

Examiners' Report  
June 2018

GCSE Combined Science 1SC0 1BH

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# Introduction

The Pearson Edexcel Combined Science, Paper 1: Biology (Higher tier) is one of six assessments taken as part of the new GCSE (9-1) Combined Science qualification.

This is the first assessment of the new GCSE (9-1) Combined Science specification and the qualification follows a linear assessment model whereby candidates must complete all the six assessments in the same single year of certification.

The Paper 1: Biology (Higher tier) assessment consists of 60 marks assessed by a variety of question types, including multiple choice questions, short answer questions, calculations and extended open-response questions. Candidates should answer all questions in a time period of 1 hour and 10 minutes. The extended open-response questions are 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 new GCSE (9-1) Combined Science qualification assesses practical knowledge and maths skills; the requirements of which are given in the new specification. Furthermore, for the Biology qualification, there are 6 core practicals which candidates must complete prior to the examination as aspects of working scientifically are also assessed in questions throughout the paper.

The Paper 1: Biology (Higher tier) paper contains questions assessing the content from Topics 1 to 5, as identified in the new specification. In this first examination series, candidates were required to respond to questions that tested their knowledge and understanding of the effect of exercise and diet on weight linked to cardiovascular disease, osmosis, cells and subcellular structures, bacterial infection and immunity, stem cells, mitosis, microscopy, enzyme activity, (including practical work and data analysis), genetic engineering, the human genome project and the effect of antibiotics on bacteria.

Questions designed to assess practical work included writing a plan for an investigation, safety precautions, (including aseptic techniques), using a microscope, controlled variables and the method and analysis of results for the practical testing of the effectiveness of antibiotics on bacteria. The maths skills assessment in this paper related to questions requiring BMI calculations, surface area calculations, percentage increase calculations, probabilities and rate calculations.

## Question 1 (a)

In this question, candidates were asked to explain why exercise can cause weight loss. The question offered two marking points; the first marking point was awarded for the idea that exercise requires energy or respiration. The idea of burning calories and an increased metabolism were also acceptable responses.

The second mark was awarded for explaining that exercise reduces fats or that the energy is obtained from fats. 'Sweating' was awarded a mark provided it was linked to the idea of water loss. Overall, the question was answered well, and many candidates scored both marks. However, some candidates did not get the second marking point as they only gave the idea that the energy in food intake was burned, rather than the idea of weight loss because fat already in the body was lost.

- 1 (a) Obesity increases the risk of a person developing cardiovascular disease.

Losing weight can reduce the risk of this disease occurring.

Explain why exercise can cause weight loss.

(2)

Exercise uses up energy that is stored in the body, so during exercise the energy is used up from the storage, hence weight is lost. It stops the storage of glucose - so it won't turn into glycogen.



**ResultsPlus**  
Examiner Comments

This response was awarded 1 mark for the reference to using up energy for the first marking point. The idea of the storage of glucose is incorrect.



**ResultsPlus**  
Examiner Tip

Do not be afraid to write what seems to be an obvious answer. Examination questions are not there to trick you.

1 (a) Obesity increases the risk of a person developing cardiovascular disease.

Losing weight can reduce the risk of this disease occurring.

Explain why exercise can cause weight loss.

(2)

exercise can cause weight loss because  
when you exercise, the fat in your  
body Respiration happens with  
factors that you need more oxygen and  
the fat is burned.



**ResultsPlus**  
Examiner Comments

This response was awarded full marks. 1 mark was awarded for the use of respiration and 1 mark was awarded for the notion that exercise burns fat.

## Question 1 (b)

This question required candidates to interpret the diagram of a stomach fitted with a gastric band, as well as an application of knowledge to an unfamiliar context. Candidates were asked to explain how a gastric band, helps a person to lose weight.

This question was allocated 2 marks. Candidates were required to provide two out of a possible three responses to be awarded full marks. For marking point 1, answers which included reference to reducing the volume of the stomach were correct. A mark was not awarded for the incorrect interpretation that it reduces the size of the entry to the stomach. For marking point 2, answers which referred to the idea of reduced food intake or restricting the amount of food entering the stomach were also correct. However, reference to just the idea of feeling full quicker was not an acceptable response. For the third marking point, answers which included reference to the idea of stored fat being used which would lead to weight loss were also correct. Most candidates scored full marks by combining the idea of a smaller stomach volume and eating less. Fewer candidates recognised that stored fat must be used in order to reduce weight.

Explain how a gastric band helps a person to lose weight.

(2)

A gastric band decreases the amount and rate food goes into the stomach allowing more time for food to be digested and used. It also reduces the size of the stomach making you eat less.



**ResultsPlus**  
Examiner Comments

In this example, 1 mark was awarded for the idea of reducing the size of the stomach. The second marking point was awarded for reference to making you eat less, which is the same as reducing food intake. There was no credit for the idea of feeling fuller.

Explain how a gastric band helps a person to lose weight.

(2)

*It stops fat from entering the stomach and being broken down into fatty acids and glycerol and is instead used for physical activity.*



This response was incorrect. No marks were awarded to the idea that a gastric band specifically reduces fat from entering the stomach.

## Question 1 (c) (i)

This question required a standard calculation of BMI with the additional maths skill of using significant figures.

