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Summer 2008

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Multiple Choice Paper B1a

General Comments

Overall it was very encouraging to see that candidates at all levels were starting to gain a deeper understanding of the way in which to tackle 'How Science Works' questions especially those relating to data interpretation and analysis. Mathematical questions in the context of graphical or tabulated data were also accessed well but stand alone mathematical questions are still causing candidates considerable problems. It is also significant to note that candidates' understanding of the reasons for global warming is vastly improved. There are still, however, considerable misconceptions regarding the likely consequences of global warming.

Foundation Tier

Simple sexual reproduction and recall of the passing on of genetic material is being well accessed by students at foundation level. In addition to this interpretation of food chains is also a significant area of improvement for these candidates. It was disappointing to note that only 32% of candidates could recognise that maggots were consumers of dead meat rather than predators. Reiteration that predators hunt and kill animals for food may be required. Competition was fairly well understood with 73% of candidates able to recognise that this could be interspecific or intraspecific but only 31% able to correctly identify the correct use of intraspecific in the paper.

Higher Tier

The common questions in this paper performed well with foundation candidates scoring lower than higher candidates on all items, this is a good indicator that candidates are being entered for the correct tier. Genetic diseases are not particularly well understood with only 38% of foundation candidates and 40% of higher candidates able to identify haemophilia and sickle cell anaemia as genetic diseases. It is very pleasing to see candidates now gaining a better understanding of the process of selective breeding which has been an issue in previous papers.

Global warming interpretation is now well understood at the higher level and even complicated mathematical calculations are being carried out well with approximately 75% of candidates gaining the marks in this type of question. Evolution continues to be a problem with candidates still making the same mistake regarding human evolution. It is not correct to state that humans evolved from apes, what is correct is that humans and apes have a common ancestor, this is an important concept which candidates are finding very difficult. Classification continues to be an area of concern with only 16% of candidates able to successfully identify the correct order, family and genus for humans.

At the very high end it is encouraging to note that 46% of candidates are able to calculate genetic inheritance percentages from quite complicated data.

GCSE Science 5006
GCSE Biology 5026

Multiple Choice Paper B1b

General Comments

In general, candidates at both foundation and higher tier performed well on graphical analysis demonstrating skill in interpreting information directly from graphs. However, taking this one step further to correctly manipulate the graphical data using mathematical techniques (multiplication and division) posed a problem for the majority of candidates. It was evident that, across the paper, candidates at all levels still hold misconceptions on topics such as the central nervous system; its structure and the function and interaction of its component parts. Candidate responses to simple recall questions on this system were, on the whole, disappointing suggesting a poor level of understanding across the ability range.

Foundation Tier

The majority of candidates at this level clearly understand the effects that the substances in tobacco have on the body. 93% of foundation candidates were able to correctly identify the lungs as the organ most affected by tobacco smoke with 92% of candidates recognising tar as a harmful component of tobacco. Similarly, a vast majority of candidates correctly identified nicotine as the addictive substance in tobacco.

Candidates performed less well on the questions related to blood composition and the function of various blood cells. Only 51% of candidates were able to identify the unnamed blood cell from the diagram as being a white blood cell. Similarly, 72% of candidates did not recognise that iron was carried by the blood plasma, with more candidates incorrectly stating that this was the role of red blood cells. In this case, candidates may have linked iron with the formation of haemoglobin in red blood cells which would justify their response although this was clearly not what the question was asking. Many candidates also failed to link the role of red blood cells with carrying oxygen; 61% of students gave the correct response to this question with 29% of candidates opting for glucose. Candidate responses to how particular white blood cells (macrophages) act to help combat infection was equally disappointing. Although 65% of candidates understood the role of white cells (lymphocytes) was to produce antibodies 68% did not know that others were able to change shape to engulf bacteria. An almost equal number of candidates thought that they (macrophages) contain fibrin to seal cuts or that they have a large surface area to carry oxygen. Many candidates may also have misread the question relating to physical barriers where the question asked which part of the body is not a physical barrier. In this case, only 43% of candidates gave the correct response of lysozymes.

Questions relating to the structure of the nervous system presented problems for the foundation level candidates. It was very disappointing that only 33% of candidates gave the correct response for the iris reflex with the most popular answer being the pupil reflex. This is a very common misconception where many candidates seem not to understand that the muscles of the iris control the diameter of the pupil, not the

pupil itself. It is also very clear that candidates are also unfamiliar with the nerve pathways involved in bringing about a response such as the change in the size of the pupil. Only 11% of candidates recognised that a motor neurone was involved in carrying an impulse from the brain to the eye to bring about the iris reflex with 68% of candidates incorrectly stating that this function was carried out by a sensory neurone.

The data obtained on candidate responses from the crossover (foundation/higher tier) questions supports evidence that the higher ability foundation tier candidates were able to access these questions fairly well. Candidates at the D/C boundary and above scored well on the questions relating to IVF and the percentage of correct answers from these candidates in response to the question asking them to analyse graphical data was encouraging.

Higher Tier

Higher tier candidates performed extremely well overall on the crossover questions showing a good understanding of the causes of disease and disease transmission. This was reflected also in the responses given to questions related to IVF where candidates showed clearly that they were well familiar with this topic including some of the ethical issues that it presents. Over a third of candidates, however, were unsure of the steps involved in carrying out IVF treatment and many did not realise that the first step in this treatment was the use of fertility hormones to increase egg production.

The questions relating to the nervous system were very poorly answered generally. It was very disappointing that only 48% of candidates understood that the brain was made up of sensory, motor and relay neurones with the remainder of responses being spread fairly evenly between the other three available answers. Only 24% of candidates gave the correct response to the question that asked them how neurones communicate with each other with more opting for 'conduction of electrical signals' rather than the correct response of 'diffusion of chemical messages'. This could be a case of misinterpreting the question to assume that it is asking how neurones transmit messages although the use of the term 'synapse' in the question should have made it clear to candidates that this was not the case. Higher tier candidates seem much more able to differentiate between reflex and non-reflex actions with 71% gaining a mark for this question and many were able to link the misuse of solvents and destruction of the myelin sheath surrounding nerve cells to less effective electrical transmission by neurones.

Candidates continue to have problems with understanding reaction times. Only 29% of candidates recognised that caffeine decreased reaction time and increased heart rate with 64% of candidates stating incorrectly that caffeine increases both reaction time and heart rate. Although a somewhat difficult concept to understand in many respects, it appears that candidates have still not grasped, as far as reaction time is concerned, that stimulants speed up our reactions and therefore decrease reaction time. A good number of candidates (80%), however, did know that caffeine is a stimulant that makes athletes more alert.

It appears that candidates are beginning to gain a better understanding of the female sex hormones and their functions in the body. It was pleasing that, in this particular

paper, they were able to apply their understanding of the functions of these hormones in an unfamiliar context. Evidence suggests that higher ability candidates understood the effects of oestrogen and progesterone on the female menstrual cycle and also, albeit to a lesser extent, the role of FSH in fertility treatment. Less than half of the candidates, however, understood which part of the body released FSH and the role of LH in menstruation.

Only the most able candidates were able to access the question relating to drug development where 23% were able to correctly identify the stages involved in drug development. This was similar for the question where candidates were expected to derive their answer using mathematical procedures. In this case only 34% of candidates were able to arrive at the correct response. As stated previously, candidates have clearly shown their skill in interpreting graphical information; 82% of candidates were able to correctly identify the trend of the graph in relation to TB and lung cancer. Statistical data shows that a fair number of candidates are unaware of how TB is transmitted with over a quarter of candidates responses implying that the bacterium is carried in food. 58% of candidates, however, understood that drug resistant forms of the bacterium were the reason for an increase in the incidence of TB.

GCSE Science 5007
GCSE Chemistry 5035

Multiple Choice Paper C1a

Foundation Tier

The first five questions were generally well answered and all areas of the specification were accessible. There was some evidence to suggest that a more careful reading of the questions would be beneficial.

Candidates understand and can explain the chemical changes specified in this unit. Questions on the Periodic table showed some confusion. A large number were unable to locate the position of period 2 and only 39% knew that all atoms of an element, e.g. copper, contain the same number of protons. The nature of the role of carbon dioxide and other chemicals in fizzy drinks is well understood. The apparatus used to collect a sample of carbon dioxide caused problems. Only 11% of candidates realised that a gas syringe was the most suitable apparatus and upward delivery and collection through water were popular incorrect choices.

Questions 17 to 20 showed that the knowledge and understanding of issues concerned with interpreting data is poor. Only 29% of candidates realised that sodium was a good electrical conductor and only 26% successfully identified chlorine.

Questions 21 to 24 involving the extraction of metals were well answered with the exception of items involving understanding the concept of oxidation/reduction and linking the method of extraction to reactivity. Only 17% of candidates realised that metals that are very reactive compared with iron are likely to be extracted by electrolysis.

Higher Tier

The first eight questions showed a good knowledge and understanding with the exception of question 20. 63% of candidates were unable to identify iodine from the data provided.

Many candidates did not know that magnesium chloride is not a base and that it would not react with sulphuric acid. 47% of candidates incorrectly chose the formula $NaSO_4$ for sodium sulphate.

Only 15% of candidates successfully attempted question 31. Lithium and rubidium are not alkaline earth metals.

Questions 33 to 36 involving copper compounds were good discriminators. 63% of candidates failed to recognise the dehydration change and the products formed when hydrated copper(II) sulphate is heated. The understanding of state symbols in equations is variable. Information regarding atomic structure proved challenging for a significant number of candidates. Only 42% of candidates correctly surmised that all atoms of bromine contain the same number of protons and confused mass number and atomic number.

Candidates appeared to be reluctant to pick the option ‘none of these’ when answering items involving a choice of statements. This was the correct choice for question 38 and only 26% of candidates chose this option.

Candidates generally performed well with question 39 involving the completion of a balanced equation.

GCSE Science 5008
GCSE Chemistry 5036

Multiple Choice Paper C1b

Foundation Tier

Candidates generally found questions 1-4 quite difficult. 43% of candidates thought that wine is produced by distillation. 25% of candidates thought that nitrogen would react with the wine and a further 25% thought that the gas was carbon dioxide.

Some questions in the next section on heating homes also proved difficult. 41% of candidates thought that burning natural gas produces no waste gases, 27% thought that methane is an element, despite being given its formula and 26% thought that the complete combustion of methane produces carbon monoxide only.

Knowledge of global warming was poor with 46% of candidates thinking that greenhouse gases damage the ozone layer and 52% believing that the 'prevent global warming' website was likely to be less biased than the Royal Society of Chemistry website.

The last two questions on useful fabrics were also poorly answered with 35% of candidates thinking that motor cycle helmet linings would not be made from coolmax and a further 26% thought that this material would not be used for socks. Only 31% chose swimming shorts where the passage of moisture would not be necessary. Despite it having been tested on several previous occasions only 33% of candidates knew the function of a 'breathable membrane'

Whilst 82% of candidates knew that spectacle lenses that darken are made from a smart material, 56% of them also thought that the sun-cream containing nanoparticles was also smart. Only 30% of candidates knew about the size of nanoparticles.

Higher Tier

As would be expected higher tier candidates performed better than foundation candidates on questions 17 to 24 but 56% thought that the sun-cream containing nanoparticles was smart and only 47% knew about the size of nanoparticles.

In question 25 only 10% of candidates knew the correct answer with 39% believing that petrol is used as a fuel for ships. 82% of candidates thought that crude oil enters the fractionating column as a liquid. Only 53% knew that kerosene has a lower boiling point than diesel oil, and only 39% could compare the chain length and viscosity of petrol and kerosene, despite being shown the positions of these fractions on the fractionating column.

Chemical equations continue to be a problem for many candidates.

The first two questions on nanotechnology were generally well answered but 17% of candidates thought that nanoparticles can make copies of themselves only 34% knew the answer to question 32. Answers to question 33 were disappointingly poor. 44% chose the correct answer but 27% believed that chlorine is obtained from liquid air and 29% that sodium is present in bleach or oven cleaner.
In question 35, 37% of candidates did not realise that water is needed during beer production to produce a liquid for fermentation to take place.

