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COMBINED SCIENCE

Paper 0653/01

Multiple Choice

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17	**A**	37	**A**
18	**D**	38	**B**
19	**B**	39	**C**
20	**A**	40	**A**

General comments

Candidates achieved a mean mark of 24.2 with a standard deviation of 6.22. These values are satisfactory but a bit lower than hoped. The Paper is intended, primarily, to discriminate between candidates in the grade C to grade G range. However, the Paper is also taken by candidates who achieve higher than grade C. As a consequence, the mark distribution tends to be skewed towards higher marks. This report concentrates more on the responses made by the grade C to G candidates.

Candidates would appear to have been well-prepared for the Physics part of the syllabus, as they answered most of them well. Teachers and candidates are to be congratulated. Physics items which the candidates seemed to find relatively easy (over 70% facility) were **Questions 30**, **31**, **32**, **34**, **37**, **38**, **39** and **40**. There were no items which caused widespread difficulty.

Two of the biology questions proved too difficult for more than half the candidates. Otherwise the remaining questions made sound contributions to the test overall and discriminated well between candidates of differing abilities.

Comments on specific questions

Question 3

Though on the difficult side, with only 52% of the candidates achieving success, this question tested an important piece of fundamental Biology and it was gratifying to see that the more able candidates fully understood that enzymes are re-usable molecules.

Question 7

This proved difficult with less than 40% opting for the correct answer. It is perhaps understandable that candidates may not have known that fats contain the greatest amount of energy per unit mass. They opted for the food providing the greatest amount of carbohydrate, but since that food also contained 50% water, it would appear that the importance of fats in the diet had not registered with a surprisingly high number which included many of the better candidates.

Question 10

This was a remarkable question since it not only proved a difficult question but it also proved to be the best question on the Paper at discriminating between the able and the less able candidates. The slightly unfamiliar nature of the diagram was probably what enabled the better candidates to use their superior powers of interpretation, leaving the rest struggling to follow the course taken by oxygenated blood around the body.

Question 14

The easiest question in the Biology section of the Paper, it demanded a piece of straight-forward basic knowledge which was competently demonstrated by 93% of the candidates.

Question 15

This question was found decidedly hard. Nearly half of the lower-scoring candidates chose **B** so that, overall, this response was the most popular. It should be noted, however, that this question is based directly on the final paragraph in Topic 1 of the syllabus so that the question should have been one of simple recall.

Question 17

Also on the hard side but less so than **Question 15**. Response **B** was again the downfall of the lower scoring candidates. This is slightly puzzling unless they were confused between resistance and conductivity.

Question 18

Another quite hard question with **B** being, once again the stumbling block for both the higher scoring *and* the lower scoring candidates. It is also possible for the latter that there was a certain amount of guessing. HBr is perhaps unfamiliar to the candidates but they were all given a hint.

Question 19

The statistics quite strongly suggest guessing across the ability range but with different 'favourites'. The higher scorers tended to favour zinc as a base while the lower scorers tended to think that sodium carbonate is insoluble. Less than a third had the right answer.

Question 21

This question is based on a familiar topic but is presented slightly differently. Slightly over half of the higher scorers answered correctly but it appears that the lower scorers were certainly guessing: indeed, in this group response **A** was the most popular by a small amount.

Questions 25

Rather harder than might have been predicted but with good discrimination. A third of the lower scorers chose **A** but response **B** was quite popular across the ability range. This suggests fairly widespread confusion about the difference between combustion and thermal decomposition.

Question 29

The vast majority of candidates knew that they had to divide distance by time. The problem was that most of these did not convert minutes to hours first. Units are always important in Science questions, and candidates should be aware of the units in any question.

Question 33

Most realised that it was surface molecules which escaped, but quite why a quarter of candidates thought they would be the less energetic molecules is a mystery!

Question 35

Only half realised that 200m is a wavelength, but almost as many thought that it is frequency. Candidates should know that metres cannot be a frequency.

