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GCSE Biology 5025

Multiple Choice Paper B1a

Foundation Tier

Overall candidates accessed the paper well although a large number attempted both tiers of the paper. Simple recall knowledge on the subject of genetics at the start of the paper was not well answered with only 54% of candidates able to correctly identify that genes are made of DNA and only 62% able to recall that chromosomes are found in the nucleus of the cell. This is rather surprising as many previous papers have asked similar questions and these marks were simple recall marks. Candidates' knowledge of fossils as evidence for evolution was good but only 64% of candidates could identify that the lowest layer of rock was most likely to contain the oldest fossils. On a positive note candidates are now showing clear knowledge of food chains and are able to interpret data on the food chains and the effects of changes within the food chains although knowledge of how this then relates to pyramids of biomass and pyramids of numbers is still low. Knowledge of natural selection and adaptation was very good in this paper with over 80% of candidates able to gain the marks in this section.

The crossover questions which cover the C/D boundary were less well accessed especially relating to classification of organisms and attention should be directed to point B1a 1.11 of the updated specification which asks candidates to be able to explain the principles of classification including the use of phylum, class, order, family, genus and species and the main characteristics of the five vertebrate groups. Only 56% of foundation candidates were able to identify the characteristics of a reptile with even less able to correctly classify organisms. Finally, computer modelling also caused candidates some problems with only 42% of candidates able to access questions based around specification point B1a 1.6 referring to advantages of computer modelling.

Higher Tier

Candidates performed fairly well across the paper but as with the foundation tier candidates there were problems in the interpretation of questions on classification although this is improving in areas where the classification is related to humans where 84% of higher tier candidates were able to correctly identify *homo sapiens*. Computer modelling also proved a problem as with the foundation tier with only 56% of candidates able to correctly identify advantages of computer modelling.

The 'How Science Works' topics of the paper are being answered much better with the candidates answering over 80% of the questions on organic farming correctly. There is still confusion regarding the genetic modification of organisms using enzymes to both cut and stick the DNA together. General questions on genetics were answered well in the later part of the paper and the ethics question was particularly well answered with 84% of the candidates getting the correct response. Questions which required candidates to draw a Punnett square (monohybrid cross diagram) in order to gain the correct answer were poorly answered with only 42% of candidates answering correctly. This is specification reference B1a 2.6 of the revised specification. Finally the process of cloning was poorly understood attention should be directed to the glossary terms for B1a which are important for the candidates to know and understand.

GCSE Science 5006
GCSE Biology 5026

Multiple Choice Paper B1b

Foundation Tier

The majority of students (92%) performed exceptionally well on the first question indicating clearly their awareness of the link between cigarette smoke and lung cancer despite the context in which the question was written. However, student responses for the three remaining questions in this section of the paper were disappointing with a general lack of knowledge evident in other aspects of this particular topic. For example, only 34% of students correctly identified carbon monoxide as being the substance that reduces the amount of the oxygen that red blood cells carry. 47% of students incorrectly named this substance as tar. It is possible that the terms 'lung cancer' and 'tar' are far more familiar to the students in relation to cigarette smoking than carbon monoxide which may not be emphasised as frequently as other terms and is therefore less memorable as a destructive substance in cigarette smoke. Surprisingly, 62% of students wrongly identified the blood as carrying microbes that cause lung infections in smokers rather than 'air'. Just under one third of students answered this question correctly.

It is clear that foundation level candidates have still not grasped the concept of reaction time. Statistical evidence suggests that there is still a great deal of misunderstanding of reaction time with only 43% of candidates completing this question correctly. It is likely that a larger number of students, 54%, chose an incorrect answer – '(Matthew's reaction time was) faster than the team average' as the length of the bar in the graph was actually longer than the other bar present in the graph although the length of the former in comparison to other bar present clearly indicated a slower reaction time. Similarly, students appear to still have problems with straightforward recall questions related to the nervous system. 39% of candidates correctly recognised the iris reflex being the reaction that takes place in response to light with 36% of students incorrectly identifying it as the pupil reflex.

The section of the paper that focussed on body defences was answered very poorly with statistics spread almost equally across the answers for each of the questions in this section. This possibly suggests some guess work involved in answering these questions and this was more apparent in the question involving a simple percentage calculation and also in the question where candidates were expected to understand that white cells produce antibodies. In the latter, only 28% of students gained a mark for their response where another 28% of students thought that antibodies produced antigens. 29% of students were also under the impression that white cells destroy antibodies.

A mixture of responses was obtained from the questions based on epilepsy with a good number of students recognising the EEG trace from a person suffering from a epileptic seizure. More general questions on the brain structure were not answered as well and less than a third of students were able to correctly name the structure indicated on the diagram of the brain as the cerebral cortex.

Foundation/ Higher Crossover Questions

The crossover questions, questions 17-24, provided clear discrimination between foundation and higher level candidates in many cases. More able foundation students performed well on many of these questions, particularly those requiring graphical analysis although it appears that the less able higher tier candidates did not perform so well on

other questions. It was surprising that 25% of higher tier students and 28% of foundation tier students incorrectly identified red blood cells as being responsible for transporting insulin around the body. Only 46% of higher tier students and 31% of foundation tier students gained credit for their response to this question.

Higher Tier

It appears that only the more able students in the higher tier are clearly able to recall information relating to the hormones of the menstrual cycle. For one particular question where students were asked to recall the comparative concentrations of oestrogen and progesterone during menstruation only 17% of candidates were able to come up with the correct answer. Student responses to the other questions in this topic were more encouraging although the statistics do indicate that many candidates continue to struggle with the somewhat complex nature of this cycle and the intricacies involved.

In a similar way to foundation tier candidates, the majority of higher tier candidates also had problems with the question relating to reaction times although in this particular case further 'help' was provided to direct more students to the correct response. It has been shown in previous papers that students generally have a good understanding of how certain drugs affect the body, more notably the effects of cigarette smoke, alcohol and cannabis. Statistics again imply this to be the case for question 30 where students were able to correctly identify cannabis as a depressant but a majority of candidates then go on to incorrectly determine that cannabis decreases reaction time. 42% of the students lost their mark by stating this whereas only 32% of candidates came up with the correct response being that cannabis and alcohol 'increase reaction times and are depressants'. As stated in a previous examiners report, candidates still seem confused over the concept that decreased reaction times mean faster reactions.

A broader range of students are becoming much more adept in their understanding of fertility treatments and the ethical issues surrounding such topics. The questions within this section of the paper were generally answered well with many C grade candidates scoring marks on questions bordering on B grade level. The question involving a more complex percentage calculation than seen earlier on in the paper was well attempted by many students with 66% arriving at the correct answer of 18 700.

The majority of the final four questions also acted as good discriminators between A*, A and B grade candidates. Many of the questions in this section were written in a context that was very likely to be unfamiliar to students but a good number of the more able students gained credit for their answers. A fair number of the more able candidates were able to link the effects of an HIV infection to the incidence of TB and to its effects on the immune system and similarly, a good number of higher tier candidates appear to understand the treatment regimes in place for people suffering from TB. A large number of students, ranging from C to A* grade, are clearly aware of how TB is transmitted with 79% of candidates giving correct responses to this question.

GCSE Science 5007
GCSE Chemistry 5035

Multiple Choice Paper C1a

Foundation Tier

Only 27% of candidates knew that at room temperature chlorine is a green-yellow gas, 51% thought that it is a colourless liquid and 16% a solution. Only 33% recognised that the heating of copper carbonate to produce copper oxide and carbon dioxide is an example of thermal decomposition with 46% suggesting that it is oxidation. 60% of candidates thought that a gas that is very soluble in water can be collected over water. Only 50% knew that sodium chloride is common salt. Only 23% of candidates knew that a pale green precipitate is produce when sodium hydroxide solution reacts with a solution containing an iron salt: 40% chose copper and 22% potassium. Only 43% of candidates knew that a yellow flame is produced by sodium salts with 29% choosing carbon. Only 51% knew that the symbol for iron is Fe with 32% choosing Ir. Only 39% of candidates recognised the reaction of sodium hydroxide solution with dilute hydrochloric acid as neutralisation with 26% thinking that it is thermal decomposition. Only 25% recognised that the solid produced when silver nitrate solution and sodium chloride solution are mixed is an insoluble salt, 27% thought that it is a soluble salt and 33% silver. Only 24% knew that when copper oxide is changed into copper the copper oxide is reduced, with 40% thinking that it is oxidised. Despite being told that aluminium is a much more reactive metal than copper, 42% chose as the method of extraction, heating aluminium oxide with carbon but using a lower temperature than that used for copper oxide with carbon. Only 35% knew that the formula of copper oxide is CuO with 26% choosing Co and 21% CO. Only 28% of candidates knew the test for ammonia.

