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ASSESSMENT and QUALIFICATIONS ALLIANCE

Report on the Examination

Science: Single and Double Award (Modular)

■ General Certificate of Secondary Education

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Paper 1 (3468/1F) Double Award

General

There were twenty questions on the paper. The first ten questions were targeted at grades E, F and G. These questions carried approximately 55% of the marks. The final ten questions were common to Foundation and Higher Tiers. They 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. It was therefore not surprising that the foundation tier candidates picked up most of their marks in the first ten questions, then comparatively few in the second ten. There was no evidence that significant numbers of candidates were inappropriately entered for this tier.

The general standard of English and the legibility of the writing appeared to be good – indeed better than in some previous years. Students who scored the maximum number of science points in questions 7 and 13 rarely lost a mark because the quality of written communication was considered below the required standard.

Most of the able candidates attempted every part of each question, leaving comparatively few blank spaces. However, weaker candidates frequently did not attempt several questions targeted at grades C and D.

Question 1 (Low Demand)

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

(a) The majority of candidates were able to score full marks. In a few cases however, the candidates had not followed the instructions in the rubric concerning the method of indicating their answers. In general, the candidates' intentions were clear but in a few cases there were so many crossings out, ringing and re-writing that it was difficult for examiners to decide what the candidate had intended.

(b) This proved to be more demanding, with only a minority of the candidates realising that evidence came from a comparison between fossils and present day specimens. Most of the other candidates either talked about the dating of fossils or left the question unanswered.

Question 2 (Low Demand)

This question on genetics was again well answered although, as with part (a) of question 1, a few candidates made rather a mess of indicating their intended answers. The most common errors were the failure to select the correct name for 'inherited factors' and the failure to appreciate that these inherited factors are passed on via the gametes.

Question 3 (Low Demand)

(a) Most candidates correctly read the figure of 220 from the graph as the melting point of fluorine, although many omitted the minus sign. A few misinterpreted the direction of the scale and therefore gave 280 as the answer.

(b) Almost as many candidates selected bromine as the element that is solid at room temperature, as chose iodine, with a few choosing fluorine.

(c) This proved rather more difficult for the candidates, with evidence that not all had referred to the periodic table as requested in the rubric. Many candidates did not appear to understand the term 'trend' and therefore tended to refer to the reactivity of the elements, whilst others referred to the boiling point rather than the melting point. Of those who did correctly refer to melting point, some of the answers were very vague, such as 'they get easier to melt as you go up the group', or 'they melt faster'.

(d) It was apparent that the properties of metals and non-metals were not generally well known. It may be that some candidates misread the question and thought they were being asked for the properties of metals. A few candidates did not realise that they were required to tick two boxes and only ticked one.

Question 4 (Low Demand)

Very few candidates were able to score maximum marks in this question. It was common to see molecule B described as being carbon dioxide instead of carbon monoxide, with CO_2 given as the formula. Molecule C was just as often described as hydrogen oxide (which was allowed by the examiners) as it was as water, although the formula was often correct. Very few candidates could name molecule D as ammonia, although they often obtained the correct formula.

A large number of candidates quoted the formulae in an unconventional format, e.g., H_3N rather than NH_3, although this was accepted by the examiners. Several candidates lost marks by using superscripts, e.g., NH^3 instead of NH_3. Teachers should advise their candidates to take care when writing chemical formulae, as answers such as Co_2 or CO2 will not be accepted.

Question 5 (Low Demand)

In this question it appeared that the uses of ultra violet rays and X-rays were better known than microwaves, gamma rays or infrared waves. Only a very small number of candidates left one of the types of radiation not joined to any of the uses. Many candidates were able to score maximum marks and the vast majority followed the instructions in the rubric correctly.

Question 6 (Low Demand)

(a) Many candidates seemed unaware that they needed to use a ruler. Often, a freehand line appeared to be curved and therefore examiners were unable to award a mark. Candidates were instructed to show how the light waves reach the eye but in some cases the lines stopped well short of the eye. A common error was to show refraction occurring in the middle of the tank at the point where the candidate's own line started, and then no refraction when the ray left the tank.

(b) This discriminated well, with the best candidates scoring maximum marks. Many thought that the light changes colour and there was often confusion between reflection and refraction.

Question 7 (Low Demand)

(a) Few candidates scored both marks. Most seemed unsure how to calculate the number of electrons in the atom or its mass number.

(b) Most candidates were able to gain some credit. The majority earned two marks by being able to state that it was the radiation that was dangerous and by specifying what this danger was e.g., damaging cells or causing cancer. Very few candidates appreciated that a low dose over a long period of time can be just as dangerous as a high dose over a short period of time. A few candidates missed the point of the question entirely and referred to the rocks crumbling as they decayed and falling down on people's houses.

Question 8 (Low Demand)

(a) Candidates showed that they were extremely adept at making pie charts. In a few cases however, the shading was so similar on the three sections that they had entered that it was sometimes very difficult for examiners to determine where one stopped and the next began.

(b) The link between respiration and breath was well known, although candidates sometimes had the order incorrect. Urine was usually correctly quoted as the way in which urea leaves the body but the fact that it is produced from amino acids was not so well understood.

Question 9 (Low Demand)

Most candidates correctly followed the rubric and ticked three boxes. Those who ticked more than three were penalised. Most managed to obtain at least one mark, with the best candidates picking up all three.

Question 10 (Low Demand)

Virtually all candidates realised that the anus is at the end of the digestive system. However, more than half of the candidates had the small and large intestines in the wrong order.

Question 11 (Standard Demand)

(a) Most candidates could name at least one correct gland (usually the ovary). When the pituitary gland was chosen, the spelling was often phonetic.

(b) Many candidates failed to realise that the question was still dealing with hormones and therefore gave a range of contraceptive devices that did not involve hormones. Others concentrated their answers around 'menstruation'. Large numbers did little more than re-state the question, mentioning only that hormones can increase or decrease fertility, rather than answering in terms of enhancing egg release or preventing egg release.

Question 12 (Standard Demand)

(a) The better candidates knew the term 'asexual', although 'artificial' and 'cloning' were very common responses.

(b) Most candidates realised that the genetic information was carried in the nucleus, although many found it difficult to express their ideas clearly. The majority thought that the nucleus carries 'characteristics'. Some candidates referring to the diagram, stated that the skin, hair and muscles were all contained in the body cell.

(c) Only the best candidates realised that the cloned embryo could be divided. Most simply talked of repeating the whole process from the beginning.

Question 13 (Standard Demand)

This proved to be a difficult question for the foundation tier candidates, for many reasons. The topic itself is conceptually difficult, having been moved from higher tier to foundation tier in the most recent revision of the national curriculum. The answer involved comprehension skills and many candidates found it difficult to express their ideas clearly in free response prose.

(a) Many candidates appeared confused as to whether it was the bacteria or the cattle that had become resistant to the antibiotics. Most answers were very vague and talked of either the bacteria 'getting used to' the antibiotics or of the bacteria 'fighting' the antibiotics. Answers in terms of bacterial immunity or adaptation were very common. Few mentioned mutation or variation.

(b) This proved slightly easier for candidates to pick up marks, with most being able to express an opinion one way or another and give a valid reason for their choice. However, ideas were frequently not expressed very clearly.

Question 14 (Standard Demand)

(a) This question discriminated well amongst the candidates, the best being able to score maximum marks but the weakest not picking up any.

(b) Group 1 was usually correctly given but Group 2 was not so well known. Many candidates gave transition metals or even Group 0.

Question 15 (Standard Demand)

It was just as common to see 7 electrons indicated in the outer shell as the correct 8, with hardly any candidates showing the minus sign.

(a) Only a few were able to state that (l) stood for liquid, many thinking that it was the number one. Hardly any knew that (aq) stood for aqueous.

(b) This part was often not attempted by weaker candidates. In part (i), several realised that the KBr and the KCl should have the number 2 associated with them but put them as subscripts instead of showing them as the number of moles. The better candidates were able to score a mark in part (ii) for realising that chlorine is more reactive than bromine. However, weaker candidates often spoke of chlorine as being stronger or more powerful.

Question 16 (Standard Demand)

Responses were, on the whole, disappointing.

(a) Many of the candidates simply wrote the letters W and A somewhere on the wave, without any attempt to indicate a distance. Others indicated distances with such imprecision that examiners were unable to award them a mark. Many candidates believed that the amplitude was the height from the top of a crest to the bottom of a trough, i.e. double the correct answer.

