PHYSICAL SCIENCE

Paper 8780/01
Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**D**	16	**A**
2	**C**	17	**D**
3	**D**	18	**A**
4	**D**	19	**D**
5	**C**	20	**A**
6	**B**	21	**B**
7	**A**	22	**C**
8	**C**	23	**B**
9	**A**	24	**C**
10	**B**	25	**D**
11	**D**	26	**B**
12	**B**	27	**A**
13	**A**	28	**C**
14	**C**	29	**B**
15	**B**	30	**A**

General Comments

The majority of candidates answered **Question 5** correctly. **Question 7**, however, proved to be very difficult.

Comments on Specific Questions

Section A

Question 1

The majority of the candidates correctly identified the vector quantities.

Question 2

Although many calculated the correct answer, a significant number of candidates incorrectly thought that dividing two quantities leads to the subtraction (rather than the addition) of their percentage uncertainties.

Question 3

A significant number of candidates confused the velocity-time graph with the acceleration-time graph.

Question 4

The majority of the candidates identified the correct vector diagram.

Question 5

The majority of candidates had no difficulty in calculating the torque.

Question 6

The effect of temperature on the Boltzmann distribution of molecular energies was well understood.

Question 7

The candidates found this question very difficult; only a small number of the better candidates could calculate the correct ratio of the intensities. The majority of candidates incorrectly thought that the intensity was proportional to the amplitude, rather than the square of the amplitude.

Question 8

The majority of candidates correctly identified the component as a thermistor whose resistance decreases as the temperature increases.

Question 9

Roughly equal numbers of candidates chose options **A**, **C** and **D**, which could suggest that many of them guessed the answer. Most candidates would benefit from some practice in answering potential divider circuit questions as part of their preparation for the examination.

Question 10

The majority of candidates were able to reach the correct conclusion from the given observation of the α-particle scattering experiment.

Question 11

The majority of candidates correctly deduced that calcium, **D**, has the lowest first ionisation energy and so is most easily oxidised. Significant numbers of candidates chose **B** or **C**, suggesting that they understood either ionisation energy increases across a period **or** that it decreases down a group.

Question 12

Almost half of the candidates knew that lime is used in making concrete. Of the remainder, almost all chose either **C** or **D**, suggesting that they were uncertain about the basic nature of lime and of the significance of pH changes.

Question 13

This question was quite well answered, with well over half of the candidates correctly choosing **A**. The most common incorrect answer was **D**, which shows the totals of all atoms in the three-unit fragment.

Question 14

This question was well answered, with the majority of candidates correctly choosing **C** as a propagation step. The most common incorrect answer was **B**, which shows a termination step in the mechanism.

Question 15

This question was poorly answered, with over half of the candidates choosing **D**. As it is the strength of the intermolecular forces present that determines the boiling points of simple molecular substances, the bond strength in the molecule, **D**, is irrelevant. Only a minority of candidates correctly selected **B**.

Question 16

Three of these reactions **do** proceed by a nucleophilic substitution mechanism. Answer **A** involves an **elimination** reaction, and so is the correct answer to the question. A significant minority of candidates chose the correct answer, with almost as many incorrectly choosing **B**.

Question 17

More than half of the candidates correctly attributed the increase in reaction rate caused by increased pressure to an increase in collision frequency, **D**. It is clear, however, that confusion still exists regarding the main reason for rate increasing with increased temperature, as **A** was by far the most popular incorrect answer.

Question 18

There was considerable confusion over the nature of the processes occurring in this extraction process. All four responses were chosen by significant numbers of candidates, suggesting that guesswork had played a part in the choice made. It was expected that the reductive role of CO in this process would be well known. However, **B** was the most popular choice. Only a minority of candidates chose the correct response, **A**.

Question 19

The most common choice was **A**, indicating that a large number of candidates think a C=C bond contains two π bonds, rather than one σ and one π bond. Only a minority of candidates correctly chose **D**.

