Examiners' Report
Principal Examiner Feedback

January 2023

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

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The paper was the sixth cycle of the new specification and tested respiration, internal environment, coordination, and gene technology.
The scope of the questions provided a good opportunity for candidates to demonstrate their knowledge and understanding of these topics.
There was an equal balance between topics 7 and 8.
The questions on this paper yielded a very wide range of responses with some excellent answers given. This resulted in an excellent spread of marks, across the full range (range 2 – 72)

There were some parts of questions that were left blank particularly at the end showing some evidence that candidates might have had insufficient time to complete the paper. Many candidates made an attempt at questions on the article which was the final question. However there were more blank questions for the article possibly indicating the lack of time for detailed analysis and preparation of the article due to time and preparation constraints over the last few years. There is clear evidence that some candidates are studying the article in detail while others only have a brief experience of it. As it accounts for 22% of the total paper mark time needs to be allocated to study it.

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

However, it is still evident that some candidates do not pay sufficient attention to the command word used in the question. This is particularly true of 'determine', 'deduce' and 'comments' questions where descriptions failed to gain the full marks. A greater range of command words were used in this paper.

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

'Suggest' questions offered candidates the opportunity to show their knowledge and understanding from across the specification.
Questions which demanded analysis, explanation, and application of knowledge to unfamiliar contexts were seen to be more challenging to candidates and proved to be excellent for discrimination.
A large number of centres are clearly using our mark schemes and examiner reports to prepare candidates. This is particularly evident where similar mark points have appeared on previous papers. eg. Q5cii cardiac and ventilation rates. However care must be taken not to just use the points from previous mark schemes without relating it to the context of the current question.

The multichoice questions did not present a problem.

Q1ai   Nearly every candidate was able to state correctly which structure contained actin and myosin from the labelled diagram of an elbow.

Q1aii Less than half the candidates could correctly state the function of the triceps, labelled W in the diagram. There seemed to be confusion between the terms extensor and flexor.

Q1bi   Candidates were confident in correctly explaining the role of the ligament in joining bone to bone. Many correctly named the bones. However relatively few candidates went on to expand on the 'joining bones' to maintaining stability of the joint which was required for the additional mark.
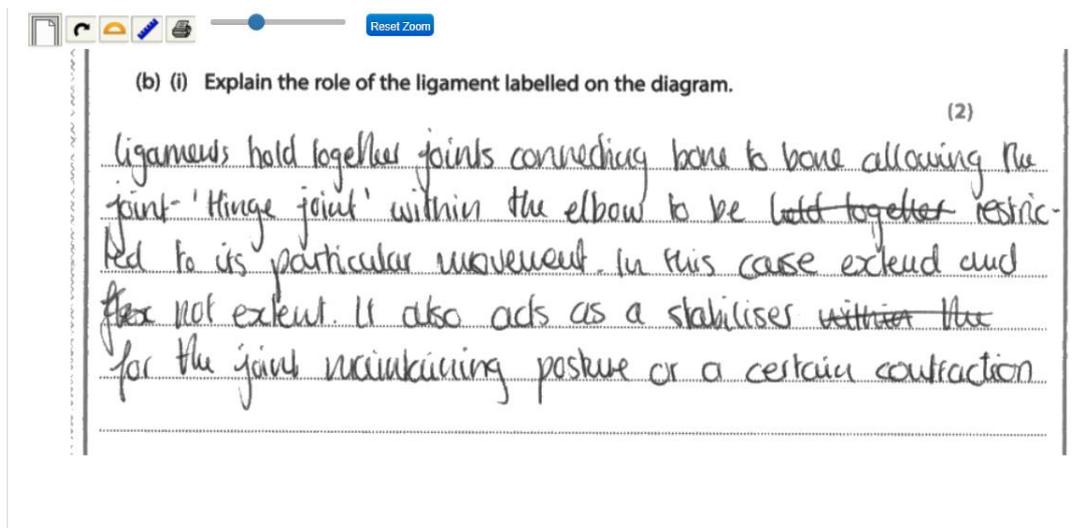
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(b) (i) Explain the role of the ligament labelled on the diagram.

(2)

Ligaments hold together joints connecting bone to bone allowing the joint- 'Hinge joint' within the elbow to be ~~held together~~ restric- ted to its particular movement. In this case extend and flex not extent. It also acts as a stabiliser ~~within~~ the for the joint maintaining posture or a certain contraction

Q1bii This was a very open ended question where candidates had to suggest one possible cause of damage to the ligament. Several candidates did not gain credit if their responses were vague eg. injury. The majority of candidates were able to give an acceptable response.

(ii) Suggest **one** possible cause of damage to this ligament.

(1)

Overextension of the ligament to an angle

(ii) Suggest **one** possible cause of damage to this ligament.

(1)

- The bones would not remain in fixed positions
- Greater intensity of exercise for long periods of time.

(b) (i) Explain the role of the ligament labelled on the diagram.

