PHYSICAL SCIENCE

Paper 0652/11
Core Multiple Choice

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

General comments

In the physics section, candidates found **Question 27** and **Question 35** more challenging than other questions.

Comments on specific questions

Question 1

The difference between Brownian motion and diffusion was not well understood by a significant proportion of the candidates.

Question 2

Ideas about chromatography are well understood by most candidates.

Question 3

The concept of isotopes was understood by a large proportion of the candidates.

Question 4

A majority of the candidates recognised J as a covalent compound.

Question 5

Most candidates recognised that diamond is a covalent solid but almost half of these candidates did not recognise that the carbon atoms are arranged in a tetrahedral pattern and chose option **A**.

Question 6

Many candidates did not understand that a balanced symbol equation should contain the correct formula of each of the substances in the reaction and these candidates chose option **A**.

Question 7

Most candidates calculated the relative atomic masses to show that the relative molecular masses of nitrogen dioxide and ethanol are 46.

Question 8

Stronger candidates understand that a reaction that releases thermal energy is an exothermic reaction.

Question 9

The idea that oxidation involves the gain of oxygen was not well understood and all options were selected.

Question 10

Ideas about relative acidity and the pH scale were well understood by almost all candidates.

Question 11

Many candidates understood that non-metals gain electrons when they form ions but the fact that they form acidic oxides was less well known.

Question 12

Many candidates were not secure in their knowledge here and there was evidence of guessing.

Question 13

The trends shown by the elements in Group I and Group VI were not well known by the candidates.

Question 14

The properties of the noble gases were well known by many candidates.

Question 15

The fact that magnesium reacts with hydrochloric acid was well known by almost all candidates. However, a significant proportion of these candidates thought that magnesium breaks easily and chose option **C**.

Question 16

Almost all candidates answered this question correctly.

Question 17

The fact that lime is manufactured by the action of heat on limestone was well known by stronger candidates. However, a significant proportion of the candidates thought it is used to neutralise alkaline industrial waste and chose option **D**.

Question 18

Stronger candidates were aware that paraffin is used as aircraft fuel but there was evidence of guesswork amongst the weaker candidates.

Question 19

A large proportion of even the stronger candidates were unaware of the fact that each successive member of a homologous series differs from the next by CH_2 and chose option **B**.

Question 20

Many candidates knew that polymers are made from unsaturated hydrocarbons. However, a significant proportion did not recognise ethene and chose option **D**, propene.

Question 24

Many weaker candidates knew that the instability was caused by movement of the centre of mass, but many believed that it had become lower rather than higher.

Question 25

In this question on work, weaker candidates often thought that the time taken to lift the box was a relevant factor, presumably confusing work and power.

Question 27

This question was challenging for many candidates, with many believing that a nuclear power station uses a chemical process, therefore opting for **D**.

Question 32

Many candidates thought that a frequency of 25 000 Hz is audible to a human and so chose option **C** rather than the correct option **B**.

Question 33

Many candidates mistakenly believed that an important property for the core of an electromagnet is that it needs to be an electrical conductor.

Question 35

This question on resistors in series and parallel was only answered well by the strongest candidates. Option **C**, being a single resistor, was a very common choice and candidates choosing this answer were unaware that adding a resistor in parallel reduces the total resistance.

Question 40

The topic here was radioactive decay and option **D** was more popular than the correct option **C**. Possibly this was chosen because 2.5 days is half of the 5 days of the final plotted point.

PHYSICAL SCIENCE

Paper 0652/12
Core Multiple Choice

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

General comments

In the physics section candidates performed very well on **Question 22**, but **Questions 21**, **28**, **24**, **33**, **38** and in particular, **Question 27** were more challenging for many candidates.

Comments on specific questions

Question 1

The difference between Brownian motion and diffusion was well understood by many of the candidates.

Question 2

Ideas about chromatography were well understood by almost all candidates.

Question 3

The concept of isotopes was understood by the stronger candidates.

Question 4

Many candidates did not recognise J as a covalent compound.

Question 5

Most candidates recognised that diamond is a covalent solid but some of these candidates did not recognise that the carbon atoms are arranged in a tetrahedral pattern and chose option **A**.

Question 6

Many of the candidates did not understand that a balanced symbol equation should contain the correct formula of each of the substances in the reaction and the same number of atoms on each side of the equation and these candidates chose either option **A** or option **B**.

Question 7

Most candidates calculated the relative atomic masses to show that the relative molecular masses of nitrogen dioxide and ethanol are 46.

Question 8

Stronger candidates understood that a reaction that releases thermal energy is an exothermic reaction.

Question 9

The idea that oxidation involves the gain of oxygen was not well understood. Many candidates thought that the loss of carbon dioxide by calcium carbonate represented oxidation and chose option **C**.

Question 10

Ideas about relative acidity and the pH scale were well understood by almost all candidates.

Question 11

Many candidates understood that non-metals gain electrons when they form ions but the fact that they form acidic oxides was less well known.

Question 12

Candidates knew that a green precipitate is produced by the iron(II) ion when sodium hydroxide is added but the test for a chloride ion was less well known.

Question 13

The trends shown by the elements in Group I and Group VI were well known by stronger candidates.

