SCIENCE

Paper 5124/01
Multiple Choice

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

Comments on specific questions (Physics only)

Questions 7 and **8** proved to be very easy with **Question 20** very demanding. The more straightforward questions, attracting a 70-80% correct response, included **Questions 3, 5, 6, 9, 16** and **19**. Some more able candidates found that were more challenged by **Questions 12, 13, 14** and **15**. Many of the questions discriminated well, in particular **Questions 4, 9, 10, 11** and **18**.

Question 1 was well answered with less able candidates choosing option C.

Question 2 was well known although both options A and D, in attracting a number of more able candidates, proved to be 'positive' distractors, ones that correlate positively with success in the test. Option C attracted the less able candidates.

Question 3 was well known by most of the candidates. Ever keen to multiply numbers, some of the less able candidates favoured option D.

Question 4 showed excellent discrimination with most of the less able candidates divided between options A and C.

Question 5 and Question 6 were both well known and correctly answered by 78% of candidates.

Question 7 and Question 8 were also well known with a correct response from 90% and 96% of candidates respectively.

Question 9 discriminated well with less able candidates divided equally between options A and D.

Question 10 showed excellent discrimination, with less able candidates divided equally between all three incorrect options.

Question 11 also showed excellent discrimination with less able candidates choosing option A. Some more able candidates, forgetting to halve the time, chose option D.

Question 12 A significant number of better candidates chose option C rather than the key, option B, failing to appreciate the significance of 'around the *circuit*'. Option A was the choice of most less able candidates.

Question 13 was not well known and indicated guesswork from the candidates, even from the more able. Both options C and D attracted more responses than did option B, the key.

Question 14 was well answered, particularly by the less able candidates! A significant number of the more able candidates chose option C.

Question 15 The numbers of candidates electing for the wrong options indicated that many were uncertain and made their choice by guesswork; this included some of the more able who made contributions to the numbers choosing one from the two incorrect options A and D. Options B and C each drew the same number of responses with the less able favouring option B, and the more able option C, the key.

Question 16 and Question 19 Both questions were well answered.

Question 17 showed some uncertainty from the more able candidates, some of who consider transformer action is caused by 'a *steady* direct current' (option B).

Question 18 An easy question which showed good discrimination, with less able candidates divided between options A and B.

Question 20 showed that the concept of 'half-life' was not understood with the key, option D, attracting only a 13% response from, in the main, the more able candidates. Option A was the choice of 69% of candidates, including some of the more able!

Comments on specific questions (Chemistry only)

Question 21

This question proved easy for the better candidates, however a significant number of the candidates thought that the mixture of two solids could be separated by filtration alone and chose option **A**.

Question 22

Another easy question for the better candidates.

Question 23

The vast majority of the candidates knew that a solution of sodium chloride in water conducts electricity.

Question 24

Almost a third of the candidates chose options **B** and **D**, both of which offered combinations of a metal and a non-metal, which are combined by ionic bonding.

Question 25

The majority of the candidates were able to balance the equation correctly.

Question 26

Calculations involving concentrations of solutions are not well understood. There was evidence of widespread guesswork even amongst the better candidates

Question 27

The carbon cycle is well known by the majority of the candidates.

Question 28

The majority of the candidates were unable to interpret the results correctly. Candidates should be aware that fine powder reacts quicker than large lumps and that a smaller mass of calcium carbonate produces less carbon dioxide.

Question 29

This question was well answered by the majority of the better candidates but there was evidence of guesswork amongst the weaker candidates.

Question 30

The majority of the candidates know that caesium reacts with water but a significant proportion of the weaker candidates thought that caesium is a non-metal and chose option **A**.

Question 31

The use of aluminium in the manufacture of aircraft is well known by the better candidates, however almost a quarter of the candidates thought that mild steel is used to make cutlery.

Question 32

The reactivity series is not well understood particularly amongst the weaker candidates as there was evidence of guesswork.

Question 33

The source and effect of pollutant gases is not understood by the majority of the candidates. It is disappointing to record that 60% of the candidates think that carbon monoxide is the cause of global warming.

Question 34

This question allowed the vast majority of the candidates to demonstrate their knowledge positively.

