GCSE
Additional Science (Route 2)

AS2HP
Report on the Examination

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General comments

Examiners continue to be concerned about a number of features that would enhance the marks students achieve but which would require very little additional effort on their part. These include avoiding leaving answer spaces blank and using rulers and calculators in appropriate places.

Students should also be reminded that simply copying out the information in the question is unlikely to gain marks and that they must 'add value' to what is given. In some questions this may be as little as making comparisons, using terms such as 'greater' or 'less than'.

Examiners also noted the number of students whose writing was so poor that it was difficult to interpret. Simply, if the writing cannot be read, despite the best attempts of several examiners, then no marks can be awarded. Schools are reminded that there are a full range of access arrangements for students that they can apply for, such as scribes or the use of a word processor.

It was evident that some students had started the examination well, but, as the questions became more demanding, had lost impetus.

In this paper, large numbers of additional pages were used. Students should be reminded that they should answer in the spaces provided and that these spaces are considered more than enough to accommodate an answer, even if half of it is crossed out and replaced. However, should more space be needed, students should use additional pages and not continue answers into the margins.

Question 1

(a) A high proportion of students selected an appropriate way to improve the investigation. Many spotted the varying sizes of the cubes of egg white and suggested that these should be all the same, or that the 'same amount of egg white' should be used in each tube. However, those who suggested the 'same number of cubes' were not awarded the mark as this number was already controlled. Many other students correctly suggested that repetition would improve the investigation. Relatively few, however, suggested one of the factors that might influence the rate of enzyme activity, such as 'temperature' or 'concentration of enzyme'.

(b)(i) Most students at least selected parts of the digestive system. The most common errors were due to a poor understanding of the data; it appeared that students often believed that a shorter time meant that the reaction was slower; and as a result, reversed the two parts of the digestive system. 'Small intestine' was seen more often than 'pancreas', although some omitted the 'small' whilst others suggested the 'large intestine'. The 'liver' was also suggested as a source of digestive enzymes all too frequently.

(b)(ii) If the wrong answer was given for enzyme A in part (b)(i), then this answer was usually incorrect, but not always. Most students could identify that enzyme A worked best in acid conditions or that the stomach contained acid. Again, a number of students seemed to have misinterpreted the data given in the table as they insisted that enzyme A did not work well in acid conditions. Bile was referred to in a surprising number of answers.

(c) There were many excellent answers to this question, giving all the industrial or domestic uses of enzymes given in the specification, along with details of the enzymes, their substrates and products. Often this was given within the first six or seven lines, but students continued to repeat the same information for the rest of the space provided and as such risked falling foul of the QWC descriptor for level 3 ('…organised and logical sequence'). Less successful students still usually managed to come up with sensible statements about enzymes or their uses. The most commonly described uses of enzymes were in (biological) detergent and in baby food. The use of enzymes in the production of slimming products was less well known and the two stage process from starch to fructose was often confused, when attempted. 'Amylase', 'protease' and 'lipase' were frequently described; and examiners were pleased to see both products of lipase activity often given. 'Isomerase' was much less well known.

Those who misread the question and described enzymes in digestion were still able to gain up to four marks for linking enzymes correctly with their substrates / products. There were, however, some students who had clearly not revised this, not insignificant, part of the specification, and struggled to gain any credit, which was disappointing. A few students misread the question to a greater extent and wrote about factors affecting enzyme activity. Such students often gave a very detailed description of denaturation (by temperature and pH), active sites and the effect of concentration, but unfortunately rarely gained any marks.

Students usually gave their responses in good English, well spelt and in an organised fashion, and it was clear that some had a made a special effort in this question.

Question 2

(a)(i) Most students correctly identified 'calcium chloride' as the solution produced in the reaction. Less successful students suggested 'calcium chlorine'. Some added 'water' to their answers although this was ignored.

