

Examiners' Report  
June 2016

GCSE Biology 5BI3H 02

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## Introduction

The B3 unit is taken by candidates doing GCSE biology or GCSE further additional science. It is taken as part of a linear assessment model and the end of the course. This was the fourth paper has been written and examined for the B3 unit in the science 2011 specification.

The paper consists of 60 marks assessed by a variety of questions including multiple choice, short answer and two extended answer questions worth 6 marks each. Candidates should answer all questions in a time period of 1 hour. The extended answer questions are also marked on their quality of written communication (QWC) so candidates should ensure that their answer includes good use of spelling and grammar and also that the answer is written with clarity.

The paper contained questions from all three topics from the unit. These included biofuels and aseptic techniques, kidney structure and function, the menstrual cycle and circadian rhythms highlighted by melatonin, the inheritance of haemophilia, the production and use of monoclonal antibodies, human evolution and migration, genetic engineering and the production of genetically modified crop plants.

Most candidates were able to access both extended writing responses well. They were able to demonstrate a good level of knowledge and understanding on how fossils could be dated based on their structure and the environment in which they were found and the advantages and disadvantages of introducing toxin genes into crop plants. However, for both six mark questions many candidates did not include sufficient key information to access level 3.

The requirement to calculate a percentage decrease proved to be challenging for candidates with many only calculating the percentage remaining rather than the decrease. Most candidates were able to give the effect of light on levels of melatonin in the blood but a surprising number made errors when reading data off the graph to use in their answer. Correctly calculating the probability of a child having haemophilia required candidates to combine their knowledge interpreting family pedigrees with inheritance patterns of recessive sex-linked genetic disorders. Consequently some candidates made mistakes during these steps and were unable to calculate an accurate probability.

Where there was specification overlap between questions on this paper and previous papers at both higher and foundation, candidates showed a particularly good level of knowledge indicating that they may have used the past papers in their preparation.

Candidates of all abilities were able to give an advantage of using microalgae to produce biofuels and some advantages of biofuels over fossil fuels. However, high ability candidates did not always recognise that microalgae need carbon dioxide for photosynthesis although most candidates recognised that factors such as temperature, pH and light intensity have to be controlled in closed systems.

High ability candidates gave good descriptions of selective reabsorption to remove glucose from the nephron but they struggles to explain that the re-absorption of water causes urea concentration to increase as the filtrate passes through the nephron. Naming structure responsible for specific roles in the urinary system challenged many candidates but most names ADH as the hormone responsible for controlling the permeability of the collecting duct.

Most candidates were able to interpret high levels of progesterone as a sign of pregnancy/fertilisation but less linked lowered progesterone levels to menstruation. There were some good explanations on the role of progesterone in the menstrual cycle.

Interpreting family pedigrees for sex-linked inheritance challenged many candidates although most were able to correctly interpret the Punnett square if it was correctly completed. There were some excellent descriptions of how monoclonal antibodies were produced and most candidates gave some details on how they can be used to detect blood clots.

The reasoning and level of detail given for explanations on the effect of the ice age on human migration were very varied with high ability candidates doing very well. There were some good descriptions of how fossils can be compared to show human evolution but the use of the environment was not described as effectively. The effect of parental care on the evolution proved challenging even for high ability candidates with most not recognising that better parental care increases an animals chance of survival.

There were some very good description of how genetic engineering is used to transfer a gene from one bacteria into another where candidates referred to specific details such as restriction enzymes, sticky end and ligase. High ability candidates were able to explain how *Agrobacterium tumefaciens* is used as a vector to transfer genes into plants. There were a number of good explanations on the advantages and disadvantages of introducing the toxin gene into crop plants. Candidates of all abilities gave balanced answers which referred to both advantages and disadvantages.

### Question 1 (a) (i)

This question asked candidates to give an advantage of the use of microalgae to produce biofuels rather than other plants. Most candidates were given the mark for the idea of less space being needed to culture the microalgae, that it could occur independently of the climate, or that they could be grown quicker. Some did not recognise the comparison to other plants and did not gain credit for the idea that they were renewable or repeated information given in the question about microalgae growing in water. Candidates were not given a mark for no space being required unless it was clear it was not land needed for food production that was being used.

(a) (i) Suggest one advantage of using microalgae rather than other plants to make biofuels.

(1)

*Microalgae take a shorter amount of time to grow than other plants.*



**ResultsPlus**  
Examiner Comments

This was given the mark against the acceptable answer than microalgae grow quicker.

(a) (i) Suggest one advantage of using microalgae rather than other plants to make biofuels.

(1)

*Do not depend on light*



**ResultsPlus**  
Examiner Comments

This was not given the mark as light is needed. The idea that the microalgae are photosynthetic is given in the question.



**ResultsPlus**  
Examiner Tip

Always read the information given in the question.