(b) Many candidates wrote down 'speed = distance/time' and then got no further. Many candidates divided 0.1 by 2. Often the unit was missing or was incorrect.

Question 17 (Standard Demand)

Of the candidates who correctly identified the radiation as beta, nearly all could give a correct explanation for the reason. However, many candidates did not even latch on to the fact that the scene

was set in a nuclear power station. Thus it was common to see all sorts of radiation quoted, including ultraviolet, infrared and even in one case, tidal waves.

Question 18 (Standard Demand)

This proved to be probably the most difficult question on the paper for the foundation tier candidates. The better ones realised that waves travelled through the fluid (which was often thought erroneously to be water). However, hardly any candidates appreciated how these waves could then dislodge the dirt particles. It was common to see reference to the waves dissolving the dirt or killing bacteria on the watch.

Question 19 (Standard Demand)

(a) Those candidates who obtained any marks, generally did so for simply stating that in the lungs, the blood gains oxygen and loses carbon dioxide. However, many candidates failed to make any reference to the blood and simply spoke of oxygen entering the lungs and carbon dioxide leaving. Very few candidates made a correct numerical reference to the composition of the blood.

(b) Plasma was rarely mentioned as being the way in which most of the carbon dioxide is transported, the white blood cells being the most common incorrect answer. However, most candidates knew that the red blood cells were responsible for transporting oxygen.

Question 20 (Standard Demand)

Most candidates correctly identified sodium nitrate, with fewer correctly identifying potassium sulphate (potassium sulphide was a common mistake). For the formulae. a good proportion were able to quote $NaNO_3$ correctly but very few were able to come up with the correct formula for potassium sulphate, KSO_4 or KS being the most common incorrect answers.

Foundation Tier

Paper 2 (3468/2F) Double Award

General

There were twenty questions on this paper. The first thirteen questions 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. Candidates gained marks when their answers were precise. Vague and unspecific responses were often seen for questions requiring explanations or descriptions. Such responses frequently repeated information already given in the question or contradicted part of what was a correct answer. It should be noted that where 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 atom, current, molecule, potential difference, resistance, respiration, spin and yield. Some very common biological processes, chemical reactions and physical equations were not well known. Experimental procedures were not understood as well as might have been expected.

The use of words 'it', 'them' and 'they' meant that many candidates lost marks when their response was ambiguous. One area of concern was the way in which some candidates represented chemical formulae: CO_2 is correct but CO^2 and CO2 are incorrect. Fundamental concepts, including straightforward factual recall, the understanding of key ideas and the application of these, were tested throughout the 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 (Low Demand)

The sentences were completed correctly in most papers. One frequent error was to give the better conditions for microorganisms as 'cool' and 'dry' instead of 'warm' and 'moist'. The most common mistake was to conclude that substances released by the decay of waste plant material are used by plants to 'respire' instead of 'grow'.

Question 2 (Low Demand)

(a) Most candidates identified correctly a reason why it would be more difficult for some animals or plants to survive.

(b) Candidates who had not read carefully that the types of chemicals spread on fields were required, gave incorrect responses such as, 'oil', 'sulphur dioxide' or 'acid'.

Question 3 (Low Demand)

Generally good descriptions were given about the benefits of the Arctic fox having thick, white fur. The idea of camouflage was well known, although vague responses such as, 'to provide protection' were not credited. The idea of insulation, although known, was often poorly expressed and incorrect responses such as 'to <u>provide</u> heat' or 'to <u>give</u> warmth' were often given.

Question 4 (Low Demand)

(a) Many candidates described the predator-prey relationship, rather than the seasonal fluctuations which they were asked to describe and that the number of greenfly was decreasing over the three years.

(b) This was usually correct although there were vague responses such as 'food'. The incorrect idea that 'greenfly eat ladybirds' was often seen, even though the stem stated that ladybirds feed on greenfly.

Question 5 (Low Demand)

(a) The hazard symbol on the hydrogen cylinder was well known, although a surprising number of candidates thought it meant that it could be used to put out fires.

(b) A large number of the candidates were unable to name H_2O as water and identified this as hydrogen oxide, for which on this occasion, credit was given. A frequent incorrect response was to name H_2O as hydroxide.

(c) Most candidates knew that a catalyst is used to make a reaction faster.

Question 6 (Low Demand)

(a) Many candidates were able to correctly identify the specific uses for fermentation. Occasionally bread and wine were given in the incorrect sentences and some gave yoghurt and cheese as the answers.

(b) Many understood that an enzyme acted as a biological catalyst or would speed up a reaction. However, the majority of candidates did not know a disadvantage of using enzymes. Few were able to give temperature or pH as limiting factors of enzyme activity. Several responses were incorrect because they stated that enzymes are 'killed'.

Question 7 (Low Demand)

(a) There were many disappointing responses. Most candidates who answered 'no' simply repeated the information given, 'nitrates in drinking water can stop respiration in babies' or gave vague reasons that it would 'harm babies', 'cause problems with drinking water' or 'humans becoming extinct'. It was apparent that many candidates considered respiration and breathing to be identical processes in this context.

(b) Many candidates were unable to count the number of nitrogen atoms in the formula of ammonium nitrate. The most common incorrect answer was 7 nitrogen atoms. A good number of candidates could calculate the relative formula mass of ammonium nitrate but did not understand how to calculate the percentage of nitrogen present.

Question 8 (Low Demand)

Good responses with many candidates gaining full marks.

Question 9 (Low Demand)

(a) The most common error was to give 'distance' instead of 'force' as the second word.

(b) Many candidates did not get full credit because they did not give a reason why the factor made the stopping distance greater; for example, 'road surface' should have stated 'wet road surface' or other acceptable reasons why the stopping distance would be greater. Sometimes candidates also gave several responses for the same mark, for example, the driver's reactions are slower included taking of drugs, drinking alcohol, tiredness, distracted by using a mobile telephone or children in the car.

Question 10 (Low Demand)

Most candidates correctly identified the object as a comet and the orbit as elliptical.

Question 11 (Low Demand)

(a) It was surprising to find so many candidates who thought incorrectly, that satellite **A** had an equatorial orbit.

(b) A reasonable number of candidates did appreciate that satellite **B** was geostationary but were unable to express their ideas clearly. Too often candidates did not display an understanding of the difference between spin (on axis) and orbit (around planet) and frequently used the word rotate to cover both words.

Question 12 (Low Demand)

(a) Many candidates did not understand the link between size of hydrocarbon molecule and boiling point. Most candidates did know that hydrocarbons are made up of hydrogen and carbon.

(b) Most candidates gained marks by mentioning the flame or the release of heat energy. Very few knew that propane reacts with oxygen to form carbon dioxide and water.

Question 13 (Low Demand)

(a) Candidates displayed a good understanding of the advantages and disadvantages of using wind and coal. The main problems were again, either using a vague statement such as 'no pollution' as the advantage of using wind, or simply repeating information already given such as 'coal generates 1000MW' as the advantage of using coal.

(b) This was usually completed correctly.

Question 14 (Standard Demand)

A number of candidates had the correct idea that plants take in carbon dioxide and that animals and/or plants give out carbon dioxide but few managed to associate these actions with the processes of photosynthesis and respiration. Several candidates stated incorrectly that carbon dioxide was needed for respiration. Only a minority understood that carbohydrates are produced during photosynthesis and that carbohydrates, rather than carbon dioxide, are transferred to animals when plants are eaten. Many candidates focussed on the movement of oxygen, even though it was stated in the stem that it was part of the carbon cycle.

Question 15 (Standard Demand)

(a) Most candidates realised that trees were being removed and probably had the idea that this would lead to less carbon dioxide uptake but they failed to express this link clearly. Few candidates referred to the burning of the trees or microbial decomposition of trees. Many failed to relate their reasons to land use and thus gave the burning of fossil fuels.

(b) Too many candidates repeated the information in the question and described global warming rather than its effects. Several were confused and referred to holes in the ozone layer.

(c) Many candidates were able to name methane as the gas.

Question 16 (Standard Demand)

(a) Many candidates correctly gave iron as a catalyst, although a significant number thought it was there because it was a good conductor of heat or that it has a high melting point.

(b) The word equation was often correct; however, several candidates lost the mark when they tried to fit 'iron' into the equation.

