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Group III

Sciences

COMBINED SCIENCE

Paper 0653/01

Multiple Choice

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3	**B**	23	**C**
4	**B**	24	**D**
5	**C**	25	**A**
6	**A**	26	**B**
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17	**C**	37	**C**
18	**B**	38	**B**
19	**A**	39	**D**
20	**C**	40	**B**

General comments

The mean mark of the candidates was 25.4, with a standard deviation of 6.4. The reliability coefficient was 0.82 so that the Paper worked effectively in discriminating between candidates.

Of the Chemistry questions only **Question 26** was on the easy side. **Questions 16**, **18**, **19** and **20** were marginally difficult with **Questions 21** and **25** decidedly more so.

The overall mean for this Paper was, as has been the case in the past, rather disappointing. However, the Physics items were generally well answered, with most items showing a good proportion of correct responses.

Physics questions which the candidates seemed to find relatively easy (over 70% facility) were **Questions 28**, **29**, **32**, **33**, **34**, **36**, **37** and **39**. There was no Physics question which caused widespread difficulties.

Comments on specific questions

Question 2

This was the easiest of the biology questions. It was a credit to the candidates that they appreciated the significance of increased surface area and its effect on the rate of enzyme activity.

Question 6

Though on the difficult side, this question worked well to discriminate between candidates of differing abilities. A lot of knowledge was being tested in one question, and some of the less able believed that they needed to know the foodstuffs for which the tests are used rather than give an analysis of the results.

Question 10

Almost a quarter of the candidates were too ready to link xylem and water and thus opted for **D**. Those more certain of their facts were able correctly to link evaporation of water with mesophyll cells.

Question 12

Over half the candidates (but, significantly, not the more able ones) thought that the arrow **B** was a label to a structure rather than a possible route of entry into the fetus. More discerning candidates realised that route **A** - through the placenta, is the one taken by viruses and drugs.

Question 16

Response **B** was rather popular (30%). Hydrogen chloride forms ions when dissolved in water but the compound itself consists of covalent molecules. This is perhaps a subtle distinction that less able candidates do not readily grasp.

Question 18

A quarter chose **A**. A possible explanation for this popularity is that such candidates merely saw that there was one oxygen molecule in each of two equations. The question was deliberately phrased in terms of molecules but, of course, account has to be taken of the number of atoms of carbon and hydrogen in the propane example.

Question 19

As many candidates chose **C** as the correct answer **A**. This question needs a little care in its reading, i.e. solid **X** is put into the circuit. Rather like **Question 16**, solid electrolytes only conduct when in solution or when melted so that this is a distinction for candidates to appreciate.

Question 20

Iron, being a metal, is not to be thought of as brittle, e.g. iron nails.

Question 25

It was disappointing that responses **C** and **D** were both more popular than the key, **A**. The question specifically refers to the complete combustion of a hydrocarbon so this rules out **C**. On the other hand, carbon dioxide is turned to solid by ice.

Question 29

This was correctly answered by the majority of candidates, but one 1 in 3 thought that 10m was a realistic length for the train.

Question 30

Candidates showed some uncertainty of the difference between mass and weight.

Question 31

Candidates proved to be not familiar with the readings required to calculate the density of the liquid.

Question 32

A good proportion chose the correct option but 10% of the candidates thought that no force was necessary to slow the car.

Question 38

A disappointing response with about one half being unable to divide *V* by *I* and choosing the largest resistance.

Question 40

The uncertainty regarding the properties of radioactive materials continues.

Paper 0653/02

Paper 2

General comments

The examination produced the full mark range and some excellent scripts were seen from many candidates who demonstrated good knowledge of the syllabus and used scientific terminology appropriately. Performance across the three science disciplines was even, and candidates were generally able to complete the Paper in the allotted time.

Comments on specific questions

Question 1

The majority of candidates scored high marks for this question.

(a) This proved to be an easy two marks for most candidates.

(b) The majority were able to draw the correct circuit and most candidates scored both marks. The most common mistake was to draw the ammeter in parallel with the lamp.

(c) Most candidates knew this. Candidates needed to write amps or amperes. The single symbol A was not accepted.

