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Examiners' Report
June 2023

GCSE Combined Science 1SC0 2BH

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Introduction

The Pearson Edexcel GCSE (9-1) Paper 4 Combined Science – Biology (Higher tier) paper is the second of two biology papers taken as part of the GCSE (9-1) Combined Science qualification and the fourth paper out of six for the qualification. This is the sixth assessment of the GCSE (9-1) Combined Science specification, and the qualification follows a linear assessment model whereby candidates must complete all six papers in the same single year of certification.

This paper 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 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. Unlike last year, candidates were not provided with advanced information so had to be prepared for questions across all areas of the specification covered by this paper.

The GCSE (9-1) Combined Science qualification assesses practical knowledge and maths skills; the requirements of which are given in the specification. Additionally, there are 6 mandatory core practical tasks that candidates must complete prior to the examinations, as aspects of working scientifically are also assessed in questions throughout the paper. This includes knowledge on equipment, safety methods, variables and controls as well as analysis and interpretation of data.

The 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 osmosis and blood glucose regulation, aerobic and anaerobic respiration, diffusion and gas exchange, the hormones of the menstrual cycle and pregnancy, the role of denitrifying bacteria and the carbon cycle.

Questions designed to assess practical work included writing a plan to see the effect of temperature on photosynthesis including controlling variables and writing a plan. The maths skills assessment in this paper related to questions requiring the inverse square law for photosynthesis, interpretation of graphical information, conversion of units, and magnification calculations putting answers into standard form.

Many candidates were able to demonstrate a good level of knowledge in the early questions, including osmosis and diffusion as well as application of their knowledge of photosynthesis and respiration. In comparison to previous years more candidates had attempted more questions with less left blank. This possibly shows the benefit of the increasing resources of past paper questions that can be used for revision.

Most candidates were able to access the extended writing responses, demonstrating some knowledge of the carbon cycle although many were limited by not referring to the correct carbon compounds. Higher ability candidates were able to apply their knowledge of the human hormones of the menstrual cycle and explain some changes that occur during pregnancy.

Although there has been an improvement in answering practical based questions it still remains a challenge for some candidates. They need to use scientific terminology more frequently when answering questions related to practical tasks and be clear on which aspect is the independent and dependent variable so they can recognise controlled variables. Across the paper, candidates generally showed that they could extract data from graphs and calculate differences between two values.

Question 1 (a)(i)

Candidates needed to extract two numbers from the graph and calculate a difference of 9 for one mark. It was well answered by many candidates although some only identified the highest value rather than the increase.

Question 1 (a)(ii)

Candidates were asked to explain why water moved out of the red blood cells of the person with diabetes. The correct response included the idea that water moved out of the cells by osmosis because the concentration of glucose was higher in the plasma than in the red blood cell across a partially permeable membrane. There were references to the glucose moving rather than the water, which was not credited and some candidates linked this question to regulation of blood glucose and not osmosis. If candidates referred to water concentration from where water is in high concentration in the red blood cell to lower water concentration in the plasma, this was credited but it is important that they refer to water or water potential here.

(ii) Water moved out of the red blood cells of the person with diabetes when the concentration of glucose in the blood was above 15 mmol per dm^3.

Explain why water moved out of the red blood cells of the person with diabetes.

(2)

The water moved out through osmosis from a high water concentration to a low water concentration.

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Examiner Comments

This gained two marks for osmosis, as it is clearly referring to water moving and high water concentration to a low water concentration was accepted.

(ii) Water moved out of the red blood cells of the person with diabetes when the concentration of glucose in the blood was above 15 mmol per dm^3.

Explain why water moved out of the red blood cells of the person with diabetes.

(2)

water moved out of the blood cell because the high concentration of glucose in the blood meant that it diffused from high to low concentration.

ResultsPlus
Examiner Comments

Water moved out of the blood is in the question. They do not make a comparative statement – a higher concentration of glucose in the blood would have been sufficient. The reference to 'it diffused from high to low concentration' was not clear if 'it' was water moving or glucose, so no marks were awarded.

(ii) Water moved out of the red blood cells of the person with diabetes when the concentration of glucose in the blood was above 15 mmol per dm^3.

Explain why water moved out of the red blood cells of the person with diabetes.

(2)

Because the ~~blood~~ rest of the blood had a lwer concentration of water and a higher glucose concentration (osmosis)

ResultsPlus
Examiner Comments

This has a comparative term used, the question is asking about red blood cells so the rest of the blood having a lower water concentration or a higher glucose concentration was accepted. Osmosis was not awarded for this response as it is not linked to water.

Question 1 (b)(i)

Candidates were expected to identify insulin as the hormone that reduces blood glucose.

Question 1 (b)(ii)

The question asks how hormones get from where they are released to their target organ and any response linking this to the bloodstream, the blood plasma or even the blood was credited. Inside red blood cells were not credited as this is incorrect. Acceptable answers are also through blood vessels or even named blood vessels.

(ii) State how this hormone is transported from the pancreas to its target organs. (1)

Blood

ResultsPlus Examiner Comments

This was sufficient for the mark.

(ii) State how this hormone is transported from the pancreas to its target organs. (1)

through plasma in the blood

ResultsPlus Examiner Comments

This response shows a clear understanding of the role of plasma in transporting substances.

(ii) State how this hormone is transported from the pancreas to its target organs. (1)

This hormone is transported through veins

ResultsPlus Examiner Comments

Named blood vessels or just blood vessels was accepted.

Question 1 (c)

The questions asked how type 2 diabetes was controlled. Most responses referred to controlling the diet or exercising but didn't link this to reducing blood glucose concentration, which limited marks. Ideas around balanced diet or healthy diet were not sufficient. Credit was given for taking medication although there were few references to the correct medication such as metformin. Credit was not given for vague references to pills, tablets, or drugs being taken. Insulin injection/pumps was an acceptable answer as in some cases this is given.

(c) Explain how type 2 diabetes can be controlled.

(3)

To regulate the concentration of blood sugars, a peson can change their diet (e.g. reduce foods with sugar), exercise more or touce medicanion in some extreme cases.

ResultsPlus
Examiner Comments

References to regulating blood sugar needed to refer to blood glucose being regulated/controlled/reduced/lowered etc. Changing diet was not enough but reduce food with sugar was sufficient for the mark. This also has exercise and take medication scoring three marks in total.

(c) Explain how type 2 diabetes can be controlled.

(3)

Type 2 diabetes can be controlled by improving your lifestyle: excersizing more and eating a healthier diet. You can take medicines that limit the effect it has on your day to day life. Measure blood glucose levels regularly to know how well your body is dealing with the insulin.

ResultsPlus
Examiner Comments

Improved lifestyle was not specific but there are marks for exercise and measure blood glucose levels regularly. Taking medicines was not enough. The mark scheme required medication or named medication. Healthier diet was not enough as it needed to be the idea of a controlled diet or one where intake of carbohydrates was reduced.

(c) Explain how type 2 diabetes can be controlled.

(3)

A healthy diet and an achive lifestyle can control a type 2 diabetes along with insulin injections if necessary.