### Question 1 (a) (ii)

This question asked candidates to name the gas that would need to be supplied to a closed system to allow microalgae to grow. Many candidates did not achieve this mark as they failed to assimilate the information given in the stem of the question that microalgae are photosynthetic and therefore require carbon dioxide. Oxygen was the most frequent incorrect response given.

### Question 1 (a) (iii)

This question asked candidates to explain the benefit of maintaining aseptic conditions. The response did not need to be specific to culturing microalgae. Marks were awarded for the idea of preventing contamination with unwanted micro organisms leading to reduced or no competition, an increase in yield or more product and preventing contamination of the product. Many candidates only achieved one mark for this item because they did not explain why having no contaminating micro organisms is a benefit. There were still some answers that gave the idea that aseptic precautions prevent the growth of any micro organisms which was not awarded credit unless clearly linked to the idea of sterilising the system before growth starts. There was also the misconception that aseptic techniques ensure conditions, such as temperature or pH, are controlled in the system.

(iii) Closed systems require aseptic precautions.

Explain the benefit of maintaining aseptic conditions.

(2)

They kill any microorganism inside the closed system, so they do not interfere with the chemical reactions taking place.



**ResultsPlus**  
Examiner Comments

This response was given zero as it isn't about preventing entry or contamination with unwanted or other micro organisms. It is not clear if they are referring to sterilisation of the equipment initially. Interfering with chemical reactions is very vague.

(iii) Closed systems require aseptic precautions.

Explain the benefit of maintaining aseptic conditions.

(2)

Aseptic conditions mean that the system is not contaminated by other micro-organisms and the system is sterile. Only the micro-algae are allowed in the system, producing a pure, uncontaminated product.



**ResultsPlus**  
Examiner Comments

This was given two marks for not contaminating the system with other micro organisms and the production of an uncontaminated product.

(iii) Closed systems require aseptic precautions.

Explain the benefit of maintaining aseptic conditions.

(2)

The conditions are controlled, so that the microalgae, for example, can be controlled at optimum temperature and gas levels.



**ResultsPlus**

**Examiner Comments**

This showed a frequent misconception, scoring zero marks.



**ResultsPlus**

**Examiner Tip**

Make sure you understand all the key scientific terms given in the specification.

### Question 1 (a) (iv)

For this item candidates needed to give two other factors that would need to be controlled in a closed system culturing micro organisms. The most common marks were awarded for temperature and pH. Light intensity and nutrients or named nutrients were also given a mark. Agitation or stirring was not awarded a mark as it is not a controlled factor. Gases or named gases were not creditworthy as they were already given in 1aii or irrelevant.

(iv) Suggest two other factors that would need to be maintained in a closed system to allow the microalgae to grow.

(2)

1 Optimum pH

2 The optimum temperature for microalgae to grow



**ResultsPlus**

**Examiner Comments**

This was given two marks for controlling temperature and pH.

(iv) Suggest two other factors that would need to be maintained in a closed system to allow the microalgae to grow.

(2)

- 1 amount of nutrients available
- 2 light intensity (amount of light)



**ResultsPlus**

**Examiner Comments**

This response was two marks for controlling nutrient levels and light intensity. This response is clearly linked to the idea of specifically allowing microalgae to grow.

(iv) Suggest two other factors that would need to be maintained in a closed system to allow the microalgae to grow.

(2)

- 1 Temperature
- 2 Oxygen intake



**ResultsPlus**

**Examiner Comments**

This response was only awarded one mark.



**ResultsPlus**

**Examiner Tip**

Ensure you read the question carefully. Microalgae are photosynthetic and the question asks for other factors that need to be maintained and carbon dioxide is given in 1aii.



## Question 1 (b)

The final item for question 1 asked for a description of the advantages of using biofuels rather than fossil fuels. Marks were given for renewable, sustainable or a description of the process, the idea of carbon neutral or a description of the process or that biofuels release less sulfur dioxide or cause less acid rain. Where two marks were given it was for the renewable and carbon neutral marking points. There were some misconceptions shown that burning biofuels does not release carbon dioxide and the idea that no sulfur dioxide is released was not credited.

(b) Biofuels can be used instead of fossil fuels as an energy resource.

Describe the advantages of using biofuels rather than fossil fuels.

(2)

Biofuels are carbon neutral because the plants used to make them absorbed  $\text{CO}_2$  from the atmosphere.  
Biofuels are renewable - more can be grown/produced whereas fossil fuels will run out.



**ResultsPlus**  
Examiner Comments

This answer was awarded both marks for renewable and carbon neutral. They have a description of both as well.

(b) Biofuels can be used instead of fossil fuels as an energy resource.

Describe the advantages of using biofuels rather than fossil fuels.

(2)

Biofuels are renewable, whereas fossil fuels are not, causing (much) less pollution.  
Therefore Biofuels will also last longer than fossil fuels, as fossil fuels will run out eventually.