Higher Tier

As would be expected, higher tier candidates performed better than foundation candidates on questions 17 to 24 but some of the weaknesses indicated above were still present with only 47% of candidates knowing the test for ammonia.

In Q 29 only 40% could identify the correct order of reactivity for the metals lithium, sodium and potassium. Only 28% could identify the correct equation for the reaction of potassium and water with 36% choosing the equation with monatomic hydrogen. In Q31 only 36% could correctly identify the reaction that would take place between a halogen and a halide salt. Preparation of insoluble salts was not well known with only 29% choosing to mix solutions in Q32 and only 28% choosing filtering, washing and drying in Q33. Only 15% could correctly identify the reagents that can be added to dilute hydrochloric acid to form zinc chloride. 24% believed that zinc cannot be used, 27% that zinc oxide and zinc hydroxide cannot be used and 33% that zinc oxide cannot be used. Only 27% answered Q37 correctly with 54% thinking that citric acid is used in vinegar. Only 24% knew that sulphuric acid and ammonia react to produce a compound used in fertiliser with 47% thinking that sodium nitrate and ammonia react. Knowledge of baking powder was weak with 53% believing that it is pure sodium hydrogencarbonate and 90% thinking that carbon dioxide is released mainly by thermal decomposition.

GCSE Science 5008
GCSE Chemistry 5036

Multiple Choice Paper C1b

Foundation Tier

All areas of the specification were accessible. There was some evidence to suggest that a more careful reading of the questions would be beneficial.

The first 8 questions were generally well answered.

Candidates understood and could explain items concerned with fuels specified in this unit. However, only 52% gave the correct use for kerosene and 41% thought the formula of carbon monoxide was CO_2. Questions involving the production of alcoholic drinks, and issues associated with these drinks, were understood and were well answered.

Responses to questions on materials such as Teflon showed some confusion. A large number of candidates were unable to interpret the graph concerning the gases in the Earth's atmosphere. Only 21% were able to deduce that nitrogen was the identity of gas X in question 18. Very few realised that hydrogen was the gas least likely to contribute to global warming.

The nature of the new materials specified was well understood but few understood the nature of nanocomposites despite the information given that they consist of nanoparticles mixed with other materials.

Higher Tier

The first 8 questions showed a good knowledge and understanding with the exception of question 19. 72% of candidates were unable to identify hydrogen as the gas least likely to contribute to global warming. A significant number suggested that nanoparticles mixed with other materials are nanocompounds.

Many candidates were unable to work out the correct order of the processes to obtain drinking water from seawater. Questions 29 to 32 involving Twaron were understood and well answered.

The interpretations of information regarding fractions obtained from crude oil were good discriminators. 43% gave the correct response for question 33.

Only 63% of candidates successfully attempted question 34 to identify the lettered fractions used as fuels in cars and lorries.

Questions 36 and 38 involving balanced equations were also good discriminators. 34% of candidates failed to recognise the correct balanced equation when butane is burnt in excess oxygen.

The understanding of the fermentation process was variable. 58% of candidates assumed that oxygen was necessary for a successful fermentation.

Candidates generally performed well with question 39 which involved the understanding of the advantages in developing bio-fuels as alternatives to fossil fuels.

Candidates were reluctant to pick the option 'none of these' when answering items involving a choice of statements. This was the correct choice for question 40 and only 44% of candidates chose this option.

GCSE Science 5009
GCSE Physics 5045

Multiple Choice Paper P1a

Foundation Tier

The entry for this tier was slightly down on November 2007.

The mean mark was 11.9 compared to 11.6 in November 2006 and 10.0 in Nov. 2007. The standard deviation was 3.5 compared to 3.6 in Nov. 2006 and 3.3 in Nov. 2007.

Overall the performance of candidates in the first 16 questions showed that they had been well prepared for the examination. In 10 out of the first 16 questions around 50% or more of candidates selected the correct option.

In particular candidates were very well prepared for questions on solar cells and their environmental implications.

Candidates also showed a good understanding of earthing and safety and generation of electricity.

Candidates struggled with the concept of power with almost 60% thinking that power is energy transferred and not energy transferred per second.

Only 27% of candidates knew how to join four 1.5 V cells to form a 6 V battery.

Only 33% of candidates knew that the useful energy change in a generator is from kinetic energy into electrical energy

Most of the common questions differentiated well between Foundation and Higher Tier students and most discriminated well between weak and strong candidates.

Candidates showed a good understanding of payback time and most were able to answer questions about an investigation using sunglasses. However, a considerable proportion of better candidates did not recognise that a bar chart was the best way of displaying results for a categoric variable.

A disappointing number of Foundation and Higher Tier candidates thought that for a given voltage current is greatest in a circuit with the greatest resistance.

Higher Tier

The entry for this tier was slightly down on November 2007.

The mean mark was 13.7 compared to 13.0 in November 2006 and 12.0 in Nov. 2007.

The standard deviation was 3.5 compared to 3.4 in Nov. 2006 and 3.1 in Nov. 2007.

Candidates once again showed that they had been well prepared for the examination with about 40% or more of candidates choosing the correct response in 12 out of the 16 higher tier questions and 60% or more in 6 of these questions.

Candidates showed a good understanding of solar cells and performed very well in calculations of electrical power and efficiency, but only 18% of candidates could cope with a calculation using V=I x R involving current in mA.

Weaker candidates struggled using a graph to calculate the capacity of a battery and in recalling that an RCCB is activated by a difference in the currents in the live and neutral wires

The thermistor investigation was handled well by many candidates but only 33% could explain what should be done with anomalous results.

Almost 80% of candidates analysed the thermistor graph to give the correct temperature change but, 32% of these thought the temperature should go down.

GCSE Science 5010
GCSE Physics 5046

Multiple Choice Paper P1b

Foundation Tier

Overall, performance on both 'Waves' and 'Space' was almost identical and it was disappointing to note the low percentage of students able to answer even the most straightforward recall items correctly. For example, although 86% realised that a star was smaller than either the Universe or a galaxy, only 69% (the highest percentage of the first 16 items) correctly differentiated between the sizes of the latter two. At the lower end, 85% thought that it was possible for an ultrasound wave to be transverse and only 20% remembered that our Sun was likely to end its life as a black dwarf – nearly 70% chose 'a black hole'.

Overlap Questions

Higher level students performed better on the overlap questions than those entered for foundation level. The major problem was when comparing analogue and digital signals where, although many knew that analogue signals were more affected by noise, considerably fewer realised that analogue and digital signals travel at the same speed. It was disappointing to find that as many as 42% of foundation students (25% higher) thought that asteroids orbit the Solar System and 37% at foundation (31% higher) thought the force of gravity on them was zero.

Higher Tier

Students generally did not understand what a black hole is. As many as 42% thought black light could escape from one and 53% thought friction was, at least in part, responsible for preventing other colours from escaping. The qualitative appreciation of accuracy shown in measuring spectral lines was quite low. As many as 31% of students thought that the curved paths followed by earthquake waves are the result of them being repelled by the Earth's core and 44% thought that telescopes scan the radiation that asteroids emit rather than reflect. More than half the candidates overstated the conclusion that can be drawn from studying a photograph of a moon. 32% concluded that the moon had craters all over it even though they can only see one side. Many others stated that the craters were caused by meteorites, without any visual evidence, and 5% even thought there was sufficient evidence to extend this single observation to **all** moons! On the other hand, candidates could identify a conclusion made by another student quite well (74%) and two-thirds realised that the experimental model suggested why scientists cannot **predict** the occurrence of earthquakes.

