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Examiners' Report
June 2019

GCSE Combined Science 1SC0 2BH

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Introduction

The Pearson Edexcel GCSE Combined Science (9-1) Paper 4: Biology 2 (Higher tier) paper is the second of two papers that combine with papers in chemistry and physics as part of the GCSE (9-1) Combined Science qualification. This is the second assessment of the GCSE (9-1) Combined Science specification and the qualification follows a linear assessment model whereby candidates must complete all papers in the same single year of certification.

Paper 4: Biology 2 (Higher tier) is awarded a total of 60 marks and it is assessed by a variety of question types, including multiple-choice questions, short answer questions, calculations and extended open-response questions. Candidates should answer all questions in a time period of 1 hour and 10 minutes. The extended open-response question is identified by an asterisk (*) in the question paper to indicate that marks are also awarded for the ability to structure a response logically.

In addition, the GCSE (9-1) Combined Science qualification assesses practical knowledge and maths skills; the requirements of which are given in the specification. Furthermore, there are 6 mandatory core practical tasks for the biology component which candidates must complete prior to the examination, as aspects of working scientifically are also assessed in questions throughout the paper.

The Paper 4: Biology 2 (Higher tier) paper contains questions assessing the content from Topics 1 and topics 6 to 9 as identified in the specification. In this examination series, candidates were required to respond to questions that tested their knowledge and understanding of food webs and biomass, transport of substances through plants and the role of stomata, the hormones of the menstrual cycle, the structure and function of the heart and the nitrogen and carbon cycles.

Questions designed to assess practical work included writing a plan to determine sampling techniques, the core practical task of respiration including the identification of improvements to the investigation and a control as well as application of knowledge to the experiments of Joseph Priestley. The maths skills assessment in this paper related to questions requiring biomass calculations, percentages and a calculation on the net mass of carbon released.

Most candidates were able to access the extended writing response, some demonstrating very good knowledge of the blood flow through the heart and the role of valves. Higher ability candidates were able to apply their knowledge of the hormones of the menstrual cycle and some were able to explain the roles of bacteria in the nitrogen cycle.

Many candidates were able to demonstrate a good level of knowledge in the early questions, including the carbon cycle and the role of stomata. The application of knowledge of core practical tasks remain a challenge and candidates need to use scientific terminology more frequently when answering questions related to practical tasks. Across the paper candidates showed they could extract data from graphs including numerical values as well as a trend.

The level of knowledge shown about food webs and the carbon cycle was very good for most candidates possibly reflecting the use of past papers as a revision strategy. However, when candidates are asked to compare two processes such as when answering the question related to cardiac output they must ensure they give details for both process for each aspect they include in their answer. Candidates also showed a relatively good understanding of the transport of substances through plants but accuracy in the use of terms such as osmosis need addressing.

The responses to the questions assessing aspects of practical work have improved since last year. This is a new component for this specification and the improvement is expected as teachers

increase their understanding of this aspect. Candidates of all abilities were able to answer questions using their practical skills knowledge, including the identification of improvements. However, candidates still need to ensure they use scientific terms, including volume and mass, accurately. Many candidates were able to write good methods for determining how to estimate the number of organisms in a garden using knowledge they were given in the question. Candidates remain confused as to the difference between controlling a variable and using a control.

Candidates of all abilities were able to access the straightforward maths questions of calculating a biomass. Calculating the number of people who could become pregnant using percentages challenged many candidates. Candidates lost marks on this for incorrectly rounding the answer, giving an answer to a decimal place rather than a whole number and not understanding the magnitude of a million. Many candidates could recall the equation for cardiac output but marks were lost by not including the correct units.

Question 1 (a) (i)

This was the maths based question, involving a straight multiplication of the biomass of a single organism with the number of organisms. A table was given where this calculation was completed for other organisms to help with answering this question. This was only 1 mark so candidates did not get any marks here for the working. The only answer allowed was the correct calculation giving an answer of 2108.

1 (a) A student was investigating the populations of organisms in a garden.

Figure 1 shows the estimates of the number and biomass of some of the organisms in the garden.

organisms	number	mean biomass of each organism in grams	biomass of population in grams
cabbages (plants)	80	70	5600
earthworms	620	3.4	?
slugs	30	4.1	123
hedgehogs	1	620	620
squirrels	2	600	1200

Figure 1

(i) Calculate the biomass of the population of earthworms in the garden.

(1)

620 x 3.4 = 2108

2108g

ResultsPlus
Examiner Comments

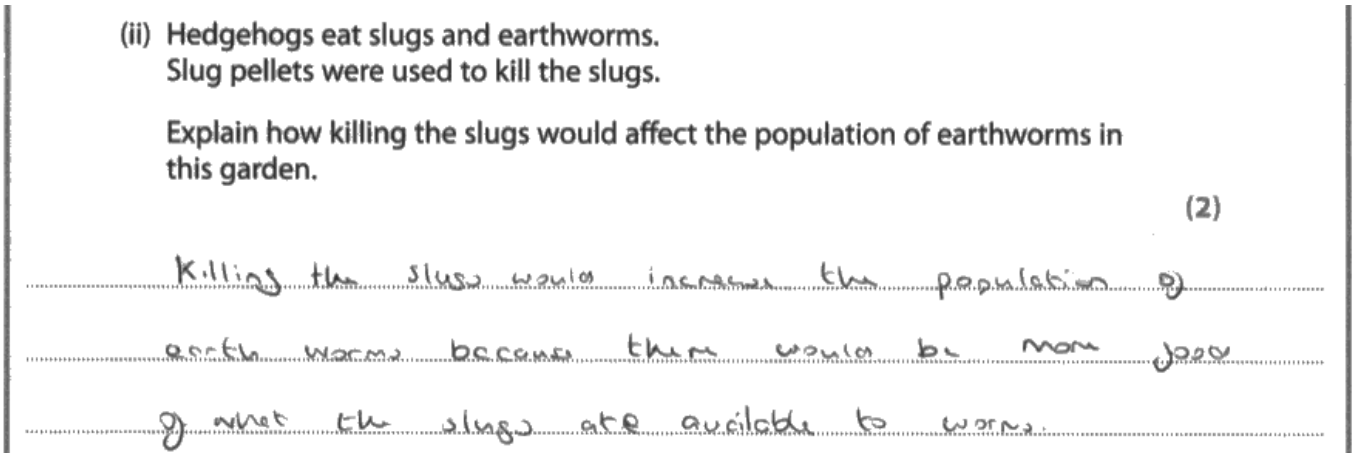
This response shows the workings and has the correct answer for one mark.

ResultsPlus
Examiner Tip

Always show workings even for calculations.