**ResultsPlus**  
Examiner Comments

This is only worth one mark for the idea of renewable. Both sentences cover the same marking point.

Less pollution is too vague for less sulfur dioxide released or less acid rain.

(b) Biofuels can be used instead of fossil fuels as an energy resource.

Describe the advantages of using biofuels rather than fossil fuels.

(2)

Biofuels are carbon neutral meaning whilst they are growing they take in  $\text{CO}_2$  and then when they are burnt they release it so they don't release more  $\text{CO}_2$  into the atmosphere. Biofuels also release less particulates that causes air pollution and release less sulphur dioxide which causes acid rain.

(Total for Question 1 = 8 marks)



**ResultsPlus**  
Examiner Comments

This response shows attention to detail in the descriptions given. It is clear that it is less sulfur dioxide which is released.

## Question 2 (a) (i)

Question 2ai asked candidates to calculate the percentage decrease in glucose concentration between the blood in the glomerulus and the end of the proximal convoluted tubule. This proved difficult for many candidates to achieve two marks as they calculated the percentage of glucose that remained at point Q in the proximal convoluted tubule and not the percentage decrease so gained 1 mark for an answer of 47.1%. High ability candidates did correctly calculate the percentage decrease of 52.9%. Many candidates showed their working for the calculation but some lost marks because they did not show their workings out.

- (a) (i) Calculate the percentage decrease in glucose concentration between location P and location Q.

(2)

$$170 - 80 = 90$$

$$\frac{170}{100} \times 90 = 153$$

..... 153 %



### ResultsPlus Examiner Comments

This is worth one mark for calculating the decrease of 90 even though the final answer is incorrect.



### ResultsPlus Examiner Tip

Always show your working.

- (a) (i) Calculate the percentage decrease in glucose concentration between location P and location Q.

(2)

$$\frac{80}{170} \times 100.$$

..... 47.1 %



### ResultsPlus Examiner Comments

This is worth one mark for calculating the 47.1%. Calculating the percentage of glucose remaining rather than the percentage decrease was a common error.

- (a) (i) Calculate the percentage decrease in glucose concentration between location P and location Q.

(2)

$$\frac{170 - 80}{170} \times 100$$
$$= - 53\%$$



**ResultsPlus**  
Examiner Comments

This response shows full workings and the correct answer for two marks.

53

%

### Question 2 (a) (ii)

This question required a description of how glucose is removed from the nephron. The marks were awarded for stating it was by selective re-absorption or that it is reabsorbed back into the blood. Further marks could be obtained by the idea that the process uses energy, occurs through active transport or against the concentration gradient or that it occurs in the convoluted tubule. High ability candidates gave some good descriptions and many were awarded maximum marks. Most gave the idea of selective re-absorption or absorption into the blood. Responses rarely referred to that fact that energy was required but convoluted tubule and the idea of active transport were frequently seen for the second mark.

- (ii) Describe how glucose is removed from the nephron.

(2)

Glucose is removed from the nephron from the proximal convoluted  
tubule in a process of selective re-absorption.



**ResultsPlus**  
Examiner Comments

This response is worth two marks for proximal convoluted tubule and selective re-absorption.



**ResultsPlus**  
Examiner Tip

Learn the names given to key biological processes.

(ii) Describe how glucose is removed from the nephron.

(2)

It is filtered through the glomerulus & Bowman's capsule but then removed by the loop of henle & convoluted tube.



**ResultsPlus**  
Examiner Comments

This response was given zero. Removed is insufficient and the loop of Henle is incorrect meaning the convoluted tubule mark could not be awarded.

### Question 2 (a) (iii)

This question asked candidates to explain why the concentration of urea changes between the proximal convoluted tubule and the collecting duct. The marks were given for stating that the concentration had increased or a mathematical calculation that showed this. The second mark was for the justification that it was due to reabsorption of water. This item proved challenging even for high ability candidates. The majority of candidates were able to recognise the increase but could not give sufficient detail on the reason for the increase. Marks were not given for the idea that all the glucose had been removed. There were some very good answers that linked the idea that the person must have been dehydrated so had produced ADH to increase the reabsorption of water. These candidates usually gained maximum marks. Lower ability candidates failed to score any marks and they should be encouraged to recognise that when a question asks for an explanation behind a change or a difference, there is a mark available for stating how it changes which is usually very straightforward to achieve.

(iii) Explain the change in the concentration of urea between location Q and location R.

(2)

the massive increase in the urea concentration is because all the ~~prox~~ nephrons in that kidney go into the tube R so the urea waste can be removed.



**ResultsPlus**  
Examiner Comments

This was only worth one mark for the increase in urea concentration. This response shows a common misconception seen during the marking of the paper that a lot of nephrons joining into the collecting duct accounts for the increased concentration.

