GCSE
BIOLOGY

8461/2F
Report on the Examination

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General

Nearly all questions were attempted by all students and there were some very good answers.

Particular problems which occurred quite frequently included:

- confusion of certain terms, eg a control and a control variable or neurone and nerve
- inappropriate use of the terms accurate, precise, reproducible, repeatable and valid and not realising that the term 'fair' is always inadequate unless suitably qualified
- not paying enough attention to information provided in the stem of a question in order to guide the response and avoid misconceptions
- repeating information given in the question, for which no marks are available, wasting valuable time
- lack of precision in the reading of data from a graph, for example reading a small square as '0.1' unit instead of 0.2
- poor handwriting, for example with numerals, especially the distinction between the numbers 1 and 2
- although chemical formulae are generally acceptable as alternatives to the names of substances, they need to be correct, for example CO_2 is an acceptable alternative to carbon dioxide but CO^2 is not
- the concept of energy transfer, for example in respiration energy is not 'produced' but is released from glucose. The idea of energy being produced, made or created is not credited.

Levels of demand

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

- **Low demand** questions are designed to broadly target grades 1–3.
- **Standard demand** questions are designed to broadly target grades 4–5.

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 (low demand)

01.1 54% of students correctly linked the scientific terms apex predator, primary consumer and producer to the correct organisms in the food chain.

01.2 86% of students were able to calculate the correct percentage transfer of biomass using the given equation.

01.3 This question differentiated very well between students. The term 'filtration' proved to be a good distracter for the removal of waste from the body of the fish.

01.4 The most common error in this question was to suggest the invertebrate animals in the food chain had no small fish eating them or that they were not eaten**,** rather than fewer being eaten as many of the fish had been killed by the disease. There was also some confusion in the use of the terms 'predators' and 'prey' in many answers.

Question 2 (low demand)

02.1 60% of students correctly selected implantation of the embryo as the purpose of the thickening of the lining of the uterus. Breaking down waste was the most commonly selected distracter.

02.2 Oestrogen was correctly selected by 84% of students as the hormone responsible for thickening the lining of the uterus.

02.3 'Egg release' was labelled on the graph as occurring on day 13, but only 54% of students were able to nominate an appropriate day upon which fertilisation was most likely to occur. Answers in the range 13 to 16 were allowed.

02.4 This question required students to link three different methods of contraception to the correct explanations of how they worked. 52% were able to do this, but the main source of confusion was that many thought the spermicidal cream would slow down sperm production rather than kill sperm.

02.5 This question required students to give reasons, using the given information, why a couple would choose to use the condom as their method of contraception. The question was quite well answered with 90% of students scoring at least two of the three marks available, mainly by referring to the low chance of pregnancy and the lack of side effects with the condom.

Many students also referred to prevention of STDs and the ease of use or availability of condoms. Some students addressed the same marking point twice, usually by referring to side effects for one answer then naming these effects in another.

Question 3 (low & standard demand)

03.1 54% of students understood that very few fossils of the earliest life forms have been found because they were soft-bodied or because they have been destroyed or decayed, or because they were very small or buried very deep in the ground or under the sea. A notable error was the suggestion that the bones or shells of early life forms had decayed, or that the fossils themselves had decayed.

03.2 Very few students were able to give sensible suggestions of how the fossil fish in the photograph was formed. There were lots of descriptions of the fish being buried but this was often under rock rather than in sediment. Many had the idea that the whole organism decayed, rather than just its soft parts.

There were occasional references to mineralisation and imprinting, although it was not always clear onto what the imprint was formed. Sometimes it appeared to be imprinted directly onto pre-formed rock.

03.3 Causes of extinction were well known, and 89% of students could suggest at least one.

03.4 While most students were able to select ‘a change in a gene’ as the definition of a mutation, a high proportion thought that it was ‘an organism with a new characteristic’, indicating confusion of the terms mutation and mutant.

03.5 Descriptions of the process of natural selection were frequently weak. There seemed to be little understanding that there had to be pre-existing variation (due to mutation) within a species so that only the better adapted survived and were able to pass on the beneficial allele / gene to their offspring. Some fell short of this and just described ‘characteristics’ being passed on.

A few strayed from the theme of natural selection and described selective breeding. 36% of students scored any of the three marks available.

Question 4 (low demand)

04.1 Although 38% of students recognised that Gregor Mendel was the scientist who had studied inheritance in pea plants in the 19th century, many students thought that this had been Charles Darwin or Alfred Russel Wallace.

04.2 85% of students recognised 'DNA' as being the genetic material.

04.3 Many students had difficulty selecting an appropriate description of when a recessive allele is expressed. 59% of all students recognised this was when the dominant allele was not present.

04.4 Given that the genotype of the tall parent pea plants was TT, 65% of students correctly gave 'tt' as the genotype of the short plants.

04.5 89% of students were able to fill in the blank spaces in the Punnett square diagram to show the resulting genotypes of offspring from a cross of two heterozygous pea plants.