(a)(ii) 'Carbon dioxide', a familiar gas, was well known, although examiners were somewhat surprised that over ten percent of students still could not name this.

(b) There were many good answers in terms of rate, although some answers stated that there was a rate increase at the start, which negated the first mark. Students were most likely not to obtain the last mark relating to the end of the reaction, as answers simply stated that it was 'plateauing' or 'levelling off' without describing the process occurring. There were many examples of inclusion of data but these were not always linked to the effect on the rate of the reaction.

(c)(i) A large proportion of students realised that the line would be steeper due to the higher temperature and correctly drew the line to the left of the original; however, it was not uncommon for the line to start appreciably above the origin and this disqualified the first mark. If the second mark was not obtained it was usually because the line was levelled off at higher volume.

(c)(ii) This was well answered by many students, with at least two of the marks being gained consistently. The third marking point was sometimes missed due to a lack of qualification regarding time, i.e. 'more collisions' – but not, as was required, 'more collisions per unit time'.

Question 3

(a)(i) This was very well answered, with students either stating that plastic is an 'insulator' or giving variations of the acceptable answers on the mark scheme. Some did suggest 'it is a poor conductor', which was not worth a mark, as this implies that plastic does conduct electricity.

(a)(ii) Again this was well answered, with the majority of the students knowing the two correct wires. If they did lose a mark it was because they had named the 'earth' as one of the wires.

(b)(i) Many students gained 3 out of the possible 4 marks for this question. A high number of students correctly calculated the power of the lawnmower using the information in the question and therefore were awarded 2 marks straight away. Some calculated the current each cable could carry and used this value to select the cable. However, a few who did this alternative calculation then mentioned that the current of the cable needed to be lower that 12A so that it did not blow the fuse. In this case they gained 2 marks for a correct calculation, but would limit their final mark to a maximum of 3 for selecting the wrong cable. A small number calculated the potential difference for each cable, despite being told in the question that the lawnmower used the mains supply of 230V. Many students recognised that a flexible cable is required for movement of the lawnmower, although some thought that the cable type was related to the conductance or the protection of the wires. The most common choice of cable was cable number 1, as they failed to recognise that only a two-core cable is needed as the lawn mower is double insulated. Instead, they incorrectly believed that, because a three-pin plug was being used, a three-core cable would be the best, or that an earth wire was needed for 'extra protection'.

(b)(ii) The examiners were hoping that the picture would have helped the students to explain the action of the RCCB, which is knowledge direct from the specification. Unfortunately, many students had no idea how they worked and confused the action with a fuse. Where they did pick up a mark it was by saying the circuit was 'cut off'. However, quite a few did use the common terminology of 'the RCCB trips' which was not enough for credit here. Those who did mention the current in the live and neutral then failed to mention that it is the 'difference' in the two current values that is detected. There were a few students who did, unnecessarily, go into detail about the workings of the RCCB, but failed to answer the question asked.

Question 4

(a)(i) The equation for aerobic respiration was well known and a very high proportion of students gained both marks. Inevitably some reversed the gases and lost both marks. Very few students used chemical symbols but where they did these were accepted, if correct.

(a)(ii) 'Lactic acid' was well known and a high proportion of students gained one mark here. However, the removal of this lactic acid was less well known by many students and often the only further mark gained was for the use of 'oxygen'. Those students who knew what happened to lactic acid during its oxidation usually gave both products, with only a small number explaining that it might be used to reform glucose.

(b) Surprisingly, few students appeared to recognise the theme running through this question. Earlier parts should have drawn their attention to both aerobic and anaerobic respiration, in particular the need for the removal of the products of anaerobic respiration from the body and its consequential need for additional oxygen (acquired by additional breathing). Hence clear links between lactic acid and fatigue, or the numbers of mitochondria / quality of blood supply to the balance between aerobic and anaerobic respiration, or to oxygen supply to muscles, were only made by more successful students. Some of these answers were very detailed and showed a good appreciation of the difference between the 100m and 10 000m runners.