GCSE Science 5009
GCSE Physics 5045

Multiple Choice Paper P1a

Foundation Tier

Some items here proved easy for most candidates with 90% knowing that rechargeable batteries can be used more than once and 87% knowing that a dynamo does not use a battery.

At the other extreme, however, as few as 29% could recall the specification statement about the capacity of a battery being measured in amp-hours. Similarly, only 30% identified a constant value of direct current (from a graph) as that from the battery in a torch and as few as 35% recalled that the earth wire, together with the fuse, is designed to protect the person not the equipment. The item with the lowest score (13%) was for calculating the cost of using an electrical heater. The power was given in W (and kW) and the price quoted as 20p per kW h. 50% did not choose the correct value to use and thought the cost of using the heater for a fish tank would be £20 for two hours – an expensive pet!

Only 58% realised that solar cells receive their energy from light energy.

As for the 'How Science Works' aspects of an experiment, 46% spotted the prediction, 67% realised that repetition improved reliability and 51% recognised that the values used to calculate an average should ignore any anomalies.

Higher Tier

There was a considerable difference (up to 35% on one item) in the percentage of candidates answering 'overlap' items correctly, in the Foundation and Higher papers. Clearly, candidates, under their teachers' guidance, are still choosing the correct tier. One of these items tested the units of power. While around 70% of each group correctly chose W as compared to J, many more Foundation candidates opted for K rather than M. As many as 59% of F-tier and 69% of H-tier candidates understood the water model of battery capacity.

Graphs were tested in several ways with varying degrees of success. Most candidates were able to select the graph with the most appropriate scale for interpolation and to interpret the time scale to explain the need for using a datalogger. Slightly fewer understood the need to extract information from a graph in order to perform a straightforward calculation. As many as 41% of the more able candidates correctly translated the relationship between current and voltage for various input powers into a display of current variation with power, for a particular value of voltage. Although, of course, candidates are not expected to produce an exponential/ logarithmic graph for themselves, they will meet such graphs on the internet or during other research. The three final questions showed that the most able candidates can handle such information. Care should be taken with units, however, as once again, many missed the k in kΩ.

Finally, once again, it has to be reported that the amazing percentage of 59% of higher level candidates think the current in a wire is the movement of positive electrons. Of course, there are such things as positive electrons but they are not on the specification for Science or Additional Science and, being antimatter, most certainly do not flow in a wire. Statement 9.8 of the specification for P1a clearly expects recall of the fact that current is the rate of flow of negative electrons.

GCSE Science 5010
GCSE Physics 5046

Multiple Choice Paper P1b

Foundation Tier

Overall the performance of candidates in the first sixteen questions showed that they had been well prepared for this module test. In 10 out of the first 16 questions over 50% of candidates opted for the correct response.

Candidates seemed secure on some aspects of the solar system and space but over 20% of candidates thought the Sun orbited the Earth.

Well over half of candidates were secure on many of the aspects of dangers and uses of radiation but uses of radiation in weather forecasting were less well known.

The common questions differentiated well between Foundation and Higher Tier candidates and in the respective tiers most discriminated well between more able and less able candidates.

Candidates showed that they had been well prepared to analyse information about wave investigations but only a small number of Foundation candidates (18%) were able to calculate the wavelength of a wave when given the distance occupied by 10 waves.

Over 30% of candidates in both Foundation and Higher Tiers thought that the electromagnetic waves in order of increasing wavelength went from radio to gamma waves.

Higher Tier

Candidates displayed a good understanding of mass, weight and gravitational field strength with over 60% of candidates choosing the correct response in a suite of questions on this topic.

Questions on stars were not answered as well with over 40% of candidates thinking that we could get some useful information about planets orbiting stars many light years away by sending a space probe.

Over 50% of candidates thought that X-rays and light travelled at different speeds in a vacuum.

Almost 60% of candidates understood that red shift gives evidence that galaxies are moving away from each other.

70% of candidates were able to use the equation F = ma but only 30% knew that the amount of force pushing the gases out of a rocket equals the amount of force pushing the rocket.

80% of candidates could use the equation speed = frequency X wavelength but over 60% of them failed to convert the frequency from kHz to Hz, i.e., less than 20% actually answered the question correctly.

GCSE Additional Science 5015
GCSE Biology 5027

Multiple Choice Paper B2

General Comments

Candidates accessed this paper well on all levels of the papers, in particular at foundation level, data analysis of bar charts was carried out very well as was understanding of photosynthesis processes. On the common and higher level of the papers data interpretation and analysis was also well accessed which indicates that candidates are becoming more confident in tackling this style of question. Once again though, there were problems in other mathematical questions such as simple multiplication questions regarding diet.

Foundation Tier

Although candidates accessed this part of the paper well, a significant area of concern is the lack of understanding of plant and animal cell structure. Only 49% of candidates could identify the chloroplasts as the main site for photosynthesis with 30% of candidates believing this process occurred in the nucleus. 69% of candidates could not successfully identify the cell wall as part of a plant cell and not an animal cell. Although photosynthesis seems to be well understood only 63% of candidates could recognise that oxygen was needed for respiration. The process of genetic modification is now understood by 60% of the candidates at foundation level which is encouraging as this involves some higher level thinking.

Higher Tier

The common questions on interpretation were well accessed with 77% of higher candidates and 55% of foundation candidates able to gain the marks in this area. The Hayflick limit seems to be well understood with 88% of higher tier candidates recognising this is a limit to the number of cell divisions but with 79% of higher candidates and only 37% of foundation candidates being able to recognise stem cells as cells without this limit. This may be due to the foundation candidates misreading this question.

Gene transfer into other organisms is an area where higher candidates have had problems, only 18% of candidates able to recognise that we use plasmids for this process. The difficult higher level topics of protein synthesis are causing problems for those A/A* candidates where they are confusing translation and transcription. It is true that this is a difficult topic but it will continue to be tested at this level. Mitosis and meiosis are a similar problem at this stage with only 48% of candidates able to identify meiosis producing non-identical nuclei.

GCSE Additional Science 5017
GCSE Chemistry 5037

Multiple Choice Paper C2

Foundation Tier

Some questions in the first section on ammonia and its compounds were poorly answered. 32% of candidates thought that ammonia is an ionic compound and 15% that it is a covalent element. Only 41% knew that (s) means solid with 35% choosing the obvious distracter of solution. Only 21% could identify ammonia from its melting and boiling point.

Candidates also found some questions in the second section difficult. Only 35% could work out the relative formula mass of methane with 51% choosing 13. 34% of candidates believed that methane is an alkene. Only 37% knew the formula of ethane with 35% choosing C_2H_6. Only 14% knew than ethene is a monomer used to make poly(ethene) with 55% believing that it is a polymer.

Only 37% could work out the mass number of an atom containing 6 protons and 8 neutrons with 30% choosing 12. 41% of candidates believed that a proton has the same mass as an electron.

Only 11% knew that a magnesium ion contains two electrons less than a magnesium atom with 58% thinking that it contained the same number of electrons as the atom. Only 19% of candidates could identify the formula of magnesium chloride with 47% choosing MgCl.

The two questions on rates of reaction proved challenging with only 31% identifying the correct graph and 38% choosing D. Only 10% knew that increasing the volume of acid would not affect the rate of reaction with 41% thinking that the rate would increase.
In question 23 only 33% of candidates chose the correct answer with a further 33% choosing C where both answers were incorrect. In question 24, 62% knew that the bonding in most carbon compounds is covalent but 30% thought that 8 carbon electrons were used in bonding.

Higher Tier

As would be expected higher tier candidates generally performed better than foundation candidates on questions 17 to 24 but answers to questions 17, 18, and 23 showed similar problems to those on the foundation tier.

Only 29% could identify the correct answer for question 29 with 64% believing that an increase in temperature would increase the yield. In question 31, 42% believed that a catalyst would increase the percentage yield of ammonia. The relationship between exothermic reactions and bond breaking and making is a difficult concept for many candidates. In question 33 only 23% could identify the correct answer with 48% thinking that statement 1 only was correct and a further 16% thinking that both statements were correct.

Electrical conduction and electrolysis were poorly understood. In question 34 only 16% chose the correct answer with 75% believing that free electrons are responsible for conduction in sodium chloride solution. Only 25% chose the correct answer to question 35 with 29% believing that lead ions move to the anode and gain electrons and a further 31% that lead atoms move.

The balanced chemical equation in question 37 proved difficult for many candidates with only 23% choosing the correct answer. 41% chose option B involving KBr_2 as a product. In question 40 only 28% chose the correct answer, a further 28% chose $FeCl_2$, 22% chose Fe_3Cl and 22% Fe_2Cl_9 probably by forgetting to subtract the mass of iron from the mass of the compound.

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 10 out of the first 16 questions over 50% of candidates opted for the correct response.

Candidates were secure on some aspects of nuclear power but 60% thought that nuclear power stations are powered by fusion reactions.

Candidates performed well with questions on road safety but, despite being given the formula, 50% failed to add the thinking and braking distance to give the correct stopping distance.

80% of candidates were unaware that 2 points where a rollercoaster has the same gravitational potential energy are at the same height and were unaware of the equivalence of work done and energy transferred.

Candidates were well prepared for questions on uses of radioactivity.

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 electrostatics and most were able to analyse information about a forces investigation.

A disappointing number of Foundation and Higher Tier candidates were unable to extrapolate a decay curve to predict a future count rate.

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 and 60% or more in 8 of these questions.

Candidates showed a good understanding of power, energy losses and gravitational potential energy calculations, but only 34% of candidates could use the equation E = ItV.

The radioactivity investigation was handled well by many candidates but almost 50% thought that an isotope of an element has a different number of protons in its nucleus.

Almost 70% of candidates could calculate acceleration from a velocity/time graph but only 20% could calculate acceleration using F = ma.

Over 70% of candidates thought that the acceleration on a skydiver would be in the opposite direction to the resultant force on the skydiver.

GCSE Additional Science 5016F
GCSE Biology 5028F

Structured Paper B2

General Comments

The paper consisted of seven questions with questions 6 and 7 in common with the 1H paper.

Candidates found the questions accessible with most questions being attempted with question 6 and 7 proving challenging to some of the less able candidates. It was pleasing to see that candidates answered the earlier questions well where some good understanding of science was seen.

Aspects of science new to the specification were examined with mixed response, with some candidates clearly having been taught salient details and others lacking the key words and science to match the marking points.

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

Question 1

This question required candidates to apply their knowledge of what happens in photosynthesis. It was pleasing to see so many correct answers here with over 50% gaining at least three of the four marks available. A small minority of candidates used nitrogen instead of carbon dioxide or reversed oxygen and carbon dioxide.

Question 2

This question was designed to test understanding of gaseous exchange in tissues.

The 55% of candidates who gained both marks available reflect the good understanding of respiration with only 2% failing to gain any marks

Question 3

This question was designed to test the skill of interpreting a graph.

Part (a)(i) was well answered with 96.5% of candidates gaining the mark.

Part (a)(ii) required candidates to find the difference between two times that had been read of the x axis. 57% of candidates did this successfully with the majority of the rest just stating the time when exercise ended.

In part (b)(i), over three quarters of candidates correctly described the effect of exercise on pulse rate.

In part (b)(ii) the majority of candidates gained a mark for stating that 'more oxygen' was required although few went on to develop this by relating this fact to increased respiration/energy usage. However, the majority of candidates did seem to have some understanding of what happens in the body during exercise. Many of the incorrect responses went on to mention an increase in heart rate to pump more blood around the body/pump blood faster without mentioning key mark scheme points.

More able candidates were able to gain full marks by relating an increase in oxygen intake to an increase in energy demand and, to a lesser extent, to prevent lactic acid build up.

Very few candidates linked the intake of more oxygen with the removal of more carbon dioxide

Question 4

This question was about reforestation and assessed an area new to the specification.

