PHYSICAL SCIENCE

Paper 0652/11
Multiple Choice

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

Comments on Specific Questions (Chemistry)

Question 1

The description of the particles in a solid is well known by many of the candidates but a significant proportion of the candidates thought that the particles in a solid are stationary and chose option **A**.

Question 2

A large majority of the candidates understand how to interpret chromatograms.

Question 3

The concept of atomic structure is well known by a majority of the candidates, however a number of the weaker candidates think that the mass number is the number of protons and/or the number of electrons and chose option **D**.

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Question 4

Almost 90% of the candidates knew that covalent bonding involves atoms sharing electrons but almost a third of these candidates thought that covalent substances conduct electricity and chose option **A**.

Question 5

A well-answered question, particularly by the better candidates.

Question 6

A well-answered question, particularly by the better candidates.

Question 7

A majority of the candidates knew that a reaction that produces heat is an exothermic reaction.

Question 8

Another well-answered question, by all candidates.

Question 9

The products of the reaction were known by the majority of the candidates although a significant number of candidates thought that water is produced rather than hydrogen and chose option **B**.

Question 10

Almost 75% of the candidates recognised that zinc is the cation present in X but the test for a chloride ion was less well known.

Question 11

There was some confusion amongst the weaker candidates who did not recognise that the question referred to Period 2 in the Periodic Table rather than Group II.

Question 12

A well-answered question, particularly by the better candidates.

Question 13

The composition of brass was not well known. There was evidence of guesswork even amongst the better candidates.

Question 14

The chemical test for water is known by a majority of the candidates.

Question 15

A significant proportion of the candidates chose option **A** which implies that air contains 50% oxygen.

Question 16

The thermal decomposition of calcium carbonate to produce calcium oxide is not well known by a majority of the candidates.

Question 17

Many candidates were able to recognise the structures of methane and ethanol.

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Question 18

A significant number of the candidates thought that hydrogen is a product of the combustion of butane and chose option **B**.

Question 19

The reactions of ethene with hydrogen, oxygen and steam are well known by a majority of the candidates.

Question 20

The vast majority of the candidates recognised the functional group in the structure as an alcohol.

Comments on Specific Questions (Physics)

Question 22

This question concerned a speed/time graph. A large proportion of candidates chose the option where the initial speed is multiplied by the total time to obtain an answer of 800 m.

Question 23

One distractor here proved almost as popular as the key. The common error was to fail to notice that the mass was given in grams, not kilograms, leading to a weight of 4500 N.

Question 24

The popularity of option **D** for some candidates suggests that they simply divided the mass by the length of one side of the cube.

Question 25

Distractor **B** was chosen by many candidates here, possibly as a result of comparing only the forces acting in each case, rather than calculating the moment.

Question 26

A common mistake here was to believe that time taken affected the work done, showing confusion between the concepts of work and power.

Question 27

Many candidates believed that the fixed points on a thermometer were the maximum and minimum values on the scale.

Question 31

The popularity of option **C** suggests that a sizeable proportion of candidates had learnt the order of the electromagnetic spectrum, but did not notice the reference to wavelength in the question stem and table heading.

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PHYSICAL SCIENCE

Paper 0652/12
Multiple Choice

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

Comments on Specific Questions: Chemistry

Question 1

The description of the particles in a solid is well known by the vast majority of the candidates.

Question 2

A large majority of the candidates understand how to interpret chromatograms.

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Question 3

The concept of atomic structure is well known.

Question 4.

The formation of covalent bonds by sharing electrons and the fact that covalent compounds have low conductivity is well known by the candidates.

Question 5

A well-answered question, particularly by the better candidates.

Question 6

A well-answered question, particularly by the better candidates.

Question 7

A majority of the candidates knew that a reaction that produces heat is an exothermic reaction.

Question 8

Another well-answered question, by all candidates.

Question 9

The products of the reaction were known by the majority of the candidates although a significant number of candidates thought that water and hydrogen are produced and chose option **A**.

Question 10

Over 90% of the candidates recognised that zinc is the cation present in X but the test for a chloride ion was less well known.

Question 11

There was some confusion amongst the weaker candidates who did not recognise that the question referred to Period 2 in the Periodic Table rather than Group II.

Question 12

A well-answered question, particularly by the better candidates.

Question 13

The composition of brass was quite well known. A number of candidates thought that nickel is added to copper and chose option **C**.

Question 14

The chemical test for water is known by a majority of the candidates.

Question 15

A significant proportion of the candidates chose option **A** which implies that air contains 50% oxygen.

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Question 16

The thermal decomposition of calcium carbonate to produce calcium oxide is not well known by many of the candidates. Many of the candidates thought that the reaction is an oxidation reaction and chose option **C**.

Question 17

Many candidates were able to recognise the structures of methane and ethanol.

Question 18

A significant number of the candidates thought that hydrogen is a product of the combustion of butane and chose option **B**.

Question 19

The reactions of ethene with hydrogen, oxygen and steam are quite well known by many of the candidates but there was some evidence of guesswork amongst the weaker candidates.

Question 20

The vast majority of the candidates recognised the functional group in the structure as an alcohol.

Comments on Specific Questions (Physics)

Question 22

This question concerned a speed/time graph. A large proportion of candidates chose the option where the initial speed is multiplied by the total time to obtain an answer of 800 m.

Question 23

One distractor proved as popular as the key. The common error was to fail to notice that the mass was given in grams, not kilograms, leading to a weight of 4500 N.

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The popularity of option **C** suggests that a sizeable proportion of candidates had learnt the order of the electromagnetic spectrum, but did not notice the reference to wavelength in the question stem and table heading.

