PHYSICAL SCIENCE

Paper 0652/11
Multiple Choice

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

Chemistry

Question 1

The vast majority of the candidates were able to identify two pure substances.

Question 2

The structure of the atom is well understood by many of the candidates.

Question 3

This was an easy question for many of the candidates.

Question 4

The definition of relative atomic mass was known by less than 50% of the candidates. A si proportion of even the better candidates chose option **A**, which does not allow for the relative mas carbon atom.

Question 5

Almost all the candidates knew that a catalyst increases the rate of a chemical reaction but the fact that the catalyst is not used up in the reaction was less well known.

Question 6

An easy question for the majority of the candidates.

Question 7

The reactions that produce carbon dioxide are well known by the candidates.

Question 8

A majority of the candidates recognised that non-metals gain electrons when they form ions but many of the weaker candidates thought that non-metals form basic oxides and chose option **B**.

Question 9

An easy question for the majority of the candidates.

Question 10

Another easy question for most of the candidates.

Question 11

The properties of the transition elements are well known by the candidates.

Question 12

The vast majority of the candidates recognised that metals exist as solids but a significant proportion of the weaker candidates thought that metals form acidic oxides.

Question 13

The composition of haematite and bauxite is well known by the candidates.

Question 14

Over 90% of the candidates realised that Z is the most reactive metal and that X is the least reactive metal. Almost half of these candidates were unable to correctly interpret the information about the reduction of the metal oxide by carbon.

Question 15

An easy question for the vast majority of the candidates.

Question 16

There was evidence of widespread guesswork even amongst the better candidates.

Question 17

The uses of the fractions obtained from the fractional distillation of petroleum are well known by many of the candidates.

Question 18

There was evidence of guesswork particularly amongst the weaker candidates.

Question 19

A large majority of the candidates identified the type of reaction as addition but a significant number of these candidates thought that substance X is hydrogen and chose option **A**.

Question 20

This was an easy question for the better candidates however many of the weaker candidates thought that the colourless liquid collected is ethanoic acid and chose option **B**.

Physics

Question 27

This question concerned sources of energy, and referred directly to the syllabus explanation of fuel energy as involving a regrouping of atoms. More than two thirds of candidates wrongly opted for **D** (nuclear energy) as the answer. Close reference to the syllabus is recommended.

Question 28

Although this was much better answered, a popular distractor was **D** (gravitational energy). Candidates should have linked the bending of the pole to strain energy.

Question 29

This was also quite well answered, although one in three candidates believed that a thermometer could measure temperatures up to 100°C using a liquid with a boiling point lower than this.

Question 30

Candidates needed to know that wood is a thermal insulator. Given that the fire was outside, which eliminated the possibility of convection around a room, only radiation could transfer heat to the girl. Fewer than half of the answers were correct.

Question 31

The most common error here was to divide the time by the number of vibrations. Candidates should be reminded that sometimes an answer will be a fraction less than one.

Question 32

Almost half the candidates opted for distractor **A**, with just under a third choosing the correct response **C**. The problem could be caused by a misconception about the image being on the surface of the mirror, or a result of misreading the question.

Question 33

Nearly one in three opted for **D**, apparently believing that soft iron is a hard magnetic material.

Question 39

Candidates found this question, on beta-decay, to be challenging. The popularity of option **C**, and particularly of option A, suggests that candidates were confusing alpha- and beta-decay.

PHYSICAL SCIENCE

Paper 0652/12
Multiple Choice

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3	**C**	23	**C**
4	**C**	24	**D**
5	**D**	25	**A**
6	**C**	26	**A**
7	**A**	27	**A**
8	**A**	28	**D**
9	**A**	29	**B**
10	**C**	30	**D**
11	**A**	31	**A**
12	**D**	32	**C**
13	**B**	33	**C**
14	**A**	34	**C**
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20	**D**	40	**A**

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Question 39

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PHYSICAL SCIENCE

Paper 0652/21
Core Theory

Key Messages

Candidates need to have a knowledge of basic facts and be able to relate practical experiments to theory.

General Comments

There were some very good scripts which showed that the candidates had been well prepared for the examination and had also put in considerable effort in learning facts and developing their understanding of the concepts. Weaknesses still exist in the use of scientific language, particularly in the electrical and nuclear topics.

Comments on Specific Questions

Section A

Question 1

The question, about simple chromatograms, it is clear that many candidates had carried out this type of experiment, and had some idea of the general techniques and the interpretation of the results.

(a) Although the majority of candidates had some understanding of the reason for keeping the water level below the line of ink dots, few expressed themselves in a clear, concise manner.

(b) Some candidates recognised that a reason for the failure of ink spot **A** to spread was its insolubility; candidates rarely went on to give the full explanation that it was in soluble in water. A common misconception was that the ink had a single component only.

(c) (i) The vast majority of candidates scored this mark, although a few counted the original spot as well as the three new spots.

