GCSE

BIOLOGY

8461/2F: Paper 2F - Foundation Tier
Report on the Examination

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General Comments

Most questions were attempted by most of the students.

Particular problems which occurred quite frequently included:

- paying insufficient attention to information provided in the stem of a question in order to guide a reasoned response, avoid misconceptions and the inclusion of irrelevant information – many students appear to miss the information given and just read the part immediately before the answer line;
- repeating (rather than using) information given in the question, for which no marks are available and which wastes both time and space. There is adequate space provided for relevant material without recourse to additional answer pages.
- careless reading of the question resulting in an inappropriate answer, for example failure to give a comparative answer to a comparative question, or not following instructions in multiple-choice items, such as to tick the correct number of boxes;
- inaccurate reading of data from a graph;
- failing to answer a question for which there was no answer line but which required the answer to be written elsewhere such as in a table or on a graph;
- there were some students whose writing was simply illegible and it was clear that these students should have had extra support;
- mis-spelling of certain terms, eg glycogen (easily confused with glucagon with hybrid spellings), and confusion of certain terms like biotic / abiotic and aerobic / anaerobic;
- although chemical formulae are generally acceptable as alternatives to the names of substances, they need to be correct, for example O_2 is an acceptable alternative to oxygen but O^2 is not;
- not checking whether the answer to a calculation is sensible – for example, it is impossible for a person to use 400 percent of their daily energy intake for evaporating sweat;
- striking an incorrect balance between depth and breadth of coverage in an extended prose answer.

Question 1

This question was about the inheritance of a human genetic condition.

01.1 Just over half the students correctly selected the option that a recessive allele was one expressed only if a person has two copies of the allele.

01.2 Most students were able to identify the correct phenotype for the given symbol in terms of both sex and having the condition maple syrup urine disease (MSUD). A small proportion simply copied one of the other phenotypes from the key.

01.3 A large proportion of students completed the Punnett square correctly. Of those who didn't, it was common for them to give offspring genotypes as single alleles.

01.4 Identification of the phenotype for the heterozygous genotype was poorly done, with many students not referring to MSUD in their answers. Almost one in five made no attempt at all.

01.5 Those students who gave correct answers in question 01.4 were frequently able to give the correct answer to this question. However the number who gained all four marks across this

and the two previous questions was not high (fewer than one-fifth). Students seemed to be somewhat confused by MSUD being the recessive allele and often gave 75%, even when their Punnett square was correct.

01.6 Most students correctly selected *dominant* as the term that described the allele **N** for not having MSUD.

01.7 Although a quarter of students gave the correct answer, DNA (with a small number giving the full chemical name), a considerable number offered all manner of substances, organelles or whole organisms. It was evident that some students either ignored the word 'substance' in the question or lacked the understanding of what a substance is.

01.8 Just over half knew that proteins are made of amino acids.

Question 2

This question was about reflexes and an investigation into the measurement of reaction times.

02.1 Nearly all students correctly selected the option that a reflex action is automatic.

02.2 There was some confusion over the naming of the various components of the reflex arc shown in **Figure 3** and, although the vast majority got at least one correct, only one fifth correctly selected the names of all three.

02.3 Although the instruction was to select *two* examples of reflexes from the five actions listed, one percent of students selected just one. However, almost 90 percent correctly selected both blinking when an insect flies into the eye and removing the hand from a hot object.

02.4 Around three-quarters of students were able to calculate the correct mean value for the reaction time from the data in **Table 1**. Those who did not, sometimes calculated the mean of the other mean values and so gained just one of the two marks available for demonstrating the method of calculating a mean. A few students transferred the numbers from the table incorrectly, ending up with the wrong answer and so could gain no credit.

02.5 Most students correctly ringed '635' in the table as the anomalous result, although some ringed the mean for student **R**, possibly believing that the mean value had been incorrectly calculated from the raw data.

02.6 Tiredness, or a synonym thereof, and drugs were the most common correct answers as possible factors affecting a person's reaction time. Some students suggested two named drugs, such as caffeine and alcohol, but only gained one mark as these were considered to be too closely related. Several suggested 'distractions' or gave an example of one.

Question 3

This question was about an investigation into phototropism.

03.1 Just over half correctly selected *tropism* as the name of the response by a plant shoot to light shining from one side.

03.2 Only a quarter of students knew that a shoot exposed to one-sided light would grow towards the light and that a shoot is darkness would increase in length as well as remaining vertical.

