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Examiners' Report January 2011

GCSE Biology 6BI05 01

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Introduction

Performance on this paper appears to have been similar to the previous session and the most challenging aspect was once again the question based on the Scientific Article. As mentioned below, preparation for this part of the paper should be thorough and detailed as there is evidence that many candidates were unfamiliar with terms and ideas. The extra time available at this, and future, sessions has resulted in fewer rushed responses towards the end of the paper although it is not obvious that there has been a higher level of achievement as a result. Questions addressing the How Science Works criteria are not well done on the whole, although there were some encouraging responses from good candidates.

Question 1(b)

As usual, the first question on the paper was intended to deal with fairly straightforward concepts and allow candidates to feel confident that they had gained some early credit. The majority of responses correctly identified parts of a joint and there was familiarity with joint repair. Clarity of expression and careful attention to command words were the main issues where credit was lost and many weaker answers did not seem to have used the number of marks available as a guide to the amount of detail required.

The majority of responses correctly identified the importance of ligaments holding bones together, and often went further in describing movement to gain the second mark. Some candidates appeared to read the command word as 'give' rather than 'describe' and so did not expand on a very simple answer.

(b) Describe the function of structure Q.

(2)

To attach and support the two bones whilst retaining flexibility for movement.



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Examiner Comments

This is an example of a clear, succinct answer. Notice that the space need not be filled and that a well chosen sentence can score more than one mark.

Ligament attaches holds the bone together. A non-elastic tissue that keeps the bones together, making helping it ~~to~~ making it strong & rigid.



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Examiner Comments

In this case, the candidate has resorted to repetition in order to try to find the second mark. A further attempt is made by giving a property of the ligament which clearly answers a different question.



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Examiner Tip

Saying something twice wastes time and will never be worth extra marks.

Question 1(c)

For full marks in this question candidates needed to comment in some way on the different properties of tendons and ligaments. Most were able to gain an easy mark for a reference to the repair of tissue, but surprisingly few went on to discuss the problem of tendons being inelastic. The number of references to problems with repairing the tendon was disappointing, highlighting the need to read the stem of the question carefully as it was clearly stated that removing tissue caused no damage.

Suggest why the use of material from structure P will mean that recovery will be quite slow and require careful physiotherapy.

(2)

The material from the tendon can be used to join broken ligaments, it will take long to recover and use physiotherapy because the material from tendons is not flexible, so it will study here to get stretched.



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Examiner Comments

This clearly relates the properties of the tendon to the time needed for recovery.

P is less elastic than Q meaning that if P is used to replace Q then there it will be harder to move the joint. physiotherapy is required to help P to stretch over time so that full recovery may happen without further damage. The patient will also have to get used to having less of structure P on the joint.



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Examiner Comments

The candidate has again made the correct use of properties and repair, but in this case has written further irrelevant material. This only penalised by wasted time but shows a lack of confidence in the answer.

Question 1(d)

Keyhole surgery is clearly well known as an alternative form of surgical treatment but the benefits of its use are less well understood. Most commonly marks were awarded for mention of reduced damage and fast recovery time but it was rare for a candidate to go on to describe the consequences of this in terms of cost or number of patients treated. Credit was not given for the very common references to blood loss or infection risk.

(d) The operation to repair the damage can be done using keyhole surgery.
Suggest the benefits of this technique.

(3)

The recovery time post-op is significantly reduced compared to conventional surgery. Also, only a couple of small incisions need to be made to insert the laparoscopes so scarring is minimised. The patients overall time in hospital is reduced so it is cheaper for the hospital.

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Examiner Comments

In this very clear answer the candidate had stated that there will be a shorter recovery time and then goes on to suggest some consequences of this.

Keyhole surgery has many benefits, as the incision under the skin is very small compared to open surgery there will be less scarring on the skin. Recovery time will be quicker as the surgery is less strenuous on the body. Keyhole surgery will heal quicker meaning the person can get back to exercise or activities quicker. Keyhole surgery uses specific materials needed to repair the damage.

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Examiner Comments

The candidate has managed to score two marks for the faster recovery time and less damage, but there is no attempt to describe how this might be of benefit. Getting back to normal activities simply rephrases the faster recovery time point.

Question 2(a)(i)

Although the context of this question is photoperiodism, it is also testing the How Science Works principles. The understanding of control of flowering was quite inconsistent, particularly in candidates achieving lower marks, and the ability to interpret experimental evidence was disappointing.

The number of candidates that were unable to interpret the diagram was very surprising, with the most common error being to simply read the values from the chart without understanding their meaning and giving 20 hours as the critical period. Less common, but still seen, were answers suggesting that the period is between 7 and 8 hours, when 7 hours is clearly excluded by the results. Answers must be precise and take into account all of the information given.

(a) (i) Using the information in the diagram, give the critical period for flowering of cocklebur plants.

(1)

12 to 20 hours.



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Examiner Comments

This is the classic error of misreading the information given.



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Examiner Tip

Take time to understand the way in which the data is presented.

Question 2(a)(ii)

A significant proportion of candidates did not have a sufficient understanding of the mechanism by which phytochrome controls flowering to score full marks in this question. A simple statement that the length of darkness was insufficient was made by many although even this was often too poorly expressed to be worth credit. Only better candidates were able to go further and explain the lack of flowering in terms of phytochrome. A surprising number of candidates were unable to correctly identify the active form of phytochrome inhibiting flowering, confusing long day and short day plants.

