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Group III

Sciences

PHYSICAL SCIENCE

Paper 0652/01

Multiple Choice

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

General comments

The mean mark for this Paper was 22.7, with a standard deviation of 6.1. The reliability coefficient was 0.79. This latter is a little lower than usual but still satisfactory as are the other statistical parameters.

Question 1 was, as usual, intended to be an easy starter and apart from this the only other Chemistry question that was found particularly easy was **Question 15**. Conversely, the harder Chemistry questions were **2**, **3**, **7**, **8** and **10**.

In the Physics section of the Paper candidates found **Questions 28**, **29** and **30** to their liking with **Questions 24**, **25**, **27**, **35** and **40** the most difficult.

Comments on specific questions

Question 2

This proved to be harder than expected with about a third choosing **D**. At this level, particles in a solid are ‘touching’ in a regular pattern: liquid particles are arranged irregularly but still touching and particles are not touching when in the gas phase.

Question 3

Only a quarter answered correctly. The topics relevant to this question are all explicitly mentioned in the syllabus and the question is not intrinsically difficult. Shaking the mixture with liquid Y dissolves P so that Q can be removed by filtration and P can then be recovered by evaporation of the solvent. Perhaps it was the need to combine these ideas that defeated the majority of the candidates.

Question 7

About 40% correctly chose **C** but more chose **D**. The more able realised that oxygen is not itself the fuel but the less able tended to go for “uranium” -perhaps the less familiar substance although referred to in the syllabus as nuclear fuel.

Question 8

Responses **A** and **C** were equally popular. The question is essentially qualitative so that a pipette is not a necessary item of apparatus.

Question 10

Only 30% answered correctly. Across the ability range, more than 30% chose **A**. This is very puzzling: ammonium nitrate is a salt and the responses included a metallic oxide!

Question 15

It is encouraging that this topic seems to be well understood.

Question 16

By contrast, this question proved rather hard with response **A** being found rather attractive. Oxides of reactive elements are unwilling to cede their oxygen to carbon.

Question 19

Only about half answered correctly with response **D** chosen by 30%. It is difficult to imagine what these candidates thought the ‘white powder’ to be and, then, if the gas was thought to be chlorine, this is not colourless.

Question 21

The most common incorrect answer was **A**, where candidates ignored the “min” label on the watch and treated the reading as just seconds. Candidates at this level *must* be able to read a stopwatch.

Question 22

Again a very disappointing result with well under half the candidates able to take the length of the rod correctly.

Question 24

Revealed a widespread confusion still exists between mass and weight.

Question 26

A good proportion chose the correct option but 20% of the candidates thought that no force was necessary to slow the car.

Question 27

Only 1 in 3 candidates realised that the object with the lowest C of M would be the most stable. The most popular choice was **A**.

Question 29

This was well done, despite the fact that 11% of the candidates thought that heat travels from the Sun to the Earth by convection.

Question 37

Most candidates answered the question correctly with the most common error being to decide that component X was a resistor, perhaps because of its vaguely rectangular shape. This is an example where candidates have not read and absorbed the information in the stem.

Question 38

The vast majority realised that the particles emitted from a cathode were electrons, but one-third of these thought the charge was positive.

Questions 39 and 40

Answers indicated considerable uncertainty regarding radioactivity.

Paper 0652/02
Core Theory

General comments

It was again very pleasing to read many scripts of genuine quality where candidates had a clear grasp of the concepts and where they expressed themselves concisely and with clarity. There was only one question which caused major difficulties across a large section of the candidature; **Question 7**, which looked at the deflection of α, β and γ - radiations. It is disappointing that this section of the work continues to be so unfamiliar as it does contain some of the most interesting and stimulating sections of Physical Science.

Comments on specific questions

Question 1

Candidates showed a good knowledge of the principles of reflection and many carefully plotted the ray of light through the periscope. The incident angle was correctly identified by the majority of candidates and there were many good suggestions for the use of the instrument.

Question 2

The question was tackled well with candidates being well versed in the effects of changing the concentration of the acid, changing the temperature and in altering the size of the limestone chips. A significant number of candidates, however gave non specific tests for carbon dioxide such as the extinguishing of a lighted splint.

Question 3

The descriptions of the motion of the sprinter were generally pleasing, though marks were lost by lack of precision, for example “acceleration” rather than “constant acceleration” in **(i)** and “constant motion” in **(ii)**. Also candidates still insist on saying “acceleration at constant speed” a clear contradiction!

