SCIENCE

Paper 5124/01
Multiple Choice

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

Comments on individual questions (Physics)

This year there was only 1 entry for the 5125 paper and individual question comments are, therefore, from the 187 5124 candidates whose scores ranged from 5 to 36 with a mean score of 19.13 and a standard deviation of 6.37. No question was found to be very easy although **Question 18** produced a correct response from more than 70% of the candidates. Some more able candidates found problems with a number of questions, particularly **Questions 9, 11** and **20**. Good discrimination was also shown in a number of questions, particularly **Questions 2, 5** and **14**.

Question 1. Only 50% of candidates were able to read the vernier scale correctly (option B). The remainder were equally divided between the incorrect options with option A attracting some of the more able.

Question 2 showed good discrimination. The incorrect responses were divided, almost wholly, between options B (the reverse axes) and C with the former more popular.

Question 3 also discriminated well with option B the most popular incorrect choice.

Question 4 was not well answered because the majority of candidates considered the original length as part of the extension under the 6N load. This led almost twice as many to choose option A rather than the key, option B.

Question 5 and Question 14 showed very good discrimination with the majority of candidates divided between two options in both. The more able candidates chose the key, option B in **Question 5** and option A in **Question 14**, and the less able an alternative option, C, in both questions. Both questions also had a 'positive distractor', option A in **Question 5** and option D in **Question 14**, indicating that more able candidates chose these.

Question 6 and Question 7. The topics of power and heat transfer were well known and the questions discriminated well with option D in **Question 6** collecting most of the incorrect responses and in **Question 7** they were almost equally divided between options A and D.

Question 8. In choosing options A and, in particular, C a third of candidates showed a lack of understanding that there is no temperature change accompanying a change of state. Most of those who did appreciate this chose correctly, option D.

Question 9 had 73% of candidates divided between options B and C with the latter drawing over twice as many responses as the key, option A. The more able candidates who chose option C were unable to adapt the wave shape to a **bar** as the vibrating source.

Question 10 also had more candidates choosing a distractor, option B, than the key, option D. This should act as a reminder to read the whole question.

Question 11 resulted in answers that showed uncertainty among candidates with all options attracting a significant number of responses. More chose option B over the key, option D, and a substantial number of the more able chose option A.

Question 12 and Question 13. A calculation for the speed of sound and an alternative unit for current were well known and both questions showed good discrimination. In both questions candidates were mainly divided between the key and one other; in **Question 12** it was option B and in **Question 13** it was option C.

Question 15 was well answered with option D the most popular incorrect response.

Question 16. The kilowatt-hour as a unit of energy, option B, was known to only 27% of candidates who were mainly drawn from the more able. Almost twice as many considered it to be a unit of power, option C.

Question 17 is a possible cause for concern in that 41% of candidates, most choosing either option A or B, were unable to correctly work out the most appropriate fuse to be fitted, option D.

Question 18 was very well answered with option A the most popular incorrect choice.

Question 19 differentiated well with less able candidates preferring option A over option D.

Question 20 showed that the concept of *half-life* was not fully understood. 'Positive distractors' (indicating the more able choosing), options A and D both required, as a first step, the correct working out of the **total** number of *half-life* periods.

Comments on individual questions (Chemistry)

Question 21

Less than half of the candidates realised that the boiling point of X was between room temperature and the boiling water. A significant number of candidates thought that the boiling point of liquid X was 100^{o}C and chose option A.

Question 22

The better candidates are aware of the relationship between the number of electron shells and the position of elements in the Periodic Table.

Question 23

The properties of sodium chloride, an ionic substance, are not well known by a large number of candidates. Over 50% of the candidates chose either B or C.

Question 24

The dot and cross diagram of ammonia was well known, particularly by the better candidates

Question 25

This question was well done by the better candidates.

Question 26

The most popular response was option B indicating that there is a lack of understanding of calculations involving volumes of gases amongst the majority of candidates. Candidates should be aware of the relationship between a chemical equation and reacting masses and volumes.

Question 27

This question was well done by the better candidates. There was an element of guesswork amongst the weaker candidates.

Question 28

The factors which influence the rate of a chemical reaction are well understood by the majority of the candidates.

