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Examiners' Report
June 2017

GCE Biology 9BI0 03

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Introduction

This is the first year in which the new A level has been examined. Many of the marking points require more than one idea: in fact, the tighter more focussed mark scheme is one of the key differences between this specification and the previous one. Overall, in the three A-level papers, 10% of the marks are awarded for Level 2 mathematical skills and this has proved a challenge for many candidates. This Specification B paper contains all the questions directed at practical skills. These could be either describing elements of a practical or they could be devising or modifying an investigation. Paper 3 also contains the higher demand command words such as Comment, Justify or Evaluate and these are likely to be used for the extended response question which in this case is worth 9 marks. Many candidates did find some of the new command words difficult. In addition, the command word Suggest is no longer used since it tended to be too vague, not directing the candidates clearly enough to the answer.

Compared to the previous specification, the new A levels have a greater emphasis on the assessment of analytical skills which some find more difficult. On the positive side, there were few signs of time pressure as all items were attempted by most candidates and it was clear that some very able students 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 word Justify. They understood that when Justify was used together with modifying a practical technique, it was not enough to give the modification without explaining why that was carried out.

Paper 3 is the practical principles paper and it is expected that candidates will be familiar with the practical skills and techniques needed in the core practicals from the specification. There is evidence from both last year and this year that this may not always be the case. 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 are encouraged to think about the reasons for certain techniques and of course 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.

More able candidates did score well on this paper and they tended to be those who:

- could analyse unfamiliar information or data;
- performed well with mathematical skills;
- explained an answer clearly;
- had understood the reasons for practical techniques used;
- were able to suggest modifications to practical procedures and explain them;
- were able to devise a practical procedure themselves, even if the context was unfamiliar.

Less able candidates tended to rely more on their revision to enable them to answer Describe questions. They tended to find A01 questions more straightforward than the other two assessment objectives, A02 and A03. There were rather a lot of gaps in their papers but hopefully, next year will see an improvement as they are able to look at past papers and learn from this year.

The assessment of the new A levels places less emphasis on recall and rote learning and it would help students if the teaching reflected this change. Students need to be comfortable in applying the biological principles they learn from the specification to novel situations and unfamiliar data. The more practice they get during their course the better prospect they will have of success in this new specification. Some teachers have been using some of the old material for revision purposes but it is very important that students spend more time on the specimen papers and the Sample Assessment Materials in order to appreciate what is required in this new specification.

There will be feedback courses to help teachers understand more clearly how to assist their students in tackling some of the more demanding and unfamiliar questions.

Question 1 (a)

This question was a simple introduction to the paper and required students to define the term 'bactericidal'. The examiners rewarded answers that indicated that these antibiotics would kill or destroy bacteria. Candidates who only wrote about the mechanism of action of these antibiotics failed to gain credit.

1 Antibiotics are widely used to treat infections.

Some antibiotics are bactericidal.

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

(1)

They kill bacteria by preventing the formation of cross linkages
in the cell wall.



ResultsPlus
Examiner Comments

This candidate scored 1 mark for stating that bacteria are killed.



ResultsPlus
Examiner Tip

Read questions carefully.

1 Antibiotics are widely used to treat infections.

Some antibiotics are bactericidal.

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

(1)

Antibiotics that prevents cross linkage in
the peptidoglycan in bacterial cells.



ResultsPlus
Examiner Comments

This candidate writes about how antibiotics work but fails to define the term 'bactericidal'. 0 marks



ResultsPlus
Examiner Tip

Read questions carefully.

Question 1 (b)

This was a challenging table to analyse and the command word 'comment' requires that data is synthesised and a judgement is made. The judgement in this question related to the time available for the appearance of resistant strains.

This was a challenging table to analyse and the command word 'comment' requires that data is synthesised and a judgement is made. The judgement in this question related to the time available for the appearance of resistant strains.

(b) The table shows information about five antibiotics.

Antibiotic	Year discovered	Time for first resistant strain of bacteria to be detected / years	Number of different types of each antibiotic that exist today
Penicillin	1928	1	>18
Tetracycline	1945	3	>16
Vancomycin	1953	27	1
Linezolid	1978	1	1
Daptomycin	1985	2	1

Analyse the data to comment on the number of types of each antibiotic that exist today. (5)

Penicillins have the most different types of antibiotics at >18 as resistant strains of bacteria were already detected 1 year after 1928, same for Tetracycline as resistant strains were detected 3 years after it was discovered hence, ^{MORE} different types were needed at >16. However Linezolid and Daptomycin only have 1 type even though resistant strains were discovered a year or 2 after. This is due to its unpopularity amongst the masses so it was unlikely to make new types.

Whilst Vancomycin only has 1 different type as the time for resistant strains to appear took 27 years



ResultsPlus
Examiner Comments

This answer gains 4 marks for making reference to mp1, mp3, mp4 and mp5.



ResultsPlus
Examiner Tip

The question wording guides candidates to the last column in the table and most marks were allocated to this column. Candidates are advised to read questions carefully: simply repeating numbers from a table is unlikely to gain credit. It is important to describe numerical data in words.

Question 1 (c)

This question examined understanding of simple aseptic technique as might be required when doing the core practicals in topic 6 of the specification. Six basic ideas were listed in the mark scheme but they served to effectively discriminate candidate responses.

- (c) Describe how you would use aseptic techniques to transfer bacterial cells growing on an agar plate to a tube containing a sterile broth.

(5)

Wash hands with distilled water.

~~Clean~~ ^{Disinfect} Clean the bench with ~~disinfect~~ 1% Virkon.

Light ~~up~~ the Bunsen flame and work near the flame.

Sterile the inoculation wire ^{loop} with the Bunsen flame and allow it cool down. Use ^{the} sterile loop to transfer bacteria.

~~Wash~~ Open the lid of the agar plate to a small extent to prevent other ^{non-target} bacteria falls on the agar plate and being cultured and cause mutations to sample bacteria.

Incubate the bacteria below 37°C to prevent bacteria with potential threat to human being cultured in human body temperature.



ResultsPlus Examiner Comments

This is a brief answer to the question but it gains full marks as five ideas from the mark scheme are evident.



ResultsPlus Examiner Tip

There are more than enough lines on the paper for answers: candidates can get full marks if they adopt an erudite, concise way of writing.

(c) Describe how you would use aseptic techniques to transfer bacterial cells growing on an agar plate to a tube containing a sterile broth.

(5)

For an aseptic technique all equipment must be sterile to prevent contamination in the experiment. Using a sterile inoculating loop gather some bacteria from the agar plate and put the loop into the sterile broth. Mix gently.



ResultsPlus
Examiner Comments

This answer lacks detail; it generalises about aseptic technique. No marks were awarded.



ResultsPlus
Examiner Tip

Candidates are encouraged to write detail in their answers.

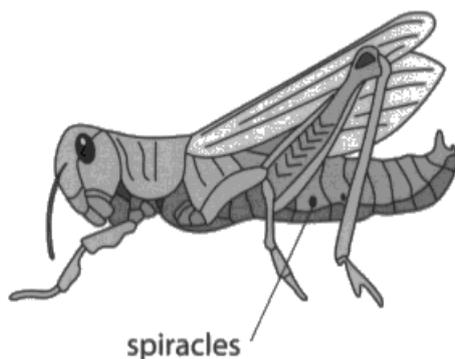
Question 2 (a)

This was another simple procedure that required brief reference to the need to pin the locust, cut open its body and then to flood the dissection with water to allow the air sacs to be visible. This practical is based on core practical 7 in the specification.

2 Insects such as locusts do not breathe through the mouth.

The gas exchange system of a locust includes air sacs, tracheae and tracheoles.

The diagram shows a locust before dissection.



(a) Describe how you would dissect a locust to ensure that the gas exchange system is clearly visible.

(3)

Make a straight incision down the middle of the body not applying too much pressure. pull apart the two openings from the incision to reveal the gas exchange. ensure locust is pinned on a board - easier access.



ResultsPlus Examiner Comments

This student had clearly done this simple procedure but only scored 2 marks because the need to flood with water is not mentioned.



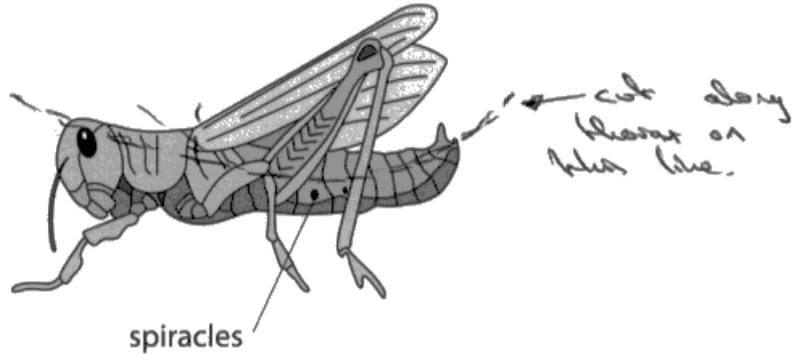
ResultsPlus Examiner Tip

When a question is worth 3 marks try to write at least 3 different ideas to maximise the chance of scoring full marks.

2 Insects such as locusts do not breathe through the mouth.

The gas exchange system of a locust includes air sacs, tracheae and tracheoles.

The diagram shows a locust before dissection.



(a) Describe how you would dissect a locust to ensure that the gas exchange system is clearly visible.

(3)

Firstly, human killing of the locust would occur (killing of the head). Then a incision would be made on the thorax just at the wings. Then from the top of the thorax with a scalpel I would cut along B of the thorax just above the spiracles.



ResultsPlus
Examiner Comments

This student only mentions the need to cut the body open and loses 2 marks for not writing about other ideas.



ResultsPlus
Examiner Tip

In a 3 mark question try to ensure your answer has at least three different themes or ideas.

Question 2 (b)

This was a challenging question for most students mainly because the command word 'comment' is poorly understood. The command word requires the synthesis of a number of variables from data/information to form a judgement. Therefore, a mark scheme will have marks available for evidence of a judgement or judgements being made. So, for example, stating that exhaled air contains other gases alone is insufficient. The mark is only given if it is made clear that these other gases could affect breathing rate.

The student concluded that carbon dioxide increased the breathing rate of the locust.

Comment on how the limitations of this method affect the validity of this conclusion.

- (5)
- carbon dioxide wasn't the only substance^(gases) that was exhaled
 - water vapour is exhaled
 - and there is still other gases in the environment such as O_2 and N_2 which could have altered the results
 - so the conclusion may not be valid
 - the volume of exhaled air, and pure oxygen weren't measured / weren't controlled, so the locust could have given more exhaled air than oxygen or vice versa, which would affect results, so the conclusion may not be valid
 - the locust was immediately given the pure oxygen, so it had no time to recover after receiving exhaled air, so the starting conditions ~~too~~ for both experiments weren't controlled so affected results
 - other controls such as temp weren't controlled which could affect results



ResultsPlus Examiner Comments

This response gained 2 marks: for stating that exhaled air also contains water vapour, and that time to recover is needed after receiving exhaled air.