(d) The majority scored well on this question, recognising the dangers from the broken insulation. It was also possible to score marks by stating the consequences of touching wires which might become completely loose, or that there was a possibility of over-heating.

Question 2

The question proved almost inaccessible for weaker candidates but it was noticeable that in some cases the principles involved in the science here had been mastered.

(a) A common misconception shown by attempts at this question is that gases have no mass. Candidates needed to be very clear that a gas is produced and that this is lost from the container.

(b) The majority of candidates recognised that *increased surface area* was a key phrase to include in the answer but it was essential that they referred to increased surface area *of the liver*.

(c) This question is often asked and it was clear that the concept of denaturing of the enzymes involved had been well learned by some but not all candidates. A common way to lose credit was to refer to enzymes being killed, or to invoke conventional collision theory to explain why the reaction rate should increase. Candidates also need to make a clear statement about the results that would be obtained and so should have commented that the mass of the mixture would not decrease.

Question 3

Candidates did not generally do as well on this question as had been anticipated, and the full mark range was seen although part **(b)(ii)** was not fully understood by most candidates.

(a) This produced a range of responses and suggested that candidates may not have fully understood the question.

(b)(i) Most candidates scored this mark.

(ii) Very few candidates scored both marks here and large numbers did not score. The question required some comments about the importance of fractional distillation. While candidates showed they had much knowledge of how the process worked they did not address why the process has to be carried out. Comments about petroleum being unfit for any particular use had been hoped for followed by the usefulness of products from the process.

Question 4

This was another question which proved challenging for many and revealed surprising weaknesses in candidates' perceptions and knowledge of conditions on the lunar surface.

(a)(i) Most candidates were able to write something sensible here but in order to score the mark they had to be very clear that the origin of the sound was the vibration of the object being struck. Lengthy answers about vibration were seen but often without reference to the vibrations in the struck object.

(ii) Several candidates wrote complex answers involving echoes and sound reflecting from solid surfaces. This question is another which is frequently asked and requires an answer based on the vibration which passes through air.

(b) The anticipated ways of scoring the marks were to refer to the (near) vacuum on the lunar surface (the general idea of the vacuum of space was accepted) and so there is no medium to carry sound. Another way to score a mark was to state that radio waves do not require a medium and so can be transmitted. Candidates sometimes stated that there is no oxygen on the moon or that the atmosphere is thinner than on the Earth. Answers like this were not credited. Far too many candidates attempted to explain the situation in terms of the moon's reduced gravity without any reference to the absence of atmosphere.

Question 5

This was generally well answered.

(a) It was very rare for candidates not to score both of these marks.

(b)(i) Generally candidates gave chlorophyll, the most common error being chloroplast.

(ii) This was well answered and the majority were able to state that excess glucose would be stored as starch. The most common wrong answers involved transpiration or excretion as the process which removed the glucose.

(c) Most candidates scored at least one mark here. Several neglected to show that the shoot had been removed from the plant and discussed the absorption of solution through the roots. Marks could be scored for simply saying that the shoot absorbed the water containing the dye and that the solution travelled through the xylem into the leaf veins. Complex answers involving diffusion, concentration gradients or the mechanism of osmosis were seen and are not appropriate in this question. However, the word diffusion often appeared in answers which did score something.

Question 6

Generally this question was not so well answered.

(a)(i) This is often asked and the best answers referred to compounds made only of the elements hydrogen and carbon. Too many candidates talked about mixtures of hydrogen and carbon.

(ii) Candidates needed to show they knew that poly(ethene) molecules were made from large numbers of ethene molecules which had joined together. They could also make obvious statements about poly(ethene) molecules contain many more atoms that a single ethene molecule, but the simple idea that poly(ethene) molecules were bigger than ethene was considered too vague.

(b) This was more accessible for most candidates and many were able to score both marks. They needed to make the two points that oxygen is needed for combustion and that the cloth cuts off the oxygen.

Question 7

Generally well answered although there was much confusion in the very important part **(c)**.

(a) Most candidates scored two of the available marks. The ureter was the most commonly mislabelled answer, with most candidates confusing ureter with urethra.

(b) This was well answered and two marks were commonly given.

