GCSE

Additional Science (Combined)

AS2HP

Report on the Examination

4409

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Additional Science Paper 2 Tier H

General

Students who scored very low marks might have been better served being entered for the Foundation tier examination.

Students should 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’.

Question 1

(a) The majority of students gave the correct answers, ‘carbon dioxide’ and ‘water’. Only a very small percentage gave neither of these responses. Chemical symbols were acceptable alternatives and it should be noted that biological units accept formats of these symbols that would not be accepted in Chemistry units.

(b)(i) Only a very tiny proportion of students failed to use the equation given to calculate a cardiac output of ‘2400’.

(b)(ii) Many of the students who failed to arrive at the correct answer ‘1392’ had contrived to include the value for blood flow to the muscles at rest, 728, in their calculation. Even so, most students gained the two marks available. The two marks were also available for students who had given the incorrect figure in part (b)(i), provided this had been used in the correct calculation.

(b)(iii) There were many possible ways that students could achieve the four marks available here. Having been instructed to refer to both blood flow and respiration, then for all four marks to be awarded at least one of these marks had to be derived from each of these areas. The repetition of Figure 2 along with the provision of the equation for anaerobic respiration should have provoked students to realise that these should both be referred to. Even given these hints a significant minority of students failed to gain any credit. Examiners expected that students would recognise that the blood flow to muscles increased during the free-dive and that the blood flow to other organs decreased during the free-dive. Each of these observations would have gained a mark. Furthermore a comparison of the reactants and products of anaerobic respiration with those for aerobic respiration, from part (a) or recalled from revision could have generated a further four possible marks. There were further, less straightforward ideas that could have provided marks. Only around a quarter of the students gained three or four marks.

Question 2

(a) Many students who had correctly identified the reactants and product then lost the mark as they omitted ‘acid’ from their answer. Aqueous was often included with carbonic acid.

(b)(i) Students usually made the link that pH4.1 was an acid and gave citric acid but were often not able to make the link to the information given to answer carbonated water.

(b)(ii) This was poorly answered as though many answers involved an acid only very infrequently was an ion given. 'Citric acid', 'carbonic' or 'carbonate' were the most popular responses.

Question 3

(a)(i) Just under half of the students correctly answered that copper oxide is a base, with salt being the most common distractor.

(a)(ii) Most students correctly named the acid as sulfuric acid, though sulfur was a frequent incorrect response.

(b)(i) The mark was most frequently obtained by a response relating to the insolubility of copper oxide. Few answered in terms of copper oxide being in excess as all the acid had reacted. Incorrect responses often described copper oxide as the product of the reaction or as a precipitate.

(b)(ii) There were good answers seen from students who had obviously carried out the practical and gave detailed descriptions of the process. Others often missed the filtration step but gave answers showing a good understanding of the crystallisation process. Weaker answers gave a random array of processes or didn't appreciate that the reaction had already been completed.

(c) Many good answers were seen linking all the ideas together, though some students failed to give both that the particles would have 'more energy' and would 'move faster'. 'More collisions' was insufficient for the third marking point with there having to be an idea of the frequency of collisions increasing.

Question 4

(a) This was poorly answered. Students needed to include reference to 'nuclei' in their answer and unfortunately many wrote about the joining of atoms or particles or named subatomic particles. A few repeated what they had already been told or said that the process 'produced energy'. Some mixed up fission for fusion or discussed fusion within stars. There were a number of answers mixing up this with some kind of chemical reaction.

(b) The students either knew this answer or they named another part of a star's lifecycle.

(c)(i) Students needed to mention mass in some way and not just 'bigger' or 'smaller'. They also had to mention the effect on time or imply it, but not 'lower life cycle'. The majority of students answered this well. It is worth reminding students that when they are giving answers about data in tables that not only does their answer match the data but also that it makes scientific sense. So an answer 'the shorter the stars life cycle the bigger the mass' would not gain a mark even though it fits the data. The idea that life cycle time has an effect on mass is incorrect. There were a few students who tried to make a conclusion about a particular star e.g. 'Star J is the …..' rather than discussing the data as a whole.

(c)(ii) There were many vague and trivial answers to this question. The estimated times for the life cycle were millions of years so the idea that no one was around to see a complete life cycle was too weak to be awarded a mark. Many mixed up the idea of an 'estimate' with 'mean' and gave answers about variations in star data, e.g the stars mass varies etc.

A few did mention too long to measure or lack of evidence. However 'no evidence' was not worth credit.

(d) The mark scheme seems like a long list of points they have to mention and many of them are not points on the specification. However, these are points which were worthy of credit and were seen in students responses. Each point represents an idea and how well the students express their ideas scientifically will lend more weight to its creditworthiness. The majority of students only attempted to describe the process of nuclear fission. This by itself only allowed access to level 2 by failing to describe how the energy is then used. The majority of the students knew that fission involved some kind of splitting, but struggled to articulate what caused the splitting and what actually split. The use of 'atom' instead of 'nucleus' was allowed once as was 'particle' instead of 'neutron'. Many were good at explaining the idea behind a chain reaction. When it came to describing how energy is used in a power station about half didn't answer, a further quarter attempted a vague description and the remainder gave good descriptions. These latter students were usually the ones who also scored well on the fission process and therefore attained Level 3. The vague responses usually omitted some key elements between the links e.g 'heat creates steam then turns a turbine to produce electricity'. The process of how the energy is used is highlighted in a sentence at the beginning of section P2.6 in the specification and it is worth remembering these sections are as important as the individual content sub sections.