Question 1 (a) (ii)

This question looked at the effect of removing organisms from a food chain. This could be answered in two ways. The response seen most often was that as slugs were killed hedgehogs had to eat more earthworms so the number of earthworms decrease. Alternatively candidates could have stated that there would be more food available for the earthworms thus the numbers would increase.



(ii) Hedgehogs eat slugs and earthworms.
Slug pellets were used to kill the slugs.

Explain how killing the slugs would affect the population of earthworms in this garden.

(2)

Killing the slugs would increase the population of earth worms because there would be more food of what the slugs are availble to worms.

ResultsPlus
Examiner Comments

This was the alternative response and worth two marks. The increased population of earthworms had to be clarified that it was linked to a greater availability of food.

(ii) Hedgehogs eat slugs and earthworms.
Slug pellets were used to kill the slugs.

Explain how killing the slugs would affect the population of earthworms in this garden.

(2)

Biodiversity, as this is the number of plants and animal in a the world of area, therefore the continuous killing of slugs would lead to a slug and earthworms population decrease.

ResultsPlus
Examiner Comments

This has one mark for the decreased population but it has not been explained so no further marks are awarded.

(ii) Hedgehogs eat slugs and earthworms.
Slug pellets were used to kill the slugs.

Explain how killing the slugs would affect the population of earthworms in this garden.

(2)

It would decrease the population of earthworms because the hedgehogs would have to eat more earthworms as the population of slugs has decreased.

ResultsPlus
Examiner Comments

This was the type of response given by most of the candidates, linking the the decrease in the population of the earthworms to the idea that the hedgehogs would have to eat more of them.

Question 1 (a) (iii)

With practical skills being assessed in exams with this specification the skill of planning an investigation is assessed on every paper and this method required a knowledge of sampling techniques to estimate the population of slugs in a garden. As slugs are slow moving organisms a quadrat would be an acceptable way of sampling these. This required the idea of using the quadrat, counting the numbers of slugs within the quadrat and an idea of scaling up from the quadrat to the area of the garden. Obviously other acceptable methods were credited including capture, mark and release methods if correctly explained. The majority of candidates scored 2/3 marks with the scaling up mark being the area where candidates lost a mark.

(iii) Describe a method that could be used to estimate the population of slugs in the garden.

(3)

By using quadrats, randomly placing quadrats around the area, count the number of slugs in a quadrat, discounting any that are more than half out of the frame, then work out an overall mean of the quadrats counted, then times the number by the amount of quadrats that fit in the whole area.

ResultsPlus
Examiner Comments

This is worth the three full marks for a quadrat, counting the number in each or calculating a mean and the final mark is given for the idea of scaling it up to the size of the garden.

(iii) Describe a method that could be used to estimate the population of slugs in the garden.

(3)

Get a quadrat which is 1m b 1m and throw it randomly On a part of the garden So the results are repsesentative of the whole area. Then Count how many Slugs in the quadrat do this again 7 times anel get an average result for the population of slugs in the garden.

ResultsPlus
Examiner Comments

This response is restricted to two marks. They have the idea of using a quadrat and counting the number of slugs and obtaining an average. There is no suggestion of scaling the calculation up to the size of the garden so the final marking point is not given.

(iii) Describe a method that could be used to estimate the population of slugs in the garden.

(3)

A method that could be used to estimate the population of slugs in the garden is by counting them over a ~~number~~ set number of days. After you have done that you can calculate the average and therefore will have an estimation for the population of slugs in a garden.

ResultsPlus
Examiner Comments

This response scored one for the idea of counting the slugs in the garden. There is no equipment named or described nor an indication of scaling up the number counted to the size of the garden.

Question 1 (b)

For this question candidates were asked to explain how cabbages, earthworms and squirrels contributed to the carbon cycle. As this is an explain question we were also looking for the science behind the movement of carbon/carbon dioxide through the carbon cycle. This was answered very well with the majority of candidates attaining 2/3 marks. Linking cabbages to removing carbon dioxide for photosynthesis and any of the organisms releasing carbon dioxide through respiration were the most common responses. Candidates could also gain marks for the idea of moving carbon when eating organisms or the role of decomposers in the carbon cycle.

(b) Explain how cabbages, earthworms and squirrels contribute to the carbon cycle.

(3)

Cabbages contribute to the carbon cycle when under going Photosynthesis by taking in carbon dioxide and changing it to oxygen. Squirrels Contribute to the carbon cycle by breathing in oxygen and breathing out Carbon dioxide same as the earth worms.

ResultsPlus
Examiner Comments

This response scores three marks. The candidate has linked removal of carbon dixoide by cabbages to photosynthesis for two marks and has squirrels and earthworms releasing carbon dioxide.

(b) Explain how cabbages, earthworms and squirrels contribute to the carbon cycle.

(3)

Cabbages take in carbon dioxide during photosynthesis. When an earthworm or a slug eats the cabbage it releases a small amount of that carbon back to the atmosphere which is taken back in by cabbages and the cycle continues.

(Total for Question 1 = 9 marks)

ResultsPlus
Examiner Comments

This response was only worth one mark for photosynthesis. No mark is awarded for carbon being taken in by cabbages as it is incorrect. Carbon dioxide is taken in.

ResultsPlus
Examiner Tip

Make sure you name the correct element or compound that contains carbon when answering questions on the carbon cycle.

(b) Explain how cabbages, earthworms and squirrels contribute to the carbon cycle.

(3)

Cabbages are a plant so take in carbon dioxide, they're then eaten by the earthworms so the carbon dioxide is passed through. It is then transfered again when the earthworms are eaten by a the squirrels.

ResultsPlus
Examiner Comments

This response scored one mark for cabbages taking in carbon dioxide. It is not passed to the earthworm as carbon dioxide so no further marks were awarded.

Question 2 (a) (i)

This question was based on one method of doing the respiration practical using hydrogencarbonate indicator. Candidates were asked how this method could be improved; this is another of the key practical tasks which needs to be assessed on all papers. In order to improve on the experiment candidates needed to use correct terminology in their responses such as measuring the mass of organisms rather than the number of organisms, or the idea of having the same volume of indicator solution. Please note the amount of indicator solution is not creditable here; candidates must refer to volume for liquids or mass for organisms. Marks were also awarded for the idea of controlling temperature using a water bath. Candidates also lost marks here as they described changing the experiment using a gas syringe etc but this is not an improvement, it is a different experiment.

2 (a) A student investigated respiration in three different organisms.

Red hydrogencarbonate indicator was placed in each of three test tubes.

Gauze was placed in each test tube to hold the organisms.

In test tube 1 the student placed four germinating peas.

In test tube 2 the student placed four dried peas.

In test tube 3 the student placed four mealworms.

Bungs were added to each of the test tubes.

The three test tubes were left for one hour.

The equipment used is shown in Figure 2.

