edexcel
advancing learning, changing lives

Examiners' Report Summer 2009

GCSE

GCSE 360Science

GCSE Science (2101)
GCSE Additional Science (2103)
GCSE Biology (2105)
GCSE Chemistry (2107)
GCSE Physics (2109)

Please note that the Examiners' Report for the Internal Assessment Activities (IAAs) and Centre Devised Activities (CDAs) is available at

http://www.edexcel.com/quals/gcse/gcse-leg/science/science

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH

A PEARSON COMPANY

Edexcel is one of the leading examining and awarding bodies in the UK and throughout the world. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers.

Through a network of UK and overseas offices, Edexcel's centres receive the support they need to help them deliver their education and training programmes to learners.

For further information please call our GCE line on 0844 576 0025, our GCSE team on 0844 576 0027, or visit our website at www.edexcel.com.

If you have any subject specific questions about the content of this Examiners' Report that require the help of a subject specialist, you may find our **Ask The Expert** email service helpful.

Ask The Expert can be accessed online at the following link:

http://www.edexcel.com/Aboutus/contact-us/

Alternately, you can speak directly to a subject specialist at Edexcel on our dedicated **Science** telephone line: **0844 576 0037**.

Summer 2009

Publications Code UG021078

Contents

	Page
Multiple Choice Papers	
5005 / 5025 (B1a)	1
5006 / 5026 (B1b)	2
5007 / 5035 (C1a)	5
5008 / 5036 (C1b)	7
5009 / 5045 (P1a)	8
5010 / 5046 (P1b)	10
5015 / 5027 (B2)	12
5017 / 5037 (C2)	15
5019 / 5047 (P2)	17
Structured Papers	
5016F / 5028F_1F (B2)	19
5016H / 5028H_1H (B2)	23
5018F / 5038F_1F (C2)	26
5018H / 5038H_1H (C2)	29
5020F / 5048F_1F (P2)	32
5020H / 5048H_1F (P2)	36
5029_01 (B3)	39
5039_01 (C3)	43
5049_01 (P3)	47
Grade Boundaries	
Multiple Choice Papers	52
Structured Papers	53

GCSE Science 5005
GCSE Biology 5025

Multiple Choice Paper B1a

General Comments

The overall performance of candidates on this paper showed a good base knowledge of the biology required. Questions involving data interpretation continue to be accessed well with candidates on the crossover questions gaining high percentages for both the foundation and higher tier options but with the higher tier candidates consistently outperforming those foundation candidates as is to be expected.

Foundation Tier

It was pleasing to see that candidates at the lower end of the foundation paper were able to access the questions related to global footprints in a bar chart style with 94% of candidates able to reach the correct answer on the first three questions. Questions based around genetics showed mixed responses, a particular concern was that only 31% of candidates were able to correctly identify the project to map the human genome as the HGP with 52% believing it to be DNA. The link between genes, chromosomes and DNA is also often misunderstood with only 35% of candidates able to correctly identify that genes are made of DNA, and with 47% of candidates incorrectly stating that genes are made of chromosomes. Questions on food chains have generally been well answered in the past and continue to be; 68% of candidates were able to identify the correct food chain and interpret information on food chains. On the crossover questions as previously stated the data interpretation was carried out well but once again candidates have difficulty with classification of organisms; in this case only 34% of higher and 29% of foundation candidates could correctly identify the kingdom Animalia, with 43% of candidates believing they belong to Protoctista.

Higher Tier

Interpretation of experimental evidence is an area of improvement for the higher tier candidates with 82% of candidates able to correctly identify cumulative graphs and interpret them accurately. 77% of higher tier candidates were also able to give a correct scientific method for the use of quadrats. The use of Punnett squares seems to be less well understood with only 31% of candidates able to identify the parent plants in a Punnett square although they may have been confused by the terms heterozygous and homozygous. Candidates are very familiar with methods of organic farming with 90% of candidates able to correctly identify that chemical pesticides are not used. The 'How Science Works' style of question on GM crops was less well accessed with only 26% of candidates able to identify that a concern of GM crops is their impact on the environment if they cross pollinated with other species. The A/A* questions at the end of the paper proved to be discriminating with candidates having difficulty with methods of cloning and only 33% of candidates were able to correctly identify that the egg must be enucleated before inserting the required genetic material into it.

GCSE Science 5006
GCSE Biology 5026

Multiple Choice Paper B1b

General Comments

Overall, the foundation tier candidates generally performed better on their section of the paper than the higher tier candidates did on theirs. There were pockets of questions on each tier that some candidates struggled with and in this case many candidates failed to gain marks for areas of the specification that have been frequently tested previously. Higher tier candidates out performed the foundation tier students on the overlap questions apart from, surprisingly, question 24 where a larger percentage of foundation candidates arrived at the correct response.

Foundation Tier (Q1-16)

Candidates started off particularly well with 93% of students being able to successfully use the data in the table to arrive at the correct response. Fewer candidates however were able to identify the role of red blood cells with 13% of candidates under the impression that these cells carry carbon dioxide. Even fewer candidates were able to identify tar as the carcinogen in cigarette smoke which is surprising considering that similar questions have been answered particularly well in previous examination series. 66% of candidates gained a mark for this question with 16% and 14% opting for carbon monoxide and nicotine respectively as the cancer causing agents.

It was very pleasing to see that a good percentage of candidates gained credit for question 5 showing good factual understanding of the nerve pathway in the context of this particular question. This has previously been a fairly challenging area for foundation candidates. However, it is quite clear that there has been a significant improvement in their basic level of understanding of this area of the specification, supported by good statistics for question 8 where 72% of candidates were able to identify which was a reflex action from the options given. The statistics for question 6 suggest that a large number of candidates have carried out the ruler-drop test to determine their reaction time! This may account for 28% of students incorrectly choosing the ruler as the best instrument to measure reaction time. Only 50% of students chose stop clock and gained a mark for their effort.

Overall, the section titled 'Fertilisation' was not answered well, indicating a general lack of understanding of the topic areas covered in this specific part of the paper. The least successful question was, surprisingly, question 12 where only 27% of students correctly identified plasma as the part of the blood that transports hormones. It seems that some guesswork was at play here with statistics spread almost evenly across all four distracters. This is particularly disappointing and it may be worth considering revising the components of the blood and reinforcing their functions during the teaching of other areas of the B1b specification, such as in 3.8, 3.11, 3.12 to name a few, with many other opportunities being found in Topic 4. There was a fair amount of misunderstanding amongst students with regard to IVF; the procedures involved and the concerns that its use might raise. This particular aspect of the specification has rarely been used previously in this context at this early stage in the paper and it is clear that the less able candidates in this tier found both

questions 9 and 10 particularly challenging. However, this topic is a good example of 'How Science Works' and it could well be an opportunity to incorporate ICT in learning by allowing candidates to carry out independent research into the application of IVF along with its advantages and disadvantages.

A few of the questions in 'Fighting Disease' also posed a problem for a large number of candidates. Only 35% of students correctly recognised a pathogen as being a disease-causing microbe and despite specialised cells being a taught component of Key Stage 3 Science and reinforced during Key Stage 4, only 26% of candidates were able to identify cell B as the white blood cell that ingests microbes. More candidates opted for the incorrect option D suggesting that this particular pictorial version of a generalised animal is possibly what they remember from previous teaching in Key Stage 3 with little reinforcement of cell specialism, even in relation to blood components, in Key Stage 4. The statistics obtained for question 16 further reinforce the evidence that candidates have clear misconceptions regarding our defence system and disease beyond the first line of defence. Only 33% of candidates correctly identified Bluetongue being vector-borne with a significantly larger percentage of candidates, 46%, failing to gain credit for stating that this disease was transmitted through direct contact. There is a clear history of poor performance on questions involving disease transmission that specifically use these scientific terms. Again, there is opportunity to reinforce this terminology throughout B1b although it could be introduced, albeit briefly, in B1a as a comparison to inherited disease.

Overlap Questions (Q17-24)

Both higher and foundation tier candidates generally performed as expected on the overlap questions and although 76% of foundation tier candidates had problems identifying the relay neurone for question 18, their understanding of the remainder of the topics covered in this section was much better. Less able foundation tier candidates were challenged by question 20, with 42% of candidates incorrectly identifying the pupil as the effector that responds to changes in light intensity. This was similar for higher tier candidates where 42% arrived at the correct response whereas 35%, like the foundation candidates, believed the effector to be the pupil. This is a common misconception amongst candidates – they see the pupil changing size and believe this to be autonomous rather than a result of the muscular action of the iris.

A good number of candidates, both foundation and higher, used their analytical skills to correctly interpret information from the graph and were able to further use this information to conclude, for question 23, that the patient was diabetic. Interestingly, 40% of foundation tier candidates arrived at the correct response for the final question in the overlap section. This was 3% more than the percentage of higher tier candidates answering correctly.

Higher Tier (Q25-40)

Apart from question 26, the performance of the candidates on the first two sections of the higher tier was generally disappointing. The statistics suggest that only the more able in this tier have sufficient understanding of the third line of defence and disease with less than 50% of pupils gaining credit for their responses to questions 25 and 28. Similarly, less able candidates were unable to elucidate how the immune response is specific, although a slightly larger percentage, 51%, gave the correct response. It is evident that candidates

still struggle with the terminology that is integral to this section of the specification and its testing irrespective of its regularity continues to discriminate between levels of ability.

Very few candidates (25%) were able to correctly identify the cornea as the structure which helps to focus light on the retina with more candidates opting for the iris. Similar problems were encountered by candidates as suggested by the statistics for question 31, although a larger number of candidates in this case (40%) were able to name the neurone, effector muscles and the response in this particular pathway. Candidates continue to find nerve transmission across the synapse challenging and this could be a result of the emphasis that is placed on electrical transmission through neurones during teaching, particularly if it is taught alongside the role of hormones as a comparison between different methods of communication.

As in previous examination series, only the more able candidates (35%) show a good understanding of the functions of the major areas of the brain although a larger percentage of candidates (69%) are clear that oxygen deprivation in the brain can lead to stroke. It was pleasing to see that a good number of candidates were able to link the effects of progesterone to those brought about by stimulants although 24% of higher tier candidates appeared to believe that an increase in communication across synapses is brought about by depressants.

As in previous examination series, candidates carried out the graphical interpretation well with 75% of candidates arriving at the correct response for question 37. Only 27% of candidates, however, were able to carry out the simple mathematical calculations to arrive at 2880 reported cases of TB for question 38 making this particular question a level discriminator. Although it appears that a large majority of candidates are able to carry out a straightforward interpretation of graphical data as shown for question 37, manipulation of data from graphs continues to be a problem for many candidates below top grade. As part of 'How Science Works', candidates should be able to analyse and interpret quantitative data and there is strong evidence here that they need more practice in this area. Questions 39 and 40 posed few problems for many candidates and most are confident in their understanding of TB transmission with 80% of candidates aware that overcrowding increases transmission rate. The statistics for question 40 were pleasing; 67% of candidates arrived at the correct answer indicating that candidates are becoming more confident in the use of terms associated with practical and investigative procedures. In this particular case, the majority of candidates were correctly able to determine the most appropriate way to collect valid data.

GCSE Science 5007
GCSE Chemistry 5035

Multiple Choice Paper C1a

Foundation Tier

48% of candidates could identify an element in group 1 as a reactive alkali metal, 35% thought that it is a reactive non metal. 50% knew that sodium chloride is used as table salt with 31% suggesting that it is used as bleach. 19% knew that sodium hydroxide is caustic soda, 41% could recognise that the break down of sodium hydrogencarbonate when heated is an example of thermal decomposition. 45% of candidates could recognise argon as a noble gas with 26% choosing halogen. 30% knew that helium and neon are inert with 31% suggesting that they form stable compounds and 27% that they burn in air. 37% of candidates knew that gold is obtained as gold metal from the ground with 24% thinking that it is extracted using carbon and 23% that it is extracted using electrolysis. 25% knew that when sodium hydroxide solution is added to a solution of a zinc salt a white precipitate is produced, 26% thought that the precipitate is blue and 40% that bubbles of gas are produced. 30% could recognise from the information given in question 17 that bubbles of gas will be seen when excess calcium carbonate reacts with dilute hydrochloric acid, with 34% thinking that there is a change in colour. 35% knew that during this reaction the dilute hydrochloric acid is neutralised. 38% knew the test for carbon dioxide with 30% thinking that the test is that it relights a glowing splint. 36% of candidates knew that in a flame test the colour is caused by the metal in the compound. 30% could recognise the reaction of anhydrous calcium chloride with water as hydration. 22% knew the formula of hydrochloric acid with 34% choosing HCl_2 and 29% Hcl. 34% knew that evaporation is used to obtain a solid from a solution with 37% choosing filtration.

