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FOREWORD

This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned**.

PHYSICAL SCIENCE

Grade thresholds taken for Syllabus 0652 (Physical Science) in the November 2005 examination.

	maximum mark available	minimum mark required for grade:			
		A	C	E	F
Component 1	40	32	27	21	18
Component 2	80	n/a	42	30	24
Component 3	80	46	31	17	13
Component 5	30	23	13	10	8
Component 6	60	40	30	22	18

The threshold (minimum mark) for B is set halfway between those for Grades A and C. The threshold (minimum mark) for D is set halfway between those for Grades C and E. The threshold (minimum mark) for G is set as many marks below the F threshold as the E threshold is above it. Grade A* does not exist at the level of an individual component.

Grade Thresholds are published for all GCE A/AS and IGCSE subjects where a corresponding mark scheme is available.

Paper 0652/01

Multiple Choice

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

General comments

The mean mark (21.9) and the standard deviation (5.6) are both relatively low compared with previous years. However, the reliability coefficient was satisfactory. The low mean seems to be the result of some disappointing responses to a few questions: these are mentioned below.

The mean of this paper was 55%, which is a decrease since this time last year. All the items appeared on equivalent papers at this level, so this was a little disappointing.

Comments on specific questions

Question 2

Only a fifth of candidates answered correctly. Over 50% of the lower-scoring candidates chose **A**, together with about 40% of the higher-scoring candidates doing likewise. The facts that hydrogen is diatomic and that helium is monatomic ought, surely, to be better known.

Question 4

The popularity of response **A** points to some basic uncertainly about the meaning of 'nucleon number'.

Question 6

The relative popularity of response **A** amongst all of the candidates similarly suggests uncertainty about the meaning of 'exothermic'.

Question 7

Despite the use of heavy type for the word "same", only 20% answered correctly and many candidates across the ability range chose **C**. The basis of the question was, of course, that the use of more concentrated acid would shorten – *not* increase – the time needed to collect the same volume of gas.

Question 9

Another question that tended to catch candidates out in that over half of the lower-scoring candidates chose **D**. Did they merely misread the question or did they not know the difference between the reactions of bases and metals with dilute acid?

Question 10

This was also found to be hard, probably because of the inclusion of aluminium rather than zinc as one of the cations.

Question 13

For the lower-scoring candidates, responses **B** and **D** were both more popular than the key (**C**). Section 7.2 of the syllabus directly relates to this question.

Questions 17-19

These three questions were all found to be marginally hard but with good to very good discrimination. In each of these questions, there may have been some guessing by the lower-scoring candidates and this implies some lack of confidence with organic chemistry.

Question 22

The vast majority of candidates simply multiplied 20m/s by 30s, thereby giving the answer **C**.

Question 24

There was clearly a lot of uncertainty. Nearly a third of candidates thought that the C of G can be found using only one hanging point.

Questions 25, 26 and 39

The facility of these questions was close to the “guessing level” of 25%, and the statistics of the individual options does indeed confirm that there was widespread guessing in each of these items.

Question 27

Very few thought the answer was **D**, but the other options had similar popularities. It could be that candidates were unsure how to deal with large numbers and negative temperatures.

Question 29

A quarter of candidates answered **D**. A triangular prism would indeed move the rays vertically, but they would not remain parallel.

Question 31

This produced good statistics, but it is interesting to note from the incorrect responses that 28% of candidates think that sound *can* travel through a vacuum, and that 23% think that sound *cannot* travel through a solid.

Question 32

There was a lot to take in, in order to answer this question, and it was pleasing that two-thirds of the candidates were able to analyse the question correctly.

Question 35

The circuit was somewhat unusual, in that we do not often put switches in parallel with components. Over 40% could cope with this situation, with the remainder being equally divided between the incorrect options.

Question 36

The candidates really did not seem to understand the reasons for connecting house lights in parallel. In fact, nearly a half thought that the current in every circuit must be the same. Where did they get this idea?

Question 37

This worked well, with the vast majority realising that the particles emitted from the cathode of an oscilloscope are electrons. Unfortunately, a third of these thought that electrons are positively charged.

Question 38

Very few thought the radiation was a mixture, but there was a lot of uncertainty about which of the other options to choose. Absorption of radiation is not difficult to understand at this level, and candidates should have been able to cope better with this item.