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PHYSICAL SCIENCE

Paper 0652/21
Core Theory

Key Messages

Candidates need to have an appreciation of the underlying linking concepts to be able to apply individual learning objectives at a level greater than straight recall.

General Comments

Although there were some papers in which a better understanding was shown, there were many papers which showed a lack of preparation.

Comments on Specific Questions

Question 1

(a) Many candidates recognised that isotopes are different versions of the same element.Fewer gave a formal explanation in terms of the number of protons and number of neutrons/nucleons.

(b) Most candidates recognised that the upper number (in this case, 6) is the proton (or atomic) number. Fewer recognised that the lower number (in this case, 14) is the nucleon (mass) number. A common error was to describe the lower number as the atomic mass. It is worth emphasising that the terms atomic number and mass number have been superseded by proton and nucleon number, and candidates should be urged to use the modern terms.

(c) The diagram of the distribution of the electrons in the carbon atom was done reasonably well. Some candidates gave the nucleon number as equal to the number of electrons.

Question 2

(a) Most candidates recognised that the weight acts vertically downwards. Only a few that the weight may be considered to act at the centre of mass. A common error was to believe the weight acted at the pivot.

(b) (i) The majority of candidates knew that weight was equal to *mg*. Some gave the unit as the kilogram rather than the newton.

weight = 800 N

(ii) A few candidates were able to calculate the moment produced by the weight of the man about the pivot.

moment = 4800 (N m)

(iii) A few candidates were able to recognise that the moment would decrease as the man walked towards the wall.

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Question 3

This question was well done.

Question 4

(a) The majority of candidates recognised that the energy transfer was by conduction. Some candidates said 'by heat'.

(b) The vast majority of candidates were able to put the metals in the correct order. The most common error was to give the reverse order.

Question 5

(a) (i) Only a minority recognised that the sodium atom becomes an ion by losing an electron. Common errors were to say it gained an electron (or occasionally a positive electron) or to say it lost (all) of its electrons or to say it reacts with chlorine.

(ii) This was not done well. Although a considerable number knew the symbol for the chlorine ion, very few recognised that the ion has 18 electrons rather than the 17 of the chlorine atom.

(b) Candidates need to be able to draw dot and cross diagrams to show covalent bonding.

(c) Virtually no candidates gave a suitable substance to react with hydrogen chlorine to produce sodium chloride. Common responses were water or sodium metal A few gave magnesium hydroxide or oxide.

Question 6

(a) The majority of candidates were challenged by this question. A few were able to give the position of the image formed in a plane mirror (part **(i)**). Many struggled to draw the rays. Candidates can be helped in their understanding of this topic by practical work involving mirrors and ray boxes. Understanding can be reinforced by practice in drawing this type of diagram.

(b) A good number of candidates showed an understanding of the laws of reflection.

(c) A minority of candidates recognised that the image was not real.

Question 7

(a) The question asked for elements present in ammonium sulfate; a significant number of candidates gave answers referring to the elements in calcium carbonate. Of those that did refer to the elements in ammonium sulfate, many missed the fact that there are two ammonium ions in each molecule of ammonium sulfate.

(b) Very few candidates completed this part question. The most common error was to miss the fact that in each molecule, there are three oxygen atoms.

relative atomic mass = 100

(c) Most candidates recognised that a neutral material has a pH of 7 for part **(ii)**; fewer realised that acidic materials have a pH of less than seven for part **(i)**.

Question 8

(a) Most candidates recognised that like charges repel. Fewer went beyond this statement to explain how the balloons became similarly charged. Some candidates believed that the balloons were rubbed against each other to create the charge.

(b) Candidates needed to recognise that the sprayed water is a conductor allowing charge to leak away. Most candidates thought that the balloons came back into contact because they had become oppositely charged and therefore attracted each other.

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Question 9

(a) Common answers here were references to transition elements conducting (heat or electricity).

(b) A good number of candidates were able to identify non-metallic elements in the same period as copper. The most common error was to give a metallic element in the period.

(c) (i) A reasonable number of candidates were able to name a suitable ore, the most common being malachite. More unusual answers were chalcopyrites and chalcocite.

(ii) The majority of candidates were able to identify a suitable metal.

(iii) Fewer candidates were able to link the lack of reactivity of the metal to it being found in its native state. The most common misconception involved the metal being formed thousands of years ago.

(d) (i) Many candidates struggled with this question. Most referred to the iron (or even the copper) rusting.

(ii) Candidates need to have an understanding of the consequences of the order of reactivity. Practical work is the best mode of experience to convey this understanding.

Question 10

(a) (i) A majority of candidates were able to define exothermic.

(ii) Although a majority were able to give the correct formulae for the different compounds in the reaction, most candidates struggled to balance the equation.

(b) (i) A good percentage of candidates were able to identify the harmful gas produced, although a significant number thought it was carbon dioxide.

(ii) Some candidates stated erroneously that carbon monoxide causes cancer or harms the lungs.

(c) (i) Few candidates demonstrated an understanding of the term homologous series. Most answers were not specific enough, for example, stating that ‘all the bonds are the same’.

(ii) This was answered well, with a good number of candidates recognising that ethene has a double CC bond whereas ethane has a single CC bond.

Question 11

(a) Very few candidates knew the circuit symbol for a fuse.

(b) Candidates performed very well on this calculation, with more than three quarters of the entry scoring all three marks.

resistance = 3.75 Ω

(c) A fair number of candidates were able to identify the 5 A fuse as being the correct fuse to fit. Very few went on to explain why this was the correct fuse.