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 especially in question 17 (54% correct), question 22 (27% correct) and question 23 (46% correct).

In question 25, 49% could recognise that the lead oxide is reduced with 22% thinking that it is oxidised. Many candidates do not realise that the first row of the periodic table containing hydrogen and helium is the first period. In question 28 this resulted in 50% of the candidates choosing an element in period 5 despite being told that bromine is in period 4. 47% could identify the correct colours and states of the halogens at room temperature but 26% thought that iodine is a purple gas at room temperature. In question 32, 39% could correctly identify the reaction that would take place between a halogen and a halide salt. In question 34 only 16% could apply the rule about names ending in -ate. As usual balanced equations caused problems with 33% choosing the correct answer in question 35 and 35% choosing **A** containing monatomic hydrogen. In question 36, 41% chose the correct answer with 30% thinking that the atomic number of sodium is 23. 24% answered question 37 correctly. 46% could use the information to obtain the correct answer in question 38, while 40% thought that ammonia cannot be collected over water because it is insoluble in water. The balanced equation in question 39 proved very difficult, only 11% chose the correct

answer, 38% thought that the formula of ammonium sulphate is NH_5SO_4 and 41% that it is NH_3SO_4. 60% of candidates thought that ammonia turns moist blue litmus paper red.

GCSE Science 5008
GCSE Chemistry 5036

Multiple Choice Paper C1b

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

Foundation Tier

The first 8 questions were generally well answered with the exception of question 6. Only 17% of candidates realised that oxygen was not present in the Earth's early atmosphere with most giving carbon dioxide, methane or ammonia.
Surprisingly in question 12, 56% of candidates mistakenly thought that using recycled plastic involves using a renewable resource instead of conserving a non-renewable resource.
Candidates understand and can explain items concerned with the food and drink specified in this unit e.g. beer and mayonnaise. However, only 32% gave the correct type of material for a sensor in question 13.
Questions involving the combustion of fuels, and issues associated with carbon monoxide, are understood and were well answered.
The nature of the new materials specified is generally well understood e.g. Gore-Tex and smart materials in questions 21 and 22. Indirect questions on materials such as Thinsulate showed some confusion. In question 23 only 21% of candidates recognised the description of Thinsulate, which would be needed as an insulating material in the ski jacket.

Higher Tier

The first 8 questions showed a good knowledge and understanding with the exception of question 23. 58% of candidates were unable to identify thin and loosely packed fibres as being the nature of the material needed for insulation in the ski jacket. In question 27 a significant number of candidates, 45%, suggested that the use of bio-fuels is totally sustainable instead of realising that supplies of crude oil would be conserved.
Many candidates were able to work out the correct answers to questions 29 to 32 with the exception of the balanced equation in question 31. Only 33% selected the correct equation.
The uses of hydrogen were not well known in question 33. Only 24% chose the correct response and the majority think that hydrogen is used in the manufacture of sulphuric acid and food packaging. The understanding of the fermentation process is variable; 54% of candidates realised the conditions necessary for a successful fermentation in question 34.
Questions involving the interpretation of information regarding fractions obtained from crude oil were good discriminators. 43% gave the correct response for question 33.
Only 35% of candidates successfully attempted question 38 to identify the lettered fractions used as the correct fuels.
Questions 35 and 40 involving balanced equations were also good discriminators. 70% of candidates failed to recognise the correct balanced equation when octane is burnt in excess oxygen.

GCSE Science 5009
GCSE Physics 5045

Multiple Choice Paper P1a

Foundation Tier

In general, performance on this paper was poor. It is difficult to reconcile the 81% of candidates who knew that a voltage is **produced** when a coil is moved near a magnet and the 66% who realised that the size of the voltage **produced** depended on the speed of movement with the 24% who knew that only a dynamo **produced** electrical energy. Most clearly understood the word produced but 25% thought electrical energy was produced by a voltmeter while as many as 39% chose a motor.

Another difficulty arose from a direct specification statement - interpretation of the phrase **alternating** current. This, of course, involves the current changing direction in the circuit, which means both positive and negative values of current. As few as 20% recognised this, with 66% opting for a smoothly varying current with different positive values only.

Fuses and the earth wire also proved challenging with 46% thinking that the earth wire protects the fuse and as many as 62% incorrectly selecting the options which imply that a fuse on its own protects the user of a circuit. Candidates were also asked to choose a lowest current value which would break a circuit containing three fuses in series: a 1 A, a 5 A and a 13 A. 46% thought 0.5 A would be large enough while 20% thought that 19 A would be required.

Perhaps the most interesting result, however, was that only 17% of candidates knew that the electric current in a wire is a flow of negative electrons. 63% chose electrons but considered them to be positive while 20% thought that it was protons which moved.

It might be true that the difference between direct and alternating current and between positive and negative electrons/protons might be somewhat esoteric. However, there are serious concerns for domestic situations in understanding the limitations of fuses and how to choose one appropriate to the task.

Overlap Questions

Most difficulty here involved the interpretation of two lines drawn on a set of axes. The concept of power as energy transferred per second was understood by only 35% even at higher tier. An equal percentage chose energy per volt and 23% - per amp.

Higher Tier

There were several items which gave very high scores particularly involving calculations and data interpretation. As many as 78% understood the origin of the term ‘Maglev’ but 19% considered that it referred to magnetic level (leaving of course 3% for a bit of magic!).

The action of an RCCB was poorly understood. A higher percentage (36%) thought it broke the circuit when the current differed in the fuse and live wires than chose the live and

neutral option. Only 21% correctly identified the direction of current and of charge movement in a circuit.

The thought experiment of increasing a variable resistance to a very high value when in parallel with a lamp produced a very poor response. Candidates failed to realise that this was virtually the same as removing it altogether.

GCSE Science 5010
GCSE Physics 5046

Multiple Choice Paper P1b

Foundation Tier

Performance, overall, was often hit and miss. Many items which relied on direct recall of fact were poorly done while candidates scored quite well on some of those which involved some thought. Good scores were obtained on these recall items: 97% knew that X-rays were used to detect broken bones and 78% that the Universe was bigger than our galaxy. However, the lowest percentage of correct responses was obtained on a space item with only 14% remembering the specification statement that all electromagnetic waves travel at the same speed (in the vacuum of space) between galaxies.

Imagining large numbers proved difficult in the context of the distance between stars. Despite being given the value for the distance between the Earth and the Sun as 150 000 000 km, very few were able to relate the scale of the Solar System to the separation of stars in a galaxy. 77% thought the average distance between stars would be less than 250 million km, which is just over the radius of Mars' orbit.

Overlap Questions

Higher level candidates performed better on all the overlap questions than those entered for foundation level. At the high performance end, 75% of foundation candidates translated data and found the key about the UFO survey while as many as 91% of higher candidates chose correctly. Similarly, 62% foundation and 83% higher realised that some people gave more than one answer. However, on discussion of water and the possibility of life, scores were lower (26% at foundation and 41% at higher). 54% of foundation candidates thought life as we know it is certain if liquid water exists on another planet.

Responses to the 'How Science Works' question about Herschell's discovery of infrared radiation was disappointing. Many chose the initial observation of non-uniformity of heating effect in the visible spectrum, many stopped at the detection of the trend in different colours and only 30% foundation and 40% higher realised that it was the extra step of proceeding into the unknown that led to the discovery.

Higher Tier

While most were able to change its subject, few candidates performed the wave equation calculation correctly, with as many as 81% ignoring the units of km/s for the speed. The ones who made the units consistent had generally scored well on the paper as a whole. Much difficulty was also experienced with action and reaction concerning rockets. 75% remembered that the rocket pushes on the gases but only 16% realised that the **explanation** for the thrust after lift-off was caused by the gases pushing on the rocket, not by the inconsequential fact that the gases may also push on the Earth. The gases, of course, accelerate the rocket even well away from the Earth's surface.

One item in the last scenario about the comet, gave candidates the chance to do an experiment. They could use a piece of paper to compare the distance between

appropriately labelled dots to find out on which of the given dates the two astronomical objects (which 62% had correctly identified as a planet and a comet) were closest. This proved quite good at discriminating but only 23% appeared to do the comparison properly. This does not seem to be because of shortage of time since 73% of candidates were able to answer the final question on the paper correctly which involved the double step of identifying the greatest change in temperature and explaining it.

GCSE Additional Science 5015
GCSE Biology 5027

Multiple Choice Paper B2

General Comments

Although there were many questions that were well accessed by all candidates at both foundation and higher tier there were a few disappointing statistics for aspects of the specification that have been well tested previously. This is evident in several cases throughout the foundation tier of the paper and to a lesser extent in the higher section. However, there were some very pleasing results which indicate an improvement in candidates understanding in areas that have previously proved somewhat challenging, with foundation tier candidates in particular showing, in many cases, their confidence in the use of specific scientific terminology.

Foundation Tier (Q1-16)

Most foundation tier candidates were able to identify the nucleus of the cell as containing DNA with 67% responding correctly. However, only 34% of candidates correctly identified water as a reactant for photosynthesis which is very disappointing. More candidates chose option C, oxygen, as their answer for this particular question which vaguely suggests that the use of 'reactant' in the stem may have thrown some candidates at this level. Similarly for question 3, only 36% of candidates were able to complete the sentences with the correct words from the table. 35% of candidates were under the impression that carbon dioxide was needed for respiration by choosing option B this being a common mistake that candidates repeatedly make. However, the combination of both photosynthesis and respiration in the same question clearly proved challenging for all but the most able candidates at this tier although the majority were clear that chlorophyll is the green chemical responsible for light absorption. It was pleasing to see that 76% of candidates were able to identify the conditions that would increase the rate of photosynthesis indicating a good basic understanding of this chemical process. 18% of candidates opted for option A for this particular question and this could be a result of them reading 'bright sunlight' at the beginning of the distracter without going on to read the remainder with any real thought.

Candidates responded well to the questions within 'Polluting the environment' showing a clear understanding of the various pollutants released from the burning of fossil fuels and their effects on the environment. However, 25% of candidates were under the impression that carbon monoxide was formed as a result of a reaction between sulphur dioxide and water although the majority were correctly aware that acid rain was the product.

The statistics for question 9 were pleasing; 74% of candidates responded correctly indicating their understanding of conditions in this particular extreme environment although only 38% were able to identify interdependence as the correct term used to describe the relationship between the tube worms and bacteria living near the deep sea vents. A slightly larger percentage (39%) incorrectly chose option D, adaptation, as their answer which implies some misconception of key scientific terminology in this area of the specification. Interestingly, 70% of candidates arrived at the correct response for question 12 where they correctly identified the features of the bumblebee as adaptations. This

statistic does not support the implication that candidates do not understand this particular term and therefore suggests that those that did not correctly respond to question 10 may not have fully understood the context of the question.

There is a very clear lack of knowledge amongst Foundation tier candidates in relation to the bacteria of the nitrogen cycle. Only 12% of candidates identified nitrogen-fixing as the bacteria responsible for converting atmospheric nitrogen into nitrates. More candidates (39%) chose nitrifying bacteria, possibly just guessing although it may be a situation where the actual word 'nitrifying' just sounds like it fits! A similar percentage (38%) chose decomposers the role of which candidates are likely to be more familiar and introduced to more frequently. Questions 14 to 16 were answered well by most candidates and it is pleasing to see that many understand that fertilisers contain nitrates for growth (81%) and the possible consequence of its overuse.

