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Summer Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Report on the Examination

Science: Single and Double Award (Modular)

■ General Certificate of Secondary Education

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CONTENTS

Science: Single Award (Modular) (3469)
Science: Double Award (Modular) (3468)

Foundation Tier

Paper 1 (3468/1F) Double Award

General

There were sixteen questions on the paper. The first eight questions were targeted at grades E, F and G and are termed Low Demand questions. The final eight questions, termed Standard Demand, were common to Foundation and Higher Tiers. These were targeted at grades C and D. This arrangement enables candidates to start with the easier questions before progressing to the more difficult ones at the end. As was the case last year, many of the foundation tier candidates picked up most of their marks in the first section, and comparatively few in the second section. However, the imbalance was less noticeable this year, with many candidates scoring well in questions 9 and 16.

The marks for Quality of Written Communication appeared in questions 6 and 10. This year marks were awarded on a different basis from last year. In question 6, candidates could earn the QoWC mark for the correct use of appropriate scientific terms. The majority of candidates did indeed earn this mark. In question 10 candidates earned the QoWC mark for the correct sequencing of scientific ideas: this mark was earned less often.

In general the standard of numeracy appeared to be better than in some previous years, with few candidates reporting that they had 'no calculator'. However, many candidates had difficulties with calculations that did not involve the use of formulae from the specification. The attention of centres is drawn to paragraph 7.5 which lists the mathematical skills which may be tested on the paper. Centres should note that it is **not** the policy of the examiners to award marks for a correct answer that has been derived by chance from an incorrectly recalled relationship.

As was the case last year, most candidates attempted every part of each question. However, there are still some candidates who do leave pages blank: they should be encouraged to attempt every part of every question.

Question 1 (Low Demand)

This proved to be a good opening question for most candidates, and generally produced high scores**.**

(a) This was correctly answered by most candidates, although in part (iii), some candidates hedged their bets by simply writing "fish" without specifying which one of the three groups of fish shown on the chart they were referring to.

(b) In (i) most candidates referred to either fossil evidence or to the discovery of bones as evidence for the existence of animal X 50 million years ago. Part (ii) was again a high scoring question, although some candidates tried to use words that were not in the box, and therefore scored no marks.

Question 2 (Low Demand)

This question asked candidates to 'cross out the two lines which are wrong in each box'. Many candidates elected to use other methods, such as circling the one they thought correct or underlining it. Examiners did allow such answers if the intention of the candidate was clear, but in some cases it was not. Candidates should be encouraged to read the rubric carefully and to follow the instructions. There was a wide variety of responses to this question with very few candidates scoring zero and very few scoring a maximum. The response to questions on genetics seems to vary greatly from centre to centre. The most common error was the reversal of the terms 'dominant' and 'recessive' with respect to cystic fibrosis and Huntington's disease.

Question 3 (Low Demand)

This question scored highly for most candidates.

(a) Candidates frequently did not relate the properties of helium to its use in filling party balloons and thus chose for the reason that it exists as individual atoms.

(b) CO_2 appeared almost universally as the correct answer for carbon dioxide, but CH_4 occasionally made an appearance as the formula for either hydrogen chloride or ammonia.

Question 4 (Low Demand)

(a) Very few candidates were able to name chlorine as the gas produced by the electrolysis of sodium chloride solution. Sodium or oxygen were the most popular incorrect answers.

(b) The responses appeared to be centre-dependent. Many candidates gave the test for oxygen instead of that for hydrogen. Others appeared not to understand what was being asked, and instead described what happens during the electrolysis of sodium chloride solution. The 'pop test' alone is insufficient to gain both marks; there should also be reference to a flame.

(c) Most candidates correctly identified the two reactants, but found it harder to name the two products. Sodium + hydrogen was a popular wrong choice, as was sodium + water. Some candidates wrote 'sodium' in the first blank space and 'hydroxide' in the second.

(d) Very few correct responses (photographic film) were seen, even from the most able candidates. The most common incorrect responses were that silver chloride is used in making jewellery or in electroplating.

Question 5 (Low Demand)

Candidates once again appeared confused between wavelength and amplitude.

(a) Candidates often gave the wavelength as 12, believing that what was required was the total length of the waves that had been drawn in the diagram.

(b) Amplitude was more often given correctly than wavelength, though a common answer was 6, being the distance from the top of the crest to the bottom of the trough.

(c) Some candidates did correctly work out the right answer, but many used incorrect relationships to do this and therefore received no marks. Where the answer was not correct, many candidates received the independent mark for a suitable unit such as Hz or waves per second.

Question 6 (Low Demand)

(a) Very few candidates appeared to recognise that this was a case of total internal reflection. The words in the box had been put there in order to help the candidates to produce a sensible answer. However, many of them chose to use the words 'critical' and 'normal' in their everyday sense, rather than in their scientific sense. Thus, examiners frequently saw answers such as 'It is critical that the light enters the prism in the right direction, and it is quite normal for it to bounce off in a different direction'. Many candidates received only one mark for recognising that reflection had occurred. They were unable to explain why it occurred.

(b) Many candidates scored maximum marks, and examiners were encouraged to see a more widespread use of rulers in drawing rays of light this year.

Question 7 (Low Demand)

(a) This generally produced good marks, although a minority of candidates failed to tick three boxes.

(b) Few candidates recognised that this was a general acid / alkali question. The single word 'acid' was required on the first dotted line, as the rubric asked for the candidates to complete the equation for the type of reaction. Examiners did however allow the mark to those who wrote 'nitric acid'. The completion of the right-hand side of the equation was less well answered, 'hydrogen' being the most popular wrong response.

(c) This was usually answered well, although some candidates had clearly not used the Data Sheet.

Question 8 (Low Demand)

(a) In (i) most candidates could usually obtain maximum marks. A very small number of candidates either failed to interpret the scale correctly or only drew two bars instead of three. Examiners were encouraged to see a large number of correct answers to the calculation in (ii). However, candidates should be encouraged to take note of the rubric that stated, 'Show clearly how you work out your answer'.

(b) Most candidates correctly identified the lungs as being the part to which the plasma transports carbon dioxide. The transport of urea however, was not well known, most candidates confusing urea with urine and starting at either the bladder or the kidneys.

Question 9 (Standard Demand)

This question was pleasingly well-answered by the majority of candidates.

(a) Some candidates were confused between the ovary and the uterus, and a few believed that it was the lining of the vagina that thickened. The spelling of 'fertility' caused problems to a few candidates who confused it with 'fertilisation'.

(b) The majority of candidates knew that the difference somehow involved X and Y chromosomes. However, sometimes these were attributed to the wrong sex. Others gave differences such as dominance. A very small number of candidates thought that they were being asked to describe the genitalia or secondary sexual characteristics.

Question 10 (Standard Demand)

Cloning appears to be poorly understood by the majority of candidates.

(a) Most candidates were able to score one mark for the idea of a clone being a replica, but very few referred to identical genes or DNA.

(b) There was much confusion between cloning and IVF treatment. Examiners also saw many excellent answers to the question set on last year's paper, ignoring that the question was about cloning an embryo. Thus the majority of candidates did not refer to splitting apart cells from embryos before specialisation, then implanting the resultant embryos into hosts.

Question 11 (Standard Demand)

(a) Few candidates gained all three marks. The mass and atomic numbers were often quoted, but then candidates were unable to use them to derive the information required. Candidates often quoted '9 protons and electrons' without clearly defining that it was nine of each. The number 9 was often quoted, incorrectly, as being the number of neutrons.

(b) This attracted a large number of correct responses. The most common incorrect response was to use 24 electrons, or to put large numbers in the outer shel1.

Question 12 (Standard Demand)

(a) In (i) only the most able candidates were able to correctly balance the equation, many candidates making no attempt. Many candidates obviously understood the principle, but placed the number 2 as a subscript. In part (ii) there appeared to be some improvement from last year in terms of the number of candidates who could correctly identify the meanings of the state symbols (s) and (g). However, there is still a disappointingly large number who do not appear to have learned these. 'Gram' was frequently given for (g), and 'solution' for (s).

(b) Only a very small number of candidates were able to work out the formula of magnesium chloride. Many appeared not to know the difference between a formula and an equation, and thus tried to write equations to show how magnesium chloride could be produced.

Question 13 Standard Demand)

(a) A majority of the candidates correctly worked out the ratio as 1:2. Some, however reversed this and gave 2:1. The most common incorrect answer was 4:1, candidates perhaps believing that there was a pattern to be followed.

(b) Only a very small minority were able to recognise that the gases combined in simple / whole number ratios or proportions.

(c) Most candidates could correctly identify Gay-Lussac as being the scientist who was correct. Many of these however, then referred to the formula of H_2O and stated that two atoms of hydrogen were needed for every one atom of oxygen rather than referring, as the rubric stated, to the results of the experiment.

(d) Many of the candidates referred to bonds: the better candidates correctly referred to covalent bonds, whilst the weaker candidates lost the mark by calling them ionic bonds. A few, perhaps still thinking of water, believed that hydrogen atoms held the two oxygen atoms together.