The calculation of the distance travelled was done exceptionally well, relatively few candidates making the usual error of multiplying the time by the maximum speed. It was therefore a little disappointing that a significant number did not realise that the speed of the runner as he finished the race could be read straight from the graph.

Question 4

Part **(a)** was done very well with virtually all candidates correctly interpreting the periodic table to find the number of protons and hence electrons in the atom, and they were well aware of the electron structure. There was good knowledge of the reactivity of the different metals in the first part of **(b)**, however a large number gave lithium as the more reactive element in Group I, and the descriptions of why the oxides were classified as basic defeated all but the strongest candidates.

Question 5

The question was done well, the majority were able to calculate the resistance of the resistor and therefore the circuit resistance, however there was some confusion how to apply this to finding the potential difference across the battery. It was also pleasing that the vast majority of candidates correctly connected the voltmeter across the unknown resistor only.

Question 6

There was a general understanding that the sodium atom lost an electron to become an ion, and that the chlorine gained an electron, however candidates did not always express themselves clearly and consequently lost credit. The explanation for the high melting point of sodium chloride was not well done, very few candidates showed any real understanding and of those that did the answers were often incomplete and lacking in detail. To gain good credit it was required that the candidate considered the strong attractive forces between the oppositely charged ions.

In the final part many candidates simply gave a test for chlorine rather than the test for the presence of chloride ions.

Question 7

The question required an understanding of the nature of radioactive emissions, which was sadly lacking. It was clear many candidates were unable to understand the experimental set up and consequently that the lead sheet stopped the β-particles from going straight to the detector. What was more disappointing was how few candidates could name a suitable detector, which was a fairly basic task.

The safety precautions were too vague, wearing protective clothing is not enough, without a comment that they should be lead lined, likewise "not touching" the source is not as good as "using tongs to hold the source".

Few candidates were unable to transfer their knowledge that α-particles have a very short range into explaining why the comparative experiment with α-particles must be done in a vacuum.

In part **(d)**, despite the guidelines given few were able to say that α-particles are more massive than β-particles, a common answer being that the α-particles were "stronger" than the β-particles. More recognised that the change in direction was due to the opposite charge, but even here understanding was at a premium, and many candidates just stated that β-particles are negative whilst α-particles are positive, whereas strictly the experiment as described does not tell us that!

The final part also led to the comment that γ-radiation is the strongest of all.

Question 8

It was pleasing how many candidates correctly calculated the molecular mass of the hydrocarbon. The formula for the next in the series caused more problems but nevertheless many candidates gave a correct response, though few gave the name of the series, which was rather disappointing. The chemical test however was known by many although the details led it to being a good discriminator in examination.

The substances released in the combustion of the hydrocarbon were known by the stronger candidates, however it was clear that many have some very muddled ideas about the meaning of the term substance, with "heat" and: "light" appearing with alarming frequency! The final parts tested the candidates well with the best getting the idea that the molten wax soaks up the wick, and that a candle with 20 carbon atoms in its molecule would soften in the hot weather whereas one with more carbon atoms would have a higher melting point and therefore not soften.

Paper 0652/03

Extended Theory

General comments

This Paper proved to be of an appropriate standard and allowed better candidates to gain most of the marks available. There was little evidence that candidates found timing to be a problem and nearly all scripts were fairly well presented and complete. Weaker candidates had difficulties with using consistent units, for example there was much confusion between dm^3 and cm^3 in **Question 5** and in **Question 2** N/m or N/cm or J were commonly used incorrectly for the unit of moment. *In calculations it is particularly difficult for candidates to convince Examiners that they are clear about substituting values unless the equation is written down.*

As in previous years too many candidates are being entered for a Paper in which they have little chance of gaining a reasonable grade. *Centres are reminded that not entering candidates for Paper 3 would enable them to omit the right hand column of the syllabus and to concentrate on the basics of the left hand column of the syllabus.*

Comments on specific questions

Question 1

Part **(a)** was usually correctly answered but most candidates failed to relate the lack of a steady trend in the melting point of the Group V elements to their changing structure.

