PHYSICAL SCIENCE

Paper 0652/01

Multiple Choice

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

Comments on individual questions (Chemistry)

The chemistry questions performed well being very similar in difficulty to those in physics

Questions 15 and **19** proved to be very straightforward with a large majority of candidates giving the correct response.

Questions 11, 13, 14, 17 and **20** were more difficult, with less than half of the candidates giving the correct response.

The following responses were popular **wrong** answers to the questions listed.

Question 1

Response **A**. Candidates thought particles were further apart but did not take account of the word ‘much’.

Question 3

Response **B**. Candidates probably did not count argon as a non-metallic element.

Question 6

Response **D**. Candidates realised that the reaction had to be exothermic but confused oxidation and reduction.

Question 11

Response **C**. This response was more popular than the correct response (**A**). Candidates realised that iron and copper were the two metals but became confused over the reaction with dilute acid.

Question 13

Response **A**. This response was again more popular than the correct response (**C**). Weaker candidates clearly did not know the trends in the properties of Group 7.

Question 14

All Responses. The number of candidates choosing each response for this question was roughly equal indicating that the majority guessed the answer.

Comments on individual questions (Physics)

Physics questions showing a facility of 60% or lower were **21**, **22**, **25**, **26**, **27**, **31**, **32**, **33**, **34**, **37** and **38.**

Percentages in brackets after an item number show the proportion of candidates choosing the correct response.

In **Question 21** (53%) many candidates chose option **A**, which was very close to the correct value. Speed/time graphs were not well understood in **Question 22** (44%), with one in three failing to halve the (20 × 10) value, but the straightforward recall **Question 23** (81%) caused far fewer problems. Although the density equation was well known for **Question 24** (78%), several candidates forgot to subtract the mass of the empty box. Widespread confusion between speed and acceleration was evident in **Question 25** (29%), causing almost half the responses to be **C**, and in **Question 26** (41%) a very large proportion of candidates believed room temperature to be a fixed point. **Question 27** (40%) showed that convection was not generally understood clearly, but better knowledge was evident of the meaning of wavelength in **Question 28** (61%).

Candidates were well prepared for **Question 29** (84%) on lenses, and generally performed well in **Question 30** (63%). **Question 31** (30%) was on magnetism, and was not well answered, with all distractors being popular. Similarly **Question 32** (43%) showed that many candidates were uncertain of the pattern of the magnetic field around a bar magnet. Candidates would benefit from being asked to consider the direction of the field lines at particular points around the magnet. The popularity of option **A** in **Question 33** (40%) indicated that it was a common misconception that thicker wires have higher resistance, suggesting that it would be useful to clarify this in teaching. Exactly half the responses to **Question 34** were incorrect, indicating a lack of knowledge of the fact that the current at every point in a series circuit is the same. The torch circuit diagram was more widely known, however, for **Question 35** (68%), and the electrical safety **Question 36** was answered correctly by 75% of candidates. In **Question 37** (51%) it was distractor **B** that was the most popular, showing either lack of knowledge of the charge of cathode rays, or confusion over the law of electric charges. Radioactive half life was thought by more than one in five candidates to be 'half the time taken for the substance to decay completely' in **Question 38** (53%). The most common misconception in **Question 39** (62%) was to confuse the penetrative abilities of alpha- and beta-particles. The final **Question 40** (72%) worked as intended, with **D** being the most frequent error.

PHYSICAL SCIENCE

Paper 0652/02

Core Theory

General comments

The standard was generally pleasing, although there was evidence that some candidates were entered who did not have the knowledge or understanding required for this paper.

Comments on specific questions

Question 1

Many candidates were able to state that the bonding in the H_2 molecule is covalent and went on to correctly draw the dot and cross diagram for the bonding of hydrogen chloride gas. However, few scored well in part **(c)**, most candidates describing the bonding rather than describing the properties of ionic compounds.

