AQA

# GCSE
# COMBINED SCIENCE: TRILOGY

## 8464/B/2H: Paper 2 Biology Higher
## Report on the Examination

8464
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## General

Students worked well and attempted all questions, even those set at high demand. Many marks were missed due to students giving vague, broad ideas when it is thought that many may well have the details needed if they stopped to think about their answers. Teachers could encourage students to stop and review their answers to check if they have given the scientific detail needed in each case.

The Required Practical Questions (RPAs) showed an improvement this series with most students showing understanding of methods, variables and validity.

The area which seems to confuse students the most, and one where teachers could perhaps spend more curriculum time, is the section on inheritance, variation and evolution. Students generally do not understand the differences between sexual and asexual reproduction, selective breeding, natural selection and evolution, genetic engineering and cloning.

Questions one and two are common with the Foundation tier.

## Levels of demand

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

## Question 1 (standard demand)

**01.1** Almost all students gained some credit for describing the ruler drop test. Most described the dropping and catching of the ruler but this mark point was not awarded if there was a countdown or warning given, or if the student was dropping and catching the ruler themselves.

Many students were able to describe exactly where the ruler should be positioned above the hand, but if a large height was indicated this was not awarded. The measurement on the ruler where it was caught was the third mark and any references to timing were ignored although many measured both.

**01.2** 88% of students correctly calculated the dose of caffeine for group D.

**01.3** 70% of students realised that a drink with no caffeine was needed to be able to see the effect of caffeine on reaction time. This could be expressed in various ways including 'as a control group', however 'a control variable' was not given credit as caffeine is in fact the independent variable. References to a 'placebo' were ignored.

**01.4** 79% of students were able to estimate the reaction time for a drop of 23 cm.

**01.5** Many students didn't appear to read this question carefully and answered a different question giving that reaction time either increased or decreased. Half the students correctly expressed the relationship as 'as the mass of caffeine increases so does the decrease in reaction time' which is directly from the graph.

Some students just quoted data from the graph which did not gain credit. 'A positive correlation' did not gain credit but was ignored if the correct relationship was also given. Likewise the statement that reaction time was quicker was also ignored if the correct answer was present.

**01.6** A 'mathematical' reason was required as to why these points were negative, so ideas related to errors or the method were not relevant. Some students surmised that the ruler was not caught at all or that they were distracted. 38% of students realised it was because the reaction time increased rather than decreased after the drink and so gained the mark.

**01.7** Three-quarters of students were able to give the correct range of results for group C.

**01.8** 47% of students were able to give one or two variables that should have been controlled. The most common correct variables were related to the position of the hand and ruler before the test or using the same hand each test.

Most incorrect responses referred to some aspect of the caffeine drink which was in fact the independent variable and already very well controlled.

**01.9** Over half of students were able to gain one mark for realising that either a reflex action is automatic or that the ruler drop test requires a conscious action or involves the brain. 9% of students gave the full answer for two marks  Some students only referred to the absence or presence of danger as distinguishing the two actions or said that the ruler drop test only needed 'hand to eye coordination' or 'did not involve the brain'.

Many answers were based on the erroneous belief that the ruler drop test did not involve a stimulus or receptors like a reflex action, or that it could not be a reflex action as it was not to avoid danger or pain.

**Question 2 (standard demand)**

**02.1** Approximately three quarters of students were able to name another greenhouse gas. Methane was the most common correct answer, but water vapour was also seen. The most common incorrect answers were carbon monoxide and nitrogen.

**02.2** Two effects of climate change were required, and many students gained both marks for stating 'polar ice caps melt and sea levels rise.' Ice caps melting was often described in vague ways that did not gain credit including 'ice melting' and 'icebergs melting.' The most common insufficient responses were 'hotter summers' or 'changes in weather.' As global warming was given in the stem of the question rising temperatures did not gain a mark.

Loss of habitat was insufficient without qualification as much habitat loss is due to human activity. Many students referred to 'animals/plants' becoming extinct which gained credit although 'species becoming extinct' was preferable. Misconceptions included that acid rain, earthquakes and volcanoes were effects of climate change.

40% of students gave two effects and a further half of students gave one effect.

**02.3** This question differentiated well between students. Almost all students answered this extended response question with 43% giving answers matching the Level 2 descriptor. The students scoring in Level 1 were able to name processes but did not give details or they did not mention photosynthesis. Confusion between photosynthesis and respiration also limited some students to Level 1.

Those students who recognised and named the processes of respiration and decay often gave better linked detail. Many referred to the decay process releasing carbon dioxide rather than the respiration of the microorganisms releasing the carbon dioxide. The passing on of carbon between levels of consumers was often overlooked.