Responses were often difficult to mark as they were not set out as an explanation of the differences between the two runners. Many answers would describe events in the muscles of the 100m runner separately from those for the 10 000m runner. These meant that the examiner had to hunt through the answer for the appropriate comparisons. Merely copying out parts of the table given in the question was not sufficient to gain any marks. Similarly, comparing muscle fibres rather than runners was not creditworthy. Reference to anaerobic respiration in the 100m runner and aerobic respiration in the 10 000m runner was the mark most often awarded. References to the lactic acid produced or the different oxygen debt were less common.

Question 5

On the whole, this question was not well answered. Students appeared to have difficulty expressing their ideas coherently and often contradicted themselves or used technical terms incorrectly.

(a) A relatively small proportion of students appeared to know the meaning of 'heterozygous', which inevitably had a major impact on the quality of response. Those who appeared to know the correct definition often only gave half an answer, that there would be 'another allele / gene for normal colour' or that the albino trait must be 'recessive'.

(b)(i) Somewhat less than a third of students appeared to know the overall structure of DNA as being 'double helix'. Those who did gain the mark usually quoted those two words, whilst others attempted descriptions, such as 'a twisted ladder', which were accepted as they conveyed both ideas. Weaker answers often omitted the 'twist' idea; and 'ladder', without that qualification, was considered to be insufficient for the mark. Those students who struggled to describe the structure in words often added a diagram, and again, if reasonably correct (i.e. showing both of the required features), the mark was awarded. There was evidence of confusion of scale by some students, suggesting that 'DNA is made of chromosomes / genes', or that 'DNA is made of amino acids or proteins'.

(b)(ii) As has often been the case in biology specifications, knowledge of protein synthesis is very weak in the majority of students. The idea that DNA is a 'code' gained some students a mark; but the idea that this code is responsible for the 'linking together of amino acids' in a 'correct order' was clearly not something that many students knew or could express. Consequently, marks for this question were very poor.

Question 6

(a) Two ideas needed to be expressed in order for the mark to be awarded. In the first case, students needed to be aware that the definition of species refers to reproduction. However, the definition goes beyond this and many students failed to add the necessary qualification that the offspring of breeding between members of a species are themselves 'fertile'. Less successful students often suggested that members of a species 'look the same' or 'live together'.

(b) Many students started their responses well, explaining that the two populations of iguana would be 'isolated' from one another. This often continued in a description of different conditions on the two islands, either as a bald statement or by quoting specific biotic conditions, such as 'food availability', 'predators', or a physical factor such as 'temperature'. At this point many answers began to break down and the last two points in the mark scheme were much less well known. Breeding with other reptiles on Anguilla was not an uncommon suggestion.

Question 7

(a) A good proportion of students correctly identified 'exothermic' as the type of reaction which gives out energy.

(b)(i) More successful students related the small pieces to a larger surface area and then to an increase in the rate of reaction. Less successful responses either stated that there was a smaller surface area, or were related to ideas such as smaller particles being able to move more easily or larger ones heating up too much and burning the person. Several students suggested that larger pieces would 'burst the bag'.

(b)(ii) The correct symbols were rarely given, with 'Fe_2', 'Fe^{2+}' and 'O', along with other random elements or ions, being more often given. '$Fe_2 + O_3$' was a very common response. Most students who gave the correct symbols were able to balance the equation, although an appreciable number gained just one mark for the '$2Fe + 3O \rightarrow Fe_2O_3$' route.

(c) Students were able to use the information given in the table to compare the two types of hand warmer, with the advantage of the disposable being warmer for longer, and the disadvantage that the disposable did not reach as high a temperature, being the usual responses seen, though a few students just stated the figures without giving a comparison.

Answers in terms of being able to reuse the reusable hand warmer were often given without students realising the need to add value and give an answer such as 'it could be used again', or explaining the difficulties of having to use boiling water to regenerate the hand warmer. Few students gave responses in terms of the energy requirements or safety aspects of reversing the reaction.

