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COMBINED SCIENCE

Paper 0653/01
Multiple Choice

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

General comments

The mean mark was 26.0; the standard deviation 6.8 - the reliability coefficient was satisfactorily high.

Questions which provided particular problems for candidates are noted below.

Comments on specific questions

Question 2

The well-tested, but nevertheless important, principle of surface area and speed of enzyme action was clearly familiar to most of the candidates making this jointly the easiest question on this section of the paper.

Question 5

Equally well-known is the link between calcium in the diet and healthy bone growth, since 95% of candidates were able to select the correct response to this question.

Question 9

This was the most difficult of the Biology questions, by some way, with the statistics suggesting that there was a great deal of guess work employed. Reassuringly, the best candidates opted for the correct answer. Perhaps the problem lay in the fact that the answer was **C**, which pointed effectively to nothing on the diagram, since there was no other realistic way of indicating the liquid in which the cells float.

Question 18 was found slightly hard but it discriminated very well across the ability range. The lower scoring candidates tended to favour response **B** (46%) rather than the key **A**. This suggests that such candidates merely overlooked the characteristic properties of transition elements having high melting points.

Question 23 was similar to **Question 18** in its level of difficulty. This is explained by the fact that 40% of the lower-scoring candidates chose **A** - but ammonia is alkaline.

Question 25, some 50% of candidates answered correctly. The surprise was that 30% of the higher scoring candidates chose **C** when it might have been expected that such candidates would be aware that oxidation and reduction occur together.

Question 26 was the hardest Chemistry question. The percentage of higher and lower scoring candidates who chose **A** was quite similar. With aqueous ammonia, Cu^{2+} gives a blue, not a green, precipitate. Apart from this, such candidates may well not have read the question carefully enough, i.e. the aqueous ammonia is in excess so that copper ions give a deep blue solution.

Question 27 was also slightly hard but it discriminated extremely well. Response **A** was the most popular choice amongst the lower-scoring candidates, but how is water formed by burning CO?

Question 31 produced reasonable statistics, but many candidates disregarded the word ‘useful’ in the stem. Clearly the only useful final energy in a tidal power station is electrical energy.

Question 32, half the candidates were unsure about energy transfer in a vacuum flask.

Question 33, the vast majority reasoned sensibly, that the shallow part was likely to be either **A** or **C**, but only just over half of the candidates answered correctly.

Question 34 was poorly answered, with all four alternatives obtaining strong support, although somewhat more did choose either **A** or **C**, where at least the order of the regions was correct.

Question 40 was reasonably answered, but over a third of candidates thought that α-particles are protons.

Paper 0653/02

Paper 2

General comments

It is always the policy of Examiners to give the benefit of any doubt caused by candidates not working in their first language. However, answers to Science questions invariably require precise wording, and candidates across the ability range sometimes lost marks through ambiguity in the way they had responded. Some parts of the syllabus continue to cause problems and in this paper the function of goblet cells and cilia had not been learned very well by many candidates. On the other hand, most candidates scored highly when interpreting distance – time graphs. The examination produced the full mark range and some excellent scripts were seen from many candidates who demonstrated good knowledge of the syllabus and used scientific terminology appropriately. Performance across the three Science disciplines was even, and candidates were generally able to complete the paper in the allotted time.

Comments on specific questions

Section A

Question 1

(a)(i) The required answers were kinetic (movement) and electrical. Many candidates lost this mark by suggesting *wind* energy as an alternative to kinetic.

(ii) Candidates needed to specify the type of potential energy (chemical) in the first box, and so the unqualified *potential* did not score. Part **(ii)** was generally done well by the majority of candidates.

(b) Most candidates across the ability range scored this mark.

(c) This caused problems for the majority of candidates. Weak candidates offered answers suggesting that fusion was a natural process whereas fission was artificial. Better candidates came closer with ideas based on a particle explanation, but only those referring specifically to the joining or splitting of *nuclei* could be awarded any marks.