GCSE Additional Science 5015
GCSE Biology 5027

Multiple Choice Paper B2

Foundation Tier

It is very good to see foundation candidates able to access practically based questions showing that the 'how science works' part of the specification is being much better understood than in previous papers. In these questions 86% of candidates were able to identify the investigation and 56% were able to identify the control for the experiment. Interpretation on information regarding respiration was less well accessed with only 39% of candidates able to correctly identify the method of oxygen getting into cells as diffusion. Attention should be directed to the glossary words in the specification which candidates need to be able to recall, explain and describe. Candidates had problems with applying their knowledge of simple plant cell structure when relating it to a root hair cell with only 21% of candidates able to recognise the cell wall and only 47% able to identify the nucleus as the place where chromosomes are found. Graph interpretation of predator-prey relationships was not well carried out with 63% of candidates getting the incorrect answer.

The crossover questions were answered better by the higher tier candidates than the foundation candidates as is to be expected although the questions were well completed by all candidates. Questions on the carbon cycle showed in general 50%-60% of foundation tier candidates gaining the correct answer but only a disappointing 34% of foundation candidates able to recognise methane as a major greenhouse gas. Data interpretation on recycling was well answered which again shows evidence that candidates understanding of the 'how science works' part of the specification is improving.

Higher Tier

Higher tier candidates accessed the crossover questions very well with 79% of candidates able to correctly identify decomposers in the carbon cycle and 91% able to recognise that combustion contributes to global warming. On the topic of recycling the data interpretation was very well completed with over 70% of candidates able to answer all these questions correctly.

Pollution is very well understood as is conservation including the multiple answer question on genetically modified organisms where 76% of candidates answered correctly. Interpretation of experimental data on plant minerals was less well accessed with only 31% of candidates able to correctly identify magnesium as being needed for chlorophyll production (specification point B2 3.5). 56% of candidates were able to recognise the reason for having a control in the experiment which shows better understanding of experimental data than previously shown. Candidates showed good understanding of the difficult topics of mitosis and meiosis with 71% of candidates giving the correct response in this section. Cloning is still less well understood with only 33% of candidates able to recognise that the genetic material for cloning comes from a body cell. Finally the process of protein synthesis was answered well although there was some confusion among candidates of the processes of translation and transcription. Overall candidates accessed the paper well both at foundation and higher tiers.

GCSE Additional Science 5017
GCSE Chemistry 5037

Multiple Choice Paper C2

Foundation Tier

The first eight questions were generally well answered and all areas of the specification were accessible.

Candidates understood and could explain the properties of metals, alloys and organic compounds in this unit. A surprisingly large number mistakenly thought that the formula for ethene is C_4H_8 instead of C_2H_4, and 33% thought that the symbol for carbon is Ca.

The questions involving diamond showed a good understanding of bonding. The questions on hand warmers were well answered apart from question 16.

Only 37% of candidates realised that using powdered iron instead of large lumps would increase the surface area of the iron and speed up the reaction. The common misconception is that by using powder the surface area is decreased and therefore smaller.

Questions 17 and 18 showed that the knowledge and understanding of issues concerned with equilibrium and molecular structure is variable. Only 26% of candidates realised that the melting points and boiling points of simple, covalent molecules would be low with 29% of candidates believing that they would be high.

Questions 21 to 24 concerning ionic compounds caused problems. A large number of candidates mistakenly believed that when alkali metal atoms react with halogen atoms electrons are shared instead of being transferred. 54% thought that electrons were shared in the formation of potassium fluoride and the properties of ionic compounds were poorly answered in question 22.

81% of candidates were unable to correctly identify the formula of sodium oxide with NaO_2 being the favourite response to question 24.

Higher Tier

With the exception of questions 19 and 20 candidates found the first eight questions difficult. The understanding of equilibrium in question 17 was variable with only 31% of candidates realising that reactions continue to take place at equilibrium.

The knowledge and understanding of ionic compounds was also problematic. One example was the nature of the bonding between alkali metal atoms and halogen atoms. A surprisingly large number of candidates (55%) thought that electrons are shared between atoms in ionic compounds. The appearance and electrical conductivity of potassium fluoride was known by only 34% of candidates in question 22.

Many candidates could not deduce the chemical formula of sodium oxide in question 24. Only 38% of candidates successfully chose Na_2O with 47% giving NaO_2.

The questions on organic compounds were generally well answered. Surprisingly 45% of candidates described chloroethene as a hydrocarbon in question 27.

Questions 29 to 32 involving non metals and the understanding of dot and cross diagrams were well answered.

Information regarding isotopes and atoms caused problems for a minority of candidates. Only 41% of candidates were unable to give the correct answer to question 33 and 52% correctly calculated the relative atomic mass in question 34.

Candidates generally performed well with questions 35 , 36 and 38 involving the speeds of reactions. The calculation of percentage yield in question 37 caused problems. Despite

being given both the theoretical and obtained yields only 32% of candidates worked out the correct answer.

GCSE Additional Science 5019
GCSE Physics 5047

Multiple Choice Paper P2

Foundation Tier

Performance in the first sixteen questions showed that candidates had been quite well prepared for the test on this module. More than 50% of candidates opted for the correct response in 10 of the first 16 questions. Eliminating real safety features of car design (82%) and identifying the correct means of charging objects (78%) got most candidates off to a good start. Compared to the high percentage who could recognise the qualitative definition of acceleration (88%), only 39% knew that it was caused by a resultant force - as many as 30% thought it would occur when the resultant force was zero!

Here is a quote from the March report:

> *"… more students wanted to prevent … explosion … by connecting plane and tanker to the ground using an insulator ..."*

In the November test, 57% wanted to use an insulator. Maybe worse, however, 61% attributed the reason to *positive* electrons. As few as 19% put the two ideas together correctly.

Overlap Questions

Interestingly, 74% of foundation students identified the position of most GPE but only 50% spotted the place of greatest KE in a fairground ride. Similarly, 73% at both tiers knew most GPE was at the start of the bungee jump. Sadly, however, the higher students did not bother to read the question referring to kinetic energy and 45% assumed the KE at the lowest point of the bungee jump was the same as the GPE at the top. This compared with only 46% who realised that at the lowest point the person is stationary and therefore has zero kinetic energy. Foundation students fared better on this item with 55% correct. In case students did not know how a bungee jump works, they were specifically told that the jumper's '*elastic* rope *slows him down*' so that he '*stops* before he reaches the water'. By contrast, 36% F-tier and 56% H-tier chose the best graphical representation of the motion.

The outcome of fission, in terms of number of daughters and neutrons, was poorly known and only one-third of foundation students understood half-life.

Higher Tier

The poorest performing item at this level was the calculation of Jo's power. While 61% might be assumed capable of using the equation in the reference section correctly, 67% **of these** failed to change from cm to m. (I seem to remember that a reason postulated for the failure of a space probe to reach Mars was that the scientists had used m for metres, the technologists had assumed it was for miles! – but I am probably wrong.) Units are important.

Almost as poorly answered was the item showing lack of appreciation of action-reaction by which the paper helicopter pulls the Earth towards it with a force equal in size (but opposite in direction) to the force by which the Earth pulls the paper helicopter (0.07 N).

Other questions about the helicopter – reason for acceleration and circular motion of a dust particle on a blade were well answered.

One item which produced a disappointing performance at this higher level was a very simple application of a Specification statement 'like charges repel'. Regardless of whether they think electrons are negative or positive (see previous reports), they should be consistent and realise that an electron will repel an electron. Only 58% did.