(c) The ideas of reversibility and yield were not generally understood. Most repeated the question by stating that some of the nitrogen and hydrogen did not react. Very few candidates realised that ammonia is removed as a liquid. Several thought that the ammonia formed in the cooler. Most appreciated that the gases were recycled.

Question 17 (Standard Demand)

(a) Most candidates failed to use the information in the introduction to the question, which stated that some calcium carbonate remained unreacted. Consequently, the common answer that the reactants had been used up was unacceptable. Very few candidates realised that they had to explain both the reduction in rate up to 12 minutes and the end of the reaction at 12 minutes.

(b) Many candidates scored full marks on the graph but there were those who drew a curve to the right of the given curve, or whose curve started to the left of the given curve but failed to level off at 83 cm^3 before 12 minutes.

(c) Although several candidates correctly referred to changing temperature or the concentration of the nitric acid, most referred to changing the amount of reactants or the use of a catalyst.

Question 18 (Standard Demand)

(a) Many candidates correctly gave mass, though many others gave weight.

(b) The equation in some correct form was often given or used. Many of the candidates who attempted this part, simply multiplied 1 000 000 N by 1500 cm. Only the best candidates realised that 1500 cm should be converted into metres for the calculation but several who did this correctly, frequently lost a mark by writing the unit incorrectly, for example j or KJ.

(c) The candidates who described the motion of the barge rather than the vertical movements of the girder achieved most of the marks. Of these candidates, too many did not use correct terminology, such as velocity/speed or acceleration in their descriptions. The weakest candidates did not use the letters/points as required or often referred to the barge as stopped between 2 and 5 hours.

Question 19 (Standard Demand)

(a) Surprisingly, only a very few candidates recognised the variable resistor. Any correct arrangement of the equation was acceptable but not many candidates gave a correct version.

(b) Descriptions were poor in both parts with the only marks being awarded for stating that there was an increase.

Question 20 (Standard Demand)

(a) There were not many candidates who identified the part as a magnet, with the generator or battery being popular with the weaker ones.

(b) Most of the marks were awarded in this part for things going faster or for more turns on the coil but there were some references to using a larger magnet.

Higher Tier

Paper 1 (3468/1H) Double Award

General

There were twenty questions on the paper. The first ten were targeted at grades C and D and were common to Foundation and Higher Tiers. These questions carried approximately 45% of the marks. The final ten questions were targeted at grades B to A* and carried approximately 55% of the marks. This arrangement enables candidates to start with the easier questions before progressing to the more difficult ones at the end. However, there was abundant evidence that significant numbers of candidates were inappropriately entered for this tier. Borderline grade C candidates struggled with the first ten questions and then found that there was little they could attempt on the rest of the paper. This led to a totally unsatisfactory examination experience for these candidates, who often vented their frustration with comments about the centre's entry policy. Centres should understand that a borderline C pupil will probably have a better chance of gaining a grade C on the foundation paper where they build in confidence whilst answering questions targeted at grades E – G.

The general standard of English and the legibility of the writing appeared to be good – indeed better than in some previous years. Students who scored the maximum number of science points in questions 3 and 17 rarely lost a mark because the quality of written communication was considered below the required standard.

Most of the able candidates attempted every part of each question, leaving comparatively few blank spaces. However, weaker candidates frequently did not attempt several of the questions targeted at grades B – A*.

Regrettably, it appeared that many centres had failed to cover several of the higher tier topics with their candidates and that other centres were not conversant with changes to the specification necessitated by changes to the national curriculum.

Question 1 (Standard Demand)

(a) Most candidates could name at least one correct gland (usually the ovary). Where the pituitary gland was chosen the spelling was often phonetic.

(b) At grade C, answers were expected only in terms of enhancing egg release or preventing egg release. Many pupils attempted to link these with specific hormones but negated their answers by referring to the wrong hormone. The roles of FSH and oestrogen were frequently confused. Progesterone is not in the specification but there were many incorrect references to it.

Question 2 (Standard Demand)

(a) The better candidates knew the term 'asexual', although 'artificial' and 'cloning' were very common responses.

(b) Most candidates realised that the genetic information was carried in the nucleus, although many found it difficult to express their ideas clearly. A majority thought that the nucleus carries 'characteristics'.

(c) Only the better candidates realised that the cloned embryo could be divided. Most candidates simply talked of repeating the whole process from the beginning.

Question 3 (Standard Demand)

(a) This topic is conceptually difficult, having been moved from higher tier to foundation tier in the most recent revision of the national curriculum. Good candidates had no difficulty in giving explanations in terms of mutation and natural selection. Weaker candidates appeared confused as to whether it was the bacteria or the cattle that had become resistant to the antibiotics. Many of their answers were very vague and talked of either the bacteria 'getting used to' the antibiotics or of the bacteria 'fighting' the antibiotics. Answers in terms of bacterial immunity or adaptation were very common.

(b) This proved slightly easier for candidates to pick up marks, with most being able to express an opinion one way or another and give a valid reason for their choice. However, ideas were frequently not expressed very clearly.

Question 4 (Standard Demand)

(a) Able candidates generally gained full marks but the weakest tended to score only one of the four marks.

(b) Group 1 was usually correctly given but Group 2 was not so well known. Weaker candidates gave transition metals or even Group 0.

Question 5 (Standard Demand)

(a) A surprising number of candidates did not attempt this part of the question. Weaker candidates tended to give 7 electrons or omit the charge.

(b) A surprising number of candidates were not able to state that (1) stood for liquid, many thinking that it was the number one. Again there were many variations on what was meant by (aq). Many stated 'in solution' but failed to indicate 'aqueous solution'.

(c) The better candidates were able to balance the equation in part (i) but weaker students often used subscripts or superscripts. Weaker candidates frequently answered in terms of position in Group 7 rather than reactivity.

Question 6 (Standard Demand)

Responses were, on the whole, disappointing.

(a) Many candidates indicated distances with such imprecision that examiners were unable to award them a mark. A surprising number believed that the amplitude was the height from the top of a crest to the bottom of a trough, i.e. double the correct answer.

(b) Many candidates used 'speed' = distance/time' rather than the wave equation. Often the unit was missing or was incorrect.

Question 7 (Standard Demand)

Of the candidates who correctly identified the radiation as beta, nearly all could give a correct explanation for the reason. However, many did not even latch on to the fact that the scene was set in a nuclear power station. Thus it was common to see all sorts of radiation quoted, including ultraviolet, infrared and even in one case, tidal waves.

Question 8 (Standard Demand)

The better candidates realised that waves travelled through the fluid (which was often thought erroneously to be water). However, surprisingly few appreciated how these waves could then dislodge the dirt particles. It was common to see reference to the waves dissolving the dirt or killing bacteria on the watch.

Question 9 (Standard Demand)

(a) Those candidates who obtained marks, generally did so for simply stating that in the lungs the blood gains oxygen and loses carbon dioxide. However, many candidates failed to make any reference to the blood and simply spoke of oxygen entering the lungs and carbon dioxide leaving. Very few made a correct numerical reference to the composition of the blood.

(b) A surprising number gave white blood cells rather than plasma. However, most candidates knew that the red blood cells were responsible for transporting oxygen.

Question 10 (Standard Demand)

Most candidates correctly identified both salts. A majority were able to quote $NaNO_3$ correctly but very surprisingly, few were able to come up with the correct formula for potassium sulphate, KSO_4 or KS being the most common incorrect answers.

Question 11 (High Demand)

Answers to this question tended to be centre-dependent. Candidates who had been trained to use Punnett squares usually gained full marks, whereas those who had used lines to connect alleles in gametes and offspring frequently made mistakes. However, many candidates attempted to answer in terms of the circles and squares given in the key to the diagram. Others gave different letters for the two alleles.

Question 12 (High Demand)

Again, answers tended to be centre-dependent. Better candidates almost always explained Darwinism in terms of variation followed by natural selection. Weaker candidates failed to mention Lamarck, or failed to complete the explanation in terms of inheritance of acquired characteristics.

Question 13 (High Demand)

(a) This was an application question based on the understanding that a grade C candidate should have, of the laboratory electrolysis of brine. Only the best candidates correctly identified the three products, oxygen being favoured by many.

(b) The majority of candidates did not know the products of the reaction between sodium and water; consequently most received only one mark – for the correct symbols on the left hand side of the equation. Many thought that sodium oxide was formed.