Common inaccuracies which prevented the award of a full six marks included the passing on of carbon dioxide rather than carbon and the idea that carbon is stored in the soil when organisms decay.

**Question 3 (standard, standard/high & high demand)**

**03.1** Half of the students gave one correct statement about vectors, usually that they were used to insert genes into an organism. A further 23% also knew that vectors were usually plasmids or viruses.

**03.2** Students were asked to explain why a herbicide resistant variety of wheat will give a higher yield than a non-herbicide resistant variety. The first marking point was the one most commonly awarded, for the idea that when a herbicide is applied, it will not affect or kill the resistant wheat. However, very few students went on gain any further marks and to fully answer the question, failing to give the consequence of the weeds being killed and the resistant wheat not killed. 40% of students gained the first mark, with 1% gaining more.

Many students do not appear to understand what a herbicide is, with some stating that herbicides eat the wheat and so herbicide resistant varieties don't get eaten. Clear indications of pests or diseases resulted in zero marks. Others simply stated that non-herbicide resistant varieties do get killed by herbicides, but this on its own was insufficient to gain a mark. Students should be reminded to avoid vague terms such as 'nutrients', as this was ignored in the second marking point. There was some misuse of the term 'immune' when answering this question.

**03.3** Some students gave excellent descriptions of examples of genetic engineering in use today, which they may well have found out when researching uses of genetic engineering. 'Golden rice with added nutrients' was a common correct answer, as was 'crops with higher yields' or 'disease resistant crops'. However, many students are still giving answers which are too vague to gain credit, such as 'GM crops' or 'disease resistance'. Crops may be resistant to certain pests but are never resistant to pesticides.

There appeared to be some confusion between selective breeding and genetic engineering from some students. Additionally, some students referred to designer babies, IVF and embryo screening, all of which were incorrect answers. Some students were confused between genetic engineering and gene therapy and described replacing defective genes, which did not gain credit. Novelties such as 'glow in the dark' animals and the many instances of natural genetic mutations such as featherless chickens, seedless fruits and

white sunflowers were not acceptable. Half of the students were able to correctly give one or two examples.

**03.4** Students found this question challenging, with a significant number of them describing the designer baby idea which did not gain credit. Some thought that by mapping the human genome we would be able to more easily predict if a child would be born with a genetic disorder, which again was not correct. There were also lots of vague statements such as 'help cure diseases' which were insufficient.

A few students did appreciate the importance of understanding the human genome for use in tracing human migration patterns from the past. A number also realised that if a gene could be identified as causing an inherited disorder this would lead to being able to offer parents embryo screening or maybe gene therapy in the future.

16% of students correctly gave a use and only a minority of students were able to follow this up with an explanation of how it could help in the future.

**Question 4 (standard & standard/high demand)**

**04.1** Almost all students gained credit for knowing at least one correct adaptation and 78% gained two marks for all correct links.

**04.2** This question provided a large range of responses with over half giving one or two correct explanations of the adaptations of orchid plants. The most common was that brightly coloured flowers would attract insects or bees for pollination, but some did not gain the mark as they just stated 'to attract bees' without explaining how this would help the orchid plant. Some students thought the bright colours might be a warning to 'predators'.

Growing attached to other plants could be linked to obtaining more (sun)light or to the symbiotic idea of obtaining water, minerals or glucose, but the vague idea of 'nutrients' is insufficient at this level. Large quantities of pollen needed to be linked to increased reproduction or seeds to gain a mark, and not to attracting insects, so was less often awarded.

A number of students linked the light seeds to wind dispersal but needed to take this further than just 'to spread' and link it to growing in new areas or further away. Thousands of seeds needed to be linked to the idea of a large population able to withstand competition or not face extinction. 12% of students gained three or four marks.

**04.3** In the last series most students did not understand selective breeding, but possibly due to emphasis this year by teachers on this topic, many now tried to apply the selective breeding process to this question which is essentially about natural selection and speciation.

Fewer than a quarter of students gained one mark usually for identifying that the purple flower was the result of a (random) mutation. As previously, any indication that the plant 'mutated' itself resulted in this mark not being awarded. The other mark often seen was for the idea that the plant with a purple flower survived and bred.

12% of students were able to continue the process and gain two to four marks. Many missed marks at this stage by referring to asexual reproduction. The final marking point regarding speciation was very rarely seen.

**04.4** 73% of students correctly identified species D as being most like the ancestral species. Those that did not, usually gave species A as it had the same colour flower. 31% of students were able to give a precise reason related to the fact that 9 of the 10 amino acids in the sequence were the same or that there was only one difference in the sequence. Describing this as 'the nearest' or 'most similar' was insufficient.

