



Examiners' Report

June 2022

GCSE Combined Science 1SC0 2BH

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Introduction

The Pearson Edexcel GCSE (9-1) Paper 4 Combined Science (Higher tier) is the fourth paper taken as part of the GCSE (9-1) Combined Science qualification, and the second biology component of the course. The qualification follows a linear assessment model whereby candidates must complete all papers in the same year of certification.

Paper 4: Combined Science (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 an extended open-response question. Candidates should answer all questions in 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 that candidates must complete prior to the examination, as aspects of working scientifically are also assessed in questions throughout the paper.

Paper 4: Combined Science (Higher tier) 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 the movement of substances through plants, the structure and function of the heart and blood vessels, the role of bacteria in the nitrogen cycle, hormones including adrenalin, thyroxine and the hormones of the menstrual cycle, as well as type 2 diabetes and conservation and reforestation.

Questions designed to assess practical work included sampling habitats, which is a core practical and applying practical knowledge to measuring transpiration in plants and the effect of exercise on heart rate, which are recommended practicals. Questions on these included the controlling of variables, a control and making improvements to methods. The maths skills assessment in this paper related to questions requiring rate calculations, unit conversions, percentages and applying skills using a given equation to calculate capture and recapture data.

Most candidates were able to access the extended writing response, demonstrating good application of knowledge on how reforestation and animal conservation projects affect biodiversity. Many candidates were able to demonstrate a good level of knowledge in the early questions, including the structure and function of the heart and blood vessels. Candidates also showed a relatively good understanding of the role of the hormones in the contraceptive pill as well as the effect on the body of exercise. Higher ability candidates were able to apply their knowledge of the human hormones, adrenalin and thyroxine and some of these candidates could explain the roles of bacteria in the nitrogen cycle including their role in crop rotation.

The responses to the questions assessing aspects of practical work have improved since the specification started. This improvement is expected as teachers increase their understanding of this aspect. Candidates of all abilities were able to answer questions using their practical skills and knowledge, including the identification of some controlled variables and improvements. However, candidates must read these practical questions carefully to ensure they are describing appropriate variables. Some candidates remain confused as to the difference between controlling a variable and using a control. Across the paper, candidates showed they could extract data from graphs and calculate differences between two values. Candidates of all abilities were able to access the straightforward maths questions of calculating a percentage, although candidates lost marks on this for incorrectly rounding the answer or giving an answer to a decimal place rather than a whole number.

Question 1 (a)(ii)

Most candidates were able to recognise one structure of the xylem including thick cell walls or a long continuous tube. There was some mention of lignin or the fact that the cells making up the xylem were dead cells. Many candidates referred to the function of the xylem and not structural features for at least one answer.

(ii) Describe **two** features of the structure of xylem vessels that can be seen in Figure 1.

(2)

1. ~~carried water up~~ made of lignin walls.

2. has no end walls



ResultsPlus
Examiner Comments

This scored two marks for lignin and the xylem vessels having no end walls. These are two structural features, many responses referred to functions of xylem.

(ii) Describe **two** features of the structure of xylem vessels that can be seen in Figure 1.

(2)

1. Xylem vessels have thick ~~walls~~ walls

2. the fluid can only flow one way through a xylem vessel.



ResultsPlus
Examiner Comments

This is worth one mark for the thick walls. One directional fluid is not a structural feature.

(ii) Describe **two** features of the structure of xylem vessels that can be seen in Figure 1.

(2)

1. Hollow tube

2. Transports particles up the plant



ResultsPlus
Examiner Comments

Hollow tube was sufficient for the mark relating to the idea of it being continuous or having no end walls.

Question 1 (b)(i)

Most candidates gained the mark for recognising that the water uptake had increased. Some went on to provide some linkage as to why this occurred including the idea that the fan had created an air flow or that water was lost from the plant or the stomata.

- (i) Explain why switching on the fan caused a change in the volume of water taken up by the plant.

(3)

The plant takes up more water as water is lost through the stomata



ResultsPlus
Examiner Comments

This scored two marks for stating that the plant takes up more water and linking this to the idea that this is because more water is lost through the stomata.

- (i) Explain why switching on the fan caused a change in the volume of water taken up by the plant.

(3)

by switching on the fan, the volume of water increased as more air flow means the rate of transpiration in a plant is faster and was able to take in and move more water.



This is a complete explanation linking the volume of water uptake increasing with there being more airflow causing a faster rate of transpiration and was given three marks.

- (i) Explain why switching on the fan caused a change in the volume of water taken up by the plant.

(3)

Using the fan means more CO_2 is being absorbed by the plant each minute, and this increases water intake volume as the plant is using both the CO_2 and H_2O in the photosynthesis process.



References to gas exchange as a result of the fan were not awarded marks but were a commonly seen misconception. This response scored one mark for increased water intake.

Question 1 (b)(ii)

This question was mostly answered correctly, the most common responses were as a comparison or to show a difference. Some candidates referred to a control but there was some confusion with control variables.

- (ii) Give **one** reason why the volume of water taken up by the plant was also measured when the fan was not switched on.

(1)

to show the difference the fan made.



Taking measurements without the fan on will mean that the results will show the difference the fan made gained the mark.

- (ii) Give **one** reason why the volume of water taken up by the plant was also measured when the fan was not switched on.

(1)

For a control test.



A control is the correct term for the measurements taken with the fan switched off.

- (ii) Give **one** reason why the volume of water taken up by the plant was also measured when the fan was not switched on.

(1)

To show that the plants were taking the same volume of water up to make the test fair.



ResultsPlus
Examiner Comments

This is not sufficient for the mark.



ResultsPlus
Examiner Tip

Fair test is a description that should be avoided. Refer to variables that should be controlled or a control that can be used for a baseline measurement.

Question 1 (b)(iii)

Most candidates gained full marks for this question. However, some struggled with finding the correct values from the graph and/or omitted to then divide by 2.