Question 14 (High Demand)

(a) Better candidates tended to know this answer but weaker candidates simply repeated the information that the elements are in the same group.

(b) Almost all candidates realised that electrons could be lost more easily but only the better ones gave convincing explanations in terms of forces. Weaker candidates tended to prefer magnetism.

Question 15 (High Demand)

Giant structures continue to provide problems for all but the most able candidates.

(a) **X** was frequently given as metal or even nucleus. Rather more candidates correctly identified **Y** as an electron.

(b) The role of free electrons in the structural properties of a metal remains a mystery to all but the most able.

Question 16 (High Demand)

The concepts underlying nuclear decay seemed to be accessible only to the most able candidates.

(a) Only half of the candidates were able to identify radium. The others tended to think that the number of neutrons defines an element.

(b) Again, many candidates referred to neutrons in their answers.

(c) A majority of candidates clearly took a guess at the correct answer.

(d) Although many candidates correctly referred to the graph and realised that the numbers or protons and neutrons had changed, only a small minority understood that a neutron had changed into a proton by losing an electron.

Question 17 (High Demand)

The specification lays out in detail what candidates are expected to understand about analogue and digital signals. In particular, the higher tier content is quite specific on the explanation of the advantages of digital signals. The majority of candidates seemed to be unaware of most of this content.

(a) Most students wrote generalisations about the differences between analogue and digital signals without getting to grips with the reason the telephone has analogue to digital and digital to analogue chips. All that was required was the recognition that the voice is analogue, the ear hears in analogue and that digital is the transmission method.

(b) Since this is a high-demand question, the examiners required understanding of the higher tier content of this part of the specification. The majority of candidates answered in terms of 'better quality' signals or even 'faster' signals.

Question 18 (High Demand)

(a) There were many good statements but all candidates should realise that a comparison question requires reference to both waves. Thus, to simply state that 'P waves are fast' gains no credit because there is no reference to the speed of S waves.

(b) Many candidates were able to interpret the graph correctly but there were many more who attempted inappropriate calculations.

(c) Better candidates realised that the speed of the waves was changing and the best stated that they were accelerating. Weaker ones confused the shape of the curves with the passage of waves through the mantle of the Earth. These candidates tended to write about refraction without referring to change in velocity.

Question 19 (High Demand)

(a) Many candidates scored full marks but the weaker ones tended to lose both marks because there was no reference to the cooling effect of evaporation.

(b) Answers to this part were very disappointing. Few candidates mentioned the cooling of the blood as cold water was absorbed. Most thought that the brain got colder because 'the nerves told it that the body was cold', ignoring the data showing that the brain temperature dropped.

(c) Many candidates had some understanding of the processes involved but lost most of the marks due to poor terminology such as, the brain sending out messages or signals; blood vessels lowering in the skin; blood capillaries constricting and hairs trapping heat.

Question 20 (High Demand)

(a) Weaker candidates ignored the question and failed to mention energy in their responses. Centres should be aware that where there is more than one mark for describing patterns, at least one of the marks will be for quantitative rather than a qualitative statement. The third quantitative mark in this part, was rarely awarded.

(b) Again, the first marking point was obtained by most but many candidates did not make a quantitative statement for the second mark.

Higher Tier

Paper 2 (3468/2H) Double Award

General

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

Large numbers of candidates were inappropriately entered for this paper. Centres should understand that approximately 50 of the 90 marks are 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 and the majority attempted most parts of their paper. 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 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 bond energy, hormone, kinetic energy, polymerisation, product, reactant, resistance and yield. Some very common biological processes, chemical reactions and physical equations were not well known. Experimental procedures were not understood as well as might have been expected.

The use of the words 'it', 'them' and 'they' meant that candidates lost marks when their response was ambiguous. One area of concern was the way in which some candidates represented chemical formulae. CO_2 is correct but CO^2 and CO2 are incorrect. Fundamental concepts, including straightforward factual recall, the understanding of key ideas and the application of these are 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)

Most candidates were able to state that plants remove carbon dioxide from the air during photosynthesis. Fewer were able to state that animals returned carbon dioxide during respiration, there being many incorrect references to breathing. A significant number referred to plants using carbon dioxide in respiration. Only a minority stated that carbohydrates, rather than carbon dioxide, are transferred to animals when plants are eaten. Many able candidates wasted time referring to microbial respiration which was not a process shown in the diagram.

Question 2 (Standard Demand)

(a) Most candidates realised that trees were being removed and probably had the idea that this would lead to less carbon dioxide uptake but failed to clearly express this link. Few candidates referred to the burning of the trees or microbial decomposition of trees. Many failed to relate their reasons to land use and thus gave the burning of fossil fuels.

(b) Too many candidates repeated the information in the question and described global warming rather than its effects. There were the expected few who referred to holes in the ozone layer.

(c) Most candidates were able to name methane as the gas.

Question 3 (Standard Demand)

(a) Most candidates correctly gave iron as a catalyst.

(b) The word equation was often correct but many lost marks by giving incorrect formulae rather than naming the substances as required.

(c) The ideas of reversibility and yield were not generally understood. Most repeated the question by stating that some of the nitrogen and hydrogen did not react. Very few candidates realised that ammonia is removed as a liquid. A minority thought that the ammonia formed in the cooler. Most were content to state that all gases were recycled.

Question 4 (Standard Demand)

(a) Most candidates failed to use the information in the introduction to the question, which stated that some calcium carbonate remained unreacted. Consequently the common answer that the reactants had been used up was unacceptable. Very few candidates realised that they had to explain both the reduction in rate up to 12 minutes and the end of the reaction at 12 minutes.

(b) Many candidates scored full marks on the graph but there were those who drew a curve to the right of the given curve, or whose curve started to the left of the given curve but failed to level off at 83 cm^3 before 12 minutes.

(c) Although several candidates correctly referred to changing temperature or the concentration of the nitric acid, most referred to changing the amount of reactants or the use of a catalyst.

Question 5 (Standard Demand)

(a) Many candidates correctly gave mass, though weaker ones gave weight.

(b) The correct equation in some correct form was often given or used. This time the weaker candidates gave mass rather than weight. Most of the candidates who attempted the calculation simply multiplied 1 000 000 N by 1500 cm. Only the best candidates realised that 1500 cm should be converted into metres for the calculation but several who did this correctly, frequently lost a mark by writing the unit incorrectly, for example j or KJ.

(c) The candidates who described the motion of the barge rather than the vertical movements of the girder achieved most of the marks. These candidates usually lost only one mark by failing to state that the acceleration between **C** and **D** was greater than between **B** and **C**. Weaker candidates tended to state that the barge was moving at constant velocity between **A** and **B** or that it was stationary between **D** and **E**.

Question 6 (Standard Demand)

(a) Surprisingly, only about half of the candidates recognised the variable resistor. Any correct arrangement of the equation was acceptable but again, only about half of the candidates gave a correct version.

(b) Most candidates recognised that increasing voltage increased the current but few referred to the lack of proportionality at higher values, most being content with 'it then levels off'. Many

candidates realised that the wire would get hot or that resistance would increase but few linked these as cause and effect.

Question 7 (Standard Demand)

(a) There were many candidates who identified the part as a magnet, with generator or motor being popular with the weaker candidates.

(b) Most of the marks were awarded for things going faster or for more turns on the coil but there were some references to using a larger magnet.

Question 8 (High Demand)

(a) Most candidates made references to reducing energy loss and making more energy available for growth. Weaker candidates merely paraphrased the introduction.

(b) Better candidates realised that microorganisms feed directly on the sewage, rapidly increase in number and remove oxygen from the water during the respiration. Many were determined to give the 'fertiliser-eutrophication' story in terms of algal blooms; their accounts received credit when they began to describe the effect of microbes on dead algae. Unfortunately, many wrongly completed their story by stating that the algae removed oxygen from the water causing the fish to suffocate.

Question 9 (High Demand)

(a) Surprisingly few of the weaker candidates realised that they simply had to add up the three numbers leading from the box labelled 'cow'.

(b) Only the better candidates recognised which figures to manipulate, although almost all correctly gave photosynthesis.

(c) Only a small minority of candidates gave both faeces and urea / urine. Most failed to realise that energy is transferred from movement as thermal energy and that this is included in the 1020 kJ on the diagram.