The correct answer, including the correct number of significant figures, scored the maximum of 3 marks, and with no workings shown. However, if the incorrect answer was given candidates were able to obtain some marks by demonstrating evidence of substituting the correct numbers into the equation for 1 mark, and evaluating this equation to the incorrect number of significant figures for 2 marks. Furthermore, 2 marks were awarded for an evaluation without the correct number of significant figures and with no workings shown.

Many candidates were able to gain the maximum of 3 marks. The answer of 22 was the most frequent response, given only two marks, as well as 21.9 which shows an error in rounding.

(c) BMI and waist:hip ratio can be used to find out if a person is obese.

Figure 2 shows some data for two males.

male	BMI	waist : hip ratio
A	27.3	0.85
B	?	0.81

Figure 2

BMI is calculated using the equation:

$$\text{BMI} = \frac{\text{mass in kilograms}}{(\text{height in metres})^2}$$

(i) Male B has a mass of 72 kg and a height of 1.81 m

Calculate the BMI of male B.

Give the answer to 3 significant figures

(3)

$$\frac{72}{(1.81)^2} \rightarrow \frac{72}{3.2761} = 21.97788$$

$$\text{BMI} = \underline{21.9}$$



In this example, the calculation has been completed correctly and the candidate has given the answer to 3 significant figures and is awarded 2 marks. However, the candidate has not correctly rounded the answer and so cannot be awarded the third marking point.



Tip on rounding numbers. If the last number is a 5 or above then the sum should be rounded up. If it is below 5 then it should be kept to the original number.

(c) BMI and waist:hip ratio can be used to find out if a person is obese.

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Figure 2

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(i) Male B has a mass of 72 kg and a height of 1.81 m.

Calculate the BMI of male B.

Give the answer to 3 significant figures.

(3)

$$\frac{72}{1.81^2} = 21.977 \dots$$

22.0

BMI = 22.0



In this example, 3 marks were awarded as the candidate has calculated the correct answer shown to 3 significant figures. The candidate has clearly shown the correct mathematical workings.



When doing mathematical calculations, always show your workings.

## Question 1 (c) (ii)

In this question, candidates were required to interpret the data given to conclude that 'male A' is overweight but not abdominally obese for marking point 1. In addition, answers that suggested male A is nearly abdominally obese were accepted. The explanation aspect of this question relates to the fact that male A's weight distribution was not around his abdomen or vital organs. The idea that male A's waist was more evenly distributed or that he has more weight on his hips than waist was creditworthy.

Some candidates demonstrated the misconception that because the data indicated that male A was only 0.05 away from 0.90 waist:hip ratio, male A had a large amount of abdominal fat. This response demonstrated a lack of understanding of waist:hip ratio, which is new to this specification.

Explain what the BMI and waist:hip ratio for male A shows about his weight distribution.

(2)

The BMI and waist:hip ratio show that the man is overweight but not ~~overweight~~ from over-eating but rather from muscle growth. This is because he is below the threshold to be classed as abdominally obese which means that the ~~weight~~ excess weight is coming from elsewhere in the body.



This response was awarded full marks. The candidate was awarded 1 mark for the fact that the person is overweight but not abdominally obese, (both details are needed for this mark). The second mark was awarded for the explanation of the term abdominally obese.



Make sure you read the question carefully to ensure you answer the whole question. In this question, a comment had to be made about BMI and waist:hip ratio. This is an 'explain' question so it is vital that an explanation is given about what this means for the person, that is to say, the man is not abdominally obese so less weight is carried around the stomach.

Explain what the BMI and waist:hip ratio for male A shows about his weight distribution.

(2)

His BMI shows him as overweight  
but his waist:hip ratio shows  
that he is normal



**ResultsPlus**  
Examiner Comments

This response was awarded 0 marks. The response states only that the person is overweight but with no reference to not being abdominally obese, (both details are needed for one mark). In addition, the candidate has not explained what abdominally obese is for an additional mark. As 'normal' is a weight category for BMI it is important not to use this term.

## Question 2 (a) (i)

In this question, the formula for calculating surface area was given and candidates were asked to calculate the surface area of chip B. Most candidates completed the mathematical calculation successfully and were awarded full marks for the correct answer, 48 or 48.0.

A common error in this question related to the values XY, XZ and YZ being added together rather than the correct process of first multiplying the values and then adding together the results. In some cases, candidates calculated the surface area of chip A, which was already given.

potato chip	length of X in cm	length of Y in cm	length of Z in cm	total surface area of four sides in cm <sup>2</sup>	total surface area of top and bottom in cm <sup>2</sup>	total surface area of chip in cm <sup>2</sup>
A	3.0	1.5	1.5	18.0	4.5	22.5
B	5.0	2.0	2.0	?	?	?

Figure 5

- (i) Calculate the total surface area of potato chip B using the formula,

$$\text{Total surface area} = 2XY + 2XZ + 2YZ$$

$$\begin{aligned} SA &= (2 \times 5 \times 2) + (2 \times 5 \times 2) + (2 \times 2 \times 2) && (2) \\ &= 20 + 20 + 8 \\ &= 48 \end{aligned}$$

total surface area = 48 cm<sup>2</sup>



**ResultsPlus**  
Examiner Comments

In this example, the candidate has given the correct answer and has shown all the mathematical workings correctly. Full marks can be given for the correct answer even if no working is shown.



**ResultsPlus**  
Examiner Tip

Always show the mathematical workings even if the calculations are straightforward.

