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Examiners' Report
June 2019

GCE Biology 9BI0 03

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Introduction

It was pleasing to note that candidates continue to show signs of improved understanding of the mark schemes and new command words. The mathematical questions continue to pose difficulties for some candidates and this is an area that needs to be practised.

This paper contains all the questions directed at practical skills, either describing elements of a practical or devising or modifying an investigation. This paper also contains some higher demand command words such as 'discuss' and 'justify' and it is clear that some candidates find the interpretation of these command words a challenge. The more able candidates demonstrate that they can address the following: analyse unfamiliar information or data; perform well with mathematical skills; explain an answer clearly and with the requisite detail; understand the reasons for using certain practical techniques; suggest modifications to practical procedures and explain them and devise a practical procedure themselves, even when the context is unfamiliar. Less able candidates tend to rely more on their revision to enable them to answer and find 'describe' questions easier to deal with. They tend to find A01 questions more straightforward than the other two assessment objectives, A02 and A03. There were fewer gaps in their papers than in past years suggesting that the questions were more accessible.

The assessment of the new A levels places less emphasis on recall and rote learning and it would help candidates if the teaching reflected this change. Candidates need to be comfortable in applying biological principles they learn from the specification to novel situations and unfamiliar data. The more practice candidates get during their course the better prospect they will have of success in the examination. Candidates would benefit from spending more time on past papers, the specimen papers and the Sample Assessment Materials in order to appreciate what is required in this new specification.

There is evidence to suggest that the demand of the long level-based question is better understood and almost all candidates were able to make an attempt at an answer. Compared to the previous specification, the new A levels have greater emphasis on the assessment of analytical skills which some may find more difficult. On the positive side, there were few signs of time pressure as the more challenging questions were attempted by most candidates, and it was clear that some very able candidates were entered for this assessment. These candidates tended to have few problems with analysing unfamiliar information, were good at mathematics and understood what was required by the command words.

They were also familiar with the practical skills and techniques used in the core practicals from the specification. The emphasis of the 9BI0_03 paper is to examine knowledge and understanding of practical work. The core practicals within the specification provide a guide to the level of understanding required, but they are not the only source of material used in the examination.

The questions in this paper test the indirect practical skills as outlined in the specification, as well as theory throughout the specification. Question analysis shows that practical questions are not done as well as the other questions. It is essential that candidates do not follow the practical worksheets 'recipe style' and instead are encouraged to think about the reasons for certain techniques and the principles of the scientific method. Any opportunities for investigative work are to be encouraged as this will assist with tackling the A03 (ii) questions that are unique to this paper. The examiners sense that candidates do not have sound knowledge of all the core practicals. It is also apparent that many candidates are capable of recalling the 'recipes' of the core practicals but struggle to justify why certain procedures are carried out. These candidates would benefit from being made to think about what they do rather than simply following instructions.

Question 1 (a)

This question was a gentle introduction to the paper. Most candidates were able to make reference to an acceptable 8:2 ratio in order to gain the mark. A common error was to add 0.2 dm3 of water to 1.0 dm3 of sucrose solution.

1 A student investigated the water potential of potato cells.

The student used this method.

- six potato cubes of the same shape and size were cut from the same potato
- each cube was weighed
- each cube was then placed into a different concentration of sucrose solution
- each cube was removed from the sucrose solution after one hour
- each cube was then reweighed and the percentage change in mass was calculated

The table below shows the results of the investigation.

Concentration of sucrose solution / mol dm^{-3}	Percentage change in mass (%)
0.0	+18.0
0.2	+5.0
0.4	−8.0
0.6	−16.0
0.8	−23.5
1.0	−24.0

(a) The student was given a 1.0 mol dm^{-3} sucrose solution.

State how the student used this solution to make a 0.8 mol dm^{-3} sucrose solution.

(1)

Get ~~10cm3~~ 1cm3 of ~~sucrose sols~~ 1.0moldm-3 of sucrose solution then add ~~10cm3~~ 9cm3 of ~~dilute~~ deionized water.

ResultsPlus
Examiner Comments

This is an example of an answer that gained no mark.

By water By diluting the solution solution using 0.2 mol dm^{-3} of deionised water.

ResultsPlus Examiner Comments

This answer provides insufficient detail and is incorrect.

Add 8 dm^3 of the 1.0 mol dm^{-3} sucrose solution to 2 dm^3 of distilled water to make 10 dm^3 of 0.8 mol dm^{-3} sucrose solution

ResultsPlus Examiner Comments

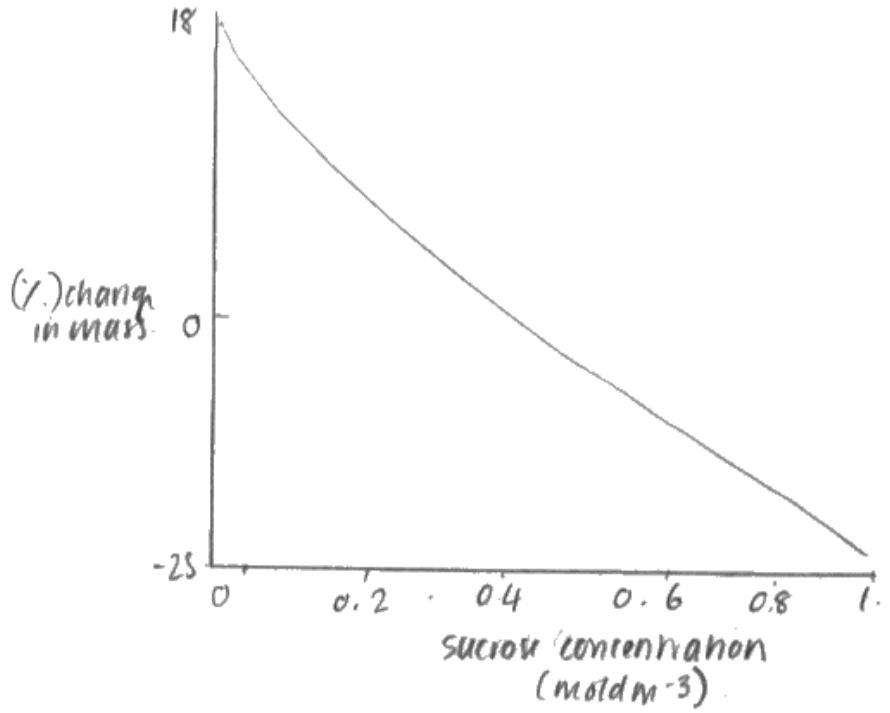
This answer gave the correct detail to be awarded one mark.

Question 1 (b)

This question posed difficulty for candidates. Core practical 6 asks candidates to determine the water potential of plant cells, so the task should have been straightforward. However, many failed to orientate the axes correctly, or to label them with acceptable detail.

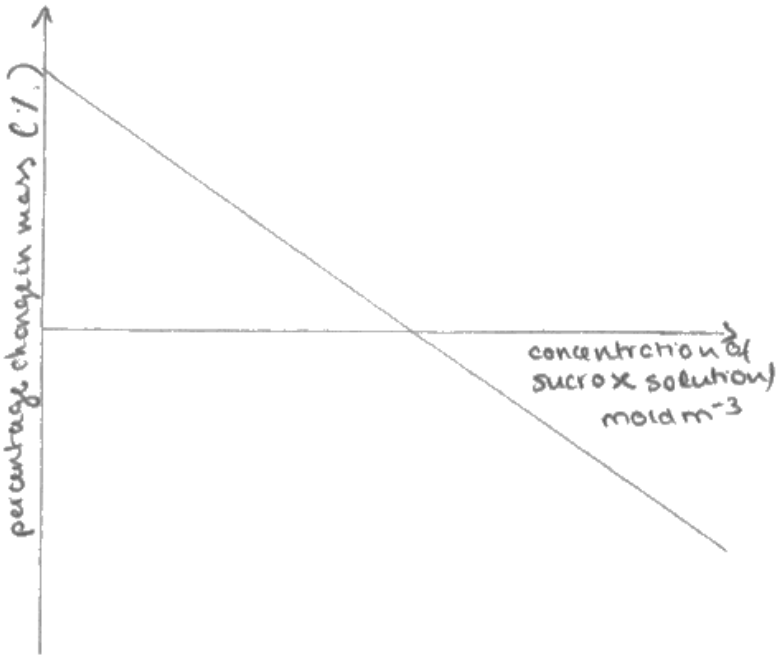
(b) Sketch a graph you could use to identify the water potential of potato cells.

(2)



ResultsPlus
Examiner Comments

This attempt gained both marks because the axes are labelled with sufficient detail and the trend line can be seen to cross zero on the y axis.



ResultsPlus
Examiner Comments

In this attempt, both marks were given because the axes are correctly labelled and the trend line crosses the x axis.

Question 1 (c)

This question challenged candidates to justify improvements to the method that would help produce more of an accurate value of the water potential of the potato cells. The command word 'justify' means that answers had to state modifications and give a reason why each modification would help. Therefore, an answer that stated the need to control temperature would not be credited, but an answer that stated the need to control temperature because it affects the rate of osmosis would be credited.

(c) The method used by the student could be improved to obtain a more accurate value for the water potential of these potato cells.

Justify **three** improvements that could be made.

(3)

* dry cubes of potato after being cut up to remove excess water (released from damaged cells)

* keep all sucrose concentrations at same temperature

* any potato after removing it from sucrose ~~concentrations~~ solutions to remove excess solution.

ResultsPlus
Examiner Comments

This candidate gets one mark for drying the solution from the cubes. The answer mentions control of temperature but does not provide any justification.

They could control temperature by placing the beakers of sucrose solutions in a thermostatically controlled water bath so every solution is at the same temperature. This is because temperature affects the rate of osmosis (higher temperatures means more osmosis). Also, being being reweighed, the cubes should be blotted dry with tissue to remove excess water on the potato surface as this affects the validity of the results. Change in mass should only be due to water on the inside of the potato. The volume of the different sucrose solutions should also be kept constant so that every potato cube is fully submerged in the solution for the whole experiment as this means the surface area of potato exposed to the solution for osmosis is kept constant for every cube (affects rate of osmosis).

ResultsPlus
Examiner Comments

This answer gained full marks by providing an acceptable justification for each acceptable improvement.

· dab potato cubes ~~before and~~ with paper towel before weighing and reweighing to get rid of excess solution.

· ~~Repeats~~ put more than one cube into each solution, so that anomalies can be spotted and a mean (not including anomalies) can be calculated.

· Use more concentrations, with smaller intervals, so that the graph is more accurate and therefore a more accurate water potential can be identified.

ResultsPlus
Examiner Comments

This answer gained full marks because each acceptable improvement was also justified by providing an acceptable reason.

Question 2 (a) (i)

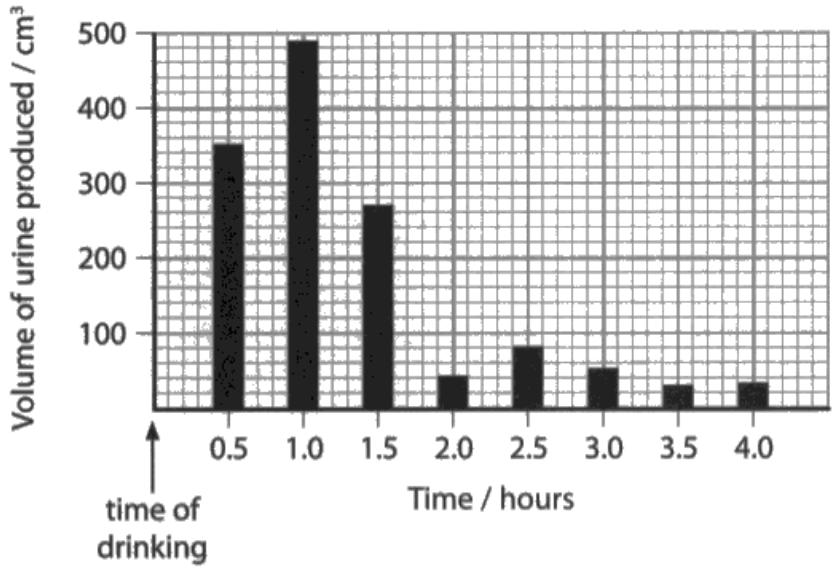
This question challenged candidates to determine the total volume of urine produced during the first two hours. An answer within the range of 1146 to 1150 gained the mark.

2 Negative feedback control of blood plasma concentration is an example of homeostasis.

A student investigated the effect of drinking water on the volume of urine produced.

The student drank one dm^3 of water and waited for half an hour. The student then collected the urine produced every 30 minutes for four hours.

The graph shows the results of this investigation.



(a) (i) Determine the total volume of urine produced during the first two hours.

(1)

40
270
490
350 +
1150

Answer 1150 cm^3

ResultsPlus
Examiner Comments

This answer gained the mark.

Answer 40 cm^3

ResultsPlus
Examiner Comments

This answer is incorrect and was not given the mark.

Question 2 (a) (ii)

This question discriminated very well. Some candidates failed to read the question carefully and simply wrote a story about the general role of negative feedback in homeostasis. Some candidates wasted valuable time by discussing the role of ADH in the reabsorption of water. Those who understood the question scored highly by referring to how dilute plasma is detected by osmoreceptors resulting in less ADH secretion from the pituitary making the collecting duct less permeable so there is less reabsorption of water. Many candidates wrongly believe that chemoreceptors are involved in detection of water potential.

(ii) Explain the role of negative feedback in the control of blood plasma concentration during the first hour after drinking water.