ResultsPlus
Examiner Comments

Neither a healthy diet nor an active lifestyle were sufficient. The use of insulin was accepted as some type 2 diabetics use insulin.

ResultsPlus
Examiner Tip

Be specific, terms like healthy and lifestyle are vague, give the specific changes needed.

Question 2 (b)(i)

Candidates were asked why the breathing rate of the athlete changed when running. The response required was either to absorb more oxygen for more respiration to release more energy or to remove more carbon dioxide from more respiration. These were alternative responses. The essential point here is that more was important, this could have been said to increase the oxygen taken in or words to that effect. Occasionally candidates referred to provide more glucose, this was not credited and the idea of producing or making energy was ignored as it is incorrect.

(b) An athlete runs every day as part of their training.

(i) Explain why the breathing rate of the athlete increases when running.

(2)

The athlete needs more oxygen in their blood to go to the working muscles so they can respire and produces more energy

ResultsPlus
Examiner Comments

More oxygen in the blood why breathing rate increases and they have linked this to respiration for two marks. Produces more energy would be ignored, it needs to be released.

(b) An athlete runs every day as part of their training.

(i) Explain why the breathing rate of the athlete increases when running.

(2)

At that point in time his body is respiring and energy is needed. He also needs more oxygen and blood flow so he's breathing rate increases

ResultsPlus
Examiner Comments

This scored two marks for linking the idea of more oxygen to respiration/energy.

(b) An athlete runs every day as part of their training.

(i) Explain why the breathing rate of the athlete increases when running.

(2)

The ~~mus~~ body requires more oxygen as it is being used to make energy

ResultsPlus
Examiner Comments

Energy cannot be made but this scored one mark for more oxygen.

ResultsPlus
Examiner Tip

Refer to energy being released through respiration, not energy being made or produced.

(b) An athlete runs every day as part of their training.

(i) Explain why the breathing rate of the athlete increases when running.

(2)

~~Anarobic respiration~~

The athlete needs more oxygen as their heart rate will be increased. The heart will require more oxygen to pump more frequently.

ResultsPlus
Examiner Comments

This scored one mark. The command word explain requires links to be made and a reason given for why the body needs more oxygen.

Question 2 (b)(ii)

Candidates were asked to state two differences between aerobic and anaerobic respiration and the majority of answers included aerobic uses oxygen and anaerobic produces lactic acid. Some candidates merely gave the reverse argument for their second point and limited themselves to one mark. Some higher ability candidates knew that aerobic takes place in the mitochondria whereas anaerobic takes place in the cytoplasm. No credit was awarded for references to different types of exercise.

(ii) When the athlete is running, their muscle cells use both aerobic respiration and anaerobic respiration.

State **two** differences between aerobic respiration and anaerobic respiration.

(2)

1 aerobic respiration uses oxygen not glucose

2 an-aerobic releases Lactic acid ~~an~~ which is not produced by aerobic

ResultsPlus Examiner Comments

The first statement is incorrect as aerobic respiration uses glucose. One mark was awarded for anaerobic releases lactic acid, which is correct.

ResultsPlus Examiner Tip

Know the equations for aerobic and anaerobic respiration.

(ii) When the athlete is running, their muscle cells use both aerobic respiration and anaerobic respiration.

State **two** differences between aerobic respiration and anaerobic respiration.

(2)

1 Anaerobic produces lactic acid

2 Aerobic produces Carbon dioxide

ResultsPlus
Examiner Comments

This scored one mark as they both refer to the products of the types of respiration. Water wasn't required as a product for aerobic respiration, either water or carbon dioxide were credited.

(ii) When the athlete is running, their muscle cells use both aerobic respiration and anaerobic respiration.

State **two** differences between aerobic respiration and anaerobic respiration.

(2)

1 Aerobic ~~the~~ occurs in the mitochondria while anaerobic occurs ~~in~~ in the cytoplasm.

2 Aerobic requires oxygen while anaerobic does not.

ResultsPlus
Examiner Comments

A number of responses showed the knowledge of the location of respiration even though it is beyond the scope of the specification. This scored two marks for two distinct differences.

Question 2 (c)(i)

This question was based on a practical for measuring photosynthesis using the indicator bromothymol blue. A table showing colour changes at different pH levels was given. Candidates were asked to explain why the air breathed out turned the BTB solution yellow. The response required was that the air breathed out contained more carbon dioxide which forms a weak acid when dissolved in water. Credit was given for turning the solution acidic or lowering the pH. If only the formula was written then this must be correct to be credited.

(c) Bromothymol blue (BTB) solution is an indicator of pH.

Figure 2 shows the colour of BTB at different pH levels.

pH	4	5	6	7 (neutral)	8
colour	yellow	yellowy green	light green	green	blue

Figure 2

When air is passed through green BTB, for one minute, the solution stays green.

When a person breathes out through a straw into BTB for one minute the solution turns yellow.

(i) Explain why the air breathed out turns the BTB solution yellow.

(2)

The air breathed out ~~contains~~ is carbon dioxide which increases the pH to acidic levels, as the pH increases the solution turns yellowy green.

ResultsPlus
Examiner Comments

This gained one mark for carbon dioxide. It referred to increasing the pH which is not correct, so this prevented awarding of the mark for acidic.

(c) Bromothymol blue (BTB) solution is an indicator of pH.

Figure 2 shows the colour of BTB at different pH levels.

pH	4	5	6	7 (neutral)	8
colour	yellow	yellowy green	light green	green	blue

Figure 2

When air is passed through green BTB, for one minute, the solution stays green.

When a person breathes out through a straw into BTB for one minute the solution turns yellow.

(i) Explain why the air breathed out turns the BTB solution yellow.

(2)

The air breathed out of the body makes the solution turn yellow because it is carbon dioxide which has been produced through respiration so will have a lower ph compared to regular air.

ResultsPlus
Examiner Comments

This gained both marks for carbon dioxide linked to lower pH.

(c) Bromothymol blue (BTB) solution is an indicator of pH.

Figure 2 shows the colour of BTB at different pH levels.

pH	4	5	6	7 (neutral)	8
colour	yellow	yellowy green	light green	green	blue

Figure 2

When air is passed through green BTB, for one minute, the solution stays green.

When a person breathes out through a straw into BTB for one minute the solution turns yellow.

(i) Explain why the air breathed out turns the BTB solution yellow.

(2)

→ The air breathed out was heavy in carbon dioxide concentration compared to the air, hence why it turned yellow

ResultsPlus
Examiner Comments

This gained one mark for carbon dioxide. Turned yellow was given in the table and did not have any interpretation.

ResultsPlus
Examiner Tip

Make sure you interpret data rather than just repeating what is written when asked to explain.

Question 2 (c)(ii)

This question followed on from the practical, with pondweed being added to the BTB solution and one test tube being kept in the dark and the other in the light. Candidates were asked to explain the results for the different tubes. Credit was given for recognising that photosynthesis can happen for the tube in the light which removes carbon dioxide from the solution. For the tube in the dark, credit was awarded for either only respiration was taking place or no photosynthesis took place.

