PHYSICAL SCIENCE

Paper 0652/11
Multiple Choice

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

General comments

Candidates found **Questions 1**, **2, 14, 20 and 22** straightforward, but had the most difficulty with **Questions 6**, **29**, **30**, **31**, **35**, **38** and, particularly, **36** and **37**.

Comments on specific questions

Question 3

Weaker candidates incorrectly believed that separating coloured dyes by chromatography is a chemical process.

Question 4

Stronger candidates were able to identify a different isotope of sodium. However, many other candidates did not understand that isotopes of the same element contain the same number of protons and a different number of neutrons.

Question 5

Most candidates recognised that each hydrogen atom shares a pair of electrons with the oxygen atom but many weaker candidates ignored the fact that there are two pairs of electrons not used in bonding in the oxygen atom and chose option **A**.

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Question 6

The structure and properties of diamond and graphite were not well understood by many candidates.

Question 7

Stronger candidates were able to deduce the stoichiometry of the equation.

Question 11

The products of the reaction between magnesium, a metal, and dilute sulfuric acid were not well known by many candidates. There was a misconception even amongst stronger candidates that water is one of the products.

Question 12

The idea that metallic oxides are basic was not well understood. Many candidates thought that sulfur is a metal and forms a basic oxide.

Question 13

The tests for cations and anions were not well known by candidates.

Question 15

Most candidates recognised that transition metals have high melting points and are good conductors of electricity but the fact that they often act as catalysts was less well known.

Question 16

Stronger candidates answered this question correctly.

Question 17

Most candidates knew that copper is the least reactive of the elements but other candidates thought that magnesium is more reactive that calcium and chose option **A**.

Question 19

Stronger candidates knew that the products of the complete combustion of methane are carbon dioxide and water.

Question 23

Many candidates believed mass and weight were alternative names for the same property and so incorrectly chose option **D.**

Question 25

In this question on energy and energy resources, a common mistake was believing geothermal energy is a store of gravitational potential energy.

Question 27

A significant number of candidates thought that conduction occurs in a vacuum in addition to radiation.

Question 29

The popularity of all options here indicated a lack of confidence about the position of the image formed by a plane mirror.

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Question 30

In this question about the focal length of a converging lens, many candidates selected **C** (the object distance). In addition option **B** (the image distance) was much more commonly chosen than the correct option, **A**.

Question 31

Many candidates believed that visible light waves travel at the highest speed in a vacuum rather than that all electromagnetic waves travel at the same speed.

Question 35

Many candidates thought that current and resistance could be measured using only a voltmeter.

Question 36

This question was challenging for many candidates. Only the strongest candidates selected the correct answer, option **B**. Many other candidates chose option **D**, presumably simply adding the values of all three resistors together.

Question 37

There was a lack of understanding of how a fuse works. Many candidates thought that replacing a 1 A fuse with a 5 A fuse would cause the lamp to glow more brightly, possibly considering that a higher-rated fuse with less resistance than a lower-rated one noticeably increases the current in the lamp.

Question 38

Although many candidates were aware that the atomic number was 53, some did not notice that the question asked for the value of the mass number of a different isotope and so chose the incorrect option **C**.

Question 40

The topic here was half-lives. Many candidates selected the incorrect option, **D** just dividing the initial mass by the number of half-lives.

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PHYSICAL SCIENCE

Paper 0652/12
Multiple Choice Core 12

There were too few candidates for a meaningful report to be produced.

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PHYSICAL SCIENCE

Paper 0652/21
Extended Multiple Choice

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

General comments

Candidates found **Questions 7**, **23**, **27**, **39**, **40** and, particularly, **Question 36** more challenging. Many candidates answered **Questions 1**, **2**, **5**, **21** and **22** correctly.

Comments on specific questions

Question 3

The equation for the calculation of R_f values was well known, particularly by stronger candidates.

Question 4

Most candidates understood the notation used to represent isotopes of an element.

Question 6

Stronger candidates answered this correctly. Many weaker candidates thought that the atoms in graphite four equally strong bonds and chose option **A**.

Question 9

Many candidates thought that electrons are gained at the anode and lost at the cathode and chose option **A**.

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Question 10

A significant number of candidates thought that the energy level diagram indicated the number of bonds broken and formed during a reaction.

Question 13

Most candidates understood that a base is a proton acceptor.

Question 16

Many candidates did not realise that dilute hydrochloric acid contains chloride ions and is not used to acidify the aqueous silver nitrate in the test for a chloride ion.

Question 17

Stronger candidates recognised that gas X is methane and that it is a main constituent of natural gas.

Question 18

Stronger candidates answered this correctly.

Question 19

The addition of bromine across the double bond was well known by many candidates but some candidates though that the –OH group bonds to the end carbon atom and chose option **D**.

Question 23

This question was challenging for many candidates.

Question 24

Some candidates did not multiply the mass by 10 to find the weight of the cube, leading them to choose option **A**.

Question 26

A significant number of candidates believed that geothermal energy is a store of gravitational potential energy.

Question 29

The most common error in this question on transfer of heat through a vacuum was to think that conduction is also involved (option **D**).

Question 30

Many candidates knew that the image produced is enlarged, but some did not recognise that it is also virtual as the lens is acting as a magnifying glass.

