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CO-ORDINATED SCIENCES

Paper 0654/01
Multiple Choice

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3	**B**	23	**B**
4	**C**	24	**C**
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6	**B**	26	**A**
7	**B**	27	**D**
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16	**A**	36	**A**
17	**C**	37	**A**
18	**B**	38	**B**
19	**B**	39	**A**
20	**A**	40	**D**

General comments

The candidates achieved a mean mark of 28.2 with a standard deviation of 6.25. These values are satisfactory. The Paper is intended, primarily, to discriminate between candidates in the grade C to grade G range. However, the Paper is also taken by candidates who achieve higher than grade C. As a consequence, the mark distribution tends to be skewed towards higher marks. This report concentrates more on the responses made by the grade C to G candidates.

There was a wide range of facility in the Biology questions. None was too difficult to make a valid contribution to the test with only **Question 4** being answered correctly by less than 50% of the candidates. Three questions, however, proved to be rather too easy since they did not discriminate sufficiently between candidates of differing ability.

Candidates would appear to have been well-prepared for the Physics part of the syllabus, as they answered most of them well. Teachers and candidates are to be congratulated. Physics questions which the candidates seemed to find relatively easy (over 70% facility) were numbers **28**, **30**, **31**, **32**, **35**, **37**, **38** and **39**. The only question which candidates found particularly hard was **40**.

Comments on specific questions

Question 1

This was one of the easy questions, but it continued to serve two useful functions. It tested an impor biological skill (the use of identification keys) and it made a welcoming start to the Paper for tense candidates.

Question 4

There is the suggestion here that candidates did not exercise enough care in reading the question. In fact 38% opted for region **A**, the palisade cell, as the site of carbohydrate manufacture whilst failing to appreciate that the label was pointing to the cell vacuole. Option **C** clearly indicated a chloroplast, albeit in a spongy mesophyll cell. There is never an intention to ‘catch out’ candidates, but there is a vital requirement on their part to read questions carefully.

Question 9

There was a basic misunderstanding in this question, (or was it again a lack of careful thought?) since 39% of candidates suggested that carbon dioxide rather than energy is *always* released during respiration. The better candidates, however, were not deceived.

Question 10

On the difficult side, this question was perhaps a little too confusing for some. Only 2% believed that the blood in vessel **Q** had more urea and more oxygen than the blood in vessel **P**. It was surprising, therefore, that only 52% opted for the reverse of that situation (the correct answer).

Question 12

Although almost too easy to be of real value, this question allowed candidates to demonstrate some sound basic understanding of Biology.

Question 14

Again proving to be one of the more simple questions, this question did indicate that almost all candidates had a sound grasp of the principles of trophic interactions - a topic that can sometimes reveal some surprising misconceptions.

Question 16

Overall, this question was found slightly hard but this was undoubtedly due to over half of the lower scoring candidates choosing **D** as their answer. Not only is this response the ‘wrong way round’ but it also ignores the instruction in the question for the *SIMPLEST* formula. “Read the question carefully” continues to be an important piece of advice.

Questions 17 and 20

By contrast, these questions were found quite easy by all candidates and this is gratifying.

Question 22

A slightly hard question but one that discriminated very effectively. The lower scoring candidates tended to choose either **B** or **C**. This might imply either that they were guessing or that they were focusing on only one of the reactant/product pairs. The important point, of course, is that oxidation and reduction occur together.

Question 23

Also slightly hard but with satisfactory discrimination. Among the lower scoring candidates, response **A** was rather popular and this is presumably due to confusion over whether barium nitrate is used to test for chloride ions or sulphate ions.

Question 24

Similar comments as for **Question 23** also apply to this question. Again, it was response **A** that wa popular with the lower scoring candidates. Limestone rocks undergo weathering but they are not *the* of weathering, being a typical example of a sedimentary rock. Was this another example of not reading question sufficiently carefully?

Question 29

The vast majority of candidates knew that they had to divide distance by time. The problem was that most of these did not convert minutes to hours first. Units are always important in Science questions, and candidates should be aware of the units in any question.

Question 33

About two-thirds of candidates answered this correctly, but a quarter thought that either amplitude or frequency changes during refraction.

Question 34

In a similar manner, only half realised that 200m is a wavelength, but almost as many thought that it is frequency. Candidates should know that metres cannot be a frequency.

Question 36

This was not answered correctly by as many as hoped, and 36% simply assumed that since there was attraction in both the situations in the stem, then when the metal rod is turned round, then both must be repulsions.

Question 40

Half-life still causes confusion in the minds of many candidates. Only one third answered this correctly. Many more spotted that four half-lives were involved, and simply multiplied by four.