(iii) Explain the change in the concentration of urea between location Q and location R.

(2)

The concentration has increased from 90  $2.7\text{mg}/100\text{cm}^3$  to  $1900\text{mg}/100\text{cm}^3$  - this is because in the LOOP of Henle water has been reabsorbed, although the amount of urea is the same, the amount of water, salt etc isn't - thus the concentration is higher.



**ResultsPlus**

**Examiner Comments**

This response was worth maximum marks. They state that it has increased and explained that the reabsorption of water is responsible for the increase.

### **Question 2 (b) (ii)**

This item required students to state that the hormone ADH controls the permeability. Despite being higher level content this was very high scoring with the majority of the candidates achieving the mark. Phonetically correct misspellings as well as the abbreviation of ADH were awarded the mark.

### Question 3 (a) (ii)

This item was answered well by candidates of all ability. They were able to recognise that a continued increasing progesterone level was a sign of pregnancy. The mark was given for fertilisation. The uterus lining is thickening is not a reason so this on its own was not creditworthy.

(ii) Suggest a reason for the increasing progesterone level of person X.

(1)

They are pregnant



**ResultsPlus**  
Examiner Comments

This was given one mark for pregnant. This was the most common answer given.

(ii) Suggest a reason for the increasing progesterone level of person X.

(1)

To maintain the thickened uterus lining ~~and~~



**ResultsPlus**  
Examiner Comments

This is a consequence of high progesterone and not a reason for it so was not given the mark.

### Question 3 (a) (iii)

This question asked candidates to explain the role of progesterone in the menstrual cycle. The marks were given for progesterone maintaining the lining of the uterus, progesterone inhibiting FSH or dropping levels of progesterone allowing FSH production, progesterone inhibiting the production of LH, and also that dropping levels of progesterone allow menstruation to occur. A good range of marks were awarded for this question and it proved to be a good differentiator of ability. The most common mark awarded was for the maintenance of the uterus lining. In comparison to previous series, there were less references to thickening the wall of the uterus which was insufficient. Most candidates who knew that it inhibited FSH also knew that it inhibited LH. Some missed the final marking point by indicating that dropping progesterone levels allowed the cycle to start again which was not creditworthy.

(iii) Explain the role of progesterone in the menstrual cycle.

(3)  
Progesterone maintains the lining of the uterus during the menstrual cycle. If the woman's egg is fertilised, levels will increase so the lining is maintained for the baby. If the egg is not fertilised, levels will decrease thus causing the lining to break and come out as the period (menstruation).



**ResultsPlus**  
Examiner Comments

This was given two marks for progesterone maintaining the lining of the uterus and a decrease in levels allowing menstruation.



(iii) Explain the role of progesterone in the menstrual cycle.

(3)

Progesterone can be secreted by a structure called the corpus luteum and progesterone inhibits the further production of FSH (follicle stimulating hormone) and LH (Luteinising hormone). Progesterone maintains the lining of the uterus until about day 24-30 and if no fertilised egg has implanted in the uterus then the level of progesterone drops (causing menstruation). If a fertilised egg implants in the uterus then progesterone levels remain high to maintain the lining of the uterus.



**ResultsPlus**

**Examiner Comments**

This response highlights the four possible marking points so was awarded full marks. This shows the attention to detail given in responses by high ability candidates.

(iii) Explain the role of progesterone in the menstrual cycle.

Progesterone inhibits the production of LH<sup>(3)</sup> and FSH. It also starts to break down the lining of the uterus.



**ResultsPlus**

**Examiner Comments**

This was worth two marks for inhibiting the production of LH and FSH. It is not clear that it is a low level that allows the breakdown of the uterus lining so was not given this marking point.



**ResultsPlus**

**Examiner Tip**

Ensure you read your answers carefully to check you have everything correctly written.

### Question 3 (a) (iv)

This item asked candidates to recall that LH is the hormone responsible for triggering the release of the egg in the menstrual cycle. Just over half the candidates were awarded the mark for this item with oestrogen and FSH the most common incorrect responses. Phonetically correct misspellings were awarded a mark but candidates do not need to give the full name, LH is acceptable.

### Question 3 (b) (i)

This question asked for candidates to use the information given on a graph to describe the effect of light on the melatonin levels in the blood. The first mark was awarded for linking the idea that light inhibits melatonin, or the reverse argument that levels rise when it gets dark. Night was accepted for dark and day accepted for light. The second mark was for using data from the graph. Most candidates gained at least one mark for giving the overall trend and nearly half obtained the second mark for correctly quoting data. A surprising number of candidates misread the information from the graph the most common being that melatonin levels peaked at midnight.

- (i) Using information from the graph, describe the effect of light on melatonin levels in the blood.

(2)

When there is less light, there is more melatonin produced. At 3am there is 68 amount of melatonin produced, this is in the dark, whereas at 4pm there is only 6 produced.