Question 5

(a)(i) Only a little over a third of students were able to name both products of lipase digestion, 'fatty acids' and 'glycerol' Some of those who did not give the latter answer confused it with other similar terms, 'glucose' or 'glycogen', whilst others simply suggested 'fat' or appeared not to recognise the term 'lipid'.

(a)(ii) Most students could identify a site of lipase production in the digestive system, the 'pancreas' was much more commonly given than the alternative 'small intestine'. Those who did not give a correct answer offered a wide range of other digestive organs along with some that were not part of the digestive system.

(b) Most students gained at least one mark here. Many referred to either the reaction 'not working' or words to that effect, or to the enzyme being 'denatured'. Descriptions of denaturation are acceptable and many gave these, as well as the simpler 'destruction'. However those students who described the enzyme as being 'killed' or 'no longer alive' were denied this mark irrespective of reference to denaturation. Some students did not realise the effect of high temperatures on enzymes and often described the reaction occurring in even less time.

(c) At least one idea about the activity of the liver, producing 'bile' to 'neutralise acid' was known by many students. However a significant minority could not offer either of these ideas.

Question 6

(a) Many students described poor fossilisation of ‘the bones’ of early life forms; it was clear that these students had little concept of the nature of such life forms. However many did describe these early life forms as being ‘soft-bodied’ or being composed of only one or a few cells and although this was often not followed up to explain why the evidence of their appearance was unavailable, around a quarter of the students were able to explain this.

(b)(i) Many students described the formation of the Isthmus of Panama ‘separating’ or ‘isolating’ different populations of the ancestral pork fish. These students usually went on to attempt to describe the different conditions on either side of the isthmus, although this description often failed to score the mark as the conditions in either habitat were described as ‘new’ rather than ‘different’. Some students saved this mark by describing specific biotic or abiotic conditions, such as ‘different temperature’ or ‘different predators’. However, for many students this was as far as they got as there was no reference to ‘genetic variation’, ‘natural selection’ or ‘the onward passage of alleles’. Instead these students then went directly to definitions of ‘species’, which was not required here, so was ignored by examiners.

(b)(ii) That species ‘cannot interbreed’ was often only repeated, in different ways or that these species showed ‘variation’. Alternative inadequate answers included explanations involving ‘successful’ interbreeding.

Those students who gained the mark here recognised that variation alone is insufficient, as all individuals of a species, barring clones, will show variation, instead the variation must be ‘too great’ or the differences ‘too many’ for interbreeding to occur.

Question 7

(a) Many students realised that lack of the small winged phenotype in the offspring meant that the allele for normal wings must be ‘dominant’. Relatively few however went any further and were unable to explain that the normal winged parent must also be homozygous, as a heterozygous normal-winged parent would result in some small-winged offspring. Those students who drew genetic diagrams for this cross often picked up the mark by showing the normal-winged parent to be homozygous.

(b)(i) Some students contradicted the information in the question that the prediction ‘is correct’, perhaps omitting the first word in what they read, believing the question to ask whether the prediction is correct. Genetic diagrams usually included Punnett squares and this form of genetic diagram is more likely to provide high marks rather than the alternative diagrams showing connecting lines. Most students showed the parental generation as heterozygous, either as a specific statement or by the gametes in a Punnett square. Indeed the simplest Punnett square could gain three marks. The mark that was most commonly missed was that for identifying the different phenotypes. Each different offspring genotype need to be linked to a phenotype, examiners did not make deductions from partial information provided by students.

(b)(ii) The most common type of response to this question referred to experimental errors of one kind of another. Hence, relatively few students gained the mark here. What was needed was a reference to the 'random' nature of fertilisation or the 'chance' of the resultant ratio matching the prediction.

Question 8

(a)(i) Most students appreciated that the reaction would be faster and placed the line to the left of the original. However many thought that higher concentration meant that more gas would be collected, not realising that the acid was in excess. Most lines were well sketched but there was occasionally either a very thick or wobbly line.

(a)(ii) Most students could correctly identify at least one control variable, though there were many references to measuring the same time intervals and using the same volume of water. Many students answered in terms of amount rather than using the correct technical terms of mass of tablets or volume of acid.

(b) Some very good chemical answers were seen, although students frequently didn't mention that the tablet would be in smaller pieces. Those who went down the biological route, linking with enzymes, saliva etc. rarely scored anything other than the faster reaction mark.