Paper 0653/02

Paper 2 (Core)

General comments

The Examination produced the full mark range although Examiners felt that there was a higher number of excellent scripts this year and far fewer very low scores. Many candidates demonstrated outstanding knowledge of the syllabus and used scientific terminology with great competence. Performance across the three Science disciplines was reasonably even, and candidates were generally able to complete the Paper in the allotted time.

Comments on specific questions

Question 1

(a) Generally this was relatively poorly answered and did not prove to be the easy opener as was intended. Candidates offered a variety of incorrect responses the most common being sepals and carpels, instead of the required ovary and ovule.

(b)(i) Most candidates correctly stated water and light.

(ii) This was far and away the most inaccessible question on the Paper and very few candidates across all abilities could negotiate the idea of discussing why the conclusion in the stem could *not* be drawn. Credit was given for any sensible suggestion based on the lack of "fair testing" and many candidates tried hard to answer along this line and were rewarded where possible. It had been hoped that good candidates might discuss that Experiments **A** and **C** showed that seeds would not germinate at lower temperature under any water and light conditions and so would not germinate in **B** anyway because of the lower temperature.

(c) The iodine test was generally well known and most candidates scored both marks. Better candidates tended to over-answer part **(i)** with much unnecessary experimental detail for a one mark question.

Question 2

(a) This question presented few problems for candidates across the ability range and most scored both marks.

(b)(i) This was generally answered correctly although the most interesting misconception which was widely seen was the idea that the colourless liquid would be condensed propane.

(ii) This was also generally well known although weaker candidates discussed bubbling as the main observation without reference to either cloudiness or carbon dioxide.

Question 3

(a)-(d) There seemed to be no particular pattern to the range of incorrect responses which suggests that many candidates were relying on guesswork. Few candidates scored both marks for part **(d)** for which all three examples of electromagnetic radiation needed to be given.

Question 4

(a) Generally the characteristics of living things had been thoroughly learned by candidates across the ability range and the majority scored both marks. Four characteristics were required for both marks and two or three scored one mark. Candidates were penalised for answers which were restricted to the animal kingdom, so were not credited for references, for example, to the need for food rather than nutrition.

(b) Both brain and spinal cord were required for the mark. Common incorrect responses included spine and nerves.

(c)(i) Generally it was easy for candidates to obtain both of the available marks. The graphs they drew needed to be the same up to the point the driver sees the child, start to drop later and hit the horizontal axis further to the right.

(ii) The majority of candidates scored one mark for reference to impairment of the functioning of the nervous system. The second mark was much less frequently scored even by better candidates, and was for reference to the increased time or distance required to stop the car. Many candidates made vague references to the fact that drivers should not drink alcohol because it causes accidents or is dangerous.

Question 5

(a)(i) Oxygen was the required answer and most candidates scored the mark.

(ii) Most candidates scored the mark for magnesium oxide.

(b) The reaction of oxides in water is frequently tested and seems to be problematic year on year. Each of the three options was represented in large numbers although an error carried forward from the pH value was allowed in certain cases. Candidates needed to discuss the formation of alkaline solutions following reaction between the oxide and water. Thus a candidate offering a pH of 5 could score a mark if they discussed the formation of an acidic solution.

(c)(i) Most candidates recognised the oxygen test illustrated in the diagram.

(ii) This was answered well by about two thirds of candidates. The most common error was the reverse of the required answer showing the formation of mercury oxide. Candidates should avoid giving a symbolic equation when a word equation is requested. Many incorrect attempts at symbolic equations failed to score.

(iii) Only better candidates were able to pick out decomposition and the most common incorrect choice was combustion. A small number of weaker candidates wrote in oxidation as a fourth choice in order to match their incorrect answer in **(ii)**.

Question 6

This was the most accessible question on the Paper with large numbers of candidates across the ability range scoring full marks.

(a) Only a small minority failed to pick out the numerical pattern in the table.