GCSE Additional Science 5016F
GCSE Biology 5028F

Structured Paper B2

The paper consisted of seven questions with questions 5, 6 and 7 being common with the 1H paper.
Candidates found the questions accessible with most questions being attempted with questions 5, 6 and 7 causing some problems to some of the weaker candidates. It was pleasing to see that candidates answered the earlier questions well where some good understanding of science was seen.
Aspects of science new to the specification were examined with mixed response, with some candidates clearly having been taught salient details and others lacking the key words and science to match the marking points.
"How Science Works" is also examined throughout the paper. Teachers may find it helpful to revisit the criteria for this aspect as some candidates do seem to find it difficult.

Question 1
Fish in a fish tank.
This question required candidates to apply their knowledge of what happens in photosynthesis, and how fish are adapted to life in water.
Part (a) was well answered with 30.1% of the candidates gaining two marks and 66.3% gaining all four marks.
In part (b) the great majority of candidates scored well showing that they fully understood how fish adapt with the correct answers of 'fin, tail; gills; streamlined shape'. Some candidates gave 'camouflage' as an answer and only two candidates giving 'mucus'. Some answers mixed up fins and gills – 'breathing through fins' or 'swimming with gills'. A number of candidates wrote of having 'no legs but flippers'.
There were many general answers for adaptation, 'able to breathe /to swim / eat under water'; 'adapt /survive to live in water'; 'eyes (or specially adapted eyes) to look under water'. A lot of candidates wrote of fish having 'scales / scaly body to move easily through water or not to soak up water'. The use of 'cold blooded' appeared as a response from some. There were very few non-attempted answers.
In part (c) 86.1% of candidates gained the mark with popular answers being 'oxygen' or 'food'. All other possible answers were given by students 'shelter'; 'nesting place'; 'a place to lay eggs'; 'removal of CO_2'; 'hiding place'; and 'provide habitat'. Where some incorrect answers occurred it was due to not understanding how photosynthesis worked in plants e.g. 'plant takes in oxygen'; 'plants give out / breathe out carbon dioxide' or what fish actually needed to breathe, 'fish breathe CO_2 from the plants'.
Sometimes too much knowledge was being given, mixing correct and incorrect answers e.g. 'plants provide food and oxygen for fish along with carbon dioxide'.
In part (d) 42.2% gained credit for answers like lack of food and protein, and not enough space. There were many confused ideas about hiding from predators/prey without thinking about the fact that they might also be fish themselves. A number also referred to a lack of oxygen without thinking that the fish would die without oxygen. Some also thought that a lack of carbon dioxide was responsible. Some also seemed to think that fish don't grow large as a favour to other fish.

Question 2

DNA.

This question was designed to test understanding of DNA.

The question was answered well with 31.3% of the candidates gaining two marks and 53.2% gaining all four marks.

Question 3

Fermentation.

This question was designed to test understanding of the process of fermentation.

Only 16.2% gained credit in part (a) with reference to sugar or glucose. Oxygen, carbon dioxide and alcohol were responses that were frequently seen.

In part (b) the full range of possible answers was covered by candidates, with 50% gaining credit. However there were many answers giving 'oxygen / air' or 'yeast rising' as reasons for the balloon inflating. Some students started off with a correct answer but then stated a misconception 'a gas rising into the balloon, it was oxygen from the yeast'.

A handful of students gave helium or hydrogen as the gas.

Part (c) contained many misconceptions about fermentation with a large number of candidates suggesting that adding carbon dioxide would speed it up, with quite a few references to photosynthesis, and some suggesting more light would speed it up. A large number also suggested more oxygen and more water. There were a surprising number who thought that simply changing the bottle - making it bigger or smaller – would make a difference. A number also thought that shaking it up would make it faster. There were some too-general answers with students suggesting 'add more of everything'. A number also had the right idea about warming it up but were not specific enough using 'heat' rather than warm and even boil it. 38.9% of candidates gave a response worthy of credit.

In part (d) 31.9% gained credit by giving a valid reason as to why the balloon stops inflating. Very few students answered to the effect that 'yeast was poisoned by alcohol' but the range of other answers were covered. The most popular answers were 'production of CO_2 stops' and 'the reaction stops'.

A few answered that 'sugar/glucose was killed off' or 'yeast had multiplied to a maximum or stopped growing'.

Question 4

The carbon cycle.

This question was about the carbon cycle and how carbon is added to and removed from the atmosphere.

18.1% of the candidates gained two marks, 43.0% gained three marks and just 11.5% gained all four marks.

Question 5

Adaptations in geese.

This crossover question was designed to test the understanding of how biological adaptations are related to an organism's environment.

In part (a) just 13.5% gained credit. Quite a few candidates thought that geese didn't need oxygen/air or that as they had smaller lungs, they no longer needed as much oxygen as other animals. There were a surprisingly large number who thought that as they flew in groups there was more oxygen available, that flying faster meant they came into contact with more oxygen or that by flapping their wings they produced/created oxygen. Some suggested that they held their breath when they were very high, then dropped down to get

oxygen when they needed it. There were a large number of references to long necks and beaks as allowing them to get more oxygen.
There were quite a few suggestions of behaviour, particularly gliding, allowing them to survive at high altitudes, many correct but not answering the question. Some talked about lower air resistance and so on without achieving the mark.
In part (b) 29.9% gained one mark and 14.5% gained two marks. A majority identified cold as being a major problem. Of these about half gave feathers as the adaptation without giving any qualification e.g. thickness. A disturbing number think birds have fur.
Strong winds was another popular choice but few met the marking points for the adaptation. There were many 'strong wings'. No food was also popular but again few met the marking points with bizarre answers about prey. Few mentioned thin air as a problem but mostly scored the adaptation mark. Being 'nearer the sun' was often thought to be hotter! Dangers from airplanes had many mentions; bumping into mountains was another amusing problem – higher than Everest!

Question 6
The physiological effects of exercise.
This crossover question was designed to test the candidates' ability to reproduce a logical sequence relating physiological responses to exercise.
In part (a) 27.6% of the candidates gained one mark, 21.1% gained two marks and just 5.5% gained all three marks. There was much confusion about heart rates and breathing rates. Good responses explained that the increased breathing rate was to 'provide more oxygen for respiration to give the energy for the extra activity of the muscles' in a very concise and precise way. There were a significant number who related the increased rate of breathing to preventing cramp / oxygen debt / production of lactic acid.
In part (b) just 13.0% gained credit, because students did not read the question properly and focused on a better way of measuring exercise rate using heart rate rather than breathing rate. Many were good quality answers explaining why measuring heart rate was more reliable, but this does not answer the question. There were many students who understood that electronic equipment was needed but were too imprecise with their answers – suggesting that the tennis player should use 'a device', 'a machine', 'an electronic thingy' and so on.

Question 7
Cloning.
This crossover question was designed to test the candidates' ability to apply their knowledge of why certain animals may be selected for cloning.
In part (a) 50.6% gained credit by referring to selective breeding or artificial selection.
In part (b) many candidates did not understand the principles of cloning. The most common correct qualities were most milk produced, healthiest, most fertile calf. Many candidates think bulls produce milk and many more seem to think that cloning involves mating.

GCSE Additional Science 5016H
GCSE Biology 5028H

Structured Paper B2

This paper consisted of seven questions with 1, 2 and 3 in common with the 1F paper. Most questions were accessible to the candidates with only question 6 performing below the expected response level.
The candidates in this series seemed to either produce a good answer or gave responses that were completely wrong.

Question 1
Adaptations in geese.
This crossover question was designed to test the understanding of how biological adaptations are related to an organism's environment.
In part (a) 31.1% gave answers worthy of credit, with 'larger lungs' being the most common answer seen. Common errors included comments about storing large amounts of oxygen from when the geese were at lower levels. Other candidates suggested that the geese had very long necks which they dipped down into air at lower levels to breathe.
In part (b) 74.9% got at least one of the two marks available, with 'cold' and 'thick/extra feathers' being the most common correct responses seen.
Overall, candidates found this question accessible, but some had problems making their responses specific enough for credit. For example, it was not uncommon to see 'cold' being correctly given for the first point and then just 'feathers' for the second part which is, of course, a characteristic of all birds.