(2)

ligaments attach bones to bones in this case the it attaches the radius with the humerus, it stabilize the elbow joint & limit extreme movement to allow movement

Q2b   In this question candidates had to describe the advantages and disadvantages of PET and MRI techniques to investigate brain function. There were some very clear responses here and many candidates achieved the full three marks. However some candidates treated the question as 'compare and contrast' so missed key points of particularly the disadvantages.

(b) Describe the advantages and disadvantages of using positron emission tomography (PET) and magnetic resonance imaging (MRI) to investigate brain function.

(3)

Advantages :
PET can give us a detailed 3D image of the structure of the brain. MRI is can be used to find out which parts of the brain are more active / use up more oxyhaemoglobin during disease/ seizure.

Disadvantages :
                                                              cancer /
∴ Tracer used is radioactive and can cause mutation
in cells. MRI does not indicate if there is internal bleeding and they both are very expensive.

PET scan shows brain function while MRI doesn't show brain function

PET scan includes use of radioactive substances so it may be carcerogenic and not safe for pregnant women; however MRI is safer; it includes no use of radioactive substance

PEBoth can detect size and site of legion tumors or legions even if it's small due to their high restaludion; however, PET scan is more accurate

Both PET is more expensive and limited than MRI; it's more avaliable

MRI takes less time than PET to show brain imm-st imaging

(b) Describe the advantages and disadvantages of using positron emission tomography (PET) and magnetic resonance imaging (MRI) to investigate brain function.

(3)

MRI uses magnetic field and H^+ ion or. to detect the function of brain so its it is not less harmful as no xrays are use, But the process is noisy and it may interfare with pacemakers. so people with pacemakers are not allowed

PET uses positron emission which gives more detailed information about brain function but by allowing to monitor the oxygen used up by the brain. But it uses positron emission that can ionise ionise and cause radiation. Xrays are present bad for body, people with pace makers cannot take this test.

Q2c   This type of question format seems to help candidates formulate their responses. They had to complete a table to give the function of cerebellum, cerebral hemisphere and hypothalamus. The only real issue here is many candidates put multiple answers in the space , ie gave a list. The general rule is that the first answer will be taken.

Complete the table to show **one** function for each part of the brain.

(3)

Part of brain	Function
cerebellum	it controls our balance and posture.
cerebral hemisphere	it give controls out voluntary actions and helps us to see, think, feel emotions.
hypothalamus	it controls our osmoregulation and thermoregulation of the body.

(Total for Question 2 = 7 marks)

Q3b   Many candidates showed a good understanding of the spinal reflex arc. This question could be answered through a labelled diagram. We saw a few of those. Most candidates could express the order correctly receptor-> sensory neurone-> relay neurone->motor neurone-> effector. Few candidates used the term synapses in their response.

(b) Describe the structure of a spinal reflex arc.

(3)

Spinal reflex starts from the receptor organ cell such as cells present on the skin surface. The receptor is connected to a sensory neurone. which travels along the stretch of the body, reaching the spinal cord where the relay neurone is present. Relay neurone forms synapse with the motor neurones, The motor neurone is connect the connected to the effect cell. through a synapse

Q3c This question was generally well answered. Candidates have a good understanding of how the nerve impulse is transmitted across a synapse. Many achieved maximum marks here. The only missing part most frequently was that the neurotransmitter diffuses across the synaptic cleft and binds to receptors on the post synaptic membrane. Many missed the diffusing part so missed mark point 4.

(c) Explain how the nerve impulse is transmitted across a synapse.

(4)

- Arrival of an impulse at the presynaptic knob as causes permeability of presynaptic knob to Ca^{2+} increases as Ca^{2+} channel open
- Ca^{2+} diffuse or enters the synaptic knob down the concentration

causes
- Vesicles containing neurotransmitter fuses to move towards presynaptic membrane, vesicles fuse with presynaptic membrane
- neurotransmitter is released into the synaptic cleft
- neurotransmitter bind to receptors on post synaptic membrane, Na^+ channel open, depolarisation occurs which if exceeds threshold level, action potential triggered in post-synaptic neurone

(c) Explain how the nerve impulse is transmitted across a synapse.

(4)

Calcium channels open and Calcium ion diffuse into the presynaptic knob where more neurotransmitters are packed into vesicles, Calcium ions allows vesicles to fuse with the pre-synaptic membrane, It then released neurotransmitter to synaptic cleft through exocytosis. The neurotransmitter binds with the receptors of post-synaptic knob and Sodium ion from sodium channel open and also allows depolarisation, for an action potential to open.

Q4ai   The majority of candidates were able to accurately state what was meant by the term mutation. Errors including missing out reference to DNA / gene/ allele. There are still candidates referring to a mutation being a change in the sequence of amino acids.

4   Cancers can develop as a result of mutations or epigenetic modifications.

(a) (i) State what is meant by the term **mutation**.

(1)

An unwanted or accidental change in the sequence of bases caused by error.