04.6 56% of students demonstrated that they understood the term homozygous by circling one of the correct genotypes in their Punnett square.

04.7 53% of students were able to give the correct ratio of '3:1' for tall plants : short plants in the offspring. Some gave the answer '1:3' while others gave ratios that were impossible to derive on the basis of the four cells in the Punnett square.

Question 5 (low & standard demand)

05.1 81% of students correctly selected the pancreas as the organ that makes insulin.

05.2 46% of students were able to select both the liver and glycogen as, respectively, the organ that insulin acts upon and the storage form of glucose in that organ.

05.3 37% of students understood that insulin could not be taken by mouth as it would be digested in the stomach.

05.4 72% of students successfully read the two values from the graph and subtracted them to find how much higher the blood glucose rose in the diabetic than in the non-diabetic. The main error was in reading the scale on the graph, where one small square represented 0.2 units and not 0.1.

05.5 57% of students were able to describe another difference between the two curves on the graph. In part, this was due to somewhat imprecise expression.

05.6 84% of students recognised the pattern in the second graph, showing the relationship between insulin sensitivity of cells and the amount of abdominal fat, as a negative correlation.

05.7 Methods of reducing the likelihood of developing type 2 diabetes were well known and 94% of students were able to give at least one, such as having a low-carbohydrate or low-fat diet, losing weight, or taking more exercise.

Question 6 (low & standard demand)

06.1 A method was required in the answer to this question, not just that the quadrats should have been placed at random, but how that randomness could be achieved.

19% of students achieved marks here. Many chose to throw quadrats, but this was not allowed unless it had been qualified. Better answers described how a grid and random coordinates could have been used.

06.2 The most common reason given for the method described in question **06.1** was to achieve randomness, or to avoid bias. 25% of students made this point.

06.3 A fair proportion of students stated that the purpose of spraying one half of the lawn with water was either to act as a control or to show the effect of the weed killer on the other half. Relatively few (17%) made both points. Some incorrectly used the term ‘control variable’ instead of **control**.

06.4 79% of students had little problem calculating the mean from the figures in the results table.

06.5 Calculation of the percentage decrease in weeds on the side of the lawn sprayed with weed killer, by substitution in the given equation, should give:

$$\frac{(10 - 2)}{10} \times 100 = 80$$

Although 70% students were successful, many errors were caused by selecting incorrect numbers to substitute into the equation.

06.6 Improvements, such as the use of more quadrats or leaving the experiment for a longer time to allow the weed killer to have its full effect, were given by 38% of students. The reason for such an improvement was given by 5% of students.

Since validity was mentioned in the question, 'to make the results more valid' was not considered a suitable reason.

Question 7 (low & standard demand)

07.1 An appropriate reason for sterilisation of the fermenter before use was given by 49% of students. Many gave insufficiently detailed answers such as 'to make it clean' or inappropriate ones such as 'to kill any remaining Fusarium from a previous batch'.

Other microorganisms possibly being present which might make toxins, or which might be pathogens, was only fully appreciated by 3% of students.

07.2 Although 42% of the students selected the correct answer of 30 ºC as the optimum temperature for growing the Fusarium, almost as many chose 20 ºC.

07.3 The key words 'glucose' and 'oxygen' used in the question should have triggered the response 'respiration'. 34% of students gave this idea in their answer. Most thought it would simply help the Fusarium to 'grow'.

Fewer than 5% went on to explain that this would provide the Fusarium with energy. Some later lost this marking point by referring to energy 'production'.

07.4 1% students seemed to appreciate that moving materials around the fermenter would result in improved access to food and oxygen, or better removal of carbon dioxide, thus enabling better growth of the Fusarium.

07.5 83% of students correctly selected the answer '200 grams' as the amount of mycoprotein equivalent to 100 grams of chicken in terms of their protein content.

Question 8 (low & high demand)

08.1 87% of students correctly selected either the volume of water added to the soil or the temperature as conditions that needed to be kept constant for all of the seedlings in the investigation. 40% of students selected both.

08.2 63% of students understood that the purpose of the aluminium foil was to prevent light reaching the shoot.

08.3 This question required students to solve a practical problem: how to measure the length of a curved shoot.

- Some suggested the use of a piece of thread along the shoot which could be transferred to a ruler for measurement.
- Others opted for a tape measure and some suggested straightening the shoot against a ruler.

Each of these was acceptable with 29% of students being completely successful. For example, an answer such as 'Use a piece of thread and measure that' would have scored only one mark due to lack of precision.

08.4 Appropriate evidence which implicated the tip of the shoot as being necessary for the plant to respond to the light involved two aspects: that fact that the shoots with the tip exposed to the one-sided light responded to it and also that those shoots with the tip covered or the tip removed did not respond. Many students just described length changes in the various shoots. 14% of students were completely successful, with 35% able to describe one piece of evidence.

08.5 42% of students correctly selected the distribution of auxin that would occur in a shoot exposed to one-sided light.