#### ResultsPlus Examiner Comments

This is worth two marks. Less light there is higher melatonin for one mark and correct data from the graph (within 1 small square) for the second mark.



#### ResultsPlus Examiner Tip

Make sure you read data off graphs accurately.

As you go through the day there is less melatonin and you feel awake but at night, lots of melatonin is produced to make you feel tired.



#### ResultsPlus Examiner Comments

This response was only worth one mark as it did not quote any data from the graph.

### **Question 3 (b) (ii)**

This item asked for candidates to recall that biological activities which follow a daily rhythm are circadian rhythms. Approximately three quarters of candidates achieved this mark. There were a significant number of misspelt answers and only those that were phonetically correct were accepted. Cyclic, cardiac and carcadian were rejected.

### Question 4 (a) (ii)

This item required candidates to interpret the family Pedigree to obtain the genotypes for person F and person G and complete the Punnett square to obtain the probability of the couple having a child with haemophilia. Where candidates successfully identified the genotypes, many went on to achieve full marks with approximately half of candidates gaining three marks. The most common error was to interpret the Punnett square incorrectly with a probability of 50%. Some candidates switched person F and person G and only scored two marks with an error carried forward. Overall this item was answered better than previous questions of this style with less incorrect genotypes given, such as an allele being assigned to the Y chromosome.

- (ii) Calculate the probability of person F and person G having a child with haemophilia.

Use the Punnett square for your answer.

(3)

		person G	
		$X^H$	$X^H$
person F	$X^h$	$X^h X^H$	$X^h X^H$
	$Y$	$X^H Y$	$X^H Y$

Probability of having a child with haemophilia ..... 0%



**ResultsPlus**

**Examiner Comments**

This shows a correct Punnett square with the genotypes clearly written. The Punnett square has been correctly interpreted so full marks were awarded.

- (ii) Calculate the probability of person **F** and person **G** having a child with haemophilia.

Use the Punnett square for your answer.

(3)

		<b>person G</b>	
		$X^H$	$X^H$
<b>person F</b>	$X^h$	$X^H X^h$	$X^H X^h$
	$Y$	$X^H Y$	$X^H Y$

Probability of having a child with haemophilia 50% ( $\frac{1}{2}$ )



**ResultsPlus**  
Examiner Comments

This Punnett square was correct but incorrectly interpreted so was only awarded two marks.

### Question 4 (b) (i)

This item asked candidates to describe how antibodies are produced. The marks were awarded for the injection of an antigen into a mouse or mammal, the production or collection of B-lymphocytes, that these are fused with cancer or myeloma cells, leading to the production of a hybridoma and finally the idea that a hybridoma can divide and produce antibodies. A range of marks were awarded for this item with high ability candidates gaining maximum marks and middle ability candidates half marks. Often marks were missed for not including the information about the injection of an antigen and the production of the correct B-lymphocyte. The idea that it was a B-lymphocyte was required but overall responses showed very good use of the key scientific terms such as B-lymphocyte, myeloma cell, and hybridoma.

(b) Blood clots can be detected using monoclonal antibodies.

(i) Describe how monoclonal antibodies are produced.

(4)

Antigen is injected into a animal, for example a mouse. B-lymphocytes are then removed and are then fused together with myeloma cells. This produces hybridomas. Hybridomas then produces specific antibodies that fight off the antigen, the mouse then becomes immune to the antigen.



**ResultsPlus**  
Examiner Comments

This response is worth four marks for a detailed description of how monoclonal antibodies are produced.

(b) Blood clots can be detected using monoclonal antibodies.

(i) Describe how monoclonal antibodies are produced.

(4)

A B lymphocyte that produces specific antibodies cannot divide, so it is fused with a myeloma cell (cancer cell) to produce a hybridoma. These are cells that can divide and produce monoclonal antibodies. The hybridoma then divides using mitosis and produces many monoclonal antibodies that are all specific to a certain antigen. These monoclonal antibodies can then be used for detecting blood clots or for radiotherapy.



**ResultsPlus**

**Examiner Comments**

This response was given three marks. It shows a very good level of scientific understanding but has lost a mark as it does not explain how the correct B lymphocyte is produced.

### Question 4 (b) (ii)

The final item on blood disorders required a description on how monoclonal antibodies can be used to detect blood clots. The marks were given for the idea of attaching a radioisotope to the monoclonal antibody, that it would be injected into the bloodstream, would bind to the blood clot and finally that the location of the clot could be determined by detection of the accumulation of the antibodies using a scanner or the idea of a specialised piece of machinery. Half of the candidates were able to gain maximum marks usually for the attachment of a radioisotope and that it would bind to the blood clot. Some of these candidates would also have given the details on how the monoclonal antibody would be detected. The idea of injecting into the blood was not often seen with responses referring to the idea of injecting into the body which was insufficient. The idea of the antibodies being stopped by the blood clot was insufficient and did not receive a mark.

