Examiners' Report

IGCSE Science (Double Award) (4437)

June 2006

delivered locally, recognised globally

Examiners' Report

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

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

For further information please call our International Customer Services Unit:

Tel +44 (0) 190 884 7750

Fax +44 (0) 207 190 5700

www.edexcel-international.org

June 2006

Paper 1F

Question 1
This consisted of eight objective answer items, where candidates had to choose the most appropriate answer from the four options given. Many candidates earned high marks on these items, with items (c) and (g) proving the most difficult.

Question 2
This required candidates to identify the trachea, bronchus and diaphragm from a section through the thorax. This was completed successfully by almost all candidates. The second part of this question involved completing sentences on the link between smoking and heart disease. Some candidates were unable to name the coronary artery and to state clearly that blockage of this artery would deprive the heart of oxygen and glucose: weaker responses included 'blood' and 'food'.

Question 3
This question described the feeding relationships between rice, insects and spiders. Candidates had to insert the organisms into a food chain in the correct order with arrows showing the direction of energy flow. All but the weakest candidates were able to gain full marks: a few lost credit for arrows in the wrong direction. The rest of the question was also answered well: candidates explained both why the farmer would want to reduce the number of insects, and the meaning of biological control.

Question 4
This question illustrated the process of micropropagation to produce carrot plants using tissue culture. Candidates were asked to suggest what might happen if the parent was not free from disease. Most were able to suggest that the offspring plants would not grow or that they would inherit the disease. They were also able to explain why the agar jelly used should be sterile. The final part of the question asked what happens between the embryo stage and the new adult plant. Few candidates were able to describe the growth of roots and shoots as the carrot plant developed.

Question 5
This contained a bar chart to show how the protein required by a female changed with age. Many candidates were able to use the graph to extract the required information to answer the questions in (a) and (b). However, some candidates failed to earn full credit for their explanation as to why 9 to 10-year olds require more protein. Correct responses required a statement stating faster or greater growth at this age. The question also asked why a mother who breastfeeds her baby needs more protein. Answers including statements such as "milk contains protein" and "the child is growing" were credited and produced by the best candidates. In the final part of the question candidates had to link food substances with their roles in the body: this was well done by most candidates.

Question 6
This question discriminated very well. Many candidates were able to add correct arrows. No marks were awarded if arrow heads were missing, or if they were wrongly attached. Whilst most realised that the letter **K** represented photosynthesis, only the best candidates correctly realised that there were three letters, **J**, **N** and **L** that represented respiration. A pleasing number of candidates noted carbon dioxide as the answer to (b)(i), recalled an acceptable named carbohydrate and named a type of decomposer, with bacteria and fungi being the most popular responses.

Question 7

The calculation proved difficult for most candidates. The correct answer of 100% was seen, but most thought the answer was 50%. A mark was available for some sign of correct working even if the answer was wrong. As such, candidates are encouraged to show their working, as asked for in the question. The role of white blood cells was understood by most, though only the better candidates discussed phagocytes **and** lymphocytes. Candidates are encourages to use correct terminology in their answers. For example, engulf is a better word to use when describing phagocytosis than the words eat or swallow. Most recalled plasma as the pale yellow liquid that blood cells float in. The biology of red blood cells was appreciated by most, though correct terminology was, once again, sadly lacking in answers. Examiners prefer to see the term biconcave rather than 'doughnut-shaped', or 'disc-shaped with a dip in the middle'.

Question 8

A surprising number of candidates struggled to write a decent 'mini-essay'. Their knowledge reflected that of a layman, as did the language used. Accounts confused deforestation with other ecological problems or discussed the benefits of the process. The best candidates appreciated the importance of trees in helping to reduce the likelihood of global warming and stressed the links with soil erosion, flooding, food chain disruption and species extinction. Practice at planning and writing 'mini-essays' of this nature would benefit all candidates.

Question 9

The 1^{st} or 2^{nd} week were accepted as answers to (a)(i) and most candidates made these choices. Oestrogen, the hormone that repairs the uterus lining, was known by many, although only the better candidates recalled that it is released by the ovary. Many incorrectly named the pituitary as the endocrine gland involved. Progesterone was expected as the answer to (b), a response appreciated only by the better candidates. Ovulation, or a correct description of ovulation, was rewarded in(c).

Question 10

Better candidates understood that protease enzyme would digest protein and therefore cause damage to lung tissue. Weaker candidates tended to repeat words in the question, merely stating that lung cells would be damaged. The fact that gas exchange would be reduced was understood by most, but only the better candidates appreciated that this was because of a reduced number of alveoli with a consequent reduction of surface area. In (b), most recalled that fertilisation requires fusion with a sperm cell, but many failed to recall that mitosis is the type of cell division that would bring about the production of sheep cells. Perhaps the fact that the egg cell is a sex cell confused candidates into thinking that meiosis was involved. As ever, candidates were penalised for incorrectly spelling mitosis. So, for example, "meitosis" was not rewarded. Many candidates were able to recall the correct words needed to complete the passage describing the steps needed to produce large numbers of transgenic cloned sheep.

Paper 2F

Question 1
This question was designed to test candidates' knowledge of the Periodic Table. Most scored well on this question with no parts proving to be more demanding than others.

Question 2
This question was designed to test candidates' knowledge of atomic structure. Most candidates scored all three marks available for labelling the diagram of the atom. A few candidates miscalculated the mass number of the atom, either by counting all of the particles or by counting only one type of particle. One or two candidates were confused by (a)(iii), since no atom with this atomic mass is shown on the Periodic Table provided. However, candidates are expected to know that it is the atomic number that determines which element an atom is. In (b), some answers got the protons and neutrons the wrong way round. One error made was to say that isotopes of the same element had different **relative** atomic masses: this must be wrong since the relative atomic mass is the average atomic mass of the atoms of an element allowing for the abundance of each isotope.