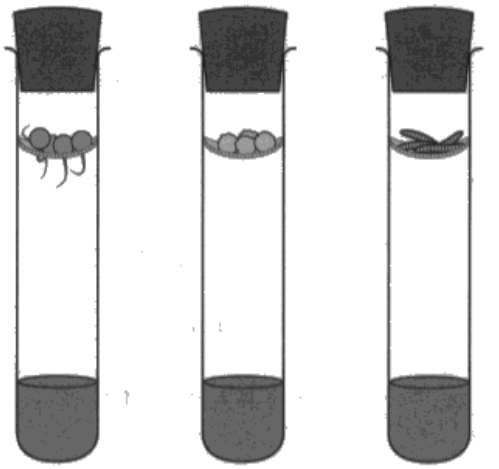


Figure 2

(i) State **two** ways this method could be improved to make the results for these three organisms more comparable.

(2)

1 Add the same volume of red hydrogencarbonate indicator

2 Repeat the method numerous times, so as to have more accurate results

ResultsPlus
Examiner Comments

This scored two marks for having the same volume of indicator and repeating the experiment.

(i) State **two** ways this method could be improved to make the results for these three organisms more comparable.

(2)

1 same amount of red hydrocarbonate indicator

2 same distance away from it.

ResultsPlus
Examiner Comments

This response scored zero. Amount is insufficient, it needed to be volume and the distance from the indicator wouldn't influence the results.

(i) State **two** ways this method could be improved to make the results for these three organisms more comparable.

(2)

1 The mass of the organisms in each test tube should be the same for a controlled test.

2 Each test tube should be kept at the same temperature.

ResultsPlus
Examiner Comments

These answers are two valid ways to improve the method so full marks were awarded.

Question 2 (a) (ii)

This question asked for a control for the experiment and marks were lost by candidates as they referred to variables to control rather than 'a control'. What was required was the idea of the same test tube set up ie with indicator but no organisms or an alternative to no organisms such as glass beads/plastic beads/stones. It is essential that candidates can tell the difference between a control for an experiment and a controlled variable.

(ii) Describe a suitable control for this investigation.

(2)

A test tube containing glass beads. As we know the beads won't respire, they can be used to test the security of the closed system and compare rates of respiration.

ResultsPlus
Examiner Comments

This response scored one mark for the idea of a test tube with glass beads. There is no indication of the tube containing indicator or being the same as the other tubes.

(ii) Describe a suitable control for this investigation.

(2)

volume of indicator should remain the same as some different volume may change at different times.

ResultsPlus
Examiner Comments

This response is describing controlled variables and not a control.

ResultsPlus
Examiner Tip

Make sure you understand the difference between controlled variables and a control.

Question 2 (b) (i)

Candidates could answer this question either from the idea of germinating peas respiring and producing carbon dioxide or the idea that dried peas do not do this. Some candidates confused photosynthesis and respiration meaning that the outcome they reached was incorrect. Please note that the term respirate is not acceptable for respire as they have very different definitions.

(b) Hydrogencarbonate indicator changes from red to yellow when more carbon dioxide is present.

The results for this investigation are shown in Figure 3.

organisms	colour of hydrogencarbonate indicator
germinating peas	yellow
dried peas	red
mealworms	yellow

Figure 3

(i) Explain why the result for the germinating peas is different from the result for the dried peas.

(2)

Germinating Peas had more carbon dioxide present during this experiment whereas the Dried Peas had ~~no~~ less carbon dioxide. Also germinating Peas is a different organism to the dried peas.

ResultsPlus
Examiner Comments

No marks were awarded for this response. The question states that the colour of the indicator changes to yellow when more carbon dioxide is present so the response had to indicate that the carbon dioxide was being released by the germinating peas. There was no link to respiration in the answer.

(i) Explain why the result for the germinating peas is different from the result for the dried peas.

(2)

The germinating peas are alive and so they respire, giving off carbon dioxide which changes the colour of the indicator to yellow. Dried peas are dead and aren't getting any water which is needed for respiration so they didn't give off any Co2.

ResultsPlus
Examiner Comments

This response scores two marks as it links respiration to the release of carbon dioxide by the germinating peas.

(i) Explain why the result for the germinating peas is different from the result for the dried peas.

(2)

The ~~germi~~ germinating peas are still germinating, growing meaning that they can still respire, differently to the dried peas which are basically dead and not able to respire.

ResultsPlus
Examiner Comments

This response scored one mark for the link to respiration but there was no link to the release of carbon dioxide which was required for further marks.

Question 2 (c)

This question required candidates to understand why cellular respiration is required in living organisms. What was required was the idea that energy is released or converted for metabolic processes such as protein synthesis, cell division, growth etc. A common error was candidates referring to producing or making energy which is not acceptable.

(c) Explain why cellular respiration is essential for living organisms.

(2)

because respiration needes to occur in every cell in the body to allow them to have energy to carry out their function in the living organisms

ResultsPlus
Examiner Comments

This response scored one by linking the need for cellular respiration to energy requirement. There is no explanation of what the energy is required for so no further marks were given.

(c) Explain why cellular respiration is essential for living organisms.

(2)

Because it is necasrary to produce energy for the organism to grow repair move and funktion

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Examiner Comments

This was awarded one mark for energy being required for growth, repair and movement. The idea of producing energy was not credited.

Question 3 (a) (ii)

This question requires an understanding of how water moves from the roots to the leaves of the plant. A few candidates lost marks as they referred to water entering the roots by osmosis. If they stated through the cells in the roots by osmosis/diffusion this was acceptable for a mark. The majority of candidates understood that water travels through the xylem but often did not extend this with the idea that it evaporates through the stomata. A few candidates mixed up the phloem and the xylem.

(ii) Explain how water in the root is transported to the leaves of the plant.

(2)

Through osmosis, the water travels out of the soil which is high concentration to inside the cell which is low concentrations.

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Examiner Comments

This response did not achieve any marks. Osmosis has to be related to movement through cells as the question asks for the transport of water from the root to the leaves, it is not asking about the uptake of water.

(ii) Explain how water in the root is transported to the leaves of the plant.

(2)

Its transported by the xylem through osmosis

ResultsPlus
Examiner Comments

This response scored one mark for xylem. Water does not travel by osmosis in the xylem. Xylem was the most frequent mark awarded for this question.

(ii) Explain how water in the root is transported to the leaves of the plant.

(2)

water in the root is transported to the leaves of the plant through transpiration in the xylem.

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Examiner Comments

This response uses key terms correctly and obtained full marks for transpiration and xylem.

Question 3 (c) (i)

This question required candidates to recognise that the size of the stomata ia controlled by guard cells.