Question 35

Many candidates know that methane is the main constituent of natural gas.

Question 36

There was evidence of guesswork particularly amongst the weaker candidates. Candidates should know that bromine adds across the double bond in an alkene.

Question 37

The representation of ethanol was recognised by the majority of the candidates but a significant proportion of the candidates chose ethanoic acid.

Question 38

This question was well answered by the majority of the candidates.

Question 39

There was evidence of widespread guesswork even amongst the better candidates. The reactions of ethanol are not well understood by the majority of the candidates.

Question 40

The majority of the better candidates identified nylon and proteins as having the same linkage.

SCIENCE

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 greater number than last year gained higher marks. It was pleasing to see that there were good answers to almost all questions, although some of the more difficult concepts were answered well by only a minority of candidates.

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

(a) Most candidates gained the mark for knowing that they had to find the gradient of the graph. The majority then went on to do so successfully. A small minority made a mistake in reading the co-ordinates of the graph and so calculated an incorrect value. The correct answer of 1.6 m/s^2 was given by most candidates.

(b) The majority of candidates gained the mark for knowing that weight is equal to mass times g. A significant minority failed to gain further marks by using 10 m/s^2 as their value of g rather than the value that they had calculated in (a). A small number used 10 m/s^2 and then multiplied by one sixth remembering that the moon's gravity was one sixth that of Earth's. Although this was not the intended method of working this out, these candidates were given full credit. The correct answer was 0.8 N.

(c) The majority of candidates knew that the distance travelled is equal to the area under the graph and worked this out successfully. A significant minority tried to use distance equals average speed times time. Almost all of these failed to gain the second mark because they used a speed of 2.125 m/s rather than the average speed. The correct answer is 0.8 m.

Question 2

(a) This was well done by many candidates who correctly stated that a micrometer screw gauge or vernier callipers are appropriate instruments. A large number of candidates, however, wrongly stated that a centimetre ruler could measure to the precision indicated.

(b) Most candidates knew that mass was equal to volume multiplied by density and so gained a mark. A significant minority, however, were unable to determine the volume correctly and did not, therefore gain any further credit. 3 cm^3 and 9 cm^3 were popular values for the volume rather than the correct value of 27 cm^3. The correct value for the mass was 202.5 g, although full marks were given to those who gave 203 g.

Question 3

Most candidates were able to calculate the moment as 330 Ncm and then went on to equate moments to gain full marks for the correct answer of 220 N. A significant minority failed to get the correct answer because they used 9.5 cm as the distance from pivot to effort rather than 11 cm as was stated in the question.

Question 4

(a) Most candidates were able to give correct energy transfers. In (i) the correct transfer is from kinetic or movement or mechanical to electrical. A small minority stated that the transfer was from gravitational potential energy into electrical. In (ii), most gained the mark for stating that the energy transfer was from electrical into light energy. Some stated that the transfer was into heat and light and also gained full credit, but no credit was given to those who stated that electrical energy was transferred into heat energy alone as this is not the correct answer to the question that was asked.

(b) Most candidates knew that the power was the work done per second or that the loss of gravitational potential energy is calculated using mgh. Rarely, however were candidates able to put both ideas together to calculate the correct answer of 3.0 W. A small number used 2.0 as the time.

Question 5

(a) This was well done by most candidates but the usual confusion about the meaning of sensitivity prevented large numbers from gaining full marks. In 1, a mark was given for knowing that the large bulb allowed a great amount of mercury to be held. A second mark was given for stating that this meant that there was, therefore, a greater movement of mercury per degree change in temperature or that the sensitivity is increased. In 2., many knew that the thin glass allowed rapid conduction of heat and so gained a mark but most of these went on to state, incorrectly that this improved the sensitivity, for which they gained no further credit. The more able minority gained the final mark for stating that it improves the speed of response.

(b) This question was well done by most candidates who showed a clear understanding of the conditions in which a thermocouple thermometer should be used.

Question 6

(a) The majority of candidates gave a convincing explanation of what is meant by a longitudinal wave, correctly stating that the vibrations are parallel to the direction that the wave moves. Only a small minority confused these with transverse waves.