(d) (i) Few candidates were able to draw the parallel circuit correctly

(ii) Many candidates gave muddled accounts, for example: ‘with more resistance in the circuit, more voltage is needed and this is too much voltage for the fuse’.

There were a significant number of candidates who recognised that the current increased when the second lamp was added in parallel, but very few went on to state that the current through the fuse would now be greater than 5 A.

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Question 12

(a) A small proportion of candidates were able to link the scatter of the points on the graph to the randomness of radioactive decay. Most gave answers referring to the drawing of a best-fit line.

(b) (i) A good number of candidates were able to read the initial activity of the sample from the graph.

(ii) The most common error in this section was to halve 60 (the top value on the time axis) to get a value for the half life.

half life = 25 s

(c) A good proportion of candidates gave sensible answers here.

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PHYSICAL SCIENCE

Paper 0652/22
Core Theory

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half life = 25 s

(c) A good proportion of candidates gave sensible answers here.

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PHYSICAL SCIENCE

Paper 0652/31
Extended Theory

Key Messages

It is important that candidates show their working to numerical problems, laying it out so that it can be followed. Generally, there are marks given for correct working and candidates can score marks even if their final answer is not correct, if correct working is clearly present.

General Comments

The standard of work showed many candidates had a sound knowledge of most of the work and that some had developed a good understanding of the more complex concepts.

Questions 5, **7** and **9** were not done well, in particular **Question 9.**

Questions 3 and **6** were done well, 3 particularly well, with candidates showing a good understanding of the concepts involved.

Comments on Specific Questions

Question 1

(a) The majority of candidates were able to correctly calculate the weight of the rocket.

weight of rocket = 1600 000 (N)

(b) (i) Candidates understood that the resultant force was the difference between the thrust of the rocket's engines and the weight of the rocket.

resultant force = 4000 000 (N)

(ii) The majority of candidates recognised that the acceleration could be calculated from the formula acceleration = force / mass. A minority tried to calculate acceleration by using 'the change of velocity per unit time'.

acceleration = $2.5\,m/s^2$

(c) The answers that were given showed that many candidates had a genuine appreciation of the situation. By far the greatest effect causing the increase of acceleration of the rocket is the reduction in the overall mass as the fuel is burnt. However, other factors such as the reduction of the frictional forces as the air becomes less dense, the reduction of the gravitational field strength do play a minor part and could be credited.

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Question 2

(a) Many candidates scored full marks. Those that failed to score full marks usually either gave the incorrect salt formed when hydrochloric acid is reacted with sodium carbonate or gave the incorrect base with which the sulphuric acid is reacted with to form magnesium sulphate. Another error was to give the metal magnesium rather than an base containing a magnesium ion.

(b) This was not well done with very few candidates giving the correct equation, the formula for sodium carbonate was the stumbling block for most candidates.

(c) Candidates need to know the term amphoteric.

(d) (i) Candidates should be able to write a simple balanced equation using ions.

(ii) Some candidates tried to explain acids and bases in terms of electron exchange rather than proton exchange..

Question 3

(a) The majority of candidates were able to put the metals in the correct order of thermal conductivity. The most common error was to give the reverse order.

(b) (i) The majority of candidates recognised that the energy transfer was by radiation. A significant minority thought that convection was the main method of transfer.

(ii) The majority made a sensible estimate of the temperature of the thermometer B.

(iii) Most candidates understood that thermometer B was at a lower temperature than thermometer A because the silvered bulb is a better reflector of radiation. A minority thought that the blackened bulb is a better conductor.

Question 4

(a) Most candidates knew that the process in which ethane is produced from crude oil is cracking, although fewer gave the full description of the necessary conditions for the process to proceed. Many candidates gave only one of the necessary conditions.

(b) The majority recognised the test to distinguish between the saturated and unsaturated hydrocarbons and gave a good description of the results. A fairly error was to refer to the ethane as ‘discolouring’ the bromine. The word ‘discolouring has a different meaning to the word ‘decolourising’ – it means that the colour has changed, not necessarily to a colourless state. To avoid this error candidates should be encouraged to use the term ‘colourless’.

(c) Most recognised this as polymerisation. Fewer recognised that it is an addition reaction which leads to polymerisation.

(d) The calculation was done well with many candidates gaining all three marks.

mass of ethanol produced = 1.64 kg

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Question 5

(a) This question tested the candidate's understanding of 'angle of refraction'. Many candidates were challenged by the novel context.

(b) This was done well. Most candidates used the correct equation and gave the answer to the required 3 significant figures. Some candidates ignored the instruction to give the answer to 3 significant figures and lost credit.

refractive index = 1.44

(c) (i) The three dimensional nature of the diagram provided a novel context and therefore a good test of a basic concept. Many candidates found this question challenging.

(ii) A common mistake was to describe the image as being magnified rather than enlarged. The word 'magnified' does not always mean 'larger'. An image can be magnified by a factor of 0.5, which means that it is half the size of the original object.

Question 6

(a) (i) The majority of candidates were able to extract the relevant information from the table.

(ii) Most candidates scored this mark. Candidates who provided more than one property of aluminium as an answer for one mark lost credit if one of the properties provided was incorrect. Candidates should be made aware that providing several different answers when only one is asked for will not result in a greater chance of being 'right'.

(b) (i) Most candidates recognised that the reason for using an alloy instead of pure aluminium was that it increases the strength of the material.

(ii) There were some very good answers to this . Many candidates concentrated either on the either the structure of metals (positive ions in a sea of delocalised electrons) or on why alloys are stronger than the pure metal, without reference to the other half of the answer.

(c) (i) Most candidates recognised that aluminium, although reactive, forms an oxide layer which sticks to it protecting it from further oxidation.