Question 3 (c) (ii)

The description of trends in graphs is another skill tested throughout these papers and it is important that candidates do not make vague statements such as 'it increases' but that they quote from the axes of the graph in their answer as well as quote from the data in their answer. In this case as the time increased from 6am to 8am the size of the stomata increased to 0.9mm, after this the size of stomata steadily decreased. It is important that candidates understand the driver for this in this case the time of day causes the change in stomata not the other way around. It is always correct to quote the X axis first as this is the independent variable.

(ii) Describe the trend shown in Figure 4.

(2)

The size of the stomata increased rapidly between 6am and 7am. After 7am the size of the stomata steadily decreased, however it remained constant between 1pm and 2pm

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Examiner Comments

This response scored 1 mark for the decrease in stomata size. The candidate has incorrectly identified the peak as being at 7am and not 8am and correct data was required for this mark.

(ii) Describe the trend shown in Figure 4.

(2)

it goes up until 8 am, then it decreases slowly from there

ResultsPlus
Examiner Comments

This response scored one mark. It goes up does not indicate what is changing so the first marking point was not awarded. The second mark for the decrease was given to avoid penalising for the same mistake twice.

(ii) Describe the trend shown in Figure 4.

(2)

from 6AM the stomata is open about 0.04mm it then rapidly increases in size at 8am to about 0.9mm then slowly decreases throughout the day until 6pm where it's at 0.24 mm

ResultsPlus
Examiner Comments

This good response scored two marks for identifiying the peak stomata size and time as well as the subsequent decrease.

Question 3 (c) (iii)

This question asked candidates to explain why temperature affected the size of stomata. There was some confusion regarding water entering through stomata rather than the idea that stomata close to reduce water loss as temperature increases.

(iii) The temperature increased from 8 am to 1 pm.

Explain why this affected the size of the stomata.

(2)

By the temperature increasing it means gas exchange will be happening more due to it being hot as a result the stomata need to be big to allow gas exchange to happen and allow water to leave due to increased rate by temperature

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Examiner Comments

This response did not score. The candidate understands that the stomata have to be open for water to evaporate but have not recognised that the stomata are reducing in size to reduce evaporation or why the stomata size decreases due to loss of water from the guard cells.

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Examiner Tip

Always check the information given in the question to ensure you are using it correctly.

(iii) The temperature increased from 8 am to 1 pm.

Explain why this affected the size of the stomata.

(2)

This affected the size of the stomata because it meant the stomata had to close as it was ~~lea~~ losing water, through evaporation, from the leaves, from the stomatas. Therefore, to stop this the plant closes its stomata so that no water is lost.

ResultsPlus
Examiner Comments

This response scored full marks for connecting the idea that the stomata are closing to prevent water loss.

(iii) The temperature increased from 8 am to 1 pm.

Explain why this affected the size of the stomata.

(2)

The stomata will get smaller because of the heat and they will take in less water because it is hotter and likely not raining.

ResultsPlus
Examiner Comments

This response scored one for the stomata getting smaller. A common misconception by candidates is the idea that stomata are involved in the intake of water.

Question 4 (a) (i)

This was a straightforward question to identify the endocrine gland that produces FSH. The pituitary gland was required but several candidates referred to ovaries and the thyroid gland.

Question 4 (a) (ii)

This question asked for the changes that happens inside the ovaries due to clomifene medication. The idea that it contains FSH which causes ova to develop inside follicles or that oestrogen was produced was required. Many candidates gained 1 mark for stating the follicle matures. Candidates who missed out on marks often described menstruation which occurs in the first five days, not the changes in the ovary which the question required.

(ii) During this therapy, a woman takes a clomifene tablet each day for the first five days of her menstrual cycle.

Describe the changes that would happen inside the ovaries during the first five days of this treatment.

(2)

The egg cells inside the ovaries would begin to mature

ResultsPlus
Examiner Comments

This response successfully identified that egg cells begin to mature during the first five days of the menstrual cycle.

(ii) During this therapy, a woman takes a clomifene tablet each day for the first five days of her menstrual cycle.

Describe the changes that would happen inside the ovaries during the first five days of this treatment.

(2)

The ovaries will produce an egg so the woman can ovulate more regularly so the ovaries will get hormones.

ResultsPlus
Examiner Comments

Eggs are not produced so no mark was awarded for this response.

(ii) During this therapy, a woman takes a clomifene tablet each day for the first five days of her menstrual cycle.

Describe the changes that would happen inside the ovaries during the first five days of this treatment.

(2)

FSH causes the egg to mature in the follicle and the first five days are menstruation. So she is likely to see the uterus lining build up as FSH stimulates the production of oestrogen which strengthens the uterus lining

ResultsPlus
Examiner Comments

This good response identified that the egg cell matures in the follicle and that oestrogen is released for full marks.

Question 4 (a) (iv)

There were some good answers in response to this question outlining that this was after ovulation and therefore progesterone was being released from the corpus luteum to maintain the lining of the uterus. The latter was the most frequently awarded mark. Some candidates lost marks due to referring to the uterus thickening or the uterus wall thickening rather than the lining thickening.

(iv) During clomifene therapy, the woman has a blood test on day 20 of the menstrual cycle.

The blood test shows a high level of progesterone.

Explain the cause of this high level of progesterone on day 20 of the menstrual cycle.

(2)

This is because during ovulation the egg is released from the follicle. The follicle turns into a corpus luteum and releases high levels of progesterone

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Examiner Comments

This response scored full marks as it indicates that the high level of progesterone is after ovulation and that progesterone is released by the corpus luteum.

(iv) During clomifene therapy, the woman has a blood test on day 20 of the menstrual cycle.

The blood test shows a high level of progesterone.

Explain the cause of this high level of progesterone on day 20 of the menstrual cycle.

(2)

Progesterone will be present during day 20 because the uterus lining begins to thicken and maintain. Progesterone causes this to happen.

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Examiner Comments

This response indicates that progesterone maintains the lining of the uterus. Candidates must ensure they refer to the lining of the uterus thickening and not the wall of the uterus. 1 mark.

(iv) During clomifene therapy, the woman has a blood test on day 20 of the menstrual cycle.

The blood test shows a high level of progesterone.

Explain the cause of this high level of progesterone on day 20 of the menstrual cycle.

(2)

By day 14 the woman should have ovulated. This leaves behind a ruptured follicle, the corpus luteum. The corpus luteum secretes progesterone in order to thicken and maintain the uterus lining in preparation for an embryo.

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Examiner Comments

This good response obtains full marks and illustrates all three points from the mark scheme. The candidate has used the scientific terms correctly.

Question 4 (b)

How oestrogen and progesterone can be used in the contraceptive pill was reasonably well understood. The majority of marks were gained from the idea of high levels of oestrogen and progesterone inhibiting the release of FSH or LH thus no eggs mature or ovulation is prevented. Several candidates understood that this causes a thickening of cervical mucus stopping the sperm from entering the uterus thus preventing pregnancy.