Question 20

This question requires an understanding of trends within the Periodic Table. Almost half of candidates correctly chose **A**. However, significant numbers of candidates thought that macromolecular SiO_2 is held together by van der Waals' forces, **B**, or, that atomic radii increase across Period 3, **C**.

Section B

Question 21

The effects of elastic and inelastic collisions were known by the majority of the candidates.

Question 22

The correct option, **C**, was the most popular one. However, almost as many candidates incorrectly chose option **D**. Simple logic should have told them that option **D** was wrong because if the boxes arrive at the ground with the same kinetic energy, then they must also arrive with the same speed.

Question 23

A significant number of candidates were unable to recall the correct order of magnitude of the wavelength of γ-rays.

Question 24

The vast majority of candidates realised that the electric force acting on the drop is increased both by increasing the charge on the drop and by increasing the potential difference between the plates.

Question 25

The majority of candidates understood what is meant by the spontaneous nature of nuclear decay.

Question 26

The polymer shown in **2** contains two bromine atoms and so is poly(1,2-dibromoethene) and, hence is wrong. A little less than half of candidates correctly chose **B**, and slightly fewer chose **A**.

Question 27

Response **4** was correctly rejected by most candidates, as its outer electrons lie in the 4p sub-shell. Just under half of the candidates correctly deduced that the all three remaining species would contain $3p^3$ electrons, and chose option **A**. Fewer thought, incorrectly, that K^{4+} would not contain $3p^3$ electrons, and so chose **B**.

Question 28

The majority of candidates correctly rejected responses **1** and **3** and therefore chose either **C** or **D**. Over half of candidates recognised that Cl_2(aq) is acidic and correctly chose **C**.

Question 29

Despite the question placing **both** X and Y in Period 3, a significant number of candidates chose **C** or **D**, which require Y to have its outer electron in a different shell from that of X. While it is true that Y has one more proton than X, this cannot explain why the first ionisation energy of Y is **lower** than that of X. A significant minority of candidates correctly chose **B**.

Question 30

A significant number of candidates incorrectly chose **C** or **D**, which required that solid **Y** was sodium chloride, despite it being formed by reaction of gas **X** with hydrogen chloride. The presence/absence of water as a by-product (response **2**) could have been easily resolved by writing an equation for Reaction one. A significant minority of candidates correctly chose **A**.

PHYSICAL SCIENCE

Paper 8780/02
Paper 2 Short Response

Key Messages

The first requirement for success is a sound knowledge of basic facts, without which candidates will not be able to tackle even the most straightforward questions.

It was clear that some candidates were thoroughly prepared for this examination, although the problems encountered by many candidates were generally caused by the lack of suitable preparation. This was particularly noticeable in questions that required simple recall, or the use of basic calculation techniques. Success at this level can only be achieved thorough preparation.

General Comments

Many candidates showed a good knowledge of the facts and a developing understanding of the concepts. However, there were also a significant number of candidates who did not have any real knowledge of the basic facts and consequently were unable to tackle even the simplest problems.

Candidates had difficulty with **Question 2**, which required them to recall basic details of the purification of impure iron, **Question 8(b)**, in which the IUPAC rules for naming compound had to be used, and **Question 10(b)**, where a sound grounding in the principles of bond energy calculations was required.

Comments on Specific Questions

Question 1

This question required straight recall of the prefixes used to alter the size of units. There were many completely correct answers. The most common errors were not knowing the power of ten indicated by mega and giga.

Question 2

This question was generally poorly answered. Although a small number of candidates were able to display a thorough understanding of this process, the majority seemed ill-prepared and were forced to make up answers. Examples of such attempts included leaving the iron to cool and then scraping off the impurities, cracking iron into smaller, more useful molecules, the use of electrolysis and distillation.

Of those candidates who did earn credit here, most recognised the need to blast oxygen through molten iron. The other creditworthy points were less well known.

