressure which reduces the chance of damage to the endothelium lining of arteries. This reduces the risk of an inflammatory response occuring and an atheroma forming due to an accumulation of white blood cells. there is less risk of a plaque forming from calcification and fibrous tissue reducing the elasticity of the artery. therefore antihypertensives reduce the risk of the arteries narrowing which can lead to CVD.

ResultsPlus
Examiner Comments

The first sentence elicited the first two marking points, whilst the second sentence achieved the third and fourth marking points.

The candidate also refers to the lowering of the risk of artery narrowing but does not refer to the lumen, so this marking point was unavailable to them.

This response also gains full marks.

(iii) Explain how antihypertensives can reduce the risk of developing CVD. (4)

~~redu~~ antihypertensives reduce blood pressure which lowers the risk of the endothelium getting damaged in arteries which ~~could~~ could cause an inflamatory response causing white blood cells and cholesterol and calcium to be deposited into the damaged wall causing a build up resulting in an atheroma being formed narrowing the lumen resulting in CVD

ResultsPlus
Examiner Comments

Whilst the reference to lumen narrowing is at the end of the passage, the passage comprises one sentence and it refers to arteries on the third line. Therefore, the lumen narrowing statement applies to arteries for the fifth marking point.

Each of the first three lines gains marking points 1, 2 and 3 in order.

A sligtly more general answer that gains the first marking point.

(iii) Explain how antihypertensives can reduce the risk of developing CVD.

(4)

It causes the blood pesure to fall as it increases the elasticity of the blood vessels, which allow for greater recoil and means that the vessels will not be as narrow. It also means that

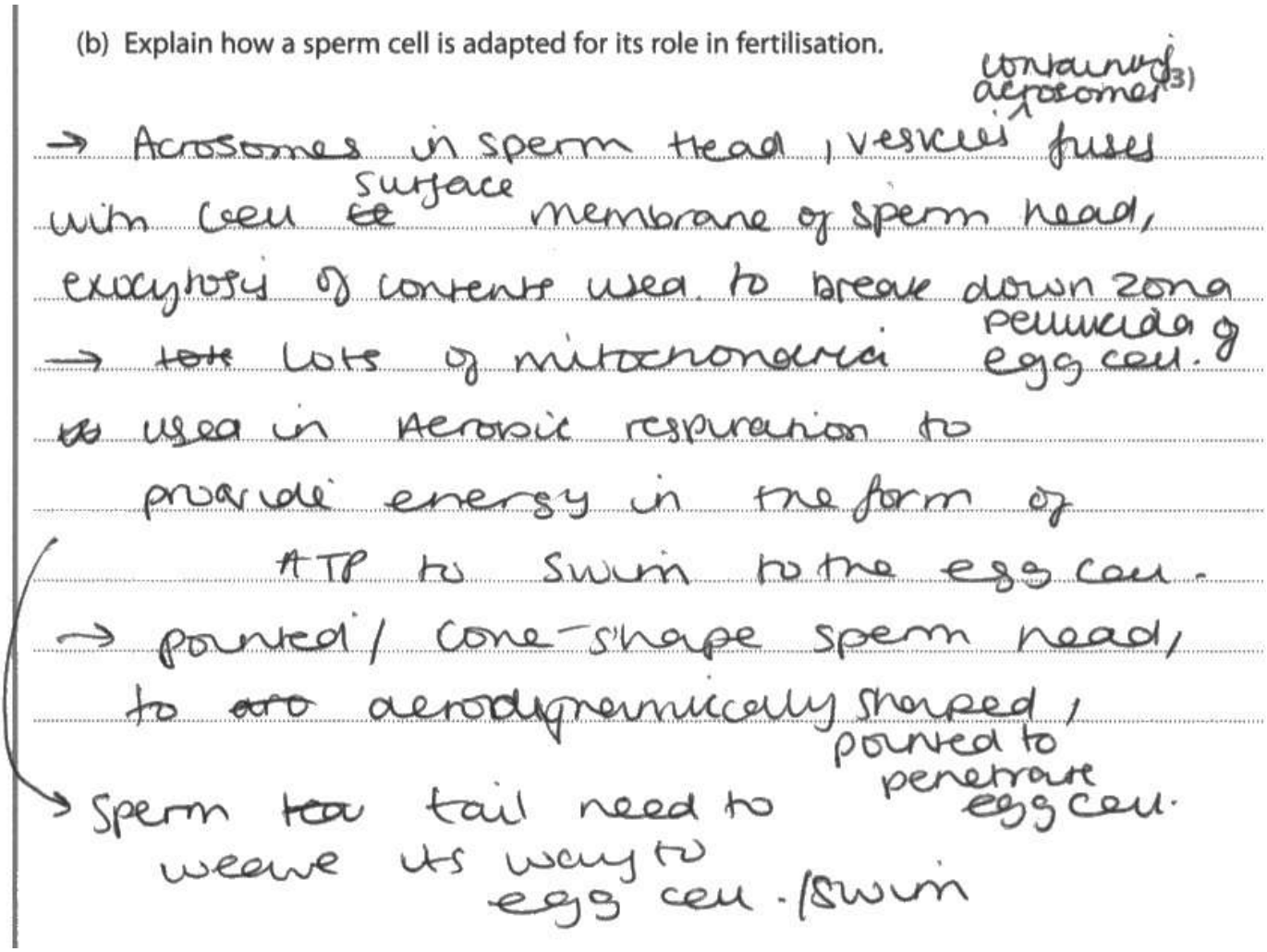
ResultsPlus
Examiner Comments

Towards the end of the response the candidate refers to 'blood vessels will not narrow'. However, to gain this mark, 'arteries' rather than 'blood vessels' was required as well as 'lumen'.

Question 6 (b)

Candidates were requested to give an explanation of sperm cell adaptations for its fertilisation function. There were a host of encouraging answers, but only a minority offered responses that considered either of the latter two marking points.

This answer gains one mark and illustrates the detail and precision required to elicit more marks.



(b) Explain how a sperm cell is adapted for its role in fertilisation.

(3)

→ Acrosomes in sperm head, vesicles containing acrosomes fuses with cell surface membrane of sperm head, exocytosis of contents used to break down zona pellucida of egg cell.