Question 31

Many candidates did not calculate the distance between the Sun and the Earth and so chose either option **C** (failing to convert the time to seconds) or option **B** (failing to convert the time to seconds and dividing speed by time instead of multiplying).

Question 35

As in **Question 31**, it was common for candidates not to convert the time to seconds, leading them to choose either the incorrect option **B** (using time in minutes) or, more often, option **C** (using time in hours).

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Question 36

There was much confusion over the effect of replacing a fuse with one of a higher rating, with a significant number of candidates believing that the lamp would become brighter, possibly considering that a higher-rated fuse with less resistance than a lower-rated one noticeably increases the current in the lamp.

Question 39

Here, although many candidates were aware that alpha-particles are deflected towards a negative plate, some candidates could not deduce the effect on them of a magnetic field and therefore selected the incorrect option **B**.

Question 40

Many candidates incorrectly selected option **C**. This value is found by halving the total count rate three times without first subtracting the background count.

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PHYSICAL SCIENCE

Paper 0652/22
Extended Multiple Choice

Question Number	Key	Question Number	Key	Question Number	Key	Question Number	Key
1	C	11	A	21	A	31	D
2	D	12	D	22	B	32	B
3	B	13	D	23	D	33	B
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7	B	17	C	27	C	37	B
8	B	18	C	28	A	38	D
9	D	19	B	29	C	39	A
10	C	20	A	30	D	40	D

General comments

Questions **19**, **31**, **35**, **36** and **40** were more challenging for candidates while Questions **2**, **3**, **21**, **22**, **28**, **33** and **38** were usually answered well.

Comments on individual questions

Question 1

The relationship between relative molecular mass and rate of diffusion was well understood by the vast majority of the candidates.

Question 5

A majority of candidates understood that particles with the same number of electrons have the same chemical properties.

Question 6

Stronger candidates answered this correctly. Other weaker candidates thought that the atoms in graphite four equally strong bonds and chose option **A**.

Question 7

Stronger candidates were able to balance the equation.

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Question 8

Most candidates were able to calculate the relative molecular masses of the compounds.

Question 9

A number of candidates thought that electrons are gained at the anode and lost at the cathode and chose option **A**.

Question 10

Some candidates thought that the energy level diagram indicated the number of bonds broken and formed during a reaction.

Question 16

A significant number of candidates did not realise dilute hydrochloric acid contains chloride ions and is not used to acidify the aqueous silver nitrate in the test for a chloride ion.

Question 17

Most candidates recognised gas X is methane and that it is a main constituent of natural gas.

Question 18

Stronger candidates answered this correctly.

Question 19

This question proved challenging for most candidates.

Question 20

Most candidates recognised that the substance described by the statements is ethanol.

Question 23

Candidates who made the most common mistake in this question on moments opted for the incorrect **B**, failing to add 50 cm to the correctly calculated distance from the pivot.

Question 30

Very many candidates knew that the image produced is enlarged, but some of these did not recognise that it is also virtual as the lens is acting as a magnifying glass.

Question 31

Many candidates did not calculate the distance between the Sun and the Earth. Incorrect options were therefore option **C** (failing to convert the time to seconds) and option **B** (failing to convert the time to seconds and dividing speed by time instead of multiplying).

Question 33

Most candidates could identify the frequency that was a sound wave that could be heard by a human.

Question 35

As in **Question 31**, it was common for candidates not to convert the time to seconds, leading them to choose either the incorrect option **B** (using time in minutes) or option **C** (using time in hours).

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Question 36

There was some confusion over the effect of replacing a fuse with one of a higher rating, with a significant number of candidates thinking that the lamp would become less bright. An even greater number believed the opposite, possibly considering that a higher-rated fuse with less resistance than a lower-rated one noticeably increases the current in the lamp.

Question 38

The meaning of different isotopes of an element was very well understood.

Question 39

Here, although many candidates were aware that alpha-particles are deflected towards a negative plate, others could not deduce the effect on them of a magnetic field, and therefore incorrectly selected option **B**.

Question 40

Many candidates incorrectly selected option **C**. This value is found by halving the total count rate three times without first subtracting the background count.

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PHYSICAL SCIENCE

Paper 0652/31
Core Theory

Key messages

Candidates should attempt all questions if possible. Candidates are disadvantaged if a question asks them to choose from a list of options and they do not offer any response.

When asked for a factor that causes some change, candidates need to identify the factor and indicate how it can be altered to bring about the desired change.

Showing working for calculations often enables partial credit to be awarded for a correct method or use of a correct equation, even if a subsequent error is made.

When asked for a chemical word equation, candidates should not make things more difficult for themselves by attempting a symbolic equation. This will need both the correct formulae and to be perfectly balanced to obtain credit.

General comments

Many candidates left questions unanswered including questions where they were asked to circle one option or to tick a box. Candidates are not penalised for getting questions wrong, so they should attempt all questions.

Comments on specific questions

Question 1

(a) (i) This first question was often correctly answered but a common error was to read the midway point between 10 and 12 as being 10.5.

(ii) Almost all candidates saw the positive gradient of the graph and interpreted this as acceleration, presumably because they thought they were looking at a speed-time graph. Many stated that after 4s the ball moved at constant speed. This was not sufficient and they needed to say that the ball had stopped or that the speed was zero.