Question 2

This question was done very well with the best candidates scoring full marks and the majority getting at least half of the available marks. In part **(a)** the majority showed that they understood the meaning of resistance and correctly calculated the value. The most common error in part **(b)** was to try and calculate the combined resistance of $\mathbf{R_1}$ and $\mathbf{R_2}$ as though they were in parallel. The final part also caused relatively little difficulty.

Question 3

Although most candidates were able to explain what is meant by a fuel, few were able to give two reasons why hydrogen makes a good fuel. Vague responses such as it being environmentally friendly are not precise enough to gain credit. Examiners were looking for something like 'it does not produce environmentally damaging greenhouse gases on combustion' or that 'it only produces water on combustion'.

It was disappointing that relatively few candidates were able to name the process by which ethanol is produced from sugar. Many candidates were aware of the limewater test for carbon dioxide, but a considerable number, erroneously, suggested extinguishing a lighted splint as an alternative. Some candidates were unable to distinguish between distillation and fractional distillation.

Question 4

Part **(a)** was done very badly. Few candidates had a real idea of the use of the oscilloscope, and those who did failed to explain clearly how the traces would change. To comment that the trace would 'get bigger' is inadequate. Candidates must use the correct scientific terminology.

It is a requirement of the syllabus that candidates are aware of the approximate threshold of human hearing, 20 ± 10KHz. A small proportion had some idea, but too many were unable to correctly link the number to the unit.

In part **(c)** many candidates correctly worked out the total distance the sound travelled but failed to recognise that this was from the bat to the wall and back again.

Question 5

Part **(a)** revealed the lack of understanding of moments that many candidates have. A few were able to visualise the physics of the situation. Others made some attempt but were unable to identify the fulcrum, and consequently multiplied the forces by the incorrect distances. It was, however, pleasing to note that many candidates showed their working in a clear manner. This enabled Examiners to see where arithmetic errors were made and to give credit where appropriate.

Part **(b)** was done somewhat better, although many candidates felt that the graph must start at the consequently showed uniformly accelerated motion in the first 12 s. It was pleasing how many ca were able to complete a calculation of the distance travelled by the boat, in what was not a straightfo situation.

Question 6

Careless use of language caused lost marks in part **(a)**, with many candidates giving the incorrect answer of 'compound' instead of 'mixture'. The most common response to part **(b)** was stainless steel, which is not, as requested, an alloy of copper. Other common responses were aluminium and nickel.

A few candidates suggested that car bodies could be protected by galvanising. The expected response was that they can be painted which combines both the protection and the cosmetic effects required. Vague answers to the final part were common with few candidates focussing on either the expense or the density of copper.

Question 7

This question covered a number of areas of physical science, starting with the transmission of energy from the Sun to the Earth. The question asked for the process and hence the term radiation was expected. Electromagnetic or light or infrared waves were accepted as suitable alternatives. Most candidates recognised the correct reflection from the mirror, although in some cases the ray was not drawn carefully enough. It was disappointing that many candidates were unable to identify the angles of incidence and reflection, nor were they aware that the angle of reflection is equal to the angle of incidence.

In part **(b)**, it was clear that conduction is the main method by which energy is transmitted through the container wall, although many different suggestions were made, including diffraction, refraction and reflection. In the second part full marks could not be scored unless some mention was made of expansion or decrease in density of the hot water.

In the final part of **(c)** candidates were required to put into words their recognition that combining the desalination plant with the power station saved energy. The better candidates were able to do this fairly well.

Question 8

There were some good answers to part **(a)**, however, it is important to remember when asked for an observation this is what should be recorded, not the actual reaction. Thus, 'bubbles are seen' is fine but a comment like, 'hydrogen is given off', is not acceptable, because the hydrogen can not be seen.

Relatively few candidates recognised that the observations when sulfuric acid is used are very similar to those observed when hydrochloric acid is used.

Question 9

The first part of this question caused more difficulty than any other on the paper. Very few candidates had any understanding of the concept of fission. Of those who did, most spoilt their answers by describing it as the splitting of an atom, rather than the nucleus of the atom.