→ lots of mitochondria used in Aerobic respiration to provide energy in the form of ATP to swim to the egg cell.

→ pointed / cone-shape sperm head, to aerodynamically shaped / pointed to penetrate egg cell.

→ Sperm tail need to weave its way to egg cell. / swim

ResultsPlus
Examiner Comments

The first marking point comprises three aspects: the acrosome, that it contains hydrolytic enzymes, and that these enzymes breakdown the zona. This response implies that the enzymes are called acrosomes and also there is no reference to digestive enzymes offered, so this mark is not achieved.

The second bullet point in the candidate's answer gives an encouraging explanation of the presence of mitochondria in the sperm cell for the second marking point.

For the third marking point to be awarded, reference needs to be made to a flagellum, not a tail, and that its function is to push the sperm towards an egg, hence the third marking point is not awarded.

A full and detailed answer that tackles the first three marking points for three marks.

(b) Explain how a sperm cell is adapted for its role in fertilisation.

(3)

Sperm cell has acrosome in head ~~digestive~~ hydrolytic enzyme which digests zona pellucida of egg to help sperm reach egg nucleus.

Sperm cell has lots of mitochondria for aerobic respiration to produce ATP used as energy to power movement flagellum Flagellum ~~acts~~ Sperm swimming by propelling it forward to help reach egg

ResultsPlus
Examiner Comments

The first paragraph offers all three elements of the first marking point, whilst the second paragraph delivers the second and then the third marking points.

Question 6 (c)(i)

This question requested that candidates supply a description of the differences between totipotent and pluripotent stem cells. It was pleasing to note that most candidates had a thorough knowledge of this topic area.

This response gave some good details but sadly confused totipotent and pluripotent.

(c) At fertilisation, a zygote is formed. The zygote is a totipotent cell. The zygote then divides repeatedly to form an embryo. There are pluripotent cells in a five-day-old embryo.

(i) Describe the differences between pluripotent stem cells and totipotent stem cells.

(3)

Pluripotent stem cells can differentiate to become any type of cell, whereas totipotent stem cells can only differentiate to become certain types of cells. Pluripotent stem cells can be found in embryos ~~whereas~~ but not bone marrow, whereas totipotent cells can be found only in bone marrow, not embryos.

ResultsPlus
Examiner Comments

No marks can be given for this answer.

A sound answer that gained two marks.

(c) At fertilisation, a zygote is formed. The zygote is a totipotent cell. The zygote then divides repeatedly to form an embryo. There are pluripotent cells in a five-day-old embryo.

(i) Describe the differences between pluripotent stem cells and totipotent stem cells.

(3)

- Totipotent stem cells can be differenciated into any body cell (eg red blood cell, neurone) however totipotent stem cells can also specialize into extraembryonic cells like the blastocyst and the placenta.
- Pluripotent stem cells can differentiate into any cell except of extra-embryonic cells.
- this stage occures after the formation of a blastocyst

ResultsPlus
Examiner Comments

The first two marking points can be awarded in the first paragraph, but only the first point because the candidate included the word 'also' on the third line.

This response includes a suitable comment for the third marking point.

(c) At fertilisation, a zygote is formed. The zygote is a totipotent cell. The zygote then divides repeatedly to form an embryo. There are pluripotent cells in a five-day-old embryo.

SO

(i) Describe the differences between pluripotent stem cells and totipotent stem cells.

(3)

Totipotent stem cells are able to differentiate into any type of cell in the body, so the whole fetus forms from the totipotent stem cells. Pluripotent cells are able to differentiate into ~~any~~ almost any type of cell, such as a neurone or muscle cell, however there are some types of cells it is unable to differentiate into, whereas totipotent stem cells can.

ResultsPlus
Examiner Comments

The first sentence covers both the first and third marking points, whilst the second sentence gains the second marking point, for a total of three marks.

Question 6 (c)(ii)

This item required candidates to describe the roles of the centromere. It was most encaouraging to see that many had a clear and detailed appreciation of the centromere.

This response identifies the common incorrect answer offered by a number of candidates.

(ii) Stem cells divide by mitosis.

Describe the role of centromeres in mitosis.

(3)

The centromeres are found in the middle of the cell during mitosis, forming an equator. The centromeres produce spindle fibres which pulls the chromosomes apart during anaphase. The centromeres producing spindle fibres is a vital stage of mitosis as it allows all daughter cells to have the correct number of chromosomes.

ResultsPlus
Examiner Comments

Whilst the candidate has referred to centromeres, they have confused these with centrioles. In consequence, no marks are awarded in this answer.

ResultsPlus
Examiner Tip

Be careful not to confuse similar biological words such as centromere and centriole, and meiosis and mitosis.

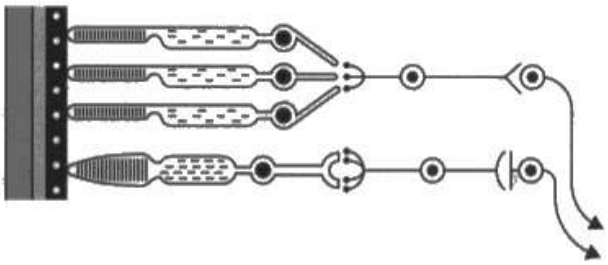
Question 7 (a)

In this item, candidates were presented with a diagram of the retina, and then asked to say why it is considered a tissue.

This answer illustrates the need to make sure that the answer is in the context of the question.

7 The human retina contains rod cells and three types of colour sensitive cell. This allows full colour vision. However, there are many inherited conditions that can affect these cells.

(a) The diagram shows a section through a typical human retina.



State why the retina can be described as a tissue.

(2)

It is made up of one type of cell performing the same function.

ResultsPlus
Examiner Comments

The diagram shows that the retina comprises more than one cell type so the first marking point cannot be given. Further, the answer does not fully offer the second marking point.

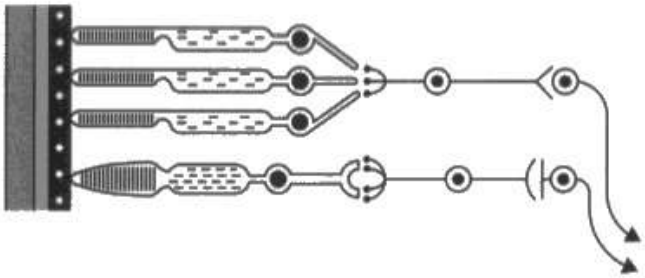
ResultsPlus
Examiner Tip

Make sure that the answer fully matches the question being asked.