(iii) Most candidates were able to calculate the average speed. A small number made the mistake of using the 6 seconds for the duration when the ball only travelled for 4 seconds.

(b) In some cases candidates did not understand that the ball was slowing down. Many candidates chose ‘gravity’ for the first sentence, as this could easily cause an acceleration.

Question 2

(a) (i) Most candidates did not recognise the description of sodium.

(ii) This question was usually answered correctly.

(iii) Candidates seemed not to know the term ‘diatomic gas’. Helium was a common incorrect answer, being a gas.

(iv) This question was frequently answered well showing knowledge of helium having a full outer shell of electrons.

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(v) Most candidates identified sodium as having 11 electrons.

(vi) Identifying aluminium as the element which forms a 3+ ion proved to be more challenging for many candidates.

(b) (i) Most candidates knew that water was required for rusting, but many then gave air rather than oxygen as being the other requirement.

(ii) Painting and galvanising were the most popular answers. Applying oil or grease were other acceptable answers but lubrication was not considered equivalent.

Question3

(a) Most candidates could identify the pivot point in the diagram but a significant number did not attempt this question.

(b) Many candidates were able to offer moment (of a force) as the name for the turning effect of a force. A considerable number of candidates confused moment and momentum.

(c) Very few candidates were able to suggest that the size of force **F** be reduced and that the force should be applied at a lower point. Many candidates gained partial credit but others suggested widening the beaker or putting water in the beaker for example.

(d) Few candidates were able to state that the lower the centre of mass, the more stable the beaker would be.

(e) (i) Candidates were expected to draw a vertical line through suspension point A. Many did not do this and drew lines at many angles at different locations. Credit was given for drawing a line of symmetry.

(ii) For those familiar with the procedure, this was expressed clearly, often as ‘the intersection of the two lines’. However, many candidates answered without referring to the lines and this suggested they were not familiar with the technique.

Question 4

(a) (i) Only the strongest candidates were able to identify all three products of electrolysis. A minority gained partial credit, usually for mentioning oxygen at the anode.

(ii) Many candidates did not attempt this question. Those that knew what inert meant were able to gain credit.

(b) (i) The question asked for a word equation but many candidates set themselves the more difficult task of writing a symbol equation, mostly without success.

(ii) Credit was given for any pH less than pH7. pH 7 was a common incorrect answer.

(c) Few candidates realised that acidic and basic oxides were related to the oxides of non-metals and metals. Of those who did make that connection, many gave the answer the wrong way round.

(d) (i) This question was often well answered. However, adding water was a frequently seen suggestion which did not gain credit.

(ii) Many correct answers were seen with the majority of candidates recognising that it was to promote plant growth or to make the soil more fertile.

Question 5

(a) Candidates rarely mentioned that the melting point is a temperature at which something happens. ‘It is when…’ and ‘It is the point at which...’ were widely used phrases that were judged to be not creditworthy. Additionally, some candidates used the term ‘dissolve’ for the transition from solid to liquid.

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(b) Very many candidates did not recognise from **(a)** that the wax plug may be involved. They answered this part of the question in isolation and assumed a sensor of some type would detect the fire and trigger the sprinklers.

(c) The question asked for a method of thermal energy transfer. Most answers were not one of conduction/convection/radiation so it seemed that candidates did not really recognise the term 'method of thermal energy transfer'. Of the three possible methods of thermal energy transfer, radiation was the most common but was not correct.

Question 6

(a) (i) Few candidates recognised a series circuit.

(ii) Many candidates did not understand the need for a complete circuit and thought that closing one switch in the series circuit would light the bulbs.

(b) (i) While many candidates could predict the effect of switch S2, very few correctly gave the effects of switch 1.

(ii) Given a choice of three options, a minority of candidates correctly chose 'larger than' and many did not give an answer.

Question 7

(a) (i) Candidates were asked to explain why the graph became less steep and then flat. Answers needed to be about the chemical reaction (being complete). Statements about no more gas being produced were interpretations of the graph rather than an explanation.

(ii) This question was answered well with most candidates stating that the rate of reaction would increase.

(iii) Suggesting an alternative method of monitoring the reaction proved to be very challenging. The most common answer was counting bubbles but this was considered to be another method of measuring the volume of the gas produced. The expected answer was rarely seen.

(b) Although many candidates correctly described the test for carbon dioxide, many answers involving lighting/relighting and popping splints were seen.

(c) The question asked how the student would determine if a reaction was exothermic. It was common to see answers of "measure the temperature" but without an indication of how the temperature would change (increase), no credit could be given.

(d) Few candidates recognised that the flour, a fine powder, had a large surface area**.** No credit was given for ideas about being very reactive or flammable.

(e) (i) The expected answer of (thermal) decomposition was seen infrequently but credit was given for stating that the reaction was endothermic.

(ii) Many candidates found the task of writing a symbol equation challenging. It was common for the correct formulae to be written down but with reactants and products swapped or mixed up, e.g. $CaCO_3 + CaO \rightarrow CO_2$

(f) Many candidates knew that CO_2 in the atmosphere was a cause of global warming but then incorrectly went on to link this with damage to the ozone layer.