Question 3
This question focused on the reaction between magnesium and sulphuric acid. In giving observations it must be remembered that if a colourless gas is produced, then the gas can not be seen (and so saying a gas is made is not a correct observation and does not score). What is seen are bubbles or effervescence, allowing us to conclude that a gas is being produced. Likewise, we can not see the metal dissolve – what we do see is the piece of metal getting smaller. In any case, 'dissolve' is not a correct term here since if the metal were dissolving we would have a solution of magnesium produced: dissolving is a physical process and this is a chemical reaction. With gas tests, the general rule is that if the test is wrong then no marks can be awarded for the result. Hence, if the test is given as 'apply a glowing spill' no mark will be awarded for the result of the test. since an incorrect test has been used. Part (c) was testing candidates' knowledge of factors that change the rate of a reaction. Many candidates selected incorrect choices and full marks were not as common as expected.

Question 4
In (a), candidates were required to complete a table showing whether a substance was an element or a compound and to state the type of bonding in the substance. The first column of the table, as expected, proved to be straightforward, since if a substance is an element it will be found on the Periodic Table. Errors were more evident in the 'bonding' column, the main one being to describe hydrogen chloride as ionic. A considerable number of candidates mistakenly thought iodine was a liquid at room temperature.

Question 5
This question dealt with organic chemistry. Part (a) was generally well answered, but candidates should be reminded to look carefully at the wording of the question; if the question asks for **one** substance then giving two is not a good idea, since if the extra substance given is incorrect no mark can be awarded regardless of any other correct answer given. Part (b) was often correct, but some candidates then did not read (c), and gave the general formula for an alkene rather than for compound C; others gave the molecular formula of compound C. The test for unsaturation proved to be a good discriminator: it should be noted that bromine when in aqueous solution is **NOT** red.

Question 6

This question was based on a reaction scheme for copper compounds. In (a), most candidates scored well, although (aq) was sometimes given as aquatic (which has a rather different meaning) and some thought that (s) stood for solution. Part (b) was very poorly answered: most candidates scored zero or one mark (that being for (ii) – although some candidates thought that W must be the symbol of the gas and so claimed it was tungsten). Part (d) proved more rewarding for many with the reaction products often correct. Most candidates correctly identified sulphuric acid in (e).

Question 7

This question was based on the elements in Groups 1 and 2. Few candidates had difficulty with (a), although in (b)(i) some candidates ignored the instruction and tried to give a symbol equation. In a few instances the gaseous product, hydrogen, was missing. In (b)(ii), the required observations were things that could be seen: a colourless gas cannot be seen, the observation is bubbles or effervescence. Other neutral answers (ones that did not gain credit but were not deemed to be wrong and so did not cancel out a correct observation) included ‘dissolving’ (since this can not be seen, and sodium solution is not the product) and ‘flame’ (since a small piece of sodium on water will not ignite unless it is restrained in some way). Part (c)(i) caused some students problems. Some described the use litmus is put to, but did not use the all important word ‘indicator’, those who added ‘pH’ or ‘universal’ to indicator did not gain the mark since litmus does not indicate pH. In (c)(ii), some students hedged their bets and gave the colour in both acid and alkali. Two answers, one of which is wrong, will never gain credit in this type of question. Parts (d) and (e) were well answered, with a minority of candidates having hydroxide as the product in (d)(i).

Question 8

This question about the industrial separation of crude oil was low-scoring for the majority of candidates. Most scored the first two marks. but the remainder of (b) often yielded only one further mark. Many gave a mathematical or dictionary definition of a fraction rather than linking it to the stem of the question which was about fractions of crude oil. Very few correctly stated that a fraction was a collection of compounds with similar boiling points. There was confusion between the industrial and laboratory process in (b)(iii). This question wanted the industrial process in which the oil is heated (not burnt as some candidates claimed) prior to the vapour being passed into a fractionating tower. Some candidates made life a little easier for themselves by drawing a diagram which made it clear that the fractions were obtained at different levels. Part (c) provided a happier ending to the question for most candidates. Carbon monoxide as the product was well known and some detailed explanations were seen in (c)(ii). However, it should be noted that carbon monoxide does not destroy haemoglobin or cells. It can, however, lead to death and this simple statement was missing from many answers

Question 9

This question was about aluminium. Very few good answers were seen in (a), and almost nobody was able to state that cryolite acted as a solvent. The mark for reducing the melting point **of the mixture** or lowering the temperature required to conduct the process were given more frequently. Some students referred to boiling points and others seemed to think that cryolite was a coolant since it cooled the process down – neither of these approaches gained credit. While many students scored well on (b), many scored poorly; incorrect electrode materials were often seen (aluminium being common). It should be noted that the gas produced by electrolysis is not carbon dioxide – this is made by oxygen reacting with the carbon of the anode.

Some misconceptions were evident in (b)(iii). The electrodes need to be replaced due to a chemical reaction in which they are used up to make carbon dioxide: they are not worn away (this is a frictional process), nor are they eroded or eaten. Imprecise answers cost some candidates marks in (c) – the important point is that aluminium is more reactive than carbon. Just saying that aluminium is very reactive is insufficient. Some answers to (d) incorrectly focused on various costs (such as the need to obtain cryolite). Those who chose to use replacement of the electrodes as a reason needed to specify that it is the anodes that are replaced (since the cathodes are not replaced frequently). All that was required in (e) was to relate the uses of aluminium to its properties, which proved unexpectedly difficult. Two important points to note are firstly, that since only iron can rust, any answer stating that aluminium did not rust (rather than did not corrode) was incorrect; and secondly, that aluminium is not a light metal (its mass depends on how much of it you have) – it has a low density. A variety of odd answers were also seen: a number of candidates suggested it was used for power cables because it did **not** conduct electricity.

Paper 3F

Question 1
Part (a) was well answered but the mark scheme did allow ‘metal’ or the name of any suitable metal or alloy. Only a small minority knew that brass is used. In (b)(i), only a minority of candidates knew that the other end of the earth wire from the plug is connected to the metal frame/case of the appliance, but most knew that appliances are earthed to prevent the user receiving an electric shock (if there is a fault). Part (c) was generally well answered and a majority were able to suggest, in (e), another electrical hazard. Pushing a plug into a socket when your hands are wet was a common response.