## Question 2 (a) (ii)

This question required candidates to provide an explanation as to why potato chip B had a greater increase in mass. For marking point 1, candidates were required to give a comparative idea for chip B, for example, that it was larger, greater or bigger. Suggestions of chip B having a higher solute concentration or lower water potential than chip A were also accepted.

Answers which suggested a larger surface area:volume ratio were incorrect. For marking point 2, candidates needed to refer to the notion that more water was going into potato chip B. Responses which just referred to the idea of water entering by osmosis were not sufficient as the process also occurs in chip A. Therefore, for marking point 2, candidates must indicate more water going into potato chip B.

(ii) The potato chips were placed in distilled water for 20 minutes.

Figure 6 shows the increase in mass of each potato chip.

potato chip	increase in mass in grams
A	0.1
B	0.3

Figure 6

Explain why potato chip B has a greater increase in mass than potato chip A.

(2)  
because potato chip B has a large surface area with ~~the~~ no water in it so by osmosis more water goes into potato chip B than A



**ResultsPlus**  
Examiner Comments

This response was awarded 1 mark for the idea of more water moving into the potato. Unfortunately, the response did not provide a comparative idea of chip B having a larger surface area to be awarded the second marking point.

## Question 2 (a) (iii)

In this question, candidates were required to explain what would happen to the cells of chip A if it was placed in a concentrated salt solution for a total of 3 marks.

For marking point 1, candidates were required to refer to the notion that the cells in chip A would lose water or become plasmolysed. Similarly, reference to chip A getting smaller, shrinking or losing mass were also acceptable responses.

For marking point 2, candidates were required to refer to the notion of water being released by osmosis. The use of the term 'diffusion' by some candidates was ignored.

For marking point 3, candidate responses needed to refer to the solute concentration gradient or the idea of water potential. However, the notion of water concentration was also accepted as knowledge of water potential itself was not required.

Most candidates were successful in achieving full marks for this question. However, candidates who were awarded 2 marks had often neglected using the term osmosis or were unable to provide a clear explanation as to why the water moved out of chip A.

(iii) Potato chip A is transferred from the distilled water into a concentrated salt solution.

Explain what will happen to the cells in potato chip A.

(3)

The cells will give out water molecules to the solution which means the mass of potato A will decrease. This is because the cells will not take in the concentrated salt solution.



This response was awarded 1 mark for reference to the concept of water moving out of the cells. No further marks were awarded as the method of water movement was not explained.

(iii) Potato chip A is transferred from the distilled water into a concentrated salt solution.

Explain what will happen to the cells in potato chip A.

(3)

Salt solution will act as a detergent  
therefore break down the  
cells in the potato.  
Potatoe becomes less dense.



**ResultsPlus**  
Examiner Comments

No marks were awarded for this response as the candidate appears to have confused the process of osmosis with the idea of the DNA extraction method.



**ResultsPlus**  
Examiner Tip

If a question is talking about water movement into and out of cells, this must be osmosis. If it is not water, it is not osmosis.

## Question 2 (b)

In this question, candidates were required to provide an explanation for the difference in sub-cellular structures between the cells of a potato and the cells in the leaf of the potato plant. Most candidates successfully obtained two marks for this question.

To be awarded the full 2 marks, candidates were required to link the idea that chloroplasts are found in the leaf because photosynthesis occurs, or that they were absent in the potato because it did not photosynthesise. In some responses, candidates described the idea of stomata or root hair cells, which are not sub-cellular structures and, therefore, an incorrect response.

(b) The potatoes of a potato plant develop underground.

Explain **one** difference in the sub-cellular structures in a cell in the potato and those in a cell in the leaf of the potato plant.

Cells in the leaves will have chloroplasts, which<sup>(2)</sup> they use for photosynthesis, the potato cells do not need these as they are underground, sunlight is needed for photosynthesis.



**ResultsPlus**  
Examiner Comments

In this example, the candidate was awarded 1 mark for reference to the fact that potatoes do not have chloroplasts. A second mark was also awarded for reference to potatoes being underground so there is no sunlight for photosynthesis to take place. This response was awarded full marks.

(b) The potatoes of a potato plant develop underground.

Explain **one** difference in the sub-cellular structures in a cell in the potato and those in a cell in the leaf of the potato plant.

(2)

The plant cell has chloroplast  
to get food from the  
sun.



This was a common error with no identification as to which plant cell has the chloroplast, therefore marks could not be awarded. When writing a response, it needs to be specific to the question.

### Question 3 (a) (i)

This question related to the working scientifically aspect of the specification assessing practical skills. The question provided information that the bacteria '*Streptococcus*' causes sore throats and skin infections. Candidates were asked to give two precautions a doctor should take when treating an infected patient.

Full marks were awarded for two relevant responses related to washing hands, wearing gloves or protective clothing, (including the idea of covering wounds), wearing a surgical mask, sterilising equipment or being immunised. The question required candidates to specify safety precautions specifically related to protecting a doctor, therefore, treating an infected patient in an isolated room was ignored. Similarly, wearing goggles was not specifically relevant to this situation and, therefore, not an acceptable response.

#### 3 *Streptococcus* bacteria can cause a sore throat or skin infection.

An illness called scarlet fever can also develop during an infection with this bacterium.

