CONTENTS

Group III

Sciences

CO-ORDINATED SCIENCES

Paper 0654/01

Multiple Choice

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

General comments

The candidates scored a mean mark of 27.5, with a standard deviation of 5.1. The reliability coefficient of 0.75 is on the low side of what is typically achieved but this is probably a consequence of the entry itself also being quite small. This fact has to be borne in mind when interpreting the statistics of the individual questions.

The starter Chemistry question (**15**) was, as usual, found quite easy but **Question 22** was the only other Chemistry question to be so described. The candidates found questions were **16**, **23**, **24** and **27** more difficult.

Once again, the mean of this Paper was close to the target figure, which is pleasing. Candidates seemed to have been well prepared for this Paper.

Candidates were very competent in most of the Physics topics covered by this Paper. It was only **Questions 31** and **38** which posed many real problems.

Comments on specific questions

Question 1

This type of question usually poses few problems for candidates. However, in this particular case, almost 90% were able to narrow the choice to options **C** and **D** but it was then difficult for many to decide whether the markings shown on the wings were ‘circular' or not.

Question 2

Although this question was a little more difficult than most others in the biology section of the Paper, it exposed those candidates who had not fully understood the process of osmosis and who thus reversed the concentrations of the solutions involved.

Question 5

It was, perhaps, reasonable for candidates to suppose that this question was to do with concentrations of oxygen in the blood, but it was also a test of whether candidates realise that there is never as much oxygen in the blood as there is in the air present in the alveoli. This latter, and crucial point was missed by all but a very few of the better candidates, resulting in the question proving to be the most difficult by far of the biology questions.

Question 12

It was always likely that the final choice for the hormone keeping the lining of the uterus in thickened condition would be between oestrogen and progesterone. Each possibility received equal support - with the correct answer, progesterone, being selected by the more able candidates.

Question 13

This question demanded a degree of understanding with relation to the information provided. It is to the credit of candidates that 94% of them were successful, making this the easiest of the biology questions.

Question 16

Nearly as many candidates chose **A** as chose the key, **B**. The burning of a liquid hydrocarbon does not, of course, require a catalyst.

Question 23

Only a quarter answered correctly. Candidates readily identified that the term 'gel' was appropriate but the majority did not appreciate that the ointment was described as "opaque" (as opposed to "clear") so that 'suspension' has also to be relevant.

Question 24

Only about a third answered correctly and more chose **B**. These latter candidates presumably (and disappointingly) failed to recognise that nitrogen dioxide - a non-metallic oxide - is also acidic.

Question 27

It is also disappointing that only a quarter chose **C** with more choosing either **B** or **D**. Many carbonates are insoluble (including calcium carbonate as relevant to the test for carbon dioxide) and metallic oxides are typically basic -see **Question 24** above.

Question 29

This was correctly answered by the majority of candidates, but 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 candidates thought that no force was necessary to slow the car down.

Question 35

A common mistake was to think that an air gap can prevent the passage of radiation.

Question 38

A disappointing response with over one third being unable to divide *V* by *I* and chose the largest.

Question 40

The uncertainty regarding the properties of radioactive materials continues.

Paper 0654/02

Paper 2

General comments

Almost all the candidates were able to gain marks on all the questions, but only the most able candidates achieved full marks on any question. A good spread of marks was achieved by the candidates. It was evident that some candidates were much better prepared for the examination than others. There was no evidence of candidates suffering from a shortage of time to complete the examination.

Comments on specific questions

Question 1

A good spread of marks was achieved on this question.

(a) Some candidates were able to answer this concisely using the terms community and habitat. Less well prepared candidates managed to answer by describing what a community and habitat was. A number of candidates tried to link it to the idea of food chains and webs.

(b)(i) This was well answered. Most candidates were able to pick out one of the two suitable food chains. A few candidates ended up with a food chain containing only three organisms.

(ii) This was again well answered. A few candidates carelessly suggested the blackjack when they had used the cotton plant in their answer to part **(i)**.

(c)(i) This was well answered by almost all the candidates.

(ii) Only the better candidates attempted to explain the nature of the energy.

(iii) Many candidates gained a mark for correctly suggesting the black-shouldered kite but many were unable to explain their reason.

Question 2

This question was only well answered by the more able candidates.

(a) Forces were not well understood. Although many candidates managed to state gravity or weight for one of the forces acting, few could explain the upward force on the rope.