(b)(i) Although the majority scored both marks some were rather vague about how they identified the anomalous point. They often referred to the *first* point rather than specifying it in terms of the data. Any sensible reference to the anomaly not fitting the general pattern or being a long way from the line of best fit scored the second point.

(ii) The majority of candidates scored both marks. The most common error involved misreading the mass scale and suggesting 40.5g rather than 44.5 (± 0.5)g. Virtually any correct indication on the graph was allowed for the *working* mark.

(c) Most candidates demonstrated that they were very familiar with density calculations and it was pleasing to see them following the instructions and quoting, correctly, the formula as requested in the question. This was important since there was an error carried forward mark available for correct substitution into an incorrect equation, provided it involved only mass, volume and density.

Question 7

(a) This was another very accessible question and the majority of candidates across the ability range scored three or four marks. There was no particular pattern of incorrect responses other than the most commonly missed mark was the first one, *species diversity*.

(b) These marks by contrast were much less frequently awarded although the concepts had been well learned in some cases. Candidates should have discussed that decomposers break down organic matter, and that they are respiring and releasing carbon dioxide into the atmosphere. There was no particular pattern of misconceptions and it seemed that many candidates had not learned this material with any clarity.

Question 8

(a)(i) Most candidates gained these marks.

(ii) The majority scored at least one mark and two marks were commonly awarded. Common errors included two upper case letters for symbols and placing subscripts before rather than after the symbol to which they applied.

(b) This was well answered generally and it was rare for candidates to fail to gain at least one mark. The most commonly missed mark was for identifying the more reactive element in Group I.

Question 9

(a) This was well answered by the majority of candidates. Candidates were penalised if they gave a battery symbol rather than a cell symbol.

(b) Most candidates had learned how to apply Ohm's Law and the correct answer of *15* ohms was usually given.

(c) This mark was gained by the majority of candidates

Paper 0653/03

Paper 3 (Extended)

General comments

Although some candidates were well prepared for this examination, it is felt that the majority were not. Very many had little or no knowledge of any of the Supplement material that was tested in these questions, and struggled to gain marks in any parts of the Paper. For some, language was a difficulty, preventing them from understanding the questions and also making themselves understood in their answers.

Almost all attempted every question, and there was little, if any, indication that time was a problem.

Comments on specific questions

Question 1

(a) Part **(i)** was well answered by the stronger candidates, who were able to explain the discrepancy in proton and electron number in a sodium ion. However, very many answered a different question, explaining how an atom becomes an ion, which was unlikely to earn them credit. Part **(ii)** required a statement that the atom and ion differed only in one electron, and as electrons have negligible mass this made almost no difference to their masses. Many candidates scored at least one mark here, and two marks were commonly awarded.

(b) Part **(i)** was perhaps the most accessible part of the question. Better candidates explained that chloride ions have a negative charge, and therefore are attracted to the positively charged anode. 'Chorine' ions were not accepted, especially as the correct spelling was provided in the question itself. Part **(ii)** was less frequently correct, with considerable confusion being shown by many. It was common to see the ions *gaining* electrons rather than losing them, even if previous answers had been correct. Some ions gained or lost protons.

(c) Some candidates were able to state both products, but this was very rare. Hydogen was the more usual correct answer, but very few candidates mentioned sodium hydroxide. Chlorine was quite frequently given, despite the wording of the question, as were sodium, oxygen, water and sodium chloride.

Question 2

This question was very poorly answered overall, with very few candidates gaining full marks.

(a) This was not well known. Very few answers suggested that the candidate had ever seen anything like this done. Many simply used a beaker of water and heated it; this would not work as a great deal of water would evaporate from the container. Marks were awarded for the use of a closed vessel with a narrow tube full of water; this would be heated and the water would rise up the tube as it expanded. There was much loose use of language here. For example, 'boiling' the water to 50 ^{o} C was commonly seen.