Question 2 (c)

A significant number of candidates thought that air sacs act as gas exchange surfaces in much the same way as mammalian lungs. Credit was given to those candidates who appreciated that the air sacs provided a reservoir of oxygen and then offered the explanation that this helped respiration in these large/active insects.

(c) Explain the role of air sacs in the gas exchange system of locusts.

(2)

- They can be inflated to supply the locust with more oxygen when it is particularly ^{active} ~~active~~, as they can be ventilated.
- So diffusion can occur more rapidly as the concentration gradient of oxygen between muscles + air is greater.



ResultsPlus Examiner Comments

This response gains 1 mark for the idea of oxygen supply but marking point 2 required the idea of activity to be linked to respiration.



ResultsPlus Examiner Tip

Try to put as much detail as possible into an answer.

(c) Explain the role of air sacs in the gas exchange system of locusts.

(2)

air sacs act as oxygen reservoirs for the insects. They are inflated by mechanical ventilation & are used when the insect ~~is~~ needs more oxygen for respiration, for example when they are flying. The air sacs are collapsible & fill with O_2 for respiration so that the O_2 supply can meet the demand as not enough O_2 can be taken in through the spiracles.



ResultsPlus Examiner Comments

This response gains both marks for the idea of air sacs being oxygen reservoirs for respiration when flying.

(c) Explain the role of air sacs in the gas exchange system of locusts.

(2)

- This is a site of gas exchange.
They have large surface area and which
allows O_2 to diffuse into the blood
and CO_2 out of the blood.



ResultsPlus
Examiner Comments

This response has no credit worthy ideas so gains zero marks.

Question 2 (d)

This question was well answered with many candidates appreciating that single-celled organisms have a large surface area to volume ratio which means that diffusion alone is sufficient. Weaker responses confused the concept of surface area to volume ratio and stated that smaller animals have a smaller surface area to volume ratio.

(d) Locusts have a complex gas exchange system because they are multicellular organisms.

Explain why single-celled organisms do not have a gas exchange system.

(2)

single celled organisms dont require a gas exchange system as their ~~to~~ large surface: Volume ratios and short diffusion distances means that substances needed within the organisms, ^{diffuse} at the rate in which they are needed. Thus eliminating need for respiration.



ResultsPlus

Examiner Comments

This candidate gains full marks for reference to a large surface area to volume ratio and short diffusion distance.

(d) Locusts have a complex gas exchange system because they are multicellular organisms.

Explain why single-celled organisms do not have a gas exchange system.

(2)

single-celled organisms have smaller diffusion distances so a gas exchange system is not ~~required~~ needed to transport the gases. the demands are much lower for single celled organisms so lesser volumes of gases need transporting. single-celled organisms have lower metabolic rates.



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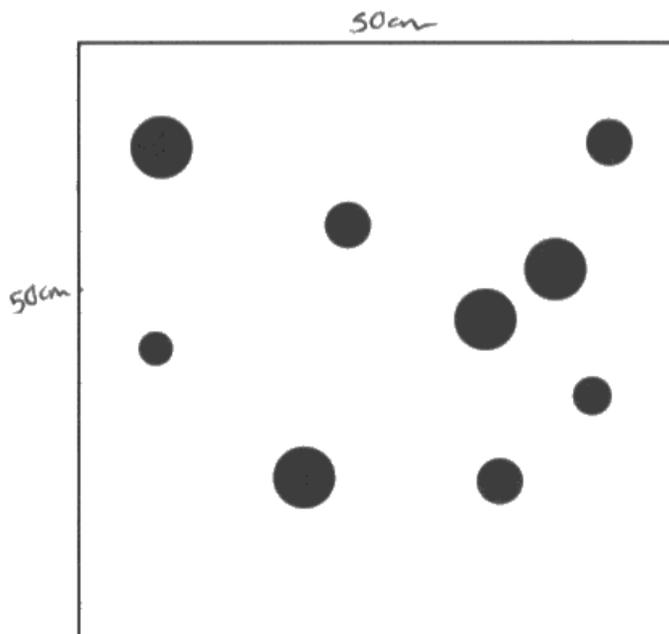
Examiner Comments

This response gains 1 mark for reference to smaller diffusion distance. There is no mention of surface area to volume ratio.

Question 3 (a) (i)

This was the first mathematics question on the paper and seemed to challenge many candidates. The correct answer of 145800 was not often seen. Examiners could still give 1 mark if acceptable working was shown, in particular the values of 2500cm² and 4050m². These values with no units shown did not gain credit.

The diagram shows the distribution of white clover plants in one quadrat from the area of trampled grassland. Each circle represents one clover plant.



- (a) (i) Use the results from this quadrat to calculate the total number of white clover plants present in the area of trampled grassland.

(2)

$$\begin{aligned} \text{total area} &= (90\text{m} \times 45\text{m}) \\ \text{Quadrat} &= (50\text{cm} \times 50\text{cm}) \end{aligned}$$

9 clover in 50cm x 50cm

$$\frac{90}{0.5} = 180 \quad \frac{45}{0.5} = 90 \quad [180 \times 90] = 16200 \text{ quadrants}$$

$$9 \times 16200 = 145800$$

Answer 145800



ResultsPlus Examiner Comments

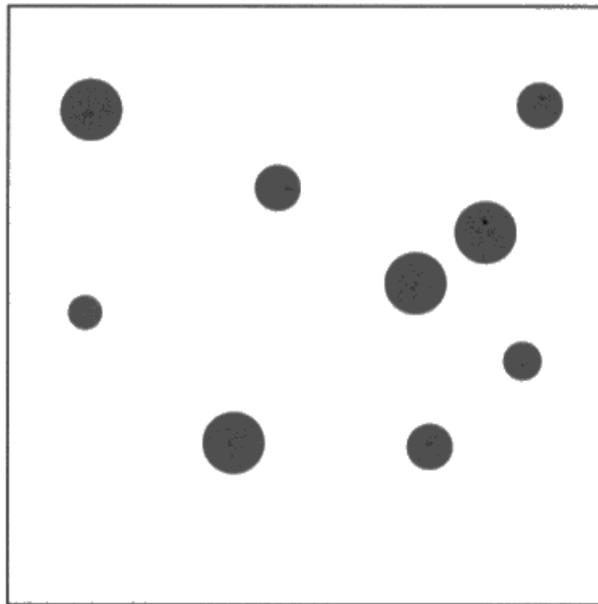
This response gains full marks regardless of what is in the working as the answer provided is correct.



ResultsPlus Examiner Tip

Make sure you write your answer on the line provided.

The diagram shows the distribution of white clover plants in one quadrat from the area of trampled grassland. Each circle represents one clover plant.



- (a) (i) Use the results from this quadrat to calculate the total number of white clover plants present in the area of trampled grassland.

$$100 \text{ cm} = 1 \text{ m}$$

$$9 \text{ plants in } 25 \text{ m}^2$$

(2)

$$50 \times 50 = 2500 \text{ cm}^2 = 25 \text{ m}^2$$

$$9 \times 162 = 1458$$

$$90 \times 45 = 4050$$

$$\frac{4050}{25} = 162$$

Answer 1458



ResultsPlus
Examiner Comments

This response gained zero because the answer is incorrect and the units are missing from 2500 and 4050 in the working.



ResultsPlus
Examiner Tip

Make sure your working is detailed.

Question 3 (a) (ii)

This question challenged candidates to explain how they might modify the method to obtain more accurate results. Most appreciated the need to use more quadrats, or bigger quadrats, and that the random placing of these quadrats was essential. In the better responses, candidates also appreciated that a larger area would then be sampled, or that it might be possible to achieve a consistent measure of the mean. Many stated that a belt transect was a sensible modification, confusing distribution with population size.

- (ii) The student used the same method to calculate the total number of white clover plants in the area of untrampled grassland.

The student decided that the calculated values were not accurate.

Explain how you would modify the method to obtain more accurate results.

(3)

C
R
Q
N
C

The student can use a larger quadrat, such as 1m x 1m. The student can use random sampling, such as random number generator on the calculator, to reduce biasness. The student can ^{repeat and} calculate running mean, to ensure sufficient data and little changes and then extrapolate the number by multiplying by the number of quadrats to estimate the areas. The student can carry out the experiment on the same day time of the day for a few days.



ResultsPlus Examiner Comments

This answer gains full marks for the ideas of using a larger quadrat, random sampling and the use of a running mean.



ResultsPlus Examiner Tip

Look at the total number of marks available and try to include at least that number of distinct ideas in your answer.

- (ii) The student used the same method to calculate the total number of white clover plants in the area of untrampled grassland.

The student decided that the calculated values were not accurate.

Explain how you would modify the method to obtain more accurate results.

(3)

- Use ~~a~~ larger quadrats as samples or use more quadrats ^{and then calculate} to find total number of plants.
- Should have used percentage cover to measure distribution of white clover plants, as some are larger than others.
- Repeat many times and find a mean value for plants per quadrat, then multiply this by factor to get it to 90m x 45m area.
- Student must decide ~~better investigation~~ ^{decide} what constitutes 'trampled grassland', it is subjective so may lead to inaccuracies when deciding what is trampled or untrampled.



ResultsPlus
Examiner Comments

Much of this response is irrelevant. The mark was given for the idea of using a larger quadrat or using more quadrats. These ideas constituted the same marking point.



ResultsPlus
Examiner Tip

Writing irrelevant material will not gain marks; candidates could use the time on other questions.

Question 3 (b) (iii)

Most candidates appreciated that trampled soil would have a lower water content, but only the better responses offered an explanation as to how this could affect the abundance of clover. Credit was also given for appreciating that trampling would cause physical damage to plants, or could allow plants better adapted to compact soil to thrive and compete.

Explain the effect of trampling on the abundance of white clover plants.

(2)

An increase in trampling to an area in question decreases the abundance of white clover plants. A reason for this could be that the pressure exerted by people's feet when trampling the area squeezes the water out of the soil to other areas which would inhibit some plant growth, however there may be other factors to take into consideration.



ResultsPlus Examiner Comments

This answer typifies what most candidates wrote, which is that there is less water in trampled soil. The command word 'explain' means that full marks will not be available unless a biological reason for the reduced abundance of clover plants is given.



ResultsPlus Examiner Tip

Make sure you understand the meaning of all command words.

Explain the effect of trampling on the abundance of white clover plants.

(2)

• Trampling decreases the abundance of white clover plants because it reduces 90% soil water content. ∴ plants have less water available for transpiration and photosynthesis.
• trampled grassland has 61% less water in the soil than ~~an~~ untrampled grassland.



ResultsPlus Examiner Comments

This answer states that there is less water in trampled soil and also links this to the process of photosynthesis. By providing a biological reason for the low abundance of clover plants both marks were gained.



ResultsPlus Examiner Tip

The command word 'explain' indicates the need for biological reasoning in the answer.

Question 3 (b) (i-ii)

Most candidates were able to name an acceptable abiotic factor that could affect the abundance of clover, with light intensity being the most common. Many were also able to describe how their chosen abiotic factor could be measured by naming the apparatus used. However, it was only in the better responses that candidates understood the apparatus should be placed in each quadrat.