Question 14 (Standard Demand)

(a) Very few candidates appeared to understand the workings of a microwave oven. Most believed that either microwaves are the same as heat waves, or that they were something to do with the light given out. Examiners read much detail about how the food is made to revolve, but very few candidates appreciated that microwaves transfer energy to the water molecules inside the food, and that energy is then transferred from water to the rest of the food. In (ii), most candidates knew the correct formula to use for the calculation, but failed to spot that the frequency had been given as 10 000 million Hz, and used 0.03 x 10 000.

(b) Many candidates did not attempt this part. Those who did attempt it frequently gave imprecise answers such as 'transverse' or 'longitudinal'. The 'Richter scale' was frequently given as the instrument.

Question 15 (Standard Demand)

Despite being a popular example for the use of beta radiation in textbooks, candidates did not answer this question well.

(a) There was much confusion between the relative penetrating powers of alpha and beta radiation. The most common answers simply stated that alpha radiation would be 'too weak' and gamma radiation would be 'too strong'.

(b) In (i) hardly any candidates appeared to appreciate that radioactivity is due to the instability of nuclei. In (ii), many candidates were able to pick up one mark for a rather generalised answer referring to cancer, but only the better candidates were able to score two marks for a more detailed answer. The weakest candidates simply repeated the question by stating that radiation is dangerous. Others fell back on 'it kills cells'. There is general confusion about the site of mutation, the most common misconception being that 'cells mutate'

Question 16 (Standard Demand)

In spite of the fact that this was the last question on the paper, examiners saw a very encouraging response to it. Nearly all candidates had attempted it, often at some length, and many scored the majority of the marks available.

(a) Most candidates were able to state that the number of men dying from lung cancer had decreased during the period in question, but only the better candidates scored the second mark for giving some numerical detail. Weaker candidates gave descriptions in terms of number of smokers.

(b) Most candidates scored one mark out of the two: most could state either that the number of men dying decreased or that the number of women dying increased, but fewer noted that the number of men dying was always greater than the number of women dying.

(c) This calculation proved difficult: some candidates actually obtained an answer that was greater than the entire population. Candidates should be encouraged always to make common-sense checks with their answers.

(d) The requirement was to make a comparison between the two graphs. Whilst many candidates did do this, others simply described each graph individually, without making any links between them. Weaker candidates ignored the data and referred to health education or medical advances.

Foundation Tier

Paper 2 (3468/2F) Double Award

General

There were twenty one questions on this paper. The first fourteen were targeted at grades E, F and G and carried about 55% of the marks. The last seven questions were targeted at grades C and D and were common to both Foundation and Higher Tiers.

All candidates appeared to have had sufficient time to complete their paper. The majority of candidates attempted most questions. Candidates gained marks when their answers were precise. Vague and unspecific responses often repeated information already given in the question or contradicted part of what was a correct answer. It should be noted that when candidates gave several answers when only one or two were required, they risked not being credited for correct ideas if errors or contradictions were included in their response.

Although most candidates had knowledge of basic scientific ideas, they seemed to have difficulty in understanding some scientific words and terminology. These included acid rain, microorganisms, current, radiation, velocity, acceleration, resources, reuse and recycle. Some very common biological processes, such as respiration, also endothermic and exothermic chemical reactions, and quantitative relationships were not well known. It should be noted that because candidates are asked to show their working, then an incorrectly stated relationship resulted in no marks being awarded, even if the figures were manipulated successfully and produced the correct answer. Experimental procedures were not understood as well as might have been expected.

The use of the works ‘it’, ‘them’ and ‘they’ meant that many candidates lost marks when their response was ambiguous. Fundamental concepts, including straightforward factual recall, the understanding of key ideas and the application of these were tested throughout the paper. Candidates still needed to be reminded that it is essential to read questions carefully, analyse the information and think about an answer before writing their response.

Foundation Tier

Paper 2 (3468/2F) Double Award

Question 1 (Low Demand)

Most candidates completed this question correctly. Some were uncertain as to whether oxygen or carbon dioxide was made during photosynthesis. A minority inserted glucose instead of carbohydrate even though that word was not on the list provided.

Question 2 (Low Demand)

(a) Most candidates identified correctly a reason why the camel is well adapted to living where there is sand. However, some candidates described how a camel is adapted to living in hot conditions rather than sandy conditions.

(b) Many candidates found difficulty in expressing a correct suggestion. Often incorrect responses included the idea that ‘camels don’t need to keep warm’ forgetting that camels are warm blooded and that the issue was one of limiting heat loss / insulation which is not needed in a relatively hot environment like the desert.

(c) The common error was to indicate that 'camels store water in their hump'.

Question 3 (Low Demand)

(a) Most candidates could not recall that pesticides or herbicides were the types of toxic chemicals used on farmland.

(b) The explanations for how acid rain is formed, from the burning of fuels, generally lacked scientific terms or did not indicate that sulphur dioxide dissolved in water was responsible.

Question 4 (Low Demand)

The majority of explanations demonstrated a weak understanding of the idea that microorganisms use oxygen in respiration to form carbon dioxide. Many candidates gave general descriptions of microorganisms feeding on sewage.

Question 5 (Low Demand)

(a) The hazard symbol on the bottle was well known.

(b) A minority of the candidates were unable to name O_2 as oxygen, a frequent incorrect response being oxide. However most knew the use of a catalyst to make a reaction faster.

Question 6 (Low Demand)

Most candidates were able to correctly identify the correct words to make wine and yoghurt.

Question 7 (Low Demand)

(a) The majority of candidates could not recall that a reaction that needs to be heated continuously is an endothermic reaction.

(b) Very few candidates used the term exothermic. Most candidates did not use the information given in the stem and stated that 'it changes colour', 'fizzes' or 'swells up'. The better candidates did recognise the significance of the reversible reaction and gained full credit by answering that 'it becomes hot and changes back to blue'.

Question 8 (Low Demand)

(a) Many candidates gained credit. There were good answers linking surface area with particle size. A few candidates failed to gain the mark because of contradictory responses linking small particle size with a lower surface area or gave a vague answer, such as 'make it smaller / bigger'. The idea of 'heating it' was acceptable.

(b) The calculation required showed that many candidates had an idea of how to calculate formula mass, even if often they answered 104. However, they did not know what to do next to calculate the percentage of iron in iron sulphate.

Question 9 (Low Demand)

Most candidates correctly identified the link between the words about the Universe and their descriptions.

Question 10 (Low Demand)

The majority of candidates knew the correct units for each of the quantities.

Question 11 (Low Demand)

(a) This was well answered by most candidates. Very few failed to identify the steeper gradient of E-F but several weaker candidates ticked three boxes. Almost all successfully identified points between which the car was stationary.

(b) The most common error was to give 'distance' instead of 'force' to complete the last sentence.

Question 12 (Low Demand)

(a) The largest object in our solar system was usually identified correctly.

(b) Very few candidates understood that planets move at high speed to stay in orbit.

Question 13 (Low Demand)

(a) Most candidates knew that these rocks were sedimentary.

(b) A significant number of candidates saw the ripple marks as a separate layer. Hence, close or near to the top were frequent answers that were allowed.

(c) Many candidates were unsure of the cause of the ripple marks.

(d) The names of the gases required as products from the burning of carbon, hydrogen and sulphur were not well known. Carbon hydroxide, carbon sulphate and sulphuric acid were typical of the many incorrect responses.

Question 14 (Low Demand)

(a) Most candidates understood Sankey diagrams.

(b) A few candidates did not gain full credit because they did not give reasons that referred to the information given on the Sankey diagrams.

(c) The word radiation led far too many candidates to choose gamma or ultraviolet rather than infra red as the type emitted by hot coal.

(d) This was generally well answered, although some candidates appeared to confuse 'surface' with 'material', giving answers such as 'skin', concrete' or 'lead'.

Question 15 (Standard Demand)

(a) Most candidates were awarded at least one mark. The failure to gain credit was as a consequence of vague or general statements such as, 'more resources needed'.

(b) The majority of candidates gained the first mark. The others tended to give incorrect reasons linked to size of country or size of population. In the second part, many responses tended to be too general, with very few mentioning a specific problem or pollutant and its effect. Often carbon dioxide emission, which causes global warming, was linked to destruction of the ozone layer.

(c) This was not well answered by many candidates, who just restated what was already in the stem. Most achieved one mark for either the idea of 'fly-tipping' or that some people would not want to pay the landfill tax. In the second part, answers here again were very general often failing to clearly demonstrate the difference between reducing, reusing and recycling waste. Candidates who did use specific examples of waste material usually gained full credit.

Question 16 (Standard Demand)

(a) Many candidates were unable to explain that the graph line for A was 'steeper' or that this reaction finished sooner. Too many candidates were not aware that the final volume of carbon dioxide produced for both A and B was the same.

(b) Most candidates understood that the particles would move faster. Very few of these candidates were able to apply the collision theory and use the idea of more successful collisions.