(4)

Over the first hour, more of the water drunk enters the blood stream, effectively diluting the plasma. Negative feedback is when a change is detected (e.g. fall in plasma concentration) and then the subsequent response counteracts and opposes this change, in this case, less ADH is released by the pituitary gland when the hypothalamus osmoregulatory centre detects conc. change and affects collecting duct & distal convoluted tubule cells in the kidney, meaning less H_2O is reabsorbed back into the bloodstream and is instead excreted as urine, meaning that plasma conc. returns to normal.

ResultsPlus
Examiner Comments

This is an example of a good answer which gained full marks. The account is clear and erudite, and makes correct reference to all the marking points except the permeability of the collecting ducts. Stating that they are affected lacks the detail required.

Hypothalamus detects change. Pituitary gland releases less ADH so collecting duct more permeable to water so urine less concentrated and more dilute. More blood plasma selectively reabsorbed. Osmosis occurs so water moves into collecting duct.

ResultsPlus
Examiner Comments

This answer gained two marks for mentioning the hypothalamus and that less ADH is released from the pituitary gland. The candidate is confused about the effect on the permeability of the collecting duct.

ResultsPlus
Examiner Tip

Read questions carefully and do not waste time writing about points that are irrelevant.

Question 2 (b)

This question challenged candidates to appreciate that less urine would be produced during the first four hours and at other times. The examiners accepted a line or bars below 100 cm^3 at each time.

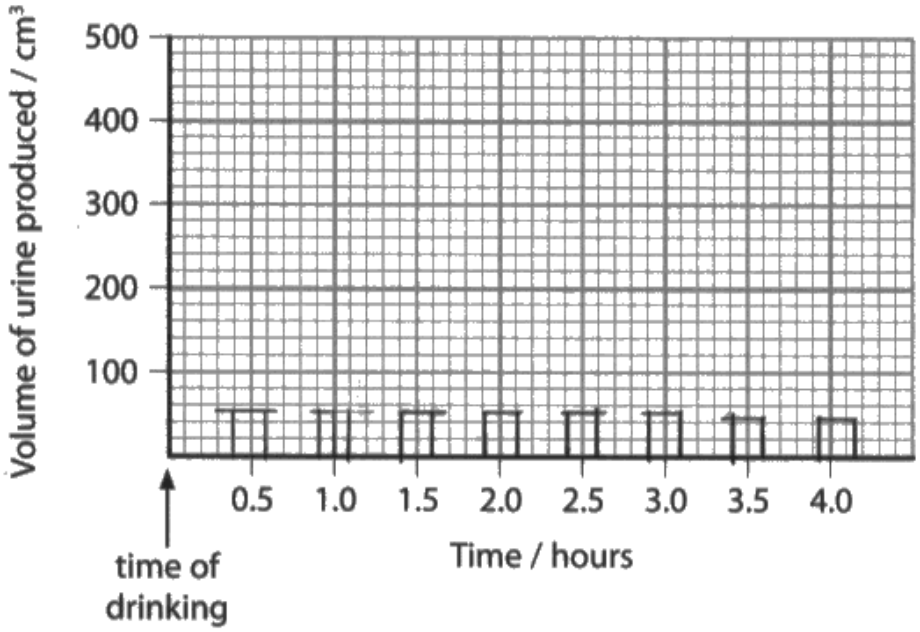
This question challenged candidates to consider the change in urine production that would occur if salt solution of the same water potential as blood plasma had been imbibed. The examiners credited answers that showed the level of urine production below 100 cm^3 at each time interval. A line, or bars, was accepted.

(b) The next day the student drank one dm^3 of dilute salt solution with the same water potential as blood plasma.

The student waited half an hour and collected the urine produced every 30 minutes for four hours.

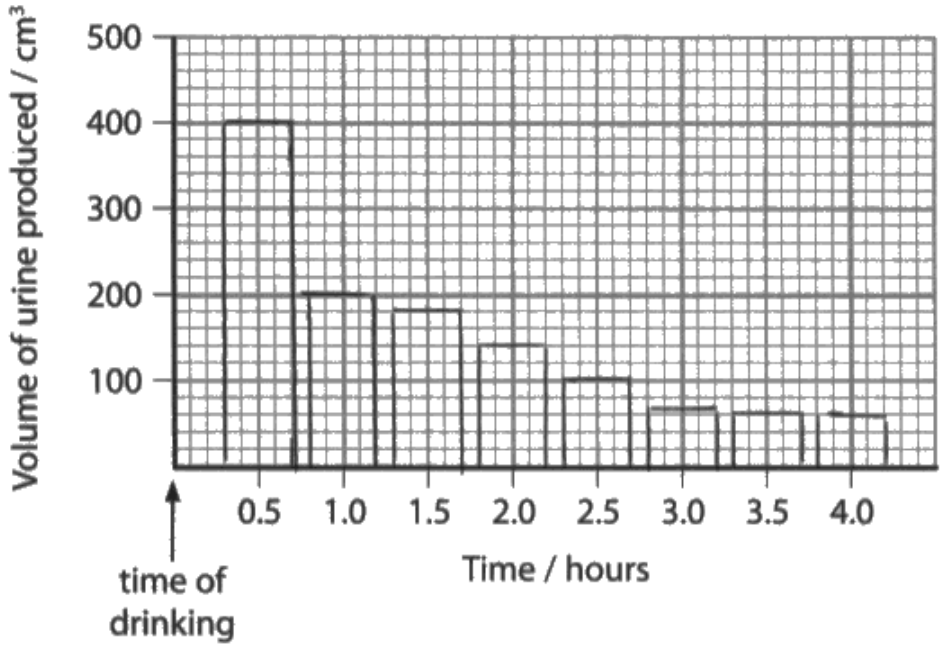
Sketch a graph to predict the results.

(1)



ResultsPlus
Examiner Comments

This answer fulfils the requirement in the mark scheme, so gained one mark.



ResultsPlus
Examiner Comments

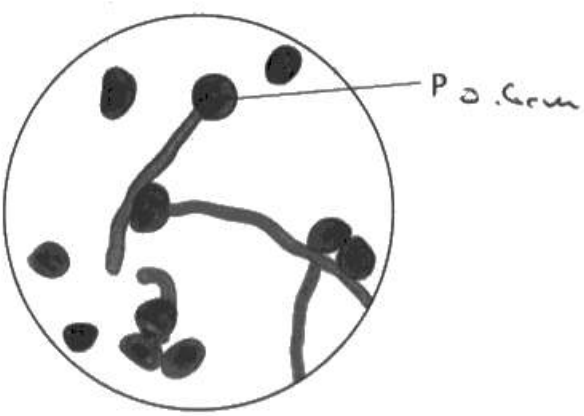
This answer shows bars above 100 so was not given a mark.

Question 3 (a)

This question anticipated that candidates would be familiar with core practical 4 which is an investigation of the effect of sucrose concentration on pollen tube growth and germination. The examiners saw many answers that indicated that candidates seemed unfamiliar with this core practical. To gain full marks candidates were expected to state that the pollen grains needed to be put on a microscope slide in sucrose solution, or an equivalent solution, and then to use the low power lens first when observing the slide. This latter point was often omitted from answers.

3 A student used a light microscope to determine the mean percentage germination of pollen grains.

The photograph shows one high power field of view observed by the student.



(a) The student used a paintbrush to obtain pollen grains from a flower.

Describe the steps taken by the student to see these pollen grains using a microscope.

(3)

- First find pollen grain on low power then focus
- Next find pollen grain on medium power then focus
- Last find pollen grain on high power then fine focus to get a clear image.

ResultsPlus
Examiner Comments

This answer gains one mark for reference to use of the low power lens but offers no detail about the use of a microscope slide and sucrose solution.

The student would get these pollen grains and place them onto a microscopic slide. ~~The student would then paint them forth as little stems as~~ He would then place a drop of water on top before placing a coverslip on top to reduce friction. Only a few pollen grains should be on the slide, ~~and also~~ Excess water would then be absorbed by putting the slide with paper towel and the slide would then be ready. The student would firstly use low power field of view to find the pollen grains, focus this and the ~~repeat~~ the steps with medium and then high power field of view.

ResultsPlus
Examiner Comments

This is a good answer that gains full marks. Water was accepted as a suitable liquid.

- Brush the paint brush onto a slide.
- Stain the pollen tubes
- place the coverslip over the pollen tubes
- place the slide on the stage and clip it down
- switch on the light and focus the eyepiece

ResultsPlus
Examiner Comments

This answer only mentions the use of a microscope slide, so was only awarded one mark.

Question 3 (b)

This question challenged candidates to calculate the magnification of a designated pollen grain. This involved converting 6mm into 6000 micrometres and dividing it by 30 to get an answer of x 200. If the answer given was incorrect, one mark was available for seeing an attempt to divide by 30 in the working.

(b) The actual diameter of pollen grain P is 30 μm.

Calculate the magnification of pollen grain P.

(2)

A1 M1 0·6 cm x 10 000 = 6000 μm

$\frac{6000}{30}$ = 200 x magnification

Answer 200 x

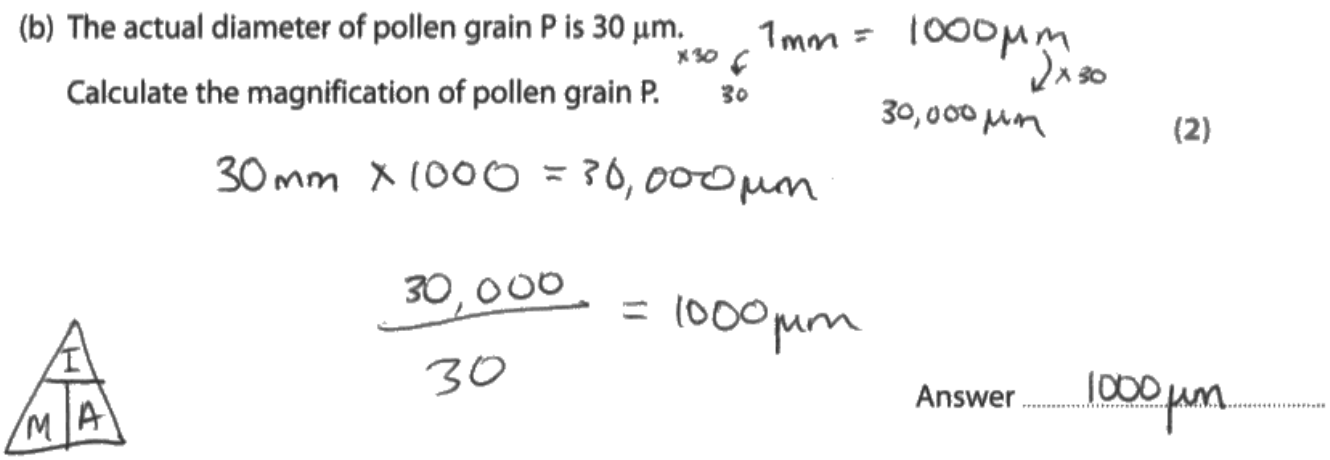
ResultsPlus
Examiner Comments

This answer gained full marks for the correct answer and only shows clear working of how it was calculated.

This question challenged many candidates. The correct answer of x200 was given two marks but, if this correct answer was not given, one mark was available for seeing any number divided by 30 in the working.

(b) The actual diameter of pollen grain P is 30 µm.

Calculate the magnification of pollen grain P. (2)



ResultsPlus
Examiner Comments

This example only gained one mark because the answer is incorrect; however the candidate shows in the working that they need to divide by 30.

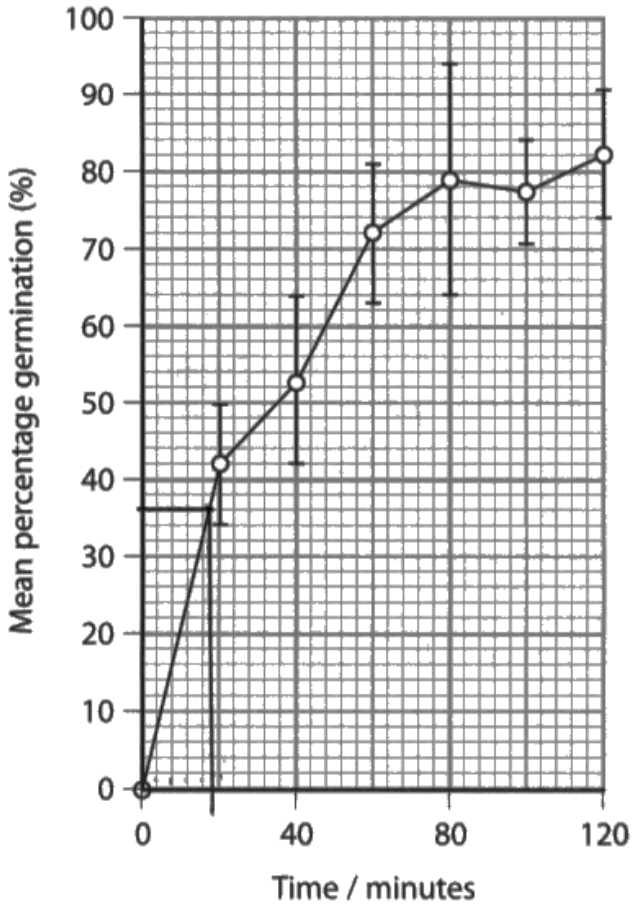
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Examiner Tip

Always show your working as marks are always available should your actual answer be wrong.

Question 3 (c) (i)

Most candidates appreciated that the standard deviation bars indicate the spread of data around the mean, although some struggled to express this in an acceptable manner. The more able candidates also gained the second mark by mentioning that the degree of overlap allows for an indication of significant difference.

(c) The graph shows the results of the investigation.