Question 3

Candidates need to be able to explain observed phenomena by applying their knowledge in different situations. In this case they needed to recognise that the resistance of a metal increases as the temperature increases, and hence when a lamp is first switched on the filament is at room temperature and that as the filament warms up the resistance increases and the current falls.

Although a good number of candidates thought this through quite well, there were also many who talked about the charge carriers going through the ammeter first then slowing down as they met the resistance. In reality conduction around the whole circuit is almost instantaneous, the signal travelling at the speed of light. Other failed attempts referred to a pile up of charge carriers at the filament.

Question 4

The majority of candidates made a reasonable attempt at this question and earned some credit here. Fully correct equations were quite common as were completely incorrect ones.

Some candidates realised that complete combustion would produce CO_2 and H_2O only, but were unable to use the ratio given in the question to deduce the formula of the alkane. The use of incorrect formulae such as C_8H_{18}, C_7H_{14}, C_2H_6 and C_2H_4 was quite common.

A minority of candidates wrote equations showing incorrect products such as CO and H_2.

Question 5

This question was answered well, with most candidates gaining some credit and a significant number gaining full credit.

(a) This was answered well, although a few candidates found difficulty with one scale division on the *y*-axis representing 0.05 m.

(b) Again, this was answered well, the most common error being a failure to recognise that the time was in milliseconds not seconds.

(c) Those who had answered the first two parts of the question successfully were, generally, able to calculate the speed of the wave.

Question 6

Part **(a)** of this question was answered well by a few candidates, but most struggled with it. The majority of candidates identified chlorine as being **either** the oxidising agent **or** the reducing agent, but very few realised that it was acting as **both**.

Many candidates deduced hydroxide ions to be acting either as the oxidising agent or as the reducing agent. Similar confusion was seen regarding Na^+, H^+, $NaC\mathit{l}O$, H_2O and oxygen, which were quite often quoted as being one or other of the agents.

The main problem associated with **(a)** stemmed from the inability of most candidates to correctly determine the changes in oxidation numbers during the reaction. Very few candidates earned credit is this area.

Many candidates balanced the equation in **(b)** and so earned credit. In most cases, errors in balancing resulted from mistakes made in counting atoms, perhaps as a consequence of rushing the question.

Question 7

(a) Definitions need to be learned (and understood) in their entirety. Many candidates were aware that electric field strength refers to the force per unit charge. Electric field strength is a vector quantity and the definition includes this, hence the unit charge referred to must be positive. Also, the definition precludes any magnetic effect by including the clause that this positive unit charge is stationary.

(b) (i) Candidates should be aware that a proton is positive and an electron is negative, and therefore the two particles will be deflected in opposite directions. They should also be aware that the proton is significantly more massive than an electron, (a ratio of approximately 2000 : 1), hence the deflection of the proton will be much less than the deflection of the electron. In practice, the proton would only be deflected by a few degrees, although credit was given to candidates who drew a reasonable curve which hit the upper plate in the last third of the plate. A reasonable curve refers to a gradual deflection increasing throughout the time that the proton is between the plates.

(ii) The neutron, being uncharged, should travel through the electric field without being deflected. Generally most candidates recognised this, although some lost credit for poor attempts at drawing a straight line; a ruler should have been used.

Question 8

The conversion of **W** into **X** involves elimination. While many candidates recognised this fact, a significant number of answers simply referred to the elimination of a bromine atom, rather than a bromine atom and a hydrogen atom, i.e. elimination of HBr, and so were incomplete.

A few candidates earned credit by quoting the reagents and reaction conditions required for this reaction.

Some incorrect answers describing the reaction as cracking or redox were also seen.

While a number of candidates correctly named **X**, many incorrect attempts were seen. The majority of errors involved one or more of the following:

- omitting one of the location numbers for the methyl groups e.g. 3-dimethylbut-1-ene
- omitting 'di' e.g. 3,3-methylbut-1-ene
- omitting the location number for the alkene group e.g. 3,3-dimethylbutene

Some candidates incorrectly applied the systematic numbering system and wrote 2,2-dimethylbut-3-ene. Answers such as 3,3-ethylbut-1-ene and 'ketone' were also seen. Overall, the IUPAC rules for naming organic compounds were not well understood by many candidates.

