CONTENTS

PHYSICAL SCIENCE

Paper 0652/01

Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**C**	21	**D**
2	**A**	22	**A**
3	**B**	23	**C**
4	**D**	24	**C**
5	**A**	25	**D**
6	**A**	26	**D**
7	**C**	27	**A**
8	**D**	28	**B**
9	**B**	29	**A**
10	**B**	30	**C**
11	**D**	31	**A**
12	**C**	32	**B**
13	**A**	33	**B**
14	**D**	34	**B**
15	**B**	35	**D**
16	**D**	36	**C**
17	**C**	37	**B**
18	**A**	38	**A**
19	**A**	39	**A**
20	**B**	40	**C**

General comments

The mean mark of the candidates was 21.4, and the standard deviation 5.9. The reliability coefficient was also satisfactory. There was an even spread of marks between nine and full marks. Of the Chemistry questions, **Question 15** was found to be the hardest (see comments below). Otherwise, all of the Chemistry questions performed satisfactorily or well. Of the Physics questions, candidates found **Questions 34**, **36** and **37** relatively easy, while **Questions 39** and **40** were incorrectly answered by a large number.

Questions which candidates found difficult are commented on below.

Comments on specific questions

Question 2

Slightly hard both for the lower and the higher scoring candidates. The reason for this appears to be the relative popularity of response **D** (30% and 26%, respectively). This seems somewhat curious, in that it might have been anticipated that hydrogen, the lightest gas, would have been thought the most likely to diffuse.

Question 5

One of the hardest questions in the paper, but with very good discrimination. Response **D** was as popular as the key **A** because nearly half of the lower-scoring candidates chose this despite the word being printed in bold. In **D**, the left hand structure is an ion not an atom, although the nucleon numbers of the two structures are the same. Perhaps these candidates are unsure of the nature of isotopes or maybe they did not examine the diagrams closely enough?

Question 9

Another of the harder questions - only 50% of the higher scoring candidates answered correctly. It is a little surprising that response **D** was found relatively popular across the ability range.

Question 10

This question was also found difficult, although it discriminated very well. Response **D** was the most popular choice amongst the lower scoring candidates (40%). This suggests some confusion between a substance being a reducing agent as against a product of reduction.

Question 11

The second hardest Chemistry question with **B** and **C** being rather popular at both ends of the ability range. They are, of course, correct statements in themselves, but they do not directly explain the decrease in balance reading as the key **D** does. This might be an example of insufficient care in reading the question.

Question 15

This question was found decidedly hard. Responses **A** and **D** were, overall, more popular than the key **B**. Mixture 1 is, of course, familiar as the blast furnace example but Cu is low and Mg high in the reactivity series so the latter *can* reduce iron(III) oxide, but the former *cannot*.

Question 19

This was amongst the harder questions, with half of the lower scoring candidates going for response **B** instead of the key **A**. Both addition reactions are clearly within the syllabus but it might have been thought that candidates would more readily have recognised the addition of steam (to form alcohol). The absence of any reference to a catalyst does not seem to have been of consequence in candidates' thinking in that few were attracted by response **D**.

Question 21

A third of the candidates homed in on **C**, presumably ignoring the 'not' in the stem, and the fact that **A** and **B** were equally important when measuring volume.

Question 22

Proved too intellectually demanding, even though the Physics involved was within the syllabus. Nearly half incorrectly chose **D**, with the rest undecided about the other three alternatives.

Question 23

The vast majority chose the correct sum in this question, but a significant number thought that straight lines were relevant.

Question 26

Many candidates disregarded the word 'useful' in the stem. Clearly, the only useful final energy in a tidal power station is electrical energy.

Question 27

There was a lot of guessing about heat transfer in a vacuum flask.

Question 28

There was some uncertainty about energy transfer.

Question 29

The majority reasoned sensibly, that the shallow part was likely to be either **A** or **C**, but less than h[...] candidates answered correctly.

Question 30

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

Question 31

A similar uncertainty was shown in answers to this question.

Question 33

Unacceptable numbers of candidates still fail to know how voltmeters and ammeters are used, although, as already commented, questions on electrical topics proved accessible to the candidates.