Question 29

This question was well done by the better candidates although a significant proportion of the less able candidates thought that salt neutralises excess stomach acid.

Question 30

The gradation of properties within a group in the Periodic Table is well known by the better candidates.

Question 31

The properties of argon are well known by the majority of the candidates.

Question 32

The better candidates identified that the metal X that is denser than water and reacts to produce hydrogen is calcium. The weaker candidates did not recognise the significance of the fact that metal X sank in the water.

Question 33

The chemistry of the blast furnace is well known by the majority of the candidates.

Question 34

Over a third of the candidates thought that oxygen remained in the syringe at the end of the experiment and chose option C. There was also an element of guesswork amongst all the candidates.

Question 35

The use of relative temperatures and pressures in this question made the question difficult for many candidates.

Question 36

The properties of a homologous series are well known by the better candidates, although some candidates chose option B, indicating that there is some confusion between empirical formula and general formula.

Question 37

This question was well answered by the better candidates. There was a significant element of guesswork amongst the weaker candidates.

Question 38

The reactions and properties of ethanol are not well known by many of the candidates.

Question 39

This was not well answered. Candidates should know that an ester is formed by the combination of an alcohol and a carboxylic acid.

Question 40

A large proportion of the candidates were able to identify the molecular formula of the monomer.

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Paper 5124/02
Theory (Physics)

Most candidates showed evidence of being well-prepared and performed well. There was the usual range of ability but a much greater number than last year gained higher marks. It was pleasing to see that there were good answers to all questions.

Calculations were well done by many and descriptions of experiments were clear and concise. A large number of candidates, however, lost marks by describing the wrong experiment.

Section A

Question 1

This was answered well by most candidates but a number used the wrong power of 10. A sizeable minority gave an answer of 7000 for both **(a)** and **(b)**. The correct answers were 7000 for **(a)** and 0.007 for **(b)**.

Question 2

(a) (i) The vast majority of candidates gained credit for knowing that they had to use F = ma and the majority of these went on to gain further credit for the correct answer. The most common mistake, made by a few, was to use 10 m/s/s as the acceleration. A small number of candidates converted 5 kg into g before using the formula and so lost credit. The correct answer is 40 N.

(ii) This was answered well by only a minority of candidates who clearly stated that the two forces are friction/drag/air resistance and weight/gravity. Many candidates were satisfied with giving "downward force" and "upward force" which gained no credit. A number stated that the two forces are "friction" and "air resistance" which gained only half the credit since both of these forces act downwards.

(b) Only the most able candidates suggested that the frictional force increased and so gained credit. A common mistake was to state that the weight decreased which is incorrect science. Others stated that the object reached terminal velocity which does not fully answer the question.

Question 3

(a) A majority of candidates were able to interpret the information on the diagram and give the correct answers to both parts of this question. A small number mixed up the two readings or gave values for the volume of 41 cm^3 or 25 cm^3 which does not take into account the volume of the solid. The correct answers were, the mass is 36 g and the volume is 16 cm^3, although any answer in the range 15.5 to 16.5 cm^3 was accepted.

(b) Almost all candidates gained credit for knowing that they needed to use "density is mass divided by volume". The large majority of these went on to use the values that they quoted in **(a)** correctly and so gained full credit. The correct answer is 2.25 g/cm^3 but any answer which properly used incorrect answers to part **(a)** was accepted.

(c) A small majority realised that water cannot be used if the solid is soluble or if it reacts with water or if it floats and so gained credit for this part. Credit was not given for "the water would evaporate", which was the most common mistake, since this is true whenever water is used.

Question 4

(a) The majority of candidates used "acceleration is change of speed divided by time" or used the gradient of the graph. Almost all of these went on to calculate the correct answer which is 1.25 m/s/s.

(b) This was well done by the majority of candidates who successfully calculated the area under the graph to find that the distance of the race is 100 m. Some of those who used "distance = speed x time" had less assured success. Some used the wrong formula, for example "speed divided by time", and gained no credit. Others used the final speed rather than the average speed during the first 8 seconds. These gained some of the credit if they worked out that the distance travelled in the final 6 s is 60 m.