4   Cancers can develop as a result of mutations or epigenetic modifications.

(a) (i) State what is meant by the term **mutation**.

(1)

It is a random change in the base sequence of the DNA.

Q4aii Almost all candidates could correctly name the type of nuclear division taking place in a tumour. It is regrettable that there are still a very small number of responses that attempt to 'hedge' their answer by using a hybrid of mitosis and meiosis.

(ii) Name the type of nuclear division taking place as a tumour develops.

(1)

Mitosis.

(ii) Name the type of nuclear division taking place as a tumour develops.

(1)

– Mieosis   (Meosis)

Q4c   Candidates struggled with the novel situation presented in this question. Candidates generally understood that the oestrogen would act as a transcription factor, but often answers were too general and not specific to the cancer cell, so they would state that proteins would be made but not link this to cell division. It is clear that many had used previous papers for revision or mocks and relied on general responses to fit the question. Responses must fit the context of the question to achieve high marks.

(c) Oestrogen stimulates some types of breast cancer to proliferate.

Oestrogen is a steroid hormone found in mammals.

Oestrogen affects up to 100 different genes.

Explain how oestrogen may result in the proliferation of some breast cancer cells.

(4)

Oestrogen travels through cell membrane is as steroid is lipid soluble. Oestrogen ent binds to receptor and enters nucleus through nuclear pore. It activates transcription factors by binding to promoter regions in DNA, causing mRNA synthesis of 100 different genes and causing translation of 100 different proteins, including proteins that regulate and activate mitosis and proteins that regulate arrival of glucose to the cell. They may also result in formation of cytokines.

Oestrogen affects up to 100 different genes.

Explain how oestrogen may result in the proliferation of some breast cancer cells.

(4)

- ~~Oestro~~ Oestrogen in the breast cell can move directly into the cell through the cell ~~membrane~~ membrane as it is a steroid hormone
- This then can bind to some receptors and then move into the nucleus through nuclear Pores
- This acts as a transcription factor turning some genes on ~~and some off~~
- Gene that codes for Protien causing cell division is transcribed then translated if it is turned on
- This causes the cell to divide ~~mto~~ uncontrollably and become cancer cells.

This oestrogen acts as transcription factors; for instance, they bind to their complementray receptors in the breast cell's forming horome receptor complex. This detaches from the cell membrane and move to the nucleus. It passes through neuclar envelope to the target gene and bind to it's promotor region. This activates the promotor region and makes the gene switched ON, so RNA polymerase can bind to the gene transcribing it to m RNA which's translated into a protein in the ribosome. This Protein stimulates further mitotic divisions of the cells as it stimulates DNA replication as it'd be enzyme, so the cell divides unlimited number of times like stem cells them genes Also, this hormone is broken down and then the receptor returns to the cell membrane

Q4d   Even though the diagram presented to the candidates in this question was unfamiliar many were able to work out what was happening and how acetylation of histone proteins could lead to increased gene expression.

Suggest how acetylation of histone proteins could result in increased gene expression.

Use the information in the diagram to support your answer.

(2)

acetylation of histones causes the ~~histone~~ ~~by~~ DNA to be loosely wrapped. This exposes the promotor region of the gene, allowing increased gene expression. Exposure of promotor region allows transcription factor to bind to it, ~~causing~~ and transcription takes place.   of the gene.

Suggest how acetylation of histone proteins could result in increased gene expression.

Use the information in the diagram to support your answer.

(2)

during acetylation, the DNA won't be tightly wrapped but they will be losely wrapped ∴ more DNA can be released to be transcribed & more genes can be expressed

when Acetyl groups're negatively Charged when they're added to histone which's Positively Charged, they bind to it and bestins decreases the ionic bonds between histone and DNA; it's negatively charged. So the DNA becomes loosely wrapped and accessible for RNA Polymerase and transcription factors to bind to them Causing transcription Cm DNA and translation of the DNA to Proteins the DNA is switched ON

(Total for Question 4 = 9 marks)

Q5bii The majority of candidates were able to interpret the RQ graph and describe the effect of exercise over a period of time on the RQ. Fewer were able to relate the decrease to a gradual change in respiratory substrate.

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

(2)

As the duration of exercise increases, the respiratory quotient decreases.
When the exercise time increases from 30 to 90 minutes, there is a 4·44% decrease in respiratory quotient.
when the exercise time is short, the substrate broken down for aerobic respiration is carbohydrate.
when the exercise time get longer, fat is broken down to release energy. Hence, the respiratory quotient is smaller.

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

(2)

When fat gets respired, more ATP is formed from a very less amount. ~~So the oxygen?~~ So the carbon dioxide released is more than the oxygen taken in, which in term reduces the respiratory quotient. Fat only gets respired when ~~a~~ carbohydrate is not readily available. Respiration using carbohydrate results in a 1:1 ratio of carbon dioxed released for ₐamount of oxygen taken in. In this case, as the person excercises, his carbohydrate store diminishes, and slowly fat is used to respire. This is shown by the decrease in respiratory quotient.