(i) Explain why the student plotted standard deviation bars on the graph.

(2)

To see the range of data from each time and
To see if the standard deviation overlap as this
affects reliability of data.

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Examiner Comments

This answer gained no marks because it only mentions range of data with no reference to mean and the mention of overlap is not linked to significance.

To compare how much each figure deviates from the mean. To form error bars & see if it overlaps. Compare between each data to increase reliability and validity.

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Examiner Comments

This answer gains one mark for mentioning the idea of spread around the mean, however the mention of overlap is not linked to significance.

It shows the spread of results around the mean to see how repeatable the data is. The greater the bars, the less accurate the mean is. The bars can also be used to see if there is significant difference between mean % at different times, i.e. if they overlap, the difference is not significant. They can also be used to carry out a stats test such as spearmans rank test.

ResultsPlus
Examiner Comments

This is a good answer in which both ideas are clearly expressed.

Question 3 (c) (ii)

This question challenged candidates to calculate the percentage of pollen grains germinating in the field of view and to use this value to determine the time from the graph. The mark scheme allowed for 36.36 or 36 or 36.4 as correct percentages with a range of times between 16 to 18 minutes.

A surprising number of candidates counted three pollen grains germinating rather than four which gave a range of times between 12 to 14 minutes. If this answer was seen, one mark was given providing that the working showed 3 grains being divided by 11.

(ii) Determine the time when the photograph was taken.

(2)

$\frac{3}{11} \times 100 = 27.\dot{2}7\%$

Answer 14 minutes

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Examiner Comments

This shows an example of an incorrect answer where one mark was allowed because the time given is within the range 12 to 14 minutes and the working shows 3 divided by 11.

ResultsPlus
Examiner Tip

Always show your working in calculation questions.

(ii) Determine the time when the photograph was taken.

(2)

4 out of 11

4/11 x 100 % = 36.36 %

Answer 20 minutes

ResultsPlus
Examiner Comments

This shows an incorrect answer but gains one mark for 36.

36 seen in the working.

4 out of 11 $\frac{4}{11}$ = 36% = 17mins

Answer 17 minutes

ResultsPlus
Examiner Comments

This shows an answer within the range 16 to 18 minutes, so gains full marks.

Question 4 (a) (i)

Candidates were expected to recall that an action spectrum shows the rate of photosynthesis at different wavelengths of light and that an absorption spectrum shows the absorption of light of different wavelengths.

4 Plant pigments are involved in photosynthesis.

The action spectrum of chloroplasts and the absorption spectrum of the pigments can be determined.

(a) (i) State the difference between an action spectrum and an absorption spectrum.

(1)

the action spectrum shows how much energy the pigment supplys the plant the absorbtion spectrum shows how much pigment is absorbed by the plant

ResultsPlus
Examiner Comments

This answer lacks the level of detail required and was given no marks.

4 Plant pigments are involved in photosynthesis.

The action spectrum of chloroplasts and the absorption spectrum of the pigments can be determined.

(a) (i) State the difference between an action spectrum and an absorption spectrum.

(1)

actionspectrum is the amount/rate of photosynthesis that occurs at a specific wavelength of light however absorption spectra is the amount of light absorbed at a specific wavelength of light

ResultsPlus
Examiner Comments

This answer provides the correct level of detail and was awarded the mark.

Question 4 (a) (ii)

This question challenged candidates to understand the reason why an action spectrum and an absorption spectrum show that chlorophyll is used in photosynthesis as their graphs follow a similar pattern. Many candidates found it difficult to express this idea, with many repeating their answer to part (i).

(ii) State how an action spectrum and an absorption spectrum show that chlorophyll is used in photosynthesis.

(1)

Both spectra

They are very similar in shape as the action spectra shows a large amount of photosynthesis occuring at the wavelength of light that chlorophyll absorbs and the absorption spectra shows a large amount of light at this wavelength being absorbed.

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Examiner Comments

The mark was awarded for the first sentence.

Question 4 (b) (i)

This question challenged candidates to understand complex data in a table in order to deduce the effect of cadmium on the synthesis of plant pigments. Most were able to state that cadmium reduces the synthesis of both chlorophyll and carotenoid pigments. Those who understood the ratios in the table also deduced that chlorophyll a synthesis is more inhibited than chlorophyll b and that carotenoid synthesis is more inhibited than chlorophyll. Candidates who described the change in the ratios with no deduction gained no credit.

The table shows information about the pigments chlorophyll a and chlorophyll b and the carotenoids present in the leaf discs after 48 hours.

Cadmium chloride concentration / a.u.	Mean concentration of chlorophyll / mg kg^{-1}	Mean concentration of carotenoid / mg kg^{-1}	Ratio of chlorophyll a : b	Ratio of carotenoid : chlorophyll
0.0	384 ± 4.2	444 ± 6.2	1.23	1.15
0.1	204 ± 4.9	270 ± 4.5	1.00	1.32
1.0	180 ± 3.6	207 ± 5.2	0.83	1.15
3.0	146 ± 4.1	140 ± 3.1	0.81	0.95
5.0	126 ± 2.7	91 ± 1.0	0.56	0.71
10.0	102 ± 1.9	64 ± 1.1	0.80	0.63

(i) Analyse the data to deduce the effect of cadmium on the synthesis of plant pigments.

(3)

The data shows that the higher the concentration of the cadmium the ~~more~~ less the concentration of chlorophyll and carotenoid which means that the plant pigments are not going to be very pigmented in colour.
The ratio of carotenoid : chlorophyll decreases as the concentration of cadmium increases.

ResultsPlus
Examiner Comments

This answer makes it clear that cadmium decreases the synthesis of chlorophyll and carotenoid and gained one mark. Describing the trend in the ratios was not credited.

ResultsPlus
Examiner Tip

Do not just describe when asked to make deductions from data.

Increasing the cadmium chloride concentration caused a decrease in the ratio of chlorophyll a:b and a decrease in the ratio of carotenoid to chlorophyll

ResultsPlus
Examiner Comments

This answer only describes changes in the ratios and gains no marks.

Cadmium decreases the production chlorophyll and carotenoid. The effect on carotenoid is greater. ~~Thus~~ With increasing carotenoid concentration, the ratio of chlorophyll a:b decreases, so there is less chroorophyll a synthesised than b. Which increasing cadmium concentrations, the ratio of carotenoid : chlorophyll decreases, so less carotenoid is synthesised in relation to chlorophyll.

ResultsPlus
Examiner Comments

This answer is succinct and clearly shows the three correct deductions worthy of full marks.

Question 4 (b) (ii)

This question challenged candidates to explain why each step in a given method was necessary. The mark scheme highlighted seven steps in the method.

(ii) Justify the method used by the scientist.

(5)

The scientists ~~used~~ grew leaves in dark as these yellow leaves contained no chlorophyll so when the ~~leave~~ leaf photosynthesises in the cadmium conc. in a light source, ~~the trees of~~ we can accurately determine the effect of cadmium on the synthesis of plant pigment like chlorophyll. Moreover, a light source is used as the researcher has better control over the light intensity & the type of light used as these can affect the rate of photosynthesis which then affects the rate of synthesis of plant pigment which ~~is not desired~~ affects results negatively as we want to see the effect of cadmium on pt synthesis of plant pigment rather than light. The same diameter used is another control as, if one disc is bigger, it'll contain more chloroplast cells which means the amount / conc. of plant pigment produced would be different therefore by keeping size of leaf same, we can have some control over the number of chloroplasts in leaves..

(Total for Question 4 = 10 marks)

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Examiner Comments

This answer gained three marks for explaining that growing in the dark removed chlorophyll; controlling light thereafter is important as light affects pigment synthesis and using the same disc diameter is important because disc size affects pigment concentration.

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Examiner Tip

This is a five mark question so try to include at least five different aspects of the method in your answer. It would be sensible to try and include more than five to give the best chance of gaining maximum marks.

By growing the plants in darkness for one week, the scientist etiolated the plant, ensuring there was no (or very little) pigment in the plants at the start of the experiment, so differences in pigment concentrations prior to the experiment would not affect the findings. Using leaf disks of the same diameter ensures there are the same mass of pigment in them, as bigger disks would contain more pigment than smaller disks. Keeping the tubes at the same temperature (27°C) ensures all plant enzymes are at the same rate, as warmer temperatures or colder temperatures will affect the rate of reaction of the enzymes catalysing the synthesis of the proteins of pigment. By exposing all discs of leaf to the same source of light, the scientist ensured all discs received the same light intensity, as having more light intensity than others would increase the concentration of pigments in the leaf discs compared to those with less light intensity. By doing repeats for each concentration of Cadmium, any anomalies could be noticed and a mean and standard deviation for each calculated.

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Examiner Comments

This answer contains five different ideas and each is explained well so the candidate was awarded full marks. Grown in darkness so no pigment at the start; discs of same diameter so same mass of pigment; use same temperature as it affects enzymes; same light as it affects pigment content and the idea of replication to allow the standard deviation to be obtained.

The plants were grown in darkness for a week in step 1 so that they could not photosynthesise. The leaf discs were put into different cadmium chloride concentrations so that the effect of cadmium chloride on the synthesis of chlorophyll and carotenoid pigments could be investigated.
The leaf discs were exposed to the same source of light so light intensity could be controlled. The tubes were all kept at 27°C so temperature could be controlled. Leafs of the same diameter ~~were~~ were used so surface area was the same variable and controlled for.

ResultsPlus
Examiner Comments

This answer makes reference to several steps in the method but the level of explanation was not deemed sufficient so the candidate scored no marks.

Question 5 (a)

The examiners gave credit to answers that made it clear that the catalase enzyme would be denatured, because named bonds would be broken, and that these events would change the shape of the active site so that it can no longer bind to the substrate hydrogen peroxide.

(a) Explain why no oxygen was produced when boiled liver was added to the hydrogen peroxide.

(3)

Enzymes denature at 40°C so the enzymes in the liver that has been boiled will have denatured. This means they can't do their job so they won't change hydrogen peroxide into water and oxygen.

ResultsPlus
Examiner Comments

This answer only mentions that the enzyme is denatured and provides no further detail, so scores one mark.

ResultsPlus
Examiner Tip

Look at the number of marks allocated to a question. This question is worth three marks so the minimum number of ideas you should include in your answer is three.

by boiling the liver, the catalase enzyme is denatured, the shape of the active site has changed, therefore harder to form enzyme - substraight complexes, meaning once the hydrogen peroxide was added, there were hardly any/ no successful collisions at all were made, so no O2 was produced, because no enzymes catalysed the reaction.

ResultsPlus
Examiner Comments

This is a good answer that gains full marks. The only idea not mentioned is the breaking of a named bond, such as hydrogen, ionic or disulfide.

The enzyme catalase had been completely denatured in the process of boiling. Once ~~tissue~~ tissue has be boiled it is no longer living. When heated catalase's structure changes and the hydrogen, ionic and disulphide bonds are broken. This results in the tertiary structure of protein completely changing meaning the substrate hydrogen peroxide can no loager be broken down

ResultsPlus
Examiner Comments

This answer mentions that the enzyme is denatured and names bonds that would be broken. The candidate fails to complete the story so only gets two marks.

Question 5 (b)

This question tested understanding of measuring the initial rate of a reaction because it means that the substrate is not limiting. Many candidates were aware that measuring the volume of oxygen produced in the first 10 seconds represented the initial rate of the reaction but the idea that the hydrogen peroxide is not limiting was more challenging.

(b) Explain why it was important to measure the volume of oxygen in the first 10 seconds.

(2)

The intial rate of reaction can be calculated for the enzyme.

ResultsPlus
Examiner Comments

This answer was typical of many. The initial rate idea is mentioned with no explanation, so the candidate gained one mark only.

This allows us to measure the initial rate of ~~reaction~~ reaction. This is needed as the initial rate is the most accurate representation of the actual rate because as the reaction proceeds, substrate or enzyme concentration becomes a ~~limiting~~ limiting factor, so the rate of ~~react~~ reaction decrease over time.

ResultsPlus
Examiner Comments

This answer has both ideas. The initial rate is identified and it is made clear that after 10 seconds the substrate will be limiting the rate of the reaction.

This allows you to calculate the initial rate, at the start the substrate is not a limiting factor but over time as products are formed, substrate level will decrease and will become a limiting factor so activity of enzyme will be effected.

ResultsPlus
Examiner Comments

This is an excellent answer that scores full marks for showing a good understanding of both ideas.

Question 5 (c)

This question challenged candidates to give four improvements to the method used by the candidate. Putting the word 'four' in bold ought to be a clue about how many ideas were expected to gain full marks, but some candidates failed to acknowledge this in their answers.

(c) The results for the volume of oxygen collected by each student using raw liver were different.

Give **four** possible improvements to the method used by these students that would reduce the variability of the results.

(4)

- Keep temperature constant as temperature could affect the rate of reaction and ∴ results
- Keep SA : volume ratio of liver relatively similar
- Keep volume & concentration of hydrogen peroxide constant
- Use a stopwatch to time 10 seconds to reduce human errors

ResultsPlus
Examiner Comments

This candidate had made four bullet points and the first three scored marks. However, the use of a stopwatch to reduce human error was not acceptable.

1. use known volume of ~~H_2O_2~~ Hydrogen Peroxide.

2. use known ~~E~~ concentration of Hydrogen Peroxide.

3. lver should be the same shape to ensure surface area : volume ratio is the same.

4. use a clip to ~~pinch~~ clip the rubber tube rather than fingers to ensure no gas will pass through.

5. ~~the~~ use a gas syringe ~~was~~ instead of burette to measure results.