(ii) A scientist placed pondweed into two sealed test tubes containing green BTB solution.

Test tube A was kept in the dark.
Test tube B was kept in the light.
All other conditions were kept the same.
Figure 3 shows these test tubes at the start of the investigation.

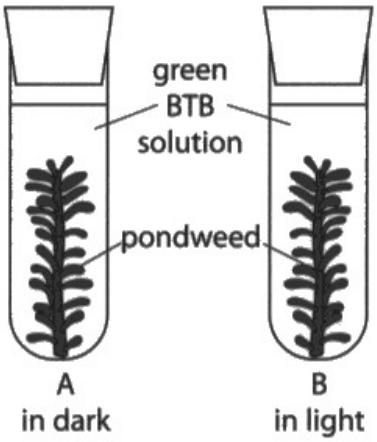

Figure 3

Figure 4 shows the colour of the BTB solution after 5 hours.

Tube A (in dark)	Tube B (in light)
yellowy green	green
acidic	neutral

Figure 4

Explain the results for tube A and tube B shown in Figure 4.

(2)

In Tube A, photosynthesis didn't occur so the solution became acidic whereas Tube B stayed neutral because it had access to sunlight and all conditions were stable.

ResultsPlus
Examiner Comments

This scored one mark for no photosynthesis in tube A. Staying neutral or having access to sunlight is not an explanation for tube B so the mark was not awarded.

(ii) A scientist placed pondweed into two sealed test tubes containing green BTB solution.

Test tube A was kept in the dark.
Test tube B was kept in the light.
All other conditions were kept the same.
Figure 3 shows these test tubes at the start of the investigation.

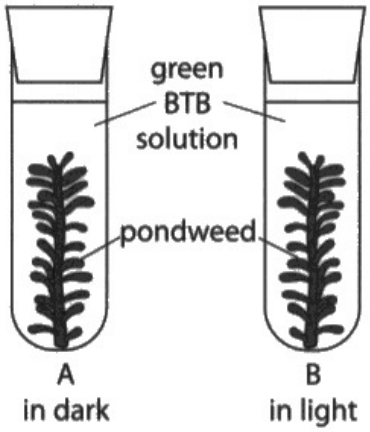

Figure 3

Figure 4 shows the colour of the BTB solution after 5 hours.

Tube A (in dark)	Tube B (in light)
yellowy green	green

Figure 4

Explain the results for tube A and tube B shown in Figure 4.

(2)

Test tube A turned yellowy green because the pondweed cannot photosynthesise without ~~with~~ the light. Test tube B in light turned green because the pondweed could photosynthesise.

ResultsPlus
Examiner Comments

This gained full marks for explaining the colours of each tube.

(ii) A scientist placed pondweed into two sealed test tubes containing green BTB solution.

Test tube A was kept in the dark.
Test tube B was kept in the light.
All other conditions were kept the same.
Figure 3 shows these test tubes at the start of the investigation.

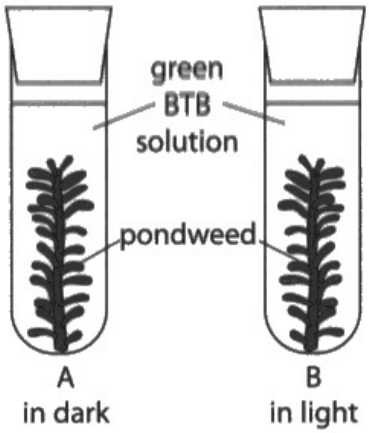

Figure 3

Figure 4 shows the colour of the BTB solution after 5 hours.

Tube A (in dark)	Tube B (in light)
yellowy green	green

Figure 4

Explain the results for tube A and tube B shown in Figure 4.

(2)

Tube A is yellowy green because in the dark there isn't enough light so the pondweed gets weaker and in the light the pH goes up so it turns to neutral

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Examiner Comments

This did not score any marks as it just repeats information given within the question and doesn't provide an explanation.

Question 3 (a)(i)

This is a question based on the photosynthesis core practical task looking at how light intensity affects the rate of photosynthesis. The question asks candidates to state why the student included a water bath. Acceptable answers included maintaining a constant temperature or as a heat shield to prevent the heat from the light from affecting the experiment. Common incorrect responses included the idea that it was needed so temperature could be measured.

3 A student investigated the effect of light intensity on the photosynthesis of pondweed.

A light source was placed at different distances from the pondweed.

The bubbles produced were counted for 2 minutes.

Figure 5 shows the apparatus that was used.

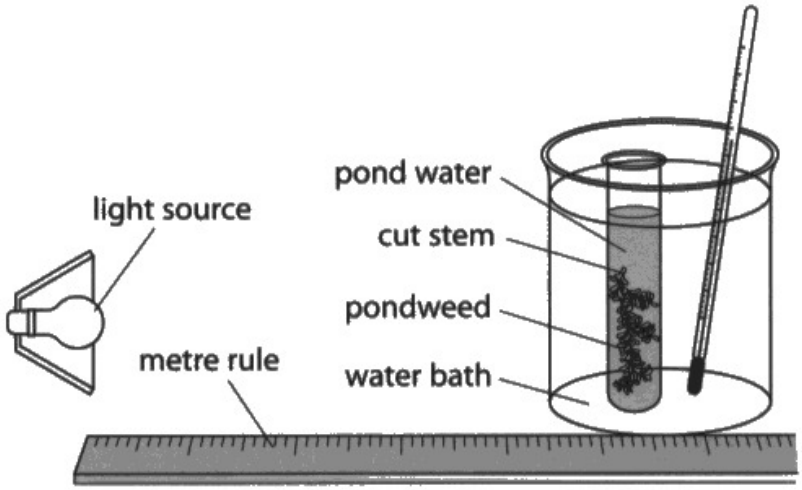

Figure 5

(a) (i) State why the student included a water bath in the apparatus.

(1)

to measure the temperature

ResultsPlus
Examiner Comments

This is not the function of the water bath.

3 A student investigated the effect of light intensity on the photosynthesis of pondweed.

A light source was placed at different distances from the pondweed.

The bubbles produced were counted for 2 minutes.

Figure 5 shows the apparatus that was used.

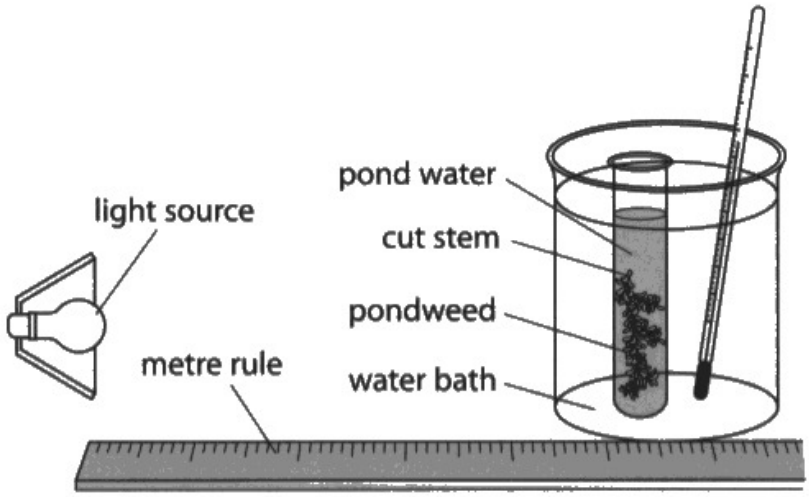

Figure 5

(a) (i) State why the student included a water bath in the apparatus.