(ii) Describe how monoclonal antibodies can be used to detect blood clots.

(2)

Monoclonal antibodies are inserted into the bloodstream and tracked, and when they meet a blood clot, they attach to the blood clot and this is detected.



**ResultsPlus**  
Examiner Comments

This item was given two marks for insertion into the bloodstream and that they attach to the blood clot.

Blood clots have specific antigens on them, the monoclonal antibodies bind to the blood clots. The doctors place markers on the monoclonal antibodies which allow them to detect the blood clot.



**ResultsPlus**  
Examiner Comments

This was given the mark for binding to the blood clots. It lacks the detail needed to get the mark for attaching a radioisotope or the method of detection.



### Question 5 (b)

This item required an explanation for the effect of the Ice Age on human migration. Candidates were awarded marks for the idea that human migration increases or that people could migrate further and they were able to link this to the subsequent marks, which were given for lower sea levels, water being locked up in ice or that seas were frozen and that this created land bridges or allowed people to cross where they previously were unable to.

(b) Explain the effect of the Ice Age on human migration.

(3)

During the Ice Age seas were frozen so sea levels dropped, this meant that humans could walk to places which are separated by water today eg: from Africa to Asia. After the Ice Age people found the land more habitable so moved / migrated. Eg: from Siberia to North America.



**ResultsPlus**  
Examiner Comments

This response was worth three marks. Seas were frozen so sea levels dropped is worth two marks. This meant that humans could walk to places separated by water now is the idea of crossing ice or shorter sea crossing and they also give the indication that migration can be further by naming countries and continents.

(b) Explain the effect of the Ice Age on human migration.

(3)

When an Ice Age occurs in an area of humans, the humans migrate elsewhere to warmer, safer areas to ensure the species survival. The last ice Age allowed colonies in Africa to travel to Asia.



**ResultsPlus**  
Examiner Comments

This was only worth one mark for the idea of migrating to warmer areas or further. There is no explanation as to how this could occur which is required for further marks.

(b) Explain the effect of the Ice Age on human migration.

(3)

The ice age meant that sea levels became very low as the water froze, exposing land that acted as bridges between continents. ~~This~~ This allowed humans to migrate over time by walking on the new exposed land. ~~Humans~~ Humans migrated from Africa to Europe or Asia, then eventually on to ~~Australia~~ Australasia.



**ResultsPlus**  
Examiner Comments

This response was awarded full marks.



**ResultsPlus**  
Examiner Tip

Ensure answers to explain questions include sufficient detail to match the number of marks given for the question. This answers illustrates the level of detail required.

## Question 5 (c)

This question asked candidates how Leakey could have used the fossils and the surrounding environment to determine that fossils he had discovered from early humans who lived 1.6 million years ago lived more recently than the fossil of Lucy. For a level 1 answer candidates needed to give a limited description of how the structure of the fossil or the environment could be used. For level 2 candidates need a simple description that made a comparison of two features seen in the fossil that were different to Lucy. Alternatively they could give one detail about how the structure of the fossil could be used and information about how the environment could be used. For level three the detailed description needed two comparative statements on the fossil structure compared to Lucy and two pieces of evidence of how the environment could be used to date the fossils. This included the idea that fossils in a higher rock layer are from a more recent species, that tools or more sophisticated tools would have been found with Leakey's fossils or that radiometric dating could be used, although very little of this aspect was seen.

References to brain size were ignored unless linked to cranial capacity or skull size. More candidates were awarded level 2 for a description that made some comparative statements between Leakey's fossils and Lucy. These responses often only gave one detail on dating from the environment or lacked the specific details. For example, some answers gave details about how location in the rock layer indicates age of the fossil without stating that the newer fossils are higher or older fossils deeper in the rock layer. Answers that were awarded level 1 often only referred to brain size or showed confusion and made comparisons with Ardi, which was not worthy of credit. Very high ability candidates were able to include sufficient detail in their answers to be awarded level 3.

\*(c) Many fossils of early humans have been discovered in Africa, including Lucy from 3.2 million years ago.

Leakey found many early human fossils in Africa from 1.6 million years ago.

Describe how Leakey used the fossils and surrounding environment to reach the conclusion that his fossils were from a species more recent than Lucy.

(6)

Leakey found his fossils in layers of sediment. as this fossil was found in layers above the ones Lucy was found ~~in~~ in it must have lived ~~before~~ after Lucy had died. His fossils were also found with tools around them as was Lucy. However, the tools around his fossil were more developed also hinting the fossil must be younger than Lucy. The ~~next~~ next piece of evidence sealed it. ~~the~~ Leakey's fossil was more human like than ape and

Lucy was more ape like than human.  
Showing how it must have been a  
~~new~~ newer fossil compared to  
Lucy.