ResultsPlus
Examiner Comments

This candidate made five bullet points which gives a good chance of gaining full marks. However, the first two bullet points cover the same marking point, and the use of a clip to reduce variability was not an acceptable idea. Therefore this answer scored three marks.

Question 6 (a)

A definition that stated that the term species is given to organisms that interbreed to produce fertile offspring gained credit.

6 A student measured the distribution of two plant species at the coast.

The distribution was measured from the high water line to 170 m inland.

(a) State what is meant by the term species.

(1)

A group of organisms with similar characteristics and can reproduce to produce fertile offspring.

ResultsPlus
Examiner Comments

This is a good answer that gained the mark.

A group of individuals that can breed to produce viable offspring.

ResultsPlus
Examiner Comments

This answer was not given the mark because the candidate refers to 'viable' offspring rather than 'fertile' offspring.

A group of organisms that produce fertile offspring.

ResultsPlus
Examiner Comments

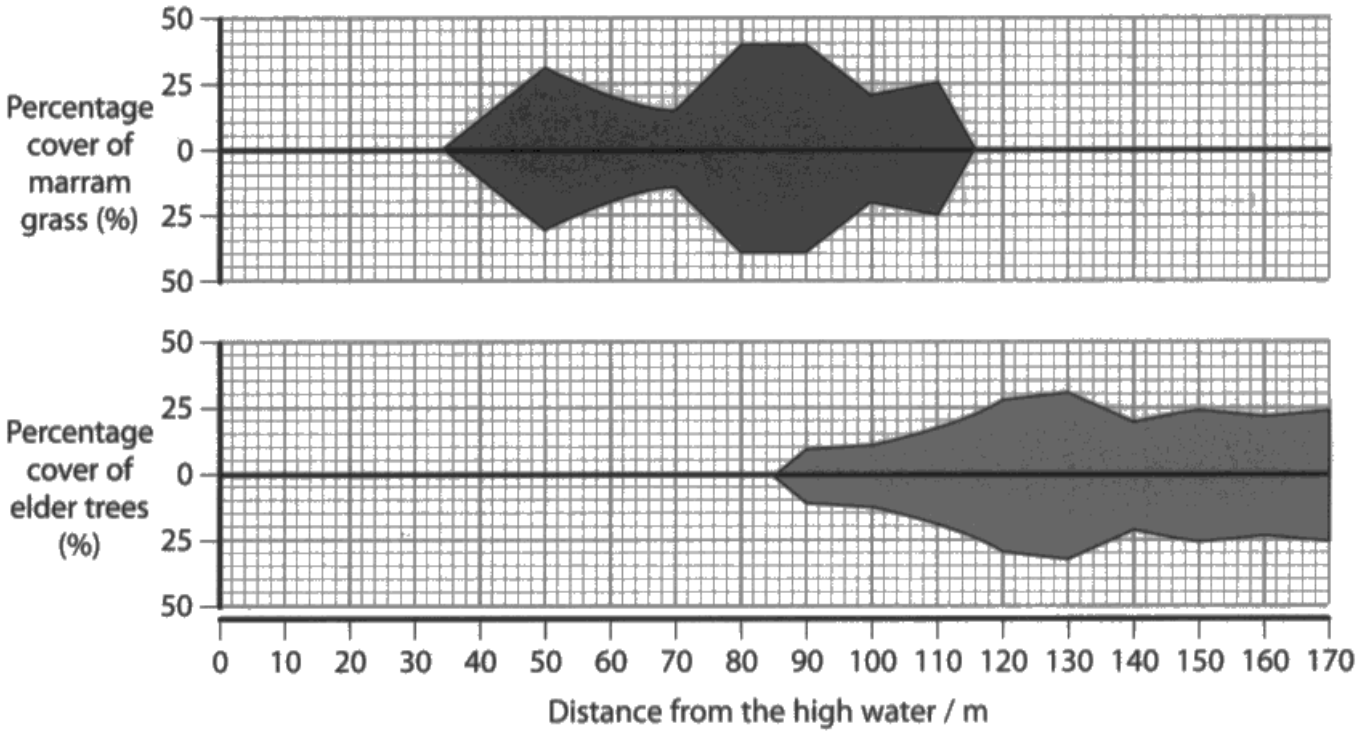
This answer was not given the mark because there is no mention of interbreeding.

Question 6 (b) (i)

This question asked candidates to compare and contrast the distribution of two plant species. These command words demand that the answer contains comments about similarities and differences. In this case, because the question was for two marks, one mark was available for a similarity and one mark was available for a difference. An answer that only contained similarities could only gain a maximum of one mark, as could an answer that only contained differences.

(b) The student represented the distribution of the two plant species in a kite diagram as shown.

The height of each kite diagram represents the percentage cover of plant species at different distances from the high water line.



(i) Compare and contrast the distribution of marram grass and elder trees.

(2)

The marram grass has a higher percentage cover closer to the high water line than the elder trees. They both have plants from 85 to 116m from the high water line.

ResultsPlus
Examiner Comments

This answer makes it clear that one difference is that the marram grass grows closer to the high water mark and one similarity that both species are found between 85 to 116 metres. So, this answer gained full marks.

The elder trees were further away from the high water than the marram grass. distributed.

ResultsPlus
Examiner Comments

This answer only contains a reference to one difference - elder trees are found further away from the high water mark than marram grass. Therefore, only one mark was awarded.

Marram Grass stays closer to the wave at a distance of 35m whereas elder trees stay further away at a distance of 85m from the high water. The marram grass percentage is more fluctuating whereas the elder tree percentage remains at a similar level with less variance. The marram grass reaches a higher percentage cover of 40% whereas the elder trees reach a max percentage cover of 32.5%. /33%..

ResultsPlus
Examiner Comments

This answer only concentrates on differences so the maximum score can only be one mark.

Question 6 (b) (ii)

This question asked candidates to explain how the data shown in the kite diagram could have been collected. Credit was given for appreciating that quadrats need to be placed at intervals along a line or transect, and that a method of measuring percentage cover within each quadrat should be described. Some candidates discussed using randomly thrown quadrats in an attempt to measure population size. This idea was not credited.

(ii) Explain how the student could have collected the data shown in the diagram.

(3)

Running a belt transect with a width of around 50 m, to ensure readings of the edge trees, and from high water mark, to 170 m inland. They then measured every 10 m along the length of the transect, recording the percentage coverage of marram grass by laying a quadrat down, and the percentage coverage of elder trees by eye.

ResultsPlus
Examiner Comments

This answer was awarded two marks for placing quadrats at intervals along a transect. The method of estimating percentage cover by eye was not credited.

The student ~~should~~ could have used a line transect and ~~placed a quadrat~~ from the high water to 170m inland and placed a quadrat at regular intervals along the quadrat. The student could see how many squares ~~of~~ of the quadrat had marram grass in them and how many squares had elder trees in them.

ResultsPlus
Examiner Comments

This answer gained full marks. It is clear that quadrats are being placed at intervals along a transect, and the method of counting the squares within the quadrat was acceptable as a means to measure percentage cover.

Question 6 (c)

This question challenged candidates to describe how the water content of soil could be measured. There were two methods described by candidates and both could get full marks. Some candidates took soil samples at intervals, then weighed, dried and reweighed until constant mass was achieved. With this method it was important not to burn the soil when drying as this would also remove the humus mass. Some candidates took samples at intervals using a probe which was pushed into the soil to the same depth or for the same length of time.

(c) The student measured the water content of the soil from the high water line to 170 m inland.

Describe how the student could have carried out these measurements.

(3)

~~this~~ Set out a transect line and use a datalogger with a probe in ~~water~~ it measure the water content of the soil at each 10 m distance. They could use more transects in different locations from the higher water to the inland and using the same datalogger record results for water content and calculate a mean.

ResultsPlus
Examiner Comments

This answer uses a probe to sample at intervals but makes no reference to depth or length of time, so gains two marks.

the student could do that by taking a soil sample, weighing it then drying it out by using ~~or~~ an oven then measuring the dry mass. ~~the~~ the difference is the mass of water. Hence water content is equal to ~~the~~ change in mass over ~~of~~ wet mass.

ResultsPlus
Examiner Comments

This answer fails to state that sampling occurs at intervals and only gains one mark for weighing, drying and reweighing the soil. There is no mention of obtaining a constant mass.

The ~~begin~~ At ~~one~~ end position. At every 10m interval in the interrupted belt transect the student would use a probe to determine the water content of the soil ensuring that ~~the~~ they measured it for the same length of time and put the probe the same distance into the soil each time.

ResultsPlus
Examiner Comments

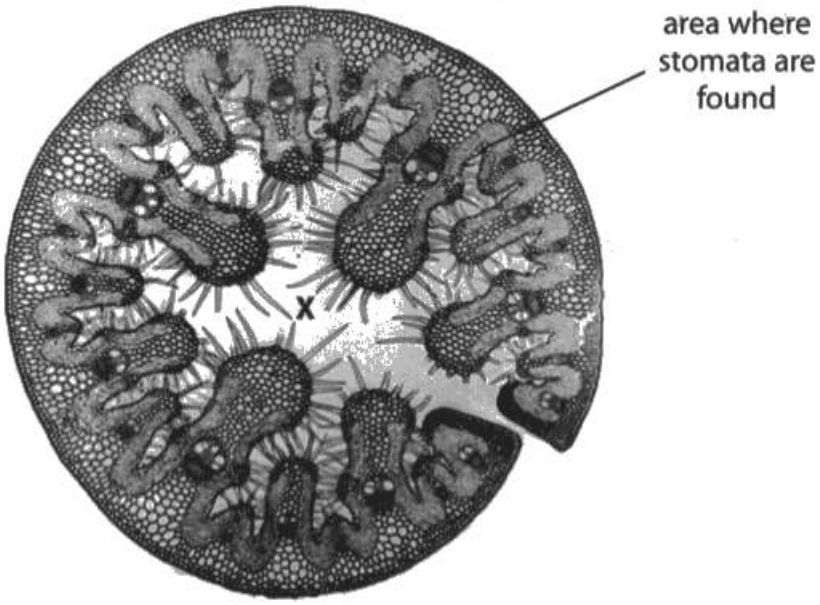
This answer gains full marks for using a probe at intervals along the transect and leaving the probe in the soil for the same length of time and at the same depth.

Question 6 (d)

This question asked candidates to explain how the structure of a marram grass leaf ensures that the water potential in the middle remains high. Marks were given for appreciating that there is less evaporation, transpiration or diffusion because of features such as curling or sunken stomata which traps water vapour or reduces the diffusion, concentration or water potential gradient. Candidates who were unsure of the term water potential struggled to gain marks.

(d) Marram grass leaves are adapted to enable the plants to survive in dry soil.

The photograph shows a section of a marram grass leaf, as seen using a light microscope.



Explain how the structure of this leaf ensures that the water potential at X remains high.

(3)

- Stomata become flaccid when water content drops
- this causes them to close up so H_2O cannot escape X.
- which allows water potential to remain high.
- xylem will feed the reigon with more water as water is evaporated.

ResultsPlus
Examiner Comments

This answer makes no reference to any of the marking points and was given no marks.

- Sunken stomata ; reducing water loss via transpiration since lower concentration gradient for diffusion of water
- a lot of air space inside leaf ; lot of water can be stored as water vapour for when it is required
- many protrusion within the leaf ; increasing surface area for water absorption via osmosis in dry soil
- heavily folded internal structure ; increasing surface area for the osmosis of water

ResultsPlus
Examiner Comments

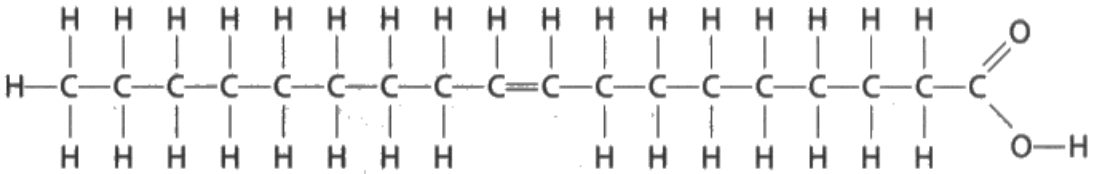
This answer makes reference to sunken stomata reducing transpiration and the idea of trapping water vapour or reducing the concentration gradient. Therefore, full marks were awarded.

Question 7 (a)

In this question candidates were provided with a diagram and they had to explain why it represented a monounsaturated fatty acid. To do this successfully they had to identify that it had a COOH attached, and that a double bond existed between two of the carbons.

7 Soya bean plants have been genetically modified (GM) to increase the concentration of certain organic molecules.

The diagram shows one of these molecules.



(a) Explain what type of molecule is shown in the diagram.

(2)

This molecule is unsaturated due to the C=C. It is a fatty acid and it is a carboxylic acid (-COOH group). It is a hydrocarbon consist of carbon and hydrogen only.

ResultsPlus
Examiner Comments

This is an example of an answer that gained both marks.

Fatty acid (unsaturated)
Long hydrocarbon chain present and C=C double bond present, so fatty acid is unsaturated.

ResultsPlus
Examiner Comments

This candidate identifies the molecule as a fatty acid but offers no explanation. One mark is given because the candidate does explain why it is unsaturated by referring to a C=C double bond.

fatty acid eg oleic acid.

ResultsPlus
Examiner Comments

This candidate knows the molecule is a fatty acid but offers no explanation. Nor does the candidate make any reference to the molecule being unsaturated, so no marks were given.

Question 7 (b)

This question tested understanding of genetic modification. Marks were given for describing the role of restriction enzyme and ligase enzyme and for using the term vector and giving a named example. An additional mark was available for commenting on the need to clone in order to produce large numbers of soya bean plants.