(iii) Calculate the rate of water uptake from 8 minutes to 10 minutes when the fan was switched on.

Use the equation

$$\text{rate of water uptake} = \frac{\text{volume of water taken up}}{\text{time taken}}$$

1) 8 mins → 52 ~~42~~

2) 10 mins → 68

$$6.8 - 6.5 = \underline{\underline{0.3}}$$

(2)

1) $\frac{52}{8} = 6.5$

2) $\frac{68}{10} = 6.8$

..... 0.3 mm³ per minute



ResultsPlus
Examiner Comments

This calculation is not correct but one mark was awarded for the two correct readings of the volume of water taken up at 8 and 10 minutes.



ResultsPlus
Examiner Tip

This response scored one mark. If they had not shown their working, they would have got zero.

(iii) Calculate the rate of water uptake from 8 minutes to 10 minutes when the fan was switched on.

Use the equation

$$\text{rate of water uptake} = \frac{\text{volume of water taken up}}{\text{time taken}} \quad (2)$$

$$\frac{8}{2} = 4$$

$$39.5 - 31.5 = 8$$

..... 4 mm³ per minute



ResultsPlus
Examiner Comments

This is worth one mark. Incorrect graph readings but recognised the need to divide the volume of water taken up by two minutes to get the rate.

(iii) Calculate the rate of water uptake from 8 minutes to 10 minutes when the fan was switched on.

Use the equation

$$\text{rate of water uptake} = \frac{\text{volume of water taken up}}{\text{time taken}} \quad (2)$$

$$52 \rightarrow 68$$

$$\frac{16}{2} = 8$$

$$\begin{array}{r} 68 - \\ 52 \\ \hline 16 \end{array}$$

..... 8 mm³ per minute



This calculation correctly shows the volume of water taken up between 8 and 10 minutes and it is divided by the 2 minutes to obtain a rate of 8 mm³ per minute.

Question 2 (a)(i)

It was well understood that the artery wall was in general thicker than the wall of the vein but the reasons for this were less well understood. Linking this to higher blood pressure in the artery was seen less often.

2 (a) Figure 3 shows a cross-section of an artery and a vein.



(Source: © The University of Kansas Medical Center)

Figure 3

(i) Explain **one** difference between the artery wall and the vein wall shown in Figure 3.

(2)

the vein wall is thin and the
artery wall is thick and elastic
this is to withstand the pressure
of the blood ^{pumping} moving round the
body



This is worth two marks. They have compared the artery (thick) with the vein (thin) and given the explanation point of enabling it to withstand the pressure of the blood.

2 (a) Figure 3 shows a cross-section of an artery and a vein.



(Source: © The University of Kansas Medical Center)

Figure 3

(i) Explain **one** difference between the artery wall and the vein wall shown in Figure 3.

(2)

the artery wall is thicker than the
vein wall because the arteries have
a much higher pressure of blood to
transport so needs more support
hence the thicker wall



ResultsPlus
Examiner Comments

This response uses the comparative word of 'thicker' for the artery wall and linked this to the higher blood pressure for both marks.



ResultsPlus
Examiner Tip

Use comparative language when comparing the difference between two structures.

- 2 (a) Figure 3 shows a cross-section of an artery and a vein.



(Source: © The University of Kansas Medical Center)

Figure 3

- (i) Explain **one** difference between the artery wall and the vein wall shown in Figure 3.

(2)

The artery wall is a lot thicker than the vein wall to allow the artery wall to expand and decrease in size for blood to flow through.



ResultsPlus
Examiner Comments

This was one mark for a lot thicker, there is no linked explanation point for the high pressure blood.

Question 2 (a)(ii)

Many candidates did not recognise that a structure found in veins but not arteries are valves and the mark was only obtained by some of the candidates.

Question 2 (b)(i)

Most candidates gained full marks as they were able to calculate that 3 is 60% of 5 dm³

(b) A human body has 5 dm³ of blood.

At rest 20% of the blood travels to the muscles.

During exercise 60% of the blood travels to the muscles.

(i) Calculate the volume of blood travelling to the muscles during exercise.

(2)

$$5 \times 0.2 = 1$$

$$5 \times 0.6 = 3$$

$$3 - 1 = 2$$

..... 2 dm³



ResultsPlus
Examiner Comments

This was one mark for working out 60% of 5 to be 3. They have then subtracted it from 20% of 5 ending up with the incorrect final answer.

(b) A human body has 5 dm³ of blood.

At rest 20% of the blood travels to the muscles.

During exercise 60% of the blood travels to the muscles.

(i) Calculate the volume of blood travelling to the muscles during exercise.

(2)

~~60% = 60/100 = 3/5~~
60% = $\frac{3}{5}$

$$\frac{3}{5} \text{ of } 5 = 3$$

..... 3 dm³



This is full marks. The candidate has worked the percentage out as a fraction but all methods are accepted.

(b) A human body has 5 dm³ of blood.

At rest 20% of the blood travels to the muscles.

During exercise 60% of the blood travels to the muscles.

(i) Calculate the volume of blood travelling to the muscles during exercise.

(2)

5 dm³ blood

$$5 \times 0.60 = 3$$

..... 3 dm³



ResultsPlus
Examiner Comments

This is one of the methods outlined on the mark scheme. Any method which results in the correct answer is acceptable.

Question 2 (b)(ii)

This item needed to make a comparative statement of more, irrespective of which explanation was given. Candidates were limited to one or zero marks if this wasn't given. Many candidates just gave a statement about more oxygen being needed without explaining why this was necessary.

(ii) Explain **one** reason why there is an increase in blood flow to muscles during exercise.

(2)

Blood carries oxygen and when exercising the muscles need ~~to~~ more oxygen to complete respiration to give energy to the working muscles.



ResultsPlus
Examiner Comments

This has the idea of more oxygen being supplied by the increased blood flow and that this is needed for respiration for full marks.

(ii) Explain **one** reason why there is an increase in blood flow to muscles during exercise.

