CO-ORDINATED SCIENCES

Paper 0654/11
Multiple Choice

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

General Comments: Biology Section

The biology questions were competently handled with the majority being correctly answered by at least half the candidates.

Comments on Specific Questions

Question 1

A significant minority of candidates chose option **A** incorrectly believing that chloroplasts and the nucleus are to be found in the vacuole of a plant cell.

Question 3

This was a demanding question as it required knowledge of where the enzyme lipase is produced and then being able to identify this organ on a diagram. It was evident that a significant number of candidates thought that the enzyme lipase is produced in the liver.

Question 6

Candidates need to understand both the terminology and function of the pulmonary circulation system.

Question 8

This was one of the most difficult of the biology questions. Candidates were required to apply some logical thought and their biological knowledge to a practical situation. A significant proportion of candidates appeared to believe that the question must be on phototropism, incorrectly choosing option **B** or **D**. The statement concerning darkness was necessary to eliminate light from the procedure.

Question 9

A significant number of candidates incorrectly chose option **C** which showed the urethra (near the connection between the urethra and the bladder). This exposed a curious misunderstanding as the key **B**, the testicle, is the structure that is found **only** in the male.

Question 10

Some of the more able candidates did not appreciate that the moment of fertilisation is when the male and female nuclei fuse, and not when the sperm releases its nucleus into the ovum.

General Comments: Chemistry Section

Questions 16 and **17** were the easiest for the candidates, with the vast majority answering these correctly. No item showed evidence of large scale guessing.

Comments on Specific Questions

Question 14

Most candidates interpreted the chromatogram correctly.

Question 16

Most candidates knew the name of the process shown.

Question 17

Most candidates know and understand the motion of particles in a gas.

Question 23

A significant number of candidates incorrectly chose option **B**, which strongly suggests that some more able candidates may have made their choice based upon knowledge of (aliphatic) alkane and alkene general formulae, rather than deducing these from the (alicyclic) structures that were drawn.

Question 24

A significant member of candidates incorrectly chose option **A**, rather than the key, **D**. Some candidates may have chosen option **A** as they may have known that metals are often alloyed to increase their strength. However, this is not always the case, as typified in the drawing of solder that was presented to the candidates.

General Comments: Physics Section

In this section candidates performed extremely well on **Question 28**, but found **Questions 30**, **33** and **39** difficult.

Comments on Specific Questions

Question 28

A very large majority of responses to this straightforward question on speed / time graphs were correct.

Question 30

A small number of candidates gave the correct response in this question concerning which energy resources did not provide energy originally derived from the Sun. Many opted for coal, apparently unaware of the origins of fossil fuels. Although renewable sources of energy are currently much discussed, fossil fuels still play a very important role.

Question 33

Many candidates incorrectly chose option **B**, not realising that as the angle of incidence was larger than the critical angle, total internal reflection would occur.

Question 39

Here candidates were asked the effect on the direction of the force on a current-carrying wire in a magnetic field if both the direction of the current and the positions of the magnetic poles were reversed. Most candidates did not appreciate that the force would remain in the original direction.

CO-ORDINATED SCIENCES

Paper 0654/12
Multiple Choice

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

General Comments: Biology

The biology questions were competently handled with the majority being correctly answered by at least half the candidates.

Comments on Specific Questions

Question 2

A significant minority of candidates chose option **A** incorrectly believing that chloroplasts and the nucleus are to be found in the vacuole of a plant cell.

Question 4

This was a demanding question as it required knowledge of where the enzyme lipase is produced and then being able to identify this organ on a diagram. It was evident that a significant number of candidates thought that the enzyme lipase is produced in the liver.

Question 5

Candidates need to understand both the terminology and function of the pulmonary circulation system.

Question 8

This was one of the most difficult of the biology questions. Candidates were required to apply some logical thought and their biological knowledge to a practical situation. A significant proportion of candidates appeared to believe that the question must be on phototropism, incorrectly choosing option **B** or **D**. The statement concerning darkness was necessary to eliminate light from the procedure.

Question 9

Some of the more able candidates did not appreciate that the moment of fertilisation is when the male and female nuclei fuse, and not when the sperm releases its nucleus into the ovum.

Question 11

A significant number of candidates incorrectly chose option **C** which showed the urethra (near the connection between the urethra and the bladder). This exposed a curious misunderstanding as the key **B**, the testicle, is the structure that is found **only** in the male.

General Comments: Chemistry

Questions 14, **16**, **18** and **22** were the easiest for the candidates, the vast majority answering these correctly. No item showed any evidence of large scale guessing.

Comments on Specific Questions

Question 14

Most candidates knew the name of the process shown.

Question 16

Most candidates interpreted the chromatogram correctly.

Question 18

Most candidates know and understand the motion of particles in a gas.

Question 22

A significant number of candidates incorrectly chose option **B**, which strongly suggests that some of candidates may have made their choice based upon knowledge of (aliphatic) alkane and alkene general formulae, rather than deducing these from the (alicyclic) structures that were drawn.

Question 25

A significant member of candidates incorrectly chose option **A**, rather than the key, **D**. Some candidates may have chosen option **A** as they may have known that metals are often alloyed to increase their strength. However, this is not always the case, as typified in the drawing of solder that was presented to the candidates.

General Comments: Physics Section

In this section candidates performed extremely well on **Question 28**, but found **Questions 29**, **32** and **38** difficult.

Comments on Specific Questions

Question 28

A very large majority of responses to this straightforward question on speed / time graphs were correct.

Question 29

A small number of candidates gave the correct response in this question concerning which energy resources did not provide energy originally derived from the Sun. Many opted for coal, apparently unaware of the origins of fossil fuels. Although renewable sources of energy are currently much discussed, fossil fuels still play a very important role.

Question 32

Many candidates incorrectly chose option **B**, not realising that as the angle of incidence was larger than the critical angle, total internal reflection would occur.

Question 38

Here candidates were asked the effect on the direction of the force on a current-carrying wire in a magnetic field if both the direction of the current and the positions of the magnetic poles were reversed. Most candidates did not appreciate that the force would remain in the original direction.

CO-ORDINATED SCIENCES

Paper 0654/13
Multiple Choice

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

General Comments: Biology Section

The biology questions were competently handled with the majority being within the range of ability of the candidates.

However, it appeared that a number of questions exposed those candidates who had not carefully leant some fundamental and straight-forward biology.

Comments on Specific Questions

Question 1

A significant minority of candidates chose option **A** incorrectly believing that chloroplasts and the nucleus are to be found in the vacuole of a plant cell.

Question 4

A significant number of candidates appeared to confuse veins and arteries. It is unclear whether candidates simply could not remember which has thin walls and valves, or if they had difficulty recognising the blood vessels in the diagrams.

Question 6

This question tested knowledge of the structure of the respiratory system, however it is clear that many candidates do not know the mechanism of expiration as all three incorrect options where chosen equally often and thus indicate guessing.

Question 7

A significant number of candidates appear to believe that the spinal cord carries impulses away from the central nervous system. Candidates should be aware of the position as well as the functions of the relay and motor neurones.

Question 8

This proved the most difficult of the biology questions. Candidates were required to apply some logical thought and biological knowledge to a practical situation. A significant number incorrectly chose option **B**.

Question 11

It was clear that the theory behind the inheritance of sex was not well understood. Almost half of the candidates did not appear to know that 50% of sperms carry the Y chromosome.

Question 13

This question on food chains was the easiest question with the vast majority choosing the key **A**.

General Comments: Chemistry Section

Questions 14, **16**, **17**, **21**, **23** and **24** were the easiest for the candidates, with the vast majority answering these correctly. **Question 22** showed evidence of large scale guessing.

Comments on Specific Questions

Question 14

Most candidates interpreted the chromatogram correctly.

Question 16

Most candidates knew the method of separation shown.

Question 17

Most candidates interpreted the representations of different structures of atoms and molecules correctly.

Question 22

The more able candidates deduced that palladium can be used as a catalyst because it is a transition element, there was evidence of guessing as all three incorrect options where chosen equally often by those not choosing the key.

Question 23

The vast majority of candidates knew the property of aluminium that makes it suitable for food containers.

Question 24

Most candidates knew that as argon is noble gas it is unreactive.

General comments (Physics)

No questions in this paper appeared to be found particularly easy by candidates. **Question 31** proved to be the most challenging.

Comments on specific questions (Physics)

Question 31

This question asked 'Which statement is **not** correct?'. The key **A** was the **only incorrect** statement. Options **B**, **C**, and **D** were all correct statements. A significant number of candidates incorrectly chose option **C**, possibly by not reading the question carefully enough.

Question 32

This question on convection currents was well answered, although a significant number of candidates incorrectly chose option **B**. The water was heated in the centre of a wide, open container meaning water could rise freely directly above the place where heat was applied.

Question 33

A significant number of candidates incorrectly chose option **A**, indicating a misunderstanding of ray diagrams.

Question 38

This question showed two resistors in parallel. A significant number of candidates appeared to just add the two resistance values together and incorrectly chose option **D** (that is the resistance for resisters in series).

Question 39

Here candidates were asked the effect on the direction of the force on a current-carrying wire in a magnetic field if both the direction of the current and the positions of the magnetic poles were reversed. Half failed to appreciate that the force would remain in the original direction.

CO-ORDINATED SCIENCES

Paper 0654/21

Core Theory

Key Message

Candidates are reminded to look carefully at the mark allocation and write their responses accordingly, for example if three marks are available, a good response would make at least three valid points.

General comments

Most candidates attempted all the questions. Candidates generally were awarded credit or partial credit on all questions. Although it appeared that candidates often knew the answers to the questions, their answers were sometimes vague. Performance depends not only on scientific knowledge but on the ability of the candidates to understand the question and express themselves clearly.

Any formula quoted should be in a standard form and use recognisable symbols. Formulae consisting of units should be avoided. Similarly formulae consisting of a mixture of words, symbols and units should also be avoided.

There was evidence of some candidates running short of time to complete the examination.

Comments on specific questions

Question 1

This question was quite well answered.

(a) (i) Most candidates correctly identified potassium chloride. Common incorrect answers were potassium or chlorine.

(ii) Many candidates were able to explain that potassium atoms lose one electron and chlorine atoms gain one electron, gaining some credit, but only the most able were able to be awarded any further credit.

(b) (i) Electrolysis was well known as the process.

(ii) The terms cathode and electrolyte were not well known. Many candidates confused the anode and cathode. A number of candidates labelled the anode as the electrolyte. When labelling the cathode candidates should make sure that it the actual electrode that they are labelling and not the connecting wires. In general there were many labels which were carelessly drawn.

(iii) Many candidates gave the correct test and the correct result. The question asked for a safe test so smelling the chlorine gas was not accepted.

(c) (i) Good data handling skills were shown by many candidates who correctly stated that the anode did not change in mass but that the cathode gained mass.

(ii) A number of candidates correctly stated that the cathode gained in mass due to copper being deposited.

Question 2

This question was quite well answered.

(a) (i) The most common incorrect response was 23 chromosomes. 23 pairs would have been an acceptable response.

(ii) The **Y** chromosome was not usually identified. Most candidates identified either every pair of chromosomes or the first pair or the last pair.

(b) Many candidates knew that genes were passed on to the next generation. The connection with DNA was not well known.

(c) Most candidates gained at least two marks here. Candidates were very successful at completing the punnet square despite what gametes they had suggested earlier. Candidates need to take care when stating ratios - for example 2/4 is not the same as 2:4.

(d) (i) Almost all candidates were able to correctly use the data on the graph.

(ii) The correct response of 29 °C was the most common response. The only other commonly seen responses were the two extremes of the temperature scale shown on the graph.