Question 17 (Standard Demand)

This question was poorly answered by many candidates. In part (d) a number of candidates correctly identified ammonia but not nitric acid as the products to be reacted to form ammonium nitrate.

Question 18 (Standard Demand)

(a) Many candidates found this difficult. The numbers '30', '15' and '2' appeared often but few candidates could work out what to do with them.

(b) Candidates usually gained at least one mark for correctly stating that the bungee jumper 'goes up'. Few candidates appreciated the significance of the gradient between 4 and 5 seconds and between 5 and 6 seconds, or what had happened when the velocity was zero. Many candidates were unclear about the difference between velocity and acceleration.

Question 19 (Standard Demand)

(a) This was reasonably well answered, although some of the candidates who correctly wrote 1900×4.5 were unable to obtain the correct answer.

(b) Many candidates understood that most of the wasted energy was heat energy.

Question 20 (Standard Demand)

Most candidates gained some credit on this question, with the better candidates producing very good descriptions. Some chose simply to describe what they could see in the two diagrams rather than describe the sequence of events that would cause the circuit to break. Incorrect ideas that were frequently seen were that, 'the coils heat up', 'the springs pass the current' or 'the button must be pressed to switch off the electricity'. Very few candidates understood that as a consequence of an increased current the electromagnetic attraction increases and attracts the iron bolt.

Question 21 (Standard Demand)

(a) Most candidates answered the first part correctly but few could display any understanding of the idea of induced current.

(b) This was answered well by most candidates. The main problem was that many candidates equated 'stronger magnets' with 'bigger magnets'.

Higher Tier

Paper 1 3468/1H

General

There were seventeen questions on the paper. The first eight were targeted at grades C and D and were termed Standard Demand questions. These questions were common to Foundation and Higher Tiers. The final nine questions, termed High Demand, were targeted at grades B, A and A*. This arrangement enabled candidates to start with the easier questions before progressing to the more difficult ones at the end. As was the case last year, many of the weaker candidates picked up most of their marks in the first section, and comparatively few in the second section. Many of these candidates would have been more appropriately entered for the Foundation Tier Paper.

The marks for Quality of Written Communication this year appeared in questions 2 and 12. Marks were awarded on a different basis from last year. In question 2, candidates earned the QoWC mark for the correct sequencing of scientific ideas: this mark was earned comparatively less frequently. In question 12 candidates could earn the QoWC mark for the correct use of appropriate scientific terms. The majority of able candidates did indeed earn this mark.

In general, the standard of numeracy appeared to be better than in some previous years, with few candidates reporting that they had 'no calculator'. However, many had difficulties with calculations that did not involve the use of formulae from the specification. The attention of centres is drawn to paragraph 7.5 which lists the mathematical skills which may be tested on the paper. Centres should note that it is **not** the policy of the examiners to award marks for a correct answer that has been derived by chance from an incorrectly recalled relationship.

As was the case last year, most candidates attempted every part of each question. However, there are still some candidates who do leave pages blank: they should be encouraged to attempt every part of every question.

Question 1 (Standard Demand)

This question was pleasingly well-answered by the majority of candidates.

(a) Most candidates obtained full marks, but some were confused between the ovary and the uterus. The spelling of 'fertility' caused problems to a few candidates who confused it with 'fertilisation'.

(b) The majority of candidates knew that the difference somehow involved X and Y chromosomes. However, sometimes these were attributed to the wrong sex. Others gave differences such as dominance. A very small number of candidates thought that they were being asked to describe the genitalia or secondary sexual characteristics.

Question 2 (Standard Demand)

(a) Most candidates were able to score one mark for the idea of a clone being a replica, but weaker candidates failed to refer to identical genes or DNA.

(b) There was much confusion between cloning and IVF treatment. Examiners also saw many excellent answers to the question set on last year's paper, ignoring that the question was about cloning an embryo. Thus, the majority of weaker candidates did not refer to splitting apart cells from embryos before specialisation, then implanting the resultant embryos into hosts.

Question 3 (Standard Demand)

(a) Able candidates mostly gained all three marks. The mass and atomic numbers were usually quoted, but weaker candidates were unable to use them to derive the information required. Candidates often quoted '9 protons and electrons' without clearly defining that it was nine of each. The number 9 was sometimes quoted, incorrectly, as being the number of neutrons.

(b) This attracted a large number of correct responses. The most common incorrect response was to put large numbers in the outer shell,

Question 4 (Standard Demand)

(a) In (i) only the able candidates were able to correctly balance the equation, with many candidates making no attempt. The majority of candidates obviously understood the principle, but placed the number 2 as a subscript. In part (ii) there was some improvement from last year in terms of the number of candidates who could correctly identify the meanings of the state symbols (s) and (g). However, there is still a disappointingly large number of candidates who do not appear to have learned these. 'Gram' was frequently given for (g), and 'solution' for (s).

(b) Only the most able candidates were able to work out the formula of magnesium chloride. Despite having access to the data sheet, few candidates appeared to have used it to extract data. Many that did, wrote down wrong charges. Many appeared not to know the difference between a formula and an equation, and thus tried to write equations to show how magnesium chloride could be produced.

Question 5 Standard Demand)

(a) Most of the candidates correctly worked out the ratio as 1:2. Some, however, reversed this and gave it as 2:1.

(b) Only a very small minority were able to recognise that the gases combined in simple / whole number ratios or proportions.

(c) Most candidates could correctly identify Gay-Lussac as being the scientist who was correct. Many of these however, then referred to the formula of H_2O and stated that two atoms of hydrogen were needed for every one atom of oxygen rather than referring, as the rubric stated, to the results of the experiment.

(d) Most candidates referred to bonds: the better candidates correctly referred to covalent bonds whilst the weaker ones lost the mark by calling them ionic bonds. A few candidates, perhaps still thinking of water, believed that hydrogen atoms held the two oxygen atoms together.

Question 6 (Standard Demand)

(a) Comparatively few candidates appeared to understand the workings of a microwave oven. Most believed that microwaves are the same as heat waves. Examiners read much detail about how the food is made to revolve, but very few candidates appreciated that microwaves transfer energy to the water molecules inside the food, and that energy is then transferred from water to the rest of the food. In (ii), most candidates knew the correct formula to use for the calculation, but many failed to spot that the frequency had been given as 10 000 million Hz, and used 0.03 x 10 000.

(b) A majority of candidates correctly gave seismic waves. Weaker candidates frequently gave imprecise answers such as 'transverse' or 'longitudinal'. The 'Richter scale' was frequently given as the instrument.

Question 7 (Standard Demand)

(a) Able candidates gained full marks but weaker candidates tended to confuse the relative penetrating powers of alpha and beta radiation. Often these candidates simply stated that alpha radiation would be 'too weak' and gamma radiation would be 'too strong'.

(b) In (i) only the more able candidates appeared to appreciate that radioactivity is due to the instability of nuclei. In (ii) most candidates were able to score two marks for an answer that usually involved mutation and cancer. The weaker candidates fell back on 'it kills cells'. There was general confusion about the site of mutation, the most common misconception being that 'cells mutate'

Question 8 (Standard Demand)

(a) Most candidates were able to state that the number of men dying from lung cancer had decreased during the period in question, but only the better candidates scored the second mark for giving some numerical detail. Weaker candidates gave descriptions in terms of number of smokers.

(b) Most candidates scored one mark out of the two: most could state either that the number of men dying decreased or that the number of women dying increased, but fewer noted that the number of men dying was always greater than the number of women dying.

(c) This calculation proved difficult: some candidates actually obtained an answer that was greater than the entire population. Candidates should be encouraged always to make common-sense checks with their answers.

(d) The requirement was to make a comparison between the two graphs. Whilst many candidates did do this, others simply described each graph individually, without making any links between them. Weaker candidates ignored the data and referred to health education or medical advances.

Question 9 (High Demand)

(a) A high proportion were able to identify the genotypes for P and Q. Use of the Punnett square enabled candidates to score well – usually 2 marks. Candidates using the cross-over diagram often got into trouble and only scored one. Many lost the third mark because they failed to identify the genotype for Huntingdon's disease. Compared to 2003, many more candidates did well on this type of question. The majority chose the 'correct' symbols (H,h). As last year, the candidates that chose inappropriate symbols, (usually squares or circles), found it difficult to score. Many made sketches of squares and circles making some attempt to show all the genotypes for all the people shown. This was not asked for.

(b) Many gained 1 mark. However, many wrote about the genotypes of the children of R and S rather than about the parental genotypes. A significant number mentioned 'carriers' or 'not carriers' showing they did not realise the significance of the dominant allele.

Question 10 (High Demand)

(a) Some candidates showed an excellent basic understanding and answered this very well, giving answers that would not go amiss on an AS paper. While these candidates knew that chromosomes replicate and that later, chromosome number halved, some had no real idea at all.

(b) All this question required was a basic idea of fertilisation and the resulting offspring having genetic material from both parents, but students tended to miss the key points and to write

generally about the subject. They obviously had some correct ideas but could not express them into words in a way that could gain all the marks.