(ii) Using the information in the diagram and your own knowledge of photoreceptors, explain why plant B has not flowered. (2)

- too much
- ~~not enough~~ Pfr has been produced through phytochromes in daylight (Pr absorbed and converted to Pfr)
 - In dark the activating Pfr is converted back to Pr
 - After 8 hours in darkness, Pfr has been reduced enough below a threshold back into Pr through enzymes and breaking down to enable the plant to flower.
 - before 8 hours of darkness, Pfr would be too high so no flowering would occur
 - plant A flowered after 8 hours of darkness but B didn't after only 7 hours.



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Examiner Comments

This response is worth more than the marks available. Note that the bullet point are acceptable and make it easier to avoid repetition and wandering answers.

In the dark, active P_{FR} (far red) form of phytochrome photoreceptor gradually turns back to P_R (red) form.
In plant B, P_{FR} has ~~to~~ not had enough time to change back to P_R, so low levels of P_R mean plant B has not flowered.

1



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Examiner Comments

This candidate know that the two forms of phytochrome are important but is unable to explain clearly the role of each form so does not score that point.

Question 2(b)

Almost all candidates were able to identify the control, and pleasingly went on to explain its purpose in the experiment. Where marks were lost it was generally as a result of poor expression.

Explain the purpose of plant E in this investigation.

Plant E is the control, so that results⁽²⁾ can be compared to a plant kept under the same conditions, it allows for comparison and helps with conclusion.

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Examiner Comments

This clearly gives the term control and explains that comparisons can be made.

Question 2(c)

High quality responses to this question were rare and only a few were able to make full use of the information to suggest an explanation for the results. Very few pointed out that plants exposed to six of darkness would not be expected to flower or that the eight hours given to the covered leaf would cause flowering, which made it quite difficult to follow some responses as there was no clear context for the remainder of the answer. Candidates should be advised to give even obvious points where they have not been made in the stem of the question. Most had some idea that leaves were involved in detecting the photoperiod but many failed to mention that the leaf was a receptor or that it contained phytochrome. A large number of candidates gave detailed descriptions of the mechanism of the response, and factors affecting it, but this was not required. Invitations to candidates to use their own knowledge are intended to suggest that not all of the marks are available for using the experimental results, but the temptation to give a full account with no evidence of thought about relevance should be resisted.

(c) Using your own knowledge of photoreceptors, explain the results of these investigations. What do they suggest about the control of flowering in cocklebur plants?

(4)

Photoreceptors absorb light energy and are found on leaves. Plants need to obtain a certain amount of light, along with water and carbon dioxide to produce flowers. We can see that if we limit the amount of photoreceptors (which are linked to proteins creating photosystems) that receive light energy we are reducing the chance of the plant flowering.



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Examiner Comments

This candidate has not been able to explain the results of the experiment and tries instead to explain in terms of light requirements of the plant. The use of 'amount' is particularly unhelpful here as it could have so many different meanings.



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Examiner Tip

Use precise terms. There is always a better word than 'amount'.

It is fairly easy to control the flowering in cocklebur plants ~~any less than 8 hours~~. Just from the investigations we can see that at 8 hours darkness the plant will flower. The results show at 6 hours or less there's no flowers (7 hours is not shown)

Plant F shows that only a part of the leaf needs to be in the dark in order for the rest of the plant to get what it needs. The necessary products can travel from the covered leaf to the rest of the plant.

Red only needs to be present in the part of the leaf in darkness (to absorb far red light to convert into P_{fr} , which works as ^{Red}light)

(d) Suggest benefits to plants of being able to respond to changes in day length



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Examiner Comments

Although there are some inaccuracies in this response the candidate has explained how the experiment can be used to explain how the flowering is controlled.

Question 2(d)

The significance of photoperiodism in plant development was poorly understood. Even good candidates were unable to give full answers and seldom considered the reliability of day length compared with other potential stimuli. Most were able to give some description of how seasonal development is controlled and how it can be of benefit, although weaker responses did not appreciate the difference between photoperiod and light availability and considered the importance of plants having access to as much light as possible.

(d) Suggest benefits to plants of being able to respond to changes in day length.

(3)

~~So they~~ So that germination is initiated when the timing is right, which is more reliable than temperature as ^{variation of} day length during the year does not change (compared to temperature).



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Examiner Comments

This is a good answer that clearly addresses the relevance of the photoperiod as a measure of time of year. It also makes the point that this is more reliable than fluctuations in factors such as temperature.

The plants will not flower during periods which are unfavourable for growth. Photoperiodism is the response of plants to changes in the day length. The flowering occurs only at the most suitable time so that pollination occurs as insects get active during that time. During ~~unfavourable~~ unfavourable periods, ^{survival} mechanism such as etiolation ~~can~~ can be initiated due to photoperiodism. Etiolation allows maximum growth in height of the plant while using minimum amount of ^(carbon) C reserves.



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Examiner Comments

Here the candidate has appreciated that development can be coordinated, but has not made the further step to discuss the reliability of photoperiod.