Question 2
A generally good response to (a) and (c). In (b), those who recognised that the silvered glass reflects radiation were often able to gain both marks for their explanations.

Question 3
It seemed that many candidates should have given themselves time to think before answering this question. For example, many did not seem to realise that the wall heater must be on the wall near to the temperature of 50 °C in Room A.

Question 4
This question was well answered with only the occasional candidate giving half dimensions in (i), or arriving at an answer of 0.2 Hz or 80 Hz in (b)(ii).

Question 5
In (a), few realised that the diagram shows that energy is conserved. However, other parts were much better answered with nearly all candidates gaining the mark in (b).

Question 6
This question was generally well answered, but in (d) some gave a unit of energy rather than a unit of power.

Question 7
Those candidates who correctly identified the normal in (a)(i) were usually able to obtain both marks in (ii). Many could then explain that the angle of incidence is equal to the angle of reflection. In (d), correct responses were generally similar to the rays already given to and from the mirror for the dog’s nose. Candidates who got into a muddle often tried to draw rays involving the dog’s ear, the mirror and the dog’s eye.

Question 8
Part (a), on the uses of electromagnetic radiation, proved slightly easier than (b), about the harm caused, but both were generally well answered.

Question 9
Surprisingly few candidates realised that arrow C points downwards from the centre of gravity, even though almost all identified force C as ‘weight’. In (iii), air resistance (or drag) was the answer expected but many restricted themselves to just ‘friction’. In (b), some who knew the feature was the gradient spoiled their answers by describing it as an ‘increasing gradient’. In (b)(ii), some secured one mark for ‘area under the graph’ but were not able to calculate this.

Question 10

Generally well answered. In (b), increasing frequency of the echo as the ship neared the cliff was a more popular answer than the increasing volume of the echo.

Question 11

Most identified the dimensions of the base of the block but only a small minority converted from centimetres to metres.

Question 12

A well-answered question, but some did not seem to understand that if a megabecquerel really does equal 1000 becquerels it would be a kilobecquerel. A minority produced uncertain decay curves. Their efforts would be improved if they used the technique of rotating the page to put the wrist on the inside of the curve.

Paper 4H

Question 1
This question discriminated very well. Many candidates were able to add correct arrows. No marks were awarded if arrow heads were missing, or if they were wrongly attached. Whilst most realised that the letter **K** represented photosynthesis, only the best candidates correctly realised that there were three letters, **J**, **N** and **L** that represented respiration. A pleasing number of candidates noted carbon dioxide as the answer to (b)(i), recalled an acceptable named carbohydrate and named a type of decomposer, with bacteria and fungi being the most popular responses.

Question 2
The calculation proved difficult for most candidates. The correct answer of 100% was seen, but most thought the answer was 50%. A mark was available for some sign of correct working even if the answer was wrong. As such, candidates are encouraged to show their working, as asked for in the question. The role of white blood cells was understood by most, though only the better candidates discussed phagocytes **and** lymphocytes. Candidates are encourages to use correct terminology in their answers. For example, engulf is a better word to use when describing phagocytosis than the words eat or swallow. Most recalled plasma as the pale yellow liquid that blood cells float in. The biology of red blood cells was appreciated by most, though correct terminology was, once again, sadly lacking in answers. Examiners prefer to see the term biconcave rather than ‘doughnut-shaped’, or ‘disc-shaped with a dip in the middle’.

Question 3
A surprising number of candidates struggled to write a decent ‘mini-essay’. Their knowledge reflected that of a layman, as did the language used. Accounts confused deforestation with other ecological problems or discussed the benefits of the process. The best candidates appreciated the importance of trees in helping to reduce the likelihood of global warming and stressed the links with soil erosion, flooding, food chain disruption and species extinction. Practice at planning and writing ‘mini-essays’ of this nature would benefit all candidates.

Question 4
The 1st or 2nd week were accepted as answers to (a)(i) and most candidates made these choices. Oestrogen, the hormone that repairs the uterus lining, was known by many, although only the better candidates recalled that it is released by the ovary. Many incorrectly named the pituitary as the endocrine gland involved. Progesterone was expected as the answer to (b), a response appreciated only by the better candidates. Ovulation, or a correct description of ovulation, was rewarded in(c).

Question 5
Better candidates understood that protease enzyme would digest protein and therefore cause damage to lung tissue. Weaker candidates tended to repeat words in the question, merely stating that lung cells would be damaged. The fact that gas exchange would be reduced was understood by most, but only the better candidates appreciated that this was because of a reduced number of alveoli with a consequent reduction of surface area. In (b), most recalled that fertilisation requires fusion with a sperm cell, but many failed to recall that mitosis is the type of cell division that would bring about the production of sheep cells. Perhaps the fact that the egg cell is a sex cell confused candidates into thinking that meiosis was involved. As ever, candidates were penalised for incorrectly spelling mitosis. So, for example, “meitosis” was not rewarded. Many candidates were able to recall the correct words needed to complete the passage describing the steps needed to produce large numbers of transgenic cloned sheep.

Question 6

This question was answered well by most candidates, who demonstrated a good understanding of the concept of energy flow.

Question 7

Candidates are encouraged to look at the number of marks allocated to questions and to ensure their answers reflect this. In (a)(i), four marks were available for distinct points: the genotype of the parents, the gametes produced, the consequent offspring and, finally, the phenotype of the offspring. The gamete mark was often overlooked, as was the phenotype of the offspring. A pleasing number of candidates understood that there was a 50% probability of the couple producing a child who will not develop Huntington’s disease. Again, a pleasing number of candidates appreciated the peculiar nature of this disease and noted that people will already have had their children before knowing they have the disease. It is appreciated that this scenario is less of an issue these days but the students had to work with the information provided. Most were able to provide reasonable accounts recalling the events responsible for the rapid withdrawal of a finger from a hot object in (c). Weaker candidates confused the sequence of the neurones and lost some credit. However, wherever possible examiners marked the points in the mark scheme independently.