(c) Too many talked about a change in a cell, not mentioning the DNA or genes. On the second part of the question, again students had the right idea but were often not specific enough to gain the marks.

Question 11 (High Demand)

(a) Some students thought that atomic number, protons and electrons were used in 1870 to generate the periodic table. However, many students showed a detailed understanding and were able to gain full marks.

(b) Most students could recognise a suitable comment from the information they were given, although some did not appear to have read the information.

(c) In (i) the majority of candidates were obviously aware that the further down the group the more reactive the element in this case. However, many were unable to explain the reason in (ii), which involved the distance of the outer shell from the nucleus, and the effect of this on the tendency to lose an electron.

Question 12 (High Demand)

(a) Able candidates often obtained full marks, including the QoWC mark, but the less able tended to confuse atoms with molecules, covalent bond with ionic bonds and energy with heat.

(b) A majority of candidates gained two marks for correctly showing four shared pairs of electrons, but some of these failed to draw the correct number of electrons in atoms W, X, Y and Z.

(c) Balancing half-equations continues to be beyond the ability of most candidates.

Question 13 (High Demand)

Ultrasound still tends to confuse most candidates.

(a) Those who read and applied the information in the introduction to the question, scored best. These candidates realised that some ultrasound waves would be reflected from the layer of muscle underneath the fat. Weaker candidates ignored this information and answered in terms of ante-natal pictures.

(b) Many realised that the oscilloscope measures time, but only the most able candidates realised that wave-speed was needed in (ii).

Question 14 (High Demand)

(a) Although this part of the question required only recall of material printed in the specification, but only the very best candidates obtained full marks. The error that alpha particles are atoms (rather than nuclei) lost most candidates half of the marks in (i). Electrons fared rather better in (ii).

(b) Almost as many candidates stated that protons change into neutrons as the reverse.

(c) It is pleasing to note that most of the able candidates can now perform this type calculation correctly. However, a significant proportion of candidates ignored the instruction to show working and therefore lost one of the marks. In (ii) many candidates forgot why the iodine-131 was used and therefore did not state that the half life should be long enough for radiation

to be able to destroy all the cancer cells. At this level 'too long a half life would make it dangerous' is too vague to gain credit.

Question 15 (High Demand)

(a) It was surprising how many students needed calculators to work out (178.5 + 1.5).

(b) Many candidates were unable to calculate a percentage and went on to give 99.2%, assuming that the same percentage of sodium would be absorbed as chloride.

(c) Understanding of the effects of ADH was limited to the most able, weaker candidates answered the two parts at random.

Question 16 (High Demand)

The concept of limiting factor not well understood, even by the more able candidates. The candidates who correctly identified the percentage of CO_2, usually limited their explanation to carbon dioxide in the greenhouse 'running out'. They generally failed to point out that there would be a high light intensity and a high temperature on a hot summer's day. Many candidates chose temperature and gave explanations in terms of wilting and stomatal closure. These are indirect effects of temperature rather than limiting effects on the process of photosynthesis.

Question 17 (High Demand)

Most candidates showed a good understanding of the Reactivity Series in parts (a) and (b). Although many mentioned electrolysis in (c), they did not always link it to the high reactivity of sodium.

Higher Tier

Paper 2 (3468/2H) Double Award

General

There were seventeen questions on this paper. The first seven were targeted at grades C and D and were common to both Foundation and Higher Tiers. These questions carried 45% of the marks.

A number of candidates were inappropriately entered for this paper. Centres should understand that approximately 55% of the marks were targeted at grades B-A*, and that borderline grade C candidates would therefore find a majority of questions well beyond their capabilities.

All candidates appeared to have had sufficient time to complete their paper. The majority of candidates attempted most questions. Candidates gained marks when their answers were precise. Vague and unspecific responses were seen for questions requiring explanations, descriptions and especially those requiring extended prose. Such responses often repeated information already given in the question of contradicted part of what was a correct answer. It should be noted that when candidates have several answers when only one or two were required, they risked not being credited for correct ideas if errors or contradictions were included in their response.

Although most candidates had knowledge of basic scientific ideas, they seemed to have difficulty in understanding some scientific words and terminology. These included bond energy, kinetic energy, radiation, current, velocity, acceleration and equilibrium. Some very common biological processes, such as energy transfer in food chains, also endothermic and exothermic chemical reactions and quantitative relationships were not well known. It should be remembered that because candidates are

asked to show their working, then an incorrectly stated relationship resulted in no marks being awarded, even if the figures were manipulated successfully and produced the correct answer.

The use of the words 'it', 'them' and 'they' meant that many candidates lost marks when their response was ambiguous. Fundamental concepts including straightforward factual recall, the understanding of key ideas and the application of these were tested throughout this paper. Candidates still need to be reminded that it is essential to read questions carefully, analyse the information and think about an answer before writing their response.

Question 1 (Standard Demand)

(a) Most candidates gave two correct reasons for the use of the land or the wood.

(b) The majority of candidates gained the first mark. A few tended to give incorrect reasons linked to size of country or size of population. In the second part most responses were correct with candidates stating a specific problem or pollutant and its effect. Most explanations correctly referred to carbon dioxide emission and its effect on global warming.

(c) The first part was well answered by most candidates. In the second part answers here again were very good with lots of well known and sometimes original ways to reduce, reuse and recycle waste.

Question 2 (Standard Demand)

(a) Most candidates were able to explain that the graph line for A was 'steeper' or that this reaction finished sooner. However, many candidates were not aware that the final volume of carbon dioxide produced for both A and B was the same.

(b) Most candidates understood that the particles would move faster. Several of these candidates were able to apply the collision theory and use the idea of more successful collisions.

Question 3 (Standard Demand)

(a) Most candidates correctly selected nitrogen, but there were many incorrect references to oxygen or hydrogen.

(b) Only the most able candidates identified that this must be an endothermic reaction.

(c) Most candidates understood that water was needed to form nitric acid from nitrogen dioxide.

(d) This part was again well answered, with most candidates correctly describing that ammonia and nitric acid react to form ammonium nitrate.

Question 4 (Standard Demand)

(a) Many candidates produced the correct answer, although the means of achieving the answer was not always clear. It should be remembered that because candidates were asked to show their working, then an incorrectly stated relationship resulted in no marks being awarded, even if the figures were manipulated successfully and produced the correct answer.

(b) Candidates usually gained at least one mark for correctly stating that the bungee jumper 'goes up'. Few candidates appreciated the significance of the gradient between 4 and 5 seconds, the negative velocity values between 5 and 6 seconds, or what happened when the velocity was zero. Many candidates seemed unable to relate the changes seen in the graph to the sequence of events in the bungee jump.

Question 5 (Standard Demand)

(a) This was generally well answered. The relationship was not as well known as expected and a mark was often lost for referring to 'mass' rather than 'force' or 'weight'.

(b) Most candidates understood that most of the wasted energy was heat energy.

Question 6 (Standard Demand)

Most candidates gained credit on this question, with the better candidates producing very good, detailed descriptions. Some weaker candidates chose simply to describe what they could see in the two diagrams rather than describe the sequence of events that would cause the circuit to break. There were, however, only a few candidates who understood that as a consequence of an increased current, the electromagnetic attraction increases and attracts the iron bolt.

Question 7 (Standard Demand)

(a) Most candidates correctly stated that the ammeter needle moved to the left or to the negative side, but few showed understanding of the idea of induced current.

(b) This was answered well by most. The main problem was that some candidates equated 'stronger magnets' with 'bigger magnets'.

Question 8 (High Demand)

Most candidates were able to explain that the energy is reduced at each stage in a food chain, although far fewer then gave four ways in which energy is transferred or 'lost'. Accounts often lacked precise use of scientific terms. An example was the term 'used up' when the candidate was attempting to describe an energy transfer. Surprisingly some candidates thought that the energy was being transferred from D $\rightarrow$ A. Others incorrectly equated the amount of energy transferred either to the size of the organism, considering A to be a large animal, or to the numbers of organisms, meaning that A had to eat a lot of B.

Question 9 (High Demand)

(a) The majority of candidates knew that carbon dioxide and methane trapped heat and that this then caused global warming and its associated consequences. However, there were far too many incorrect references to higher concentrations of carbon dioxide and methane affecting the ozone layer. Very few referred to energy / heat radiation, confining their answers to heat being reflected back and forth from the Earth and the 'blanket' of greenhouse gases. Energy / heat radiation was often incorrectly referred to as 'rays' or sometimes 'light'.

(b) Many candidates stated that carbon dioxide had a greater effect than methane but few gave correct quantitative relationship. Those who did attempt this were usually correct.

(c) In their explanations, most candidates tended to refer to methane being explosive or producing dangerous gases when burned. The production of carbon dioxide was not often stated and very few realised the consequent effect on global warming.

Question 10 (High Demand)

(a) The better candidates could derive the correct answer. However, there were a surprisingly large number who could not work out the relative formula mass of $FeSO_4$.

(b) The balancing of the chemical equation was often correct.