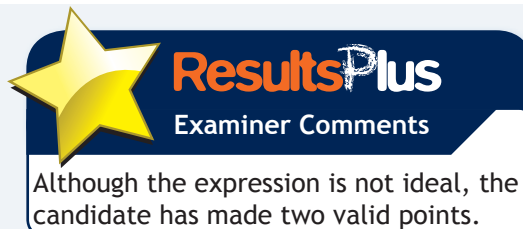
Question 3(a)

As is common with questions involving experimental use of animals, candidates found it very difficult to concentrate on the science that they have learned rather than emotive considerations of animal welfare. The straightforward recall questions were dealt with quite well by most, but the interpretation of data and application of knowledge proved to be discriminating.

Part a was answered well by most candidates and full marks were commonly awarded. The most common misunderstanding was to miss the implied comparison with the use of dopamine itself, but one mark was usually available for the reference to low dopamine levels in Parkinson's disease.

(a) Explain why L-Dopa is used to treat people with Parkinson's disease. (2)

- Can travel to brain, can be taken up through blood in the brain as dopamine too large, cannot.
- L-Dopa precursor of Dopamine so ~~can~~ when in the brain can be converted to dopamine.



Question 3(b)

Better candidates scored well on this recall question but full marks were rare for those with lower achievement. Knowledge of how MDMA affects the nervous system is required, but a significant number of candidates were not able to give a clear explanation of how serotonin levels are affected at synapses. There were a large number of vague and poorly expressed descriptions of changes at a synapse showing a lack of detailed learning of the mechanism of action. Some appeared unaware that serotonin is a neurotransmitter and made no mention of a synapse.

(b) Explain how MDMA could affect levels of serotonin in the brain.

(3)

MDMA can bind to proteins on the presynaptic membrane of serotonin releasing synapses. It binds to proteins responsible for reuptake of serotonin, inhibiting them, meaning that levels of serotonin in the synaptic cleft increases. MDMA can also cause the reuptake process of serotonin to the presynaptic membrane to reverse causing yet more serotonin to enter the synaptic cleft.



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Examiner Comments

This is a very clear answer showing good understanding of how MDMA affects synapses.

MDMA stimulates the neurones ~~and~~ to release excess chemicals in the brain, one of these being serotonin, which then increases the levels to a normal level ~~that~~ of serotonin that everyone should have.



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Examiner Comments

This candidate is clearly trying to gain marks by making vague statements about serotonin levels. There is no reference to a synapse and the candidate has no idea about the mechanism of action of MDMA.



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Examiner Tip

There is no substitute for thorough learning of detail.

Question 3(c)(i)

The majority of candidates appreciated the need to mimic the effects of Parkinson's disease in the animal model before starting to test treatments.

(c) In trials of this treatment, marmosets (small monkeys) were given a drug to reduce dopamine production. They were then treated with L-Dopa until they showed the side effects observed in the treatment of people with Parkinson's disease.

(i) Suggest a reason why the marmosets were treated with a drug to reduce dopamine production.

(1)

Because in parkinsons, dopamine production is low because the receptors are damaged, so they were trying to replicate the conditions in the marmosets.



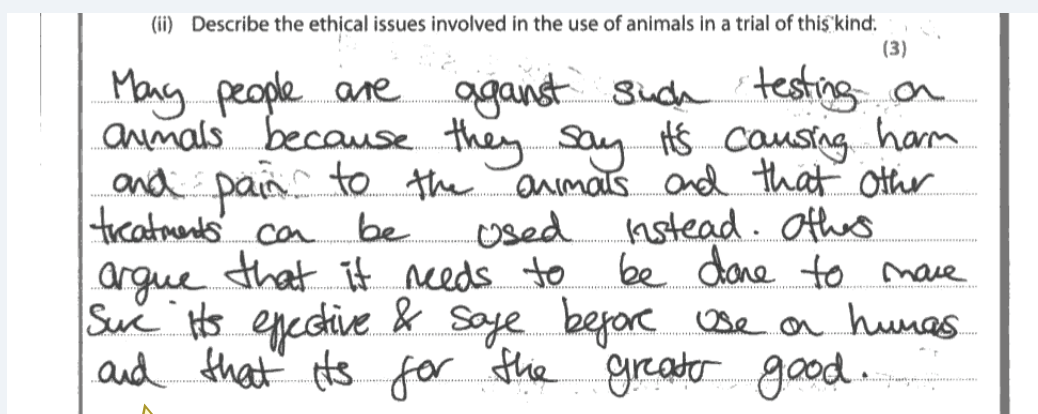
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Examiner Comments

A typical correct answer giving the reason for the treatment very clearly.