(b) The student investigated the effect of one abiotic factor on the abundance of white clover plants.

(i) Name one abiotic factor, other than soil water content, that could affect the abundance of white clover plants in these areas.

(1)

pH of soil

(ii) Describe how you would measure the abiotic factor named in (b)(i).

(2)

You could use a pH meter and stick it into the soil where the plants are present.

This would give you a quantitative result.



ResultsPlus Examiner Comments

This answer gains full marks as it includes an acceptable named abiotic factor, an acceptable apparatus and states where the pH meter should be used.

accurate.

(b) The student investigated the effect of one abiotic factor on the abundance of white clover plants.

(i) Name one abiotic factor, other than soil water content, that could affect the abundance of white clover plants in these areas.

(1)

light intensity

(ii) Describe how you would measure the abiotic factor named in (b)(i).

(2)

Again I would take multiple readings using a random number generator for coordinates. However at the chosen spot I would use a remote colorimeter, this is able to accurately measure a quantifiable reading of light intensity. This would be done on a clear (non-cloudy) day so that weather related readings are not due to increased ^{light} intensity.



ResultsPlus

Examiner Comments

This answer only gains the mark for part (i). The named apparatus is unacceptable and there is no mention of where the apparatus should be placed. In this case, the apparatus named is inappropriate; it would be unlikely that the latter idea would be credited.



ResultsPlus

Examiner Tip

Acknowledge the importance of practical procedures as they form a large part of the assessment in this paper.

Question 4 (a)

This question asked candidates to describe how urea is produced in mammals. Credit was given for appreciating that deamination was involved, that ammonia combines with carbon dioxide and that urea is eventually produced in the ornithine cycle. A significant number of candidates failed to read this question carefully and wrote about urine production instead of urea production.

4 Mammals produce urea as a nitrogenous waste product.

(a) Describe how urea is produced in mammals.

① Deamination of -NH_2 groups from ^{excess} amino acids. ② The amines are converted into ammonia. ③ Ammonia (NH_3) is combined with CO_2 another substance in the Ornithine cycle, producing urea. This occurs in the liver.



ResultsPlus

Examiner Comments

This candidate understands that deamination is involved but fails to link ammonia to carbon dioxide. However, the second mark was awarded for appreciating that urea is produced in the ornithine cycle.

Question 4 (b)

Most candidates were able to recall that the cluster of blood capillaries in the Bowman's capsule is the glomerulus. However, to gain the mark, the term had to have the correct spelling.

Question 4 (c) (i)

Most candidates were able to successfully name this process as ultrafiltration.

Question 4 (c) (ii)

Most candidates appreciated that molecular size was the reason why some molecules appeared in the filtrate and others did not. Simply stating that protein is a big molecule or that urea is a small molecule was insufficient. Candidates needed to relate molecular size to the difficulty in passing through the barriers that exist at the Bowman's capsule. Candidates also needed to understand that full marks are not going to be given if the answer only contains a description. The only mark available for description in this question was that smaller molecules have the same concentration in the plasma and filtrate.

- (ii) Analyse the data to explain the difference between the protein and the other molecules or ions in the filtrate in Bowman's capsule.

(3)

The data shows that protein is 7 to 9 % in the blood plasma of the kidney, however is 0% of the ~~fit~~ filtrate produced in Bowman's capsule and urine in the bladder. All other molecules except water has a % of 0.1 - 0.37 filtrate produced in the Bowman's capsule. This is because protein is useful for our bodies so it does not ~~go~~ into become a part of ~~urine~~ ^{urine} ~~urine~~ urea as it is not a waste product. Sodium and Chloride ions have a % filtrate and % urine concentration because they are not essential to the body's needs and so can be excreted.



ResultsPlus Examiner Comments

This answer has no marking points evident. The candidate simply describes the concentrations and fails to appreciate that the questions demands an explanation.



ResultsPlus Examiner Tip

When asked to explain, credit is given for a biological reason - not for describing by putting the data into words.

(ii) Analyse the data to explain the difference between the protein and the other molecules or ions in the filtrate in Bowman's capsule.

(3)

No protein molecules are produced in the Bowman's capsule. This is because the molecules are too large to fit through the basement membrane. The largest amount of filtrate produced is shown is water. This is because water is reabsorbed as the membrane becomes permeable to water. These molecules are small so they can pass through.



ResultsPlus
Examiner Comments

This candidate scores 2 marks for explaining why protein is not found in the filtrate and that smaller sized molecules are found in the filtrate. The only idea missing from the answer is the observation that smaller molecules have the same concentration in the plasma and filtrate.



ResultsPlus
Examiner Tip

Full marks cannot be gained if you only describe when you are asked to explain.

Question 4 (c) (iii)

This question challenged many candidates. There were three stages involved in getting the correct answer: calculation of the increase in urea concentration; calculation of the increase in chloride concentration, and finally, calculation of how many times more concentrated urea is than chloride. Many subtracted rather than divided to calculate the increase in concentrations, and continued to subtract thereafter. The correct answer was automatically credited with full marks but was only credited if it was expressed to no more than two decimal places. The same logic was applied to allowing for marks in the working if the correct answer was not evident.

(iii) Urea and chloride ions both become more concentrated as they pass from Bowman's capsule to the urine in the bladder.

Calculate how many more times urea becomes concentrated compared with chloride ions.

$$\frac{2.}{0.03} = 66.67 \quad \frac{66.67}{1.62} = 41.1 \quad (3)$$

$$\frac{0.60}{0.37} = 1.62$$

Answer 41.1



ResultsPlus Examiner Comments

The answer of 41.1 was not one of the four acceptable answers but 66.67 and 1.62 were acceptable in the working, so this candidate gained 2 marks. If candidates are working to 2 decimal places, their answer should be expressed to 2 decimal places.



ResultsPlus Examiner Tip

Always show your working because marks can be credited even if the final answer is not correct.

are useful to the body so they do not diffuse across due to
 (iii) Urea and chloride ions both become more concentrated as they pass from the low concentration gradient Bowman's capsule to the urine in the bladder.

Calculate how many more times urea becomes concentrated compared with chloride ions.

$$\begin{array}{l} 0.03 \rightarrow 2 \quad \times 66.7 \\ 0.37 \rightarrow 0.6 \quad \times 1.62 \end{array} \quad (3)$$

$$66.7 \div 1.62 = 41.2 \text{ times}$$

Answer 41.2



ResultsPlus
 Examiner Comments

This response gained all 3 marks regardless of any working shown, as 41.2 is one of the four acceptable answers.

now the 7-4% of protein has left.

(iii) Urea and chloride ions both become more concentrated as they pass from Bowman's capsule to the urine in the bladder.

Calculate how many more times urea becomes concentrated compared with chloride ions.

UREA $\frac{2.0}{0.03} = 6.67 \times \text{concentrated}$ (3)

Chloride $\frac{0.60}{0.37} = 1.62 \times \text{concentrated}$

$\frac{6.67}{1.62} = 4.12 \times \text{more concentrated the chloride}$

Answer 4.12



ResultsPlus
 Examiner Comments

The answer of 4.12 is incorrect. Although this candidate has divided, the value of 6.67 is incorrect but the value of 1.62 is acceptable, and it is for this working that 1 mark is awarded.

(iii) Urea and chloride ions both become more concentrated as they pass from Bowman's capsule to the urine in the bladder.

Calculate how many more times urea becomes concentrated compared with chloride ions.

(3)

$$\text{urea } 2 \div 0.03 = 66.6$$

$$\text{chloride } 0.6 \div 0.37 = 1.621$$

Answer 64.98 (2dp)



ResultsPlus
Examiner Comments

This candidate scored zero because the answer is incorrect and the working gives values that have inappropriate rounding. Had this candidate divided 66.6 by 1.621 to give an answer, one mark would have been available.

Question 4 (c) (iv)

This question asked for an explanation for the fact that there is no glucose in the bladder. Credit was given for answers that discussed the reabsorption of glucose by active transport at the proximal convoluted tubule.

(iv) Analyse the data to explain the glucose concentration in the bladder.

(2)

Glucose in the blood plasma enters the filtrate via ultra filtration. However, this glucose is required by the body so it for respiration so is returned to the blood via selective reabsorption.



ResultsPlus

Examiner Comments

This answer gains one mark for reference to reabsorption.



ResultsPlus

Examiner Tip

The first two sentences are not needed. Candidates need to be precise with their answers.

(iv) Analyse the data to explain the glucose concentration in the bladder.

(2)

glucose is a small molecule & so it will enter the Bowman's capsules but it being reabsorbed from proximal tubule during the absorption process.



ResultsPlus

Examiner Comments

This is a better answer because it also points out the location of the reabsorption.

Question 4 (c) (v)

This question tested understanding of the role of the loop of Henle in producing concentrated urine. The mark scheme credited ideas relating to events at the ascending limb and collecting duct. Most candidates gained a few marks but only the best responses explained five of the six available ideas in the mark scheme in a concise manner.

(v) Explain how the loop of Henlé is involved in the production of concentrated urine.

(5)

The loop of Henle operates on a counter-current basis whereby the ascending loop is impermeable to water whilst the descending loop is impermeable to ions. This means that at the ascending loop, water cannot ~~leave~~ the filtrate as the loop is impermeable, ~~but ions continue~~ to diffuse out ~~of~~ into the medulla ensuring that the medulla is always more concentrated than the filtrate. At the descending loop, water leaves the filtrate and enters the blood capillaries, making the filtrate more concentrated as well as the medulla because there is less water available. This means that the medulla remains salty so a maximum ^{concentration} gradient can be obtained along the whole length of the medulla. This then allows maximum water to be reabsorbed from the filtrate in the collecting duct as it passes through the salty medulla. Because water moves from where it is at a higher concentration (the filtrate) to where it is at a lower concentration (the medulla) and thus enters the blood making the urine less dilute and minimising excess water loss.



ResultsPlus Examiner Comments

This is a typical example of an answer that lost credit because it lacked detail and precision. The marks were awarded for knowing the ascending limb is impermeable to water and that the medulla has a low water potential.

Marking point 4 was not given because the term 'multiplier' is absent. Marking point 1 is not awarded because the ions are not named and the process of diffusion is incorrect. Marking point 6 is not given because the term 'osmosis' is not evident. The collecting ducts are mentioned, but not their permeability.



ResultsPlus Examiner Tip

Appreciate that marking points often have more than one idea that must be satisfied before the mark is awarded. So, detail and precision are essential.

Question 5 (a)

The vast majority of candidates were able to name the type of inhibition produced by the fluoride ions as being 'competitive'.

Question 5 (b)

This levels-based question tested the ability of candidates to modify the apparatus and then to describe how the modified apparatus could be used. Finally, the question demanded reference to how significance could be established regarding the rate of anaerobic respiration. A variety of means of analysis was credited such as calculating a mean, plotting a graph or calculating the volume from the tube diameter. Higher level analysis required reference to statistical analysis.

Reference to analysis was used to decide on the level in which an answer could be put. A response had to have reference to at least one way in which analysis could be carried out to be deemed worthy of level 2, and at least two ways in which analysis could be carried out to be deemed worthy of level 3. Marks within each level depended on the number and quality of the indicative points for modifying, using the modified apparatus and reference to ways of analysis. The top mark of 9 was only given if reference to statistical testing was given as one of the ways of analysis.