A clear answer for the first marking point.

7 The human retina contains rod cells and three types of colour sensitive cell. This allows full colour vision. However, there are many inherited conditions that can affect these cells.

(a) The diagram shows a section through a typical human retina.



State why the retina can be described as a tissue.

(2)

Because it is a group of cells working together.

ResultsPlus
Examiner Comments

Unfortunately, the candidate did not quite finish off their response with 'for a function' idea for the second marking point.

Question 7 (b)(i)

Candidates were expected to describe how rhodopsin is reformed after being broken down in bright light. Whilst a number had a thorough knowledge of this, a number confused retinal and retinol.

An answer that gains one mark.

(b) One recessive genetic condition affecting the eye is fundus albipunctatus.

In this condition the speed of rhodopsin formation in rod cells is reduced after exposure to bright light.

(i) Describe the process of rhodopsin formation in rod cells after exposure to bright light.

(2)

combine

Retinal and opsin are ~~joined together~~ to form rhodopsin. Bright light stimulates the ~~level~~ production of rhodopsin.

ResultsPlus
Examiner Comments

The first sentence achieved the second marking point but the second sentence fails to gain the first point.

This candidate's answer shows a relatively common incorrect answer.

(b) One recessive genetic condition affecting the eye is fundus albipunctatus.

In this condition the speed of rhodopsin formation in rod cells is reduced after exposure to bright light.

(i) Describe the process of rhodopsin formation in rod cells after exposure to bright light.

(2)

After exposure to bright light, rhodopsin splits into cis-retinal and opsin and opsin binds to the cell membrane of the rod cell, closing sodium ion channels whilst they are still removed so the cell can be hyperpolarised and an action potential can occur. Impulses are sent to the brain via the optic nerve.

ResultsPlus
Examiner Comments

Whilst the question refers to rhodopsin formation, a number of candidates described the breakdown of rhodopsin which could not be credited.

ResultsPlus
Examiner Tip

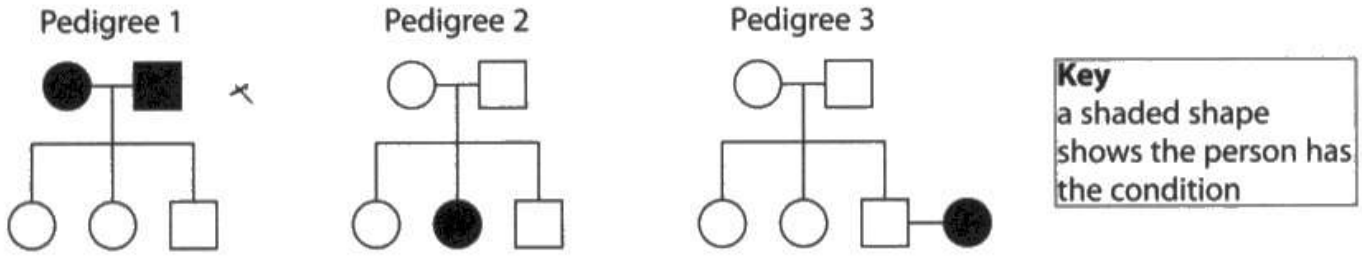
Make sure the question is thoroughly understood so that the answer offered is suitably targeted.

Question 7 (b)(ii)

Candidates were presented with three family pedigrees and had to select the one that demonstrated that a named genetic condition was recessive. They then had to explain their choice. It was excellent to read a large number of answers that displayed good candidate knowledge of inheritance.

In this response, the candidate shows an error seen on more than one occasion.

(ii) The diagram shows three family pedigrees. Each pedigree shows the inheritance of a different genetic condition. Only one of the pedigree diagrams definitely shows that fundus albipunctatus is inherited as a recessive condition.



Explain which family pedigree shows the inheritance of fundus albipunctatus.

(2)

Pedigree 3 because the parents don't have the condition indicating they have dominant alleles but the grandson has it this indicates parents were carriers of the recessive allele.

ResultsPlus
Examiner Comments

No marks could be awarded as the candidate has not selected the appropriate family pedigree, and has also incorrectly interpreted the family pedigree.

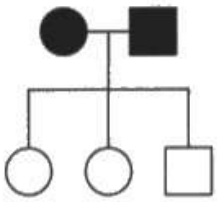
ResultsPlus
Examiner Tip

Make sure that you can distinguish between those who are offspring in a family pedigree and those who are not.

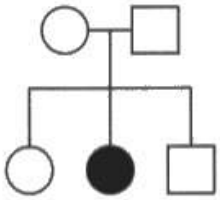
A correct pedigree selection, supported with a clear explanation.

(ii) The diagram shows three family pedigrees. Each pedigree shows the inheritance of a different genetic condition. Only one of the pedigree diagrams definitely shows that fundus albipunctatus is inherited as a recessive condition.

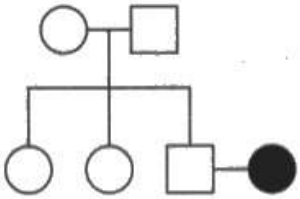
Pedigree 1



Pedigree 2



Pedigree 3



Key
a shaded shape shows the person has the condition

Explain which family pedigree shows the inheritance of fundus albipunctatus.

(2)

Pedigree 2, as both parents do not have the condition, meaning they parents are carriers of the condition which may been have passed on to it's offspring.