Leakey could have also used Carbon  
dating to find out how ~~and~~ old  
of the fossils were exactly.

But in conclusion his fossils must be more  
recent than Lucy.



### ResultsPlus Examiner Comments

This was a level 2 response worth 4 marks. There are two clear methods for dating the fossils from the environment but referring to Lucy as more ape-like and the newer fossil more human like is too vague for how Leakey was able to use the fossils.

The fossils found was named Turkana boy  
and the fossils surrounding the environment  
~~then~~ allowed Leakey to conclude they were more  
recent than Lucy because:

Stone tools found ~~by~~ near the fossils, such as  
arrow heads, had a more complex design  
which required a large brain compared with  
Lucy's smaller sized brain.

The bone structure of the Turkana boy ~~on~~  
(1.6 mya) was tall and narrow waisted, which  
suggests that he walked fully upright like  
us, whereas as the bone structure of Lucy  
~~suggests~~ had longer arms, possibly used for hanging

off trees like chimpanzees, which suggests that the Leakey's fossils ~~were~~ show higher more evolution in the fossils found. Lucy's head was relatively small compared with Leakey's fossils, also suggesting a larger brain for the Turkana boy which shows more evolution. Fossil dating from rocks also reveal how old the fossils are, and by measuring how deep underground the fossils were buried and comparing them should show Lucy was buried deeper, suggesting the fossils are older.



**ResultsPlus**  
Examiner Comments

This is a level 3 response, worth full marks, highlighting the indicative content needed for a detailed description.



## Question 5 (d)

This question proved challenging even for high ability candidates. It required an explanation of how parental care contributes to evolution. Credit was given for the idea that better parental care leads to increased survival of offspring and that means these offspring are more likely to reproduce and pass on their characteristics, genes or skills. Some candidates were awarded the second mark for the idea that offspring that survive can pass on their genes, but very few candidates recognised that it had to be better parental care that leads to increased survival. Some candidates stated that parental care increases the chance of survival but this was insufficient.

(d) Human evolution has been influenced by parental care.

Explain how parental care contributes to evolution.

(2)

By parental care, the young are being taught how to find food and survive on their own. Although parents put themselves at risk, teaching the young and caring for them allows a continuation of the bloodline and DNA in order to for future evolution in the bloodline.  
\* and to adapt to harsh environments



### ResultsPlus Examiner Comments

This response scored zero, as it describes parental care but does not explain how it contributes to evolution.



### ResultsPlus Examiner Tip

Ensure you answer the question that is being asked. This answer describes parental care but does not explain how it contributes to evolution.

A high amount of parental care ensured increased the chance of survival for the offspring therefore they were more likely to survive and pass on their genes which caused them to have a high amount of parental care.



### ResultsPlus Examiner Comments

This was awarded two marks as they have made the connection that it is a higher amount of parental care that increases survival so that genes for this level of parental care are passed onto the offspring.

## Question 6 (a)

This question is based on higher content in the specification but was answered very well by candidates with nearly half scoring maximum marks. It asked for a description of how the toxin gene from *Bacillus thuringiensis* is transferred to *Agrobacterium tumefaciens*. The mark scheme required specific terms to be used such as restriction enzyme, sticky ends and ligase and this is where marks were lost by some candidates using vague terms such as cutting enzymes. The marks were for the plasmid from *Agrobacterium* being cut with a restriction enzyme, the gene from *Bacillus thuringiensis* being cut or isolated using restriction enzymes, that restriction enzymes leave sticky ends, the gene can be inserted into the plasmid using ligase and that the recombinant plasmid is placed into *Agrobacterium*. There were many inaccuracies in the phrasing of some answers, which led to marks not being awarded, for example, cutting *Agrobacterium* with a restriction enzyme and putting the plasmid into a bacterium without specifying which bacterium.

### DNA technology

- 6 Recombinant DNA technology is used to insert the insulin gene into bacteria.

The same technology is used to transfer a toxin gene from the bacterium *Bacillus thuringiensis* into *Agrobacterium tumefaciens*.

- (a) Describe how the toxin gene from *Bacillus thuringiensis* is transferred to *Agrobacterium tumefaciens*.

(3)

A restriction enzyme is used to cut the toxin gene out of the bacterium. The ~~base~~ enzyme cuts ~~it~~ in such a way that it undoes base pairings - leaving a sticky end. The same restriction enzyme is used to cut a gene out of the plasmid of *A. tumefaciens*. The toxin gene (Bt toxin) is inserted into the plasmid and ligase enzymes join the sticky ends together to form recombinant DNA. The plasmid is then inserted back into the *A. tumefaciens* bacterium, thus producing an *A. tumefaciens* bacterium with the toxin gene from *B. thuringiensis*.