A number of responses failed to remove the woodlice and these responses were restricted to level 1. Inappropriate methods that measured aerobic respiration or kept the KOH were restricted to level 2, provided that at least one way in which analysis could be carried out was evident.

Discuss how you would modify this apparatus and use it to find out if fluoride ions have a significant effect on the rate of anaerobic respiration in yeast.

(9)

Keep the temperature constant in the reaction using a water bath. Remove potassium hydroxide solution in the tube. Fill the glass tube with a liquid and visualize the level of liquid with a scale reading. Remove oxygen from the tube. Use woodlice with similar size and surface area. Put woodlice with fluoride ions in the tube and record the level of liquid every 20 seconds. For control set-up, Put woodlice with no fluoride ions in another tube with same environment. Record the level of liquid in the same time interval. Calculate the volume of carbon dioxide produced by the

woodlice by anaerobic respiration.

Compare the results of the control set-up and the ~~the~~ set-up with fluoride ions.

Carry out repeats to obtain more data.



ResultsPlus Examiner Comments

This example was given a mark of 3. There are many ideas from the indicative content but this candidate is using woodlice and so is restricted to Level 1.



ResultsPlus Examiner Tip

Read the question carefully. This question expects the modification to replace woodlice with yeast.

Discuss how you would modify this apparatus and use it to find out if fluoride ions have a significant effect on the rate of anaerobic respiration in yeast.

(9)

1. Replace the woodlice with yeast cells.

~~2. Remove the KOH solution & replace it with limewater to absorb CO₂.~~

3. Also add a mixture of varying concentrations (i.e. repeating the experiment with different conc's concentrations of fluoride ions)

4. Have a spot of coloured dye in the glass tube along with a scale so you can calculate the CO₂ used up.

5. Have a CO₂ rich, set concentration of gas in the apparatus.



ResultsPlus Examiner Comments

This example scored 3 marks. There are four ideas worthy of indicative content and the candidate has replaced woodlice with yeast, but there is no reference to analysis which restricts the answer to Level 1.

Discuss how you would modify this apparatus and use it to find out if fluoride ions have a significant effect on the rate of anaerobic respiration in yeast.

3000
E
(9)

- Woodlice is removed since it can affect volume of O_2 and CO_2 and it is not being investigated
- Remove the potassium hydroxide since the volume of CO_2 produced from anaerobic respiration will be the measure of rate of respiration
- Add yeast solution to absorb Oxygen from test tube
- ~~Add yeast and solution~~ Fluoride ions in solution
- Use a straight glass tube instead of a bended U-shape and place a ruler or some type of scale next to it to measure distance moved by coloured liquid. Ensure every tube is air sealed.
- Add yeast and fluoride ions and leave for known length of time.
- After time, measure how far ^{distance} colour liquid has moved (h)
Find volume of CO_2 by $V = \pi r^2 h$ where r is radius of capillary glass tube
Divide volume of CO_2 by time yeast left in fluoride ions apparatus to get rate.
- Repeat investigation without fluoride ions to measure effect on rate of anaerobic respiration
- Repeat each experiment at least 5 times and calculate mean rate of anaerobic respiration.
- Ensure temperature kept constant by using a ^{thermostatically controlled} water bath.
- Ensure pH kept same using buffer solution.



ResultsPlus Examiner Comments

This answer was given a score of 8. There are many ideas from the indicative content, the woodlice have been replaced by yeast and the method is appropriate. In addition, there are two references to analysis - calculation of rate and calculation of mean. However, to get the top mark at least one analysis had to be a reference to statistical testing.



ResultsPlus Examiner Tip

Levels-based questions are not about the quantity that is written - they are about the quality of the answer produced.

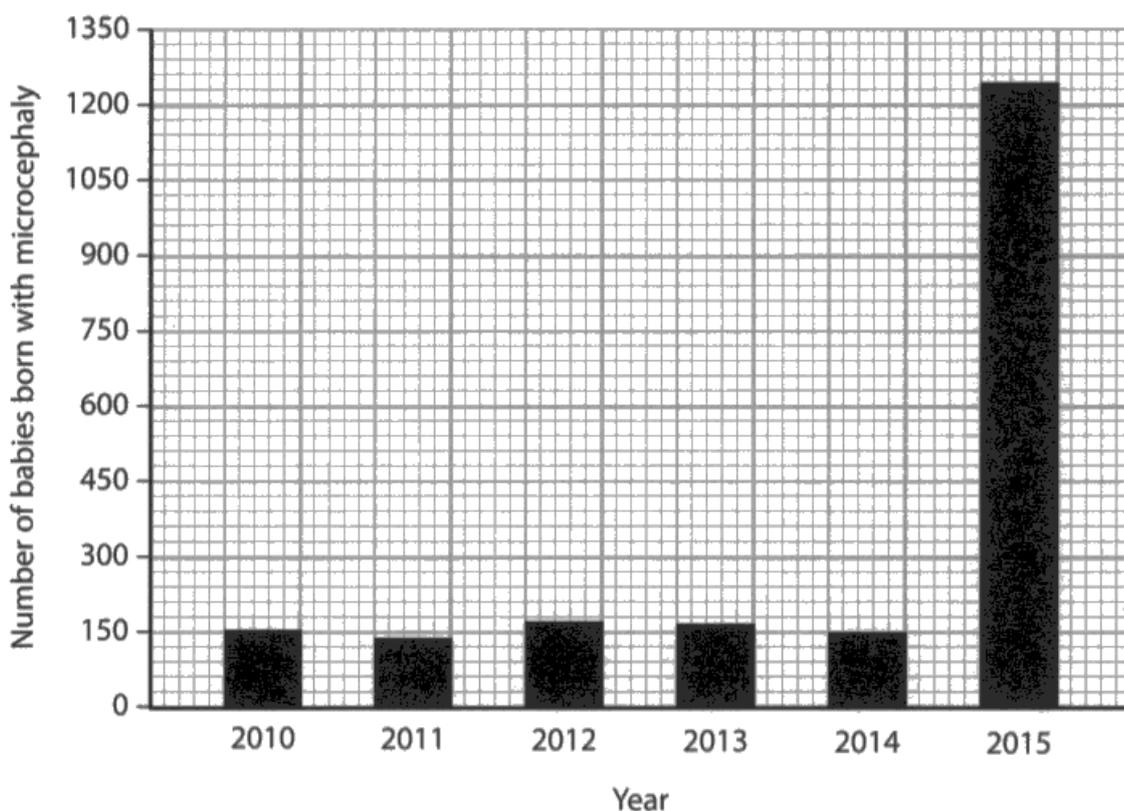
Question 6 (a)

This question required candidates to read values from the graph and then use them to calculate a percentage. A large number struggled to read the correct values from the graph. If the candidate did not give the correct answer, credit was given for the correct values from the graph if they were present in the working. The values accepted were 150 for 2014 and a range between 1240 to 1245 for 2015.

- 6 In February 2016, the World Health Organisation (WHO) declared a public health emergency because of the spread of the Zika virus.

The mild symptoms, such as joint pains, headaches and a slight temperature increase lasted only a few days. However, Zika virus has been linked to a birth defect called microcephaly.

The graph shows the number of babies born with microcephaly in Brazil from 2010 to 2015.



- (a) Calculate the percentage increase in the number of babies born with microcephaly in 2015 compared with 2014.

(2)

Answer 200 %



ResultsPlus
Examiner Comments

The answer is incorrect and there is no working to award a mark, so this response gains zero.



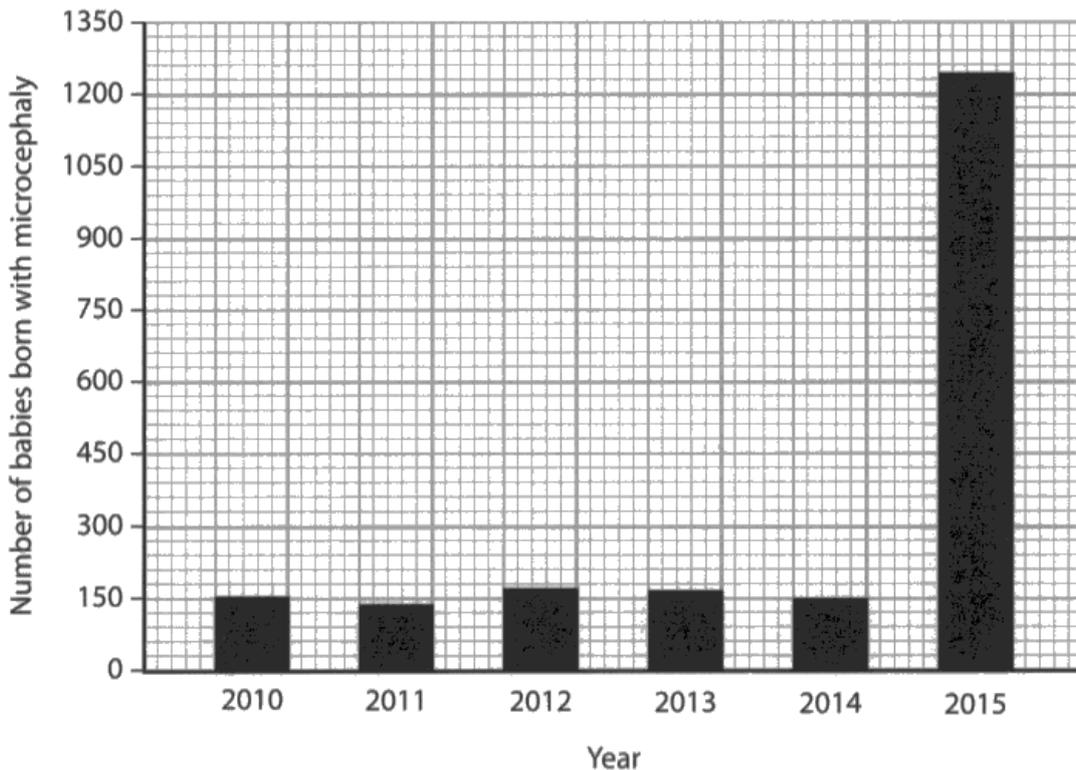
ResultsPlus
Examiner Tip

Always show your working as marks are available from your working if your answer is incorrect.

- 6 In February 2016, the World Health Organisation (WHO) declared a public health emergency because of the spread of the Zika virus.

The mild symptoms, such as joint pains, headaches and a slight temperature increase lasted only a few days. However, Zika virus has been linked to a birth defect called microcephaly.

The graph shows the number of babies born with microcephaly in Brazil from 2010 to 2015.



- (a) Calculate the percentage increase in the number of babies born with microcephaly in 2015 compared with 2014.