Question 2

(a)(i) This was answered very well by most candidates.

(ii) The majority of candidates scored one mark by discussing that low red blood cell numbers would cause oxygen deficiency in the body. The second mark for explaining the effect on respiration and/or energy production was not so commonly obtained.

(b)(i) Candidates needed to explain that iron is essential for the formation of haemoglobin, and that haemoglobin in turn is an essential component of red blood cells. Very few candidates mentioned haemoglobin at all. Generally the question was not well answered.

(ii) Candidates needed to specify *red* meat or *green* vegetables. Other correct answers were accepted e.g. chocolate and egg (although egg white had to be rejected if specified) and it was clear that most candidates had learned this part of the syllabus well.

Question 3

(a)(i) This question was answered well by most candidates. Careless use of particle vocabulary caused the loss of the mark in some cases. Some candidates gave a correct general definition of a chemical formula rather than focusing on the specific meaning of Cl_2.

(ii) Atomic structure rules are usually well learned and this year was no exception. Most candidates scored the available marks. It was decided to allow *electron shell* in addition to the expected answer of *electron* for the lower box.

(b) In general, candidates are well aware of the role of chlorine in the treatment of water for domestic use. However, they needed to specify that *bacteria* or *micro-organisms* are killed by chlorine. The words *germs* or *bugs* were not accepted. The second mark for stating why bacteria need to be removed was not so frequently scored.

Question 4

(a) The most common incorrect answers here were *coil* and *resistor*. Most candidates obtained the mark.

(b) Attention is drawn to the new format of this type of question which gives clearer guidance to candidates that they must write the formula they intend to use as well as the subsequent working. Many candidates lost the formula mark even though they gave the correct numerical answer of 480volts. The formula must contain an = sign and use unambiguous symbols or words.

(c) The common misconception that voltage must be high because the electricity *has a long way to go* was once again much in evidence. Another common mistake was to suggest that high voltage reduces the resistance of the wires. Of those candidates obtaining any marks, all correctly discussed the need to reduce energy losses. The second mark was rarely given and was for stating that high voltage allows low current.

(d)(i) The first mark was for any reference that a.c. referred to an *electrical* current (the simple statement that it meant *alternating current* was allowed). The second mark was for a clear explanation of the term alternating. Candidates needed to say more that that the current *could be reversed* or *went both ways*. The idea of repeated or continuous reversal was required.

(ii) Far too many candidates gave simplistic answers such as *the unit used to measure frequency.* The idea of oscillations per second was required.

Question 5

(a) The majority of candidates had learned the definition of consumer and so scored at least one mark. The most common mistake was the confusion of meanings of population and community. Roughly half the candidates scored two marks on this question.

(b)(i) Required answers included temperature, availability of food, rainfall. Many candidates did not seem very clear about the meaning of the term *environmental factor*.

(ii) Most candidates knew that the snails should be allowed to mate and scored a mark for suggesting this. The second mark was for specifying what needed to be studied once the offspring had appeared. Candidates were generally less clear about this. The simple suggestion that stripes should be compared between parents and offspring would have been sufficient. Some very able candidates wasted a great deal of time giving detailed explanations of the genetic principles involved.

Question 6

(a)(i) This was answered correctly by most candidates.

(ii) The simple answer *it is unreactive* was not enough to score the mark. Candidates needed to state that argon is a noble gas or make some reference to its atomic structure. The most common incorrect answer was the idea that argon is present at too low a level for it to react.

(iii) It was necessary here to discuss the production of toxic gases such as carbon monoxide or nitrogen oxides, and to emphasise their toxicity to humans. Generally, the question was well answered.

(b)(i) Many candidates understood the concept of a balanced equation but could not express it clearly enough. Any response which unambiguously expressed the idea of equal amounts of *each type* of atom in reactants and products was acceptable. Many better candidates wisely decided to spell it out in terms of actual numbers of atoms.