(iii) The idea that there would be more females than males was quite well known. However few candidates were able to make the connection with a decreased fertility.

Question 3

(a) (i) This was well worked out by almost all candidates.

(ii) Many candidates correctly explained that the motorcycle did not stop because the speed never reached zero. A number of candidates incorrectly suggested that the motorcycled stopped after six or ten seconds.

(b) A significant number of candidates incorrectly tried to describe changes in both frequency and amplitude for both situations.

(c) The calculation was well done by many candidates. A number of candidates incorrectly quoted the formula as R = V/A rather than R = V/I. The unit for resistance was well known.

(d) Candidates found this part challenging. A number were able to explain that the molecules would move faster but then could not explain what effect this would have. Many candidates tried to explain how the tyres would have become hot.

(e) (i) and **(ii)** These parts were well answered. However candidates needed to refer to charges in their answers, for example in **(i)** stating that opposites attract was insufficient to be awarded credit.

Question 4

Many candidates found this question challenging.

(a) The definition of transpiration was not well known. Many candidates described perspiration.

(b) (i) This was usually correct. A few candidates drew multiple arrows which sometimes went in both the correct direction and a wrong direction.

(ii) This was not well known. Few candidates were able to name a suitable mineral ion.

(c) (i) Almost all of the candidates who completed the diagram suggested a position of the xylem tissue although only a few candidates drew a correct transverse section of the root.

(ii) Only a few candidates knew the function of the phloem.

(d) Root hair cell was quite well known.

Question 5

(a) (i) Hydrogen was not well known as the gas given off in test-tubes **A** and **B**. Oxygen and carbon dioxide were frequent incorrect answers.

(ii) A significant number of candidates who had identified hydrogen in **(i)**, frequently quoted the test for oxygen or carbon dioxide.

(iii) Many candidates correctly predicted the pH, however gave vague or inaccurate explanations. All that was required was a reference to some of the acid having reacted or been used up.

(b) (i) and **(ii)** Most candidates correctly determined that temperature would be 18 °C, and went onto explain that this was because there was no reaction.

(iii) Few candidates correctly identified test-tube **E** as the endothermic reaction. Those who did usually gave a suitable explanation.

(c) Many candidates were awarded credit by suggesting either that there was a greater surface area or that the metal in test-tube **A** was more reactive.

Question 6

(a) A significant number of candidates attempted to draw one straight line which passed through the fibre, however some drew a suitable set of straight lines at the correct angles going through the fibre.

(b) (i) Energy was not well known. Many candidates suggested radiation.

(ii) Few candidates were able to suggest a suitable difference between γ-radiation and infra-red radiation.

(c) (i) Almost all candidates were able to deduce the correct starting temperature.

(ii) The idea that cork was a thermal insulator was not well known.

(iii) and **(iv)** Many candidates correctly suggested that the temperature in can **B** rose higher than can **A**. Correct reasons to explain why this happened were less common. Some candidates attempted to explain that the temperature rise was greater by calculating the temperature rise for both cans.

Question 7

(a) (i) Respiration was well known.

(ii) The correct equation was quite well known. Some candidates incorrectly gave oxygen the other product.

(b) Most candidates correctly identified the time at which the carbon dioxide concentration was the lowest.

(c) Few candidates were able to explain why increased blood flow was important during exercise. A number of candidates knew that it was to provide more oxygen, but very few referred to more glucose or respiration.

(d) Most candidates described why the body needed more lactic acid to be produced, rather than answering the question.

Question 8

(a) (i) Few candidates were able to correctly describe background radiation.

(ii) Most candidates gave the correct answer of 800 counts per minute.

(iii) Some candidates found it difficult to express their answer clearly.

(b) There were many vague responses referring to damage to the environment or radiation or explosions both as an advantage or disadvantage of an oil-fired power station. A number of candidates gained credit for a reference to oil being non-renewable.

(c) (i) This was fairly well known. Some candidates did not include a power source. Other candidates added unnecessary ammeters or voltmeters. Some of the candidates who did draw suitable circuit diagrams did not identify which diagram was which.

(ii) This was not well answered. The most popular correct answer was that if one lamp failed the others would still work.

Question 9

Many candidates found this question challenging.

(a) (i) and **(ii)** Few candidates gave correct responses to either of these parts. A hydrocarbon containing only carbon and hydrogen was not well known.

(b) (i) Many candidates knew that ethanol was used in alcoholic drinks, but gave the response alcohol. This was deemed to be too vague.

(ii) Few candidates knew that ethene reacted with steam or water to produce ethanol.

(iii) The definition of a catalyst was quite well known. Many candidates suggested that catalysts were enzymes. Candidates need to emphasise that a catalyst is *not used up* in a reaction; it is inaccurate to state that it does not take part in the reaction.

(d) (i) and **(ii)** Neither of these parts were well answered. A good diagram could be awarded full credit in **(i).**

Question 10

(a) (i) Some candidates understood the significance of being asked to use a double headed arrow to indicate one wavelength and produced a clear answer.

(ii) Very few candidates were able to give a correct response. A few candidates gained credit for giving a general definition of frequency.

(iii) Few candidates were able to describe the difference between a longitudinal wave and a transverse wave, either by words or by drawing a diagram. Credit was generally awarded where there was a diagram.

(b) (i) This was well answered by most candidates showing good data handling skills.

(ii) A few candidates were able to draw sufficient molecules randomly arranged but touching.

(iii) This was well answered by most candidates showing good data handling skills.

Question 11

(a) Nucleus was well known. Some candidates named the cell membrane as the cell wall.

(b) Producing bile was the commonest correct response.

(c) This was quite well answered.

(d) Most candidates knew what to do here. However most were unable to correctly convert from centimetres to millimetres.

(e) Very few candidates were able to answer this part. A few candidates gave general explanations of arteries or veins, but could not relate this to the specific blood vessels associated with the liver.

Question 12

(a) (i) Many candidates attempted to give answers related to the position of the numbers with the elements in the Periodic Table.

(ii) A few candidates suggested that element **N** had a higher melting point than element **P**, with only the most able going on to explain why.

(iii) Many candidates correctly identified element **L**. In the explanations, there was sometimes confusion between a group and a period.

(b) Covalent bonding was not well known. There were no common incorrect responses.

(c) (i) This was well answered.

(ii) Most candidates found this very difficult. Very few candidates were able to convert from dm^3 to cm^3.

CO-ORDINATED SCIENCES

Paper 0654/22

Core Theory

Key Message

Candidates are reminded to look carefully at the mark allocation and write their responses accordingly, for example if three marks are available, a good response would make at least three valid points.

General comments

Most candidates attempted all the questions. Candidates generally were awarded credit or partial credit on all questions. Although it appeared that candidates often knew the answers to the questions, their answers were sometimes vague. Performance depends not only on scientific knowledge but on the ability of the candidates to understand the question and express themselves clearly.

Any formula quoted should be in a standard form and use recognisable symbols. Formulae consisting of units should be avoided. Similarly formulae consisting of a mixture of words, symbols and units should also be avoided.

There was evidence of some candidates running short of time to complete the examination.

Comments on specific questions

Question 1

This question was quite well answered, although some candidates found parts of the question challenging.

(a) (i) Candidates needed to suggest values for both the mass and the weight. Many candidates incorrectly suggested that both the mass and the weight would be less.

(b) Few candidates suggested that there needed to be a resultant upwards force to accelerate the rocket.

(c) All four forms of energy were well known.

(d) Many candidates correctly stated that sound cannot travel thorugh space, or that sound requires a medium to travel through.

(e) (i) Very few candidates attempted to describe ionising radiation.

(ii) Some candidates were able to describe some of the effects of ionising radiation on the body.

(f) Most candidates placed the waves in their correct place. However a number of candidates placed them at the wrong ends of the electromagnetic spectrum or filled in all the boxes.

Question 2

This question was quite well answered.

(a) Ovary and vagina were well known.

(b) The functions of parts **Y** and **Z** in the uterus were not well known.

(c) Most candidates gained partial credit, usually for describing the joining together of the egg and sperm cell.

(d) Methods to reduce being infected with HIV were well known.

(e) (i) Few candidates were able to explain how an HIV infected mother could pass the virus on to her baby at birth.

(ii) Many candidates used the data in the table to determine that there would be a reduced probability of the baby becoming infected.

(iii) The idea that babies could be infected with HIV through breastfeeding was not well known.

Question 3

Candidates found parts of this question difficult.

(a) (i) Hydrogen and helium were fairly well known although many candidates suggested the elements from lithium to neon.

(ii) Few candidates suggested neon as the least reactive element in the second period. Beryllium was a common incorrect answer.

(iii) Period four was a common correct answer here.

(b) (i) This was not well answered. Many candidates included electrons in their answer.

(ii) Very few candidates managed to explain that the reason why the atoms increase in size from lithium to potassium was due to an increased number of electron shells.

Question 4

Some parts of this question were answered well.

(a) Many candidates gained partial credit for suggesting that food molecules were broken down during digestion.

(b) Amylase was not well known.

(c) (i) Many candidates worked out that the rate of digestion was fastest at the start of the experiment.

(ii) Very few candidates knew that maltose was the product of digestion in the test-tube.

(iii) Most candidates gained partial credit by sketching a suitable graph.

(d) Very few candidates knew that starch molecules needed to be digested so that smaller soluble molecules could pass into the bloodstream.

Question 5

(a) This was very well answered by most candidates, showing good knowledge of elements and their symbols.

(b) (i) Many candidates wrote down a correct word equation.

(ii) Only the most able candidates realised that they need to describe a general physical property of a metal. A significant number gave answers involving reactivity.

(iii) Only a few candidates were able to name the substance that had been reduced. Those that did were usually unable to explain why the substance had been reduced.

(c) (i) Very few candidates knew that the cathode was the negative electrode.

(ii) Many candidates incorrectly suggested that the bromide ions gained electrons during electrolysis, revealing a misunderstanding of the chemistry involved.

Question 6

This question was poorly answered.

(a) (i) A few candidates were able to work out that the frequency was 0.3 Hz. The most common incorrect answer given was 3.33 Hz.

(ii) Very few candidates were able to describe the difference between a longitudinal wave and a transverse wave, either by words or by drawing a diagram. Credit was generally awarded where there was a diagram.

(iii) The most common correct response was sound waves.

(b) (i) Most candidates were able to calculate the volume of the block.

(ii) Many candidates were able to calculate the density of the block. Very few candidates gave the correct unit for density.

(c) (i) Very few candidates suggested infra-red radiation. There were many incorrect responses of ultraviolet.

(ii) The process of evaporation was not well known. Candidates gained credit for the idea that some of the molecules had more energy or moved faster than other molecules.

Question 7

(a) Only a few candidates were gained full credit. Candidates were least able to match the description of a compound.

(b) (i) Few candidates were able to compare the two fractions and give reasons why fraction **P** could be used as a fuel. Many candidates incorrectly suggested that **R** was a waste product and therefore could not be used as a fuel.

(ii) Few candidates were able to determine that the two compounds that had a higher concentration in the vapour were carbon dioxide and water vapour.

(iii) Many candidates worked out that the low temperature meant that something had frozen. The most popular incorrect answers were heptane and kerosene.

(c) (i) Most candidates used the data from the table to describe a trend shown by the graph.

(ii) Many candidates identified the boiling point of heptane as 100 °C. A common incorrect answer was 0 °C.

(iii) A number of candidates identified one of the alkanes that was a gas at 20 °C, however only the most able wrote down both **A** and **B**.

Question 8

(a) A significant number of candidates gained full credit for this part.

(b) (i) This was well answered.