(b) Many candidates failed to work out when the stuntman would be moving fastest and consequently were unable to state at what stage the stuntman would have the greatest kinetic energy.

(c) Most candidates correctly drew a straight line going through the origin. A number attempted to make it curve at some stage without any explanation as to why.

Question 3

(a) Full marks were only obtained by the more able candidates. Many candidates did not appear to know the meanings of the terms used.

(b)(i) Many candidates gained both marks here. Marks were generally lost by candidates giving vague or inaccurate answers.

(ii) The fact that biogas contains carbon dioxide was well known, but few candidates were able to explain that this meant that there would be less combustible material in biogas.

(c) Many candidates gained only one mark here. They were either able to explain the meaning of the term thermoplastic or polymer but not both.

Question 4

Only the more able candidates did well on this question.

(a)(i) This was poorly answered. The candidates seemed to have a better grasp of animal/human biology than they did of plant biology.

(ii) This again was poorly answered. Few candidates gave the correct answer ovule.

(b)(i) Few candidates realised that light was not required and many candidates gave very vague answers when trying to explain that the temperature required had to be above 3 °C.

(ii) Many candidates gained one mark here for stating that the plants would grow towards the light but few could explain why. Answers were again vague and imprecise.

Question 5

(a) This was well answered by all but the weakest candidates. All three parts seemed accessible to most candidates.

(b)(i) Many candidates gained two marks here and very few failed to gain at least one mark. A good understanding of the concepts involved was shown.

(ii) Many candidates managed to correctly state an alternative energy source but many were unable to describe its use to generate electricity.

(c)(i) This part was not well answered. Words beginning trans- were often used but often the word was not transformer. However the better candidates not only knew that it was a transformer, but a step up transformer.

(ii) Only the better candidates explained the reason in terms of reducing energy losses.

Question 6

This question was generally well answered by most candidates, showing excellent preparation.

(a) Most candidates gained at least two marks here. They generally understood the notation used in the question and were able to handle the data and correctly state the correct number in each case.

(b)(i) This part was well answered.

(ii) Candidates were able to describe either a difference in a chemical property or physical property in this part.

(c)(i) Many candidates got this right. There did not seem to be a common wrong answer.

(ii) The better candidates explained this concisely in terms of mass of oxygen lost. The weaker candidates, although eventually being awarded the mark needed to write considerably more due to their lack of precision.

Question 7

Candidates found this a difficult question. Most answers were too imprecise to gain marks. Only the most able candidates gained good marks.

(a)(i) Most candidates were aware that atoms vibrated but were not able to explain accurately the effect of heating.

(ii) Similarly, most candidates were unable to explain what happened to the atoms when conduction occurred.

(b) Many candidates failed to mention the strong inter-atomic forces present. The common error was to discuss the close packing of the atoms.

(c) Predictably, the common wrong answer was 800 J/kg °C. Most candidates failed to realise that the size of this quantity would not change with changing mass.

(d) Although many candidates mentioned latent heat or change of state, few were able to describe what was happening to the particles at this time.

Question 8

(a) Many candidates failed to realise the significance of the two labelling lines from **A** and thought that they were some kind of bracket. Consequently their answers were usually head and body.

(b)(i) This part was usually answered correctly.

(ii) Many candidates got this right but far too many are still referring to the egg or ovum as an ovule.

(iii) The most able candidates answered this correctly. Weaker candidates discussed DNA telling the cell what to do.

(c)(i) This was invariably correctly answered.

(ii) Many candidates managed to mention either the control of puberty in males or a secondary sexual characteristic. The weakest candidates were again too imprecise in their descriptions of secondary sexual characteristics.

Question 9

(a) This was well answered.

(b)(i) Most candidates were able to give a difference between a mixture and a compound. Marks were again lost due to imprecise answers.

(ii) Although many candidates gained two marks, a number thought that the temperature would be increased.

(iii) Many candidates failed to score here.

(c)(i) Almost all the candidates knew the purpose of a catalyst.

(ii) Few candidates understood this part. There were a number of answers in terms of rates of reaction, but few candidates mentioned nitrogen's stability.

Question 10

This question was very well answered with many candidates getting full or nearly full marks.

(a) Very few candidates were confused by the two quantities written on the light bulb.

(b) A few candidates gave an incorrect answer here, usually suggesting that the resistance would not change.

(c) This part was invariably well answered.

(d) This part was again well answered. A few candidates were unable to describe the use of their choice.