(b) The formula $v = f\lambda$ was well known by most candidates but a significant minority were unable to change this to $\lambda = v/f$ in order to work out the correct answer. Many divided f by v and a small minority multiplied the speed by the frequency. The most able calculated the correct answer of 0.75 m.

Question 7

(a) It was pleasing to see that most candidates knew the correct formula and were able to apply it correctly to work out the correct value for the refractive index of 1.53. Only the least able minority failed to use sines.

(b) The first mark was given to those who showed that the ray was refracted away from the normal. This mark was gained by most candidates. The second mark was for drawing the emergent ray parallel to the incident ray. This mark was gained by a small majority.

Question 8

(a) This was the least well-done part of **Question 8** but, pleasingly, a large number of candidates knew that potential difference is energy divided by charge and so were able to work out the correct answer of 6 V.

(b) The majority knew that current is charge divided by time and so calculated the current to be 1.5 A.

(c) Most candidates knew that power could be found by dividing energy by time or by multiplying current by potential difference and so were able to work out the correct answer of 9 W.

Question 9

(a) Pleasingly, almost all candidates knew that a beta particle is an electron.

(b) The most able were able to calculate the number of neutrons to be 52 and so gained the mark. The less-able minority stated, wrongly that the number was 90.

(c) Most candidates knew that the number of electrons in a neutral atom is equal to the number of protons and so, correctly, gave a value of 38 for this part.

(d) Only the most able knew that when a beta particle is emitted, a neutron changes into a proton and so realised that the proton number increases by 1. These were able to work out the correct answer of 39.

Question 10

(a) The majority knew that the voltage would decrease or that the frequency would decrease but rarely did candidates know that both occur. Only the most able drew a graph showing both decreased amplitude and decreased frequency.

(b) This question was the least well-answered on the paper. Very few candidates stated that the a.c. generator causes a varying magnetic field in the core and that this induces an e.m.f. in the secondary coil.

Section B

Question 11

(a) This question was not popular but those candidates who attempted it scored well. Most candidates scored at least four of the five available marks. A mark was awarded for a diagram showing the wire with a suitable power supply and an ammeter and voltmeter correctly connected. Only a very small minority made the usual mistake of drawing the voltmeter in series with the rest of the circuit. A second mark was given for showing some means of varying the voltage so that a series of readings could be taken. A third mark was gained by stating that current and voltage are measured and a fourth for showing that these are found by reading the ammeter and the voltmeter. The fifth mark was for stating that the p.d. is then changed and the procedure repeated. The most common mistake was to draw a circuit that did not allow the voltage to be changed.

(b) Most candidates gained some credit for drawing a graph which was a straight line through the origin but many failed to gain a second mark for correctly labelled axes. Most commonly, candidates omitted the units.

(c) This question was surprisingly badly done by all but the most able. A mark was awarded for knowing that the resistance would be less. The second mark was for realising that the current in the wire would be greater and the final mark for relating this to a change in the gradient of the line. Most candidates, surprisingly, thought that using a wire of greater cross-section would cause the graph to become curved.

Question 12

(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 how to use a plotting compass to plot the field around the magnet. A small number lost a mark for not stating that the position of the magnet needs to be marked. A significant minority described the less-satisfactory method of using iron filings to plot the field. This method was given a maximum of 3 marks.

(b) Most candidates gained at least two of the available marks. The majority gave good accounts of how the coil could be used to make a magnet, although many lost credit by stating that they would use an iron rod. The method of demagnetising a magnet was clearly known; most candidates specified that a.c. should be used but only a minority of them knew that the current needs to be reduced slowly or the magnet needs to be removed in an east-west direction. Only a very small number confused d.c and a.c.

(c) This was extremely well-answered with most candidates gaining full marks.

Question 13

(a) This question was answered well by a small majority of candidates. The most common mistake was to describe an inappropriate experiment. Many candidates described an experiment to compare how well two different surfaces absorb or emit radiant heat. These candidates gained no marks. The able candidates who described a suitable experiment scored marks for describing a method of heating the rods equally; the most convincing suggested using a tank of hot water. Further marks were gained for describing a method of detecting how quickly heat was transferred (wax on the rods was the most common method), for stating what observations would be made and for explaining how these observations would tell them which was the better conductor of heat.