5ci   Calculations have improved over recent sessions. It is recommended that candidates show their working as even an incorrect response may gain some credit in their working. It is vital that candidates read the stem of the question and do as requested. In this case the answer was required in standard form. A significant number of candidates calculated the total population but did not give the answer in standard form.

Give your answer in standard form.

(2)

$105\,500 + 158600 = 264100$

$7.6\% \times 264100 = 20071.6$

$= 2.00716 \times 10^4$

$= 2.01 \times 10^4$

Answer 2.01×10^4

Give your answer in standard form.

(2)

$$264100 \times 0.076 = 20072 \text{ people.}$$

Answer .... 20072 ....

Give your answer in standard form.

(2)

% of lung cancer = 7.6%.

~~Totale~~ Total male and female in 80year group = 264100

$$\frac{7.6}{100} \times 264100 = 20072$$

$$= 2.0072 \times 10^4$$

Answer 2.0072×10^4

5cii   This question one proved quite challenging. A significant number said that heart rate and ventilation rate would decrease (until the person died). Those who did understand that both would increase also tended to understand that this was to compensate for the lack of oxygen in the blood. However only a few related the reduced surface area of alveoli to diffusion, and the idea that thicker mucus increased diffusion distance was only seen a couple of times. When mucus was mentioned, candidates suggested that it would cause infection or limit oxygen intake with no reference to diffusion.

Deduce the effects on the heart rate and ventilation rate in a person who smokes and has COPD.

(4)

Vasodilation occurs in the ~~bloo~~ lung blood capillaries, so there is increased blood flow, carrying WBC for immune response. ~~Hence heart rate incr~~ ~~Thick mucus blocks airways and smoking dam~~ Smoking damages ~~the~~ alveoli walls, reducing surface area for gaseous exchange, ~~causso~~ less oxygen is absorbed, causing amphysema. Heart rate increases to supply sufficient oxygen to respiring tissues *and remove CO₂*, since ~~oxygen~~ *blood* ~~concentration~~ *PH* is low, which is detected by chemoreceptors ~~thant~~ that send impulses to SAN to increase frequency of wave of depolarisation. Thick mucus blocks airways further reducing oxygen intake. Chemoreceptors in medulla oblongata a detect low blood concentration and send impulses via sympathetic nerve to diaphragm and intercostal muscles, increasing their **(Total for Question 5 = 10 marks)** frequency of contraction, so ventilation rate increases.

(4)

Smoking causes damage to alveoli, so it becomes irregularly shaped, decreasing surface area to volume ratio, so less O_2 can diffuse into the alveoli. Also, production of thick mucus makes it difficult for ciliated cells in airways to remove it away. So, it narrows the lumen of trachea and bronchi reducing surface area and concentration gradient, reducing diffusion rate of O_2. So less O_2 diffuses into blood, less O_2 supply to body cells, less aerobic respiration and anaerobic respiration takes place producing lactate that is transported in liver decreasing pH. This is detected by chemoreceptors in aortic and carotid bodies, to send impulses to CVC center in medulla oblongata, to send impulses via sympathetic nerve releasing noradrenaline to SAN, increasing the frequency of waves of depolarization increasing heartrate, stroke volume and cardiac **(Total for Question 5 = 10 marks)** output, increasing blood supply and more O_2 to repay O_2 debt. Also, chemoreceptors send signals to ventilation center in medulla oblongata, to send nerve impulses via sympathetic nerve to diaphram and intercostal muscles for more frequency of contractions for more rate and depth of breathing, increasing ventilation rate to supply more O_2 to cells.

Q6a   Candidates are becoming more adept at comparing slow and fast twitch muscle fibres. However in this question they were asked to explain the importance of slow twitch muscle fibres in the athletes listed in the table. It was not a direct comparison between slow and fast twitch muscle fibres. Most could describe the general pattern but often failed to explain what the effect of having a larger capillary network or more myoglobin would have on oxygen supply so allowing aerobic respiration.

Explain the importance of slow twitch muscle fibres in these types of athlete.

(3)

- Slow twitch ~~muscles~~ fibres rely on ATP of aerobic respiration,
- So it has more mitochondria to undergo aerobic respiration.
- Slow twitch ~~muscles~~ fibres also have more ~~myot~~ myoglobin to transport oxygen to cells to for respiration.
- Therefore slow twitch fibres is more important for long distance runner (all runners except 100m runner)
- 100 m runner requires muscles to contract quickly, So requires more fast twitch fibres than slow twitch fibres.

Explain the importance of slow twitch muscle fibres in these types of athlete.

(3)

Slow twitch muscle fibres are important to 10000m runners and marathon runners, as the ~~muscle~~ muscle fibres contract slowly, hence it leads to less fatigue, allowing the runners to run for longer.