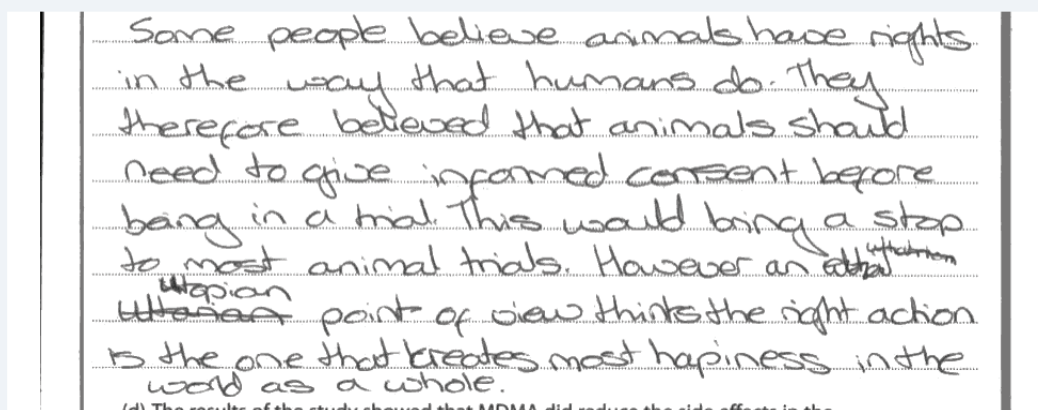
Question 3(c)(ii)

Many candidates appeared to have lifted their responses straight from “animal rights” literature and listed how the animals’ rights might be affected without discussing the ethical issues. Clearly most candidates were against using animals but they failed to explain why or to consider any contrary arguments. Most commonly, the need for animals to give informed consent and their inability to communicate their wishes was raised. Such questions are often score very poorly, particularly for lower achieving candidates, as they fail to appreciate the difference between considered ethical arguments and opinion. References to formal ethical standpoints were uncommon and candidates should be encouraged to view the learning in this area of the course in the same way as any other topic.


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Examiner Comments

This is an example of slightly less emotive responses. Marks are gained for the description of the use for greater good and for the suggestion that other methods might be used if available.


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Examiner Comments

There is no need for animals to give consent to treatments. However the greater good appears again for a mark.


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Examiner Tip

Do not give your opinion on ethical issues. Give the ethical standpoints you have learned.

Question 3(d)

There were a number of clear, concise answers that fully described phase testing of potential drugs, but equally many weaker responses were vague and lacking in detail. It is important that trials are described accurately in terms of the number and type of people involved.

(d) The results of the study showed that MDMA did reduce the side effects in the marmosets.

Describe the steps that would need to be taken before a similar treatment could be used in humans.

(3)

There would have to be a number of tests on willing humans. For example the use of placebos and MDMA to see if it is effective. Before testing humans the lethal dosage would have to be found by another test on animals. Also it would have to be tested for side effects like the L-dopa was tested.

(Total for Question 3 = 12 marks)



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Examiner Comments

A mark is gained here for mention of a placebo, but the remainder is too imprecise to score. There is a clear list of stages that must be given for marks to be scored.

The drug would then pass to Phase I human trials. Here a small group of volunteers would be used to see if the drug has the desired effect. Phase II and Phase III follow with larger sample sizes. If the results are what is expected then the drug is then licensed by the authorities and then sold to the general public.



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Examiner Comments

This highlights the precision required. A small number of volunteers is not enough - they must be healthy in the first instance.

Question 4(a)

Muscle structure and the role of anaerobic respiration in contraction was well understood by many candidates and there were many clear and accurate descriptions. The number of errors in the calculation showed that a large number of candidates do not read the information as carefully enough to avoid losing quite straightforward marks. Once again, candidates should be careful to avoid responding to a term or phrase by giving a detailed account of irrelevant material. Thorough reading of the stem is essential.

The majority of candidates were able to score a mark for the correct calculation but most failed to see that everything was expressed per million molecules and left this out of their answer.

(a) Use this information to calculate the number of myosin molecules changing shape during the contraction of this muscle fibre. Show your working.

(2)

$$\frac{3.5 \times 10^{-3}}{1.7 \times 10^{-6}} = 2058.824 \text{ (3. a. p.)}$$

Answer 2058.8



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Examiner Comments

This illustrates the typical error of forgetting about the millions given in the question.

Question 4(b)(i)

Only a few candidates were unable to identify a fast twitch fibre.

Question 4(b)(ii)

This question discriminated well, with a high proportion of weaker candidates giving vague accounts of anaerobic respiration or missing the indication that mitochondria could not account for all of the ATP needed for muscle contraction. Higher achieving candidates gave good and clear accounts of the process. The important point that reduction of pyruvate provides a supply of NAD for glycolysis was not explained well, and candidates should be discouraged from using abbreviations for compounds such as phosphocreatine without explanation. Some candidates saw the question as an opportunity to give a detailed description of the sliding filament theory, clearly having misread the instructions.

(ii) The energy required for contraction of muscle fibres is provided by ATP. Describe how enough ATP is made available for contraction of this muscle fibre, despite there being only a few mitochondria.

(5)

ATP is produced in mitochondria. Krebs cycle ~~and~~ happened in mitochondria and the electron transport chain are in the inner membrane of mitochondria. H atoms will split into protons and electrons. Electrons will move from I complex to another along the electron transport chain, ^{producing energy through redox reaction} protons will move to the intermembrane space. Then, protons will diffuse back to the matrix through stalk particles. ATP is made here with aid of ATPase. Oxygen will pick up hydrogen atom to form water. ATP produced will be used for contraction of muscle. AT

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Examiner Comments

Here the candidate has not appreciated that anaerobic respiration is the important focus of the question. A mark is gained for the reference to anaerobic respiration but the additional detail is not relevant.