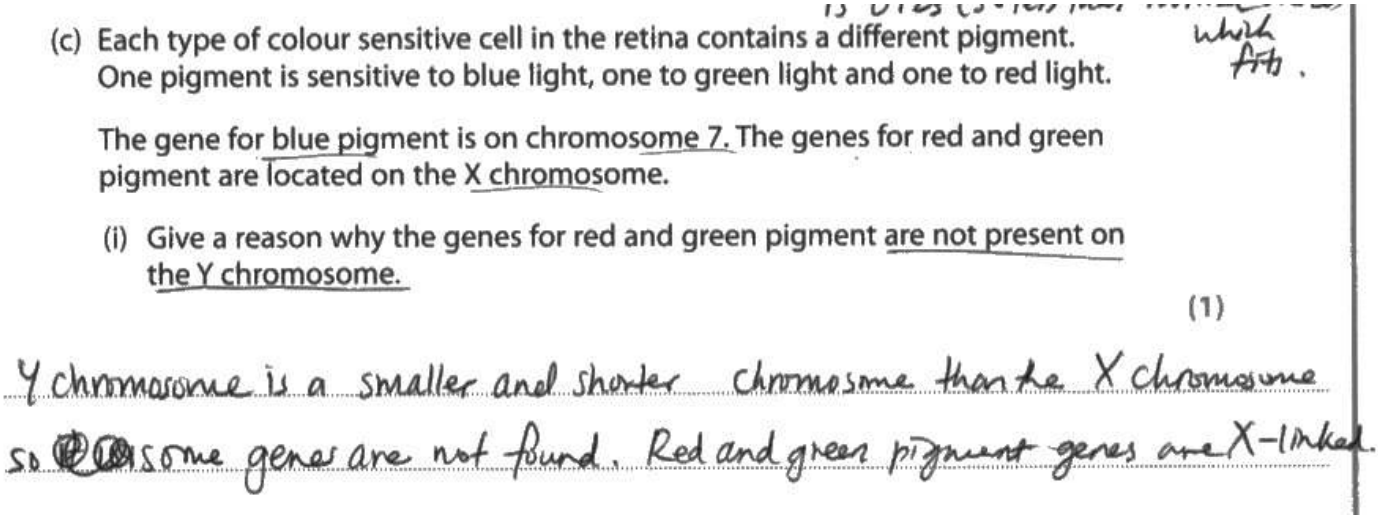
ResultsPlus
Examiner Comments

Both marks can be awarded in this answer.

Question 7 (c)(i)

The vast majority of candidates offered a creditworthy response to this item about why the red and green visual pigment genes are not found on the Y chromosome in humans.

A short and clear answer.



(c) Each type of colour sensitive cell in the retina contains a different pigment. One pigment is sensitive to blue light, one to green light and one to red light.

The gene for blue pigment is on chromosome 7. The genes for red and green pigment are located on the X chromosome.

(i) Give a reason why the genes for red and green pigment are not present on the Y chromosome.

(1)

Y chromosome is a smaller and shorter chromosme than the X chromosome so [illegible]some genes are not found. Red and green pigment genes are X-linked.

ResultsPlus
Examiner Comments

The mark is awarded on the first line.

Question 7 (c)(ii)

This calculation required the candidates to carry out more than one process to find the proportion of males in a population that were not colour blind. Most candidates were able to gain at least one mark.

Question 7 (c)(iii)

In this item, candidates are requested to explain how colourblindness is inherited. Whilst they had been given information about blue, red and green colourblindness, many did not distinguish between them. When candidates wrote more generally about colourblindness, marks could be gained as though they were specifically referring to the sex-linked form of colourblindness.

A response with some correct elements but insufficient to gain any marks.

(iii) Deduce how colour blindness is inherited.

(4)

occurs on sex chromosome X and Y. inherited only on x chromosome. men have only x and y whilst women have both x & x. occurs on x chromosome. ~~perfect~~ men are always carrier passed onto kids. if both parent are carrier and ~~heterozyg~~ homozygous is present in child then blindness is inherited.

mutation occurs.

~~alleles for~~ alleles for colour blindness passed on as humans reproduce.

This leads to a change in allele frequence. more people have the allele for colour blindness

ResultsPlus
Examiner Comments

No marks awarded.

An answer that confused X and Y chromosomes but did identify the difference in numbers of red-green colourblind men and women.

(iii) Deduce how colour blindness is inherited.

(4)

Colour blindness may be sex-linked as it is more present in males than females. This means the gene is found on the x chromosome but not on the Y chromosome. As males have two x chromosomes they have an increased risk of inheriting colour blindness than females who have an X and Y chromosome. Colour blindness may be recessive due to how it is only present in a small percentage of the sample in (ii).

ResultsPlus
Examiner Comments

The second marking point can be awarded on the first and second line.

Question 8 (b)(ii)

This question relates to phytochrome. It required candidates to explain how a light stimulus affects phytochrome such that the plant responds by a growth increase. Many displayed good knowledge about the effect of light on phytochrome behaviour. However, it was uncommon to see answers where candidates had considered how phytochrome far-red caused an increase in plant growth.

A very well thought through and accurate answer which does discuss how P_{FR} leads to increased plant growth.

(ii) Explain how the response of phytochrome to a light stimulus can cause an increase in plant growth.

(3)

during the day there is a large amount of red light so therefore more P_R is converted to P_{FR} so therefore during the day there are more P_{FR} phytochromes. during the summer when the nights are short and the days are long There is a large amount of P_{FR} during the day and as the night is short not a lot of P_{FR} is converted to P_R as the conversion is slow in darkness. Therefore the excess P_{FR} phytochromes act as ~~transcription~~ transcription factors and causes cell elongation which increases plant growth.

ResultsPlus
Examiner Comments

Much of the passage considers the first marking point. However, on the last two lines the fourth and then third marking points are presented.

Question 9 (a)(i)

Candidates were asked to calculate the percentage difference in the concentration of a neurotoxin between two different pufferfish tissues. Whilst many demonstrated excellent application of mathematical skills, it was not uncommon for candidates to offer answers that did not take account of the different concentration units for the two tissues.

An incorrect answer.

9 Many organisms that live in the sea produce poisonous chemicals called neurotoxins.

(a) Pufferfish produce a neurotoxin called tetrodotoxin (TTX). This is believed to be a defence against predators.

An investigation studied TTX from five individuals of the same species of pufferfish.

(i) The investigation showed that the distribution of TTX within the pufferfish varies, as shown in the table.

Tissue	Mean concentration of TTX / mass per gram of tissue
Liver	0.046 mg
Muscle	2.000 µg
Gonad (ovary/testis)	0.365 mg
Skin	25.000 µg

Calculate the percentage difference in mean concentration of TTX in pufferfish liver tissue compared with skin tissue.

(2)

543.5 %

ResultsPlus
Examiner Comments

As no working has been offered, and the answer is not correct, no marks can be given.