(ii) Many candidates recognised a similarity between the two inks; fewer were able to articulate the difference between the two. Other candidates missed potentially good answers by not referring to the components, only the position of the spots.

Question 2

The question showed candidates were familiar with this type of work and despite weaknesses in processing information, most candidates were able to demonstrate some understanding.

(a)(i) This was done well; the care taken was evident in the number of candidates who drew perpendicular lines down from the front of the vehicle to the metre ruler.

positions of car / cm: 75, 51, 27, 3

(ii) The majority of candidates had an understanding of the interpretation of the pictures and although there was some had difficulty in expressing themselves, there were some good answers.

(iii) There were many correct answers; the most common error was a failure to recog... speed is equal to the change in distance divided by time elapsed. Another error, ... significant number of candidates, was to think that the time intervals were 20s, not 0.20s

speed = 120 c...

(b) Whilst most candidates recognised that the car was accelerating down the slope, some were confused by the direction of numbering on the metre ruler and thought that the car was decelerating.

Question 3

Some candidates found this question very challenging.

(a) A few candidates were able to identify the alkali used to make potassium nitrate, most giving potassium metal as their answer. More recognised that the acid should be nitric acid. Commonly seen wrong answers were nitrate and nitrogen.

(b) Few were able to identify the reaction as a neutralisation reaction.

(c) Most candidates recognised that the water needed to be evaporated off in order to get crystals of potassium nitrate. A few gave further details, such as cooling (where direct heating was used) or drying. Some went into detail of filtering, expecting the crystals to be found in the residue.

Question 4

Candidates need to understand that convection can produce down-drafts as well as updrafts and be able to explain why these air currents happen. Candidates' answers indicated that the incomplete explanation that 'heat rises' is still commonly understood to be enough of an explanation; candidates need to refer to density changes in their explanations.

(a) (i) A few candidates recognised that the experiment demonstrated convection. Candidates benefit from seeing this type of experiment first hand.

(ii) A few candidates showed an understanding of why the smoke is drawn through the apparatus.

(b) (i) Candidates should be aware that the Earth is heated by the sun, primarily, by visible and infra red radiation.

(ii) An understanding that the rocks, hotter than the surrounding ground, heat the air, which then rises to form the thermal was required to answer this part.

Question 5

Many candidates demonstrated some understanding but needed to be able to show an understanding at a deeper level for full credit.

(a),(b) This is a standard equation which should be familiar to all candidates.

(c) Many candidates answered this question by repeating the question, for example *'Because hydrogen is a clean fuel*', or, '*because it does not produce any pollutants*'. Answers to a question must add substantially to the information given in the question in order to be awarded credit. For example a statement such as *'It does not produce any pollutants, such as carbon dioxide*', while not a perfect answer, gives additional, pertinent information of substance. Candidates who stated that the product of the reaction is water needed to go on to say that water is the only product to be awarded credit.

(d) Many scripts gave answers that did not go far enough. For example, it is not enough to say that hydrogen is expensive, without saying why – that it is expensive to extract from water.

Question 6

The question explored candidates' knowledge of wave behaviour and the electromagnetic spectrum. There were some good answers but some candidates struggled to recall salient terminology and behaviours.

(a) Relatively few candidates were able to name the phenomenon that was being demonstrated by the experiment.

(b) Although a few candidates scored all three marks, the majority scored one or two.

(c) (i) Many candidates struggled to recall the names and order of the regions of the electromagnetic spectrum.

(ii) This was not answered well.

Question 7

Candidates performed well on this question, which explored the properties of the halogens and their reaction with Group I metals.

(a) This was well understood by most candidates, although a few candidates stated that this was because chlorine is a non-metal or because it is a halogen.

(b) Most candidates recognised that fluorine is a gas at room temperature.

(c) Candidates generally seemed aware that the reactivity of the halogens decreases going down the Group.

(d) (i) Most candidates correctly surmised that the compound formed when chorine reacts with sodium is sodium chloride. Candidates were asked to *name* the compound so the chemical formula was not sufficient for credit

(ii) The answers were split, fairly evenly between the correct answer, ionic, and the incorrect one, covalent. To be able to answer this type of question with confidence, candidates need to understand basic ideas of chemical bonding.

Question 8

This question required a good fundamental knowledge of magnetism and a deeper understanding of the magnetic effect of an electric current.

(a) This question required candidates to recognise that the compass needle is a small magnet and then make the deduction that movement of the needle implies that there is a change in the magnetic field around the needle, inferring that the change in the magnetic field is associated with a change in the current in the wire. This is a challenging question, and only the strongest candidates were able to make the deduction correctly.

(b) (i) This part was done well with most candidates gaining the first mark and many gaining the second as well.

(ii) Again, this was well done, with most candidates recognising that soft iron will only act as a temporary magnet.