The advantages and disadvantages of nuclear power showed a lack of thought. Candidates should be aware that although nuclear power stations create fewer greenhouse gases than a conventional power station, this does not mean there are no pollutants as many of the waste products are potentially very damaging to the environment. Similarly, statements such as 'the plant might explode like a bomb', show a lack of understanding. Candidates should know about the dangers of radioactive isotopes leaking into the environment and the difficulties of disposing of and storing radioactive waste.

Question 10

Part **(a)** tested the candidates' understanding of chemical formulae. There were some good answers, some scoring full marks. Part **(b)** explored the understanding of mass calculations, again some good answers were given, although a significant number of candidates failed to read the question properly and tried to find the mass of one mole of ammonium nitrate, rather than the mass of nitrogen in one mole of the substance.

Question 11

In part **(a)** only a small proportion of candidates recognised that the radioactive isotope would ne brought closer to the detector if the isotope emitted alpha particles, and of those who did, very few ju their answers by explaining that alpha particles are absorbed by a few centimetres of air.

In part **(b)** only a few candidates linked the corrected count rate to the need to allow for background radiation. Attempts to draw the graph were varied, with some excellent efforts. Few understood the concept of half-life, with the majority of candidates thinking that it was half the time over which the experiment was run.

Question 12

Most candidates had some idea that the catalyst speeded up the reaction, although few went on to explain the details of why a ceramic material is used, why the catalyst is spread thinly and why it lasts a long time.

There were, however, some pleasing attempts at balancing the equation.

Question 13

It was disappointing how few candidates had a thorough knowledge of the nature of the subatomic particles.

Part **(b)** was done rather better, many knowing that the proton number is the number of protons in the nucleus.

PHYSICAL SCIENCE

Paper 0652/03
Extended Theory

General comments

It was pleasing to note the high standards produced by many candidates who showed genuine knowledge and understanding of the syllabus. There are still some who clearly are not ready for this level of examination, and for whom the core paper might be more appropriate.

It was encouraging that the majority of candidates included the correct units in their calculations.

Comments on specific questions

Question 1

Part **(a)** of this question challenged many candidates, although many scored full marks. However, a large number were not able to sort the problem out, many trying to use force = mass × acceleration or work = force × distance. Even those who recognised it as a moments problem and just had difficulty sorting out the relevant distances, failed to set their work out in a way which gave the Examiners the option of giving stage marks.

Part **(b)(i)** was done much better, the most common error being to start the graph at the origin, showing uniform acceleration, not uniform speed, for the first twelve seconds. The calculation of the deceleration was done well, although a significant number of candidates gave the unit as m/s not m/s^2. The calculation of the distance travelled was also done quite well, with many candidates correctly finding the area under the graph, although some simply multiplied the maximum speed by the time taken.

Question 2

The description of the reactions of the three Group I elements was done well, with the majority of candidates scoring at least half of the available marks The most common error was omitting to describe the movement of sodium and potassium on the surface of the water. The vast majority of candidates had little difficulty in correctly completing the equation in part **(a)(ii)**.

The majority of candidates were able to identify the electron structure as the information which told them that the elements in the table are in Group II. They also identified the density as the physical trend, and correctly described it as decreasing going down the group. The explanation of why Group II elements are good conductors caused many more problems. Although many recognised that there was ‘a sea of electrons’, the explanations were muddled and did not establish the structure of a lattice of positive ions through which the free electrons move carrying the charge.

Question 3

This question covered a wide range of physical science, starting with the transmission of energy from the Sun to the Earth. The question asked for the process and hence the term radiation was expected. Electromagnetic or light or infrared waves were accepted as suitable alternatives. Most candidates recognised the correct reflection from the mirror, although in some cases the ray was not drawn carefully enough.

In part **(b)** it was clear that conduction is the main method by which energy is transmitted through the container wall, although many different suggestions were made, including diffraction, refraction and reflection. In the second part full marks could not be scored unless some mention was made of expansion or decrease in density of the hot water.

It was disappointing that in part **(c)** many candidates were unable to identify the slip rings (in rings' was a common error) or the carbon brushes. More candidates recognised that the former is made from (soft) iron and also recognised that it is used because it is a temporary magnet.