(2)

Blood travels quicker around the body e.g. to the lungs, to provide oxygenated blood for aerobic respiration. Also, nutrients and energy is required for the muscles to keep working at a high rate.



ResultsPlus
Examiner Comments

This scored one mark for aerobic respiration. There is no indication that the increased blood flow is supplying **more** oxygenated blood.

(ii) Explain **one** reason why there is an increase in blood flow to muscles during exercise.

(2)

There is an increase in blood flow because ~~on~~ the rate of aerobic respiration is ^{increasing} ~~taking place~~ meaning that the body needs more oxygen. In order for the heart to take in more oxygen, the heart contracts more, leading to it pumping more blood around the body.



ResultsPlus
Examiner Comments

This is two marks. The explanation is in the reverse order to the mark scheme but still fully explains why an increase in blood flow is needed.

(ii) Explain **one** reason why there is an increase in blood flow to muscles during exercise.

(2)

Because ~~aerobic~~ anaerobic respiration is taking place, meaning it is helping the muscles function but this also leads to a build up in lactic acid. In order to remove this build up blood must flow to the muscles to provide oxygen, resulting in an increased blood flow.

(Total for Question 2 = 7 marks)



ResultsPlus
Examiner Comments

This also gained two marks for the idea that lactic acid needs to be removed and that it is a product of respiration. This is the second alternative of the explanations shown on the mark scheme.

Question 3 (a)(ii)

Most candidates recognised that unit conversions require a calculation involving a 1000 but many divided rather than multiplied and so did not obtain the mark.

Question 3 (b)(i)

More candidates answered the first part of the question correctly, identifying X as decomposers, but often stated nitrogen-fixing bacteria, de-nitrifying bacteria or just bacteria for Y in the second part.

(b) Figure 5 shows part of the nitrogen cycle.

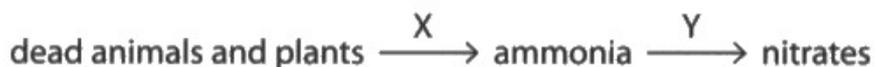


Figure 5

(i) Identify the types of microorganism involved in process X and process Y.

(2)

X. ~~also~~ ~~nitrogen~~ nitrifying bacteria

Y. denitrifying bacteria



ResultsPlus
Examiner Comments

This scored zero as nitrifying bacteria is against X and not Y and denitrifying bacteria is incorrect for Y.

(b) Figure 5 shows part of the nitrogen cycle.

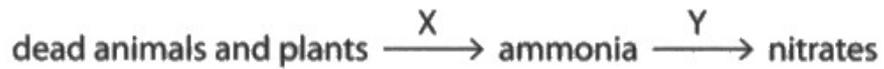


Figure 5

(i) Identify the types of microorganism involved in process X and process Y.

(2)

x ~~Decomposers~~ Decomposers.

y Nitrifying bacteria



ResultsPlus
Examiner Comments

Decomposers is correct for X and nitrifying bacteria is correct for Y so both marks were awarded.

(b) Figure 5 shows part of the nitrogen cycle.

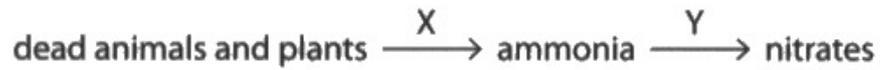


Figure 5

(i) Identify the types of microorganism involved in process X and process Y.

(2)

X Decomposers

Y Bacteria



ResultsPlus
Examiner Comments

This gained one mark. Bacteria is not sufficient for the mark.



ResultsPlus
Examiner Tip

Make sure answers are detailed enough.

Question 3 (b)(ii)

Most candidates did not have an understanding of crop rotation. Many candidates discussed leaving fields empty to replenish for a season or that different crops had different nitrate requirements. Of those that did have some understanding, the use of legumes or named plants such as peas and beans were seen. Very few responses referred to nitrogen-fixing bacteria, there was some confusion with nitrate-fixing bacteria and also that the crops themselves were able to fix nitrogen.

(ii) Explain how crop rotation increases nitrate levels in the soil.

(3)

The plant's ^{root nodules} contain nitrogen fixing bacteria which turns the atmospheric N_2 into nitrate / ammonia so it can be used ~~for~~ by ^{other} plants in the later years. This helps to improve the amount of nitrates in the soil for plants to use to make proteins and growth. So after each year, there will still be nitrates in the soil for different plants.



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Examiner Comments

This response explains the role of crop rotation in full detail. It has root nodules, nitrogen fixing bacteria and the bacteria using the atmospheric nitrogen. They also have the bacteria producing ammonia, which is the additional guidance, although they already had this mark.

(ii) Explain how crop rotation increases nitrate levels in the soil.

(3)

The rotation of crops increases nitrate levels in the soil because the crops contain nitrates which can be released into the soil depending on the concentration gradient. Rotating the crops allows nitrates to be released into the soil increasing nitrate levels.



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Examiner Comments

This answer mainly repeats the question without adding any further details. The response was scored zero.



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Examiner Tip

Do not repeat the question as part of your answer.

(ii) Explain how crop rotation increases nitrate levels in the soil.

(3)

Crops contain nitrogen-fixing bacteria that converts nitrogen in atmosphere to nitrates. It is exchanged with the soil through the phloem.



This response scores two marks for the nitrogen-fixing bacteria converting nitrogen. They do not refer to the roots or leguminous plants.

Question 3 (b)(iii)

Most candidates were able to gain the mark for identifying that the crops would grow more, but fewer were able to identify that the nitrates produced proteins or amino acids for the growth, with many candidates opting instead to explain how improved growth would improve crop yields which is a repeat of the question.

(iii) Explain why increased nitrate levels in the soil improve crop yield.

(2)

This leads to better yields because the crops have nutrients in the soil to absorb. Crops use ~~nitro~~ nitrate to synthesise proteins to grow ^{and repair} which therefore indicates that more nitrate in soil leads to improved yields

(Total for Question 3 = 9 marks)



This response has a linked explanation of the use of nitrates to synthesise proteins for growth for full marks.