(iii) There were some good descriptions of the effects observed, which were clearly understood by many candidates.

Question 9

A number of candidates found this a challenging question. Candidates need to have a good know[ledge of] basic facts.

(a) Although some candidates were aware of the steps in purifying water there were a considerable number who were muddled.

(b) Candidates need to be familiar with simple tests for the presence of different materials. In this case relatively few candidates were aware of this common test.

(c) Few candidates were aware of the test for pure water. The unique boiling and freezing points of a pure material will always identify it.

Question 10

The question explored candidates' basic understanding of simple circuitry, in particular the difference between series and parallel circuits.

(a) (i) Many candidates found the resistance of the two resistors in series but then went ahead to use this in the equation $V = IR$ and gave the current value of 0.5 as the resistance.

resistance = 12 Ω

(ii) Most candidates correctly applied the formula to get the correct value of the current (relative to their answer in **(a)(i)**). However, many gave an incorrect unit.

current = 0.50 A

(b) (i) Relatively few candidates knew that potential difference is measured with a voltmeter. Many candidates named components which were unrelated to measurement such as variable resistance.

(ii) The use of the voltmeter was not well known. Of those who knew that a voltmeter is connected in parallel with the component across which the potential difference is being measured, a few drew it across both resistors (or across the battery).

(iii) Only the most able candidates were able to tackle this problem in a meaningful way.

Potential difference = 2.0 V

(c) (i) A good number of candidates understood the concept of a parallel circuit and completed the circuit diagram correctly.

(ii) Few candidates were able to state that a parallel circuit has a lower resistance than a series circuit using the same components. A common error was to describe the current as moving faster (or slower). Candidates should be aware that current is a rate – the rate of change of charge.

Question 11

(a) Only a few candidates showed an understanding of the meaning of a homologous serie recognised that the term had been met in the study of hydrocarbons – but rarely did cand refer to relevant points such as a common functional group.

(b) This section was done extremely well with many candidates scoring all three marks. It is very pleasing that candidates have the understanding to be able to derive a chemical formula from the structural formula and vice versa.

(c) Few candidates recognised that the primary use of methane is as a fuel, with many thinking that it could be used as a solvent or as a base for making alcohols.

(d)(i) There was a general recognition of the difference in bonding which distinguishes alkenes from alkanes.

(ii) Only a few candidates were able to describe the relevant test.

Question 12

(a) (i) Only a very few candidates were able to demonstrate an understanding of nuclear fission. Of these few candidates, some of them spoilt their answers through a use of incorrect language. It is important to recognise that in fission it is the nucleus of the atom which splits into two approximately equal parts, not the atom itself.

(ii) The question asked the candidates to name the type of energy that the particles possess due to their motion. A commonly seen error was *nuclear*.

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Question 13

The question investigated candidates' knowledge and understanding of stoichiometry. There were some excellent answers, showing genuine understanding. Most candidates demonstrated some knowledge of the required processes.

(a) The majority of candidates successfully calculated the relative molecular mass of potassium nitrate. The most commonly seen error was to add the relative molecular masses of potassium, nitrogen and oxygen, without recognising the different numbers of atoms of each in the molecule.

$M_R = 101$

(b) As in part **(a)** most candidates were able to calculate the relative molecular mass of potassium phosphate and a considerable number were able to take the calculation forward to show that the percentage of potassium (by mass) is greater than 50%.

PHYSICAL SCIENCE

Paper 0652/22
Core Theory

Key Messages

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General Comments

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$M_R = 101$

(b) As in part **(a)** most candidates were able to calculate the relative molecular mass of potassium phosphate and a considerable number were able to take the calculation forward to show that the percentage of potassium (by mass) is greater than 50%.

PHYSICAL SCIENCE

Paper 0652/31
Extended Theory

Key Messages

It is important that candidates communicate clearly, both when describing a technique, explaining a principle or attempting a numerical problem. There are always marks to be gained for candidates who attempt a problem but fail to get the correct answer, provided the Examiner can understand what the candidate is trying to do and can see correct steps in the calculation.

General Comments

There were some outstanding papers with candidates showing a really good understanding of the syllabus. All candidates showed knowledge of some of the work and were able to access at least parts of the paper.

Comments on Specific Questions

Question 1

The question explored candidates' ability to interpret experimental results and to make a simple calculation of acceleration from a speed-distance graph.

(a) (i) The vast majority of candidates took care in reading the position of the car. Many correctly calculated the distance travelled. The most common error was to calculate the distance travelled in successive time intervals rather than the total distance travelled.

Position of trolley/cm; 87, 67, 39, 3.
Total distances travelled/cm; 12, 32, 60, 96.

(ii) There were some excellent graphs. The most common errors were to miss out the (0,0) point and to join the points with a ruler rather than to draw a single smooth curve.