(c) This important type of question is often asked and too many candidates are still suggesting that birth control methods in general will prevent the spread of STD's. Hence many answers involving female contraceptive devices were offered and rejected. Abstinence is an acceptable answer but vague suggestions about sending one's partner off for a health check with no further development of the answer could not be credited.

Question 8

Candidates overall seemed to have been well prepared for these types of calculations and many scored full marks which considerably boosted their total for the Paper. There were no particular instances of a common wrong answer. Generally candidates could either do the calculations or not.

(a) The answer 10 000 kg was usually seen.

(b) The answer 45 m^3 was usually seen.

(c) Errors were carried forward from part **(a)**. In order to score all the marks the candidates needed to follow the instruction to write down the formula they used, show their working and calculate the answer correctly. Most did do this. Candidates are advised to write out the formula in words rather than leave it in symbolic form. Any obviously inappropriate symbols in formulae were penalised even if the final answer of 2222 kg/m^3 was correct.

(d) Similar comments to the above applied here as well. The answer 14 000 000 J was often seen even if earlier parts of the question had been incorrectly done. As is often the case, the most common incorrect answer is based on work done = mass x distance.

Question 9

Responses to this were very varied. It was clear that many candidates had not learned this basic chemistry and so the question was inaccessible.

(a)(i) The accepted order of answers moving down the table was **B A C**. The absence of any reference to gas meant that **D** was not accepted as an alternative to **A**. Generally this question was not answered well.

ii) The majority scored both marks here but there was a surprisingly large minority who did not recognise the limewater test. All of the common gas tests were seen as suggested answers here.

(b)(i) Candidates had to state clearly that pH *increases*. Vague answers such as *it goes neutral* are not acceptable.

(ii) It was clear that knowledge of acid–base reaction equations was very varied. Candidates often scored a mark for giving water as one of the products but in far too many cases candidates did not suggest a nickel compound of any description. Unfortunately neither nickel sulphite nor nickel sulphide could be allowed. Candidates offering formulae instead of words, as asked in the question, were not credited.

Paper 0653/03

Extended Theory

General comments

There was a larger entry for this Paper this year, including many candidates who were much better able to deal with the topics covered in the Supplement of the syllabus than has often been the case in the past. Overall, all questions proved accessible and no one question or part of question consistently proved difficult. However, it was common for at least one question to be done badly by all the candidates within a particular Centre, suggesting that not all of the topics had been covered. The actual question causing these difficulties could be any of them, with **Questions 2**, **3**, **5**, **6** and **7** featuring most frequently. **Question 8**, on the other hand, was always done well by all but the weakest candidates.

There were some problems with legibility. Despite all attempts by the Examiners, it was sometimes impossible to read the candidate's writing. Particular difficulties can arise with numbers, especially 1 and 7 which are easily mistaken if written carelessly.

Comments on specific questions

Question 1

This was done well on the whole, although candidates often showed less secure knowledge of blood vessel structure than of the function of red blood cells. In **(b)**, most understood that the lack of a nucleus probably provides more space for oxygen transport, and a few of the better candidates also explained that the cell is full of haemoglobin which combines with oxygen. Better candidates were also able to state that the shape of the red blood cell provides it with a relatively large surface area, but only a very few went on to explain that this increases the rate of diffusion of oxygen into and out of the cell. Several candidates seem to believe that oxygen is transported attached to the surface of the cell.

Part **(c)** was generally answered well, although it would be good to see fewer candidates stating that respiration 'makes' energy.

Question 2

This was answered extremely well by many candidates, but others knew little or nothing about this topic. Some mention of a *nucleus* was expected in the definition of 'radioactive decay'; this was less frequently correct than the definition of half-life. Better candidates had no difficulties with **(b)**, while others got as far as working out that this represented four half lives but stopped there.

Part **(c)** was often answered correctly, usually in terms of the direction in which alpha and beta would be deflected. A few candidates wrote about magnetic fields. Many, however, simply stated that alpha had a positive charge and beta a negative charge, which does not answer the question. Others inappropriately wrote about penetrative properties.

Part **(d)** caused no problems for many candidates, who correctly stated that the alpha particles remove electrons from atoms within the material.