Question 11

(a)(i) This part was well answered. Most candidates stated iodine. A few gave one of the other reagents used to carry out food tests.

(ii) Although candidates were aware of the relative size of starch molecules, many did no read the question carefully enough. An explanation of the test results for both inside and outside the tube was needed.

(iii) Similarly most candidates realised that the glucose molecules are small, but failed to explain the test results for both inside and outside the tube.

(b) Many candidates gained one mark here, but only the most able were able to gain both marks. Marks were lost for not being precise enough about what was being broken down - starch rather than food and few candidates knew that maltose was produced.

Question 12

(a)(i) This answer was well known. There were very few mistakes here.

(ii) This part was well answered.

(iii) This part was again well answered.

(b) Most candidates realised that carbon dioxide was produced but a number failed to explain this as an observation by omitting reference to bubbles or effervescence.

Paper 0654/03

Extended Theory

General comments

Candidates' performance on this Paper was very variable. A few candidates scored very highly, but for the majority quite a few parts of the Paper appeared to be testing material that was entirely unfamiliar. There was considerable evidence that some candidates had not studied some topics at all, for example hardness of water.

There was no indication that time was a difficulty for any candidates. There did not appear to be any questions where candidates misunderstood the information provided or the questions asked. However, a significant number of candidates did not make use of the information provided in the questions - for example in the first line of **3 (c)** where formulae were given - suggesting that they had not read the questions particularly carefully.

Comments on specific questions

Question 1

(a) Even where the formula was not known, most candidates managed to calculate at least one of the values correctly in **(a)**, using those already given as a guide. Several lost a mark by not showing any working at all; where this is asked for there is always at least one mark awarded for it, so candidates should *always* show working in these circumstances.

(b) This was either known or not. Some candidates knew the numbers but did not write units, despite these having been given earlier in the question.

(c)(d) On the whole, this was well answered, with many getting all the numbers in the correct sequence. However, only a very few understood anything at all about modulation, so **(d)** was often left blank or answered completely inappropriately.

Question 2

(a)(ii) Surprisingly few candidates could answer this correctly, with many answers far too high. This should have been completely avoidable, because the sentence just above clearly states that carbon dioxide concentration was *increased* to 0.1 %, so they should at least have been able to give a number below that. Some knew a number but did not state that this was a *percentage*.

(ii) This was better answered, with most realising that this was something to do with photosynthesis (though a few wrote about respiration). Many answers, though, were at a lower level than required on this Extension Paper, stating for example that photosynthesis 'makes energy for the plant'. Some reference to glucose or starch or carbohydrates was expected.

(b)(i) This was again not well answered. Although some candidates did realise that this related to convection, which they described clearly, many did not and there were many very vague answers to do with letting humid air out, or radiation.

(ii)(iii) These were equally poorly done. Most candidates did not *explain* anything at all, simply describing the numerical results in words, or saying that 'it is too hot for them at 25 °C'. Better candidates correctly described the effect of a temperature rise on reaction rates in **(ii)**, and the possible denaturation of enzymes in **(iii)**.

(c) This was better answered, and even candidates who had done poorly throughout the rest of the question managed to get at least two of the four conditions in **(iii)** and so score one mark here.

Question 3

(a)(i) This was not at all well answered. The Examiners were looking for the idea that this is a trend in a property (or a named property) along a period, which is repeated in other periods. Many answers related to *groups*, not periods. Several of those who attempted to describe the properties shown in the table said that melting points increase as you go from left to right - apparently not noticing that they only do this until half way and then decrease again.

(ii) However, most did pick out silicon in this part and many were able to explain how they predicted this using the data already given.

(b) This was even more difficult for most candidates. Many tried to answer in terms of carbon being a solid and neon a gas. However, there were a few good answers, explained in terms of carbon having a giant molecular structure, with many bonds which required large amounts of energy to break them. Neon, on the other hand, has a simple atomic structure, so less energy is needed to separate the particles.

(c)(i)(ii) Part **(i)** was usually correctly answered, and most were able to write the equation correctly in **(ii)**. Quite a few candidates, however, did not use the formulae provided in the question itself.

Question 4

(a)(b)(c)(d) The calculations were often well done. The most frequent errors came in **(d)**, where some candidates did not realise that they had been told the value of the resistors in the first line of the question, and others did not know how to add resistors in parallel.

(e) This was very well answered by many candidates, but others appeared to know nothing at all about static electricity. The latter often gave completely inappropriate explanations, involving such concepts as positive electrons and magnetism. Those who understood usually picked up all four marks very easily.