ResultsPlus
Examiner Tip

Consider whether it is worth showing your calculations, as half the marks could be achieved, even if the answer is incorrect.

A soundly laid out response that offered a correct answer.

9 Many organisms that live in the sea produce poisonous chemicals called neurotoxins.

(a) Pufferfish produce a neurotoxin called tetrodotoxin (TTX). This is believed to be a defence against predators.

An investigation studied TTX from five individuals of the same species of pufferfish.

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Skin	25.000 µg

Calculate the percentage difference in mean concentration of TTX in pufferfish liver tissue compared with skin tissue.

(2)

25 − 0.046 × 100 = 54.2 / 0.046

µg → mg

mg → µg

25 ÷ 1000 = 0.025

$\frac{0.025 - 0.046}{0.046} \times 100 = -45.65\% \rightarrow 45.7\%$

45.7 %

1mm → 1000µm

1000µm → 1cm

10000µg = 1 gram

10000µg = 10 mg

ResultsPlus
Examiner Comments

Both marks awarded.

Question 9 (a)(ii)

In this question, candidates were presented with some data on the level of toxicity due to a neurotoxin found in four different pufferfish tissues. The level of toxicity was assessed using mice, and candidates were required to describe why mice were used.

This answer illustrates a response that offers a range of reasons why mice may be used, but not all of the reasons fully tackle the question.

(ii) The investigation also tested the toxicity of the different tissues from each of the five pufferfish.

The level of toxicity was tested in mice, and the results are shown in the table.

	Level of toxicity per gram of pufferfish tissue / arbitrary units			
Sex of fish	**Liver**	**Muscle**	**Gonad**	**Skin**
Female	126	4	398	18
Female	239	6	485	17
Female	112	4	350	16
Male	4	3	3	15
Male	4	3	4	17

Some humans eat pufferfish.

Describe why mice were used to determine the level of toxicity.

(3)

They are abundant and similar to humans. More ethical than checking toxicity in humans. Mice are less complex than humans and may feel less pain. They are small and don't take up alot of space, good storage. Easy to take care of.

ResultsPlus
Examiner Comments

The first half of the first sentence may be true but is not a reason for using mice to test neurotoxin toxicity levels. The second half of this sentence is too general to gain the second marking point. However, the ethical reference can be given the third point.

The rest of the paragraph does not focus on the specifics of the question being asked. Therefore this answer achieves one mark.

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Examiner Tip

Always look to see what aspect of a topic area is being tested in a question.

A sound answer that gains two marks in the first third of the response.

(ii) The investigation also tested the toxicity of the different tissues from each of the five pufferfish.

The level of toxicity was tested in mice, and the results are shown in the table.

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Male	4	3	4	17

Some humans eat pufferfish.

Describe why mice were used to determine the level of toxicity.

(3)

Because they have similar anatomy to humans (both Mamals) so results can be applied to humans. They don't ~~be~~ May be more ethically acceptable as they aren't testing on humans first so aren't endagering human lives. Don't have to see much quick and geister as they don't have to get consent or test effect on the whole organism before they can test toxicity, which they would have to in humans.

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Examiner Comments

The first sentence gives sufficient detail and clarity to achieve the second marking point. The second sentence is then awarded the third marking point.

Question 9 (a)(iii)

Candidates had to use the data provided to deduce the effect of pufferfish sex on the level of toxicity in four different pufferfish tissues. It was good to see so many clear and considered answers that recognsed the range of different levels of toxicity in male and female pufferfish tissues.

A short and focused answer that offered the second and third marking points respectively.

(iii) Deduce the effect of the sex of the pufferfish on the level of toxicity for different pufferfish tissues.

(2)

- Female puffgish have significantly more toxicity in their livers and gonad compared to males.
- Males and females have similar levels of toxicity in muscle and skin tissue.

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Both marks awarded.

A response that touches upon two aspects but required more precision to gain the marks.

(iii) Deduce the effect of the sex of the pufferfish on the level of toxicity for different pufferfish tissues.

(2)

Female pufferfish produce more toxicity than male pufferfish. There is a 97% increase of toxicity of puffer in females than males in the liver.

ResultsPlus Examiner Comments

The first sentence would not gain the first marking point as it needed to focus on the tissues investigated. For the second marking point to be given, both liver and gonads need to be discussed.

Question 9 (b)

This is one of the two six mark indicative content questions in the paper. The question required candidates to discuss how the investigations given in the question supported the idea that neurotoxins could act as medical treatments for two different conditions.

Most pleasingly, it appears that generally candidates are becoming more adept at considering such questions.

This response would fall within the level 1 category.

*(b) *Conus* is a predatory marine snail. It uses a neurotoxin, conotoxin, to paralyse the muscles of its prey.

The neurotoxins conotoxin and TTX work in different ways:

- Conotoxin inhibits calcium ion movement across the cell surface membrane
- TTX inhibits sodium ion movement across the cell surface membranes

Discuss how the investigations support the potential use of neurotoxins as painkillers and treatments for uncontrolled muscle movement in humans.

(6)

Neurotoxins inhibit electrical impulse in neurons and inhibit muscle movement by blocking calcium ions movement. This properties could potentially be used ~~as paint~~ in medicine. Conotoxin, by inhibiting Ca^{2+} ions it inhibits the tropomiosin movement and it results in myosin heads not being able to bind to the receptors. Hence limiting the muscle movement. It can be used to stop uncontrolled muscle movement in humans.

TTX inhibits sodium ion movement thus not allowing neurons to create concentration gradient and sending impulse to the brain. It can be used as painkiller

as it inhibits neurons ability so send electrical impulses notifing about pain.

ResultsPlus
Examiner Comments

The first paragraph is quite general, but then the candidate refers to conotoxin. However, they do not do so in terms of it being a neurotoxin and therefore its effect on neurones.

Towards the bottom of the first page, and onto the second page, the candidate considers TTX. The candidate has been told that it inhibits sodium ion movement, and offers a little more detail in this respect for 1 mark.

The candidate also offers a correct conclusion, linking TTX with pain relief so a second mark can be given.

This is a more rigorous and detailed response which is considered to be a good level 2 answer.

*(b) *Conus* is a predatory marine snail. It uses a neurotoxin, conotoxin, to paralyse the muscles of its prey.