In part (a) 67% of candidates gained one mark – usually for knowing that reforestation involved planting new trees. A large number of candidates, 40%, gained full marks for the strong indication that these new trees were planted in an area where trees had been cut down. Some candidates lost marks for not expressing themselves clearly. For example, use of the term 'replanting' often caused confusion and lost candidates marks in frequent responses such as 'replanting trees that are cut down'. It is possible that candidates thought that they needed to put 're' in front of planting as the question was about 're'forestation. Some answers were seen where other forestry practices, for example, coppicing, were described.

In parts (b)(i)/(b)(ii), it was disappointing to see so few candidates answering this well, with many repeating themselves and the main creditable answer being seen referring to oxygen production or carbon dioxide intake. It appears that the term 'biodiversity' is very poorly understood, even by more able candidates; with more correct references to 'more habitats' being given in (b)(ii) than in (b)(i). Other incorrect responses frequently included the non creditworthy, unscientific 'more homes (for animals)'. There were some very good answers to part (ii) seen that included reduced flooding.

Question 5

This question was about anabolic steroids.

In part (a) 74% of candidates could correctly suggest that athletes take anabolic steroids to increase performance and/or muscle size. Candidates lost the mark through vague answers referring through omitting 'muscles'.

In part (b) candidates that gave specific answers, for example "women grow facial hair" or "causes liver failure' gained marks with far too many other candidates giving vague answers like " damages organs", "makes women more like men", or repeating what they had said in part (a).

In part(c), more than half the candidates correctly stated that people thought that athletes that take anabolic steroids are 'cheating'. Candidates lost marks here, again, by vague answers.

Question 6

This crossover question was designed to test understanding of photosynthesis and its applications to a biosphere.

Part (a): This basic structure and function question was disappointingly answered by candidates considering that it had been on the previous examination paper. Only 35% gained 1 mark mainly from identifying chloroplast but a significant number of these failed to gain the second mark by writing vague answers like to make food instead of the specific answers as prescribed in the mark scheme.

Part (b) was well understood by many foundation candidates with 68% gaining at least one mark, it was a pity that some candidates misinterpreted this question as why do plants need to be in the biosphere as opposed to outside on Mars with answers like "because they can not survive outside it" being seen as an answer by a significant minority. Others candidates just wrote oxygen and food without the word 'make' thus not gaining marks through poor examination technique rather than actual lack of knowledge.

Part (c) was generally well answered with 67% gaining at least one mark clearly showing that they understood the implications of the greater distance on plant growth. Candidates gaining one mark usually obtained this for mentioning 'less light' and incorrect responses most commonly included 'less Sun' or gave answers relating to Mars being closer to the Sun than Earth despite the question being very clearly worded. In this case, candidates mentioned 'too hot/plants dry up/no water/etc'.

Question 7

This crossover question was designed to test understanding of the ethics of terminations as part of 'How Science Works'.
In part (a) many responses implied that candidates were unfamiliar with key terms such as fetus, embryo, conception, contraception and often got these scientific terms mixed up. Most answers from foundation candidates incorrect referred to the fetus being 'less developed' or that 'life begins at 24 weeks'
The 15% that gained one mark for this question did so by stating that now a fetus born at 24 weeks has a good chance of surviving but failed to develop this to state that this was due to improved medical technology.
In part (b) it was pleasing to see many candidates having a good understanding of why terminations can be legally undertaken after 24 weeks but unfortunately most of these were unable to write their response concisely enough to be credited with vague answers like "if the fetus is ill" or "if the mother is in danger" as opposed to the more specific answers given by 23% of foundation candidates as specified in the mark scheme.
In part (c), again, it appears that foundation candidates are still finding it difficult to present ethical viewpoints and therefore very few (7.3%) gained a mark for this question. The candidates who were not credited here again failed to develop their answers and common responses included those like 'only God has the right to take a life' and 'some religions think it is murder', 'life is sacred' or 'this is killing an unborn child'.

GCSE Additional Science 5016H
GCSE Biology 5028H

Structured Paper B2

General Comments

The paper consisted of seven questions with questions 1 and 2 in common with the 1F paper. The questions were accessible to the candidates and few unanswered questions were seen.

Content that is new to the specification did seem to prove challenging for some candidates, but there were also examples of content carried forward from the legacy specification that are still not clearly understood.

"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

This crossover question was designed to test understanding of photosynthesis and its applications to a biosphere.

In part (a) there were many correct answers. Common errors were giving chlorophyll for chloroplasts and that chlorophyll was made by photosynthesis. In general the process of photosynthesis was well understood. Some thought that photosynthesis was a substance made by the chloroplasts.

In part (b) those candidates who gave incorrect answers thought that the question was about why the plants were kept inside the biosphere as opposed to outside i.e. conditions etc. It was a pity that some candidates misinterpreted this question as why do plants need to be in the biosphere as opposed to outside on Mars with answers like "because they can not survive outside it" being seen as an answer by a significant minority. Others candidates just wrote oxygen and food without the word 'make' thus not gaining marks through poor examination technique rather than actual lack of knowledge.

In part (c) most had the idea of less light and colder, and there were answers mentioning that it will be hotter on Mars. A few reasoned around the fact that it will have a longer year and that the seasons will be different. Several candidates noting that temperature was actually -60 degrees. Many had the idea that the less light will cause no photosynthesis. Some thought Mars was closer to the sun.

Question 2

This crossover question was designed to test understanding of the ethics of terminations as part of 'How Science Works'.

An alarming number of candidates think that a fetus somehow becomes a human between 20 and 24 weeks. Many responses were about feeling too bad about aborting something that resembled a human, rather than something with no legs or arms. A few clearly identified medical/scientific advances however, several referred to survival with "medical help".

In part (b) it was pleasing to see many candidates having a good understanding of why terminations can be legally undertaken after 24 weeks but unfortunately most of these were unable to write their response concisely enough to be credited with vague answers like "if the fetus is ill" or "if the mother is in danger".

In part (c), it appears that many candidates are still finding it difficult to present ethical viewpoints. The candidates who were not credited here again failed to develop their answers and common responses included those like 'only God has the right to take a life' and 'some religions think it is murder', 'life is sacred' or 'this is killing an unborn child'.
The majority of answers gave reference to killing or murder without mentioning the right to life. Very few referred to a specific religion.

Question 3

This question was designed to test understanding of the structure and functions of DNA.
When asked what DNA contains the code for making, many candidates gave genes. Amino acids, proteins, polypeptides and RNA were all acceptable responses. There were lots of different answers for bases such as RNA and amino acids. The majority of candidates got guanine correct but there was a wide variation of spellings.

Question 4

This question was about gaseous exchange in the alveolus, and the effect on muscle cells of insufficient oxygen.
In part (a) most recognised the need for additional O_2 during exercise (expressed in many ways) and/or the increased production of CO_2, however, several simply wrote about gas exchange without identifying the gases. There were some misconceptions e.g.

- CO_2 made into O_2,
- alveolus creates CO_2 and O_2,

Many recognised the need for increased blood flow although there were several misconceptions about this:

- more red blood cells made,
- capillaries move faster,
- increased amount of blood.

Very few gave clear descriptions of the changes to O_2 or CO_2 content of blood at the tissue although there were several references to deoxygenated or oxygenated blood.
Less than 0.5% of the answers referred to the concentration gradient between the alveolus and the lung capillaries or its maintenance.
Several had O_2 leaving and CO_2 entering lungs/alveolus during breathing and there were some who felt that breathing increased the number of alveoli.
In part (b) the majority referred to the production of lactic acid and cramp without mentioning anaerobic respiration, missing the point of the question.

Question 5

This question was about the effects of human interference in natural populations, and asked candidates to analyse some data.
Many candidates described hunting or poaching but did not mean killing but just capturing or sedating the elephants and removing their tusks. Many candidates thought that if the tusks were removed from the elephants without killing them then the 'tuskless' genes would also be removed. However there were also a lot of well explained answers where the candidates clearly understood that the effect would be an increase of the 'tuskless' genes in the gene pool.

In part (b) generally they understood the effect of increased elephant populations of competition for food/water or space though some simply referred to "resources" without being specific. Several wrote incorrectly about "elephant's prey" being reduced. Many recognised the effect of grazing on either the other herbivorous species and/or the environment even though the ideas were often expressed clumsily. Interestingly there were some who suggested that the increase in excrement would have a beneficial effect on the fertility of the ground. There were several suggestions about the polluting effects of increased methane or CO_2 from the elephants. Many cited increase in ivory poaching although some wrote this as "increased hunting elephants for tusks". A very small number wrote about the long-term population effects of more/fewer elephants with tusks. The idea of increased tourism was quite frequent and the conflict with humans was commonly described in many different ways e.g. damage to crops, damage to villages/fields, less places for humans to live, herds being dangerous to humans, etc.

Question 6

This question was about cell division, and the Hayflick limit.

In part (a), many candidates were able to correctly complete the table.

In part (b), most candidates recognised that the Hayflick limit was linked with cell division. Many clearly expressed this as the limit to the number of divisions either explicitly or by citing the maximum number of divisions in human cells. Several however were vague about what aspect of the division was limited or were of the view that it was a limit to the "number of cells" which could divide. There were many who claimed that the Hayflick limit was relevant to both mitosis and meiosis, although only a very small number thought it related only to meiosis. Most knew that stem cells did not have a Hayflick limit although there was not always clear understanding of the location of or purpose of stem cells. At least one candidate was able to write about totipotent cells in this context. Many knew of the link between Hayflick limit and cancer although the way of expressing this was not always the most explicit with reference to tumours or tumour cells rather than cancer.

GCSE Additional Science 5018F
GCSE Chemistry 5038F

Structured Paper C2

The paper consisted of five questions with question 5 in common with the Higher Tier paper. Questions 1 to 3 were targeted at the E/F/G level, the remaining questions were targeted at the C/D level.

Question 1
This question was generally answered well.

Question 2
Candidates often scored well with their knowledge of metals but not all of them thought through the purpose of the particular item. Many candidates scored a mark in part (i) by mentioning that aluminium conducts electricity, but went on to give further irrelevant answers referring to cost and strength. Some candidates thought that the aluminium should be an insulator to prevent the public getting electric shocks – quite how it then conducted the electricity is a mystery. Surprisingly, there were a considerable number of blank answers, and candidates should be advised to make reasonable attempts and to read all the information given which is often helpful. Most candidates knew what an alloy was, but poor expression often cost them a mark. In part (iii) most answers referred to strength. The idea of the cost implication in using steel was not understood. Most answers could have been better, if the assumption that steel is always 'stainless' or rust-free had been cleared up.

Question 3
The first two parts of the question were well answered. It was worrying to see a substantial number of candidates equating covalent bond with 'double bond' since it is a 'strong bond'. It was pleasing, however, to note that may realised that the aim for the bonding was to complete the participating atoms' electron shells. Ultimately, many candidates knew what bonds were for ('to hold atoms together') but not what they actually are.

Question 4
This straightforward question was well answered, but candidates should be advised to use words and not symbols when word equations are required.

Question 5

The naming of the compounds was very poor (even carbon dioxide). Part (c) was not an easy question for the majority. Most candidates picked the wrong compound but curiously did mention that the 'double bond' or 'unsaturation' was the reason for the decolorisation. Carbon dioxide was wrongly picked as it has two pairs of double bonds. Some did recognise that this is typical of 'alkenes'. Ethanol was a surprisingly popular wrong answer, perhaps because it was named in the paper. The equation was very poorly answered and demonstrated clearly that many pupils have little understanding of writing equations using symbols let alone balancing them. Very few successfully managed to write the formula for the ethene molecule. Many of those who understand that a hydrocarbon consists of carbon and hydrogen only managed to balance the equation sensibly (making the number of carbon and hydrogen atoms correctly total).

GCSE Additional Science 5018H
GCSE Chemistry 5038H

Structured Paper C2

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

Question 1

Although it seemed to be a straightforward start to the paper, it was disappointing to see so many candidates unable to name the three compounds shown in part (a), particularly carbon dioxide.