The question did ask for an evaluation and there were many good attempts seen, with most creditworthy answers referring to the idea of the reusable warmer not staying warm for a sufficient length of time for a long walk.

Question 8

Generally students did not demonstrate much knowledge or understanding of the preparation of insoluble salts by precipitation. The question had two distinct parts: the naming of the soluble salts to be used; and then a description of the method to be used. Few were able to interpret the information in the table to give the two soluble salts necessary to prepare silver bromide. The soluble salt they were most likely to correctly identify was 'silver nitrate'. Many students actually started with 'silver bromide', despite being asked to prepare it. 'Bromine' was a very common suggestion. Many did not use the table at all and just suggested a random array of reagents.

There were some very clearly written and well understood methods seen in response to this question. However, few realised that the process required was precipitation, with a wide range of processes mentioned. 'Electrolysis' was very common, as were 'filtration' and 'evaporation', but without mention of an insoluble salt. The descriptions given were often those used in the preparation of soluble salts, for example, 'evaporation' and 'crystallisation'.

Even if the salts had been correctly identified, solutions were rarely mentioned, which meant that the mixing mark was difficult to award. Though many students appreciated that filtration was necessary at some point, there was little understanding of what filtration was meant to achieve and what to do with the residue and the filtrate. Many students then went on to crystallise the product in the filtrate, which was incorrect.

The last marking point was virtually never awarded. Even the most successful students omitted the need to wash a residue before drying. This, on the whole, did not penalise students as they were able to achieve full marks from the previous marking points.

Question 9

(a)(i) This was, in general, well answered, usually in terms of the process being 'cheaper', which was then qualified by 'using less energy'. Most used the idea that less energy was required, often qualified with a reference to the cost, which was ignored. Incorrect responses were usually based around a 'rates' argument, suggestions that it was molten 'quicker', or the idea that the lower temperature was reached 'faster'.

(a)(ii) This again was well answered by some students. Those who missed out on marks tended to give no indication of ions being free *to move*, only mentioning 'free ions' and 'free' or 'delocalised' electrons.

(b)(i) Students either demonstrated a good understanding or a total lack of understanding of the process. There were a few examples of correct symbols which were then altered to Na^{2+} or an altered electron number.

Others failed to realise that sodium was produced, despite the information in the question, so didn't include sodium as a product. Other common incorrect responses included '$NaCl \rightarrow Na$' or '$Cl^- \rightarrow Na^+$'. Others who did not know the symbol for sodium failed to look on the periodic table and often started with 'So' or 'SC' as the symbol for sodium.

(b)(ii) Only about a third of the students correctly gave 'reduction'. A wide range of other suggestions was offered, along with a considerable number who could make no offer.

(b)(iii) This was, on the whole, poorly answered with very confused responses, showing a lack of understanding of the chemistry of the processes occurring at the positive electrode. Many students confused the process and gave descriptions of aluminium oxide electrolysis, carbon dioxide being produced, or electrolysis of aqueous sodium chloride. Others gave responses in terms of electroplating.

The first marking point was most frequently achieved in answers, though there were many low level responses simply referring to 'opposites attracting'. Reasons for incorrect answers included use of 'chlorine', as opposed to 'chloride', and 'atoms' rather than 'ions' being attracted. There were a number of occasions where it appeared that students believed that the electrodes themselves were moving.

The second marking point was frequently mistaken for electrons being gained. Contradictions were evident, such as 'losing electrons which is called reduction', and the idea that electrodes lost or gained 'electrons' rather than 'ions'.

Marking point three was the least common, with little understanding that an atom or molecule would be produced. There were many examples of hydrogen and sodium hydroxide being formed, suggesting that students misread the question and thought they were answering in terms of sodium chloride solution.