Question 5

(a) All parts were often well answered, although - as might be expected - there was confusion between ureter and urethra. This is one case where correct spelling is very important (as is legible writing).

(b) However, this was less well answered by many. Even those who realised this was something to do with more sweat being released on a hot day often misunderstood the relationship, many appearing to think that sweat releases so much urea that the kidneys do not need to excrete it. It is probably unwise to teach candidates that sweat 'excretes' urea - the urea in sweat is present in low concentrations, and is there by accident rather than by design. The important factor here is *water* balance, a point missed by very many candidates. Some candidates appear to use the term 'transpiration' to describe sweating, and this is incorrect.

(c) This was usually very well answered.

Question 6

(a) Although some answers did suggest an ionic compound - or a named one - relatively few said that this should be dissolved in water. Many suggested using a molten substance, which is incorrect.

(b) Most were able to get at least some marks, although on the whole, understanding was quite poor. By no means all know that loss of electrons is oxidation.

(c) There were some very good answers, but many candidates were not able to describe metallic bonding.

(d)(i) This was not at all well done. Many candidates did not describe an *observation*. Others did not use the information given, suggesting for example that the mixture would fizz. Acceptable answers included a rise in temperature, the appearance of a reddish solid, the magnesium dissolving or the loss of the blue colour.

(ii) This was very well answered by some candidates, but many others left this blank.

(e) This proved very difficult for all candidates, including those who did well in other parts of the Paper. The correct answer is magnesium and calcium, as they have the same number of atoms. Most chose calcium and strontium.

Question 7

(a) This elicited a whole range of answers. Many were excellent, scoring all 8 marks, but many others were very poor indeed.

(i) This was the highest scoring, with most candidates knowing that haemoglobin is found in red blood cells, and also that it transports oxygen. However, weaker candidates often stated that its function is to make blood red, or to supply the blood with iron.

(ii) Many candidates seemed to think that an antibody is a cell, or that it functions inside a cell. Very few stated that it is found in the blood plasma (a statement that it is *made in* white blood cells was also accepted). Most knew that it had something to with the immune system, and many were able to say that it helped to destroy or inactivate pathogens, viruses or bacteria. The term 'germ' is not specific enough for this Paper and should be avoided. One or two candidates cheered the Examiners by stating that antibodies protect us against foreign agents.

The function of proteases in digesting proteins to amino acids (or peptides) was quite well known, although by no means all candidates were able to state this, nor to say with any precision where it happens. Similarly, most knew that insulin has something to do with blood sugar, but could not say exactly what, nor where insulin is found. The expected answer was that it is found in the blood plasma (a statement that it is secreted by the pancreas was accepted) and that it reduces blood glucose levels. Statements that it 'controls' blood sugar levels were not credited, nor that it is 'in charge of' blood glucose levels.

The biuret test was well known and described by some candidates, but more often it was confused with other tests and all colours of the rainbow appeared as signs of a positive result.

Question 8

(a)(i) Most candidates answered this correctly, even if they then went on to give no more correct responses throughout the rest of the question.

(ii) However, it was relatively rare for this to be correct.

(b) Even this proved difficult for some, although all that was required for the first mark was the idea that the output force is greater than the input force. The second mark was given for relating this to the particular context provided, for example by saying that as the pressure was the same on both pistons the force on the one with the larger area was greater.

(c)(i) Very few candidates appeared to know that in a liquid the particles are touching one another. Without this knowledge, they could not state that, let alone explain why, liquids cannot be compressed.

(ii) However, more did know that gases *can* be compressed, so answers were often a little better.

(d)(i) Most knew that heating a gas would increase the pressure, but only better candidates explained this in terms of particle behaviour, or said that the increase would be proportional to the temperature rise.

(ii) There were many correct answers, though there was some confusion between Kelvin and Celsius.

Question 9

(a) This was generally well answered, although many candidates did not clearly show how they had arrived at their answer.

(b)(i)(ii) They were able to answer **(i)**, but ran into difficulties in **(ii)**, where relatively few understood that it was the removal of calcium from the water that had softened it. Indeed, the idea of 'soft' and 'hard' water seemed completely unfamiliar to many, causing them problems throughout the rest of this question.