Fibre (5)

Muscle contain actin, and myosin proteins. Sliding filament theory happens. Calcium ions attach themselves to ^{toponin} actin, exposing the binding site ^{present} on actin. Actin has 2 protein molecules, toponin and topomyosin. Myosin forms cross-bridges with actin. Myosin head releases ADP + P_i, binding to actin with force, causing forward ^{movement} in muscles. Energy is released, ATP is formed, releasing/breaking the bond of myosin and actin. ATP is broken to ADP + P_i by the myosin head and myosin becomes upright again. This process continues.

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Examiner Comments

Another way of misreading this question was to hope that it required detail of the sliding filament theory.

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Examiner Tip

Pay attention to the clues in the question.

Question 4(b)(iii)

Most candidates identified build-up of lactate as a problem in anaerobic respiration and scored both marks. Fewer went to explain the significance of this for metabolic processes, but full marks were available for a fairly simplistic response.

(iii) Explain why you would expect this type of muscle fibre to fatigue quickly. (2)

Pyruvate reduced to lactate, ^{when starting oxidising} ~~to so~~ NAD⁺ Lactate forms lactic acid in solution. changes the pH ~~into~~ within cell.
 (H⁺ Interfers with active site of enzymes neutralising positive sites, substrate can no longer bind)
 Anaerobic respiration hence cannot be sustained



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Examiner Comments

This is not a particularly clear answer but it includes reference to lactate build up and the effect of pH on enzymes.

They don't contain many mitochondria the site for cell respiration. They have small amounts of oxygen rich myoglobin so not much oxygen for respiration.
~~not~~ Mainly anaerobic respiration which can't carry on for long periods of time due to build up of lactic acid.



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Examiner Tip

This response gains full marks in the second paragraph but wastes time restating the question in the first.

Question 5(a)

Understanding of the process of aerobic respiration was tested quite fully in this question and most candidates were able to deal with the straightforward factual recall but found the application to experimental data challenging. The difficulty of some parts of this question made it very difficult for any but the most able to access high marks.

Very few candidates were unable to give glycolysis as the process, although there were several inventive spellings. These were not penalised where there was no ambiguity but clearly careful learning of technical terms is important.

Question 5(c)(i)

This proved to be very difficult for most candidates. Some, instead of answering the question, gave an excellent response to a question that appeared on a previous paper suggesting over-coaching. Unfortunately, on this occasion it was necessary to use data from the graph as a guide and this was not well done. The comparison of two rates of oxygen uptake was the most common creditworthy response. Many of the stages and reactants of the process were mentioned but with insufficient detail or in the wrong context and there was evidence of rote learning of much more detail than required by the specification. It was common for candidates to suppose that pyruvate had the most carbon atoms in an attempt to see a pattern, but the relationship with oxidation was rarely appreciated.

- (i) Using the information in the diagram and the graph, suggest an explanation for the differences in oxygen uptake between bacteria using pyruvic acid, molecule B and molecule C as a substrate.

(4)

The bacteria using pyruvic acid takes up oxygen at a steady rate and the total is about 0.57 cm^3 whereas molecule B and C tend to take up oxygen much slower rate but much closer to each other they only about 0.4 cm^3 this is because the bacteria take easy organic acid gas through the cell cycle where ATP is produced therefore oxygen take up is more gradual but at a high rate however molecules B & C do not produce any ATP therefore oxygen is not produced as a result therefore the rate of take up of oxygen is slower.



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Examiner Comments

This illustrates the point that stating values without some comparison will not be worth credit.



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Examiner Tip

Always manipulate or compare values. Do not leave it for the examiner to do for you.

Oxygen uptake for ~~test~~ bacteria in ~~pyruvic~~ pyruvic acid is the highest followed by molecule B and molecule C. As pyruvic acid converts into Acetyl CoA and later to molecule A, molecule B and molecule C, more amount of NAD is reduced to NADH. Therefore, a higher amount of oxygen is needed to accept electron from these NADH so that NAD can be regenerated and ATP can be produced. If molecule B was used NADH produced will be lower compared to pyruvic acid. Molecule C produces the least NADH ~~among~~ among these three.



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Examiner Comments

This candidate has made comparisons of rates and has appreciated the link with NAD production and oxygen requirement.

Question 5(c)(ii)

Responses to this question were considerably better than to the previous question and the link to their understanding of oxygen debt was often made.

(ii) Suggest **one** reason for the rapid oxygen uptake by bacteria in a medium containing lactic acid. Give an explanation for your answer.

(2)

Oxygen debt - lack of oxygen due to lactic acid increasing in bacteria meant the bacteria had to increase rapid uptake - due to anaerobic and the lack of oxygen due to increased CO_2 and lactic acid.



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Examiner Comments

The most common correct response included reference to oxygen debt.

Question 6(a)

This was the first question on the paper to assess quality of written communication and there were many very good and clear answers describing the functioning of the heart in a logical sequence.

Explanations of the term were often too vague and unclear to be worthy of both marks. Most were able to explain that the contraction of cardiac muscle cells does not require external stimulation, but explanations of the link with depolarisation were rarely given.

6 Cardiac muscle is myogenic.

The rhythmic contraction of the heart, in a particular sequence, is a feature of the cardiac cycle.

(a) Explain what is meant by the term **myogenic**.