(b) Hormones are also used as a method of contraception.

Explain why taking high levels of oestrogen and progesterone in the combined contraceptive pill reduces the chance of pregnancy.

(2)

Because oestrogen and progesterone stop ~~the~~ FSH and LH being realeased.

ResultsPlus
Examiner Comments

This response scored one mark for either inhibits FSH or inhibits LH. There is no linked explanation as to why this reduces the chance of pregnancy which would be required for further marks.

(b) Hormones are also used as a method of contraception.

Explain why taking high levels of oestrogen and progesterone in the combined contraceptive pill reduces the chance of pregnancy.

(2)

Progesterone inhibits the production of FSH, therefore less follicles will mature into eggs. ~~Oestrogen~~

ResultsPlus
Examiner Comments

This response scores full marks as they have explained that inhibiting production of FSH will prevent follicles maturing.

(b) Hormones are also used as a method of contraception.

Explain why taking high levels of oestrogen and progesterone in the combined contraceptive pill reduces the chance of pregnancy.

(2)

Progesterone produces mucus in ~~cervix~~ cervix to stop sperm from entering to meet egg. And oestrogen stops egg from being released by inhibiting FSH and LH.

ResultsPlus
Examiner Comments

This illustrates a different mark scheme point with mucus production preventing the sperm from reaching the egg as well as linking preventing the egg being released by inhibiting LH. Again, full marks.

Question 4 (c)

This question asked for some higher order mathematical skills and candidates tackled it in a variety of ways. Calculators are allowed in the examination so candidates should use these when calculating percentages. The first mark was awarded for calculating 13.2% of 32.6 million. The second mark for understanding that 1.2% of the population taking the pill could get pregnant whilst on the pill and the last for a correct rounding of the answer as the answer requires a number of people thus we cannot have 0.4 of a person. Alternatively, some candidates calculated 98.8% of the number of people taking the pill with most subtracting this from the total. Some candidates scored 2 marks for only giving the 98.8% without completing the subtraction. Some candidates lost this mark by rounding up instead of rounding down.

(c) The female population of Britain is 32.6 million.

The percentage of this population taking the combined contraceptive pill is 13.2%.

The combined pill is 98.8% effective.

Calculate the maximum number of females taking the combined contraceptive pill who could become pregnant.

(3)

13·2% of 32·6 million = 4303200

98·8% of 4303200 = 4251561·6

4303200 − 4251561·6

= 51638·4

51638

ResultsPlus
Examiner Comments

This response gives the correct answer for maximum marks. It shows very clear working which is essential to ensure that candidates can obtain some marks if their final answer is incorrect.

(c) The female population of Britain is 32.6 million.

The percentage of this population taking the combined contraceptive pill is 13.2%.

The combined pill is 98.8% effective.

Calculate the maximum number of females taking the combined contraceptive pill who could become pregnant.

(3)

13.2% of 32.6 million = 4.30 million

98.8 % of 4.30 million = 4.25 million

4.30
4.25 −
0.05

0.05 million

(Total for Question 4 = 11 marks)

ResultsPlus
Examiner Comments

This response scored 2 marks for correct workings. The final answer is not sufficiently accurate for full marks.

Question 5 (a) (i)

In general candidates are getting better at this style of question on graph interpretation. This question asked for a comparison so it is important for the mark that there is some comparative in the answer such as the stroke volume of the person training for the marathon was always higher that the person who did not train. Other common responses were the idea that as heart rate increases the stroke volume of the person who trained for the marathon increases but this did not happen for the person who did not train. Where candidates lost marks is when they only gave information on one of the people rather than comparing them.

5 (a) Figure 5 shows the stroke volume at different heart rates of a person who has trained for a marathon and of a person who has not trained for a marathon.

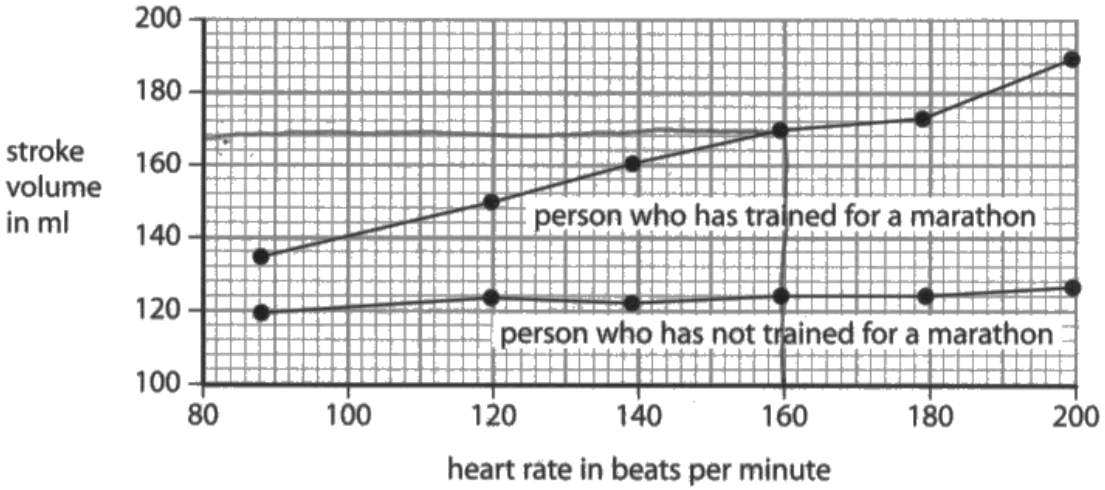


Figure 5

(i) Compare the effect of heart rate on stroke volume of the person who has trained for a marathon with the person who has not trained for a marathon.

(2)

The person who's trained for the marathon gets to a higher heart beat rate quicker than someone who hasn't because the person who has trained their stroke volume increases and therefore increasing their heart rate quicker.

ResultsPlus
Examiner Comments

This response did not score any marks. They have described the effect in the opposite direction. An increase in stroke volume does not increase heart rate. This error was seen more in lower ability candidate responses.

ResultsPlus
Examiner Tip

Use the x and y axis to ensure you describe the effect shown on a graph correctly.

(i) Compare the effect of heart rate on stroke volume of the person who has trained for a marathon with the person who has not trained for a marathon.

(2)

The person who has trained has a higher Stroke volume compared to the person who ~~has~~ has not trained. every time heart rate increases the Stroke rate increase for the person who has trained however person who has not trained Stroke volume ~~stays at 30ml stays~~ under 130ml ~~for~~ ~~stays the same~~ as heart rate increases

ResultsPlus
Examiner Comments

This response is worth 2 marks. They have given the idea that the stroke volume of the person who has trained is higher and that it increases as heart rate increases. They also indicate that there is little change in the stroke volume of the person who hasn't trained.