(1)

The water bath takes the lights heat intensity, not effecting the pondweed.

ResultsPlus
Examiner Comments

This response described the use of the water bath as a heat shield for one mark.

3 A student investigated the effect of light intensity on the photosynthesis of pondweed.

A light source was placed at different distances from the pondweed.

The bubbles produced were counted for 2 minutes.

Figure 5 shows the apparatus that was used.

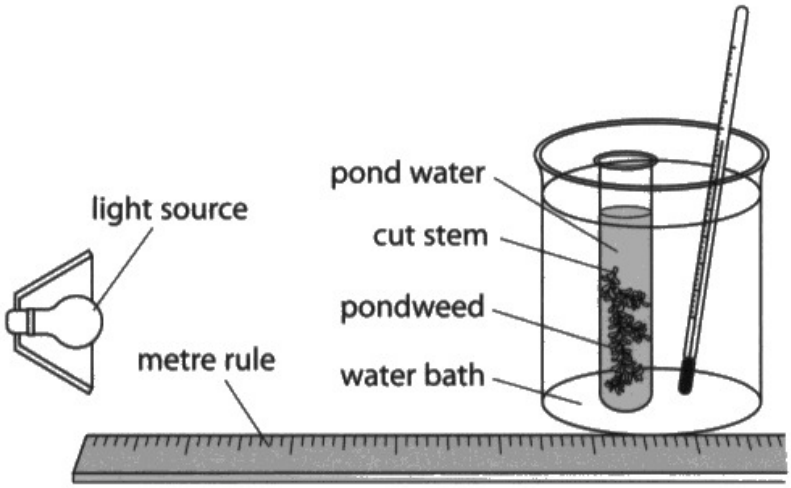

Figure 5

(a) (i) State why the student included a water bath in the apparatus.

because it will help keep the pondweed at a steady temperature

(1)

ResultsPlus
Examiner Comments

This response was awarded the mark for the idea of maintaining the temperature of the pondweed.

Question 3 (a)(ii)

Candidates were asked to state two variables that needed to be controlled. In this case, there were several possible answers including temperature, volume of pond water, mass of pond water, and carbon dioxide concentration. Once again, we do not credit the amount of water/pondweed as we are expecting scientific units to be used. Some candidates recognised that the light source would need to be the same but others suggested that light intensity or distance from the lamp needed to be controlled.

(ii) State **two** variables that should be controlled when completing this investigation.

(2)

1 Temperature of water bath

2 Amount of / Mass of pond weed in the water

ResultsPlus Examiner Comments

This was awarded two marks for controlling temperature and for the mass of the pondweed.

Amount is ignored as it does not give a measurement value.

(ii) State **two** variables that should be controlled when completing this investigation.

(2)

1 Light source always have to stay on and on the same brightnes

2 The ruler must not be moved

ResultsPlus Examiner Comments

This gained one mark for the idea of using the same light source which should be the same so that the only change is distance.

The rule not being moved is irrelevant.

(ii) State **two** variables that should be controlled when completing this investigation.

(2)

1 The light source distance.

2 ~~Temperature~~ ~~control variable~~
The amount of pondweed.

ResultsPlus
Examiner Comments

This did not score as the light source distance is being changed and amount of pondweed is not a measurement.

ResultsPlus
Examiner Tip

Use terms that allow a measurement and not amount, eg mass, volume, length.

Question 3 (b)(i)

Candidates were asked to calculate the light intensity at 25cm from the lamp. A table of values was given where the light intensity had been calculated for four other values. The candidates were also informed to use the inverse square law for photosynthesis. They had to apply their knowledge either by trial and error using the calculated values in the table or by applying the inverse square law. They scored two marks for writing out the calculation $1 \div 25^2$ and all three marks for the correct answer of 0.0016 (arbitrary units) on the answer line. It is always important to show working in all calculations.

(b) Figure 6 shows the results of this investigation.

distance from the lamp in cm	number of bubbles in two minutes	light intensity in arbitrary units
5	62	0.04
10	60	0.01
15	43	0.0044
20	32	0.0025
25	11	?

Figure 6

(i) The light intensity was calculated using the inverse square law for photosynthesis.

* Calculate the light intensity at a distance of 25 cm from the lamp.

Include the equation for the inverse square law in your answer.

(3)

$\left(\frac{1}{5}\right)^2 = 0.04$

$\left(\frac{1}{25}\right)^2 = 1.6 \times 10^{-3}$

0.0016

0.0016 arbitrary units

ResultsPlus
Examiner Comments

This shows working out of the inverse square law and the correct answer for three marks.

(b) Figure 6 shows the results of this investigation.

distance from the lamp in cm	number of bubbles in two minutes	light intensity in arbitrary units
5	62	0.04
10	60	0.01
15	43	0.0044
20	32	0.0025
25	11	?

Figure 6

(i) The light intensity was calculated using the inverse square law for photosynthesis.

Calculate the light intensity at a distance of 25 cm from the lamp.

Include the equation for the inverse square law in your answer.

(3)

0.0016

0.0016 arbitrary units

ResultsPlus
Examiner Comments

This scored full marks for the correct answer.

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Examiner Tip

Workings are not required but always recommended in case you make a mistake in your calculation.

(b) Figure 6 shows the results of this investigation.

distance from the lamp in cm	number of bubbles in two minutes	light intensity in arbitrary units
5	62	0.04
10	60	0.01
15	43	0.0044
20	32	0.0025
25	11	?

Figure 6

(i) The light intensity was calculated using the inverse square law for photosynthesis.

Calculate the light intensity at a distance of 25 cm from the lamp.

Include the equation for the inverse square law in your answer.

(3)

$\left(\frac{1}{11}\right)^2 = 0.09$

0.09 arbitrary units

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Examiner Comments

This candidate has attempted to work out the inverse square law but has not succeeded.

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Examiner Tip

If there is data in the table use it to help you work out the required calculation.

Question 3 (b)(ii)

For the investigation, the candidates were told that the number of bubbles was counted and they were then asked how this method could be improved to get a more accurate measurement of the gas. Answers included using a gas syringe to collect the gas or to get a measurement of the volume. Alternatively, they could use a data logger or video camera and playback in slow motion to ensure they counted every bubble. Also accepted was to use an inverted measuring cylinder with water where the oxygen displaced the water, giving them a measure of volume.

(ii) Explain how the student could improve this investigation to get a more accurate measurement of the gas produced.

(2)

By using a gas syringe he can get a more accurate measurement

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Examiner Comments

A gas syringe is worth one mark, a more accurate measurement just repeats the information from the question.

ResultsPlus
Examiner Tip

Avoid repeating the wording from the question as it will not gain marks.