The neurotoxins conotoxin and TTX work in different ways:

- Conotoxin inhibits calcium ion movement across the cell surface membrane
- TTX inhibits sodium ion movement across the cell surface membranes

Discuss how the investigations support the potential use of neurotoxins as painkillers and treatments for uncontrolled muscle movement in humans.

(6)

Conotoxin inhibiting calcium ions movements means that they cannot move across the cell surface membrane. They can then not cause vesicles of neurotransmitter to move towards the pre synaptic membrane. Vesicles are then unable to fuse with the membrane and cannot diffuse across the synaptic cleft. The membrane does not become depolarised and an action potential is not generated. This means that impulses are not sent and muscles will not be moving in an uncontrolled manner. However, too much of this drug could lead to a lack of movement in the muscles so the dose must be controlled. This would not be as effective as a pain killer because the impulses are sent by action potentials to cause movement and not pain.
Inhibiting sodium ion channels with TTX could also lead to membranes not being able to become depolarised and action potentials being unable to be generated. TTX could be used as a pain killer because it could stop action potentials being created at areas which

are affected. It would be less useful for controlling muscle movement as it cannot stop action potentials being generated completely.
There are risks with both of the drugs that muscle movement could be significantly reduced so the right dose is crucial.

ResultsPlus
Examiner Comments

This candidate has given an encouraging and detailed account of how conotoxin paralyses and then a correct conclusion. Linked to this, there is a more straightforward consideration of TTX on a neurone which means that both aspects of level 2 have been fulfilled. However, more detail about the effect of TTX in neurone physiology would be needed or/and an additional conclusion for the response to be in level 3.

ResultsPlus
Examiner Tip

Check the breadth of the question.

In this case, the question was about neurotoxins on humans, but the investigations were confined to two neurotoxins only and tested on mice, so this limited the support the investigations could supply.

Question 10 (b)(i)

Candidates were required to consider an investigation where athletes carried out warm-up and then increasing levels of exercise at two different temperatures to measure core body temperature, and sweat production (indirectly). They were then asked to explain why the athletes were not allowed to eat or drink during the investigation.

A sound answer that gained two thirds of the available marks.

(b) At the start of the investigation, each athlete swallowed a small digital thermometer so their core body temperature could be measured. A mean core temperature was calculated.

The athletes carried out warm-up activities for 20 minutes in a chamber set at 16 °C.

After warming up, each athlete exercised. The intensity of the exercise was increased at three-minute intervals. Each athlete exercised until they were unable to continue.

The change in body mass of each athlete during the warm-up activities and the exercise was recorded. The mean change in mass was calculated and used as a measure of the sweat produced.

The warm-up and exercise were repeated at a temperature of 32 °C.

(i) Explain why the athletes were not allowed to eat or drink during this investigation.

(3)

make the investigation unfair
if one eats or drinks then all athletes do
it would create anomalies making results
not valid, reliable or accurate
eating or drinking something rich in carb
could change the core body temperature eg could
lower
would reduce
it.

ResultsPlus
Examiner Comments

The second, third and fourth lines give enough clarity to be awarded the fourth marking point.

The last two lines offer an explanation relating to eating or drinking altering body temperature, and the candidate has even given a directional answer, for the third marking point.

Two marks awarded.

This answer is on the right lines but needed more detail to gain the mark.

(b) At the start of the investigation, each athlete swallowed a small digital thermometer so their core body temperature could be measured. A mean core temperature was calculated.

The athletes carried out warm-up activities for 20 minutes in a chamber set at 16 °C.

After warming up, each athlete exercised. The intensity of the exercise was increased at three-minute intervals. Each athlete exercised until they were unable to continue.

The change in body mass of each athlete during the warm-up activities and the exercise was recorded. The mean change in mass was calculated and used as a measure of the sweat produced.

The warm-up and exercise were repeated at a temperature of 32 °C.

(i) Explain why the athletes were not allowed to eat or drink during this investigation.

(3)

because this would affect their ~~overall~~ change in body mass

ResultsPlus
Examiner Comments

To achieve the first marking point, the direction of mass change needs to be given.

No marks awarded.

ResultsPlus
Examiner Tip

If an answer involves a change and you know the direction of that change, consider putting this into your answer.

This answer offers an alternative way of stating the fourth marking point.

(b) At the start of the investigation, each athlete swallowed a small digital thermometer so their core body temperature could be measured, A mean core temperature was calculated.

The athletes carried out warm-up activities for 20 minutes in a chamber set at 16 °C.

After warming up, each athlete exercised. The intensity of the exercise was increased at three-minute intervals. Each athlete exercised until they were unable to continue.

The change in body mass of each athlete during the warm-up activities and the exercise was recorded. The mean change in mass was calculated and used as a measure of the sweat produced.

The warm-up and exercise were repeated at a temperature of 32 °C.

(i) Explain why the athletes were not allowed to eat or drink during this investigation.

(3)

As a control variable to ensure that all in the increase in temperature was due to the warm-up and exercise they were doing. It also may be due to ensure that the digital thermometer would work at it's optimum.