(2)

$$\begin{aligned} 2014 &= 150 \text{ babies} \\ 2015 &= 1245 \text{ babies} \end{aligned}$$

$$1245 - 150 = 1095$$

$$\frac{150}{1095} = \cancel{0.14} \times 100 = \text{Answer } 14 \dots \dots \dots \% \\ \cancel{14} \dots \dots \dots 14\%$$



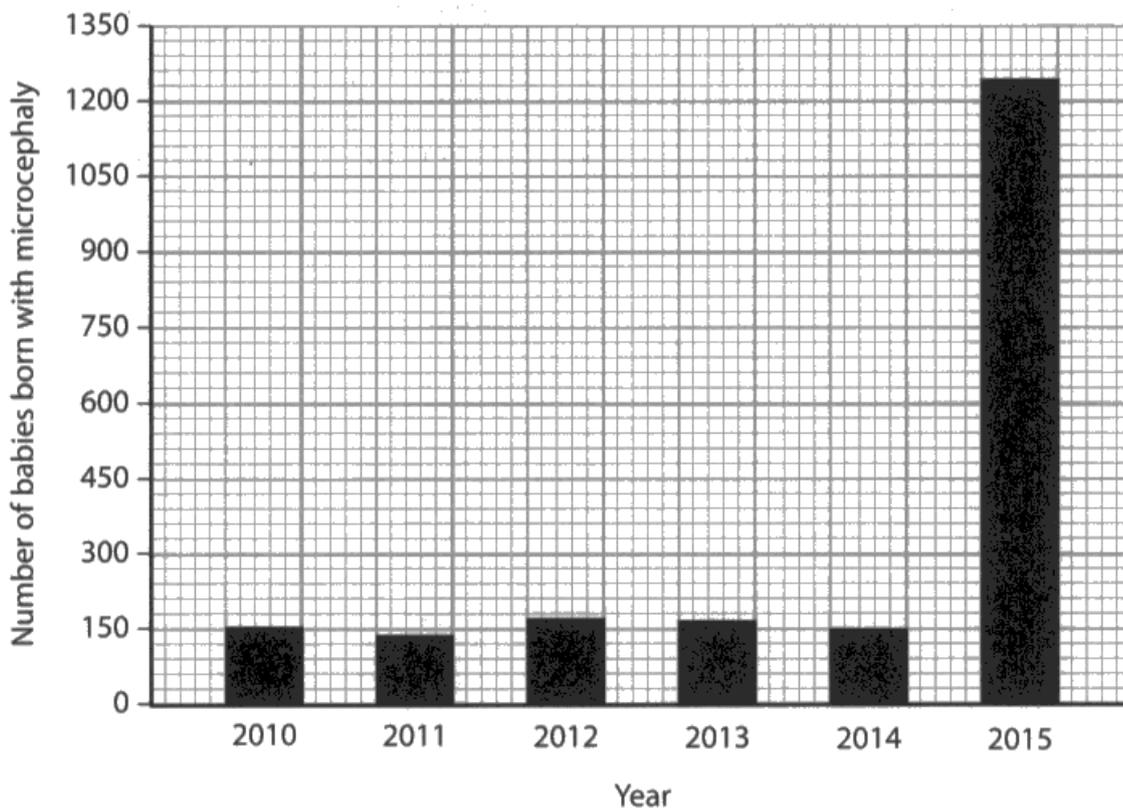
ResultsPlus
Examiner Comments

The answer is incorrect but the working shows correct readings from the graph of 150 and 1245, so 1 mark was awarded.

- 6 In February 2016, the World Health Organisation (WHO) declared a public health emergency because of the spread of the Zika virus.

The mild symptoms, such as joint pains, headaches and a slight temperature increase lasted only a few days. However, Zika virus has been linked to a birth defect called microcephaly.

The graph shows the number of babies born with microcephaly in Brazil from 2010 to 2015.



- (a) Calculate the percentage increase in the number of babies born with microcephaly in 2015 compared with 2014.

(2)

$$150 \rightarrow 1240$$

$$\frac{1240}{150} \times 100 = 826.6$$

$$- 100$$

$$= 726.6$$

$$\approx 727$$

Answer 727 %



ResultsPlus
Examiner Comments

The answer of 727 is within the acceptable range so both marks were awarded.

Question 6 (b) (i)

Most candidates were aware of why antibiotics are ineffective against viruses. The most common accepted response was that they are non-living. The second marking point required candidates to not only understand that antiviral drugs are needed, but also to explain why. As such, candidates also needed to mention that antiviral drugs inhibit replication before they could be given credit.

(b) Zika virus is transmitted to humans by infected mosquitoes.

(i) Explain why another type of drug, rather than antibiotics, has to be used to treat Zika virus infections.

(2)

Antibiotics are used against bacterial pathogens but the Zika virus infections are caused by a virus therefore the antibiotics will not be effective against them and other types of drugs has to ^{be} used such as antiviral drugs.



ResultsPlus Examiner Comments

This answer gained no marks. There is no reference to viruses being non-living and although antiviral drugs are mentioned there is no link to them inhibiting replication.

Many answers were like this one, explaining that antibiotics are only effective against bacteria and not against viruses and then not offering an explanation.

(b) Zika virus is transmitted to humans by infected mosquitoes.

(i) Explain why another type of drug, rather than antibiotics, has to be used to treat Zika virus infections.

(2)

Antibiotics ~~do~~ are not effective on ~~other~~ viral infections, as viruses are not ~~the~~ living organisms. Therefore antivirals or vaccines have to be used instead.



ResultsPlus Examiner Comments

This response gained a mark for the idea of viruses not being living organisms but then fails to explain why antiviral drugs need to be used.



ResultsPlus Examiner Tip

When asked to explain you need to provide detailed biological reasons.

Question 6 (b) (ii)

This question was challenging to most candidates. Credit was given for answers that made it clear that identification of fluorescent mosquitoes was needed because these mosquitoes would definitely be genetically modified. These GM mosquitoes could then be allowed to breed, a process that could be repeated for several generations.

(ii) Scientists have suggested that genetically modified (GM) mosquitoes could be used to help combat the spread of the Zika virus.

Mosquito eggs are injected with DNA, from GM mosquitoes. This DNA contains a gene for fluorescence. However, only one in a few thousand injected eggs results in a GM mosquito.

Explain how this procedure could help in the production of large numbers of GM mosquitoes.

(4)

Mosquitos reproduce in very large numbers so even though only 1 in 1000 eggs result in a GM mosquito, because of the large numbers of offspring, there will be more GM mosquitos created. Because they have a gene for fluorescence they can be easily identified by using a UV light. Therefore, the successful GM mosquitos can be identified easily by scientists, captured, and then bred together to produce a large number of GM mosquitos.



ResultsPlus
Examiner Comments

This answer gained 3 marks for evidence of marking points 1, 2 and 3.

- (ii) Scientists have suggested that genetically modified (GM) mosquitoes could be used to help combat the spread of the Zika virus.

Mosquito eggs are injected with DNA, from GM mosquitoes. This DNA contains a gene for fluorescence. However, only one in a few thousand injected eggs results in a GM mosquito.

Explain how this procedure could help in the production of large numbers of GM mosquitoes.

(4)

the DNA from genetically modified mosquitoes are injected into
the mosquito eggs before they are born



ResultsPlus
Examiner Comments

This is a poor answer gaining no marks as there is no evidence of any of the marking points.

Question 6 (b) (iii)

Most candidates gained at least 1 mark for appreciating that mosquito nets prevent people being bitten. The better answers then made it clear that this would reduce the spread of Zika or appreciated that mosquitoes are vectors for other diseases and therefore the spread of these diseases would be reduced.

(iii) Explain why the Brazilian government has advised people to use mosquito nets, even if they have already contracted the Zika virus.

(2)

To prevent further mosquitoes from biting and picking up the virus (from the blood) and transferring it to someone else. Other infectious diseases may also be prevented, like malaria. So, mode of transmission is halted.



ResultsPlus

Examiner Comments

This answer contains all three marking points but can only be awarded a maximum of 2. The answer shows that biting is prevented, so is the spread of Zika. It also shows that the spread of another disease - malaria - is prevented.

(iii) Explain why the Brazilian government has advised people to use mosquito nets, even if they have already contracted the Zika virus.

(2)

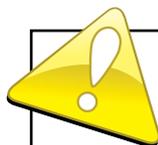
Mosquitoes can also carry another harmful pathogen that can infect humans known as the malarial parasite which can cause malaria.



ResultsPlus

Examiner Comments

This answer only demonstrates the idea that mosquitoes spread other diseases so gains 1 mark.



ResultsPlus

Examiner Tip

Look carefully at the number of marks available and try to include at least that number of individual ideas in the response.

Question 6 (c) (i)

The correct response of 315 was seen in many answers but a surprising number wrote 35.

Question 6 (c) (ii)

This was a challenging question that required candidates to appreciate that this unusual virus uses its RNA directly in translation to make viral protein and to make more copies of its RNA.

(ii) Unlike human immunodeficiency virus (HIV), Zika is not a retrovirus.

Describe what happens to the Zika RNA once it is in the cell.

(2)

Stats to ~~reproduce~~ replicate RNA strand
in the nucleus of cell.



ResultsPlus
Examiner Comments

This response gains 1 mark for the idea of making more RNA.

(ii) Unlike human immunodeficiency virus (HIV), Zika is not a retrovirus.

Describe what happens to the Zika RNA once it is in the cell.

(2)

RNA is used directly as mRNA for translation once
in the cell. So directly creates viral proteins with
the host. It can also mutate many times changing its antigenic
structure.



ResultsPlus
Examiner Comments

This response gains 1 mark for the idea of translation and viral protein.



ResultsPlus
Examiner Tip

A response worth 2 marks will need two distinct ideas in the answer if full marks are to be credited.

Question 6 (d)

This question challenged candidates, with many making incorrect reference to restriction enzymes cutting the polyprotein. Credit was given for the idea that peptide bonds would be broken/hydrolysed and that a protease enzyme would be involved.

- (d) During the replication of the Zika virus, the ten proteins that are coded for in the RNA are produced as a single polyprotein molecule.

Explain how this polyprotein molecule is converted into ten separate protein molecules.

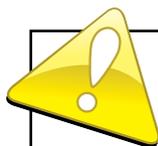
(2)

The polyprotein molecule is cut either by hydrolysis which displaces water. Restriction endonuclease which is a cutting enzyme. Or a spliceosome which is a multi enzyme complex and can cut molecules and rejoin them.



ResultsPlus Examiner Comments

This answer shows confusion over the enzyme involved and makes no mention of the bonds that are hydrolysed so no credit was given.



ResultsPlus Examiner Tip

Read questions carefully. It is clear that a polyprotein is involved not DNA, so mention of restriction enzymes is inappropriate.

- (d) During the replication of the Zika virus, the ten proteins that are coded for in the RNA are produced as a single polyprotein molecule.

Explain how this polyprotein molecule is converted into ten separate protein molecules.

(2)

peptide bonds between the amino acids break at different points in the polyprotein molecule so it is split into ten separate protein molecules.



ResultsPlus Examiner Comments

This answer mentions the correct bonds but makes no reference to the enzyme involved.

Question 7 (a)

This question required straightforward use of the Hardy Weinberg equation but seemed to challenge many students.