(iii) Explain why increased nitrate levels in the soil improve crop yield.

(2)

Because nitrates is what crops absorb and when there is high nitrate levels, more crops are able to grow and absorb these nitrates in the soil.



This response links nitrates for growth to get a higher yield but does not extend this to include the idea that proteins are needed, only obtaining one mark.

Question 4 (a)(i)

Many candidates scored at least one mark for this question with some correctly linking oestrogen and progesterone to the suppression of LH and FSH. If they identified these two hormones, then it was unusual for them not to give the link to follicle development/ovulation. A significant number of candidates only considered the role of oestrogen and progesterone and if this was the case then they rarely scored as they linked this to the thickening of the uterus lining or to inhibition of a menstrual period. A number of candidates scored two marks for linking the thicker cervical mucus to blockage of sperm.

4 (a) The combined contraceptive pill contains artificial versions of oestrogen and progesterone.

(i) Explain how the combined contraceptive pill prevents pregnancy.

(2)

combined pill increase the
cervical mucus so sperm can't
reach the egg



This gained two marks for the additional guidance knowledge that the pill increases cervical mucus preventing the sperm reaching the egg.

4 (a) The combined contraceptive pill contains artificial versions of oestrogen and progesterone.

(i) Explain how the combined contraceptive pill prevents pregnancy.

(2)

Increasing the levels of oestrogen and progesterone ~~it~~ inhibit the release of FSH and LH, which are the hormones that release and mature the egg cell. Without FSH and LH the egg cannot mature and therefore cannot be fertilised.



This response gives the explanation of the hormones LH and FSH being inhibited and the prevention of the egg maturing or being released.

4 (a) The combined contraceptive pill contains artificial versions of oestrogen and progesterone.

(i) Explain how the combined contraceptive pill prevents pregnancy.

(2)

If release oestrogen and progesterone which stop an egg from maturing and being released.



This scored one mark as the pill does prevent the egg being released but it is not linked to how this is the case.

Question 4 (a)(ii)

This question was not accurately answered with many candidates giving the idea of forgetting to take the pill or side effects of the pill which is not a disadvantage of using the combined pill as the only form of contraception. The majority of correct responses identified that STIs could still be spread, with a smaller – but still significant number – referring to the slight chance of pregnancy.

(ii) When taken correctly, the combined pill can be over 99% effective.

Taking the combined pill can lead to weight gain.

Give **one** other disadvantage of using the combined pill as the only method of contraception.

(1)

Mood swings.



This is a side effect of hormone use/imbalance but it is not a disadvantage of only taking the pill as a method for contraception.

(ii) When taken correctly, the combined pill can be over 99% effective.

Taking the combined pill can lead to weight gain.

Give **one** other disadvantage of using the combined pill as the only method of contraception.

(1)

It doesn't protect you from sexually transmitted infections



This is a disadvantage of only using the pill as a method of contraception for one mark.

(ii) When taken correctly, the combined pill can be over 99% effective.

Taking the combined pill can lead to weight gain.

Give **one** other disadvantage of using the combined pill as the only method of contraception.

(1)

It delays Menstrual cycle.



This is linked to the idea of how it works as a contraceptive but not why it is a disadvantage of using the pill as the only form of contraception.

Question 4 (b)

Candidates on this paper found this question challenging. Some candidates gained a mark for stating that blood glucose levels were high or that the body was resistant to insulin. Many candidates think that the inability to control blood glucose levels is because insulin is not produced or that the body cells are "immune" to insulin. Few candidates were able to relate the resistance to insulin to the inability to convert glucose in the blood to glycogen in the liver.

(b) Excessive weight gain and obesity increase the likelihood of developing type 2 diabetes.

Explain the effect of type 2 diabetes on the body.

(3)

type 2 diabetes means that your body doesn't respond to insulin. This means when blood glucose levels are high your liver won't respond to be helped by turning glucose into glycogen meaning your blood glucose levels will remain high.



ResultsPlus
Examiner Comments

This is worth three marks for the body not responding to insulin, so blood glucose levels are high and glucose is not turned to glycogen.



ResultsPlus
Examiner Tip

Make sure you spell glycogen, glucose and glucagon correctly in responses.

- (b) Excessive weight gain and obesity increase the likelihood of developing type 2 diabetes.

Explain the effect of type 2 diabetes on the body.

(3)

Cells can become resistant and not react to the insulin. The pancreas can't produce enough ~~fast~~ ~~the~~ insulin to match the ~~the~~ glucose level. The excess glucose can become ~~fast~~ fat and ~~burst cells~~ lead to cells being burst.



ResultsPlus
Examiner Comments

This scores one mark for cells becoming resistant to insulin. Although they have referred to excess glucose it is not in the blood, so this mark was not given.



ResultsPlus
Examiner Tip

When taking about glucose levels make sure you link it to **blood** glucose levels.

(b) Excessive weight gain and obesity increase the likelihood of developing type 2 diabetes.

Explain the effect of type 2 diabetes on the body.

(3)

Type 2 diabetes means you become ~~immune~~ to immune to your insulin and there is a risk of ~~it getting too high and killing you~~. your glucose levels getting too high and killing you.



ResultsPlus
Examiner Comments

This did not score a mark. Immune is rejected against the idea of resistance as it is incorrect. The glucose is too high but it is not blood glucose.

Question 4 (c)

Many responses to this question limited themselves by only obtaining conclusions from the data. Some candidates were unable to correctly interpret the data for blood glucose and red blood cells as within the normal range, with some stating they were over. Most candidates concentrated only on the elevated levels of TSH and thyroxine and failed to appreciate the significance of the tests that were within the normal range. Those who recognised the role of thyroxine frequently gave the idea of increased metabolism gaining at least two marks for this aspect. Some high scoring responses showed knowledge of the role TSH and its stimulation of the thyroid gland to produce thyroxine.