Question 40

This was one of the items which candidates seemed to find “easy”, but the statistics of **C** and **D** show that 18% of candidates believe that the nucleus contains electrons.

Paper 0652/02

Paper 2 (Core)

General comments

The standard of candidate was similar to last year, and continues to reflect that only a limited number of candidates are entered for the Core Paper. Generally the candidates showed an appreciation of some parts of the work but failed to show more than a rudimentary understanding of major areas. It is important that all candidates are familiar with all parts of the Core Syllabus and are able to apply their knowledge in simple situations.

Comments on specific questions

Question 1

(a) This section of the question required a simple explanation of convection in the atmosphere. It was somewhat disappointing that a great number of candidates did not recall that the process is called convection. However, the explanation for the existence of convection currents was done quite well, with the majority of candidates recognising that warm air is less dense than cold air so rises, or (better) cold air is denser than warm air so falls. However, very few candidates explored the idea sufficiently to ask themselves why warm air is less dense.

(b) Most candidates recognised the formation of raindrops in a cloud is an example of condensation.

(c) The interpretation of the graph was reasonable, although the common errors of assuming that in the first section the drop was rising and that in the second section the drop had hit the ground and was stationary were not uncommon. Candidates were penalised for careless use of language; for example constant motion is not necessarily the same as constant speed.

Question 2

Diffusion was recognised, however very few candidates were able to apply the kinetic theory to explain why the diffusion is slow. The ideas of the kinetic theory are relatively straightforward and are of key importance in the understanding of the nature of matter.

Question 3

(a) There are many uses for both mild and stainless steel, and candidates gave a wide range, it is important to be specific; for example a comment such as “in surgeries” is not acceptable, “medical instruments” is better but still vague, whereas “forceps in a surgery” is quite clear and can lead to no confusion.

(b) The explanation of the action of water and oxygen on mild steel and on stainless steel was done well – with many candidates giving good clear accounts. There was a minority, however, who were under the impression that stainless steel already had a (chromium) coating which stopped it from rusting!

Question 4

(a) This part was a straightforward insertion of suitable energy types, many of the stronger candidates showed clear understanding of the process.

(b)(i) Many candidates recognised the type of power station that was being described: a geothermal station, and were clear that it was advantageous in that it did not use scarce fossil fuels nor did it add to pollution or global warming. A few were less clear and simply referred to them as being environmentally friendly – this really is too vague.

(ii) This section gave candidates an opportunity to put their thoughts into their own words. Predictably, candidates found this the hardest section on the paper – and the ideas are not easy! The common assumption that the gravitational potential energy is converted into kinetic energy of either the turbines or the water in the pipes is invalid. Once the turbines are turning, their speed does not change, similarly the water in the pipe must have the same speed all the way down (think of current in a circuit!). The problem becomes more complex than it appears at first glance. Credit was given for sensible discussion of conversion of the gravitational potential energy of the water to electrical (potential) energy at the turbines.

Question 5

(a) Most candidates recognised the (paper) chromatography although fewer gave a meaningful explanation for the use of locating agents, one even explaining that they show you the best place to live!

(b) Some candidates were clearly aware of fractional distillation, others less clear. It is important that candidates are encouraged to use exact terminology for processes. Few candidates stated that bitumen was the residue left after all other fractions had been evaporated off from crude oil.

Question 6

(a) A vast range of answers was given here, including alpha radiation, beta radiation, sound etc.

It is disappointing how many candidates are not familiar with the electromagnetic spectrum.

(b) There is an equally disappointing number of candidates who recognise that the speed of *all* electromagnetic radiation is the same in a vacuum.

(c) The majority realised that the picture showed an image gained by the use of *x*-rays.

(d) Relatively few candidates were able to give the upper threshold of human hearing, about 20 000 Hz, although answers ranging from 15 to 30 kHz were accepted.

Question 7

A challenging question, nevertheless there were some good attempts at naming and drawing the structures of the different hydrocarbons. Ethane and ethanol were recognised by many, and good attempts were made to draw the structures, disappointingly fewer recognised poly(e)thene to be the polymer.

Question 8

(a) This question showed the importance of candidates carrying out practical work for themselves. Attempts by candidates from some Centres showed an understanding of techniques which cannot be learnt from a text book, such as putting the magnet *under* the paper, gently sprinkling iron filings, tapping the paper.