(b) Most candidates were able to answer this correctly, although some wrote 'Yes' or 'No', which could not be credited.

(c) This was disappointing, and it was very rare to give all three marks. Quite a few candidates were able to draw a normal at the correct point, but only very few indeed could label the angle of refraction. They were slightly better at extending the ray from the eye into the water and showing the apparent position of the object.

Question 3

(a) Better candidates had no difficulty here, explaining that enzymes are proteins which act as catalysts. Many also gave lists of properties of enzymes. However, as might be expected, many of the weaker candidates simply stated that they are something which helps with digestion, which did not gain any marks.

(b) A range of good suggestions came from the better candidates as answers to **(i)**. These included the long time it would take to do the test, the need to heat the liquid which would interfere with the experiment itself, and the fact that the test would not distinguish between lactose and glucose. Many were also able to suggest suitable times in **(ii)**. Credit was given here for any time less than 250 s for B, and any time greater than 300 s for C, including 'never'. Some candidates wrote '0' in the box for C, and this could not be credited as it implies that glucose would be detected at 0 seconds. Several of the weaker candidates attempted to derive answers arithmetically, multiplying 300 by 6 and then by 18. This, by chance, gave them one of the two available marks. However, even those who had given inappropriate answers to **(ii)** were often able to explain that the enzyme would be denatured at this high temperature in their answer to **(iii)**. It is good to see far fewer suggestions that the enzyme would be 'killed'.

Question 4

(a) Many candidates were able to state that bubbles, fizzing or effervescence would be observed, and also to complete the word equation. However, weaker candidates had no idea what to write in the boxes in **(ii)**, and many strange substances appeared. A few wrote formulae instead of words, which was not credited.

(b) Better candidates had no difficulty in **(i)**, but the majority did not understand that a gas is produced and leaves the apparatus. Part **(ii)** was a little easier for them, although even here many candidates appeared to be completely lost, making suggestions such as keeping the temperature constant which indicated that they had completely failed to grasp the point of the experiment. In **(iii)**, descriptions were often very good, but many lost marks because of poor expression of their ideas. For example, it is not enough to say that there would be 'more collisions' at the higher temperature; 'more frequent collisions', or collisions happening 'more often' was expected.

Question 5

(a) This was answered much less well than expected. The expected answer to **(i)** was an arrow pointing downwards labelled 'gravity' or 'weight', and another arrow pointing upwards labelled 'air resistance' or 'friction.' Most did draw two arrows, but weaker candidates often had one or both of them pointing sideways or at an angle rather than straight up and down. Many had problems with the terminology and 'air pressure' and even 'air force' appeared frequently. Only the better candidates were able to answer **(ii)** correctly.

(b) In part **(i)**, the expected answer was two arrows just like the ones in **(a)(i)**. If candidates had made an error in naming the forces there, it was not penalised again here. Part **(ii)** was not well answered, with many of the weaker candidates suggesting that the force of gravity would now be less because the parachute was producing more upward force. Better candidates were able to explain that gravity remained unchanged, while air resistance increased because of the large surface area of the parachute.

(c) This section was much more accessible than **(a)** and **(b)**, and most candidates scored well in these three parts. In **(i)**, however, many did not realise they needed to give a *section* of the graph, such as AB, and simply gave one letter. The expected explanation was that the line was not straight over the named section. Parts **(ii)** and **(iii)** were often entirely correct, although some had difficulty reading the graph accurately, and several gave answers in minutes rather than seconds. Some of the weaker candidates misunderstood the graph completely, suggesting that AB showed the parachutist going up in the aircraft, BC showed the aircraft travelling along, and CD showed her jumping out and falling to the ground.

Question 6

(a) This was not well answered. Most candidates appeared to have little idea of leaf structure and function. Better answers did explain that the structures labelled A contained chlorophyll, and were able to explain its role in photosynthesis. They tended to do less well on B, with relatively few stating that this allowed carbon dioxide to diffuse to the photosynthesising cells. Many thought that it was a vacuole.