Question 11 (High Demand)

Most candidates could use the balanced symbol equation and the bond energies to correctly calculate the energy required to break bonds and the energy released on bond formation. The third mark was not always gained because although the energy difference was found to be – 184kJ (or 184kJ released), candidates often then stated that the reaction was endothermic. A number of candidates gained no credit because they confined their answer to a description of an exothermic reaction without mentioning bond energies.

Question 12 (High Demand)

(a) The majority of candidates used the data in the table to conclude that as the pressure increased the percentage of ammonia increased, but correct explanations were rare. When an explanation was attempted it was usually in terms of the increased pressure increasing the frequency of collisions rather than to correct references to the number of molecules on either side of the symbol equation for the reversible reaction, or simply that the forward reaction was favoured.

(b) Many candidates knew the fact that a low temperature means that the reaction would be slow or take too long.

(c) Most candidates again concluded correctly from the data in the table that an increase in temperature would cause a decrease in the percentage of ammonia. However, they attempted to explain this in terms of particle energy rather than the change in equilibrium because the backward reaction was favoured. Many candidates did understand that an increase in temperature would increase the rate of reaction but not that it would increase the rate of both the forward and backward reactions.

Question 13 (High Demand)

Many candidates used the values for mass and acceleration to correctly calculate the force. The choice of several quantities meant that the candidate needed to be able to recall the correct formula to derive force and as in all calculations, a stated incorrect relationship resulted in zero marks despite a correct answer.

Question 14 (High Demand)

(a) This calculation proved more difficult because of the relationship involved. Many candidates did not convert their final answer to kilojoules.

(b) Many candidates did not gain full credit because they did not include both the type of orbit and the purpose of the particular satellite.

Question 15 (High Demand)

Responses were generally disappointing. Too many candidates simply restated information from the stem and then went on to describe the sequence of events once the main stable period had ended. Many candidates could describe how ‘dust and gas’ were pulled together by gravity, but then wrote very vague explanations of what happened next. A minority of candidates realised that the process that released energy was called ‘nuclear fusion’. There were as many candidates who thought this energy was from the burning of hydrogen. Very few candidates understood the idea that during the main stable period of the Sun the gravitational pull is balanced by expansion forces, caused by the very high temperatures.

Question 16 (High Demand)

(a) Most candidates could identify that sample A was the most useful as it contained more of the light fraction. However, few went on to gain the second mark by giving a quantitative explanation.

(b) There was a variety of wrong answers. Many candidates drew a correct pentane molecule but then lost the mark by adding double bonds between the carbon atoms. Very few candidates gained both marks by specifying the use of heat and a catalyst. Most often a mark was gained by mentioning cracking. Some candidates confused the process with fractional distillation.

Question 17 (High Demand)

(a) Most candidates could describe the unsuitability of using fossil fuels. Those who chose nuclear power often did not gain credit because they did not refer specifically to the problems of nuclear radiation and disposal of radioactive waste.

(b) Many candidates scored well on this part. Most could describer the problems involved in the use of renewable energy sources, although most confined their answers to visual pollution.

Foundation Tier

Paper 1 (3469/F) Single Award

General

There were sixteen questions on the paper. The first eight questions were targeted at grades E, F and G and were termed Low Demand. The final eight questions, termed Standard Demand, were common to Foundation and Higher Tiers. These were targeted at grades C and D. This arrangement enables candidates to start with the easier questions before progressing to the more difficult ones at the end. As was the case last year, many of the foundation tier candidates picked up most of their marks in the first section, and comparatively few in the second section. However, the imbalance was less noticeable this year, with many candidates scoring well in questions 9 and 16.

The marks for Quality of Written Communication appeared in questions 6 and 10. This year marks were awarded on a different basis from last year. In question 6, candidates could earn the QoWC mark for the correct use of appropriate scientific terms. The majority of candidates did indeed earn this mark. In question 10 candidates earned the QoWC mark for the correct sequencing of scientific ideas: this mark was gained less often.

In general the standard of numeracy appeared to be better than in some previous years, with few candidates reporting that they had ‘no calculator’. However, many had difficulties with calculations that did not involve the use of formulae from the specification. The attention of centres is drawn to paragraph 7.5 which listed the mathematical skills which may be tested on the paper. Centres should note that it is **not** the policy of the examiners to award marks for a correct answer that has been derived by chance from an incorrectly recalled relationship.

As was the case last year, most candidates attempted every part of each question. However, there were still some candidates who did leave pages blank: they should be encouraged to attempt every part of every question.

Question 1 (Low Demand)

This proved to be a good opening question for most candidates and generally produced high scores.

(a) This was correctly answered by most candidates, although in part (iii), some hedged their bets by simply writing 'fish' without specifying which one of the three groups of fish shown on the chart they were referring to.

(b) In (i) most candidates referred to either fossil evidence or to the discovery of bones as evidence for the existence of animal X 50 million years ago. Part (ii) was again a high-scoring question, although some candidates tried to use words that were not in the box and therefore scored no marks.

Question 2 (Low Demand)

This question asked candidates to 'cross out the two lines which are wrong in each box'. Many elected to use other methods, such as circling the one they thought correct, or underlining it. Examiners did allow such answers if the intention of the candidate was clear, but in some cases it was not. Candidates should be encouraged to read the rubric carefully, and to follow the instructions. There was a wide variety of responses to this question, with very few candidates scoring zero and very few scoring a maximum. The response to questions on genetics seems to vary greatly from centre to centre. The most common error was the reversal of the terms 'dominant' and 'recessive' with respect to cystic fibrosis and Huntington's disease.

Question 3 (Low Demand)

This question scored highly for most candidates, the only common error being to confuse 'flammable' with 'oxidising agent'.

Question 4 (Low Demand)

(a) Most candidates were able to extract the correct advantages and disadvantages from the information.

(b) Most candidates were able to correctly ascribe protease; fewer ascribed lipase; and very few ascribed invertase.

Question 5 (Low Demand)

Candidates once again appeared confused between wavelength and amplitude.

(a) Candidates often gave the wavelength as 12, believing that what was required was the total length of the waves that had been drawn in the diagram.

(b) Amplitude was more often given correctly than wavelength, though a common answer was 6, being the distance from the top of the crest to the bottom of the trough.

(c) Some candidates did correctly work out the right answer, but many used incorrect relationships to do this and therefore received no marks. Where the answer was not correct, many candidates received the independent mark for a suitable unit such as Hz or waves per second.

Question 6 (Low Demand)

(a) Very few candidates appeared to recognise that this was a case of total internal reflection. The words in the box had been put there in order to help the candidates to produce a sensible answer. However, many of them chose to use the words 'critical' and 'normal' in their everyday sense rather than in their scientific sense. Thus examiners frequently saw answers

such as 'It is critical that the light enters the prism in the right direction, and it is quite normal for it to bounce off in a different direction'. Many candidates received only one mark for recognising that reflection had occurred. They were unable to explain why it occurred.

(b) Many candidates scored maximum marks, and examiners were encouraged to see a more widespread use of rulers in drawing rays of light this year.

Question 7 (Low Demand)

(a) Surprisingly, relatively few candidates recognised the resistor. Many gave 'voltmeter or ammeter' rather than volts and amps respectively.

(b) Again, a surprisingly high number of candidates did not recognise the correct equation.

(c) Most candidates obtained full marks, but weaker candidates often gave 'visible' energy rather than light.

Question 8 (Low Demand)

(a) In (i) most candidates usually obtained maximum marks. A very small number either failed to interpret the scale correctly or only drew two bars instead of three. Examiners were encouraged to see a large number of correct answers to the calculation in (ii). However, candidates should be encouraged to take note of the rubric that stated, 'Show clearly how you work out your answer'.

(b) Most candidates correctly identified the lungs as being the part to which the plasma transports carbon dioxide. The transport of urea however was not well known, with most confusing urea with urine and starting at either the bladder or the kidneys.

Question 9 (Standard Demand)

This question was pleasingly well-answered by the majority of candidates.

(a) Some candidates were confused between the ovary and the uterus, and a few believed that it was the lining of the vagina that thickened. The spelling of 'fertility' caused problems for a few candidates who confused it with 'fertilisation'.

(b) The majority of candidates knew that the difference somehow involved X and Y chromosomes. However, sometimes these were attributed to the wrong sex. Others gave differences such as dominance. A very small number of candidates thought that they were being asked to describe the genitalia or secondary sexual characteristics.

Question 10 (Standard Demand)

(a) The majority of candidates were able to give at least one correct factor, but many weaker candidates continued to refer to 'Sun' rather than light.

(b) There was the usual confusion between acid rain, ozone layer and greenhouse effect. Since most candidates did not refer to acid gases dissolving in rain water, few candidates gained the QoWC mark. Weaker candidates, as ever, restricted their answers to 'killing animals'.

Question 11 (Standard Demand)

(a) Few candidates gained all three marks. The mass and atomic numbers were often quoted, but then candidates were unable to use them to derive the information required. Candidates often quoted '9 protons and electrons' without clearly defining that it was nine of each. The number 9 was often quoted, incorrectly, as being the number of neutrons.