Question 8

Part (a) was well answered with only a small number of candidates not scoring full marks, usually because they wrongly described the curve for mean water temperature. Candidates clearly have a good understanding of photosynthesis and many appreciated that low temperatures or low light intensity in winter would reduce photosynthesis, with a consequent detrimental affect on plankton numbers. Part (c) was among the most difficult parts of the paper. However, better candidates were able to appreciate that the insolubility of starch affords osmotic benefits which allow more storage in less space. Marks were also given for recognition that starch is larger than glucose, is less likely to be lost from cells, and is less likely to become involved in reactions.

Question 9

In (a)(i), many candidates lost marks by repeating the question. The evaporation of sweat linked to loss of heat was required, but many stated that sweating produces water on the skin which helps the body to cool down. In (a)(ii), the perennial error of describing the movement of blood vessels nearer to the skin surface was found in a disappointingly large number of scripts. Vasodilation is only understood correctly by the better candidates, as is its effect of bringing more blood to the skin surface where it can transfer heat from the body as radiation or convection. A pleasing number of candidates understood the role of ADH in helping to conserve water in the blood of the dehydrated cyclists, although some did confuse the issue by stating that less ADH would be released. Many candidates gave an acceptable definition of homeostasis and were able to give acceptable examples, such as the control of temperature or of glucose levels. Candidates who stated osmoregulation as an example had clearly not read the question carefully.

Question 10

Almost all the candidates were able to describe correctly that the shoot is bent towards the light. Most also recalled that the name of this response is positive phototropism. Only the better candidates appreciated that auxin will be found more on the darkened side of the shoot and that reason for the bending is that auxin causes cells to elongate. Many recalled the importance of the phototropic response in helping plants to obtain light for photosynthesis.

Question 11

At Higher Tier, detailed answers are required; and in (a), a named mineral was expected together with its function. Therefore, candidates who recalled the role of nitrates in the synthesis of proteins gained credit as did those who recalled the role of phosphate in DNA or ATP, or those who recalled the role of magnesium in chlorophyll manufacture. This level of response was only seen in the scripts of the better candidates. In (b)(i), candidates were expected to appreciate that insects would be killed and that the advantage of this would be better crop productivity. Marks were also given for recognising disadvantages by referring to the possible detrimental affect on other organisms, the possibility of the development of pest resistance and the need for reapplication. The term biological control was recalled by many better candidates, although many others were able to describe what the term means. In (c), good candidates named restriction and ligase enzymes, and were able to provide acceptable examples of vectors. The use of the terms ‘scissors’ and ‘glue’ was not credited.

Paper 5H

Question 1

This question was based on the elements in Groups 1 and 2. Few candidates had difficulty with (a), although in (b)(i) some candidates ignored the instruction and tried to give a symbol equation. In a few instances the gaseous product, hydrogen, was missing. In (b)(ii), the required observations were things that could be seen: a colourless gas cannot be seen, the observation is bubbles or effervescence. Other neutral answers (ones that did not gain credit but were not deemed to be wrong and so did not cancel out a correct observation) included ‘dissolving’ (since this can not be seen, and sodium solution is not the product) and ‘flame’ (since a small piece of sodium on water will not ignite unless it is restrained in some way). Part (c)(i) caused some students problems. Some described the use litmus is put to, but did not use the all important word ‘indicator’, those who added ‘pH’ or ‘universal’ to indicator did not gain the mark since litmus does not indicate pH. In (c)(ii), some students hedged their bets and gave the colour in both acid and alkali. Two answers, one of which is wrong, will never gain credit in this type of question. Parts (d) and (e) were well answered, with a minority of candidates having hydroxide as the product in (d)(i).

Question 2

This question about the industrial separation of crude oil was low-scoring for the majority of candidates. Most scored the first two marks. but the remainder of (b) often yielded only one further mark. Many gave a mathematical or dictionary definition of a fraction rather than linking it to the stem of the question which was about fractions of crude oil. Very few correctly stated that a fraction was a collection of compounds with similar boiling points. There was confusion between the industrial and laboratory process in (b)(iii). This question wanted the industrial process in which the oil is heated (not burnt as some candidates claimed) prior to the vapour being passed into a fractionating tower. Some candidates made life a little easier for themselves by drawing a diagram which made it clear that the fractions were obtained at different levels. Part (c) provided a happier ending to the question for most candidates. Carbon monoxide as the product was well known and some detailed explanations were seen in (c)(ii). However, it should be noted that carbon monoxide does not destroy haemoglobin or cells. It can, however, lead to death and this simple statement was missing from many answers

Question 3

This question was about aluminium. Very few good answers were seen in (a), and almost nobody was able to state that cryolite acted as a solvent. The mark for reducing the melting point **of the mixture** or lowering the temperature required to conduct the process were given more frequently. Some students referred to boiling points and others seemed to think that cryolite was a coolant since it cooled the process down – neither of these approaches gained credit. While many students scored well on (b), many scored poorly; incorrect electrode materials were often seen (aluminium being common). It should be noted that the gas produced by electrolysis is not carbon dioxide – this is made by oxygen reacting with the carbon of the anode. Some misconceptions were evident in (b)(iii). The electrodes need to be replaced due to a chemical reaction in which they are used up to make carbon dioxide: they are not worn away (this is a frictional process), nor are they eroded or eaten. Imprecise answers cost some candidates marks in (c) – the important point is that aluminium is more reactive than carbon. Just saying that aluminium is very reactive is insufficient. Some answers to (d) incorrectly focused on various costs (such as the need to obtain cryolite). Those who chose to use replacement of the electrodes as a reason needed to specify that it is the anodes that are replaced (since the cathodes are not replaced frequently). All that was required in (e) was to relate the uses of aluminium to its properties, which proved unexpectedly difficult.

Two important points to note are firstly, that since only iron can rust, any answer stating that aluminium did not rust (rather than did not corrode) was incorrect; and secondly, that aluminium is not a light metal (its mass depends on how much of it you have) – it has a low density. A variety of odd answers were also seen: a number of candidates suggested it was used for power cables because it did **not** conduct electricity.