Overlap Questions (Q17-24)

Apart from question 20 higher tier candidates significantly out-performed the foundation tier candidates on the common questions. Although most of the statistics indicate that both foundation and higher tier candidates responded well in most cases, foundation tier candidates performed particularly well on question 21. Here 70% of candidates were able to identify the correct response to support Aaron's statement, as opposed to 88% of higher tier candidates, clearly showing their strength in analysing quantitative data in tabular form. 74% of higher tier candidates were able to use the pictorial information to determine that cell X was a stem cell for question 17 although only the more able foundation tier candidates (34%) were able to reach the correct conclusion in this case. It appears that a fair number of foundation tier candidates do not understand the embryo as a 'ball of cells' with 30% of these candidates opting for this response to this question. Interesting, 40% of foundation tier candidates were able to identify the correct word equation for respiration, despite the question not stating that this was the chemical process being tested. This is a greater percentage than that obtained for question 3 (36%) on the foundation tier which indicates that, in a different context and format, foundation tier candidates are more able to show their understanding of this reaction. The statistics for question 20 imply an almost equal level of understanding between foundation and higher tier candidates of the potential of stem cell technology. 46% of foundation candidates and a disappointing 48% of higher candidates arrived at the correct response for this item. This area of the specification easily lends itself to independent research and possible project work, particularly as it is a very fast moving area of science that is continually changing. It is important that candidates remain up to date with current science and this particularly exciting area can provoke much thought and discussion to be shared with others. This, of course, can lead to learning in a much broader sense and will help candidates to develop their own ideas on controversial issues such as this.

Higher tier candidates were more successful in their responses to questions 22 to 24 than the foundation tier candidates. 61% of higher tier candidates were able to correctly identify the factors necessary to ensure valid results whereas more foundation tier candidates (46%) thought that quantity of reactants was unimportant, but repeating was, in obtaining results that were valid. 35% of foundation candidates gained credit for this question. Similar statistics are seen for questions 23 and 24; more higher tier candidates are familiar with the fermentation carried out by yeast than foundation tier candidates

although a good percentage of the latter (46%) understood that alcohol was the food product produced from this reaction.

Higher Tier (Q25-40)

Candidates performed well on questions 25 to 28 reinforcing not only the implication that they have good strengths in graphical interpretation but also in their understanding of this area of the specification. Question 27 posed the greatest challenge with candidates having to use both the information in the table and the graph to determine that rat-tailed maggots would be found between X and Y. In this case 51% gained credit whereas 35% of candidates decided that the water was more polluted between W and X. A good 76% of candidates understood the organisms in the table to be living indicators.

A slightly different version of a diagram depicting mitosis confused some candidates possibly due to the way in which the daughter cells were labelled. However, more able candidates were able to elucidate that each daughter 'p' cell was identical to the original, with 43% gaining a mark for their response to question 29. 23% of candidates, the next highest percentage, chose meiosis as the type of cell division taking place resulting in haploid cells, again likely to be due to the format of the diagram. This question proved to be a good discriminator. A greater percentage of candidates (64%) correctly identified the nature of the cells produced by mitosis but 16% thought that the cells produced by mitotic division were identical to the parent but not to each other.

Only 36% of candidates were able to determine the number of bases in the insulin gene from the information given in the stem of the question and despite the error in the options for question 34, which did not affect the answer to this item, only 36% were correctly able to identify the correct mRNA sequence for the insulin gene. Candidates proved their knowledge of the locations of both translation and transcription with 70% responding correctly to question 35 although 22% showed some confusion by concluding that transcription takes place on ribosomes and translation in the nucleus.

It is disappointing that candidates continue to show a lack of understanding of the role of minerals other than nitrates in the health of plants. A greater percentage of candidates (35%) responded incorrectly for question 37 being under the impression that potassium is required for chlorophyll production with 23% thinking that potassium is needed for protein synthesis. Only the more able candidates on the higher tier were able to correctly identify that magnesium is important for the production of chlorophyll with 31% of candidates gaining credit for their response. More candidates were able to show their understanding of the role of nitrates for question 38 with 52% understanding that the growth of the plants would be stunted if their uptake of nitrates was reduced. Similarly, just over half of the candidates proved their good awareness of terms used in investigative and practical work and this improvement is very pleasing. 55% of candidates identified option D as the correct response for question 39 indicating that they are becoming much more familiar with terms such as validity and are able to distinguish its meaning from other terms such as accuracy and reliability.

GCSE Additional Science 5017
GCSE Chemistry 5037

Multiple Choice Paper C2

Foundation Tier

The first 8 questions were generally well answered and all areas of the specification were accessible.

Candidates understand and can explain the properties of metals, alloys and organic compounds in this unit. A surprisingly large number mistakenly think that the formula for methane is C_4H or C_4H_4 instead of CH_4, and 23% thought that the symbol for aluminium is Au.

The questions involving carbon chemistry showed a good understanding. Only 29% of candidates realised that Buckminsterfullerene was pure carbon with coal being the common incorrect response.

The questions on oils and fats were reasonably answered apart from question 15.

Only 28% of candidates realised that a polyunsaturated molecule contains more than one double bond. The common misconception is that the term refers to ionic bonds or single bonds only.

Questions 17 to 19 showed that the knowledge and understanding of issues concerned with bonding and molecular structure is variable. Only 34% of candidates were able to calculate the relative formula mass of silica in question 20.

Questions 21 to 24 concerning rates of reaction proved challenging. A large number of candidates mistakenly chose the wrong experiment in question 21. However, 49% of candidates chose the correct answer in question 22.

67% of candidates were unable to correctly identify the equation in 23 with the unbalanced equations being the favourite responses.

Higher Tier

With the exception of question 21 candidates found the first 8 questions straightforward. In this question 45% of candidates could not relate the size of the marble chips to the correct experiment.

The knowledge and understanding of hydrocarbons was problematic. Only 44% correctly identified the formula of propene in question 25 while 60% recognised the structure of butane in 26. The boiling point and electrical conductivity of propane was known by only 40% of candidates in question 27. A surprisingly large number of candidates, 65%, were unable to deduce that when propane is shaken with bromine water the colour stays orange.

Many candidates could not deduce the chemical formula of magnesium bromide in question 29. Only 46% of candidates successfully chose $MgBr_2$ with 35% giving Mg_2Br. The other questions on bromides were generally well answered. The ionic half equation in question 32 caused the usual problems with only 26% correct.

The questions on halogens and their compounds were good discriminators. Surprisingly 51% of candidates described the (poly)chloroethene molecule as an unsaturated hydrocarbon molecule in question 35.

Pleasingly 49% of candidates were able to give the correct answer to question 36, which was a significant improvement to questions involving empirical formula calculations compared to previous years.

The understanding of equilibrium in questions 37 and 39 is variable with only 24% of candidates choosing the correct option in 37. The effect of temperature and pressure on the Haber process was only correctly realised by 35% of candidates in question 39.

The dot and cross diagram representing ammonia in question 40 was only correctly answered by 37% of candidates. 36% chose the option, which had a molecular formula of N_2H_6.

GCSE Additional Science 5019
GCSE Physics 5047

Multiple Choice Paper P2

Foundation Tier

Overall the performance of candidates in the first 16 questions showed that they had been well prepared for the examination. In 12 out of the first 16 questions over 50% of candidates opted for the correct response and in 8 of these questions over 60% were correct.

Candidates demonstrated a good understanding in questions on radioactivity and its uses and resultant forces.

Most candidates were secure on some aspects of electrostatics but only 30% were aware that in a nuclear reactor energy is released by splitting/ fissioning atomic nuclei.

Candidates performed well with questions on motion and almost 50% correctly answered a more challenging question about energy transfer during part of a roller coaster ride. However gravitational potential energy still causes confusion. Only 34% correctly identified a car at the highest point of a roller coaster ride as having the most gravitational potential energy, with 20% choosing the lowest point on the ride.

Common questions differentiated well between foundation and higher tier candidates and most discriminated well between less able and more able candidates.

Candidates showed a good understanding of radioactivity and nuclear power. In particular there was a marked improvement from previous tests in candidates' ability to analyse the decay curve of a radioactive source.

Candidates coped very well with straightforward calculations about work done and using $E = ItV$.

Higher Tier

Candidates once again showed that they had been well prepared for the examination with over 50% of candidates identifying the correct response in 11 out of the 16 questions.

The radioactivity investigation was handled well by many candidates but over 40% thought that a radioactive tracer emitting alpha radiation could be detected outside a patient's body.

Many candidates showed a good understanding of nuclear power including environmental issues but almost 50% thought that nuclear fusion is used in nuclear power stations.

Most candidates demonstrated a good understanding of momentum and terminal velocity but less than 50% could calculate acceleration using $F = ma$.

Only 30% of candidates were able to cope with both a unit and subject change when using E = ItV to calculate current.

GCSE Additional Science 5016F
GCSE Biology 5028F

Structured Paper B2

General Comments

This paper consisted of seven questions with 6 and 7 in common with the higher paper. All questions were accessible to the candidates.
The candidates in this series seemed to either produce a good answer or gave responses that were completely wrong. Candidates entered for 5028F scored slightly higher than candidates entered for 5016F on average on most questions. It was pleasing to see candidates using techniques like underlining key words in the body of the question.

"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

Cells

This question was designed to test basic knowledge of cell structures. Most candidates correctly selected chloroplast as the correct response. 50% of candidates scored 3 marks on part (b). This question was made very accessible to candidates by using the 'join the box' style.

Question 2

Extreme environments

This question was designed to allow candidates to demonstrate their knowledge of how altitude affects humans.
The great majority of candidates (90%) gained the first two marks but the third marking point was much lower at 70%, so there is clearly confusion in understanding the effect of altitude on red blood cells.

Question 3

Factors affecting the growth of plants

Part (a) required candidates to interpret data concerning plant species growing near to the sea. Most candidates scored the first mark but relatively few went on to correctly note the change at 20m. A significant number answered in terms of numbers of plants rather than numbers of species, or referred to animals. It is surprising how many candidates noted that the number of species decreased. The second marking point was for recognising that the number of plant species levelled off at 20m and beyond. Few candidates gained this second mark.

Part (b) asked for a reason to explain the pattern. Many candidates do not recognise the effects on plants of the salt in seawater. Many thought that the plants were drowned or

that there was too much water nearer the sea. Many answers were incomplete or poorly focussed e.g. “Further back from the beach conditions are more suitable for plant growth”, “the soil is richer”, “plants grow better away from the sea”, “there is more sunlight/oxygen/space”, “it’s easier for plants to grow”.
Examples of good responses include “The sea contains too much salt for most plants to grow” and “few plants use salt water, most need fresh water to grow”.

Question 4

Biosphere

Most candidates knew that process A was respiration, although there were a few who thought it was photosynthesis.

In part (b) 27% of candidates scored both marks by stating that plants should be increased and the number of animals or humans decreased. Quite a few had these reversed and other misconceptions about conditions on Mars included “Open the windows”, “Let more oxygen in” and “There should be fewer cars”.

Many different responses were seen for part (c), and 40% correctly gave bacteria, microorganisms, or fungi. Some candidates gave a list of more than one type of organism e.g. animals/bacteria thus losing the mark.

Question 5

Fermentation

In part (a) 'one' ingredient was asked for but some answers included a list, which was unfortunate if it included wrong responses. Other candidates offered apples/ grapes confusing the process with cider and wine making. 54% gained credit here and water, hops and barley were the most common correct responses

In part (b) 37% correctly gave respiration, but many other processes were seen.

In part (c) just 2% of candidates referred to the rapid growth of the microorganisms and to the idea that they could be grown anywhere in the world. One or two referred to this type of food production being acceptable to vegetarians. In many cases it was difficult to establish whether the response referred to the food growing quickly or to the microorganisms. Common misconceptions included “makes food more healthy“, “cheap to make“, “speeds up the process, “makes food last longer“, 'and “kills bacteria growing on the food“.