It is also important as it contains a large amount of mitochondria, hence it can produce more ATP by aerobic respiration. It also contains a lot of myoglobin, hence it can store up oxygen, sufficient. It has a large capillary network, enabling sufficient supply of oxygen and nutrients for respiration and other metabolic functions

Q6ci This calculation of cardiac output did not present any problems. As the units were given in the stem it was not expected to be included in the answer. A few candidates did not change cm³ min $^{-1}$ to dm³ min $^{-1}$

Use the equation:

stroke volume = cardiac output ÷ heart rate

Give your answer in dm³ min^{-1}.

(2)

Cardiac output $= \dfrac{57}{1000} \times 65$

$= 3.705 \ dm^3 \ min^{-1}$

Answer ...3.705 dm³ min^{-1}

Use the equation:

stroke volume = cardiac output ÷ heart rate

Give your answer in dm³ min^{-1}.

(2)

stroke volume $= \dfrac{cardiac\ output}{heart\ rate}$

$\Rightarrow$ cardiac output = stroke volume × heart rate

$= 57\ cm^3 \times 65\ bpm$

$= 3705\ cm^3\ min$

Answer ...3705 cm³

Q6ciii Ratios are a common mathematical skill required in this paper. Candidates were asked to calculate the ratio of body surface area of patient A to B. The majority of responses were accurate. A few calculated the ratio of B to A which did not gain credit.

(iii) State the ratio of the body surface area of patient A to patient B.

(1)

~~1.54 : 2.2~~

1.54 : 2.39

= 1 : 1.55

$\frac{2.39}{1.54}$ = 1.55

Answer 1 : 1.55

(iii) State the ratio of the body surface area of patient A to patient B.

(1)

1.54 : 2.39 = 0.6

Answer 0.64

Q6di Practically every candidate could make an appropriate comment on the effect of running speed on cardiac output and the subsequent decrease after 11mph.

(i) Comment on the effect of running speed on cardiac output.

(2)

As the running speed increases, the cardiac out also increases but up to 11 miles/hour. After 11 miles/hour, the ~~cardiac~~ cardiac output decreases a little bit.

(i) Comment on the effect of running speed on cardiac output.

(2)

As running speed increases, cardiac output increases, upto a speed of 11 mph, after which cardiac output decreases so the max cardiac output possible by them is 5.6 dm³/min

Q6dii The content of this question has appeared in some guise in several recent sessions. Many candidates recognise the increase in carbon dioxide which is sensed by chemoreceptors leading to an increase in innervation from the medulla / cvc. Fewer candidates explained that the SAN depolarises more frequently or that there was an increased rate of heart muscle contraction.

Explain how an increase in the rate of respiration causes an increase in the heart rate of an athlete.

(3) Q06dii   3

A higher rate of respiration means more q is needed and there's more more CO₂ Produced which dissolves in blood and lowers the PH.
This is detected by Chemoreceptors in aortic bodies which spend impulses to CVC in medulla and it respond by sending more impulses to SAN increasing frequencing of waves of depolarisation increasing heart rate

Explain how an increase in the rate of respiration causes an increase in the heart rate of an athlete.

(3)

Increase in rate of respiration produces more CO_2 per second. So concentration of CO_2 in blood is high, which is detected by chemo-receptors in carotid arteries and aorta. The medulla oblongata sends more impulses to the ~~SA~~ SAN. So the SAN produces ~~me~~ wave of depolarisation more frequently, increasing the heart rate.

(ii) Exercise increases the rate of respiration in muscles.

Explain how an increase in the rate of respiration causes an increase in the heart rate of an athlete.

(3)

High blood CO_2 and low pH is detected by chemoreceptons in the medulla oblongata by the cardiovascular system. Impulses are sent along the sympathetic nervous system to the SAN. The SAN acts as a pacemaker. It is stimulated and fires waves of depolarisation more frequently which increases heart rate.

Q6diii This question was done quite well with majority of candidates describing the conversion of lactic acid to pyruvate/ glucose which would then be used in link reaction / Krebs cycle/ aerobic respiration. Many missed the idea of the lactic acid being transported to the liver.

(iii) Anaerobic respiration produces lactate.

Describe what happens to this lactate.

(2)

Lactate will transfer to the liver and convert back to pyruvate so pyruvate can go to mitochondria for link reaction.

(iii) Anaerobic respiration produces lactate.

Describe what happens to this lactate.

(2)

The lactate is brought to liver, where it is oxidired to pyruvates to be used in aerobic respiration, Krebs cycle, of liver cells.

Q7ai   Candidates generally understood that increased sucrose led to increased dopamine and were able to comment on the overlapping error bars and their impact on validity but very few commented on the methodology. There were no comments seen stating that the results show a correlation but not necessarily a causation.

(i) Comment on the results shown in the bar chart and how they support this conclusion.

(4)

as Concontration of sucrose increase the Dopamine Percentage increase so the desire of rats to eat increase. However, the results are not reliable because error bars overlap and error bars are very large. number of repetitions are not Known. other variables are not Controlled like age and gender of rats So results are not valid. Sample size is not Known.