(d) The use of plant hormones in food production was not well known. Only a minority of candidates answered correctly in terms of fruit ripening both at the crop stage and during transport. Many candidates were content to state that 'it makes plants grow better'. Others confused insecticides with herbicides.

Question 10 (High Demand)

(a) Only the best candidates were able to balance the symbol equation.

(b) Most candidates simply stated that the reactants needed energy to react; this was not usually linked to molecules or activation energy. Only the best candidates answered in terms of the activation energy needed and bond breaking.

(c) In the first part, a majority of candidates failed to distinguish between reactants and products, often giving calculations involving both. Again, only the most able candidates understood the relationship between bond breaking, bond forming, endothermic and exothermic.

Question 11 (High Demand)

(a) Only the weaker candidates failed to do this calculation correctly.

(b) The calculation involving relative formula masses caused problems for the majority of candidates. Weaker candidates did not realise that they had to calculate the relative formula masses of Fe_2O_3 and 2Fe. Many had forgotten that the haematite was not 100% iron oxide, even though they had performed a calculation based on this in part (a).

Question 12 (High Demand)

(a) Most candidates recognised correctly that the bus was heavier but there were relatively few answers that referred to both mass and kinetic energy.

(b) Many candidates used the correct equation but only the most able could cope with the v^2 part of this. Weaker candidates subtracted 12 m/s from 18 m/s and then used the equation. Candidates who did not follow the instruction, 'Show clearly how you work out your answer', could not be credited with full marks even if the final answer was correct. In the final part, the majority of candidates failed to refer to v^2.

Question 13 (High Demand)

(a) The majority of candidates seemed unaware of the account of a star's lifetime as given in the Specification. Most candidates referred to red giants and white dwarfs but only the best could explain these in terms of forces.

(b) Again it was shown that only the best candidates understood the concept of red shift. Weaker candidates made no reference to light in their explanations and frequently answered in terms of planets. It was rare to see an answer which explained how red shift provides evidence for an expanding Universe in terms of speed. Most candidates merely stated that 'galaxies are moving away and this shows expansion'.

Question 14 (High Demand)

(a) This question was not very well answered. Although many candidates used the terms saturated, unsaturated, single bonds and double bonds in their descriptions, it was often unclear whether these bonds were between carbon atoms or between carbon and hydrogen atoms.

(b) Most candidates gave responses involving bonds but failed to answer the question which required an explanation that many monomers join up to form a polymer/long molecule.

Question 15 (High Demand)

Several marks could have been obtained by using comparative costs from the table but most candidates ignored it or gave only partially correct answers such as, 'renewable is cheaper than nuclear'. References to environmental effects were usually on the level of 'it is cleaner / dangerous', rather than referring to specific pollutants such as carbon dioxide, sulphur dioxide and radioactive waste.

Foundation Tier

Paper 1 (3469/F) Single Award

General

There were twenty questions on the paper. The first ten were targeted at grades E, F and G. These carried approximately 55% of the marks. The final ten questions were common to Foundation and

Higher Tiers. They 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. It was therefore not surprising that the foundation tier candidates picked up most of their marks in the first ten questions, then comparatively few in the second ten. There was no evidence that significant numbers of candidates were inappropriately entered for this tier.

The general standard of English and the legibility of the writing appeared to be good – indeed better than in some previous years. Students who scored the maximum number of science points in questions 7 and 13 rarely lost a mark because the quality of written communication was considered below the required standard.

Most of the able candidates attempted every part of each question, leaving comparatively few blank spaces. However, weaker candidates frequently did not attempt several questions targeted at grades C and D.

Question 1 (Low Demand)

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

(a) The majority of candidates were able to score full marks. In a few cases however, the candidates had not followed the instructions in the rubric concerning the method of indicating their answers. In most of these cases, the candidates' intentions were clear but in a few cases there were so many crossings out, ringing and re-writing, that it was difficult for examiners to decide what the candidate had intended.

(b) This proved to be more demanding, with only a minority of the candidates realising that evidence came from a comparison between fossils and present day specimens. Most of the other candidates either talked about the dating of fossils, or left the question unanswered.

Question 2 (Low Demand)

This question on genetics was again well answered although, as with part (a) of question 1, a few candidates made rather a mess of indicating their intended answers. The most common errors were the failure to select the correct name for 'inherited factors' and the failure to appreciate that these inherited factors are passed on via the gametes.

Question 3 (Low Demand)

(a) Most candidates correctly read the figure of 220 from the graph as the melting point of fluorine, although many omitted the minus sign. A few misinterpreted the direction of the scale and therefore gave 280 as the answer.

(b) Almost as many candidates selected bromine as the element that is solid at room temperature as chose iodine, with a few choosing fluorine.

(c) This proved rather more difficult for the candidates, with evidence that not all had referred to the periodic table as requested in the rubric. Many candidates did not appear to understand the term 'trend' and therefore tended to refer to the reactivity of the elements, whilst others referred to the boiling point rather than the melting point. Of those who did correctly refer to melting point, some of the answers were very vague, such as 'they get easier to melt as you go up the group', or 'they melt faster'.

(d) It was apparent that the properties of metals and non-metals are not generally well known. It may be that some candidates misread the question and thought that they were being asked for

the properties of metals. A few did not realise that they were required to tick two boxes and only ticked one.

Question 4 (Low Demand)

(a) Fully correct answers were rare. Most candidates seemed to see little difference between sugar, milk sugar, starch and fructose.

Question 5 (Low Demand)

In this question it appeared that the uses of ultra violet rays and X-rays were better known than microwaves, gamma rays or infrared waves. Only a very small number of candidates left one of the types of radiation not joined to any of the uses. Many candidates were able to score maximum marks and the vast majority followed the instructions in the rubric correctly.

Question 6 (Low Demand)

(a) Many candidates seemed unaware that they needed to use a ruler. Often a freehand line appeared to be curved, and therefore examiners were unable to award a mark. Candidates were instructed to show how the light waves reach the eye but in some cases the lines stopped well short of the eye. A common error was to show refraction occurring in the middle of the tank at the point where the candidate's own line started and then no refraction when the ray left the tank.

(b) This discriminated well with the best candidates scoring maximum marks. Many candidates thought that light changed colour, and there was often confusion between reflection and refraction.

Question 7 (Low Demand)

(a) Few candidates scored both marks. Most seemed unsure how to calculate the number of electrons in the atom or its mass number.

(b) Most candidates were able to gain some credit. The majority earned two marks by being able to state that it was the radiation that was dangerous and by specifying what this danger was, e.g., damaging cells or causing cancer. Very few candidates appreciated that a low dose over a long period of time can be just as dangerous as a high dose over a short period of time. A few candidates missed the point of the question entirely and referred to the rocks crumbling as they decayed and falling down on people's houses.

Question 8 (Low Demand)

(a) Candidates showed that they were extremely adept at making pie charts. In a few cases however, the shading was so similar on the three sections that they had entered, that it was sometimes difficult for examiners to determine where one stopped and the next began.

(b) The link between respiration and breath was well known, although candidates sometimes had the order incorrect. Urine was usually correctly quoted as the way in which urea leaves the body but the fact that it is produced from amino acids was not so well understood.

Question 9 (Low Demand)

The better candidates gained full marks but weaker candidates tended to confuse absorber with emitter.

Question 10 (Low Demand)

(a) Many candidates did not appear to understand the term 'relationship' and therefore did not include both boiling point and number of carbon atoms in their description.

(b) The majority of candidates seemed totally unaware of differences such as flammability or viscosity between diesel and paraffin.

(c) Remarkably few gave carbon and hydrogen; the most common incorrect answer was carbon dioxide.

Question 11 (Standard Demand)

(a) Most candidates could name at least one correct gland (usually the ovary). When the pituitary gland was chosen the spelling was often phonetic.

(b) Many candidates failed to realise that the question was still dealing with hormones and therefore gave a range of contraceptive devices that did not involve hormones. Others concentrated their answers around 'menstruation'. Large numbers did little more than re-state the question, mentioning only that hormones can increase or decrease fertility, rather than answering in terms of enhancing egg release or preventing egg release.

Question 12 (Standard Demand)

(a) The better candidates knew the term 'asexual', although 'artificial' and 'cloning' were very common responses.

(b) Most candidates realised that the genetic information was carried in the nucleus, although many found it difficult to express their ideas clearly. The majority thought that the nucleus carried 'characteristics'. Some candidates, referring to the diagram, stated that the skin, hair and muscles were all contained in the body cell.