(b) Describe how soya bean plants can be genetically modified to produce large numbers of GM soya bean plants.

(4)

⇒ Chracteristic gene that is desired for gm plant cut using restricta endonuclease, produces sticky ends
⇒ Same restricta endonuclase used to cut plasmid vector and cut to produce complementary stickyends
⇒ plasmid and the cut gene are joined by DNA ligase using strong covelent phosphodiester Bnds to produce a recombinat DNA
⇒ recombinant DNA is inserted into the Soya Bean Plant DNA by methods such as gene gun or viral infecta.
⇒ or heat shock ⇒ DNA inserted into the plant will be expressed nd each time plant reproduces DNA is passed on

ResultsPlus
Examiner Comments

This answer gained full marks by describing the role of restriction and ligase enzymes, using the term vector and giving a named example such as plasmid or gene gun.

Desired gene is isolated, using restriction enzyme, using same restriction enzyme cut space in soya beans DNA, place gene into soya beans DNA using ligase, grow soya beans and used produced seeds with desired genes

ResultsPlus
Examiner Comments

This answer is poorly expressed and was given one mark for the role of restriction enzyme. Using ligase to place the gene lacks the requisite detail.

The target DNA in the soya bean is cut using the same restriction enzyme as is used to cut the foreign DNA. Because they have been cut by the same restriction enzyme, the DNA strands are now complementary so the sticky ends join by complementary base pairing.

This is placed into the chromosomes of the plant cells which are then grown in culture so all contain the genetically modified gene.

ResultsPlus
Examiner Comments

Only one mark was given for the role of restriction enzyme.

Get the required plasmid and gene and combine the gene into the plasmid. Then place the plasmid into the plant. This would mean the plant is now injected with the modified gene. It will then grow with those characte-ristics. The plant will then breed with other plants passing on the genes and this will result in the new plant possessing the GM soya bean characteristics.

ResultsPlus
Examiner Comments

This answer lacks the detail expected at A level and only gains one mark for mentioning plasmid.

Question 7 (c)

This question challenged candidates to devise an investigation to measure the effectiveness of an edible vaccine in mice. The examiners rewarded those who appreciated that the mice used should be of the same sex, age or species and that they should have had no previous exposure to the virus. This latter idea proved to be the most elusive in answers. Credit was given if candidates made it clear that a large number of mice should be used and that they should be split into those given the vaccine and those given a placebo. The examiners gave credit for the method of measuring effectiveness which often involved measuring antibodies or the number of white blood cells. Candidates who observed symptoms, illness or survival in mice also gained credit.

(c) Some plants have been genetically modified to express viral antigens.

These plants are used as edible vaccines and stimulate immunity when eaten.

Devise an investigation that a scientist could use to measure the effectiveness of this vaccine in mice.

(5)

• Obtain one control group of mice which are not given the plant ~~but are~~ and another group of mice which are fed the pl genetically modified plant to 'stimulate' immunity. Ensure that mice have not been exposed to the illness before to ensure the reliability of the results.

• Feed the ~~mi~~ experimental group the GM plant for a week to allow the immunity to take place and the mice to build immunity. Keep the two groups separate and control their exposure to other animals, etc.

• After the week has passed its course, expose both the control group and the experimental group to the virus the plant expressed viral antigens for an

hour and then leave them for a period of time e.g. 3 day.

- Then test the mice for the virus in question and record results. From these results you the scientist can estimate the effectiveness of the vaccine in mice.

ResultsPlus
Examiner Comments

This answer starts well and gained a mark for using mice that had not been exposed to the virus before the investigation and another mark for giving some mice the vaccine (GM plant) and other mice a placebo (normal plant). Thereafter, no credit is evident.

Devise an investigation that a scientist could use to measure the effectiveness of this vaccine in mice.

Use highe number of mice (600), for highe number of results (representitive) (5). Use three groups of mice (200 each), one left as a control group, ~~one given~~ for comparison; one given placebo, to ensure results aren't psychological, and one given the edible vaccine. reliable.

This edible vaccine must contain weakened or inactive viral antigens to trigge immune response.

The mice are control variables, so age, and prior exposure to disease (health) must be controlled, and identical. The mice could be exposed to a viral, not harmful disease after a week of either taking placebos, the edible vaccine, or nothing. This week must be controlled in terms of ~~that~~ monitoring their exposure to bacteria or pathogens that could effect results.

Once exposed to the virus, numbers are obtained on ~~which~~ how many are recieving symptoms of the virus. This would be visually obtained. This virus must have little harmful effect, due to the ethical considerations for the live animals.

Then plot the amount of mice with the virus, and the amount immune & calculate mean percentage. Plot on table, then on graph.

(Total for Question 7 = 11 marks)

X axis; placebo / vaccine / control. Y axis; % immune

ResultsPlus
Examiner Comments

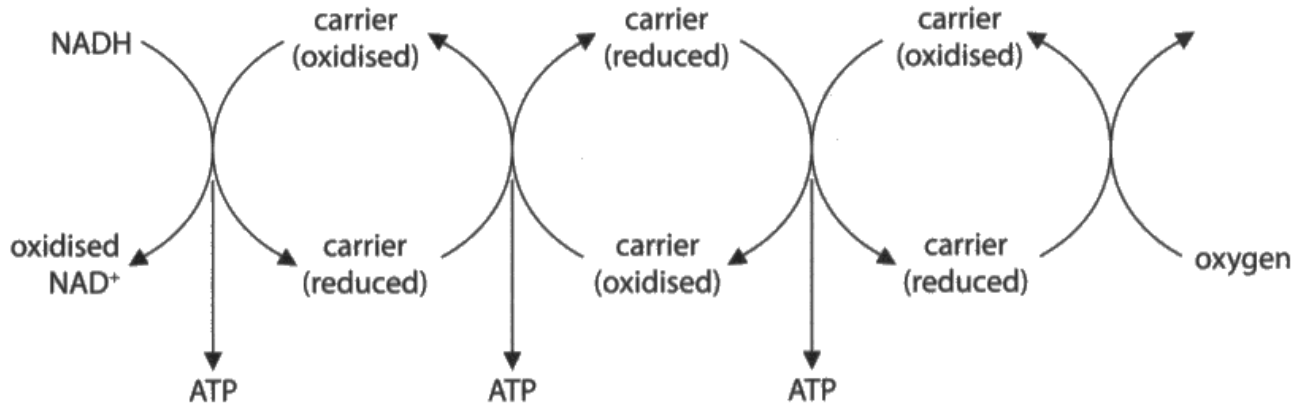
This answer was awarded four marks. Mice are used in sufficient numbers in each group and it is clear that the vaccine has been given to some, but not to others. The age of the mice has been controlled and symptoms are visually observed.

Question 8 (a)

This question tested knowledge and understanding of the electron transport chain. To gain marks candidates needed to recall that oxygen acts as the final electron acceptor and forms water when it is reduced. Most candidates scored at least one mark and many achieved both.

8 The electron transport chain requires oxygen and synthesises ATP.

The diagram below shows part of the electron transport chain.



(a) Describe what happens to oxygen at the end of the electron transport chain.

(2)

Oxygen is the terminal H^+ and e- acceptor.

$\frac{1}{2} O_2 + 2H^+ + 2e^- \longrightarrow H_2O$

Water is produced which diffuses out of the mitochondrion and cell and into the blood stream, then RBC through the alveoli to be exhaled as water vapour.

ResultsPlus
Examiner Comments

This candidate scored full marks. If the equation had been the only writing, two marks would still have been given.

Oxygen is reduced as ATP is produced to form ADP

ResultsPlus
Examiner Comments

This answer was only given one mark for stating that oxygen becomes reduced. There is no mention of the formation of water.

Question 8 (b) (i)

This question tested the ability to do a simple calculation and express the answer in standard form. Most candidates were able to do the calculation but expressing the answer in standard form posed more of a problem. If the answer was incorrect, one mark was still available if 0.0125 could be seen in the working.

(b) A scientist investigated the oxygen consumption of four different mammals.

The table shows the results of this investigation.

Mammal	Body mass / kg	Oxygen consumption / $dm^3\ h^{-1}$	Oxygen consumption / $dm^3\ kg^{-1}\ h^{-1}$
Shrew	0.002	0.0216	1.08×10^{1}
Cat	3	1.5	5.00×10^{-1}
Human	80	24	3.00×10^{-1}
Elephant	4000	50	

0.108
0.5
0.3
0.0125

(i) Calculate the oxygen consumption of the elephant.

Convert your answer into standard form.

(2)

$\frac{50}{4000} = 0.0125$

1.25×10^{-2}

Answer 1.25×10^{-2} $dm^3\ kg^{-1}\ h^{-1}$

ResultsPlus
Examiner Comments

This response shows the correct answer and the working is clear and succinct. Therefore, two marks were awarded.

(b) A scientist investigated the oxygen consumption of four different mammals.

The table shows the results of this investigation.

Mammal	Body mass / kg	Oxygen consumption / $dm^3\ h^{-1}$	Oxygen consumption / $dm^3\ kg^{-1}\ h^{-1}$
Shrew	0.002	0.0216	1.08×10^{1}
Cat	3	1.5	5.00×10^{-1}
Human	80	24	3.00×10^{-1}
Elephant	4000	~~0.050~~ 0.005	1.25×10^{-5}

$\frac{0.0050}{4000}$

$\frac{0.0050}{\text{hour}} = 1.25$ (2)

Answer 1.25×10^{-5} $dm^3\ kg^{-1}\ h^{-1}$

ResultsPlus
Examiner Comments

This candidate gained no marks because the answer is incorrect and 0.0125 cannot be seen in the working.

50 ÷ 4000 = 0.0125

1.25×10^2

Answer 1.25×10^2 $dm^3\ kg^{-1}\ h^{-1}$

ResultsPlus
Examiner Comments

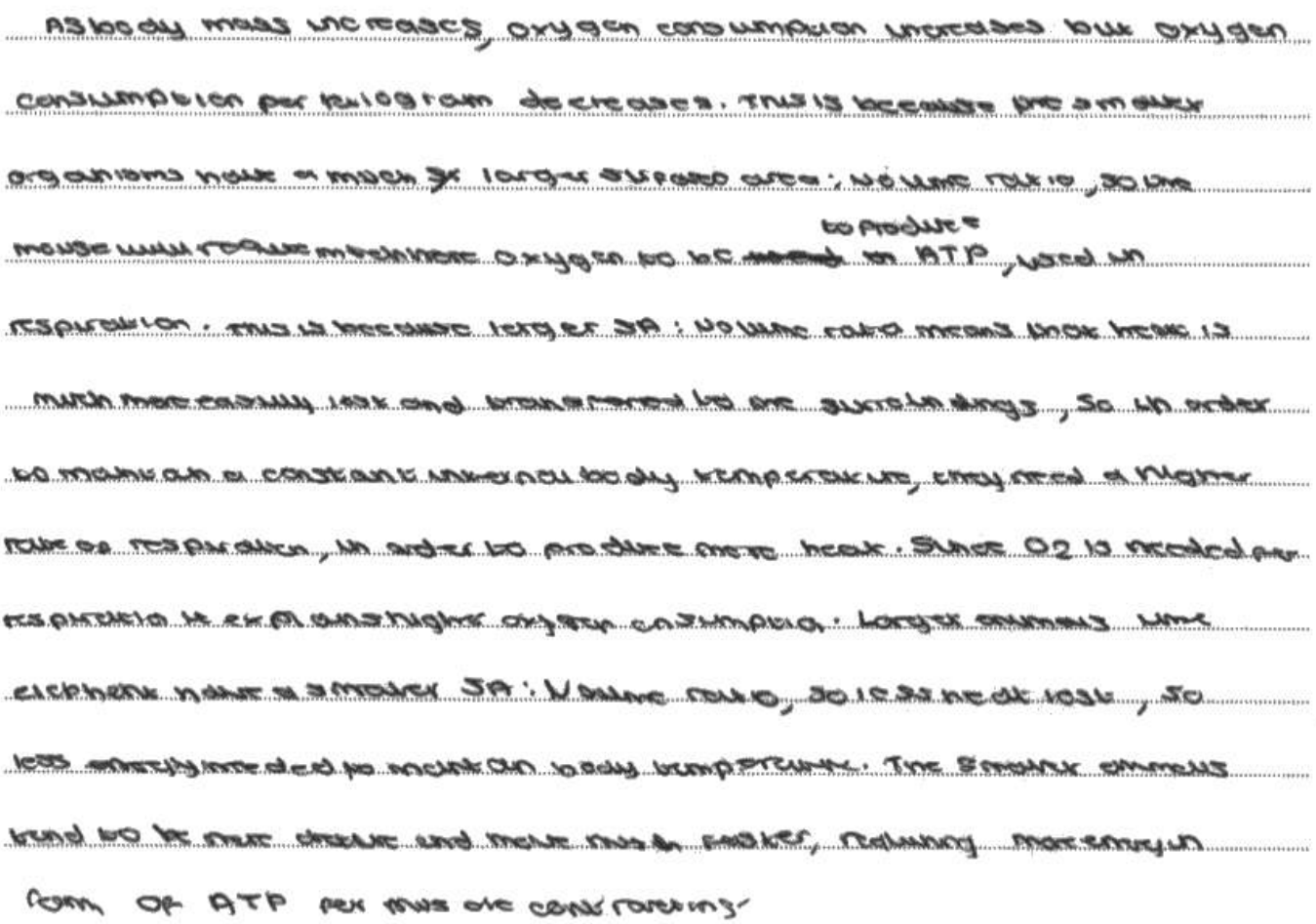
This answer gained one mark for showing 0.0125 in the working.