Paper 0654/02

Paper 2 (Core)

General comments

Almost all the candidates were able to attempt all the questions. Many managed 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. Many candidates found one or two of the questions quite difficult. There was no evidence of candidates suffering from a shortage of time to complete the examination.

A small number of candidates wrote some of the answers in red ink, clearly ignoring the instructions on the front cover of the Paper. An increasing number of candidates are beginning to include the abbreviations they use in text messaging within their answers. This is a trend, which must be discouraged.

Comments on specific questions

Question 1

A good spread of marks was achieved on this question.

(a) Some candidates were able to answer this using correct differences, but some candidates did not make it clear to which cell they were referring.

(b) This was well answered by many candidates. Some candidates lost the mark by referring vaguely to germs rather than infection, bacteria or viruses.

(c)(i) HIV was generally well known. A few candidates unsuccessfully attempted to write o of HIV.

(ii) Most candidates scored maximum marks here. Those who did not score maximum marks u lost the mark(s) due again to vague answers mentioning blood or needles without giving suffic detail.

Question 2

This question was only well answered by the more able candidates. Most candidates found it quite difficult especially in terms of describing whether the particles involved were moving or merely vibrating.

(a) A number of candidates confused boiling and evaporation here. There was also confusion as to whether the particles were already moving on a cooler day. Few candidates really understood the process of evaporation.

(b) A number of candidates confused expansion and melting here. Again, many candidates were unclear as to whether the particles were vibrating before being heated. There was also a common misconception that the particles themselves expanded.

(c) This part was better answered. Again some candidates were unclear as to whether the particles were vibrating before being heated. Some candidates gave an answer in terms of the involvement of delocalised electrons. This was acceptable, but their explanations were far from clear.

Question 3

(a) This part was well answered. The only common error was when candidates mentioned that elements contained only one atom rather than one type of atom.

(b)(i) This was well answered. The only wrong answer commonly offered was potassium bromi*ne*.

(ii) This part differentiated well. Whilst many candidates were able to explain why strong heating was necessary, a number of candidates did not really understand the basics of electrolysis.

(iii) Many candidates gave a correct answer here related to the fact that potassium or metal ions were positively charged and therefore attracted to the negative electrode. Some candidates suggested that it must be the negative electrode because brown fumes were being given off at the positive electrode. A number of candidates mentioned that potassium was positive but did not mention that it was the potassium ion.

(iv) There were not many candidates who managed to gain all three marks here on what was basically a multiple-choice question.

Question 4

(a) Whilst many candidates gained one mark here, there was much confusion regarding differences. These included differences in breathing and where the animals lived. A number of candidates incorrectly answered in terms of claws, tails and length of tongue.

(b)(i) Many candidates gained full marks.

(ii) Many candidates gained full marks.

(iii) Most candidates knew the genotypes but less knew the phenotypes and gametes produced.

(iv) Irrespective of their answers to the last part of part **(iii)**, almost all the candidates knew that the ratio was 3:1.

Question 5

(a) Most candidates were able to give an answer about less energy being used or the hovercraft moving more easily, but few candidates appreciated that the hovercraft would suffer less wear and tear due to this low friction.

(b)(i) There were many wrong answers here. Some answers were 2000N, which showe between mass and weight but many wrong answers involved calculations using the a cushion.

(ii) A surprising number of candidates were unable to see the connection with the previous part. So gave answers, which had no connection with previous part whilst others gave a value slightly greater than the previous part.

(c) All parts were well answered, showing excellent data handling skills.

Question 6

(a) Most candidates gained at least one mark here. Either they knew the source of the fossil fuel or that it took millions of years to form. A few thought that fossil fuels were made from fossils.

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

(ii) Although most candidates had an idea that the length of the molecule was the crucial factor, they were not able to describe this clearly enough to gain the mark.

(iii) This was well answered.

(iv) This was well answered.

(c) There was much confusion here. Whilst many candidates were able to give correct answers in terms of single and double bonds, some gave very vague answers. Answers in terms of containing or not containing the maximum amount of hydrogen were also acceptable, but few candidates did this successfully.

Question 7

(a) Most candidates gained full marks here.

(b) The idea of respiration was not really understood by many candidates, some thought it only happened at night, others thought that photosynthesis was a form of respiration.

(c) This part was almost invariably answered correctly.

(d)(i) Although many candidates knew that a producer made its own food, some thought it made its own energy.

(ii) Whilst many candidates gained at least one mark for describing eating as the process by which energy is transferred in a food chain, few candidates mentioned a named substance. Many candidates tried to answer the question they wanted to be on the Paper about energy losses up the food chain.

Question 8

(a)(i) Most candidates were correctly able to identify a suitable magnetic material.

(ii) Most candidates offered some suggestion but many were too vague to gain credit.