ResultsPlus
Examiner Comments

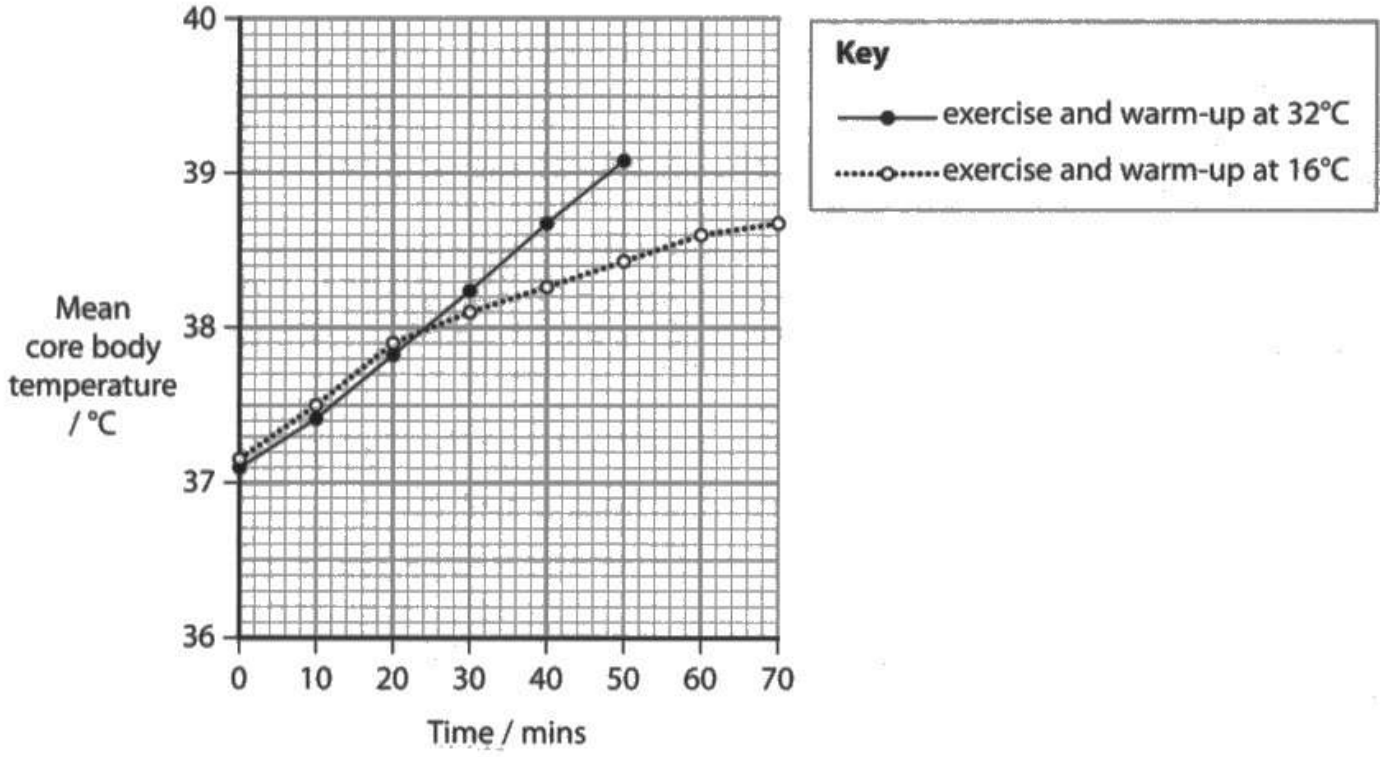
The first three and a half lines nicely describe the first marking point. This was the only mark seen.

Question 10 (b)(ii)

Candidates were presented with a graph showing the mean core body temperature of athletes as they warm-up and carry out exercise at two different environmental temperatures. Candidates had to explain the effect of the environmental temperature on the warm-up and exercise periods. Whilst a number of pleasing responses were encountered, it was not uncommon for candidates to offer a descriptive response rather than an explanation.

This response not only offers a short description, it is rather general in nature, not distinguishing between the warm-up phase and the exercise period, as requested in the question.

(ii) The graph shows the effect of the warm-up activities (from 0–20 minutes) and exercise (from 20 minutes) on mean core body temperature.



Explain the effect of environmental temperature on core body temperature during warm-up activities followed by exercise.

(3)

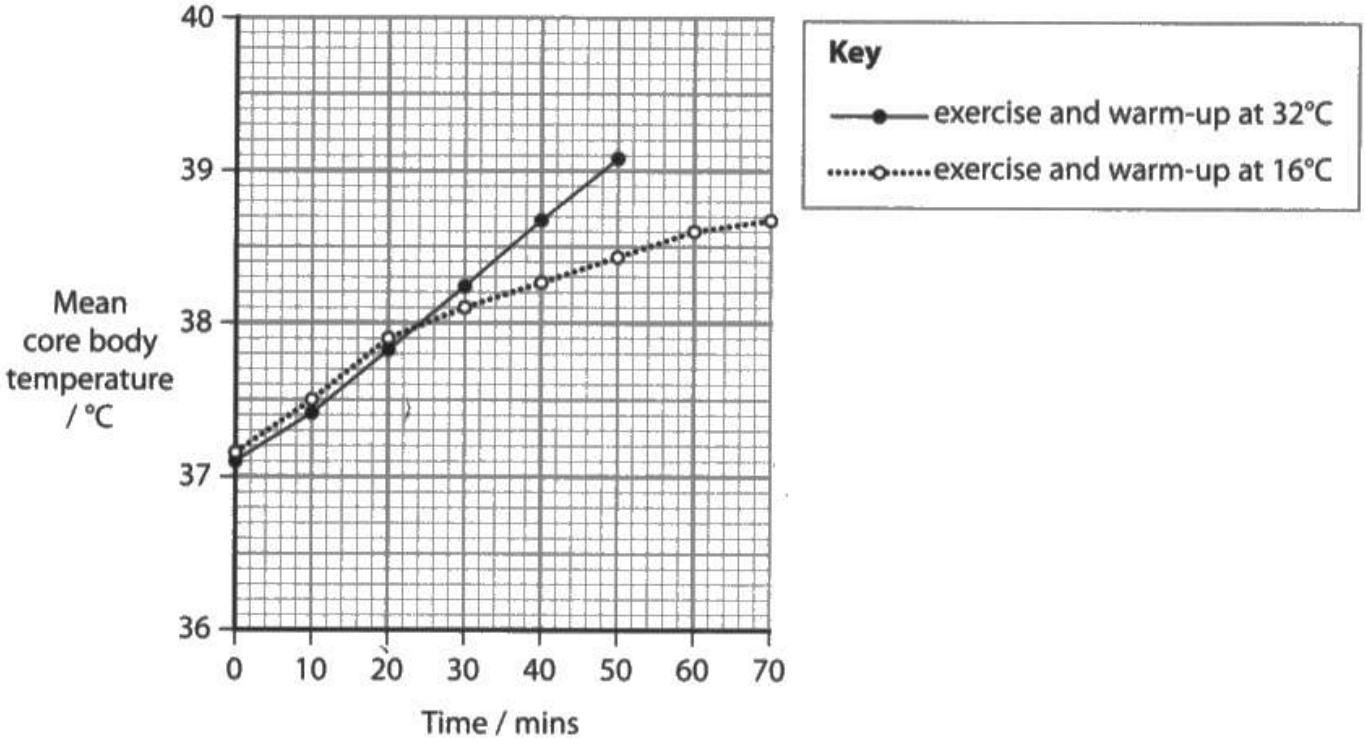
We can see from the graph ~~that~~ that a higher environmental temperature causes the mean core body temperature to be ~~higher~~ higher.