Question 8 (b) (ii)

This question asked candidates to explain the relationship between body mass and oxygen consumption in the mammals listed in the table. Candidates were expected to look at the final column in the table to answer this question. Therefore, they ought to deduce that smaller mammals consume more oxygen. Candidates who looked at the penultimate column could still gain a mark if they stated that larger mammals consume more oxygen providing they also quoted the units of $dm^3\ h^{-1}$ in support of this statement. Thereafter, credit was given for noting that mammals are endotherms that need to maintain their body temperature. As such, smaller mammals with a larger surface area to volume ratio lose more heat. This heat needs to be regenerated by respiration which is why smaller mammals consume more oxygen than larger mammals. Many candidates wrote about larger mammals consuming more oxygen because they are bigger and have more cells. These ideas gained no credit. Answers expressed in the converse could also gain credit.

(ii) Explain the relationship between body mass and oxygen consumption in these mammals.

(4)



ResultsPlus
Examiner Comments

This answer gains a mark for stating the converse idea that larger mammals consume less oxygen per kg and gains a second mark for stating that smaller mammals have a larger surface area to volume ratio. The candidate also makes it clear that more heat is lost from smaller mammals and that this heat is regenerated by respiration. In all, four marks were awarded.

Bigger the body mass, the higher the oxygen consumption (/dm³ h⁻¹). However, the oxygen consumption (/dm³ kg⁻¹ h⁻¹) decreases as the body mass increases. This shows that the amount of oxygen the mammal consumes in proportion to its weight decreases but the overall oxygen consumption of the mammal is larger than a smaller mammal.

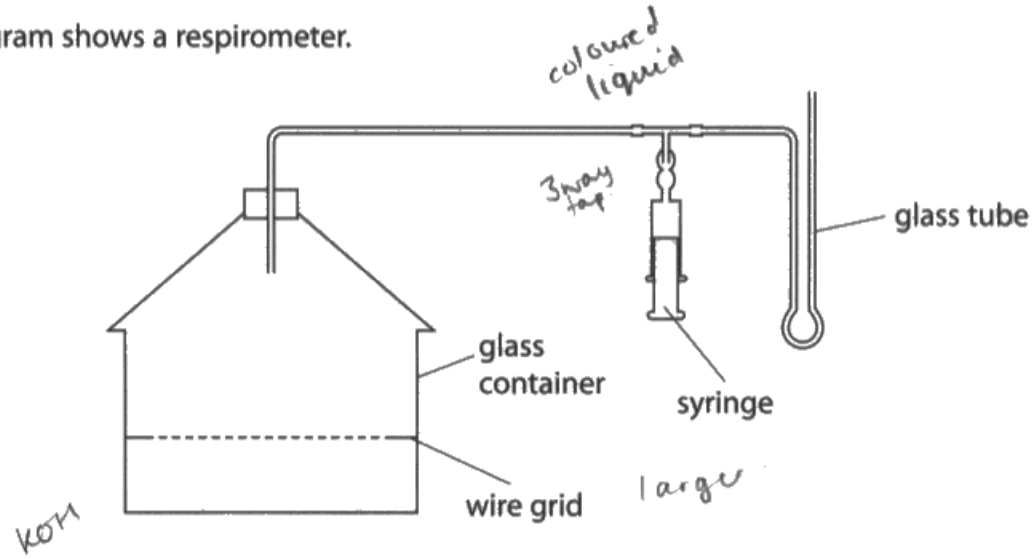
ResultsPlus
Examiner Comments

This answer only gains one mark for stating that larger mammals consume more oxygen and giving the correct units to support this statement. That said, the candidate reaffirms the mark by stating that oxygen consumption decreases in larger mammals. Unfortunately the candidate makes no attempt to explain this pattern.

Question 8 (c)

This question challenged candidates to modify a respirometer and to describe how it could be used to measure the mean oxygen consumption of a rat. Most appreciated the need to have a substance such as soda lime to absorb carbon dioxide and the need to have a coloured liquid in the glass tube so movement could be seen. The use of a scale to measure distance moved and the idea of multiplying the cross sectional area by this distance to obtain the volume consumed were also a common inclusion. Finally, the examiners credited a method of allowing repeat measurements and the use of a water bath to control temperature.

(c) The diagram shows a respirometer.



Explain how a student could modify this respirometer and use it to measure the mean oxygen consumption of a rat.

(4)

At the bottom of the glass container, place potassium hydroxide which will absorb any CO_2 produced by the rat. Add some coloured liquid into the glass tube and attach a ruler next to it, so that when the coloured liquid moves, the distance it moves can be measured. Attach a 3 way tap to the respirometer, which will allow the amount of oxygen in the glass container to be controlled, so that the rat can adjust before the experiment begins. Make sure the wire grid has small enough gratings so that the rat cannot fall through into the KOH as it is poisonous.

ResultsPlus
Examiner Comments

This answer was awarded three marks for the use of KOH to absorb carbon dioxide, the use of a coloured liquid in the glass tube and the use of a ruler. The mention of a 3-way tap was not linked to the idea of resetting the coloured liquid to allow repeats to be made so no credit was given.

(4)

Place a rat inside the large container. Add soda lime beneath the wire grid so it does not touch the rat. Ensure rat is not subjected to any stress. Make sure all connections are airtight. Place a drop of coloured fluid in the glass tube and use a graduated glass tube so that the distance it moves over 10 minutes can be recorded. Use $\pi r^2 h$ to calculate volume of oxygen consumed. Release rabbit after each experiment and allow acclimitisation after each experiment before starting the stopwatch. Syringe used to reset the coloured drop.

ResultsPlus
Examiner Comments

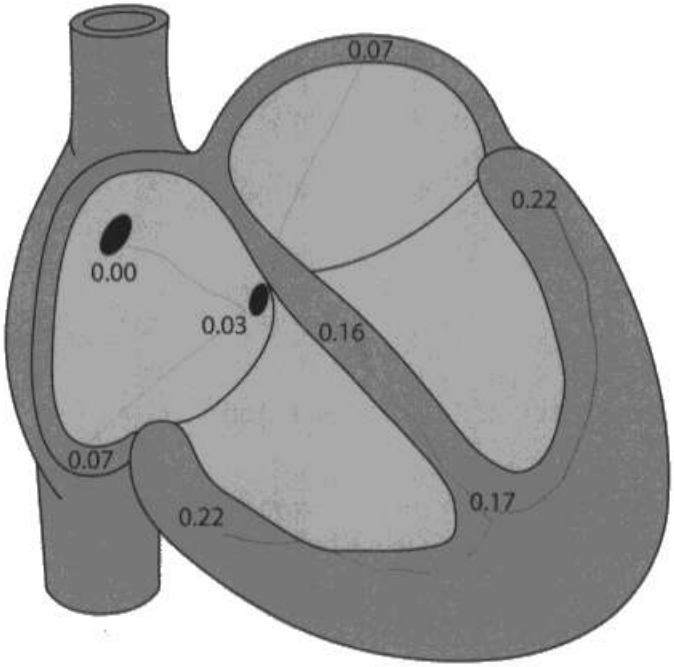
This answer gained full marks. The candidate mentions the use of soda lime to absorb carbon dioxide and the use of a coloured liquid in the glass tube. The idea of using a graduated glass tube was credited as was the method described to calculate volume consumed. Finally, the candidate also mentions the use of a syringe to reset. All five of these ideas were noted but the maximum score that could be given on this question was four.

Question 9 (a)

This question challenged candidates to identify parts of the heart involved in the cardiac cycle and relate this to the timings shown in the diagram. The examiners credited those who noted that the impulse starts at the SAN and takes 0.03s to reach the AVN where there is a delay. Credit was given to those candidates who also noted that atrial systole takes 0.07s and that the impulse would be in the septum or Bundle of His at 0.16s to 0.17s and in the Purkyne fibres at 0.17s to 0.22s. Those who also noted that ventricular systole ends at 0.22s or that the ventricles contract from the base upwards gained credit as did those who stated that the atrioventricular valves open during atrial systole or close during ventricular systole.

Candidates who quoted numbers with no link to the names of parts of the heart lost credit.

9 The diagram shows the time taken in seconds for an impulse to travel through the human heart.



(a) Analyse the information to explain how the times shown in the diagram relate to the cardiac cycle.

(5)

- The wave of depolarisation starts at the SAN
- The wave of depolarisation then travels to the AVN which makes the atria to contracts, causing atrial systole at 0.07s
- After a little delay from 0.07s to 0.16s the wave of depolarisation travels from the AVN to the bundle of His and splits into 2 branches of Purkinje tissues which causes ventricular systole and makes the ventricles contract at 0.22s
- The slight delay allows the ventricles to fully fill up with blood before the contraction
- The cardiac muscle then relaxes, producing diastole

- Ventricles also contract from the bottom-up, from 0.17 to 0.22s

ResultsPlus
Examiner Comments

This answer gained full marks. It is clear that depolarisation starts at the SAN and that atrial systole takes 0.07s. The idea that the depolarisation reaches the AVN was not credited because it is not linked to the time of 0.03s. However, it is clear that there is a delay at the AVN and that the depolarisation is at the Bundle of His at 0.16s. The final credit was given for the idea that the ventricles contract from the bottom up and ends at 0.22s.

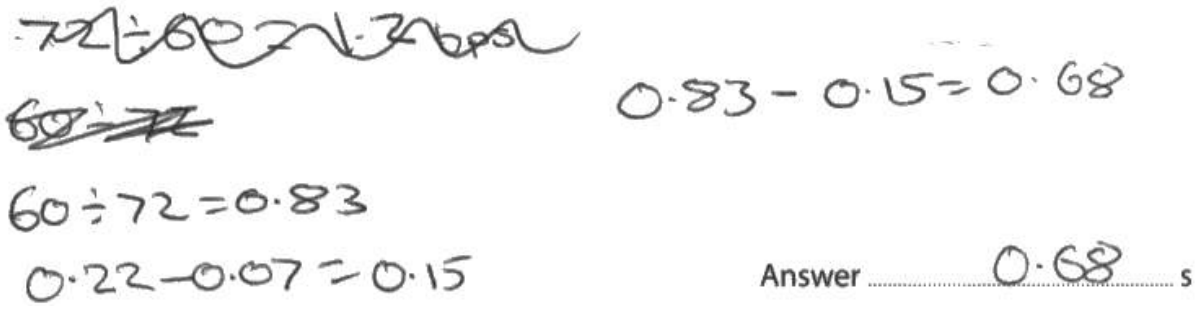
Question 9 (b)

This was the most difficult calculation in the paper. Many candidates struggled to obtain the duration of one heartbeat by dividing 60 by 72. Instead they divided 72 by 60. Once the correct answer of 0.83 was obtained, the challenge was to find the difference between 0.83 and the time that the ventricles would be contracted during one cardiac cycle. This latter number was gained by deducting the time of ventricular systole from 0.83 to give an answer of 0.77 (if 0.06 was used for contraction time) or 0.78 (if 0.05 was used for contraction time).

(b) The mean heart rate of this heart was 72 beats per minute.

Calculate how long the ventricles are relaxed during one cardiac cycle.

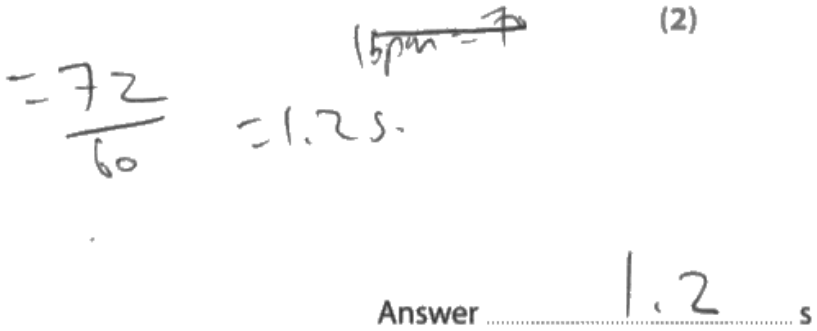
(2)



ResultsPlus
Examiner Comments

The answer given is incorrect, but this candidate gained one mark for showing 0.83 in the working as the duration of one heartbeat.

(2)



ResultsPlus
Examiner Comments

This answer was given no credit as it simply shows the incorrect duration of one heartbeat.

$\frac{60}{72} = 0.8\dot{3}$

$0.17 \rightarrow 0.22 = 0.055$

$0.8\dot{3} - 0.05 = 0.78\dot{3}$

Answer 0.78 s

ResultsPlus
Examiner Comments

This response shows the correct answer and was awarded both marks.

Question 9 (c) (i)

This question was well-answered though some candidates scored poorly because they simply described the data in the table and offered no explanation. Credit was given for noting that the lowered pH of the plasma would be detected by chemoreceptors. Some candidates described the change in pH as becoming more acidic which was not credited. Marks were given if it was clear that the medulla oblongata was involved and that the stimulation of a sympathetic nerve caused the release of noradrenaline at the SAN which would produce more impulses to increase the heart rate.

(c) The effect of exercise on the pH of blood plasma and heart rate was investigated.

The investigation used a sample of three people.

The table shows the results of the investigation before and after excercise.

Activity	Mean pH of blood plasma	Mean heart rate / beats min^{-1}
Rest	7.4	72
Exercise	7.2	94

(i) Analyse the data to explain how the pH of blood plasma affects heart rate.

(4)

when the blood pH drops, the mean heart rate ~~wi~~ ~~th~~ increases rapidly as an decrease of 0.2 in pH leads to an increase of 22 bpm. This is due to chemoreceptors noticing a drop in pH and therefore an increase in CO_2 so they send impulses to the cardiac control centre in the medulla oblongata which then stimulates heart rate by increasing impulses down the sympathetic pathway.