(2)

Myogenic means it is self-coordinate, i.e. it doesn't require a nerve impulse to initiate the response.



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Examiner Comments

Typically responses made reference to lack of external stimulation but not the fact that depolarisation is spontaneous.

Question 6(b)

This was an opportunity for candidates to show that they are able to give a detailed description of a process in a logical sequence and most rose well to the challenge. A large number of accounts reached full marks long before the end and were worthy of more marks had they been available. A significant number of candidates read the question too loosely and felt that the role of the autonomic nervous system was relevant, despite the guidance from the previous question and the instruction to discuss coordination of the contraction rather than its control. The role of valves in controlling blood flow was the weakest element of many answers and it is still a common misconception that the valves are closed by some means other than pressure of blood.

*(b) Describe how the sequence of muscular contraction in the heart is coordinated and how the movement of blood through the heart is controlled.

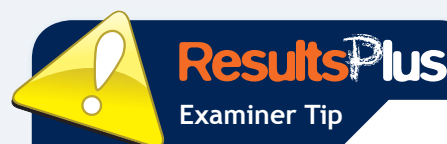
(6)

The sinoatrial node in the wall of the right atrium initiates the heartbeat. It sends an electrical impulse over the ~~walls~~^{walls} of the atria causing them to depolarise (contract). The impulse reaches the AVN (atrio ventricular node). There is a slight delay before the AVN sends on this impulse to ensure the atria have fully contracted and all the blood has filled the ventricles. The AVN then sends this impulse to the bundle of His, a group of muscle fibres responsible for sending this impulse on to the Purkyne fibres. The fibres spread the impulse over the ventricular walls causing them to contract from the bottom upwards. The ventricles expell blood around the body.

(Total for Question 6 = 8 marks)



This is a good clear answer but does not address the whole question. There is no reference made to the control of blood flow by valves so full marks are not available.



Answer the whole question.

(b) Describe how the sequence of muscular contraction in the heart is coordinated and how the movement of blood through the heart is controlled.

(6)

pulse sent from the SAN to the AVN. ~~AVN~~

The pulse is sent from SAN to the atrioventricular valve where there is a brief delay. The pulse then continues to the Atrioventricular Node (AVN), where a pulse is sent down through the walls of the ventricles.

The blood is pushed into the ~~AVN~~ atrium, which contracts + pushes the blood through the valves (tricuspid valves) and into the ventricles. The valves close behind ensuring the blood doesn't flow backwards. The ventricles then contract and push the blood to the lungs or to the body, again the valves close behind to ensure no blood runs back.



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Examiner Comments

This response manages to hit a couple of the marking points but it is disorganised and uses poor terminology such as 'pulse'.



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Examiner Tip

Use correct and accurate terms.

Question 7(a)

As has proved to be the case in previous series, the question based on the Scientific Article was quite clearly the most demanding. Low scores on some parts of the question are suggestive of inadequate preparation as the meaning of terms and phrases in the text should be prepared in advance. Irrelevant answers were not uncommon which may well be the result of inadequate identification of links to other units. This question, it should be remembered, can draw on any area of the specification.

There was some confusion of what a photoreceptor protein might be, with rods and cones being offered quite frequently. Description of the function were much too vague at times and would have benefited from a precise role of rhodopsin rather than a description of the full functioning of a rod cell.

(a) Name one 'retinal photoreceptor protein' (second paragraph on page 2) and describe its function.

(2)

is in the eyes and detects the level of light in its surroundings and sends signals to the lens to make the pupil alter size accordingly.



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Examiner Comments

This clearly misses the instruction to name the protein and uses vague terminology such as signal. It describes functions of things other than the photoreceptor protein.

Rhodopsin - made up of retinal and opsin. When rhodopsin is broken down into its components the sodium channels in rod cells close so sodium ions are pumped out but can't diffuse back in. This means inhibitory neurotransmitters are not released, which in turn caused an action potential to be initiated.

(b) Explain what is meant by 'The human genome project could help to change that' initiated.



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Examiner Comments

This is an excellent answer that gives more detail than can be rewarded when two marks are available.

Question 7(b)

Explanations of the Human Genome Project were unclear, with vague references to mapping taken from the text being common. This is an area that could have been prepared in advance with a precise understanding of the process and its significance.

(b) Explain what is meant by 'The human genome project could help to change that' (fourth paragraph on page 2).

(2)

When the human genome project has finished mapping out all the genes in the human body, then we look properly into the transcription factors which turn them on or off.



ResultsPlus

Examiner Comments

This answer appears to be using phrases from the text to provide an explanation. It does not go far enough with explaining what is involved.



ResultsPlus

Examiner Tip

Find out about terms and concepts in the article as a part of your preparation.

Investigating human genes in more depth could help find more information about our molecular genetics & more can be known on transcription factors.



ResultsPlus

Examiner Comments

In this case the consequences of the project are given, but not how the information is being obtained.

Question 7(c)

Although this question is clearly addressing the nature and nurture debate it is not enough to simply state that without explanation. A number of weaker candidates lost credit in this way and they should be advised that popular phrases without explanation will rarely gain credit. Most candidates were able to suggest that genes make a contribution to the diseases but that other factors are likely to be involved. It was pleasing to see so many appropriate examples illustrating answers.