(ii) This question is very commonly asked in one form or another and yet candidates often struggled to express answers clearly. Too many are still offering the incorrect idea that mixtures can easily be separated whereas compounds cannot. This answer was not accepted. A more qualified version of this idea, that mixtures can be separated (often) by physical methods whereas compounds cannot be, is acceptable. Far safer answers involve the ideas that components in mixtures retain their properties, or that the composition of mixtures are variable. The idea that the different elements in the compound would be bonded together is also acceptable.

(c) There were a pleasing number of correct responses to this question. Candidates needed to explain that combustion of hydrogen produces (non-polluting) water whereas hydrocarbon combustion produces oxides of carbon.

Question 7

This was the most accessible question on the paper with many candidates scoring full marks.

(a) The most common way that candidates lost one mark was for failing to write down a correct formula (see comments under **Question 4 (b)** above). Otherwise it was obvious that candidates were very familiar with this part of the syllabus.

(b)(i) Most scored this mark. A very few lost the mark by stating, for example, *B* rather than *B to C.*

(ii) All apart from the weakest knew what this was about although candidates needed to specify that a *horizontal, flat* or *zero gradient* rather than *straight* line indicated constant speed.

(iii) Most scored this mark.

Question 8

In general, part **(b)** was not answered well.

(a) Candidates needed to be very precise with their labelling of the pleural membrane. They needed to avoid labelling the pleural fluid. The most common error was to label the pleural fluid and the other common mistake was to label the ribs. The other parts of the diagram were usually well known.

(b)(i) The function of the goblet cells and the cilia had not been learned very well. Many candidates offered vague suggestions and did not explain mucus production or the role of cilia in sweeping foreign substances trapped in mucus away from the lungs.

(ii) This was also a troublesome question for many candidates. Of those who did discuss damage to the respiratory system, too many suggested that both cilia and goblet cells are damaged. Very few candidates understood that excess mucus fails to be swept out of the lungs and that bacteria subsequently can breed within the lungs.

Question 9

(a) A common mistake was to suggest iron for the first blank. Electrolyte was quite well known as was the charge on metallic ions. The fourth blank needed the name of an electrode rather than the opposite charge given for the third blank.

(b)(i) This question was quite well answered although candidates should be warned to give *observations* when asked. Consequently, answers such as *copper ions go to the cathode* will not gain credit in this case.

(ii) This was well done with the most common mistakes being the use of the word *chloride* instead of *chlorine* and the addition of spurious other substances, a common one being oxygen.

Paper 0653/03

Extended Theory

General comments

Most candidates were able to at least attempt all parts of all questions, and there was a pleasing number of excellent scripts. A few Centres, however, continue to enter candidates inappropriately for this paper, resulting in a significant number scoring less than 20 marks overall, and some not even 10. Paper 3 is designed to discriminate between grades A to C.

Language is clearly a problem for some, both in understanding the question and in communicating with the Examiner.

Time did not appear to be a problem for any candidates.

Comments on specific questions

Question 1

(a) Many were able to complete the table entirely correctly. The most common incorrect answers were ‘starchase’ in the first box and ‘large intestine’ or ‘pancreas’ in the last.

(b)(i) Most candidates answered this well, stating that animals would eat the seeds and then drop them in their faeces in a different place. Some, however, thought that this was something to do with pollination, and wrote about bees and nectar.

(ii) This was not well known. A very high proportion of candidates suggested using Benedict’s solution. 1 mark was available for crushing the seed, another for stating the reagent(s) that would be added to it, and a third for the purple colour which would indicate protein.

Question 2

(a)(i) Many candidates did this very well, and 3 marks were often awarded. A very common error, however, was to draw arrows on the rays going *from* the eye *to* the lamp. Some drew more than one ray, but they were not penalised for this so long as everything else was correct. A few candidates appeared not have access to a ruler or other straight edge, and drew wobbly lines by hand, which lost them at least 1 mark.