(b) There were many good answers. Common errors were to take the maximum speed, not the change in speed, and to confuse units (giving m/s^2 or cm/s rather than cm/s^2)

acceleration = 206 cm/s^2

Question 2

This was a straightforward question exploring electronic configurations on particles, their charges and chemical combinations.

(a) Although the majority of candidates gave the correct chemical symbol for the different particles, relatively few were able to show the correct charge.

(b) This part was answered well, with most scoring the mark.

Question 3

The question looked at trends amongst the noble gases and explored why helium is used in lighter than air balloons.

(a) Most candidates recognised that the boiling points of the gases increased down the group.

(b) Candidates are not expected to know the precise value of boiling points of elements. The question looked at trends and it is pleasing that the vast majority of candidates were able to make a sensible estimate of the boiling point of argon.

(c) This part of the question, done well by many, was challenging for many others. Candidates were expected to give a reasoned answer, using data from the stem, to explain why helium could be the only suitable gas to use in this lighter than air balloon. Many scripts gave only a qualitative answer. As a general rule, where precise figures are given, candidates will be awarded credit for using those figures quantitatively.

Question 4

The question looked at the use of a thermocouple as a thermometer.

(a) All but a handful of candidates recognised that the two wires should be made from two suitable, different metals.

(b) Some candidates recognised that there would be a change in the reading on the voltmeter; very few recognised that the different temperatures at the two junctions caused an e.m.f. across the voltmeter. A large number thought that the thermometer measured two temperatures at the same time.

(c) Common errors were to state that the thermocouple was more accurate than a 'ordinary' thermometer and that it detected smaller temperature changes. These properties of a thermocouple rely on the accuracy and the sensitivity of the voltmeter used (and the calibration used in converting an e.m.f. to a temperature difference) rather than being intrinsic to the thermocouple itself.

Question 5

This required candidates to have a good understanding of covalent bonding and the consequence of the bonding on the properties of the materials.

(a) (i) While a good number of candidates recognised that the covalent bonds in diamond are strong, few went on to state that the bonding between layers in graphite is weak.

(ii) Once more, the simple idea that there are free/mobile electrons in graphite was well known, but few candidates took the explanation further, explaining that the free electrons are from the bonding between layers, or conversely, that all the valence electrons in diamond are used in covalent bonding.

(iii) In this section many candidates tried to compare the melting points of diamond and graphite rather than explaining why they both have high melting points. It is important that candidates read the question carefully and answer the question that is set.

(b) The important point here is that although the bonding <u>within</u> the methane molecule is very strong (covalent), the forces <u>between</u> methane molecules are very small. Very few candidates picked up this point.

(c) (i) The majority of candidates used their understanding to give a totally correct equation.

(ii) There were some excellent answers here, some discussing chlorophyll and chloroplasts going much deeper than was required. Where marks were lost it tended to be because candidates did not explain that the energy from the sun was absorbed by the plant.

Question 6

The question tested the ability of candidates to apply basic concepts in an unfamiliar situation.

(a) (i) A few answers demonstrated a good depth of thought. Many answers stated simply that aeroplane was a long way from the transmitter.

(ii) Understanding of the use of a c.r.o. was very limited, with few candidates being able to calculate the time lapse between the pulses.

time = 2.25×10^{-4} s

(iii) The vast majority of candidates simply multiplied the speed by the time calculated in **(ii)**, not recognising that the pulse had to travel to the aeroplane and back again.

distance = 34 000 m

(b) (i) This required a straight application of the wave equation ($c = f\lambda$). The speed of microwaves was given in the previous section, but relatively few candidates used this correctly. Many candidates did not convert the wavelength from millimetres to metres to match the units of the wave speed.

frequency = 4.0×10^{10} Hz

(ii) This was done quite well, although many answers – such as, '*in (mobile) phones*' – needed to be worded more precisely for credit. In the example given, candidates needed to explain that '*the signal from a mobile phone is transmitted by microwaves*'.

Question 7

(a) The graph was plotted and drawn well. The most commonly-seen errors were joining the points by straight lines and a failing to include the (0,0) point.

(b) The vast majority were familiar with the test for carbon dioxide. Generally, candidates should be encouraged to give a full answer when asked for a test, for example, explaining how the carbon dioxide is introduced to the lime water (e.g. '*bubble carbon dioxide through the limewater*'). A few candidates stated the extinguishing of a lighted splint was a test for carbon dioxide.

(c) (i) A good number of candidates correctly deduced from the information that as there were still marble chips remaining the acid must have all been used.

(ii) Most candidates were able to correctly calculate the RMM of calcium carbonate. Fewer were able to take the calculation further; the fact that the volume had to be found from the graph in **(a)**, causing difficulty.

mass = 0.17 g

(d) Where candidates understood the chemistry, the sketch graph was drawn well. A significant proportion found this part difficult.

Question 8

(a) (i) Most candidates recognised that these were step up and step-down transformers with proportion stating that the 'up and down' referred to the voltage.