(ii) This was not well answered. Many candidates simply rewrote the question rather than describe how the oxygen concentration changed.

(iii) Very few candidates were able to give a cause for the oxygen concentration changes.

(iv) Preventing respiration was not well known.

Question 9

(a) The calculation was well done by many candidates. A number of candidates incorrectly quoted the formula as R = V / A rather than R = V / I.

(b) (i) Various correct methods for making the electromagnet stronger were described.

(ii) Few candidates were able describe a use for an electromagnet that showed the difference between a permanent magnet and an electromagnet.

(iii) Many candidates knew the correct circuit symbol for a voltmeter. Only the most able connected the voltmeter in parallel with the coil. The most common position was somewhere within the original series circuit.

Question 10

(a) Geotropism was not well known. However a number of candidates used the concept of geotropism to explain later parts of this question.

(b) (i) and **(ii)** A few candidates were able to explain either the growth of the shoot upwards or the growth of the root downwards. Very few candidates were able to describe both.

(c) This was better answered. Many candidates were able to describe how the roots and shoots responded to light coming from one side.

(d) Most candidates were able to state two characteristics of living organisms. A few candidates confused their answer by referring to the senses.

Question 11

(a) Many candidates gained partial credit for completing one equation correctly. The most popular correct equation was the first one where hydrogen was required as the additional product.

(b) (i) The limewater test for carbon dioxide was rarely stated. Consequently few candidates were able to describe the result of this test.

(ii) Many candidates assumed that a decrease in the reaction time meant a decrease in the reaction. Therefore many answers given were the wrong way round – for example a decrease in acid temperature rather than an increase.

(c) (i) This was not well answered. There were few references to the acidity of the soil and neutralisation. Many candidates suggested that it was a fertiliser.

(ii) Strong heating was not well known as the method for producing calcium oxide from calcium carbonate.

Question 12

All parts of this question were very well answered by most candidates.

(a) (i) and **(ii)** There were very few incorrect answers to these parts. Candidates showed good data handling skills.

(iii) Many candidates were able to make the connection between increased speed and increased kinetic energy.

(b) Most candidates calculated the distance as 784 m correctly.

(c) (i) and **(ii)** Most candidates correctly identified the two lamps in each part.

CO-ORDINATED SCIENCES

Paper 0654/23

Core Theory

Key Message

Candidates are reminded to look carefully at the mark allocation and write their responses accordingly, for example if three marks are available, a good response would make at least three valid points.

General comments

Most candidates attempted all the questions. Candidates generally were awarded credit or partial credit on all questions. Although it appeared that candidates often knew the answers to the questions, their answers were sometimes vague. Performance depends not only on scientific knowledge but on the ability of the candidates to understand the question and express themselves clearly.

Any formula quoted should be in a standard form and use recognisable symbols. Formulae consisting of units should be avoided. Similarly formulae consisting of a mixture of words, symbols and units should also be avoided.

There was evidence of some candidates running short of time to complete the examination.

Comments on specific questions

Question 1

This question was quite well answered.

(a) (i) Most candidates correctly identified potassium chloride. Common incorrect answers were potassium or chlorine.

(ii) Many candidates were able to explain that potassium atoms lose one electron and chlorine atoms gain one electron, gaining some credit, but only the most able were able to be awarded any further credit.

(b) (i) Electrolysis was well known as the process.

(ii) The terms cathode and electrolyte were not well known. Many candidates confused the anode and cathode. A number of candidates labelled the anode as the electrolyte. When labelling the cathode candidates should make sure that it the actual electrode that they are labelling and not the connecting wires. In general there were many labels which were carelessly drawn.

(iii) Many candidates gave the correct test and the correct result. The question asked for a safe test so smelling the chlorine gas was not accepted.

(c) (i) Good data handling skills were shown by many candidates who correctly stated that the anode did not change in mass but that the cathode gained mass.

(ii) A number of candidates correctly stated that the cathode gained in mass due to copper being deposited.

Question 2

This question was quite well answered.

(a) (i) The most common incorrect response was 23 chromosomes. 23 pairs would have been an acceptable response.

(ii) The **Y** chromosome was not usually identified. Most candidates identified either every pair of chromosomes or the first pair or the last pair.

(b) Many candidates knew that genes were passed on to the next generation. The connection with DNA was not well known.

(c) Most candidates gained at least two marks here. Candidates were very successful at completing the punnet square despite what gametes they had suggested earlier. Candidates need to take care when stating ratios - for example 2/4 is not the same as 2:4.

(d) (i) Almost all candidates were able to correctly use the data on the graph.

(ii) The correct response of 29 °C was the most common response. The only other commonly seen responses were the two extremes of the temperature scale shown on the graph.

(iii) The idea that there would be more females than males was quite well known. However few candidates were able to make the connection with a decreased fertility.

Question 3

(a) (i) This was well worked out by almost all candidates.

(ii) Many candidates correctly explained that the motorcycle did not stop because the speed never reached zero. A number of candidates incorrectly suggested that the motorcycled stopped after six or ten seconds.

(b) A significant number of candidates incorrectly tried to describe changes in both frequency and amplitude for both situations.

(c) The calculation was well done by many candidates. A number of candidates incorrectly quoted the formula as R = V/A rather than R = V/I. The unit for resistance was well known.

(d) Candidates found this part challenging. A number were able to explain that the molecules would move faster but then could not explain what effect this would have. Many candidates tried to explain how the tyres would have become hot.

(e) (i) and **(ii)** These parts were well answered. However candidates needed to refer to charges in their answers, for example in **(i)** stating that opposites attract was insufficient to be awarded credit.

Question 4

Many candidates found this question challenging.

(a) The definition of transpiration was not well known. Many candidates described perspiration.

(b) (i) This was usually correct. A few candidates drew multiple arrows which sometimes went in both the correct direction and a wrong direction.

(ii) This was not well known. Few candidates were able to name a suitable mineral ion.

(c) (i) Almost all of the candidates who completed the diagram suggested a position of the xylem tissue although only a few candidates drew a correct transverse section of the root.

(ii) Only a few candidates knew the function of the phloem.

(d) Root hair cell was quite well known.

Question 5

(a) (i) Hydrogen was not well known as the gas given off in test-tubes **A** and **B**. Oxygen and carbon dioxide were frequent incorrect answers.

(ii) A significant number of candidates who had identified hydrogen in **(i)**, frequently quoted the test for oxygen or carbon dioxide.

(iii) Many candidates correctly predicted the pH, however gave vague or inaccurate explanations. All that was required was a reference to some of the acid having reacted or been used up.

(b) (i) and **(ii)** Most candidates correctly determined that temperature would be 18 °C, and went onto explain that this was because there was no reaction.

(iii) Few candidates correctly identified test-tube **E** as the endothermic reaction. Those who did usually gave a suitable explanation.

(c) Many candidates were awarded credit by suggesting either that there was a greater surface area or that the metal in test-tube **A** was more reactive.

Question 6

(a) A significant number of candidates attempted to draw one straight line which passed through the fibre, however some drew a suitable set of straight lines at the correct angles going through the fibre.

(b) (i) Energy was not well known. Many candidates suggested radiation.

(ii) Few candidates were able to suggest a suitable difference between γ-radiation and infra-red radiation.

(c) (i) Almost all candidates were able to deduce the correct starting temperature.

(ii) The idea that cork was a thermal insulator was not well known.

(iii) and **(iv)** Many candidates correctly suggested that the temperature in can **B** rose higher than can **A**. Correct reasons to explain why this happened were less common. Some candidates attempted to explain that the temperature rise was greater by calculating the temperature rise for both cans.

Question 7

(a) (i) Respiration was well known.

(ii) The correct equation was quite well known. Some candidates incorrectly gave oxygen the other product.

(b) Most candidates correctly identified the time at which the carbon dioxide concentration was the lowest.

(c) Few candidates were able to explain why increased blood flow was important during exercise. A number of candidates knew that it was to provide more oxygen, but very few referred to more glucose or respiration.

(d) Most candidates described why the body needed more lactic acid to be produced, rather than answering the question.

Question 8

(a) (i) Few candidates were able to correctly describe background radiation.

(ii) Most candidates gave the correct answer of 800 counts per minute.

(iii) Some candidates found it difficult to express their answer clearly.

(b) There were many vague responses referring to damage to the environment or radiation or explosions both as an advantage or disadvantage of an oil-fired power station. A number of candidates gained credit for a reference to oil being non-renewable.

(c) (i) This was fairly well known. Some candidates did not include a power source. Other candidates added unnecessary ammeters or voltmeters. Some of the candidates who did draw suitable circuit diagrams did not identify which diagram was which.

(ii) This was not well answered. The most popular correct answer was that if one lamp failed the others would still work.

Question 9

Many candidates found this question challenging.

(a) (i) and **(ii)** Few candidates gave correct responses to either of these parts. A hydrocarbon containing only carbon and hydrogen was not well known.

(b) (i) Many candidates knew that ethanol was used in alcoholic drinks, but gave the response alcohol. This was deemed to be too vague.

(ii) Few candidates knew that ethene reacted with steam or water to produce ethanol.

(iii) The definition of a catalyst was quite well known. Many candidates suggested that catalysts were enzymes. Candidates need to emphasise that a catalyst is *not used up* in a reaction; it is inaccurate to state that it does not take part in the reaction.

(d) (i) and **(ii)** Neither of these parts were well answered. A good diagram could be awarded full credit in **(i).**

Question 10

(a) (i) Some candidates understood the significance of being asked to use a double headed arrow to indicate one wavelength and produced a clear answer.

(ii) Very few candidates were able to give a correct response. A few candidates gained credit for giving a general definition of frequency.

(iii) Few candidates were able to describe the difference between a longitudinal wave and a transverse wave, either by words or by drawing a diagram. Credit was generally awarded where there was a diagram.

(b) (i) This was well answered by most candidates showing good data handling skills.

(ii) A few candidates were able to draw sufficient molecules randomly arranged but touching.

(iii) This was well answered by most candidates showing good data handling skills.

Question 11

(a) Nucleus was well known. Some candidates named the cell membrane as the cell wall.

(b) Producing bile was the commonest correct response.

(c) This was quite well answered.

(d) Most candidates knew what to do here. However most were unable to correctly convert from centimetres to millimetres.

(e) Very few candidates were able to answer this part. A few candidates gave general explanations of arteries or veins, but could not relate this to the specific blood vessels associated with the liver.

Question 12

(a) (i) Many candidates attempted to give answers related to the position of the numbers with the elements in the Periodic Table.

(ii) A few candidates suggested that element **N** had a higher melting point than element **P**, with only the most able going on to explain why.

(iii) Many candidates correctly identified element **L**. In the explanations, there was sometimes confusion between a group and a period.

(b) Covalent bonding was not well known. There were no common incorrect responses.

(c) (i) This was well answered.

(ii) Most candidates found this very difficult. Very few candidates were able to convert from dm^3 to cm^3.

CO-ORDINATED SCIENCES

Paper 0654/31
Extended Theory

Key message

Candidates should be reminded to take care to show working clearly, and to give formulae using the correct abbreviations as listed in the syllabus. They are expected to give correct units with their answers and give an appropriate number of significant figures.

When answering extended questions, candidates should be reminded to use the correct scientific terminology when describing or explaining phenomena. There were some instances where candidates were unable to gain credit, due to using incorrect terminology.

Candidates should be reminded to take care of spelling when naming scientific equipment and apparatus.

General comments

The majority of candidates showed a wide range of knowledge and understanding across the syllabus. Most candidates attempted to answer all the questions, and the majority communicated their responses clearly. Extended answers were well structured and ideas generally expressed well.