- (c) A woman had unexplained weight loss and fatigue. She had blood tests to investigate the cause of these symptoms.

Figure 6 shows the results.

blood test	woman's result	normal range
TSH level	5.6 mU/l	0.4 to 4.9 mU/l
thyroxine level	27.5 pmol/l	9.0 to 21.0 pmol/l
red blood cell count	5.2×10^6 cells/ μ l	4.2 to 5.4×10^6 cells/ μ l
glucose level	82.0 mg/dl	72.0 to 99.0 mg/dl

Figure 6

Comment on the results of these blood tests and the possible causes of the woman's weight loss and fatigue.

(4)

The woman's TSH and thyroxine levels are way above the normal range. Her red blood cell count and glucose levels are in the normal range. She has enough glucose and red blood cells for the normal range but too much TSH and thyroxine. ^{Compared to}



ResultsPlus
Examiner Comments

This scores two marks for extracting the information from the table correctly; referring to TSH and thyroxine being above the normal range and red blood cells and glucose being in the normal range. The candidate needed to extend the answer to indicate what these mean for the woman.

- (c) A woman had unexplained weight loss and fatigue. She had blood tests to investigate the cause of these symptoms.

Figure 6 shows the results.

blood test	woman's result	normal range
TSH level	5.6 mU/l	0.4 to 4.9 mU/l
thyroxine level	27.5 pmol/l	9.0 to 21.0 pmol/l
red blood cell count	5.2×10^6 cells/ μ l ✓	4.2 to 5.4×10^6 cells/ μ l
glucose level	82.0 mg/dl ✓	72.0 to 99.0 mg/dl

Figure 6

Comment on the results of these blood tests and the possible causes of the woman's weight loss and fatigue.

(4)

Both the red blood cell count and glucose levels are within the normal range for a human, however the high levels of thyroxine and TSH (thyroid stimulating hormone) suggest she is suffering from hyperthyroidism. Which is when the TSH over stimulates the thyroid gland into releasing higher than usually levels of thyroxine which help the body's metabolic rate steady. Because there is too much thyroxine the metabolism of the woman increases and glucose or other starches used to create energy are over stimulated leading decreased stored fats which cause weight loss. The energy mus weight loss causes fatigue as the body loses stored energy.



This is an excellent response that has extracted the information from the table for both the hormones, the red blood cells and glucose and how they relate to the normal range. They link the high level of TSH to overstimulating the thyroid gland causing hyperthyroidism and a high metabolic rate.

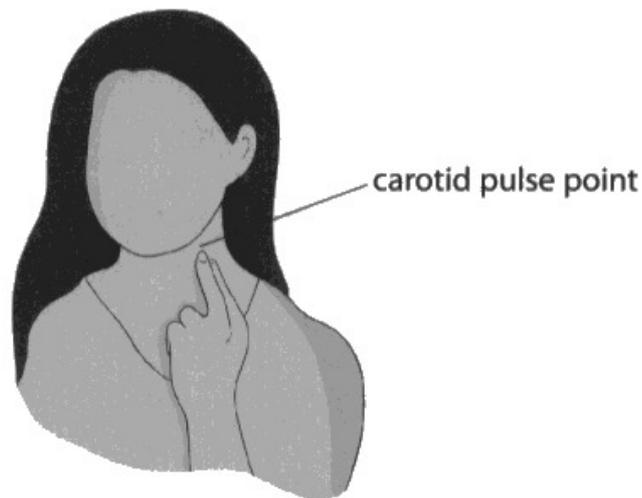
Question 5 (a)(i)

A surprisingly high number of candidates struggled to identify how to calculate the beats per minute, whilst a significant number interpreted the question as to how to feel the pulse rather than count it. It is important that candidates read the information given as often this will hold the key to the answer.

- 5 The effect of different types of exercise on the heart rate of an athlete was investigated.

The athlete counted the number of beats in 10 seconds at the carotid artery pulse point, as shown in Figure 7.

This measurement was used to calculate the heart rate.



(Source: © dityazemli/Shutterstock)

Figure 7

The athlete exercised for 20 minutes.

The heart rate was recorded every 5 minutes during each type of exercise.

- (a) (i) State how the heart rate was calculated using this method.

(1)

they would've counted the beats then multiplied by 6 to get the beats per minute.

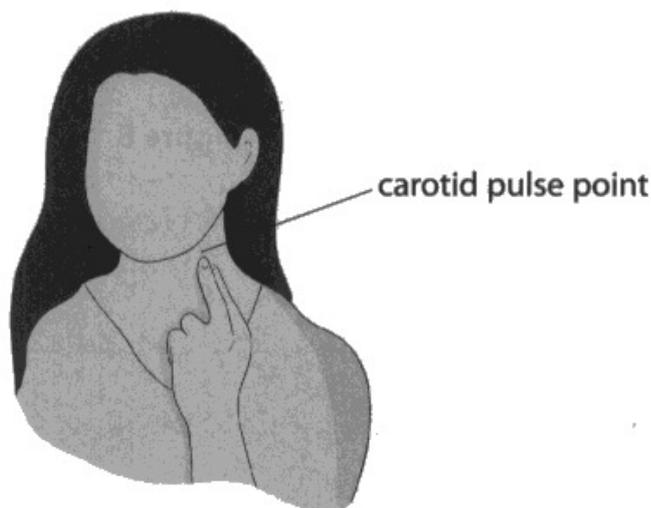


This response shows that the candidate has read the information in the question and that the number of beats in 10 seconds needs to be multiplied by 6 to get the heart rate which is measured in beats per minute.

5 The effect of different types of exercise on the heart rate of an athlete was investigated.

The athlete counted the number of beats in 10 seconds at the carotid artery pulse point, as shown in Figure 7.

This measurement was used to calculate the heart rate.



(Source: © dityazemli/Shutterstock)

Figure 7

The athlete exercised for 20 minutes.

The heart rate was recorded every 5 minutes during each type of exercise.