(ii) Some candidates recognised that transmitting electricity at high voltages saves energy. A few wen on to explain that this was because a lower current is used (for the same power transmission).

(b) (i) Most candidates recognised that copper is a good conductor and therefore suitable for transmission of electrical energy. For full credit, candidates needed to explain why the structure of copper makes it a good conductor. Few candidates answered fully.

(ii) This section tested candidates' ability to think about a real situation. Copper cables tend to stretch over time under their own weight and the steel is used to strengthen the cable.

Question 9

The question required candidates to show an understanding of basic organic chemistry, in particular, the production of ethanol from ethane and fermentation.

(a) There were some very good answers with many gaining full marks. Common errors were to add a pair of extra electrons in the carbon atoms or to draw the structure of ethane.

(b) (i) The majority of candidates recognised (catalytic) cracking. A number were unable to name the process – the most common error was to think that this was an example of polymerisation.

(ii) Many candidates scored 1 mark out of 2, but few scored both marks. A common error was to refer to 'high heat' rather than high temperature.

(c) (i) To answer this question successfully candidates needed to calculate the RRM for both ethene and ethanol. A few candidates succeeded in doing even this but a significant proportion then did not know what to do with these figures.

mass = 1.7 kg

(ii) This was done well with most candidates showing a good understanding of fermentation. The most common error was to state that the process takes place at a high temperature.

Question 10

The question tested candidates' knowledge and understanding of the process of nuclear fusion, ... use of the Einstein formula $E = mc^2$.

(a) (i) This was poorly answered, with candidates confusing fusion with fission and simple radioactive decay. Amongst those who demonstrated some understanding, many stated that fusion was the joining of two atoms to make a larger atom. At the temperatures at which fusion occurs, all electrons have been stripped of all their electrons, leaving a plasma of electrons and nuclei. It is these nuclei which fuse to make larger nuclei.

(ii) This was done quite well. It is important that candidates are accurate when naming electromagnetic radiation. For example, *visible light* is much better than the simple *light*; similarly *infra red* is more precise than *heat*.

(b) The powers of ten involved in the calculations in this question made the arithmetic difficult for many candidates.

(i) This question required that the mass of two deuterium nuclei be subtracted from the mass of the products. Some candidates may have lost credit available for working as a result of poor and confusing layout.

(ii) Very few candidates recognised that the mass in the equation is the mass lost during the process, not the total mass of the products.

energy = 5.2×10^{-13} J

(iii) Candidates needed to deduce that number of reactions per unit time is equal to the total energy released per unit time divided by energy released in each reaction.

number of reactions per second = 8×10^{38}

PHYSICAL SCIENCE

Paper 0652/32
Extended Theory

Key Messages

It is important that candidates communicate clearly, both when describing a technique, explaining a principle or attempting a numerical problem. There are always marks to be gained for candidates who attempt a problem but fail to get the correct answer, provided the Examiner can understand what the candidate is trying to do and can see correct steps in the calculation.

General Comments

There were some outstanding papers with candidates showing a really good understanding of the syllabus. All candidates showed knowledge of some of the work and were able to access at least parts of the paper.

Comments on Specific Questions

Question 1

The question explored candidates' ability to interpret experimental results and to make a simple calculation of acceleration from a speed-distance graph.

(a) (i) The vast majority of candidates took care in reading the position of the car. Many correctly calculated the distance travelled. The most common error was to calculate the distance travelled in successive time intervals rather than the total distance travelled.

Position of trolley/cm; 87, 67, 39, 3.
Total distances travelled/cm; 12, 32, 60, 96.

(ii) There were some excellent graphs. The most common errors were to miss out the (0,0) point and to join the points with a ruler rather than to draw a single smooth curve.

(b) There were many good answers. Common errors were to take the maximum speed, not the change in speed, and to confuse units (giving m/s^2 or cm/s rather than cm/s^2)

acceleration = 206 cm/s^2

Question 2

This was a straightforward question exploring electronic configurations on particles, their charges and chemical combinations.

(a) Although the majority of candidates gave the correct chemical symbol for the different particles, relatively few were able to show the correct charge.

(b) This part was answered well, with most scoring the mark.

Question 3

The question looked at trends amongst the noble gases and explored why helium is used in lighter balloons.

(a) Most candidates recognised that the boiling points of the gases increased down the group.

(b) Candidates are not expected to know the precise value of boiling points of elements. The question looked at trends and it is pleasing that the vast majority of candidates were able to make a sensible estimate of the boiling point of argon.

(c) This part of the question, done well by many, was challenging for many others. Candidates were expected to give a reasoned answer, using data from the stem, to explain why helium could be the only suitable gas to use in this lighter than air balloon. Many scripts gave only a qualitative answer. As a general rule, where precise figures are given, candidates will be awarded credit for using those figures quantitatively.