Part (d) concerned what happened to the surplus yeast at the end of the process. Few candidates gave responses that hit the nail on the head. “It was left over because the yeast had grown”. Many other answers were qualified well: “It’s finished producing beer and is no longer needed”, “It’s not needed in the beer”, “it’s not needed any more”. Some misconceptions included that the left over yeast was the remainder of what was put into the fermenter at the start: “most used up”, too much put in”. Another was that “the yeast couldn’t be used again”. Others were: “all the goodness has gone, it’s dead”, “You

can't take any more alcohol out of it". There were several references to yeast being bacteria.

Most candidates correctly identified another use for yeast, although some answers were not accurate: "used as bread/soil/compost".

Question 6

Acid rain

This is the first of the crossover questions.
This question was designed to test candidates' understanding of the way that acid rain is formed and the effect that it has on the environment.
93% correctly described the pattern in sulphur dioxide emissions between 1970 and 2005.
Many candidates gave short answers to part (b) e.g. "cars", "factories" and burning fuels, which did not gain them credit. 23% gave sufficient detail e.g. "burning fossil fuels" and "from car exhausts".
In part (c) a few good answers were seen for example: "Sulphur dioxide reacts with rain to form sulphuric acid. The acid rain dissolves limestone". A very common misconception is that sulphur dioxide goes into seas, lakes, and rivers before entering the air which it does by evaporation and then mixes with the rain.
There were a number of instances of sulphur reacting with water in the air and sulphur dioxide or sulphur were often said to react with CO_2 and other gases before forming the acid rain.
In describing the effects of acid rain on the environment, there were many uses of vague terms like: "it affects", "it erodes", "corrodes materials", "makes things corrode". Then there were the terms like "burns" and "melts". "Kills plants" was the most frequent correct effect of acid rain.

Question 7

Eutrophication

This was the second crossover question.
This crossover question was designed to test the ability of candidates to apply their knowledge of eutrophication.

In part (a) candidates gave a lot of answers involving dead plants and animals. A number of responses included weed killers, pesticides and acid rain as sources of nitrate in the water. 21% gave acceptable answers like fertilisers, tap water and sewage.

In part (b) 59% of candidates scored both marks by referring to the idea that light would be blocked so there would be less photosynthesis, although "sun" or "sunshine" was seen instead of sunlight in a number of scripts. A number of answers used 'affect their growth' without saying in what way growth was affected. Many candidates felt that growth was restricted due to 'lack of space' or the plants at the bottom being 'strangled' or that the nitrates had poisoned the plants at the bottom of the pond.

Part (c) asked about the effect of the decay of the algae on the pond environment. 5% gained both marks with responses like "Microorganisms like bacteria will decay the dead

blanket weed and respire as they live. This uses up all the oxygen in the water, killing the fish and other underwater life". Many candidates thought that the pond would turn green, dirty, smelly etc. and that the fish would die, so gained one mark. There was a common misconception that the sinking of the blanket weed to the bottom of the pond and its subsequent rotting would bring great benefits to the pond, returning it to health - other plants would receive more light, photosynthesise more, make more oxygen and the animals would therefore thrive.

GCSE Additional Science 5016H
GCSE Biology 5028H

Structured Paper B2

This paper consisted of six questions with 1 and 2 in common with the foundation paper. Most questions were accessible to the candidates with some excellent answers to questions reflecting how well the subject matter had been learnt. There was some evidence of good practice seen such as underling key words and bullet points to ensure that, for example, three points were made when there were three marks available.

Question 1

Sulphur dioxide and acid rain

This crossover question was designed to test the understanding of how acid rain is formed and the effect of acid rain on the environment.
Part (a) was a simple graph interpretation question and was correctly answered by 98.5% of candidates. 46.4% of candidates answered part (b) correctly with marks being lost by answers that were not specific enough, e.g. burning fuels, or just stating power stations, cars or factories, where to gain credit, an implication of sulphur dioxide being produced by burning fossil fuels was looked for. There were many answers with vague, scientifically incorrect statements about how acid rain is formed. These included the gases are absorbed by the clouds, rivers absorb the sulphur dioxide and when this water evaporates, it is acid rain and the water vapour and the sulphur dioxide mix to form acid rain. There were also very few detailed answers with regard to the effect of acid rain and most marks were gained by stating that the rain made lakes more acidic which killed fish. Many candidates confused erode and corrode. It is possible that these misconceptions are due to remembering the diagram so often used to show acid rain formation and yet not fully understanding the processes involved. Whilst 57.4% gained at least one mark here, only 5.9% gained all three marks available.

Question 2

Eutrophication

This crossover question was designed to test the ability of candidates to apply their knowledge of eutrophication. 58.6% of candidates were credited with the mark available in part (a). Some candidates just stated nitrogen and a few that suggested that nitrates were the source of nitrates. Part (b) was well answered with 83.9% of candidates being awarded both marks available with many clearly stating all three marking points in a logical sequence. Part (c) was less well answered with candidates tending to state that the rotting blanket weed would improve the pond environment by releasing nitrates for growth of plants.

Question 3

Growth factors

This question was designed to test the candidate's ability to demonstrate their knowledge of the effects of growth substances on the body. Part (a) was well answered with 91.9% gaining at least one mark. Some candidates were not awarded the first mark as they stated that the growth substances would make the body grow or more muscles grow. Some very clear answers were seen in part (b) from the 47.3% of candidates that were awarded at least one of the two marks available. Some candidates lost marks by just writing one word, like cancer, and others that it would damage the body. Some candidates had clearly learnt negative side effects of growth substances and stated some correct psychological effects but missed the part of the question that said the effects have to be on the body. Part (c) was correctly answered by 70.3% of candidates.

Question 4

Fermenter conditions

This question allowed the candidate to demonstrate their knowledge of how fermenter conditions are controlled. Simply stating that sterilisation kills microorganisms in part (a), missed the point of the question. 60.4% of candidates did, however, take this forward and stated that if not, these microorganisms would then compete with the culture that is being grown. It was disappointing that so many candidates stated in part (b)(i), that the air was filtered to remove gases, or a named gas, usually carbon dioxide, or made a general vague statement, for example to clean the air. 33.4% of candidates gave correct responses with some showing understanding of the requirement to have filters capable of removing viruses. Part (b)(ii) was correctly answered by 33.2% of candidates with again vague answers like "because the microorganisms need air (to grow) being the main reason for not being credited here. In part (c), computers was deemed insufficient for the mark, with 74.5% correctly stating that the probes were required, or occasionally, that samples could be taken and tested. Once more it was insufficient detail that lost candidates marks. Many candidates stated that if the conditions were controlled then the microorganisms will grow, without stating that the control would optimise growth or yield. Some very good answers were seen that showed excellent understanding by candidates when they explained whet will happen if, for example, the temperature became too hot or too cold.

Question 5

Deforestation

This question tested the ability of candidates to interpret a graph and state their knowledge of the effects of deforestation.
In part (a) 91.6% of candidates correctly stated that three regions showed an increase in forestation and 81.4%, that South East Asia was the region where the highest percentage of deforestation had taken place, but Oceania was the most common response wrongly given.
In part (b) 85.4% of candidates gained at least one of the three marks with most explaining increased carbon dioxide levels due to burning of the trees. Some excellent responses were seen that explained the effects with 16.4% of candidates gaining all three marks. Again, it

was disappointing to see answers with incorrect science like “kill habitats”. Fortunately, these were relatively uncommon.

Question 6

Cloning

This question allowed candidates to demonstrate their detailed knowledge of a biological procedure.
Just over 50% gained at least 1 mark, with 7.2% gaining all five marks available.
Part (a) was often correctly answered with credited responses being roughly equally split between using the term enucleated and describing the procedure.
Part (b) often had just one correct point, the use of a surrogate mother. Good answers were regularly seen with a clear and logical sequence shown.
Some candidates had a mark deducted for having points made in the wrong order, most commonly supplying the electric shock to stimulate mitosis after it had been implanted in the surrogate mother. Many candidates had a mark deducted by stating that the cell was fertilised somewhere in the procedure. Others discussed removing the DNA instead of the nucleus.

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 - 4 were targeted at grades E/F/G and the last question was targeted at grades C/D.

Question 1

Part (a) consisted of three controlled response questions and the results showed that the candidates associate conduction of an electric current with metals and that it is associated with free electrons in the structure.

The majority of the candidates, some 79%, could identify correctly the elements present in sodium chloride, although it was a little mystifying how a candidate could interpret the formula as representing the elements titanium and iron.

Question 2

The majority of the candidates could identify the substances in part (a) as alkanes and turn the displayed formula for ethane into a molecular formula. However, in part (c) the success rate of the correct answer showed that most candidates were opting for the third option as something they probably could relate to quite easily.

Surprisingly only 31% of the candidates could work out the correct relative formula mass of methane and use the relative masses correctly, leaving a sizeable number with no idea of how to carry out this simple calculation.

Part (e) was about the test for alkenes. Although a slim majority knew the colour of bromine water, there were still a sizeable number who try to get away with using the term 'clear', erroneously on this occasion. Giving the candidates the negative result for the test made the item a little more difficult, however 43% of the candidates managed to work their way through to score the mark. However, many did not seem to recognise the positive result as an identification test for alkenes/ unsaturation.

Question 3

The examiners were quite disappointed by the answers they saw to part (a). What should have been a simple task of an explanation in terms of surface area and a comment about increased frequency of collisions proved an almost rarity. More than 75% failed to score a mark. The most common response that the candidates wrote was the chip being 'broken-down' or 'broken-up' as their way of referring to 'smaller pieces'. Many were confused and wrote that the powder had a *smaller* surface area and hence was faster. Very few, only 0.5%, gained the second mark.

Equally disappointing were the answers to part (b). This should be a fairly simple question that should score highly among the entire entry cohort, however, only 42% achieved the mark. Many candidates wrote about increasing the amount of acid, increasing the

concentration of the marble powder, making the marble into a liquid and some suggested 'heating the water'.

In part (c) (i) it was rare to see a correct answer. Only 6.6% of the candidates could explain that an enzyme is a biological catalyst or that it is something that speeds up reactions. The majority gave an explanation about something that breaks up food or some interpretation involving bacteria. Part (ii) revealed how many candidates were misinformed about 'natural fertilisers'. More candidates gained 1 mark than 2, with the mark being awarded for the advantage. A range of ideas were given but the most common were 'cheaper' and 'grow faster/bigger/better'. Many candidates thought the potato would be 'better' or 'taste better'.
Those who gained the disadvantage mark usually did so for an explanation involving eutrophication and surprisingly this term was seen correctly used several times. Many candidates merely stated 'pollution' but did not give enough detail for the mark. Surprisingly many candidates thought that the natural fertiliser would cause the potato to grow slower or to rot and many answers were suggesting disease due to natural fertiliser.
Some candidates thought that fertiliser meant it could not be organic. A few enterprising candidates tried:
Advantage : 'grows quicker'
Disadvantage : 'grows slower'.

Question 4

This question concerned a restricted number of elements of the periodic table shown by letters P – U inclusive. Some candidates scored well, gaining all four marks, but typically a range of answers were seen and it would be difficult to draw any conclusions other than inspecting the percentage of correct answers:

(a) 50%
(b) 55%
(c) 44%
(d) 26%

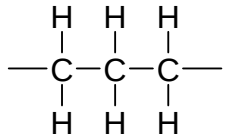
Question 5

Overall this was a poor scoring question on material according to specification that should be examined at this level.

As candidates had performed well on question 2, referring to alkanes and alkenes, it came as a surprise that on part (a) (i), this question was answered so badly. Over 90% scored no marks for this part of the question. The majority offered an explanation based on a polymer being a type of plastic (or words to that effect). Some gave an answer involving poly reacting with propene. The few that did use the term 'monomer' did not apply it in the next question.

It was rare to see a correct answer to part (ii). Most that offered an answer tried the idea of extra molecules being added to a polymer. Overall, only 0.9% of the candidates achieved both of the marks to part (a)

In part (b), only 3.5% of the candidates gained both marks. Several understood that a double bond was needed but often had 5 bonds around the middle carbon. Others drew compounds with 2 double bonds. One of the most common seen was



and frequently with no bonds shown at all. Some candidates did attempt dot-and-cross diagrams and there were reports of the occasional candidate performing well.