Question 3

This question was often answered very well indeed, but there were still many candidates who had little understanding of what was happening. For example, weaker candidates often suggested in **(a)(i)** that the temperature should be kept constant. Better candidates usually mentioned either the mass or surface area of the magnesium, or the concentration of the sulphuric acid, and were also able to answer **(ii)** in terms of the same mass of magnesium being used in both experiments. (Sulphuric acid was stated to be in excess.)

Most candidates realised that an increase in the temperature results in an increased rate of reaction. However, there were quite a few answers to **(b)(i)** which stated that 'temperature increases the rate of reaction' which was not given credit. Part **(ii)**, though, was almost always well answered, the main error here being to say that the particles 'vibrated' more rather than *moving* more rapidly.

Part **(c)(i)** was surprisingly poorly answered by large numbers of candidates. The most frequent errors were giving magnesium sulphide or water as products. It was disappointing to see many of the weaker candidates not even realising that hydrogen was a product, despite the whole question having been about its production. Simlarly, **(ii)** was often incorrect.

Question 4

Answers to **(a)** often correctly picked out the information that DDT is not very soluble (not *insoluble*, which was not credited) and breaks down slowly. Part **(b)** elicited, as expected, a wide range of answers, with the better candidates giving clear explanations of how this pesticide could accumulate up a food chain. Weaker candidates struggled, suggesting, for example, that the birds absorbed the DDT through their feathers when they sat in the fruit trees, or through their feet when they stood in the water.

Part **(c)** caused no problems at all to many candidates, but others showed that they are confused about the meaning of the term ‘biological control’. Weaker candidates suggested that it was something to do with birth control, genetic engineering or breeding animals to save them from extinction. Some thought that it involved pesticides.

Question 5

This question tended to be done either very well or very badly.

Many candidates did not know how to draw a normal on the diagram, which then stopped them from showing the angles of incidence and refraction. Some drew the normal correctly, but then could not identify the angles. Some drew normals at both surfaces, labelling the angle of refraction where the ray exits the block. Those who understood what was happening usually answered **(b)** correctly, although an answer of 40° was also very common.

There were some good answers to **(c)**, with explanations making good use of the diagrams and also the candidates’ own knowledge. Several wrongly stated that **B** showed the critical angle.

The easiest way for candidates to gain both marks in **(d)(i)** was with a clear diagram, although a written description could also do this if explained clearly. Many candidates did not say, or show, that the rays they were describing were *parallel*, simply saying that ‘rays’ were brought to a focus. Descriptions of real and virtual images were varied and not always correct; the answers which most often gained credit here were in terms of the possibility of projecting a real image onto a screen. Many answers incorrectly said that virtual images were always upside down, or always right way up; others seemed to think this must be something to do with computers.

Question 6

This, like **Question 5**, tended to be done very well or very badly.

In **(a)(i)**, there were many correct answers, but quite a few candidates wrote about chlori<u>n</u>e ions, or thought that it was electrons which moved through the electrolyte. Nevertheless, even these candidates sometimes managed to explain that sodium ions are positively charged and so are attracted to the negative charge of the cathode in their answer to **(ii)**. Many, however, stopped there, only the better candidates going on to say that the sodium ions took electrons from the cathode to become neutral atoms.

Part **(iii)** proved to be the most difficult part of the question. Many answers stated that the aqueous solution would not conduct electricity, while others wrote that sodium chloride is not soluble. Some stated that the hydrogen ions, rather than the sodium ions, would be attracted to the cathode, which of course is not correct. However, better candidates were able to explain that, as sodium is more reactive than hydrogen, hydrogen ions take electrons from the cathode in preference to sodium, which remains as an ion in solution.

Part **(b)(i)** was often answered in terms of the addition of oxygen, but the correct answer was that the sodium lost electrons. In **(ii)**, the change of colour from green to purple was awarded one mark, and the second mark was given for the statement that sodium hydroxide is an alkali, or has a high pH. Quite a few candidates could not explain this, and many appeared not to be using the information given in the word equation. Others said that sodium is an alkali and therefore has a high pH - they had obviously become confused with the description of sodium as an ‘alkali metal’.