Many were able to calculate q^2 as 0.0004, but then used this number to calculate the value of p using the $p + q$ equation, giving the wrong value of 0.9996.

The correct answer of 3.92% was only seen in about half of the responses. Credit could be given for the working if the answer was incorrect. Credit was given for each stage of the calculation in a cumulative fashion.

(a) The incidence of babies born with cystic fibrosis in Australia is 1 in 2500.

Use the Hardy Weinberg equation, $p^2 + 2pq + q^2 = 1$, to calculate the percentage of Australians who are carriers of cystic fibrosis.

(4)

$$\begin{aligned}q^2 &= 0.0004 \\q &= 0.02 \\(p+q)^2 &= 1 \\p+0.02 &= 1 \\p &= 0.98 \\p^2 &= 0.9604\end{aligned}$$

$$\begin{aligned}p^2 + 2pq + q^2 &= 1 \\0.9604 + 2pq + 0.0004 &= 1 \\2pq &= 0.0392\end{aligned}$$

Answer 3.92 %



ResultsPlus
Examiner Comments

This is an excellent response with clearly laid out working and the correct answer. It gains all 4 marks.

(a) The incidence of babies born with cystic fibrosis in Australia is 1 in 2500.

Use the Hardy Weinberg equation, $p^2 + 2pq + q^2 = 1$, to calculate the percentage of Australians who are carriers of cystic fibrosis.

(4)

$$q^2 = \frac{1}{2500}$$

~~Area~~

$$q = \sqrt{\frac{1}{2500}} = 0.02$$
$$p + q = 1$$
$$p = 0.98$$
$$p^2 = 0.9604$$

~~Area~~

$$2pq = 0.0392 \approx 4\%$$

Answer 4 %



ResultsPlus

Examiner Comments

The answer has been rounded up to 4 which is incorrect, but the working clearly shows the cumulative steps needed to get as far as 0.0392, so 3 marks were awarded.



ResultsPlus

Examiner Tip

Always show your working as marks are available if your answer is incorrect.

Question 7 (b)

This question was well answered but the layout of the responses often left much to be desired. In weaker responses, candidates failed to choose the same letter to represent the alleles, or used X and Y symbols, or used the letters p and q.

- (b) A woman is a carrier of the cystic fibrosis allele. Her partner does not have cystic fibrosis and is not a carrier.

Use a genetic cross to determine the probability of this woman producing a child who is also a carrier.

(4)

Woman

	P	q
Partner	P	Pq
	P	Pq

PP = not carrier
not infected

Pq = carrier

1:1

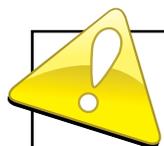
Probability 0.5



ResultsPlus

Examiner Comments

This answer shows all the marking points but loses one mark for using different letters to represent the alleles.



ResultsPlus

Examiner Tip

When choosing letters to represent dominant and recessive alleles, always choose the same letter but make one a capital letter.

(b) A woman is a carrier of the cystic fibrosis allele. Her partner does not have cystic fibrosis and is not a carrier.

Use a genetic cross to determine the probability of this woman producing a child who is also a carrier.

let cystic fibrosis allele = a normal, a disease ⁽⁴⁾ allele.

$Aa \times AA$

	Aa
Aa	$AA Aa$
Aa	$AA Aa$

\therefore ch carrier = $\frac{1}{2}$.

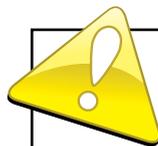
Probability 50%



ResultsPlus

Examiner Comments

This answer shows all the marking points, albeit in a Punnett square, and was given full marks.



ResultsPlus

Examiner Tip

With genetics questions make sure to show the parental genotypes and gamete genotypes as distinct entities.

Question 7 (c) (i)

This question required candidates to understand that the 7.0% salt solution would lower the water potential in the mucus and that this would cause osmotic uptake from the lung cells. Responses tended to use language that lacked the detail required at A level.

- (i) Explain why only the fine spray of 7.0% salt solution resulted in mucus that contained more water.

(2)

7.0% solution is hypertonic that has higher salt concentration than body fluid, so water will diffuse out from cells down water potential gradient via osmosis, mucus produced contains more H₂O.



ResultsPlus Examiner Comments

This student gained both marks for stating that the mucus would be hypertonic and that water would move into it by osmosis. Failure to have used the term 'osmosis' would have lost the second mark.

- (i) Explain why only the fine spray of 7.0% salt solution resulted in mucus that contained more water.

(2)

The 7.0% salt solution increased the water potential of the mucus. Therefore more water moved into the mucus. The 0.9% salt solution was not enough change to the water potential to result in a noticeable difference.



ResultsPlus Examiner Comments

This answer incorrectly describes the water potential in the mucus and also fails to use the term 'osmosis' when describing the water movement. A mark of zero was given.



ResultsPlus Examiner Tip

When describing water potential note that a low water potential equates to a strong solution.

- (i) Explain why only the fine spray of 7.0% salt solution resulted in mucus that contained more water.

(2)

The 7.0% salt solution is a more concentrated solution and will therefore affect the water potential of cells in the lungs. Causes the mucus to ~~be~~ contain more water as water will move into the ^{mucus} ~~airways~~ from the blood & tissue fluid by osmosis from an area of high Ψ to an area of low Ψ because the salt solution has caused Ψ to become more negative.



ResultsPlus
Examiner Comments

It is clear that this candidate understands the concept of water potential and that the water will move by osmosis so both marks were awarded.



ResultsPlus
Examiner Tip

This candidate uses a symbol to represent water potential which is acceptable. The use of symbols or abbreviations needs careful thought as they may not always be known or acceptable in the mark scheme. In this paper many used the PCT for the proximal convoluted tubule in question 4(c)(iv). This representation was accepted but other letter combinations may not be in future examinations.

Question 7 (c) (ii)

This question required candidates to appreciate that the 0.9% salt solution was isotonic and therefore there would be no osmotic effect. Candidates struggled to grasp these ideas, more often commenting on the possible effects of pure water.

- (ii) Explain why the control group inhaled a fine spray of 0.9% salt solution, rather than a fine spray of pure water.

(2)

Cells surrounding the mucus do not contain pure water ~~due~~ due to the solutes and components in the cell
∴ using pure water would cause the water to enter the cell.
Instead, a salt spray of 0.9% salt solution was used as this will be isotonic to the solution inside the cells surrounding the mucus so there will be no net movement of water between cells and mucus

(Total for Question 7 = 12 marks)



ResultsPlus Examiner Comments

This answer started to gain credit on the fourth line. Both marks were awarded for understanding that the isotonic nature of 0.09% saline will result in no movement of water. In this question the term 'osmosis' was not required.



ResultsPlus Examiner Tip

The first three lines are not relevant. Only relevant information can gain credit and the time could be used on other questions.

- (ii) Explain why the control group inhaled a fine spray of 0.9% salt solution, rather than a fine spray of pure water.

(2)

0.9% salt solution is isotonic to ~~the~~ human body fluid. If a fine spray of pure water is used, the cells may burst as water goes into cells by osmosis.



ResultsPlus Examiner Comments

This candidate gets 1 mark for reference to isotonic but fails to link this to lack of water movement.

Question 8 (a) (i)

Candidates were rewarded for appreciating that red light is absorbed by chlorophyll. Red light absorption by pigment only gained one mark. Many wrote about phytochrome pigments and this level of poor understanding was not credited.

(i) Explain why red light was used in this investigation.

(2)

~~When red light is~~ Red light is absorbed by the green pigment in dastine, to allow photosynthesis to occur. Red light is used because the pzment will absorb it, so it will give good results.



ResultsPlus

Examiner Comments

This answer gained 1 mark for the idea of red being absorbed but there is no reference to chlorophyll so the second mark was not awarded.

(i) Explain why red light was used in this investigation.

(2)

Red light is ~~at~~ highly absorbed by ~~chlorophyll~~ chlorophyll according to the absorption spectra.



ResultsPlus

Examiner Comments

The ideas of red light being absorbed by chlorophyll are both evident so 2 marks were awarded.

(i) Explain why red light was used in this investigation.

(2)

Red light has the lowest wavelength and would be the only light able to pass through



ResultsPlus

Examiner Comments

This answer lacks reference to any of the ideas in the mark scheme so it gained no marks.

Question 8 (a) (ii)

This question rewarded students who appreciated that leaf pigment would be present because the cutting process would have damaged the leaf cells.

(ii) Explain the absorbance value at 0 minutes.

(2)

The student did not wash or leave the leaf disks in distilled water so excess pigment not washed off that occurred due to cutting hence at 0 in mins an absorbance reading occurred - no excess pigment washed.



ResultsPlus
Examiner Comments

This response contains both marking points and was given full marks.

(ii) Explain the absorbance value at 0 minutes.

(2)

The time between placing the cuvette into the colorimeter, absorbance would have increased due to washing this present in the environment.



ResultsPlus
Examiner Comments

This answer lacks any credit worthy ideas so was given zero.

Question 8 (a) (iii)

This question required candidates to comment on the effect ethanol has on the phospholipid component of cell membranes which would allow pigment to escape. Credit was not given if the term lipid was used rather than phospholipid.

(iii) Explain the effect of ethanol on plant cell membranes.

pigment washed off.
(2)

as ethanol concentration increases, the cell membrane phospholipid bilayer becomes distorted and more fluidity occurs allowing bigger molecules such as the pigment to be released which wouldn't normally. Ethanol increases plant fluidity by breaking the phospholipid bilayer allowing more molecules to pass through.



ResultsPlus
Examiner Comments

This answer makes reference to phospholipid and to the release of pigment, so gains both marks.

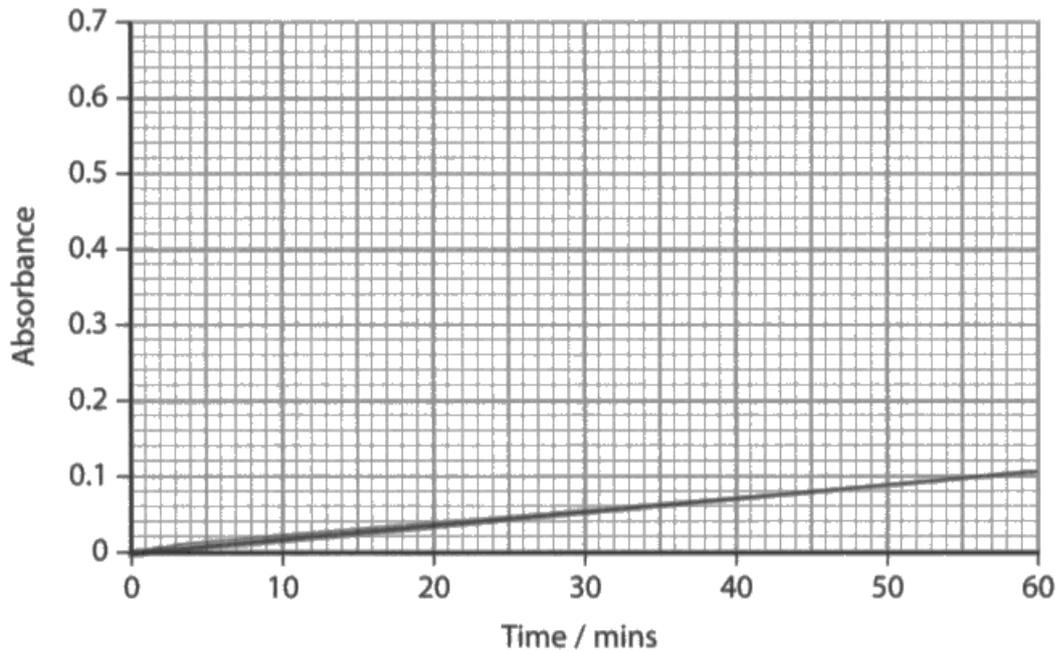
Question 8 (b)

In this question, marks were given for starting the line at 0.05 absorbance and then continuing the line at that level until 60 mins.