(ii) Many candidates recognised that zinc is more reactive than iron and therefore oxygen reacts with it in preference to iron. However a few candidates stated that zinc 'rusts' before the iron. Candidates should be aware that rusting refers to the formation of iron oxide only.

Question 7

(a) Candidates need to learn and understand terms like charge, current, resistance, potential difference, and e.m.f.

The term e.m.f. is often misunderstood by candidates. The majority of answers referred to 'the force (or voltage) which pushes charge around the circuit'. Candidates should be aware that, despite the name, the e.m.f. is not a force but a statement of the energy transfer associated with unit charge as it goes once around the circuit.

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(b) (i) This question was answered well. The most common error was not to convert the minutes into seconds.

charge = 72 C

(ii) Candidates found this question more challenging. Candidates are required to know and be able to use the equation $E = I V t$

energy = 346 (J)

(iii) Candidates should know and be able to use the fact that the sum of the p.d.s across the components in a series circuit is equal to the total p.d. across the supply.

potential difference = 1.2 (V)

(iv) Most candidateswho answered this part knew that the resistance of a component is equal to the potential difference across it divided by the current through it.

resistance = 5.0 Ω

(c) (i) Whilst most candidates recognised that doubling the length of the wire doubled the resistance, fewer considered the effect of using a thinner wire. Amongst those that did, a minority recognised that halving the diameter decreases the cross sectional area by a factor of 4 .

resistance = 40 Ω

(ii) The best answers recognised that the voltage was shared between the resistor and the wire, and if the wire had increased resistance then it would have a larger share of the voltage and consequently the share of the resistor would be smaller. An alternative approach, used by a few candidates, was to recognise that the circuit current would drop and consequently the potential drop across the resistor (whose resistance stayed constant) would drop.

Question 8

(a) Most candidates recognised that both oxides of nitrogen and carbon dioxide increased as the twentieth century progressed. Fewer used the figures to compare the rate of increase of nitrogen oxides and carbon dioxide for the second mark.

(b) This was answered quite well, with recognition that the nitrogen oxides were being converted into nitrogen.

(c) Most candidates gave at least one common pollutant relevant to the use of petrol engines.

(d) Candidates found this a challenging question. There are no simple formulae to remember and use. Candidates needed to think about what they are doing, working in a logical manner and explaining their working clearly.

volume of carbon dioxide = 1680 dm^3

Question 9

(a) Candidates generally find electromanagnetism and induction confusing. Candidates need to be given chances to induce voltage and charge by handling magnets in order to appreciate the complexities of the process. Only a few answered indicated that the candidate recognisde that it is not simply the presence of a magnetic field or flux near a conductor which induces an e.m.f. in the conductor, but <u>the change</u> of that flux as it links with that conductor.

(b) This follows on from **(a)**, the magnet is replaced by a current carrying coil and the current is switched off. Most candidates erroneously think that with a steady current producing a constant field will induce a current in the second coil. It is the switching of the current off, which causes the magnetic flux to drop to zero which induces an e.m.f.. It is just like moving the magnet away, the flux through the second coil gets less thus an e.m.f. is induced.

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Question 10

(a) Although some candidates were confused by the melting points for chlorine and bromine being negative, most candidates were able to extract the relevant information from the table.

(b) There was some confusion regarding the colour changes, with some thinking chlorine would act as a bleach or that chlorine would add a green hue. Nevertheless the majority of candidates answered the question well.

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PHYSICAL SCIENCE

Paper 0652/32
Extended Theory

Key Messages

It is important that candidates show their working to numerical problems, laying it out so that it can be followed. Generally, there are marks given for correct working and candidates can score marks even if their final answer is not correct, if correct working is clearly present.

General Comments

The standard of work showed many candidates had a sound knowledge of most of the work and that some had developed a good understanding of the more complex concepts.

Questions 5, **7** and **9** were not done well, in particular **Question 9.**

Questions 3 and **6** were done well, 3 particularly well, with candidates showing a good understanding of the concepts involved.

Comments on Specific Questions

Question 1

(a) The majority of candidates were able to correctly calculate the weight of the rocket.

weight of rocket = 1600 000 (N)

(b) (i) Candidates understood that the resultant force was the difference between the thrust of the rocket's engines and the weight of the rocket.

resultant force = 4000 000 (N)

(ii) The majority of candidates recognised that the acceleration could be calculated from the formula acceleration = force / mass. A minority tried to calculate acceleration by using 'the change of velocity per unit time'.

acceleration = $2.5\,m/s^2$

(c) The answers that were given showed that many candidates had a genuine appreciation of the situation. By far the greatest effect causing the increase of acceleration of the rocket is the reduction in the overall mass as the fuel is burnt. However, other factors such as the reduction of the frictional forces as the air becomes less dense, the reduction of the gravitational field strength do play a minor part and could be credited.

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Question 2

(a) Many candidates scored full marks. Those that failed to score full marks usually either gave the incorrect salt formed when hydrochloric acid is reacted with sodium carbonate or gave the incorrect base with which the sulphuric acid is reacted with to form magnesium sulphate. Another error was to give the metal magnesium rather than an base containing a magnesium ion.

(b) This was not well done with very few candidates giving the correct equation, the formula for sodium carbonate was the stumbling block for most candidates.

(c) Candidates need to know the term amphoteric.

(d) (i) Candidates should be able to write a simple balanced equation using ions.

(ii) Some candidates tried to explain acids and bases in terms of electron exchange rather than proton exchange..

Question 3

(a) The majority of candidates were able to put the metals in the correct order of thermal conductivity. The most common error was to give the reverse order.