(iii) This part was usually answered correctly.

(iv) Many candidates got this right but many merely put the words magnetic and field into a sentence.

(b)(i) Most candidates identified the wavelength correctly. A straight line with arrowheads at both ends showed this clearly. A number of candidates used wavy lines or combinations of lines, which were confusing.

(ii) A number of candidates confused amplitude and frequency.

(iii) Most candidates realised that the sound was quiet, but a number were unable to explain this in terms of amplitude. Again there was confusion between, amplitude, frequency and pitch.

Question 9

A well answered question, with even the weaker candidates gaining good marks.

(a)(i) This was well answered, even though many candidates found it difficult to spell chemotherapy.

(ii) Analgesic was fairly well known, but there were a number of popular wrong answers including aspirin and painkiller.

(b) A common error here was to list the elements rather than the state the number of elements.

(c)(i) This was well answered.

(ii) This was well answered.

(iii) There were many different correct answers given here, showing a wide range of knowledge of these metals.

(d) Many candidates scored at least one mark here, but there was confusion with acid rain and the greenhouse effect.

Question 10

This question showed a wide range of marks obtained by the candidates.

(a)(i) Many candidates were either able to state that it was the biuret test or were able to state the reagents required. Benedicts and iodine were, predictably, the common wrong answers.

(ii) Even candidates who gave the wrong test in part **(i)** usually gave the correct colour change of purple.

(b) This was well answered by many candidates, showing a good understanding of the process of protein digestion.

(c)(i) Although some candidates knew the correct organ, the commonest answer was the kidney.

(ii) Most candidates scored one or both of the marks here.

Question 11

(a) This part was poorly answered. Although many candidates will have known that electrons are negatively charged they failed to state it. Some candidates tried to answer in terms of friction on the screen when the electrons hit it.

(b) About half the candidates appreciated that the voltmeter needed to be connected in parallel across filament. Nearly all the candidates were able to draw the correct symbol for a voltmeter.

(c) Many candidates correctly gave two factors here, although voltage and current were common wrong answers from the weaker candidates.

(d) Most candidates answered this correctly.

Question 12

(a)(i) Most candidates gained at least one mark here. The least known element was nitrogen.

(ii) Most candidates appreciated that the glucose molecules needed to be joined to each other but many failed to suggest that the chain would continue on beyond the length of the chain drawn.

(iii) Most candidates gained one mark here. Either they knew that the polymer molecule was large or they knew that it contained small molecules that had been joined together, but rarely both.

(b) Most candidates realised that carbon dioxide was tested using limewater, but many candidates failed to show on their diagram that the carbon dioxide had to be bubbled through the limewater.

(c) Only the most able candidates gained two marks here.

Paper 0654/03

Paper 3 (Extended)

General comments

As always, there was a very wide variation of performance on this Paper. Many candidates were able to deal competently with every question, and marks over 90 were not uncommon. At the opposite extreme, significant numbers of candidates appeared not to have any experience of many of the topics from the Supplement of the syllabus that were tested here.

There was no evidence of any particular question being difficult for candidates to understand, apart from the graph in **Question 7**, where some of the weaker candidates failed to read the information above it and wrote about 'algae bacteria' in their answers to **(c)(i)** and **(ii)**.

Almost all candidates appeared to have finished the Paper in time, and, indeed, marks on **Question 10** were often high.

In general, candidates are getting better at showing their working for calculations, although weaker candidates often fail to do this in a way that is easy to understand. They should also realise that, if asked to state a formula, then this frequently carries a mark. Formula triangles, although a useful aid, are not the same as a full formula. Similarly, most candidates now take care to give either a balanced equation or a word equation as asked, but there were still numerous examples of word equations in **Question 3 (b)(i)** and of formulae in **9 (a)(iv)**.

Comments on specific questions

Question 1

Most candidates were able to make a reasonable attempt at this question, in general scoring better on part **(a)** than on **(b)**.

(a) The majority of answers to **(i)** were correct, although not all candidates did as asked and drew label lines; it is very difficult to be sure exactly what is being labelled if the letter is perched on top of the diagram itself. Most were also able to state that the presence of petals was an indication that this is an insect-pollinated flower, and many described the position or shape of the stigma or anthers also. Comments on nectaries (none is visible) or on the pollen itself were not credited. Part **(iii)** was answered very well by many candidates, but there is still a lot of confusion about pollen grains travelling down to the ovule.