Question 14

Many candidates thought that the noble gases exist as diatomic molecules and chose option **A**. There was evidence of guesswork amongst the weaker candidates.

Question 15

The fact that magnesium reacts with hydrochloric acid was well known by the vast majority of the candidates. However, a significant proportion of these candidates thought that magnesium breaks easily and chose option **C**.

Question 16

Almost all candidates answered this question correctly.

Question 17

The fact that lime is manufactured by the action of heat on limestone was well known by almost all candidates.

Question 18

Stronger candidates were aware that paraffin is used as aircraft fuel.

Question 19

Most candidates were unaware of the fact that each successive member of a homologous series differs from the next by CH_2 and chose option **B**.

Question 20

Most candidates answered this question correctly.

Question 24

Many weaker candidates knew that the instability was caused by movement of the centre of mass, but many believed that it had become lower rather than higher.

Question 25

In this question on work, candidates often thought that the time taken to lift the box was a relevant factor, presumably confusing work and power.

Question 27

This question was only answered well by stronger candidates, with many believing that either a hydroelectric or a nuclear power station uses a chemical process.

Question 31

As many candidates thought that alpha radiation was part of the electromagnetic spectrum as those who chose the correct response, **C**.

Question 33

Many candidates mistakenly believed that an important property for the core of an electromagnet is that it needs to be an electrical conductor.

Question 35

This question on resistors in series and parallel was only answered well by the strongest candidates. Option **C**, being a single resistor, was a very common choice and candidates choosing this answer were unaware that adding a resistor in parallel reduces the total resistance.

Question 38

The topic here was the cathode-ray tube and option **A** was as popular as the correct option **D** with these candidates failing to realise that there must be a vacuum in the tube for it to work.

PHYSICAL SCIENCE

Paper 0652/21
Extended Multiple Choice

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

General comments

In the physics section candidates found **Questions 26**, **27**, **39** and, in particular, **Question 25** more challenging than other questions.

Comments on specific questions

Question 1

The difference between Brownian motion and diffusion was not well understood by a significant proportion of the candidates.

Question 2

Ideas about chromatography were well understood by almost all candidates.

Question 3

Most candidates understood that an ionic bond is formed between a metal to a non-metal. However, some candidates thought that electrons are shared and chose option **A**.

Question 4

This question was answered correctly by stronger candidates.

Question 5

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

Question 6

Stronger candidates answered this question correctly.

Question 7

The relationship between the volumes of gases and the stoichiometry of a chemical reaction was well understood by stronger candidates.

Question 8

Stronger candidates understood that a reaction that releases thermal energy is an exothermic reaction.

Question 9

This question proved challenging for many candidates.

Question 10

Stronger candidates understood that oxidation involves the gain of oxygen.

Question 11

There was evidence of guesswork amongst the weaker candidates.

Question 12

The amphoteric nature of aluminium oxide was quite well known but the nature of the other oxides was less well known.

Question 13

The fact that the Group number of an element is shown by the number of electrons in the outer shell of an atom of the element was well known by almost all candidates.

Question 14

The properties of the noble gases were well known by many candidates.

Question 15

The fact that magnesium reacts with hydrochloric acid was well known by almost all candidates. However, a significant proportion of these candidates thought that magnesium breaks easily and chose option **C**.

Question 16

The reactions that occur in the blast furnace were well known by many candidates.

Question 17

Stronger candidates were aware that paraffin is used as aircraft fuel but there was a misconception, particularly amongst weaker candidates, that bitumen is used to make waxes and polishes.

Question 18

The process of breaking down alkanes to form alkenes was understood by most candidates.

Question 19

Many candidates knew that polymers are made from unsaturated hydrocarbons. However, some candidates did not recognise ethene and chose option **D**, propene.

Question 20

The conditions used to manufacture ethanol were not well known by many candidates. Candidates should know that high pressure and high temperature is used in the manufacture of ethanol from ethene but yeast and a low temperature is used during fermentation of glucose.

Question 25

This question was only answered well by the strongest candidates. Many candidates opted for **C**, the value obtained by simply multiplying *g* by the height.

Question 26

A very common error in this question on mass-energy was simply to give the value of the speed of light and to choose option **B**.

Question 27

This question was challenging for many candidates, with many believing that a nuclear power station uses a chemical process, therefore opting for **D**.

Question 36

Many candidates here failed to convert the time to seconds, arriving at option **B** as their choice.

Question 39

The topic here was the cathode-ray oscilloscope and options **B** and **C** was more popular than the correct option, **D**. Candidates choosing one of these distractors either failed to understand the link between amplitude and Y-gain or were confused over the meaning of Y-gain sensitivity.

PHYSICAL SCIENCE

Paper 0652/22
Extended Multiple Choice

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

General comments

In the physics section candidates found **Questions 25**, **27**, **39** and, in particular, **Question 26** more challenging than other questions.

Comments on specific questions

Question 1

The difference between Brownian motion and diffusion was not well understood by many candidates.

Question 2

Ideas about chromatography were well understood by most candidates.

Question 3

Almost all candidates understood that an ionic bond is formed between a metal to a non-metal.

Question 4

Stronger candidates answered this question correctly.

Question 5

Most candidates understood the structure of graphite but its properties were less well known as many candidates chose option **C**.