Part **(d)** explored the combination of this power station and a desalination plant. The method by which wa is recovered from sea water is distillation. The final part of the question required candidates to put into words their recognition that combining the two processes saved energy, and the better candidates were able to do this fairly well.

Question 4

Part **(a)** of this question was done well, the majority knowing that the process is (catalytic) cracking, and that a catalyst and a high temperature are required. The majority then went on to successfully balance the equation in part **(b)(i).** The bromine test for identifying alkanes and alkenes was well known and well described, as was the name of the process of making a polymer from a monomer. However, only the best candidates were able to give the correct equation for the formation of poly(propene). Many did not attempt this final part and of those who did, the most common error was to show a double bond remaining between the carbon atoms.

Question 5

The first three parts of this question were done very well with the majority scoring full marks. The most common error of those who did not score full marks was to fail to select the correct information in part **(a)**. Resistance = potential difference/current was known, but this was often then multiplied by the 0.5 m.

The final part was designed to be challenging and it was no surprise that only the top candidates scored well. Candidates had to decide what to calculate, how to calculate it from a large amount of information and finally to compare the power from the two cases. The most common error here was not recognising that the current will be reduced, and thus the current from part **(a)** could not be used.

Question 6

This question was not done well. Although most candidates recognised that the energy required from photosynthesis comes from the Sun (or from sunlight / light / ultraviolet light) few went on to calculate the mass of water required for the process, nor to calculate the volume of oxygen produced. This type of calculation causes problems because it is not done simply by applying a formula; candidates have to think their way through the complete process. This requires fairly sophisticated thinking skills and lots of practice.

Question 7

In part **(a)** the curve was drawn well and few candidates had real trouble in calculating the half-life, although some of the weaker candidates thought that the half-life was half the time for which the readings were taken (15 s).

Part **(b)** was also done well, the most common error being the failure to realise that the proton number increases by one on beta decay.

Question 8

Part **(a)(i)** of this question caused more difficulties than any other question on the paper. Although most candidates recognised that diamond has a higher melting point than graphite, they failed to link their arguments to produce a convincing whole. Either there was a mention of weak bonds in graphite or there was a mention of the layered structure. However, rarely were the weak bonds linked to the bonds between the layers.

Similarly in part **(a)(ii)** there was general recognition that graphite is a better conductor than diamond, but the discussion of free electrons in the two materials lacked conviction.

Part **(b)** was done much better with virtually all candidates recognising that carbon dioxide has a (double) covalent bond. The dot and cross diagram was also done to a good standard with many candidates gaining full marks. The most common errors were to give a single bond and/or to fail to give the correct number of electrons in the outer shells.

Question 9

In part **(a)**, it was disappointing how few candidates were able to describe nuclear fusion. Many d radioactive decay, others fission, some even thought it was some form of chemical reaction. Even who had some idea of its nature spoilt their answers by describing it as the combining of two atoms, ra than the nuclei of the atoms.

More candidates scored credit on the calculation, but even here there was a large number who were, clearly, not familiar with the concept. Of those who were working along the correct lines a common error was to fail to square the speed of light, despite having written down the correct equation.

PHYSICAL SCIENCE

Paper 0652/05

Practical Test

General Comments

It was disappointing that no candidates achieved high scores. In some cases candidates seemed under prepared for practical work, and there was some evidence to suggest that examination materials could have been better prepared. Supervisors must read the instructions carefully and make every effort to ensure that materials, particularly solutions, are prepared exactly as given.