(a) (i) State how the heart rate was calculated using this method.

(1)

~~CO heartbeats per minute~~
~~HR/SV~~



ResultsPlus
Examiner Comments

This is how heart rate is measured but does not show how it could be calculated from the number of beats in 10 seconds.

Question 5 (a)(ii)

Many candidates were able to identify a heart rate monitor or fitness monitor (smartwatch or Fitbit were seen) but a significant number stated that a stopwatch could be used. Taking readings for longer or repeating readings were frequently seen.

(ii) Give **two** ways of improving the method used to obtain the data needed to calculate the heart rate.

- (2)
1. measure the heart rate ~~twice~~ twice at every interval.
 2. Use a machine to count the heart rate. It's more accurate.



This scored two marks as it shows two improvements to the method used to obtain the data needed; repeating the readings and using a monitor.

(ii) Give **two** ways of improving the method used to obtain the data needed to calculate the heart rate.

(2)

1. Count the beats for 30 seconds and use a stopwatch.
2. Times this number by 2 to find your heart rate per minute.



ResultsPlus
Examiner Comments

This only scored one mark as the second comment is how to calculate the beats per minute. The mark was awarded for counting the beats for longer.

(ii) Give **two** ways of improving the method used to obtain the data needed to calculate the heart rate.

(2)

1. Do ~~the~~ the experiment ~~more~~ a few more times to gain more accurate results
2. Measure pulse at different points on the body.



ResultsPlus
Examiner Comments

Doing the experiment a few more times is the idea of repeating for one mark. Measuring the pulse at different points is not an improvement to the method.

Question 5 (a)(iii)

It appears that candidates are improving when answering this style of question. They were asked to comment on the data with the majority of candidates able to talk about heart rate increasing when running and quoting relevant data. They were less able to talk about a small fluctuation when walking, although many candidates gained this mark by stating it rose and fell between 90bpm and 96bpm. The levelling out of the heart rate when running between 15 and 20 minutes at 180bpm was missed by many candidates.

Figure 8 shows the results of this investigation.

type of exercise	heart rate in bpm				
	0 minutes	5 minutes	10 minutes	15 minutes	20 minutes
running	90	156	168	180	180
walking	90	96	90	96	90

Figure 8

(iii) Comment on the difference in the heart rates during these types of exercise.

(3)

Running increases the heart rate more than walking does. Running for a longer period of time increases the heart rate more to a certain point.



ResultsPlus
Examiner Comments

This has one difference in that running increases the heart rate more than walking. It does not use data to illustrate the levelling off or refer to the pattern of the heart rate when walking.



ResultsPlus
Examiner Tip

Include data in your answers to illustrate the points you have made.

Figure 8 shows the results of this investigation.

type of exercise	heart rate in bpm				
	0 minutes	5 minutes	10 minutes	15 minutes	20 minutes
running	90	156	168	180	180
walking	90	96	90	96	90

Figure 8

(iii) Comment on the difference in the heart rates during these types of exercise.

(3)

Running had increased her heart rate more than walking. Her heart rate when running had ~~only~~ increased till 15 minutes and then did not increase further. Heart rate while walking fluctuated going up and down between 90 and 96.



ResultsPlus
Examiner Comments

This has running increasing HR more than walking which is in the additional guidance. It also has the idea of it increasing till 15 minutes and then not increasing further and while walking the HR fluctuated.

Figure 8 shows the results of this investigation.

type of exercise	heart rate in bpm				
	0 minutes	5 minutes	10 minutes	15 minutes	20 minutes
running	90	156	168	180	180
walking	90	96	90	96	90

Figure 8

(iii) Comment on the difference in the heart rates during these types of exercise.

(3)

When the person is running the heart rate is increasing rapidly to a maximum of 180 bpm but while walking the heart rate roughly stays the same.



ResultsPlus
Examiner Comments

This has an increasing heart rate for running and roughly staying the same for walking for two marks. They do not get the levelling off mark as there is no indication of levelling off at 180 b.p.m, just that it reached a maximum.

Question 5 (b)(i)

The adrenal gland was identified by most candidates as the gland that produces adrenalin.

Question 5 (b)(ii)

The understanding of the effect of adrenalin on the liver proved to be a problem with some candidates just linking adrenalin to the fight or flight response without giving details. Answers relating to higher blood pressure or more blood flow were also seen. Few candidates recognised that the effect on the liver is the conversion of glycogen in the liver into glucose causing an increase in blood glucose levels. Some of the higher-level responses were able to recognise that adrenalin binds to receptor sites on the liver.

(ii) Explain the effect of adrenalin on liver cells during exercise.

(3)

It causes the liver cells to convert glycogen into glucose. This speeds up respiration because more glucose is produced, creating more energy.



This response correctly identifies the conversion of glucose into glycogen for two marks. They could have improved the response by mentioning that the glucose is released into the blood.

(ii) Explain the effect of adrenalin on liver cells during exercise.

(3)

Adrenalin binds to receptors in the liver cells to ~~the~~ break down glycogen stores and ~~the~~ release glucose into the blood stream so the body has more energy when exercising.



ResultsPlus
Examiner Comments

This detailed explanation includes all the marking points; binding to receptors, the breakdown of glycogen, releasing glucose and release into the blood stream.

Question 5 (c)

This question was well answered with most candidates able to identify lactic acid building up. Some candidates correctly linked this to anaerobic respiration to attain full marks. Some responses incorrectly linked the change in pH to sweating more or water loss in muscles.

- (c) After high intensity exercise, the pH of muscles can decrease from pH 7.0 to pH 6.3.

Explain this change in pH.

(2)

This is because the muscles will start to respire anaerobically ^{due to lack of oxygen}, which creates build up of lactic acid in the muscles which can be painful and has therefore change the neutral pH to slightly acidic.



ResultsPlus
Examiner Comments

This scores both marks for linking anaerobic respiration to lactic acid.