Question 4
This question was about the extraction and uses of metals. While many candidates scored both marks in (a), a number wrote equations which did not involve carbon at all. The balanced symbol equation in (b) proved to be very difficult for some candidates. Many candidates chose to make something other than iron – oxides of iron or oxygen gas were not unusual products. Some excellent answers were seen to (c), with some very logical structures; those who did not know the chemistry involved often picked up one mark for forming slag. Part (d) proved to be more difficult than expected: some candidates claimed that 'zinc rusted instead of iron' – since only iron can rust this statement is incorrect. What should have been said is 'zinc corrodes instead of iron' this should then have been linked with the idea that zinc is more reactive than iron and that the iron will not rust. Some very bizarre answers were seen in (d). Some candidates thought zinc had a low density and so it helped the ships float; others thought zinc had a high density and so it kept the ships upright.

Question 5
Part (a) required candidates to write a chemical equation with state symbols. Many candidates ignored the instruction to include state symbols and a large number of others used monovalent magnesium in the equation and so were unable to score any marks. Where state symbols were included, common errors included stating HCl was a liquid or that $MgCl_2$ was a solid. Most candidates managed to score some marks when drawing the sketch lines on the graph. While the relative gradients of the lines was usually correct there were more problems with predicting the final volume of gas collected: line **B** very rarely indicated that the final volume of gas would be half that shown by the printed line. Most candidates managed to gain at least one mark in (c), although it was common for candidates to claim that *atoms* or *molecules* were moving faster rather than *ions*: in this situation it is safer to use the general term *particles*. Part (d) required a chemical test for chloride ions. Tests for chlorine gas were depressingly frequent and performance was rather centre dependent.

Question 6
This question was based on chorine. The production of chlorine from the electrolysis of brine was well known. However, the equation for the reaction in (b) was very poorly done, with strange products such as BrCl being far from uncommon. Part (c) was concerned with the chlorination of an alkane. To answer (c)(i) and (ii), candidates were expected to use the information in the equation provided and realise that Cl_2 and HCl would both change the colour of blue litmus. It was not uncommon for the two observations to be the wrong way round. Some excellent calculations were seen in (d). Where a candidate failed to obtain the correct answer, credit was given for evidence of some correct working. However, credit for correct working can only be given if the examiner can follow what has been done: spaces filled with seemingly random calculations with no indication as to what the candidate thought they were doing failed to score. Some candidates had the empirical and molecular formula the wrong way round.

Question 7

Some candidates failed to attempt (a): this can only be due to not reading the examination paper with sufficient care. The meaning of the term exothermic was well known, although when writing the equation in (b)(ii), many candidates forgot the information given in the stem to (b), and so did not show that the reaction was reversible. The effect of changing the conditions on the amount of product formed was not well known, with answers being seemingly random. Descriptions of how to conduct a titration in (c) were also very poor, with most candidates scoring one or zero marks. Some points to bear in mind include:

- The volume of sodium hydroxide used was 10.0 cm^3, so this solution should be placed in a conical flask. Its volume should be measured with a pipette since a measuring cylinder is not sufficiently accurate for titration work.
- The volume of sulphuric acid used was 16.70 cm^3, so it must have been in the burette.
- An indicator is required. If one is named, it must be an acid/alkali indicator and a colour change is required at the endpoint – if a colour change was stated, it must be the correct one for the indicator used. Universal Indicator is not suitable for titrations since it does not have a sharp colour change at the endpoint.
- The solution in the burette should be added slowly near the endpoint (not all the way through): only candidates who wrote about doing repeat runs tended to score this point.

Question 8

This question dealt with the chemistry of alkenes. The definitions in (a) should have been straightforward recall questions, but they caused unexpected difficulties. In both cases two marks were available: this should suggest to candidates that two things were required in each answer. In (a)(i), candidates were expected to explain the meaning of both words and in (ii), the ideal answer would have referred to both molecular formulae and structural formulae. Very few correct isomers for C_5H_{10} were drawn: many structures had carbon (or hydrogen) with the wrong valency and often did not contain the correct numbers of atoms. Part (c) was demanding and some very good answers were seen. Common errors were to leave the double bond in the polymer structure for propene, or to omit the double bond in the monomer structure for styrene. Candidates were not expected to recall the structure of styrene, but they should have been able work it out from the structure of poly(styrene). Part (d) was not well answered. While most students were able to score something in (i), very few could draw the structure of the brominated product and an equally small number realised that the polymer would not contain any double bonds in (iii).

Paper 6H

Question 1
In (a), candidates were asked to link named electromagnetic radiations to their uses. The use of gamma rays and ultraviolet was well known although a few candidates mixed up the uses of infra-red and microwaves. In (b), the above named radiations had to be linked to the harm that they could cause. A common error was to link ultraviolet to skin burns and infra-red to blindness instead of the other way round. The entire question was drawn from the phrases used in the specification.

Question 2
Part (a)(i) asked candidates to mark with an **X** the centre of gravity of a racing car whose diagram showed an unlabelled vertical arrow pointing downwards to represent its weight. A significant number of candidates did not answer the question. Of those who did, many marked the **X** too far from the vertical line in question. Part (a)(ii) asked candidates to complete a table linking forces acting on the car to letters on the diagrams. Errors were very rare. Part (b)(i) showed a velocity-time graph for a racing car accelerating from an initial velocity of 10 m/s. Asked what feature of the graph showed acceleration, candidates were expected to comment on the slope of the line. Instead many simply wrote that it speeds up or that it accelerates. Some answers just mentioned a straight line without any reference to slope. Part (b)(ii) required a calculation of the distance moved. Few candidates got the right answer because, although they correctly calculated the area of a triangle (300 m), they forgot to add the area of the rectangle (200 m) due to the car not starting from rest.