There were a few instances where candidates did not do as asked, appearing to write answers to an alternative question, rather than the one being asked. For example, some candidates gave a formula of a compound when asked for a name or wrote a word equation when asked for a symbol equation, or where candidates gave a description instead of an explanation as required by the question.

Comments on specific questions

Question 1

(a) Many candidates correctly stated the blast furnace. Responses just referring to a 'furnace' unqualified rather than a blast furnace were not awarded credit. Others incorrectly gave electrolysis.

(b) Some candidates correctly identified iron oxide or Fe_2O_3 as the main compound from which iron is extracted. Many candidates incorrectly stated haematite or iron ore. The question asked for the compound rather than the raw material used.

(c) Most candidates correctly described in detail the transferring of two electrons from magnesium to sulfur, when magnesium sulfide is formed and were awarded full credit. A minority of candidates incorrectly described covalent bonding of magnesium and sulfur.

(d) Some candidates were able to give a correct equation for the formation of magnesium sulfide. Many candidates tried to complicate the formula by including the charges. This was unnecessary, however these were given credit if correct. A minority of candidates used incorrect symbols to identify the formation of products. Candidates should be reminded to use an arrow to indicate the formation of products.

(e) Many candidates were able to identify that the reason for magnesium sulfide having a very high melting point was that it was an ionic compound or that it had strong ionic bonds. Fewer candidates referred to the strong attraction between opposite charges or ions. Some candidates incorrectly stated that magnesium sulfide was an alloy, thus resulting in a very high melting point.

Question 2

(a) Many candidates correctly described the cell as diploid. A variety of incorrect genetic terminology was seen. This included the terms haploid, allele, gamete, homozygous and heterozygous. Candidates should be reminded to apply the correct biological terminology, when answering questions on genetics.

(b) (i) A significant number of candidates were awarded full credit for this part. Candidates correctly identified the male and female gametes and used these to complete the genetic diagram, giving the correct ratio of 1 : 1. A common error was to state the female gametes as 'XX' 'XX' rather than 'X' and 'X' and the male gametes as 'XY' and 'XY' rather than 'X' and 'Y'. Candidates should be reminded that gametes are haploid.

(ii) The most able candidates gave responses identifying that although the probability results in a 1 : 1 ratio, this is only a probability, and that as fertilisation is random results can differ from this ratio.

(c) (i) This was well answered with most candidates gaining credit. Those who did not gain the credit were not clear when describing the effect of increasing temperature. Candidates should be encouraged to identify and describe trends in data.

(ii) This was well answered with most candidates gaining credit. A small minority gave the incorrect answer of 25 °C. Candidates should be encouraged to use a ruler and draw lines on stimulus graphs in order to help them to accurately read data points.

(iii) Only a few candidates were able to suggest suitable explanations for the effect of temperature on percentage of eggs that hatch into females. The best responses linked increased temperature with activation of genes or enzymes.

(iv) This question was generally well answered with most candidates gaining some credit. Most candidates were able to state that an increase in global warming would increase the number of females hatching. Fewer candidates were able to explain the effect of this uneven ratio on fertility and population size.

Question 3

(a) (i) Most candidates were able to give the correct answer of 8.8, the most common incorrect answer was 4.4 A.

(ii) This calculation question was completed well, with candidates laying out formulae and working clearly and precisely, gaining full credit. Those that did not generally transferred the incorrect figures or used the incorrect formula. A small minority of candidates stated amps in the equation rather than current. Candidates should be reminded to use the correct terms; either words or symbols would have been acceptable.

(b) Most candidates clearly expressed correct formulae and working to calculate the correct answer of 48 W. Some candidates incorrectly expressed current as amps.

(c) Most candidates gained partial credit for this question. The majority of candidates recognised that increased temperature would result in the particles moving faster or having increased kinetic energy. Fewer were able to link this to increased force or frequency of collisions. Many candidates could also explain that the collisions of the air particles were with the walls of the tyre.

Question 4

(a) Only a few candidates correctly defined translocation. Many were able to express the idea that a substance was moving from one part of the plant to another but fewer were able to describe it in more detail. Some candidates confused the movement of sucrose with the movement of water. Some candidates incorrectly gave the movement of both water and sucrose in the phloem and xylem.

(b) (i) This question was answered particularly well with nearly all candidates having drawn an arrow pointed upwards in the xylem.

(ii) Fewer candidates were able to correctly place an '**X**' at the point of lowest water potential. Those candidates that did not place the '**X**' correctly, commonly placed the '**X**' at the bottom of the xylem vessel or within the cell wall.

(c) Few candidates gained full credit for this question. Almost all of the incorrect responses gave a description of osmosis between cells rather than the mechanism of transpiration pull within the xylem vessel.

(d) Some candidates gave a correctly named mineral ion, with nitrate being the most common correct answer. Many candidates did not provide a substance and gave an unqualified answer of 'minerals' which was not creditworthy.

Question 5

(a) (i) The majority of candidates named the correct gas. The most common incorrect answers given were oxygen and carbon dioxide.

(ii) Many candidates predicted a pH within the accepted range. Most of these candidates were generally also able to provide a correct explanation of the acid concentration being lowered, raising the pH. Some candidates confused decreased acidity with lowering the pH rather than raising the pH.

(b) (i) Many candidates gave the correct answer of 18 °C. Some candidates did not follow the instructions and did not write a temperature value in the space provided in the table.

(ii) Candidates that gave the correct temperature were generally able to provide a correct explanation. Some candidates who simply repeated the observation 'that no gas was produced' rather than writing an explanation (that there was no reaction) were unable to be awarded credit.

(iii) Only some candidates gave the correct test-tube **E**. Many gave the incorrect answer of **A**, which was the test-tube with the greatest increase of temperature. Very few candidates were able to provide a detailed explanation. The best responses recognised that the temperature had decreased or that it was an endothermic reaction.

(c) This question was answered well with many candidates giving at least one reason for the difference in the production of gas in test-tube **A** and test-tube **B**. Common correct answers included differences in reactivity and surface area. Some candidates incorrectly referred to errors in methodology or differences in sizes or mass of metals.

Question 6

(a) Most candidates gave at least one correct property of electromagnetic waves. Some candidates gave the generalised properties of waves, which were not creditworthy.

(b) (i) Most candidates were able to draw the pathway of an infra-red ray. Candidates should be reminded, when drawing ray diagrams to use a ruler, continue the ray along its original pathway and then reflect the ray at the correct angle inside the fibre. A minority of candidates continued the ray straight through the optical fibre rather than reflecting within it.

(ii) Many candidates gave a correct medical use for optical fibres. The most common misconception seen was relating optical fibres to ophthalmology.

(c) (i) Many candidates identified that the lid and cork mat were used to prevent heat loss, but only the most able gave correct mechanisms for the heat loss.

(ii) This question was well answered with many candidates stating that dull black surfaces are better absorbers of heat. Some candidates referred to the surfaces attracting more heat, which was not credited. A significant minority described the cans as having different surfaces without linking this to an explanation of the difference in temperature.

(d) (i) Few candidates were able to describe the difference between evaporation and boiling. Credit was awared to those few who stated that evaporation could occur at any temperature.

(ii) Most candidates gained some credit by using the correct formulae to complete the calculation. Candidates should be reminded to take care when writing formulae and ensure that formulae are written in symbols or words, not a mixture of both. A significant number of candidates did not convert their answer from J into kJ and were unable to be awared full credit.

Question 7

(a) (i) Many candidates gave the correct process as anaerobic respiration. A few incorrectly gave *aerobic* respiration.

(ii) Some candidates wrote the correct word equation for anaerobic respiration, however many incorrectly included carbon dioxide and oxygen in their responses. A minority gave the equation for fermentation, which was not credited.

(b) Nearly all candidates gave the correct time of 32 seconds. Candidates should be reminded that it is acceptable to use a ruler to draw on the stimulus graphs provided, in order to obtain accurate data readings.

(c) (i) Some candidates correctly stated that lactic acid production would decrease due to increased blood supply providing more oxygen. Candidates that were able to explain the effect of increased blood flow on the rate of lactic acid production generally gained full credit. A significant number of candidates incorrectly linked increased blood supply with increased lactic acid production due the provision of more glucose.

(ii) Again some candidates incorrectly linked the increased blood supply with decreased lactic acid removal, however these were fewer than in **(c) (i)**. Candidates gained partial credit for stating that lactic acid would be removed faster.

(d) Many candidates gained partial credit for explaining that the athlete breathed rapidly and deeply to obtain more oxygen. Most of these candidates were able to go on to explain that the oxygen was used to repay the oxygen debt or breakdown lactic acid. A minority of candidates referred to the need to exhale the carbon dioxide or the need for extra energy which were not creditworthy.

(e) This question was generally well answered with many candidates correctly explaining that less lactic acid would be produced due to increased oxygen supply.

Question 8

(a) (i) Some candidates correctly stated the meaning of the term *background radiation*. A minority of candidates simply reworded the question providing various permutations of radiation that is in the background.

(ii) The vast majority of candidates gave the correct number as 800 counts per minute.

(iii) A significant number of candidates forgot to take the background radiation into account during their calculations, however they were still able to gain partial credit if they carried out the calculations correctly.

(iv) Many candidates were able to correctly state the number of protons and electrons as 98. There was a number of different neutron number written; the most common incorrect number was 153.

(v) Most candidates found this question challenging.

(b) (i) Many candidates gained partial credit for completing the sentences. Some candidates used the incorrect transmission voltage and / or the voltage supplied to consumers' homes.

(ii) Most candidates gained at least partial credit. Some candidates gave the incorrect formula and the correct percentage. Fewer candidates used the incorrect and calculated 110%.

Question 9

(a) (i) Most candidates were able to correctly identify which compounds were hydrocarbons, gaining full credit. Candidates should be reminded that hydrocarbons consist of only carbon and hydrogen atoms.

(ii) Most candidates correctly stated that ethene was unsaturated explaining that it was due to the presence of a double bond.

(iii) Some candidates did not give a complete answer, stating only that the solution would be colourless, rather than stating the orange / brown solution was decolourised or turned colourless and were unable to be awarded credit.

(b) (i) Many candidates gave at least one correct use of ethanol.

(ii) Many candidates gave the correct response. A few candidates gave incorrect substances including oxygen.

(iii) Many candidates gave the correct conditions for the reaction used to produce ethanol. Candidates should be reminded to be precise in their answers. Some candidates only stated pressure and temperature rather than high temperature and high pressure.

(iv) Only the most able candidates correctly named the reaction as an addition reaction. A variety of incorrect answers were seen including cracking, polymerisation and redox. Hydration was an acceptable alternative to addition.

(c) Many candidates were able to explain why compound **X** was reduced stating that **X** had lost oxygen. Only a few candidates were able to link reduction with the gain of hydrogen, but most of these candidates went on to provide a correct explanation of the oxidation of ethanol.

Question 10

(a) (i) Some candidates gained full credit by calculating the distance as 35 m. The most common incorrect answer given was 25 m, due to calculating the area incorrectly (usually for not including the area of the rectangle beneath the triangle). Candidates who used the incorrect area but had set their working out clearly were awarded partial credit.

(ii) The majority of candidates gained full credit. Candidates should be reminded to set out formulae and working clearly.

(b) Some candidates correctly linked increased loudness with increased amplitude and lower pitch with decreased frequency. Some candidates muddled their responses, linking volume with frequency and pitch with amplitude. Some candidates incorrectly linked increasing loudness with increased amplitude and frequency, and lower pitch with decreased frequency and amplitude, and were not awarded any credit.