Question 8

(a) Answers needed to be about the nucleus not about the atoms. "Same symbol/element" was not accepted for same proton number. Relative atomic mass was not accepted for mass number.

(b) Many candidates correctly determined the half-life but taking the maximum value on the time axis and dividing by two was a common method of producing an incorrect answer.

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(c) (i) Candidates were expected to know that alpha particles were readily absorbed and so would not penetrate smoke. Both beta and gamma radiation were more popular answers. Many candidates used the earlier parts of the question to realise that this would be ionising radiation, so answers like radio and IR were common.

(ii) The majority candidates understood the question and correctly used the graph to determine that the count would drop in 1.2 years.

Question 9

(a) (i) Although many candidates stated the hydrocarbons contained hydrogen and carbon, comparatively few gained full credit for 'only' or the idea of there being no other types of atom present.

(ii) This proved to be challenging for many candidates, who did not consider the elements present or did not include compounds containing oxygen. However, some candidates did not recognise the significance of 'complete combustion' so many answers incorrectly suggested carbon monoxide.

(iii) Usually this question was answered well with coal being the most common answer. Crude oil and petroleum were accepted but oil on its own and products produced from refining were not.

(iv) Many candidates were able to explain that saturated implied the presence of a double carbon-carbon bond.

(v) Some candidates knew that bromine water would be decolourised but stated the observations the wrong way around. A few candidates did not notice the word 'observation' in the question and attempted to give the products of their expected reactions.

(b) (i) Candidates who realised the question was asking them to balance the equation generally gained credit.

(ii) A number of candidates knew the answer, 'fermentation'.

(iii) Fuels/solvents and sanitisers were common answers which gained credit. Some candidates offered answers which were too vague like 'medicine'. Answers of alcohol or drinks were ignored.

Question 10

(a) (i) Correct answers were frequently seen but the wavelength seemed to be the more difficult of the two. The wavelength is easily determined by looking at the adjacent peaks but more difficult if crossing the x-axis is used.

(ii) Although this question could be easily answered by knowing the formula relating periodic time and frequency, it was intended to test the understanding of frequency. If candidates understood that the frequency was the number of vibrations per second, then knowing one vibration took 0.2 s should have enabled them to calculate how many would occur in one second. Correct answers were rarely seen.

(ii) The question was about a wave on a rope so answers like 'sound', 'light', etc. were not accepted.

(b) (i) The correct answer of refraction was frequently seen but some candidates gave reflection or diffraction.

(ii) Few candidates were able to state that it was the reduction in speed that produced the change in direction of the wave in the shallow water. There were many answers which suggested a change in density. This suggested that they were relying on knowledge of refraction of light where a change in density does cause a change in speed and hence, refraction.

(c) (i) Only stronger candidates answered this correctly. Candidates were meant to extend the two rays shown to the mirror, draw a normal ray and then draw the rays reflected. Many did not recognise the mirror and drew rays straight through. Few drew a normal ray and so the reflected rays were often not remotely drawn with angle of incidence equal to angle of reflection.

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(ii) In this question, credit was given for either knowing that the image was positioned at the intersection of two construction lines/rays (however badly drawn) or for knowing the position of an image in plain mirror. This second approach gave some credit to candidates who knew where the image should be and drew arbitrary lines which often changed direction so they would intersect in the correct place.

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PHYSICAL SCIENCE

Paper 0652/32
Core Theory 32

There were too few candidates for a meaningful report to be produced.

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PHYSICAL SCIENCE

Paper 0652/41
Extended Theory

Key messages

Stronger candidates included their working out in calculations so that partial credit could be awarded for a correct method even if the final answer was incorrect.

General comments

Candidates were not confident in carrying out the physics calculations.

There were a number of blank answers throughout the paper. Candidates are advised to attempt every question.

Comments on specific questions

Question 1

(a) Most candidates knew galvanising prevented rusting.

(b) Cracking was often correct.

(c) Crystallisation was a common incorrect answer.

(d) Reduction was not often stated correctly

(e) Fractional distillation was usually stated correctly.

Question 2

(a) Some candidates knew micrometer. Incorrect answers included ruler, tape measure, gauge, and callipers.

(b) (i) Most answers showed an **X** between an extension of 10 to 12 mm. Some candidates did not follow the instructions for the question and did not use an **X** to identify the limit.

(ii) Very few candidates showed their working on the graph. The units were often incorrect with N mm or mm / N being the most common. Some inverse gradients were determined.

Question 3

(a) Most candidates stated the effect of impurities. Weaker answers stated that the melting point changed, without saying how it changed, or stated that it increased.

(b) Most knew the + ion was sodium. Often chloride was given as chlorine. Many candidates appeared to overlook the diagram and did not complete it. Those that did attempt to complete the structure, were usually correct.

(c) This was poorly expressed by most candidates. Sodium chloride was often thought to contain covalent bonds. The terms intra and intermolecular forces were usually incorrectly used. It was rare to see reference to an attraction between ions in sodium chloride. Where candidates gained credit, it was for recognising that more energy is required to break up sodium chloride than chlorine.

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Question 4

(a) Many candidates drew a reflected ray with the correct angle. Candidates frequently forgot to label the normal and incident ray.

(b) (i) Many different types of electromagnetic radiation were quoted and it was equally likely to see gamma rays as it was one of the correct EM types.