It seemed that the ideas of addition polymers had escaped the candidates since only 2.2% of the candidates scored marks on part (c). Many candidates discussed ideas about covalent bond formation but did not mention double bonds being present. Others mentioned the double bonds but took it no further. Most who got the first mark also got the second mark although not all. There were a lot of descriptions of covalent bonding in terms of sharing electrons that did not meet the mark scheme.

In part (d), 24% of the candidates gained one mark for a description involving melting (a few for softened). Only a few discussed 'no crosslinking', 'weak/no intermolecular forces' as an explanation to the melting or softening of a polymer when it is heated. Many candidates discussed particles/atoms/bonds/electrons moving rather than molecules of the polymer. Several candidates discussed bonds breaking or weak bonds, but these were generally implying *intra*-molecular situations rather than *inter*-molecular ones. Few – less than 1% of the candidates - gained 2 marks. Some candidates thought it was the pressure of the water as they were rowing that caused the shape change.

Finally in part (e) the majority made a valid suggestion about why recycling is important. However, a significant number offered vague answers such as 'to stop pollution' / 'to stop global warming' / 'to save the ozone layer' / 'because it's eco-friendly'.

Revision Tips

- Learn the test and result to identify the various substances as indicated in the specification.
- Learn how the various factors (increased temperature, concentration and surface are) affect the rate of a chemical reaction and explain in terms of colliding particles.
- Practice drawing the structure of the first four alkanes and the corresponding alkenes.
- Learn the names of the first four alkanes by using a mnemonic such as '**M**onkeys **E**at **P**eanut **B**utter' – **M**ethane, **E**thane, **P**ropane, **B**utane.
- Practice answering past GCSE questions *without* rewriting the question. Restating the question gains no marks at all.

GCSE Additional Science 5018H
GCSE Chemistry 5038H

Structured Paper C2

This is a higher tier paper consisting of four questions. The first question was common with the foundation tier paper.

Question 1

The idea that polymers were made of long chains of repeating units was familiar to most candidates. The majority of correct responses referred to molecules or hydrocarbons in a chain. Terminology let some candidates down, with references to atoms in a chain rather than molecules or 'molymers'. Some simply stated that 'polymers are plastics'. The meaning of addition was much less well answered, the concept seemed to be not to be well understood or at least expressed. One common misconception was that many propene chains were involved i.e. that one polymer was being added to another. Another false idea was that the polymer could be combined with other elements, have a CH_3 added, or could be added to other substances to change their properties. Also, the idea that the polymer had many uses was regularly seen.

The poor response to part (b) was disappointing. Several flawless responses were seen, including some dot and cross diagrams. However, most candidates only scored one mark for a molecule with a **single** double bond ($CH_2=CH_2=CH_2$ was common). Most common incorrect answers seen were variations of propan-1,2-diene or propene with tri- and penta-valent carbons. Many answers did not even contain a double bond ($CH_2-CH_2-CH_2$ was also common).

In part (c) few candidates scored full marks for the two expected responses. Many candidates were aware of the polymer chain formation, but in most cases it was clear they had no idea of how the polymerisation process starts with the breaking of the double>C=C< bond. Several answers did mention a covalent bond being broken, but not specifically the >C=C< bond. It is suggested that a better understanding of the process would seem to be a way forward.

Happily, part (d) was better answered. Many candidates scored mainly only on the idea that there were no / weak cross-links or correctly referring to weak intermolecular forces. Fewer gained credit for the plastic melting or softening, or that molecules move. The difference between the bonding of atoms and the forces between molecules is still not clear in candidates' minds. These were often used interchangeably and often were contradictory in their answers.

Part (e) had a wide range of suitable responses so was high scoring. Most got one of the ideas of: re-use and conservation of natural resources; the overuse of landfills; the release of toxic and greenhouse gases when burning polymers; or saving energy. "It makes Mr Brown happy" wasn't given a mark, and in general vague references to helping the environment and preventing pollution were mark losers.

Question 2

Part (a) was well answered. In part (b) the idea of an electron being transferred from the outer shell of a sodium atom to the outer shell of a chlorine atom leading to full outer shells in each ion was reasonably well understood, with many detailed explanations. The most obvious error connected with this question was the assumption that the bonding in sodium chloride was covalent with the resultant sharing of electrons. Occasionally electrons moved the wrong way from chlorine to sodium, or electrons were swapped between the two atoms.

In part (c) the idea that strong bonds require a lot of energy to be broken seems to be well established. However, the number of references to covalent bonds or intermolecular forces was quite extraordinary. And this is with sodium chloride! Some did not link high temperature (stated in the question) to large amount of energy.

Question 3

Part (a) was well answered, with quite a few candidates giving the answer in the form of a diagram. The following answers were all seen: 18; 40; lists of the particles; 8,8,2; 10; 32; 8,8,4; positive; C_3H_8; it has 3 full shells; 2,7; stable with a full outer shell; it is not an electric conductor; 172; ; 2,8; Ar^{22}; 8; 22 covalent bond. It is clear from this that some candidates are not entered for the correct tier. In the second part, most knew that argon was a noble gas - although some have been watching *Lord of the Rings* and we had mention of the noble Aragon. Lack of reactivity was explained as a result of having a full outer shell of electrons. Confusion arose is some who thought that Argon has electrons which can produce light (*c.f.* flame tests?) or allow electricity to be conducted through the gas. Also in a mix up with advertising signs, Argon giving out light was seen.

It was sadly rare to see a fully correct answer with full working shown in part (b). It was a pity that some of those who did calculate correctly ignored the instruction to give the answer to three significant figures. One would have expected that common sense would rule out answers not between 20 and 22.

Question 4

Similar questions to this have been asked previously. The idea of weak intermolecular forces is not well established. Many answers referred to weak bonds or weak covalent bonds. Many has their logic inverted, and simply wrote 'because it is gas'.

Part (b) was much better answered. Many candidates correctly showed the necessary 3 pairs of shared electrons to gain at least one mark. Common errors were the omission of the lone pair of electrons on the outer electron shell of nitrogen or in some cases to show only one non-bonding electron. Quite a few responses clearly had not grasped covalent bonding, since often a series of concentric circles with NH_3 at the centre was shown, with varying numbers of electrons in the shells. The clarity and size of diagrams was often poor making it difficult to award marks. It is advisable to draw the shells carefully and very clearly place the shared electrons within the overlap. If the shells are not drawn the examiner can have difficulty in interpreting the diagram.

Dynamic equilibrium continues to be the preserve of the most able candidates. Many answers incorrectly related to an increased rate of reaction producing an increased percentage yield of ammonia. Surprisingly, many responses gave correct explanations, but forget to mention how the equilibrium yield was affected. The most common explanation was based on the endothermic reaction being favoured by a higher temperature. Many simply mentioned in their explanation that the reaction would be reversed or becomes exothermic or simply quoted Le Chatelier's principle without applying this to their answer. Some simply quoted reaction conditions for the Haber Process, or inferred that the catalyst was the cause of the changing equilibrium yield, or mentioned that ammonia might be denatured at higher temperatures. In quite a few cases, where little or no understanding was evident, candidates discussed the potential hazard of the process, e.g. risk of explosions due to a high temperature.

The idea that a catalyst speeds up the reaction was commonly seen in part d, together with comments about how the catalyst is not used up or how it reduces the activation energy. Some said that catalysts improve the yield of reversible reactions.

Part (e) was very disappointing. Some knew the formula for ammonia but not nitric acid (N or NO, N_2O, NO_2, NH, N_3 all given) or provided a word equation.

Revision Suggestions

- Learn the meaning of 'addition polymer'.
- Practise drawing a variety of alkane and alkene molecules with tetravalent carbons (isomers are a good way of tackling this).
- Learn the difference between bonding and structure: e.g. covalent bonds in **one** molecule and inter-molecular forces **between** molecules in the structure.
- Learn the reasons for the high/ low melting and boiling points of different structures.
- Be able to identify which substances are ionic and which covalent.
- Practise calculations of relative atomic mass.
- Practise the expression of answers in careful English with good use of Chemical terminology.
- Use past papers to help.
- Learn how to apply Le Chatelier's principle.

GCSE Additional Science 5020F
GCSE Physics 5048F

Structured Paper P2

General Comments

As mentioned in previous reports, a major weakness is recall of standard definitions and vocabulary. Calculation, too, is a weak area. In part this is due to non-use of a calculator, but more importantly candidates were unable to substitute into equations correctly. As mentioned in more detail below, candidates need to ensure that they substitute dimensionally correct quantities into equations; for example, selecting a distance quantity in metres and not metres/second. Conversely, and pleasingly, 'How Science Works' is often a strength for many candidates.

Examination technique was often poor. There was evidence that many candidates did not read the paper with sufficient care for the detail of the instructions. When asked for three 'ticks', four or two will not do; a one mark question does not need a paragraph or more in response; a two mark question is not going to gain full marks with two or three terse words.

Although there are no marks allocated to quality of written communication, it was disappointing to see candidates failing to gain physics marks due to the lack of clarity and inconsistency in their answers. 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 plan and then re-read their answers. There was no evidence that candidates had insufficient time for the paper.

Question 1

Stopping Distances

This question was well answered by the vast majority of the candidates, although some candidates failed to tick the required three responses. Less than 5% failed to gain a mark in part (a). In part (b) many candidates confused the 'reaction time' with 'reactions' and so gave answers such as 'faster' or 'it is a lot less'. Some gave the consequences of being tired e.g. 'more likely to crash'. This is one occasion where more careful reading of the question would have been beneficial.

Question 2

Nuclear Power Stations

Throughout this question there was evidence of confusion between nuclear power stations and fossil fuel power stations. In part (a), over 80% of the candidates responded that nuclear fuel is burned or heated with neutrons. In part (b) the fuel commonly chosen was 'oil'; less than 40 % gained both marks. Incorrect responses may have been triggered by the use of the term 'fuel', despite the scenario and the stem of the question repeatedly mentioning 'nuclear'.

Part (c) was better answered; nearly 70% could correctly identify 'turbine and generator'. There was similar confusion evident in parts (d) and (e). However, many candidates failed to secure the marks because they answered with insufficient or trivial detail. In (d) responses where the candidate does little more than repeat the stem (e.g. 'because they use dangerous substances') were common as were responses such as 'they use big machinery'. In (e), we commonly saw responses such as 'because they clean it before they dump it' or 'they are not burning anything'. In part (e), it was pleasing to note that the improvement in the level of response. Nearly 15% of candidates gave a correct response compared to fewer than 10% in previous series. However, there were still a worryingly large percentage of candidates who think the best way to deal with nuclear waste is to burn it! Some candidates, again, gave incomplete answers such as 'in proper containers' without specifying what was meant by 'proper' or mentioning storage conditions.

Question 3

Smoke Alarm

It was expected that this question which was closely tied to the specification would be accessible by the candidates. However it was obvious that many candidates had not studied the smoke alarm as a specific example. As might be expected, candidates were more successful with the structure questions in part (a) than with the free response question in part (b). Over 40% of candidates knew that the source ionises the air and over 55% knew that the source emits alpha particles. However, how the smoke alarm works was far less well known or understood; less than 25% of candidates knew that the smoke reduces the current in the circuit, and under 15% knew why the shielding only needs to be thin. The range of answers for (b) showed ingenuity with answers such as 'so that the current is secure in the shielding', or 'so that the smoke can get in' or 'so that the sound can get out'.