(c) Most candidates gained full credit for dividing the distance that they had calculated in part **(b**) by 14 s. A small minority divided this distance by 8 s and so gained only the credit for knowing that they needed to divide total distance by time. A small number tried to find the arithmetical average of different speeds from different stages in the race and gained no credit. The correct answer is 7 (.143) m/s.

Question 5

(a) This was well done by most candidates who carefully drew the normal and indicated the correct angles, stated that the correct formula is "sin i divided by sin r" and drew a plausible ray which refracted away from the normal. A large minority either did not draw a normal, and so were unable to show the correct angles, or indicated the angles between the normal and the surface. These gained no credit for part **(a)**. A few candidates did not gain credit for part **(c)** either because they drew no ray at all or drew a ray reflecting from the surface or drew a ray that refracted towards the normal.

(b) This question was well done by most candidates who used the formula sin i divided by sin r to calculate the correct answer of 1.4 (or 1.39). The usual minority did not use sines and simply divided angle of incidence by angle of refraction and so gained no credit.

Question 6

(a) Only a very small minority of candidates gained credit for stating that the sun's energy originates as nuclear reactions within the sun. Most candidates, however, correctly stated that the energy reaches Earth by radiation and so gained credit for part **(ii)**. A small minority stated that the energy reaches Earth by solar energy and were not given credit.

(b) Only the most able minority gained credit for stating that the solar cells convert light or solar energy into electrical energy. Many thought that they convert heat energy into mechanical energy. Slightly more candidates gained credit for stating that the motor converts electrical energy into kinetic energy or mechanical energy. The most common error was to state that the motor converts kinetic energy into potential energy.

Question 7

(a) The circuit diagram was well drawn by most candidates with only very few drawing a series circuit or destroying credit by shorting out the resistors.

(b) Most candidates gained full credit for using the correct formula to calculate the effective resistance of the parallel combination of resistors. A small minority simply added up the two resistances and a few others made the mistake of stating and using the formula $R = 1/R_1 + 1/R_2$. This is a common mistake every year. Candidates should be reminded that the formula should be 1/R not R. Perhaps candidates would have more success if they used "R = product of resistances divided by the sum of the resistances". The correct answer is 6 Ω.

(c) (i) Many candidates successfully used I = V/R to find the correct value of the current. The most common mistake was to use 6 Ω as the resistance or to use an incorrect version of the formula. The correct answer is 1.3(3) A.

(ii) This was well done with the majority of candidates correctly using P = IV to calculate the correct answer of 16 W. Many candidates rounded up their answers in part **c(i)** and so did not get exactly 16 W but these were all awarded full credit.

Question 8

(a) This was the least well-done part of ***Section A***. Only a minority knew that they needed to multiply the power in kilowatts by the time in hours to work out the number of units and then to multiply by the cost of one unit to find the total cost. Some candidates changed the power into watts and many failed to convert the time into hours.

(b) Only the most able gained credit for stating that the normal operating current of the heater is more than 10 A and therefore the fuse would melt when the heater operated normally.

Question 9

Only a minority gained credit for stating that the narrow bore or the large bulb are features that improve the sensitivity of the thermometer. Even fewer went on to give a convincing explanation to show that either of these allows a greater movement of mercury along the tube for each degree change in temperature. The majority showed confusion over what is meant by sensitivity by stating that the bulb was made of thin glass to allow a faster response. This answer gained no credit.

Question 10

(a) The majority gained credit for stating that there are 8 neutrons in the nucleus of carbon-14. 6 neutrons and 14 neutrons were both common incorrect answers.

(b) Most candidates gained credit for indentifying the radiation as β-radiation and most of them linked this to the changes in the nucleus to gain further credit.

Question 11

Most candidates gained some credit for this question but only the minority gained full credit for stating that the air near the heating coil expands and becomes less dense so rises and that this process is repeated to set up a convection current.

Section B

Question 12

(a) Almost all candidates gained most of the available credit for describing a suitable experimental arrangement and detailing the readings that need to be taken. Fewer candidates wrote that the experiment should be repeated for different values of force and distance and a small number stopped short of stating what should be done with the readings to verify the principle of moments. Weaker candidates simply drew a seesaw and explained why one side went up or down.