Part **(c)** was poorly answered. Compound **Z** is shown in the reaction scheme as being a co-product of compound **Y**, so also formed by the addition of water across the double bond. Very few candidates correctly deduced that the alternative addition reaction would give 3,3-dimethylbutan-1-ol. In many instances, the structure drawn for **Z** was simply the structure of **Y** viewed from a different angle. Some candidates offered structures in which the carbon skeleton had been rearranged, for example, 2,3-dimethylbutan-2-ol. A few drew alkene or ketone structures.

Question 9

(a) The majority of candidates recognised that this was a centripetal force directed towards the centre of the Moon.

(b) This part caused many more problems. The simplest and best answers stated that work is force times displacement in the direction of the force, and the force on the satellite is always at right angles to its velocity, hence no work done. Some candidates referred to the displacement being zero which was an allowable alternative provided the candidate made it clear that this referred to the satellite making a complete orbit of the Moon.

Question 10

In **(a)**, most candidates earned credit. The main source of error was showing two, or zero, lone pairs of electrons around the N atom.

The calculation in **(b)** caused considerable problems to many candidates. While some were well practised in this type of question, many clearly were not and so struggled here.

The main sources of error were omitting to use the $\Delta H_{reaction}$ value ($-900\,kJ\,mol^{-1}$) given in the equation, the use of incorrect Data Booklet values and miscalculations of the numbers of each type of bond broken/formed.

PHYSICAL SCIENCE

Paper 8780/03

Paper 3 Structured Questions

Key Messages

Some of the credit is allocated to the simple recall of facts, definitions and processes. Thorough revision in such areas should occupy a significant portion of the time set aside for examination preparation. In many cases it was clear that revision in these areas had been insufficient or ineffective.

General Comments

As in previous years, there was clear evidence of a lack of effective preparation on the part of a significant number of candidates. However, the overall level of performance in areas such as calculations and organic chemistry did show some improvement on previous years.

A significant number of candidates made no attempt to answer parts of some questions. It is more likely that this was due to lack of specific preparation than to time constraints as such omissions occurred throughout the paper rather than just at the end.

Some candidates had clearly learned the work well and had a good knowledge and understanding of the syllabus content. Generally candidates must learn to set calculations out in a logical manner so that the Examiner can see where any mistakes have been made and can thereby apply error carried forward.

Comments on Specific Questions

Question 1

This is a question that tested candidates' knowledge and understanding of the structures, bonding and properties of metallic and ionic substances. Although some candidates coped well with the question, many struggled.

(a) This part was well answered, with many candidates earning full credit. Where errors were made, they mere mostly on the sodium metal diagram, where negative charges were sometimes shown.

(b) In order to answer these questions successfully, candidates needed to clearly and unambiguously explain metallic bonding and ionic bonding work. Some well-prepared candidates did this but many more either simply stated that the particles were held together by metallic bonding and ionic bonding or gave vague explanations that earned no credit.

(c) A fair number of candidates correctly explained the conductivities of solid and molten sodium in terms of delocalised electrons that move through the metal/carry the charge in both phases. Rather more candidates, however, vaguely referred to the presence of delocalised electrons or stated that electricity could flow through the metal.

In the main, the explanations of the difference in conductivity between the two phases of sodium chloride were poor. A relatively small number of candidates correctly identified the ions as being the charge carriers and explained the difference in conductivity in terms of the mobility of these ions. The majority of candidates attempted to explain this difference in terms of the presence/absence of delocalised electrons.

Question 2

(a) The majority of candidates gained some credit for this sectionat least for the correct calculation of the kinetic energy lost or the gravitational potential energy lost. The skill required to answer this question was to sort out clearly where energy is lost. Although a good number of candidates calculated both correctly, they then subtracted one from the other instead of adding the two to find the total energy loss.