(b) There were some reasonable attempts to draw the field, however not enough care was taken: lines of flux must start and finish (unless they go 'off' the paper) on a pole, not near a pole. A line of flux shows the direction of the force on a north-seeking pole hence lines can *never touch nor cross.*

Question 9

(a) The majority of candidates successfully completed the first two lines of the table, and though fewer were able to give the electron configurations, which were, of course identical.

(b) There were some good drawings of the covalent bonding of hydrogen and chlorine, although many candidates had little idea.

(c) Again there were some who clearly understood the ionic bonding, the donation and receiving of an electron to form a positive and a negative ion, while others had little idea. Several, perhaps influenced by the previous covalent bonding of hydrogen chloride, assumed this too, was covalent.

Very few candidates were able to explain why these ions formed a strong bond.

(d) This part also caused major problems, only a handful of candidates realised that the ions, locked in a lattice in the solid, were free to move and carried the current in the liquid state.

(e) The majority of candidates who made an attempt at this made the common error of identifying the chlorine molecule (bleaching of litmus paper) rather than the chloride ion. Of those who did attempt to test for the existence of the ion several did not add silver nitrate but merely added dilute nitric acid.

Question 10

(a) It was pleasing to see some good definitions of noble gases; full outer shell of electrons, but less encouraging to see the attempts to describe an alpha particle – this is a common question and candidates should be aware that an alpha particle is a high energy helium nucleus (not atom) which is emitted from the nucleus of a decaying nuclide.

(b) Many candidates did not know what an alpha particle is and were unable to make any realistic attempt at this part. A common error, in the better attempts, was to make the alpha nucleon and proton numbers negative, this is an error Examiners have rarely come across previously and which needs to be avoided.

(c) Very few candidates had any real idea of how to approach this problem, the mass at the beginning needs to be halved three times to get to 4.5 g, and as this happens in three minutes, it is clear that the answer is *1 minute*.

Question 11

(a) Vague answers were common here, whilst many candidates were aware that carbon monoxide was formed during incomplete combustion, few thought to state that it was incomplete combustion of carbon based fuels. Relatively few realised that nitrogen and oxygen would combine only (and thankfully only) at high temperatures – the better answers talked about in car engines and during lightening strikes.

Question 12

(a) Quite a significant number realised that calcium oxide could be obtained by heating the calcium carbonate – and more were able to correctly complete the equation, though few recognised the process as being endothermic. Where candidates recognised that carbon dioxide was produced in the process the test was correctly identified.

(b) Surprisingly, relatively few recognised that the process of treating acidic waste was one of neutralisation.

Question 13

(a) Virtually every candidate recognised that this was to do with safety with water in the shower-room/bathroom, however very few went on to explore this, by explaining that water is a conductor, and that a person would be well earthed on a wet floor or that a large current could pass through him/her.

(b) This was well done, not an easy calculation with the realistic numbers, and the two lamps in parallel.

resistance = 960 Ω

(c) It was really pleasing was that in this final section a large number of candidates had the understanding to look through the figures and to recognise that the current from the supply was simply the sum of the currents through the two bulbs.

current = 0.5 A

Paper 0652/03

Paper 3 (Extended)

General comments

There were some quite good papers; nevertheless it is clear that too many candidates, with neither the knowledge nor the understanding for this level are being entered for this paper, rather than the less demanding Core Paper. It was disappointing that there seemed areas of the syllabus with which virtually no candidates were familiar, it can not be overestimated how important it is that candidates cover the complete syllabus in detail.

The questions which showed this lack of knowledge were **Question 6** (moments), **Question 8** (nuclear fusion) and **Question 10** (emf and internal resistance). At the higher grades it is expected that candidates not only have a knowledge of the basic work but are also able to apply their knowledge in different situations, this was not often apparent.

Comments on specific questions

Question 1

(a) A nice gentle introduction in which the vast majority of candidates scored both marks.

(b)(i) This was not done at all well, the equation does require a small amount of work to get it to balance, but there is no excuse for candidates, at this level, to give diatomic molecules, such as H_2 as simply H. The concept of balancing simple equations is important and time must be devoted to developing this skill.