(b) Part **(i)** was surprisingly badly done, with a whole range of inappropriate answers, such as protein, occurring. Cellulose was seen only rarely. Similarly, very few were able to name either magnesium or nitrogen in **(ii)**; chlorine appeared regularly. Nevertheless, they could still pick up marks in **(iii)** if they realised that this element would be taken up by the roots from the soil.

(c) Only very few candidates appeared to be familiar with this part of the syllabus. The expected answer was that the phloem vessels would be damaged or destroyed, thus preventing products of photosynthesis being transported down to the roots.

Question 7

(a) In **(i)**, most candidates correctly suggested that the temperature would go up, and some were able to state that this would happen because it is an exothermic reaction, or one which gives out heat. Some were also able to balance the equation. Part **(iii)** was more difficult, and only better candidates were able to give either OH^- or K^+. However, most were able to make a creditable attempt at the dot and cross diagram of a water molecule, and many did this entirely correctly.

(b) Those who understood that this was about displacement and the reactivity series usually had no problems here, and this was often answered very well.

Question 8

(a) Most candidates had difficulty expressing themselves here. Credit was given for the idea that the light bulbs wasted a lot of energy.

(b) This was only answered correctly by a very few candidates, largely because only they gave the answer in joules.

(c) This was surprisingly badly done. All possible combinations of resistances appeared in **(i)**, and even those who realised they needed to add the two values often gave their answer as Ω and not kΩ. Similarly, a whole range of answers were seen to **(ii)**, often involving long calculations using V = IR. Some candidates subtracted the resistance from the voltage to arrive at an answer.

(d) This should have been very straightforward, and well-prepared candidates easily picked up all three marks. However, once again most struggled. Even those who knew the formula for adding resistances in parallel often forgot that they had calculated 1/R, and not R. Once again, many also forgot that the units were kΩ. Part **(ii)** once again showed confusion, with all sorts of complicated calculations appearing followed by wrong answers.

Question 9

(a) This question revealed a widespread misunderstanding of what a pulse is. Very few candidates realised that it is related to heartbeat. Most answers to **(i)** simply stated that blood pressure is higher in an artery than in a vein, making no mention of the *fluctuation* in pressure which is felt as a pulse. There was much irrelevant writing about oxygenated and deoxygenated blood. In **(ii)**, the difference in blood pressure could be credited. However, many candidates appear to think that the arteries pump blood. It was rare to be able to award more than one mark for part **(a)** overall.

(b) This part of the question was much better answered than **(a)**. Many were able to name lymphocytes in **(i)**. The arrow for **(ii)** could be anywhere before 4 days, and better candidates did this correctly. However, weaker candidates often drew it somewhere along the curve, suggesting that antibodies were being produced before infection with the virus.

Part **(iii)** was quite well answered, as was **(iv)**; most candidates showing some understanding of the action and specificity of antibodies. However, only the better candidates mentioned immunosuppressant drugs in **(v)**. Weaker answers suggested that the new kidney was not immune, that the kidney had chicken pox, or even that kidneys are responsible for producing antibodies.

Paper 0653/04

Coursework

General comments

Nature of tasks set by Centres

Only a small number of Centres submitted coursework for the June examination. Most have provided coursework in previous years and have acted on advice given. In most Centres all the tasks set were appropriate to the requirements of the syllabus and the competence of the candidates. In only one Centre was there some minor confusion about a few tasks. The standard of candidates' work was comparable with previous years.

Teacher's application of assessment criteria

In nearly all Centres the assessment criteria were understood and applied well for all of their activities. There has been a steady improvement in the Centres' application of assessment criteria. Only one Centre (new to the scheme) tried to assess both skill C1 and C4 in the same investigation. Advice has been given to help the Centre avoid confusion in future.