Question 11

(a) (i) Only a few candidates were able to describe the role of bile using the correct terminology. Common misconceptions included that bile was an enzyme responsible for the digestion of fats into fatty acids and glycerol. A significant minority incorrectly suggested that bile broke down fats into amino acids. Some candidates also described bile as neutralising stomach acid, although this is true, stomach acid is not involved in the digestion of fats and so was not creditworthy.

(ii) This question was generally answered well. Most candidates gained partial credit for a correct function of liver cells.

(b) Some candidates correctly suggested that increased folding would increase the surface area of the cells, although only a few went onto link the increased surface area with increased area for absorption or diffusion of substances. Some candidates incorrectly thought that the folding on the cell membrane would make the membrane thicker or more permeable.

(c) (i) Candidates should be reminded to refer to mineral ions or mineral salts rather than *minerals* unqualified. Some candidates gave the functions of plant roots rather than root hair cells and some incorrectly referred to body hair.

(ii) This question was very well answered. Nearly all candidates could describe the function of red blood cells and most were able to give at least one correct structure and related function of red blood cells. Some candidates gave structures without describing the associated function.

Question 12

(a) (i) Many candidates correctly gave the proton number as the number of protons in the atom or nucleus. Candidates who referred to the number of protons in the *element*, were not awarded credit.

(ii) This question was answered well with many candidates stating that **L** and **O** were in the same group and being able to state the number of electrons in their outer shells. A small minority of candidates misread the question and described the differences between elements **L** and **O**.

(b) Most of the diagrams were carefully drawn with electrons of different atoms and the shared electrons clearly shown, although few candidates gained full credit. Common responses that did not gain credit included using the incorrect symbols of one central oxygen bonded to two carbons and bonding the carbon and oxygen atoms with a single rather than the correct double bond.

(c) (i) The required answer was the numerical value of 2.2 with the unit g. Almost all candidates were able to correctly calculate the correct mass.

(ii) Many candidates correctly calculated the correct number of moles.

(iii) A significant number of candidates who correctly carried out the calculation, were unable to be awarded full credit, as they had not converted the volume of drink from cm^3 to dm^3 as required by the question.

CO-ORDINATED SCIENCES

Paper 0654/32
Extended Theory

Key message

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Candidates should be reminded to take care of spelling when naming scientific equipment and apparatus.

General comments

The majority of candidates showed a wide range of knowledge and understanding across the syllabus. Most candidates attempted to answer all the questions, and the majority communicated their responses clearly. Extended answers were well structured and ideas generally expressed well.

There were a few instances where candidates did not do as asked, appearing to write answers to an alternative question, rather than the one being asked. For example, some candidates gave a formula of a compound when asked for a name or wrote a word equation when asked for a symbol equation, or where candidates gave a description instead of an explanation as required by the question.

Comments on specific questions

Question 1

(a) (i) Most candidates knew that the mass remained the same and that the weight was lower. A few thought both would be reduced and that the weight was always 10 times the mass.

(ii) Most candidates knew that mass was unaffected by gravitational field and many explained that it was the amount of matter an object contained. Many candidates explained weight as the force or pull of gravity or used the formula W = mg. Candidates who just repeated their answer from part **(i)** were not awarded credit.

(b) Only the more able candidates gave the expected answer in terms of unbalanced forces or a resultant upward force being needed to accelerate the rocket. Most simply stated the rocket would not move which was insufficient to gain credit.

(c) Most candidates quoted the correct formula, however a significant number were unable to substitute correctly. A significant number did not square the velocity or used velocity in km / hr. Many did not convert their answer to kJ as required and were unable to be awarded full credit.

(d) The majority of candidates knew that sound required a medium and would not travel through a vacuum.

(e) Few candidates could explain ionising radiation. Many thought it was a radiation which consisted of an ion. Some tried to explain its effects such as damage to cells but few referred to atoms losing electrons.

Question 2

(a) Most candidates correctly labelled the umbilical cord and many the amniotic sac (amnion). Some confused the latter with the lining of the womb.

(b) Most candidates had the idea of protection of the fetus but many thought it played a major role in nutrition.

(c) Only the more able candidates gave changes to the composition of the blood. Some credit was given when this was implied but many described the functions of the placenta or umbilical cord.

(d) Most candidates were familiar with the contents of tobacco smoke but few identified carbon monoxide. Those who gave this as the answer generally knew that it combined with haemoglobin but did not refer to reduction of oxygen levels in the mother's blood.

Question 3

(a) Most candidates answered this question well; however some ignored hydrogen and helium and took period 2 to be the first period. Some gave a symbol when a name was required for **(ii)** and some gave the least reactive element in Group II.

(b) (i) The majority of candidates were able to draw and label a lithium atom correctly. A few put all the electrons on one shell and some put 7 electrons or 7 neutrons.

(ii) Most candidates correctly linked the increased size of atoms to the number of electron shells but quite a number just said more electrons, protons and neutrons. Some answered part **(iii)** here and gave the same answer twice.

(iii) Most candidates knew that the outer shell was lost when the ion was formed but some had the idea that an ion was part of an atom and must therefore fit inside the atom.

(iv) Many candidates knew that the outer electrons had a weaker attraction for the nucleus because of their greater distance from it and less energy being required for ionisation. Some thought it was due to increased surface area.

Question 4

(a) (i) Most candidates correctly stated that the reaction rate was fastest at the start.

(ii) The majority of candidates realised this was because the starch was at its highest concentration. A few referred to temperature.

(iii) Most candidates drew a correct graph with only a small number drawing it below the original.

(iv) Only the more able candidates explained decreased rate of reaction at 25 °C in terms of particle energy and collision rate. Many simply stated that the reaction was higher at a higher temperature or that 35 °C was nearer the optimum temperature.

(b) (i) Most candidates identified the capillary but not the lacteal.

(ii) Almost all candidates realised that the shape of villi increased the surface area.

(iii) Only the most able candidates explained that chemical digestion breaks large molecules into smaller molecules.

Question 5

(a) Almost all candidates were awarded full credit.

(b) (i) The majority of the candidates who knew correct formulae were able to balance the equation. Although most candidates knew that graphite was carbon, many used an incorrect formula, putting C_2, C_3 etc. Most candidates identified the gaseous product as carbon dioxide but some thought it was carbon monoxide. Despite being given PbO in the question, quite a few used other oxides of lead.

(ii) Quite a high proportion of candidates incorrectly thought that reduction was loss of electrons. Others referred to oxygen and did not mention electrons.

(c) Most candidates stated that the current would decrease. Only the more able candidates related the lead bromide solidifying to the ions being unable to move. A significant number explained lack of conduction being due to no free electrons which was not creditworthy.

Question 6

(a) Those who correctly used the formula: wave speed = wavelength × frequency, often found it difficult to calculate the frequency. Some used the formula: speed = distance / time, but only a few of these related distance to wavelength and the time for each wave front to travel that distance.

(b) (i) The most able candidates explained this with reference to the wave machine passing vibration to water molecules and the water molecules passing the vibration from one to another. There were some who referred to sound particles moving through the water.

(ii) Many candidates thought that the speed of sound in water would be lower than that in air, rather than higher.

(c) (i) Most candidates knew that the energy of the Sun could increase the kinetic energy of the particles of the water in the pool. Few had the idea of the particles having a range of energies but realised that higher energy would enable them to break free from the liquid. Only the more able candidates referred to the intermolecular forces.

(ii) Many candidates used temperature rather than temperature change or t rather than Δt and thus credit could not be awarded as their formula was incorrect. Many were unable to convert the answer to MJ correctly.

Question 7

(a) Most candidates were able to assign at least three letters correctly.

(b) (i) Few candidates were able to compare the two fractions and give reasons why fraction **P** could be used as a fuel. Many candidates incorrectly suggested that **R** was a waste product or slag and therefore could not be used as a fuel. Very few referred to ease of ignition or made reference to **R** using too much energy to burn.

(ii) Although most knew the products of combustion of hydrocarbons were carbon dioxide and water, carbon, hydrogen and fuel were included as well as oxygen and nitrogen.

(iii) Most candidates who wrote water in **(ii)** knew that the crystals were ice as the water had frozen.

(c) (i) Although many candidates could name other homologous series, most were unable to say what the term meant. Many referred to elements rather than compounds and characteristics were confused.

(ii) Most candidates gave a boiling point within the required range.

(iii) Although almost all candidates could identify the trend, very few gave a creditworthy explanation. Many just referred to more bonds and those who referred to stronger bond / forces rarely identified these as being between molecules.

Question 8

(a) Many candidates gained full credit for completing the sentences. Some thought acid rain had a higher pH and some that carbon dioxide was the main cause of acid rain. A few thought acidic gases were emitted from nuclear or hydroelectric power stations. Almost all knew that the problem was reduced by burning less fossil fuels.

(b) (i) The majority were awarded full credit showing good data handling skills in this part.

(ii) Most candidates knew which information in the table was relevant to the question but many simply quoted it rather than using it to explain the effect.

(iii) Most candidates realised that trout would not survive at pH 3.5 and would no longer compete for food. Again some simply quoted relevant data about the trout.

(c) Very few candidates were able to make valid suggestions as to how acidity would harm the cells of the fish. Generic or vague responses such describing effects which would be seen on the body (of the fish) were not awarded credit.

Question 9

(a) (i) Many candidates appeared not to know the formula relating power to current and voltage. A significant number did not convert kilowatts to watts.

(ii) Most candidates knew the formula relating resistance to voltage and current. However, although resistance = voltage / current is acceptable, volts / amps is not.

(b) (i) Only the most able candidates correctly drew the voltmeter connected across the terminals. Some put the meter parallel to a wire which would have made a short circuit and some added cells.

(ii) Most candidates had the idea of a sine wave but a significant number did not draw a wave with a similar periodicity or have approximately the same amplitude above and below the time line.

(iii) Most candidates gave the idea of stronger magnets, faster rotation of the coil or more turns of wire round the coil, gaining credit.

Question 10

(a) Sensitivity is a characteristic of living organisms defined in the syllabus as the ability to detect or sense changes in the environment (stimuli) and to make responses. Many candidates tried to quantify it as a measure of how sensitive an organism was and often confused this with reaction time.

(b) (i) Most candidates recognised this as geotropism, some incorrectly gave phototropism despite being told that the container was lightproof.

(ii) Most candidates realised that the downward growth of the roots would benefit the plant by increasing the chances of absorbing water and (mineral) ions or salts. Some candidates also recognised that this would enable roots to stabilise the plant. The majority knew that upward growth of the stem would increase the chances of absorbing light to enable photosynthesis. Since the question concerned seedlings answers referring to increased chances of pollination and competition were not creditworthy.

(c) Although many candidates recognised auxin as a growth hormone, only the more able realised that it inhibited growth in the roots and thought it rose to the top of roots even under the influence of gravity.

Question 11

(a) Most candidates were able to identify the products of the reactions correctly. Common errors were to write water as a product of the first reaction and hydrogen for the third reaction.

(b) (i) The vast majority of candidates were able to read the correct volume from the graph.

(ii) Most candidates could explain the shape of the graph in terms of decreased reaction rate due to a reactant being used up. Candidates should be reminded to be unambiguous, when describing shape, as in this instance the line becoming horizontal (and not just 'straight) was the key observation required.

(iii) Most candidates correctly read the final volume of carbon dioxide although some used the volume from **(i)**. Most also knew that the number of moles was obtained by dividing the volume by the volume of one mole; however many did not convert both volumes to the same units.

Question 12

(a) The vast majority of candidates identified the correct part of the graph.

(b) The vast majority of candidates correctly stated a point on the graph where the car was moving.