Question 6

This question was answered well by stronger candidates.

Question 7

The relationship between the volumes of gases and the stoichiometry of a chemical reaction was well understood by stronger candidates.

Question 8

Stronger candidates understood that a reaction that releases thermal energy is an exothermic reaction.

Question 9

Most candidates recognised that the silver salts turn black when they are exposed to light but many candidates thought that the silver ions are oxidised to silver and chose option **A**.

Question 10

Stronger candidates understood that oxidation involves the gain of oxygen.

Question 11

Most candidates recognised that compound Y was water. However, the idea that alkalis are proton acceptors was less well understood by weaker candidates.

Question 12

The amphoteric nature of aluminium oxide was quite well known but the nature of the other oxides was less well known.

Question 13

The fact that the Group number of an element is shown by the number of electrons in the outer shell of an atom of the element was well known by almost all candidates.

Question 14

The properties of the noble gases were well known by many candidates.

Question 15

The properties of magnesium were well known by almost all candidates.

Question 16

The reactions that occur in the blast furnace were well known by many candidates but the idea that silicon(IV) oxide reacts with calcium oxide in the blast furnace to remove impurities in the iron ore was less well known.

Question 17

Stronger candidates were aware that paraffin is used as aircraft fuel but there was a misconception, particularly amongst weaker candidates, that diesel is used as a fuel for oil stoves.

Question 18

The process of breaking down alkanes to form alkenes was understood by many candidates. However, there was some confusion amongst weaker candidates between cracking and polymerisation.

Question 19

This question was answered well by most candidates.

Question 20

The conditions used to manufacture ethanol were not well known by many candidates. Candidates should know that high pressure and high temperature is used in the manufacture of ethanol from ethene but yeast and a low temperature is used during fermentation of glucose.

Question 25

This question was only answered well by the strongest candidates. Many candidates opted for **C**, the value obtained by simply multiplying *g* by the height.

Question 26

A very common error in this question on mass-energy was simply to give the value of the speed of light and to choose option **B**.

Question 27

This question was challenging for many candidates with many believing that a nuclear power station uses a chemical process.

Question 39

The topic here was the cathode-ray oscilloscope and option **C** was more popular than the correct option, **D**. Candidates choosing this distractor were confused over the meaning of Y-gain sensitivity.

PHYSICAL SCIENCE

Paper 0652/31
Core Theory

Key messages

Candidates should always show their working for calculations.
Candidates should take care to draw diagrams with precision.

General comments

Many candidates showed a good understanding of the syllabus areas.

Comments on specific questions

Question 1

(a) (i) The majority of candidates were able to determine the distance travelled by the car. However, very few candidates showed any working, which often limited the credit that could be awarded.

(ii) Candidates had no difficulty calculating a speed using their answer to **(a)(i)**.

(b) (i) Many candidates found this task challenging. Very few correct answers consisting of a horizontal straight line to represent constant speed were seen. Many candidates gained partial credit for showing the car starting or ending its journey at their calculated speed.

Question 2

(a) A wide range of properties of metals were given. A significant number of candidates seemed not to understand the term 'property' and so gave answers that were not properties but, for example, were uses.

(b) Copper, silver, gold were the expected answers. Credit was given for many other transition metals that can be found naturally.

(c) Iron was the expected answer. Credit was given for other metals used in the manufacture of stainless steel including copper, titanium, nickel and cobalt.

(d) Many candidates correctly identified iron as the metal extracted from Haematite.

Question 3

(a) (i) Many candidates responded correctly with gravitational potential energy. However, kinetic energy was a frequently seen incorrect answer.

(ii) Most candidates were able to specify kinetic energy, but far fewer correctly named a second form. Thermal energy and sound energy were also credited.

(b) (i) Candidates either correctly calculated 1400 Nm for the moment and gained full credit or they divided the force by the distance and gained no credit.

(ii) This was one of the more challenging questions on the paper. Many candidates gave answers which might, for example, relate more to work done than to moments. A number of candidates described in words how to calculate a moment of a force. The idea of 'turning effect' was rarely seen.

Question 4

(a) Many candidates were able to state that sodium had one electron in its outer shell. Alternative answers in terms of ion formation were accepted as were other approaches such as specifying distinctive shared properties of the alkali metals like their reactions with water.

(b) Few candidates had difficulty in identifying the proton and mass numbers. Alternative correct names like atomic number, nucleon number were accepted.

(c) (i) Almost all candidates correctly named sodium chloride.

(ii) Writing a balanced equation was challenging for some candidates. Credit for balancing the equation was not given if the species were incorrect. The most common error was to have chlorine as Cl and not as Cl_2.

(d) Many candidates were able to gain credit by either giving the correct symbols or the correct charges. Few candidates gained full credit, however.

Question 5

(a) (i) Most candidates were able to record the temperature, but a few mistook the water level in the beaker as being the point at which to read the scale. Some candidates did not read the question carefully enough. Some candidates gave the temperature difference between room temperature and the temperature of the beaker of warm water.

(ii) Many candidates identified the expansion of the liquid in the thermometer as the reason for the liquid level moving up. Many other answers were seen including ideas that it needed to do so in order to show the correct temperature and explanations about particles gaining energy and moving faster. Credit was given if the particle explanation included a description of the particles moving further apart and hence implying expansion.