(a) (i) Give **two** precautions a doctor should take when treating a patient who is infected with *Streptococcus*.

(2)

The doctor should wear gloves if they contact the skin because if they ~~don't~~ <sup>don't</sup> they could get the infection. They ~~also~~ should also wear a face mask if they are looking at the patient's throat because the infection ~~can~~ <sup>can</sup> get breathed in, by ~~the~~ <sup>the</sup> doctor.



**ResultsPlus**  
Examiner Comments

This response was awarded full marks for the reference to using gloves and a face mask as safety precautions.



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Examiner Tip

When answering questions on safety issues, make sure the safety precaution is relevant to the practical task being investigated.

### Question 3 (a) (ii)

In this question, candidates were assessed on the mathematical skill of calculating a percentage change in mass.

The first marking point was awarded for calculating the difference and the second marking point was awarded for calculating the correct percentage change. Full marks were awarded for the correct answer without showing mathematical workings.

Candidates were awarded 1 mark for calculating the difference correctly. However, some candidates incorrectly divided the difference by the final number (5943) and not the starting number (2830), which gave the incorrect percentage change.

However, 1 mark was awarded for calculating the percentage change from the incorrect answer to the first part of the calculation, provided that candidates had shown the mathematical workings in order that the point of error could be identified.

- (ii) From September 2013 to March 2014 there were 2830 cases of scarlet fever in the UK.

From September 2014 to March 2015 there were 5943 cases of scarlet fever.

Calculate the percentage increase of the number of cases of scarlet fever between the periods September 2014 to March 2015 and September 2013 to March 2014.

(2)

$$\begin{aligned} 5943 - 2830 & \div 100 \\ & = 31 \end{aligned}$$

..... 31 %



This response demonstrates a common error with this question. The candidate has shown the correct workings for the subtraction in the first part of the calculation. Unfortunately, the answer to the subtraction was incorrect and therefore, the candidate was unable to calculate the percentage change correctly. This response was awarded 0 marks.

(ii) From September 2013 to March 2014 there were 2830 cases of scarlet fever in the UK.

From September 2014 to March 2015 there were 5943 cases of scarlet fever.

Calculate the percentage increase of the number of cases of scarlet fever between the periods September 2014 to March 2015 and September 2013 to March 2014.

(2)

$$\% \text{ increase} = \frac{\text{new} - \text{old}}{\text{old}} \times 100$$

$$= \frac{5943 - 2830}{2830} \times 100$$

$$= 110\%$$

..... 110 %



**ResultsPlus**  
Examiner Comments

This response was awarded full marks. The candidate has shown the correct initial calculation and the correct percentage is given on the answer line. It is noted that both marks can be awarded if the correct answer is written on the answer line with no mathematical workings.



**ResultsPlus**  
Examiner Tip

To calculate percentage change, first calculate the difference in the change and divide this result by the initial percentage then multiply by 100. This works for any percentage change including percentage change in mass.

### Question 3 (c)

Generally, candidates answered this question very well frequently scoring the maximum of 3 marks.

Candidates were asked to explain how an adult develops immunity to the toxin produced by bacteria. For marking point 1, marks were awarded for the idea that the toxin enters the body, or that the adult caught scarlet fever as a child or previously. For marking point 2, reference had to be made to an immune response and not just the idea that they became immune, as this was given in the question. The production of lymphocytes was also an acceptable response for marking point 3. Reference to both B and T lymphocytes were awarded a mark, but white blood cells was not credited, neither were memory cells for memory lymphocytes.

(c) Most cases of scarlet fever occur in children.

Adults have usually developed immunity to a toxin that the *Streptococcus* bacteria produce during infection.

Explain how an adult develops immunity to the toxin.

(3)

Memory lymphocytes could be working for the adults to be immune to the toxin. As a child, the toxin might have entered the body and the white blood cells could have already produced an antibody for the toxin so when it enters the second time, the memory lymphocytes get triggered therefore alerting white blood cells and fighting them faster than the first time. It kills the toxin before the adult shows any symptoms.



This response was awarded 3 marks. 1 mark was awarded to the idea of the toxin initially infecting the person. 1 mark was also awarded for reference to the production of antibodies, in this case. The final marking point was awarded for the reference to the memory lymphocytes.

(c) Most cases of scarlet fever occur in children.

Adults have usually developed immunity to a toxin that the *Streptococcus* bacteria produce during infection.

Explain how an adult develops immunity to the toxin.

(3)

An adult can develop immunity to the toxin by taking a small dose of it first. Then they can get this small dose will make the antibodies fight against the *Streptococcus* bacteria leading to a stronger immune system as the fight against the immune system will



This response was awarded 2 marks. The idea of the introduction of the toxin was awarded 1 mark, and making antibodies was also awarded 1 mark. Unfortunately, there was no mention of memory lymphocytes to be awarded the third mark. This third element of the marking criteria was the most commonly missed.

## Question 4 (a)

This question required candidates to apply scientific knowledge, which is an important skill. Candidates were asked to describe the benefits of being able to re-programme adult cells in order that they become cells with the properties of embryonic stem cells.

Candidates of higher ability scored well on this item. In some cases, candidates only described the benefits of embryonic stem cells and did not apply their scientific knowledge and consider the context of the question.

The first marking point was awarded for the knowledge that embryonic stem cells can differentiate into any cell type. The notion of many different cell types was an acceptable response, but no marks were awarded for just the idea that cells can differentiate.