ResultsPlus
Examiner Comments

This answer makes it clear that chemoreceptors detect a fall in pH and that the medulla oblongata is involved in increasing impulses in a sympathetic nerve. Therefore, this answer gained three marks.

Question 9 (c) (ii)

This question allowed candidates to demonstrate their understanding of validity. Credit was given if they made it clear that a sample larger than three people is needed to identify anomalies and make sure that any conclusion is not based on flawed data. Credit was also available to those who recognised that a valid comparison can only be made if the people used in the investigation had the same lifestyle, health, fitness, sex or age and that the intensity and duration of the exercise were controlled.

(ii) There were errors in the design of this investigation that reduced the validity of the data.

Explain how this investigation should have been designed to ensure the data was valid.

(4)

There should be more than three people tested in order to remove anomalies. They should also be of the same age and have no health conditions which could otherwise affect heart rate - ensures a valid test.

the people tested should also do the same type of exercise for the same amount of time as more strenuous activity would cause a higher heartrate per some.

ResultsPlus
Examiner Comments

This answer gained full marks as all four of the marking points are evident. More than three people are needed is linked to the idea that anomalies need to be addressed. The use of people of the same age and health is evident as is the need to use the same type of exercise for the same length of time.

we do not know the age of the three people in the experiment. Some may be fitter or healthier so their heart rates would be different and they would have a higher heart rate. The heart rates should be measured immediately after exercise, though we don't know how long after exercise the results were taken. The people in the experiment should all do the same type of exercise, as some exercises may be harder than others. This would ensure the data was valid.

ResultsPlus
Examiner Comments

This answer gained one mark for the idea of using the same type of exercise. The candidate mentions age and health as factors that are unknown but does not tell the examiner that these need to be controlled so credit could not be given.

there should have been more than 3 people used and each of them should have been the same age, gender and roughly the same athletic ability. This is because an elderly females heart rate isn't going to be comparable to a young, fit males HR when participating in exercise. The use of more people would have allowed a larger recall of data making the test more valid. It also doesn't specify how long after exercise the HR or blood pH was taken nor does it say the form of exercise or how long it occured for which could have altered the results.

(Total for Question 9 = 15 marks)

ResultsPlus
Examiner Comments

This answer was given one mark for appreciating that the people used in the investigation should be the same age. The candidate mentions the need to use more than three people but offers no reason why. The candidate also identifies that the form of exercise and the length of exercise are unknown but does not make it clear that the same type and duration of exercise need to be used.

Question 10 (a)

The first challenge in this question involved calculating the correct Chi squared value. To do this, candidates needed to recognise that the expected values in this investigation are 20, 10 and 30. Many thought these values were 20, 20 and 20. The correct calculation gave a Chi squared value of 36.6 which gained both marks in part (i). The incorrect calculation using the wrong expected values gave a Chi squared value of 37.2. This latter answer was credited with one mark only. Candidates could also gain one mark for any incorrect answer providing the examiners could see 20, 10 and 30 in the working.

In part (ii), the mark scheme allowed full marks to be obtained whether 36.6 or 37.2 had been calculated. Any answer in part (i) that was less than the critical value of 5.991 could still gain full marks for the converse argument.

(a) (i) Calculate the Chi squared value using the formula shown.

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

(2)

Answer 36.6

(ii) The table shows some critical values of Chi squared at different degrees of freedom.

Degrees of freedom	*p* value				
	0.900	0.500	0.100	0.050	0.010
1	0.016	0.455	2.706	3.841	6.635
2	0.211	1.386	4.605	5.991	9.210
3	0.584	2.366	6.251	7.815	11.345
4	1.064	3.357	7.779	9.488	13.277

Use your calculated Chi squared value and this table to comment on the conclusion the student should make about the null hypothesis.

(4)

3-1=2. At 0.05 crit is 5.991. 36.6 is significantly higher so null hypothesis is rejected, there is a significant correlation between each and it is NOT due to chance.

ResultsPlus
Examiner Comments

The correct answer of 36.6 in part (i) gained two marks. In part (ii) three marks were awarded for making it clear that 36.6 is greater than 5.991, at two degrees of freedom, and that the null hypothesis should be rejected.

(a) (i) Calculate the Chi squared value using the formula shown.

(2)

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Answer 37·2

(ii) The table shows some critical values of Chi squared at different degrees of freedom.

Degrees of freedom	*p* value				
	0.900	0.500	0.100	0.050	0.010
1	0.016	0.455	2.706	3.841	6.635
2	0.211	1.386	4.605	5.991	9.210
3	0.584	2.366	6.251	7.815	11.345
4	1.064	3.357	7.779	9.488	13.277

Use your calculated Chi squared value and this table to comment on the conclusion the student should make about the null hypothesis.

(4)

37·2 > 9.210 ∴ for a significance level of 0·01, the Chi squared value is greater than the critical value therefore there is sufficient evidence to reject the null hypothesis and accept that mice show a significant preference for different types of squares, in this case corner squared and that the probability of the data being collected was not due to chance.

ResultsPlus
Examiner Comments

This answer was awarded one mark in part (i) for the incorrect calculation producing the number 37.2. However, all four marks were awarded in part (ii) because it is clear that use of the critical value of 9.210 means that two degrees of freedom are involved and the null hypothesis is rejected. This is because 37.2 is greater that the critical value of 9.210 at a p = 0.01. This candidate also makes it clear that the mouse shows a distinct preference for corner squares.

(a) (i) Calculate the Chi squared value using the formula shown.

(2)

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

$\frac{(42-36)^2}{30} = 1$ $\quad \frac{(6-8)^2}{8} = 0.5$ $\quad \frac{(12-16)^2}{16} = 1$

$1 + 1 + 0.5 = 2.5$

Answer 2.50

(ii) The table shows some critical values of Chi squared at different degrees of freedom.

Degrees of freedom	*p* value				
	0.900	0.500	0.100	0.050	0.010
1	0.016	0.455	2.706	3.841	6.635
2	0.211	1.386	4.605	5.991	9.210
3	0.584	2.366	6.251	7.815	11.345
4	1.064	3.357	7.779	9.488	13.277

Use your calculated Chi squared value and this table to comment on the conclusion the student should make about the null hypothesis.

(4)

The degrees of freedom is 2 (3-1) and the probability is 0.050 so therefore the critical value is 5.991. This value is greater than the chi squared value therefore you would ~~reject~~ accept the null hypothesis as there is no significant ~~difference~~. There is a significant difference ~~as~~ preference in which square the mice goes in.

ResultsPlus
Examiner Comments

This answer was given no credit for part (i). However, two marks were given in part (ii) because it is clear that two degrees of freedom are involved and the candidate appreciates that the calculated Chi squared value of 2.50 is less than the critical value of 5.991. However, for the converse argument to continue the candidate should have accepted the null hypothesis.

(a) (i) Calculate the Chi squared value using the formula shown.

(2)

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

	O	O − E	$(O-E)^2$
M	6	−14	196
S	12	−8	64
C	42	22	484
			744

$$\chi^2 = \frac{744}{60} = 12.4$$

Answer 12.4

(ii) The table shows some critical values of Chi squared at different degrees of freedom.

Degrees of freedom	*p* value				
	0.900	0.500	0.100	0.050	0.010
1	0.016	0.455	2.706	3.841	6.635
2	0.211	1.386	4.605	5.991	9.210
3	0.584	2.366	6.251	7.815	11.345
4	1.064	3.357	7.779	9.488	13.277

Use your calculated Chi squared value and this table to comment on the conclusion the student should make about the null hypothesis.

(4)

The X^2 value is greater than the critical value at a p-value of 0.05. This means that the null hypothesis can be rejected as there is sufficient evidence. We can say that the mice do show a significant preference for different types of squares.

ResultsPlus
Examiner Comments

This answer gained no marks for part (i) as the calculated value is incorrect and there is nothing in the working to credit. Two marks were awarded in part (ii) because the candidate makes it clear that 12.4 is greater than the critical value at p = 0.05 and that the null hypothesis should be rejected. The answer gives no indication of the degrees of freedom and lacks detail about the type of square being preferred.

Question 10 (b)

This question challenged candidates to identify limitations in the exploratory investigation and then to justify how they could be addressed. The mark scheme had four limitations: only one mouse was used meaning more should have been used because mice may behave differently; there is no indication that light or temperature had been controlled and these factors may affect preference; there was no indication that sex, age or species had been controlled and these factors may affect behaviour; and, finally, there is no indication that the box had been cleaned and the scent of other mice may influence behaviour. Many candidates struggled to identify limitations and those who did then struggled to explain why these needed to be addressed.

(b) The method used by the student had limitations.

Justify how the student could modify the investigation to address these limitations.

(3)

One modification could be that he could do this same investigation with multiple mice in the same environment to establish whether exploratory behaviour is present in all mice or just some ~~of~~. This will allow for more accurate conclusions to be made.

ResultsPlus
Examiner Comments

This answer was given one mark for the idea that more mice should be used because mice behave differently.

The student could have repeated the investigation with other mice to see if the same patterns are shown.
The box should have been marked on the underside rather than the bottom as the mouse may have moved due to the lettering.
All other variables should be controlled e.g. temperature, age of mouse, light intensity as these factors could affect where the mouse goes.

ResultsPlus
Examiner Comments

This answer gained two marks. The candidate links use of more mice to the idea of looking for a similar pattern which implies mice may behave differently. The candidate also links the control of temperature or light to the idea that these abiotic factors could influence preference.

Question 10 (c)

This question was well-answered. Candidates were able to describe the bleaching of rhodopsin, the closure of sodium ion channels, the role of the sodium ion pump in creating hyperpolarisation, leading to the prevention of neurotransmitter release, and the consequent depolarisation of the bipolar cell. The most common error was to state that the neurotransmitter release increased.

(c) The mouse uses its eyes when exploring in the box.

Describe the role of rod cells in initiating action potentials to the brain of the mouse.

(5)

Rod cells are normally permeable to sodium ions so they ~~are no~~ naturally have a positive potential, causing glutamate to be released at the synapse to cause an inhibitory potential at the sensory neurone. When light is absorbed, rhodopsin in the rod cell ~~bree~~ seperates into opsin and retinal as cis retinal is converted to trans retinal. Opsin binds to the cell membrane, blocking the ~~cell mem~~ Na^+ voltage gated channels, so the cell is hyperpolarised, preventing the IPSP. The ~~sta~~ action potential can then be achieved in the bipolar sensory neurone and is transmitted to the brain through the optic nerve.

ResultsPlus
Examiner Comments

This answer gained four marks for making it clear that rhodopsin is changed to opsin and retinal, sodium ion channels are blocked, hyperpolarisation occurs and an action potential occurs in the bipolar cell. This candidate wasted time at the start of the answer by writing in general about rod cells rather that getting straight down to answering the question.

ResultsPlus
Examiner Tip

Do not waste time by writing about information that is not relevant to the answer.

In darkness, the sodium ions move into the rod cell by diffusion, through the open sodium channels, whilst the sodium ions are being actively pumped out of the cell by active transport. This causes the release of neurotransmitter glutemate, which inhibits the depolarisation of the bipolar neuron. In light, the pigment rhodopsin found in rod cells break down into retinal and opsin. This process is known as bleaching Sodium ion channels close and the sodium ions are actively pumped out of the cell by active transport. The release of the inhibitory neurotransmitter is stopped, so the bipolar neurone is able to depolarise. The action potential is carried by the optic nerve to the brain

ResultsPlus
Examiner Comments

This answer was awarded full marks, though again valuable time is wasted by writing about what happens in darkness. The candidate makes it clear that in light rhodopsin changes to retinal and opsin, sodium ion channels close, the sodium ion pump continues, the release of neurotransmitter is stopped and the bipolar cell is depolarised. The naming of the bipolar cell as a neurone was ignored.

Question 11 (a)

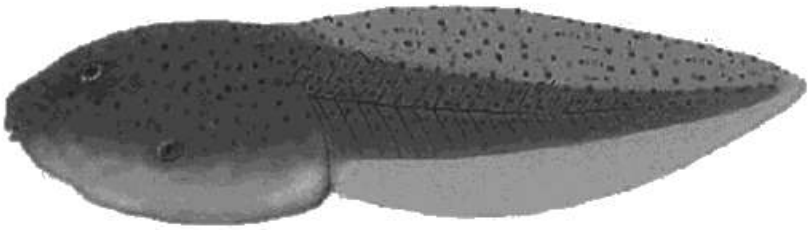
The mark scheme allowed the following answers to this question: Eukarya, Eukaryota, Eukaryotes and Eukaryotae. Some candidates lost credit by believing the domain to be Animalia, or wrote Animalia Eukarya as their answer.

11 The adult American bullfrog, *Rana catesbeiana*, can live in water or on land.

Adult frogs lay eggs in water where they are fertilised.

The fertilised eggs develop into tadpoles that live only in water.

The photograph shows a tadpole.



(a) State the domain to which *Rana catesbeiana* belongs.

(1)

Rana

ResultsPlus
Examiner Comments

To give the generic name was a common error but gained no mark.

Eukarya

ResultsPlus
Examiner Comments

This answer is correct and was given the mark.

Animalia



This answer was also a common error.

Question 11 (b)

Candidates should be familiar with how fish gills are adapted for gas exchange and this question tested this idea in a novel context. The question asked for explanations so the marks could not be awarded solely for description. The examiners gave credit for stating that the gills would have a large surface area for diffusion, that they would be thin to provide a short diffusion distance and that they would allow blood to flow to maintain a concentration gradient.