(b) Most candidates gained some credit for showing that they knew how to calculate a moment and that they needed to equate moments about the pivot. The majority of these went on to calculate the correct answer of 37.5 N.

(c) This question was badly done by all but the most able. Only a small minority stated that the wide heavy base means that the centre of gravity is low and that the base is wide. Even fewer went on to gain full credit for explaining why this improves stability.

Question 13

(a) This question was very popular and was well answered by most candidates who scored most of the marks available. Most were able to give a clear account of the experimental arrangement and detailed the readings that needed to be taken. The majority gained further credit by specifying that the distance between the person making the sound and the person measuring the time needs to be at least 500 m to minimise errors and a small number lost some credit for not stating what needs to be done with the readings to work out the speed of sound. Most candidates stated that the experiment should be repeated in the opposite direction to allow for any effect of wind. A minority

of candidates attempted to describe a method involving echoes. Whilst this allowed full credit to be gained, most found it difficult to describe the method convincingly.

(b) Most candidates gained full credit for describing that vibrations are passed from particle to particle and that this results in a longitudinal wave or a series of compressions and rarefactions. A small minority stated incorrectly that the wave is a transverse wave.

(c) This was extremely well-answered with most candidates gaining full credit. Almost all showed that they need to use "distance = speed x time" and successfully calculated the total distance travelled by the wave as 66 m. Most of these gained full credit for realising that this is the distance to the object and back, and gave the correct distance between camera and object as 33 m.

Question 14

(a) This question was the least popular in ***Section B*** but was well answered by most of those who attempted it. Most gained credit for describing an arrangement that allowed relative movement between the wire and the magnet and described some way of measuring the induced e.m.f. Many then went on to gain further credit by describing a change in either the speed of movement or the strength of the magnet and described how the readings change as a result. A sizeable minority described only how reversing the direction of movement reverses the e.m.f. As this does not answer the question, these gained no further credit.

(b) This question was well-answered. Most candidates who attempted it calculated the correct answer of 6 V.

(c) Only a minority knew that iron is used since it is easier to magnetise and demagnetise and that it produces a stronger magnet. The most common answer was that iron does not rust. This gained no credit since it is incorrect and irrelevant.

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Paper 5124/03
Theory (Chemistry)

Section A

Question 1

Name, symbol and physical properties of specified metals and non-metals.

Well answered. Standard properties of metals and non-metals were accepted. Just specifying 'gas', for example 'oxygen', was not accepted unless 'at room temperature and pressure' was also included.

Question 2

Quite a difficult question involving descriptions of elements, compounds and mixtures.

A common error was in failing to realise that a substance with 'different atoms in a fixed ratio' must be a compound.

Question 3

Properties of acids and alkalis, with a test for an ammonium salt and a metallic carbonate.

The result of simple Universal Indicator tests for acids and alkalis was usually given correctly. In the case of the reaction with hydrochloric acid, all the following were accepted: ammonium chloride, carbon dioxide, carbonic acid and water.

For the reaction with sodium hydroxide, all of the following were accepted: ammonia, ammonium hydroxide, sodium carbonate and water.

As the question did not ask for a name, chemical formulae when correct were accepted for full marks.

Question 4

Paper chromatography, including an analysis of the results of one procedure.

(a) Extremely well answered. Evidently candidates were well capable of analysing the quite complex chromatogram that was included.

(b) Weaker candidates drew separate pieces of apparatus rather than 'the apparatus that could be used to produce this chromatogram'. Few candidates realised that the original ink spots should not be dipped directly into the solvent.

(c) Knowing that 'if the dyes on bank notes are soluble in water then the dyes will run as soon as they are handled or become wet' was the intended basis of the answer to this question. That 'bank note inks are water insoluble' or 'bank notes are waterproof' was sufficient to earn this mark.

Question 5

Electronic structures and determinations from the number of protons and neutrons within a nucleus.

This was considered to be quite a demanding question and yet a very high proportion of candidates answered it well.

(a) Non-metals will accept electrons into their electronic structure for stability. Many candidates believed that 'partially filled electron shells' resulted in non-metallic character.

(b) Most candidates could determine atomic mass and atomic number when given the number of protons and neutrons in a nucleus. The difference in nuclear structures between isotopes of the same element was well understood.