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(ii) This was done quite well. It is important that candidates are accurate when naming electromagnetic radiation. For example, *visible light* is much better than the simple *light*; similarly *infra red* is more precise than *heat*.

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(i) This question required that the mass of two deuterium nuclei be subtracted from the mass of the products. Some candidates may have lost credit available for working as a result of poor and confusing layout.

(ii) Very few candidates recognised that the mass in the equation is the mass lost <u>during</u> the process, not the total mass of the products.

energy = 5.2×10^{-13} J

(iii) Candidates needed to deduce that number of reactions per unit time is equal to the total energy released per unit time divided by energy released in each reaction.

number of reactions per second = 8×10^{38}

PHYSICAL SCIENCE

Paper 0652/51
Practical Test

Key message

When instructed to indicate on the graph the values used to calculate the gradient, it is important to show these values on the graph rather than in the space provided for the calculation.

General comments

Candidates were able to attempt all questions on this paper and only a very small number of candidates left parts unanswered.

Comments on specific questions

Question 1

Following instructions, making measurements and recording observations are skills required for this paper. A number of Centres used lenses where the focal length was not the specified 15 cm. However this was allowed for in the mark scheme and candidates were not penalised.

The table in part **(a)** was always completed. Common errors were not recording distances to the nearest mm and using too few significant figures for the values of *v* and *u*.

Although a large range of responses were accepted for part **(b)**, this part was not answered well.

For part **(c) (i)**, the graph axes were usually labelled correctly; however the scales chosen did not always make the best use of the grid. Where the scales were sensible, the plotting was usually carried out accurately. A small number of candidates plotted points as unacceptably large blobs. Some candidates plotted *u* wrongly. A significant number of candidates drew curves despite the instruction to draw the best fit straight line. Odd scales should be avoided wherever possible as this makes plotting difficult and time-consuming for the candidates.

For part **(c) (ii)** candidates were asked to indicate on their graphs the values chosen for calculating the gradient. Candidates were unable to be awarded full credit if this was not seen. Gradients calculated directly from table values only gained credit if the best straight line passed through these points.

The calculation in **(c) (iii)** did not present any problems and the accuracy mark was related to the $u = 30$ cm reading. This accuracy mark was generally awarded to candidates who had carried out the experiment well (even if they used a lens with a different focal length).

The last part was well answered.
.

Question 2

In part **(a)**, most candidates reported a black colour, but some thought it was a liquid because of the way the powder was moved by the evolved gas.

The colour change on adding the hydrochloric acid to **X** in **(b) (i)** was often not recorded but most candidates reported a change in the limewater. For the limewater test candidates should be reminded that ‘cloudy’ is not an acceptable alternative to ‘milky’ or ‘white precipitate’. Most candidates stated that the gas was carbon

dioxide but this answer was only credited when evidence of a gas or a change in the limewa
recorded. Identification of the anion as a carbonate was not dependant on any other responses.

Parts **(b)(ii)** and **(c)(i)** were well answered. For part **(c)(ii)** many candidates recorded only '*blue p*
'*dark blue solution*' rather than both answers, and could not be awarded full credit. Many candidates nee
to use the word '*precipitate*' or its abbreviation '*ppt*' where appropriate. Alternative descriptions were generally not accepted. The misuse of '*soluble in excess*' or '*insoluble in excess*' was commonly seen, for example, '*blue ppt insoluble in excess to give a dark blue solution*'.

The displacement reaction in **(c)(iii)** worked well and the full range of observations was seen. The most common responses were '*bubbles*' and '*magnesium goes black*'. A relatively small number of candidates were able to identify the type of reaction.

X was often identified correctly as copper carbonate. Those candidates just giving '*copper*' as their answer did not gain credit.

PHYSICAL SCIENCE

Paper 0652/61
Alternative to Practical

Key Messages

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

General Comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques.

Comments on Specific Questions

Question 1

In this question candidates were using temperature rises to compare the conduction of heat by three different materials.

(a) Most candidates read whole number temperatures correctly, but a few tried to read the temperature to more than one decimal place aiming for greater precision than the apparatus allowed, a recurring theme throughout the paper for a few candidates.

(b) Some candidates ignored the temperature of the water bath (80 °C) when predicting that the final temperature of the water in the bottles would reach 100 °C!

(c) Nearly all candidates correctly ordered the three materials in order of decreasing ability to conduct heat correctly

(d) Some candidates appreciated that the thickness of the material, not the bottle, could affect the rate of heat conduction through the walls of the bottles, and most could fix at least one variable to ensure a fair test. Candidates needed to refer explicitly to the temperature and volume of the water in the bottle, not the tank.

(e) Many candidates knew that electrons, not ions, were responsible for conducting heat energy through a metal, but very few attributed the inability of electrons to travel through plastic and glass to the covalent bonds present in those materials.