(c) Only the best candidates realised that the cloned embryo could be divided. Most simply talked of repeating the whole process from the beginning.

Question 13 (Standard Demand)

(a) Although the primary causes were well known, many candidates gave only causes, e.g. stating that trees had been cut down but not following with the effect – that this reduced the amount of carbon dioxide removed from the air via photosynthesis.

(b) Again, many answers stopped short of a full explanation, e.g. stating that the plant had long roots but not following this with the effect – that this enabled the plant to collect water from a greater area/depth.

Question 14 (Standard Demand)

(a) This question discriminated well amongst the candidates, the best being able to score maximum marks, but the weakest not picking up any.

(b) Group 1 was usually correctly given but Group 2 was not so well known. Many candidates gave transition metals or even Group 0.

Question 15 (Standard Demand)

(a) The volume at 40 °C was often given rather than the increase in volume.

(b) Most candidates stated that increasing temperature increased the speed of the particles, but then went on to simply repeat this in the statement about collisions. Many stated that the particles collided with more energy but fewer gave more often.

(c) Very few candidates realised that the fall in volume was due to the death of the yeast or denaturation of enzymes. Many stated that the sugar had run out.

Question 16 (Standard Demand)

(a) Weaker candidates struggled to find a word to describe the orbit of a planet.

(b) All but the weakest candidates were able to identify the comets.

(c) Most candidates failed to distinguish between the search for life on other planets and SETI. Thus, answers were given in terms of the search for water or for carbon compounds. Few mentioned the use of radio telescopes.

Question 17 (Standard Demand)

Of the candidates who correctly identified the radiation as beta, nearly all could give a correct explanation for the reason. However, many did not even latch on to the fact that the scene was set in a nuclear power station. Thus, it was common to see all sorts of radiation quoted, including ultraviolet, infrared and even in one case, tidal waves.

Question 18 (Standard Demand)

This proved to be probably the most difficult question on the paper for the foundation tier candidates. The better candidates realised that waves travelled through the fluid (which was often thought erroneously to be water). However, hardly any appreciated how these waves could then dislodge the dirt particles. It was common to see reference to the waves dissolving the dirt or killing bacteria on the watch.

Question 19 (Standard Demand)

(a) Those candidates who obtained any marks generally did so for simply stating that, in the lungs, the blood gains oxygen and loses carbon dioxide. However, many failed to make any reference to the blood and simply spoke of oxygen entering the lungs and carbon dioxide leaving. Very few made a correct numerical reference to the composition of the blood.

(b) Plasma was rarely mentioned as being the way in which most of the carbon dioxide is transported, the white blood cells being the most common incorrect answer. However, most candidates knew that the red blood cells were responsible for transporting oxygen.

Question 20 (Standard Demand)

(a) Weaker candidates appeared to make arbitrary decisions about the positions of the pointer.

(b) Candidates often showed that they understood the factors but gave weak answers such as, larger magnet (rather than stronger magnet) and larger coil (rather than more coils).

Higher Tier

Paper 1 (3469H) Single Award

General

There were twenty questions on the paper. The first ten were targeted at grades C and D and were common to Foundation and Higher Tiers. These questions carried approximately 45% of the marks. The final ten questions were targeted at grades B – A* and carried approximately 55% of the marks. This arrangement enables candidates to start with the easier questions before progressing to the more difficult ones at the end. However, there was abundant evidence that significant numbers of candidates were inappropriately entered for this tier. Borderline grade C candidates struggled with the first ten questions and then found that there was little they could attempt on the rest of the paper. This led to a totally unsatisfactory examination experience for these candidates, who often vented their frustration with comments about the centre's entry policy. Centres should understand that a borderline C pupil will probably have a better chance of gaining a grade C on the foundation paper where they build in confidence whilst answering questions targeted at grades E – G .

The general standard of English and the legibility of the writing appeared to be good – indeed better than in some previous years. Students who scored the maximum number of science points in questions 3 and 17 rarely lost a mark, because the quality of written communication was considered below the required standard.

Most of the able candidates attempted every part of each question, there being comparatively few blank spaces left. However, weaker candidates frequently did not attempt several questions targeted at grades B – A*.

Regrettably, it appeared that many centres had failed to cover several of the higher tier topics with their candidates and that other centres were not conversant with changes to the specification, necessitated by changes to the national curriculum.

Question 1 (Standard Demand)

(a) Most candidates could name at least one correct gland (usually the ovary). If the pituitary gland was chosen the spelling was often phonetic.

(b) At grade C, answers were expected only in terms of enhancing egg release or preventing egg release. Many pupils attempted to link these with specific hormones but negated their answers by referring to the wrong hormone. The roles of FSH and oestrogen were frequently confused. Progesterone is not in the specification but there were many incorrect references to it.

Question 2 (Standard Demand)

(a) The better candidates knew the term 'asexual', although 'artificial' and 'cloning' were very common responses.

(b) Most candidates realised that the genetic information was carried in the nucleus, although many found it difficult to express their ideas clearly. The majority thought that the nucleus carried 'characteristics'.

(c) Only the better candidates realised that the cloned embryo could be divided. Most candidates simply talked of repeating the whole process from the beginning.

Question 3 (Standard Demand)

(a) Although the primary causes were well known, weaker candidates gave only causes e.g., stating that trees had been cut down but not following with the effect – that this reduced the amount of carbon dioxide removed from the air via photosynthesis.

(b) Again, many answers stopped short of a full explanation, e.g. stating that the plant had long roots but not following this with the effect – that this enabled the plant to collect water from a greater area / depth.

Question 4 (Standard Demand)

(a) Most candidates were able to score maximum marks but the weakest recognised only one or two of the elements.

(b) Group 1 was usually correctly given but Group 2 was not so well known. Many candidates gave transition metals or even Group 0.

Question 5 (Standard Demand)

(a) Weaker candidates often gave the volume at 40 °C rather than the increase in volume.

(b) Most candidates stated that increasing temperature increased the speed of the particles but weaker candidates then went on to simply repeat this in the statement about collisions. Most stated that the particles collided with more energy but fewer gave more often.

(c) Relatively few candidates realised that the fall in volume was due to the death of the yeast or denaturation of enzymes. Many stated that the sugar had run out, ignoring the information at the beginning of the question.

Question 6 (Standard Demand)

(a) Weaker candidates struggled to find a word to describe the orbit of a planet.

(b) All but the weakest candidates were able to identify the comets.

(c) Most candidates failed to distinguish between the search for life on other planets and SETI. Thus, answers were given in terms of the search for water or for carbon compounds. Few mentioned the use of radio telescopes.

Question 7 (Standard Demand)

Of the candidates who correctly identified the radiation as beta, nearly all could give a correct explanation for the reason. However, many did not even latch on to the fact that the scene was set in a nuclear power station. Thus it was common to see all sorts of radiation quoted, including ultraviolet, infrared and even in one case, tidal waves.

Question 8 (Standard Demand)

The better candidates realised that waves travelled through the fluid (which was often thought erroneously to be water). However, surprisingly few candidates appreciated how these waves could then dislodge the dirt particles. It was common to see reference to the waves dissolving the dirt or killing bacteria on the watch.

Question 9 (Standard Demand)

(a) Those candidates who obtained any marks, generally did so for simply stating that in the lungs, the blood gains oxygen and loses carbon dioxide. However, many candidates failed to make any reference to the blood and simply spoke of oxygen entering the lungs and carbon dioxide leaving. Very few made a correct numerical reference to the composition of the blood.

(b) A surprising number gave white blood cells rather than plasma. However, most candidates knew that the red blood cells were responsible for transporting oxygen.

Question 10 (Standard Demand)

(a) Weaker candidates appeared to make arbitrary decisions about the positions of the pointer.

(b) Candidates often showed that they understood the factors but gave weak answers such as, larger magnet (rather than stronger) magnet and larger coil (rather than more coils).

Question 11 (High Demand)

Answers to this question tended to be centre-dependent. Candidates who had been trained to use Punnett squares usually gained full marks, whereas those who used lines to connect alleles in gametes and offspring, frequently made mistakes. However, many candidates attempted to answer in terms of the circles and squares given in the key to the diagram. Others gave different letters for the two alleles.