(b) (i) The majority of candidates recognised that the energy transfer was by radiation. A significant minority thought that convection was the main method of transfer.

(ii) The majority made a sensible estimate of the temperature of the thermometer B.

(iii) Most candidates understood that thermometer B was at a lower temperature than thermometer A because the silvered bulb is a better reflector of radiation. A minority thought that the blackened bulb is a better conductor.

Question 4

(a) Most candidates knew that the process in which ethane is produced from crude oil is cracking, although fewer gave the full description of the necessary conditions for the process to proceed. Many candidates gave only one of the necessary conditions.

(b) The majority recognised the test to distinguish between the saturated and unsaturated hydrocarbons and gave a good description of the results. A fairly error was to refer to the ethane as ‘discolouring’ the bromine. The word ‘discolouring has a different meaning to the word ‘decolourising’ – it means that the colour has changed, not necessarily to a colourless state. To avoid this error candidates should be encouraged to use the term ‘colourless’.

(c) Most recognised this as polymerisation. Fewer recognised that it is an addition reaction which leads to polymerisation.

(d) The calculation was done well with many candidates gaining all three marks.

mass of ethanol produced = 1.64 kg

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Question 5

(a) This question tested the candidate's understanding of 'angle of refraction'. Many candidates were challenged by the novel context.

(b) This was done well. Most candidates used the correct equation and gave the answer to the required 3 significant figures. Some candidates ignored the instruction to give the answer to 3 significant figures and lost credit.

refractive index = 1.44

(c) (i) The three dimensional nature of the diagram provided a novel context and therefore a good test of a basic concept. Many candidates found this question challenging.

(ii) A common mistake was to describe the image as being magnified rather than enlarged. The word 'magnified' does not always mean 'larger'. An image can be magnified by a factor of 0.5, which means that it is half the size of the original object.

Question 6

(a) (i) The majority of candidates were able to extract the relevant information from the table.

(ii) Most candidates scored this mark. Candidates who provided more than one property of aluminium as an answer for one mark lost credit if one of the properties provided was incorrect. Candidates should be made aware that providing several different answers when only one is asked for will not result in a greater chance of being 'right'.

(b) (i) Most candidates recognised that the reason for using an alloy instead of pure aluminium was that it increases the strength of the material.

(ii) There were some very good answers to this . Many candidates concentrated either on the either the structure of metals (positive ions in a sea of delocalised electrons) or on why alloys are stronger than the pure metal, without reference to the other half of the answer.

(c) (i) Most candidates recognised that aluminium, although reactive, forms an oxide layer which sticks to it protecting it from further oxidation.

(ii) Many candidates recognised that zinc is more reactive than iron and therefore oxygen reacts with it in preference to iron. However a few candidates stated that zinc 'rusts' before the iron. Candidates should be aware that rusting refers to the formation of iron oxide only.

Question 7

(a) Candidates need to learn and understand terms like charge, current, resistance, potential difference, and e.m.f.

The term e.m.f. is often misunderstood by candidates. The majority of answers referred to 'the force (or voltage) which pushes charge around the circuit'. Candidates should be aware that, despite the name, the e.m.f. is not a force but a statement of the energy transfer associated with unit charge as it goes once around the circuit.

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(b) (i) This question was answered well. The most common error was not to convert the minutes into seconds.

charge = 72 C

(ii) Candidates found this question more challenging. Candidates are required to know and be able to use the equation $E = I V t$

energy = 346 (J)

(iii) Candidates should know and be able to use the fact that the sum of the p.d.s across the components in a series circuit is equal to the total p.d. across the supply.

potential difference = 1.2 (V)

(iv) Most candidates who answered this part knew that the resistance of a component is equal to the potential difference across it divided by the current through it.

resistance = 5.0 Ω

(c) (i) Whilst most candidates recognised that doubling the length of the wire doubled the resistance, fewer considered the effect of using a thinner wire. Amongst those that did, a minority recognised that halving the diameter decreases the cross sectional area by a factor of 4 .

resistance = 40 Ω

(ii) The best answers recognised that the voltage was shared between the resistor and the wire, and if the wire had increased resistance then it would have a larger share of the voltage and consequently the share of the resistor would be smaller. An alternative approach, used by a few candidates, was to recognise that the circuit current would drop and consequently the potential drop across the resistor (whose resistance stayed constant) would drop.

Question 8

(a) Most candidates recognised that both oxides of nitrogen and carbon dioxide increased as the twentieth century progressed. Fewer used the figures to compare the rate of increase of nitrogen oxides and carbon dioxide for the second mark.

(b) This was answered quite well, with recognition that the nitrogen oxides were being converted into nitrogen.

(c) Most candidates gave at least one common pollutant relevant to the use of petrol engines.

(d) Candidates found this a challenging question. There are no simple formulae to remember and use. Candidates needed to think about what they are doing, working in a logical manner and explaining their working clearly.

volume of carbon dioxide = 1680 dm^3

Question 9

(a) Candidates generally find electromanagnetism and induction confusing. Candidates need to be given chances to induce voltage and charge by handling magnets in order to appreciate the complexities of the process. Only a few answered indicated that the candidate recognisde that it is not simply the presence of a magnetic field or flux near a conductor which induces an e.m.f. in the conductor, but the change of that flux as it links with that conductor.

(b) This follows on from **(a)**, the magnet is replaced by a current carrying coil and the current is switched off. Most candidates erroneously think that with a steady current producing a constant field will induce a current in the second coil. It is the switching of the current off, which causes the magnetic flux to drop to zero which induces an e.m.f.. It is just like moving the magnet away, the flux through the second coil gets less thus an e.m.f. is induced.