(ii) This proved more difficult than **(i)**. There was no need for lines to be drawn showing the apparent rays behind the mirror, but many did do this. Marks were given for the image being behind the mirror, and the same distance behind it as the lamp is in front. A significant number thought that the image would be on the surface of the mirror.

(b) Both sections caused difficulties. Many candidates confused radio waves with sound waves. It was very common for them to state that the waves travelled at different speeds. For **(ii)**, acceptable answers included frequency or wavelength.

Question 3

Performance on this question varied especially widely, seemingly indicating that some candidates were not familiar with the extraction of iron from its ore.

(a)(i) The expected answer was limestone or calcium carbonate. Oxygen was a common error.

(ii) This was not well done. Even candidates who did well on other parts of the paper often gave 'coke' as a reactant. A few attempted to give a balanced equation, despite the word 'word' being written in bold type.

(iii) This proved relatively easy, with most candidates able to state that oxygen has been removed.

(b)(i) There are now fewer candidates using the 'criss-cross' method to attempt to explain their answer. 1 mark was awarded for an explanation in terms of balancing charges, and another for the correct formula.

(ii) Weaker candidates often made errors here, for example using proton numbers instead of mass numbers. Another surprisingly common error was to work out the relative formula mass as if there were two iron ions and three oxygen ions in the formula.

Answer: 160.

Question 4

Candidates who read and understood the information at the beginning of this question usually answered it well. Unfortunately, many of the weaker candidates did not pick up the term 'transpiration rate' in the first line.

(a)(i) Very many wrote 'temperature' here, demonstrating a complete lack of understanding of how the investigation had been carried out. The most common correct answer was light, and some also mentioned humidity or air movement.

(ii) This was usually correctly answered in terms of light and photosynthesis. A few thought that it was to allow the student to see the plant inside the bag.

(b)(i) Those who understood that this was all about transpiration had no difficulties here. Others wrote about oxygen or carbon dioxide.

(ii) Most picked up one mark for stating that plant **A** had been kept at a higher temperature. Good answers explained that a higher temperature speeded up the rate of evaporation of water in the plants, and also the rate at which it diffused out of them.

(iii) This was expected to be difficult for all but the best candidates, and it proved to be so. Some did, however, give excellent answers, referring to the plant or the soil running short of water and therefore the gradient down which the water was moving becoming less steep. Some also suggested that the stomata might have closed to conserve water.

Question 5

This was often well done, and it was common to award 5 marks. However, a very frequent error was to state or to show in a diagram that the particles do not touch in the liquid state. Most candidates were able to explain that the particles vibrate in a solid, move in a liquid and move entirely freely in a gas. They usually also stated that the particles are very far apart in a gas. Many did not mention the forces between the particles, but those who did usually earned at least 1 mark.

Question 6

(a)(i) A few candidates erroneously tried to write a balanced equation here. Some were confused by the mention of sulphur in the stem of the question, and others thought that hydrogen was one of the products. However, most picked up least 1 mark.

(ii) Most mentioned sulphur dioxide, although unfortunately this often was said to cause damage to the ozone layer or global warming. Marks were awarded for the production of sulphur dioxide when the fuel is burnt, as well the damage that is done by acid rain.

(b) As might be expected, candidates either knew this well or had no idea. Fewer candidates are now saying that the brown solution becomes 'clear', rather than 'colourless'.

(c)(i)(ii) All but a few candidates were able to answer this correctly. The commonest error was to assume that ethene contain one carbon atom.

Question 7

(a)(i) Most answers suggested that the candidates did understand the relationship between mass and gravity, and both marks were often awarded. Weaker candidates wrote confused answers, often involving volume. Some just said that the mass of **A** would be greater than that of **B**.

(ii) Most candidates gave a correct answer of 60 cm, but fewer were able to explain how they arrived at this number. However, a mention or description in terms of clockwise and anticlockwise moments was often given by better candidates.

(b)(i) Although almost all answers showed the centre of mass on the vertical midline of both containers, by no means all placed it below midway on the flask and above halfway on the glass. Sometimes it was shown entirely outside the two vessels.