The second marking point was awarded for the idea that embryonic stem cells would not need to be used or that embryos did not need to be killed. However, reference to solely unclarified ethical issues were not awarded a mark.

The third marking point was awarded to the notion that there was less chance of rejection, which was not a common response by candidates. The fourth marking point was awarded for the uses of embryonic stem cells, such as treating currently incurable conditions or named conditions. Cell transplants or replacing faulty cells was also an acceptable response. However, repairing faulty cells was not credited but repairing damaged tissue was an acceptable response.

**4 (a) In 2012, two scientists were awarded the Nobel prize for their research on stem cells.**

**They showed that adult cells could be reprogrammed to become cells with the properties of embryonic stem cells.**

**Describe the possible benefits of this research.**

**(3)**

Adult cells reprogrammed to become live embryonic cells is beneficial as adult cells have a restriction on what they can be programmed into, so ~~is~~ if its live embryonic cells it can become specialised ~~cells~~ to become any cells.



**ResultsPlus**  
Examiner Comments

This response was awarded 1 mark for the idea that embryonic cells can become specialised into any cell therefore implying this is what the reprogrammed stem cells can do.



Always look to the number of marks allocated to a question and ensure that you make the correct number of points to attain all the marks.

- 4 (a) In 2012, two scientists were awarded the Nobel prize for their research on stem cells.

They showed that adult cells could be reprogrammed to become cells with the properties of embryonic stem cells.

Describe the possible benefits of this research.

(3)

embryonic <sup>stem</sup> cells have the ability to become any cell needed, but only exist in an embryo which would need to be harvested in order to get the stem cells, this many people morally believe is wrong. The benefits of using adult cells means the body will not reject them as they would already be part of them and no moral issues around embryos would be called up upon.



This response was awarded full marks. 1 mark was awarded for the idea that embryonic stem cells can differentiate into any type of cell. 1 mark was also awarded for the idea that the cell will not be rejected. Finally, a mark was awarded for the idea that embryonic cells do not need to be called on.

## Question 4 (b) (iii)

This question required candidates to provide two relevant points of information to be awarded the full 2 marks. However, candidates were generally awarded 1 mark for this question by stating that DNA is replicated during interphase. More able candidates were able to give acceptable answers for marking point 2 related to the production of cell organelles or named cell organelles. Responses related to marking point 3 to the idea of metabolic activities taking place or cell growth was less frequently mentioned by candidates. Frequent incorrect responses included that the nuclear membrane dissolved.

(iii) Interphase is part of the cell cycle.

Describe what happens during interphase.

(2)

In interphase the cell increases its number of sub cellular structures and duplicates its DNA to have enough for 2 new cells (a complete set of chromosomes for each new cell)



**ResultsPlus**  
Examiner Comments

This response was awarded the full 2 marks. 1 mark was awarded for mentioning that DNA replicates and subcellular structures are equivalent to organelles. The reference to subcellular structures, such as ribosomes/mitochondria was also an acceptable response and was awarded 1 mark.

## Question 4 (c)

This question required candidates to use their practical skills and knowledge obtained from completing the core practical on microscopy to explain how a magnification of  $\times 400$  could be obtained. To be awarded the full 2 marks, candidates needed to name both lenses and a combination of lenses that would total  $\times 400$  given, provided the eye piece was equal to or lower than the objective lens. Candidates awarded 1 mark did not name the lenses or referred to the objective lens as the magnification lens.

Explain how a magnification of  $400\times$  can be obtained using the lenses on a light microscope.

(2)  
~~at~~ on the Microscope you need  
to use lenses with the magnification  
 $\times 40$  and  $\times 10$  which then  
equals the magnification of  
 $\times 400$



**ResultsPlus**  
Examiner Comments

In this example, the candidate has referred to the two lenses that are to be used, but the response does not indicate which lens is which. Therefore, this response was awarded 1 mark.



**ResultsPlus**  
Examiner Tip

In questions based on practical tasks, such as microscope use, try to give the detail. In this case, the names of the eyepiece and objective lens.

## Question 5 (a) (ii)

With practical knowledge now being assessed as part of the new specification, this question required candidates to explain why a variable needed to be controlled for the investigation. The question required candidates to read carefully and interpret the information about the investigation that was probably unfamiliar. This question was awarded 2 marks; the first mark was awarded for recognising that the mass of the potato disc is a variable, or stating what would happen if the mass was not controlled. The second mark was awarded for explaining that it allows the results to be compared, or that it means the amount of catalase is the same in each reaction. The idea that it makes the results valid was accepted but the idea of reliable or a fair test was not credited.

(ii) The potato discs all had the same mass.

Explain why the student used potato discs with the same mass.

(2)

This must be a controlled variable  
because if they don't have the same  
mass we will obtain inaccurate  
results



**ResultsPlus**  
Examiner Comments

In this response, the candidate was awarded 1 mark for correctly identifying that using the same mass is a controlled variable.

## Question 5 (a) (iii)

This question required candidates to recognise two other controlled variables for the investigation. Responses which identified hydrogen peroxide as a controlled variable had to include the volume or mass of hydrogen peroxide and not just the amount. Some incorrect responses stated variables that had already been controlled, or for giving the independent or dependent variable. The most frequently correct responses were temperature and pH.