(b) Some candidates did not seem to be familiar with the term 'fixed point'. Consequently many responses were seen in which candidates specified some part of the thermometer or the scale and then said this part did not move.

(c) The majority of candidates gained credit for the idea of liquid turning to vapour/gas or for the description of the liquid bubbling. Very few candidates described the constant temperature while the liquid boils.

Question 6

(a) Candidates were clearly familiar with the term 'exothermic' and could explain its meaning.

(b) (i) Balancing the equation proved to be challenging for most candidates.

(ii) Naming one of the products presented few problems for the majority of candidates. Weaker candidates did not understand the meaning of the term 'product'.

(c) Very few candidates noticed the reference to incomplete combustion in the question. Consequently, most candidates guessed at various hazards including the inevitable concern that something might explode. Successful candidates mentioned carbon monoxide and its poisonous nature.

(d) Few candidates could name hydrogen as a fuel that released no carbon containing compounds when burnt.

Question 7

(a) (i) and (ii) A few candidates had little idea about the terms 'amplitude' and 'wavelength' and drew an arrow to a specific point on the wave. Some candidates drew arrows that generally indicated the wavelength or amplitude. Sufficient care was not taken to ensure that the length of the drawn arrow was the wavelength/amplitude.

(b) (i) Most candidates gained credit for drawing three wavefronts that had changed direction when inside the shallow region. Many also drew the refracted waves with constant wavelength and gained further credit.

(ii) Drawing the correctly refracted waves did not always mean that candidates knew the name of the process and 'diffraction' was a common response.

Question 8

(a) Most candidates were able to give the formula for propane.

(b) The correct answer of 58 was widely seen with few arithmetical errors. Those that failed to gain credit used incorrect methods.

(c) (i) Many correct structures for ethene and ethane were seen. A common error was to omit the double bond in ethane. A few candidates transposed the two structures.

(ii) Only the strongest candidates answered this question correctly. A fairly common error was to name the reagent as bromide solution. Some candidates were able to gain partial credit for just recalling that there would be no reaction with the alkane.

Question 9

(a) (i),(ii) Only stronger candidates were able to identify the two regions of the electromagnetic spectrum.

(b) Few candidates considered the general properties of electromagnetic radiation. Most candidates chose increasing/decreasing and so only stronger candidates gained credit here.

(c) This question was not answered well. Many candidates suggested microwaves but there were also many responses which seemed to ignore the information given in the question. It was not unusual to see responses like 'the top' or 'the spoon'.

Question 10

(a) Most candidates knew that small solids were removed by filtration. Many alternatives for solids were accepted. A few candidates incorrectly stated that bacteria/microbes were removed by filtration.

(b) (i),(ii) The use of chlorine and its role in killing microbes was widely understood.

(c) (i) Only the strongest candidates answered this question correctly. Some candidates were not familiar with anhydrous copper sulfate as a test for water. Some confused the colour changes with those for cobalt chloride and then others got closer to the correct answer but described the white solid as being colourless which was not accepted.

(ii) Very few candidates knew that anhydrous copper sulfate was made by heating the hydrated salt.

Question 11

(a) Many candidates could identify component S as being a variable resistor.

(b) (i) This question tested the idea of current flow in a series circuit and was only answered well by stronger candidates. Many candidates divided the two values given without real thought or understanding.

(ii) Those candidates who had just divided the two values in **(b)(i)** were deterred from doing so again and so did not get the correct answer.

(c) Most candidates assumed that an extra resistor would increase overall resistance and therefore reduce the current.

Question 12

(a) This was a challenging question for most candidates. In the context of aluminium pans, candidates did not see the problem in terms of surface area and rate of reaction. Candidates frequently assumed that the composition of the aluminium pan was different, possibly an alloy, from the powered aluminium.

(b) (i) Only the strongest candidates answered this question correctly. The expected answers of flour mills and coal mines were rarely seen. Credit was given to answers referring to gunpowder.

(ii) Many candidates correctly suggested avoiding naked flames or keeping the powders in enclosed containers as a means of avoiding explosions. However, others did not answer the question as they advised on safety equipment like glasses and protective clothing to help in the event of an explosion.

(c) (i) Many answers were offered to this question including dung, soil, protein and nitrogen fertilisers. It seems likely that not all candidates understood the idea of a raw material for an industrial process.

(ii) Many candidates answered this correctly. Higher temperatures, and use of catalysts were frequently seen and given credit. Unsuccessful candidates suggested more nitrogen and/or ammonia rather than higher concentrations or higher pressures. Additionally, greater surface area was not given credit unless the candidate specified ‘of the catalyst’.

Question 13

(a) (i),(ii), (iii) Some correct values were seen, but very few candidates were able to correctly give the number of protons, neutrons and electrons present in an atom of ^{131}I.

(b) (i),(ii) Only the strongest candidates answered this question correctly.

PHYSICAL SCIENCE

Paper 0652/32
Core Theory

Key messages

Candidates should always show their working for calculations.
Candidates should take care to draw with precision when asked to indicate answers in this way.

General comments

Many candidates showed a good understanding of the syllabus areas.

Comments on specific questions

Question 1

(a) (i) The volume of the block was calculated correctly by the majority of candidates.