(ii) Marks were awarded for the idea that the flask has a wider base and a higher centre of mass. A few of the best answers included drawings showing the position of the centre of mass in relation to the base as the flask or glass is tipped over.

Question 8

(a) A surprising number could not answer this. Many left it blank. Incorrect answers included organism and system.

(b)(i) Most candidates scored all three marks here. A few, however, confused the onion epidermis with the epidermis of a leaf, and attempted to draw detailed diagrams of leaf structure. Others drew a section through an onion.

(ii) This in part depended on the candidates' understanding of what onion epidermis is. If they were familiar with this, then it was easy for them to write about chloroplasts, and the fact that an onion is underground, or that a leaf photosynthesises.

Question 9

(a)(i) Almost all answered this correctly. Vinegar was the most common incorrect answer.

(ii) This proved extremely difficult for most candidates, who apparently did not know what an ionic equation is. Quite a few wrote word equations, while others wrote balanced equations showing an example of neutralistaion.

(b) This was frequently answered well, although some very weak candidates could not get even one product of the reaction correct. It was clear that many had used the information that a gas was given off, but some thought that this would be hydrogen.

(c) The quality of the answers here appeared to depend on whether candidates had ever seen this done, or done it themselves. Some did not even suggest mixing the acid and copper oxide. Some attempted to write a balanced equation and explain what it meant, with no mention of how anything could be done. However, better answers easily picked up all three marks. The very best explained that you would add copper oxide in excess, and then filter the mixture before allowing water to evaporate.

Question 10

(a) Most answers made at least one correct suggestion here, usually that alpha radiation can cause cancer. Other correct statements included the high ionising power of this radiation, damage done to DNA, mutations and damage to cells.

(b) One mark was given for stating that alpha radiation has a charge, and a second for knowing that this is a positive charge. Some confused electric fields with magnetic fields, while many had no idea at all.

(c) This, like **(b)**, was difficult for many candidates. All that was required was to say that, as an alpha particle is two protons and two neutrons, the nucleus of the radon atom would lose these when an alpha particle is emitted.

Paper 0653/04

Coursework

General comments

Nature of tasks set by Centres

Only a small entry submitted coursework for this session of the examination. All the assessments set were appropriate to the requirements of the syllabus and the competence of the candidates. The nature of the tasks was well understood.

The standard of candidates' work was comparable with previous years, with candidates covering the whole mark range. Candidates were offered a good range of assessment opportunities.

Teacher's application of assessment criteria

The assessment criteria were understood and applied well for all of the activities. No Centre tried to assess both skill C1 and C4 in the same investigation.

Recording of marks and teacher's annotation

The use of annotation on candidates' scripts to indicate or justify where marks have been awarded has been encouraged for the last few examination periods.

Centres are recommended to make use of "tick lists" when assessing skill C1.

Good practice

Too few candidates to make any useful observations.

Paper 0653/05

Practical

General comments

The standard of questions was considered to be similar to previous years whilst the performance of candidates was thought to be rather below the standard expected. Very few candidates appeared to have met a cooling curve before and graphs in **Questions 1** and **3** consisted of a series of joined up points. Despite the annual comment that this is not acceptable, candidates persist. It would appear that some candidates had problems completing **Question 3** in the time allowed. However, it should be pointed out that the paper is one and a half hour duration and not necessarily thirty minutes each question, and **Questions 1** and **2** are not long questions.

Comments on specific questions

Question 1

(a) Some candidates took the zero reading to be the temperature of the cold water rather than the starting temperature for measurements of cooling whilst a significant number failed to record the zero reading at all. Both lost a mark. There were no penalties for the readings themselves provided they showed a cooling trend and tube **B** fell more quickly than tube **A**.