Question 7

This was yet another question where some candidates had no problems at all, while others struggled throughout.

Most were able to say that a tissue was a group of cells, and many also stated that the cells were of the same type, or had a similar function. Most, too, could correctly label a partially permeable membrane on the diagram. Answers to **(c)** were often entirely correct, or entirely confused. A number of candidates seemed to think that sugar was diffusing into the cells, and invented a variety of ways in which this could cause the vacuoles to break up.

In **(d)**, it was disappointing to see so few candidates understanding that water moves into *both* cells in these circumstances, and that the plant cell does not burst because the cell wall prevents this. Many thought that the plant cell did not take in water because it was a 'low concentration'. Others thought that the cell wall stopped the water going in.

Question 8

This question was often very well done, with even relatively weak candidates able to pick up at least some marks.

Part **(a)** was almost always correctly answered, but in **(b)** many of the weaker candidates gave the units in m/s rather than m/s^2. In **(c)**, the commonest error was to multiply speed by distance, rather than finding the area under the curve. However, this was often correctly answered.

Part **(d)** caused a few more difficulties, but still was well done in many cases. There were several possible approaches, perhaps the commonest being to work out that the stone would have gone 320 m by 8s, so it must hit the ground somewhere between 7 and 8s. Another common approach was to rearrange the 'area under the curve' formula to find the value of time which gave an area of 300 m.

In **(e)**, most knew the formula pe = mgh, but quite a high proportion of candidates then failed to realise that they had been given the *weight* of the stone and not its mass. Some did the calculation correctly, but then gave the units as newtons rather than joules.

Question 9

Answers to **(a)(i)** were sometimes incomplete, with candidates stating that one isotope had more neutrons than the other without saying how many, or which isotope they meant. However, many scored both marks here. Part **(ii)** was also often correct.

Most of the stronger candidates correctly gave covalent as their answer to **(i)**, though 'ionic' appeared almost as often. However, very many had difficulty with the equation, many not even realising that they had been given the formula for hydrogen chloride, while others wrote H + Cl on the left hand side, rather than $H_2 + Cl_2$. Part **(iii)** was often completely correct, even when a candidate had earlier stated that the bonding was ionic. Some candidates wasted quite a lot of time by drawing in *all* the electrons, rather than the outer ones as requested.

Paper 0653/05
Practical

General comments

The performance of candidates was very similar to previous years. All questions were readily accessible and all marks were used. There were no problems with time. This particular Paper relied heavily on Supervisors' results and thanks to them for providing the necessary information.

<u>Comments on specific questions</u>

Question 1

Apart from a very small number who probably reversed solutions **A** and **B**, therefore producing observations the wrong way round, candidates were able to obtain smaller chips for part **(a)** and larger chips for part **(b)**. It was necessary to obtain chips with a difference of no more than 0.3cm and within a similar margin of the Supervisor's result. The majority were able to correctly calculate the percentage change in size although a minority used the new size rather than the change in size. A significant number did not know the meaning of the term water potential and simply answered in terms of different concentrations. This did not matter and all marks could be scored if a correct explanation was given to fit the results. A correct explanation for solution **A** scoring two marks almost invariably meant a correct explanation for solution **B** and a further two marks. Not surprisingly, candidates scored highly on this question.

Question 2

A very large number of candidates did not carry out the first instruction to weigh the beaker to the nearest gram. Did they not understand this requirement, or did they think credit would be given for weighing more accurately? It was such a common error that a mark was not deducted on this occasion. Such an instruction is given for good reason and it must not be assumed that it will always be overlooked. A smaller number were unable to correctly calculate the mass in kg. Examiners did apply a penalty to those who did not follow instructions in part **(b)** to record weighings to the nearest 0.1g and temperatures to the nearest 0.5^{o}C. This penalty was strictly applied and whole numbers required to be written 3.0g rather than just the figure 3. Although the temperature drop can be calculated from data books, some tolerance was permitted. A mass of 3.0g was expected to produce a 7.0^{o}C drop and suitable adjustment for other temperatures. Two marks were given for a temperature within 1^{o}C of this and one mark if within 2^{o}C. Many were able to score the mark in part **(c)**. A simple comment to the effect that it dissolved endothermically because the temperature fell scored the mark. Some responded that energy was absorbed. This too was acceptable.