Question 2

In this question candidates are using an illuminated object, converging lens and screen to measure t

(a) Most candidates could read a metre rule correctly. Candidates needed to realise that results m be tabulated to the same degree of accuracy as results which have been entered already on the question paper.

(b) Most candidates plotted the results correctly, but a few candidates confused the scales and did not heed the very different scales on each axis. Most drew a line of best fit correctly, and a number showed how they found the gradient, ideally by drawing a triangle, on the graph as instructed; a few used values from their table. A few candidates needed to make sure the graph between the points used for the determination of the gradient was a straight line.

Question 3

In this question candidates are analysing a green powder through thermal decomposition, precipitation and displacement reactions.

(a) Nearly all candidates knew that carbon dioxide turns limewater milky, and most interpreted this test to imply a carbonate was present. A few candidates suggested carbon instead.

(b) Most candidates scored both marks for a labelled diagram illustrating filtration. A few omitted either the funnel or the filter paper.

(c) Few candidates identified copper hydroxide as the precipitate on adding dilute ammonia to an aqueous copper salt; fewer referred to the blue solution formed in excess ammonia.

(d) A few candidates correctly described the changes in appearance of the solution or iron filings when displacing copper from copper nitrate solution.

(e) Many candidates deduced that solid **X** was a sulphate or a compound of iron; the best candidates used correct observations to deduce that solid **X** was copper carbonate.

Question 4

Candidates were expected to understand the preparation of a soluble salt by neutralisation of sulphuric acid by sodium hydroxide.

(a) The burette was correctly read by the majority of candidates; many either gave greater accuracy for their reading than the scale, or inverted the scale.

(b) Candidates in general answered in terms of molar amounts, despite the clear indication in the question that the concentrations were unknown, instead of heeding the reference to litmus changing colour and answering in terms of neutralisation and the contrasting acidity and neutrality of the two possible salts.

(c) The very best candidates scored maximum marks for describing the preparation of sodium sulphate by titration, evaporation, etc. Many candidates thought that excess sodium hydroxide could be filtered off, while others thought that the salt formed as a precipitate during the titration.

(d) Rather than halving the volume of sodium hydroxide in order to prepare sodium hydrogen sulphate, most candidates suggested that a change in the crystallisation procedure was needed, such as not heating to evaporate off water.

Question 5

Candidates were expected to identify some elements from Period 3 from symbol, method of stora appearance, and to distinguish between the acidic nature of non-metal oxides and the basic nature of metal oxides.

(a) Almost all candidates identified magnesium and many identified silicon rather than silica.

(b) A significant number of candidates thought that P was potassium, and suggested that Potassium should be stored under water.

(c) The colour of chlorine was well known. Candidates needed to refer to the appearance of the gas for identification, so answers describing a test for chlorine could not be accepted.

(d) Some candidates realised that electrical conductivity was a suitable test for all metals. Several candidates chose to react aluminium with an acid or proposed other non-general metal tests.

(e) Most candidates knew that sulfur burns with a blue flame. Some candidates proposed that the reason for adding the water to the jar was to "cool it" or "to put out the flame". Many scored well on the colours of universal indicator.

Question 6

This question required the candidates to calculate resistance from a given formula from the readings on voltmeters and ammeters and to have general knowledge of simple circuits.

(a) Most candidates scored some marks; some candidates lost marks by not recording their reading to the appropriate precision. If candidates did make mistakes reading the meters, ecf was used to mark their answers for resistance in this question and in **(b)(i)**.

(b) The most commonly suggested reason for the variation in the resistance values was a reference to the variation in the variable resistance or the current and voltage. A large proportion of candidates realised that the results should be averaged.

(c) Electrons were often identified as the particles involved in conduction, but not many gave the correct direction of travel in the circuit.

PHYSICAL SCIENCE

Paper 0652/62

Alternative to Practical

Key Messages

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

General Comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques

Comments on Specific Questions

Question 1

This question examined the heating effect of an electric current.

(a) Candidates had to read an ammeter and voltmeter and then use their readings to calculate the power output of a heater. The vast majority had no problem reading these meters to the precision asked for, and any errors in one part of the question did not penalise the candidate in subsequent calculations.

(b) Candidates proved less able to read thermometers, with some candidates unsure whether to read down from 40 or up from 30. The question asked the candidate was required to read and record to the nearest 0.5 ^{o}C; this means that the candidate needed to record 35.0 rather than 35 in the table.

(c) Candidates who looked at Fig. 1.1, as instructed, found the two methods that were used to prevent heat loss during the experiment.

(d) Candidates had to refer to molecules moving faster or state that collisions between molecules were more energetic; "they gained energy" was insufficient to answer the question.

Question 2

This question required the candidate to find the mass and volume of a metre rule and thus calc density of the material from which it was made.