Question 3
A drawing showed a stationary ship and a distant cliff. In (a)(i), practically all candidates knew that the echo from the cliff of the sound from the ship's foghorn was due to reflection. In (a)(ii), most candidates knew that the time taken for the sound to travel back from the cliff to the ship was half the value of the time lapse between the foghorn sounding and its echo being heard back on the ship. In (a)(iii), calculations of the distance of the ship from the cliff given the speed of sound were almost always correct. A small number of candidates mistakenly used a speed of 300 m/s rather than the given value of 330 m/s. This type of error is thankfully rare but is penalised. In (d), candidates were asked how the captain could tell that the moving ship was getting closer to the cliff when the foghorn was sounded every ten seconds. Many good answers were seen, referring to the increased loudness, the increased frequency or the shorter time delay. Answers stating that the sound travelled back faster were less satisfactory. In (c), candidates were asked how the frequency of the sound from the foghorn is related to its wavelength. Many satisfactory responses were seen where the relationship between wave speed, frequency and wavelength was given. Many candidates stated correctly that as the frequency increases the wavelength decreases, but a few did not address the question by writing 'the frequency and wavelength are both small'.

Question 4
A diagram showed a rectangular block, with its dimensions. In (a), candidates had to calculate the area under the block. The dimensions were given in cm and the answer was expected in m^2. An error at this stage was carried through and lost a maximum of one mark. In (b), candidates were asked to state the equation which relates area, force and pressure: many mistakes were seen. If candidates had been asked a similar question relating pressure, force and area many more would have been successful, giving $p = F/A$ (in words). However, because convention dictates that the quantities must be given in alphabetical order, a number of candidates tried but failed to get an unfamiliar expression with A as the subject ($A = F/p$). Candidates need to know that they should present the more familiar expression in situations like this.

Question 5
In (a)(i), the data from a table showing activity against time for a radioactive isotope was plotted and a curve of best fit drawn. Very few errors (such as misplotting) were seen. A small number of candidates joined neighbouring points with a ruler. For the determination of half life in (a)(ii), practically all candidates used the data from the table rather than taking values from the graph. This gave the correct, exact answer of 2 hours. Some candidates successfully used the graph but a few, having successfully plotted the point (0, 64 000), incorrectly halved 64 000 to draw a horizontal line from 34 000 instead of 32 000, even though again they had just successfully plotted the point (2, 32 000). In (b), most candidates did not know that 1 MBq is equal to 1 000 000 Bq, more often thinking it was 1 000 Bq.

Question 6
In (a), candidates were asked to calculate the deceleration of a car passenger wearing a seat belt. Given the values of force and mass, practically all candidates were able to do this successfully and give its unit. In (b), candidates were asked to draw on the diagram of the passenger an arrow showing the direction and line of action of the given force, and many were able to gain full marks for this.

Question 7
In (a)(i), many realised that only one of the angles shown could be greater than the critical angle, but in (ii), they did not include the term ‘total internal reflection’ in their explanation. In (b)(i), the request to state the relationship between critical angle and refractive index produced an uncertain response. The following was seen disconcertingly often: c = 1 / sin n. Part (c) required the drawing and explanation of a ray with an angle of incidence less than the critical angle leaving a tank of water and emerging into air. This was very well answered.

Question 8
In (a), the calculation of kinetic energy (5J) given the mass and speed of a hammer hitting a nail was competently done and the appropriate unit given. In (b), the gravitational potential energy (3J) of the stationary hammer at a given height was also very well done, especially as a value for *g* was not provided. In (c), candidates were expected to account for the difference in their calculated values as the work done by the person using the hammer. Instead of determining this by 5J – 3J = 2J, many candidates repeated the previous calculation to determine the work done using ‘force × distance’ and so were unable to gain a further two marks for an explanation based on the conservation of energy.

Question 9
In (a)(i), a calculation using Boyle’s law was uncharacteristically badly answered with a substantial number of candidates trying to use the relationship p/V = constant. Furthermore, when an initial pressure of 120 kPa was increased by 20 kPa the second pressure was often taken as 20 kPa instead of 140 kPa. Many candidates were unable to state two assumptions made in the calculations. In (b)(i). the definition of density occasionally referred to weight and area, instead of mass and volume. The explanation as to why the density of air in a balloon increases when taken to the bottom of a swimming pool allowed for follow-through marks from previous errors, but many candidates did not mention that mass remains unchanged.

Question 10
In (a)(i), candidates were asked 'What is meant by a magnetic field line?', but gave answers better suited to the question 'What is meant by a magnetic field?', frequently referring to regions or areas rather than directions. The only correct answers seen were those that stated that that it was a line running from N to S. In (a)(i), the question of how a straight copper wire could produce magnetic field lines was answered well, with slightly more suggestions for passing a current through it than for moving it between the poles of two bar magnets. In (b), candidates were shown a diagram of a flexible current-carrying copper wire dipping into a tray of mercury placed between the unlike poles of two bar magnets. They were then expected to use the Left Hand Rule to draw labelled arrows to show the directions of current, magnetic field and motion. A sizeable minority of candidates was unable to show the correct direction of the current, given the positive and negative terminals of the power supply; and many showed two conflicting directions for the magnetic field. The direction of motion was often shown opposing the given direction of the current. In (c) and (d), candidates were asked to state two changes that could be made to increase the force acting on the wire and give two reasons why mercury was suitable for this demonstration. These parts were very well answered.

Question 11
Candidates were asked to fill in gaps to show their knowledge of atomic physics and radioactivity. Many candidates scored all nine marks. In (a), candidates were asked to pick from numbers between –4 and +4 to show the changes in atomic number and mass number during alpha, beta and gamma decay respectively. A small number of candidates gave 4 instead of –4 for the change in mass number during alpha decay. In (b), the method of completing a nuclear equation by writing in the missing numbers, was well known, as was the meaning of the term 'isotope' in (c).

Question 12
Candidates were shown the paths of three alpha particles passing through a gold atom. One went through undeviated, one was slightly deviated and the third one came back in the original direction. They were then asked to comment on the information provided by these paths on (a) the structure of the atom, (b) the size and mass of the nucleus, and (c) the likely charge on the nucleus. In (a), many candidates stated that the atom had gaps in it without specifying the nature of these gaps. In (b), the response 'small' and 'massive' or 'heavy' would have scored two marks. A response of 'large' or 'big' was only acceptable if this was in comparison with the alpha particle. Some unexpected confusion was seen in (c), with responses such as 'negative because the alpha is positive'. There was also a tendency to refer to 'deflection' instead of 'repulsion'. A small minority of candidates stated the properties of the alpha particle or the path(s) throughout.