(b) This question was very well-answered. Most candidates were aware that heat is transferred by molecular vibrations being passed from particle to particle in the rod.

(c) In (i) only a minority knew that the insulated box ensures less heat loss by conduction or convection. In (ii), whilst most were aware that black is a good absorber of radiation, surprisingly few realised that this results in more rapid or more efficient heating of the water.

SCIENCE

Paper 5124/03
Theory (Chemistry)

Section A

Question 1

Uses of five different substances. Well answered.

(a) 'Zinc' was usually correctly given

(b) 'Sulfur dioxide' or 'oxides of nitrogen' are the gases which cause acid rain. 'Sulfuric acid' was often given and earned zero marks.

(c) 'Acetylene (ethyne)' was the expected answer, as described in the syllabus, but 'hydrogen', though rarely given, also gained the mark available.

(d) 'Diamond'. Several candidates realised that an allotrope of carbon was needed but incorrectly gave 'graphite'.

(e) 'Yeast', 'zymase' and, even, the general term 'enzymes' were all accepted as organisms that ferment sugars.

Question 2

The particles present in hydrogen gas and molten potassium chloride. Poorly answered. It was not clear whether candidates realised that molten potassium chloride is a liquid, with all the associated properties.

(a) Movement – 'fast moving' gas particles and 'slower' moving liquid particles were the responses required. Candidates often used the term 'moving freely' in distinguishing between the particles in solids and liquids. This failed to earn any marks. 'Random' / 'non random' movement of particles to describe the movement in gases/liquids was not accepted

Arrangement - 'far apart' and whatever could be interpreted as 'closer together than in gases' were the responses sought.

Attraction for one another – either 'slight attraction' or 'no attraction' were both accepted as descriptions of the particles in a gas and 'strong' attraction between the particles was the description required for the ionically bonded sodium chloride. 'Ions' did not need to be included.

(b) 'Moving/mobile' 'ions' is of course the basis for electrical conduction in the melt of an ionic compound such as potassium chloride. Answers based upon 'clouds/streams of electrons' earned zero marks, as did answers that used the conductivity of the metal, potassium, within the compound, to explain conduction. These latter descriptions were commonplace.

(c) Many candidates believed that breaking covalent bonds is easily completed and this results in hydrogen having a low boiling point. The ease with which the intermolecular forces between hydrogen molecules is the basis of the response required. This was given - but not often.

Question 3

The electronic structure of covalently bonded methane, its relative molecular mass and derived structures.

(a) Very well answered. Imperfect answers were awarded a mark for any of the following three factors in the structure drawn: a shared pair of electrons; seemingly eight electrons in the outer shell of a carbon atom; seemingly two electrons in each of four hydrogen shells.

(b) The elements, compounds and mixtures illustrated by this series of diagrams were extremely well identified by most candidates.

Question 4

The alkali metals

(a) (i) The various ways of describing the fact that the element has one electron in its outer shell earned the mark available. 'Needs seven more electron for a stable structure' was also accepted, at this level of understanding.

(**ii**) Well answered with 'eleven protons' and 'twelve neutrons', though 'twelve nucleons' often, erroneously, appeared,

(**iii**) Most candidates realised that different isotopes of the same element differ by the numbers of neutrons in their respective nuclei.

(b) The meaning of 'property' was interpreted liberally by Examiners and so such 'properties' as 'most reactive of the Group', 'displaces from a solution the ions of metals above francium in the Group' and any property of a metal were all individually accepted for each of the three marks available.

(c) Candidates could choose any element from Group VI and Group VII in writing these two formulae. Both, for example, FrO_2 and O_2Fr were accepted as being correct for the compound formed between francium and oxygen.

Question 5

Properties of acids and bases. Very well answered.

The source of the acidity of hydrochloric acid was accepted as being either H^+ or H_3O^+. The range of pH acceptable for this acid was 0-3 and the range of pH acceptable for sodium hydroxide solution was 10-14. The product of neutralisation was identified correctly by most candidates - though, as a 'name' was required, the formula was not accepted.

Question 6

Definition and uses of 'relative molecular mass'.