(b) This attracted a large number of correct responses. The most common incorrect response was to use 24 electrons, or to put large numbers in the outer shell.

Question 12 (Standard Demand)

(a) In (i) surprisingly few gave catalyst or enzyme. The more able candidates gave heating and stirring in (ii). Weaker candidates gave vague statements such as 'temperature' or 'increase the amount of peroxide'.

(b) Few candidates referred to oxygen and even fewer to its escape from the flask

Question 13 Standard Demand)

(a) A majority of the candidates correctly worked out the ratio as 1:2; some however reversed this and gave it as 2:1. The most common incorrect answer was 4:1, candidates perhaps believing that there was a pattern to be followed.

(b) Only a very small minority were able to recognise that the gases combined in simple / whole number ratios or proportions.

(c) Most candidates could correctly identify Gay-Lussac as being the scientist who was correct. Many of these however then referred to the formula of H_2O and stated that two atoms of hydrogen were needed for every one atom of oxygen, rather than referring, as the rubric stated to the results of the experiment.

(d) Reference to bonding or to electrons was all that was required, but few candidates gave either of these. A few, perhaps still thinking of water, believed that hydrogen atoms held the two oxygen atoms together.

Question 14 (Standard Demand)

(a) The more able correctly deduced that a polar orbit was required, but relatively few stated that the orbit should be low. Those who did refer to the height of the orbit, often gave ridiculously low answers such as 1000 metres. Correct reasons were rarely seen and those that were, were frequently of the level 'to scan the whole of the Earth'.

(b) Most candidates realised that gravity was involved, but there were few references to speed. Weaker candidates were usually under the impression that there was no gravitational force acting on a satellite.

Question 15 (Standard Demand)

Despite being a popular example for the use of beta radiation in textbooks, candidates did not answer this question well.

(a) There was much confusion between the relative penetrating powers of alpha and beta radiation. The most common answers simply stated that alpha radiation would be 'too weak' and gamma radiation would be 'too strong'.

(b) In (i) hardly any candidates appeared to appreciate that radioactivity was due to the instability of nuclei. In (ii), many candidates were able to pick up one mark for a rather generalised answer referring to cancer, but only the better candidates were able to score two marks for a more detailed answer. The weakest candidates simply repeated the question by stating that radiation is dangerous. Others fell back on 'it kills cells'. There was general confusion about the site of mutation, the most common misconception being that 'cells mutate'

Question 16 (Standard Demand)

In spite of the fact that this was the last question on the paper, examiners saw a very encouraging response to it. Nearly all candidates had attempted it, often at some length, and many scored the majority of the marks available.

(a) Most candidates were able to state that the number of men dying from lung cancer had decreased during the period in question, but only the better candidates scored the second mark for giving some numerical detail. Weaker candidates gave descriptions in terms of number of smokers.

(b) Most candidates scored one mark out of the two: most could state either that the number of men dying decreased or that the number of women dying increased, but fewer noted that the number of men dying was always greater than the number of women dying.

(c) This calculation proved difficult: some candidates actually obtained an answer that was greater than the entire population. Candidates should be encouraged always to make common-sense checks with their answers.

(d) The requirement was to make a comparison between the two graphs. Whilst many candidates did do this, others simply described each graph individually, without making any links between them. Weaker candidates ignored the data and referred to health education or medical advances.

Higher Tier

Paper 1 3469/H

General

There were seventeen questions on the paper. The first eight questions were targeted at grades C and D and were termed Standard Demand. These questions were common to Foundation and Higher Tiers. The final nine questions, termed High Demand, were targeted at grades B, A and A*. This arrangement enables candidates to start with the easier questions before progressing to the more difficult ones at the end. As was the case last year, many of the weaker candidates picked up most of their marks in the first section, and comparatively few in the second section. Many of these candidates would have been more appropriately entered for the Foundation Tier Paper

The marks for Quality of Written Communication appeared in questions 2 and 12. This year marks were awarded on a different basis from last year. In question 2, candidates earned the QoWC mark for the correct sequencing of scientific ideas: this mark was earned comparatively less frequently. In question 12 candidates could earn the QoWC mark for the correct use of appropriate scientific terms. The majority of able candidates did indeed gain this mark.

In general the standard of numeracy appeared to be better than in some previous years, with few candidates reporting that they had ‘no calculator’. However, many had difficulties with calculations that did not involve the use of formulae from the specification. The attention of centres is drawn to paragraph 7.5 which listed the mathematical skills which may be tested on the paper. Centres should note that it is **not** the policy of the examiners to award marks for a correct answer that has been derived by chance from an incorrectly recalled relationship.

As was the case last year, most candidates attempted every part of each question. However, there were still some candidates who did leave pages blank: they should be encouraged to attempt every part of every question.

Question 1 (Standard Demand)

This question was pleasingly well-answered by the majority of candidates.

(a) Most candidates obtained full marks, but some candidates were confused between the ovary and the uterus. The spelling of 'fertility' caused problems to a few candidates who confused it with 'fertilisation'.

(b) The majority of candidates knew that the difference somehow involved X and Y chromosomes. However, sometimes these were attributed to the wrong sex. Others gave differences such as dominance. A very small number of candidates thought that they were being asked to describe the genitalia or secondary sexual characteristics.

Question 2 (Standard Demand)

(a) Almost all candidates scored two marks, usually for stating space and light or nutrients.

(b) This part of the question carried a mark for Quality of Written Communication. To score this, the candidate had to express the complete idea of sulphur dioxide dissolving or reacting with rainwater and the resulting acid then being harmful to plants and animals or damaging to buildings. Many scored two marks for acid rain and its damaging effects but many were unable to say how the acid was formed, even though the idea of sulphur dioxide 'mixing with clouds' was allowed. Many included sulphur dioxide as being the cause of global warming or the destruction of the ozone layer or both, so could only gain a maximum of one mark.

Question 3 (Standard Demand)

(a) Able candidates usually gained all three marks. The mass and atomic numbers were usually quoted, but weaker candidates were unable to use them to derive the information required. Candidates often quoted '9 protons and electrons' without clearly defining that it was nine of each. The number 9 was sometimes quoted, incorrectly, as being the number of neutrons.

(b) This attracted a large number of correct responses. The most common incorrect response was to put large numbers in the outer shell.

Question 4 (Standard Demand)

(a) Most candidates gave catalyst or enzyme in (i). Most scored at least one mark for heating, stirring or increasing the concentration of peroxide in (ii). More able candidates also gave the addition of more manganese dioxide. A significant number incorrectly gave the addition of more hydrogen peroxide.

(b) The quality of answers to this part was very disappointing. Even able candidates thought that the mass decreased because a gas was produced and that gases are lighter than liquids. Many thought that the hydrogen peroxide evaporated into the flask.

Question 5 (Standard Demand)

(a) Most of the candidates correctly worked out the ratio as 1:2. Some, however, reversed this and give it as 2:1.

(b) Only a very small minority were able to recognise that the gases combined in simple / whole number ratios or proportions.

(c) Most candidates could correctly identify Gay-Lussac as being the scientist who was correct. Many of these however then referred to the formula of H_2O and stated that two atoms of hydrogen were needed for every one atom of oxygen, rather than referring, as the rubric stated, to the results of the experiment.

(d) Most candidates referred to bonds: the better candidates correctly referred to covalent bonds whilst the weaker candidates lost the mark by calling them ionic bonds. A few, perhaps still thinking of water, believed that hydrogen atoms held the two oxygen atoms together.

Question 6 (Standard Demand)

(a) A large number did not read the question and went on at length to explain how a geostationary satellite would be used. Many were able to state or to give the idea of a polar orbit but had no real idea of height, often stating that it would be low but then going on to say that it would be in the atmosphere or on its edge. Having stated an orbit, many were able to explain that it needed to be low to 'get clear pictures' but had difficulty explaining with any clarity, the need for it to be over the poles.

(b) Most knew that gravity was involved, but very few went on to include the speed factor. A number of weaker candidates went into a lengthy explanation of how the lines on the shuttle kept it in orbit.

Question 7 (Standard Demand)

(a) Able candidates gained full marks but weaker candidates tended to confuse the relative penetrating powers of alpha and beta radiation. Often these candidates simply stated that alpha radiation would be 'too weak' and gamma radiation would be 'too strong'.

(b) In (i) only the more able candidates appeared to appreciate that radioactivity is due to the instability of nuclei. In (ii) most candidates were able to score two marks for an answer that usually involved mutation and cancer. The weaker candidates fell back on 'it kills cells'. There is general confusion about the site of mutation, the most common misconception being that 'cells mutate'

Question 8 (Standard Demand)

(a) Most candidates were able to state that the number of men dying from lung cancer had decreased during the period in question, but only the better candidates gained the second mark for giving some numerical detail. Weaker candidates gave descriptions in terms of number of smokers.

(b) Most candidates scored one mark out of the two: most could state either that the number of men dying decreased or that the number of women dying increased, but fewer noted that the number of men dying was always greater than the number of women dying.