(c) Almost all of the candidates correctly calculated the acceleration and most gave a correct equation although this was not specifically required.

(d) Most candidates knew that the distance could be calculated as the area under the graph and gained credit , however a significant number misread the graph for either the speed of **QR** or the time for point **R** being incorrect.

CO-ORDINATED SCIENCES

Paper 0654/33
Extended Theory

Key message

Candidates should be reminded to take care to show working clearly, and to give formulae using the correct abbreviations as listed in the syllabus. They are expected to give correct units with their answers and give an appropriate number of significant figures.

When answering extended questions, candidates should be reminded to use the correct scientific terminology when describing or explaining phenomena. There were some instances where candidates were unable to gain credit, due to using incorrect terminology.

Candidates should be reminded to take care of spelling when naming scientific equipment and apparatus.

General comments

The majority of candidates showed a wide range of knowledge and understanding across the syllabus. Most candidates attempted to answer all the questions, and the majority communicated their responses clearly. Extended answers were well structured and ideas generally expressed well.

There were a few instances where candidates did not do as asked, appearing to write answers to an alternative question, rather than the one being asked. For example, some candidates gave a formula of a compound when asked for a name or wrote a word equation when asked for a symbol equation, or where candidates gave a description instead of an explanation as required by the question.

Comments on specific questions

Question 1

(a) Most candidates completed the sentences about evolution gaining credit.

(b) (i) Correct analysis of the data for antibiotic resistant bacteria recognised that the difference between countries **A** and **B** in 1980 was not significant, whereas incidence in country **A** was significantly more than **B** in 2010. Candidates should be reminded that just restating data and / or information given in the question is not creditworthy.

(ii) The most able candidates used the ideas that mutation produces resistance in some bacteria to the antibiotics in use, that they were more likely to survive and reproduce and thus pass on that resistance. It was not always clear that only some bacteria would be resistant or that the probability of survival would increase.

(iii) Many knew that resistance was caused by overuse of antibiotics.

Question 2

(a) (i) Most candidates correctly converted of the unit of power to watts, and showed their working.

(ii) The majority of calculations of resistance showed the correct formula and units.

(b) Most candidates were able to describe that an increased current would cause an increased force on the wire in a magnetic field, and that the force was reversed when the current was reversed.

Question 3

(a) (i) The majority knew that 1% of air consisted of gases other than nitrogen and oxygen.

(ii) Argon was most often correctly given as another gaseous element in air; other responses were sometimes neither elements nor present in significant amounts.

(b) (i) and **(ii)** It was recognised by most that the volumes of the gases were the same. The explanation needed to recognise that this was because each contained 1 mole at the same temperature and pressure.

(iii) The question asked for a difference between **1 mole** of each of the gases, so the answer had to refer to a bulk property such as mass, rather than a general property of the elements, such as reactivity.

(c) (i) Only a few candidates knew that nitrogen was separated from liquid air by fractional distillation.

(ii) The use of methane or natural gas as a raw material in the production of hydrogen was not well known.

(iii) Most candidates worked through this part of the question competently. A number of candidates did not recognise that the number of moles of nitrogen was half the number of moles of ammonia formed. A significant number were unable to calculate the mass of 1 mole of nitrogen.

Question 4

(a) (i) Most candidates knew that, for the car to accelerate, the driving force was greater than air resistance. A few candidates gave a correct explanation using the concept of resultant force, and were awarded credit.

(ii) The use of the formula $F = ma$ to calculate the accelerating force was well understood. Finding the acceleration caused difficulty, with the increase in speed sometimes being substituted for ‘a’ in the formula.

(iii) The formula for kinetic energy was well known. The most able candidates realised that they had to apply it twice to calculate the difference between the initial and final energies.

(b) The best ray diagrams were drawn carefully with a ruler. The rays should have been drawn first, with arrows, and the mirror added to ensure that the angles of incidence and reflection were equal.

(c) An understanding of the particulate model of propagation of sound through air was required to answer this question. Able candidates wrote that the engine vibrations were passed on to air particles around it, the vibrations then being passed on from particle to particle to the driver. However, a significant number of candidates muddled these ideas with a description of sound waves and could not be awarded credit.

Question 5

(a) Answers restating the fact that light was necessary for photosynthesis were common. To be awarded credit, candidates had to state that light was the energy source.

(b) Most candidates knew that oxygen was collected in the test-tube, with a minority incorrectly giving carbon dioxide.

(c) Those who knew the reactants and products of photosynthesis usually wrote the balanced equation gaining credit.

(d) (i) Nearly all candidates drew a graph showing the increase in the rate of photosynthesis with light intensity. The best responses showed an approximately linear relationship at first, with the graph levelling off at high intensity.

(ii) The explanation for the shape of the graph at low intensities needed to involve the effect of increasing the light **energy** on rate, rather than simply describing the relationship between the quantities on the graph. There were a few good suggestions for limiting factors which prevented further increase in the rate of photosynthesis.

(e) Temperature, carbon dioxide concentration and water availability were the most common correct suggestions.

(f) Most candidates knew that the green substance present in plants was chlorophyll, and that it was responsible for the absorption of light energy.

Question 6

(a) The formulae of the halogens were usually written correctly. The physical properties were not well known.

(b) The word equation was done well by a majority of candidates.

(c) Most candidates knew that chlorine killed bacteria in drinking water, preventing illness.

(d) Candidates who accurately transferred the information from the question correctly were usually able to write the balanced equation gaining credit.

Question 7

Many candidates gained full credit in all parts of this question on human reproduction. Credit was only awarded in part **(c)** when candidates used the correct spelling for the types of nuclear division.

Question 8

(a) (i) Almost all candidates used the graph correctly to find the difference in power consumption of the lamp.

(ii) Several correctly wrote the formula for efficiency in terms of power output and input. Many showed the working leading to correct answers. A sizeable minority of candidates considered the data from lamp type **B** first, causing them to write each answer in the wrong place.

(iii) The majority gave greater efficiency or lower power consumption of lamp type **A** as a reason for the environmental advantage of its adoption. The most able candidates linked this to the reduced use of fossil fuels in power stations.

(b) Although the question specified a nuclear reactor, the input to the energy flow chart was not always written as nuclear energy. Kinetic energy in the turbine was recalled more often.

(c) (i) Only the most able candidates correctly wrote the definition of half-life.

(ii) Those candidates who knew any of the properties of nuclear radiation usually wrote two valid differences between α- and β-radiation gaining full credit.

Question 9

(a) (i) Some candidates knew that ethene decolourised orange bromine solution, and that ethane had no effect. Candidates who did not state the colour change were unable to be awarded credit.

(ii) The formula of butene was often stated correctly with it being recognised as a member of the alkenes.

(b) (i) While most candidates knew that ethene was polymerised, few recalled the full name of the reaction as **addition** polymerisation.

(ii) Many correctly stated the name of the polymer as a form of poly(ethene), however a few wrote the name of a compound derived from another monomer.

(iii) The products of complete combustion of the hydrocarbon were well known.

Question 10

(a) (i) The majority of candidates correctly named the blood vessel and the chamber of the heart.

(ii) Most drew the correct direction of blood flow.

(iii) Many candidates showed some understanding of blood circulation. Candidates needed to make it clear that blood was passed through the heart twice and that oxygenated and deoxygenated blood was kept separate.

(iv) Most candidates explained the lower pressure of blood flowing to the lungs as being due to the shorter distance from the heart. Some attempted to make a connection between pressure and oxygen content.

(b) (i) Most gave the blood vessel in the wrist as an artery, a few incorrectly suggested it was a vein.

(ii) Candidates found this question challenging. The most able candidate responses referred to a surge in blood or explained that blood was pumped at each heart beat rather than as a continuous flow.

(iii) Some candidates referred to increased pulse rate causing more blood to flow to the muscles and so delivering more oxygen, gaining credit. A few candidates referred to increased respiration causing increased energy release.

Question 11

(a) (i) and **(ii)** Most candidates explained that wood was used in the handle because it was a poor conductor. A few candidates who also stated that a shiny surface was a poor emitter of heat radiation, gained full credit. Statements such as 'heat being reflected back into the water' were not creditworthy.

(b) The description of conduction often included increased vibration of particles. Only the most able described the transfer of the energy of vibration from particle to particle. Good descriptions of convection stated how particles moved further apart, causing less dense water to rise, gained credit. Some candidates inaccurately referred to the density of particles increasing, and were not awarded credit.

(c) The majority correctly calculated the pressure exerted by the saucepan using $P = F / A$.

(d) Many candidates knew a form of the formula for specific heating capacity. A significant number of candidates mixed words and symbols or did not convert the units.

Question 12

(a) Most candidates knew at least one of the properties of transition metals, gaining credit.

(b) (i) and **(ii)** This question was answered well with candidates being able to use the Periodic Table to deduce the number of electrons in an atom of iron and in the outer shell of an atom of aluminium.

(c) (i) Many candidates knew that aluminium was oxidised, and that oxidation involved the loss of electrons. Only the most able candidates specified that the particle which was oxidised was an aluminium atom, or that it was converted to a positively charged ion.

(ii) Those that knew that there was less chemical energy in the products recognised that it was an exothermic reaction or explained in terms of heat energy being transferred to the surroundings. Some candidates inappropriately treated the reaction as a closed system and tried to apply the principle of conservation of energy.

CO-ORDINATED SCIENCES

Paper 0654/04

Coursework

(a) Nature of tasks set by Centres.

All the assessments set were appropriate to the requirements of the syllabus and the competence of the candidates. The standard of candidates work was comparable with previous years with candidates covering the whole mark range.

(b) Teacher's application of assessment criteria.

The assessment criteria were understood and applied well. Skills C1 and C4 were not assessed in the same investigation.

(c) Recording of marks and teacher's annotation.

Tick lists were used against centres' criteria, particularly for skill C1. Comments justifying how marks were awarded were seen.

(d) Good practice.

It was noted that annotations were written on the script at the point where the marks were awarded.

CO-ORDINATED SCIENCES

Paper 0654/51

Practical Test

Key message

The ability to recognise a graphical relationship as proportional or inversely proportional is essential in this paper and is part of the Mathematical Requirements in the syllabus.

General comments

The exercises worked well and all candidates were able to complete this paper in the time allowed. Although there were graphs in both **Question 1** and **Question 3**, different skills were being tested.

Comments on specific questions

Question 1

A significant number of candidates did not record temperatures within the limits set in the question or to the nearest degree in part **(a)**.

Many candidates were awarded full credit in part **(b)**. Common errors were recording the height in centimetres or in the wrong column.

For part **(c)** graphs were generally well plotted however, a small number of candidates chose awkward scales, often resulting in plotting errors. A significant number of candidates assumed that the line should be straight when a curve clearly fitted the points better. Straight lines or curves were accepted as appropriate but undulating curves that joined all of the points were not creditworthy. Labelling was usually included and correct.

For part **(d)** most identified the gas as carbon dioxide, although other gases were suggested.

For part **(e)**, candidates found suggesting an improvement challenging.

Statements in **(f)(i)** were generally creditworthy, with the most common error being to discuss the amount of gas or foam rather than yeast activity. For part **(ii)** many candidates proposed the use of one mixture which was gradually heated. More able candidates used water baths at different temperatures, but it was very rare to see the inclusion of the fine tuning of temperature.

Question 2

The accepted observations in part **(a)** were adjusted according to Supervisor's comments. However, common mistakes were the use of the word transparent instead of colourless and the confusion of the terms residue and filtrate, with the colours accurately recorded, but sometimes reversed.