(iii) State **two** other factors that need to be kept the same to improve this investigation. (2)

The volume of the solution needs to be kept the same. Also the concentration of the solution needs to be kept the same.



In this response, 1 mark was awarded for reference to the volume of the solution, as there is only one solution. However, no marks were awarded for reference to the concentration of the solution as it is this factor that is being tested.



Always use specific units when referring to solutions or solids. The amount will not be credited. If it is a solution, then use the term volume. If it is a solid, use the term mass.

## Question 5 (b) (i)

This question uses the command words, 'state' and 'explain'. Therefore, to be awarded the full 4 marks, candidates were required to provide a valid conclusion of the results of the investigation given, and explain the outcome using scientific knowledge and understanding.

Most candidates were awarded 1 mark for the conclusion. Many candidates were able to describe the data that justified the conclusion but were often unable to explain it. Responses that scored well on this question were those that gave scientific knowledge and understanding related to the idea that by increasing the amount of substrate, increases the chance of collisions, so more enzyme substrate-complexes are formed, and oxygen is released faster.

Just the idea of a negative correlation was ignored, unless the correlation was explained. The idea of the enzyme and substrate combining, or meeting, was acceptable for an explanation of collisions.

However, in responses where the conclusion was deemed incorrect, the linked explanation could not be correct, therefore, no marks were awarded.

(b) Figure 11 shows the results of this investigation.

The student calculated the rate of reaction using

$$\frac{1}{\text{time in seconds}}$$

concentration of hydrogen peroxide solution (%)	time taken for disc to rise (s)	rate (s <sup>-1</sup> )
5	325	0.003
10	245	0.004
15	132	0.008
20	72	0.014

Figure 11

(i) State and explain a conclusion based on these results.

(4)

The higher the concentration of hydrogen peroxide solution the quicker the disc takes to rise, meaning the rate will increase. This is because the higher the concentration the bigger the reaction so the potato will rise quicker.



In this response, the candidate was awarded 1 mark only for the conclusion. In order to be awarded marks for the explanation, the candidate would need to have indicated that there is more substrate or more hydrogen peroxide so more reactions between enzyme and substrate can occur, thus more oxygen being produced to raise the potato disc.

(b) Figure 11 shows the results of this investigation.

The student calculated the rate of reaction using

$$\frac{1}{\text{time in seconds}}$$

concentration of hydrogen peroxide solution (%)	time taken for disc to rise (s)	rate (s <sup>-1</sup> )
5	325	0.003
10	245	0.004
15	132	0.008
20	72	0.014

Figure 11

(i) State and explain a conclusion based on these results.

(4)

the higher the % of peroxide the less time taken for the disc to rise this is because there is more peroxide then there is more ~~a~~ reaction taking place and more bubbles being produced making it easier/quicker to lift the disc.



In this response, the conclusion is correct. 1 mark was awarded for reference to more peroxide being equivalent to more substrate. An additional mark was awarded for the idea that more bubbles caused the disc to rise faster.

## Question 5 (b) (ii)

Most candidates answered this question well, and were awarded the full 2 marks, by recognising that the result needed to be expressed to three decimal places. However, 1 mark was awarded even if the answer had not been expressed to three decimal places where the mathematical workings were correct.

- (ii) The student repeated the investigation with a 25% hydrogen peroxide solution and recorded a time of 75 seconds.

Calculate the rate of reaction for the 25% hydrogen peroxide solution.

$$\begin{aligned} \frac{1}{\text{seconds}} \quad \frac{1}{\text{time in (s)}} &= \frac{1}{75} & \text{rate} &= \frac{1000}{\text{time}} & (2) \\ &= 0.013 \\ &= 0.13 \times 10^{-1} & & & \\ & & & & 0.13 \times 10 \dots \text{s}^{-1} \end{aligned}$$



**ResultsPlus**  
Examiner Comments

In this response, the candidate has written the incorrect answer on the answer line but was still awarded 1 mark for the correct mathematical workings.



**ResultsPlus**  
Examiner Tip

It is important to check through your work at the end of the paper to ensure that there are no mistakes in transferring a mathematical mark to the answer line.

## Question 5 (b) (iii)

The application of scientific knowledge to experimental data is an important skill. This question asked candidates to give the reason why a further increase in concentration of hydrogen peroxide did not lead to an increase in rate of reaction. It required candidates to recognise that the substrate concentration is no longer limiting the rate of reaction, or that there is now another factor limiting the rate of reaction. The idea that all the active sites were occupied or that the enzyme was saturated was also acceptable. The idea that the enzyme has started to denature was only accepted if linked to a change in pH, the hydrogen ion concentration or acidity.

(iii) The student decided that the rate for the 25% hydrogen peroxide solution was not anomalous.

Give the reason why the result was not anomalous.

(1)

There is usually a 'sweet spot' for reactions to take place, where the ~~environment~~ <sup>products</sup> for the reaction are at the optimal conditions.



In this response, no marks were awarded. The candidate needed to relate to the fact that this is no longer the limiting factor, or that all the active sites of catalase are occupied. The 'sweet spot' could be the active site, but this has not been stated by the candidate.

## Question 6 (a) (i)

Candidates of all abilities demonstrated a good level of knowledge for this question.