Question 39

This was in a slightly unusual form, but the Physics was fairly standard. Nevertheless, it was clear that most candidates guessed.

Question 40

It would seem that most candidates failed to take note that the question was about the *nucleus* of the helium atom. A large majority chose **D**, which includes two electrons, which would be correct for an atom of helium. Candidates must read questions carefully.

Paper 0652/02

Paper 2 (Core)

General comments

The overall performance of candidates in general seemed to be weaker compared to the previous years. While some candidates did quite well there are many that performed below expectation. It appeared that some candidates are not adequately prepared for the examination; meaning that some topics are probably never studied. For example, **Question 8** required explanations based on the kinetic particle theory, which hardly any candidate could answer satisfactorily.

Candidates struggled with the answers for **Questions 2**, **7**, **9** and **10**. These questions targeted the topics of electromagnetic spectrum, nuclear physics, some environmental chemistry and electricity. The answers given here were either below average or not given at all, leading to the conclusion that these are difficult topics. **Question 5 (a)**, calculating average speed, revealed itself to be the most easily accessible, as most candidates scored those three marks. **Questions 1**, **3** and **4** were in most cases average and better answered. Candidates should learn how to study the syllabus content towards 'Knowledge with Understanding'. They should learn to apply the content knowledge to new real situations, and answer in context of the setting provided in the question; relating the studies' facts towards the situations given. For example, in **Question 11**, reference to the relationship between reactivity and extraction method was often given, but then the answer was lacking the reference to the information provided in the question.

In some Centres, candidates still struggle a lot to express themselves in English, especially in answers requiring explanations. Candidates should be encouraged to write and to speak in order to practice correct use of scientific terminology. They should also keep their answers brief.

Still, it is encouraging that candidates in many areas did perform well and with guided attention given to the mentioned weak topics, it is expected that these results should continue to improve.

Comments on specific questions

Question 1

The answers to the first part were straightforward recall, that sodium would lose one electron to become a positively charged ion. While chlorine would gain one electron to become a negatively charged ion, in many cases candidates confused the difference between chlorine and chloride, although it was stated in the question. They also seemed to fail to recognise that only one electron is involved in the transfer. Many wrote generally 'loss/gain of electrons', where the plural 's' was of course not correct. For the description of how sodium chloride is formed from sodium and chlorine, in most answers the first answers were repeated, but then hardly any candidate was able to state that the oppositely charged ions (positively charged sodium and the negatively charged chloride ion) attract each other, resulting in sodium chloride. Many candidates also wrongly stated that electrons are shared, which was the first part of the answer in part **(b)** of the question. The indication that for the diatomic molecule of chlorine, each atom contributes one electron to the sharing, in order to obtain a stable noble gas configuration, was essential for the second mark. Candidates who did provide a correct drawing of the electron arrangement in the molecule were rewarded with full marks.

Question 2

In general, this question was not well answered by most of the candidates. They seemed to confuse the regions of wavelengths for Ultraviolet (**R**) and infra-red (**S**) radiation. Very few could state that electromagnetic radiation all travels at the same speed. The correct mentioning of the speed itself was given credit, while the wavelength for the greatest intensity, as the graph indicated, was any value between 1.34 and 1.39.

Question 3

Although many candidates received close to full credit for the answer here, they exposed an indication of the dividing level of practical activities carried out. The order in which the required information was presented was not satisfactory. In order to score full marks, there should have been clear indication that the mixture of salt and pepper needed to be added to water to dissolve the salt, followed by filtration to separate and capture the insoluble pepper on the filter paper. Rinsing the pepper was optional, but drying was awarded one mark, while gentle heating to cause quick evaporation and hence crystallisation of the salt scored the fourth mark.

Question 4

This question was in general well answered; the approximate mass of a proton was 1, while the relative charges on a neutron is zero or neutral and on an electron 'negative one' or '–1'.

Question 5

(a) The calculation with straightforward substitution into the formula of average speed = total distance (m)/total time (s) was in most cases correctly done. The correct working (formula or substitution) scored one mark, while one mark was awarded to the correct numerical answer of 8 m/s, with the third mark for the correct unit, 'metres per second' (m/s).