Question 2
The physiological effects of exercise.
This crossover question was designed to test the candidates' ability to reproduce a logical sequence relating physiological responses to exercise.
In part (a) 92.6% of candidates achieved all three marks with 33.2% gaining all three available. Those scoring just one mark tended to gain credit by stating that more oxygen was required/used. Higher scoring candidates developed this to include respiring muscles, and more energy, to produce some excellent answers.
In part (b), where only 29.4% gained the available mark, it was disappointing to see so many answers suggesting that a 'pulse/heart' monitor would be a more reliable way of counting breaths.

Question 3
Cloning.
This crossover question was designed to test the candidates' ability to apply their knowledge of why certain animals may be selected for cloning.
Part (a) was well answered with 84.9% giving the correct answer of selective breeding/artificial selection. The remainder giving a variety of linked wrong answer with sexual/asexual reproduction being commonly seen.
Part (b) where 93.2% of candidates scored at least one mark with 41.2 gaining both allowed candidates to show that they could apply their knowledge to suggest what characteristics would be looked for in dairy cattle. The majority of marks lost were from

vague answers, for example 'quality' rather than specifying, for example, the fat content of the milk.

Question 4

Fertilisers and sowing densities.

This question tested the candidates' ability to complete a graph and then interpret the data supplied.

In part (a), where 96.9% gained at least one mark, with 77.2% gaining all three available, it was gratifying to see the standard of plotting and line drawing which has steadily improved over the last few years. It would have been advantageous for some candidates to use a pencil and rubber rather than pen given the ensuing mess resulting from attempted alterations. There were a few candidates who did not draw a line on the graph and centres are advised to go over this point with candidates.

In part (b) only 24% of candidates could suggest a correct plant chemical made using nitrates with protein and chlorophyll being common correct responses. Of the rest, glucose and sugar were at least chemicals whereas many gave answers like wheat and plant.

Part (c) was well answered by 45% of candidates who explained their choice of amounts well. Some of these however gained one mark by only referring to either the density or the mass of fertiliser applied. Some candidates just stated the maximum mass of fertiliser (1000Kg) ignoring the 'flattening off' of the graph. The majority of candidates who did not gain marks gave vague answers, for example 'the more the fertiliser, the more the growth'.

Question 5

Sewage spill in the river.

This question tested the knowledge of eutrophication. Some were still under the impression that eutrophication was only about algal blooms and oxygen deficit causing the death of fish. It was disappointing that the term 'eutrophication' was seen only rarely as it is on the specification and was worth a mark. Too many candidates failed to demonstrate an understanding of the issues involved writing answers that included: sewage eating the fish, and sewage covering the surface as a crust stopping the light from entering the river which then 'magically' caused the algae to grow.

In part (a) where 44.1% of candidates scored at least one mark, but less than 1% scored all three available, candidates were just unable to explain what was happening in terms of good scientific principles. Many did not know that sewage contained nitrates/phosphates and suggested that the sewage washed fertilisers from the fields although some then went on to gain a mark from stating the consequence of extra nitrates in the soil. Many candidates seemed to have learnt the principles of eutrophication by rote without understanding the underlying ideas involved.

In part (b), 36% of candidates correctly answered the question with the sewage being washed downstream, or stating that the nitrates/phosphates had been used up by the algae. The others either failed to express themselves scientifically with vague answers like 'the sewage moved away' or were unable to visualise the situation with answers including 'sewage crawling up stream to get away from the algae'

Question 6

Active uptake in roots.

This question tested the ability of candidates to interpret some data and apply scientific principles regarding the uptake of minerals by roots.
In part (a) 14.1% correctly stated that magnesium was required by plants to make chlorophyll. This was disappointing as this question usually scores well in the multiple choice questions. Wrong answers included 'oxygen', 'glucose' and 'flowers'.
Part (b) was only answered correctly by 7.7% of candidates with them being unable to show an understanding of limiting factors. This was always intended to be a harder question aimed at the A/A* candidates.
In part (c) 9.9% of candidates were credited with at least one mark. The question included the clue that the poison stopped aerobic respiration and it was therefore very disappointing that so few pupils failed to even say that this led to less energy. Where active uptake was seen, the candidate usually expanded their answer to gain all three marks. Poor science was repeatedly seen with the magnesium ions poisoned and killed, plants shutting down until the poison went away and the roots leaving the ground and the plant moving away to find soil that was not poisoned.

Question 7
Protein synthesis.
In part (a), 46.1% of candidates achieved the mark usually by stating that RNA was a single strand compared to DNA being double, RNA was shorter than DNA, or that in RNA the base A/adenine was replaced with U/uracil. Marks were lost by candidates again not being specific enough in their answers, for example, 'RNA is not all of DNA'.
In part (b) where 49.2% gained at least one mark, and 11.8% gained all three, it was pleasing to see some excellent answers showing a good understanding of translation. Some candidates confused and contradicted their answer with, for example 'the triplets being on the ribosomes or the proteins', thus losing a mark but on the whole those candidates who answered this question with any understanding of the process scored reasonably well.

GCSE Additional Science 5018F
GCSE Chemistry 5038F

Structured Paper C2

The paper consisted of five questions. Question 5 was common with the Higher tier; questions 1, 2 and 3 were targeted at F/G and the remaining two questions were targeted at C/D. Many of the candidates found question 5 particularly challenging as it involved much of the more difficult aspects at this level.

Some problems seen in this paper that were common with previous ones included writing word equations and recalling details about atomic structure and bonding.

"How Science Works" is also examined throughout the paper. Teachers may find it helpful to revisit the criteria for this aspect as some candidates do seem to find it difficult.

Question 1
The opening question was aimed at allowing even the weaker candidates to achieve marks. Unfortunately some candidates could not read the thermometer correctly in part (a) with answers as 24, 25 or 27 (^{o}C) seen. It was disappointing to see so many incorrect answers to (a) (ii); some candidates had difficulty in subtracting 20 from 26 as evident with the answer of 5 (^{o}C). Some candidates merely gave a description such as 'it went up'. However, over 95% scored the mark on part (i) and 88% obtained the correct answer in part (ii). Only a minority of candidates scored correctly in part (iii).

The word equation presented a difficulty for the majority of the candidates, with only 47% getting it correct. Many could not properly identify the reactants and products from the question and many did not appear to understand that nitrate was provided by nitric acid. One of the major errors to otherwise correct answers was the inclusion of additional products in the word equation, such as water, oxygen or hydrogen. A significant number of candidates wrongly interpreted the question as requiring symbols and invented chemical formulae such as 'Am' (= ammonia?) and 'AmNi'.

Question 2
Parts (a) and (b) were testing the ideas of structure and were answered correctly by the majority of candidates. This level of correct responses was also seen in part (c) where over 62% recognised these types of medicines as being weak or ineffective. Many opted to use expressions about not having enough medicine such as: 'not strong enough'; 'too dilute; 'not enough in it'. Not tested, not proven or not effective, as a response was generally well worded; a responsible point for young adults of the future.

Question 3
It was disappointing to see that many candidates did not score three straightforward marks in part (a), with 60% able to label the diagram of the atom correctly with the names of the sub-atomic particles. Although many followed what the question was asking, the particles were invariably labelled incorrectly. The other ideas concerning atomic structure as tested in parts (b) and (c) also presented some difficulty for many candidates. Only a few candidates were able to score full marks in these two items. From the examination statistics, 24.5% scored 2 marks, 31.8% scored 1 mark in part (b); just over 63% could

identify the atomic number and the atomic mass of lithium in part (c) and only a disappointing 27% could write out the electronic structure of lithium. Candidates should be advised that information about the mass, charge and the location of the sub-atomic particles needs to be learnt. Similarly for electronic structures, candidates should be advised to practise writing the electronic configuration certainly for the first 10 elements at this level.