Question 4

Speed-time graph

The majority of candidates were able to access part (a) of this question; they could extract the data from the graph. However, in part (b), while it was apparent that many had correctly selected the equation, few could select the appropriate quantity for distance; looking back as far as the stem to find 400m proved to be difficult. Instead, candidates chose to use a speed, often the maximum speed either of the line (13m/s) or of the grid provided (14m/s) instead of the distance, and thus calculated an average acceleration. There were a significant number of candidates who wrote '8' without any workings shown. As far as can be ascertained, this is because '8' is the closest speed to the letter B on the graph. Very few candidates showed their working out; bald answers were the norm. A very few number of candidates showed not just their workings but also a list of symbols and quantities viz. distance = 400m, time = 57 s; this method is to be applauded as such candidates were invariably successful.
Part (c) was also accessible as over 70% of the candidates gained the mark. Part (d) proved to be more difficult for the vast majority of candidates. It was a little more common here to see 'the working out' and in these cases we were able to give partial credit to candidates who used a (dimensionally correct) speed when evaluating the kinetic energy rather than using for example time.

Question 5

Electrostatics

This question proved to be the most difficult of the entire paper with fewer than 25% gaining two or more of the available marks. In part the poor performance was due to incomplete answers, for example, in part (b), candidates identified that a spark could occur but failed to go on to say that this could ignite the fuel, or in part (a) failing to identify the negative charge as being carried by electrons. However, there were many examples of inappropriate terms such as positive electrons being used. In part (c), the quality of the explanation was poor; many candidates stated that 'charges become neutral' rather than 'charges are neutralised' and few mentioned the role of the wire as a conductor.

Question 6

X-ray Fluoroscope

This question had strong elements of 'How Science Works' which proved to be accessible to many candidates. In part (a), many were able to give good sensible reasons. Several candidates became confused with the historical aspect and responded with phrases such as 'X-rays in those days were less damaging'. In part (b), there were many incomplete answers. At this end of the paper it is insufficient to answer simply 'because it is dangerous'; the answer needed further expansion with phrases such as 'in large doses' or 'because it damages cells'. Less able candidates confused x-rays with radioactivity in particular gamma radiation.
In part (c), again there were a significant number of candidates who could give sensible suggestions , 'training' and 'correct use of safety procedures' were the most common responses. However in part (c), less than 10% of candidates were able to suggest 'real time image' as a suitable advantage of a fluoroscope. Weak answers included 'better image' and 'lower energy x-rays'. Some candidates thought that fluoroscopes were less dangerous because they emitted 'light'. (The word 'admitted' was often used instead of 'emitted' in many explanations.)

Suggestions for improvement

1. Analyse this and previous papers with your candidates as a preparation for future exams. Demonstrating that there are always marks for

- recall of standard definitions, units, and vocabulary;
- calculations;
- interaction with data;
- applications

can enable candidates to target their revision more effectively.
Candidates also need to know that the demand of the paper increases at the end, and therefore fuller answers are required.

2. 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.

3. Practice the type of linked and carefully structured calculations as in question 4. There is often one of these in each series. As mentioned above, candidates who wrote down a list of quantities that they needed for each equation were more successful. Showing' working out' is essential for partial marks.
Refuse to mark illegible work or calculations done without showing the method. You can be tough with your class marking and/or mock exam and it should ensure that your candidates get the mark that they deserve. In a GCSE exam incorrect bald calculations get no marks whereas calculations with working shown usually can gain at least some of the marks. If a candidate's writing is illegible or if (s)he writes crucial words so poorly that we can't make them out (e.g. fission and fusion) (s)he will not gain the mark.

4. As always, get candidates to check that they have answered every section. There was some evidence that some candidates had not seen question 3. Some candidates are helped by underlining to focus on the detail of the question. The specific meanings of the instruction words could be included in vocabulary revision.

5. Practice writing frames for questions such as 6b where more extended writing is required. For example, for two (or more) marks (or if the question is at the end of the paper), a concept needs to be followed by consequence, a consequence needs to be backed up with an explanation, or an analysis needs to be accompanied by a judgement.

GCSE Additional Science 5020H
GCSE Physics 5048H

Structured Paper P2

General Comments

It was pleasing to note improvements in the way candidates attempted both the 'How Science Works' sections of questions and the questions which involved calculations. In many cases, however, candidates were hindered by poor or inaccurate use of technical language in explaining ideas such as half-life, isotope or movement of charge. Units, for quantities such as momentum, are still not well known.

Question 1

Most candidates knew that this question, about the dangers posed by static electricity, involved moving charges. Almost 80% of them scored at least 1 mark. The details of the process, however, seemed to be less well known and not well explained. Only 40% of candidates were able to score 3 marks or better out of the available 5 marks on this opening question.

Common errors were to refer to the movement of positive charges or positive electrons or electrons rubbing against each other.

Question 2

This question was about how uncertainties in scientific knowledge change over time in the context of X-ray machines.
In part (a) nearly all candidates were able to offer a sensible suggestion as to why, 50 years ago, parents may have allowed children to stay on X-ray fluoroscopes. In part (b), most candidates could identify the basic danger and many expanded their answer in terms of exposure, dose, cell damage or the need for shielding. Nearly 70% of candidates were able to develop their answers in part (c) to score at least 1 of the 2 marks available.

Question 3

In parts (a) and (b) candidates were asked to discuss the effectiveness of car safety technology and the perception of risk. Although the information they were given was not straightforward to interpret, it was encouraging to see that almost 70% of candidates scored 2 marks in part (a) and 80% were able to score the mark in part (b).
In part (c), only a few could fully explain measures designed to reduce the rate of change of momentum in the context of a crumple zone in a car. Those who gained 1 of the 2 marks did so by referring to the increased time of the impact or to energy transfer.

Question 4

In (a)(i), poor use of technical language cost many candidates the mark. Many had the idea that isotopes involved differing numbers of neutrons, but gave vague and incorrect answers

along the lines of: "two or more elements having the same atoms but with differing numbers of neutrons" or "two atoms with different atomic masses" .
In (a) (ii), the best answers compared the numbers of protons in the alpha particle and tritium nucleus but these were few and far between. Only about 10% of candidates scored this mark.
In Part (b), it was encouraging to see correct answers from almost 50% of candidates in terms of properties of beta particles. Those who answered in terms of containment of the gas did not score.
In part (c), some candidates were able to describe half-life correctly in terms of the decay of either the radioactive material or the activity. The best answers began "It is the time for…". A significant number of otherwise sound answers were spoiled by relating the time to the decay of a single atom or similar poor use of technical language. Candidates were generally more successful in estimating the half-life from the graph, although once again missing units cost a mark.
Most candidates did well in part (d), providing a statement referring to the graph and a judgement about the reliability of the claim. Too many were not specific enough and merely repeated the stem of the question. A number omitted a judgement even though they had correctly analysed the situation. The need for repetition by other scientists showed a limited understanding of reliability. It was not uncommon for candidates to attack the manufacturer as being biased without justifying this opinion.

Question 5

The numerical parts of the calculations in part (a) were often well done but the unit for momentum was not well known, even given that this question was aimed at the higher grades.
Part (b) was the final question on the paper and proved to be very demanding. Very few candidates scored all three marks and only about 13% scored 2 or more of the available 3 marks. Full marks could be gained in (i) by saying that Frank would continue moving in a straight line when the sledge changed direction as there was no force on Frank (e.g. friction between him and the sledge) to make him change direction. A very few nu,ber of candidates stated that Frank stayed on the sledge (friction or holding on) and full credit was available to them. Among the common errors were to explain what happens to the sledge and not to Frank or to describe centrifugal force pushing Frank away from the centre.

Suggestions for improvement

1. Analyse this and previous papers with your candidates as a preparation for future exams. Demonstrating that there are always marks for

- recall of standard definitions, units, and vocabulary;
- calculations;
- interaction with data;
- applications

can enable candidates to target their revision more effectively.

Candidates also need to know that the demand of the paper increases at the end, and therefore fuller answers are required. Able candidates should be aware that this is a full range paper and therefore there are questions targeted at below grade C.

2. 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.

3. Practice the calculations! Showing' working out' is essential for partial marks. Ensure that candidates always work in the correct units.

4. Refuse to mark illegible work or calculations done without showing the method. You can be tough with your class marking and/or mock exam and it should ensure that your candidates get the mark that they deserve. In a GCSE exam incorrect bald calculations get no marks whereas calculations with working shown usually can gain at least some of the marks. If a candidate's writing is illegible or if (s)he writes crucial words so poorly that we can't make them out (e.g. fission and fusion) (s)he will not gain the mark.

5. As always, get candidates to check that they have answered every section, identified all the instruction words (state, suggest etc), and the quantities to be used in calculations. Some candidates are helped by underlining to focus on the detail of the question. The specific meanings of the instruction words could be included in vocabulary revision.

6. Practice writing frames for questions where more extended writing is required. For example, for two (or more) marks (or if the question is at the end of the paper), a concept needs to be followed by consequence, a consequence needs to be backed up with an explanation, or an analysis needs to be accompanied by a judgement.

GCSE Biology 5029

Extension Paper B3

General Comments

This paper consisted of 13 questions. Most questions were accessible to the candidates with the exception of questions 4 and 11 where answers were vague and did not have the specificity required for credit. Some excellent answers to questions were seen throughout the paper reflecting how well the subject matter had been learnt. There was some evidence of good practice seen such as underling key words and bullet points to ensure that, for example, three points were made when there were three marks available.

Question 1

Animal communication

This question allowed candidates to interpret the body language shown in a picture and demonstrate their knowledge of how humans communicate.
Parts (a) and (b) were generally well answered, with 98.3% gaining at least 1 mark and 67.4% of candidates being credited with all three marks available. Most candidates that lost marks did so by not qualifying their responses, e.g. just stating that the cat's fur was different or that the cat had a facial expression.
Part (c) was again accessible to candidates with 99.3% gaining credit with 89.2% achieving both marks available. There were many ways that candidates could achieve these two marks and a wide range of acceptable answers were seen.

Question 2

Products from microorganisms

Some candidates had clearly learnt the basics required here with 73.4% gaining at least 2 marks.

Question 3

Conditioning

The vast majority of candidates, roughly 96%, correctly responded here with just a few candidates making errors like writing 'thinking' in the last space.

Question 4

Soy sauce production

Part (a) was badly answered with many candidates not even being able to write a substance in either part. Yeast was a common error example of this as was bacteria. Other responses that showed a poor understanding included elements like oxygen as an example of a substance broken down by enzymes. Only 26.4% gained the first mark and 26.3% gained at least one mark in part (ii).

Parts (b) and (c) were answered slightly better, though it was clear that the process of making soy sauce was not well understood by candidates in the detail required. There was some evidence that candidates did not know that the names in italics were organisms as they spoke of them in terms of them being enzymes, or products.

Question 5

Monitoring bird behaviour

This question was well answered with the vast majority of candidates scoring well, with 98.5% and 99% of candidates scoring in parts (a) and (b) respectively.
85.3% of candidates gained the mark in part (c) with the current candidate confusion between validity and reliability being the main reason for dropping marks.
In part (d) 90.0% of candidates were credited. Common answers were not disturbing the birds and the idea of recording the visits so that data could be checked.

Question 6

GM yeast and cheese

Parts (a) and (b) were reasonably well answered with 34.9% gaining 1 mark and 52.4% gaining both marks. There was a reasonably lenient selection of words that were deemed acceptable for the action of chymosin on milk to make this question accessible. Thicken, however, was an insufficient response as this is more applicable to yoghurt production.
Part (c) was less well answered with many candidates repeating the answer they put for (a) that it was suitable for vegetarians, missing the point of the question which clearly asks why people opposed GM products.

Question 7

Sex selection

Whilst some candidates just stated use sperm, others were slightly better and stated use male sperm. This was still deemed insufficient as the candidates should be able to state X or Y sperm at this level. Some candidates also just stated 'use IVF' which of course, on its own is insufficient for sex selection of offspring. 33.6% gained one mark, usually from stating separating/using the X or Y sperm. Only 7.5% gained both marks.
Part (b) was answered much better, with 79.6% gaining at least 1 mark. Many answers here were quite specific, for example exemplifying the reduce risk of sex linked genetic disorder with the example of haemophilia. Those that dropped a mark often did so through vague responses like stating it is not natural.