(b) Most candidates knew the correct relationship between stability, base in contact and the centre of gravity. However, some failed to identify **R** as the most stable one because of its lowest centre of gravity and the large base/foot making contact with the surface the trophy stands on. The mentioning of large surface area alone was not given any credit.

Question 6

This question required basic recall of knowledge about metals and transition elements, which was in general very well answered. The properties of metals which are in the transition element area could have been any two of: high density, high melting point (NOT boiling point!), forming coloured compounds, used as catalysts or have more than one oxidation state, valency or ion. For part **(b)** a choice of any two of the following was given full credit: painting, greasing, coating with plastic and one of galvanising/tin plating/sacrificial protection.

Question 7

The answers to this question showed great variation. While the definition of isotopes as being atoms with the same atomic number but different nucleon numbers, due to the different number of neutrons in the nuclei, and that a Geiger Muller tube was a suitable detector, was well done, in most cases the rest of the answers showed lack of understanding of the content. The reason why the method was not suitable for a liquid that emits alpha particles is that the alpha radiation would be absorbed by the plastic bottle because it does not have high penetration ability and has a short range. The count rate after three minutes, showing all working, would be 480/2 = 240, 240/2 = 120 and finally 120/2 = 60. This could have been also $480/2^3$ = 480/8 = 60. The explanation for background radiation scored full marks if it was clear that it originated from radioactive isotopes in the air/earth/rocks/buildings.

Question 8

Hardly any candidate could obtain any marks for their answers for this question. They all seemed to fail to relate the facts from the Kinetic Particle theory to the rate of reactions and hence the number of effective collisions between particles. Most answers repeated what the question had indicated, ‘the reaction is slower when the acid is more dilute’ or ‘the reaction is faster in hot conditions’, which was not required. These facts had to be related to the ‘particle level’ and its implication had to be stated, for example, the more dilute acid has less number of acid particles per volume and hence there are larger spaces between particles, causing less effective collisions between the reagent’s particles and hence a slower reaction.

Question 9

(a) The expected answer should have included that there are only single bonds between the carbon atoms and no more hydrogen atoms could combine with a saturated hydrocarbon. Some alternative equivalent explanations were accepted as long as it was clear that the bonds between the carbon atoms were referred to.

(b) Hardly any candidate could obtain full marks as they ignored the instruction ‘name’. This means the answer had to be the names of the substances, being carbon dioxide and water, not the formulae. The description for a clean fuel had to include mentioning that during complete combustion no harmful substances/pollutants, such as carbon monoxide, sulphur oxides, nitrogen oxides nor carbon/soot [any two to be mentioned] are produced.

Question 10

In general, the answers to this question showed that candidates do not understand the mechanism of a bimetallic strip. Two different metallic substances are fixed together, but because they are different, they expand differently during heating. This different expansion causes the strip to bend. In this case they had to realise the fact that during heating both substances in the bimetal strip expand (1 mark), but that the downward bending was caused by the greater expansion of brass (1 mark), or simply brass expands more than iron in this bimetal strip (2 marks).

Part **(b)** was an application, but it differed from the usually referred to example the thermostatic control device in electrical heating elements of irons, kettles and heaters. Any reference to these was not credited. Candidates had to study carefully the given electrical circuit, and realise that there was a light bulb in the circuit. A closed switch **S** would mean the current would flow, the light would be on, but this causes heating up of the bimetal strip, which in turn would respond by bending. This interrupts the circuit and the light would turn off. As long as the shape of the bimetal strip returns to normal, the light bulb would turn on again. This causes an on and off ‘flashing’ of the light. The application then had to mention such useful on-and-off switching of light, as for example, traffic lights, indicator lights in a car, warning lights of alarm-systems, but disco light is too vague and ‘strobe’ was also not accepted.

Question 11

(a) Most candidates answered this correctly with metals having generally high density and being conductors (or high conduction of electricity was accepted as well), while non-metals generally have a low density and are insulators. Few did confuse the content on the table and scratched out answers numerous times, causing more mistakes.