(a) Using 'total number of protons and neutrons' to define 'relative molecular mass' earned zero marks. Such standards as $1/12^{th}$ of a carbon-12 atom, one hydrogen-1 atom and $1/16^{th}$ of an oxygen-16 atom were all equally acceptable.

(b) The reason for not obtaining this mark was not, as expected, that candidates could not write the correct formula for potassium hydroxide but, more usually, for incorrect addition.

(c) A simple calculation that was not always answered correctly of the mass of hydrogen chloride present in 250 cm^3 of a solution of 2.0 mol/dm^3 hydrochloric acid. In this instance the relative molecular mass of hydrochloric acid was given.

Question 7

Reactivity series of metals. Evidently the style of this rather unusual and difficult question did not deter candidates as they produced exceedingly good answers, showing excellent chemical understanding.

(a) Only the metal with the code name 'epsilon' is below hydrogen in this reactivity series and so is the only one of these metals that will not corrode in moist air.

(b) Only 'alpha' is more reactive than 'beta' and so is the only metal present in this series that will displace 'beta' from its oxide.

(c) The least reactive of the metals positioned above hydrogen in this series of metals is 'delta'. Hence 'delta' will react most slowly with hydrochloric acid to produce hydrogen gas.

(d) Copper will appear below hydrogen in a reactivity series. So, copper could be represented by the code name 'epsilon'.

Section B

Question 8

Manufacture of iron and calculating mass and volume of carbon dioxide so produced.

(a) Three suitable equations, balanced and with fully correct formulae, would have earned the full six marks for this section. The most difficult of these, that which involved the production of calcium silicate, caused the greatest problem to candidates. However, mention of the word 'slag' earned a single mark. Very well answered.

(b) F - Barium sulphate – of these four compounds, this was identified with greatest difficulty.
G - Iron(II) hydroxide – usually correctly identified.
H - Iron(III) hydroxide – usually correctly identified.
I - Iron(II) sulphate – usually correctly identified. Candidates not recognising the sulphate but correctly given the formula of the iron(II) salt they had, incorrectly, identified, still earned the mark available for the formula. In other words they were not penalised twice for a single error. This technique of marking is commonly applied when marking all of these questions.

Question 9

Determining and explaining speed/rate of reactions.

(a) A very simple description of how particle size and temperature affect the rate of a reaction was enough to earn full marks.

(b) Some candidates described how to <u>compare</u> rates of reaction rather than to <u>determine</u> the rate of reaction, going down the route e.g. 'use two forms of calcium carbonate, add acid, observe the bubbles, fastest bubbles, fastest reaction', rather than the route e.g. 'use calcium carbonate chips, add acid, measure the total volume of gas produced over time, using a gas syringe and stop clock and calculate rate from a volume against time graph'. In doing so they were penalised in that two marks of the mark scheme, those given for plotting and interpreting a graph of volume of gas produced against time, were not available to them.

Of course, the rate of a reaction varies according to when the rate is measured – sometimes being slow and sometimes being fast. Better answers, and there were many, determined the rate by explaining that the gradient of a graph that displayed 'volume of gas produced' against 'time' was the rate at any one point in time. Less good answers did not contain a graph but determined a mean rate by dividing the overall volume of gas produced by the time for the reaction to reach completion.

(c) A simple control, the reaction used for either answers to 'b', and a change in temperature needed to be described in deciding whether the a rate of reaction will or will not depend upon temperature, either bubbles being produced faster or a steeper graph at a higher temperature, was considered sufficient for full marks to be awarded.

Question 10

Separating petroleum into its fractions and the basis of polymerisation.

(a) Only a very simple description of the means whereby petroleum is separated into its various fractions was required. 'Heating, passing into the lower part of the fractionating tower, and collecting the fractions at different levels' was enough. This was less well answered than any other part of this paper and yet required no more than factual recall. Names of the fractions so obtained were well remembered, as were their uses.

(b) A structural formula for ethene was enough and so displayed hydrogen atoms were not essential though, of course, were not penalised in any way.

An explanation of the reason why ethene can be polymerised had to centre upon the existence of a double carbon-to-carbon bond and that many molecules are needed to form a polymer. Many candidates gave the chemical formula of poly(ethene). The 'n' that appears in a correct formula was sufficient to earn the mark available for 'many molecules'.