Candidates were required to explain how a gene is inserted into a plasmid, including the use of restriction enzymes to produce sticky ends and ligase. Phonetically correct spellings, such as 'ligase' were accepted but 'lipase' was rejected. The idea of matching sticky ends was accepted for complementary. No marks were awarded for responses which did not include these details. For example, enzymes cut the DNA was not creditworthy.

### 6 (a) Yeast cells can be genetically modified to produce a painkiller.

This painkiller is usually obtained from opium poppies.

One method for genetically modifying a yeast cell uses a plasmid containing the desired gene.

(i) Explain how a gene can be inserted into a plasmid.

(2)

Restriction enzymes can be used to cut the yeast cells DNA. This creates room for the poppy's plasmid to be inserted. The sticky ends can be stuck back together, creating a strand of DNA. This is done by Ligase.



In this response, 1 mark was awarded for the idea that ligase joins DNA together. The complementary sticky ends must be on the required gene and plasmid for the mark, and restriction enzymes must cut out the gene/DNA or plasmid.



In questions about genetic modification, it is vital you include the names of the enzymes involved, for example, restriction enzymes to cut the DNA and ligase enzymes to stick the DNA together.

## Question 6 (a) (ii)

Issues surrounding genetic engineering were examined in this question which required candidates to apply their knowledge to the specific context of identifying the possible benefits and risks of producing painkillers from genetically modified yeast cells. Candidates were not awarded marks for vague statements about genetic engineering being unethical as specific details were required in the response.

In some responses, candidates demonstrated limited knowledge of this topic by stating that painkillers were genetically modified, that the yeast was ingested or that we do not know the impact of the painkillers on humans. For example, answers such as the yeast could have a negative effect on humans were ignored.

The idea that it was easier to produce painkillers from genetically modified yeast cells was insufficient as the response needed to relate to the ease of extraction for marking point 3. In addition, the idea of reduced biodiversity and cross pollination is not an acceptable response, but the possibility of risks of the GM yeast entering the environment was credited. Furthermore, issues surrounding cost are unsubstantiated and, therefore, were not credited.

Candidates were awarded marks for a more commonly expressed idea that an increased yield could be obtained in a shorter amount of time. The risks element to this question required more detail. Less able candidates often struggled to explain the risk element in a cohesive way. Moreover, marks were more commonly awarded for an explanation of the benefits rather than risks.

(ii) Discuss the possible benefits and risks of producing painkillers from genetically modified yeast cells rather than extracting the painkillers from poppies.

(3)

~~The bene~~ Some benefits of using genetically modified yeast cells ~~is~~ are that it ~~produces more pain~~ can code proteins for pain killers, this means it can increase the yield of the painkillers produced. Another benefit is that ~~is~~ by genetically modifying the yeast cell to produce painkillers ~~rather than its much easier to~~ ~~is~~ access rather than extracting it from poppies. However a ~~disadvantage~~ disadvantage is that it ~~may~~ may cause negative symptoms on the user.



In this response, the full 3 marks were awarded for the idea that there is a higher yield and it is easier to obtain than extracting from poppies. The risk element referred to the idea of having a negative side effect. Although these answers seem quite straightforward, they are nonetheless acceptable answers.

## **Question 6 (b) (ii)**

This extended open-response question covered three aspects: (i) the effect of changes in DNA sequence, (ii) the impact of the ability to sequence a genome on the individual and, (iii) the impact of the knowledge on medical treatments. The idea of influencing medical treatment is given in the question and therefore is not credited.

A mark was awarded in the Level 1 mark band for stating some valid content from one of the three areas.

To be awarded a mark from the Level 2 mark band, responses needed to demonstrate a good description of one of the three areas, or a combination of two of the areas. Marks were more commonly awarded from this mark band for details on sequencing the genome to diagnose possible diseases and the idea of personalising medicines.

To be awarded a mark from the Level 3 mark band, responses needed to contain content from all three areas. The top range of the Level 3 mark band was awarded to responses that were sufficiently structured and coherent, in line with the descriptors given in the mark scheme.

In some responses, there was evidence of a misconception of the idea that scientists could alter the sequence of the genes to impact the individual. More able candidates produced rounded responses, addressing all three areas and included more detail on the effect of mutations, which was not required but demonstrated comprehensive synoptic knowledge of the topic.

\*(ii) In 2003, the first complete human genome was sequenced.

The genomes of different people have **small changes** in the **sequence** of the **DNA bases**.

Describe how **these changes** in DNA sequence can **affect the individuals** and how **sequencing a person's genome** could **influence their medical treatments**.

(6)

These small changes in DNA can affect the individuals as they may be more prone to diseases because of the mutation (caused by a change in the DNA's bases). For example a person may not be able to produce a particular protein. It also affects the person's phenotypes - so how dark their shade of brown ~~hair~~ eyes are. It could influence medical treatments as certain people's DNA bases may only be able to make use of a certain amount of medicine before it becomes excessive. It could also influence how often they are screened for the likes of certain cancers, if they are more likely to get it based from their genome, then they could be screened more often to catch it at an earlier stage. The genome could also show whether they would be resistant to particular anti-biotics, which then can be catered to a different one. However, knowing they are more prone to an illness might make them stressed or nervous every time they get ill - even if it is a common bug. It might also mean they have to pay more life insurance if they are likely to get a fatal illness. It might also mean discrimination when getting employed - as employers would want to hire someone who will not need sick leave. However it might promote them to live a healthy life.