(i) Comment on the results shown in the bar chart and how they support this conclusion.

(4)

The more Concentration of Sucrose, the higher dopamine percentage increase.
Dopamine lead to more desire of the rats to eat,
Can be Concluded because there is a positive correlation. The result may not be valid as the error bar overlap.
More samples of different concentration of Sucrose should be added in the investigate for more valid results, as there are only 3 of them.

Q7aii This calculation proved to be a challenge to several candidates even though they had been given the equation for standard deviation. Many did not calculate the 58 row and as a results got the total wrong. The biggest error was not giving the answer to 2 significant figures as requested.

result (x)	$x - \bar{x}$	$(x - \bar{x})^2$
45	−15	225
63	3	9
74	14	196
58	−2	4
	$\sum(x - \bar{x})^2 =$	434
	$n - 1 =$	3
	$S =$	12.00

$$S = \sqrt{\frac{434}{3}}$$

Give your answer to two significant figures.

(2)

result (x)	$x - \bar{x}$	$(x - \bar{x})^2$
45	−15	225
63	3	9
74	14	196
58	− 2	4
	$\sum(x - \bar{x})^2 =$	434
	$n - 1 =$	3
	$S =$	12.03

$$S = \sqrt{\frac{434}{3}}$$

Q7b   Most candidates could describe at least two effects of adrenaline. Very few candidates stated that the adrenaline was released into blood from the adrenal glands or that it binds to receptors on target organs.

(b) When humans are in danger or under stress they respond by activating the 'fight or flight' response.

Describe the role of adrenaline in the fight or flight response.

(3)

The adrenaline binds to specific receptors receptors on the heart and increases the heart rate so that more blood is transferred transferred, to muscle cells. Blood is diverted away from parts which are relatively less important and transported to the muscles. The pupils become dilated give increasing sensitivity of the eye.

(b) When humans are in danger or under stress they respond by activating the 'fight or flight' response.

Describe the role of adrenaline in the fight or flight response.

(3)

Adrenaline is released into the blood, it causes pupil dilation, increased heart rate, increased ventillation rate. had contric These changes make the person more capable of carrying out responses appropriate to their situation which often include vigorous movement and the need for increased concentration. It is released by adrenal gland.

Q7c   Although candidates did use the information given (including the graph, which was positive to see), there was a general lack of detailed explanation in many of the answers which made it difficult for candidates to access level 3. Most e marks were given for a fairly basic explanation of the role of insulin and glucagon. There was often confusion about glucagon/glycogen. Comments about diabetes were not seen. Many candidates struggled with a relevant comment about negative feedback linking a correct description of reducing {insulin/glucagon} secretion once blood glucose levels have returned to normal / decreased stimulation of pancreas by nerves.

Discuss how negative feedback is involved in the control of blood glucose concentrations.

Use the information in the diagram and the graphs to support your answer.

(6)

At 8 am when a the person has a meal the blood glucose concentration rises this is the chemoreceptors in the pancreas detects the high blood sugar and promots insulin release this causes stimulates glucose uptake from blood and is stimulaty glycogen formation. the Then the chemoreceptors in the liver detects This lowers the blood glucose concentration. The fall in blood glucose concentration is detected by chemoreceptors in the liver and impulses are sent to the pancreas to stop the production of insulin via a negative feedback loop loop. The liver then stimulates glycogen breakdown to raise blood sugar levels again this process continues at all meal times and during respiration to control blood glucose level.

Discuss how negative feedback is involved in the control of blood glucose concentrations.

Use the information in the diagram and the graphs to support your answer.

(6)

Negative feedback is a mechanism that change a value away from set (normal) range to ~~to~~ the value within the normal range. After each meal (9am, noon and 5pm), the sugar inside the blood increases (due to carbohydrate in the meal), stimulates the release of insulin and inhibits release of glucagon, so insulin travels from β-cells in pancreas though blood to the liver to stimulate the ~~hydrolysis~~ conservation of ~~glucose~~ glucose into glycogen forming glycosidic bonds, which decreases the glucose level. The insulin also travels to the tissue cells and bind to their receptors, to increase uptake of glucose from blood, and increase respiration. The blood glucose ~~level~~ concentration after meal 1 is increased by 20 mg lower³ then decreases – due to homeostasis – by 10 mg lower³, and insulin increases by 33 units cm⁻³ after meal 1 then decreases by 20 units cm⁻³, while glucagon concentration fluctuates. ~~the~~ After the meal by some time, the (glucose) sugar blood level decreases, stimulating the release of glucagon and inhibits release of insulin, and glucagon travels to the liver to stimulate hydrolysis of glycogen to the glucose by breaking 1,4 and 1,6 glycosidic bonds, increasing glucose level in blood. The highest increase of insulin is after meal 1. Meal 3 contains most carbohydrates as it causes largest increase of blood glucose concentration. After Meal 3 by 3 hours, the insulin concentration decreases by 30 units cm⁻³ from 8pm to 8am.