(ii) Candidates were familiar with the task of finding the weight of an object and calculating this and giving the correct units was done well by most candidates.

(iii) Calculating the density of the block was more discriminating a task than finding the weight. Nevertheless, a small majority of candidates successfully completed this task.

(b) (i) Almost all candidates could identify when the boat was travelling at constant speed and read the correct value from the graph.

(ii) Determining the time it took for the boat to slow down using the speed-time graph presented a greater challenge. Weaker candidates often gave the time at which the boat finally stopped rather than the time interval for which it was decelerating.

Question 2

(a) The great majority of candidates were able to name the group which contains Chlorine

(b) The small number of incorrect responses either named elements which were not in period 3 or gave the names of non-metals

(c) Candidates were asked to name a non-metal in period 3 that was a solid at room temperature. This part was answered significantly less well than other parts of the question.

(d) A small number of incorrect responses were seen identifying elements which are not gases at room temperature.

(e) The majority of candidates correctly identified sulfur/sulfur dioxide as the element and compound responsible for acidic pollution.

Question 3

(a) Many candidates answered this question well but a number of candidates did not offer any response. Some candidates drew imprecise arrows which only roughly indicated the amplitude and wavelength and which could not be credited.

(b) (i) This question was challenging for the majority of candidates but stronger candidates answered correctly.

(ii) Very few candidates had difficulty giving the range of frequencies that humans can hear.

(iii) Most candidates could explain that sound waves could not travel in a vacuum because of the need for air/a medium/something to vibrate.

(c) (i) Stronger candidates were able to identify that the longer lead would have a greater resistance and so the current through the drill motor would be lower.

(ii) Only the strongest candidates answered this question correctly.

Question 4

(a) Almost all candidates identified the formula for hydrogen chloride and the name of *NaCl*.

(b) Giving the formula of the ions in *NaCl* presented significantly more challenge. Weaker candidates often named the elements and give no indication of charges present.

(c) The dot and cross diagram for the structure of hydrogen chloride was well drawn by most candidates.

(d) Stronger candidates could explain positive and negative ion formation but a significant number of candidates found this question challenging.

Question 5

(a) (i) and (ii) Most candidates were able to identify the switch and drew a circuit diagram of the torch.

(b) (i) Most candidates knew that light was refracted by the lens but they were often unable to follow this up with an explanation based upon change of speed when moving between air and glass.

(ii) Naming the focal point and the focal length proved to be quite challenging for many candidates.

(c) Identifying the two regions of the EM spectrum presented few problems to candidates.

Question 6

(a) A significant number of candidates did not attempt this question. Weaker candidates suggested apparatus suitable for collecting a liquid and possibly had no means of measuring volume.

(b) The majority of the candidates were able to balance the equation for the decomposition of hydrogen peroxide.

(c) This proved to be a challenging question. Candidates often realised that “not being used up in the reaction” was the evidence being sought. Many just gave descriptions of what a catalyst would do or what the reaction would look like.

(d) Relatively few candidates identified an enzyme as an organic catalyst.

Question 7

(a) Most candidates were able to give to properties of metals.

(b) (i) Most candidates were able to identify copper sulfate and water as the products of the reaction.

(ii) Many candidates stated either that the reaction was one of neutralisation or that it was an example of base plus acid, but very few mentioned both points in order to gain full credit.

Question 8

(a) A small minority of candidates knew that electrons were emitted during thermionic emission.

(b) A large proportion of candidates did not attempt this question. Partial credit was given for the correct direction of deflection, i.e. towards the lower half of the screen. Further credit was awarded for a straight line path after the particle had passed between the deflection plates of the cathode ray tube.

(c) This question was often left unanswered. Those candidates that did respond, frequently identified heat as the energy the particles had before hitting the screen and this may have been because the diagram showed a heater.

Question 9

(a) Most candidates were able to identify a raw material containing calcium carbonate.

(b) The idea of using lime to neutralise soil was widely understood.

(c) Few candidates had difficulty explaining the meaning of the term “endothermic”.

(d) Most candidates struggled to explain either that bond formation released energy or that in the reaction more energy was released than absorbed.

(e) Low concentration (of carbon dioxide) and low temperature at which the reaction takes place were the expected responses to this question but these were rarely seen.

Question 10

(a) Candidates had no difficulty determining the number of protons and neutrons in a tritium nucleus.

(b) Balancing the nuclear equation for the decay of tritium presented few problems to candidates.

(c) Many candidates stated that the display would get dimmer with time. Full credit could be gained by reference to the half-life but not if the implication was that after two half-lives the tritium would have completely decayed/ the display would go out.

(d) Many candidates could describe some measures adopted for safe storage of radioactive materials in schools.

Question 11

(a) Many candidates were able to explain that a double bond was required for polymerisation to take place.

(b) The majority of candidates were able to draw the structure of the repeating unit of the monomer but a significant number of candidates did not offer any response to this question.

(c) Many candidates were able to name the polymer formed from propene.

(d) (i) Explaining that a hydrocarbon was a compound of hydrogen and carbon only was a challenge for most candidates. A significant number of candidates realised that carbon and hydrogen were involved but few stated or implied that there were no other elements present.