(b)(i) This part was very disappointingly answered by the majority, though there were some good answers here and there. A surprisingly large number made no attempt to describe the structure of the fruit, as asked in the question. These candidates tended to draw diagrams of a whole plant, with an animal eating a fruit from it, then wandering off to defecate somewhere else. Of the two marks available, one was awarded for some statement about the fruit itself (for example that it is sweet, fleshy or has hooks) and the second for how this helps it to be dispersed (for example it is eaten and the seeds egested - not 'excreted' -, or it is carried on the animal's fur).

(ii) This was also found difficult by the weaker candidates. Quite a number described an advantage of *animal* dispersal (seeds are given a heap of fertiliser) which was not what the question asked. Better candidates were able to state that this reduced competition, and that it enables the plant to spread to new areas. Other good answers included the idea that it avoided the whole species becoming extinct if there was a local disaster, or that it encouraged outbreeding by increasing the chances of unrelated plants growing near to each other.

Question 2

(a) This was not easy, and many candidates struggled to work out the answer to **(i)**; many incorrectly gave 30 dm^3. However, if they knew the formula $P_1V_1 = P_2V_2$, they could still gain full marks on part **(ii)**, as many did. Unfortunately, many others did not know this relationship, and tried to use pressure = force/area. The better candidates were then able to suggest that temperature may have changed, relating an increased temperature to increased pressure in their answers to **(iii)**.

(b) This proved a much easier part of the question, and almost all candidates gained g... **(i)**. Only a very few misunderstood how this sensor works, with some very strange s... relating to magnetism and other phenomena. Full marks were common here, as they were...

Question 3

For many candidates, this was their best question on the Paper. Full marks were quite commonly seen.

(a) Almost all candidates were able to identify the temperature rise shown on the screen, and to state that this showed that heat was given off as the acid was added to the alkali. Most also correctly gave a pH of 7 in their answer to **(ii)**, and stated that this is the point at which neutralisation has just been completed, or that the peak in temperature shows the reaction has finished. They were also able to read off the value of 22.5 cm^3 from the graph.

(b) This part proved more difficult. Although most candidates were able to pick up at least one mark for the question, with the majority getting it entirely correct, there were quite a few instances of word equations being written. Other common errors included using NaOH instead of KOH; writing KHO instead of KOH; or thinking that hydrochloric acid has the formula HCl_2.

Part **(ii)** was less well done. Either words (hydrogen and hydroxide) or symbols (H^+ and OH^-) were accepted. Many did not know this, and gave hydrogen and oxygen. A few even suggested potassium and chloride.

(c) Part **(i)** caused little difficulty for most; if they had given an incorrect formula for potassium hydroxide earlier and reused it here, they could still get full marks for this section. However, **(ii)** caused more problems, with many blindly trying to apply a formula they knew, instead of seeing that all they needed to do was to multiply their answer to **(i)** by 0.25.

Question 4

(a) A surprising number of candidates were not able to answer **(i)** correctly. Some left the table blank, but most did at least attempt answers, and the better candidates gave three correct responses. Part **(ii)** also proved not to be as easy as expected. Hydrogen was not accepted. Acceptable answers included any of the noble gases and water vapour. A few candidates gave gases which were already in the table.

(b) Many were able to make a suitable suggestion for **(i)**, such as time needed for the breathing rates to adjust to the new concentration, or for the carbon dioxide concentration to reach the same level all over the room. However, part **(ii)** was difficult for many candidates, who seemingly read the x-axis as if it were time. Thus answers such as ‘the man’s breathing rate increases more rapidly than the echidna’s’ were common. Marks were awarded for stating that the echidna’s breathing rate did not increase as much overall, and for some comment on the relative flatness of the curve for the echidna compared with the man, at higher carbon dioxide concentrations.

(c) Those candidates who thought about diffusion had no problems here, but many did not. Quite a few tried to give an explanation relating to oxygen concentrations. In **(ii)**, marks were available for the idea that a raised blood carbon dioxide concentration could be an indication of increased respiration in the tissues, and that increasing the breathing rate could supply more oxygen for this, and also remove the excess carbon dioxide quickly.

(d) This was the most accessible part of the question, and was often answered entirely correctly.

Question 5

(a) Marks were given in **(i)** for the idea that fossil fuels are running out, and also for a specific example of how their use can lead to pollution. Quite a few candidates lost a mark here by stating only that ‘they cause pollution’, without saying what kind - for example, that they produce carbon dioxide, or exacerbate global warming, or produce sulphur dioxide, or cause acid rain. Parts **(ii)** and **(iii)** were often well answered, although a few misread the question and gave advantages rather than disadvantages. Credit was not given to answers which suggested that nuclear power stations always release radiation - though radiation leaks were accepted - or that they are more likely to have accidents.