Recording of marks and Teacher's annotation

Following suggestions made encouraging the use of annotation on candidates' scripts many more Centres are using this technique to indicate or justify marks awarded. There is still scope for further improvement with some Centres writing comprehensive summaries but not indicating the point at which the mark was awarded. Tick lists remain popular with particularly skill C1. Many Centres have developed very comprehensive recording systems.

Good practice

Some Centres make very useful comments about individual candidate's performance on a summary sheet. Many Centres have developed a booklet of tasks and dedicated assessment criteria.

Paper 0653/05

Practical Test

General comments

The answers were very varied with few excellent candidates and a number of poor ones. Whilst all three questions were accessible and very few were unable to adequately perform the experiments, the level of deduction was often poor. **Question 3** was easily the most poorly answered. All the marks were used and the mark scheme produced a good spread. There was no evidence of a shortage of time.

Comments on specific questions

Question 1

Easily the best answered question. Candidates who knew something about food tests were able to score well. In one or two instances the enzyme failed to work and consequently some candidates did not observe any colour changes with the biuret reagent. It is difficult to speculate why this should have happened as Supervisors were asked to check its working before the examination started.

(a) Most were able to report that the test-tube became warm although a small minority thought it became cold! A clear observation suggesting the formation of water droplets was required e.g. condensation or a clear liquid. Steam produced or fogging were not acceptable observations. Most, although by no means all, correctly detected carbon dioxide.

(b)(i) The majority were able to identify the protein by noting the change in colour of solution B. Often a mark was lost by recording that solution A did not change. Presumably the addition of a blue solution to a colourless one is seen by some as 'no change'. It was necessary to distinguish between the two blue colours in A and B and record that B contains the protein to score both marks.

(c) Almost all candidates recorded an appropriate colour change here and reported the presence of a sugar. Many were able to relate this to the question in part **(iii)** and correctly wrote *yes* in the space. The answer 'yes' did not score if it did not follow from part **(ii)**. A reasonable number appreciated the breakdown of the starch to a sugar, thus explaining how it was known that the protein was an enzyme.

Question 2

The level of achievement in this question was just satisfactory despite it being a routine experiment and one that could well have been carried out during routine laboratory work.

(a) There were some very variable results with a variety of errors. Some of the errors included, not recording the mass in grams, incorrect conversion to a force, measurement of extension in centimetres and placing the ruler up the wrong way. Each of these errors was penalised. Some were unable to collect the required number of extensions.

(b) Graph construction was poor considering a graph is almost always required in this Paper somewhere. Some candidates appear to delight in making their plotting difficult by choosing a complicated scale. Although the question asked for a straight line there were a number of zig zags, which as always lost a mark. A reasonable number of candidates sensibly made use of the origin to help them draw the 'best straight line'. Particularly helpful when the points were somewhat scattered.

(c) Many had not read the question in advance and did not make provision for the reading of the required extension. The few who realised the relationship was a linear one, calculated the value from a combination of other readings.

(d) Poorly answered. This type of question has been asked for some years yet there are still candidates who think it is some totally unrelated question demanding some previous knowledge. In this case it was necessary to determine the extension caused by the unknown mass, read off the force and calculate the mass. It was necessary to explain how the mass was calculated from the force to score the third mark.

Question 3

(a) Few appreciated or perhaps did not understand the significance of noting which metal formed the negative. The whole question became difficult if there was no understanding of electron flow. Hence few noted that zinc was the negative in the third test and those that did might well have guessed. Although the values of voltage did fluctuate somewhat, it was only necessary to be within 0.2V of the Supervisor.

(b) Some correctly reported that magnesium was the most negative metal but very few appeared to know why. The explanation required some mention of electron movement and simply referring to the size of the voltage did not score.

(c) A mark was awarded to those who stated magnesium, zinc, copper.

(d) Almost all candidates struggled here. It is appreciated that this part was difficult to all but those who had a good understanding of this subject. Some were able to score at least one mark by realising that the former experiment had to be repeated with the inclusion of the metal X. Again it revolved around the direction of electron flow rather than just the magnitude of the voltage.