(ii) Some candidates knew that a black pot would improve the absorption of the radiation. Some also suggested 'matt' but many incorrectly gave 'shiny'. A large number stated 'metal', which was already given in the question.

(iii) Some candidates referred to particles vibrating. The answer that particles move was insufficient as it did not say how they move. Fewer candidates used the idea of energy being transferred by electrons.

(iv) It was common to have information from the question repeated in answers, for example, stating that hot water rises. Where credit was awarded, it was usually for stating that the hot water becomes less dense.

(v) Very few candidates named the gas as water. Hydrogen, oxygen, nitrogen and other gases such as methane were more commonly suggested.

Question 5

(a) (i) The majority knew the state symbol was g.

(ii) Addition was well known.

(b) Some candidates thought fermentation involved ethene as a reactant. A few suggested chemical catalysts.

(c) Reasons why the combustion of fossil fuels needs to be reduced were well known. There was a common misconception that carbon dioxide causes ozone depletion.

(d) The majority of candidates could describe the meaning of a homologous series. A common error was that members have the same molecular formula. It was insufficient to state "they have similar characteristics or properties", without clarifying this with similar chemical.

(e) The majority of candidates correctly circled nonanol.

Question 6

(a) Some candidates could determine the moment.

(b) (i) Candidates found this challenging. Very few could get any further than converting the 15 kg into 150 N.

(ii) Very few candidates could calculate the magnitude of the force.

(c) (i) The majority of candidates could calculate the volume of the rock.

(ii) A minority of candidates used their volume from **(i)** to calculate *h*.

Question 7

(a) Most candidates could explain why sodium is more reactive than magnesium. The strongest answers identified that sodium has one electron to lose and magnesium has two.

(b) Candidates who successfully identified H_2 as a product usually went onto give a correctly balanced symbol equation.

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(c) The majority of candidates correctly determined the order of reactivity.

(d) (i) Most candidates described the limewater test. Common incorrect answers referred to using a splint or the limestone test.

(ii) Sodium chloride was well known. A few candidates incorrectly stated sodium chlorine.

(e) The definition of an acid as a proton donor was well known. A few candidates simply repeated the information in the question, and gave “it takes part in proton transfer”.

Question 8

(a) Thermistor was known by most candidates.

(b) (i) Candidates found this very challenging and very few calculated the resistance correctly.

(ii) The potential difference was rarely correct and this was often left blank.

(c) Candidates found this very challenging and very few could calculate the new potential difference.

(d) Variable resistor was well known. Thermostat was a common incorrect answer.

Question 9

(a) The majority of candidates determined the mass of aluminium. Others got no further than the *M*r of aluminium oxide or made an error with the mole ratio.

(b) Candidates found this challenging and there were many blank answers here.

(c) Most candidates could state a suitable property of aluminium that makes it useful as a food container. A few used the incorrect terminology of rusting rather than corroding.

Question 10

(a) Candidates who attempted this question could usually determine the number of turns in the secondary coil. Stronger candidates showed full working out.

(b) Some candidates could determine the current in the primary coil.

(c) Some candidates were able to explain why a transformer needs a.c. to work.

(d) (i) Most answers stated that energy or heat is lost and some candidates knew that thicker wires could carry a larger current. Fewer referred to the decrease in resistance.

(ii) Some good explanations of what is meant by the circuit not being 100 percent efficient were seen. Weaker answers were vague, such as “output is less than input”.

Question 11

(a) The term isotopes was well known. A few candidates thought that the number of electrons was significant.

(b) Candidates found determining the formula of copper(II) nitrate challenging.

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PHYSICAL SCIENCE

Paper 0652/42
Extended Theory

Key messages

Stronger candidates included their working out in calculations so that partial credit could be awarded for a correct method even if the final answer was incorrect.

General comments

Candidates were not confident in carrying out the physics calculations.

There were a number of blank answers throughout the paper. Candidates are advised to attempt every question.

Comments on specific questions

Question 1

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(b) (i) Most answers showed an **X** between an extension of 10 to 12 mm. Some candidates did not follow the instructions for the question and did not use an **X** to identify the limit.

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(b) Most knew the + ion was sodium. Often chloride was given as chlorine. Many candidates appeared to overlook the diagram and did not complete it. Those that did attempt to complete the structure, were usually correct.

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Question 4

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(ii) Some candidates knew that a black pot would improve the absorption of the radiation. Some also suggested 'matt' but many incorrectly gave 'shiny'. A large number stated 'metal', which was already given in the question.

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(d) The majority of candidates could describe the meaning of a homologous series. A common error was that members have the same molecular formula. It was insufficient to state "they have similar characteristics or properties", without clarifying this with similar chemical.

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(b) (i) Candidates found this challenging. Very few could get any further than converting the 15 kg into 150 N.

(ii) Very few candidates could calculate the magnitude of the force.

(c) (i) The majority of candidates could calculate the volume of the rock.

(ii) A minority of candidates used their volume from **(i)** to calculate *h*.

Question 7

(a) Most candidates could explain why sodium is more reactive than magnesium. The strongest answers identified that sodium has one electron to lose and magnesium has two.

(b) Candidates who successfully identified H_2 as a product usually went onto give a correctly balanced symbol equation.