Question 4

It was pleasing to see several candidates capable of scoring well on this question. However, many candidates had problems with knowing the correct answer to (i) in part (a). It was interesting to see one inventive candidate giving the answer as 'mono(ethene)', but several either had not come across the term 'monomer' or did not know how to identify the small molecule making up a polymer from its name. This was shown by only 26.5% scoring the mark in this question. The examiners reported that part (ii) was poorly answered in general as many responses were too vague to be counted as correct or giving 'plastic' but not associated with any item; overall only 56% could identify an everyday poly(ethene) item. Some candidates showed a complete lack of understanding of subject material by giving, leather, tin and china as examples of materials made from poly(ethene). Some phonetic spellings of 'cling film' were seen, and this and carrier bags were probably the most frequently seen correct answers.

Only about half the candidates scored both marks in part (b), with the function of the plasticiser being known better than that of the cross-linking substance. Some candidates appeared not to understand the function of the additives from the way the boxes were linked up.

Question 5

It was disappointing to see that about 40% of the candidates understood the term 'endothermic' in part (a). Several confused the word with exothermic by stating that heat was given out. A significant number gave totally incorrect responses, indicating a lack of subject knowledge.

In part (b) just under half of the candidates could correctly give the name of the gas evolved, but the balancing of the equation was not so successful with over 85% getting this wrong. The remainder of the questions proved to be challenging for many of the candidates. Part (iii) was misunderstood by the majority (80%) of the candidates. The use of the powdered form rather than lumps to make the reaction faster was attributed to the solid dissolving quicker and not to increased surface area. Many responses stated that 'it was faster because it did not have to break down' or 'lumps already broken down' without any further clarification.

Equally part (iv) was misunderstood by many candidates – only a disappointing 31.5% obtained the correct answer, with the majority of incorrect answers suggested adding a catalyst. Other incorrect answers gave 'add more acid' without acknowledging the need for an increase in concentration. Incorrect wording or grammar also hindered correct marks; e.g. 'use the pure acid' or use of single word answers such as 'temperature' or 'concentration' without further clarification. Many candidates also demonstrated a significant lack of subject knowledge by identifying hydrochloric acid as a solid and not a liquid.

It was rare to see a correct answer for part (c). A few students gained the full two marks (7.7%) in part (i) however and this pleasing to see. Many showed a lack of subject knowledge by not recognising how positive ions are formed. A significant number showed an understanding of electron transfer and could have gained marks but contradicted themselves by stating that calcium 'gains or loses electrons to form a positive ion'.

In part (iii), a very small number of candidates also scored the full two marks (1%), but most of those gained a mark for stating that the bonds were strong. Only a few recognised that ionic bonding was involved.

Revision tips

- Learn the structure of the atom, the names of the particles, their masses and their charges.
- Learn the difference between 'exothermic' and 'endothermic' and what causes the different changes.
- Learn the names of some everyday items made from polymers such as poly(ethene), polystyrene and PVC.
- Learn the chemical formulae of some simple compounds such as carbon dioxide, water, and sodium chloride.
- Learn the effects of the factors that affect the rate of a chemical reaction, and explain what happens in terms of colliding particles.
- Practise writing word equations from a description about a chemical reaction; balancing simple chemical equations.

GCSE Additional Science 5018H
GCSE Chemistry 5038H

Structured Paper C2

The paper consisted of four questions. Question 1 was common with the Foundation tier; questions 1 and 2 were targeted at C/D and the remaining questions were targeted at A/B.

Question 1

Part (a) was well answered. Many answers explained an endothermic reaction as one where more energy is put in than comes out, or, very encouragingly, more energy to break bonds than is released – some answers at AS level standard. The most common misconception was that an exothermic reaction was one that needed heat/energy to start it, a confusion with activation energy. Some had confused answers for example the answer might be worded 'takes heat in and feels hot'.

Part (b) was also well answered. In (iii) common incorrect responses included - smaller surface area (candidates presumably thinking of each small particle), dissolves more easily or powder is already broken down. In part (iv) an even mix of increase concentration and increase temperature were seen. The most common wrong answers were to add a catalyst (not a change to the acid), use more acid or dilute the acid. Some simply stated 'concentration' or 'temperature' but not whether it should be increased or decreased.

In part (c) the idea of electrons being lost was generally understood and more often than not 2 electrons were mentioned. The most common wrong answers were when electrons were gained or shared. There were many different answers to the question about melting point. Strong Bonds and a lot of energy needed to separate/break bonds were often seen, but the concept of the fact that the particles were ions proved to be more difficult. Many students used the term atoms or molecules instead of ions e.g. it needs a lot of energy to separate atoms. There is a lot of confusion about the nature of particles and the term molecules is often used as a general term. There were a lot of answers, which talked about strong intermolecular forces and mention of covalent bonds was also quite common.

Question 2

The weaker candidates did not seem to understand the terms used in part (b). Carbon in group 4 was common and the better candidates linked the outer shell electrons with group number. A common incorrect response was a reference to the atomic number and position in the table. Some stated that it is in group 6 because it has 6 electrons. Many responses included both group 4 and period 2 with good explanations of why this is so.

The question about the covalent bond showed that many students had the idea of shared electrons but not that two were involved in a single bond (a shared electron (singular) was common). Sharing electrons to fill outer shells was the most common answer. A common wrong answer was that a covalent bond is a double bond.

In part (d) there were many candidates who were unable to identify the relevant information from the question to give a correct answer. Other candidates lost marks by only referring to **either** carbon fibres **or** graphite and only scored a single mark. Many

candidates failed to gain full credit by mentioning that the carbon fibre is stronger but failing to give a reason for this based on the crumpled/interlocked sheets. Common incorrect answers implied that carbon fibres have "stronger covalent bonds" compared to graphite, or "bonding between the atoms in the layers" being stronger. Several incorrect answers discussed the concept of differences in density, suggesting that carbon fibres were **lighter** than graphite, as opposed to discussing strength or flexibility.
Several incorrect answers gave explanation about electrical conductivity in graphite by reference to delocalised electrons. A common misconception was to refer to carbon fibres having an ionic structure and graphite being covalent, or to simply compare the structure of graphite and diamond.

Question 3
The half-equation was generally not well answered. Many answers involved Cl in the equation or only gave half the equation e.g. $Mg^{2+} + 2e$, a possible misconception about the meaning of the term half-equation. Other responses typically included an attempt at writing the whole equation. Some had Mg^{2+} on the right and others had e^{2-}. Some even managed to include 6V dc in the equation. Most correct answers were balanced - there were few who were able to write the half equation but were unable to balance it successfully. The 1 mark answer -2e was seen more than expected.

The straightforward questions in parts (b)-(d) had surprisingly variable answers. Only a few correct answers seen as to why ionic compounds conducted electricity when molten. Again the idea of which particles are involved caused problems. Many answers mentioned atoms or molecules or electrons moving instead of ions and there were some references to "it must be a liquid to work". The explanation of metal conductivity was much better answered. The idea of free electrons, delocalised electrons or electron clouds was often seen. The most common wrong answers talked about metals having spaces between atoms through which electricity can flow. Some had the idea of electrons bumping/colliding into each other and "passing the charge on" to the next one. The idea of how an alloy 'gains' strength was rarely correct. It was clear that alloy structure was not understood. Many answers mentioned the idea of adding a "stronger" metal or that one metal reinforced the magnesium or there were stronger bonds because of the new metal. The idea of the added atoms being a different size was lost on most, as was the layer structure of metals.

Question 4
In part (a) the answer that bromine water turns clear was a common error and many answers failed to give the colour of bromine water so only scored 2 marks. However the question was well answered. Some thought that poly(ethene) would decolourise the bromine water faster than ethene because it contains many double bonds, a possible confusion with poly-unsaturated.

In part (b) those candidates that knew about cross linking generally scored both marks. The most common misconceptions were (a) thermosetting plastics have stronger bonds than thermoplastic, thus having a higher melting point, and (b) the polymers/atoms were closer together in thermosetting plastics and further apart with thermoplastics. A sizable minority scored no marks because they simply repeated the properties of these plastics from the question often with some embellishments. Some unsuccessful candidates merely talked of weak and strong bonds without making the distinction as to where these weak/strong bands were located.