Credit was awarded for using a sensible number of significant figures. This was an estimate, with all the data in the table given to one significant figure, and therefore the answer should also have been given to a maximum of two significant figures.

(ii) Once a figure had been obtained for the energy loss, all that was needed was to divide by 30 minutes (1800 s) in order to calculate the average power loss.

(b) (i) This could be tackled by calculating the kinetic energy and finding the stopping distance using the work done against friction which equals stopping force × distance. Alternatively, the deceleration of the airliner could be found from force = mass × acceleration, then this used in the equations of motion. The most common error using this second method was a failure to recognise that the acceleration is a negative quantity and that the final speed is zero rather than $250\,km\,h^{-1}$. A significant number failed to convert the speed into $m\,s^{-1}$. Answers ranged from a few metres to hundred thousands of kilometres. Candidates need to be realistic and consider whether their answer is sensible.

(ii) Any sensible suggestion which included safety factors scored credit here, for example 'a wet runway means the frictional forces will be less and therefore a longer stopping distance is needed' or 'increased loading means more mass therefore less deceleration'. The important point here is that the candidate considers the situation and explains in terms of the physics of the problem rather than using incomplete explanations.

Question 3

This question revealed significant deficiencies in the knowledge and understanding of many candidates. Relatively few candidates had a clear understanding of what is meant by the term *mole*. Also, a minority of candidates were unable to recall the ideal gas equation, suggesting that they had not prepared themselves sufficiently well for questions of this type. As a consequence, they were unable to earn credit in **(c).**

(a) A minority of candidates correctly defined the *mole* in terms of the <u>number</u> of particles present (the Avogadro constant/6.023×10^{23}). In many cases, there appeared to be confusion between this definition and that for *Relative Atomic Mass*;. Many attempts were seen where comparison was made between the mass of the molecule and the mass of ^{12}C atoms.

(b) In **(b)(i)**, a large proportion of candidates successfully proved that 1.09×10^{-2} mol of oxygen gas had been formed. Of these, however, the majority made no attempt to complete the question by determining the total moles of gas formed. Some confused attempts were seen in which the molar gas constant, R, was used. A fair number of candidates made no attempt here.

The majority of candidates who had earned full credit in **(b)(i)** were similarly successful in **(b)(ii)**. In addition, a significant number of candidates who had not completed **(b)(i)** coped well with **(b)(ii)**. In the main, errors in the calculation in **(b)(ii)** tended to result from the use of an incorrect mole ratio or an incorrect M_r(nitroglycerine) value. Again, a fair number of candidates made no attempt to answer **(b)(ii)**.

(c) A high proportion of candidates correctly quoted the ideal gas equation. A few candidates gave an incorrect equation or wrote a chemical equation.

Overall, the calculation in **(c)(ii)** was very well done, with a high proportion of candidates earning full credit. Some candidates used a different value from that given in the question for the total moles of gaseous products. Occasionally, arithmetic, rounding or unit errors were seen.

Question 4

To answer this question well candidates needed a sound knowledge of the kinetic molecular model and an understanding of the term pressure.

(a) (i) The question asked for an answer in terms of the kinetic molecular model, and so answers which merely talked about the atmosphere squashing the mercury did not score credit. A failure to understand the kinetic molecular model has consequences elsewhere in the course, for example in rates of reaction.

(ii) Only explanations in terms of the kinetic molecular model scored credit.

(b) This required the formula $p = h\rho g$ to be applied to a manometer. The common errors were failure to convert the heights from millimetres to metres and a lack of understanding that the excess pressure is equal to the pressure exerted by a column of mercury of height equal to the difference between mercury levels in the two arms of the manometer.

Question 5

(a) Candidates often did not recognise that in order for light to reach both of the double slits it must spread from the first slit, and hence that diffraction must occur. There were some reasonable attempts to explain this, although the majority failed to link diffraction with the light spreading to both slits.