(b) Both parts were often correctly answered, with **(ii)** proving a little more accessible [illegible] expected answer to **(i)** was that the voltage is stepped up as this minimises *energy* lo[illegible] electricity is transmitted from the power station to its points of use. Most could answer **(ii)** [illegible] although there were a few instances of candidates getting the numbers back to front, or missi[illegible] somewhere and therefore ending with an answer of 5:8.

Question 6

(a) The test most frequently given was using damp red litmus, which turns blue. Some candidates correctly described using hydrogen chloride gas, which produces white 'smoke' on contact with ammonia. A surprising number described ways of generating ammonia, rather than - or as well as - testing for it.

(b) Both parts were well answered. Many candidates knew that not all of the nitrogen and hydrogen would react in the reaction vessel, and others explained that the reaction is reversible. They also knew that the catalyst speeds up the reaction, so that without its presence the percentage of ammonia obtained would be lower.

(c) This part of the question was less well answered than the previous sections. The expected answer to **(i)** was that nitrogen gas is unreactive, and some did know this. However, many answers suggested that plants could not absorb gases, or that nitrogen was not soluble. Some even suggested that nitrogen molecules were too big to fit through the stomata. Part **(ii)** was not well known, and, although some of the better candidates could name at least two of oxygen (or air), water and a named catalyst, many simply guessed.

(d) This was very disappointingly answered. Even those candidates who knew that sulphuric acid should be reacted with the ammonia solution could often go no further than that, and correct descriptions of mixing until neutral, how neutrality would be indicated, and how to evaporate water to leave crystals were relatively rare. Many had no idea about how this could be done, and did not gain any marks at all.

Question 7

(a) This was another question which was surprisingly poorly answered. Better candidates explained that the plants would use the nitrogen compounds to make proteins, and this would increase their rate of growth, or increase the yield. A mark was also available for the suggestion that the soil might be short of nitrates. However, most answers were much more vague, simply suggesting that the plants need nitrogen to grow.

(b) This, too, was disappointingly answered. All sorts of complicated answers relating to the nitrogen cycle appeared in **(i)**, along with descriptions (usually incorrect) of how the ions would be transported within the plant. The expected answer was that the ions would be taken up into root hairs, by diffusion. Some candidates knew about active transport and this was credited. Many, though, thought that this occurs by osmosis. Xylem did occasionally appear as an answer to **(ii)**, but this was relatively rare.

(c) Some candidates answered this very well, showing a good understanding of the process of eutrophication, and making good use of the information provided in the graph. However, weaker candidates struggled to make any correct statements in their answers to either **(i)** or **(ii)**. A few looked only at the graph and not at the information above it, and wrote about 'algae bacteria'. In **(i)**, marks were awarded for explaining that the numbers of algae increase close to where the fertiliser flowed into the river, and then decrease downstream where the fertiliser has been diluted or used up. In **(ii)**, the question was worded carefully to guide candidates towards thinking about bacteria, but many completely failed to mention them. These candidates suggested that it was the algae which were responsible for using up the oxygen, and hence the fall in fish numbers. There were many good answers scoring full marks, but many with zero or one, the latter most often for explaining that the fish died (or moved away) because of the oxygen shortage.

Question 8

(a) Most answers to **(i)** were correct, the most common error being that switch **B** would be o[illegible] last row of the table. In **(ii)**, marks were given for stating that the voltage would remain uncha[illegible] or that the voltage drop across the motor would be less; and for stating that the current flow[illegible] through the motor would be less. Part **(iii)** was usually well answered, though some of the weaker candidates simply wrote 'It would be unchanged', which was not accepted. Part **(iv)** proved very difficult, although some good answers were seen which provided an explanation related to the relationship between energy, voltage and charge.

(b) This was well answered, and full marks were frequently awarded. The most common errors were to fail to give the full formula, or to include just temperature, rather than temperature change; and to give incorrect units in the final answer.

Question 9

(a) A wide range of sources for methane were accepted. Part **(ii)** was usually well answered, as was **(iii)**, although a few candidates did not know what was meant by a displayed formula. Part **(iv)** was also often correct, but many could not answer this, suggesting products such as propene or propane oxide. A few gave formulae instead of words, which was not acceptable.

(b) Some candidates had problems balancing the equation, and a few failed to answer this at all. Part **(ii)** was often well answered, with good explanations being given in terms of the charges on the positive palladium ions and the negative chloride ions needing to balance to form a neutral compound. Part **(iii)** was also quite well done. Marks were awarded here for the idea that carbon monoxide is harmful to humans, that we cannot detect it with our own senses and therefore need a detector, and some suggestion of what might be done to avoid harm if it were to be detected, such as leaving the room or opening some windows.

Question 10

This question was often high-scoring, with **(a)(ii)** proving the most difficult section.