The final mark was for an idea of the final, bulk product; chlorine. A good number of students did realise that this would be formed.

Question 10

(a)(i) About half the students gained the two marks for the correct atomic and mass numbers; and about half were awarded no marks or did not attempt the question. In order to successfully complete this question, students had to know three things: the structure of the alpha particle; which number represented the atomic number and mass number; and how to complete a nuclear equation. Clearly quite a few students did not know at least one of these three.

(a)(ii) The examiners were looking for knowledge of the penetration ability of alpha radiation; and then the ability to link this to the effects when the radiation is either outside or inside the body. Many students knew that alpha radiation 'couldn't pass through the skin' or 'the chocolate wrapper' or that it 'doesn't travel very far in air'. A few referred to it being 'weak', but did not expand on this.

The second mark was awarded for recognition that when the chocolate was eaten, the radiation was now inside the body and therefore harmful. The majority of students missed the subtlety of this and repeated what they were told in the question, or failed make any reference to the fact that it was dangerous when inside the body.

Only a few students attained the third marking point by mentioning the 'ionising' nature of the radiation and that it can 'cause cancer'. For those who did not gain the mark here, answers were vague. Some referred to alpha radiation not being able to escape when inside the body with no other information; and there were quite a few who wrote about chemical reactions and digestion of radium into other less-harmful substances.

(b) This should have been a straightforward question for the students, reading a single number directly from the graph. The only aspect which made it more demanding was the units on the time axis. Just under half of the students managed to gain 2 marks. Those who did lose a mark did so by not looking at the axis carefully enough and giving an answer of '1.6'. There was quite a high proportion of students who did bizarre things with the numbers from the graph as they clearly had no idea of the concept of half-life.

(c) To gain full marks for this question, students had to pick Technetium-99 and give two reasons, but students could gain at least one mark if they picked either of the other two radioactive substances and then gave a correct physics statement as per the additional guidance on the mark scheme. A good number of students selected the correct isotope and justified it by its half-life, only gaining 2 marks. Quite a few thought that gamma 'causes no damage' as it 'passed through the body'. Radon was a popular incorrect choice justified by its half-life, but many thought that its alpha radiation was somehow safer, perhaps using their misunderstanding from the previous question. Quite a few repeated the information in the table without adding further explanation; and some answered the question without mentioning which isotope they were referring to.

Question 11

Much of this question assessed the students' knowledge of the fusion section of the specification. There were a good number of students who knew this topic well; however, there were too many who had not studied the main points as outlined in the specification.

(a) The examiners were a little disappointed with the number of students who gained no marks on this question. Quite a few failed to mention 'dust' for the first mark; and omitted the idea of 'gravity' for the second mark. Some students lost marks by explaining the process of nuclear fusion.

(b)(i) Again, this was disappointing. Rather than giving the answer in a clear concise way, the majority of students tried to explain the forces acting in a detailed way and often ended up with incomplete answers.

(b)(ii) Students' knowledge of the life-cycle of a star was good and there were quite a few who went into considerable detail, including aspects of the cycle that are not examined in this specification. Many students unfortunately lost a mark by writing 'super red giant' rather than 'red super giant'. Other marks were generally lost by getting the order incorrect, or by saying that a black hole is formed *from* a neutron star. A diagrammatic response was also creditworthy here and a small number did choose this option and generally gained full marks.

(c) There was a good spread of marks for this question. There were quite a few different ways to gain credit, depending on how the information was interpreted and then communicated. From the previous question the students seemed to know the life cycle well and so they were able to gain marks here by explaining the idea that 'not all stars explode'. They articulated this in the variety of ways described in the mark scheme. Less well known was the fact that only elements up to iron are created in stars. Often, the part of the answer dealing with this idea was vague, describing 'lighter elements' or 'only hydrogen and helium' being made in stars.

Mark Ranges and Award of Grades

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

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

UMS conversion calculator www.aqa.org.uk/umsconversion