(Total for Question 7 = 15 marks)

Q8a   Clearly some candidates have done more work on the article than others. It does account for 22% of the total paper mark and expands on the specification. Here candidates needed to suggest why there is a relationship between the ageing process and neurodegeneration. Several candidates linked the idea to an increase / accumulation of ROS and damage to mitochondria. This was also linked to damage to neurones and reduced nerve depolarisation. Seldom was it linked to a named change in brain chemistry.

(a) Suggest why there is a relationship between the ageing process and neurodegeneration (paragraphs 1 and 2).

(3)

Aging is progressive time related accumulation of changes responsible for or atleast involved in increased susceptibility to disease and death. As brain is sensitive to aging process. By increasing age, mitochondria will be damaged due to the presence of excess Ros produced by oxidative phosphory Ros cause oxidative stress and may cause damage to neurones. Also when mitochondria is damaged aerobic respiration decrease so less ATP is present causing. Therefore by increasing age, the risk of neurodegeneration in c...

(a) Suggest why there is a relationship between the ageing process and neurodegeneration (paragraphs 1 and 2).

(3)

As time progresses, due to release of reactive oxygen species and free radicals as by-product of oxidative phusphorylation, these are free radicals damage the neurones increasing the gap between synapses, and inactivating some of the neurones. Dopaminergic neurones are also damaged so less dopamine is produced. This leads to neurodegenerative disease such as called Parkinson's diseases.

Q8b   There was a wide variety of responses here. Some candidates gave detailed responses about Krebs cycle while others gave a detailed account of oxidative phosphorylation. Often there was a confusion between inner membrane / intermembrane and intermembrane space.

(b) Describe how energy released from glucose is used in oxidative phosphorylation (paragraph 2).

(3)

In oxidative phosphrorylation, energy from glucose is used to pump H^+ ions in the intermembrane space. H^+ ions move through ATPsynthetase through active transport, which requires energy released from glucose to produce ATP.

(b) Describe how energy released from glucose is used in oxidative phosphorylation (paragraph 2).

(3)

Oxidative phosphorylation is the oxygen dependent reactions taking place in the electron transport chain. With the help of glucose, energy from the reduced NAD passes its ~~ete~~ H^+ ions to the pump where the pump gets reduced and takes up the H^+ ions in the intermembrane space. H^+ ions ~~passes~~ pass through the ATP synthetase where ADP combined with inorganic phosphate is produced. The electrons, H^+ ions combine with oxygen to produce water for the oxidative phosphorylation.

Q8c   Many candidates simply quoted from the article and it was clear that they didn't really understand the material. There was an obvious difficulty throughout q8 with linking the information given about ROS to what they know about the role and function of genes and what happens when they go wrong. Mp1 and 4 were not seen.

(c) Explain how free radicals (reactive oxygen species, ROS) can cause damage to mitochondrial DNA (paragraphs 2 and 4).

(3)

They can break phosphodiester bonds in DNA than strands, hydrg & hydrogen bonds between complementary bases (separating the strands), or cause mutation by changing the number or sequence of bases in the DNA.

(c) Explain how free radicals (reactive oxygen species, ROS) can cause damage to mitochondrial DNA (paragraphs 2 and 4).

(3)

ROS attack the nucleotide chains in mtDNA, breaking the hydrogen bonds between DNA bases and breaking phosphodiester bonds between individual nucleotides, leading to DNA mutations. These effects occure more easily as mtDNA is located next to the site of production of ROS.

Q8d   Some candidates understood that stem cells were the starting point, and that some genes would be switched on. However very few linked this to brain cells for mp5. Too often general knowledge of differential gene expression was not linked to the context of the question or the article.

(d) "The brain is a remarkable organ composed by highly differentiated cells… with different morphology, according to their role and their localization" (paragraph 6).

Describe how this differentiation can occur.

(3)

cell diffentiation occurs due to epigenetic modifications, where the stem · cells Can be differenciated into brain cells by DNA methylation and histone modifications where some genes can be Switched off and some genes can will be turned on by that the cells can be differenciated.

Describe how this differentiation can occur.

(3)

Certain transcription factors activate in the cells located in the brain. These transcription factors bind to certain promoter regions in DNA of these cells, switching on genes involved in synthesis of proteins like Na^+/K^+ pump, which are involved in brain function. Any other gene is switched off. Active genes are transcribed to produce mRNA molecules that are then translated in ribosomes into proteins like Na^+/K^+ pumps. This allows formation of a structure of a neurone, and the function of a neurone. For example; Na^+/K^+ pump forms in cell surface membrane. It actively pumps K^+ ions inside the "cell" and Na^+ ions outside the "cell".

Q8e Many candidates could infer that proteome linked to proteins. However many confused the term with genome. A few stated that it referred to a protein in the mitochondria rather than proteins.

(e) Explain what is meant by the phrase 'mitochondrial proteome' (paragraph 7).