(ii) Stronger candidates could name methane and give its formula for full credit. Weaker candidates made errors like “methane” and “CH_5”.

PHYSICAL SCIENCE

Paper 0652/41
Extended Theory

Key messages

Candidates should ensure they answer all parts of the question as it has been set.

In questions requiring calculation, candidates should ensure they set out their working clearly to ensure it can be understood.

General comments

Although there were some very good answers seen, there were many which showed that the candidates only had a limited understanding of the principles and concepts of the syllabus. It is important that candidates cover the whole of the syllabus in order to be thoroughly prepared for the examination.

Questions 4, **7** and **10** were answered particularly well, whereas **Questions 5**, **9** and **11** proved more challenging.

Comments on specific questions

Question 1

(a) Although most candidates understood that the meaning of the moment of a force, few recognised that a force has many possible moments, depending on the point about which the turning effect is considered.

(b) (i) Although some candidates answered this well, there were many who did not take sufficient care in drawing the position of the line of action of the force supplied by the spring.

(ii) Only the strongest candidates answered this question well. A significant number of candidates did not recognise the correct distance between the weight and the pivot. Others did not provide a unit or gave an incorrect unit.

(iii) A few candidates were able to continue the complete the calculation which required an understanding of the balancing of moments.

(iv) Many vague answers such as “the ruler moves downwards” were seen. More specific answers such as, “the left hand end of the ruler moves downwards” or “the ruler rotates in a clockwise movement”, were required.

Question 2

(a) This was done well with many candidates scoring at least partial credit.

(b) (i) Although there were some good answers, many candidates found the balancing of the equation very challenging.

(ii) Many candidates did not recognise that zinc is deposited on steel to galvanise it. Those who did identify zinc generally gave a good explanation of how the protection works.

(iii) There were some good answers to this question but some candidates were not aware that sodium is very reactive and certainly too reactive for this job.

(c) This was answered reasonably well with the majority of candidates recognising that compound **B** was the one more likely to contain iron, although the reasoning was not always given clearly.

(d) Only the strongest candidates answered this question correctly.

(e) Although candidates had a vague idea about why an alloy is stronger and less malleable than pure metal, few candidates gave a clear explanation of the molecular differences between the two.

Question 3

(a) This was answered well by many candidates but some gave statements which did not recognise the process of calibration, such as “he wants to know the melting point and boiling point of water”.

(b) The attempts to calculate the temperature shown on the thermometer were very varied. There were some excellent answers seen but some others where the calculations were unclear.

(c) (i) This was done quite well with most candidates answering correctly.

(ii) Only the strongest candidates answered this question correctly. A common error was to think that a reduction in the thickness of the bulb wall would make it more sensitive. Although this would make it quicker acting, any effect on the sensitivity would be minimal.

Question 4

(a) This was answered well by the majority of the candidates.

(b) Many candidates answered this well but some did not answer the question in terms of proton transfer as the question asked.

(c) Only the strongest candidates recognised that the procedure could not be followed as magnesium carbonate is insoluble and therefore crystal would not form in the same way.

Question 5

(a) (i) Few candidates showed an understanding of the term “principal focus”.

(ii) Only the strongest candidates were able to draw in the position of the image.

(iii) The better candidates knew that the image is real because the rays are refracted enough to converge and cross.

(b) (i) Few candidates recognised that with a virtual image, the rays from a point on the object diverge after passing through the lens and appear to come from a point behind the lens.

(ii) Many candidates found this question challenging and only a few answered correctly.

Question 6

(a) There were some good attempts at this more complex calculation but many candidates found it challenging.

(b) (i) This was answered quite well with most candidates recognising that carbon monoxide would be formed. A common error was to think that the second substance formed would be hydrogen.

(ii) Most candidates named a polluting product, but not all went on to explain what the adverse effect of combustion of ethane is.

Question 7

(a) Candidates showed a good knowledge of the relationship between current, potential difference and resistance and generally completed the calculation successfully.

(b) This question was challenging for many and candidates had to be able to show a real understanding of circuitry to find the simple way of approaching the calculation. The simplest approach was to recognise that the current in $\mathbf{R_2}$ was equal to the total current minus the current in $\mathbf{R_1}$. An alternate approach was to solve the problem by the calculation of the combination of the two resistors in parallel and then to use the formula $1/R_{total} = 1/R_1 + 1/R_2$. The strongest candidates answered correctly.

(c) Most candidates were able to complete this question successfully.

Question 8

(a) Although the majority of candidates recognised that the phosphoric acid is used as a catalyst, a significant number thought it was to acidify the reaction mixture.

(b) There were some good answers for this question, but many candidates incorrectly indicated that the oxygen remained as an ion.

(c) (i) Only the strongest candidates answered this question correctly.

(ii) This was answered quite well.

Question 9

(a) (i) The parts of the transformer were not well known by many candidates.

(ii) This was answered quite well, although some candidates failed to compare the turns on the two coils just stating “there are fewer turns”.

(b) Electromagnetic induction is a challenging concept and candidates struggled to articulate how a transformer works. Those who showed some understanding did not often generate a complete explanation.

(c) Answers to this question were often too vague ‘”In a power station” or “in a power line” did not give a use of the step-down transformer. However, simpler correct answers, such as “charger for a cell phone” were given by many candidates.