Question 12 (High Demand)

Again, answers tended to be centre-dependent. Better candidates almost always explained Darwinism in terms of variation followed by natural selection. Weaker candidates failed to mention Lamarck, or failed to complete the explanation in terms of inheritance of acquired characteristics.

Question 13 (High Demand)

(a) Very few candidates answered in terms of alginate beads or resin. Most answered in terms of heating or freezing.

(b) Many candidates obtained all four marks for using scales that employed the full lengths of both axes, correctly plotting both sets of data and drawing good curves of best fit.

(c) Most answers were of a poor standard. Few used the data to make quantitative statements, such as 'the rates were the same up to 40 °C' or 'above 50 °C the rate was always higher with the immobilised enzyme', or 'above 80 °C the rate was five times higher'.

Question 14 (High Demand)

(a) Better candidates tended to know this answer, but weaker ones simply repeated the information that the elements are in the same group.

(b) Almost all candidates realised that electrons could be lost more easily but only the better ones gave convincing explanations in terms of forces. Weaker candidates tended to prefer magnetism.

Question 15 (High Demand)

The concepts underlying nuclear decay seem to be accessible only to the most able candidates.

(a) Only half of the candidates were able to identify radium. The others tended to think that the number of neutrons defines an element.

(b) Again, many candidates referred to neutrons in their answers.

(c) A majority of candidates clearly took a guess at the correct answer.

(d) Although many students correctly referred to the graph and realised that numbers of protons and neutrons had changes, only a small minority understood that a neutron had changed into a proton by losing an electron.

Question 16 (High Demand)

The specification lays out in detail what candidates are expected to understand about analogue and digital signals. In particular, the higher tier content is quite specific on the explanation of the advantages of digital signals. The majority of candidates seemed to be unaware of most of this content.

(a) Most students wrote generalisations about the differences between analogue and digital signals, without getting to grips with the reason the telephone has analogue to digital and digital to analogue chips. All that was required was the recognition that the voice is analogue, the ear hears in analogue and that digital is the transmission method.

(b) Since this is a high-demand question the examiners required understanding of the higher tier content of this part of the specification. The majority of candidates answered in terms of 'better quality' signals or even 'faster' signals.

Question 17 (High Demand)

The 'star story' continues to present problems for the majority of candidates.

(a)(i) Only the most able stated that a supernova was involved or that large gravitational forces were involved. Many answered in terms of 'light being sucked in'.

(a)(ii) Few appeared to know about the detection of X-rays produced when gases spiral into a black hole. The majority stated that they can be detected 'because there is nothing there'.

(b)(i) Many answered in terms of dust particles joining together, often due to gravity. Only the best candidates answered in terms of fusion of the nuclei of the lighter elements.

Question 18 (High Demand)

(a) Many candidates scored full marks but weaker ones tended to lose both marks because there was no reference to the cooling effect of evaporation.

(b)(i) Answers to this part were very disappointing. Few candidates mentioned the cooling of the blood as cold water was absorbed. Most thought that the brain got colder because 'the nerves told it that the body was cold', ignoring the data that showed that the brain temperature dropped.

(b)(ii) Many candidates had some understanding of the processes involved but lost most of the marks due to poor terminology such as 'the brain sending out messages or signals'; 'blood vessels lowering in the skin'; 'blood capillaries constricting' and 'hairs trapping heat'.

Question 19 (High Demand)

(a) This part was well answered. Most candidates were able to identify loft insulation as the most effective method and provided calculations supporting this conclusion.

(b) A surprising number made no reference to heat/thermal energy in their responses.

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 the 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 degrees 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 tended to achieve final grades of about half to one grade higher than indicated by an average of their module test grades.

Centre-assessed component

General

This was the first year of operation for this particular coursework assessment scheme. The four Skill Areas remained the same, with the same mark allocations of 8, 8, 8 and 6 marks. However, the mark descriptions have been amended for the new scheme. The amendments are not major, and represent a refinement of the previous ones rather than a completely new set of criteria. The intention was to clarify the mark descriptions, whilst at the same time opening up possibilities for other kinds of investigations, such as those based on computer simulations or web searches. The one major change was the abolition of any specific marks for Spelling, Punctuation and Grammar: thus the maximum mark this year was 60 for Double Award rather than 63 as in previous years. For Single Award and the separate Sciences, the maximum mark was 30.

The great majority of centres coped well with the new aggregation rules this year and only on a very few occasions did moderators have to apply a penalty for non-compliance with the requirements. A small number of centres erroneously used marks from more than the maximum number of investigations, and in doing so reduced the total marks for some candidates.

Grade Boundaries

As in previous years, the grade boundaries for this component are common across all awarding bodies and for all specifications that use this set of mark descriptions.

At the awarding meeting this year it was noted that, on Double Award, the mean mark was lower than in previous years. The reason for this is that, previously, a candidate needed only to score one set of good marks for Skills P, O, A and E. These would then be totalled and doubled. This year there was no doubling of the total mark out of 30. Instead, centres were required to submit two sets of marks for each candidate, which were added together. Often one set of marks was not as good as the other, resulting in a lower total than would have been the case last year. This effect was particularly noticeable in the middle of the mark range, rather less noticeable at the top, and least noticeable of all at the bottom. Account was taken of this at the award meeting and that is the reason why the grade boundaries for Single Science and the separate Sciences are not always simply half of the marks on the Double Award scheme.

Administration

Most centres coped admirably with the new administrative arrangements this year. It should be remembered that if there are 20 or fewer candidates at a centre, the work of all the candidates should be sent to the moderator with only the pink copy of the centre mark sheet while the top copy should be sent to AQA and the yellow copy retained for your records. Where there are more than 20 candidates, the pink **and** yellow copies of the centre mark sheets should be sent to the moderator and the top copy to AQA as usual. The moderator will then inform the centre which candidates' work should be sent by returning to them the yellow copy of the centre mark sheet with the sample required marked on it. The centre should then send the sample to the moderator and retain the yellow copy.

Each portfolio of work sent to the moderator should have a candidate record form stapled to the front. The most common error with these sheets was that many centres did not obtain the signature of the Head of Centre. It is vital that the reverse side of these forms is completed and the marks are highlighted or ringed, to show which pieces of work have contributed to the final mark for the candidate. If this is not done and the moderator cannot clearly identify where the marks have been awarded, then the work must be returned to the centre. This results in a delay and could delay the issuing of an award in extreme cases.

When sending candidates' portfolios, centres should ensure that the work of each candidate is either stapled together in the top left-hand corner or, if it is too bulky, held together with a treasury tag. Paper clips, folders, ring binders and plastic wallets should NOT be used. It is also important that the task sheet, which should indicate clearly those investigations that have contributed to the final mark in each of the four Skill Areas, is fastened to the top of the candidates work and not placed in a separate envelope.

Many centres this year were using the incorrect envelopes. As these envelopes are used for the return of the coursework, it is important that the correct ones are used. Plastic envelopes, padded envelopes and brown paper cannot be reused and so again may cause a delay.

Application of the criteria

During the last academic year, a large number of training meetings were held all over the country and each centre was required to send at least one representative. These meetings were greatly appreciated and resulted in a much clearer understanding on behalf of teachers as to how to apply the mark descriptions. As a result, moderators found it necessary to adjust a much smaller percentage of centres this year compared with previous years.

The three main problems which were common to those centres whose marking was out of tolerance this year were:

a) **Hierarchy.** Some centres are still not applying the rules in a hierarchical manner. For example, it is not possible to award P.8b unless the requirements for both P.6a and P.6b have been met.

b) **Scientific knowledge and understanding**. Some centres are awarding very high marks where there is no indication that candidates have *used* a sufficient depth of scientific knowledge and understanding. Simply quoting passages from a textbook without any indication as to how it has helped them to formulate the plan or arrive at a conclusion is not sufficient.

c) **Annotation.** Many centres provided excellent annotation this year but in some cases it was missing altogether. Annotation is particularly important in cases where it is not obvious how or where the candidate has met the requirements of a lower mark descriptor when a high mark has been awarded. This is especially important in cases where the evidence is ephemeral.

Choice of suitable tasks

Moderators noted that this year there appeared to be a contraction in the range of investigations being carried out. A large number of centres tended to offer either photosynthesis or osmosis for Sc2, rates of reaction for Sc3 and resistance of a wire for Sc4. It would be a great pity if investigations were restricted to just these few and it is hoped that, once centres have become familiar with the new criteria, we shall again see a broad range of stimulating investigations that will enable candidates to explore science in an interesting way.