(a) Part **(i)** was very well answered. Most candidates knew that KE = $^1/_2mv^2$, and were able to use this to carry out a pair of calculations (usually suggesting a value for the mass of the car) and then show that one value was 4 x the other. However, not all then answered **(ii)** in terms of energy, despite the question clearly stating that they should they should use their answer to **(i)**. Several tried to use momentum or force in the answers.

(b) Part **(i)** was usually well answered, with most candidates able to quote the formula F = ma and then substitute into this to obtain an answer of 4 m/s^2. The most frequent errors were to convert the mass of the car into a weight, or to give incorrect units in the final answer. Part **(ii)** required a little more mathematical skill, and not all could cope with the square and square root. If **(i)** had been answered incorrectly, candidates were allowed to take their wrong answer forward into **(ii)**, and could still gain two marks for this if they used this answer in the correct way.

Paper 0654/04

Coursework

General comments

Nature of tasks set by Centres

This year 19 Centres submitted coursework for the June examination. Most have provided coursework in previous years and have acted on advice given. In most Centres all the tasks set were appropriate to the requirements of the syllabus and the competence of the candidates. Some Centres had introduced cue cards to help weaker candidates. In only one Centre was there some minor confusion about a few tasks. The standard of candidates work was of a slightly higher standard than previous years. Candidates' work covered the whole mark range with the impression that the mean was higher. Some work was outstanding.

Teacher's application of assessment criteria

In nearly all Centres the assessment criteria were understood and applied well for all of their a There has been a steady improvement in the Centres' application of assessment criteria. Only one C (new to the scheme) tried to assess both skill C1 and C4 in the same investigation. Advice has been gi to help the Centre avoid confusion in future.

Recording of marks and Teacher's annotation

Following suggestions made encouraging the use of annotation on candidates' scripts many more Centres are using this technique to indicate or justify marks awarded. There is still scope for further improvement with some Centres writing comprehensive summaries but not indicating the point at which the mark was awarded. Tick lists remain popular with particularly skill C1. Many Centres have developed very comprehensive recording systems.

Good practice

Some Centres make very useful comments about individual candidate's performance on a summary sheet. Many Centres have developed a booklet of tasks and dedicated assessment criteria. Two Centres introduced spreadsheet format to summarise all candidates' marks across all assessments. A few Centres provided help cards to enable candidates with difficulties to proceed.

Paper 0654/05

Practical Test

General comments

There were some very good answers and evidence that many candidates were well prepared for the examination. It was particularly good to see that there is improvement in answering the planning part of a question i.e. where candidates have to suggest a further experiment or devise a plan for performing an unfamiliar task. All marks were used and the mark scheme produced a good spread. There were few very poor candidates. **Question 3** was the least well answered. The results for **Question 3** relied upon Supervisor's results; all of whom played their part in the provision of these results.

Comments on specific questions

Question 1

This question was very well done with many candidates reaching a maximum or near maximum mark. A few Supervisors reported problems with testing for protein. Sufficient time is given for these problems to be identified before the candidates start their test and difficulties of this kind should be dealt with.

(a) Most stated that the test-tube became warm although a small number thought it became cool! It was necessary in part **(ii)** to record an appropriate observation of water such as condensation or drops on the side of the tube. A statement that water was produced did not count as an observation. The majority correctly identified carbon dioxide. Part **(iv)** was usually correct but **(v)** less well answered. Even the obvious 'no burning' mark was not scored by many. In contrast, part **(vi)** was well answered.

(b) A high percentage of candidates did this test correctly and identified B as the protein. However, a mark was sometimes lost by recording no change when solution A was tested. Adding a blue solution to a colourless one does produce a change.

(c) Excellent. A wide range of colours was accepted such as red, green and yellow. Most were able to identify the conversion to a sugar and consequently answer yes to part **(iii)** and make some deduction as to how the sugar was formed.

(d) Most appeared to know the test for starch and scored two marks although few gave a full answer in terms of what would happen if no starch was present as well as the observation if starch was present.

Question 2

(a) Almost all candidates were able to perform the experiment and collect five sets of readings were lost for such errors as a wrong force or extension value in centimetres rather than millim Some did not have the ruler with the zero at the bottom therefore producing a set of nega values for the extension. Apart from a penalty mark this did not affect the rest of the question.

(b) The graphs were very well done with few awkward scales and few reversed axes. Although the points were sometimes scattered, the question asked for a straight line and the majority obliged. A good number did not make use of the origin and a mark was lost if the line did not or would not pass through the origin.

(c) Some were caught out by not reading in advance that the extension for a force of 3.5N was required. Consequently the scale did not permit such a reading. Many calculated it by taking a combination of readings, which was acceptable in view of the linear nature of the graph.