(ii) The majority of candidates knew the test for hydrogen, however there remains a minority, who threw the marks away by introducing not 'a lighted splint' but 'a glowing splint'; a glowing splint will not ignite the hydrogen.

(c) There were some quite good answers here, but a common error was to say that more gas/hydrogen would be given off, rather than that the gas would be given off at a faster rate.

Question 2

(a) The use of Snell's equation is not easy, and the calculation caused some serious problems, nevertheless the syllabus demands a knowledge and understanding of the equation and candidates need to develop the skill.

Angle of refraction = 39.(05)^{o}.

(b) It was very disappointing that many candidates had little idea of this. Many did not even know the meaning of the angle of incidence. Many did not know that the ray will be refracted towards the normal when it enters the more dense glass block, and that the emerging ray should be parallel to the incident ray.

Question 3

(a) The section was done well, with a significant number of candidates able to correctly calculate the number of moles of sulphuric acid, although errors in converting units were common. Likewise many recognised that the same number of moles of copper(II) sulphate would be formed. The calculation of the relative formula mass was done well, as was the calculation of the mass of copper(II) sulphate.

Moles of sulphuric acid = 0.02

Moles of copper(II) sulphate = 0.02

Relative formula mass of copper(II) sulphate = 160

Mass of copper(II) sulphate = 3.2 g

(b) This section was not done to the standard that might be expected for a standard laboratory exercise. Many candidates did not filter out the excess copper(II) oxide, thus denying themselves any chance of getting clean crystals of copper(II) sulphate.

Question 4

(a) The graph plotting was done well, the most common error was to show constant deceleration in the final section – any non linearity of the line was sufficient to show non-uniform deceleration.

(b) Most candidates are familiar with the equation for kinetic energy; ½ mv^2, but many then substituted in ½ x 0.15 x 20, ignoring the squaring of the speed.

Kinetic energy = 30 J.

(c) This caused more problems than anticipated with large numbers of candidates dividing the change in speed by 10 s, rather than 0.10 s.

Acceleration = 200m/s^2.

Question 5

(a) This was an even simpler equation to balance than the one in the first question, but still candidate after candidate used monatomic oxygen rather than go through the difficult(?) process of doubling the number of hydrogen molecules.

(b) Good knowledge was shown, of the use of catalytic converters to remove nitrogen oxides from car exhausts. Most recognised that carbon monoxide is a poisonous gas, many giving much more detailed descriptions of its action.

(c) The vast majority recognised that the advantage of hydrogen as a fuel is that its only by product is water and is therefore non-polluting, but few recognised the major problem is storing it on board as it would need to be liquefied and pressurised, though some did gain credit for recognising that less energy is released, per unit mass, in burning hydrogen rather than petrol. As for the disadvantage: no credit was given for the statement that hydrogen is explosive, so is petrol! Hydrogen, being gaseous is arguably safer than petrol, because the unburnt hydrogen would move upwards away from the vehicle.

Question 6

(a) Very few candidates scored any marks at all in this section. It should be basic knowledge that for any object to be in equilibrium the resultant force on it must be zero and the resultant moment (about any point) must also be zero.

(b) A few candidates were able to state that the meaning of *uniform* in this context is that the centre of mass is at the middle of the ruler.

(c) Attempts at the calculation often did not get started. Credit was given to any candidate who attempted to balance the clockwise and anticlockwise moments! Although a percentage recognised that the clockwise moment could be found by multiplying 50 g (or better 0.5 N) by 10 cm, virtually no candidate, even when they had correctly stated the meaning of a uniform ruler, took the weight of the ruler acting at the centre of the ruler!

Mass of the ruler = 23 g.

Question 7

(a) This section was well done with the vast majority recognising that curve **A** showed the most concentrated acid because the carbon dioxide was given off most quickly, fewer went on to fully explain that the more concentrated the acid the quicker the reaction. Most candidates understood that the volume of carbon dioxide released was determined by the mass of calcium carbonate used.

(b) This was also done well, with candidates clearly recognising that the speed of reaction increases with temperature.

(c) Those candidates who had an understanding of moles made a good attempt at all three parts of this, however units again caused problems with some candidates thinking that over 4 tonnes of calcium carbonate would be required to produce 100 cm^3 of carbon dioxide! The message is that candidates must look critically at their answers.