Question 8

Carnivore/Herbivore feeding

Candidates related to this question well and gave good detailed responses that showed a clear understanding of the concepts covered.
87.5% of candidates gained the mark in part (a) with 93% gaining at least one mark in part (b) with 61% gaining all three marks.

Part (c) was slightly less well answered with 67.0 and 72.6% of candidates gaining the respective marks for parts (i) and (ii). Marks here were yet again lost through vague answers like stating that the wildebeest live in a herd. Not only was this stated in the first part of the question but, on its own, it does not explain how it helps them avoid become prey.

Question 9

Reducing cholesterol

Candidates found this question accessible and the answers, even when insufficient, showed that they related to the question.
Part (a) was correctly answered by 43.8% of candidates. There were a few spellings that were too close to other substances to allow, and prospective candidates should be made aware of how important spelling is for some technical words. These included styrol and styrene, and estarnol.
Part (b) responses, where 84.3% of candidates gained at least 1 mark, showed a good understanding of the principles involved with marks not being awarded for vague answers, for example, 'affects the blood flow', or inaccuracies, for example, 'causes deposits in veins, which stops blood getting to the heart'.
45.9% of candidates gained the mark in part (c) with many just stating that the spread should be trialled on many people, or that the cholesterol levels would have to be measured both 'before' and 'after' using the spread. Those candidates that were not credited here often gave very weak answers that restated the question saying that it should be trialled. Some suggested just telling everyone with one candidate suggested that data was made up and published.

Question 10

Selecting mates

This question was quite a good discriminator with candidates showing a variety of responses with almost all gaining at least one mark. It was pleasing to see that the responses were kept scientific with very little anthropomorphic statements as has been seen in previous years.
53.2% of candidates scored the mark in part (a). Those that dropped the mark often paraphrased the question stating, for example that they were attracted to them.
Part (b), where 36.7% were awarded the mark, again often generated a reworking of the question, with many simply stating that longer tails made it harder to fly.
In part (c)(i), 84.3% of candidates gained the mark.
Part (c) (ii) 33.4% gave answers that clearly showed that they understood the problem that there were too many chicks for the male to supply sufficient food. The other 66.6% of candidates often suggested that the chicks would be less weight as they had inherited a shorter tail which would obviously give them less weight!

Question 11

Genomic medicines

This question was poorly answered with only 2% gaining the mark in part (a). Most candidates stated what an allergy was: that the patient reacted badly to the medicine; rather than answering the question and explaining why they have an allergic reaction to penicillin.
Part (b) was answered better with 47.4% gaining 1 mark and 21.2% gaining 2 marks. Only 1.6% gained all three marks available. Candidate's responses showed that many did not know or at best did not have a clear understanding of what a genomic medicine was. It was not uncommon to read answers where the candidate suggested that the medicines were genetic, were inherited, or were used to cure genetic disorders like cystic fibrosis.

Question 12

GM crops

This question was accessible to candidates and although many (75.7%) were not credited in part (a) as they stated that the genes were altered rather than new genes being inserted, their answers showed that they understood the underlying principle behind genetic modification. Just a few restated the question saying that genetically modified was when you modify the genes of an organism.
Part (b) proved to be a good discriminator with roughly equal proportions of candidates getting each possible mark: 0 marks (13.4%), 1 mark (16.5%), 2 marks (20.6%), 3 marks (22.4%) and all 4 marks (27.1%). Those candidates that did not score highly often filled the space with one response, e.g. increased food supply, which they then repeated and extended to say how this would provide more food, which would stop people starving etc.

Question 13

Hunter-gatherers

This question, being the last question, was looking for quite specific answers showing detailed understanding.
Part (a) generated 1 mark for the majority of candidates with relatively few (16.0%) adding the idea that hunter-gatherers are nomadic. Several stated that they ere nomadic but then disqualified this by saying that they lived on a farm. Some candidates stated that hunter-gatherers got their own food, which of course is insufficient as it applies to many other ways of life.
Part (b) generated some excellent answers showing a good understanding of the two ways of life. 65.3% of candidates gained at least 1 mark. Typical responses that were not credited included 'use tools' 'communicate' (as both groups do both of these).
Part (c) required the candidates to recognise and state where the change occurred. 10,500 to 11,000 years ago. 31.6% of candidates scored at least 1 mark here expressing themselves well. Most candidates that did not score here simply stated that the people ate gazelles, 13,000 years ago and domesticated goats and sheep 9000 years ago. Candidates need to be made aware that the final questions are going to require more than simply describing the data presented to them.

GCSE Chemistry 5039

Extension Paper C3

General Comments

This paper contained seven questions. It is untiered, covering all grades from G to A*. The paper gave the candidates plenty of scope to show their knowledge and understanding across a wide range of topics. Three areas of weakness are recurrent.

- Firstly, the candidates' inability to show their working in calculations, and poor legibility of their scripts;
- Secondly, the poor descriptive experimental work particularly associated with volumetric analysis;
- Thirdly, the writing and balancing of both standard and ionic equations.

Question 1

Many candidates could describe a flame test properly. The idea of cleaning the nichrome wire was not often mentioned and but a minority used the term 'sterilisation'. Unfortunately, many used inappropriate apparatus, such as tongs or spatulas, or even tin lids. In addition, some held the substance over, above and even under the flame, rather than in the flame, as required. A few just sprinkled the substance over the flame. Whilst this may be a demonstration it is not acceptable as a text method.

It was pleasing to note that most candidates correctly answered the ion test questions in parts (b) and (c).

Question 2

Part (a) was very accessible with few mistakes, 'drinking' being the favourite answer. In part (b) the majority of candidates knew the answer sodium carbonate but a significant number stated either sodium hydroxide or sodium chloride. In part (c), many scored the oil/ester etc mark, but fewer scored the alkali mark (alcohol being a common wrong answer instead). A common error was to have two answers from one group e.g. oil and fat.

The majority of candidates knew about the formation of 'scum' in hard water, but often did not state how detergents were different thus not fully answering the question. It is always advised in comparison questions to write about both substances being compared. Many candidates knew about enzymes (with a few mentioning washing at lower temperatures) for biological detergents, but a significant number wrongly stated that they were 'organic' or 'natural' substances or 'friendly to the environment'.

Question 3

Many candidates had been taught what was produced from sulphuric acid, such as paints, dyes and fertilisers. A significant number mentioned 'car batteries' which is a use of the acid, rather than the use of acid in further production. A common wrong answer was soap. Other errors came from the candidate mentioning substances used in the Contact process

such as sulphur and sulphur dioxide. A significant number produced some interesting answers e.g. fizzy drinks, acid rain, vinegar and lemon juice.

Part (b) was not as well answered as the Principal Examiner expected. Many stated that pure oxygen would explode, be too reactive, give a different sulphur oxide product, would not be able to react with the other gases found in air, or was flammable.

In part (c) the catalyst was usually known. For the equation, most scored 1 mark for the equilibrium sign (although there were odd variations on this), fewer scored 2 or 3 for the correct substances / balancing. SO_4 and other strange species were given as the product and many equations were unbalanced.

Many candidates were familiar with the process of converting sulphur trioxide to sulphuric acid. Most common errors included dissolving the gas in water, dilute sulphuric acid or oleum. Some suggested 'condensing the gas to make liquid' – this was surprisingly common, perhaps in a confusion with the Haber process.

Question 4

Most scored two correct properties in part (a), although 'unreactive with water' is an error to avoid. Some candidates were not specific enough with their answers such as 'coloured'.

The electrolyte for copper purification was usually well known. It was pleasing to note many reasonable attempts for the descriptions of what occurred at each electrode. Many candidates had a basic understanding of the process and knew that the electrode disintegrated or that oxidation happened. Errors included pure copper collected at the bottom of the electrode or that copper was reduced. Equations scored marks here, although only a few candidates used this option. There was careless mixing of atoms and ions in some descriptions e.g. some thought that the Cu^{2+} ions coated the cathode. In part (iv) there were two groups of candidates. One group was able to identify the importance/use/value of the impurities such as gold and silver but the other group thought they related to an indication of the efficiency of the electrolytic process in terms of 'to see if everything is working', or to re-use the impurities to make more copper.

Question 5

Many candidates suggested that additional ions could be in the water and there were sensible suggestions on possible sources of inaccuracy in the experiment. However a significant number suggested that the lead would evaporate with the water. Many thought the experiment was at fault because the basin had not been weighed although implied in the stem or that the sample was too large that it could not be evaporated properly.

As noted in previous reports it has to be repeated that candidates' understanding of ionic equations is severely tested by such questions. There is a general tendency to spray charges over all substances in the hope that they will gain some marks. Some candidates did not even write down the lead ion correctly or could not work out the formula of lead iodide or an iodide ion.

Part (b)(ii) was usually done well and many candidates saw the need for a specific test for lead ions. Part (b)(iii) was rather pleasing with a great deal of good attempts and an

appreciation of the difference between qualitative and quantitative by many (with a substantial number using these terms correctly). However, candidates should guard against repeating the stem of the question saying that 'titration will find the concentration'.

The examiners were again disappointed at the quality of the titration description, not an uncommon question in this paper. Here are some points:
-safe working is assumed;
-some did not know the names of apparatus needed;
-many explained that sodium hydroxide or hydrochloric acid should be put into a conical flask or some other container without saying how this was done;
-some want to use a pipette to fill a burette;
-Universal Indicator seemed to be the favoured indicator;
-candidates' understanding of the use of indicators for specific purposes are weak, some not introducing an indicator to the solution but writing about a colour change;
-some candidates did not know the colour changes of their chosen indicator;
-techniques were poor with some candidates adding 10 cm^3 portions from the burette to the conical flask. It is not good practice to add liquid from the burette slowly from the beginning, only near the end point;
-mentioning swirling, white tiles, drop by drop toward the end point were all rare;
-some candidates seem unable to organise their thoughts into a coherent report.

Question 6

Part (a) was well done. The standard of writing the required equation varied considerably. There were those (few) that gained the two marks easily, those that gained one mark for the correct reactants and those that gained zero because they were unfamiliar with writing organic formulae or did not know the products and reactants. The C_2H_5 group was often misplaced in the ester. A major problem occurred with those trying to write a molecular formula and getting the totals wrong or some variation of a structural formula.

The performance on the calculation was better this year with many candidates scoring full marks. There still remains a large number who are incapable of showing their working and thus penalising themselves. There were others who are unfamiliar with the mole and its application or determining relative formula masses. Part (ii) was usually well done and candidates had clear thoughts about costs, wastage, and efficiency.

In part (iii) many tried a variation of producing another ester, usually with ethanol, but several ended up producing methyl ethanoate. However, even when another alcohol was chosen, water was sometimes missed from the products.

Question 7

Many candidates were able to give a sensible chemical answer to part (a), such as the reaction being exothermic or potassium's low melting point. Others simply said "it reacted with water" or "it's a group one metal". Surprisingly, in part (b) few were able to state that the gas was hydrogen and many favoured oxygen. In part (c) most thought that potassium caused the flame to be lilac, rather than potassium ions. Some tried sophisticated answers in terms of electronic transitions – well done to them and their teachers.

The answer to part (d) was disappointing with a significant minority stating red. In addition, many other candidates tried to cover themselves by stating two colours for example purple/blue or bluey-red.

The state symbols were poorly completed. The liquid (l) state for water was not known and many chose (s) for the sodium hydroxide or (l) for the chlorine. Part (ii) was much better answered, with many going for the soap option as being a use of sodium hydroxide; some went on to describe how chlorine and hydrogen were used in several processes.

In part (iii) a very pleasing number answered correctly, but some said ions instead of electrons, or, inevitably, that oxygen was gained. Another ionic equation gave a mixed performance. Electrons were added instead of being subtracted and positrons were suddenly found when the electrical balancing proved difficult. The equation for an ion forming an atom was given one mark. Candidates need more practice with balancing charges.

Revision Tips

- Practise the descriptions of experimental work e.g. flame tests.
- In comparison questions to write about both substances being compared.
- Practise balancing equations, including for industrial processes and ionic equations.
- Learn how to describe a titration, including the correct use of indicator, and why universal indicator is unsuitable.
- Learn how to name esters.
- Learn litmus colours properly.
- Practice applying state symbols to equations.