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Question 10

(a) Although some candidates were confused by the melting points for chlorine and bromine being negative, most candidates were able to extract the relevant information from the table.

(b) There was some confusion regarding the colour changes, with some thinking chlorine would act as a bleach or that chlorine would add a green hue. Nevertheless the majority of candidates answered the question well.

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PHYSICAL SCIENCE

Paper 0652/51

Practical Test

Key Message

Comparing repeated readings and judging whether these readings are reliable is an essential practical skill.

General Comments

The majority of candidates were able to carry out all three practical exercises. Clearly the lack of graph plotting removed some time pressure. Where there were problems with chemicals or apparatus, such as the starch in question 1, allowances were able to be made during the marking process.

Comments on Specific Questions

Question 1

Most candidates recorded a time in excess of 10 s for the solution to turn blue-black. Times recorded varied greatly from 20 s to 1500 s, which suggested that the starch had not been freshly prepared in some cases. Candidates were not penalised for this. The addition of the Fe^{2+}, Fe^{3+} and X^{2+} ions generally resulted in candidates correctly recording much shorter reaction times. Inappropriate precision was often used. Calculation of reciprocals rarely caused difficulty. It was surprising to see a minority of candidates recording 1 / t values as fractions and not attempting to calculate the reciprocal in decimal form.

The majority of candidates correctly concluded that the metal ions were acting as catalysts for the reaction. Many were able to use their results to explain why they had arrived at their conclusion.

Only the most able candidates were able to make a sensible comment about the reliability of the experiment by comparing the results they had obtained when no metal ion was present. The term reliability was often confused with the term fair test. Very few candidates understood that if the results on repetition were close (within 10%), then they could consider their results to be reliable. In part **(e) (i)**, most candidates understood the need to maintain a constant volume but very few were able to propose a sound modification. In part **(e) (ii)** relatively few candidates, after having being told to observe the reaction again, and to observe it carefully, were unable to record the formation of a precipitate and its colour. Many candidates were able to observe that the reaction occurred very quickly or instantaneously. Part **(f)** produced good results and metal **X** was usually identified. In this case Cu^{2+} was accepted as an alternative to copper.

Question 2

This straightforward measuring exercise was performed competently by the majority of candidates. When measuring the diameters of the top and bottom of the cup and the height of the cup, candidates were expected to quote their measurements with an accuracy which reflected the resolution of the ruler they had used. A significant minority of candidates wrote down distances which were to the nearest centimetre which was not accepted. A relatively small number of candidates wrongly took their measurements from the diagram of the cup that appeared in the question paper.

The average diameter and the volume of the cup were usually calculated correctly in part **(a)**. The volume was very often quoted to an unacceptably large number of decimal places or significant figures. Most candidates missed the clue in the stem of the question, namely to calculate the approximate volume, to quote their answer to the nearest cm^3.

Part **(b)** appeared to be carried out well despite some candidates encountering difficulties with the total volume of the measuring cylinder and with the lack of scale at low values of volume. The most common

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correct sources of inaccuracy suggested by candidates were that either water was spilled on transfer or that it was difficult to judge when the cup was full. A significant number of candidates misread the question and made a comment about the procedure carried out in part **(a)**.

V and V_w were stated as answers to **(b) (iii)** fairly equally. This was despite being told in part **(a)** that the method was an approximate one. Of those candidates who correctly chose the second method, many could not produce an acceptable explanation.

A few candidates used the string to measure the diameters in part **(c)** and then calculate the circumferences. This was not accepted as a ruler could have been used directly for this method, as in the first method. Of those who wrapped the string around the cup, few used more than two readings and many used just one, making averaging impossible. There were a significant number of correct answers using the diameters of the top and bottom of the cup. If just the middle of the cup was chosen, it was expected that candidates should wrap two or more loops around the cup and calculate the average. The easy calculation in part **(c) (iii)** was made more rigorous by demanding two or three significant figures in the answer. Good candidates gave the answer to this accuracy.

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PHYSICAL SCIENCE

Paper 0652/52

Practical Test

Key Message

In Chemistry, a lack of effervescence with the addition of an acid should be reported as this indicates the absence of the carbonate ion.

General Comments

Candidates were able to carry out both exercises in the allocated time. The standard of graph plotting was high and there were fewer difficult scales.

Comments on Specific Questions

Question 1

Although **P**, calcium ethanoate (acetate), is not a chemical that is routinely analysed at this level, the tests in this question are frequently encountered by candidates. Relatively few candidates observed the blue flame of propanone (acetone) burning and the darkening of the solid. Condensation was often recorded.

In part **(b)** the correct change in the colour of the litmus was often seen. The lack of effervescence on adding the acid and its significance were rarely recorded. This test, indicating the absence of the carbonate ion, has now appeared several times in practical tests.

Candidates coped better with the negative result of the sulfate test in part **(c)** and both marks were often scored. A number of candidates incorrectly assumed that the use of the barium chloride reagent indicated the presence of the sulfate ion.

The reaction between **P** and nitric acid produces calcium nitrate and **Q** which is ethanoic acid (acetic acid). Many candidates performed well in part **(d)** and often identified ethanoic acid by its smell, although the identification was not required at this level. Ethanoic acid is a weak acid so reacts with calcium carbonate less vigorously than hydrochloric acid of the same concentration.

The solid **R**, formed in part **(a)** by heating **P**, is calcium carbonate. In part **(e)**, most candidates observed the white precipitate in the limewater. The effervescence produced by adding acid to **R** was rarely recorded. Nearly all candidates correctly deduced the presence of carbonate but not all prefixed this with ‘calcium’ which was needed to identify compound **R** fully.