(c) Suggest why genes are only partly responsible for the development of cancer and heart disease.

(3)

Because lifestyle choices can also influence the way our bodies work, such as smoking which can cause a build up of tar in the lungs or mutations of lung cells, ~~causing~~ causing lungs to be less efficient than at oxygen uptake so the heart has to work harder to provide oxygen to muscles causing heart disease.



ResultsPlus

Examiner Comments

This is a good answer as far as it goes but has not given examples from both of the situations included in the question.

This is ~~for~~ because environmental and other factors come into play. For instance cancers may be caused by exposure to carcinogenic substance while heart disease may be caused due to a stressful lifestyle, lack of exercise and so on and so forth.

(3)



ResultsPlus

Examiner Comments

This is a better answer that does address both cancer and heart disease.

Question 7(d)

Although there were some misguided attempts to describe the difficulty of inserting genes into cells, many found the appropriate references to the need for transcription factors to switch the gene on. The mark scheme was rather precise in requiring explicit reference to the fact that the appropriate transcription factor might not be present and many candidates missed this point. Once again, giving obvious points in a response will often be worth credit.

(d) Attempts to treat cystic fibrosis with gene therapy have not yet been successful.

Use information in the article to suggest reasons why inserting the correct gene into a cell may not be all that is required.

(3)

The thought may be that an undamaged gene will 'override the effects of damaged genetic material'. This may not be true as it could effect the gene pattern and cause other problems within the body. Also the body may reject the newer gene which means the bodies defence organisms will be attacking itself.



ResultsPlus

Examiner Comments

This candidate does not appear to have understood the concept of gene therapy and has resorted to guesswork. Again, preparation of ideas in the article is key, particularly when there are concepts that are in the course involved.

(3)

there may be certain transcription complex which are un-present. so when the RNA combine with the new ~~PNA~~ correct DNA. the gene are turned off so ~~of~~ correct protein are not made.



ResultsPlus

Examiner Comments

This answer is nearly worth full marks but is let down by poor expression. It doesn't quite say that transcription factors are needed.

Question 7(e)

This was the second occasion that QWC was assessed and good candidates were able to give clear accounts of transcription and translation, accurately spelling technical terms. Some descriptions were rather disjointed and vague in places and in particular the role of tRNA was badly explained. Weaker candidates struggled with a number of aspects of the process and failed to score well.

*(e) Explain how RNA templates are used to specify the chemical structure of a protein.

(6)

The RNA polymerase attaches to the promoter region on the coding strand of an unzipped DNA molecule. It moves along the coding strand, creating mRNA through complementary base pairing. The mRNA moves out of the nucleus through nuclear pores to ribosomes in the cytoplasm. The mRNA attaches and tRNA brings triplets of bases that complement the sequence on the mRNA. Each triplet codes for an amino acid, which are joined together by peptide bonds. So the sequence of bases on the RNA template specifies the sequence of amino acids in the protein.



ResultsPlus

Examiner Comments

This candidate has given more detail of transcription than is needed and then is unable to clearly explain the role of the tRNA.

RNA templates are the ~~base~~^{molecules} that control transcription. During the 'copying' of DNA they line up opposite to the DNA and copy the code. This is an exact opposite, due to specific base pairing, but further specific base pairing from mRNA means that the original code on the DNA is the one that determines the chemical structure of a protein.

Because of this fairly complicated, two-tier method of making amino acids, mutations or mistakes can happen relatively easily. It is this that can give rise to beneficial mutations (leading to evolution) or harmful mutations (the development of genetic diseases).



ResultsPlus

Examiner Comments

This is a clear case of poor understanding. The idea that mRNA molecules line up alongside DNA is surprisingly common and the second paragraph is clearly irrelevant.



ResultsPlus

Examiner Tip

Learn the detail of important processes as a sequence of events.

Question 7(f)

This proved to be difficult for most, with the majority selecting text from the article and quoting phrases without explanation. Often the correct information was used, but it is important to show understanding, particularly when the question has directed candidates to the relevant paragraph. In this case, some understanding that shape and binding were involved was required.

(f) Explain how a transcription factor might 'recognise a particular stretch of DNA' (first paragraph on page 4).

(2)

These proteins all have an active site that will bind to only a certain shape substrate, for example just certain bases on the DNA.



ResultsPlus

Examiner Comments

This is an example of a good answer that describes shape as important and that the sequence of bases dictates shape. Note that phrases from the text have not been quoted as an answer.

Transcription factors have a DNA-Binding domains which always matches to a specific Groove within the DNA. like a key and lock.



ResultsPlus

Examiner Comments

This is a more typical answer that reveals no understanding but selects phrases from the text.

Question 7(g)

Although many candidates were able to find some of the ways in which new genes may arise, and they scored well as a result, there was further evidence of candidates quoting text without explanation. Many found sub-functionalism and retro-position but did not go on to say what they were or how they might be involved.

(g) Use the information in the article to describe ways in which new genes can arise.

(5)

- Genes can arise from ~~frame shift~~ introns (junk DNA) becoming exons and becoming expressed
- Several small beneficial mutations can lead to a gradual accumulation of genes.
- Gene duplication & gene mutation → new gene.
- Retroposition; mRNA copies genes, to make protein → turned back to DNA, inserted elsewhere in genome.