(ii) Explain how the student could improve this investigation to get a more accurate measurement of the gas produced.

(2)

use a gas syringe to collect the gas produced and measure it accurately. Or repeat experiment

ResultsPlus
Examiner Comments

Full marks were awarded to this response for the use of a gas syringe to collect the gas produced.

(ii) Explain how the student could improve this investigation to get a more accurate measurement of the gas produced.

(2)

could set up a camera in slow motion so you can count the bubbles better. A student could also change the distance from the lamp to 2cm instead of 5cm, giving us more values and a more accurate average.

ResultsPlus
Examiner Comments

This response shows an improvement to the method for measuring the gas produced as the count of bubbles would be more accurate.

(ii) Explain how the student could improve this investigation to get a more accurate measurement of the gas produced.

(2)

have more than one person count the bubbles to get more accurate results

ResultsPlus
Examiner Comments

This does not improve the accuracy of the measurement and therefore did not gain credit.

Question 3 (c)

Candidates were asked to devise a plan to show that temperature is a limiting factor in photosynthesis using the apparatus given. Marks were awarded for keeping the light at the same distance or a given distance or keeping the same light intensity. Counting the number of bubbles produced or measuring the volume of gas produced was also awarded a mark. Repeating the experiment at different temperatures or giving a list of temperatures was awarded a mark and the idea of controlling the mass or pondweed, type of pondweed, or the carbon dioxide concentration was also awarded a mark.

(c) Devise a plan to show that temperature is a limiting factor in photosynthesis.

Use the apparatus shown in Figure 5.

(3)

Place light source 10cm away from pondweed. Place pondweed beaker in water bath to get a temperature of 10°C wait 2 minutes for the pondwater to change temperature and start a stopwatch and count the amount of bubbles produced. Repeat experiment with different temperature to see how much bubbles produced as temperature changes. control variable, can calculate mean.

(Total for Question 3 = 11 marks)

ResultsPlus
Examiner Comments

This gained a mark for placing the light source 10cm away, counting bubbles and for repeating the test at different temperatures. Although they state controlled variable, they do not give an indication of the variable which was required for the mark.

(c) Devise a plan to show that temperature is a limiting factor in photosynthesis.

Use the apparatus shown in Figure 5.

(3)

By keeping the light, the same distance away from the test tube and changing the temperature of the environment that the pondweed is in will show how temperature affects the rate of photosynthesis. The temperature of the water bath can be monitered using the thermometer.

ResultsPlus
Examiner Comments

This had keeping the light the same distance away from the test tube and changing the temperature of the environment, which is sufficient for the idea of completing it at different temperatures. There is no indication of what data would be collected.

(c) Devise a plan to show that temperature is a limiting factor in photosynthesis.

Use the apparatus shown in Figure 5.

(3)

put the plant in a test tube ~~for~~ with water and use a clamp to hold it above the flame of a bunsen burner. Use a ~~the~~ thermometer to record the temperature of the water at regular intervals and record the amount of bubbles that are being produced at that certain temperature. ~~A~~ Continue until the rate of bubbles starts to decrease, as it's reached its optimum ~~temperature~~ temperature that the plant can photosynthesise at.

ResultsPlus
Examiner Comments

This had the idea of continuous heating so the mark for changing the temperature was not awarded. The marking points are independent so one mark was awarded for recording the amount of bubbles.

(c) Devise a plan to show that temperature is a limiting factor in photosynthesis.

Use the apparatus shown in Figure 5.

(3)

I would first use the same apparatus shown in Figure 5 to see the effect of light intensity on the photosynthesis of pondweed. Once I have gathered my results. I would use the same apparatus in Figure 6, but without the water bath. This will allow for the heat given off by the lamp to affect photosynthesis. I would record the number of bubbles produced in two ~~minets~~ minutes. I would then compare my results from the apparatus with the water bath and the one without the water bath.

ResultsPlus
Examiner Comments

This gained one mark for recording the number of bubbles but the link to the light affecting the temperature is not a correct method. Using the lamp to change the temperature was not accepted.

Question 4 (a)(i)

This question expected candidates to identify that oxygen moves from the alveolus into the capillary.

Question 4 (a)(ii)

This question expected candidates to identify carbon dioxide as the gas that moves from the capillary to the alveolus.

Question 4 (a)(iii)

Candidates were asked to explain how gases move from the alveolus to the capillary. Answers included diffusion for one mark, down a concentration gradient or from high concentration to low concentration for one mark. Through a membrane was also awarded a mark. Some responses included osmosis rather than diffusion, which was not credited.

(iii) The capillary wall is only one cell thick.

Explain how gases move from the alveolus to the capillary.

(3)

The alveolus and capillary are very close together decreasing the distance for the gases to travel from the alveoli to the capillary gases are moved through diffusion.

ResultsPlus
Examiner Comments

This had diffusion for one mark. Decreasing the diffusion distance is not about the process of how the gas moves.

(iii) The capillary wall is only one cell thick.

Explain how gases move from the alveolus to the capillary.

(3)

- They diffuse through the cell wall -
from an area of low concentration to an
area of high concentration.
- The process of diffusion

ResultsPlus
Examiner Comments

This gained one mark for diffusion. The cell wall is incorrect and the direction of diffusion is incorrect.

(iii) The capillary wall is only one cell thick.

Explain how gases move from the alveolus to the capillary.

(3)

Gas diffuses from the alveoli which has a high concentration of oxygen (or gas) to the capillary which has a low concentration of oxygen through a very thin permeable membrane (the capillary wall)

ResultsPlus
Examiner Comments

This gained full marks for diffuses, high concentration to low concentration and through a thin permeable membrane. Semi-permeable and partially permeable membrane were also accepted.

Question 4 (a)(iv)

This was an applied question and was aimed at the higher-grade responses. Candidates were asked to explain the advantages of blood cells passing through one at a time along a capillary. Acceptable answers included slowing the blood flow so more diffusion can take place across a shorter diffusion distance. Gas exchange was acceptable for diffusion and also acceptable was the idea that this maximised the uptake of oxygen to each red blood cell. Many responses referred to blood clotting or higher and lower blood pressure, these were not credited.

(iv) **Explain the advantages of red blood cells passing one at a time through this narrow capillary.**

(3)

- The rate of flow is slower which allows more time for diffusion*
- Each cell is close to the alveoli so diffusion can occur more easily.
- more of the surface area of the cell is exposed so diffusion can occur at a faster rate.

ResultsPlus
Examiner Comments

This shows a response that illustrates a clear understanding. It gained the mark for the rate of flow is slower as the question asks about RBC, more time for diffusion/faster rate of diffusion, each cell is closer to the alveoli is shorter diffusion distance and it also has the idea of more surface area.

(iv) Explain the advantages of red blood cells passing one at a time through this narrow capillary.

(3)

No blood cell will pass through without exchanging carbon dioxide for oxygen, making them oxigenated. Moreaver, it allows for quicker diffusion as all blood cells can ~~tech~~ touch the walls of the ~~capillaries~~ capillaries.