Question 3

All candidates were able to perform five experiments using suitable temperatures and scored two marks. The Supervisor's values were invaluable for comparison purposes and candidates were expected to be within 10 seconds for the first experiment at 35^{o}C. As the time became shorter, it was necessary to be within 2 seconds at a temperature of 60-65^{o}C. A mark was given for a consistent set of results and this was judged from the graph. All readings needed to be within two seconds of the curve drawn. Many failed to choose suitable scales and consequently the curve was almost a straight line. In part **(e)**, although most said it was necessary to cool down the solution, very few described how this would be done. Placing the solution in a freezer or even carrying out the experiment in a freezer did not score. The most likely method was to place both solutions in an ice bath and carry out the experiment as before. Many of those who did think to use an ice bath, overlooked the fact that the *two* solutions needed to be cooled.

Paper 0653/06

Alternative to Practical

<u>General comments</u>

The Examiners were impressed by the good overall standard of the entries for the November examination in both Combined and Co-ordinated Sciences, Alternative to Practical Paper. Graph-plotting skills seem to have improved and well-worded explanations were often provided for results of the experiments.

There were obvious gaps in the laboratory experience of some candidates. These were shown up by the poor answers to **Questions 3** and **6**.

Comments on specific questions

Question 1

(a) The unit of time used in the question was given only as "/s" in the table heading. Some candidates missed this altogether or substituted "minutes", showing that they had never tried this simple experiment.

(b) As mentioned above, most candidates scored all four marks for graph-plotting. The most common error was in labelling the axes. Some candidates incorrectly plotted temperature on the vertical axis.

(c) In describing the relationship between the temperature and the time taken, credit was given for an answer such as "the higher the temperature, the quicker the reaction", but not for "the rate of reaction increased as the temperature was raised." Teachers may find this rather strict, but it was the first question in the Paper demanding an explanation. Many candidates did not seem to comprehend that "time" has units, and could not explain that the time decreased, only that the process was "quicker".

(d) This asked candidates to show *on the graph* how they derived the temperature at which the reaction time was 50 s. An otherwise correct answer without this indication was not credited.

(e) A way to show a relationship between the temperature and the rate of reaction was given only by the very best candidates. An acceptable answer mentioned the finding of the gradient of the graph at a particular point, or the comparison of the temperature with the reciprocal of the time, e.g. by plotting T against 1/t.

(f) Here, the Examiners wanted a practical comment about how to get the reacting solutions to 0^{o}C, such as the use of ice or a refrigerator. Too many candidates said they would cool the solutions without describing how this should be done.

Question 2

(a)(i) All candidates are required to bring to the examination room aids such as ruler, compasses, protractor and calculator. Some candidates did not possess a ruler, so they could not do this part of the question. A few did not realise that the rectangle clearly labelled "chip from solution A" needed measurement and measured instead the chip in the test-tube in Fig.2.1. An accuracy of +/- 1 mm was required.

(ii)(iii) The simple mathematical ability asked for was beyond some candidates, but the vast majority scored all the marks here.

(b) The Examiners deliberately avoided the use of the term "water (or osmotic) potential" in the introduction to this section, as they wanted the candidates to appreciate the importance of the concentration of the solute in the solutions A and B. In consequence, those who wrote "the concentration of solution A was lower than inside the chip" were wrong. They meant the *concentration of water*, but omitted to write this. Candidates should be aware of the dependence of "water potential" on what is practically controllable, the concentration of the solution.

(c) Even when mistakes were made in **(b)**, the answer "the solution outside the chip, and inside the chip, were of equal concentration" gained both marks here.

Question 3

The Examiners appreciate that not many Schools possess the apparatus to demonstrate radioactivity. However, they feel that this kind of experiment is fundamental to the understanding of the characteristics of emitted particles and rays. The question dealt with ideas about rates, background radiation (often misunderstood) and safety considerations.

(a) This was accessible to almost all candidates.

(b) Many candidates were ignorant of background radiation from natural sources and thought that removal of the source left behind some of the radioactivity, or that radioactivity is somehow present in the atmosphere.