(d) A large number scored two marks by correctly stating that the force was directly proportional to the extension. A mark was deducted if the line did not pass through the origin. No mark was awarded to those who simply stated that the extension increased with force.

(e) Almost always a suitable line was drawn.

(f) The most common error here was the failure to recognise the use of the line already drawn. Some were more intent on trying to calculate a spring constant. Providing the existing line was used, many were able to score three marks. Some lost a mark by either not indicating how the force was converted into a mass or incorrectly indicating how this was done.

Question 3

Many candidates did not understand this question and certainly failed to appreciate that it was necessary to concentrate on the direction of electron flow. This made it difficult to answer parts **(c)** and **(f)** correctly.

(a)(b) Although many scored a mark for the negative metal in each case, this was probably guesswork for some. It was necessary for the recorded voltage values to be within 0.2V of the Supervisor's values. Many scored all three marks for these values.

(c) Many correctly stated magnesium for one mark but few understood why. It all hinged on appreciating that it was the negative terminal when connected to zinc and copper and the zinc was the negative when connected to copper.

(d) Most stated the correct order.

(e) The most common observations were, bubbling, colour fading, brown or black solid produced and a rise in temperature. All such answers were treated as correct. The explanations were less well described. Some recognised displacement and some realised that copper was being formed. Very few mentioned the transfer of electrons that was required for the second mark. Many thought the gas oxygen was evolved!

(f) Candidates struggled here, very few managing to score three marks. A popular choice was to use the displacement experiment rather than the measurement of potential difference. Using the former was really out of order as no solutions of the cations were mentioned. The expected method was to repeat the experiment of measurement of potential difference with each pair of metals, noting the voltage and particularly which metal was the negative. The value of the potential difference alone is insufficient to correctly answer this question.

Paper 0654/06

Alternative to Practical

General comments

The Examiners are pleased to report that there have been fewer very poor candidates than in previous years and that the overall quality of Papers has been improved. Centres are to be commended for their good preparation of candidates for the Alternative to Practical examination. This preparation must include certain minimum elements: the first, is sufficient laboratory experience and the second is adequate practice in problem solving using experimental results. The Paper seeks to test these two areas above all, and mere learning of scientific fact is rarely enough to gain a good mark. This is made clear in the following comments on individual questions.

Comments on specific questions

Question 1

This was mainly well answered.

(a) Most candidates constructed a neat and comprehensive table, with correct headings and units, though in recording the data some omitted the zero readings of the meniscus. A few tried to draw graphs instead of a table. Some omitted the units cm, s, in the headings, and this led to errors in **(b)**.

(b) Four marks were possible for finding the average "water loss" in cm/s. Study of the mark scheme will reveal how the Examiners awarded intermediate marks, for example, if correct total distances were divided by an incorrect time. Only a small minority of candidates achieved full marks, possibly because most had never seen a potometer experiment carried out. Many candidates added up all the distance readings and then divided the total by nine, the number of readings. Others simply gave an answer and showed no working.

(c) Many candidates incorrectly tried to relate speed of transpiration to shoot thickness and xylem vessel diameter rather than to the area of the leaves or to stomatal density. The explanation should also refer in some way to evaporation of water from the leaves. Some candidates also mentioned environmental factors here instead of in part **(d)**.

(d) A wide variety of environmental factors controlling evaporation from the leaf were suggested, including the ubiquitous global warming! The underlying fault lay in the failure to relate to the laboratory conditions of the potometer experiment, choosing to refer instead to the area where the plant might grow naturally.

Question 2

This question was based on a corresponding question in the Practical Examination. To prevent entirely mathematical answers, the potential differences shown for Mg - Zn and Zn - Cu did not add up to that for the Mg - Cu couple. Study of Fig. 2.2 will reveal how this anomaly is still entirely acceptable, since the voltmeter on the left is showing its maximum reading.

(a)(b)(c) Most candidates scored well in these parts of the question, though the logic of deriving **(c)** from the answers to **(a)** and **(b)** escaped those who did not know that magnesium is the most reactive of the three metals.

(d) Examiners hoped that magnesium, always "more negative" than the others, would lead candidates to the obvious (and simple) conclusion that the more reactive of two metals will be the one that must be connected to the negative terminal of the voltmeter to show a reading. Alas, this was rarely the conclusion drawn by the candidates. Otherwise, still using this experiment, they explained that the magnitude of the potential difference between metals showed how dissimilar they are in reactivity.

Many candidates preferred to rely on chemical reactions such as displacement of another or of hydrogen from an acid. The Examiners did not accept answers based on in reactivity with water unless heating was mentioned. It should be common knowledge and copper do not react at room temperature with water.

Question 3

Many candidates who did not study the description found this question too difficult.