Specific Comments

Question 1

Some candidates were unable to give the refractive index. Whilst candidates were not expected to necessarily understand its meaning, it was simply a case of writing down a figure given to them. Many candidates satisfactorily carried out five separate experiments constructing ray diagrams, although a significant number managed only four. Rather too many gave five sets of angles when only one or two drawings were submitted, and in extreme cases no drawings at all. Graphs were adequate but very few observed the instruction to draw a smooth curve. The two highest angles of incidence were important in showing that the line was not straight. Very few used the origin as another point in this particular experiment. Plotting was good, likewise the reading off the line for part **(f)**. Answers to part **(g)** varied. The question instructed candidates to use the table given to read or estimate the sine of each angle. A number decided to use calculators or other tables to produce these numbers, and consequently gave slightly different answers from those expected. The calculated value for the refractive index did not necessarily agree with the figure given in **(a)**. The commonest answer given to part **(h)** was a simple one word 'No'. Very few commented that the answer was within experimental error, or considered experimental errors at all. Answers to part **(i)** often remarked that the angles would be different, failing to suggest that if the refractive index was larger, then the angle would be smaller because the denser the medium the greater the ray is bent.

Question 2

Answers to part **(a)** indicated that candidates had very little idea of estimating volumes, or some unsuitable dropping pipettes were used. A dropping pipette should produce a drop of less than 0.1 cm^3. Answers in excess of this were very common. The instructions were very clear that the concentration of the solutions were to be adjusted to ensure that no more than 10 drops were required to decolourise 3 cm^3 of the lowest concentration of potassium permanganate. There was little uniformity between candidates' answers. When performed carefully, the values should have been x cm^3, x/2 cm^3 and x/4 cm^3. If the experiment was carried out according to instructions, the iron(II) would have been changed into iron(III) which would produce a brown precipitate in part **(e)**. Far too many gave a green precipitate. Comments are made every year concerning the failure to correctly use the word precipitate. The practical notes are quite clear and terms such as 'white solution', cloudy solution or white emulsion are not acceptable. Consequently many did not score the marks in **(f)**. There was an exception in **(f)(ii)**. Silver ions react slowly with iron(II) ions and the solution gradually takes on an off-white cloudiness before an obvious precipitate is formed. Many candidates correctly named the solution **X** as iron(II) sulfate, although in some cases they gave very little evidence for this decision. Answers to part **(h)** were very varied.

PHYSICAL SCIENCE

Paper 0652/06
Alternative to Practical

General comments

Good grades were earned by candidates from many Centres, but there were other groups of candidates whose practical experience was sparse, as illustrated by their answers to the questions in this examination. The Examiners expect candidates to have carried out some practical work in the laboratory and to be familiar with the normal range of school apparatus. Candidates must also have learned the standard tests listed in the syllabus.

Comments on specific questions

Question 1

This question was designed to test the candidates' knowledge of electrical resistance, beginning with everyday ideas about lamps. Confusion was caused by the inclusion of the data printed on the lamps which gave the recommended voltage and wattage for their use. Another problem arose in part **(c)** when candidates used the word "power" rather inaccurately in comments like "The lamp was supplied with too much power". Despite the problems, many candidates gained full marks for this question.

(a) Most candidates were able to read and record the values, even though interpolation had to be used.

(b) (i) The equation V = IR had to be rearranged to find R. A few candidates found this difficult and for those who failed to do this and suggested a wrong formula, the error was carried forward to parts **(ii)** and **(iii)**.

(ii) Those without a calculator found it hard to arrive at the final answer.

(iii) Most candidates were able to gain credit for this part of the question.

(c) Some candidates suggested that the lamp filament had burned out because too much voltage had been applied, or its resistance was too low. Many candidates could not satisfactorily answer this part.

(d) (i) This was found to be the hardest part of the question.

(ii) A commendable number of candidates answered this correctly.

Question 2

Most candidates gained a few marks for their answers to this question, but high marks were very rare.

(a) (i) To make a fair comparison of the three solutions, the same volumes must be used. A clue was given in the diagram of the experiment which showed a measuring cylinder. Despite this, a high percentage of candidates said that the same number of drops of solution **X** must be added each time.

(ii) To make all the reacting particles come into contact, the mixture must be stirred.

(iii) Some candidates appeared not to have read the first part of the question and gave the answer "when the mixture becomes clear", which could not be credited.

(iv) A surprising number of candidates chose the lowest number of drops to identify concentrated permanganate solution.