(Total for Question 6 = 12 marks)

This response was awarded marks for each of the three categories in the indicative content. The candidate has described a change in the DNA as a mutation and the effect of this on the phenotype, with a suggestion for possible uses of this information in looking at the susceptibility to disease. The candidate has also suggested medical treatments. Therefore, this response was placed in the Level 3 mark band and the top mark of 6 was awarded for a logical response.

**\*(ii) In 2003, the first complete human genome was sequenced.**

**The genomes of different people have small changes in the sequence of the DNA bases.**

**Describe how these changes in DNA sequence can affect the individuals and how sequencing a person's genome could influence their medical treatments.**

**(6)**

Changes in the DNA sequence  
can affect individuals. If the DNA  
sequence is affected then it  
can cause ~~concern~~ problems  
with people's appearance like  
their eye colour, hair colour.  
Changes in DNA can also cause medical  
treatment for a person's genome like  
if their parents don't have an illness  
but the ~~dad~~ DNA changes then the  
baby's genome will change with can  
cause problems like the child might  
end up with two faulty ~~allele~~ alleles.  
With then can cause the child  
to have an illness ~~like~~ ~~some~~ ~~serious~~ ~~illnesses~~



In this response, the candidate has demonstrated understanding of some of the indicative content from the first aspect of the question. In particular, the candidate has referred to changes in the phenotype. Therefore, this response was placed in the Level 1 mark band and was awarded a mark of 2 for a logical response.



For the 6-mark question, it is always worth attempting to answer the question if you have some knowledge of the topic area.

\*(ii) In 2003, the first complete human genome was sequenced.

The genomes of different people have small changes in the sequence of the DNA bases.

Describe how these changes in DNA sequence can affect the individuals and how sequencing a person's genome could influence their medical treatments.

(6)

- People all have different DNA because of genetic variation.
- They can have genes which are the same as other people.
- This gene that could be a cause of a disease genetic disease that these people share.
- Some people won't be affected by the gene if it is recessive, since it would take two recessive alleles to cause the disease.
- ~~Making a~~ sequencing a genome could reveal if a person has a gene that causes an issue.
- This will allow doctors to respond appropriately to the disease to help treat the person.
- Genes have recessive and dominant alleles. Dominant alleles always take effect if present.
- Sequencing a genome can also help to find out the offspring's chances of receiving an allele that causes a disease/issue.



In this response, the candidate has demonstrated understanding of two aspects of the indicative content related to genetic variation and the causes of a genetic disease, such as, if the gene causes an issue and, it helps find the offspring's chance of inheriting a genetic disease. This response was placed in the Level 2 mark band as two aspects of the indicative content were demonstrated. A mark of 4 was awarded as the response is coherent.

# Paper Summary

## Overall Performance

Most candidates were able to access the extended open-response question well by demonstrating good knowledge of the effect of analysis of gene mutations on individuals and the influence on their medical treatments.

Many candidates were able to demonstrate a good level of knowledge in the questions related to diet and exercise. However, questions related to osmosis were challenging for some candidates who were able to interpret the data given in the question but did not apply their knowledge of the process sufficiently well when explaining the results.

The level of knowledge shown about immunity was very good for most candidates but the application of their knowledge on stem cells to a context was more challenging. Candidates of all abilities showed limited knowledge on genetic engineering and only more able candidates were fully able to discuss the benefits and risks of the process when it was applied to a context.

The assessment of practical work in the new qualification has replaced the controlled assessment component of the previous specification. Candidates of all abilities were able to answer questions using their practical skills knowledge, including questions on safety precautions and the identification of controlled variables. However, candidates need to ensure they use scientific terminology more accurately, for example, related to volume and mass, rather than using terms like 'amount'.

The question related to an explanation as to why a variable needed to be controlled was more challenging for candidates, especially as it was not in the context of a core practical.

Candidates of all abilities were able to access the more standard maths questions, such as calculating a rate, BMI and the surface area of a rectangle. However, candidates found the calculation of a percentage increase more challenging and weaker candidates did not use probabilities in their answers to the challenging genetics questions. Candidates of all abilities were able to analyse data to give a conclusion to the enzyme investigation, but only more able candidates were able to explain the conclusion using scientific ideas. Furthermore, candidates need to read the questions carefully to determine whether they are required to describe or explain interpretations of data, as expected in the questions related to waist:hip ratio and BMI.

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

- Recognise that the word 'explain' means additional scientific information is needed that is linked to the answer given.
- Use all the information given in the question to help construct an answer whilst avoiding the repetition of information which has already been given, and giving vague response which will not gain credit.
- Consider the context of the question to ensure candidates apply their scientific knowledge to the situation they are being asked about.
- Develop their practical skills knowledge to ensure they understand the difference between the factors being investigated and controlled variables.
- Check the number of marks given for the question and ensure that they have included enough facts to match the marks awarded.

- Ensure that they can interpret family pedigrees for both the sex of the individuals and use genetic terms in their answers.
- Use scientific terminology accurately where possible in responses.
- Always show the mathematical workings when doing calculations as a mark can be awarded for errors carried forward.
- Think about the structure of your answer to the extended open-response questions before starting to write. This is to ensure that the answer shows clarity of writing, while remembering that accurate spelling and grammar in these questions is also important.

## Grade Boundaries

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

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