(a) A few candidates recorded the heights $\mathbf{h_3}$, $\mathbf{h_4}$ and $\mathbf{h_5}$ in the wrong column, and others recorded the heights in centimetres. Others read the scales "inverted".

(b) Those who did not realise that extension = (270 - height) did not know how to complete the last column of the table. Some drew a straight line on the graph beginning with the data already given, rather inaccurately read off the values and then filled in the last column. Others did not read the scales and tried to calculate everything.

(c) The straight line had to pass through the origin to gain all three marks here.

(d) The word "proportional" or a related word had to be used to describe the relationship. "Linear" was not acceptable.

(e) Candidates who understood the experiment often gave elegant answers to this question and showed how to convert the extension in mm to mass in g or kg. Alas, the usual confusion between *mass* and *weight* showed itself in other candidates' answers.

Question 4

This and the preceding question were based on the corresponding practical questions in Paper 5.

(a)(i) Candidates were required to complete the table referring to the combustion of bread. The conclusion that the reaction is exothermic was not always drawn. Most candidates knew the limewater test for carbon dioxide.

(ii) This elicited many responses that were partly correct but not the scientific answers that are sought at this level, for instance "Our cells do not burn up" or "heat is not given out during respiration". Acceptable answers included some reference to respiration as a slow enzyme-controlled oxidation of glucose, either aerobic or anaerobic. Very few candidates gave a correct answer to this question.

(b)(i) This proved a problem for many candidates who had learned the food test by rote, as they did not know that biuret reagent is a blue solution, but they knew that the copper(II) complex formed is purple.

(ii) The test for starch, was well answered.

(c) Most candidates seem to have learned that a positive response to Benedict's test is an orange colour. When "reducing sugars" react with alkaline copper(II) solution, the sequence of colours observed is usually green - yellow - orange - red and the product is the red copper(I) oxide. This reaction provides a nice link between biology and chemistry within the syllabus, and such connections should be emphasised. Many candidates wrote that the red colour observed showed that the mixture was acid. Others did not seem to know that enzymes are proteins.

Question 5

Some candidates found an unintentional source of confusion between parts **(a)** and **(c)** of this question, where two very different solutions are both described as *purple*. A few candidates inferred that in **(c)**, potassium manganate(VII) must be present in the tube with calcium hydroxide! The connection between the parts of the question lies in the diffusion of the solid into the water, which takes place in both **(a)** and **(c)**. **(b)** and **(c)** are based on a beautifully simple experiment that demonstrates all the colours of Universal Indicator in one test-tube.

(a)(i) The crystals *dissolved* and the particles *diffused*. These two processes could be described in other words for the two marks awarded here.

(ii) Stirring, heating and crushing the crystals are the ways of speeding up the processes. Some candidates incorrectly suggested that a catalyst could be added.

(b) Some candidates wrote that the colour of the indicator shows that calcium hydroxide is basic. The only answer accepted was "alkaline", since there are many bases that are insoluble in water and would give a neutral reaction.

(c)(i) The Examiners looked for the idea that a solvent, in this case water, was added or that only a small amount of the solute was present in a large volume of solution. "Not concentrated" was rejected.

(ii) "The ethanoic acid had been neutralised by the calcium hydroxide" was the accepted answer, though "neutral" gained one mark.

(iii) This was harder, since not only had neutralisation occurred but also more calcium hydroxide had dissolved so that it was now in excess. Answers such as "The solution was still alkaline" or "The acid had not reached the calcium hydroxide" were rejected.

(iv) The Examiners did not expect the correct name for the salt of ethanoic acid, but some candidates provided it. The general equation "acid + alkali → salt + water" was an acceptable answer, as was an equation providing any recognisable name for a salt formed at the same time as water.

Question 6

This was a straightforward question in which candidates had to read balance windows and the scale of a measuring cylinder and manipulate the resulting figures. The Examiners realise that two different answers for **(b)(ii)** are possible, depending on which way the subtraction is done. Both answers, 15.0 g and 15.2 g, were accepted.

(a) Most candidates scored the three marks available here.

(b) A minority of candidates, but still a surprisingly large number, failed to correctly calculate the masses.

(c) Only the answer 55 cm^3 was allowed.

(d) The answer looked for was "**(b)(i)** and **(c)**" but a description of the necessary results, mass of the solution and its volume was given the mark. "**(b)** and **(c)**" was rejected as not specific enough.

(e) This was often well answered, but far too many candidates began their answer with an instruction to "Fill the measuring cylinder with hexane", or to "Place 50 cm^3 of hexane in the cylinder." In this case, the addition of the sodium chloride would take the total volume into the ungraduated section of the cylinder or cause the hexane to spill. Answers involving the use of a displacement can were also accepted.