Question 13
In (a), candidates were asked to complete sentences describing the process of nuclear fission. Few knew that the energy released is in the form of the kinetic energy of the fission products, referring instead to heat energy. In (b), the relative sizes of the incoming neutron, the fissioned nucleus, the fission fragments and the extra neutrons were expected to be linked with the symbols for U-235, Ba-141, Kr-92 and the neutrons. Judging by the amount of crossing out, this produced some uncertainty. It seemed that many candidates could not bring themselves to fill in as many as three of the boxes with the symbol for the neutron.

Paper 7

General comments

This paper had similar requirements to those set in May in November 2005, and was felt to be of a similar standard. First impressions were that the candidates did not perform quite as well as in May 2005, although a wide range of marks was seen.

Question 1

Most candidates answered this correctly, although some candidates gave **B** instead of **D**, linking the stopwatch to exercise.

Question 2

Most candidates were able to count the seeds in (a)(i) and gained full marks here. In (a)(iii), there were some errors in the scale of the graph, and some axes were the wrong way round. A few candidates missed out years when labelling their axes. In (a)(iv), most candidates gave sensible answers relating to the advice. In (b), most candidates were able to give two factors that should be kept the same. Again, in (c), candidates understood about reliability and said the experiment should be repeated or that more readings should be taken. A few lost marks as they referred to ages.

Question 3

Several candidates did not make a point that reflected even or equal treatment in (a)(i). Some candidates gave the answer 5 in (a)(ii), suggesting that they did not read the question properly. Part (b)(i) was well answered, as was (ii), though some candidates referred to human error. Part (c) was done well by most, but some candidates did not appear to understand that all light or all dark was required for a control.

Question 4

Although some candidates referred to a 'graduating cylinder', most answered (a) correctly. Part (b)(i) was answered well, although there was some reference to 'stop mixing' or other incorrect suggestions. In (b)(ii), a significant number of candidates made no reference to time, or to a method for varying temperature, and therefore only gained one mark. In (b)(iii), most candidates realised that a change in the light would cause the anomaly, but a significant number tried to explain why it was an anomaly instead. Most candidates answered (c)(i) correctly, although many also included an explanation here instead of in (ii). In (c)(ii), most missed the first mark on low kinetic energy or movement, but many got the marks for optimum and denatured. Some referred wrongly to yeast being denatured or enzymes being killed. Many candidates missed the marks in (d), but a few understood what was wanted and expressed their answers well. Readings at closer internals was more frequently seen than those relating to around the optimum.

Question 5

Part (a)(i) was generally well done, but there were some odd formats in the table. Part (a)(ii) was also well answered, either with an explanation or an example. Many candidates gave a description of other factors that would affect transpiration in (b), rather than concentrating on more evidence to support the conclusion.

Question 6

There were many good accounts scoring full marks. The most common errors were heart rate measurement often not linked to time, little mention of control and measurement of breathing instead.

Paper 8

General Comments

Questions in this paper are targeted at full range of grades from A* to G.

Question 1

This question was designed to test candidates' familiarity with common examples of laboratory apparatus and their uses. High scores were expected, and few candidates lost more than 1 or 2 of the 7 marks available. Common errors included naming the pipette as a burette, and using the gas syringe to measure the volume of a solution. The main cause of lost marks was the fractionating column, partly due to a poor diagram, which is regretted.

Question 2

In (a), the safety precaution hoped for was one specific to the corrosive nature of sodium hydroxide, so general precautions such as "wear a lab coat" or "tie your hair back" were not accepted, although "wear eye protection" was. The burette readings in (b) were generally correct, with only a minority reading the scales upwards instead of downwards, or writing the readings in the wrong boxes. In this particular question, although the liquid levels were actually on the 0.1 cm^3 divisions, candidates should remember that they are expected to read to the nearest half-division, so it is good practice to quote values such as 20.20 rather than 20.2 (as shown in the table in (c)). In (c), very few candidates seemed to be familiar with the concept of concordance in burette readings, which in this paper means that readings should differ by no more than 0.20 cm^3. Every possible combination of ticks was seen, with the ticking of the last three being the most common (perhaps on the assumption that the first result will be inaccurate, or perhaps because this was the only one beginning with 28, rather than 27). Some candidates failed to place ticks as requested, but were able to score this mark when their choice was clear from their subsequent working in calculating the average. A small minority of candidates seemed unable to calculate an average from their ticked results correctly.

Question 3

The vast majority of candidates correctly calculated the mass and percentage in (a). Part (b) was also well answered, with the commonest error being to state that crushing the rock salt would make more dissolve. Quite a few candidates wrote about the reaction, instead of the dissolving being faster, although this was not penalised. Very few candidates scored all 3 marks in (c). Quite a number got no further than just weighing, with many of these failing to score because it was not clear what was being weighed. Others repeated the method shown in the diagrams.

Question 4

The use of a polystyrene cup in (a) elicited a surprising variety of responses. Although many correctly mentioned its insulating properties, some went on to suggest that the glass beaker would break because of the great heat, while others thought that the polystyrene cup prevented the reactants from attacking the glass. A few claimed that as the polystyrene cup could be thrown away it would avoid having to wash the glass beaker! The thermometer readings in (b) were generally correct, with errors similar to those found in the burette readings in Q 2. The drawing of the two-line graph in (c) will have been unfamiliar to most candidates, and it is pleasing to report that so many produced excellent lines that scored all 4 marks.

The weakest candidates plotted 12 points instead of 6, or drew curves that started at 15°C, or had lines curving towards each other rather than crossing. Some of the general errors common to all graph-plotting questions were seen, such as misreading the scales, using large blobs for points, or drawing multiple lines. Most who succeeded in (c) had little trouble in (d), although some misreading of scales was again in evidence. Most candidates mentioned repeating in (e), but this response did not score unless it was related to the volumes in (d). A pleasing number of candidates gave a correct reason for their choice of potassium hydroxide in (f).