Paper 0653/06

Alternative to Practical

General comments

The Examiners are pleased to report that there have been fewer very poor candidates than in previous years and that the overall quality of Papers has been improved. Centres are to be commended for their good preparation of candidates for the Alternative to Practical examination. This preparation must include certain minimum elements: the first, is sufficient laboratory experience and the second is adequate practice in problem solving using experimental results. The Paper seeks to test these two areas above all, and mere learning of scientific fact is rarely enough to gain a good mark. This is made clear in the following comments on individual questions.

Comments on specific questions

Question 1

This was mainly well answered.

(a) Most candidates constructed a neat and comprehensive table, with correct headings and units, though in recording the data some omitted the zero readings of the meniscus. A few tried to draw graphs instead of a table. Some omitted the units cm, s, in the headings, and this led to errors in **(b)**.

(b) Four marks were possible for finding the average “water loss” in cm/s. Study of the mark scheme will reveal how the Examiners awarded intermediate marks, for example, if correct total distances were divided by an incorrect time. Only a small minority of candidates achieved full marks, possibly because most had never seen a potometer experiment carried out. Many candidates added up all the distance readings and then divided the total by nine, the number of readings. Others simply gave an answer and showed no working.

(c) Many candidates incorrectly tried to relate speed of transpiration to shoot thickness and xylem vessel diameter rather than to the area of the leaves or to stomatal density. The explanation should also refer in some way to evaporation of water from the leaves. Some candidates also mentioned environmental factors here instead of in part **(d)**.

(d) A wide variety of environmental factors controlling evaporation from the leaf were suggested, including the ubiquitous global warming! The underlying fault lay in the failure to relate to the laboratory conditions of the potometer experiment, choosing to refer instead to the area where the plant might grow naturally.

Question 2

This question was based on a corresponding question in the Practical Examination. To prevent entirely mathematical answers, the potential differences shown for Mg - Zn and Zn - Cu did not add up to that for the Mg - Cu couple. Study of Fig. 2.2 will reveal how this anomaly is still entirely acceptable, since the voltmeter on the left is showing its maximum reading.

(a)(b)(c) Most candidates scored well in these parts of the question, though the logic of deriving **(c)** from the answers to **(a)** and **(b)** escaped those who did not know that magnesium is the most reactive of the three metals.

(d) Examiners hoped that magnesium, always "more negative" than the others, would lead candidates to the obvious (and simple) conclusion that the more reactive of two metals will be the one that must be connected to the negative terminal of the voltmeter to show a reading. Alas, this was rarely the conclusion drawn by the candidates. Otherwise, still using this experiment, they explained that the magnitude of the potential difference between metals showed how dissimilar they are in reactivity.

Many candidates preferred to rely on chemical reactions such as displacement of one metal by another or of hydrogen from an acid. The Examiners did not accept answers based on differences in reactivity with water unless heating was mentioned. It should be common knowledge that zinc and copper do not react at room temperature with water.

Question 3

Many candidates who did not study the description found this question too difficult.

(a) A few candidates recorded the heights $\mathbf{h_3}$, $\mathbf{h_4}$ and $\mathbf{h_5}$ in the wrong column, and others recorded the heights in centimetres. Others read the scales "inverted".

(b) Those who did not realise that extension = (270 - height) did not know how to complete the last column of the table. Some drew a straight line on the graph beginning with the data already given, rather inaccurately read off the values and then filled in the last column. Others did not read the scales and tried to calculate everything.

(c) The straight line had to pass through the origin to gain all three marks here.

(d) The word "proportional" or a related word had to be used to describe the relationship. "Linear" was not acceptable.

(e) Candidates who understood the experiment often gave elegant answers to this question and showed how to convert the extension in mm to mass in g or kg. Alas, the usual confusion between *mass* and *weight* showed itself in other candidates' answers.