**ResultsPlus**  
Examiner Comments

This was awarded full marks. It includes the specific details that required to get the marks including restriction enzyme, sticky ends and ligase.

## Question 6 (c)

This item asked for an explanation of how *Agrobacterium tumefaciens* transfers the toxin gene to crop plants. The marks were awarded for the idea that it infects the cell or acts like a vector, it transfers the gene, plasmid or DNA into the plant cells or plant DNA and that it causes the growth of a tumour or crown gall. This is a higher specification statement and proved to be challenging even for high ability candidates. Often candidates were awarded either the first or second mark due to a lack of detail in their responses. Spraying the crops with the bacteria was insufficient and inserting the gene into the plant required more specific detail for the mark. The idea of the development of a tumour or crown gall was not often seen.

(c) Explain how *Agrobacterium tumefaciens* transfers the toxin gene to the crop plants.

(2)

It is a pathogen which invades plant cells and it acts as a vector to insert its genes into the plants DNA. Once it has inserted its genes into the plants DNA, the gene will develop in the plants stems and leaves.



**ResultsPlus**  
Examiner Comments

This answer has the idea of invading the plants cells as a vector and inserting it's genes into the plants DNA for two marks.

(c) Explain how *Agrobacterium tumefaciens* transfers the toxin gene to the crop plants.

(2)

*Agrobacterium tumefaciens* is a vector which means it carries the toxic gene. It transfers it to crop plants when settling on the crop plant.



**ResultsPlus**  
Examiner Comments

This was given one mark for vector but does not include sufficient detail as to where the toxin gene is being transferred.



## Question 6 (d)

The second six mark question on the paper asked for an explanation of the advantages and disadvantages of introducing the toxin gene into crop plants. A level 1 response gave a limited explanation of one advantage or one disadvantage. A level 2 response required an explanation that included either at least two advantages or two disadvantages or one disadvantage and one advantage. A level 3 answer needed to be detailed and refer to the key advantages of the effect on crop yield and reduce need for insecticides and two disadvantages including that it can lead to the evolution of toxin resistance. The idea of insects developing immunity was ignored. Some answers confused herbicides and pesticides but overall the quality of responses was very good. The majority of candidates gave a level 2 response. Those with good quality answers sometimes missed the idea that it reduces the need for pesticides or confused resistance and immunity. Nearly all answers attempted to refer to advantages and disadvantages.

\*(d) Cells containing the toxin gene produce a chemical that kills insects.

Explain the advantages and disadvantages of introducing the toxin gene into crop plants.

(6)

The advantages are that these plants will now fight away insects that would otherwise damage crops. This could improve yield size but also reduce the chemical insecticide use currently in the food industry. Reducing insecticide use can improve the environment and create healthier organic foods. There are disadvantages however, the over use of this toxin gene ~~in~~ in plants could cause insects to build up an immunity to the toxin rendering it useless. Also introducing new genes into plants could

be expensive and many people have a problem with genetic modification - this could cause conflicts of opinions.

(Total for Question 6 = 12 marks)



### ResultsPlus Examiner Comments

This was a level 2 response. The use of the word immunity is incorrect.



### ResultsPlus Examiner Tip

Make sure you use the correct scientific terms.

\*(d) Cells containing the toxin gene produce a chemical that kills insects.

Explain the advantages and disadvantages of introducing the toxin gene into crop plants.

(6)

The advantages are; the toxin will deter pests including an eating the crops and so there is a higher crop yield. No pesticides have to be used. However, there is a chance that these GM crops could cause cross-pollination between different plants, in which the consequences of this are unknown. It may result in several different species being created, and we would be required to research them and their properties. Also, if there are too many GM crops with toxin genes, over time the insects could become immune and build up a resistance to the toxin and the gene would become ineffective. Finally, the insect-killing toxins could greatly decrease their population and therefore decrease the

Food source for many different animals, affecting the balance between the population of different species in an environment.



**ResultsPlus**  
**Examiner Comments**

This is an excellent level 3 response showing a detailed explanation referring to an increased yield, less use of pesticides and the development of resistance against the toxin.

## Paper Summary

Based on their performance on this paper, candidates should:

- Always show the working when doing calculations as a mark can be awarded for errors carried forward in this case.
- Ensure they read graph scales accurately when extracting information from the graph.
- Check the number of marks given for the question and ensure that they have included enough facts to match the mark awarded.
- Ensure that they can interpret family pedigrees for both the sex of the individuals and genotypes for sex-linked inheritance.
- Ensure that they know the structures involved in organ systems, the functions of the different structures and hormones which regulate them.
- Use scientific terminology accurately where possible in responses.
- 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 them construct their answer but avoiding repeating the information which has already been given and giving vague response which will not gain credit.
- Think about the structure of the answer before starting to write when tackling the extended answers to ensure that the answer shows clarity of writing and flows, 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>

Ofqual  
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