Question 2

This electrical exercise produced good sets of results. Most errors in part **(a)** were either the omission of units, transposing voltage and current readings or recording readings to inappropriate numbers of decimal places.

Plotting of points for the graph was generally done well and choosing sensible scales always helps with this. Scales should result in at least half of the grid being used for plotting the points. Most candidates drew a suitable straight line although curves and poorly sketched lines were seen.

Candidates continue to use less than half of their line to calculate the gradient and so not obtain the first mark. Also too many do not indicate on the graph, either with a triangle or with coordinates, which values were used. A small number of candidates used data from the table which is only valid if the line passes

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through these points. The calculation of the gradient was usually correct and many candidates chose the appropriate number of significant figures, two or three, for the answer in part **(d)**.

The reading of the meter scales was rarely given as possible source of inaccuracy in part **(e)**. More commonly candidates commented on the wire or the crocodile clips. Answers referring to the measurement of the length of the wire were accepted. It was rare to see both marks scored in this part.

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PHYSICAL SCIENCE

Paper 0652/61

Alternative to Practical

Key Messages

Candidates should be reminded that they should follow the degree of accuracy of any entry already made when entering data into tables, and that they should give calculated answers to a sensible number of significant figures.

General Comments

Candidates performed well when asked to enter data from measuring instruments.

The Chemistry questions were better answered than the Physics questions, where candidates struggled to apply theory to make predictions.

Comments on Specific Questions

Question 1

This question asked candidates to consider the practical details concerned in determining the boiling point of an organic liquid.

Many candidates scored the first mark in part **a(i)** by referring to the vapour being cooled as soon as it entered the condenser or the condenser being filled throughout. Some went on to refer to the condensing of water or steam, or the water mixing with the organic liquid. In part **a(ii)**, some correctly made reference to the flammability and a few to the toxicity of the vapour, but several referred to explosions and danger.

The three temperatures shown in part **(b)** were correctly read by over 90% of candidates.

In part **c(i)**, the trend in boiling points was correctly answered by the majority. Some candidates amalgamated the two homologous series and did not identify a trend specific to a homologous series.
In part **c(ii)**, the suggested boiling point was nearly always correctly predicted.

While answering part **(d)**, some candidates made reference to the thermometer not being able to reach the required temperature, rather than the hot water.

Question 2

This question asked candidates to consider the action of a catalyst by comparing rates, and then refer to the chemistry of copper.

Many candidates gained both marks for identifying two different pieces of apparatus for measuring volume.
In part **(c)**, most candidates did not follow the example given and entered 3.9 rather than the integer value of 4. Almost all candidates identified the better catalyst, supported by a correct reason.

In part **(e)**, several candidates identified the metal copper, but few continued to name copper hydroxide. Copper oxide, sulphate, nitrate and “ammoniate” were commonly seen errors.

In part **(f)**, only a handful of candidates realised the need for constant volume – a few added the required volume, not of water but of a metal ion.

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Question 3

This question required candidates to compare two different methods for finding the volume of a cup.

A large majority of candidates gave three correct answers when required to measure the dimensions of a cup to the nearest 0.1 cm. Some then found the average of all three rather than two as instructed. Most candidates were able to substitute their answer to part **a(iv)** correctly into the given formula.

Most candidates were able to read the value "55" correctly from a measuring cylinder shown in part **(b)**. The several who incorrectly gave "54" as the reading were able to gain a mark for correctly subtracting their value from 250.

Most of the marks for part **(c)** were gained through reference to spillage or incomplete filling of the cup; very few referred to the inherent inaccuracy of the cylinder, but several referred to error on behalf of the candidate e.g. due to parallax.

Many candidates in **(d)** realised that the masses must be subtracted, but then did not go on to relate the answer to the required volume.

Question 4

This question required candidates to consider a circuit for measuring and comparing the resistances of three different resistors, and then identify them given data about the lengths and thicknesses of the resistance wire.

The majority of candidates were able to read the voltmeters to give three correct resistor voltages in part **(a).** About half identified the correct name for the controller, but fewer drew it correctly – the symbols for transformers and diodes were commonly-seen wrong answers.

The majority of candidates gave the correct order in **(c)(i)**. A smaller majority related voltage and resistance correctly in **(c)(ii)** but an inverse relationship was often quoted.

The calculation in **(d)** was usually correct. In part **(e)**, most candidates reversed the order.

Question 5

This question concerned the design of apparatus to dissolve carbon dioxide, followed by eventual determination of the concentration of the solution thus obtained by the addition of limewater, and then the demonstration of the change in acidity.

Answers to **(a)** were often poor. Common errors included the use of a bung, the delivery tube not entering the liquid, or the use of limewater. Candidates need to draw apparatus arrangements carefully, including detail that will allow the apparatus to work effectively for the practical function that is proposed.

In part **(b)(i)**, few answers referred to cloudiness or milkiness; the majority looked for a colour change, a precipitate or effervescence. Reading from the inverted scale in **(b)(ii)** was quite poor, and of those who understood the scale, several scored a maximum of two marks as they entered the third reading as 7 instead of 7.0. In **(b)(iii)** the average of three readings was usually correctly found.

The calculation of part **(c)** was generally correct but often expressed to more than two significant figures. A few candidates substituted incorrectly, either by using a volume other than 25 for the carbon dioxide solution, or misreading 0.015 as 0.15. Most candidates could name an appropriate indicator, bromothymol blue appearing a few times, but the colour change for litmus was sometimes reversed, while for universal indicator the chosen first colour was often red.

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Question 6

This question required candidates to consider the timing and hence calculation of the speed and acceleration of a truck running down a smooth slope of varying height. Candidates were also asked to consider the energy transfers involved.