Question 4

This and the preceding question were based on the corresponding practical questions in Paper 5.

(a)(i) Candidates were required to complete the table referring to the combustion of bread. The conclusion that the reaction is exothermic was not always drawn. Most candidates knew the limewater test for carbon dioxide.

(ii) This elicited many responses that were partly correct but not the scientific answers that are sought at this level, for instance “Our cells do not burn up” or “heat is not given out during respiration”. Acceptable answers included some reference to respiration as a slow enzyme-controlled oxidation of glucose, either aerobic or anaerobic. Very few candidates gave a correct answer to this question.

(b)(i) This proved a problem for many candidates who had learned the food test by rote, as they did not know that biuret reagent is a blue solution, but they knew that the copper(II) complex formed is purple.

(ii) The test for starch, was well answered.

(c) Most candidates seem to have learned that a positive response to Benedict’s test is an orange colour. When “reducing sugars” react with alkaline copper(II) solution, the sequence of colours observed is usually green - yellow - orange - red and the product is the red copper(I) oxide. This reaction provides a nice link between biology and chemistry within the syllabus, and such connections should be emphasised. Many candidates wrote that the red colour observed showed that the mixture was acid. Others did not seem to know that enzymes are proteins.

Question 5

Some candidates found an unintentional source of confusion between parts **(a)** and **(c)** of this question, where two very different solutions are both described as *purple*. A few candidates inferred that in **(c)**, potassium manganate(VII) must be present in the tube with calcium hydroxide! The connection between the parts of the question lies in the diffusion of the solid into the water, which takes place in both **(a)** and **(c)**. **(b)** and **(c)** are based on a beautifully simple experiment that demonstrates all the colours of Universal Indicator in one test-tube.

(a)(i) The crystals *dissolved* and the particles *diffused*. These two processes could be described in other words for the two marks awarded here.

(ii) Stirring, heating and crushing the crystals are the ways of speeding up the processes in **(i)**. Some candidates incorrectly suggested that a catalyst could be added.

(b) Some candidates wrote that the colour of the indicator shows that calcium hydroxide is basic. The only answer accepted was “alkaline”, since there are many bases that are insoluble in water and so would give a neutral reaction.

(c)(i) The Examiners looked for the idea that a solvent, in this case water, was added or that only a small amount of the solute was present in a large volume of solution. “Not concentrated” was rejected.

(ii) “The ethanoic acid had been neutralised by the calcium hydroxide” was the accepted answer, though “neutral” gained one mark.

(iii) This was harder, since not only had neutralisation occurred but also more calcium hydroxide had dissolved so that it was now in excess. Answers such as “The solution was still alkaline” or “The acid had not reached the calcium hydroxide” were rejected.

(iv) The Examiners did not expect the correct name for the salt of ethanoic acid, but some candidates provided it. The general equation “acid + alkali → salt + water” was an acceptable answer, as was an equation providing any recognisable name for a salt formed at the same time as water.

Question 6

This was a straightforward question in which candidates had to read balance windows and the scale of a measuring cylinder and manipulate the resulting figures. The Examiners realise that two different answers for **(b)(ii)** are possible, depending on which way the subtraction is done. Both answers, 15.0 g and 15.2 g, were accepted.

(a) Most candidates scored the three marks available here.

(b) A minority of candidates, but still a surprisingly large number, failed to correctly calculate the masses.

(c) Only the answer 55 cm^3 was allowed.

(d) The answer looked for was "**(b)(i)** and **(c)**" but a description of the necessary results, mass of the solution and its volume was given the mark. "**(b)** and **(c)**" was rejected as not specific enough.

(e) This was often well answered, but far too many candidates began their answer with an instruction to "Fill the measuring cylinder with hexane", or to "Place 50 cm^3 of hexane in the cylinder." In this case, the addition of the sodium chloride would take the total volume into the ungraduated section of the cylinder or cause the hexane to spill. Answers involving the use of a displacement can were also accepted.