(i) Compare the effect of heart rate on stroke volume of the person who has trained for a marathon with the person who has not trained for a marathon.

(2)

The person who has trained for the marathon has a higher ~~fre sk~~ stroke volume than the person who hasn't trained for a marathon.

ResultsPlus
Examiner Comments

This response scores one mark for giving the comparison between the two graphs, that the person who has trained for a marathon has a higher stroke volume.

Question 5 (a) (ii)

For this question candidates had to recall the equation to calculate cardiac output, which is in the specification, then read from the graph and calculate the cardiac output. The question asks for the units to be given in the answer which many candidates missed so lost 1 mark. The units should be ml per minute or l per minute if converted. A common error was ml per beat per minute which is incorrect as well as giving m for metres instead of minutes.

(ii) Calculate the cardiac output for the person who has trained for a marathon when the heart rate is 160 beats per minute.
Give the units in your answer.

(3)

170 x 160 = 27200

ResultsPlus
Examiner Comments

This response scored 2 marks for the correct numerical answer. No units are given.

ResultsPlus
Examiner Tip

Read the question and give units when they are requested.

(ii) Calculate the cardiac output for the person who has trained for a marathon when the heart rate is 160 beats per minute.
Give the units in your answer.

(3)

170 x 160 = 27200 ml/m

27200 ml/m

ResultsPlus
Examiner Comments

This response scored two marks. The unit given is incorrect as m stands for metres. This was a common mistake made by candidates who did provide units.

ResultsPlus
Examiner Tip

Make sure you know and understand units for mass, volume and time.

(ii) Calculate the cardiac output for the person who has trained for a marathon when the heart rate is 160 beats per minute.
Give the units in your answer.

(3)

cardiac output = stroke volume × heart rate

C = 160 × 170

C = 27200 ml/min

27200ml/min

ResultsPlus
Examiner Comments

This response scored maximum marks for the correct numerical value and the correct units. The correct unit was accepted in different formats.

Question 5 (b)

This 6 mark question required a logical flow to the answer, starting with the blood entering the heart through the vena cava into the right atrium, travelling through a valve to the right ventricle, then exiting through the pulmonary artery to the lungs. The blood then returns to the heart through the pulmonary vein and enters the left atrium, goes through a valve to the left ventricle, then is pumped to the body through the aorta. There were some excellent responses here with candidates correctly naming the valves although this was not required. Confusion between the right and left side of the heart lost candidates some marks but if they had blood flow correctly through one side of the heart they could access Level 2 for 3 or 4 marks dependent upon if they correctly linked this to the lungs or not. Level 1 could be attained by naming a correct chamber or blood vessel not mentioned in the question. A number of candidates had the blood flowing from the ventricle into the atrium and picked up Level 1 for isolated knowledge.

*(b) Blood from the body enters the heart through the vena cava.

Describe how this blood flows through the heart and lungs to leave the heart through the aorta.

Include references to the chambers of the heart and the relevant valves in your answer.

(6)

Once blood from the vena cava it enters the right atrium and then will go ~~the~~ to the right ventricle once here it will travel to the lungs on ~~it~~ through the pulmonary artery to become oxygenated through gaseous exchange which capillaries take in oxygen at the alveoli and once the blood is oxygenated it will travel back to the heart through the pulmonary vein and then enter the left atrium it will then go to the left ventricle once here it will then ~~out~~ leave the heart through the aorta to be sent to vital organs and working muscles.

ResultsPlus
Examiner Comments

This is a very good Level 2 response. They have correctly given the blood flow through both sides of the heart and the link with the lungs. The missing knowledge preventing them accessing Level 3 is about the role of valves in the heart.

vena cava → right atrium → tricuspid valve → right ventricle → lungs → pulmonary artery → left atrium → pulmonary vein → tricuspid → left ventricle → aorta → body.

*(b) Blood from the body enters the heart through the vena cava.

Describe how this blood flows through the heart and lungs to leave the heart through the aorta.

Include references to the chambers of the heart and the relevant valves in your answer.

(6)

the deoxygenated blood ~~from arou~~ travelling around the body in ~~veins~~ low-pressure ~~veins~~ veins flows ~~into~~ through the vena cava (on the right side of the heart). It then enters the right atrium, then past the ~~bicuspid~~ bicuspid valve ~~and~~ (to ensure it flows one way only) and into the right ventricle. From ~~there~~ there, the pulmonary vein takes the deoxygenated blood to the lungs, where it flows through capillaries around alveoli and becomes oxygenated. It then travels back to the heart through the pulmonary artery, and into the left atrium. After the left atrium, oxegenated blood ~~flow~~ flows through the tricuspid valve into the left ventricle. The thick heart muscle in the left ventricle pumps ~~the~~ the oxygenated blood into the ~~a~~ aorta, to be pumped around the body and deliver oxygen to cells and muscles, to become deoxygenised and return back ~~into~~ through the vena cava, and is ~~rep~~ repeated.

ResultsPlus
Examiner Comments

This response was awarded a Level 3 for the blood flow through both sides of the heart and to the lungs including the role of valves in the heart. The response was awarded 5 marks for the pulmonary blood vessels being switched.

*(b) Blood from the body enters the heart through the vena cava.

Describe how this blood flows through the heart and lungs to leave the heart through the aorta.

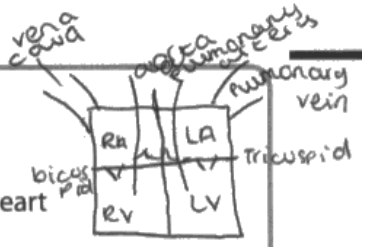
Include references to the chambers of the heart and the relevant valves in your answer.

(6)

De oxygenated blood enters the heart through the vena cava. Then it passes through the right atrium, then through the tricuspid valve and into the right vertical. it is then pumped through a semi lunar valve and out of the pulmonary artery to the lungs. At the lungs the de oxygenated blood collects oxygen. It then returns to the heart through the pulmonary vein. It then passes into the left atrium, then flowing through the bicuspid valve into the left ventrical. The blood is then pumped through a semi lunar valve and out through the aorta to the body.

ResultsPlus
Examiner Comments

This is a top Level 3 response awarded 6 marks. It is concise but refers to the correct chambers, location of the valves and the link to the lungs.