ResultsPlus
Examiner Comments

This gained the mark for oxygen is going into a blood cell as it implies all blood cells will get it and it also had quicker diffusion for two marks in total. Blood cells can touch the walls of the capillaries was not sufficient for shorter diffusion distance.

(iv) Explain the advantages of red blood cells passing one at a time through this narrow capillary.

(3)

- then red blood cells wouldn't hit in each other
- ~~as~~ which would cause blood clot to happen
- and it would pass through at a constant speed.
- it diffuses at a shorter distance

ResultsPlus
Examiner Comments

One mark was awarded for short diffusion distance. The idea of prevention of blood clots was a commonly seen incorrect response.

Question 4 (b)

This question was a mathematical calculation for the surface area of a human lung. One mark was awarded for the correct calculation of 70 and one mark for including the correct units for the area which was mm^2. Some candidates tried to convert this into cm^2 which was credited if calculated correctly.

(b) The average number of alveoli in each human lung is 280 million.

The surface area of 1 million alveoli is 0.25 m^2.

Calculate the total surface area of a human lung.

(2)

$0.25 \times 280 = 70$

$70 m^2$

ResultsPlus
Examiner Comments

This scores full marks for the correct answer with the unit.

(b) The average number of alveoli in each human lung is 280 million.

The surface area of 1 million alveoli is 0.25 m^2.

Calculate the total surface area of a human lung.

(2)

0.25 m^2 X 280mill = 70

70

ResultsPlus
Examiner Comments

This answer is the correct numerical value but no unit is given so one mark was awarded.

ResultsPlus
Examiner Tip

Always check if a unit is required.

(b) The average number of alveoli in each human lung is 280 million.

The surface area of 1 million alveoli is 0.25 m^2.

Calculate the total surface area of a human lung.

(2)

280×0.5
$= 140$

280×0.25^2
$= 17.5 m^2$

$17.5 m^2$

ResultsPlus
Examiner Comments

This has the correct unit but incorrect calculation as the candidate has squared the surface area.

Question 5 (a)(ii)

This question asked candidates to explain how two of the hormones shown in the diagram could cause ovulation. The reference to LH or luteinising hormone was awarded a stand-alone mark here. Alternatively, candidates could give the process that FSH causes the egg to mature in the follicle. FSH stimulates the release of oestrogen. High levels of oestrogen cause an LH surge. This causes the egg to be released from the follicle.

(ii) Explain how **two** of the hormones shown in Figure 8 cause ovulation.

(3)

The high levels of oestrogen cause a surge of LH. The surge of LH (rapid increase) results in the rupturing of the follicle where the egg had been maturing, resulting in ovulation.

ResultsPlus
Examiner Comments

This response gained full marks for high levels of oestrogen, a surge of LH and a description of ovulation with rupturing of the follicle where the egg had been maturing. The word ovulation was not sufficient as it is in the question.

(ii) Explain how **two** of the hormones shown in Figure 8 cause ovulation.

(3)

FSH (formed in the pituitary gland) cause an egg to mature in the ovaries. ~~This stimulates the release of oestrogen~~ LH (also formed in the pituitary gland) cause the egg to be released from the ovaries. This causes ovulation.

ResultsPlus
Examiner Comments

This gained full marks for FSH linked to the egg maturing, LH and causing the egg to be released.

(ii) Explain how **two** of the hormones shown in Figure 8 cause ovulation.

(3)

LH stimulates an egg to be released, which stimulates the release of oestrogen. This means that ovulation can occur and when the egg reaches the uterus, it can implant into the uterus lining, if fertilised.

ResultsPlus
Examiner Comments

This scores two marks for the knowledge that LH is involved in ovulation and that ovulation is the release of an egg.

(ii) Explain how **two** of the hormones shown in Figure 8 cause ovulation.

(3)

by FSH and LH increasing, this stimulates an egg follicle to be released during ovulation, so ~~the more in~~ the increased levels create a higher chance of pregnancy when you are ovulating.

ResultsPlus
Examiner Comments

This gained one mark for the knowledge that LH is involved. Egg follicle released is not ovulation.

Question 5 (a)(iii)

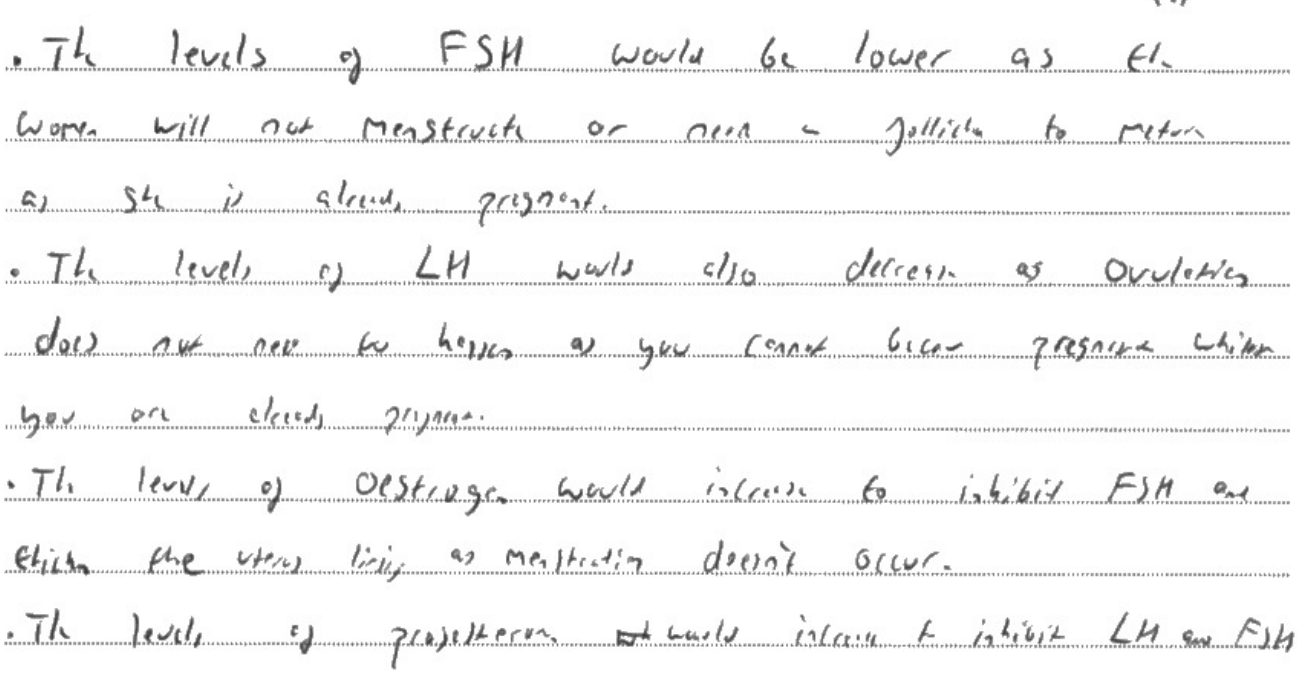
Candidates were asked to interpret the diagram to identify that the period of menstruation was three days.