(b) Those candidates who showed some understanding of interference generally gained some credit but few recognised that there would be no change in the separation of the fringes, the only change being in the brightness and increased sharpness. The most common error was to state that there would be increased diffraction, which did not answer the question.

(c) (i) In scientific terms monochromatic light is light of a single wavelength (or frequency). It is not enough to describe it being a single colour, because what we see as a single colour covers a fairly large range of wavelengths.

(ii) This part of the question required candidates to think about what would happen in a novel situation. Many correctly talked about coloured fringes being seen, although only a few were able to give any form of explanation. Others made the very valid conclusion that as white light is a whole range of wavelengths, no fringes would be seen.

Question 6

This question clearly identified those candidates who were thoroughly prepared for the examination and those who were not. Many candidates struggled here.

(a) This part was very poorly answered, with only a small number of candidates earning full credit. While many candidates recognised that the reaction was reversible, most answers went no further than this. Some credit was earned for recognising that the forward and backward rates are equal but the constant concentrations of reactants and products was very rarely mentioned. Most candidates seemed to be trying to make up an explanation.

(b) The quality of answers to **(b)(i)** was heavily polarised. Higher scoring candidates tended to cope well with the question and earned credit. Many candidates, however, either ignored or were unable to use the fact that the forward reaction is exothermic. As a consequence, the effect of temperature changes on the equilibrium position were not correctly deduced or explained.

In **(b)(ii)**, the majority of candidates recognised that the reaction rates would increase at the higher temperature of 45 °C but very few answers went beyond this point. A common misconception was that the increase in rate primarily resulted from an increased collision rate, rather than from an increase in the proportion of molecules with energy greater than the activation energy.

(c) While a fair number of candidates correctly calculated the enthalpy change in **(c)(i)**, mistakes were very common. Many candidates overlooked the fact that there are two moles of NO_2(g) in the equation, so by far the most common incorrect answer was –24.02.

Many candidates seemed to be confused by what is meant by the term *enthalpy change of formation*. As a consequence, very few correct equations were seen in **(c)(ii)**. Some equations showed **2**NO_2(g) on the right-hand side; others showed N_2O_4 as the product or showed the formulae of compounds on the left-hand side. A large minority of candidates made no attempt to write an equation.

(d) This part was poorly done. Relatively few candidates were sufficiently familiar with this decomposition reaction to write correct products in their equations, and fewer still correctly balanced the equation. A common error was to omit O_2 from the right-hand side.

Question 7

This question took candidates through a calculation to find the energy gained by an electron when it is accelerated through a potential difference. Although this is quite a long calculation which requires candidates to think about the quantities involved, it is a skill which candidates must develop.

(a) The first part required the simple use of the formula $R = V/I$. The most common error was a failure to correctly convert the µA into A.

(b) (i) The most common mistake was to assume that the whole potential drop, of 5000 V, was across the safety resistor. In practice most of the potential drop is across the electron tube, with only a small fraction across the safety reisistor. To find this the formula $P = I^2 R$ needed to be used. At this level candidates need to be able to sort through information to decide on the most appropriate formulae.

(ii) Once more, candidates needed to read through the information given to plan their way through the calculation.

(c) The first part was a simple use of the formula $Q = It$, followed by a calculation of the number of electrons striking the anode each second and hence the energy gained by each electron.

Question 8

While some candidates coped well with most of this question, others struggled and many omitted one or more parts of the question.

(a) While a fair number of candidates correctly identified one or other of the types of reaction involved, relatively few correctly identified both. Some identified the **P** to **Q** reaction as involving redox. This was not accepted as organic reactions are defined in terms of the process occurring to the organic reactant, in this case, oxidation.

(b) A large proportion of candidates successfully determined the empirical formula of compound **T**. Errors tended to involve the incorrect determination of the mole ratio or multiplying the percentage values by the respective A_r values. Some incorrect answers were given with no working being shown. A significant minority of candidates made no attempt at this calculation.