Most candidates knew what a hydrocarbon was in part (b), but failed to score the mark through using incorrect terminology such as hydrocarbon atoms, (containing) carbon molecules and hydrogen molecules. The majority of the candidates correctly identified the hydrocarbons, but surprisingly many included D as part of the answer.

In part (c) the majority of candidates scored at least one mark, but many candidates were unable to make the connection between the double bond and its reaction with bromine water, despite this having been regularly tested in previous examinations. Some candidates lost marks as a result of incorrectly naming a specific alkene. A small minority assumed that the double bonds in carbon dioxide would also produce a reaction with bromine water. Other misconceptions seen included: ethanol as it is reactive, CO_2 because it is the only one without hydrogen, and ethane because it has single bonds.

It was disappointing that a significant majority of candidates appeared to be unfamiliar with the general equation for cracking in part (d). In addition, many were unable to balance a chemical equation. Sadly, some thought that cracking implied the separation of the carbon from the hydrogen permanently, despite the obvious clue in the stem of the question.

Question 2

The majority of candidates correctly completed the table in part (a), but many used random numbers that at times defied logic.

Part (b) showed that a majority of candidates understood and could explain the transfer of electrons in ionic bonding – many did so at length with very competent explanations showing good and thorough understanding. However, far too many produced responses claiming covalent bonding or showing much confusion about the difference between ionic and covalent bonding.

Although a (small) majority of candidates gained credit for this using suitable phrases to answer part (c), far too many shot themselves in the foot with descriptions of ionic bonding and then going on to write about molecules, intermolecular forces, covalent bonding and/or double bonds. More distressing was the lack of understanding of what melting point is, confusing it with boiling point, considering melting to be a 'reaction'.

It was disappointing to see only a few candidates achieve the mark in part (d). It was generally the exception to see a correct response. The greater majority of incorrect responses referred to the movement of electrons. Other incorrect responses included sodium being a metal, atoms free to move, and molecules being strongly bonded.

Question 3

The greater majority of candidates score both marks in parts (a) and (b). Even those who did not gain credit usually did so because their response was not quite clear enough rather than a complete failure to understand. Candidates should be reminded that 'dangerous' and 'unsafe' need to be qualified at this level.

Many correctly worked answers were seen in part (c). The most common error was an answer of 37.5%. However, several candidates demonstrated poor concepts by giving percentage answers in excess of 100! It was disappointing to see a significant number unable to answer this question as it is not the first time this concept has been tested. Similarly it was disappointing to read on several responses 'did not have calculator' or similar.

Question 4

Part (a) was generally well answered, with a majority of candidates being able to state that the reaction was exothermic explicitly or in so many words. A few were only able to state that light was produced. Others who failed to gain credit did so as a result of trying to bring oxygen into the situation, no doubt confusing what they had seen or done themselves with the evidence in the question.

Only a minority of candidates scored any marks in part (b). In the majority of cases this was through candidates forgetting that chlorine is diatomic; the most common mistake was to use Cl_3 or 3Cl. A small number were confused by 'iron (III) chloride' and tried to bring III into the equation.

There were many excellent answers seen to part (c), with candidates able to express themselves using the high level concept of electron shielding. However, for the majority of candidates there were many good answers to this question but again language was often weak with 'There are more outer shells' being a common statement. Although most candidates knew that on going down the group there were more electrons, too many said that there were more in the <u>outer shell</u>. It was clear that because they did not know the correct electron configuration for Br many tried to work it out coming up with the idea that down the group there were fewer electrons in the outer shell. Br is 2,8,8,8,8,1 was common, which led to the argument that Br would loose an electron and not gain one. It was disappointing to see how few candidates realised that elements in the same group have the same number of outer shell electrons.

The idea of larger surface area was generally well understood in part (d). Too many answers said the particles in iron wool were spread out so they could move about more. Other misconceptions included that iron wool was less dense or had less particles, in the wool the iron atoms were not strongly bonded. Relatively few answers talked about increased collisions and simply said that the iron and chlorine reacted more. Some simply said 'because of collision theory'.

Question 5

In the final question of a Higher Tier paper, candidates should expect to see a demanding question and the topic of equilibria as it appears on the specification is likely to be tested in this way and at this level.

Very few good answers seen in part (a) with few candidates able to explain the shift in equilibrium due to changing conditions. In many cases it was clear that the term yield was not understood, although many referred to the amount of ethanol being lower at a higher temperature. Common misconceptions included: increased temperature increased the rate of reaction so there would be more ethanol, references to a lower yield due to enzymes being denatured at higher temperatures, the ethanol would evaporate. There were also references to 'not the optimum temperature'.

Although part (b) was correctly answered by a minority of candidates (as would be expected), there was good understanding by those who did gain credit and also by those who nearly, but not quite, gained full credit. Amongst those who did not, many did not understand the notion of 'yield' as in part (a), others directly contradicted the statement(s) in the stem of the question and some even said that they didn't want too much ethanol. A distressing minority saw the word ethanol and wanted to write about fermentation, enzymes or yeast.

Very few good answers were seen in part (c). A large number of candidates seemed to be confused between 'endothermic' and 'exothermic' and many had breaking bonds as giving out energy and bond formation taking it in. Of those who got this right many then failed to get the final mark by referring to 'number of bonds'. The biggest problem was that many who may have understood the concept suffered poor expression in writing out their answer, e.g. 'More energy is given out when bonds are formed than when they are broken'. The term 'needed energy' often caused confusion as it was used by many candidates in the context of both breaking and forming bonds. Some candidates had bonds forming in the forward reaction and breaking in the reverse direction. Most of those who scored all 3 marks did so with one simple clear sentence.

Revision tips

- Learn the meanings of a wide variety of specific terms used in the specification, such as hydrocarbon, cracking. Building up word list will help in this respect.
- Learn the differences between ionic and covalent bonding and how different types of atoms combine to form the different bonding types.
- Learn how to explain the properties of ionic and covalently bonded substances.
- 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.
- Practise writing and balancing chemical equations for a variety of chemical reactions.
- Learn how to explain what happens when changes are made to a reaction in equilibrium.

GCSE Additional Science 5020F
GCSE Physics 5048F

Structured Paper P2

Question 1

(a)(i) A good start to the paper for most candidates with almost half of them scoring full marks.

(a)(ii) and (b)(ii) The ideas that the helium atom has no overall charge and the alpha particle is positively charged were not well known, with the vast majority of candidates scoring no marks for these questions. This was concerning as in (b)(i) the majority of candidates were able to state the difference between a helium atom and an alpha particle.

Question 2

(a) Overall this question was answered well but more candidates were able to say why some people might think a nuclear power station might be unsafe than were able to make a statement in support of nuclear power stations. Common misunderstandings about nuclear power stations included "give off carbon dioxide" "affect the ozone layer".

(b) The vast majority of candidates scored at least one mark here with one third of them going on to get all three marks. The sequence of events taking place in obtaining electrical energy from nuclear fuel was well understood.

Question 3

(a) Almost 50% of candidates were able to score one mark here, giving a reason in terms of angle of ascent or some safety consideration. Only about a half of these then went on to give a second reason in terms of, for example, the car engine.

(b) Most candidates chose the correct formula for change in potential energy (no mark available for just this) and about 40% went on to get full marks for the calculation. The most common error was to square the value for "g", probably because of the appearance of the unit m/s^2 .

Question 4

(a)(i) The majority of candidates scored both marks here, showing a good understanding of the effect of mass on initial acceleration.

(a)(ii) A large number of candidates failed to realise that the mass of the bike did not affect its maximum speed and that air resistance was the significant factor here.

(b)(i)(ii) The vast majority were able to read the correct time values from the graph.

(b)(iii) This depended upon from where on the graph the candidates took their values. Those who selected the obvious point (time 10 s, velocity 4 m/s) almost all went on to calculate the acceleration correctly. Those who selected other points (or the wrong cyclist) usually went on to make further errors in the calculation.

Question 5

(a) Very few candidates scored full marks here. The most common errors were using the wrong distance in the formula for work done and not giving the correct unit.

(b) By contrast, a good proportion of candidates scored both marks for this calculation.

(c) To score any marks in this part, candidates had to know the connection between work done and energy transferred and then to make correct statements concerning "wasted" energy or efficiency. Very few were able to do this, with over 90% of candidates scoring no marks.

GCSE Additional Science 5020H
GCSE Physics 5048H

Structured Paper P2

General Comments

It was evident that some candidates were unfamiliar with standard definitions and vocabulary. Many candidates failed to 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.

The lack of a calculator was still a problem for many candidates. In general the standard of calculation was better than seen in March; candidates could, on the whole, select the correct equation, but did not always substitute in the correct value nor did they show skill in transposition. Units were also a problem area in that many candidates did not realise that equations only 'worked' when the data had the correct units.

There was a reduction in the number of candidates who wrote in pencil, but some candidates still failed to write legibly. There was no evidence that candidates had insufficient time for the paper. When candidates wrote at length the quality of their English deteriorated; attempts to make things clearer often did the reverse. The advice to think first seemed to have been missed by many candidates.

As mentioned in November and March, centres should consider the advisability of entering C or D grade candidates for a paper where 50% of the available marks are targeted at these grades as it gives such candidates limited opportunity to demonstrate their abilities in physics.

1. Energy in a Mechanical and Electrical System

It was evident that centres had instructed about good examination technique in part (a) as most candidates wrote down the equation. However only 75% of candidates could consolidate on this and gain any marks. Despite the equation being given in full on page two the most common error was incorrect substitution of the distance.

The calculation was better done in part (b), with less than 8% of the candidates failing to gain at least one mark. There were a similar number of candidates who could not correctly calculate the energy.

Part (c) was poorly answered; the concept of energy losses in a system was not well known. Few candidates were able to name two energy types and even fewer were able to state the place where the energy loss occurred.

2. Uses of Radioisotopes

As stated in the general comments, the straightforward definitions of essential vocabulary, half life and isotope, were not well known. Just over 50% of the candidates failed to gain any of the available marks. In part this was due to incomplete answers such as 'the amount of time an isotope has decayed'. However many candidates paid scant attention to detail with answers such as 'the time it takes for an *atom* to decay' or 'the time taken for the *reactivity* to halve'. In order to gain the mark it was necessary to be clear and correct on both the time involved and exactly what was halved. There were similar problems with the responses given for isotope. Again two correct concepts were required; again many poor responses were seen with incorrect use of terminology such as 'molecule'.

The graph in part (b) enabled most candidates to gain some marks. There were some excellent graphs seen with accurately plotted points and good lines of best fit. Less than 20% of all the candidates were able to gain all the marks. Candidates do need to be reminded, however, that at this level, much is required for the marks. Common errors on the graph were to transpose the axes (confusion of the independent and dependant variables), incorrect plotting (especially of the first point) and multiple attempts at a best fit line. Less commonly seen were point to point lines, incomplete axes labels and awkward scales. For the determination of half life the most common error was to halve 1000 instead of 980. There were also a significant number of candidates who could not correctly read off a value from their own scale.

In part (c), over two thirds of the candidates were able to correctly calculate the rate of heat output of the heater module. A few then went on to multiply this by 3 cm (the length of the module). Most were able to gain a mark by stating that this rate of heat output was low (and therefore the heater module was safe to hold). Candidates also used information from the stem re alpha emission but many concentrated on the lack of penetration of skin rather than the role of the ceramic case in absorbing the emissions or the range of alpha particles. Only 20% of candidates gained all three marks.

Many candidates were able to apply the information about RTG units in parts (d)(i) and (d)(ii). However it is disappointing to note that many candidates thought that there was no light in space. In part (d)(iii) only the more able candidates were able to demonstrate a good understanding of the consequences of a shorter half life, most were able to relate half life to the RTG's life span but very few could relate the activity

Commonly candidates responded that the output would be lower.

3. Motion of an Air Puck

In part (a)(i), over 85% of candidates gained two of the available marks despite the content being emboldened in the specification. However less than 25% of the candidates then gained the extra mark for correctly giving the unit of momentum. Over 60 variations for the unit of momentum were seen; the most common being 'p' or 'kg/m/s'. The kinetic energy calculation in part (a)(i) was well answered with two thirds of the candidates gaining both marks.

Less than 50% of candidates gained the mark in part (b) for reduction of friction. The most common error was that the puck increased in speed.

Part (c) was aimed at the higher grades and was a good discriminator at that level. Surprisingly few candidates knew that reaction forces were the same size as the action force in part (c)(i); many candidates 'shared' the force between the two pucks in various ways. Unsuccessful candidates in part (c)(ii) selected the wrong equation for acceleration (maybe because this equation had 'a' as the subject of the formula?). A few did select correctly but could not transpose the equation.

GCSE Biology 5029/01

Structured Paper B3

General Comments

The paper was non-tiered and consisted of thirteen questions. This was the first time that this part of the specification has been examined.

Candidates found the questions accessible with most questions being attempted by most candidates. It was pleasing to see that even low scoring candidates were able to pick up marks across the paper.

Aspects of science new to the specification were examined with mixed response, with some candidates clearly having been taught salient details and others lacking the key words and science to match the marking points. Some aspects of previous specifications, e.g. the production of soy sauce, caused some candidates difficulty.

"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

This question required candidates to apply their knowledge of carnivores, herbivores and omnivores. Candidates found the question most accessible and answered well.

Question 2

This question was designed to test understanding of diet. This was answered well by the majority of candidates who gained three marks on the first part of the task and at least two on the second. Some candidates lost an odd mark by not being specific enough e.g. stating that grilled fish was "a source of protein" rather than suggesting that "grilled fish was a better source of protein"

Question 3

This question was designed to test understanding of courtship. Candidates found the question most accessible and answered well.

Question 4

This question was about the effects of herbicide on GM crops and resultant yield.

This was generally well answered. Most gained the 'higher yield' mark and mentioned 'less competition'. Although most candidates realised that it would kill the weeds they didn't specifically say that it would then allow the crops to grow. There were a number of candidates who failed to realise that herbicides kill weeds and although candidates seemed to have good knowledge of GM crops some just wrote about GM in general. Coppicing can lead to more biodiversity because more light can penetrate thus increasing the range of plants that can grow, which increase habitats for animals. Several candidates scored one mark.

Question 5

This question was about pheromones and how moths use pheromones to find mates.

Part (a) (i) was answered well by with many candidates gaining the mark by referring to the pheromone being 'less concentrated'. Some simply wrote that the pheromone 'spreads out' which is in the stem of the question and was therefore not credited whereas more specific answers e.g. ' the particles become more spread out as they move away from the moth' were creditworthy.

Some excellent answers were seen for part (a) (ii) that clearly showed a good understanding of using the concentration gradient to find the female moth. A minority of candidates had moths just stating that the male moth would fly to where the pheromone came from.

In part (b), many candidates' responses referred to not attracting the wrong species. There was a variety of ways in which candidates were awarded this marking point. Sometimes candidates gained the 2nd mark for mentioning reproduction being unsuccessful if mating with a different species. Such responses tended to be of a very good quality using key words such as hybrid and sterile/ infertile offspring to develop their ideas. A large proportion of responses referred to not wanting to attract predators.

Question 6

This question was designed to test understanding of the applications of how science works, experimental design, and aspects of learning and habituation. In part (b) the majority of candidates gained a mark here for testing young/newly born squirrels from London with loud noises. Many then misread the rest of the question which required them to explain how the results supported either habituation or innate behaviour and lost marks by saying, for example, "I think that the squirrels will react to the loud noises". A few gained marks for devising an experiment involving country squirrels.

Question 7

This question was designed to test understanding of why communication can be an important part of animal behaviour for animals that live in groups.

Part (a) required the candidates to develop the points in the stem and unfortunately some merely paraphrased it by saying, for example, "Gorilla's need more facial expressions because they live in larger family groups". A creditworthy response developed this to say therefore there were more interactions within a day. A significant number of the latter answers went on to give examples thus gaining the second mark.

In part (b) (i) the majority of candidates gained 2 marks for this, in fact most responses mentioned much more than was required. Weaker responses used more general terms such as 'moving calmly/ gently' and so were not able to gain the mark. There were a number of candidates that failed to understand the point of the question – they listed the behaviour the cameraman should look for to recognise if the gorilla is going to charge them. And a very few misunderstood the question completely suggesting that the cameraman should do the opposite of what was required to get some "good shots".

In part (b) (ii) a few candidates wrote that the gorilla was just trying to scare the challenger off which again missed the point of the question. The majority, though, correctly stated that gorillas don't want to become injured and so don't engage in fighting. It was pleasing to see that a significant number of candidates developed their answer to encompass consequential points, for example, "the alpha male may not be able to fight the next challenger off" or "if injured, the male would not be able to feed himself well enough to survive".

Question 8

Part (a) was designed to test understanding of aspects of anthropomorphism. This was generally well answered with many candidates taking clues from the anthropomorphic diagram of a cartoon dog.

Part (b) asked candidates about the reasons why people keep animals as pets. Although the majority of candidates gained two marks here, some repeated themselves by giving answers like "for companionship" and "because they like to be with them – they are like friends". The commonest responses seen were companionship, and protection.

Part (c) proved to be a harder question for many candidates who described how to domesticate animals rather than describe the benefits. It was pleasing to see good answers describing how domestication improved the supply of food and resulted in less aggressive animals so were less likely to cause harm to themselves and the 'farmer'.

Question 9

This question tested a very new area of the specification – the use of plant and plant extracts for medicinal purposes. There was a considerable variation in the spelling of cinchona. Phonetically correct answers were accepted.

In part (b) (i), most candidates gained a mark usually by using words such as 'side-effects' or 'poisonous'. Those that didn't gain a mark had used 'dangerous' and 'unsafe'. There were a few candidates that referred to it passing on an infection/ disease.

In part (b) (ii) many candidates were able to gain a mark for mentioning 'growing more artemisia' or genetically engineering microorganisms to produce artemisinin. This question required candidates to describe a range of ways to increase artemisinin production and it is therefore a pity that many just described one in great detail, which thereby gained no more extra marks. Some candidates confused Artemesia with artemisinin with answers like "take a gene out of artemisinin…." or "use yeast to produce Artemesia.

Question 10

Question 10 tested understanding of a process that has been in previous specifications. Some very good answers were seen here with detailed, accurate procedures for soy sauce production. A few candidates lost one mark by getting a point out of sequence, and others by disqualification of marks through wrongly classified organisms e.g. " Use the bacterium Aspergillus" It is a concern that a significant minority left this question blank suggesting that the these candidates were unfamiliar with even the very basic points expected

Question 11

This question was about the use of prebiotics as functional foods. Many candidates were clearly confused between prebiotics and probiotics.

A majority of candidates gained 1 mark for increased growth of good bacteria. Health benefits were rarely mentioned and then only in a vague way. References to improve digestion, clean gut were seen quite often. More able candidates talked about good bacteria being able to digest oligosaccharides but some failed to add that this would increase growth in the population in the intestines. They also failed to mention that there was a decrease in the growth of bad bacteria caused by being out-competed by the good bacteria.

Question 12

Question 12 tested understanding of the issues surrounding the ability to choose the gender of children.

In part (a) responses were at times very lengthy. Some of the points made should have been written in Q12 (b) where they would have gained a mark. A lot of responses failed to mention what would happen to the other sex i.e. they just stated 'more males'.

In part (b), candidates rarely qualified their 'playing god/ unnatural/ wrong to interfere with nature' comments. Only a handful referred to a specific religious group – most just left it as 'religious people'. Many candidates gained a mark for the 'leading to choosing other characteristics' point; possibly indicating that discussions in lessons has encompassed this point. Although many candidates failed to use the exact words 'sex linked genetic disease' they were able to give a good description of the disease only affecting one sex and some were able to make reference to haemophilia to gain a mark.

Question 13

This question gave candidates the opportunity to express themselves in a more open-ended way.

Part (a) asked candidates to use an example from dog training to help explain what is meant by the term 'conditioning'. A large proportion explained in great detail about Pavlov's classical conditioning experiments. Those that realised it was about operant conditioning usually gained 2/3 marks – usually for the 'desired behaviour', 'reward' and, less frequently, the 'operant conditioning' point. Rarely did candidates gain the 4th mark for identifying that it needed to be 'reinforced' or 'increased frequency of behaviour'.

Part (b) asked candidates to describe how an animal's parents and early experiences in life impact on the way it behaves as an adult. Many candidates gained a mark for 'parents teaching its children' and for using the word 'imprinting'. Most responses then proceeded to give a detailed example of imprinting. A large proportion of responses referred to 'pigs being more aggressive if left by their parents' which failed to score as this did not answer the question. It was pleasing to see a few excellent answers that elucidated their response with ramifications of not being taught by parents, for example, "…..the bird will therefore not learn the correct song for its species and so won't find a mate".

GCSE Chemistry 5039/01

Structured Paper C3

General Comments

Although this was a new specification, the general standard of chemistry shown was similar to previous years. Similarly, candidates do not always explain their answers clearly enough or show their working in calculations; this obviously reduces their overall marks. The candidates' practical experience appears limited in some areas and it was particularly noticeable in their answers to the volumetric question (Q8). Other areas where more attention could be given include ionic concepts in equations, electrolysis and also basic concepts in organic chemistry.

This being a non-tier paper, question one was targeted at the F/G level (about 10% of the total marks available), questions 2 – 4 at the C/D level (about 40% of the marks) and questions 5 – 8 at the A/B level (about 50% of the marks).

Question 1

Most candidates answered parts (a) and (b) with ease, although occasionally LI and Li^+ were seen for part (a), and for part (b) 'alkaline' was erroneously used by some candidates.

The word equation in part (c) was usually well answered, but sometimes carbon dioxide replaced hydrogen. Most candidates answered the remaining two items correctly.

Question 2

There were some good answers for part (a), which included toxins, bacteria and disease. However some failed to relate the consumption of the water for dinking to the need for purification.

In part (b), again there were some good answers where candidates mentioned droughts and economic or energy reasons. Some got diverted on to ethical and third world issues when the question stated 'our homes'.

There were many candidates who failed to understand the meaning of 'chemical test' in part (c). A test requires a reagent and a result. Consequently, many stated 'use blue litmus' in part (i) without giving any indication of the result. Some candidates thought red litmus would be a suitable test.

Part (ii) was often well answered with a high proportion of candidates scoring the full three marks. However, some missed the use of dilute hydrochloric acid or failed to give details of the precipitate. Some candidates confused the test with the part (iii) of the question and used sodium hydroxide as the precipitating reagent.

Part (iii) was often answered well. Some candidates failed to mention the precipitate dissolving in **excess** sodium hydroxide and several wanted to use hydrochloric acid as the reagent confusing the answer with the part (ii) no doubt.

The last part of this question was usually well understood. However, some candidates associated the word qualitative with 'quality of the water'. A common misconception was the idea of the quantitative test used to find the amount of water that was polluted rather than the idea of the amount or concentration of the pollutant in the river water.

Question 3

Part (a) was usually answered well and many candidates were able to score both marks here in part (b). However some associated making electrical wires with a property without mentioning electrical conductivity. Other common misconceptions were using the single word 'conduct' without reference to electricity or stating that the transition metals melt at 1085 ^{o}C or that they (metals or metal compounds?) are all blue.

Most candidates knew the electrolyte used for the purification of copper in part (c), although some used and were credited for copper chloride. More able candidates found little problem with parts (ii) and (iii), but less able ones did not read the question about 'see happening' and wrote about seeing electrons or ions moving to the cathode in part (ii) and a high proportion stated that the ions lost electrons to become copper in part (iii).

Question 4

There were many correct answers for the balanced equation in part (a). Less able candidates invented some unusual sulphur and oxygen compounds.

It was pleasing to see that the broad terms hydrophobic and hydrophilic were well understood by many candidates for part (b). However, coupling these terms to explain the removal of grease sometimes proved more difficult for some. Most candidates were able to explain the difference between the action of soap and detergent in hard water areas in part (ii), although it was a little disappointing to see several confuse scale with scum in their answers. Candidates often thought that biological detergents were a living organism in part (iii) which eat biological material. Less able candidates simply stated that biological detergents worked better without explanation. More able candidates were able to discuss enzymes, washing at lower temperatures and dissolving 'biological' stains. It was interesting that some thought biological detergents had no effect on or were better for the environment and were a 'green alternative' to normal detergents.

Question 5

The loss of electrons was given by many candidates in part (a) but a few thought that the Fe^{3+} ion gained electrons.

In part (b) many candidates scored both marks for part (i). Some stated a precipitate without a colour and some produced colours for precipitates which were imaginative. Any suitable colour based on brown (eg red-brown, orange-brown etc) was acceptable, as was 'rust coloured', but not 'red'. The ionic equation proved difficult for most candidates. Some tried putting positive and negative charges everywhere on formulae and others tried to use standard equations with limited success. Clearly this is an area that needs particular attention for the future.

Question 6

Many candidates were successful with the calculation in part (a) but some insisted on using 24 dm^3 in a division or a multiplication. The molar volume of a gas was not provided since it was not necessary for the calculation.

The -O- H group was usually identified correctly in part (b). Less able candidates encircled the -O-. Bizarrely some circled the CH_3- group.

Hydrogen was usually given as the gas formed in part (c) but there were some who preferred carbon dioxide or methane as product of the reaction.

It was interesting to see that many candidates were able to give the correct name of the ester in part (d); others had attacks of nomenclature creativity. Drawing the structural formula of the ester proved difficult for most and even those who attempted to draw any ester linkage found that they had to invent unreal covalencies for carbon hydrogen and oxygen. Too often correct answers were spoiled by pentavalent carbon atoms in the ester group.

Question 7

For many candidates part (a) was an easy 4 marks. It should be pointed out to candidates that excessive significant figures are not acceptable in an answer and that setting out a calculation in an exam question is important as examiners are instructed to see how marks can allocated for a working method even when an incorrect final answer has been obtained. The calculation of the formula masses for calcium carbonate and sodium carbonate were often seen, but several candidates then used the wrong ratio and ended up with an answer of 1 060 000 tonnes. Equally it was disappointing to see many candidates loose the final mark by trying to convert their answer to tonnes. It is surprising to see that candidates could manipulate numbers in so many incorrect ways.

Many candidates scored some marks for the equation for the neutralisation reaction in part (b). The less able candidates did not know the formula of sodium sulphate or that carbon dioxide and water are formed in this type of reaction.

Question 8

In the final question of a non-tiered paper, it should be expected that a demanding question should be set in order to differentiate at the top end of the ability range of candidates.

Although the more able candidates clearly understood the need for a well defined end-point in a titration for part (a), several lost the mark through poor expression. Common misconceptions seen here included that universal indicator was too dilute, doesn't work with calcium hydroxide, or only measures the pH.

It was clear that the practical experience of candidates with respect to titrations was limited. Their knowledge of procedures and use of basic apparatus such as a pipette and burette showed fundamental flaws. For example, pipettes were often used to fill burettes, burettes were used to deliver volumes of liquids when a pipette should have been used, universal indicator was used when in part (a) they were told it was not suitable, and many had little knowledge of end-points or colour changes in

indicators such as methyl orange. For those candidates that had such experience full marks were readily available and obtained; others struggled to even gain credit for suitable experimental points such as 'swirling the contents', correct use of a conical flask (not beaker!), use of a white tile etc.

The volumetric calculation was a good discriminator. The simple formula to determine the amount of substance in a volume of solution was little known in part (i). However, many candidates recognised that that there was a molar ratio of 1:2 in part (ii) and a scaling factor of 10 was required in part (iii).

In part (d), even though candidates had often miscalculated the mass of calcium hydroxide in (c)(iii), they were still able to gain credit for the mass dissolved by multiplying their answer to (c) (iii) by 74. Some candidates even stated and were credited for writing 'answer to the last question x 74'.

Part (e) required candidates to apply their practical experience to a new situation. Many candidates were able to do this successfully but others forgot basic things such as weighing the evaporating basin before finding the mass of the residue. Others weighed the basin and its contents before and after evaporation thus finding the mass of water rather than the barium chloride.

Revision tips

- Learn the structural formulae of all the basic types of organic compounds listed in the specification.
- Learn the chemical tests (+ results) for the metal ions and non-metal ions.
- Practise calculations on reacting masses, gas volume calculations, concentration of solutions and those based on the results of titrations.
- Practise calculations using the mathematical relationships:

$$\text{Number of moles of substance} = \frac{\text{mass of substance (g)}}{\text{formula mass}}$$

$$\text{Number of moles of a gas} = \frac{\text{volume of gas (cm}^3\text{)}}{24\,000} \quad \text{or} \quad \frac{\text{volume of gas (dm}^3\text{)}}{24}$$

$$\text{Number of moles of substance in solution} = \frac{\text{volume of solution (cm}^3\text{) x concentration (mol/dm}^3\text{)}}{1000}$$

(Note: these mathematical relationships should be learnt as they are not required to be given in an examination)

- Practise writing and balancing chemical and ionic equations for a variety of chemical reactions

GCSE Physics 5049/01

Structured Paper P3

General Comments

As for paper 5020/5048 H, it was evident that some candidates were unfamiliar with standard definitions and vocabulary. Many candidates failed to 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.

The lack of a calculator 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. Units were a problem area in that many candidates did not realise that equations only 'worked' when the data had the correct units.

There was no evidence that candidates had insufficient time for the paper. Very few candidates wrote out of the spaces allocated, and those that did indicated clearly where the extension was located. A number of candidates failed to write legibly; this seemed to be a higher percentage than on paper 5020/5048 H.

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. The advice to think first seemed to have been missed by many candidates.

1. Basal Metabolic Rate

This question was low demand, but surprisingly nearly 50% of candidates failed to gain the first mark for an explanation of BMR. Some candidates failed to show good examination technique and did not select three methods in part (b) when there were three marks available. Nearly all the candidates were able to gain both marks for part (c).

2. Cathode Ray Tube

This question was also low demand. However nearly one third of the candidates could not correctly identify the anode and the cathode in part (a). In part (b) there were significant numbers of candidates who failed to gain each mark; for example nearly one quarter did not know that the electron beam is produced by the cathode.

3. Stability and Beta (Minus) Decay

In part (a) the most common mistake was to place the cross in the region of *stability* not instability, albeit on the very edge of the region. Three quarters of all the candidates knew that too many neutrons leads to beta minus decay, but just less than 60% knew what happens to the proton and mass numbers during this decay.

4. Total Internal Reflection

This question started with a simple explanation of a common glossary term, refraction. However nearly 50% of the candidates failed to gain this first mark. In part (a)(ii) the instruction to complete the diagram *accurately* was ignored by a large percentage of candidates; their reflection angles were insufficiently precise for them to gain both marks.

Less than 20% of all the candidates gained all three marks in part (b). the most common error was to describe the purpose or method of use for the endoscope rather than give an explanation of how an endoscope works as directed by the question. The benefit of using endoscopes rather than open-wound surgery was well understood, with just a few candidates omitting the comparison.

5. External Radiation Therapy

As in question 4, this question started with a explanation of a common glossary term, palliative therapy. It may be that some candidates were confused by the term 'therapy' instead of 'care', but fewer than 40% could correctly explain what this meant.

Part (b) proved to be very demanding overall, with many candidates gaining just one mark for the effect of the radiation on living matter. The key factor, reduction of the effect on normal cells, was not understood by the vast majority of candidates. In part (b)(iii) a common error was to assume that *all* of Sohanna's neck was affected and therefore a 'machine-gun' approach to irradiation was necessary. This is one of the questions referred to in the general introduction where many candidates failed to write coherently.

Although the entire question was about *external therapy*, this fact was ignored by a large number of candidates. Just less than 60% of the candidates identified gamma as the correct source in part (b)(i). Very few candidates were then able to go on and select barium-133 and mention the long half life in part (b)(ii). Most candidates responded that the half life should be short, and thus chose actinium-223, barium-129 or thorium-233.

6. Quarks

The term fundamental particle was quite well known. Just over 60% of the candidates gained both marks for part (a). A few candidates referred to fundamental particles as 'building- blocks' rather than as indivisible particles.

The calculation in part (b)(i) was also well done; the most common error was omission of the sign of the charge on a proton. In part (b)(ii), most candidates were able to state 'dud' or the equivalent. Less than 10% of candidates failed to gain any marks for this question.

In part (c) most candidates (~70%) were able to state that a down quark becomes an up quark. Of the rest, the most common errors were to assume that an up quark was gained (total quark count =4) or that *all* the quarks became up quarks. Approximately 10% of candidates knew that the electron was ejected from the nucleus. The most common misconception was that the electron was somehow absorbed into the electron shells (and thus neutralised the atom!).

7. PET Scanner

Balancing nuclear equations proved to be beyond most candidates with less than one third correctly identifying X as a neutron. Most candidates responded with gamma, thus demonstrating a lack of understanding of mass conservation.

In part (b)(i), poor examination technique was shown as many candidates failed to notice that two marks were available.

For part (b)(ii) the key factors in using short half life tracers were not understood. How long the fluorine stays (radio)*active* in the body is determined by the half life whereas how long the fluorine *stays* in the body is a determined by biochemistry and excretion; most candidates failed to show any appreciation of the distinction. Similarly, for the disadvantage, most candidates mentioned the necessity for a short test rather than the necessity to have the test a short time after the fluorine was made.

The most common error in part (c) was to re-write the stem of the question almost verbatim. Only 25% of the candidates gained either mark here.

8. Gases

As mentioned previously, questions which required explanations were often poorly attempted. Part (a) was no exception; only 10% of candidates were able to gain all the available marks and almost a third gained none of the marks. Worryingly, some of the common errors showed that candidates had little knowledge of the arrangement of particles in a gas; additional air was seen to be filling the tyre so that the particles were squashed together and were pushing the walls of the tyre out.

The gas law calculation in part (b) suffered mainly because candidates did not change the temperatures into Kelvin. More than a third of the candidates failed to gain any of the available marks. All the usual mistakes were seen; incorrect substitution, incorrect transposition and an inability to cope with powers of 10 (on a calculator or otherwise).

9. Absorption of Radiation and Pulse Oximetry

In part (a)(i) 60% of candidates knew that a LED is a light emitting diode. Many candidates omitted this section. In part (a)(ii) 50 % of the candidates gained both marks but 28% made mistakes with the units or failed to read the wavelengths with sufficient accuracy. It was pleasing to note that over 40% of the candidates in part (a)(iii) were able to make the comparison of absorption correctly. The most common error was to assume that the radiation absorbed the blood. A few candidates launched themselves into a description of the entire absorption spectra for both oxygenated and deoxygenated blood.

The meaning of 'non-invasive' was quite well understood with over 60% of the candidates gaining the mark. Similarly, over 75% were able in part (b)(ii) to gain at least one of the marks for the other factors affecting the light detected. A frequent insufficient response was a variation on the information given in the stem of the question; for example 'oxygenated blood'. In part (b)(iii) candidates were asked to describe and explain the features of the graph. Only 20% of the candidates could do both. This is another of the questions referred to in the general introduction where many candidates failed to write with precision. Expressions such as 'the bumps or squiggles shows that the heart is beating' are inappropriate and insufficient at this level. Other candidates wrote (poorly) at length about the purpose of a pulse oximeter e.g. 'the important features are that it shows the amount of oxygenated haemoglobin, this shows how healthy the blood is and if there is any need for treatment'.

GCSE Additional Science – Centre Devised Units 5021 (B2), 5022 (C2) and 5023 (P2)

Summer 2008 was the first examination series for this examination component.
CDAs in these units count for 10% of the overall marks for the examination. CDAs in 360 GCSE Additional Science form one of three alternative modes of examination for B2, C2 and P2 units. Centres opting for this mode of assessment can choose up to three CDAs per candidate, (one from each of B2 C2 or P2,) so this form of assessment can count for 10, 20 or 30% of a candidate's marks.

Written communication

Centres tended to be generous in this area, but it was probably the area where there was least disagreement between the centres and the moderators. Centres tended to mark more accurately towards the lower end of the mark bands. To be awarded 7 or 8 marks, a candidate's work should have a clear logical structure. This means the candidate should set the scene for the whole assignment and link the parts together well. Words from the glossary should be integrated into the work at appropriate places and it needs to be clear that their meaning is understood. In at least one centre candidates took the list of words from the glossary for the topic and for every word gave a dictionary definition, whether it was relevant to the task or not. The centre then awarded 8 marks merely because the candidate had a glossary.
It is a concern that some less able candidates were given credit by centres for words and phrases they used in the text, which the candidates simply did not understand. There was little in-depth treatment involving scientific understanding.
The work produced by some candidates appeared to have just been copied and pasted from the Internet and there was a clear distinction between this work and the candidate's own written work. Centres were often awarding marks to candidates based on this copied work and not on the candidates' own ability, even when there was an obvious difference between it and typical "student speak".
Many candidates word processed their reports and so were able to demonstrate the ability to produce clear and well structured work with a minimum of spelling and vocabulary errors thanks to the computer's spelling and grammar checking facility.

Analysis

Centres tended to be generous in this area also, particularly at the top end of the mark bands. Many candidates were given credit where they had not clearly linked discussion to the data in their results table, or to their graphs. For a full analysis, the candidate should make specific reference to the figures in the tables or graphs. To gain 6 marks, the links to scientific knowledge should be explained well. To gain 7 or 8 marks, there should be a clear discussion about reliability and validity. Many candidates were confused by the distinction between the two ideas, yet were often awarded high marks by the centre.
The candidates who did questionnaires for the recycling projects normally drew graphs, although these were mainly bar charts and pie charts which produced simplistic conclusions. For the plastics project, many candidates did practical work, gave results and drew either bar or line graphs and then drew conclusions. In general, it was quite rare to see many line graphs. There was a limited amount of numerical analysis of any data. For the smoke detector task, the candidates often copied a graph about half-life, sometimes without graph paper, but did not indicate why this graph would be relevant. There were quite a few smoke detector projects with very little data (again, this could be down to PowerPoint being the format of choice) and it was therefore difficult for the candidates to gain many marks. In most cases there was a lack of depth to the discussions which may be partly due to the data collected, (or provided by the teacher), for analysis. There was very little

consideration of reliability and even less of validity. Discussions on the implications of results were virtually non-existent.

Applications and Implications

Many candidates made a good attempt at this section. However, credit was sometimes given at the highest mark band, just because two sides were given to an argument. Centres are respectfully reminded that candidates need to gain all the criteria for mark band 5-6 in order to be considered for the award of 7-8 marks. To get into mark band 5-6, the statements need to be well reasoned, though marks were often given when this was not the case.

Rarely were marks greater than 5 or 6 justified and often 4 marks was the norm achieved on moderation. This was however, the easiest section to moderate. Most candidates found it easy to argue for an application such as recycling but found the counter argument much more difficult. However, many did not discuss the scientific implications in any great depth, preferring to bullet point or list the advantages and disadvantages without discussion. Centres are advised that the scientific implications have an equal weighting with the arguments for and against an issue. It would have been pleasing to see more candidates attempt to form their own opinions based on their results.

Consultancy Service

Edexcel has in place a free Consultancy Service for centres considering using this mode of assessment for either the GCSE Additional Science or GCSE Biology, Chemistry and Physics extension units. Centres may either send in a draft version of their task to a named Principal Moderator, or alternatively they can send in completed, marked tasks so that the standard of marking can be checked prior to submission of the work for moderation. It is encouraging to see that some centres have made use of this service during the last academic year. Full details of this service are on the secure part of the 360 Science website.

Examples of CDAs seen this year:

In this first year, it is perhaps not surprising that the majority of centres have used the exemplars in the guidance material which Edexcel has provided.

For Unit B2 the most popular task was “Recycling”.
For Unit C2 the most popular task was “Plastics” followed by “Gold”.
For Unit P2 the most popular task was “Smoke Alarms” followed by “Braking Distance”.

Some centres provided candidates with a structured format – requiring answers to be given to a list of questions based upon provided data. This is not to be recommended for more able candidates since this approach limits achievement. For less able candidates this type of approach may be more appropriate however.

In a number of instances the design briefs were not provided by the centre. This made it very difficult to judge the amount of assistance given to candidates, and hence made the moderator’s job much harder. Centres are respectfully reminded that moderators do need to see the assignment briefs, transcriptions, or information sheets etc, and these must be included with the candidate work.

Some centres designed their own tasks, and they are to be congratulated for making the effort to do so. However, several of these had one major problem in common – insufficient attention was often paid to the design of the tasks, which resulted in a mis-match between the task and the some of the assessment criteria.

The design of the CDA tasks can allow for a range of methods of presentation. By far the most popular was the written report (as we expected) but it was good to see less able candidates exploring other methods of presentation, such as booklets, PowerPoints and posters. In some cases the standard of IT skills used in presentation was excellent. Such methods of presentation however, are not recommended for more able students, as they may restrict their ability to satisfy all parts of the assessment criteria. PowerPoints must always be accompanied by a transcript in order to aid the moderation process.

Few annotations were seen on the centre devised assessments this year, and even fewer centres provided details of why marks were awarded using the assessment criteria. In consequence a considerable amount of moderator time was spent in looking for marks which the centre had awarded. Centres are respectfully reminded that internally assessed work should be annotated using minimalist notation such as WC 5, A 6, AIS 4. Notes such as these placed in the margin, at the point of achievement, are all that is required. Any additional detail as to reasons for the award of marks is optional, and at the centre's discretion.

There was little evidence of effective internal standardisation. Centres should be reminded that this is very good practice and a comprehensive process of internal standardisation needs to be put in place for the future. More thorough internal standardisation is likely to identify and clarify the differences between the centre's markers in the accuracy of applying the assessment criteria, and also make agreement between centre and moderator more likely.
Edexcel's moderators would have appreciated some notification from centres that the work had been internally moderated. A brief note to the moderator is all that is required.

In **Biology unit B2** it was noted that candidates were more able to use their scientific knowledge when doing the "stem cell" task compared with the exemplar "Recycling" task. Very few candidates attempted "stem cells" however, preferring instead to try their hand at "Recycling".

In **Chemistry unit C2** centres are asked to note that in the Plastics task some considerable polymer science, with the correct use of glossary terms, is required to access the highest mark bands.
Those candidates who attempted the "Gold" task often failed to discuss the concept of alloying when applied to the task, in any sort of detail. Candidates generally found this task difficult.
The science behind both of the tasks is important and must be evident for the award of high marks.

In **Physics Unit P2** scientific explanations for the radioactive decay curve are expected for the smoke alarm task, which should consider the random nature of radioactive decay. Some candidates did not include a decay curve and so struggled with AO3 in particular.

Many of the tasks that were presented in PowerPoint form did not include any additional notes made by the candidates. Centres are respectfully reminded that these are necessary for effective moderation.

Plagiarism
Prior to the examination series commencing, one of the major concerns the Principal Moderators had was the likelihood of candidates plagiarising work downloaded from the Internet. There was certainly some evidence of this malpractice.
It is acceptable for the use of a sentence or two (at most) to be used, but quotation marks must be placed around the downloaded material and it must be properly referenced. Centres are respectfully reminded that in situations where candidates cannot be trusted to undertake this type of task responsibly outside the centre, then the work must be completed under the teacher's guidance in the centre - see FAQ 1 in "Exemplar centre devised internal assessments with guidance part 2" (November 2007).

It is pleasing to note that plagiarism was not as widespread as had been feared, but teachers must be ever mindful of this possibility. A candidate's comment that "….also to substantially attenuate the insulin resistance for example thiazolidinediounes…." apparently was not challenged by the teacher.

Summary
Some centres devised mark their own schemes which related specifically to the task assessed. Where centres used these, rather than the general criteria, there were sometimes significant mark differences between the centre and the moderator. These centre mark schemes appeared to be selective in choosing which of the generic criteria should make up a certain mark range. Consequently they disadvantaged their candidates and this situation could have been avoided had the centres used the free Consultancy service in advance of submitting the work for moderation.

Both candidates and markers tended to be more comfortable when there had been an obvious discussion of the assessment criteria before the work began. It is perfectly acceptable for candidates to be given copies of the assessment criteria, and the words explained to them. Many of the most successful centres used subheadings in the design of their tasks to cue appropriate responses. This approach is perfectly acceptable.

Where teachers had marked very carefully and standardised their work effectively, their annotated notes frequently quoted directly from the assessment criteria. This was most useful to moderators in helping to support teachers' assessments.

This year, there was some work that was exemplary in its assessment, and there were a few centres which produced very innovative work, which built on the exemplars in the guidance material. Teachers are encouraged to develop their own material, possibly starting with the exemplar material as a base, and adapting it in order to make good use of the local environment and to maximise the potential of the candidates in their centres.

Taking everything into account, for the first examination series in 2008, centres are to be commended for the enthusiasm in embracing this unit. It is acknowledged that much developmental work is required by a centre undertaking CDA tasks for the first time. Edexcel will continue to support centres to improve candidates performance.

GCSE Biology, Chemistry and Physics – Centre Devised Extension Units 5030 (B3), 5040 (C3) and 5050 (P3)

Summer 2008 was the first examination series for these examination components.
CDAs in these units count for 30% of the overall marks for the examination. They are alternative to the one hour single tiered structured extension papers in each of the B3 C3 and P3 units.
CDAs in these units are expected to produce work of comparable standard to the alternative written paper.

Centres choosing this option are required to produce a portfolio of student work totalling 108 marks. The portfolio may be put together in a number of ways, ranging from four separate tasks at 27 marks each, to one task at 108 marks. There are a number of other possible combinations, of course. The maximum marks available for an individual CDA task are either:- 27, 54, 81 or 108, depending on the amount of specification coverage. For more details, please see the new Edexcel booklet "Exemplar Centre Devised Internal Assessments with guidance" issued in September 2008.

Consultancy Service
Edexcel has in place a free Consultancy Service for centres considering using this mode of assessment for either the Additional Science or GCSE Biology, Chemistry and Physics extension units. Centres may either send in a draft version of their task to a named Principal Moderator, or alternatively they can send in completed, marked tasks so that the standard of marking can be checked prior to submission of the work for moderation. It is encouraging to see that some centres have made use of this service during the last academic year. Full details of this service are on the secure part of the 360 Science website.

Some centres devised their own mark schemes which related specifically to the task assessed. Where centres used these, rather than the general criteria, there were sometimes significant mark differences between the centre and the moderator. These centre mark schemes appeared to be selective in choosing which of the generic criteria should make up a certain mark range. Consequently they disadvantaged their candidates and this situation could have been avoided had the centres used the free Consultancy service in advance of submitting the work for moderation.

Examples of CDAs seen this year:
In this first year, it is perhaps not surprising that the majority of centres have used the exemplars in the guidance material which Edexcel has provided.

For Unit B3 the most popular tasks were "Biotechnology" and "Animal Behaviour".
For Unit C3 the most popular tasks were "Chemical Detection" and "Esters".
For Unit P3 the most popular tasks were "Gas Laws" and " PET Scans."

Some centres provided candidates with a structured format – requiring answers to be given to a list of questions based upon provided data. This is not to be recommended for more able students since this approach limits candidate achievement. For less able candidates this type of approach may be more appropriate however.

In a number of instances the design briefs were not provided by the centre. This made it very difficult to judge the amount of assistance given to candidates, and hence made the moderator's job much harder. Centres are respectfully reminded that moderators do need to see the assignment briefs, transcriptions, or information sheets etc, and these must be included with the candidate work.

Some centres designed their own tasks, and they are to be congratulated for making the effort to do so. However, several of these had one major problem in common – insufficient attention was often paid to the design of the tasks, which resulted in a mis-match between the task and the some of the assessment criteria. In the extension units, for example, the assessment criteria for AO2 (Application of skills) require candidates to address features such as "ethical issues", and to "discuss benefits and risks of scientific advances". In AO3 (Practical enquiry and Data handling) candidates are required to "evaluate their methods" (of data collection processes), and state how strongly their conclusions can be supported by the quality of their evidence. Such features were frequently missing from many of the candidates' work in the extension units, which unfortunately limited the candidates' achievements. It is very important to pay close attention to the design of the task, ensuring that all of the assessment criteria may be achieved.

The design of the CDA tasks can allow for a range of methods of presentation. By far the most popular was the written report (as expected) but it was good to see less able candidates exploring other methods of presentation, such as booklets, PowerPoints and posters. In some cases the standard of IT skills used in presentation was excellent. Such methods of presentation however, are not recommended for more able students, as they may restrict their ability to satisfy all parts of the assessment criteria. PowerPoints must always be accompanied by a transcript in order to aid the moderation process.

Few annotations were seen on the centre devised assessments this year, and even fewer centres provided details of why marks were awarded using the assessment criteria. In consequence a considerable amount of moderator time was spent in looking for marks which the centre had awarded. Centres are respectfully reminded that internally assessed work should be annotated using minimalist notation such as AO1 8, AO2 6, AO3 7. Notes such as these placed in the margin, at point of achievement, are all that is required. Any additional detail as to reasons for the award of marks is optional, and at the centre's discretion.

There was little evidence of effective internal standardisation. Centres should be reminded that this is very good practice and a comprehensive process of internal standardisation needs to be put in place for the future. More thorough internal standardisation is likely to identify and clarify the differences between the centre's markers in the accuracy of applying the assessment criteria, and also make agreement between centre and moderator more likely.
Edexcel's moderators would have appreciated some notification from centres that the work had been internally moderated. A brief note to the moderator is all that is required.

Where candidates had used PowerPoint to support a spoken presentation, the most effective submission was from a centre that included the PowerPoint material on CD-ROM. Importantly, the teacher had also enclosed handout style printouts that she had annotated to record important ephemeral evidence e.g. "the candidate correctly used this graph to explain how half-life can be determined." This approach is to be commended.

Both candidates and markers tended to be more comfortable when there had been an obvious discussion of the assessment criteria before the work began. It is perfectly acceptable for candidates to be given copies of the assessment criteria, and the words explained to them. Many of the most successful centres used subheadings in the design of their tasks to cue appropriate responses, e.g: "benefits and risks" or "ethical issues" for AO2 and "analysis", "evaluation" or "suggested improvements" for AO3. This approach is perfectly acceptable.

Where teachers had marked very carefully and standardised their work effectively, their annotated notes frequently quoted directly from the assessment criteria. This was most useful to moderators in helping to support teachers' assessments.

Plagiarism

Prior to the examination series commencing, one of the major concerns the Principal Moderators had was the likelihood of candidates plagiarising work downloaded from the Internet. There was certainly some evidence of this malpractice.

It is acceptable for the use of a sentence or two (at most) to be used, but quotation marks must be placed around the downloaded material and it must be properly referenced. Centres are respectfully reminded that in situations where candidates cannot be trusted to undertake this type of task responsibly outside the centre, then the work must be completed under the teacher's guidance in the centre - see FAQ 1 in "Exemplar centre devised internal assessments with guidance part 2" (November 2007).

It is pleasing to note that plagiarism was not as widespread as had been feared, but teachers must be ever mindful of this possibility. A candidate's comment that "….also to substantially attenuate the insulin resistance for example thiazolidinediounes…." apparently was not challenged by the teacher.

In **Biology unit B3**, some centres showed innovation and originality, particularly with tasks set for the "Animal Behaviour" topic. Choice chamber experiments using maggots or woodlice were carried out by the candidates, generating useful data which could be analysed and evaluated appropriately.

Candidates from one centre visited a local zoo, observing the behaviour of animal primates. Others watched videos of bird behaviour, making observations from secondary sources.

The work seen for the "behaviour" topic was generally more interesting for both candidates and moderators, than work seen for the "biotechnology" topic.

Both the diabetes and the anthropomorphism CDAs were suitable tasks. About half of the centres gathered primary data for the diabetes task. However, sometimes that data just related to the production of a standard curve with no unknowns. It would have been preferable for the standard glucose curve data to be related more clearly to the identification of someone with diabetes. Some candidates simply did the standard curve, and no more. The candidates in some other centres simply compared methods of measuring glucose (often with no actual data present). This meant that it was not really possible to discuss validity or reliability sensibly. Very few assignments had the sources referenced, even at the end of the assignment. Most that were presented in PowerPoint form did not include any additional notes made by the candidates. In such cases transcriptions are required by the moderator.

In **Chemistry unit C3** the quality of work seen was variable, though some excellent work was seen in particular for the "Chemical Detection" task. This task enabled candidates to show their knowledge from three sections of the specification and their knowledge and was generally very good. Most candidates struggled on the ethical issues which are thrown up by scientific advance and these discussions were sometimes quite limited. Some candidates produced a degree of data evaluation,

but comments about appropriateness of methods were infrequent. As with the additional science CDAs, candidates did not usually consider the reliability or validity of the evidence particularly well, nor were they able to offer suggestions for improvement.
Candidates who submitted chemistry CDAs generally demonstrated a considerable depth of knowledge and understanding of how science works. Most candidates could apply this knowledge to general situations and were able to demonstrate a good understanding of the benefits and risks of scientific advance. Data was usually presented appropriately in the form of a graph or chart and conclusions were normally drawn. However, most candidates found it difficult to explain how far the data supported their conclusions. As with the additional science CDAs, candidates did not consider the reliability or validity of the evidence particularly well.
The "Esters" task was new work for many centres though some made very good attempts to cope with the chemistry, discussing the use of cosmetics for animal testing.
However, very few were able to make the link from the chemistry of esters with the use of animals for the testing of cosmetic products which may well contain esters as emollients.

In **Physics Unit P3** any X ray task requires details of electron beams in order to match the Topic 5 "Particles" specification. In the "PET Scanning" task candidates often did not pay sufficient attention to key issues such as ß decay and annihilations. Such details are extremely helpful in order to access the highest marks. Further, achievement with this task was often hindered by a lack of data analysis to match AO3. This may be addressed by experiments or simulations concerning the absorption of gamma rays or the half-life of a radionuclide.
Some centres were unsure of the requirements of the specification and provided tasks that fell outside the specification. For example, one centre provided a task on the resistance of a wire (from Sc1 days) which was moderated as leniently as possible using the generic assessment criteria. Given that this CDA task was an alternative to the content of a written paper for P3, this task was inappropriate. Thankfully this was an extreme case; more common were tasks that just touched upon the specification and as such did not really assess an aspect of the main part of the specification. An example is the Boyle's Law task. This is briefly mentioned in topic 5, but the main thrust in the specification is the relationship between temperature and pressure, though many centres attempted to make this law fit into a Boyle's law scenario.

AO1
Centres were sometimes too generous, awarding 8 or 9 marks where the structure and referencing was not clear. To be awarded the highest marks, the material should be very clearly structured and referenced, within the text at the appropriate place. It should be very clear what information is the candidates' own work and what has come directly from a website, for example.
Centres need to be clear that to score 7 to 9 marks some considerable detail is required. The comments relating to scientific knowledge and understanding in the criteria stress the word "detail". This means that the academic demand of the task should be at, or near, the limits of a GCSE specification.
Technical terminology was not always understood and in some cases irrelevant to the requirements of the task.

AO2

Centres are respectfully reminded that for candidates to be awarded the highest marks, the candidates should include a detailed discussion of the ethical issues and the benefits and risks of scientific advances. This was often not well done. In many cases centres did not give opportunities in the tasks chosen for candidates to look at sensible benefits and risks and identify relevant ethical issues. A good example in the case of "PET scans" was a discussion on the pros and cons of animal testing of drugs and cosmetics. This was presented as a related ethical issue to the use of PET scanning as the scan involves the injection of a glucose based solution with a radionuclide in it. This was oblique to say the least, and the problem could have been avoided had the centre used the consultancy service before moderation.

In some cases high marks were being awarded when the amount of material presented was very sparse and not in sufficient detail.

In general, however, the work of lower ability candidates was marked accurately by centres.

The idea that the scientific method used should be the object of analysis at this level does not yet seem to be universally understood. Nevertheless there were many examples of good practice seen. Most centres had taught the candidates to question the value of scientific information retrieved from a range of different sources.

AO3

This was probably the area that gave most concern. Sometimes credit was given when there was confusion between reliability, validity, and accuracy, or just very general statements were made. To be awarded marks in the highest mark band, it should be clear that the candidate understands these terms well, giving examples from their work how these areas could be improved. In many cases, full marks were awarded within mark band 2 when the candidate had not indicated how strongly their evidence supported their conclusion. This aspect of mark band two was very rarely seen in candidate work.

Summary

This year, there was some work that was exemplary in its assessment, and there were a few centres which produced very innovative work, which built on the exemplars in the guidance material. Teachers are encouraged to develop their own material, possibly starting with the exemplar material as a base, and adapting it in order to make good use of the local environment and to maximise the potential of the candidates in their centres.

Taking everything into account, for the first examination series in 2008, centres are to be commended for the enthusiasm in embracing this unit. It is acknowledged that much developmental work is required by a centre undertaking CDA tasks for the first time. Edexcel will continue to support centres to improve candidates performance.

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	19	17	15	13	10	8		
F	24				17	14	11	9	7

5006/5026	Max mark	A*	A	B	C	D	E	F	G
H	24	19	17	15	13	10	8		
F	24				17	14	11	9	7

5007/5035	Max mark	A*	A	B	C	D	E	F	G
H	24	17	14	11	9	6	4		
F	24				15	12	9	7	5

5008/5036	Max mark	A*	A	B	C	D	E	F	G
H	24	16	14	12	11	7	5		
F	24				15	12	9	7	5

5009/5045	Max mark	A*	A	B	C	D	E	F	G
H	24	16	14	12	11	8	6		
F	24				14	11	9	7	5

5010/5046	Max mark	A*	A	B	C	D	E	F	G
H	24	17	14	11	9	7	6		
F	24				14	11	9	7	5

5015/5027	Max mark	A*	A	B	C	D	E	F	G
H	24	19	17	15	13	10	8		
F	24				17	14	12	10	8

5017/5037	Max mark	A*	A	B	C	D	E	F	G
H	24	14	12	10	8	5	3		
F	24				12	10	8	6	4

5019/5047	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

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	20	17	14	11	8	6		
F	30				17	14	11	8	5

5018/5038	Max mark	A*	A	B	C	D	E	F	G
H	30	17	13	9	6	4	3		
F	30				15	12	9	7	5

5020/5048	Max mark	A*	A	B	C	D	E	F	G
H	30	20	17	14	12	8	6		
F	30				17	13	9	6	3

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	40	35	31	24	18	12	6

5039	Max mark	A*	A	B	C	D	E	F	G
	60	42	34	26	18	14	10	6	2

5049	Max mark	A*	A	B	C	D	E	F	G
	60	48	41	34	28	22	16	10	4

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

Grade Boundaries

Centre Devised Internal Assessment Units

Additional Science

Raw Mark Grade Boundaries

5021

Max mark	A*	A	B	C	D	E	F	G
24	22	19	16	14	12	10	8	6

5022

Max mark	A*	A	B	C	D	E	F	G
24	22	19	16	14	12	10	8	6

5023

Max mark	A*	A	B	C	D	E	F	G
24	22	19	16	14	12	10	8	6

Uniform Mark Grade Boundaries for these units

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

Biology, Chemistry and Physics Extension Units

Raw Mark Grade Boundaries

5030

Max mark	A*	A	B	C	D	E	F	G
108	86	76	66	56	46	36	26	16

5040

Max mark	A*	A	B	C	D	E	F	G
108	86	76	66	56	46	36	26	16

5050

Max mark	A*	A	B	C	D	E	F	G
108	86	76	66	56	46	36	26	16

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

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