(b) Many candidates did realise that the question asked about the relationship bet reactivity of metals and their extraction method: In general (which was not sufficient for marks), the more reactive a metal is, the more difficult it is i.e. costly/involves more energ to extract it from its ore. This answer had to incorporate the information given in the que namely that gold is unreactive and is therefore found (uncombined) in its natural state, while iro more reactive, but less reactive than carbon and can be obtained from haematite using heating with carbon and lastly that aluminium is the (most reactive) more reactive than iron and therefore needs electrolysis to be extracted from bauxite. Credit was given for the correct sequence of the reactivity of the three given metals (1 mark) and one mark for the relationship between reactivity and extraction method for one of them.

Question 12

In order to obtain two marks, the symbol of the voltmeter had to be correctly drawn, parallel to the wire. Should it have been across the cells only one mark was awarded. The reason for including a variable resistor was misunderstood in many answers. It served in the circuit to control the voltage across the wire, as it varies the current in the circuit, due to the changing resistance it offers the circuit. Only mentioning of the change of resistance did not obtain the available marks. The correct relationship between the diameter of a wire and its resistance is that the greater the diameter (that means thicker) the lower the resistance of the wire. Many candidates just said that this change would decrease the resistance, which was correct.

Paper 0652/03

Paper 3 (Extended)

General comments

Few of the candidates sitting this examination were able to make significant in-roads with many of the questions. This is an Extension Paper and is intended to challenge those candidates likely to gain the higher grades at IGCSE. Most scripts were completed and legible.

It is essential that candidates understand the significance of *command words* such as explain and define. Marks cannot be gained in explain questions unless candidates give the reason for something, whilst define means a formal definition must be written. Candidates must be careful when using units; for example, the unit of acceleration is m/s^2 *not* m/s, molar masses are in mol and chemical volumes in dm^3. Candidates would be well advised to write down the equation that they are using in numerical calculations – when answers are given with no working, credit can neither be given for equations or substitutions when the answers are wrong. Restating information that is given in the question may offer answers that seem plausible but cannot be awarded any credit.

Comments on specific questions

Question 1

Many candidates found this question to be difficult and few scored more than half marks. Most candidates recognised the acid as being nitric and about a third of the candidates could write an equation (although often not fully balanced). Few candidates described the observation correctly – carbon dioxide being produced being the most common response to part **(c)**. Few candidates recognised that, in order to obtain a solid sample of copper(II) nitrate, the solution needed to be filtered (to remove the excess solid) and the solution be evaporated slowly. Again very few candidates stated that a similar method could not be used to prepare sodium nitrate because sodium carbonate is soluble in water.

Answer: balanced equation: $CuCO_3 + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2O + CO_2$.

Question 2

This question was reasonably well answered. Most candidates recognised that a black coloured s best for absorbing radiation, fewer remembered that it should be dull or matt. Rather less than ha candidates went on to explain that any other surfaces would reflect some radiation. Although m candidates recognised that the liquid should expand when heated many gave considerable irrelevant deta that would be unlikely to be true. A significant minority of weaker candidates describe the radiation as being nuclear radiation (i.e. the effects of radioactive decay). The difficulties of absorbing low intensity thermal radiation were unclear to many candidates. Examiners sought the ideas that that water has a high specific heat capacity and therefore temperature rises and subsequent expansion would be very limited with little incident radiation. Failure to understand the problems rather unsurprisingly meant that few candidates could makes sensible recommendations regarding the solution of the problem. When candidates did make sensible recommendations, such as using a smaller flask, thinner walls or a tube of narrower bore, they were unable to explain why such changes would be effective.

Question 3

This question was generally well answered. Most candidates recognised diamond as being the harder of the two carbon structures and graphite as being the better conductor. Of these many candidates were able to explain their answers on terms of the crystal structures. Many candidates drew acceptable diagrams of carbon dioxide showing two double bonds and a share of eight electrons in each shell. Although it was clear that the majority of candidates understood that carbon monoxide resulted from incomplete combustion, many argued this very poorly. Typically answers based on there being too much carbon rather than insufficient oxygen usually faltered. There were many very good answers regarding the effect of carbon monoxide on haemoglobin.