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(c) The majority of candidates correctly determined the order of reactivity.

(d) (i) Most candidates described the limewater test. Common incorrect answers referred to using a splint or the limestone test.

(ii) Sodium chloride was well known. A few candidates incorrectly stated sodium chlorine.

(e) The definition of an acid as a proton donor was well known. A few candidates simply repeated the information in the question, and gave “it takes part in proton transfer”.

Question 8

(a) Thermistor was known by most candidates.

(b) (i) Candidates found this very challenging and very few calculated the resistance correctly.

(ii) The potential difference was rarely correct and this was often left blank.

(c) Candidates found this very challenging and very few could calculate the new potential difference.

(d) Variable resistor was well known. Thermostat was a common incorrect answer.

Question 9

(a) The majority of candidates determined the mass of aluminium. Others got no further than the *M*r of aluminium oxide or made an error with the mole ratio.

(b) Candidates found this challenging and there were many blank answers here.

(c) Most candidates could state a suitable property of aluminium that makes it useful as a food container. A few used the incorrect terminology of rusting rather than corroding.

Question 10

(a) Candidates who attempted this question could usually determine the number of turns in the secondary coil. Stronger candidates showed full working out.

(b) Some candidates could determine the current in the primary coil.

(c) Some candidates were able to explain why a transformer needs a.c. to work.

(d) (i) Most answers stated that energy or heat is lost and some candidates knew that thicker wires could carry a larger current. Fewer referred to the decrease in resistance.

(ii) Some good explanations of what is meant by the circuit not being 100 percent efficient were seen. Weaker answers were vague, such as “output is less than input”.

Question 11

(a) The term isotopes was well known. A few candidates thought that the number of electrons was significant.

(b) Candidates found determining the formula of copper(II) nitrate challenging.

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PHYSICAL SCIENCE

Paper 0652/51
Practical Test

Key messages

To do well in this examination, candidates need to have a thorough grounding in practical work during the course. Candidates should have as much personal experience of carrying out experiments themselves as possible.

Centres are provided with a list of required apparatus well in advance of the examination date. Where centres wish to substitute apparatus, it is essential to contact Cambridge to check that the change is appropriate and that candidates will not be disadvantaged. Any changes made, must be recorded in the Supervisor's report.

When describing the colour changes when solutions are mixed together, candidates should be made aware that 'clear' is not a suitable description of a colour.

General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical techniques in chemistry and physics.

This year, only a minority of candidates were able to demonstrate some ability and understanding across the whole of the range of practical skills being tested. All parts of the practical tests were attempted and there was no evidence of candidates running short of time. Not all candidates were able to follow instructions correctly, record observations clearly and perform calculations accurately and correctly. Many candidates were not able to derive conclusions backed up by evidence they had gathered.

Comments on specific questions

Question 1

(a) Most candidates completed the table and had a full set of precipitate heights for the different volumes of aqueous sodium carbonate added. However, in many cases the height of the precipitate did not increase as one read down the table. Despite the fact that the unit mm was clearly written at the head of the height column, it was obvious from the numbers entered that many candidates had recorded their heights in cm.

(b) (i) Most candidates named a burette or a measuring pipette as a piece of apparatus suitable for measuring the 5 cm^3 of aqueous barium nitrate more accurately than a measuring cylinder. A dropping/teat pipette was not accepted here.

(ii) Candidates found it challenging to explain why it is difficult to get an accurate value for the height of the precipitate, even though they had just carried out this measurement themselves. Only stronger candidates stated that the bottom of the test-tube is curved or that it is difficult to align the ruler with the bottom of the test-tube.

(c) (i) The graph axes usually had the correct orientation and quantity but the units were often missing. There was little evidence of the use of scales that increased in inconvenient increments, such as 3 or 7. Choosing such scales makes the points much harder to plot and more difficult for them to be seen clearly. Most of the plots were plotted to within a tolerance of half a small grid square.

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(ii) There were many graphs where the attempt at a best-fit line resulted in all points which did not lie on the drawn line, being on the same side of the line. A sizeable minority of the lines drawn indicated that the concept of best fit was clearly not well understood by all candidates.

(iii) The majority of candidates used their graphs correctly to describe the relationship between the height of the precipitate and the volume of aqueous sodium carbonate added.

(iv) Most candidates succeeded in using their graphs to estimate the height of the precipitate formed when 4.0 cm^3 of aqueous sodium carbonate was added to the test-tube. However, many candidates did not follow the instruction to indicate on the graph to show how the answer had been reached.

(d) Few candidates suggested how the procedure could be adapted to increase confidence in the results. Of those candidates who suggested repeating the experiment, only a small minority went on to add that the results should then be averaged.

Question 2

(a) (i) The standard of the drawing of the assembled filtration apparatus was often not good. The majority of diagrams were drawn freehand and carelessly. However, there were some excellent diagrams in which candidates had taken great care to show all components of the assembled apparatus.

(ii) The instruction to label the residue and the filtrate on the diagram was often not followed. When labels were present, they were nearly always correct.

(b) (i) Only a minority of candidates gave both of the observations needed to describe what was seen when dilute nitric acid is added to the test-tube. Most candidates noticed that bubbles of gas were given off. Far fewer candidates went on to state that the precipitate dissolved to form a colourless solution.