ResultsPlus
Examiner Tip

Make sure you do not refer to respiration as respirating at this is incorrect.

(c) After high intensity exercise, the pH of muscles can decrease from pH 7.0 to pH 6.3.

Explain this change in pH.

(2)

As when the oxygen is ~~not~~ no longer present in the body the glucose that is left turns into lactic acid which burns muscles turning pH slightly acidic



ResultsPlus
Examiner Comments

This scores one mark for lactic acid, it does not give details of why the lactic acid gets produced which would complete the explanation.

Question 6 (a)(i)

Many candidates scored all three marks for this question. The most common mistake was leaving the estimate of the population as a decimal instead of rounding to a whole number, candidates did not understand that a fraction of an organism is not a possibility. A small number of candidates did not subtract the number they calculated from 50 but were still able to gain two of the three available marks.

- 6 (a) Scientists use a technique called mark and recapture to estimate animal populations in a habitat.

A sample of the population is captured and a harmless mark is added to each animal.

These animals are released and after a period of time the population is sampled again.

This second sample includes some recaptured animals that have marks on them.

The population can be estimated using this equation

$$\text{population size} = \frac{\text{number marked in the first sample} \times \text{size of the second sample}}{\text{number recaptured in the second sample}}$$

A scientist used this technique to determine the change in the population size of snails in a pond from March to July.

Figure 9 shows the results.

month	number marked in the first sample	size of the second sample	number of recaptured animals	population size
March	18	22	8	50
July	12	18	10	26

Figure 9

- (i) Using data from Figure 9, calculate the difference in the population size from March to July.

(3)

$$\frac{12 \times 22}{10} = 26.4$$

$$50 - 26 = 24$$

Difference in the population size 24



This has used the incorrect number for size of second sample from the table (they have used the value for March) but they do round it to the nearest whole number and subtract it to get the difference so were awarded two marks in total using the error carried forward.



Always show workings to calculations in case you make a mistake.

- 6 (a) Scientists use a technique called mark and recapture to estimate animal populations in a habitat.

A sample of the population is captured and a harmless mark is added to each animal.

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March	18	22	8	50
July	12	18	10	

Figure 9

- (i) Using data from Figure 9, calculate the difference in the population size from March to July.

(3)

$$\frac{18 \times 22}{10} = 39.6$$

Difference in the population size ~~50~~ 39.6



This scored zero as they have the wrong numbers from the table.
There is no rounding or subtraction from 50.

- 6 (a) Scientists use a technique called mark and recapture to estimate animal populations in a habitat.

A sample of the population is captured and a harmless mark is added to each animal.

These animals are released and after a period of time the population is sampled again.

This second sample includes some recaptured animals that have marks on them.

The population can be estimated using this equation

$$\text{population size} = \frac{\text{number marked in the first sample} \times \text{size of the second sample}}{\text{number recaptured in the second sample}}$$

A scientist used this technique to determine the change in the population size of snails in a pond from March to July.

Figure 9 shows the results.

month	number marked in the first sample	size of the second sample	number of recaptured animals	population size
March	18	22	8	50
July	12	18	10	21.6

Figure 9

- (i) Using data from Figure 9, calculate the difference in the population size from March to July.

(3)

$$\frac{12 \times 18}{10} = \frac{216}{10} = 21.6$$

$$50 - 21.6 = 28.4$$

Difference in the population size 28.4



This was awarded two marks as it was not rounded to a whole organism.



Remember when working with organisms you cannot have a fraction of an organism.



This response clearly shows the workings to obtain the correct answer.

Question 6 (a)(ii)

Many candidates had little knowledge of how to control the sampling and provided responses including the weather, temperature or area within the lake. The higher ability candidates mentioned the same points (such as a method of marking the snails with a permanent pen, same time spent sampling, or the same time between the first and the second sample). Some candidates showed no understanding of how to sample a population and suggested that capturing the same number of animals in each sample was needed.

(ii) State **two** factors the scientist should control when sampling the habitat in March and July.

(2)

1. Time of day

2. Same location.



ResultsPlus
Examiner Comments

This scored one mark for sampling at the same time of day. The habitat is already being sampled which is the same location so this did not get the mark.

(ii) State **two** factors the scientist should control when sampling the habitat in March and July.

(2)

1. The period of time between resampling should be the same.
2. How the animals are being captured.



ResultsPlus
Examiner Comments

The capturing of organisms is the sample size so not a factor that should be controlled. The same time between the first and second sample is a variable to be controlled so this response was awarded one mark.

(ii) State **two** factors the scientist should control when sampling the habitat in March and July.

(2)

1. The time of day the sample it.
2. How long they sample it for.



ResultsPlus
Examiner Comments

These are both variables that should be controlled when sampling the habitat, so this response is worth two marks.

Question 6 (b)

Many candidates gained a mark by identifying fertilisers as a factor that causes eutrophication but then very few went on to link this to a build-up of nitrates. Many candidates talked about the effects of eutrophication rather than the cause, referring to algal blooms and plants in the pond being unable to photosynthesis. It is important that candidates read the question carefully before answering.

(b) This pond is affected by eutrophication.

Explain one possible cause of eutrophication.

(2)

A cause could be fertiliser from farms being washed due to rain flood into the pond. This increases nitrates and increases plant growth causing eutrophication. An increase in algae plant growth blocks the sunlight so the plants underneath die and decompose.



Eutrophication.



ResultsPlus
Examiner Comments

This response has the idea of the fertilisers entering the water increasing the nitrates so was awarded two marks.

(b) This pond is affected by eutrophication.

Explain **one** possible cause of eutrophication.

(2)

Overgrown algae over the pond
which is caused by fertiliser
from the crops.



ResultsPlus
Examiner Comments

This is one mark for the fertilisers but the overgrown algae is a description of eutrophication and not a cause.



ResultsPlus
Examiner Tip

Read the question carefully and make sure you answer what you have been asked.