Moles of carbon dioxide = 0.0042

Moles of calcium carbonate 0.0042

Mass of calcium carbonate = 0.42 g.

Question 8

(a) Only a small minority knew that the process which fuels the Sun is nuclear fusion, answers ranged from explanations of the transmission of energy to Earth by radiation to combustion of hydrogen. This is most disappointing. Of those who were able to name the process, few made a good attempt at describing it, of those few attempts the most common error was to describe the process as the combining of two hydrogen atoms to form helium, without any realisation that under the conditions for fusion that all the electrons would be ripped from the nuclei, and it is the nuclei which combine.

(b) Some candidates were aware of the Einstein mass-energy equation others E = Mc, or simply guessed from the information in the question. Of those who knew the formula the mistake made in **Question 4 (b)** was replicated, the failure to include the squaring of the speed.

Question 9

(a) The recognition of the alkanes was good as was the recognition which of the compounds would dissolve in water, giving an acidic solution.

(b) The test to distinguish between alkanes and alkenes was well known and the section was answered well. Fewer candidates however recognised the process as catalytic cracking.

(c) The attempts to draw the polymer were quite disappointing, many drawing butane, pentane etc., it is necessary that a cell is drawn with the open bonds at either end, preferably in a bracket with a subscript n to show the long chain.

Energy released 1.08 x 10^{20}J.

Question 10

Very few candidates showed any understanding of internal resistance and emf. The answers in **(a)** showed this clearly, and even though many candidates were able to score full marks in **(b)** by mechanically working through, even this did not seem to guide them to really think about the problem, and they did not recognise that 1.4925 V is very close to the stated emf of 1.5 V.

current = 0.015A

p.d = 1.49 (25) V

Paper 0652/05
Practical Test

General comments

The degree of difficulty of the paper was thought to be very similar to previous years, whilst the performance of the candidates was slightly below par. Although the marking produced a good spread of marks there were few high scoring answers. However, there was no evidence to suggest candidates were under prepared for the paper and it is good to see practical work being done in Centres that have small numbers of candidates.

Comments on specific questions

Question 1

The main criticism applies to a lack of appreciation as to the degree of accuracy required. Most appeared to assume that several places of decimals inevitably means greater accuracy. Some of the tables constructed were rather scrappy and certainly lacked the use of a ruler. Three columns were expected with correct headings. Although the length P was always recorded, its value was often outside the limits required. A careless mistake, resulting in the loss of an easy mark. If the instructions were followed in respect of 80-90 g of plasticine being provided, it was surprising to find some candidates using all masses less than about 30 g. The question requested about 10 g of plasticine to be removed each time and it was clear that many did not appreciate the word 'about' resulting in masses decreasing by exactly 10 g each time. Some very unnecessary work would be required to ensure the removal of exactly 10 g each time. The commonest error was failure to record the time to the nearest second. Any accuracy greater than this simply made the remainder of the question far more complicated than necessary. Many of those who did record the time to the nearest second for 20 swings then went for silly accuracy in calculating the time for 1 swing. Calculating to two decimal places made graph plotting difficult and inevitably produced points that were not on a straight line. The majority of candidates therefore concluded that the mass did make a difference to the period of swing. Even the few who realised that the difference was insignificant lacked the courage to state that the period of swing remained the same. The commonest answer to part **(g)** was a statement that it was more accurate. This did not score the mark. Very few stated the difficulty in measuring the time for one swing. Most were able to score one or two marks on the last part.

Question 2

Most correctly answered yellow for the appearance of the solid **A** after heating with rather fewer saying it was white on cooling. The word precipitate was often used here, showing complete ignorance of the meaning of the word. 'Same as before' was not an acceptable answer. Some thought the gas evolved in **(a)(iii)** turned litmus blue and concluded an ammonium salt. Part **(v)** was not well answered. A variety of answers were given, some even thinking it was a hydrocarbon. The expected answer was 'a carbonate'. Part **(b)** produced few correct answers. There are a number of possible observations to make if the salt is heated strongly enough, e.g. water condensed on the tube, the solid turns white then brown, smoke produced. Parts **(ii)** and **(iii)** were usually answered correctly. Very few candidates scored the two marks for part **(d)** due almost entirely to a failure to appreciate that one cannot obtain a precipitate if the starting point is already a solid, especially when that solid is already green. It is essential to dissolve the solid in water before adding the sodium hydroxide. Once again it is a failure to fully understand the use of the word precipitate.