The uses of ethanol were well known. Many different answers were seen, fuel being the most common. Common wrong answers included fertilizer, alcohol, bread making, paint stripper, medicines and petrol.

A significant number of candidates correctly completed the calculation by a variety of routes. A significant number calculated the number of moles of ethanol correctly, but failed to multiply by the relative formula mass of ethene to arrive at the final answer. Some candidates made it very difficult to award marks by either failing to present all their working or by the haphazard way they set the calculation out on the paper. Others that set their working out clearly gained two marks for an incorrect final answer from an initial error since the rest of their working showed a correct method that could be clearly understood. Often minor errors were seen, whereby the rounding of the ratio 28/46 led to a final answer slightly outside the permissible range. Some misconceptions that were seen, where attempts by candidates to quote formulae for atom economy and to try to calculate this quantity, or to think that they were calculating empirical formulae.

Revision Tips

- Learn which particles are found in which type of structure (ionic, covalent, metallic)
- Study the specification to identify likely half-equations and practise writing them
- Learn the properties, and reasons for the properties, of ionic compounds and alloys
- Practise calculations

GCSE Additional Science 5020F
GCSE Physics 5048F

Structured Paper P2

Question 1
(a) This was a good start to the paper with almost all candidates able to identify at least one effect of static electricity and well over half able to identify two.

(b) This was answered correctly by over two thirds of the candidates even though the spelling of "repel" was variable. Some incorrectly used "detract". Another common mistake was to assume that two negative charges made a positive.

Question 2
(a) It was encouraging to see that over half of the candidates were able to give some detail about why the radiation from this source was dangerous. Simply stating that it was harmful was not sufficient to gain the mark.

(b) About two thirds of the candidates were able to explain that increasing the distance between the person doing the experiment and the source would reduce the danger. The most common mistake here was to refer to the distance between the source and the detector. Only half of these were then able to gain the second mark by explaining that reducing the time taken to do the experiment would reduce the danger by reducing the exposure.

(c) It was disappointing to see that only just over a third of the candidates were able to suggest a further precaution to reduce the danger.

Question 3
In this three part calculation question, it was encouraging to see 60 % of the candidates able to select and use the equations to gain at least three of the five marks available. Errors concerning the number of supports used to lift the car were only penalised once in the whole question. It was disturbing to note that a significant proportion of the candidates did not appear to have a calculator.

Question 4
(a) and (b) This involved extracting information from a diagram and using it to calculate the osprey's speed in km/h. A significant majority of candidates were able to do this successfully.

(c) Here candidates needed to show an understanding of force diagrams and to apply this to the bird in flight. Most were able to identify the accelerating force correctly and a good proportion were able to say which force the osprey needed to reduce in order to lose height. However, few were able to suggest appropriate ways in which she might do this.

(d) Less than a quarter of the candidates gained a mark here. The most common mistake was to answer without referring to forces when the question had specifically asked for the answer in terms of forces. Some candidates seemed to think that being 'more air resistant' meant that the fish was affected less by the wind.

Question 5

(a) Splitting of the nucleus was a well understood concept and some candidates knew that more neutrons were produced. Very few mentioned the energy release or the fact that an unstable isotope was initially formed. A common mistake was to talk about 'daughter uranium'.

(b) Very few candidates knew that the control rods absorb neutrons. A small number were able to gain a mark by relevant reference to a chain reaction.

(c) Fewer than 10 % of candidates gained full marks here but about 30 % were able to identify either one environmental or one social effect and credit was given whether this appeared in part (i) or part (ii).

GCSE Additional Science 5020H
GCSE Physics 5048H

Structured Paper P2

General Comments

There was some evidence that candidates were a little more familiar with standard definitions and vocabulary although this was still a weak area. This is a problem that centres are advised to address. Candidates can gain relatively straightforward marks relating directly to statements in the learning outcomes and glossary in the specification.

In general the standard of calculation was better than seen in June; candidates could, on the whole, select the correct equation and substitute in a dimensionally correct value. However transposition is still a problem area for many candidates. There was no evidence of problems with units.

Some candidates failed to write legibly. There was no evidence that candidates had insufficient time for the paper. When candidates wrote at length the quality of their English deteriorated; attempts to make things clearer often did the reverse. Candidates would be well advised to re-read their answer for sense.

1. Nuclear power

Part (a) involved a straightforward recall of the process of nuclear fission. Over 35% of the candidates gained all three marks, with another 24% gaining two marks. Not many candidates mentioned energy release despite the context being that of a power station. It was nice to see that many candidates availed themselves of the space to draw diagrams. These were often accurate, but common mistakes involved the omission of daughter nuclei from the chain, and lack of labelling. The most common errors included: a lack of detail, confusion with chain reaction and a lack of precision in the description of the fission fragments as 'particles', 'daughter atoms' or 'cells'. Surprisingly nearly 20% failed to gain any mark.

Part (b) was poorly attempted with the majority of the candidates either rephrasing the stem of the question or attempting an explanation that involved electricity. Less than 40% of the candidates knew that the function of the control rods is to absorb neutrons. A few confused the function of the control rods with the function of the moderator.

In part (c) over 60% of the candidates could give a sensible environmental effect on the local community of having a nuclear power station nearby. There were very few answers about the reduction in release of CO_2 or greenhouse gases. Many candidates gave an answer such as "nuclear waste would harm the environment" which lacked the necessary precision or detail. On the whole nuclear power was seen in a very negative light.
It is worrying that many candidates wrote that nuclear power stations increased the background radiation level or that there was waste 'lying around' without any reference to risk of accident. There was a widespread misconception that nuclear power stations release radioactive contaminants into the environment as a matter of course during normal operation.

The term 'social effect' was often perceived as being to do with 'socialising' and so many candidates failed to gain this mark. Better job prospects were often cited.
Nearly 30% of all candidates failed to gain any mark in part (c).

2. Forces, free body diagram and energy calculations

A surprising number of candidates (over 20%) left part (a) blank; this could be because they failed to read the instruction at the top of the page and simply assumed that the diagram was there to illustrate part (b). However, over 25% of all candidates gained both marks. There were centres where candidates are very well prepared and were able to produce excellent free body diagrams. 'Drag' and 'air resistance' were well known terms (although a few candidates just mentioned 'friction') as were 'weight' and 'gravity'. Common mistakes involved: roughly drawn, freehand arrows which were not vertical or horizontal, arrows which were the incorrect length, (possibly the lack of use of a suitable measuring instrument to draw arrows of the correct length), lines without arrow heads or labels, and arrows which did not start from the centre point of the osprey.

Part (b) was well answered by nearly all candidates with over 95% gaining the mark for (b)(i), over 67% gaining both marks in (b)(ii) and over 60% gaining the mark for (b)(iii). It was pleasing to see that many candidates had successfully attempted to apply scientific ideas to an unfamiliar situation.
In (b)(ii) the vast majority of candidates reduced lift. Most suggestions were about not flapping or flapping less frequently. Better candidates used the words "at a lower frequency". Changing wing shape was also often mentioned. Many candidates tried to answer in terms of reduction in thrust resulting in less forward velocity and hence less lift. Unfortunately they often got themselves into a tangle and shot themselves in the foot somewhere along their chain of reasoning. In (b)(iii) unsuccessful candidates failed to mention a force in their answer (despite the clear instruction to do so) and only mentioned streamlining of the fish. A few candidates thought that the fish would provide more thrust.

The calculations in part (c) were well attempted. Nearly 85% of the candidates could calculate the resultant force in (c)(i). In part (c)(ii) over 55% of candidates gained three marks with a correct answer, many with a bald answer which showed no working out. There was, however, some misunderstanding of which forces were to be used. A minority of candidates ignored the answer from (c)(i) completely and calculated a new value of upwards force, often arriving at a completely different value. This error in particular hints at lack of practice at coping with the carefully structured questions found in this examination. In the cases where the wrong force was used, other errors also appeared, such as incorrect transposition or even an incorrect equation. Incorrect units were not an issue, either the correct unit was given, or none at all. In (c)(iii), apart from some surprising errors where candidates attempted to convert kilograms to grams or used the wrong value for g, the majority gained full marks. Credit was given for calculations either based on work done or based on gain in gPE.