(ii) The majority of candidates correctly described the test and identified the gas given off as carbon dioxide. The observation for a positive result was nearly always stated correctly.

(iii) Only stronger candidates gave the observation that there was no reaction when a few drops of barium nitrate were now added to the test-tube.

(c) Only a very small number of stronger candidates were able to explain why nitric acid is also added along with aqueous barium nitrate to test for sulfate ions. The fact that it is to remove carbonate ions because they also give a white precipitate with barium nitrate was not known.

Question 3

(a) (i) Most candidates measured the angle of incidence θ correctly as 30°. A minority of candidates read the protractor incorrectly and gave the complement of this angle.

(ii) The use of optics pins to locate the refracted ray was done well, and the instruction to continue the line joining pins P_3 and P_4 back to the normal line was usually carried out correctly. The locating pins P_3 and P_4 were often placed too close together. This led to a lack of accuracy in the position of point H.

(iii) The lengths of the lines GE and GH were almost always recorded and measured correctly to within ±1 mm of the correct values. The calculation of the refractive index of the block, by substitution into the given formula, was usually correct and within the allowed tolerance (1.3 to 1.7). Candidates who had placed the locating pins P_3 and P_4 too close together tended to have answers outside this range.

(b) (i) Most candidates followed the instructions and repeated the experiment using an angle of incidence of 50°.

(ii) The calculation to find another value for the refractive index of the glass was usually correct. further credit was often not gained because both values of the refractive index were not given to 2/3 significant figures, as required, or were incorrectly given a unit – usually °.

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(c) (i) Candidates were asked to state whether their values of refractive index from **(a)(iii)** and **(b)(ii)** could be considered to be equal within the limits of experimental accuracy, having been told that this is true if their values are within 10 per cent of each other. Candidates found this difficult, with only stronger candidates supporting their suggestion with a valid calculation. The easiest way to show this was to calculate the ratio of the smaller of the two values to the larger. If the value obtained was 0.9 (90%) or greater, then the quantities could be considered to be equal. Another equally acceptable method was to calculate the ratio of the difference between the two values to either of the original values. If the answer obtained was 0.1 (10 per cent) or less, then the quantities can be considered to be equal. If both values of refractive index recorded by candidates were equal, it was sufficient to just state that to obtain full credit.

(ii) Only a very small number of correct answers to this more demanding question were seen. The second value obtained for the refractive index was likely to be more accurate, as the measured lines were longer, so any small error in their measurement was less significant.

(d) Candidates also found this final part difficult, even though they had carried out the experiment, and should have recognised the difficulties involved in obtaining accurate results. Many left this part unanswered. Answers such as that it is difficult to align the pins exactly/to place the pins vertically, gained credit.

Question 4

Most candidates realised that in addition to the apparatus listed, an ammeter and a voltmeter were needed in order to measure the resistance of the conducting putty. Far fewer candidates included a ruler or a measuring tape so that the diameter of the putty could be measured.

Candidates were required to give a brief description of the method used, including a circuit diagram to show how the resistance of the putty would be measured. Although most candidates stated in their methods that the current in the circuit and the potential difference across the conducting putty needed to be measured, the circuits drawn often contradicted this. Stronger candidates drew a correct circuit, but many circuits showed voltmeters connected in series in the circuit and ammeters connected in parallel with the conducting putty. Candidates often forgot to mention that the diameter of the resistance of the putty should be changed and the experiment repeated, so that the resistance of a range of diameter values could be recorded.

Few candidates gained more than partial credit for listing the control variables in this investigation, namely that the length of the conducting putty and the type/material of conducting putty should remain constant for each diameter taken.

Most candidates gained credit by drawing an appropriate table of results and giving relevant headings with units. Only three columns labelled, diameter, potential difference and current were required. Extra columns were sometimes included and these were ignored. However, in some cases the units were incorrect or missing, despite the instruction to include them.

Most candidates did not explain clearly how they would process and use their results to reach a conclusion. The most common correct answer was that the resistance readings should be calculated and compared with the corresponding diameters to see how/if the resistance of the conducting putty depended on its diameter. Some stronger candidates suggested plotting a graph of diameter against resistance to identify the relationship between them.

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PHYSICAL SCIENCE

Paper 0652/52
Practical Test

Key messages

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General comments

The aim of the examination is to enable candidates to display their knowledge and understanding of practical techniques in chemistry and physics.

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Most candidates realised that in addition to the apparatus listed, an ammeter and a voltmeter were needed in order to measure the resistance of the conducting putty. Far fewer candidates included a ruler or a measuring tape so that the diameter of the putty could be measured.

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PHYSICAL SCIENCE

Paper 0652/61
Alternative to Practical

Key messages

Candidates should have as much practical experience as possible to enable them to suggest ways to improve a particular experiment in terms of its reliability, accuracy and consistency of result.

Candidates should read questions carefully from beginning to end before answering to help them to establish and understand the context of an experiment.

Graphical representation of data must include labelled axes which include units, sensible linear scales allowing half the paper to be covered, accurate plotting of points, and careful drawing of a single best-fit line.

General comments

Candidates attempted most questions and the paper was accessible overall.