Question 6

Simple organic reactions.

(a) 'Poly(ethene)', 'polythene' and 'polyethylene' were all acceptable names for the product that results when polymerising ethene. 'Oxidation' of ethanol results in ethanoic acid. 'Ethyl ethanoate' is the result of reacting ethanoic acid with ethanol.

Well answered.

(b) A common misunderstanding amongst candidates was to believe that the low boiling point of a small covalently bonded compound such as ethene is either the result of the weak bonding between the atoms or the weak bonding that results from a double bond. Few candidates described the presence of 'weak intermolecular forces', the correct reason for low boiling point.

Question 7

Rates of reaction.

(a) The cotton wool in the mouth of the flask is both to prevent acid spray leaving the flask and dust entering.

(b) Many candidates wrongly believed that the flask and its contents lost mass because the calcium carbonate (having been mixed with an acid) was 'being used up'. It was not considered enough to just write 'carbon dioxide is produced': for the mark to be awarded, the candidate had to indicate that she/he realised that the gas produced was 'given off' or 'lost' or 'was no longer included in the total mass being measured'.

Many candidates correctly determined from the graph supplied, that the reaction rate was decreasing but far fewer realised that after about thirteen minutes the reaction had stopped.

The calculation from the graph of mass lost and average rate of reaction over the first eight minutes was usually completed correctly. An impressive result.

Question 8

This question was/is considered to be very demanding as it certainly puts candidates in the position of not having to rely solely on their memory for an answer.

(a) Candidates had to realise that an element (given a fictitious symbol Aa) that combines with chlorine to form a compound with the formula AaC*l* must be a metal with a valency of one and so be placed in Group 1 of the Periodic Table of Elements. This is quite a task and yet many, many candidates were successful in its completion.

The level of reactivity of the metals in Group 1 increases on proceeding down the table and so the first member of this group must have the symbol Aa. Not an easy concept to grasp but many did.

(b) Hence, Bb must be sodium, which reacts vigorously with water to liberate hydrogen. Using the special symbol Bb in writing the reaction of this element with water caused problems. At this level, writing B_2O as a product was considered sufficient to earn some of the marks available.

Section B

Question 9

Preparation and properties of lime.

(a) Producing lime by heating calcium carbonate was rarely described. Many candidates believed that the industrial process to make lime involves adding calcium metal to water. A diagram was not required. However, many candidates knew the uses of lime with many describing its use by farmers in their fields to reduce acidity.

(b) The properties of lime and the compounds that can be prepared from it were well known. Most candidates correctly identified the test for a chloride using acidified silver nitrate solution and the test for carbon dioxide using limewater.

Question 10

Sulfur dioxide and carbon monoxide as pollutant gases, with a calculation.

(a) The response 'burning fossil fuels results in the production of sulfur dioxide and carbon monoxide' earned zero marks as it was a rewrite of the question. Sulfur, carbon and, in the case of carbon monoxide, a limited amount of air / oxygen, needed to be included in an answer for full marks to be earned.

(b) This section was very poorly answered. Few candidates included the necessary but simple chemical equation.

Even though a candidate failed to earn the mark available for '2g' of sulfur, she/he could still gain the full marks available for knowing how to convert this incorrect mass of sulfur into a mass and volume of sulfur dioxide, providing the correct technique was used.

Question 11

Homologous series and the properties of alkanes.

(a) Several candidates gained two marks by giving a long list of the chemical reactions and of the trends in physical properties associated with the homologous series that they had named. Examples of the general characteristics accepted, each earning a single mark to a maximum of three marks, included: 'represented by a general formula', 'having similar chemical properties', 'having the same functional groups', 'showing a trend in certain physical properties', 'differing from the next in the series by CH_2', and 'having a common method of preparation'.

(b) Few candidates failed to give the correct structural formula for ethane. The necessary relative molecular mass and so the percentage of hydrogen in the hydrocarbon was often calculated correctly.

The substances resulting from burning ethane in excess air were well known though carbon monoxide often appeared, incorrectly, in the chemical equation that candidates were asked to write. A common error, when attempting to write a complete chemical equation for this reaction, was to describe ethane as a solid. The difficult balancing of this equation was well done.