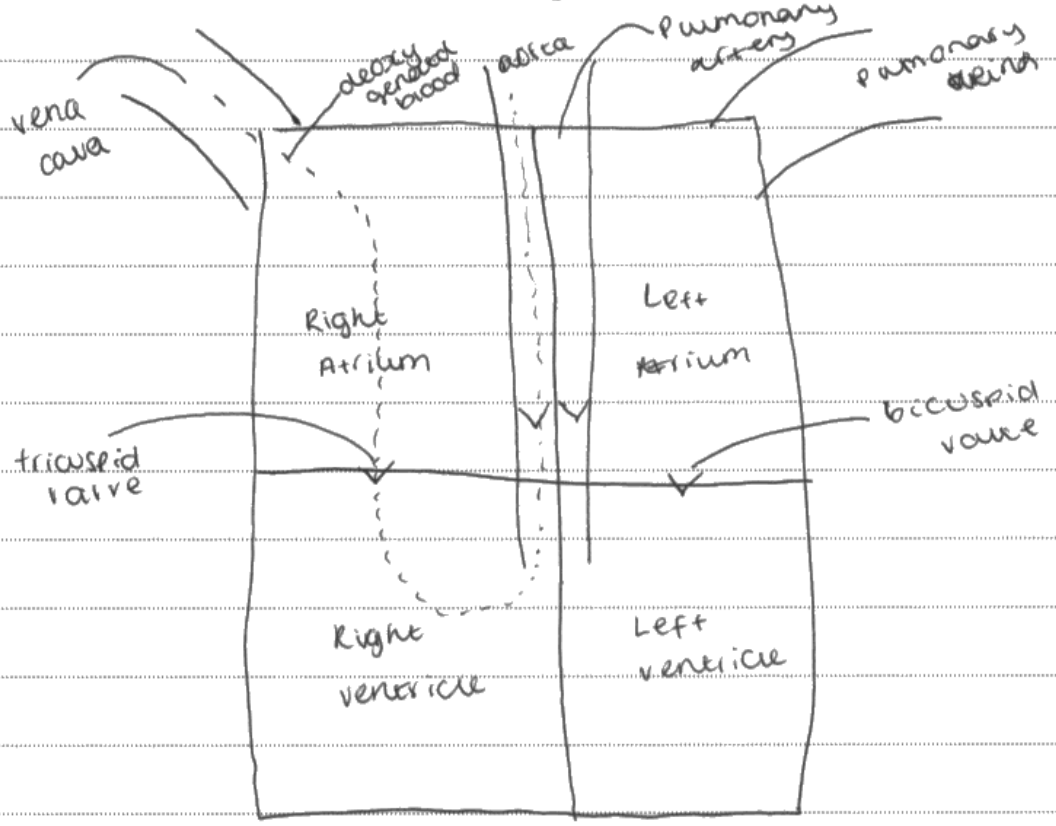
*(b) Blood from the body enters the heart through the vena cava.

Describe how this blood flows through the heart and lungs to leave the heart through the aorta.

Include references to the chambers of the heart and the relevant valves in your answer.

(6)

The vena cava recieves deoxygenated blood from the body. This enters the right atrium and sends it to the right ventrical but not before it goes through the tricuspid valve (which prevent the back flow of blood). ~~thi~~ Then the right ventricle sends the blood to the aorta ~~going~~ through another ~~the~~ valve. The aorta sends this deoxygenated blood to the lungs. When it goes to the ~~near~~ lungs it goes through gas exchange where the ~~lung~~ O_2 ~~diff~~ from air and CO_2 is wasted.



ResultsPlus
Examiner Comments

This response scored Level 3 with 5 marks and illustrates that a diagram can be used in extended open responses. The blood vessels are incorrect for the aorta and pulmonary artery but they describe the blood flow through the right side of the heart to the lungs. They also show in the diagram the blood flow through the left side of the heart including valves.

Question 6 (a)

This maths question required candidates to calculate the difference in the movement of carbon into and out of the atmosphere over a year. They firstly had to identify which was moving in and which was moving out which required considerable application of knowledge. The mathematical demand was not high but an understanding of movement was. Many candidates calculated a mean and therefore could not be awarded the marks. Some candidates did half of the calculation thus finding the movement into the atmosphere rather than finding both and subtracting them.

6 (a) Figure 6 shows the global movement of carbon into or out of the atmosphere.

process	movement of carbon into or out of the atmosphere in gigatonnes per year
photosynthesis	120.1
respiration	119.6
ocean uptake	92.8
ocean loss	90.0
combustion of fossil fuels	6.4

Figure 6

Calculate the net mass of carbon added to the atmosphere each year.

(2)

120.1 + 119.6 + 92.8 + 90.0 + 6.4

= 428.9

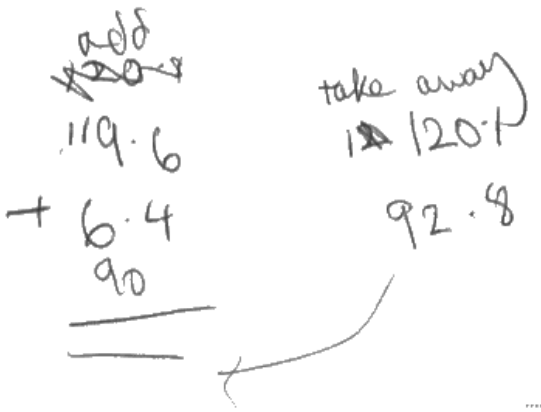
428.9 gigatonnes

ResultsPlus
Examiner Comments

Many candidates totalled the gigatonnes of carbon per year and did not obtain marks. Candidates did not understand the term net.

Calculate the net mass of carbon added to the atmosphere each year.

(2)



3·1 gigatonnes

ResultsPlus
Examiner Comments

This candidate recognised that some processes released carbon and some removed it from the atmosphere and obtained 2 marks for calculating the net mass added.

Calculate the net mass of carbon added to the atmosphere each year.

(2)

~~120·1 + 119·6 + 92·8 + 90 + 6·4~~

= 90

119·6 + ~~92·8~~ + 6·4

=

216 gigatonnes

ResultsPlus
Examiner Comments

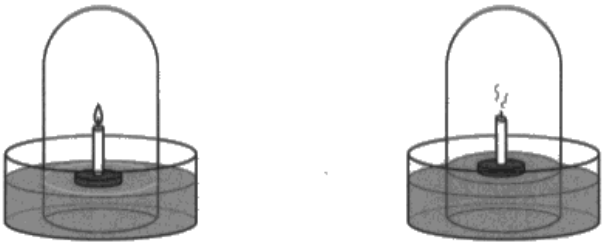
This candidate obtained 1 mark by doing the most frequent response seen in candidates scoring a single mark: they have totalled the processes that add carbon to the atmosphere.

Question 6 (b) (i)

This was well understood with many candidates understanding that oxygen was required for the candle to burn. There were a couple of errors where candidates thought carbon dioxide was required.

(b) Joseph Priestley was a scientist who investigated how green plants and combustion affected the carbon cycle.

Figure 7 shows his first experiment.



candle sealed in a bell jar

candle after 3 minutes

Figure 7

(i) State why the candle was not burning after three minutes.