No marks can be given for this answer.

This response achieves two out of a maximum of three marks.

(ii) The graph shows the effect of the warm-up activities (from 0–20 minutes) and exercise (from 20 minutes) on mean core body temperature.



Explain the effect of environmental temperature on core body temperature during warm-up activities followed by exercise.

(3)

During the warm up ~~activity~~ activity, there is an increase in mean body temperature (0-20 mins) However after that, at 32°c (exercise) the mean core body temp increases at a ~~cont~~ ~~constan~~ faster rate ~~than~~ and higher temperature than exercise at 16°c. This is because at 32°c an increased temperature increases the kinetic energy of enzymes and therefore ~~more~~ more enzyme-substrate complexes are made. More heat is ~~produced~~ released (as a result of aerobic respiration).



The first sentence is a general lead-in. However, the second one suitably offers the third marking point. Then at the end of this answer, the second marking point is found.



Make sure you can distinguish between 'describe' and 'explain'.

Question 10 (b)(iii)

In this six marker indicative content question, candidates were required to evaluate the idea that athletic training programmes should take account of differing environmental conditions to aid performance.

A short answer that offers two judgements from the data.

*(iii) The mean performance of the athletes was measured during the exercise as:

- mean length of time of exercise
- mean maximum power output
- mean rate of sweating.

The table shows the mean performance for the two types of sport.

	Mean length of exercise / min		Mean maximum power output / a.u.		Mean rate of sweating / kg hour^{-1}	
Type of sport	at 16 °C	at 32 °C	at 16 °C	at 32 °C	at 16 °C	at 32 °C
Endurance	64	47	4.4	3.7	0.9	1.6
Mix-trained	57	40	3.0	2.5	0.9	1.7

The results of this investigation were used to suggest that training programmes should take into account different environmental conditions.

Evaluate the evidence to suggest that this would benefit the performance of athletes when competing in different environmental conditions.

(6)

The mean exercise length of the athletes is shown to be higher at 16 °C than at 32 °C for both endurance and mix trained athletes and the amount of sweating is shown to be higher at 32 °C

ResultsPlus
Examiner Comments

Whilst two judgements have been given there is no conclusion offered, so this response sits within level 1, and was given 1 mark.

This is a level 2 response which was awarded 3 marks.

*(iii) The mean performance of the athletes was measured during the exercise as:

- mean length of time of exercise
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- mean rate of sweating.

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	Mean length of exercise / min		Mean maximum power output / a.u.		Mean rate of sweating / kg hour^{-1}	
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The results of this investigation were used to suggest that training programmes should take into account different environmental conditions.

Evaluate the evidence to suggest that this would benefit the performance of athletes when competing in different environmental conditions.

(6)

This suggestion is sensible, as at different temperatures, the mean length of exercise, maximum power output and rate of sweating is different in both endurance sport and in mix-trained sport.

→ For instance in endurance sport at 16° the length of exercise time is higher at 16° than at 32°c suggesting that athletes unable to train for a longer amount of time at higher temperatures, thus if they took this into account, they can perform at lower temperatures to increase the exercise duration time. E.g. its 64mins at 16°c but 47mins at 32°c (7min difference).

→ For maximum power output in ~~endurance its higher at 32°c (3.7au)~~, both endurance and mixed trained

is higher at 16°c than at 32°c e.g. in endurance its 0.5 au higher suggesting athlets can use more power at lower temperatures.

→ Athletes sweat less at 16°c in both endurance and mix-trained they sweat 0.9 kg/hour which is less than the 1.6 kg/hour in endurance and 1.7 kg/hour in mixed training

→ overall environmental factors affect the efficiency of ~~training and~~ the athelete's performance. They perform better at lower temperatures so the claim is sensible and lower temperatures have a better effect on training.

ResultsPlus
Examiner Comments

The first paragraph refers to differences, but no direction, eg increase maximum power output at the lower temperature, whilst the second paragraph only considered endurance sports.

The third paragraph, however, offers suitable judgements on maximum power output and sweating for both sports types.

As the final paragraph offers one conclusion, the combination of a conclusion and two judgements moves it into level 2 , but cannot be given four marks as only one conclusion – relating to performance – has been offered.

A fairly concise response that is within the level 3 bracket.

*(iii) The mean performance of the athletes was measured during the exercise as:

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- mean rate of sweating.

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The results of this investigation were used to suggest that training programmes should take into account different environmental conditions.

Evaluate the evidence to suggest that this would benefit the performance of athletes when competing in different environmental conditions.

(6)

~~No detail of~~ sample size of athlete is very small and might not diverse enough to extrapolate or represent the whole sets of real athlete. Individual are different. ~~and~~ No statistic test to ~~check~~ test the value like S.D., T test. There might be other effect of variable to the performance of exercise like height, muscle mass.

performance is compared by length of exercise and maximum power since the sweating rate is relatively the same in same temp. Thus, Higher temperature increases the rate of sweating which might affect dehydration. The different in condition like lower temperature increases both power and length of exercise in both type of sport. Thus, it might be more efficient to ~~know~~ exert highest performance in different temperature / condition.

however, the significant values are not indicate that those value in each temp are different from each other or not. At the same temp, the performance of athlete are relatively the same, so, can't conclude.

ResultsPlus
Examiner Comments

This candidate offers two conclusions and three judgements on the first page. In consequence, this answer gained five marks.

Paper Summary

Based on candidate performance on this paper, candidates should:

- Always take note of the command word being used. Make sure the difference between 'explain' and 'describe' is known, and what is required when a question refers to 'determine'
- Read the question most carefully, so that the response provided is tailored to the focus of that question
- Biological words need to be fully appreciated, for example, know the difference between chromosomes and chromatids, alleles and genes, and centrioles and centromeres
- Consider whether an answer supplied should include a direction. Rather than stating the mass altered, should it state that it increased?
- Consider processing numerical data rather than just repeating it
- Take account of units
- Always make sure that handwriting is sufficiently clear.

Grade boundaries

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