(b) Many candidates, who appeared to have had little or no laboratory experience, sugges delivering one drop into the 10 cm^3 measuring cylinder and reading off the volume.

(c) (i) The test for a sulfate was described and an observation asked for, but few were able to adequately provide this.

(ii) Any mention of "green" was credited here.

Part **(c)** was not well answered.

(d) (i) There were very few correct answers to this question, although "iron(III)" was sometimes given as the answer.

(ii) Some candidates were able to answer that the iron(III) ions are oxidised or lose electrons.

Question 3

Many candidates were able to score well in this question, revealing that this was an experiment that they had seen or had carried out.

(a) (i) Candidates who had seen or had done this experiment found no difficulty in drawing the path of the light ray. Others did not first draw both of the straight lines through the positions of the locating pins, so the ray through the block was at an incorrect angle to the normal.

(ii) A normal had to be drawn at the point where the ray enters the block. Strictly, this should have been at exactly 90° to the block, but the Examiners were less concerned about a slight inaccuracy.

(iii) Candidates who followed the example diagram found labelling their diagram easy.

(iv) Those who had drawn a poor diagram and had no protractor guessed at the dimensions of the angles, using the other data provided. However, if the candidates' data did not match the actual values of the angles on their diagram, no marks could be awarded.

(b) Some candidates extended the line to the origin although instructed not to do so. Despite this, many candidates scored well here.

(c) Many candidates ignored the instruction to show on the graph how the angle of incidence was determined.

Question 4

The answers to this question were disappointing, suggesting that many candidates are not experiencing practical work in the laboratory. It is this kind of question that poorly-prepared candidates will find most difficult, although even if a candidate had not used a Bunsen burner, most parts of the question could be answered.

(a) (i) This question was badly answered, with few candidates able to explain why the soot formed.

(ii) Very few candidates were aware of the structure of the flame.

(b) (i) Candidates had simply to state that in flame **B** the sodium nitrate melts.

(ii) In flame **C**, the sodium nitrate decomposes. This was almost never given as the answer. Most candidates suggested that the sodium nitrate boils, and did not go back to change this answer even if they answered part **(c)** correctly.

(c) Many candidates correctly described the test for oxygen and gained full marks.

(d) The better candidates could answer this correctly, but some merely wrote that "the bl hotter than the yellow flame."

Question 5

Some candidates answered this question well and showed that they could apply mathematics to the data and also write sensibly about energy changes.

(a) (i) Some candidates read the times incorrectly as 0.5 s and 0.6 s, suggesting that they did not study the introduction to the question.

(ii) The time of fall from the maximum height is found by halving the times of flight.

(b) (i) This was usually well done, except by those candidates who drew a horizontal line instead of a vertical line.

(ii) A significant number of candidates tried to use the formula "distance = speed × time" which is not applicable here, since the ball is accelerating instead of moving at a steady speed.

(iii) If candidates gave the incorrect formula mentioned above and used a distance and time obtained from the graph, some credit was given.

(c) A complete range of abilities was revealed by the answers to this question.

Question 6

The reaction of the alkali metals with water should be well known, either from laboratory experience or by seeing video or film evidence. Candidates who had seen the reactions of the alkali metals could answer this question well.

(a) A few candidates gave answers such as "how long the reaction lasts" or "how much fizzing takes place". These do not answer the question. Candidates must clearly understand the meaning of the word "observation" in order to answer questions of this type.

(b) "Potassium bursts into flames" was the observation needed to answer this part of the question, to show that potassium reacts more strongly than sodium.

(c) There were many unsatisfactory diagrams drawn. Teachers should encourage their candidates to greater accuracy and familiarity with the shapes of commonly used apparatus.

(d) (i) There was much confusion with this question. Sodium oxide, oxygen and even carbon dioxide were given as products.

(ii) Errors were carried forward, so that if carbon dioxide was given as a product, a correct description of the test was given a mark. An indicator with its colour change was sufficient to identity sodium hydroxide, although other tests were also suggested and credited.