(b) The choice of a suitable scale presented no problems and the plotting of the points was well done. However, the drawing of the lines was almost always very poor. The instruction was to draw a smooth curve through the points and in any case candidates ought to have appreciated that each point was unlikely to be precise. The failure to draw a smooth curve inevitably lost a mark. As has already been stated, there is never justification for joining the points when each point is part of a continuous experiment. Candidates must understand the reason for drawing a graph. This failure was extended into part **(d)** where a further series of disjointed lines were often drawn.

(c) Usually at least 1 mark was scored by simply confirming that huddling is effective. The second mark for an explanation was often awarded.

(d) Some candidates decided to plot a number of fictitious points and almost all drew zig zag lines.

Question 2

Some supervisors thought a measuring cylinder was required. None of the measurements were that critical and in any case candidates should be able to estimate small volumes as used in this type of exercise.

(a) A good number of candidates reported a green solution although a blue solution was the expected result. As long as the described colour contained some element of blue, the mark was awarded.

(b)(i) This was poorly answered considering it is a standard chloride test and a full description is given in the notes provided. Consequently the only acceptable answer was ‘a white precipitate’. Answers such as ‘milky’ do not score and only lead to the conclusion that carbon dioxide is present.

(ii) Well answered.

(c) Very poor responses although many correctly thought a test for copper was required. Again, the test is given in full in the notes yet very few were able to score 3 marks. Some decided that more than one test was required whilst others simply suggested that sodium hydroxide be used without describing the test.

(d) Very few candidates were able to correctly identify ammonium chloride, even when the anion had been identified and ammonia named as the gas in **(b)**. The ammonium ion seemed unknown. The metal oxide was often correctly reported as copper oxide although the evidence was frequently very thin.

Question 3

Very poor answers indeed. As already indicated many failed to do justice to this question perhaps because of insufficient time. However, a large number produced a blank answer suggesting they were unable to attempt the question. Surely one or more temperatures could have been measured within the time. The solubility of potassium nitrate is well-documented and accepted temperatures needed to be within an 8°C range of the expected temperature. As with **Question 1** any lines drawn were zig zags and not a smooth curve. There were a few correct answers to part **(f)**, the value depending on the graph drawn.

Paper 0653/06

Alternative to Practical

General comments

Many Centres prefer to enter their candidates for this examination, rather than either the Practical examination or Internal Assessment of Practical Work. The Examiners accept that this examination is also preferred for candidates who have been unable to undertake regular laboratory work. Careful preparation for the examination is no less necessary than for real practical exercises.

The Alternative to Practical examination contains questions based on the four experimental skills, C1 to C4, to be found in the syllabus section entitled Assessment Criteria for Practicals. Candidates need to be able to demonstrate the following skills:

- using and organising techniques, apparatus and materials
- observing, measuring and recording
- handling experimental observations and data
- planning, carrying out and evaluating investigations.

Analysis of the questions in the November 2003 examination will reveal how the Examiners have attempted to test these skills. Not all can be tested in any one question, but overall, the paper explores all of them.

The answers are marked with the practical nature of the situation very much in mind. For instance, in **Question 3 (e)**, potassium nitrate can be obtained by evaporating the solution to dryness; a more correct technique for crystallisation is partially evaporating and then cooling, or by evaporation over a boiling water bath. The full marks are only obtained by a careful description of one of these processes. Similarly in **Question 4 (d)**, candidates are asked for their conclusions about the effectiveness of huddling. Answers that were not based on the results of the experiment described in the question, but referred instead to animal behaviour, merited no marks.

The evaluation of an experiment and amendment of its design to give more accurate or reliable results can also be found, for example in **Questions 1 (e)** and **6 (f)**. The accuracy of almost all experiments can be improved by repeating and averaging the results. Candidates can also gain marks by referring to conditions that should be kept constant, and to greater accuracy of measurement.

Candidates are urged to make use of the Notes for use in Qualitative Analysis wherever possible.

Comments on specific questions

Question 1

An experiment with water fleas was described in the question. The candidates were asked to calculate the average heart rate in beats per minute, plot the results on a graph and then draw conclusions from the data.