Question 5 (a)(iv)

This question was aimed at the candidates achieving a grade 7 and above. They were asked to explain how the levels of each hormone would be different if the woman was pregnant. Each of the hormones should be mentioned including the inhibition of FSH by oestrogen and the inhibition of LH and FSH by progesterone. These were sometimes a little muddled. The role of FSH remaining low so no egg matured in the follicle was credited. LH remaining low to prevent ovulation was credited. Also credited was the idea that oestrogen and progesterone levels remain high to maintain the lining of the uterus. There were some responses linked to the uterus wall thickening rather than the lining, these were not credited.

(iv) **Explain how the levels of each hormone in the woman shown in Figure 8 would be different, if she was pregnant.**

(4)



ResultsPlus
Examiner Comments

This gained full marks for lower FSH as no follicle to mature, decreased LH linked to ovulation not occurring, increased oestrogen to inhibit FSH and thickening the uterus lining. They have also had the third marking point again for progesterone inhibiting LH and FSH.

ResultsPlus
Examiner Tip

Bullet points for each hormone is a good technique for answering this question.

(iv) Explain how the levels of each hormone in the woman shown in Figure 8 would be different, if she was pregnant.

(4)

The hormones LH and FSH (which are released from pituitary glands) would be much higher since

The hormones LH and FSH would be lower and this is because progesterone and oestrogen inhibit the release of FSH and LH so no eggs can mature and ovulate anymore. On the other hand oestrogen (released from ovaries) and progesterone (released from corpus luteum) would be high. This is because once the egg is fertilized the level of progesterone needs to stay high to maintain the uterus lining.

ResultsPlus
Examiner Comments

This response does not get the third marking point as they have incorrect science linking oestrogen to the inhibition of LH. They have linked lower FSH and LH to no eggs maturing and ovulating gaining two marks. This also has high progesterone linked to maintaining the uterus lining. This would also be awarded for high progesterone stopping the uterus lining breaking down. Three marks in total.

(iv) Explain how the levels of each hormone in the woman shown in Figure 8 would be different, if she was pregnant.

(4)

- oestrogen would decrease due to the lack of ovulation when pregnant.
- Progesterone would increase as it creates a thick spongy uterus lining for the egg.
- As LH_2 role is to release an egg, it would decrease as another egg is not meant to release during pregnancy.
- FSH

ResultsPlus
Examiner Comments

This gained two marks for progesterone would increase linked to creating a thick spongy uterus lining and LH decreases linked to the idea that this would stop an egg being released.

Oestrogen decreasing was a commonly seen error and this response does not indicate what happens to FSH or why.

(iv) Explain how the levels of each hormone in the woman shown in Figure 8 would be different, if she was pregnant.

(4)

FSH and LH levels would decrease as they could be harmful to the egg cell. Oestrogen levels remain near enough the same. Progesterone levels increase as it protects the egg cell.

ResultsPlus
Examiner Comments

This response attempted to address the role of each hormone but the reasons were not correct and no marks were awarded.

Question 6 (a)(i)

This required the conversion of 6 mm into 6000 micrometres. The unit was not required.

Question 6 (a)(ii)

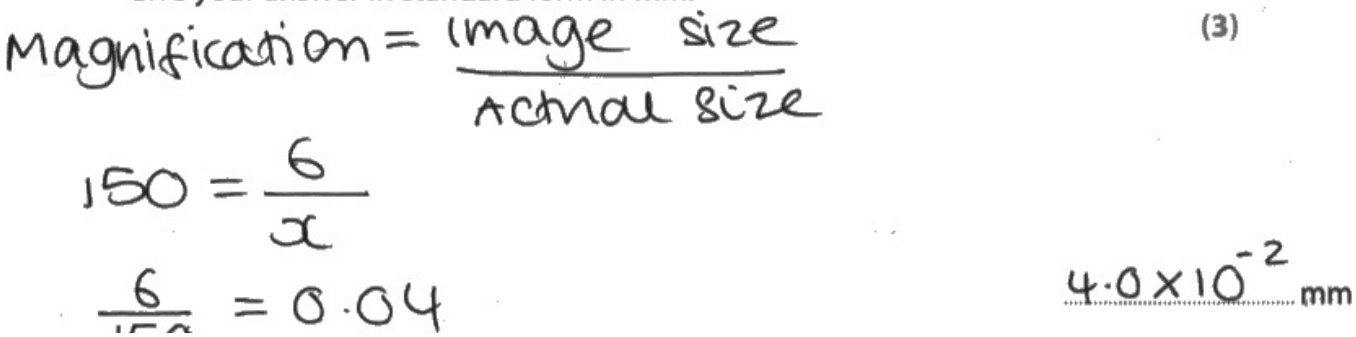
This was a magnification calculation requiring the calculation of the actual size of a guard cell using a given measurement. The most common error here was that candidates did not convert their answers into standard form as requested in the question. The correct answer was 4.0×10^{-2}.

(ii) The image has been magnified 150×.

Calculate the actual size of the guard cell.

Give your answer in standard form in mm.

(3)



ResultsPlus
Examiner Comments

This showed the correct working and the answer given in standard form for full marks.

(ii) The image has been magnified 150×.

Calculate the actual size of the guard cell.

Give your answer in standard form in mm.

(3)

$\frac{6}{150} = 0.04$

0.04 mm

ResultsPlus
Examiner Comments

This is the correct answer but not given in standard form. It scored two marks.

ResultsPlus
Examiner Tip

Always read maths questions carefully so you give your answer in the correct form and with units if required.

(ii) The image has been magnified 150×.

Calculate the actual size of the guard cell.

Give your answer in standard form in mm.

(3)

$\frac{0.006}{150} = 4 \times 10^{-5}$

~~$\frac{0.06}{150} = 4 \times 10^{-4}$~~

4×10^{-5} mm

ResultsPlus
Examiner Comments

This candidate tried to convert the unit, which was not required. It was the only error made as the answer is correct for their measurement value. Answers which were incorrect by any number of a power of 10 were awarded two marks.

(ii) The image has been magnified 150×.

Calculate the actual size of the guard cell.

Give your answer in standard form in mm.

(3)

150×6000000
$= 9 \times 10^8$
$= 900000000$

9×10^8 mm

ResultsPlus
Examiner Comments

This is the wrong calculation but one mark was awarded for converting their answer correctly into standard form. Workings had to be shown to gain this mark.

Question 6 (b)

Candidates were asked to explain the role of denitrifying bacteria in the nitrogen cycle. There were a few misconceptions here, with the conversion being given the incorrect way around but some candidates recognised that denitrifying bacteria converts nitrates into nitrogen gas. Nitrites were acceptable for nitrates were nitrogen compounds.

(b) Explain the role of denitrifying bacteria in the nitrogen cycle.

(2)

Too much nitrogen in the soil so it converts nitrogen into nitrates in the air.

ResultsPlus
Examiner Comments

This is the reverse reaction and incorrect.

(b) Explain the role of denitrifying bacteria in the nitrogen cycle.

(2)

denitrifying bacteria turn nitrates from the soil into ammonia.