**Question 5 (standard, standard/high & high demand)**

**05.1** Most students were able to identify one way to improve the method given for the RPA of measuring a population of organisms; in this case, daisies in a school field. 57% of students gave both improvements correctly.

**05.2** Most students made a good attempt at this tough multistep calculation. A third gained two marks for correctly calculating the area of the school field. A further 12% of students gained a further one mark, most usually for converting the incorrect answer they derived into standard form with two significant figures. 10% correctly calculated the result but failed to express it in the required format, while 7% calculated a totally correct answer.

**05.3** This extended response question asking about factors which would affect the distribution of daisy plants on the school field was intended to be challenging. To give answers reaching Level 2 or 3 the student needed to include a high degree of accurate detail to explain each factor. Students who identified only factors, or who discussed only one factor, would be unlikely to get a mark awarded above Level 1. To gain a mark in Level 3 quite a lot of strong linking with accurate detail was needed for several factors and a clear understanding of how each one affected the distribution. It was not required to label each factor as biotic or abiotic but if the student chose to do so it needed to be correct.

11% of students gave enough accurate detail to be awarded five or six marks (Level 3). 57% of students gained three or four marks (Level 2) and 26% achieved one or two marks (Level 1). Very few students gained no credit or did not attempt a response. This question differentiated well throughout the ability range of students.

**Question 6 (standard/high & high demand)**

**06.1** This question required a straightforward and general definition of homeostasis – the idea that internal conditions of a body or cell are regulated so that they are optimal for all functioning.

The first strand of this definition was often given correctly, although no credit was allowed for statements such as 'control of the body' or 'maintenance of the body's living conditions' where there was no qualification of this being 'internal'. Answers which embraced regulation of both internal and external environments were clearly incorrect but probably reflected the students' knowledge that 'changes' in these environments are the triggers for homeostasis. Some students inappropriately referred to things, organs, reactions, activities, structures, functions, or systems being controlled.

The second strand of the definition, however, was seen far less frequently. Words such as regular, correct, normal, good, healthy or right were all too vague for 'optimal'. Similarly, references to conditions being kept stable, steady or balanced, whilst true, did not go far enough, as they may not necessarily be 'optimal'. Some students focused on hormones or on specific examples of homeostasis, but an overarching definition of the term was required for credit.

Others were completely confused and followed the trigger of the prefix 'hom(e)o' by referring to '(homozygous) genes' or to evolution, reflecting the generic name for a human. Some recalled 'environment' in their learned definition and then gave ecological responses. 41% of students earned the first mark point and 9% gained the second.

**06.2** 36% of students gave the correct response of glucagon as the hormone which is released if blood glucose concentration falls too low. It was expected that students could spell this scientific word and so the various combinations of glycogen, glucose and glucagon seen were not accepted.

**06.3** This challenging question required students to describe how the data presented in a graph showed that one individual had diabetes. Many jumped too quickly, saw a graph of blood glucose concentration in two people and immediately thought that the question was actually asking something different i.e. for a comparison to show that one individual was 'normal' and the other was 'diabetic'. References to person A were ignored in the marking of the question but a student who followed this line of argument often found it difficult to gain much credit.

Although the command word in the question was 'describe' many students still felt the need to 'explain'. As a result, they both wasted time and also failed to home in on the detailed descriptions of events that were required. Students should have assessed the graph and question carefully and noted – firstly, that information about normal blood glucose concentrations was given for comparison; secondly, that this information referred separately to fasting and non-fasting levels; thirdly, that the question tariff was three marks and that plotted data on the graph followed through three distinct stages; finally, that the question asked specifically for the use of data.

One mark was available for appreciating that the fasting blood glucose level in person B was higher than normal. Students did not gain credit if 'fasting' was omitted or if the reference to 'high' was not comparative.

One mark was available for noting that blood glucose reached a very high level after the drink. Students failed to get credit if the context of 'non-fasting' or 'after the drink' was not made clear. No mark was awarded, either, if 'high' was not qualified in some way to imply that it was 'very' high. Blood glucose levels would go up immediately after a glucose drink, regardless of whether the person was diabetic or not. In addition, the mark was for the blood glucose reaching this (very) high level and not for the speed at which it achieved it. Blood glucose levels would rise quickly after a glucose drink, regardless of whether the person was diabetic or not. Consequently, answers such as blood glucose levels 'shot up' or 'rose rapidly' after the drink gained no credit.

One mark was available for appreciating that blood glucose levels fell slowly or took a long time to fall after the initial rise. This point had to relate to a description of the graph and it was insufficient to say 'it took much longer for the glucose to be converted to glycogen'.

Students could only access full marks in this question if they used correct data from the graph in support of one of the points they made. Some answers incorrectly referred to insulin, rather than to blood glucose levels, and no credit could be given.