(c) Here a number of candidates described other types of radiation e.g. from the electromagnetic spectrum.

(d)(e) A wide variety of "safety" precautions were described. What was needed was a sensible and prudent handling of the source by tongs, not pointing it at the body, storage in a secure place in a lead-lined box with a familiar "radioactive" label. This last essential was rarely mentioned. Many thought that radioactivity could be contained in airtight boxes, could be switched off, or was decreased at lower temperatures.

Question 4

There was, as ever, a lack of accuracy of ideas about breathing and respiration. This is surprising considering that this activity is common to everyone! The most regrettable delusion is, of course, the notion that "we breathe in oxygen and we breathe out carbon dioxide." This question was designed to test whether candidates had experience of practical work to investigate changes in the composition of air.

(a)(i)(ii)(iii) Most candidates answered these parts correctly. **(iii)** was the beginning of the problems for candidates whose knowledge was imperfect. An error in **(i)** was carried forward to give credit to those who had merely misinterpreted the diagram. The explanation sought was that there is more carbon dioxide in expired air.

(b)(i)(ii) The Examiners looked for a comment that the body is using more oxygen in respiration to gain more energy, therefore more carbon dioxide is produced. Some candidates mentioned that anaerobic respiration may have occurred, and that an oxygen debt was thereby incurred. Any two points were sufficient.

(c) Candidates' answers too often mentioned that expired air contains little or no oxygen, since all the oxygen is used by the body and carbon dioxide is produced instead. Some averred that "we breathe in oxygen and breathe out carbon dioxide" believing that "air" and "oxygen" are synonymous. It is in areas like this that a closer liaison should be encouraged between chemistry and biology.

Question 5

(a) The Alternative to Practical Paper always contains exercises in reading balance windows and thermometers. It assumed that the majority of Centres give candidates practical work involving weighing using modern balances and temperature measurement using mercury-in-glass thermometers.

The most common error was a failure to accept the scales as the actual measurement of mass, again showing a lack of experience. A candidate would add the readings in Figs 5.1 and 5.2 to find the new mass of the beaker + solid **Z** and then subtract them again to find the mass of solid **Z**.

(b) The temperature change was given as $\mathbf{T}_2$ - $\mathbf{T}_1$ to emphasise the decrease in temperature, but this proved to be a trap for the unwary, as the negative sign of the sum was carried forward into **(c)** and **(d)**. Then this was accepted as the indication that the reaction was exothermic!

(c)(i) Far too often candidates failed to divide by 1000 to convert the mass from grams to kilograms. The weakest merely added three noughts on to the end! In the case of, say, an error by one decimal place, the error was carried forward to **(c)(ii)** and **(d)**, but if totally unrealistic answers resulted no credit was given.

(d) The most common error here was a failure to add the terms within the bracket before multiplying by the temperature change.

(e) Apart from the obvious error in stating that the reaction was exothermic because the temperature went up, other mistakes in the explanation occurred. Some stated that the reaction was endothermic, because no heat was given out. This was not accepted. Others asserted that the drop in temperature showed that heat had been lost, so the reaction must have been exothermic. Teachers will agree that the identification of a reaction as exothermic or endothermic needs some careful thought and accurate description.

Question 6

The Examiners wanted to set a question about salt formation that was a step removed from the usual reaction between sodium hydroxide and hydrochloric acid. Candidates were required to read the information about the acid, the alkali and a suitable indicator and then describe how to use them in experiments.

(a) The process of crystallisation was often mentioned without clear instructions for the process, for example heating to remove water by evaporation until a saturated solution is left and then allowing this to cool. A point could be gained for previously filtering the lemon juice to remove solids. Far too many candidates suggested the addition of sodium hydroxide here, merely because it was mentioned in the introduction.

(b) The better candidates described how to use an indicator to show when equal amounts of acid and alkali had been added. Some marks could be gained merely by suggesting that the sodium hydroxide solution and the citric acid should be added and then the mixture evaporated by heating. Many could not give even these basic details. The importance of neutralisation and salt formation in so many everyday processes can be illustrated by simple laboratory experiments.