(1)

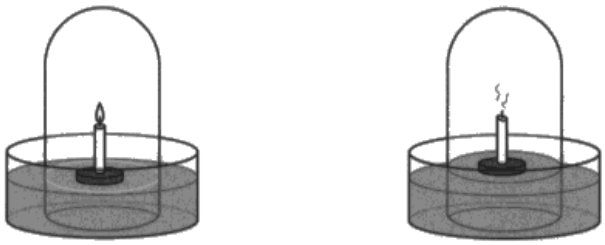
because there is no oxygen in the sealed bell jar.

ResultsPlus
Examiner Comments

This candidate was awarded the mark for recognising that the candle was not burning after three minutes because there was no oxygen.

(b) Joseph Priestley was a scientist who investigated how green plants and combustion affected the carbon cycle.

Figure 7 shows his first experiment.



candle sealed in a bell jar

candle after 3 minutes

Figure 7

(i) State why the candle was not burning after three minutes.

(1)

All there was is carbon dioxide so it blew it out

ResultsPlus
Examiner Comments

This candidate shows some knowledge of combustion but the response does not answer the question and no marks were awarded.

Question 6 (b) (ii)

This question extended knowledge and candidates found this a little more tricky, often confusing photosynthesis and respiration with the idea that the plant was removing oxygen through the process of photosynthesis.

(ii) Joseph Priestley continued the investigation but placed a plant inside the bell jar as shown in Figure 8.

Figure 8

He observed that the candle stayed alight for two minutes more than the candle in the bell jar in the first experiment.

Explain his observation.

(2)

the plant produces oxygen for and carbon dioxide for the flame to keep lighth and to keep it burning.

ResultsPlus
Examiner Comments

This response is contradictory and unclear and did not gain credit as they indicate that the plant provides oxygen and carbon dioxide to the flame which is incorrect.

Explain his observation.

(2)

The plant woula have been photosynthesising, which produces oxygen so there was more oxygen content in the jar so the candle could do more combustion and so stay alight longer.

ResultsPlus
Examiner Comments

This clear response scores both marks for linking photosynthesis by the plant to the release of oxygen for combustion.

Explain his observation.

(2)

The plant ~~ret~~ produces oxygen ~~and~~ (when turning carbon dioxide into oxygen) and the oxygen allows the candle to still burn but not enough oxygen is made quick enough so the fire doesn't last much longer

ResultsPlus
Examiner Comments

This response scored one for releasing oxygen but did not link this to the explanation that it was released by photosynthesis for the additional mark.

Question 6 (b) (iii)

The variables that needed to be controlled in an experiment were assessed here. The volume of air in the bell jar was needed but once again candidates lost marks by referring to the concentration of air in the bell jar. References to the size/type of candle were awarded marks and many candidates were able to access at least one of these marks.

(iii) State **two** variables that would need to be controlled to compare these two experiments.
(2)

1 Size of the bell jar

2 light intensity.

ResultsPlus
Examiner Comments

There are a number of variables that were acceptable and listed on the mark scheme. A response including size of the bell jar and light intensity was awarded both marks.

(iii) State **two** variables that would need to be controlled to compare these two experiments.
(2)

1 amount of oxygen in bell jar without the plant

2 Same Candle

ResultsPlus
Examiner Comments

This response was not awarded a mark. The bell jar contains air and using the same candle is insufficient; it would need to be the same size or the same type.

(iii) State **two** variables that would need to be controlled to compare these two experiments.

(2)

1 Size of bell jar

2 Size of candle

ResultsPlus
Examiner Comments

This response illustrates a common answer seen worth 2 marks. There is no requirement to give further details for controlled variables.

Question 6 (c)

Higher ability candidates answered this question well but many candidates struggled with the role of the different bacteria in the nitrogen cycle. The majority of marks were awarded for the idea of decomposers being involved. The role of nitrifying and nitrogen fixing bacteria were sometimes confused. The nitrogen fixing bacteria convert atmospheric nitrogen into nitrates (ammonia or nitrates accepted here) and nitrifying bacteria converting ammonia into nitrites/nitrates. The least seen bacteria in this response was the role of denitrifying bacteria in the nitrogen cycle converting nitrates back into nitrogen.

(c) Nitrogen is cycled through the environment.

Describe the roles of bacteria in the nitrogen cycle.

(4)

There are four types of bacteria involved in the nitrogen cycle. Decomposers decompose dead organisms and return the nitrates to the soil. Nitrogen - fixing bacteria can be found in nodules of legumes and are responsible for changing unreactive nitrogen gas in the air to ammonia and nitrates in the soil. Nitrifying bacteria changes ammonia into nitrites and then nitrates, to be absorbed by plants. Denitrifying bacteria converts nitrates in the soil back into nitrogen gas, returning it to the atmosphere.

ResultsPlus
Examiner Comments

This clear and concise response scored the maximum four marks. They have a sentence for the role of each type of bacteria in the nitrogen cycle.

ResultsPlus
Examiner Tip

When describing a process ensure your answer is logically ordered so all aspects are covered.

(c) Nitrogen is cycled through the environment.

Describe the roles of bacteria in the nitrogen cycle. (4)

N ironegying bacteria takes Nitrogen from the atmosphere and turns it into ammonia*, then nitrogen fixing bacteria turns the ammonia into nitrates which plants can use when they want food. Denitrifying bacteria turns nitrates back into nitrogen and put it back into the atmosphere. finally, decompcoers are bacteria that feed on the nitrogen that is left from the dead plants when they begin to rot. * these are found in root nodules of legumes.

ResultsPlus
Examiner Comments

This response names bacteria involved in the nitrogen cycle but links most of them to the incorrect process. One mark was awarded for the denitrifying bacteria.

Paper Summary

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

- Recognise that the word 'explain' means additional scientific information is needed that is linked to the answer given.
- Use all the information given in the question to help construct the answer but avoid repeating the information which has already been given, and giving a vague response which will not gain credit.
- Develop their practical skills knowledge to ensure they understand the difference between the factors being investigated, controlled variables and stating a control.
- If terms such as valid, reliable, accurate and precise are used candidates should ensure they know the scientific meaning of these terms.
- Ensure they know the core practical tasks and that they can apply the knowledge of these to new situations.
- Use scientific terminology accurately in open responses.
- Ensure they consistently apply rules for rounding up numerical answers.
- Read mathematical questions carefully to note whether an answer is required in standard form or to a specified number of significant figures and include the correct units.
- Always show the mathematical working when doing calculations as a mark can be awarded for errors carried forward.
- Consider the context of the question to ensure they apply their scientific knowledge to the situation they are being asked about.
- Check the number of marks given for the question and ensure that they have included enough facts to match the marks awarded.

Grade Boundaries

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

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