Question 10

This question was answered well by almost all candidates.

Question 11

(a) Candidates need to understand the random nature of radiation.

(b) Stronger candidates recognised the concept of background radiation and answered well.

(c) Only the strongest candidates answered this question correctly. Candidates need to be aware of the relative penetrating power of different types of radiation.

Question 12

Most candidates answered this question correctly.

PHYSICAL SCIENCE

Paper 0652/42
Extended Theory

Key messages

Candidates should be reminded to draw diagrams clearly and precisely.

General comments

Many of the candidates showed an excellent knowledge and understanding of the key concepts in the syllabus and were well prepared for the examination. **Questions 2**, **5**, **9** and **11** were answered particularly well.

Comments on specific questions

Question 1

(a) Most candidates understood how to find the weight of an object given its mass and were also able to calculate the extension of the spring from the two diagrams.

(b) This question was generally answered well. The most common error was to forget to add the extension to the unstretched length of the spring.

(c) Most candidates understood what was meant by the limit of proportionality and correctly marked the point on the graph.

Question 2

(a) Nearly all candidates recognised the diagram as a model of the structure of an alloy and many showed an understanding of why alloys are less malleable than the pure metals.

(b) Most candidates knew a suitable use of copper and gave a reason as to why copper was suitable for that job.

(c) Many candidates answered this well and gained full credit.

Question 3

(a) Most candidates recognised that the energy was potential energy, but a significant minority did not specify it as gravitational potential energy. There are many forms of potential energy. Elastic, chemical, electric nuclear are all examples and it was important to be specific in answering this question.

(b)(i), (ii) This was answered well with many of the stronger candidates correctly calculating both the work done and the (average) power developed. Weaker candidates often tried to use all the information given in calculating the energy **(i)**, which demonstrated that they had not developed the skill of **(iii)** selecting relevant information to solve a particular problem. In **(iii)** most candidates recognised that the crane was not 100 per cent efficient and work would need to be done against forces other than gravity, for example friction.

Question 4

(a) Only the strongest candidates recognised that that caesium would react explosively with water. More candidates realised that the solutions formed would be acidic with a suitable pH number.

(b) This was answered exceptionally well with nearly all candidates identifying the correct metals.

(c) (i) A significant number of candidates did not recognise that aluminium forms an impervious oxide layer which stops it reacting further.

(ii) This question was usually answered very well.

Question 5

(a) Nearly all candidates recognised that the method of energy transfer from the Sun to Earth is by radiation. Answers which were acceptable included electromagnetic radiation, infrared radiation and visible radiation.

(b) Although the majority of candidates answered this correctly, weaker candidates thought that black 'attracts' radiation.

(c) Most candidates recognised that energy travels through the metal by conduction and were also able to give a reasonable description of the mechanisms involved in conduction.

Question 6

(a) Only stronger candidates showed an understanding of the decomposition of silver bromide, the base on which photography was built and few recognised that it is the silver which is reduced.

(b) This question was usually answered well.

(c) This was answered quite well with many candidates giving good evidence for their prediction.

(d) Most candidates answered this question well.

Question 7

(a) Some candidates drew the wavefronts with insufficient care. Candidates needed to use compasses and then to ensure the circles were centred on the centre of the gap and that the diameter of the arcs drawn increased in steps equal to the wavelength of the incident wave.

(b)(i), (ii) The marking of the amplitude of the wave needed to be done with care. Equally, the measurement of the wavelength needed care, not only in identifying the correct distance, but also in reading the
(iii) scale correctly. The calculation of the frequency in **(iii)** was well done by stronger candidates, but some candidates failed to rearrange the formula correctly.

Question 8

(a) (i),(ii) In **(ii)** the most common error was to fail to convert the minutes into seconds.

(b) The explanation of the low power output when the two heaters are connected in series was given fairly well. However, the second part, where the heaters were connected in parallel caused more problems. Nevertheless, stronger candidates gave good explanations.

Question 9

This question was answered well by almost all candidates.

Question 10

(a) Stronger candidates worked logically and explained what they are trying to do at each stage in their answers to this question.

(b) Most candidates had a good idea of the meaning of a homologous series, although there was a tendency to miss the idea of the same general formula. Candidates had little difficulty in completing the equation and their understanding of the use of a catalyst was good.

Question 11

(a) Electromagnetic induction was challenging for many candidates. However, nearly all candidates gained at least partial credit with stronger candidates answering fully correctly.

(b) Most candidates recognised that the parts of the motor indicated were slip rings. The most common error was to label them as a commutator or a split ring commutator. The graph question was more challenging for many candidates. The idea that the both the amplitude and the frequency of the induced electromotive force increased was recognised by stronger candidates. In some cases the drawing of the new wave lacked precision.

Question 12

(a) Only the strongest candidates recognised that the ratio of the number of moles of $H_2 : O_2$ was 2 : 1 and consequently the ratio of the volumes would also be 2 : 1.

(b) This final question was answered reasonably well but some candidates failed to point out that the only product of combusting hydrogen is water.

PHYSICAL SCIENCE

Paper 0652/51
Practical Test

Key messages

Candidates should note that “clear” is not a suitable description of a colour.

General comments

This paper was completed by all candidates and it was rare to see a part that had not been attempted.