(c) Part **(c)(i)** was very poorly answered. A large proportion of candidates made no attempt at one or more of the structures; many made no attempt at any of the structures. Some candidates did deduce the structures for the reduction product, **S**, and the oxidation product, **R**, however, very few correctly identified the dehydration product, **T**.

Many candidates drew acceptable displayed formulae for compound **Q**, however, mistakes were not uncommon. The most frequently seen errors included structures with missing hydrogen atoms or with carbonyl groups showing single C—O bonds. A significant minority of candidates made no attempt here.

(d) The majority of candidates suggested an appropriate test to distinguish between **P** and **Q**. Of these, however, a significant number described inappropriate observations; some quoted the same observation for both compounds, while others reversed the correct observations. Some candidates suggested the use of acidified potassium dichromate(VI). As **P** is a primary alcohol, both **P** and **Q** would react with this reagent and so it would not distinguish between this pair of compounds. Similarly, as both **P** and **Q** contain carbonyl groups, the use of 2,4-DNPH is not appropriate. A significant minority of candidates made no attempt here.

In **(d)(ii)**, many candidates who suggested the use of Tollens' reagent or Fehling's solution in **(d)(i)** earned credit by identifying the functional group as aldehyde. Some candidates quoted *alcohol* as the functional group. However, if their test in **(d)(i)** was not suitable for determining the presence of this functional group, this response earned no credit. A number of other functional groups, such as carbonyl, carboxylic acid and amine were also quoted by some candidates. A significant minority of candidates made no attempt here.

Question 9

(a) **(i)** The learning of simple laws and definitions is essential for success. This is the simpler of Kirchhoff's two laws and should be known by all candidates.

(ii) Most candidates simply quoted the law of conservation of energy without referring back to the idea that potential difference is the energy lost per unit charge and that e.m.f. is the energy given to unit charge.

(b) **(i)** This was a very simple application of the first law which many candidates did well. Others failed because they did not study the directions of the currents accurately.

(ii) This was a simple application of the second law around a clearly defined loop, which caused quite a lot of difficulties.

(iii) This was a slightly more difficult application of the second law and a good minority successfully completed this part.

(iv) This was poorly answered. When asked to 'show' that a relationship is true, there must be an explanation and not just a series of figures. The key here is the recognition that when I_2 is zero then $I_3 = I_1$, which had to be stated for credit to be awarded.

The majority of candidates ignored the two different currents in the outer loop and used the total resistance in that loop.

PHYSICAL SCIENCE

Paper 8780/04
Advanced Practical Skills

General comments

The paper set for this AS level examination was appropriate for the candidates who were entered for it. The practical work involved proved to be the right level of difficulty in that it enabled almost all candidates to carry out the manipulative work required. Some candidates had difficulties processing their results: this was where they did not gain some or all of the available marks.

Others made vague or incomplete statements about their observations and as a result did not gain some of the available marks.

Taken together both questions produced a satisfactory distribution of marks with nearly the full range available being used.

Candidates had enough time to complete the paper; there is almost no evidence that they ran out of time.

The practical skills required proved to be within the capabilities of most candidates: where marks were lost it was often where not enough care was taken with recording readings and/or observations. Where candidates experienced difficulties it was possibly because they had not had enough previous opportunity to do practical work of this nature.

Some candidates, again fewer than previously, did not make enough consideration of the use of consistent significant figures and/or decimal points when making measurements in the Physics question.

It is important that candidates continue to take care when recording their observations and to use acceptable terminology with the units clearly included in the appropriate places.

Comments on specific questions follow.

Question 1

This experiment seems to have worked very well for most candidates.

It proved to be well within the capabilities of all candidates to carry out the experiment and to obtain valid results.

Most candidates followed the instructions well and were able to make a reasonable attempt at the experiment.

Where they lost marks it was because they made mistakes in the graph drawing and following parts of the question.