(a) Candidates had to read the position of a circle, representing the mass, on a rule. Candidates who failed to gain credit here failed to follow the instruction to read the position of the centre of the mass **M**. The candidates were asked to record their results into an already partially-filled table. The results given in the table were an indication of the level of precision required in all the recorded numbers; the candidates needed to record all of their results to one decimal place, i.e. 68.0 rather than 68.

(b) A grid was provided and five points had to be plotted, the three already given as well as the two rs calculated by the candidate. A best straight line was required. The vast majority of candidates plotted these points well. Candidates who find their lines zig-zagging over the page should take this as an indication that they need to check their working carefully.

Some candidates found it difficult to plot the graph. Candidates were given an instruction to show on the graph the values used in calculating the gradient. This was often ignored.

(c) The gradient was used to calculate the mass of the rule using the equation given. Whatever value the candidate calculated for the gradient could be used and no further loss of marks occurred provided the answer calculated was correct.

(d) Candidates were instructed to use the symbols shown to show how they could be used to find the density of the material. Candidates that did not use these symbols could not gain credit for this part of the question.

Question 3

This question consisted of a series of tests, observations and conclusions made by a student with the purpose of identifying the ions present in a solution of an unknown solid. Candidates need to be aware of the tests and results involved in analytical chemistry.

(a) When dilute nitric acid is added to the unknown a gas is given and a green solution formed, the candidate would have observed bubbles rising in the solution. The green colour suggests the presence of a transition metal. Candidates are told that the student concludes that unknown solid contains carbonate ions, and should be able to deduce from that that the bubbles of gas must have turned limewater cloudy. Similarly, the conclusion that the solid contains chloride ions should indicate that the student would have seen the formation of a white precipitate when aqueous silver nitrate was added to the solution of the solid in nitric acid.

(b) The cations were identified, by the addition of ammonia solution and sulfuric acid, as copper (II) and iron (III). Again, candidates needed to be able to work backwards from the conclusions to the observations that the student must have made.

(c) Finally candidates had to name the salts that could have been used to make the unknown solution. Either iron (III) chloride and copper (II) carbonate or copper (II) chloride and iron (III) carbonate were acceptable.

Question 4

Candidates looked at the distillation of crude oil and some of the properties of the fractions.

(a) Many candidates correctly identified the piece of apparatus labelled **X**, but many struggled to la the correct direction of water flow on the diagram.

(b) Many candidates gave melting point temperature or density as a difference, but some candidates failed to give a physical property, or simply said "*temperature*".

(c) Most candidates were able to draw the molecule of hexane.

(d) Most candidates thought that the production of carbon dioxide was the reason that black smoke was produced, others stated the colour was caused by carbon in the flame, although correct this did not score as it did not answer the question.

(e) Candidates were asked to give an example of an environmental problem caused by crude oil escaping from a drilling rig **and** state which fraction is most likely to cause the damage. Many candidates gave answers such as "acid rain" or "global warming" indicating that they needed to read the question more carefully.

Question 5

Three samples of vinegar were titrated with aqueous sodium hydroxide and pure dry crystals of sodium ethanoate were prepared.

(a) The scales were read correctly by many candidates. Some candidates failed to check the direction of the scales, confusing 28.2 with 27.8, for example. Most candidates were able to identify the most and least concentrated samples.

(b) Candidates had to complete a word equation in the form; Acid + Alkali = Salt + Water. The acid and alkali were given to the candidate. It was rare to see a correct equation even though the salt, sodium ethanoate, was given in the question. Few gave the correct colour of full range indicator for a <u>weak</u> acid, many candidates stating '*red*' or a shade of red.

(c) When asked to describe how the student could prepare pure dry crystals of sodium ethanoate, a number of candidates felt unable to make an attempt and left the answer space blank. As can be seen by the number of lines and mark award of (4) a detailed answer was required. Some candidates gave the simple description '*crystallise*', with no further experimental detail.

Question 6

Candidates were asked to take measurements relating to a wave drawn by a pen attached to a harmonic oscillator (a springy strip) on a moving tape underneath.

(a) A trace was shown and the candidate was asked to describe how the amplitude of the wave was changing. By the answers, given a large number of candidates need to be more familiar with the term amplitude.

Candidates had to measure the wavelength of one of the waves shown in a diagram. Candidates needed to follow the instruction "to the nearest 0.1 cm". The candidates were given the formula linking speed to frequency and wavelength, and many were able to rearrange this to calculate a frequency.

(b) Candidates had to convert a wavelength into a speed. They were reminded that one wave takes 0.25 s, which information was also given to them at the start of the question. Candidates were also asked to give the unit for speed. Although some candidates tried to put figures in the space for units, many candidates scored well here.

(c) Candidates were required to calculate the speed of the trolley at a different point.

(d) Candidates were asked to show that the trolley accelerated between the above points. The question said that the trolley accelerates, so the simple answer "it gets faster" failed to score. Candidates needed to make reference to their calculations in **(b)** and **(c)**, as instructed in the question.