Candidates needed to be more precise when explaining their solutions to part **(a)**. It was often unclear which times, if any, were being measured, and by whom.

Almost all candidates transferred correctly read times into the appropriate space in the table given in part **(b)**.

In **(c)**, a few responses showed an understanding of the question with correct calculation of the speed/acceleration of the trolley. A large number of candidates presented a jumble of numbers with an inaccurate use of units. Candidates need to lay out their work clearly, explaining the reasoning behind their calculations when presented with a 'show' question.

A minority of candidates gained both marks for part **(d)** by presenting valid justification for their prediction.

A number of candidates realised the trolley would be going faster in part **(e)** but fewer related this to the difficulty in measuring the times. A significant number stated that the slope was so steep that the trolley would fall off! The energy transfer mark in part **(f)** was gained by nearly all candidates.

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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 measuring cylinders, thermometers, stopwatches etc. Candidates should have performed identification tests on the range of substances detailed in the specification

General Comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques. The reading of the instruments was of an excellent standard. The drawing of chemical apparatus proved very challenging for many candidates. The standard of graph drawing was generally high but drawing of curves proved challenging for some candidates. Candidates need to enter data into tables to the same number of significant figures as the data already there.

Comments on Specific Questions

Question 1

(a) Most able candidates gained credit. Common incorrect responses included sodium, nitrate, hydrochloric acid, sulfuric acid.

(b) More able candidates gained credit. Common incorrect responses included beaker for the first quantity and measuring cylinder for the second.

(c) (i) More able candidates gained credit. Common incorrect responses included phenolphthalein, methyl orange and litmus.

(ii) More candidates gained credit for the pH value.

(d) The very best candidates were able to answer this question.

(e) More able candidates drew creditworthy diagrams. Some candidates omitted this question and a significant number chose to filter.

(f) Whilst many candidates filtered the crystals diagrams were often not creditworthy as the filter paper was not included in the funnel or the diagram was not labelled. The question stated that the diagram should be labelled.

Question 2

(a) A very small minority of candidates gained credit. Most gave the test for either hydrogen or oxygen.

(b) (i) Many candidates gained credit for the result of the test but few gained credit for the diagram. Incorrect diagrams included sealed receiver vessels and delivery tubes not going into the limewater.

(ii) Many candidates gained credit although hydrogen was seen quite often.

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(c) Some candidates gained credit. Calcium chloride was a popular incorrect response.

(d) (i) Many candidates chose a correct indicator and gave the correct colour change but some reversed the colour change.

(ii) Few candidates gained credit. Popular incorrect responses included the reaction being too fast or the tube breaking.

(e) Most able candidates gained credit for monitoring the gas often by use of a syringe but very few appreciated the use of a specific time or a time for a specific amount of gas. Common incorrect responses included timing until the reaction was complete or choosing the one in which the bubbles stop first.

Question 3

(a) (i) Some candidates read the ammeter dials correctly but many candidates' values had a difference of 0.1 from the actual value. Most candidates read the voltmeter dials correctly.

(b) (i) Some candidates gained full credit for the plotting and the line and many gained credit for the plotting.

(ii) Some candidates indicated the values on the graph but many did not. When calculating the gradient of a line over half of the line should be used and the triangle used should be drawn. Many candidates inverted the division.

(iii) More able candidates gained credit.

(c) (i) Few candidates gained credit.

(ii) Most able candidates gained credit. To make sure the current or voltage didn't run out was a popular incorrect response.

Question 4

(a) (i)&(ii) Most candidates read the scales correctly.

(a) (iii) Most candidates gained credit for the subtraction.

(b) (i) Many candidates plotted the points correctly.

(ii) Many candidates gained credit for the best fit line but a significant number did not extend the line to the origin.

(c) (i) Some candidates identified the values on the graph and the most able calculated the gradient. Many candidates omitted this question. The triangle should be marked on the graph and should use more than half of the line.

(c)(ii) The majority of candidates omitted this question. The most able gained credit.

(d) The most able candidates gained credit. Common non creditworthy responses included repeat, read carefully, read accurately, average and use a ruler.

Question 5

(a) (i) Most gained credit.

(ii) Many candidates gained credit. A significant number thought the nail would rust albeit more slowly.

(iii) More able candidates gained credit. The most popular answer gave paint as the reason without saying what the paint does to prevent the rusting.

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(b) (i) Many candidates gained credit. Some candidates omitted the lighted splint or used a glowing splint. A small number used limewater.

(ii) More able candidates added a correct reagent but although they had the correct colour of the product they frequently omitted precipitate**.** A number of candidates omitted this part.

(iii) Many candidates gained credit.

(iv) Few candidates gained credit.

(c) More able candidates gained some credit with a few candidates gaining full credit. Many candidates discussed a Hooke's Law experiment with the wire extending rather than bending or repeated the stem of the question or discussed their knowledge of the relative strengths of iron and steel.

Question 6: Density of Liquids

(a) Many candidates gained credit.

(b) (i) Many candidates read the measuring cylinders correctly but some did not record the values to 0.5 cm^3.

(ii) Many candidates gained credit with a few reversing the order.

(c) More able candidates gained partial credit with a few gaining full credit. The chemical tests given included drinking the water or using an indicator. The physical tests included boiling (with no temperature) or seeing if it a colourless liquid.

(d) (i) Some candidates gained partial credit, usually for mass, and a few gained full credit. Common incorrect responses included beaker, ruler or cylinder for volume and rule or beaker for mass. Some thought density could be measured directly with a balance or a cylinder.

(ii) Many gained credit. A small number inverted the division.

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