ResultsPlus
Examiner Comments

This has the correct reactant but incorrect product so only one mark was awarded.

(b) Explain the role of denitrifying bacteria in the nitrogen cycle.

(2)

Denitrifying bacteria releases nitrogen into the surrounding area increasing the levels of nitrogen in earth's atmosphere.

ResultsPlus
Examiner Comments

This has the correct product but no reactant for one mark.

(b) Explain the role of denitrifying bacteria in the nitrogen cycle.

(2)

~~turns nitrites into nitrates. which plants can use.~~

turns nitrates back into Nitrogen gas, N_2

ResultsPlus
Examiner Comments

This shows the complete process of nitrates to nitrogen gas for two marks.

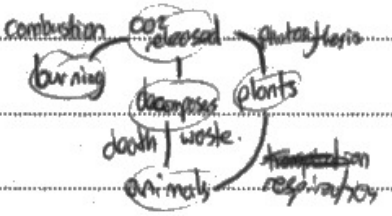
Question 6 (c)

This was the extended open-response question and asked candidates to describe how carbon is cycled through the biotic and abiotic components of the ecosystem. The response should include reference to the processes of photosynthesis, respiration and decomposing as well as the idea of combustion or oceans becoming a carbon sink. The answer must also relate to the correct carbon compound, for example in the case of photosynthesis and respiration it is carbon dioxide. For the answer to attain a Level 3 all these need to be referred to correctly. For a Level 2 response there could be a detailed response of the abiotic or biotic carbon cycle or a simple description of how carbon is cycled in each. For a Level 1 response a simple description of how carbon is cycled, including the idea that animals eat plants or other animals and take on carbon. The most common error limiting marks for this question was referring to plants taking in carbon, either from the air or the soil or animals releasing carbon without referring to the correct carbon compound.

*(c) Describe how carbon is cycled through the biotic and abiotic components of an ecosystem.

(6)

Plan: Biotic - living = plants, animals - ~~respiration~~ respiration - decomposers, photosynthesis.
Abiotic - non-living = burning fossil fuels.



An abiotic factor carbon is cycled through is the burning of fuels. CO_2 is released from combustion. From carbon dioxide being released, biotic factors begin to play their role. Plants take in the CO_2 through photosynthesis, where then Otygen and Carbon is released. By animals eating the plant they take in carbon dioxide and release it through respiration. When animals die or excrete, this acts as a decomposers which further releases carbon dioxide through respiration again.

ResultsPlus
Examiner Comments

This has a correct abiotic process of combustion linked to the release of carbon dioxide. They then correctly describe plants taking in carbon dioxide which is the description linked to the process of photosynthesis. They also correctly reference the role of animals and decomposers so have reached Level 3. They gain six marks for correctly referencing photosynthesis, respiration and combustion as an abiotic process. Labelled diagrams for the carbon cycle were marked for all descriptions but must indicate which way the carbon/carbon compound is being cycled.

*(c) Describe how carbon is cycled through the biotic and abiotic components of an ecosystem.

(6)

Carbon Dioxide from the air will be absorbed by organic compounds in plants. Plants are eaten by animals. This animal will respire, releasing CO_2, and will die causing decomposers to respire as well, also releasing CO_2 in the air. Dead material will eventually become fossils. Fossil fuels can be combusted releasing large amount of carbon dioxide into the air. Furthermore, plants also die and will decay through decomposers (which respire). ~~Plant~~ Living plants also respire which releases CO_2 back into the atmosphere.

ResultsPlus
Examiner Comments

This response correctly describes how carbon is cycled through plants, animals, decomposers and the combustion of fossil fuels so was awarded Level 3. They use the correct carbon compounds but they do not identify photosynthesis for the process so gained five marks.

*(c) Describe how carbon is cycled through the biotic and abiotic components of an ecosystem.

(6)

~~when all~~ All biotic features respire (plants, animals) which causes carbon dioxide to be released into the atmosphere. When biotic components feed on plants / trees which contain carbon they ~~produce waste / excrete~~ take in the carbon and then transfer this to the waste products when they excrete. The carbon in the excretion is used by the soil for plants which again allows them to take it in but can also be transferred to decomposers and bacteria which feed on waste products including faeces and dead biotic creatures. They also respire and so release carbon dioxide into the atmosphere as ~~a~~ when they live and feed. When they die plants use their waste as fertilisers for growth transferring the carbon to the plants. Plants also take in carbon dioxide during photosynthesis from the atmosphere (abiotic factor) which is then used to make glucose for the plant and other animals that eat it. When both plants and animals die the carbon is absorbed by the soil (abiotic) where it will be absorbed once more by another plant / or transferred to decomposers.

ResultsPlus
Examiner Comments

This has animals release carbon dioxide and plants release carbon dioxide which is two ways that carbon is cycled so gains Level 2 for two biotic descriptions. Plants do not take in carbon so this is ignored (we do not negatively mark). They do then reference plants taking carbon dioxide during photosynthesis, which combined with the correct reference to respiration gains four marks. They have two linked processes. The response does refer to decomposition but has no reference to the abiotic aspects so cannot gain Level 3.

*(c) Describe how carbon is cycled through the biotic and abiotic components of an ecosystem.

(6)

Abiotic is a non-living factor that affects a community. Biotic is a living factor that affects a community. ~~Plants~~ organisms such as plants or algae take in carbon dioxide in order to photosynthesise. This can be described as an abiotic factor because the concentration of carbon dioxide is affecting the organism and it's rate of photosynthesis which produces food (glucose). Carbon is cycled through living factors too. for example, animals will eat their prey and then breathe out carbon dioxide which is given to plants for photosynthesis.

ResultsPlus
Examiner Comments

This was awarded Level 2 worth three marks. They correctly link plants taking in carbon dioxide to photosynthesis and animals releasing carbon dioxide. This wasn't linked to respiration preventing four marks being awarded.

*(c) Describe how carbon is cycled through the biotic and abiotic components of an ecosystem.

(6)

Carbon is released from humans which is then ~~absorbed~~ respired by plants. ~~Carbon is~~ fossil fuels are burnt ~~which~~ and they fill the air with carbon dioxide & ~~mo~~ monoxide, this then rises and goes into the air, it can then cause acid rain when it goes into the clouds.

ResultsPlus
Examiner Comments

This response refers to carbon being released from humans which is incorrect, it is also not respired by plants. This response gained two marks for a Level 1 response of fossil fuels releasing carbon dioxide.

Paper Summary

Based on their performance on this paper, candidates should:

- Always refer to scientific quantities when stating variables to be controlled using the terms volume, mass, etc. No credit is awarded for amount.
- Distinguish between controlling a variable, such as the volume of a substance and the factor that is being investigated.
- Ensure that when answering questions about osmosis, water concentration is referred to, or even better water potential, to show that it is the water moving not another substance.
- Always look to the number of marks allocated for a question to ensure the maximum number of points has been applied.
- Always include the relevant units in a mathematical calculation.
- Always check calculations for additional information such as putting the answer in standard form or to a specific number of decimal places.
- Avoid repeating information from the question or just quoting data from tables or diagrams without adding an interpretation.

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