Question 6 (c)

Most candidates were able to give a good account of the benefits of reforestation and link it to at least one atmospheric gas. The best responses were able to relate this to climate change/global warming. However, fewer candidates could give a good account of animal conservation with most only really able to gain credit from the “stop animals from going extinct” idea. Some candidates were able to relate animal conservation to the maintenance of food webs but very few made any reference to the maintenance or importance of maintaining genetic diversity; some responses did refer to breeding programmes in zoos and ecotourism and the majority of these were able to achieve level 3. Some candidates wrote very good responses on reforestation, but ignored animal conservation entirely, limiting themselves to level 1. A significant number of candidates gave limited information on animal conservation programmes, invariably the preservation of species, and were limited to level 2, despite good responses on reforestation.

*c) Reforestation has a beneficial effect on air composition and biodiversity.

Animal conservation projects can also have a beneficial effect on biodiversity.

Explain the beneficial effects of reforestation and animal conservation projects.

(6)

The benefits are that it reserves nature and its wildlife, making the landscape ~~and~~ beautiful and ^{with lots of biodiversity} unpolluted. This means there could be an increase in ecotourism. An increase in ecotourism also provides more jobs, ~~as do the~~ so do the conservation projects. Also, ~~conserving~~ making sure animals don't go extinct helps to keep the food chain going, this will not have an effect on our food supply like fish stock. Animals can also provide us with future medicines which will overall benefit the economy as well as letting future generations see the extraordinary animals and the biodiversity we see.



ResultsPlus
Examiner Comments

This response only refers to aspects of animal conservation so was restricted to level 1. It has preventing extinction for a benefit and links it to the food chain, which is how animal conservation helps improve biodiversity, so was awarded two marks.

*c) Reforestation has a beneficial effect on air composition and biodiversity.

Animal conservation projects can also have a beneficial effect on biodiversity.

Explain the beneficial effects of reforestation and animal conservation projects.

(6)

biodiversity is when animals in an ecosystem work together to survive and gradually adapt to the environment. reforestation will help all animals big and small as trees provide shelter, food and habitats for most animals as we see birds ~~at~~ mostly build nests in trees high up away from predators to protect their offspring, showing how reforestation is beneficial in the reproduction of wildlife. animal conservation projects like putting endangered animals in enclosed habitats can be seen as both cruel and beneficial as encaging an animal is cruel ~~and~~ but it is to stop ~~at~~ this species from becoming extinct and to reproduce in a protected environment in hope of highering the birth rate ~~of~~ this species so it doesn't become extinct in generations to come.



This was a level 2 response. They have the idea of habitats for reforestation but there is no further detail for this aspect, limiting the response to level 2. For animal conservation they have the idea of increasing the birth rate to prevent extinction and enclosing animals in habitats being protective. This allowed them to get four marks for the top of the level as it is how animal conservation projects will improve biodiversity.

* (c) Reforestation has a beneficial effect on air composition and biodiversity.

Animal conservation projects can also have a beneficial effect on biodiversity.

Explain the beneficial effects of reforestation and animal conservation projects.

(6)

- Reforestation is the act of restoring plants that were native to a region but were removed for ^{some} reason eg. deforestation. The native plants encourage natural habitats for organisms to feed / mate / shelter. These plants also increase levels of oxygen as biomass will have increased. Reforestation also means that there could be more resources for the use of humans eg. medicinal plants, animals for consumption. This also allows for stable food chains / populations. The fact the plants are native ensures indigenous species thrive.
- Animal conservation projects entail protecting a species that is near to extinction and is commonly partnered with breeding programmes. This means that extinction is less likely which is essential for maintaining biodiversity. This ensures stable food chains and manageable species populations. The more animals on the earth ensure a higher biomass which is essential for managing pests and supporting human life. It can also protect ecosystems as ^{individual} species (individuals) are essential for the wider community, ~~of~~ biotic and abiotic factors including



This is a level 3 response but it is limited to five marks because it does not give the effect of reforestation on the levels of carbon dioxide in the atmosphere.

It has a detailed explanation for both reforestation and animal conservation.

*c) Reforestation has a beneficial effect on air composition and biodiversity.

Animal conservation projects can also have a beneficial effect on biodiversity.

Explain the beneficial effects of reforestation and animal conservation projects.

(6)

Reforestation allows more ~~air~~ trees to develop. This means the amount of photosynthesis increases. This benefits air composition as it means more carbon dioxide from the atmosphere is being taken in and more oxygen ~~to~~ will be ~~disto~~ released into the atmosphere. It can also benefit biodiversity as it gives more species shelter and a place to nest. This could maybe increase the different amount of bird species, for example.

Animal conservation can have a beneficial effect as it could allow the species of ~~the~~ animals that are on the verge of extinction to breed and increase the amount ~~of~~ that species has and send it back out into the wild. This will prevent extinction.



This has sufficient detail for six marks. They refer to the atmospheric gases involved in reforestation and the idea of introducing animals back into the wild for animal conservation, which is sufficient detail to enable level 3 to be awarded.

Paper Summary

Based on their performance on this paper, candidates should:

- recognise that the word 'explain' means additional scientific information is needed that is linked to the answer given.
- understand that when comparisons between two sets of data or two structures are being made, that the language used in responses should be comparative – 'greater', 'faster', 'quicker', 'more' etc.
- read the information given in the introduction to the question but avoid repeating it in the answer as it will not gain credit.
- ensure that methods for core practicals are understood including the differences between controls and control variables. Candidates should use scientific terminology more frequently when answering questions related to practical tasks.
- make sure that the roles of the different hormones as well as the different types of diabetes are clearly understood.
- ensure that when two aspects are required in an extended open response that both aspects are included in the response, to a similar level of detail if possible.
- be clear on the roles of bacteria and microorganisms in the nitrogen cycle.
- ensure that they consistently apply rules for rounding up numerical answers and understand that fractions of organisms are not possible. Read mathematical questions carefully to note whether an answer is required in standard form or to a specified number of significant figures.

Grade boundaries

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

<https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html>