Very few investigations were seen which the moderators deemed to be unsuitable, although in some cases the level of demand was set very much below the ability level of the candidates involved.

Computer simulations and ICT

The changes to the Mark Descriptors this year specifically enabled computer simulations and web searches to be added to the range of techniques which could be used for investigations. However, the moderators saw very little evidence of such techniques being used.
If computer simulations are used, it is important to remember that the candidate must be allowed to make the same decisions that would have to be made in a 'real life' situation, e.g. choice of equipment, the number and range of readings to be made, and the degree of accuracy with which readings are taken. Programmes that introduce random errors into the readings are more suitable than those that consistently produce exactly the same results.

A few centres were using computer simulations as a method of carrying out preliminary work prior to the main investigation. The advice given however is that, if the main investigation consists of a 'hands-on' approach using laboratory equipment, then so should the preliminary work.

Web searches pose a particular problem with regard to preliminary work. In some cases it may be possible for the candidate to review a number of different sites before selecting the one or ones that are going to be used; it may then be possible to classify this as preliminary work. As with all preliminary work, however, the candidate should indicate how the results of the preliminary work have helped to formulate the final plan.

There was little evidence of any increase in the use of data-loggers this year. Where such instruments are used, annotation should be used to make clear the extent of the role that they have played and how much of the subsequent processing was done by the data-logger rather than the candidate.
The only real use that candidates appear to be making of ICT to any significant extent is in word processing and graph drawing.

In the case of the latter, candidates must still exercise judgement in selecting the most appropriate type of graph to use. In many cases it is advisable only to use the graph drawing package to plot the points, a suitable best-fit line then being drawn on by hand. In some cases candidates are producing graphs from Excel in which the scale and grid lines are most unsuitable, and render any analysis or interpolation extremely difficult.

Comments on specific Skill Areas

Skill Area P

A few centres were becoming somewhat lax concerning P.4a this year. This is one of the mark descriptions that has been reworded to allow for a wider variety of styles of investigation. However, if a traditional type of investigation is carried out, this is where the idea of 'fair testing' comes into play. Some candidates showed no evidence that they had considered the effect that other variables might have had.

In P.6a some candidates either quoted a piece of theory from a textbook first, or appended it as an afterthought at the end of their plan. In neither case was there a link to show how the scientific knowledge had helped the candidate to develop the plan.

There was a marked improvement in the application of P.8b this year. This was probably as a combined result of the mark description being rewritten and the training given at the meetings. Some candidates are still not quoting the results of such preliminary work, but on the whole there has been an encouraging improvement.

Centres should remember, however, that the hierarchy rules still have to be met: P.8b should not be awarded, even if the candidate has successfully carried out preliminary work, if the lower mark descriptions have not been matched.

Skill Area O

There were several problems here:

a) **Degree of precision and skill.** In some cases centres were awarding high marks for work that lacked precision and reliability, as determined by the evidence in Skill Area A. Where results had been repeated, a comparison between individual measurements and average measurements would have allowed a judgement to be made about the reliability. As a rough guide, if these differ by more than 10% then the reliability should be called into question.

b) **Repeats.** Many candidates appear to have carried out repeats as a matter of course, perhaps because they have been told to, but there was little evidence that they understood the reason

why. In other cases a candidate had taken a single set of results, identified one or more as being anomalous but had made no effort to go back and check it.

c) **Class results.** Moderators reported more instances this year of whole class results being used. Whilst the pooling of results can be used to advantage, teachers must be aware that they are required to be able to identify the contribution made by individual candidates to the collection of such results, and an annotation to this effect made on the written account. When a moderator sees an identical table of results given in thirty different candidates' work, it becomes very difficult to justify the award of marks unless some explanation is given.

It is regrettable that many candidates are still giving incorrect units or no units at all in tables of results.

Skill Area A

Most moderators reported that this Skill Area was much improved this year. In particular, more candidates were drawing suitable lines of best fit where appropriate, although inevitably some were still drawing 'dot-to-dot' lines where these were not appropriate.

A common failing still amongst candidates is to draw a good graph but then fail to comment on any pattern that it shows. Anomalous results should be clearly identified on any graphs, preferably by circling them. Some candidates are correctly identifying anomalous points, but then still forcing the line of best fit to take account of them.

Some centres are still awarding high marks in this Skill Area where the level of scientific knowledge and understanding does not warrant it.

Skill Area E

Moderators reported that progress here seemed to vary very much from centre to centre. In some centres there was a marked improvement, particularly with regard to E.6a, but in others this was not the case.

E.6b is another mark description that has been modified from the previous scheme and some centres appeared not to have grasped this.

On the old scheme, the mark description referred to 'improvements' – this has now been deleted. Nevertheless, some centres were awarding E.6b on the basis of a list of suggested improvements. The new Mark Description asks the candidates to *'describe, in detail, further work to provide additional relevant evidence'.*

For further guidance on how to apply the Mark Descriptions, centres are advised to read the AQA publication 'Success with Science Coursework' and to get in touch with their coursework adviser.

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	74.3	23.0
Paper 2 3468/2F	90	175	64.3	20.2
Module Tests 3468/M	300	210	100.5	23.2
Coursework 3462/8/C	60	140	78.0	21.9
Foundation tier overall 3468	540	700	317.1	74.4

		Max. mark	C	D	E	F	G
3468/1F boundary mark	raw	90	48	39	31	23	15
	scaled	175	93	76	60	45	29
3468/2F boundary mark	raw	90	42	34	27	20	13
	scaled	175	82	66	53	39	25
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	367	310	253	197	141

Higher tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper 1 3468/1H	90	175	73.3	27.4
Paper 2 3468/2H	90	175	64.6	26.5
Module Tests 3468/M	300	210	145.5	19.4
Coursework 3462/8/C	60	140	103.0	18.0
Higher tier overall 3468	540	700	386.4	78.7

		Max. mark	A*	A	B	C	D	allowed E
3468/1H boundary mark	raw	90	60	48	36	24	19	-
	scaled	175	117	93	70	47	37	-
3468/2H boundary mark	raw	90	55	44	33	22	15	-
	scaled	175	107	86	64	43	29	-
3468/M boundary mark	raw	300	253	225	197	170	145	-
	scaled	210	177	158	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	499	430	361	292	238	211

Provisional statistics for the award

Foundation tier (267,542 candidates)

	C	D	E	F	G
Cumulative %	26.5	52.8	75.4	90.0	96.7

Higher tier (144,594 candidates)

	A*	A	B	C	D	allowed E
Cumulative %	9.3	27.3	58.6	89.4	97.7	98.9

Overall (412,136 candidates)

	A*	A	B	C	D	E	F	G
Cumulative %	3.2	9.6	20.6	48.6	68.5	83.6	93.1	97.5

Science: Single Award (Modular) (3469)

Foundation tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
3469/F	90	175	61.8	23.9
3469/M	150	105	44.8	12.8
3463/9/C	30	70	37.3	10.9
Foundation tier overall 3469	270	350	143.9	40.5

		Max. mark	C	D	E	F	G
3469/F boundary mark	raw	90	52	42	33	24	15
	scaled	175	101	82	64	47	29
3469/M boundary marks	raw	150	86	74	62	50	38
	scaled	105	60	52	43	35	27
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	192	163	134	105	76

Higher Tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
3469/H	90	175	64.9	21.2
3469/M	150	105	69.2	9.5
3463/9/C	30	70	49.7	9.8
Higher tier overall 3469	270	350	183.8	33.3

		Max. mark	A*	A	B	C	D	allowed E
3469/H boundary mark	raw	90	62	50	38	27	19	-
	scaled	175	121	97	74	53	37	-
3469/M boundary marks	raw	150	127	113	99	86	74	-
	scaled	105	89	79	69	60	52	-
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	250	219	118	157	126	110

Provisional statistics for the award

Foundation tier (22,830 candidates)

	C	D	E	F	G
Cumulative %	12.2	29.3	52.1	75.2	90.6

Higher tier (2,350 candidates)

	A*	A	B	C	D	allowed E
Cumulative %	2.7	13.6	40.6	77.1	93.0	95.7

Overall (25,180 candidates)

	A*	A	B	C	D	E	F	G
Cumulative %	0.3	1.3	3.8	18.2	35.2	56.1	77.1	91.0

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).