ResultsPlus

Examiner Comments

This is an answer that is not particularly well expressed but does identify and explain some ways in which new genes can arise.



ResultsPlus

Examiner Tip

Explain what is meant by information quoted from the article.

Genes can arise due to small beneficial mutations, but would take a while. It could happen during gene duplication, when mistakes can create extra copies of DNA or entire chromosomes. Subfunctionalism could occur, where if a mutation knocks out¹ function of the gene, the other is still intact. If it occurs in the duplicated gene, it will be okay. Organism will have 2 genes with 1 function each as the gene can later pick up a new function. Retroposition could occur, where RNA is made back into DNA, but is different from original as it has no promoter region & may not contain introns. This could be inserted somewhere else in the genome. Frameshift mutation could occur, where DNA reading frame is altered, changing all the amino acid sequence. Could occur from scratch or from Junk DNA.

**ResultsPlus**

Examiner Comments

This is an example of a good, well expressed answer that gives clear explanations of the ideas selected from the text.

Question 7(h)

Most candidates were able to link the chemical to inflammation but were unable to go further to explain how this might cause atherosclerosis. They were more likely to simply state that it did, rephrasing the question.

(h) Explain how NF-k B might have a role in the development of atherosclerosis.

(2)

As it is a part-time transcription factor, it only enters the cells nucleus at certain times. For example it may be when cholesterol is high, so when a person eats a lot of fatty foods NF-kB may enter the nucleus and read the genes to cause inflammation in the arterial walls.



ResultsPlus

Examiner Comments

This illustrates the tendency to give a partial answer. Inflammation is identified, but its role in causing atherosclerosis is not explained.

- IT IS INVOLVED IN THE INFLAMMATORY RESPONSE

- ONCE THE ENDOTHELIUM CELLS ARE DAMAGED

- THIS INITIATES THE RESPONSE IN WHICH NF-KB IS PART OF

THIS ~~RESPONSE~~ BRINGS WITH IT LDL'S WHICH THEREFORE PROMOTE

A FATTY DEPOSIT WHICH BUILDS UP & NARROWS THE ARTERY TO

AN ARTERY



ResultsPlus

Examiner Comments

This is a better example describing the development of atheroma in response to inflammation.

Question 7(i)

This was a difficult question, but good candidates were able to suggest that only one strand of the DNA is normally a coding strand and that the frame produced by start codons reduce the number of possible ways of reading DNA to one. Many candidates were confused and thought that DNA is read in more than one way.

(i) Explain why a DNA strand is not read 'in six different ways' (eighth paragraph on page 8).

(2)

There are only 3 bases on the DNA strand if the sequence becomes different, it does not alter number of bases on triplet codon.



ResultsPlus

Examiner Comments

This is a clear example of how a confused candidate has tried to make sense of the text. With something this complex preparation is key.

Mutations are deleted. DNA is only read in one directions and uses template strand to transcribe mRNA. They are read from up to down.



ResultsPlus

Examiner Comments

This candidate has managed to find a mark for appreciating that DNA is read in one direction only. Again, the misunderstood ideas from the text indicate a lack of preparation.

Question 7(j)

This was the latest attempt to ask candidates to explain how natural selection is thought to work and as with all other attempts the results were broadly disappointing. Many accounts suggested that any fish without the protein would suddenly keel over at some unexplained time leaving other to survive. There was often a lack of appreciation that selective advantage may not be all or nothing and that gradual change is possible. Similarly, survival was often the most important issue with no reference to reproduction or the effect on subsequent generations. As usual, unexplained phrases such as 'survival of the fittest' were not given credit.

(j) About 10 million years ago, an event led to the production of antifreeze protein in one Antarctic fish. Explain why almost all Antarctic fish now contain antifreeze protein.

(3)

This is because all the fish are likely to be offspring from that fish as without that protein it would be very hard to live in that climate. Also the mutation which formed that protein is very rare and therefore it would be very unlikely that the other antarctic fish gained it from their own specific mutation.

(Total for Question 7 = 30 marks)



ResultsPlus

Examiner Comments

This answer illustrates the vague answers give when precise descriptions of natural selection are required.

This is because the antifreeze gene is advantageous to have, fish without the gene will not be likely to survive and will die. Therefore the fish with this advantageous mutation had a big advantage when the ice age came as the selection pressure was huge and killed this made ~~an~~ allowed fish with that gene to survive and reproduce passing on their gene to offspring who in turn were also a lot more likely to survive and pass the gene on.



ResultsPlus

Examiner Comments

This is a typical response that makes the points about surviving to reproduce and alleles becoming more common. It is worth knowing the difference between an allele and a gene in this circumstance.



ResultsPlus

Examiner Tip

Alleles and genes are not necessarily the same thing. Know how they differ and which term to use.

Paper Summary

It is difficult to avoid making the same observations as usual about the performance of candidates. More attention to reading the stem of the questions and a better appreciation of the meaning of command words would allow candidates to show their knowledge and understanding more clearly. This paper is unlikely to have too many straightforward recall questions and it is important that candidates have as much experience as possible of interpreting the type of questions used. There are a few areas where performance is consistently poor, such as ethical questions on the use of animals and natural selection, and it would be of benefit to give these particular attention where they have been highlighted in this report.

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