Question 5

Part (a) was generally correct, with just a few candidates giving the depth of liquid, or of liquid-plus-foam. Relatively few candidates scored full marks in (b). Quite a number of points were misplotted, and the drawing of the smooth line of best fit was poorly done. Identifying the features in (c) proved a challenge for candidates, and full marks were rare, with the weakest scoring only with temperature. A minority thought that the other metals should be in the same group of the Periodic Table as magnesium, or that they should have the same reactivity. Perhaps the most common unacceptable answer was that the masses of metal should be the same, rather than the number of moles. Although hardly any candidates mentioned moles, those who wrote "amount" scored because this term has the meaning of amount in moles. Common acceptable answers were that the metals should be powdered like magnesium, that the same volumes of acid-plus-detergent should be used, and that the proportions of acid and detergent should be the same. The full range of marks was seen in (d), but there were many common errors. These included identifying Metal 5 as having the most reliable results because it had the most results, rather than Metal 2 (where there were 4 results much closer together). The anomalous result (105) stood out from the others, but even so was often inadequately identified just as Student S or Metal 3, rather than as a combination of the two. The most reactive metals were frequently taken as the two with the longest times, rather than those with the shortest times. Many of those who made the correct identification gave as their reason that there was a result missing, rather than that the results were similar.

Paper 9

Question 1
Most candidates were able to measure the depth and write down an answer in the range 75.5 to 76.0 mm in (a). In (b)(i), most candidates recognised that **X** was a stand and in (ii), many were able to describe how to check that the glass tube is vertical. Responses which involved tying the string of the plumb line round the top of the glass tube or lowering the plumb line into the tube full of oil were not credited. Good answers were seem to bo (c) and (d). In (e), most candidates suggested putting the magnet next to the steel ball and carefully moving it upwards to drag the steel ball out of the oil. Responses which involved tying string to the magnet and dropping it into the oil did not get either mark; those who thought the magnet would be sufficiently powerful to lift the steel ball through the oil if placed at the open end of the tube only got one mark. Most candidates were able to explain, in (f), why the experiment should be repeated several times. Part (g) was well answered by almost all candidates.

Question 2
Almost all candidates were able to use a protractor with sufficient accuracy in (a). For angle *i*, a measurement in the range 32° to 34° was required but for angle *r*, which is easier to measure on the diagram, the only accepted measurement was 60°. A wide range of acceptable responses was offered in (b), from a covered torch with a slit to a laser. Most candidates constructed a suitable table in (c), and inserted the readings in order. Points were, in general, accurately plotted and most recognised a curved line of best fit was more appropriate than a straight line. Some 'curves' did not gain credit because they were a series of lines drawn point to point, either with or without the assistance of a ruler. A significant minority of candidates failed to extrapolate their curves to make a prediction in (d)(iii).

Question 3
Almost everyone correctly stated that the method required in (a) was to measure the length of each side and to use the equation $V = l \times b \times h$, or, because it is a cube, to measure one side and to use the equation $V = l^3$. In (a)(ii), most had the right idea of partially filling the measuring cylinder with water, reading the volume, carefully adding the pebble, reading the new volume and then calculating the difference in the readings. Some correctly used a eureka can and a measuring cylinder. However, a small minority unsuccessfully proposed filling their measuring cylinder with water, adding the pebble and somehow measuring the overflow. Most named the instrument correctly in (b). However, it is not a 'beam balance' or a 'weighing machine'. Nearly all candidates gave the correct answer in (b)(ii). In (c)(i), nearly all candidates gave the value as 2.4, and in (ii) they reasoned that this was appropriate because all the other densities have been calculated to two significant figures. This is correct and sensible and was worth one mark. However, for two marks candidates needed to make the point that, as the mass and volume have only been measured to two significant figures, it is not possible sensibly to give the answer to more than two significant figures. One excellent answer stated that 'The measurements for mass and volume are used to calculate the density and they are both to two significant figures. The density should also be to this degree of precision. To quote it to more significant figures would be implying it is more accurate than it really is.' In (c)(iii) and (iv), nearly all candidates were able to write a suitable conclusion and to explain why the student's prediction was incorrect. The small minority who lost marks in (iii) did so because they attempted to describe false relationships between mass or volume and density, e.g. 'as mass increases, so does density'.

Question 4

Both readings were almost always correct in (a). In general candidates made a variety of appropriate points in (b), and a typical two-mark response was 'The candidate uses a black tube to stop reflected light coming in from the sides. You only want to measure the light which comes straight into the tube from the measured direction.' Both labels were usually completed correctly in (c)(i). In (c)(ii), a fairly high degree of accuracy was expected with answers in the ranges 276 to 280 degrees and 96 to 100 degrees. Candidates who misunderstood the implication of the information at the start of the question, and who had accurate answers but in the reverse order, were awarded one of the two available marks. In (d), candidates either made a prediction of 500 Ω by reasoning that 360° is equivalent to 0°, then explaining this in (iv) and gaining all three marks, or extrapolated their curve and read where it crossed the 360° vertical for just one mark.

DOUBLE AWARD (SCIENCE) 4437, GRADE BOUNDARIES

Option 1 : with Paper 7 (Biology) & Paper 8 (Chemistry)

	A*	A	B	C	D	E	F	G
Foundation Tier				57	46	36	26	16
Higher Tier	80	68	56	44	33	27		

Option 2 : with Paper 7 (Biology) & Paper 9 (Physics)

	A*	A	B	C	D	E	F	G
Foundation Tier				57	46	36	26	16
Higher Tier	80	68	56	45	33	27		

Option 3 : with Paper 8 (Chemistry) & Paper 9 (Physics)

	A*	A	B	C	D	E	F	G
Foundation Tier				57	46	35	25	15
Higher Tier	80	68	56	44	33	27		

Note: Grade boundaries may vary from year to year and from subject to subject, depending on the demands of the question paper.

For more information on Edexcel International, please contact our
International Customer Services Unit on +44 (0) 190 884 7750
or visit www.edexcel-international.org
Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: 190 High Holborn, London WC1V 7BH,UK