6% of all students gained all three marks, 19% of students gained two marks and 24% gained one mark.

**06.4** This question required students to understand the differences between the two types of diabetes. If the incorrect types were ascribed to the two people then no marks were available for the student's reasoning. The people referred to in the question were person A and person B and the two types of diabetes are Type 1 and Type 2. The correct and unambiguous use of letters and numbers in answers here was, therefore, a priority. Some students wrongly referred to type A/B diabetes; others hurriedly wrote the numbers 1 and 2 in a way that was unclear to examiners. Where specific letters or numbers are required in answers, students are advised to think very carefully before putting pen to paper and to, possibly, consider writing numbers in words if they feel that their figures might be misconstrued. The same applies to crossings out. If changes are made to answers, they must be unambiguous if credit is to be awarded.

Full and accurate answers relating to person A were rarely seen. Students had to refer both to the fact that insulin was 'produced' and also to body 'cells' being unable to respond or being resistant to it. If the context of production was incorrect, e.g. liver, then no mark was credited. If the lack of response was linked to the body without the qualification of cells or if the student said that 'the body was insulin resistant', again, no credit could be given.

Answers relating to person B were invariably better. The mark was not awarded, however, for responses that were too vague e.g. 'cannot produce the right amount of insulin' / 'cannot produce insulin properly' or 'the body is not producing enough'. Given the data in the question, it was also clearly wrong to say that person B produced 'no insulin'. Students occasionally referred to reasons which did not fully reflect the data given e.g. due to genetic factors or obesity; others described possible ways of treating the diabetes. Such answers gained no credit on their own. A third of students explained one answer, usually Type 1 for person B but very few gave the detail needed to explain Type 2.

**06.5** This question required students to apply their knowledge of blood glucose control in a novel situation. Thus, a majority of students did not gain any credit. Although this was not an easy question, many students at least attempted to give reasoned and detailed answers. The context of the question was given in an order that was hoped might help understanding but, nevertheless, very few complete accounts were given.

Students were asked to explain the different possible outcomes when both starving and non-starving children ate lychee fruits. Many struggled to find appropriate biological knowledge to frame their responses and jumped at key words that they hoped would give clues. These included – 'THS', 'enzymes', 'liver', 'day (and night)', 'fat' and 'glucose'.

'THS' led some into thinking that this was an infectious disease, arguing that starving children would have very weakened immune systems that could not cope, leading to death. Enzymes' opened up several different approaches, apart from the expected one, including e.g. no amylase to break down the fruit and release glucose, no lipase to break down fats, enzymes being denatured as a result of high temperatures in the tropics, lychee fruits containing the enzyme which then attacked the liver. Others thought that an enzyme which led to the release of glucose had, in the context of the whole of question six, to be glucagon. Some answers, unfortunately, also referred to enzymes being 'killed'. 'Liver', in conjunction with 'fats', led a few students to discuss how no emulsification by bile was possible. Others referred to THS being a liver disease. 'The 'day and night' aspect led to

answers which suggested that starving children would be unable to cope with many lychee fruits on 'empty stomachs' just before going to sleep.

The most common incorrect lines of argument, however, centred on 'fats'. Many answers implied that a lack of food meant that the starving children would have no fats in their bodies at all meaning that no glucose could be released. The students were, therefore, paying little attention to the effects of eating lychee fruits. Other answers focused on fats not being broken down and, therefore, accumulating in the body, leading to eventual heart disease and death. Some mistakenly equated fats with 'glycogen'.

Discussions of 'glucose' itself were often misplaced. Rather than lychee fruits containing a molecule preventing the release of glucose, many argued that they would, themselves, contain large amounts of the sugar. It is possible these students confused hypoglycaemia and hyperglycaemia. The children would be overloaded with glucose and unable to store it, leading to other problems (e.g. with water levels and osmosis) and, ultimately, death.

Other misconceptions that arose in answers included e.g. respiration 'produces' energy or energy is 'used' in respiration. Weak answers were always too vague, even if not incorrect, to gain credit e.g. 'the body will not be at its optimum level' or it will not be possible to 'respire properly'. Few students correctly referred to glycogen stores in non-starving children, but good responses did make the link to their absence in starving children.

Students should, perhaps, be advised to marshal their ideas in a brief plan before answering questions of this sort. They should also pay heed to all information given in the stem of the question rather than to just a few aspects.

Only the most perceptive students recognised that the difference in effects on the children lay in the presence or absence of glycogen stores in the muscle or liver which could be used to restore blood glucose levels. If they did recognise this, they gained three to five marks. The most common single mark awarded was for the knowledge that without glucose respiration would stop, leading to death.

### Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

### Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.