(a) A few candidates did not know how to find the average.

(b) Most candidates chose sensible scales for the axes and plotted all the points. The Examiners noted an improvement in the standard of graph drawing compared to previous years, and few candidates made serious errors.

(c) An increase in alcohol concentrations caused progressively greater decrease in heart rate of the daphnia. Most candidates were able to deduce this from the graph.

(d) This question draws attention to the social implications of the experiment, and nearly all candidates responded, pointing out that the speed of reaction of the human nervous system decreases when under the influence of alcohol.

(e)(i) The Examiners were looking for a clear analysis of a source of error, such as the difficulty of counting heart beats, the way in which small errors are magnified by multiplication, the possible inaccuracy of the concentration of the alcohol solution unless all water is first removed from around the flea, variations in the water fleas used and so on.

(ii) The improvement suggested need not be linked to the error noted in **(i)**, but many candidates chose to make the connection. Among the answers credited were ideas such as counting for a full minute, using more fleas at each concentration and using a constant temperature.

There were many good answers to this question, but few candidates scored the maximum ten marks.

Question 2

The question depended on the candidates reading and then understanding the significance of the change of volume in each of the graduated syringes in terms of the absorption or production of gas. Some candidates read the syringes correctly, but appeared not to notice that the initial reading of the syringe was 25 cm^3, not 0 cm^3. Thus they believed that all of the experiments involved the evolution of a gas, whereas a gas was absorbed in *Experiment 2*. Candidates were told that there may be more than one correct answer each time, so some of them tried to give two or even more names of metals that would behave as described. This error was ignored if the explanation was correct.

(a) Most candidates read the syringes correctly, though some gave 20.5, 0.3 and 40.4 as the answers.

(b)(i) Copper or zinc have no reaction with cold water.

(ii) Iron would react with water in the flask, absorbing oxygen and forming rust.

(iii) Calcium or magnesium would react with water and give off hydrogen.

Candidates could score a part mark by showing that they understood when oxygen had been absorbed or hydrogen had been evolved, even if they chose the wrong metals.

(c) The name of the “gas” given off was variously described as calcium oxide, magnesium hydroxide, zinc oxide, carbon dioxide, and even methane or ammonia.

A commendable proportion of candidates obtained full marks in this question.

Question 3

This question involved finding the solubility of a salt. This technique is not in the syllabus, but sufficient information was supplied for the candidates to answer the question.

(a) Most candidates were able to read the thermometer scales correctly.

(b) The calculation of the solubility at 70°C was found by simple proportion. Many candidates found the mean of the solubilities for *Experiments 1* and *3*; this gave the wrong answer. Others, unable to do the calculation, read the value from the graph. This was credited if the value given was the correct answer, 140g per 100g water.

(c) Candidates were expected to plot the points with an accuracy of +/–1 g or 0.5°C; most were able to do so. If a value for *Experiment 2* was stated in **(b)**, this point should appear on the graph. A smooth curve results. Extrapolation of the curve through the origin was ignored, though wrong.

(d) The point **P** was correctly interpreted by most candidates.

(e) The answer "evaporate to dryness" was awarded one mark here, since the Examiners were seeking a more detailed answer. Two marks were gained by describing evaporation over a boiling water bath or by suggesting partial evaporation followed by cooling.

Question 4

The introduction to this question was detailed and it was necessary for candidates to thoroughly understand it. Failure to do so was shown by candidates who thought that the beakers were filled with water or that that the temperature was read every ten minutes.

(a) All but a few candidates read the thermometer scales correctly.

(b) A few candidates tried to draw a graph instead of constructing a table. The most common errors were the omission of the units from the headings and the omission of the reading at time 0 minutes. The clear display of data is essential for a well-organised investigation, and teachers are urged to give their candidates practice in the construction of tables such as this one, including zero readings and properly labelled headings.

(c) A few candidates with language problems failed to answer this question, but most gave tube **A** as the correct answer.