GCSE Physics 5049

Extension Paper P3

General Comments

It was evident that some candidates were still unfamiliar with standard definitions and vocabulary, although this area has improved since the last series. Many candidates did not gain relatively easy marks which related directly to such statements in the glossary and learning outcomes in the specification. This is a problem area that can be easily addressed by centres.

Calculator use was still a problem for many candidates. Candidates could, on the whole, select the correct equation, but did not always substitute in the correct value. Candidates found difficulty with exponential form. Candidates rarely cancelled the same quantities on both sides of an equation, preferring to continue with the numbers until the final evaluation. Transposition of equations, either algebraically or with quantities substituted in was also problematic for many candidates. Units proved difficult for many candidates who did not realise that equations only 'worked' when the quantities were in the correct units.

There was no evidence that candidates had insufficient time for the paper. A number of candidates failed to write legibly.

When candidates wrote at length, the quality of their English deteriorated: attempts to make things clearer often did the reverse. Candidates showed significant weakness in being able to write coherent explanations with a clear logical structure. For questions later in the paper (or for questions carrying two or more marks) a concept needs to be followed by consequence, a consequence needs to be backed up with an explanation, or an analysis needs to be accompanied by a judgement. The advice to think first seems not to have been followed by many candidates.

Question 1

Kinetic Theory of Gases

This question was designed to discriminate at grade F as thus many candidates were able to gain seven or more of the marks. In part (a) the most common error was that candidates did not realise that the pressure of the gas was constant. Surprisingly, over 25% of the candidates could not convert 100^{o}C into kelvin. In part (d), there were many contradictory responses such as 'the movement is still and the particles are moving at average' and some which showed poor understanding of absolute zero such as 'if it were any colder, they would stop moving'.

Question 2

PET Scanner

This question gained most candidates full marks. Less than 1% found difficulty with the sequencing of actions in the scanner. This was another question which was designed to discriminate at grade F.

Question 3

ECG

This was an application question that was designed to differentiate at grade C. For most candidates the most difficult part was (a) as just over 40% gained the mark. In part (b) the action of the heart was well known with over 75% of the candidates gaining both of the marks. Part (c) leans heavily on 'How Science Works' and was well answered with nearly 95% gaining two or more marks. In some cases the candidates could not see much difference between the first and the third graph.

Question 4

Stability Curve and Beta Minus Decay

Over 50% of candidates were able to gain full marks in part (a). Some candidates were careless with their placement of A (for alpha) and others positioned the unstable isotopes *inside* the stability band. In part (b) the balancing of the nuclear equation depended on recall of the properties of both beta and gamma radiation. Surprisingly over 50% of the candidates were unable to do this and so failed to gain any marks. Usually gamma was correctly given zero mass, but beta often had its mass and charge interchanged. Only a few candidates gave the average atomic mass (35.5) for chlorine.

Part (c) was straightforward recall of specification statements. As in previous series, recall is a weakness for many candidates; candidates were unable to explain what happens to a nucleus during gamma decay. The other two sections of part (c) were somewhat better answered; the most common mistake was to confuse the quarks involved in beta decay. Nearly 30% of the candidates were unable to name a fundamental particle involved in beta minus decay.

Question 5

Work Done Calculation

The level of demand of this question was raised by requiring candidates to calculate the distance involved. There were some numerical errors made at this stage, but if the working out was shown this was allowed for in subsequent stages of the calculation. Candidates then needed to calculate the work done and state the unit of their answer. Frequently candidates worked throughout in cm instead of m and then stated the unit as joules consequently losing the last mark. Just over 45% of the candidates gained two marks rather than three.

Question 6

Diagnosis And Treatment Of Prostate Cancer

This question proved to be the most difficult in the paper. In part (a) under 15% of the candidates were able to explain what ultrasound radiation is; many gave a description of its use, some candidates omitted key concepts such as the frequency of the sound. Candidates were often able to suggest an advantage for Cameron, but then showed poor examination technique and gave the same safely based advantage for the consultant.

As was also apparent in question 8, there is confusion as to the differing uses of source types in medical physics. In part (b) the source is used to destroy the cancer, not locate it, yet more than 50% of candidates incorrectly included gamma with either beta or alpha (or both). Few candidates included neutrons or photons. Part (b)(iii) required extended writing, but frequently candidates ignored the instruction to state **and** explain. Consequently responses failed to gain full marks. It was evident that there were some centres where candidates were exceptionally well prepared for this application question. It was pleasing to note that some candidates explained toxicity and elimination (of the source from the body). Part (b)(iv) there was evident confusion between distance/intensity and speed/dose. Candidates attempted to use the equation 'intensity = power/area' rather than intensity decreases with distance. In some cases this was not a problem e.g. 'the closer, the more intense as it is not spread out as much' but in others it led to confusion e.g. 'if the area is more than the power then the intensity is less'. Another common error was that the intensity increased as the speed of the source increased.

Candidates were able to suggest a suitable advantage and disadvantage for the 'How Science Works' question in part (c). The most popular answer in the second section related to side effects.
Less than 10% of the candidates failed to gain either mark, with almost 60% gaining both marks.

Question 7

Gas Law Calculation

As for the previous calculation in question 5, the most common mistake was an incorrect unit. However it was pleasing to find that almost 30% of the candidates gained all four marks. The answers to this question were centre dependant; clearly some candidates had practiced similar calculations and thus obtained the correct answer easily while in some cases it was apparent that trial and error was being used, the candidate being not at all clear as to what they were doing.
Many candidates failed to convert the temperature into kelvins. Generally, with the exception of temperature, the substitution was correct. The technique of cancelling factors (in this case, 10^5) on both sides of the equation was rarely seen. There were many errors seen with the subsequent rearrangement and/or evaluation. It was fairly common to see answers which gave the temperature either incredibly cold (0.00098 K or -555 ^oC !) or incredibly hot (10099 K). Basic algebra seems to be a problem for a significant number of candidates. A number of candidates got the calculation correct, but due to a lack of care, failed to actually write the correct answer down!

Question 8

Radioactive Tracers

Part (a) was poorly answered, with just 30% gaining the mark. Candidates failed to give the correct level of detail required. The answers seen were weak and incomplete. At this end of the paper, it is insufficient to write simply 'they are penetrating' without giving the consequence e.g. 'so they will exit the body'.

Part (b) gave similar issues in terms of the required amount of detail. Many candidates were able to identify the correct radioisotope but failed to capitalise on this with answers that were complete explanations. Some candidates ignored the amount of space they had been given and wrote tersely 'short half life' and 'low energy'. Over a third of the candidates failed to gain any marks for this part.

In part (c), almost 65% were able to explain the term 'palliative care', with a common confusion being that its purpose was to extend life. Unlike the previous balancing a nuclear equation question, the majority of candidates were able to gain at least one of the marks in part (c)(ii).

Question 9

X-ray Tube

The recall start to this question was not expected to be as challenging as candidates clearly found it; fewer than 50% knew the term 'thermionic emission'. Neither was it expected that the effect of the p.d. on the electrons would be so poorly known or understood. Less than 25% of the candidates could explain that the electrons accelerated towards the anode.

The calculation in part (b)(ii) was well answered by many candidates. The unit was not always given and in some cases the wrong power was used for the charge of the electron. However over 30% gained two marks and a further 45% gained all three marks. In some cases poor arithmetic or lack of calculator skills (especially the exponential function) featured as well as carelessness in transcribing numbers.

The final question on the paper proved again to be centre dependant. A number of candidates clearly understood what they had to do and gave concise clearly worked answers. Many however wrote 'fudges' of immense proportions. The significance of the '10s' was lost to many candidates. Almost 70% of the candidates failed to gain a mark for this section.

Suggestions for improvement

1. Analyse this and previous papers with your candidates as a preparation for future exams. Demonstrating that there are always marks for

- recall of standard definitions, units, and vocabulary;
- calculations;
- interaction with data;
- applications

can enable candidates to target their revision more effectively.
Candidates also need to know that the demand of the paper increases at the end, and therefore fuller answers are required. Able candidates should be aware that this is a full range paper and therefore there are questions targeted at below grade C.

2. 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.

3. Practice the calculations! Showing' working out' is essential for partial marks. Ensure that candidates always work in the correct units. Candidates seem to be especially poor at powers of 10, transposition of equations and realising and stating when the answer they arrive at is clearly wrong (as in question 7).

4. Refuse to mark illegible work or calculations done without showing the method. You can be tough with your class marking and/or mock exam and it should ensure that your candidates get the mark that they deserve. In a GCSE exam incorrect bald calculations get no marks whereas calculations with working shown usually can gain at least some of the marks. If a candidates' writing is illegible or if (s)he writes crucial words so poorly that we can't make them out (e.g. fission and fusion) (s)he will not gain the mark.

5. As always, get candidates to check that they have answered every section, identified all the instruction words (state, suggest etc), and the quantities to be used in calculations. Some candidates are helped by underlining to focus on the detail of the question. The specific meanings of the instruction words could be included in vocabulary revision.

6. Practice writing frames for questions where more extended writing is required. For example, for two (or more) marks (or if the question is at the end of the paper), a concept needs to be followed by consequence, a consequence needs to be backed up with an explanation, or an analysis needs to be accompanied by a judgement.

7. Many able candidates are more able to organise their revision if they have a copy of the specification. This does not need to be the entire book, the thirty four statements in topic five and the twenty five statements in topic six are sufficient.

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	21	19	17	15	12	10		
F	24				18	15	12	10	8

5006/5026	Max mark	A*	A	B	C	D	E	F	G
H	24	19	17	15	13	10	8		
F	24				16	13	11	9	7

5007/5035	Max mark	A*	A	B	C	D	E	F	G
H	24	18	15	12	10	7	5		
F	24				15	12	9	7	5

5008/5036	Max mark	A*	A	B	C	D	E	F	G
H	24	20	18	16	14	11	9		
F	24				16	13	10	8	6

5009/5045	Max mark	A*	A	B	C	D	E	F	G
H	24	19	16	14	13	10	8		
F	24				13	11	9	7	5

5010/5046	Max mark	A*	A	B	C	D	E	F	G
H	24	17	15	13	11	8	6		
F	24				14	12	10	8	6

5015/5027	Max mark	A*	A	B	C	D	E	F	G
H	24	20	18	16	14	11	9		
F	24				16	13	10	8	6

5017/5037	Max mark	A*	A	B	C	D	E	F	G
H	24	19	16	13	11	8	6		
F	24				15	12	10	8	6

5019/5047	Max mark	A*	A	B	C	D	E	F	G
H	24	21	18	16	14	10	8		
F	24				18	15	12	9	6

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	21	18	15	12	9	7		
F	30				17	14	11	9	7

5018/5038	Max mark	A*	A	B	C	D	E	F	G
H	30	18	14	10	7	5	4		
F	30				14	12	10	8	6

5020/5048	Max mark	A*	A	B	C	D	E	F	G
H	30	20	17	13	10	7	5		
F	30				14	11	9	7	5

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

Biology, Chemistry and Physics Extension Papers

Raw Mark Grade Boundaries

5029	Max mark	A*	A	B	C	D	E	F	G
	60	45	41	37	33	27	21	16	11

5039	Max mark	A*	A	B	C	D	E	F	G
	60	46	38	29	21	16	12	8	4

5049	Max mark	A*	A	B	C	D	E	F	G
	60	48	42	36	30	24	19	14	9

Uniform Mark Grade Boundaries for these units

Max UMS	A*	A	B	C	D	E	F	G
120	108	96	84	72	60	48	36	24

Further copies of this publication are available from
Edexcel Publications, Adamsway, Mansfield, Notts NG18 4FN

Telephone 01623 467467
Fax 01623 450481

Email publications@linneydirect.com

Order Code UG021078 Summer 2009

For more information on Edexcel qualifications, please visit www.edexcel.com/quals

Edexcel Limited. Registered in England and Wales no.4496750
Registered Office: 190 High Holborn, London WC1V 7BH