In part **(b)** many candidates correctly recorded the final colourless solution and concluded the presence of the zinc ion. Only a few candidates noted the white precipitate in each case. Some incorrectly described the precipitate as 'cloudiness' and were not awarded credit.

For **(c)** **(i)** a colour of the solution was almost always recorded but very few candidates recorded the presence of bubbles or effervescence. Simply saying that a gas is evolved is not an acceptable observation. For part **(ii)** – as in part **(a)** – the colours for the filtrate and residue were accurately recorded, but sometimes reversed.

The copper ion was the usual conclusion in part **(d)** when a dark blue solution was observed but this was not always accompanied by the observation of a blue precipitate. Once again cloudiness was incorrectly used as a substitute for precipitate.

The required reagent for part **(e)** was well known but many omitted the observation or simply gave the colour without the word precipitate or its abbreviation, ppt.

Question 3

There were many excellent sets of readings seen for part **(a)**. A common error was the recording of current values in the voltage column and vice versa. Less common errors were recording values with no decimal places, not using the length values given in the question and recording resistance values with an inconsistent number of significant figures. Where candidates recorded exact values, e.g. 1.00 / 0.20 = 5, these were accepted.
A significant number of candidates either omitted the units in the table or did not know the unit of resistance.
For part **(a)(v)** correct answers were rarely seen; many candidates referred to the danger of electrical shocks which was not creditworthy.

For part **(b)**, most candidates chose a scale for the graph which allowed ease of plotting and made good use of the grid. Plotting was done well and many good straight lines were seen. A few candidates chose non-linear scales and were therefore unable to be awarded full credit.

In part **(c)** very few candidates described the relationship as proportional although this is a skill required in the Mathematical Requirements section of the syllabus. Those that recognised proportionality usually correctly related this to the straight line they had drawn.

CO-ORDINATED SCIENCES

Paper 0654/52

Practical Test

Key message

When asked to describe colours in a question it is important to do so and not to use responses such as 'no change'.

General comments

The exercises worked well and all candidates were able to complete this paper in the time allowed. Candidates found the Biology experiment challenging. The test for the ammonium ion which is described on the last page of the paper did not seem to be that well known.

Comments on specific questions

Question 1

This experiment required a considerable amount of care to be taken however it gave acceptable results for most candidates. Table 1.1 was sometimes filled in with comments that were not colours and this was not credited.

For part **(b)** only the most able candidates responded with the idea of allowing the equilibration of temperature to occur in the water-bath.

Few candidates were awarded full credit in **(c)**. Candidates should be encouraged to use their skills to develop an argument using both data and knowledge. It is perfectly acceptable to repeat observations providing they are linked to what is happening biologically or chemically.

For part **(d)** most candidates gave the correct conclusion and were able to explain why starch was still present in tube **B**.

Despite there being several sources of error in this experiment, only a few gained credit for part **(e)**.

For part **(f)** most understood what was required, but often did not understand what measurements should be taken.

Question 2

The temperature changes allowed depended on the Supervisor's results which were supplied efficiently from all Centres.

For part **(a)**, for all three salts, candidates were required to record the temperatures to the nearest 0.5 °C which required values to end in .0 or .5. However this was only applied rigorously to the first marking point, so candidates who had not done this were not penalised more than once.

For part **(b)**, the signs for temperature changes were done well, an improvement from past papers, and most candidates recognised the dissolving of **P** as an exothermic process.

In part **(c)(ii)** the identification of the copper ion did not cause many difficulties except using 'cloudy' as a description of a precipitate; Cu as an unacceptable answer was rarely seen. For part **(c)(ii)**, ammonia was often identified but very few candidates recognised this as the test for the ammonium ion. Candidates should be reminded to use the Notes for use in Qualitative Analysis on the final page of the paper. Constructing a

usable table in **(c)(iii)** proved to be quite a challenge for some candidates. Most were able to carry out the tests, make suitable observations and arrive at conclusions. Candidates should be reminded it important to make conclusions to *eliminate* possible ions, as well as conclusions which positively identify an ion.

Question 3

Measurements in this spring question were carried out well. Some candidates used different values of the masses added to the spring and these were only accepted if the Supervisor had explained why the values in the question paper were not suitable.

Part **(a)(ii)** was not done particularly well and candidates need to be much more precise in their drawing of arrows to represent a distance being measured. The concept of extension was well understood.

For part **(b)**, there were relatively few non-linear scales on the graph and the plotting was mostly accurate. Despite a best fit straight line being specified, a number of candidates drew curves and many did not realise that the origin was the most accurate point and that the line should have passed through the origin.

Parts **(c)** and **(d)** did not cause any real difficulties but in some cases the density was outside the accepted range, subject to Supervisor's results, suggesting that the experiment had not been carried out carefully enough.

Many candidates suggested a creditworthy improvement for part **(e)**.

CO-ORDINATED SCIENCES

Paper 0654/53

Practical Test

Key message

When making conclusions in the Chemistry exercise it is important to check the information given at the start of the question.

General comments

The three exercises were carried out well, particularly the Physics, and all candidates were able to complete this paper in the time allowed. In the Chemistry question, candidates should be reminded to not to refer to a precipitate as being 'cloudy'.

Comments on specific questions

Question 1

Generally this gave good results. Where the iodine solution supplied was very dilute, this often meant that the results were starch were inconclusive. The Supervisors Results were used to ensure than no candidate was disadvantaged.

For part **(b)**, the colour changes in these food tests were not as well-known as expected. Carbohydrate was a common answer given for starch (for liquid **B**), as was sugar for reducing sugar or glucose (for liquid **C**).

Candidates found part **(c)** quite challenging. Many candidates were able to produce a reasonable plan but a significant number were unable to state clearly how their observations would lead to the identification of the more concentrated solution.

The nutrients in **(d)** were often correctly stated. However only the most able gave good explanations as to why they were broken down. A few candidates discussed the passing through cell membranes of moleclues, although mention of solubility was rarely seen.

Question 2

The appearance of solid **P** in the test-tube, which was required as the first observation, in part **(a)**, was not often recorded, although credit could have been awarded in a number of ways. The success of finding the correct test may have depended on the order in which the gas tests were carried out, however many candidates were able to describe the correct test and identify the gas given off as carbon dioxide.

In part **(b)(i)** very few candidates recorded seeing bubbles although most described the resulting solution. Very few observed the increased temperature of the test-tube. Part **(b)(ii)** was usually recorded correctly but a significant number of candidates identified **P** as zinc carbonate or another metal carbonate, despite being told at the start of the question that **P** was a magnesium compound.

Cloudy was a common description of the mixture in part **(c)(i)** whereas faint ppt. would have been more appropriate together with its colour. Parts **(c)(ii)** to **(c)(iv)** caused no difficulty and were well understood so it was surprising that many answers to **(c)(v)** did not include hydroxide.

For part **(d)**, only a few candidates identified magnesium hydroxide and magnesium oxide correctly, despite the chemistry being similar to calcium's, and being told at the start of the question that the reactions of magnesium compounds were going to be investigated.

Question 3

Parts **(a)** to **(c)** were carried out competently by the majority of candidates. The most common error seen was not recording temperatures to the nearest 0.5 °C which requires values to end in .0 or .5. A number of transcription errors when calculating thermal energies were also seen.

There was an 'accuracy mark' awarded in part **(d)(ii)** which was gained by many candidates.

For part **(e)** very few candidates were awarded full credit for suggesting why their value (for the specific heat capacity of glass) could be inaccurate.

CO-ORDINATED SCIENCES

Paper 0654/61
Alternative to Practical

Key Messages

Although this is an Alternative to Practical paper, candidates are expected to be familiar with experimental techniques and to have carried out experiments similar to the ones shown in the paper. Candidates should have used standard laboratory apparatus and be able to read values from measuring cylinders, thermometers, stopwatches etc.

General Comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques. Candidates should be reminded to take care when rounding calculated values. The standard of graph drawing was high.

Comments on Specific Questions

Question 1

This experiment investigated the effect of temperature on yeast activity.

(a) Most candidates read the temperature correctly.

(b) Many candidates marked *h* correctly from the top of the foam to the bottom of the tube. Some candidates did not mark the bottom of the measurement.

(c) Most candidates plotted the points correctly and drew two lines of best fit. A small number of candidates had non-linear scales or joined each point to the next by a ruler. A significant number didn't draw any lines or drew two straight lines unconnected to the points.

(d) When planning an investigation, candidates need to consider the range of the independent variable, identification of the control variable(s) and how the dependent variable will be measured. A significant number of candidates rewrote the method given earlier in the question.

Question 2

This experiment details a series of tests used to identify a solid.

(a) While many candidates drew the filter paper carefully and clearly, some drew it as a plug at the neck of the funnel or had a gap in the filter paper at the neck of the funnel. Very few candidates did not draw the filter paper. Some candidates labelled the filtrate and the residue correctly, however some candidates reversed them. A significant number didn't label them at all.

(b) Many candidates identified the white precipitate but few stated the precipitate redissolved in excess ammonia.

(c) (i) More able candidates realised that the gas given off was carbon dioxide and so gave a correct limewater test. Many candidates incorrectly used lighted or glowing splints.

(ii) The most able candidates realised a blue precipitate was formed and that the precipitate redissolved into a blue solution. White precipitate was a common incorrect answer.

(d) Most able candidates appreciated that an insoluble brown precipitate was formed. Some candidates had a red brown colour produced with no mention of precipitate or solution and a significant number had a white precipitate forming.

Question 3

This was an investigation into the relationship between the length of a wire and its resistance.

(a) Most candidates read both dials correctly.

(b) Most candidates calculated both resistances correctly with only a few candidates entering the values to more than one decimal place.

(c) (i) Many candidates correctly chose suitable scales for both axes, correctly plotted the points and drew a line passing through the origin. Some candidates reversed the axes, a few had non-linear scales and some didn't extend the line through the origin.

(ii) Most able candidates described the relationship as proportional or directly proportional but most linked increasing length to increasing resistance.

(d) Very few candidates appreciated that the wire would heat up. A number of candidates believed that keeping the power on would make the current become larger or that the resistance would become charged.

(e) More able candidates appreciated that the current would be greater or the resistance lower but many candidates thought that the resistance would be higher.

Question 4

This experiment was measuring vital capacity.

(a) Many candidates realised that air should be blown into the rubber tubing with some appreciating that the air would go into the bell jar. Most did not appreciate that a large breath should have been taken in first and all the air in the lungs blown in to the jar or that the volume of the air should be measured.

(b) More able candidates realised that reliability is checked by repetition but only a few realised that the results would need to be compared for consistency.

(c) (i) Whilst many candidates specified that candidates of different heights should be used, only a few specified what should be measured. Only the most able gave a factor that should be controlled such as age or gender.

(ii) A graph of height vs vital capacity was seen from the more able candidates. However, most drew a table of results. In order to see a pattern if a table is used then the results needed to be in height order and not random.

(d) Many candidates appreciated that the candle would burn for longer in inhaled air as it contains more oxygen or that the candle would go out more quickly in exhaled air as it contains more carbon dioxide. A significant number of candidates appeared to believe that inhaled air is all oxygen and exhaled air is all carbon dioxide.

Question 5

This was an investigation into the boiling and freezing points of a liquid.

(a) (i) Most answered in terms of the liquid bubbling, with only the most able candidates stating that the temperature remains constant at the boiling point.

(ii) Many candidates thought that the thermal energy had reached its peak or that it was being lost. A few candidates knew that evaporation was occurring and that it is caused by thermal energy.

(iii) Most candidates read the temperature correctly.

(iv) Condensation was well known but the loss of energy less so.

(b) (i) Many candidates appreciated that a solid was formed. A significant number of candidates did not give an observation, referred to the process as freezing or stated that ice was formed, and were not awarded credit.