Paper 0652/06

Alternative to Practical

General comments

Many Centres are to be congratulated on the good standard achieved by their candidates in this paper. The answers showed that candidates had "hands-on" experience of practical work in chemistry and physics.

The Examiners try to construct questions that ask how to do experiments, demand a recall of well-known reactions and results, give opportunity to record and process data and suggest extensions to experimental methods. They try to devise a gradient of difficulty to let weaker candidates score the easy marks and enable others to demonstrate their greater ability.

An emphasis is placed on experimental, rather than on theoretical details. As a result of this, candidates without the relevant laboratory experience have, as usual, been at a disadvantage. Many candidates have answered some questions badly, showing their lack of experience of laboratory work in sections of the syllabus such as chemistry. A "whole-subject" approach to science is essential if candidates are to be well-prepared for this examination. It should certainly not be regarded as an easy option to the Practical Examination or to Coursework.

The emphasis on answers that show awareness of practical details is well illustrated by **Question 5** parts **(c)** to **(e)**. The Examiners needed a diagram showing litmus paper held in the mouth of a heated test-tube; the description of a wood splint being lit and then the flame blown out to leave it glowing; and an explanation of the testing of solid **B** by first dissolving it in water and then adding aqueous sodium hydroxide to produce a precipitate of a characteristic colour. Far too many candidates who had never seen or carried out these tests relied on rote-learned details that did not correctly answer the questions.

Some candidates showed a lack of experience in the techniques of answering the questions set in this paper. They did not read the questions all through before beginning to write, they failed to read balance and volume scales and they attempted to complete tables of data without understanding how to do so. Candidates need practice in exercises of this type so that they can demonstrate their true abilities.

Comments on specific questions

Question 1

The reactions of sodium metal and of sodium hydroxide formed the basis of this question. This area is fundamental to the syllabus, so it was disappointing that very many candidates could neither describe the reaction of sodium with water nor go on to interpret the flow diagram of the reactions.

(a) Anyone who has seen what happens when a piece of sodium is placed into cold water must remember its behaviour, melting into a blob, floating and moving around before it disappears. Alas, very few totally correct answers were seen.

(b) Universal Indicator colours should be known for the common laboratory reagents, so here the Examiners looked for purple or violet as the answer. Some candidates answered this question.

(c)(i)-(iii) Surprisingly, the least well-answered of the three unknowns was white precipitate **S**; silver chloride. This suggests that candidates have not become familiar with the tests for anions and aqueous cations that form part of the Notes for Use in Qualitative Analysis given in the syllabus.

(d) This was more difficult, and failure of most candidates to identify salt **R** (ammonium chloride) suggests that they could not interpret the flow diagram.

(e)(i) In previous years, weaker candidates have not understood the meaning of the word "precipitate" and the answers to this question bears this out. There were very many diagrams of solutions being evaporated to obtain crystals, whereas the Examiners looked for the use of a filter funnel and paper to separate the solid precipitate from the liquid.

(ii) Few candidates knew that a silver salt darkens when exposed to bright light, the basis of black-and-white photography.

Overall, few candidates scored more than three or four marks in this question. Candidates need opportunities to see notable reactions and to do test-tube experiments to investigate the properties of common laboratory reagents.

Question 2

This question tested the knowledge of series and parallel circuits and their different effects on the current passing through the components. There were many good or excellent answers. The most disappointing aspect of the answers was a lack of understanding of the concept of resistance, although most candidates were able to calculate the resistance of a lamp given the potential difference and the current passing through it.

(a)(i)(ii) Many candidates correctly read the ammeters and assigned the current values to the correct switch combinations. The most common error was to write "0.6 A" for the current passing when all three switches were closed. This meant that for one lamp, the current passing would be 1.8 A. The candidate therefore gained three marks out of five, losing two marks because of one error.

(iii) Errors in completing Fig. 2.3 were carried forward in marking this part of the question, so that a candidate who wrote "1.8 A" for one lamp could then score by putting this value into the formula R = 3.0/current. However, a candidate who used "0.6 A" in this formula but had *not* assigned this current to *one* lamp in Fig. 2.3, lost the mark even though this gave the correct answer for one lamp, 5 ohms.