03.3 The most common answer to this was simply to 'see how the plant grows in the dark', so there were relatively few who explained the purpose of experiment **2** as an experimental control. The term 'control', so often seen in previous examinations, was noticeable for its almost complete absence, and even the idea of it being a comparison was not common.

03.4 Almost three-quarters of the students selected the suggestion of shining light from all sides on an extra seedling as a means of increasing the validity of the investigation.

03.5 Almost three-quarters also chose keeping each seedling at the same temperature as a suitable control variable.

03.6 Despite *gravity* being referred to in the Specification, by far the most common correct answer for a stimulus to which plant roots are sensitive was 'water'. 'Light' was not an unusual answer, despite it being specifically excluded by the question.

03.7 Considering that students would have completed questions 02.4 and 02.5 not long before they answered this question, it was surprising how few could give correct answers here for reasons why scientists often repeat investigations several times. Reference to calculating a *mean* (or sometimes 'average') often gained a mark, but reference to *anomalies* was much less common. Ideas about validity, accuracy and repeatability were not uncommon, but were not credited.

Question 4

This question was about the effects of untreated sewage entering a river.

04.1 The vast majority of students were able to select *bacteria* as the type of organism that had the most rapid increase in numbers in **Figure 6** when sewage entered the river.

04.2 Although many students gained one mark for the idea that the numbers of both organisms decrease (further down the river) or that bacteria decrease when the protozoa increase, relatively few students put both of these ideas in their response as evidence that the protozoa in the river feed on bacteria. Students commonly described bacteria and protozoa increasing simultaneously at the point of sewage entry, which does not indicate the feeding relationship. A small proportion of students gave details about other populations in the river which were not asked for in the question.

04.3 The process responsible for the decrease in oxygen concentration when the sewage entered the river was given as *respiration* by only half the students. The most common incorrect response was 'photosynthesis'. Some correctly suggested 'aerobic respiration' but a few qualified respiration incorrectly as being 'anaerobic'.

04.4 There were many who gained one mark, to account for the parallel increases of both algae and oxygen concentration in the river, by referring either to photosynthesis or to the idea that algae produce oxygen, but only one in six could put both ideas together. It was often evident from the detail in their answers that these students had revised this part of the Specification well.

04.5 It was surprising that so many students (almost 10 percent) made no attempt at this question which involved plotting bars on the graph rather than writing on an answer line. Most of those who did gained both marks, with accurate plotting of the values given in **Table 2** and appropriate shading. Some students appeared to have forgotten to use a pencil in their drawing, perhaps not bringing one to the examination at all; so when errors were made, they had difficulty erasing them. The most common errors were to omit the bar for the 80 sludgeworms at site **A**, to plot 8 as 6 for the bloodworms at site **B** and to omit any attempt at shading to parallel that given in the key.

04.6 The relationship between oxygen concentrations at sites **A** and **B** and the relative populations of sludge worms and mayfly nymphs at these sites was expressed in a variety of ways, although just over a quarter gained both marks for making the correct comparisons for population sizes of the two species. Weaker students often quoted data from **Table 2** but did not include comparisons, while some referred to all the organisms in the table.

Question 5

This question was about the menstrual cycle and methods of contraception.

05.1 Almost two-thirds of students correctly selected *oestrogen* and *progesterone* as the female reproductive hormones. One in eight students included testosterone in their selection.

05.2 The role of FSH in causing eggs to mature in the ovary was known by almost two-thirds of students, although many thought it caused the breakdown of the uterus lining.

05.3 Given that a sperm cell could survive inside a woman's reproductive organs for five days and an egg for one day, with ovulation on day 14, the range of days when intercourse could result in fertilisation (i.e. 9 to 15) was correctly calculated by only one in twenty students. A wide range of suggestions was made, many of which bore little resemblance to the correct answer and it was difficult to understand how they had been arrived at.

05.4 Students who showed sufficient knowledge to get to Level 3 (about a quarter of students) frequently referred to condoms and the pill and how each of these works. Reference to the patch, an implant or the diaphragm were commonly made. Some students went somewhat over the top and suggested that castration (often in the vernacular) was an appropriate method of contraception and although this would be effective, the method was not credited. Weaker students often gave a list of methods but were unable to explain how they work. The most commonly understood method was the use of the condom, often described as stopping sperm from reaching the woman's body, the vagina or the egg.

Question 6

This question was about temperature variation in a primitive mammal, the echidna, and in a human.

06.1 Reading the highest and lowest values for the echidna's body temperature from the graph in **Figure 9** should have been very straightforward. Whereas some students misread the small divisions on the scale as representing 0.5 or 2°C (rather than 1°C), others misunderstood the question and gave the highest and lowest values of the peaks or of the troughs. Thus only three-quarters gained credit.