Question 9 (standard demand)

09.1 Students had to select two examples of reflex actions from a list of five different actions. 23% of students recognised that both releasing saliva when food entered the mouth and withdrawing the hand from a sharp object were reflexes, with withdrawal from a sharp object being the more common option.

09.2 28% of students understood that a **bright** light, or **increase** in light intensity, would cause constriction of the pupil of the eye, with many just giving 'light' as an insufficient answer.

09.3 42% of students knew that the structure labelled on the diagram of a frontal view of the eye was the iris. Incorrect answers included the 'retina', the 'cornea' and the 'lens'.

09.4 8% of students were able to state that muscle contraction in structure Q (the iris) caused the decrease in size of the pupil.

Some students made incorrect references to 'ciliary muscles' or stating that muscles 'contract and expand' (muscle 'relaxation' was ignored by examiners). Other incorrect answers seen referred to 'enlargement' of the iris or to muscles 'constricting'.

09.5 This 'extended response' question was marked on the basis of a 'level of response' mark scheme. An answer at level 2 (4–6 marks) would refer to three key features of the given diagram of the reflex arc: the receptor, the neurones and the effector, in terms of their functioning and given in the correct sequence. The inclusion of further details, such as the conduction of impulses (rather than 'messages' or 'signals'), the mechanism of transmission at the synapses, the nature of the effector (muscle or gland) and how it responded (contraction or secretion) determined the mark awarded.

Answers at level 1 (1–3 marks) would typically:

- omit essential features, such as one of the neurones
- state that the effector carried out an 'action'
- include an incorrect detail, typically the involvement of the brain
- might give the neurones in an incorrect sequence.

14% of students gave level 2 responses and with 50% achieving any marks at all. 14% of students did not attempt an answer at all.

Question 10 (standard demand)

10.1 Students had to decide whether the trend in carbon dioxide concentration and air temperature, as shown in the graph, was to stay constant, to decrease or to increase during each of three given date ranges. 50% of students were completely successful, the main errors being in deciding which trend was applicable to the air temperature.

10.2 13% of students were able to explain how an increase in carbon dioxide concentration might cause an increase in temperature. Answers needed to be in terms of reducing the loss of heat / long-wavelength radiation / infra-red radiation from the Earth or acting as an 'insulator'.

Errors included the mention of ultra-violet radiation, the ozone layer and the fact that heat was released in the process of combustion which was also the process that released carbon dioxide. There were also many references to 'global warming' offered as an explanation rather than as a phenomenon in need of explanation.

10.3 This 'extended response' question was marked using a 'level of response' mark scheme. An answer at level 2 (3–4 marks) required students to give evidence both for and against the proposition that an increase in carbon dioxide in the atmosphere was the cause of an increase in air temperature. The inclusion of numerical data (as stated in the question) was required to back up their argument.

One approach was to make use of the trends already worked out in answer to question **10.1**, possibly adding on numerical values from the graph to illustrate the point being made. For example, from 1960–1977 the concentration of carbon dioxide rose by about 20 ppm (from 320–340 ppm) while the temperature decreased by around 0.4 ºC.

Since there was no grid on the graph, approximate numerical values were allowed. However, many students misread or misunderstood the scales on the graph. For the given example, they stated that carbon dioxide concentration rose from 0.1 to 0.3 (ppm or ºC), or that the temperature changed from 0 ºC to −0.4 ºC or even from 320 ºC to 280 ºC. 26% of students gave level 2 answers.

Many students did not use data from the graph and / or only gave evidence for one side of the argument, usually in favour of the proposition.

10.4 55% of students were able to give the burning of some sort of fuel (eg a fossil fuel or wood) as a human activity that would cause higher concentrations of carbon dioxide in the atmosphere in the winter than in the summer. This could have been described indirectly in terms of examples such as driving cars or the use of home heating systems.

10.5 24% of students could state that 'photosynthesis' was the biological process that lowered the concentration of carbon dioxide in the summer. Many attempted to answer in terms of human activities.

10.6 Loss of habitat, usually in terms of polar bears in the Arctic, changes in migration patterns, and extinction, were the main examples given as effects of rising global temperatures on living organisms. 43% of students were able to give at least one of these. Quite commonly, answers were too vague, such as organisms dying.

Question 11 (standard demand)

11.1 42% of students were able to calculate that the missing column on the bar graph for water loss in faeces was 120 cm^3. A common error was to give the answer '0'.

11.2 45% of students correctly selected 'respiration of glucose' as the metabolic process that produced water.

11.3 89% of students suggested correctly that sweating was the process by which more water was lost through the skin in a person running a 10-kilometre race. 355 of students were able to go on to explain that this was in order to cool the body.

11.4 In order to explain why more water was lost during the race by breathing, it was necessary to give a comparative answer. 54% of students were able to explain that the person would breathe more heavily and / or more frequently during the race. 6.2 of students were able to explain that the rate of respiration would have increased, with 0.5% of students saying this was because of the extra energy needed to run.

Many who did mention respiration did not gain credit as they did not emphasise the increased respiration rate during exercise. The terms respiration and breathing were also frequently confused.

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.