There seemed to be few instances of candidates not having sufficient time to complete the paper. Many candidates used the bullet points provided when attempting the planning question which aided them in covering all areas.

Comments on specific questions

Question 1

(a) (i) A burette was the expected answer, but graduated pipette and syringe were also accepted and provided by many candidates. Use of a graduated measuring cylinder was not seen as an improvement, and beakers, dropping pipettes and even occasionally rulers did not gain credit.

(ii) The precipitate heights were generally measured correctly, and usually entered to two significant figures to match the other data in the table.

(iii) Candidates were expected to draw attention to the curved base of the test-tube when accounting for the difficulty in getting accurate measurements of the height of the precipitate. However, some candidates either referred to the lack of graduations or the unclear boundary of solution and precipitate which was not credited due to the 10 minute settling time referred to in the question.

(b) (i) Height and volume were the minimal requirements when labelling axes but units for both were required. Some candidates missed the 4.0 when labelling the x axis having been told that there is no test-tube 4, but complete reading of the question before answering it would have eliminated this error. Apart from this, most axes were linear, covered over half the paper and points were plotted carefully and accurately.

(ii) Some candidates forced a line of best fit to go through the origin and did not realise that a line may be straight or curved to best match and extend over the full range of their plots. Some candidates drew two lines and in this case it was not possible for credit to be awarded for either.

(iii) Most candidates linked the trends in both variables as they increased but few referred to the maximum height being reached with consequent levelling out. Proportionality was only credited if it matched their graph.

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(iv) Most candidates showed working on the graph so credit was given even if the 4.0 had originally been omitted. Most candidates read from the scale to the required accuracy.

(c) In a question about excess candidates needed to be more specific so answers such as “the reaction is over” or “one reagent is in excess” were insufficient.

(d) Most candidates offered the idea of repetition but without averaging and so did not gain credit.

Question 2

(a) (i) A label was required in addition to a filter paper which was distinguishable from a funnel in having a closed base and approximate V shape. Some candidate suggested flat filter papers and these were not credited.

(ii) A number of candidates either left the diagram unlabelled or reversed the filtrate and residue. Occasionally, when chemical names were provided they were reversed or were the names of the reagents.

(b) (i) Smoke, froth and gas were common incorrect answers, but most candidates realised that evidence of a gas was bubbling.

(ii) The carbon dioxide test was well known but tests for hydrogen, ammonia, and the use of limestone were are given by some candidates.

(c) Very few candidates realised the reason for the addition of nitric acid despite the information in the question. Rather than the removal of the competing carbonate ion, many candidates simply referred to acidification or even catalytic properties.

(d) Candidates were expected to realise that either a blue flame is hotter than a yellow flame or that the colour change would be clearer in a blue flame. Some candidates referred to incomplete combustion, stronger heating or a more visible colour, none of which were credited.

Question 3

(a) (i) Most candidates measured an angle accurately, but quite a few measured from the block rather than the normal.

(ii) Some candidates did not place their crosses or symbols on the line, but most were a sufficient distance apart.

(b) (i) Constructions needed to be carefully attempted so that the two lines met on the edge of the block and GE was extended as far as E on the top edge of the block.

(ii) Measurement was usually accurate but a few candidates did not give their answers to the usual minimum of two significant figures.

(iii) Most candidates manipulated their lengths successfully and gave their answer to two or three significant figures.

(c) (i) Most candidates produced the correct answer from the given figures but only a few attached units to their answers.

(ii) Candidates were expected to use their figures to evaluate whether their answers were equal. The vast majority gave the correct answer but few went on to calculate ten per cent and therefore showing the evidence for their conclusion.

(iii) A few candidates gained credit here for larger angle of incidence or longer lines, but the majority referred to values having been provided for the second experiment or that the experiment had already been practised.

(d) The idea of repetition and averaging, or the use of a sharp pencil, were credited for a few candidates. Reference to the pins was expected, either relating to their large separation, verticality,

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thinness, or the viewing of their bases. Several candidates made vague reference to avoiding parallax errors or improvement in accuracy of apparatus.

(e) It was evident from the lack of reference to difficulty in the aligning or placement of the pins that many candidates lacked practical experience in this field. Many candidates referred to variation in eyesight, quality of rulers, lack of significant figures, or irregular/poorly placed blocks.

Question 4

Candidates were required to design an experiment to investigate the relationship between the diameter of some conducting putty and its resistance.

Most candidates addressed the bullet points, and stronger candidates gained full credit for through well-developed and well-expressed answers.

Most candidates knew that the various diameters of putty were needed, but several did not actively measure the diameter and therefore omitted the use of a ruler. A large number of candidates did not draw a circuit and/or include a table with column headings all with units. Quite a few candidates did not include both an ammeter and a voltmeter, or just used a resistor, and many lacked control of the length of the putty rather than lengths of wires, current or voltage.

Most candidates realised that at least three diameters were needed, but repetition was often too vague, even if it included averaging, usually referring to the whole experiment and not being closely linked to either the same piece of putty or the ammeter and voltmeter readings. A few candidates suggested plotting a graph but did not make it clear what was being plotted.

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PHYSICAL SCIENCE

Paper 0652/62
Alternative to Practical

There were too few candidates for a meaningful report to be produced.

Cambridge Assessment International Education

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