06.2 Almost 90 percent of students successfully counted the five peaks in the graph as representing the times when the echidna woke up from hibernation.

06.3 This question was particularly poorly answered, with fewer than one in twenty gaining credit. Very few students referred to food stores at all and of those who did, hardly any included the idea that waking up from hibernation to hunt for food resulted in replacement, or prevented the stores running out.

06.4 A liitle over one third of students selected the answer *respiration*, the other two options, 'diffusion' and 'excretion', being almost as common.

06.5 The most common correct answers for the use of energy in the echidna's body referred either to movement in one form or another (usually locomotion) or to keeping the echidna warm. A small proportion suggested growth or muscle contraction and a very small number gave 'active transport'. Just under half of the students were successful in this question.

Questions **06.6** to **06.8** related to temperature control in humans by sweating.

06.6 Most students (almost two-thirds) completed the calculation correctly to find the amount of energy the athlete used each day for evaporation of sweat. Of those who did not, the most common answer was 1280 kJ, achieved by dividing 3200 by 2.5, rather than multiplying the two values to give a correct value of 8000 kJ.

06.7 Just over half the students successfully calculated that the athlete used 25 percent of the daily energy intake to evaporate sweat, with just a few forgetting to multiply the fraction by 100, thus gaining just the one mark. As in question **06.6**, the most common error resulted from inverting the fraction and dividing 24000 by 6000, so arriving at 400%, there being no evidence of students questioning this answer and reconsidering their calculations.

06.8 Although almost two-thirds understood that resting would reduce the amount of sweat produced, a surprisingly high minority of students believed that resting, rather than running, would increase sweat production. Some of the latter showed they had misunderstood the question by stating that resting would allow the athlete to 'store up sweat' to be released when next exercising, thus increasing sweating then.

Question 7

This question was about classification, evolution and extinction.

07.1 **Table 3** gave the classification of two species of trilobite with two of the classification groups left blank. Students had to choose the missing groups, *kingdom* and *genus*, from a list of five alternatives. Only a quarter of students chose correctly. 'Community' and 'mammal' proved to be good distractors.

07.2 A similarly small proportion knew that the given classification system was invented by Linnaeus. In fact, 'Darwin' was a more common choice.

07.3 The binomial name of trilobite **A** should have been relatively easy to deduce from **Table 3** but *Elrathia kingii* was the *least* common option selected from the three given alternatives.

07.4 The correct two pieces of evidence in support of the scientist's hypothesis that trilobite **B** may have evolved from trilobite **A** were that **A** was found in older rocks and that **B** was the more complex of the two. Almost 40 percent of students ticked both these options, but the idea that both were found in the same type of rock, although incorrect, was commonly selected.

07.5 Completion of the three sentences to describe fossilisation, using words from the box, proved challenging for many with only one in eight getting all three correct.

07.6 Considering the number of times that causes of extinction have been asked for in previous examination years, performance here was not as strong as might have been expected. However those who gained marks often referred to climate change or global warming, predators and the lack of food. Common insufficient answers included 'changes' in temperature (which happen by the hour) and unsuitable 'weather' or 'environmental change', each of which is too vague. Fewer than one quarter were able to give three suitable suggestions.

07.7 A lack of evidence or that nobody was there at the time were each given frequently as a suggestion for why scientists cannot be sure of the cause of extinction of the trilobites. Weaker students got no further than saying that it was a 'long time ago' or that there are 'many ways to become extinct'. Only just over one third gained credit.

Question 8

This was the first of three questions common to both the Foundation and Higher Tier papers. The topic was reproduction and meiosis.

08.1 Almost one third of students correctly selected whether each of the three statements applied to sexual and/or asexual reproduction. The most common error was not knowing that in *both* types of reproduction genes are passed from parents to offspring. A large proportion appeared to be using little more than guesswork.

08.2 A variety of plant parts, often not even of a flower, along with processes, sub-cellular structures and occasionally plant or even animal organs were suggested as the name of the male gamete in flowering plants. Fewer than a quarter gave the correct name, *pollen*.

08.3 and **08.4** Interpretation of the graph in **Figure 12**, which showed changing amounts of DNA in a cell before, during and after meiosis, was fairly good where, respectively, around 50 percent and 40 percent of students chose the correct period of DNA synthesis and the correct times of cell division. But it was odd that so many others chose 4-5 hours for copying of the DNA, a time when its mass remained constant, and chose times for cell division when the mass of DNA was not being halved.