Question 2

Although most candidates were able to write down the equation for the moment many failed to complete the calculation in appropriate units. As usual N/cm and N/m (and occasionally J) was commonly used but often answers were incorrectly written as 2400 Nm or 24 Ncm. Most candidates were able to give a definition of power in terms of energy or work done per unit time. Few candidates were able to relate the power to changing moments as the position of the pedal moved. Examiners were seeking an answer that related this change to changes of perpendicular distances and/or changes in forces applied.

Question 3

Less than half the candidates were able to deduce the charges on the ions and hence the chloride formula. Very few candidates seemed aware of the test to distinguish iron(III) chloride from iron(II) chloride. In part **(b)** most candidates made a good attempt at writing a balanced equation for the reduction of Fe_2O_3 by carbon. Again most candidates remembered that limestone is used in the blast furnace although *quicklime* and *calcium oxide* were relatively common, incorrect, alternative answers. The majority of candidates were aware that their chosen solid was used in order to remove impurities from the ore.

Question 4

Most of part **(a)** and **(b)(i)** of this question were well answered with the majority of candidates remembering the equations for weight, kinetic energy and potential energy. The most common mistake was for candidates to fail to convert 1.2 g into kg before substituting their answers into the equations. Few candidates were confident enough to write down the upward force as being equal to the weight in **(a)(ii)**. In **(a)(iii)** and **(b)(i)** candidates were not further penalised for failing to convert g into kg in **(a)(i)**, provided their answers were consistent. In **(b)(ii)** most candidates simply drew the tried and tested straight line origin graph – whereas the gravitational potential energy falls from a maximum to zero (linearly) with time. Very few candidates recognised that for a fruit falling at its terminal velocity there would be no interchange of gravitational potential energy and kinetic energy – instead the kinetic energy remains constant and the gravitation potential energy is converted into the internal energy of the fruit and of the air (*heat* instead of *internal energy* was condoned in this case).

Question 5

This question was generally poorly answered. Few candidates were able to make a reasonable attempt at parts **(a)**, **(b)** or **(c)(iii)**. Answers to **(a)** were usually too vague to gain credit – *to remove the solid* – being a typical response that was not accepted by the Examiners. Answers to **(b)** were usually vague too. Few candidates recognised that calcium oxide could not be used to prepare calcium sulphate because calcium oxide is insoluble. Despite the prompt in the stem of **(b)**, very few candidates suggested using calcium nitrate in **(b)(ii)**. Most candidates were able to calculate M_r as being 40 for magnesium oxide and most of these candidates went on to correctly calculate that there were 0.2 moles of magnesium oxide in 8 g (although 5 was a relatively common alternative answer). Very few candidates were able to show that 0.1 dm^3 of sulphuric acid would be needed to react with this mass – the most common mistakes being to invert the concentration formula or to ignore the concentration of the acid entirely.

Question 6

The context of a ripple tank appeared unknown to or completely misunderstood by many candidates. This meant that there were large numbers of very unclear answers. A large number of candidates tried to explain the projected images in terms of the water waves themselves rather than the effect that the water waves had on the light. Very few candidates had any idea regarding how to measure the wavelength in terms of the spacing between the bright and dark bands and those candidates who argued in terms of the wave equation, $v = f\lambda$, rarely gained credit for their answers. Part **(c)** was done comparatively well and it was pleasing to see how candidates were able to convert the frequency of the waves in Hz to the rate of rotation of the motor in revolutions per minute.

Question 7

This question was relatively well answered by candidates. Many candidates were able to give the formula for methanol as CH_3OH and correctly drawn dot-and-cross diagrams were quite common. Weaker candidates often attempted to draw structural formula-type diagrams or double and triple bonds between atoms. Most candidates were able to give a reason why ethanol and methanol are members of the same homologous series. Again most candidates were able to write the equation for the addition reaction between ethene and steam. There were a large number of vague answers to the statement of two conditions necessary for the reaction to occur and answers such as *heat* or *pressure* gained no credit. Most candidates suggested *cracking* as the industrial method of obtaining ethene but without the word *alkanes* this gained no credit. *Fermentation* was a fairly frequent incorrect response to part **(c)**.

Question 8

This question discriminated the weaker from the stronger candidates very well indeed. In the best answers candidates found the combined resistance of the resistors in parallel (4Ω) and added this to the series resistor to make a total of 12 Ω. The current was then found using $I = V/R$ and the voltmeter reading was found by multiplying the 4Ω by the current (0.5 A) to give a value of 2 V.