(b) Most candidates were able to draw a circuit with three lamps in series with the ammeter. A few also included a voltmeter in series with the other components, losing a mark since they should know that its high resistance would not permit any current to flow.

(c)(i) Only a minority of candidates could explain that the series circuit had a higher total resistance than the parallel circuit. Many less able candidates wrote that the current was split up between the lamps or that the first lamp used up most of the current, leaving only a small current for the other two lamps.

(ii) These last mentioned candidates went on to say that the series lamps were progressively dimmer! However, most candidates correctly answered that lamps in the parallel circuit would be brighter.

Question 3

The Examiners designed this question as one that would combine balance scale reading with chemical knowledge and calculation of percentage composition. It is gratifying to note the many completely correct answers. The most disappointing aspect of the chemistry was the failure to describe the colour of copper metal. A significant number of answers that were otherwise faultless included the assertion that "copper is a blue solid".

(a)(i)-(iii) Most candidates read the scales and subtracted to find the mass of brass. A few candidates read the scales from top to bottom, failing to notice the integers increasing from bottom to top.

(b)(i)(ii) What was needed here was the idea that the zinc would react with the acid producing bubbles of hydrogen, the obvious immediate *observation*. It is important that the word "observation" is correctly interpreted by candidates. The observation that "a colourless solution would be produced" is not relevant in this case, since the acid that was added was already colourless. Similarly, the second answer follows from the first that the bubbling would cease when all the zinc had been dissolved. "The mass of brass had decreased" was also unacceptable as an answer, since at this stage, the beaker and its contents were not being weighed. A minority of candidates gave correct answers to both parts.

(iii) The appearance of copper residue was not often correctly described. The most common incorrect answer was "blue". Suggestions that it was pink, rusty, brown, golden-yellow, etc. were accepted, but not "copper-coloured".

(c)(i)(ii) Rather more mistakes were made in calculating the mass of the copper left over than had been made in calculating the mass of brass. A significant number of candidates calculated the mass of zinc dissolved, probably because they had not appreciated the logic of the question.

(d) A pleasing proportion of candidates calculated the percentage of the brass that was copper, to earn two marks. Errors in **(c)(ii)** and elsewhere were carried forward in marking this calculation. One mark was awarded if either the quotient or divisor was incorrect in the formula "**x**/**y** x 100", or if the correctly-stated formula was wrongly calculated. Whole groups of candidates were unable to find a percentage, suggesting that this had not formed part of their study.

Question 4

The effects of acceleration due to gravity are felt by everyone, yet this question was not well answered by most candidates. The Examiners appreciate that the notions of speed and acceleration are difficult and that the questions were subtle and searching, but they feel that they are relevant and appropriate.

(a) Few candidates failed to measure the angles of slope, suggesting that they had correctly included protractors in their examination materials.

(b) This was a harder exercise. Candidates had to find the total distance travelled after 1.0, 1.5, 2.0 and 2.5 s. A majority of candidates did so, but many thought that what was needed was the additional distance travelled in each 0.5 s period. Others were quite unable to work in decimal fractions of a metre. Despite these errors, enough data was included in the table for the next questions to be answered.

(c) Those candidates who did not understand the meaning of acceleration were now at a disadvantage. Some said that since the distances travelled increased, this showed acceleration, but this would be true even if a constant speed had been maintained by the ball. They had to show that the distances travelled in each 0.5 s period had increased. Some calculated the average speed in 1.0 s and then in 2.0 s; this showed an increase, so they earned the marks. Yet other candidates compared the distances travelled by the ball on the three slopes, an irrelevant consideration.

(d) This may appear to be the hardest part of the question, but if the train of thought of parts **(c)** and **(d)** is followed, the obvious answer is that there is a greater acceleration if the angle of slope is increased. An even more satisfying answer was given by the intelligent candidates who observed that when the angle was increased, the end of the slope was higher from the floor, so the ball had greater potential gravitational energy. As it ran down, this extra energy was converted to greater kinetic energy. Answers that suggested that the gravitational force was increased by the greater angle gained no credit.