(d) The first mark was a clear indication that the candidate understood that huddling is effective. For the second mark, the Examiners were looking for an acknowledgement that in this model of "huddling", test-tube **A** stayed warm longer, therefore retained heat energy. Some reference to the slower conduction or radiation of heat to the outside, or to the insulating effect of the surrounding test-tubes, gained the third mark. Answers that did not refer to the experiment but described actual animals huddling together for warmth did not gain the second and third marks.

(e) A number of points were made by candidates to suggest improving the accuracy of the experiment. Placing the same volume of water in each tube, placing stoppers in the tubes, starting tubes **A** and **B** at the same temperature, using more sensitive thermometers, repeating the experiment and finding averages, all gained marks. Marks were not awarded for proposals to use larger numbers of huddled tubes, or to read the temperatures more frequently and over a longer time period.

Question 5

This question is based on the Notes for use in Qualitative Analysis found in the syllabus. Candidates are expected, wherever possible, to have carried out these experiments in order to observe the tests and draw conclusions. As in previous years, the standard of answers to questions about this aspect of experimental work was poor, and very few candidates gained a satisfactory mark in this question. Many answers consisted of guesses.

(a) The expected conclusions to *Tests 1*, *3*, *4* and *5* were as follows: copper or a transition metal, no carbonate or hydrogencarbonate present, chloride present and ammonia given off. Some slight variations to these answers were credited.

(b) Any test that could reasonably be expected to work, such as Universal Indicator turning blue or purple, was awarded 2 marks, even the repeating of the "red litmus paper turning blue" mentioned in the observation to *Test 5*.

(c) Some candidates gave verbatim the words learned from the Notes "light blue ppt., soluble in excess, giving a dark blue solution." This was offered both in **(i)** and **(ii)**, although the information was applicable when correctly separated into the effects seen when a few drops of aqueous ammonia then later, excess of ammonia is added to a solution of copper ions. This shows the hazards of rote learning when not coupled to practical experience.

(d) The very first line of the question should have given candidates strong clues, but alas, most of them forgot what they had read or had not read it at all. Copper oxide and ammonium chloride were the expected answers.

Question 6

This question attempts to explore the candidates' understanding of the transfer of energy by waves. Much depends on the correct understanding of the diagram. Many candidates did not appreciate that point **X**, at which a gun is fired, is 1000 metres away from point **Y**. The use of a cathode ray oscilloscope is suggested in the syllabus. Enough information is given in the question to enable candidates to deduce all the answers.

(a) Far too many candidates could not answer this question satisfactorily.

(i) The words "radio wave" or "radio signal" gained the mark here.

(ii) "Sound wave" was the expected answer, but "longitudinal wave" was an alternative.

(b) Most candidates did not realise that the sound would be too weak to be heard at a distance. The weaker candidates said that the microphone at point **Y** was sending the sound to point **X**.

(c) The diagram of the c.r.o. screen posed great problems, because candidates did not understand the function of the time-base.

(i) The six squares between inputs **A** and **B** gives a time lapse of 3.0 seconds. The better candidates could deduce this, but most failed to give the first decimal place and so lost a mark.

(ii) Seven and a half squares between inputs **A** and **C** gives a time lapse of 3.75 seconds.

(d) Here, the calculation of speed is a simple matter of dividing the answers to **(c)** into 1000 to give the answer in metres per second. Errors in part **(c)** were carried forward so more candidates were able to score. This gives a speed of sound as 333.3 m/s in **(i)**, 266.7 m/s in **(ii)**.

(e) Candidates were invited to consider how the slow response of the observer at point **Y** would invalidate the result, making the answer to **(d)(i)** more accurate.

(f) A more reliable answer will be achieved by repeating the experiment several times and finding an average. Other suggestions accepted were timing over a longer distance and using a c.r.o. screen with a more accurate scale.

Answers to this question were often rather disappointing. Some candidates had perhaps to hurry their answers because they had not carefully allocated the time allowed for the examination.