(2)

mito chondrial proteome is the whole set of different proteins found in a mito mito chondria

(2) Q08e   2

Different and distinct proteins that're only found and Produced in mitochondria

Q8f Candidates struggled to explain why synaptic mitochondria were more susceptible to ageing than mitochondria found in other parts of the neurone. Some inferred it was related to energy requirements or rate of respiration. A few linked this to a greater accumulation of ROS.

(f) Explain why synaptic mitochondria are more susceptible to ageing than the mitochondria found in other parts of a neurone (paragraph 9).

(2)

Because synaptic mitochondria has to undergo more oxidative phosphorylation to produce more ATP for influx of Ca^{2+}, fuse of vesicles to release neurotransmitter to synapses (exocytosis), so that more free radicals are produced, and create oxidative stress.

(f) Explain why synaptic mitochondria are more susceptible to ageing than the mitochondria found in other parts of a neurone (paragraph 9).

(2)

Synaptic mitochondria requires more energy for synaptic activity thus more ATP is produced and the release of ROS increases

As synaptic mitochondria're more active
than other of cells due to higher ATP
requirement in the synapse (like release
of neurotransmitter and reformation). Thus,
they produce more ROS which damages
the mitochondria itself, leading to ageing.

Q8g   Very few candidates suggested that mtDNA had genes for mitochondrial function which coded for proteins. A few suggested that the proteins produced had a named specific role in oxidative phosphorylation.

As it codes for mitochondrial proteins
that're needed in oxidative phosphorylation
and ATP synthesis
      like ATP synthase and electron carriers
      (it transcribed and translated to
      them)

(h) Suggest how damaged mitochondria are removed by autophagy (paragraph 11)

(g) Explain why the mitochondrial genome is essential for oxidative phosphorylation (paragraph 10).

(2)

As   mitochondrial   genome   contains   gene   that
code for proteins such as   ATPase   and   ETC for
oxidative   phosphorylagtion

(g) Explain why the mitochondrial genome is essential for oxidative phosphorylation (paragraph 10).

(2)

Mitochondrial genome contains all the genes coding for mitochondrial protein like- elee proteins of electron transport chain and ATP synthase. These proteins are needed in oxidative phosphorylation. ETC is needed to receive and release electron and ATP synthase is needed to form ATP.

Q8h   A real mixed bag here – several candidates tried to explain autophagy which was given in the stem. A few used the term mitophagy which was in the article and gained credit. Many suggested the action was linked to whole cell processes like phagocytosis and the formation of phagosomes. However many gained credit for stating enzymic digestion using hydrolytic enzymes.

(2) Q08h   2

There're hydrolytic enzymes that released by lyososmes (not endocytosis) as lysosomes fuses with damaged mitochondria. Then cell membrane. Then, the enzymes breakdown the mitochondrial structures like crista and Protiens

(Total for Question 8 = 20 marks) Q08_Total   12

TOTAL FOR PAPER = 90 MARKS

(h) Suggest how damaged mitochondria are removed by 'autophagy' (paragraph 11).

(2)

the damaged mitochondria are engulfed by phagocytes they are enclosed in a vesicles which fuses with lysozome. the lysozome lysozome produces lysozymes that breaks down the damaged mitochondria. the damaged mitochondria is are engulfed and digested in by phagocytes in a process of autophagy.

(Total for Question 8 = 20 marks)

TOTAL FOR PAPER = 90 MARKS

(h) Suggest how damaged mitochondria are removed by 'autophagy' (paragraph 11).

(2)

after the of mitochondria is split into 2 other mitochondrias, the damaged mitochondria undergoes autophagy (mitophagy) where a vesicle forms around it called autophagosome containing it in it, then a lysosome with hydrolytic enzymes will fuse with the autophagosome and release the hydrolytic enzymes on the damaged mitochondria hydrolysing all of its structures

SUMMARY
A few suggestions for improving candidate performance are given below.
- candidates need to have time study the article.
- candidates need to refer to the command word used in the question and focus their answer in an appropriate manner. Appendix 7 in the specification lists all the command words and their meaning. This is particularly true for explain, describe, deduce, and comment on as command words.
- in graphs candidates need to check the labelling of the axes and scales.
- in level-based question the diagrams and graphs need to be used as well as relevant knowledge and understanding.
- in calculations it is better to show the workings as well as an answer as if the answer is incorrect candidates may gain some credit for correct working. Care needs to be taken in the interconversion of units – e.g. cm^3 to dm^3, and mm to µm.
- also in calculations care needs to be taken to ensure that the answer is in the required format e.g. two significant figures, standard form and the number of decimal places.
- Candidates must ensure that their responses are legible. There was a clear increase in very tiny writing.
- If a candidate puts part of an answer in a place somewhere else on the paper it is vital that the candidate indicates this.
- Many suggest questions refer to novel situations. Candidates need to use knowledge from the specification and apply it to this situation in specific terms rather than in generalisations.