Question 9

(a) Students found writing a balanced symbol equation difficult. 'S' was often given as the symbol for sulfur dioxide and the diatomic oxygen gas was rarely seen with both 'O' and 'O_3' seeming to be more common. Vanadium or vanadium oxide appeared quite often with students failing to appreciate that as it was a catalyst it would not appear in the main part of the equation. Those who gave the correct symbols were often then unable to balance the equation correctly.

(b) Most students knew that catalysts are used to speed up the reaction but then gave descriptions of how catalysts worked rather than realising that the faster reaction would result in lower energy usage which reduces costs. Others talked about speeding up the overall process rather than the specific reaction. Many answered in terms of catalysts lowering the activation energy but did not explain why the catalyst would be used in an industrial process.

(c) A lot of students thought that increasing the pressure of the gases affected the temperature or energy. Few were able to link increased concentration to a faster reaction with many just stating that it gave more collisions but didn't give any link to per unit time for the rate. 'More' is insufficient in this case. Others wrote in terms of an increase in the rate of reaction, which was given in the question without explaining why the rate would change.

Question 10

(a) Few related their answer as to why silver nitrate is used in solution. Even those who did often failed to give the idea of the ions being able to move which was necessary to obtain the mark. A variety of different incorrect answers was seen giving little indication of any understanding of the process. Some gave answers which lacked detail such as ‘so can conduct electricity’ or gave incorrect responses such as delocalised electrons being present in silver nitrate solution to carry the charge.

(b) Overall there was little understanding of the process occurring at the negative electrode, with less than a fifth of students being able to correctly complete the half equation. Despite being given Ag as the product many students did not realise that you therefore needed to start with silver. A few didn’t use the data table and started from Ag^{2+}. Others gave a variety of atoms rather than ions, with ‘copper’ and ‘nitrogen’ being very common. A large percentage did not realise the need for electrons in a half equation and reacted two substances together.

(c) There were a few excellent answers seen but this was a difficult question which demonstrated a lack of understanding by most students of the processes involved in plating. Students who stated decrease rarely linked their response to silver plating on to the copper cathode and those who said increase rarely wrote about silver ions being formed initially at the anode.

Question 11

(a) A high number managed to gain 2 out of 3 marks for this question. The common errors were to miss the ‘+’ from the proton charge and writing ‘small’ or ‘neutral’ as the neutron charge.

(b) In the specification ‘an atom which has lost or gained an electron is a charged particle called and ion’. Therefore examiners were looking for knowledge of what an ion is rather than another name for an ‘ion’ so examiners ignored reference to ‘charged particle’. Very few were awarded the marks many wrote about ‘particle’ for ‘atom’ or about subatomic particles being ions. As this was a combined paper a few added information from their Chemistry knowledge about having full outer shells, which although possibly incorrect, was ignored.

Question 12

It is worth reminding students that parts of questions tend to follow on from one another and information given in one part can help them in a later section. This question gave a story about an experiment culminating in the identification of the types of nuclear radiation under test. Unfortunately the majority of students failed to realise the connections.

(a) Few students recognised the reason using a mean was because of the random nature of radiation and instead gave ideas about improving the results in some way. If they mentioned improved precision this negated the mark.

(b) The majority of students failed to recognise they were told the value of the background count and connect this to the value where the graph levels off. They gave incorrect answers in terms of the GM tube being too close and always detecting radiation or being too far away. When they didn't mention 'background' they could still gain credit by the idea that radiation is always in the air, but not 'radiation is always there'.

(c)(i) & **(c)(ii)** The vast majority did not make any reference to the graph which limited their total marks. A high number failed to link what they were told about background count to the background count in the table. All of this meant there were a variety of answers for these two questions which the examiners deciphered to make a decision as to what was correct physics and what was correct interpretation of the data. Therefore for **(c)(i)** students could get the type of nuclear radiation incorrect but still gain marks if they had interpreted the table correctly and identified that the radiation was stopped by thick paper or aluminium. Unfortunately many thought it was 'beta' as it could penetrate paper (even though the count was the same as aluminium). For **(c)(ii)** gamma was a common answer but students often answered in generic terms saying 'gamma gets through everything' rather than linking answers to the materials in the table.

Question 13

(a) This was not answered particularly well. It was clear students either knew the action of a fuse or what the earth wire was for, but only a few could connect them together. Those that knew the workings of the earth wire and fuse usually managed to get 3 marks and lost a mark for missing one of the steps out. The most common step missed was the idea the current in the earth wire and therefore live wire is initially larger than normal. A high number of students articulated their ideas vaguely as the earth 'taking away the current' or 'redirecting the current away from the casing', but then didn't go on to answer the question. A number said the 'earth wire stops electricity'.

(b) To be awarded marks the students needed to add value from the statements in the table, not just repeat what was in the table. A common mark gained was for the an idea it is 'safer' and examiners allowed 'less dangerous' or 'less likely to be electrocuted' but ignored references to dying such as 'less people die with RCCB than fuses' unless detailed qualification was given. Quite a few gained a mark for the idea that the RCCB works quicker or faster. Not many gained the 'don't need any fuse wire' mark as they tended to express the idea that a fuse needed replacing which wasn't worth credit.