Common mistakes were:

equating the combined resistance of the 12 Ω and 6 Ω resistors by the equation $R = \frac{1}{12} + \frac{1}{6}$;

adding all three resistances together;

rearranging V= IR incorrectly;

multiplying the total resistance by the current to produce a voltage of 6 V again.

Question 9

This question was poorly answered. Most candidates knew that aluminium rapidly forms an oxide, when exposed to air and tried to base all their answers on this – with little success. Few candidates differentiated between the corrosion of aluminium and iron and talking of all corrosion as being *rusting* was fairly commonplace. Most candidates were not able to relate the effect of the amphoteric nature of aluminium oxide to the alkalinity of sodium hydroxide, in their answers. Most candidates recognised bauxite as being the main ore of aluminium but many answers, to why reduction of bauxite by carbon was inappropriate, were too vague.

Question 10

This question was often well answered although candidates were less sure that the principle of electromagnetic induction requires a changing current than that a current in the primary coil induces a voltage across the secondary coil and that the output voltage is greater than the input voltage in a step-up transformer. The calculation was usually well done, although some equations were written very ambiguously.

Paper 0652/06
Alternative to Practical

General comments

There was a noticeable improvement in the overall level of comprehension exhibited by the candidates on all questions in the Paper. Scientific knowledge on those areas of the syllabus covered by the Paper was sound in most cases with very few candidates scoring very low marks and the vast majority of candidates were able to access most parts of most of the questions and give creditable answers. There was a pleasing improvement in the accuracy of reading scales on scientific instruments and in performing calculations and drawing graphs. Weaknesses were still apparent in the ability of some candidates to provide descriptive accounts of experimental procedures such as those required in **Questions 4** and **6**.

Comments on specific questions

Question 1

(a) The majority of candidates read the clock dials correctly with the only infrequently occurring error being the first reading which some candidates recorded as 44s instead of 39s.

(b) The graph was plotted correctly by the vast majority of candidates who therefore gained all four of the available marks. A few candidates failed to follow the instructions for the graph and provided a horizontal scale for time, thereby losing the first mark, although most gained the remaining marks by plotting the graph points correctly and drawing a smooth curve. Some candidates lost the final mark by joining the points with straight lines rather than drawing a curve. Overall candidates answered this question well.

(c) The majority of candidates provided the correct answer for this part of the question, correctly interpreting the graph as showing an decrease in time or increasing rate of reaction as the temperature rises.

(d) Most candidates recorded the correct value from their graph although a few misread the question and read the time scale at a temperature of 50° rather than the temperature scale at a time of 50s.

(e) Most candidates struggled with this part of the question with only a very few giving a correct answer related to plotting a graph of 1/time against temperature or measuring the gradient of the curve drawn for part **(b)**. Many candidates gave answers indicating that they would divide the temperature by the time to determine the rate.

(f) Most candidates failed to appreciate that the emphasis of this part of the question related to the temperature 0°C and simply described how they would do the experiment without reference to temperature control. Examiners did *not* accept answers related to doing the experiment in a fridge or freezer and were looking for responses related to the use of ice surrounding the apparatus. Many candidates surprisingly assumed that if the apparatus was left to cool that it would eventually reach 0°C.

Question 2

(a) The majority of candidates correctly calculated the six ‘counts per minute’ values to score both marks. A few candidates mistakenly divided the total count values by 300 or 600 having calculated the time in seconds rather than using the values in minutes given in the table.

(b) Many candidates correctly gave the reason as 'background radiation' or as a 'control'. Answers stating 'to see how much radiation was left when the sample was removed' were not accepted by Examiners. Many candidates provided vague answers to this part of the question and failed to score.

(c)(i) Many candidates gave the correct answer (gamma radiation) to score the mark. Some candidates seemed to be unfamiliar with radiation from radioactive sources and gave answers related to other areas of the electromagnetic spectrum e.g. infra-red, ultra-violet etc.

(ii) Many candidates gave the correct answers (alpha and beta radiation) to score the marks. Some candidates gave gamma and beta as the answers.

(iii) Many candidates gave the correct answer (alpha radiation) to score the mark.

(d) Many candidates provided answers that were too vague to score the mark, e.g. wear protective clothing or goggles. Examiners were looking for more specific answers related to radioactive materials e.g. not handling samples, keeping a safe distance etc.

(e) Many candidates scored one mark for a reference to keeping the sample in a lead-lined box but most failed to score the second mark by indicating that the sample should be 'locked up'. Vague answers related to keeping the samples cool or under water were not credited.