(c) This calculation proved difficult: some candidates actually obtained an answer that was greater than the entire population. Candidates should be encouraged always to make common-sense checks with their answers.

(d) The requirement was to make a comparison between the two graphs. Whilst many candidates did do this, others simply described each graph individually, without making any links between them. Weaker candidates ignored the data and referred to health education or medical advances.

Question 9 (High Demand)

(a) A high proportion was able to identify the genotypes for P and Q. Use of the Punnett square enabled candidates to score well – usually 2 marks. Candidates using the cross-over diagram often got into trouble and only scored one. Many lost the third mark because they failed to identify the genotype for Huntingdon's disease. Many more candidates did well on this type of question compared to 2003. The majority chose the 'correct' symbols (H,h). As last year, those that chose inappropriate symbols, (usually squares or circles), found it difficult to score. Many candidates made sketches of squares and circles making some attempt to show all the genotypes for all the people shown. This was not asked for.

(b) Many gained 1 mark. However, many wrote about the genotypes of the children of R and S rather than about the parental genotypes. A significant number mentioned 'carriers' or 'not carriers' showing they did not realise the significance of the dominant allele.

Question 10 (High Demand)

(a) Some candidates showed an excellent basic understanding and answered this very well, giving answers that would not go amiss on an AS paper. While these students knew that chromosomes replicate and that later, chromosome number halved, some had no real idea at all.

(b) All this question required was a basic idea of fertilisation and the resulting offspring having genetic material from both parents, but students tended to miss the key points and to write generally about the subject. They obviously had some correct ideas but could not express them into words in a way that could gain all the marks.

(c) Too many talked about a change in a cell, not mentioning the DNA or genes. On the second part of the question, again students had the right idea but were often not specific enough to gain the marks.

Question 11 (High Demand)

(a) Some students thought that atomic number, protons and electrons were used in 1870 to generate the periodic table. However, many students showed a detailed understanding and were able to access full marks.

(b) Most students could recognise a suitable comment from the information they were given, although some students did not appear to have read the information.

(c) In (i) the majority of students were obviously aware that the further down the group the more reactive the element in this case. However many were unable to explain the reason in (ii), which involved the distance of the outer shell from the nucleus and the effect of this on the tendency to lose an electron.

Question 12 (High Demand)

(a) In (i) able candidates were able to score three marks by correctly extracting 175 and 130 from the graph, carrying out the correct subtractions and dividing 45 by 20. A large number were able to extract 175 and 130 but then went on to make some very involved and incorrect calculations that could not even pick up a mark for errors carried forward. In (ii) able candidates recognised the fact that the amount of reactants was diminishing as time increased. Very few were able to give an answer in terms of the number of collisions taking place each second.

(b) Some very good answers were given in terms of the cost of enzymes having to be separated from the product at the end of a batch process and / or not being able to use them again, so

more expensive enzymes are needed. Some good answers were also given in terms of immobilised enzymes being used in continuous processes. Few mentioned the labour costs involved. The majority of weaker candidates answered in terms of stopping and starting batch processes and so failed to score.

Question 13 (High Demand)

Ultrasound still tends to confuse most candidates.

(a) Those who read and applied the information in the introduction to the question scored best. These candidates realised that some ultrasound waves would be reflected from the layer of muscle underneath the fat. Weaker candidates ignored this information and answered in terms of ante-natal pictures.

(b) Many realised that the oscilloscope measures time, but only the most able candidates realised that wave-speed was needed in (ii).

Question 14 (High Demand)

(a) Although this part of the question required only recall of material printed in the specification, only the very best candidates obtained full marks. The error that alpha particles are atoms (rather than nuclei) lost most candidates half of the marks in (i). Electrons fared rather better in (ii).

(b) Almost as many candidates stated that protons change into neutrons as the reverse.

Question 15 (High Demand)

(a) Few candidates were able to answer in simple terms of the Universe starting in one place with a big explosion and expanding ever since. The majority confused the question with the origin of our solar system and so failed to score.

(b) To score the mark for Quality of Written Communication, candidates had to link the ideas of galaxies moving away from us / each other shown by light shifting to the red end of their spectrum and the bigger the shift the greater the distance from us. Only the most able scored all three marks on this question. It was clear that many candidates had no knowledge of this part of the specification.

Question 16 (High Demand)

(a) It was surprising how many students needed calculators to work out (178.5 + 1.5).

(b) Many candidates were unable to calculate a percentage and went on to give 99.2%, assuming that the same percentage of sodium would be absorbed as chloride.

(c) Understanding of the effects of ADH was limited to the most able: weaker candidates answered the two parts at random.

Question 17 (High Demand)

(a) Few gave good clear answers in terms of decommissioning costs or the problems in disposal of waste nuclear fuel. Most answered in terms of pollution and radioactive leaks.

(b) In (i) a large number of candidates confused tidal power stations with wind turbines, wave power and hydroelectric power. Few appreciated the size involved, the difficulty and cost of building in water or the relatively small amount of electricity generated (and therefore a large barrage is needed). In (ii) many thought that the waves around Britain were too small or that

there were not enough tides. Some good answers were given in terms of habitat destruction, few suitable estuaries to build them, or rivers silting up.

(c) (d) Abler candidates scored all four of these marks. They understood the significance of the boiling points and were able to state that the hydrocarbons were unsaturated, had double bonds or that they were alkenes.

Module Tests

346001, 346002, 346005, 346006, 346009, 346010, Double Award 346013, 346015, 346017, Single Award

Each test consisted of ten multiple choice type questions to be completed in 30 minutes. Five questions were common to both Foundation and Higher Tiers. Tests for all modules were available in the Winter, Spring and Summer sessions. Candidates could take the tests in any order and could sit either tier for each test. The tier of the terminal paper determined the tier of award.

Centres received the raw mark grade boundaries obtained in each test series, along with the UMS (uniform mark scores) for each candidate, before the entry date for the next series of tests. Use of uniform marks took account of the varying degree of difficulty of different versions of the tests.

At the end of the course the total uniform marks for all candidates were standardised against aggregations for the written papers and coursework. This process accounted for differences in the ability of the cohorts of candidates taking each test, as measured against their performance on the terminal papers. All marks were then combined in the normal way to give the total mark and final grade boundaries for the subject.

Teachers should note that the uniform marks for each test were more important for a candidate's final grade than the notional, advisory grade for that test. Candidates at grades A* - D tended to achieve slightly higher final grades than indicated by an average of their module test grades.

Centre-assessed component

General

This was the second year of the operation of the amended assessment scheme for Sc1. Most centres followed the procedures correctly, producing well-annotated and internally moderated work. Consequently, moderators found that they were generally in close agreement with the marks awarded by the centres. Centres that did not follow the procedures correctly also tended to have a lower standard of annotation and internal moderation and were therefore more likely to be out of tolerance

Administration

Most centres this year returned their requested sample quickly with relatively few requiring follow up calls. However, some were returned incomplete and in some cases the Candidate Record forms had candidate numbers or signatures missing. Some centres had not completed the marks on the back of the Candidate Record Form or did not highlight which marks had contributed to the final total. This is essential, and if not completed will mean that the moderator must return the work to the centre for this to be done, leading to inevitable delays that may possibly hold up the issue of results for the centre.

More discrepancies between the marks on the Candidate Record Forms and Centre Mark Sheets were noticed this year.

The due date for the submission of coursework is always May 5th. As moderators have to work to a very tight time-scale, it would be much appreciated if any centres that are in a position to submit their samples before this date could do so. Some delays were caused this year by centres not submitting both the pink and yellow sheets of the Centre Mark Sheet forms. It would also be of great help if centres could submit to the moderator a list of their candidates in rank order.

Annotation of Candidates' Work

Most centres had annotated their candidates' work in a way that considerably helped the moderation process. A few centres had not annotated at the point where they wished to award the mark – instead preferring to use checklists or a short summary at the end of the piece of work allied to an overall mark: this caused considerable difficulties during the moderation process in trying to decide why a particular mark had or had not been awarded.

Choice of Suitable Tasks

Most centres had chosen suitable tasks for their candidates to investigate; however, the range of investigations tended to be very restricted, i.e. Osmosis, Photosynthesis, Rates of Reaction, and Resistance comprised about 80% of the total. A few centres chose tasks that were not suitable.
Very few new investigations were seen and very little IT work. There was little use of data-logging.

Single Skill Investigations

A small number of these were seen, all used to fill gaps in pupils' portfolios and mainly in Skill Areas A and E. The information that the pupils had been given was not always forwarded to the moderator. It is very difficult to assess whether the candidate has been able to confirm the prediction made or evaluate the method employed if the moderator is not informed of these details.

Application of the Criteria

Nearly all centres took account of the hierarchy principle of the criteria and the Level of Demand arrow – though some centres still were awarding high marks, particularly in the Skill Area O, for very low demand activities e.g. measuring refraction, dissolving, or dropping parachutes.