(b) Adult frogs use lungs for gas exchange but tadpoles use gills.

Explain how gills are adapted for gas exchange.

(3)

Gills have filaments that further fold into many ~~lamellae~~ lamellae which increases the surface area giving more area for diffusion to occur. These lamellae are also very ~~thin~~ thin which gives a ~~short~~ shorter diffusion pathway for oxygen. The filaments are also in many rows which ~~allows~~ again increases the surface area.

ResultsPlus
Examiner Comments

This answer provides an explanation for having a large surface area and for being thin but offers no indication of the value of having blood flow. It was given two marks.

(3)

Gills have very short diffusion distances so gases do not have far to travel, they have a very rich blood supply to increase the concentration gradient for oxygen to diffuse across into the gills and they have a very large surface area increased by gill lamellae so more gas exchange can take place.

ResultsPlus
Examiner Comments

This answer gained one mark for linking blood supply to concentration gradient. There is no mention of being thin so the idea of a short diffusion distance could not be credited. A large surface area is mentioned but is linked to gas exchange, not diffusion. Gas exchange was not credited as the term is used in the stem of the question.

ResultsPlus
Examiner Tip

Repeating words used in the actual question will not gain credit.

There is a counter current flow of blood* gills contain lamellae which are thin to give short diffusion distance and have a large surface area to volume ratio to increase diffusion of oxygen ~~increased concentration gradient~~ and increased

* to maintain a concentration gradient

ResultsPlus
Examiner Comments

This answer gained full marks because the benefit of each adaptation is explained.

Question 11 (c) (i)

This question challenged candidates to appreciate that the fall in pH is due to anaerobic respiration producing lactic acid and that pyruvate is reduced in the process. The first two ideas were common in answers but the latter idea was less frequent. Many candidates wrote about less aerobic respiration and the production of carbon dioxide during exercise, ideas that were not credited.

(c) (i) Human activity can cause pollution that reduces the oxygen concentration in water.

Explain why a low oxygen concentration in the water would lower the pH of the blood of the tadpole.

(3)

~~More~~ Less oxygen present means aerobic respiration is unable to occur. Therefore anaerobic respiration occurs meaning pyruvate is converted to lactate which forms lactic acid. This acid is present in the blood lowering the pH. The lactic acid is unable to be broken down as the oxygen supply is not restored.

ResultsPlus
Examiner Comments

This answer refers to anaerobic respiration and the production of lactate so gained two marks. There is no mention of pyruvate reduction, or NADH oxidation, so the third mark was not given.

A low oxygen concentration means the tadpole cannot absorb enough oxygen for aerobic respiration to meet the energy requirements of the tadpole. The tadpole will respire anaerobically to produce ATP and also reduce pyruvate and reoxidise NADH. Anaerobic respiration involves the formation of lactic acid, which is then released into the blood. It is an acid so it lowers the pH of the blood.

ResultsPlus Examiner Comments

All three marking points are mentioned in this answer, so full marks were given.

Less oxygen means aerobic respiration is limited so it respires anaerobically. Pyruvate is reduced to ~~lactic acid~~ lactate and reduced NAD is oxidised to NAD. Lactate forms lactic acid which lowers pH of blood.

ResultsPlus Examiner Comments

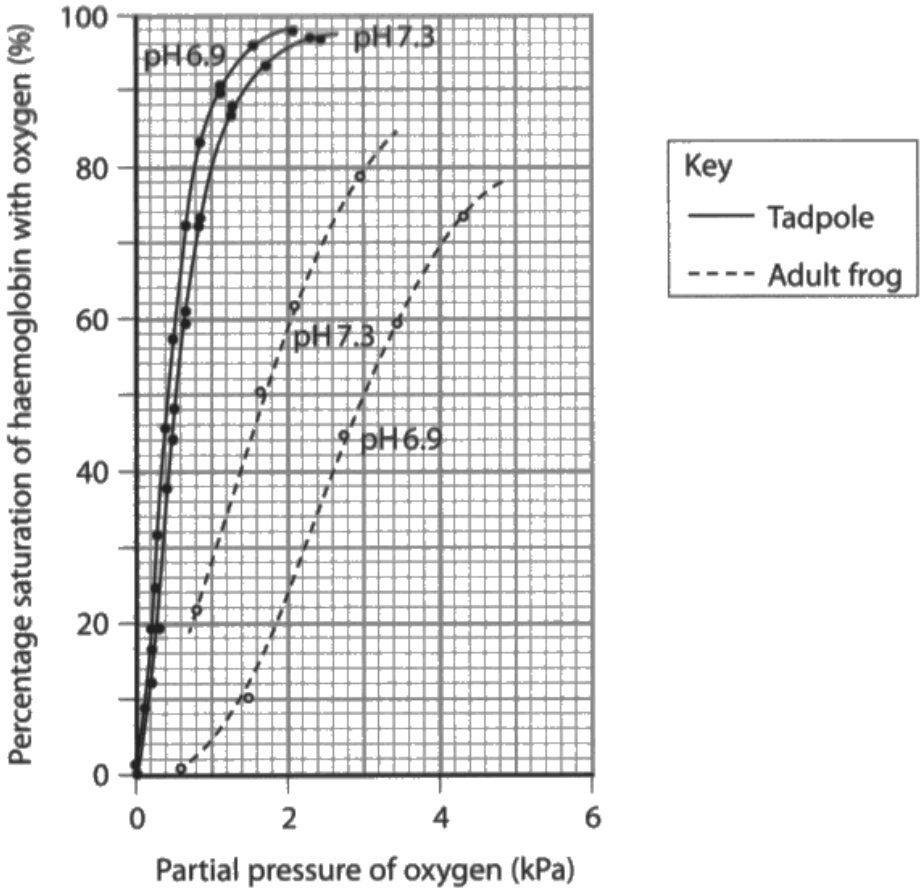
This answer also gains full marks. The term reduced NAD is read as being equivalent to NADH.

Question 11 (c) (ii)

This level based question challenged candidates to discuss how the shape and position of frog and tadpole dissociation curves at different pHs reflect the habitat in which they live. The examiners looked at three categories: description of the curves (D), explanation linked to any description (E) and linking of these ideas to the habitat in which the animals live (H). A level 1 answer only made reference to 1 to 3 ideas from D, E or H. A level 2 answer needed to have reference to 4 to 6 ideas from D, E or H, but at least one reference had to be from H. A level 3 answer needed to have reference to 7 to 9 plus ideas from D, E or H, but at least two references had to be from H.

The mark scheme lists examples of indicative content from D, E and H.

*(ii) The graph shows the effect of pH on the oxygen dissociation curves of haemoglobin for adult frog blood and tadpole blood.



The adult frog can either live on land or in water. The tadpole always lives in water.

Discuss how the shape and position of the dissociation curves reflect the habitat in which these animals live.

(9)

The tadpole's habitat has a higher percentage of hymoglobin in the water and waters pH is neutral where as the frogs habitat has a more straight-er line to it also the first one doesn't start at 0% it starts at 20%.

ResultsPlus
Examiner Comments

This answer was awarded no marks because there is no reference to an acceptable D, E or H.

The adult frog is larger and so has a lower surface area to volume ratio than the tadpole, meaning the frog loses heat at a lower rate and so doesn't need as high of a respiration rate as the tadpole. The frog thus has less CO_2 in its blood and so generally has a higher blood pH. The frog lives in both water and land while tadpoles are only in the water, meaning the frog acquires more O_2 overall than the tadpole

due to the air the frog is exposed to on land has a higher O_2 concentration than the water. ~~This is why the frog needs more O_2 to tadpole~~ The tadpole needs more O_2 than the frog but lives in a low O_2 concentration area, hence why the tadpole haemoglobin transports O_2 more effectively as shown by the left most curves for the tadpole in order to reach their O_2 demands for enough respiration, so the tadpoles have enough heat for optimum enzyme activity. The pH 7.3 curve for the tadpole is more right as the tadpole is carrying out less activity and so respiring less, hence the higher pH due to less blood CO_2. Therefore less O_2 is required and the haemoglobin doesn't need to transport as much of it. Frogs however have less metabolic activity and so need less O_2 for less respiration, hence why their curves are more right.

ResultsPlus
Examiner Comments

This is an example of a level 2 answer that was awarded two marks. The account mentions that air contains more oxygen than water (H) and that the higher pH in a tadpole moves the curve to the right (D). The biological explanations with other ideas are poorly linked and gain no credit.

→ The Bohr effect describes the movement of oxygen dissociation curves down and to the right as the concentration of CO_2 increases. ∴, resulting in the affinity of haemoglobin for O_2 decreasing

→ Tadpole's haemoglobin has a higher affinity for oxygen, as it is shaped less like a sigmoid curve, with a small decrease in partial pressure of O_2 having a large effect on the % saturation of haemoglobin with O_2, (as illustrated by a steeper gradient) with 0 kPa of O_2 resulting in 0% saturation.

→ ~~This is because~~ At a lower blood pH of 6.9, tadpoles have

an 8% higher saturation of haemoglobin than at pH 7.3 at 2kPa of oxygen. This is because a small decrease in the pH of the blood increases the affinity of haemoglobin for oxygen, as tadpoles only live in water and hence require a large store of O_2 for respiration as water contains less O_2 than the air per cm^3, hence it is necessary for tadpoles to have a larger store of O_2 in the blood at any one time than adult frogs. Changes in blood pH have less impact on the dissociation curves for tadpoles.

→ in adult frogs, the Bohr effect occurs as the curve moves downward to the right when the pH of the blood decreases, indicating an increase in O_2 concentration. This because more O_2 is required by respiring tissues to respire aerobically hence the affinity of haemoglobin for O_2 decreases and the % saturation decreases as the partial pressure of oxygen decreases. in a sigmoid curve shape. This is because as adult frogs also live on land, there is more O_2 in atmospheric air than which can be breathed in during gas exchange, hence the haemoglobin must have a lower affinity for oxygen. Frogs are more active than tadpoles as movement on land requires more energy, which is why the curve is S shaped to provide more O_2 easily to respiring tissues, whereas tadpoles are less active and have a smaller body mass, hence a lower partial pressure of O_2 is needed for % saturation of haemoglobin to decrease. as haemoglobin

→ overall the tadpole has a high affinity for O_2 as less O_2 is available in water, and it doesn't exhibit the Bohr effect like the adult frog.

(Total for Question 11 = 16 marks)

ResultsPlus
Examiner Comments

This account gained 9 marks. It is level 3 because two references are linked to habitat: firstly, frog activity on land is linked to haemoglobin affinity for oxygen; secondly, the recognition that there is less oxygen in water than in air. There are at least seven D's and E's to support these two H's, so full marks were awarded.

For both pH the Tadpoles haemoglobin has a greater affinity for oxygen at all pahial presser of oxygen than the adult frog. The shape is also different. For a tadpole as partial presse of oxygen increases the % saturation rapidly increases the begins to level off. This is due to a very high affinity. for a frog the Increase in % saturation starts slow. Increases quickly the begins to decrease in a S shape. this is due to cooperative bonding.

At a partial pressure of 2kpa the % saturation for a tadpole is 96 and 98 %. Increase for a frog it is between 60 % and 24 %.

$\frac{97}{\text{Mean } 42} \times 100$ This is a increase in average affinity of 231 %.

The Reason for this is beause Tadpoles spend the whole time in water whereas frogs may spend some of the time on land. There is a much lower ~~higher~~ partial pressure of oxygen in water than in the air. This means the heamaglobin need a much greater affinity for the oxygen as there is less of it. Oxygn still needs to bind to the heamaglobin in the lungs and dissociate in the respiring tissues. Frogs have adapted to change the heamaglobin This is a a physiological adaptation.

The reason why there is a lower affinity at lower ~~pressure~~ pH is due to the bohr effect. As cells respire more, more CO_2 is increased as O_2 is used CO_2 lowers the pH of the blood so heamaglobin has adapted to lower it's affinity so more oxygen is unloaded in the respiring tissues so aerobic respiration can continue to occur.

ResultsPlus
Examiner Comments

This account has one H where the candidate mentions that there is less oxygen in water than in air, even though it is expressed as ppO_2. There are at least five D's and E's so this answer was given level 2 and a score of six marks.

Paper Summary

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

- Read the question carefully because there may be an unfamiliar command word that needs a little extra thought.
- Write concise answers that include the detail and terminology expected at A Level. Candidates are encouraged to use scientific language worthy of this level of assessment. As such, a term such as 'amount' when referring to volume or concentration is unlikely to gain credit. Similarly, the term nutrient should not be used when glucose or any other named substance is being referred to.
- Try to understand the command words used in the examination paper and make sure that any answer addresses the meaning of each command word. For example, if a question has the command word 'explain' it will not be possible to gain full marks if only a description is offered. Similarly, when asked to justify candidates need to provide reasons to support their answer.
- Always show working in any mathematical question as credit is always available should the final answer be incorrect. Avoid the use of numbers that have too many significant figures in them as this is unlikely to gain credit. As a guide, use the same number of significant figures as in the actual data shown in the question and read the question carefully in case there are clues given.
- Make sure you understand all the core practicals listed in the specification. When carrying out the practicals, try to discuss the reasons for carrying out certain techniques with your partner, if working together, or with your teacher. This is the practical paper, and it is apparent that many candidates seem unable to answer questions that require basic recall of procedures, such as using a microscope or preparing a microscope slide.
- Practise mathematical questions.
- Look at the number of marks available in each question and try to ensure that the answer contains at least that number of themes or ideas.
- Do not waste time by repeating the stem of the question before starting the answer. This time is lost and is unavailable for questions that require unravelling of information in graphs or tables.

Grade Boundaries

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

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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