3. Circular motion

In part (a), many candidates were unable to correctly draw the tangential line to show the velocity of the satellite. The force was usually drawn correctly. Some candidates were a little meagre with the length of their arrows making it hard to arrive at a clear judgement. Just over 25% of the candidates gained both marks.

Part (b) was not well answered with over 45% of candidates failing to gain any of the marks. Common errors included descriptions about terminal velocity, wind resistance, the lack of friction in space and the lack of gravity in space. As in part (a) this question was very centre dependent. About 20% of the candidates gave very good and thorough answers. The most common one mark responses were for 'the satellite's direction changes' or for 'velocity is a vector'. Few candidates went on to explain that the velocity itself was changing. A number of candidates mentioned "changing acceleration". There were few mentions of centripetal force, either directly or indirectly.

4. Background radiation and cosmic radiation

Nearly 60% of candidates were able to gain the mark in part (a).The most common responses seen were 'rocks', 'nuclear power' , 'X-Rays', 'radon' and 'food' . Quite a few candidates lacked precision in their answers e.g. 'hospitals'. However as in question 1(c), many candidates wrongly identified nuclear power stations as contributing towards background radiation.

In part (b) very few correct and full responses were seen. At this end of the exam paper, a low-level response such as 'radiation from space' is not enough to gain credit. Most candidates had no problem with the origin of cosmic rays but, despite the prompt in part (c), very few referred to particles, high energy, or ionising. A small minority of candidates confused cosmic radiation with U.V. and mentioned ozone layers. There were some pleasing answers which gave good descriptions of the solar wind.

In part (c) very few candidates could explain the meaning of ionising. Some candidates just repeated the stem of the question, e.g. 'can ionise things'. Confusion of ions, ionic and isotopes was also seen. It was relatively common for candidates to respond that the radiation consisted of ions. Some candidates attempted a description of ionising but instead gave descriptions of nuclear rearrangements such as the removal or ejection of protons and/or neutrons. Most candidates, however, simply described the biological effects e.g. damaged cells, the risk of cancer or just the general harmful nature of ionising radiation. About a fifth of the candidates gained the mark for this part.

In part (d)(i) some candidates knew about radioactive rocks and radon, but the majority did not. This is a very poorly understood concept. The impression was given that some candidates were desperate to write something down and trawled the paper to find anything from another section to give a response. The reasons for Cornwall having higher background radiation demonstrated the true creativity of some candidates. The county appears to be littered with all manner of abandoned nuclear facilities, old uranium workings, missile bases and craters from atomic bombs used in the First World War. It was commonly believed that Cornwall was almost on the equator, and hence somehow closer to the sun. Much radiation appeared to originate from Cornwall's proximity to the sea. Other common explanations blamed the Cornish nuclear power factories (!) and its unusual low/high altitude. Answers relating to cosmic radiation were also prevalent.

Part (d)(ii) showed better responses, many candidates gained a mark here, particularly if they placed 'No' as their initial response. Those who went for 'Yes' gave responses that were weaker.

A number of candidates spread a one mark answer (comparatively low count-rate and therefore acceptable safety) over both spaces. Many candidates knew about the need for proper ventilation for houses to avoid breathing in an alpha emitting gas. Measures to

exclude radon from buildings were quite commonly mentioned – fans, membranes, extra ventilation etc.
Some candidates overlooked the *slight* increase in background (i.e. "still low"). Other errors included missing the fact that the increased background is due to a gas – hence can be breathed in – and noting that it emits alpha, which has a limited range in air.
There were unfortunately many trivial answers about 'gives you cancer' 'ionised cells', 'mut(il)ation' and 'deformed babies'. Another common response was that alpha radiation was completely safe as it couldn't penetrate the skin. A touching faith in scientists was occasionally apparent with statements such as 'they would have moved us away from the area if they knew it to be unsafe'.

Over 20% of the candidates were able to gain all the marks for part (e). The best answers used a diagram to explain the effect of the Earth's magnetic field on the cosmic rays in the solar wind. Some candidates failed to make it clear that they were referring to cosmic radiation and hence only gained one mark.
The idea of what the Earth's magnetic field does seems poorly understood by the majority of candidates. Over 60% of the candidates failed to gain any of the marks. Radiation was often attracted by a magnetic field. In many cases it was clear that the candidate referred to earth-bound background and not cosmic radiation. The idea of the field trapping the radiation was quite common. There were often vague references to 'The Northern Lights' which failed to link the phenomenon with cosmic radiation. It was obvious from this that the material had been covered in the centre. As for part (c), there was some confusion with the ozone layer and U.V.

Suggestions for Improvement

1. Ensure that the vocabulary of physics is well known. There is a glossary of terms in the specification that can be helpful. Many starter or plenary activities can be devised along these lines. There will always be some of these 'recall' type questions on each paper.

2. Practise the type of linked and carefully structured calculations as in question 2(c). There is often one of these in each series.

3. Free-body diagrams were poorly done this time, so students know the rules and practise these during revision sessions.

4. Students need to know which sections are in bold in the specification. There are not many of them but the last part of the paper usually covers at least some of them.

5. As always, get students to check that they have answered every section. There was some evidence that some students had not seen question 2(a). The specific meanings of the instruction words could be included in vocabulary revision.

Grade Boundaries
Multiple Choice Papers – Science and Additional Science

Raw Mark Grade Boundaries

5005/5025	Max mark	A*	A	B	C	D	E	F	G
H	24	17	15	13	12	8	6		
F	24				17	14	12	10	8

5006/5026	Max mark	A*	A	B	C	D	E	F	G
H	24	18	16	14	12	9	7		
F	24				15	12	10	8	6

5007/5035	Max mark	A*	A	B	C	D	E	F	G
H	24	15	13	11	9	6	4		
F	24				14	11	9	7	5

5008/5036	Max mark	A*	A	B	C	D	E	F	G
H	24	18	16	14	12	7	4		
F	24				16	13	10	7	4

5009/5045	Max mark	A*	A	B	C	D	E	F	G
H	24	18	16	14	12	9	7		
F	24				15	12	10	8	6

5010/5046	Max mark	A*	A	B	C	D	E	F	G
H	24	17	15	13	11	8	6		
F	24				13	10	8	6	4

5015/5027	Max mark	A*	A	B	C	D	E	F	G
H	24	20	18	16	14	11	9		
F	24				15	12	10	8	6

5017/5037	Max mark	A*	A	B	C	D	E	F	G
H	24	18	15	12	10	7	5		
F	24				16	13	10	8	6

5019/5047	Max mark	A*	A	B	C	D	E	F	G
H	24	17	15	13	11	9	8		
F	24				16	13	11	9	7

Uniform Mark Grade Boundaries for these units

	Max UMS	A*	A	B	C	D	E	F	G
H	40	36	32	28	24	20	18		
F	27				24	20	16	12	8

Note: On higher tier papers, the "allowed" grade E is calculated as half a grade width

Grade Boundaries

Structured Papers

Additional Science

Raw Mark Grade Boundaries

5016/5028	Max mark	A*	A	B	C	D	E	F	G
H	30	16	14	12	10	8	7		
F	30				19	15	11	8	5

5018/5038	Max mark	A*	A	B	C	D	E	F	G
H	30	18	14	10	7	5	4		
F	30				18	14	11	8	5

5020/5048	Max mark	A*	A	B	C	D	E	F	G
H	30	21	18	15	12	9	7		
F	30				20	16	12	8	4

Uniform Mark Grade Boundaries for these units

	Max UMS	A*	A	B	C	D	E	F	G
H	40	36	32	28	24	20	18		
F	27				24	20	16	12	8

Note: On higher tier papers, the "allowed" grade E is calculated as half a grade width

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