Skill Area P

Centres should make sure that when a 'brain-storming' session has taken place prior to the investigation, the method written up by the candidate is the candidate's own work. This year moderators noticed an increase in the number of instances where the work of several candidates at a centre was very similar. Teachers are reminded of the need to ensure and confirm that each candidate's work is his or her own: in cases where there appeared to be an undue amount of collusion, moderators had to refer work to the Malpractice Unit at AQA for further enquiries to be made. In some cases it appeared that the results of a 'brain-storming' session had been left on the board, and candidates had simply copied them.

In a similar vein, teachers should make sure that they do not provide candidates with 'prompt sheets' that are so specific that they are virtually a set of instructions. Prompt sheets can serve a useful purpose provided that they are generic and leave candidates sufficient opportunity to make their own decisions.

For **P.4a** and **P.6a**, candidates obviously need to consider other factors that may influence the outcome of the investigation in order to ensure that they carry out a fair test. However, some

candidates are taking this to extremes: they end up writing several pages covering a survey of all different aspects of the investigation before deciding to carry out just one aspect. In some cases they even carry out the practical work for several aspects. This is not necessary and in extreme cases led to moderators trying to decide which particular aspect had been awarded the marks by the centre.

For **P.4b**, a diagram showing how the equipment is to be used, together with a list of apparatus to be used will usually suffice.

A few centres awarded high marks when there was insufficient evidence of detailed scientific knowledge and understanding to support it.

The award of **P8b** has generally improved, but still caused some problems for some centres. The easiest way to obtain the mark is to carry out a preliminary practical experiment – however the candidates need to be aware that they must report their results and say how this has informed their plan.

Skill Area O

The presentation of tables of results was generally good, although **O.6b** was quite frequently awarded when the units were incorrect or had been omitted. **O.6a** had been awarded in some instances where candidates did not carry out repeats when their results clearly contained errors.

One of the difficulties that centres seem to have is deciding whether, a piece of work which is worth 6 marks in Skill Area O should be considered for 7 or 8 marks**.** This year, **O.8a** had occasionally been awarded when the level of demand of the activity was insufficient or there was insufficient evidence of the degree of accuracy. One useful 'rule-of-thumb' to apply is to check if any of the results are more than ± 10% from the mean: if so, it is doubtful that the requirements of **O.8a** will have been met. Another good indicator is the standard of the graph that the candidate has drawn.

Skill Area A

Most candidates were able to report the conclusions from the results they had obtained, but a few presented a graph with no comment whatsoever.

The standard of the graphical work varied considerably. Some centres were still awarding **A.6a** despite their candidates not choosing suitable scales, incorrectly labelling axes and not drawing a correct line of best fit. Often, candidates did not show the true origin of the graph, and were therefore make spurious conjectures concerning direct proportionality based on a selected and highly magnified portion of the results. Some centres did not appreciate that **A.6a** could be awarded for numerical processing e.g. calculating the resistance of a wire.

It should be remembered that if an investigation is chosen that involves categoric variables, then it will not be possible to comment upon any pattern or trend in the results.

In **A.8a** the quality of the scientific knowledge and understanding was not always at the level required for the award of this mark. Similarly in **A.8b** the appropriate depth of analysis was not always at the correct level, with candidates not always explaining the extent to which the conclusion supported their prediction.

A.8b still presents difficulties for candidates to attain. Numerical processing of the graph would often help access to this Mark Description.

Skill Area E

This was still the area that caused the candidates most difficulty. Again marks were often given for work that was not at the level expected.

E.6a often lacked an explanation as to why results were anomalous and specific comments on the reliability of the evidence obtained.

E.6b was often awarded for using a different variable or a statement to take more results rather than showing how additional information could be provided and used to further the evidence.

Summary

The overall impression this year was that the standard of work seen was very similar or slightly better than that of last year. As the criteria upon which the marks are based is unchanged, and bearing in mind the very large entry size, the moderators saw no reason to change the grade boundaries from those of last year. The grade boundaries are therefore as follows:

Double Award

Max mark	A*	A	B	C	D	E	F	G
60	53	47	41	36	30	25	20	15

Single Award

Max mark	A*	A	B	C	D	E	F	G
30	27	24	21	19	16	13	10	7

Mark Ranges and Award of Grades

Science: Double Award (Modular) (3468)

Foundation tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper 1 3468/1F	90	175	69.8	21.7
Paper 2 3468/2F	90	175	72.3	23.3
Module Tests 3468/M	300	210	100.0	23.4
Coursework 3462/8/C	60	140	78.6	22.2
Foundation tier overall 3468	540	700	320.9	76.5

		Max. mark	C	D	E	F	G
3468/1F boundary mark	raw	90	45	37	29	22	15
	scaled	175	87	72	56	43	29
3468/2F boundary mark	raw	90	48	39	30	22	14
	scaled	175	93	76	58	43	27
3468/M boundary marks	raw	300	170	145	120	95	70
	scaled	210	119	102	84	67	49
3462/8/C boundary mark	raw	60	36	30	25	20	15
	scaled	140	84	70	58	47	35
Foundation tier scaled boundary mark		700	372	314	256	199	142

Higher tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper 2 3468/1H	90	175	85.0	27.4
Paper 2 3468/2H	90	175	76.8	27.2
Module Tests 3468/M	300	210	145.1	20.1
Coursework 3462/8/C	60	140	103.6	17.7
Higher tier overall 3468	540	700	410.7	79.1

		Max. mark	A*	A	B	C	D	allowed E
3468/1H boundary mark	raw	90	66	54	42	30	25	-
	scaled	175	128	105	82	58	49	-
3468/2H boundary mark	raw	90	63	51	39	28	19	-
	scaled	175	123	99	76	54	37	-
3468/M boundary mark	raw	300	251	224	197	170	145	-
	scaled	210	176	157	138	119	102	-
3462/8/C boundary mark	raw	60	53	47	41	36	30	-
	scaled	140	124	110	96	84	70	-
Higher tier scaled boundary mark		700	523	454	385	316	257	227

Provisional statistics for the award

Foundation tier (289,122 candidates)

	C	D	E	F	G
Cumulative %	26.9	53.0	74.9	89.3	96.3

Higher tier (151,442 candidates)

	A*	A	B	C	D	allowed E
Cumulative %	9.3	27.9	59.8	89.1	97.8	99.1

Overall (440,564 candidates)

	A*	A	B	C	D	E	F	G
Cumulative %	3.2	9.6	20.6	48.3	68.4	83.2	92.7	97.3

Science: Single Award (Modular) (3469)

Foundation tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
3469/F	90	175	63.6	21.2
3469/M	150	105	43.6	13.1
3463/9/C	30	70	37.3	10.7
Foundation tier overall 3469	270	350	144.4	37.5

		Max. mark	C	D	E	F	G
3469/F boundary mark	raw	90	50	42	34	26	18
	scaled	175	97	82	66	51	35
3469/M boundary marks	raw	150	86	73	60	47	34
	scaled	105	60	51	42	33	24
3463/9/C boundary marks	raw	30	19	16	13	10	7
	scaled	70	44	37	30	23	16
Foundation tier scaled boundary mark		350	189	161	134	107	80

Higher Tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
3469/H	90	175	58.1	24.3
3469/M	150	105	67.8	10.7
3463/9/C	30	70	49.9	9.1
Foundation tier overall 3469	270	350	176.0	36.7

		Max. mark	A*	A	B	C	D	allowed E
3469/H boundary mark	raw	90	62	49	36	24	16	-
	scaled	175	121	95	70	47	31	-
3469/M boundary marks	raw	150	127	113	99	86	73	-
	scaled	105	89	79	69	60	51	-
3463/9/C boundary marks	raw	30	27	24	21	19	16	-
	scaled	70	63	56	49	44	37	-
Higher tier scaled boundary mark		350	249	216	183	151	120	104

Provisional statistics for the award

Foundation tier (24,182 candidates)

	C	D	E	F	G
Cumulative %	12.2	30.2	53.4	76.0	89.5

Higher tier (2,548 candidates)

	A*	A	B	C	D	allowed E
Cumulative %	3.5	14.7	39.8	74.8	93.2	97.1

Overall (26,730 candidates)

	A*	A	B	C	D	E	F	G
Cumulative %	0.3	1.4	3.8	18.1	36.2	57.6	78.0	90.2

Definitions

Boundary Mark: the minimum (scaled) mark required by a candidate to qualify for a given grade. Although component grade boundaries are provided, these are advisory. Candidates' final grades depend only on their total marks for the subject.

Mean Mark: is the sum of all candidates' marks divided by the number of candidates. In order to compare mean marks for different components, the mean mark (scaled) should be expressed as a percentage of the maximum mark (scaled).

Standard Deviation: a measure of the spread of candidates' marks. In most components, approximately two-thirds of all candidates lie in a range of plus or minus one standard deviation from the mean, and approximately 95% of all candidates lie in a range of plus or minus two standard deviations from the mean. In order to compare the standard deviations for different components, the standard deviation (scaled) should be expressed as a percentage of the maximum mark (scaled).