(ii) The question asked for the temperature to be read to the nearest 0.5 and gave answers to this precision. However there were many answers of 16 and 17 which were not creditworthy.

(iii) The most able candidates appreciated that the thermal energy given out is used to stop the temperature falling. Many candidates thought that the thermal energy stayed the same because the temperature stayed the same.

Question 6

This experiment was about measuring the height of a cliff.

(a) (i) Many candidates transferred the times correctly however some gave the full timer reading rather than using the example of the readings already in the table.

(ii) Many candidates appreciated the continuous nature of the experiment and so correctly entered the times into the table, the main error was entering the time for the rock to fall into this row.

(iii) Most candidates correctly subtracted the values in the table.

(b) (i) Most candidates substituted into the formula correctly although some used 3.2 instead of 3.3 and some didn't square 3.3. Overall the calculation was performed well, but many incorrect rounding were seen.

(ii) Few candidates discussed the decreasing effect of errors when using averages and most discussed reliability.

(c) Of the two parts to this question, the time taken for the sound to travel to either student **B** or to both students and the consequence of this to the recording of the times; many candidates addressed one part so were unable to gain full credit.

CO-ORDINATED SCIENCES

Paper 0654/62
Alternative to Practical

Key Messages

Although this is an Alternative to Practical paper, candidates are expected to be familiar with experimental techniques and to have carried out experiments similar to the ones shown in the paper. Candidates should have used standard laboratory apparatus and be able to read values from measuring cylinders, thermometers, stopwatches etc.

General Comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques. The reading of the instruments was of an excellent standard but candidates need to take care when rounding calculated values.

Comments on Specific Questions

Question 1

This was an investigation into enzyme activity.

(a) (i) Iodine as the reagent to test for starch was well known but Benedict's was a common incorrect answer.

(ii) The majority of candidates discussed colours but many gave just the starting or ending colour, however both were required for credit to be awarded. Some went on to explain that the starch was broken down, but very few stated that it was amylase.

(b) (i) and **(ii)**
Candidates needed to state that starch was still present for part **(i)** and then explain that this was because the amylase had been denatured (due to it being boiled). Many candidates answered in terms of the colour remaining blue-black and not changing.

(c) Most candidates identified a possible source of error in the experiment.

(d) Candidates found planning the investigation very challenging and many only rewrote part of the method already given. When planning an investigation, candidates need to consider the range of the independent variable, identification of the control variable(s) and how the dependent variable will be measured.

Question 2

This experiment involved the energy changes on dissolving.

(a) Candidates gained credit for realising that the salt was powdered to increase the rate of dissolving. Many candidates gave an explanation in terms of increased surface area increasing the rate of reaction.

(b) (i) The majority of candidates read both thermometers correctly.

(ii) The majority of candidates correctly calculated the temperature changes but some candidates either omitted or reversed the signs.

(c) More able candidates gained full credit. A few candidates reversed the terms. A significant number of candidates named an energy type usually heat, chemical or kinetic.

(d) This question required candidates to look at the diagram and suggest changes to improve the accuracy of the experiment. Improvements such as putting the thermometer into the body of the solution, use a thermometer or use a stirring rod were not creditworthy as they were already given in the diagram.

(e) The vast majority of candidates found this question challenging.

Question 3

This experiment involved Hooke's Law and an application of it.

(a) (i) The majority of candidates read both rulers correctly.

(ii) Many candidates appreciated the proportional relationship between the load and extension.

(b) The majority of candidates read both rulers correctly.

(c) (i) The majority of candidates correctly calculated the density, however a significant number of candidates made rounding errors.

(ii) The majority of candidates gave mass.

(iii) The majority of candidates gave volume, however a small number gave velocity.

(d) The possible causes of inaccuracy was not well answered with few candidates gaining full credit.

Question 4

This was an experiment looking at a product of respiration.

(a) (i) Many candidates appreciated that limewater in flask **2** was testing for carbon dioxide and to confirm that it had been removed.

(ii) The more able candidates realised that if there was no carbon dioxide the limewater would remain colourless. A significant number thought the limewater would go milky.

(b) (i) and **(ii)**
Many candidates repeated their answers for **(a) (i)** and **(a) (ii)** without considering that the limewater was now testing the air after it had been past the insects. More able candidates appreciated that the limewater would go milky or cloudy due to the carbon dioxide given off from the insects.

(c) Few candidates appreciated that a control for this experiment would be to have no insects in flask **3** as this would then confirm that the carbon dioxide had come from the insects. Many candidates thought the control meant a control variable and so discussed factors to keep the same.

(d) (i) Many colours were given by the candidates but the majority incorrectly gave either green or blue. The most able gave red / orange / yellow.

(ii) More able candidates appreciated that the change was due to carbon dioxide, few knew that the carbon dioxide was acidic and almost no candidates realised that the carbon dioxide was dissolving in the water.

(e) Respiration was known by many candidates.

Question 5

In this experiment metals were being identified by a series of reactions and tests.

(a) (i) Hydrogen was well known.

(ii) The test and result for hydrogen gas was well known. However a significant number suggested using a glowing splint and were unable to be awarded credit.

(b) (i) Many candidates realised that the white precipitate was calcium carbonate. Incorrect answers of calcium, calcium oxide or calcium hydroxide were frequently seen.

(ii) Calcium hydroxide known only by the most able candidates. Calcium, calcium oxide or carbon dioxide were common incorrect responses.

(c) The majority of candidates named metal **A** as magnesium.

(d) (i) The majority of candidates knew that a white precipitate was formed. Only the most able knew that the white precipitate redissolves in excess.

(ii) Very few candidates appreciated that the green precipitate was $Fe(OH)_2$.

(e) Very few candidates knew that a white (silver chloride) precipitate would be formed. A significant number just wrote ‘silver’ or ‘no reaction’, and were unable to be awarded credit.

Question 6

This was an investigation of the Law of Reflection.

(a) (i) More able candidates measured the two angles correctly. ‘30 and 30’ was a common incorrect response.

(ii) Many candidates stated that the normal needed to be perpendicular to the mirror. A significant number used imprecise terminology such as ‘the normal was not straight’ and were unable to be awarded credit.

(iii) Many candidates gave creditworthy responses by stating that the law was not obeyed and explaining why.

(b) (i) The rays were generally drawn well.

(ii) More able candidates measured the two angles correctly. ‘55 and 65’ was a common incorrect response.

(iii) Many candidates found this part on identifying the mistakes challenging.

(c) Only by the most able candidates knew that these particles were electrons.

CO-ORDINATED SCIENCES

Paper 0654/63
Alternative to Practical

Key Messages

Although this is an Alternative to Practical paper, candidates are expected to be familiar with experimental techniques and to have carried out experiments similar to the ones shown in the paper. Candidates should have used standard laboratory apparatus and be able to read values from measuring cylinders, thermometers, stopwatches etc.

General Comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques. The reading of the instruments was of an excellent standard but candidates need to take care when rounding calculated values. The standard of graph drawing was high.

Comments on Specific Questions

Question 1

This experiment involved a variety of food tests.

(a) Many candidates knew the colours of the positive tests for reducing sugars and protein but a significant number had the colours reversed or wrote blue for both.

(b) The majority of candidates gained credit for at least one correct test. Protein was the most well-known, and reducing sugar the least well known.

(c) Only the most able candidates gained full credit. Some candidates appreciated the need for the volumes of **D** and **E** to be the same; others stated the need to keep other factors constant or the conditions of the Benedict's test. Many thought that the speed of colour change or the darker shade of colour would indicate a more concentrated solution rather than red / orange being more concentrated and yellow / green being less concentrated.

(d) The majority of candidates incorrectly thought that the grease spot test was the test for liquid fats. Of those that correctly added ethanol many didn't then add water but still gave the result as cloudy.

Question 2

This experiment followed a series of reactions of a compound.

(a) (i) Some good diagrams were seen. However, many candidates drew a bung in both tubes or had the delivery tube not in the limewater in the second tube.

(ii) The majority of candidates knew that the limewater would go cloudy.

(iii) Carbon dioxide was known by the majority of candidates.

(iv) Many candidates correctly identified the compound as a carbonate, but oxide and chloride were common incorrect answers.

(b) (i) The majority of candidates identified the solution as alkaline.

(ii) More able candidates identified copper(II) hydroxide. Copper and copper oxide, were common incorrect answers.

(c) (i) Many candidates discussed the solid melting, oxidation or no change being seen without referring to the chemical reactions and were unable to be awarded credit.

(ii) Many candidates repeated the earlier part of the question, with the solid dissolving and forming an alkaline solution. Only the most able candidates identified the formation of magnesium hydroxide.

Question 3

This was an experiment about energy changes on mixing.

(a) A popular incorrect answer was a ruler; only the most able knew that a measuring cylinder would be required.

(b) The majority of candidates read both thermometers correctly.

(c) The changes in thermal energy were known by the majority of candidates.

(d) (i) Most candidates calculated 27 correctly, common incorrect responses were 32 or 59.

(ii) Most candidates calculated 32 correctly, common incorrect responses were 27 and 59.

(e) (i), **(ii)** and **(iii)**
The majority of candidates correctly calculated the energy changes.

(iv) The majority of candidates correctly calculated the specific heat capacity, however a significant number of candidates made rounding errors and were unable to be awarded credit.

Question 4

This was an experiment about photosynthesis of pond weed.

(a) Most candidates drew an arrow from the bulb to the centre of the beaker. A significant number of candidates drew the arrow to edge of the beaker.

(b) Completion of the chart was performed correctly by the majority of candidates. Occasionally the value for 20 cm was incorrectly given as 100.

(c) Most candidates correctly assigned suitable scales to both axes, correctly plotted the points and drew a curve of best fit. A small number of candidates had non-linear scales or joined each point to the next by a ruler. Candidates who had not read the axes labels carefully enough were awarded partial credit.

(d) The majority of candidates correctly read the value from their graph, however a significant number of candidates did not show on the graph how this was done.

(e) (i) Photosynthesis was known by the majority of candidates with a small number suggesting respiration.

(ii) Only the most able candidates gave the relationship correctly. A number of candidates discussed either amount of light or number of bubbles produced, which were not the variables listed in the question.

Question 5

This experiment followed the energy changes of reactions.

(a) The majority of candidates read both thermometers correctly.

(b) Most candidates correctly assigned labels and suitable scales to both axes, correctly plotted the points and drew curves of best fit. A small number of candidates had non-linear scales, did not include units or joined each point to the next by a ruler.

(c) (i) The majority of candidates identified copper sulfate with a correct reason, however a significant number gave no reason, and were unable to be awarded credit.

(ii) Many candidates knew that the temperature rise would be greater and most gave the correct reason.

(d) More able candidates identified the solid as copper and the solution as zinc sulfate.

Question 6

This was an investigation of the density of solids.

(a) (i) The majority of candidates correctly calculated the volume of the block.

(ii) The majority of candidates read both scales correctly.

(iii) The majority of candidates correctly calculated the two densities but a number of candidates made rounding errors.

(iv) More able candidates were able to choose the greater relative atomic mass as being the significant factor in making the density the largest.

(b) (i) Almost all candidates gave values to the nearest cm, and wrote whole numbers, although the question asked for values to the nearest mm. Candidates should be reminded to check that the precision of their answers matches the precision required by the question.

(ii) The majority of candidates correctly calculated the volume.

(c) (i) Water being absorbed by the wood was given by the majority of candidates.

(ii) The most able appreciated that the balsa contained more air spaces. Many candidates thought that the balsa contained more or less carbohydrates.