(e) It seems some candidates did not understand the wording of the question. Strictly, there can be only one answer to the question "Which of the following is *most* likely…?" Many candidates ticked more than one box and could not gain the mark.

Only the first answer is correct. The mass of the balls was different, but the gravitational acceleration would be the same. The air resistance would be the same since the balls were the same size. The force of gravity would not have changed. Very few candidates obtained this mark.

There were some candidates whose scores were commendable for this question, though few managed to progress beyond part **(b)**.

Question 5

This question, like **Questions 1** and **6**, was based on the corresponding question in the Practical Examination, Paper 5. Candidates in the Practical Examination were provided with samples of two solids, **A** and **B**, which were zinc carbonate and iron(II) sulphate. The Paper 6 questions mirrored the tests and their results. Candidates are required to learn the tests and positive results for gases and ions.

It was not enough, however, to have learned the tests "parrot-fashion" since there were traps for the unwary.

(a)(ii) The litmus paper stayed red, so the gas could be acid or neutral, but the name of an acid gas such as carbon dioxide was not accepted.

(iii) Most candidates found it easy to write that the lime-water turned milky or white.

(b)(i) A mark could be earned by writing that the crystals gave off water vapour or that they were hydrated or became anhydrous. The identification of "an iron salt" was not accepted.

(iii) The splint did not re-kindle, so the candidate must conclude that the gas could not have been oxygen. Again, the suggestion of a named gas that does not re-light a glowing splint, such as nitrogen or carbon dioxide was not accepted.

(c) Now the candidate had to show a test-tube being heated, with a piece of red litmus paper held in the *mouth of the tube.* Some fantastic drawings were submitted, including the collection of the gas over water before its testing with litmus, which would not have worked.

(d) This provided many more candidates with a dilemma, how to do the glowing splint test? The splint has to be lit in a flame and then *blown out* to leave a glowing end. Without this step in the answer, no mark was awarded.

(e) The final hurdle for the "rote-learners" was in describing how to test solid **B** for iron(II) and iron(III) ions. Solid **B** must first be *dissolved in water* before adding aqueous sodium or ammonium hydroxide. Very many otherwise correct answers began "Add aqueous sodium hydroxide to both iron(II) and iron(III) compounds..." thus losing a mark. Sometimes, the colours of the precipitates were given in the wrong order; one mark was earned, instead of two, for this answer.

Despite the problems encountered in this question, some candidates were well-prepared and scored commendably.

Question 6

This question described the investigation used as the physics experiment in Paper 5. The time taken for 20 swings of a weighed pendulum was found, then the mass of the plasticine used as the pendulum bob was progressively reduced and the time was again found. The Examiners chose a clock that depicted whole seconds only. The results therefore varied a little with the accuracy of the experimenter.

(a)(i) Most candidates were able to fill in the masses and times of 20 swings.

(ii) The times for one swing shown in the table were correct to the second decimal place, so a similar accuracy was required for the candidates' answers.

(iii) The majority of candidates made mistakes in plotting the graph. In this question, the time of swing and the mass of the pendulum could be mathematically related, as is the case for most graphs in physics investigations.

Most candidates ignored this possible relationship and instead chose to display the small variation in the time of swing. To do this they used a small range of time on the *x*-axis such as 1.5 to 2.0 seconds. The resulting graph plot showed a wildly fluctuating swing, whereas in fact the total variation of only 0.1 s was within an experimental error of 5%.

Candidates should know that, to establish a mathematical relationship between variables, the origin should be included in the graph plot and due regard shown for experimental errors.

In awarding the three marks for plotting this graph, one was awarded for using the range 0 to 2 seconds on the *x*-axis, with the axes properly labelled. The second mark was earned by plotting all five points accurately according to whatever scales had been chosen. The third mark was gained only by drawing the best straight line.

(c) The effect of changing the mass on the time of swing could only be correctly judged if a straight-line graph had been drawn. Any other answers were ignored. However, candidates could gain the mark by saying that variation in the mass did not alter the time of swing very much.

(d) The point that the time of swing of a pendulum depends on the acceleration due to gravity appears to have been missed. Very few answers mentioned this possibility. Rather more candidates gave the correct answer that the length of the string has an effect, but these were in the minority; most could not get away from the errors they had made in interpreting the results of the experiment and said that change in mass would change the time of swing.