Question 3

(a) Most candidates correctly read the four scales and calculated the mass of solid Z, thereby scoring all five marks. A few candidates read the scales in reverse and recorded 39.8g and 42.3g for the masses and 26.5°C and 17.2°C for the temperatures although this was quite rare.

(b) The temperature change was most often calculated correctly – many candidates did not indicate that the temperature change was negative but this was not penalised by Examiners.

(c)(i) The conversion of the mass of the beaker into kilograms was mostly calculated correctly, the most frequently occurring error being division of the mass in grams by 100 instead of by 1000.

(ii) Most candidates correctly calculated the heat energy from their value for **(c)(i)**. Some candidates lost the mark by failing to quote their answer to an appropriate level of accuracy (i.e. 2dp).

(d) Most candidates correctly calculated the total heat energy change from their value for **(b)** and **(c)(ii)**.

(e) The majority of candidates realised that the energy change was endothermic because there had been a temperature drop or negative energy change in the reaction. Some candidates appeared to understand the idea but failed to gain the mark because they stated that the reaction was 'exothermic' i.e. simply chose the incorrect word.

Question 4

(a) Most candidates scored at least one mark for this part of the question and many scored two. One mark was usually lost either because candidates did not mention filtering the juice before evaporation or allowing the evaporated juice to cool and therefore crystallise. Weaker candidates simply stated that the 'crystallisation method' should be used and this failed to gain any credit. Some candidates also assumed that the juice had to be reacted with sodium hydroxide to form the crystals and this also negated the award of any marks. Frequent references to growing the crystals on string suspended in the juice were noted by Examiners.

(b) Only the more able candidates scored high marks on this part of the question, with very few scoring all seven. Many candidates stated that the crystals should be dissolved in the sodium hydroxide directly and failed to appreciate the need to dissolve the crystals in water and then perform a titration. It was apparent that weaker candidates simply based their answer on a need to refer to all of the items mentioned in the question and seemed to have little real understanding of the required process. Occasional errors in otherwise good answers were noted when candidates indicated that the sodium hydroxide should be put into the burette.

Question 5

(a) The majority of candidates drew the correct symbol for the switch and there were very few incorrect answers.

(b) This part of the question was very well answered by the vast majority of candidates with very many of them scoring all three marks. A common error was the failure to indicate the correct position for switch **S3** which was frequently placed next to lamp 3.

(c) Most candidates knew the correct symbol for the voltmeter and the majority correctly placed it in parallel with the battery. Weaker candidates lost the second mark by placing the voltmeter *in series* with the battery.

Question 6

(a) Most candidates correctly identified the gas as carbon dioxide. A few incorrect answers were noted, predominantly hydrogen or oxygen. Where the answer was correct candidates usually provided the correct choice of liquid as the reactant i.e. liquid **A**.

(b) Many candidates correctly indicated that the result showed that the liquid was alkaline or had a pH greater than 7. Weaker candidates incorrectly guessed that the liquid had a pH of 7 and was neutral (consequently giving liquid **C** as the reactant) or that it was acidic (thereby giving liquid **A** as the reactant).

(c) The vast majority of candidates correctly identified liquid **C** as their choice of answer.

(d) Only the more able candidates identified the precipitate as a sulphate and the liquid as **A** (sulphuric acid). Weaker candidates simply guessed thus providing a wide range of incorrect responses from 'sulphur' to 'copper nitrate'.

(e) Most candidates linked this reaction to the test for carbon dioxide and correctly identified the liquid as calcium hydroxide (i.e. limewater).

Question 7

Answers to this question provided the widest range of marks of any question on the Paper, ranging from 0 to 6. Although most candidates were familiar with the idea of chromatography many found it difficult to provide a detailed and sequenced answer to the question. Weaker candidates simply attempted to use all of the equipment in whatever way they could without much thought being given to the outcome e.g. teat pipettes, the pencil and the ruler were variously used to suspend the chromatography paper using the paper clip. Some attempts were made to use radial chromatography to identify the inks but little credit could be given to such answers unless they were carefully structured. Many candidates suggested suspending the chromatography paper in mixture **M** instead of a suitable solvent such as water or ethanol. The best answers used carefully drawn diagrams to illustrate the experiment and the expected results, and some candidates gained all six marks with carefully labelled diagrams alone.