08.5 and **08.6** Only one in seven suggested that the lowest value on the graph, at the end of meiosis, would be the amount of DNA in a sperm cell. In **08.6**, the suggested amount of DNA in an embryo was frequently a value lower than that given for the sperm cell, with fewer than one-third suggesting the same value as that found at the start of the graph.

Question 9

This was the second of three questions common to both the Foundation and Higher Tier papers. The topic was biotic and abiotic factors that affected the populations of earthworms in two habitats.

09.1 Only one in forty students were able to identify four relevant factors. The most commonly suggested were water, oxygen and temperature for abiotic factors and food and predation for biotic factors. Most students appeared to have little understanding of the distinction between the two types of factor and it was common to find at least some factors in the incorrect category. A significant proportion of weaker students appeared to have a poor understanding of what was required and copied out the four bullet points regarding features of earthworms into the four available spaces or sometimes decided on a couple of factors and wrote them in both sections to gain one or two marks.

09.2 While it was clear that a significant proportion of students had spent time completing fieldwork, there were also many who made no attempt at an answer. There were also students who appeared to misunderstand the question and gave often accounts of why the earthworm populations might be different in the different areas.

Some students included sufficient detail regarding control variables, randomising test areas, counting worms and how to deal with the results for both areas to gain access to Level 3. However some omitted vital components of this, in particular randomising the sampling areas or using chemical **X**, and could only gain a mark at Level 2. Those students who omitted reference to both areas were limited to Level 1.

A small but significant number of students determined the number of earthworms in the whole of the field and lawn and then compared these. This was not an appropriate comparison (and may have reflected practice at a related question from the November 2021 examination) as the question specifically referred to the number of worms per m^2.

A considerable minority of students suggested that throwing quadrats is a suitable way of achieving randomness, which is not only potentially dangerous but also is unlikely to achieve randomness and appropriate representation of the whole area.

Fewer than one in eight achieved level 3 although another third wrote answers worthy of level 2.

Question 10

This was the final common question on the topic of insulin and blood glucose, and the relationship between obesity and Type 2 diabetes.

10.1 Over two-thirds of students selected appropriate times from the graph in **Figure 13** for when insulin would be expected to be in high concentration. The most common answers given were around the time of the peak in blood glucose concentration. Those students who gave incorrect times frequently chose 2.5 hours, the time when blood glucose was at a minimum. A number of students gave answers such as 5.9 or 6, showing that they had been reading the wrong scale, giving the peak blood glucose concentration as the answer. For possible future reference, students should be aware of the difference, for example, between 1:40 and 1.4, when referring to time – in this particular question either format was acceptable as it was sufficient to indicate a value within the correct range.

10.2 There was a low number of very detailed correct answers to explain the effect of insulin on blood glucose, usually referring to the *liver* and *glycogen*. Occasionally, from those students who attempted it, glycogen was misspelt in such a way that it could be confused with glucagon. Whether blood glucose concentration would be increased or decreased was given in similar proportions; however many appeared to misunderstand what was required on the 'effect' line.
Many students appeared to have little understanding of diabetes, with fewer than one third scoring any of the three marks available.

10.3 and **10.4** These questions involved interpretation of the height – body mass graph in **Figure 14**. Nearly 70 percent of students correctly deduced that person **A** was underweight, but only around one-third could give sufficiently precise values (68 to 90) for the range of healthy weights for person **B**, given a height of 1.9m, even though this fell on a major gridline. Although some tolerance was allowed, many gave values just outside those acceptable, such as 66 or 69 at the lower end and 89 or 91 at the upper end. Weaker students appeared to draw numbers from a variety of other places on the graph.

10.5 This question involved the selection of appropriate data from a simple table that compared blood concentratons of cholesterol, glucose and insulin in an obese person with mean values for people who did not have Type 2 diabetes. Just over a quarter of students were able to point out that person **C** had *higher* concentrations of both glucose and insulin. Simply quoting figures from the table, without a comparison, was inadequate, as was the use of a non-comparative term such as 'high' concentration. Any mention of cholesterol, which was quite common, was deemed inappropriate – the question tested the selection of *relevant* data.

10.6 The majority of students knew that exercise was a means of reducing the chance of developing Type 2 diabetes. Most also knew that 'diet' was relevant but many answers, such as 'a heathy diet' or 'a balanced diet' were inadequate; it was necessary to state that the diet contained less sugar / carbohydrate / fat or involved weight loss. Thus fewer than one in five scored both marks.

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.