Comments on specific questions

Question 1

The majority of candidates were able to draw a filter funnel and a piece of filter paper in **(a) (i)**. A few candidates drew unassembled apparatus for which credit was also given. Labelling was done well and very few candidates confused the residue and filtrate labels. The most common colours were colourless for the filtrate and grey for the residue. Some candidates incorrectly described the residue as being black. Clear was not an acceptable description of the colour of the filtrate because clear means transparent.

“White ppt.” was a common response in **(b) (i)** but fewer candidates recorded that the precipitate disappeared to produce a colourless solution. Once again clear was not accepted as an alternative for colourless. Most candidates concluded that zinc ions were present.

In **(b) (ii)** the tests for a chloride and a sulfate were usually present although not always correctly described. The test for a carbonate was often not placed at the beginning and often lacked the correct observation of bubbles or effervescence.

The correct answer to **(b) (iii)** was the chloride test but candidates often gave the sulfate test as an answer. The carbonate test was only given by stronger candidates.

The test in **(c) (i)** usually produced a pop sound but the resulting colourless liquid was often wrongly described as clear, grey or black. Most candidates realised that the gas was hydrogen but very few identified the type of element as a metal, sometimes naming a specific metal. Relatively few candidates suggested sodium hydroxide solution or ammonia solution in **(c) (iv)**, often giving an irrelevant reagent.

Question 2

Candidates had no difficulty in generating current and voltage values for **(a)**. Many candidates knew why the circuit should be switched off between readings.

In **(c)**, many candidates were able to calculate the resistance and power of the series circuit.

For the parallel circuit in **(d)**, readings of current and voltage were always recorded but in several cases the voltage varied too much and current was only recorded to one decimal place.

Most candidates were able to calculate the resistance and powers for the parallel resistors in **(e)** and **(f)**. A small number of candidates did not simply add the resistances as instructed but tried to use the parallel resistors formula. However, they did add the powers correctly.

In **(g)** many candidates were unable to decide whether two values were the same or different taking experimental error into account. A valid discussion using an arbitrary experimental error was accepted.

Very few candidates gave an observation to answer **(h)**. Few candidates gave answers including the lamps glowing brighter in the parallel circuit.

PHYSICAL SCIENCE

Paper 0652/52
Practical Test

Key messages

Candidates should have as much personal experience of carrying out experiments themselves as possible in preparation for this paper.

General comments

The majority of candidates were well prepared and able to demonstrate some ability and understanding across the whole of the range of practical skills being tested. All parts of both practical tests were attempted and there was no evidence of candidates running short of time. The majority of candidates were able to follow instructions correctly, record observations clearly and perform calculations accurately. However some candidates seemed less able to reach conclusions backed up by the evidence they had gathered.

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.

Comments on specific questions

Question 1

(a) (i) Most candidates recorded the correct initial observation when solutions **J** and **H** were mixed. Few candidates used the term "white precipitate". Many candidates wrote that the mixture turned milky or cloudy white. Both of these descriptions were credited.

Fewer candidates went on to observe that the white precipitate disappeared to leave a colourless solution. Of those who did, many recorded that the solution became clear or transparent. The words "clear" and "transparent" are not enough to describe a colourless solution, as coloured solutions can also be clear and transparent.

(ii) The observations made when the other five pairs of solutions were mixed were usually correct, but again the words "clear" and/or "transparent" were used instead of "colourless".

(b) The analysis of the observations made in **(a)** was done well and a majority of candidates were able to identify the four solutions correctly.

(c) (i) The observations recorded when the four solutions were tested with silver nitrate and copper sulfate solutions were generally correct.

(ii) Candidates found it more challenging to explain how the observations that they had made in **(i)** confirmed the identities of the four solutions that they had already identified in **(b)(iii)**. The tests for anions were sometimes mixed up and stated incorrectly, despite these tests appearing in the qualitative analysis notes at the back of the question paper.

Question 2

(a) (i) Some candidates did not follow the instruction given to measure the unstretched length l_0 of the spring to the nearest 0.1 cm and so could not be awarded credit.

(ii) Candidates were asked to use a ruler to mark the length they had measured in **(i)** on the diagram provided. A straight line was expected, but some candidates drew the distance freehand.

(iii) The value of the length of the spring when stretched by a 1.0 N load was usually within the tolerance allowed and recorded in the table to the nearest 0.1 cm.

(iv) Candidates had little difficulty in completing the table with the spring lengths for the five different loads recorded.

(b) This question on practical technique was challenging for many candidates. Candidates had difficulty articulating how they ensured that they had measured the length of the spring as accurately as they were able. Parallax was sometimes mentioned, but not qualified. Candidates needed to explain how they avoided parallax errors when using the rule to measure the length. Other acceptable answers were to clamp the ruler vertically and/or to have the ruler as close to the spring as possible.

(c) Most candidates chose an appropriate scale for their graph, plotted their points correctly and drew a sensible best-fit line. Occasionally the instruction to start both axes from (0, 0) was ignored. This led to problems in using the graph to determine the unstretched length l_0 of the spring.

(d) Only the strongest candidates were able to relate the difference between the value of l_0 determined from the graph and the value of l_0 measured in **(a)(i)** as being attributable to experimental error.

(e) