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Examiners' Report March 2008
GCSE 360Science

GCSE

GCSE Additional Science (2103)

GCSE Biology (2105)
GCSE Chemistry (2107)
GCSE Physics (2109

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Overall candidates appeared to be well prepared for this paper and accessed questions reasonably well at both foundation and higher tier levels, however at foundation graph interpretation and data analysis was less well done than in November paper. However scientific knowledge appears to have improved, at higher tier there are still problems with experimental data analysis.

Foundation

It was pleasing to see that candidates had reasonable grasp of the process of photosynthesis, with 70% of the candidates able to recognise that plants use carbon dioxide and that their energy comes from sunlight, however only 52% of candidates were able to identify the main site for photosynthesis was in the leaves. Understanding of base pairing on a DNA molecule was poorly understood with only 49% of candidates successfully identifying cytosine base pairing with guanine. When looking at experimental data candidates are still confusing how to measure the size of living things in terms of their wet/dry mass. If it is living then we must look at comparing wet mass or we would have to kill the organism. Graph interpretation is understood on a basic level but where two variables are present students become confused. On the crossover questions it was pleasing to note that 67% of candidates were able to calculate a percentage. On experimental data related to sulphur dioxide candidates are still confused with regards to the control and also confuse validity, reliability and accuracy. Most pleasing on the foundation paper was candidates understanding of deforestation and biodiversity.

Higher

As with the foundation candidates, the experimental data related to sulphur dioxide was poorly understood. Only 26% correctly identified the control of the experiment although it was pleasing to note that 69% were able to identify how to take valid results. The carbon cycle was well understood with candidates able to identify well the processes of respiration and combustion. The use of respiration to provide energy for active transport for the uptake of minerals is still a problem with only 30% of candidates giving the correct response to this question. The use of fermenters seems to be well understood by higher tier candidates, although candidates are still confused regarding insulin production. The use of stem cells in the production of a cloned embryo is a complex process and this is reflected by only 37% of candidates able to correctly identify the stages of this. It was very pleasing to note that the ethics and social responsibility regarding stem cell research which is part of the How Science Works section of the course is being better understood with 69% of candidates being able to correctly identify the ethical problems related to cloning embryos.

Additional Science 5017
Chemistry 5037

Foundation

The first 10 questions were generally well answered and all areas of the specification were accessible.

Candidates understand and can explain the uses of metals, alloys and plastics in this unit. A surprisingly large number mistakenly think that the formula for the chloride ion is Cl instead of Cl^- and only 41% knew that polymers are large molecules. The problems of the disposal of plastics are well understood. The conversion of large hydrocarbon molecules into new molecules by cracking caused confusion. Only 44% of candidates realised that alkanes and alkenes could both be formed during cracking.

Questions 17, 18 and 19 showed that the knowledge and understanding of issues concerned with atomic number, electronic configurations and bonding is variable. Only 30% of candidates realised that the atomic number of an element is equal to the number of protons in the nucleus of its atom with 27% of candidates believing that electrons are in the nucleus. 58% of candidates were unable to correctly identify the electronic configurations of lithium and fluorine. A large number of candidates mistakenly believe that when alkali metal atoms react with halogen atoms electrons are shared instead of being transferred.

Question 24 involving the calculation of a relative formula mass was well answered.

Higher

The first 8 questions showed a good knowledge and understanding with the exception of the nature of the bonding between alkali metal atoms and halogen atoms. A surprisingly large number of candidates were unable to correctly work out the number of shared electrons in all the bonds in an ammonia molecule.

Many candidates did not know the chemical formula of ethane. Only 38% of candidates successfully described the boiling points and conductivities of simple molecular covalent compounds. 64% of candidates failed to recognise the trend of the intermolecular forces in the halogens with the atomic number decreasing.

Questions 31 and 32 involving the understanding of dot and cross diagrams and empirical formula calculations were well answered.

Information regarding isotopes and atoms caused a significant number of candidates problems. Only 38% of candidates correctly identified the hydrogen atom Z isotope in question 34.

Candidates were unable to recognise the presence of a full outer shell of electrons in given electronic configurations and relate it to the inert gases.

Candidates generally performed well with questions 37 to 40 involving the speeds of reactions.

Additional Science 5019
Physics 5047

Foundation tier
Several items were successfully answered by a significant percent of foundation candidates notably to do with stopping (91%) and thinking (86%) distances. When asked to calculate the braking distance from a given equation, however, all options proved equally attractive. Candidates were further asked about the ease of predicting values from given charts, by extrapolation to a value more than three times the maximum data given. While it was expected that they would choose to use the straight line variation, the most popular distractor (41%) would involve using a curve of rapidly increasing slope.

As many as 59% successfully applied their knowledge of penetrating powers of ionising radiation to parts of the human body.

At foundation level, more candidates wanted to prevent the risk of explosion during refuelling by connecting plane and tanker to the ground using an insulator rather than a conductor.

Referring to a nuclear power station, the most popular distractor (39%) was that the energy went from nuclear to chemical energy to kinetic to electrical.

Overlap questions
When a marble falls through oil, as few as 57% of foundation candidates thought that the forces on the marble "just after the marble is released" are unbalanced while 51% thought that the marble accelerates because resistance is bigger than gravity. A second item about the marble tested the idea of omitting anomalies before taking averages. Somewhat surprisingly, this was answered correctly by a higher percentage of foundation candidates than higher ones. Most candidates overall just took the average of all three results. Asked about the risk taken in a vertical fall ride, 59% of foundation and 68% of higher candidates correctly answered.

Higher tier
The unit for momentum was known by only 54%. As many as 34% opted for the unit of force.

For How Science Works items, only 26% correctly identified the recording of the original results as **not** being part of the validation process. All the options attracted roughly equal numbers of candidates. 30% of candidates thought that fusion is comparitively easy to control.

In performing the maths to calculate GPE 64% scored the mark. Only 44% however had the understanding that (with no friction, see assumptions) the car would have the same amount of KE at the bottom of the first hill. It appears that most candidates understood how current and voltage could be related to power but could not then transfer this into energy. This led to 44% choosing the rather high value of 60 000 A for the current flow.

The interpretation of the graph showing the uneven step arrangement which is characteristic of much scientific progress was better answered on this paper than previously, although quite a lot of candidates were still unsure about interpolation from this type of visual display of data.

Additional Science 5016F
Biology 5028F

The paper consisted of six questions with questions 5 and 6 in common with the 1H paper. Candidates found the questions accessible with most questions being attempted and questions 5 and 6 causing some problems 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 cells during respiration.

Candidates found the question accessible and most answered this question well. A few candidates confused respiration with photosynthesis.

Question 2

This question was designed to test applications of How Science Works by asking the candidates to interpret a graph. Most were able to do this, but some lost marks for a lack of precision. Most candidates were able to define growth in humans, and also give another measure for growth other than height. Several candidates gave dry mass which is a little impracticable for humans.

Question 3

This question was designed to test candidates understanding of the applications of How Science Works as well as the skill of interpreting a graph.

Most candidates gave valid responses to parts (a) and (b).

In part (c) many candidates scored no marks. This is because they did not provide a comparison, e.g. more people; more power stations; more energy required; people use cars more.

Question 4

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

Many candidates were able to say that the trunk is cut off near ground level, and the photograph may have helped them.

Very few candidates were able to explain that not all trees are coppiced at the same time, because not all trees are at the desired size; using a rotation gives an annual crop; and leaving mature trees helps to maintain biodiversity by providing habitats for other organisms.

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 crossover question was about regeneration and assessed an area new to the specification.

(a) This was a straightforward recall question with many candidates correctly using the technical term 'mitosis' Incorrect responses included the expected spellings that were closer to meiosis and a few that gave non specific responses, for example, reproduction

(b) Some candidates picked up a mark for correctly using the idea of stem cells. A few realised that the stump had to heal. Some misread the question and gave a detailed description of mitosis. A few less able candidates merely described what was shown in the illustration in general terms of 'the leg re-grows', 'the stump gets bigger', 'the leg grows shorter and the toes are made' failing to grasp the need for a more detailed answer.

(c) Many candidates wrote vaguely about regeneration in general and a few said that this research would help understanding newts better. One interesting answer stated that we wouldn't have to worry about newts if we cut their legs off. Others thought that the research would lead to humans being able to regenerate.

Question 6

This crossover question was designed to test understanding of the applications of How Science Works, experimental design and aspects of photosynthesis and plant growth.

(a) This was a straightforward recall question with many candidates correctly writing photosynthesis.

(b) Where candidates scored here they tended to gain one mark for suggesting that the tree would not use up all the carbon dioxide or that the carbon dioxide used up would be replaced through respiration/decomposition/air movement with few putting both of these points to gain full marks. Candidates lost marks here by giving vague answers that suggested that simply there is a lot of carbon dioxide in the air. Some stated that most or all of the air was carbon dioxide. Whilst only a few candidates thought that grass was not a plant, many more thought that carbon dioxide was not needed for photosynthesis. A fair number manifestly misread the question as asking why Stefan's idea is likely to be **correct**.

(c) This was a How Science Works question with some candidates showing a clear understanding of the requirement to sample soils and test these for nitrates to establish a range for the sample. Many candidates, however, misread the question and described how to conduct the final investigation. Others plucked figures from nowhere or wrote vaguely of "little nitrate, average nitrate and lots of nitrate" as useful concentrations. Surprisingly few suggested using a secondary source.

In part (c)(ii) more able candidates had no difficulty; 'Amount of light' was the most common correct answer although a range of responses was seen covering all marking points, others did not think things through and offered **nitrate concentration** A significant number just mentioned the colour of the grass rather than how green the grass was.

Additional Science 5016H
Biology 5028H

The paper consisted of six 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 cause some candidates difficulty, 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 question was about regeneration and assessed an area new to the specification.

(a) This was a straightforward recall question with 76% of candidates correctly using the technical term 'mitosis' Incorrect responses included the expected spellings that were closer to meiosis and a few that gave non specific responses, for example, reproduction

(b) Candidates scored an average of almost 1 mark here with some getting tangled in terminology. Some excellent answers were seen with a clear understanding of cells becoming unspecialised, dividing and then differentiating. Many picked up a mark for correctly using the idea of stem cells. Some misread the question and gave a detailed description of mitosis. A few less able candidates merely described what was shown in the illustration in general terms of 'the leg re-grows', 'the stump gets bigger', 'the leg grows shorter and the toes are made' failing to grasp the need for a more detailed answer.

(c) 58% of candidates scored here with those who did not writing vaguely about regeneration in general and a few said that this research would help understanding newts better. One interesting answer stated that we wouldn't have to worry about newts if we cut their legs off.

Question 2
This question was designed to test understanding of the applications of How Science Works and aspects of photosynthesis and plant growth.

(a) This was a straightforward recall question with 82% of candidates correctly writing photosynthesis.

(b) Where candidates scored here they tended to gain one mark for suggesting that the tree would not use up all the carbon dioxide or that the carbon dioxide used up would be replaced through respiration/decomposition/air movement with few putting both of these points to gain full marks. Candidates lost marks here by giving vague answers that suggested that simply there is a lot of carbon dioxide in the air. Some stated that most or all of the air was carbon dioxide. Whilst only a few candidates thought that grass was not a plant, many more thought that carbon dioxide wasn't needed for photosynthesis. A fair number manifestly misread the question as asking why Stefan's idea is likely to be **correct**.

(c) This was a How Science Works question with many candidates showing a clear understanding of the requirement to sample soils and test these for nitrates to establish a range for the sample. Many candidates, however, misread the question and described how to conduct the final investigation. Others plucked figures from nowhere or wrote vaguely of "little nitrate, average nitrate and lots of nitrate" as useful concentrations. Surprisingly few suggested using a secondary source.

In part (c)(ii) more able candidates had no difficulty; 'Amount of light' was the most common correct answer although a range of responses was seen covering all marking points, others didn't think things through and offered **nitrate concentration** A significant number just mentioned the colour of the grass rather than how green the grass was.

Question 3

This question was designed to test understanding of the applications of How Science Works as well as the skill of drawing a graph. It was based around how the conditions in a fermenter can be monitored and controlled.

(a) This was answered well with most candidates scoring all three marks. Most candidates plotted the points accurately. Lines of best fit were mainly good

(b) A small number only referred to the pH at the bottom of the fermenter; others failed to identify whether they were referring to the top or the bottom in their answer; several wrote answers implying that the independent variable was time "After 40 minutes, the pH at the bottom did not change"

(c) This was generally well answered, but emphasis on the even distribution of substances throughout the mixture was not always made. pH was considered by some to be a substance. In addition to this there were a lot of vague responses for example "to mix the contents" which scored no mark as this was thought to restate the stem of the question.

Question 4

This question was about sulphur dioxide and lichen biodiversity.

Part (a) required a very specific response which required candidates to indicate that the concentrations decreased because there is less burning of fuels that contained sulphur. Some discussed political edicts and others stated that we are "more eco-friendly" or "use alternative energy sources" which by itself does not explain the reduction in sulphur dioxide emissions.

Part (b) was answered better with some excellent answers being seen that described how lower sulphur dioxide led to less acid rain and thereby increasing numbers of lichen species and thus increased lichen biodiversity. It was a pity that a significant number simply stated that lichens grow, possibly indicating their basic understanding of the problem but not a clear idea of what biodiversity means. A few candidates suggested that lichens need sulphur dioxide to survive so lichen biodiversity would decrease.

Question 5

This question was about protein synthesis and included a diagram to help the candidates.

(a) This was well answered. The average mark being 1.81 out of a possible 2. Errors occurred in place value e.g. 95 or 9500 and several candidates took $19m^3$ to be 19^3. It was pleasing to see that most candidates are now showing their working out and as a result scored at least one mark.

General points regarding (b), (c), (d)

It was pleasing to see that this topic had been taught well in some centres as some candidates gave excellent answers to solve the problems posed. However, some candidates lost marks because of their lack of understanding of scientific concepts, for example, the position of Mars in the Solar System relative to the Earth and Sun with many believing it is closer to the sun, and what is meant by the term algae; a sizable minority believing it to be a bacteria which therefore did not photosynthesise or need carbon dioxide. A few candidates showed very little understanding of the problems of colonising Mars for example, discussing extra oxygen being needed for burning trees that had been cut down and brought back into the dome.

(b) It was pleasing to see candidates applying their knowledge with regard to the carbon cycle and the way limiting factors for photosynthesis would be affected by Mar' position in the solar system. It was unfortunate that some did not know the position of Mars relative to the Earth and Sun. Some candidates related their answer to human aspects rather than the effects on the algae missing the point that an average meant that some people being larger/more active was taken into account. A significant number of candidates missed the point that it would be the algae providing the oxygen and talked about low atmospheric O_2.

(c) A common misconception was that algae did not require any nutrients or light. Wheat often was said not to produce any oxygen.

(d) Candidates were losing marks because they did not understand how the panels work. Candidates lost marks by stating that panels increased sunlight, attract light, focus light or reflect light. The panels will make the conditions optimum was the response required and whilst a lot of candidates recognised that growth would be higher with more intensive or longer periods of light, they failed to link this to increased rates of more intensive or longer periods of light, they failed to link this to increased rates of photosynthesis.

Question 6

This question was about protein synthesis and included a diagram to help the candidates.

It was pleasing to see the number of candidates who scored well on this question and many of those that did not give fully scoring answers at least showed an understanding of the process.

The most able candidates had scored 5 marks before half-way through their account, and there was clear evidence of detailed teaching and clear understanding, with mentions of many highly technical ideas, some more appropriate to A level. There was a significant group of candidates who had heard the technical terms but had no idea of what they meant or how protein synthesis works. Whilst DNA replication was understandable, photosynthesis, genetic engineering, even mitosis were tangled up in some very convoluted writing. Very few candidates used the diagrams productively, annotating them and referring to them.

Additional Science 5018F
Chemistry 5038F

This was the second examination paper of the new specification. The paper consisted of six questions with questions 5 and 6 in common with the 1H paper. Questions 1 to 4 were targeted at the F/G level, the remaining two questions were targeted at the C/D level.

Question 1
In part (a), many candidates confused mixtures of metals as being compounds rather than alloys. Most scored correctly on part (b), but several thought that mild steel was 'soft' rather than 'malleable' in part (c).

Question 2
Many candidates could describe the type of reaction in part (a) as being exothermic or as combustion, but several thought the reaction was endothermic. Completing the table correctly presented few problems with only a few candidates not knowing the name of the alkane with two carbon atoms and a fewer number drew a molecule with 3 carbon atoms or missed off some hydrogen atoms.

Most candidates knew the type of bonding in part (c), and the majority could identify the double bond as being the cause of unsaturation in an alkene in part (d). Wrong answers included: 'single bond', 'covalent bond' and 'the bonding'.

In part (e), most could identify poly(propene) as a polymer.

Question 3
Only about half of the candidates could correctly describe the process in part (a) as electrolysis or electroplating. In part (b), only a few candidates could correctly describe an ion. The most common wrong answer was that it was a 'metal'. Other quite common answers included 'element', 'atom', 'molecule' and 'positive electron'. It was evident that several candidates had not read the introduction to the question by giving the formula of silver nitrate as 'SN', and only a few could use the formula of the ions provided to give the correct answer of $AgNO_3$. Many candidates could explain why the silver ions moved to the fork, but a significant number thought it was due to magnetism and several referred to the silver **electrode** rather than the silver **ions**.

Question 4
Most candidates could identify the reaction as being reversible in part (a), but it was disappointing to see only a few could calculate correctly the relative formula mass in part (b). Here, many gave the answer as (14 + 1) x 3 = 45, or 14 + 1 = 15.

Many knew why a catalyst was used in the Haber process, with the majority giving the answer as 'to speed up the reaction'. At this level it was extremely surprising (and pleasing) to see answers as 'to lower the activation energy' and 'to reduce costs by using a lower temperature'. Some erroneously thought it made the reaction 'stronger' or 'reversible' and some thought it was used because it 'could be used again and again'.

In part (d), many candidates knew the purpose of using fertilizers in part (i), but several thought it was to kill insects, pests etc, to stop bugs etc eating crops, or even 'to keep the soil moist'. In part (ii), many candidates related to the effect on pollution of rivers /

lakes / water supplies and knew the effects it caused. A few were well versed in eutrophication. However, several thought it caused global warming, poisoned the soil or caused damage to the O-zone layer!

Question 5

Many candidates scored well in part (a) with most stating that plastic does not rot and is non-biodegradable or that it will be there for a long time. Several misunderstood the question by referring to the **burning** of plastics and several thought that this part of the question was connected to part (b), and linked plastic waste with crude oil: some thought that the layer of unrotted plastic would prove a barrier to getting the depleting stocks of crude oil out of the ground – 'people would be unable to dig through to the crude oil' was a typical answer. Others thought that the plastic waste might contaminate or soak up remaining crude oil. In many cases, candidates used the buzz phrases – global warming, damage the environment etc – without thought.

In part (b), many candidates scored both marks here, mostly picking up on the shortage of fuel and plastic. Many also recognised prices rising but some gave as the reason that demand would be increasing, rather than the supply decreasing. The words 'chemists making/producing useful substances' cropped up in so many answers; unfortunately, they seemed to think that 'useful substances' is a scientific description worthy of credit needing no exemplification. Several candidates also seemed to have little knowledge of the present supply of fuels/energy and their sources. Because they knew that some crude-oil based fuel is used for central heating, they said that, if crude oil ran out, then there would be no central heating, despite many of them (probably the majority) almost certainly living in homes heated by (natural) gas. Equally, only about 2% of the electricity in this country is produced from oil and yet many thought that as soon as the oil ran out, all electricity would stop being produced. More concerning were: when the crude oil runs out, we will have to start using fossil fuels instead; there won't be any cooking/vegetable oil; products lost will include coal.

Question 6

It was clear that most candidates did not read the stem of the question and thought the diagram showed the electron arrangement of **chlorine** and consequently gave the answer in part (i) as 2,7. Only a minority gave the correct answer as 2,8,7. A few gave the answer as 7,2,1. However, many scored on part (ii) by identifying that the two elements had the same number / 7 electrons in their outer shell. Common incorrect answers were: same number of electrons/ same electronic structure.

In part (b), many candidates knew about the full / 8 electron outer shell of neon and a good number were able to describe the consequent lack of electron change being responsible for its unreactivity. One major barrier to good answers here, which often required careful reading, was the poor level of language on the part of many of the candidates.

Only a few candidates could correctly give the mass number of the element in question; many used various combinations of the numbers provided instead. This then caused a problem in identifying correctly the element from the periodic table.

Additional Science 5018H
Chemistry 5038H

This was the second examination paper of the new specification. The paper consisted of five questions with questions 1 and 2 in common with the 1F paper. Questions 1 to 3 were targeted at the C/D level, the remaining questions were targeted at the A*/A/B level.

Question 1
The candidates had a good understanding of the issues arising from the disposal of plastic and depletion of crude oil. Most knew that (most) plastic did not readily biodegrade. The most common second mark was awarded for the consequence that plastic took up valuable space in landfill sites. However, some candidates thought that the plastic in the ground would stop the drilling for new oil – 'people would be unable to dig through to the crude oil' - and others gave consequences of burning plastics, presumably through careless reading of the question. Others lost marks when very generalised reasons were given – the use of buzz phrases – global warming, damage the environment – without thought does not receive credit. Most candidates were able to give well reasoned responses – a large variety was permitted – about the problems of crude oil supplies becoming exhausted. The commonest answers were to do with the lack of fuels for vehicles and the lack of availability of plastics, although some candidates expected there to be no energy supplies at all after crude oil has run out. It was interesting to note socio-political responses with varying degrees of insurrection predicted after price rises. Answers lacking clarity of explanation lost marks – the term 'useful substances' (from the question's stem) required exemplification in answers.

Question 2
It was clear that most candidates did not read the stem of part (a) and thought the diagram showed the electron arrangement of chlorine and consequently gave the answer in part (i) as 2,7. Only a minority gave the correct answer as 2,8,7. A few gave the answer as 7,2,1. However, the vast majority scored on part (ii) by identifying that the two elements had the same number, or seven, electrons in their outer shell. Common incorrect answers were that the atoms had the same number of electrons (presumably misquoting 'outer electrons') or atoms, or the same electronic structure. The reason for the unreactivity of neon was well known and most candidates were able to score both marks. There was evidence that some candidates knew the reasons for the unreactivity of the noble gases but were unable to explain it in a clear and unambiguous manner, using incorrect terms such as "free electrons", "spare electrons" or "this atom is happy". Again, the careless use of 'atom' instead of 'electron' cost marks, and it is clear that some candidates do not read through their answers after they have completed the paper. 75% of the candidates answered part (c) correctly.

Question 3
It is surprising that the mean mark in part (a) was just less than 1, particularly when only 3 state symbols had to be correct. It is clear from scripts that some candidates did not understand that $CaCO_3$ has one carbon (not three). In the state symbols HCl was often given (l), but less forgivably water was given (aq) and even (g) for calcium carbonate. Some careless writing here cost marks, and state symbols should not be capitals (although on this occasion it was not penalised.) Many candidates were able to score at least two of the three marks available for this question. The collision theory seemed to be well understood by most candidates. The increased speed of movement of particles and the subsequent increase in collision rate were where most candidates gained marks. Candidates who did not gain three marks lost a mark by either not linking an increase in energy with an increase in speed of particles or by not clearly indicating an increase in collision rate. Some less able candidates thought that the addition of heat acted as a catalyst or that it lowered the activation energy or

that heat produced more particles or made the particles expand in size. The majority of candidates were able to give a way of following the reaction, typically for reference to the need for time measurement/measuring instruments. Typical errors were: to vaguely put down the use of a 'computer' without having qualified this (use of datalogger was credited). Others simply stated 'measure the temperature/ use a thermometer'. Blindly putting down how the thiosulphate/ acid experiment was monitored ('…when the X disappears…') was careless.

Question 4

The dot and cross diagram for water produced a range of answers. Many candidates were able to show that they knew a covalent bond was a single shared pair of electrons. The more able candidates produced clear unambiguous diagrams to show the bonding in water (although not all were strictly dot and cross – it helps examiners if dots are used for one element and crosses for the other). Less able candidates drew stick diagrams or a random arrangement of dots/crosses often with no atoms indicated. There were a surprising number of attempts to draw O-H-O or even O-O-H molecules; candidates are reminded that they need to check their work carefully. Common mistakes in otherwise correct answers were H having 2 electrons and O having 3 shells. Some diagrams that used circles showed the correct numbers of electrons but were drawn so that they did not clearly show pairing. In part (b) many candidates only referred to the structure of diamond. A common error referred to the number of bonds to be broken (either 4 in diamond and 2 in water or many in diamond). Some referred to double bonds and cross links. Terminology was often weak with many references to inter-molecular bonds in diamond. It is clear that this aspect of the specification is not well understood. Like equations, calculations are an important part of GCSE Chemistry. Part (c) was answered very badly. Less able candidates should be advised to calculate relative formula/ molecular masses first – this is usually worth one mark, and it was disappointing to see that so many candidates could not calculate this for water, with the most common mistake being $2H_2O$ = 1+1+1+1+16 = 20. There was a noticeable lack of logical or structured working out in many cases. This often made it difficult to award one or two marks.

Question 5

Only a significant minority of candidates showed a competent understanding of reversible reactions and dynamic equilibria. There were some interesting suggestions as to what could be present (e.g. helium, bromine and carbon monoxide). Too many candidates attempted to introduce oxygen, water and/or carbon dioxide, showing an inability to read the question as well as a paucity of chemical experience. There were some creative names for compounds of hydrogen and nitrogen produced by candidates who were not aware, not having truly read the question or revised, that NH_3 is ammonia with nitrates, nitrogen hydroxide and ammonium hydrate (but not nitrogen hydride or hydrogen nitride). Some thought that reversible reaction went to completion, then all the way back again ("nitrogen and hydrogen because the reaction is reversible so the ammonia turns back into nitrogen and hydrogen"). There were answers which indicated that all three (hydrogen, nitrogen and ammonia) were present but that the nitrogen and hydrogen were in trace amounts because not all had reacted. It was evident in part (b) that changes to equilibria were poorly known. Few candidates actually understood the effects of changing a condition in the Haber Process/ reversible changes. A similar problem regarding the Haber Process was encountered for the question on the H-Tier Paper in November 2007. Typically one mark was scored mainly for 'increased/more ammonia' and occasionally for 'equilibrium shifted to the RHS' but few gained any credit for the explanation - simply referring to ideas about greater number of collisions, pressure increasing the rate, or quoted standard conditions for the Haber Process. A common misconception was that 400 ^{0}C and 200 atm are the perfect conditions and any change would make the reaction work less well giving a decrease in product. It needs to be noted that there were several excellent answers, with correct explanations based on the numbers of molecules or moles. In part (c) the more able candidates understood the

balance of rate and percentage yield in producing a profitable industrial process based on Le Chatelier's principle. Many also correctly used the information given in the question. However less able candidates thought that enzymes were denatured or killed at higher temperatures or lower temperatures would give too much yield. Some thought that 50% yield was what was wanted.

Showing working out by long hand methods and in some cases a direct statement indicated that there were still a significant number of candidates without calculators. The responses tended to be fairly full so there was no real evidence to suggest that in general candidates were short of time on this paper.

Question 1
(a) The marking scheme allowed the majority to gain at least one mark for 'slippery' or 'lack of grip'. Some did give 'friction', but 'only a limited number of these identified the surfaces involved (the most common way to gain the second mark). Comments about the braking distance sometimes failed to identify that it would have increased.
(b) Well answered, safety belt and air bag were the most common responses.

Question 2
(b)(i) Most candidates scored the charge or static mark, but few knew where it came from, the common suggestion was from the rubbing between the driver and the seat, or friction when the hand made contact with the handle.

Many candidates thought that both the person and the car were charged, either with the same or opposite charge and either repulsion or attraction or "reaction" produced the shock.

Both positive and negative electrons were described, but nevertheless credit was given for the movement of charge. Energy rather than charge was described by a noticeable number of candidates.

There was a small number of very clear answers that involved charge/electron transfer through Phillip because he was earthed.

(b)(i) The most frequent answer involved 'less friction when it is wet'. Other common suggestions not gaining credit were

- as water is an insulator electricity could not flow from the car to Phillip, or vice versa because it could not get through the water.
- the water being a conductor, so the car or Philip were earthed
- heat/the Sun produces charge

A minority gained the mark for realising that charges 'leak' in damp conditions.

Question 3
(a)(i) The suggestion of the atom exploding was very common, but splitting or similar was required by the mark scheme. Some described the release of daughter **cells.** .
Some took the picture very literally, saying the neutron becomes a uranium nucleus or a star!
It was clear that a small number of candidates could answer this very well without needing to refer to the diagram.

In part (b) many lost a mark by giving an extra tick as well as the two correct ones.

Question 4
(a)(i) Despite help in the stem asking for an answer in terms of energy only a minority gave a full correct response. Many wrongly concentrated on either forces and/ or speed

(a)(ii) The energy loss was realized by very few candidates although some gained credit for recognizing that energy would be needed to ascend the next peak. Many thought that smaller peaks helped to slow the roller coaster down towards the end of the ride and gained no credit. Others focused on the peaks looking smaller from a distance.

(b) The link between electrical energy and work done was missed by a majority of candidates, although some did gained the mark for making this link and many of these went on to give the correct numerical answer.

Question 5
(a) Most candidates were able to recall enough on properties of radiation to gain at least one mark

(b) Some candidates muddled the properties of alpha beta and gamma radiation whilst others appreciated the penetrating power of gamma. 'Strongest' source lost the mark. Answers involving gamma rays seeing the items in the lorry did not gain credit.

(c) Candidates more frequently gained just one mark here showing a confusion about what the numbers in the notation mean.

(d) The interpretation of the data was done quite well except for a few who got it all the wrong way round. Most recognised that the Cobalt-60 was more penetrating or gave a faster process. A limited number failed to gain the mark because the answer given was too vague e.g. Cobalt has a better performance in every way.
The most common mistakes for the X -rays were

- that the longer scanning time meant that it was more thorough
- if they are used in hospitals they must be safe
- less penetration would mean that humans would be safer.

It was good to see that most candidates made a reasonable attempt at some of the application side of question 5

Additional Science 5020H
Physics 5048H

General comment
It was evident that many candidates were unfamiliar with those parts of the specification which were in bold. Many candidates failed to gain relatively easy marks which related directly to such statements in the specification.

The lack of a calculator was still a problem for many candidates. In general the standard of calculation was poorer than expected, in part due to misreading of the questions but mainly due to arithmetical mistakes.

The levels of scientific literacy and mathematical literacy seen were a little better than in November. 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. The quality of English deteriorated as answers became longer in their attempt to make things clearer. The advice to think first seemed to have been missed by many candidates.

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

Question 1 - Using radiation to scan for contraband.
In part (a) most candidates correctly placed one tick in each row, but a few confused rows with columns. Few candidates gained both marks.

Part (b) was well answered; the correct answer was seen in around 70% of answers. It was nice to see that the term 'most penetrating' was commonly used; a pleasing use of scientific language. A few candidates wrote that 'gamma could SEE through the walls of the lorry' which failed to gain the mark. Very few candidates talked about ionisation without a reference to safety, or the other way round.

Part (c) was poorly answered even by more able candidates. This is one example of where candidates needed more practice in order to eliminate both physics and arithmetical errors.

The ‘performance’ section of part (d) was very well answered; a few candidates failed to gain credit for vague answers such as ‘the cobalt scanner is better in every way’. In the safety section a significant minority of candidates chose X-Rays because they were less penetrating despite the information about penetration in the table.

Question 2 - The accelerating trolley
Throughout this question, many candidates failed to read the question with sufficient care. For each calculation the mass to be used was mentioned in the stem of the question but incorrect mass in the answer was a very common error.

In part (a)(i) the correct numerical answer (7.366) was seen in about half the scripts, with the remainder largely derived from the use of the wrong mass (5, 5.93, and rarely 4.07). About 5% of candidates demonstrated a lack of understanding of the meaning of the units of acceleration, where candidates would write 0.93 kg x 7.92 m/s^2 → 0.93 x 7.92 x 7.92 (=58.336).

All directions were commonly used, including compass points and arrows in part (a)(ii). Many candidates lost the mark due to an inability to express themselves with expressions such as 'against the trolley'.

In part (a)(iii) most candidates gained at least one mark for mentioning the pulley. However many candidates failed to specify 'wheels AND table' or 'trolley AND bench' and thus did not gain the second mark. Air friction/drag was rarely mentioned, as were axles.

In part (b)(i) many candidates chose the correct equation; however the correct answer was not as evident as one might have expected it to be. Frequently candidates used the wrong value for the mass and substituted 0.93kg or 5.93kg. Most gained a mark for a correct calculation with incorrect mass but it was obvious that often this was a mechanical exercise in using a calculator.

Part (b)(ii) was disappointing. In this section candidates mostly recalculated, (wrongly) the value of KE. Credit was given for carrying forward an incorrect answer from 2(b)(i).
However, it would appear that 'PE lost = KE gained' is not as well understood as it should be. For many candidates it was not apparent that the answer could just be written down without calculation. A variety of methods were seen including putting numbers into the KE formula with little indication of where the numbers came from.

The calculation for velocity in part (b)(iii) was poorly done. The correct answer was rarely seen. A correct answer from an error carried forward was more common, however in many cases this final section was either blank or attempts to use the other equations at the start of the paper were seen. It seems that this formula and the required calculation were not well understood. The most frequent errors included;

- manipulating the equation incorrectly before substituting
- using equations of motion involving time
- using the acceleration figure from 2(a) as a velocity
- omitting to take the square root at the end of a good response.

Very few candidates got 5/5 for question 2(b).

Question 3 - Nuclear Fusion
It was surprising that few candidates were able to give a clear description of nuclear fusion in part (a). For most this was a source of energy which they knew by name only. The idea of **nuclei** fusing was not seen as much as expected, despite the specification being very clear. Many candidates answered in terms of atoms or particles. Some confused fusion with fission. A few candidates gained the mark by describing the fusion of Hydrogen into Helium.

In part (b) it was not uncommon to read that "warm dry conditions" were required. Many candidates seemed to confuse the process with chemical bonding. The high pressure (particle density) requirement was seldom seen.

Question 4 - Cosmic radiation
In part (a)(i) there were many clear and concise answers. However it appeared that some candidates did not know the term. Many gave answers which were little more than rearranging the two salient words. A few gave answers relating to the atmosphere or thought that this radiation came from the Earth. A small minority were totally confused and thought it was cosmetic radiation due to too much make up.

Part (a)(ii) was a fairly well answered question. Dangers were usually extreme and cancer seemed to be the answer of choice. Some very good answers were seen relating cosmic radiation to its ionizing ability or to **genetic** mutation.

In general part (b) was quite poorly answered. In part (b)(i) many candidates spotted the relationship and described it in straightforward terms. Some candidates found it difficult to express what they wanted and included the idea of "the dose" for clarification; in doing so they answered part (b)(ii) as well. A few showed confusion between altitude and latitude. However candidates did not always read the question, hence answers comparing doses were seen. In addition a number of candidates wrote that the longer you fly the higher the altitude.

Although it was usual to be able to give a mark in (b)(i), for part (b)(ii) it seemed that many candidates did not interpret the graph as a plot of equal dose, but rather a graph showing how flight times in general varied with altitude. Hence the standard of responses was quite low. The idea of a shorter time for the same dose was infrequently seen. However there were some excellent answers in this section by more able candidates who clearly saw what was being asked.

In part (b)(iii) few candidates could clearly explain that cosmic radiation is absorbed by the atmosphere. The most popular answer was proximity to the source of the radiation. Vague terms were often seen; 'nearer to the sun'. Many seemed to think that the atmosphere **started** only at some considerable distance above the Earth and the "edge of the atmosphere" seemed to be a starting point rather than the end. There was often confusion about the role of the ozone ('O-Zone') layer.

The graph in part (c)(i) was done well by most candidates; the only common plotting error was (10.6, 400), the other common error was an inability to draw the line of best fit correctly. This is a skill that needs further work in centres as significant minority chose to join the points with ruled lines.

Part (c)(ii) was very poorly answered; many candidates responded in terms of the atmosphere or the temperature in equatorial latitudes. It was very rare to see a fully correct answer to this part of the question. Common incorrect responses included;

- physical geography; tilt/rotation of the Earth, shape of the globe
- candidates experience of flight with exposure (UK flights passing over the equator are long haul; UK flights to northern Europe are not.)
- greater exposure/dose at the equator.
- an equatorial hole in the ozone layer
- equatorial conditions; more sunny at the equator, or hotter at the equator
- the equator being closer to the sun

The idea of the Earth's magnetic field was rarely seen with the existence of the magnetosphere being almost universally unknown.

Few candidates perceived any increase in the level of demand for part (d) despite it being the last question on the paper. Part (d)(i) needed a more specific answer than the similar earlier question; but most answered in trivial terms; hence it was the case that this question did not score as well. There was a lot of mutation of **cells** but mutation of **genetic material** was rarely seen.

In part (d)(ii) it was apparent that candidates had not really grasped the penetrating power of cosmic rays. There is a clear misunderstanding of what can be done to minimise radiation effects. Most candidates seemed to be unable to think through the problem and could only make suggestions about shielding.

The answers seen were typical of the worst of answers seen in exam papers; the airhostess was advised to wear lead lined underwear, or take special medicine, or rub gel into her stomach, or use a badge dosimeter as protection. Lead planes were also common as was advice not to fly over the equator.

The most common correct answer was to change to lower altitude flights. Shorter flights' without reference to altitude or direction (i.e. over equator) did not gain credit.

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Raw Mark Grade Boundaries for GCSE Additional Science Unit Tests

5015/5027	Max mark	A*	A	B	C	D	E	F	G
H	24	18	16	14	12	9	7		
F	24				18	15	13	11	9

5016/5028	Max mark	A*	A	B	C	D	E	F	G
H	30	18	15	12	10	8	7		
F	30				14	11	8	6	4

5017/5037	Max mark	A*	A	B	C	D	E	F	G
H	24	17	15	13	11	7	5		
F	24				15	12	9	7	5

5018/5038	Max mark	A*	A	B	C	D	E	F	G
H	30	20	16	12	9	6	4		
F	30				18	14	10	7	4

5019/5047	Max mark	A*	A	B	C	D	E	F	G
H	24	16	14	12	10	7	5		
F	24				13	11	9	7	5

5020/5048	Max mark	A*	A	B	C	D	E	F	G
H	30	20	17	14	12	9	7		
F	30				17	14	11	8	5

Uniform Mark Grade Boundaries - All Units

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

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

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