Question 4

This question was either answered extremely well or else very poorly indeed. Few candidates were able to quote relevant equations and gain some credit by that route. Often numerical answers were simply written down (usually incorrect) without any working being shown. In part **(a)(i)** 16V and 2V were common incorrect alternatives to the correct answer of 8V. Many candidates gained credit for calculating a current which was consistent with their peak voltage value. A significant number of candidates either quoted the current version of the transformer equation or else inverted one of the sides of the voltage equation. Other candidates used the **(a)(i)** voltages as the primary (rather than secondary) voltage. Most candidates were unable to make any sensible attempt at calculating the period. Surprisingly few candidates recognised the symbol for the diode and even less were able to show half-wave rectification on the screen.

Answers: **(a)(i)** 8V, **(ii)** 0.8 A, **(iii)** 12 V, **(iv)** 80 ms.

Question 5

Most candidates were able to recognise diffusion as the process by which the two gases move along the tube. Although most candidates recognised that the ammonia was diffusing faster than the hydrochloric acid, few explained this in terms of the relative mass of the molecules. Very few candidates were able to gain credit for explaining that a proton is transferred from the hydrochloric acid to the ammonia to produce the positive ammonium ion. Although many candidates described testing for ammonia by turning red litmus to blue few actually explained the need to react the ammonium chloride with sodium hydroxide (and warming) before performing the litmus test.

Question 6

This question was not well answered. Few candidates were able to define refractive index either in terms of the angles of incidence and refraction or the ratio of the velocities of light in a vacuum to that in a material. Very few candidates were able to explain that as 60° is greater than 40° the range of angles in air was greater than that in water. Despite few candidates being able to define refractive index, many were able to calculate it for the situation shown.

Answer: **(b)(ii)** 1.35.

Question 7

The formula for aluminium oxide was generally well-known. Although most candidates had a re idea of the meaning of amphoteric, few could state this unambiguously. The Examiners sought the ide amphoteric compounds could act as an acid or a base in that they can tend to neutralise both acids bases. Most candidates were able to state a use for aluminium and also appropriate properties. The phras does not rust was common and was not awarded credit – candidates must be able to distinguish between rusting and corroding. Most candidates either correctly suggested that thallium oxide was basic because thallium is a metal (or that the trend down the group was towards becoming more metallic); however the suggestion that thallium oxide is amphoteric because aluminium oxide is amphoteric was relatively common.

Question 8

Although it was clear that most candidates understood the principle of operation of the release mechanism for the falling ball few phrased their answers in terms of accurate physics. Many talked about charges rather than magnetism and others described the power rather than the current being interrupted. Most candidates were able to use the weight equation although perhaps half of these failed to convert the mass from grams to kilograms. Explanations relating to the possible effect of air resistance were quite mixed but the best answers stated that, since steel is much denser than air, the weight of the ball would mean that air resistance would hardly affect its motion. A high proportion of candidates made an attempt at calculating the acceleration due to gravity. Many answers were flawed by belief that the average speed would be the maximum speed or by quoting acceleration as being velocity divided by time rather than the correct definition of change in velocity divided by time.

Answers: **(b)** 0.2 N; **(d)** 10.4 ms^{-2}.

Question 9

Few candidates stated all three essential conditions for fermentation to take place. Most said that it needed to be warm (without suggesting the range of temperatures) and few mentioned the need for a glucose *solution*. Most answers included reference to either yeast or a named enzyme in yeast. Nearly all candidates correctly calculated M_r of glucose to be 180 but 92 was quite commonly seen for ethanol. With error carried forward the mass of ethanol was often correctly calculated although a significant proportion of candidates forgot the 1:2 ratio of glucose to ethanol. The calculation of the volume of CO_2 followed a similar pattern to that of ethanol.

Answers: **(b)(i)** 180 and 46, **(ii)** 18.4 g, **(iii)** 9.6 dm^3.

Paper 0652/04
Coursework

General comments

Nature of tasks set by Centres

Only a small entry submitted coursework for this session of the examination. All the tasks set were appropriate to the requirements of the syllabus but some were not sufficiently demanding.