(b) Almost 100% of candidates were able to draw up a suitable table and to obtain 8 sets of results.

A handful of candidates gave some very odd values for the resistance of the resistor networks. It was not clear where they had obtained these numbers. One or two even tried giving more than one number for each entry in this column.

A greater proportion than previously were able to correctly include the units with their Colum headings. Where there was a mistake it was with the units of $1/I$: they were either omitted altogether or given as A instead of A^{-1}.

The use of significant figures was better than previous years but a few candidates are still showing inconsistencies: the most common error was to write a whole number answer without any figures after the decimal point, e.g 5 instead of 5.00. etc.

It was good to see that most candidates were able to calculate 1/*I* correctly.

(c) (i) The standard of graph drawing was very good. It was pleasing to see that only a handful of candidates used an awkward scale. Units were sometimes omitted from the axes labels. Most candidates used at least half of the graph paper in BOTH directions as required.

There were the usual minor careless plotting errors.

A few candidates plotted *I* instead of 1/*I*.

(ii) This was generally done well except that some candidates chose to use a triangle which was far too small. At least half of the working part of the graph needs to be used.

It was good to see that a decreasing number of candidates using numbers from their results table rather than the required readings from their graphs.

(iii) The most common error here was for candidates to correctly read the intercept but then to fail to find the reciprocal.

(d) Many candidates did not understand that 1/E was equal to the gradient.

It was also acceptable to use readings from the graph in simultaneous equations: The few who tried to do this using readings from their table did not gain the mark.

(e) (i) (ii) Most candidates were correctly able to identify the 25 ohm network as the rogue one. As it was possible for this to have been constructed in 2 different ways, both correct, identifying the the network was all that was needed to gain this mark.

(iii) Some candidates correctly realised that by measuring the current through each individual resistor was the way to do this. They were able to correct the power sauce and ammeter in series with each resistor in turn: it was not necessary to separate soldered resistors, they contact/wires could simply be held in place at the ends of each resistor.

However some of them went on to calculate the resistance of the network instead of the rogue resistor.

It was also acceptable to calculate the resistance of this network from the original results and then to calculate using the concept of resistors in series and parallel to calculate the individual resistors resistance. This was rarely attempted successfully to conclusion.

Question 2

The vast majority of candidates were able to carry out the tests and obtain results. Where marks were lost it was because of careless experimentation or sloppy recording of observations.

Candidates need to make clear statements about their observations made during wet tests. They need to link the colour to the state; e.g. ‘blue’ would not get the mark when it should be a ‘blue solution’ or ‘blue precipitate’-

(a) It was not always clear that candidates had actually carried out these tests. Many had a positive result for both anions’ many seemed to have copied the information from the tables at the end of the examination paper.

Candidates needed to state the reagent used (silver nitrate, barium chloride, etc.) and to give the correct observations with solution **P** to gain full marks.

(b) Sloppy recording was the main problem in this section.

They often failed to link their colours to the state of the closured substance.

Other candidates gave indefinite colour combinations, e.g. 'blackish-red' rather than the 'brown' that was required. Others gave a list of colours or the wrong state with the wrong colour.

Also candidates need to ensure that solutions are thoroughly mixed before making their observations'.

(c) (i) Most candidates correctly identified the sulphate anion with suitable evidence.

Iron(II) was the correct answer for one of the cations. Some candidates either just stated 'iron' or gave iron(III). Sometimes iron(II) **and** iron(III) were given

The other correct answer of 'ammonium' was sometimes incorrectly stated as 'ammonia'.

Chromium and copper were common incorrect answers as was chloride.

(ii) A small proportion of candidates were able to identify that hydrogen peroxide was an oxidising agent. A smaller number correctly identified the zinc as a reducing agent. However very few of these were able to quote any valid evidence from their observations in part **(b)**.

(iii) Some candidates mentioned that the iron(II) was becoming iron(III) but very few mentioned that the air or oxygen was involved.