(b) The student also carried out a control, using water instead of 40% ethanol. *more molecules to pass through.*

Draw a line on the graph to show the results for this control.

(2)



ResultsPlus

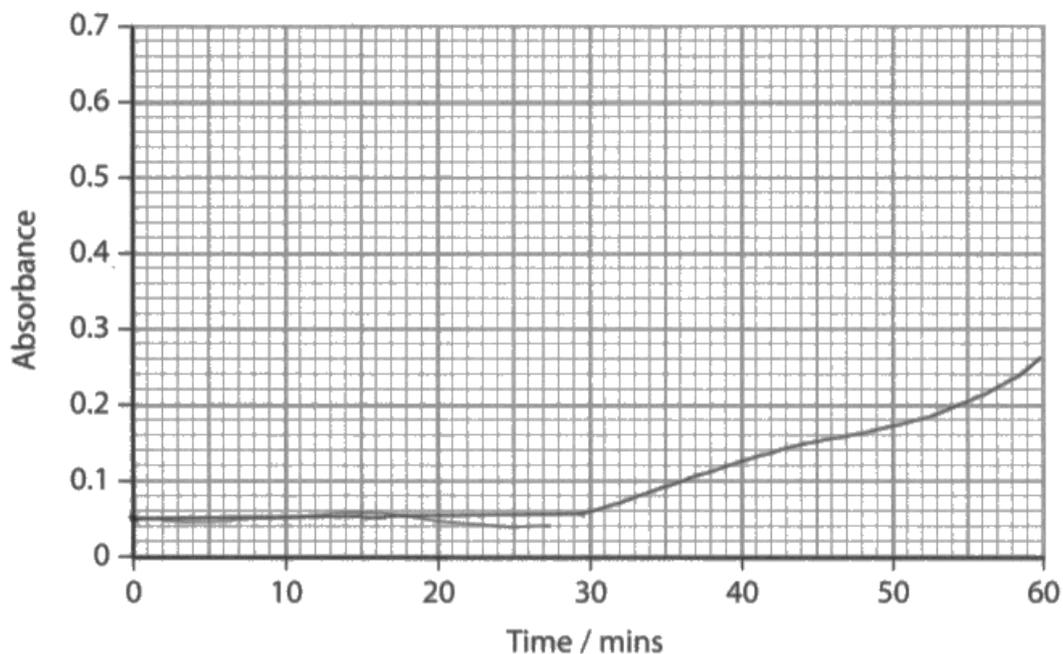
Examiner Comments

This response gains no credit because the line does not start at 0.05 nor does it remain at that level.

(b) The student also carried out a control, using water instead of 40% ethanol.

Draw a line on the graph to show the results for this control.

(2)



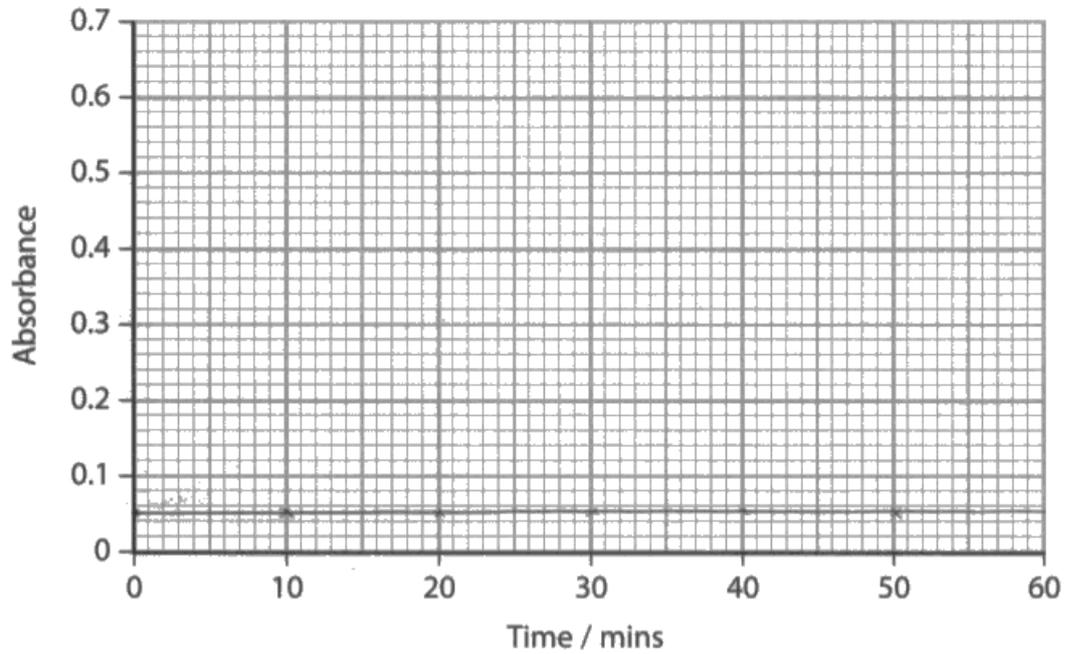
 **ResultsPlus**
Examiner Comments

This response gains 1 mark for starting at 0.05. The second mark is not given because the line does not remain at 0.05.

(b) The student also carried out a control, using water instead of 40% ethanol.

Draw a line on the graph to show the results for this control.

(2)



ResultsPlus
Examiner Comments

This response gains both marks for starting at 0.05 and for continuing at that level.

Question 8 (c)

This was a low-scoring question, as most candidates did not meet the requirement of the command word 'justify'. This command word demands evidence to support any statements made in the answer. Many gave sensible statements but then failed to justify them.

Some did make an attempt to justify but the quality of the justification was not worthy of A level. For example, the statement that temperature needs to be controlled required the justification that temperature affects diffusion. The justification that it affects the results is insufficient.

- (c) The student then investigated the effect of ethanol concentration on leaves from different plant species.

Justify the modifications to the procedure in part (a) that will be required to obtain valid data.

(5)

In Step 1 the student needs to ensure that all leaf discs are the same size. This will be because if the discs are different sizes then there will be a different amount of pigment for each plant species which will make the investigation invalid.



ResultsPlus Examiner Comments

This candidate appreciates that the leaf discs must be of the same size and also provides an acceptable justification with regard to the amount of pigment.



ResultsPlus Examiner Tip

When asked to 'justify' you must make your statement and then offer a reason.

- (c) The student then investigated the effect of ethanol concentration on leaves from different plant species.

Justify the modifications to the procedure in part (a) that will be required to obtain valid data.

disks

(5)

All plant leaves of different species will need to have a similar surface area and a similar mass. The plant leaves will be exposed to the ethanol same concentration of ethanol for the same total period of time. ^{10 minutes} 6 plants of each species should be used as a repeat. ~~pH and temperature will have to~~ Temperature will have to be kept constant throughout the experiment. The same colorimeter should be used. The same volume of solution should be measured. The amount and intensity of the shaking of the boiling tube should be the same.



ResultsPlus
Examiner Comments

This candidate makes several sensible statements but fails to justify any of them.

Question 9 (a)

This question was a challenge because data for glass is not shown in the graph. In the better responses, candidates appreciated this and realised that if glass is used it must have similar storage properties as the best material in the graph - metal. These properties include the ability to keep air and moisture out as these would promote germination in storage, an undesirable event. Credit was also given for appreciating that glass allows for seeds to be observed without removing the lid. Marks were available for making converse statements about paper or cellophane.

(a) Analyse the data to explain why seeds are stored in glass containers in the Millennium Seed Bank.

- Glass is an excellent temperature isolant, it will prevent ⁽⁴⁾ temperature fluctuations outside from happening on the inside, therefore successfully maintaining optimal conditions
- It also maintains humidity effectively, as water vapour cannot go through glass in the same way as it does with e.g. paper
- Time does not ~~corrupt~~ corrupt glass in the same way it would do with metal by oxidation or paper by degrading ~~or~~ or excess humidity
- Cheaper than metal, not expensive
- Gives ability to check on seeds without altering conditions by opening lid due to glass being see-through



ResultsPlus Examiner Comments

This answer makes it clear that glass will keep water vapour out and that there is no need to take the lid off as the seeds can be seen through the glass. Both these ideas gain credit so this response was awarded 2 marks.

(a) Analyse the data to explain why seeds are stored in glass containers in the Millennium Seed Bank.

(4)

- The data shows that metal is most effective material comparing to paper and cellophane for storage as it had highest percentage germination.
- Water from humidity can dampen and moistened the paper hence reducing viability ^{of seeds} during storage as data shows the most decrease in percentage germination after for first 24 months.
- cellophane may still allow some moisture to penetrate, hence a relatively ^{lower decrease in} higher percentage germination ~~but~~ than paper.
- ~~Both~~ Paper could only store for 26 months and cellophane for 80 months.
- ~~By using glass containers prevents any moisture from~~ because these materials ^{and decomposes} degrade over time. Using glass containers prevents any moisture from penetrating ^{hence keeping seeds} ~~hence affecting~~ dry. And glass ~~do~~ last longer as it ~~does~~ does not decompose or degrade.



ResultsPlus Examiner Comments

This answer makes it clear that seeds contained in metal have the highest germination and that paper is not good at keeping moisture at bay. Both these ideas are acceptable so this response was awarded 2 marks.

(a) Analyse the data to explain why seeds are stored in glass containers in the Millennium Seed Bank.

(4)

metal shows the largest percentage of germination at around 80-90%.

The results fluctuate. Cellophane and paper show lower amounts of germination. The less opaque substances show a smaller amount of germination.

Glass is not opaque, least germination should occur. If the seeds are being germinated, they cannot be stored.

Glass is clear. Paper has the lowest germination percentage. ~~seeds~~



ResultsPlus

Examiner Comments

This answer only gains 1 mark for the idea that metal has the highest germination. No explanation is offered so no more marks are available.



ResultsPlus

Examiner Tip

Questions with the command word 'explain' will not allow full marks to be obtained unless there is some reference to biological reasoning.