(iii) Answers were often very disappointing indeed, with many candidates apparently having no idea at all about how to do a simple experiment. Many added unnecessary complications such as washing clothes or hands. Many made no attempt at comparison, simply suggesting adding sodium carbonate to some water and seeing if it lathered when soap was added. However, there were some clearly described simple and entirely appropriate experiments, involving the use of two samples of water of equal volume, one with added sodium carbonate and one without. Equal volumes of soap were added to both, and shaken for equal amounts of time. The quantity of lather was then compared; if sodium carbonate had softened the water, then this sample would have more lather.

(iv) Most candidates could not answer this, but some did know that you could use an ion exchange resin (or sodium permutit) and could explain how it worked. Others correctly described distillation.

Paper 0654/05

Practical

General comments

Although the marks suggest a very slight improvement on last year, the standard of candidates' work was probably about the same. All parts of the Paper were answered in a satisfactory manner and apart from one part in question three all marks were readily accessible. There were a few very good answers and also a small number of poor answers. Supervisor's comments and their results were particularly important in marking this Paper and thanks to them for providing all the necessary information.

Comments on specific questions

Question 1

All parts of the question were answered and most appreciated the ideas being tested. A small number presumably muddled their solutions A and B resulting in enlarged chips in part **(a)** and smaller chips in part **(b)**. Candidates were expected to obtain the length of the chips within 0.3cm of each other in both parts, and most succeeded in that. They were also expected to be within 0.3cm of the Supervisor's average. Although most were able to correctly calculate the change in size, some simply used the final size rather than the change in size to perform the calculation. A large number were clearly unfamiliar with the term 'water potential' but were able to answer in terms of concentration. They were not penalised for this. So long as a clear explanation was given as to why there was a change in size and in which direction the water moved, both marks were awarded. In practice, if one explanation was correct, the second explanation was also correct.

Most stated that water entered the plant cells and the most common explanation was to provide support for the plant. It was very easy to score the mark in **(d)(i)** and almost every candidate did so. Many scored both marks in part **(ii)** by stating that water makes the plant cells turgid and hence gives plant rigidity.

Question 2

Very few candidates took notice of the instruction to weigh the beaker to the nearest gram. Although no penalty was applied this time, it may well be done in future. A good number did not perform the conversion correctly, thus losing this mark. The vast majority weighed the sample to one decimal place. Some who weighed to a whole number were penalised if the mass was recorded simply as 3g rather than 3.0g. A similar penalty applied to the measurement of temperatures. The instruction clearly stated to the nearest $0.5^{o}C$ and every temperature needed to reflect this statement. Whole numbers such as 21 or 22 lost a mark. A mass of 3.0g was expected to produce a drop in temperature of $7.0^{o}C$, whilst 2.5g produced $6.0^{o}C$. Candidates scored two marks if within $1^{o}C$ of the value and one mark if between one and two degrees.

Only a small number gave an acceptable answer to **(c)**. The most likely answer was to provide suitable lagging. The commonest answers included using more solid, more water or using more accurate apparatus. None of which scored the mark. It is of course possible to calculate the actual rise in temperature for part **(e)** and candidates were expected to be within two degrees of this, taking into account that the calculation makes certain assumptions that were not valid in this exercise. It would appear that many did not score the marks here because they did not ensure that the water added was at exactly $60^{o}C$. Far too many thought that it was just a matter of heating until the temperature had been reached and then adding. Candidates were expected to heat until the appropriate temperature had been exceeded then allow to cool.

Question 3

Results for rate experiments are always somewhat variable and much depends upon the Supervisor's values. One had to assume that all candidates used the same solutions and that the Supervisor's times were a guide. Almost all candidates performed five experiments and used a good spread of temperatures. Two marks were scored for this. Two temperatures were selected for comparison between the candidate values and the Supervisor. The starting temperature of $35^{o}C$ was one of these and the other was $60^{o}C$. The lower temperature obviously produced a long time and consequently a margin of 10 seconds was allowed, whilst at the higher temperature, only 2 seconds was allowed. The fifth mark was awarded to those who produced a curve with all times within 2 seconds of the line. In the event, few candidates realised that they were required to take readings from the graph and found they had not chosen suitable scales. Indeed, scales were frequently cramped. Part **(g)** defeated almost all candidates. The expected answer was to use the reciprocal of the time as a measure of the rate and plot a new graph. Most realised that they needed to cool the solution but only a small number realised that surrounding both solutions with melting ice would enable this to be done. Most thought it was enough to cool one of the solutions.

Paper 0654/06
Alternative to Practical

General comments

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.