Teacher's application of assessment criteria

The assessment criteria appear to be understood. However only outline marking descriptors were evident with insufficient detail.

Recording of marks and teacher's annotation

Centres are not annotating scripts. Tick lists were not used.

Suggestions have been made encouraging the use of annotation on candidates' scripts.

Good practice

Too few candidates or Centres to make any observations.

Paper 0652/06
Alternative to Practical

General comments

Many schools and colleges prefer to enter their candidates for the Alternative to Practical 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.

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*. Teachers are urged to organise activities that will give their candidates experience of using these 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 this 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 example, **Question 1 (d)** asks for a test to show the presence of water in a few droplets. Theoretically, the boiling and freezing point will demonstrate the identity of water, but it would be impracticable to find the boiling point using only a small amount of liquid, so this answer is rejected. Similarly in **Question 4 (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.

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 2 (c)** 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 greater accuracy of measurement.

Candidates are urged to use the *Notes for use in Qualitative Analysis* wherever possible. The answers to **Question 5** have revealed the usual ignorance of test tube reactions for identifying anions and cations.

Comments on specific questions

Question 1

This question is based on the chemical reactions occurring when a candle burns in air.

(a) All but a few candidates were able to read and record in seconds the times shown on the stopclocks. A few thought the clocks read minutes and multiplied by 60 to give seconds, but a moment's thought should have dismissed this as unrealistic.

(b) Most candidates correctly wrote that a larger beaker made the candle burn for a longer time, since more air or oxygen was available. Unsatisfactory answers included the idea that the larger beaker gave more space for the products of combustion.

(c) Almost all wrote that carbon dioxide is formed.

(d) Anhydrous copper sulphate is turned blue, or cobalt chloride paper is turned pink, were the expected answers. Finding the boiling point or freezing point is not practicable in this experiment.

(e) Many candidates whose answers were good so far, now gave unscientific explanations about the formation of carbon dioxide and water. "Carbon dioxide is always the product of combustion, and water is formed when heat condenses" were often given as the answer. The Examiners looked for a knowledge that candle wax, a hydrocarbon, is the source of the carbon and hydrogen oxidised during the combustion process. "Carbon dioxide and water are the products of combustion" was rejected as an inadequate answer.

Question 2

The question is constructed around an unusual method of finding the mass of a metre rule, but go test the candidates' knowledge of the Principle of Moments.

(a) The pivot positions were easy for almost all the candidates to read.

(b)(ii) A sizeable group of candidates did not follow the instruction to use the last line of the data in Fig. 2.3, and so calculated the wrong values of $\mathbf{d_1}$ and $\mathbf{d_2}$. This made the calculation in part **(ii)** more difficult. Some lost a mark here by not giving the unit of mass, g.

(c) What was needed here was simply to find the average of the calculated masses of the rule. Poorer candidates did not understand the significance of the question.

(d) This was the most difficult part of **Question 2**, especially for candidates who had never used similar apparatus to establish the principle of moments. The Examiners expected candidates to suggest placing the pivot under the 50cm mark, hanging the small rock on one side of the ruler, using the 100g mass to balance the ruler and finally using the principle of moments to calculate the mass of the rock. Many, however, suggested replacing the 100g mass by the rock, and then adjusting the pivot position to balance the ruler. This would work equally well if the principle of moments is correctly applied. Unfortunately, those who knew nothing of this principle suggested using the formula given in **(b)**, and there was also much confusion over $\mathbf{d_1}$ and $\mathbf{d_2}$.

Many candidates failed to give good answers to **Question 2**, showing that their studies had not included the principle of moments.

Question 3

The question depended on the candidates 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 $25cm^3$, 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.

(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 and so on.

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

Question 4

This question involved finding the solubility of a salt. This 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; m[illegible]e to do so. If a value for *Experiment 2* was stated in **(b)**, this point was also expected to [illegible] on the graph. A smooth curve results. Extrapolation of the curve through the origin was [illegible] 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 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 wild 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 answer was sometimes was offered both in **(i)** and **(ii)**, although the information was only applicable when correctly separated into the effects seen when first, a few drops of ammonia, then 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 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. with a more accurate scale.