Question 9 (b)

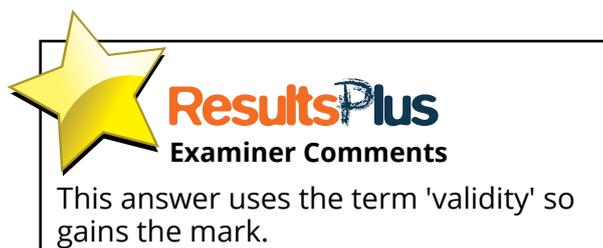
The examiners gave credit for answers that made it clear that the use of 50 seeds is needed to produce a valid measure of viability. Credit was also given if candidates made a sensible reference to enabling the identification of an anomalous result

(b) Each time the seeds are tested for viability, 50 seeds are used.

State why 50 seeds are used.

(1)

Because it gives a wider range to increase
Validity of results.

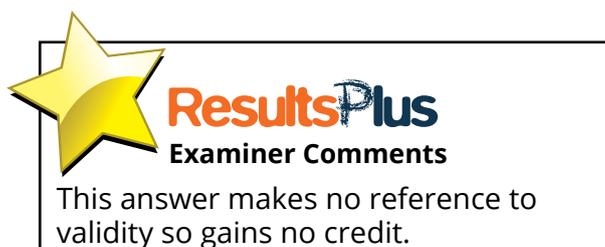


(b) Each time the seeds are tested for viability, 50 seeds are used.

State why 50 seeds are used.

(1)

For accurate results - large sample size.



Question 9 (c)

This calculation challenged many candidates. The correct answer of 37% year⁻¹ or 3.08% month⁻¹ was seldom seen, but a mark was available for noting 74 as the answer when subtracting 16 from 90 in the working

A correct answer that failed to provide the units would only gain 1 mark.

- (c) Calculate the rate of change in viability of the seeds stored in a cellophane container for the first two years.

(2)

$$\begin{array}{r} 90\% \\ - 16\% \\ \hline 74\% \end{array}$$
$$\begin{array}{r} 90 - 20 = 70 \\ 24 - 0 \\ \hline \end{array}$$

Answer



ResultsPlus Examiner Comments

This response does not show the correct answer or any acceptable working so gains no credit.

- (c) Calculate the rate of change in viability of the seeds stored in a cellophane container for the first two years.

(2)

3.08% per month

$$\begin{array}{r} 90 - 16 \\ \hline 24 \end{array}$$

Answer 3.08% per month



ResultsPlus Examiner Comments

3.08% per month is a correct answer so both marks were awarded.

(c) Calculate the rate of change in viability of the seeds stored in a cellophane container for the first two years.

0: 90%. 1st year = 73%. 2nd year = 16% (2)

$$\frac{16 - 90}{2}$$

Answer -37 % per year



ResultsPlus
Examiner Comments

The answer is correct so both marks were awarded.

(c) Calculate the rate of change in viability of the seeds stored in a cellophane container for the first two years.

(2)

0m - 90%
24m - 16% 90 - 16 = 74

$$\frac{74}{16}$$

Answer 4.625



ResultsPlus
Examiner Comments

The answer is incorrect but the working shows $90 - 16 = 74$ which is acceptable for 1 mark.



ResultsPlus
Examiner Tip

Show your working as a mark might be available even if the answer is incorrect.

Question 9 (d) (i)

This question challenged most candidates. The mark scheme credited answers that made it clear that the viability test requires conditions that are similar to the country of origin of the seeds because if these conditions are not used, the seeds would not germinate even if they are viable. Additional credit was given for giving an abiotic factor that affects germination.

(d) Seeds from other parts of the world are stored in seed banks.

(i) Explain how the viability test would be different for these seeds from other parts of the world.

(3)

- seeds from different parts of the world will require different levels of water and temperature to germinate depending on the environment they are from → tropical plant seeds will require higher humidity and temperatures than other plants to germinate



ResultsPlus
Examiner Comments

This answer makes it clear that humidity or temperature can affect seed germination and that the viability test needs to have these abiotic factors at the same level as the place of origin. Therefore, 2 marks were awarded.

Question 9 (d) (ii)

Candidates who appreciated the role of day length and phytochrome pigments in flowering did well in this question. However, many failed to make this link and scored poorly as a result.

- (ii) Explain why plants grown from these germinating seeds may not flower at the same time of year as they would have done in their country of origin.

(2)

The local conditions would be different. ~~From~~ The length of daylight exposure depends on ~~the seasons~~ ~~season~~, ~~but~~ the position on the surface of the Earth as well as the season.



ResultsPlus Examiner Comments

This candidate understands that day length can affect flowering but makes no reference to phytochrome, so gains 1 mark only.



ResultsPlus Examiner Tip

Try to include at least the same number of different ideas in your answer as the number of marks available.

Question 10 (a)

This question required candidates to devise an investigation based around principles of core practical 6. Credit was given for submerging potato and carrot pieces of the same surface area to volume ratio into at least five concentrations of sucrose or salt concentrations for the same period of time. These pieces needed to be weighed before and after, and also dried. The results should be plotted on an appropriate graph so that the point at which the line crosses the x axis can be found. Additional credit was allowed for understanding that the age, part of tissue or the temperature should be controlled.

10 (a) Devise an experiment, which uses changes in mass, to compare the water potential of carrot tissue with the water potential of potato tissue.

(5)

First get 5 pieces of carrot and 5 pieces of potato all of equal mass. This is important to ensure validity of the ~~test~~ experiment. ~~Leave them in beakers of Hydrochloric acid to~~ Then make serial dilutions of sucrose solutions e.g. have 5 solutions with concentrations from 1.0 to 0.0001. Place a one piece of carrot and one piece of potato in each of the solutions and leave them for 10 mins. After 10 mins remove them and measure the mass of each piece and record the results in a table.



ResultsPlus Examiner Comments

This answer only gains 1 mark for reference to five sucrose concentrations. Pieces of equal mass is not credit worthy. Leaving the pieces for the same time is fine but the marking point also required stating that the pieces need to be submerged. The pieces were weighed but there is no reference to being dried.



ResultsPlus Examiner Tip

When devising an investigation make sure as much detail as possible is given. In theory, a person reading your method should be able to carry out the investigation without needing further clarification.

10 (a) Devise an experiment, which uses changes in mass, to compare the water potential of carrot tissue with the water potential of potato tissue.

(5)

- Using the same potato cut 5, 3cm^3 cubes of potatoes
- " " " carrot " 5, 3cm^3 cubes of carrots
- Weigh each ^{cube} ~~block~~ separately
- ~~Place each~~ Place one carrot cube and one potato cube in 10cm^3 of water (one test tube per cube) =) Control
- Place one cube of each ^{species} ~~set~~ containing 1cm^3 sucrose solution 9cm^3 water
- Repeat w/ 2cm^3 sucrose solution, 8cm^3 water
- " " 4cm^3 sucrose " , 6cm^3 water
- " " 5cm^3 sucrose solution, 5cm^3 water
- Compare the percentage change in mass ~~from~~ for the carrots and potatoes
- The greater the % increase in mass the greater the water potential of the vegetable



ResultsPlus
Examiner Comments

This answer gains 2 marks for using the same sizes of potato and carrot tissue and for using five concentrations of sucrose solution.

10 (a) Devise an experiment, which uses changes in mass, to compare the water potential of carrot tissue with the water potential of potato tissue.

(5)

Use a cork borer to make identical cylinders of potato and carrots. Make sure they have equal lengths.

⊗ Weigh the cylinders.

Prepare 5 different concentration of ~~sucrose~~^{glucose} solutions ~~and~~ and ~~drop~~ drop in each solution a potato cylinder and a carrot cylinder. Let it sit until it reaches equilibrium.

Remove the cylinder and dry the surface. Reweigh and obtain the change of mass. Repeat 3 times per concentration.

Plot a graph of change of mass against concentration for each of the 2 plants.

Find the point at which the line of best fit crosses the x axis (change in mass = 0). That is the ~~water potential~~^{cell sap concentration} of the plant.

Finally compare the 2 ~~water potential~~ by finding the ratio

The lower the cell sap concentration, the higher the water potential.



ResultsPlus
Examiner Comments

This was a good answer that had four of the marking points in evidence. The ideas lacking were submergence of the tissue samples and control of their age, part of tissue or temperature.



ResultsPlus
Examiner Tip

Be precise in devising investigations. Give as much detail as possible so that anybody trying to follow your instructions can do so without having to ask any questions about how to do each step.

Question 10 (b)

This question challenged candidates. Most simply described the data in the table and offered no explanation. Credit was given for answers that made it clear that the salt concentration in *Salicornia* is always higher than the water in the mud and this must be achieved by active uptake. The consequence of having a higher salt concentration is that water will be taken up by osmosis.

The results are shown in the table.

Distance upstream from sea / km	Salt concentration / arbitrary units	
	<i>Salicornia</i> plants	Water in the mud
0.0	60.0	2.8
1.6	60.0	1.1
4.8	55.0	0.6
8.0	75.0	0.2

Analyse the data to explain how *Salicornia* is adapted to life in salt marshes.

(3)

as the distance from the sea increases, the salt concentration in the plant increases but the salt conc. in the water in the mud decreases. This may be because the plant is taking up the salt by active transport against the concentration gradient. It has adapted to life in salt marshes as it has made its tissues more ~~or~~ salty so that water will still move into the plant by osmosis despite the external salty conditions. Because the plant is adapted to have a higher salt conc. than the mud, water will move into the plant by osmosis.



ResultsPlus
Examiner Comments

All three marking points are evident so 3 marks were awarded.



ResultsPlus
Examiner Tip

Be careful not to only describe data from tables when being asked to explain.

The results are shown in the table.

Distance upstream from sea / km	Salt concentration / arbitrary units	
	<i>Salicornia</i> plants	Water in the mud
0.0	60.0	2.8
1.6	60.0	1.1
4.8	55.0	0.6
8.0	75.0	0.2

Analyse the data to explain how *Salicornia* is adapted to life in salt marshes.

(3)

Salicornia plants have a much higher salt concentration than surrounding water in mud. This means water diffuses into the plant by osmosis following a concentration gradient.



ResultsPlus

Examiner Comments

This candidate appreciates that the salt concentration in the plant is higher than in the water in the mud and that this makes osmotic uptake possible. There is no reference to active transport so this answer was awarded 2 marks.

The results are shown in the table.

Distance upstream from sea / km	Salt concentration / arbitrary units	
	Salicornia plants	Water in the mud
0.0	60.0	2.8
1.6	60.0	1.1
4.8	55.0	0.6
8.0	75.0	0.2

Analyse the data to explain how *Salicornia* is adapted to life in salt marshes.

(3)
Data shows that there are most *Salicornia* plants further at 8km from the sea. Also here at 8km, there is least water in the mud. However, at 0km from sea and at 1.6km from sea, there are 60 plants of the species, yet more water in mud at 0km. This shows the plant can adapt to either much or little water, as the amount of species increased appears fairly constant.

(Total for Question 10 = 8 marks)



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Examiner Comments

This answer is confused and the candidate thinks that the numbers refer to the number of plants and not salt concentrations. No marks were credited.

Paper Summary

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

- 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. Read the question carefully because there may be an unfamiliar command word that needs a little extra thought.
- Write concise answers that include detail expected at A level.
- 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. If 'justify' is used, then the significance of each answer given must be explained.
- Always show working in any mathematics 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.

Grade Boundaries

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

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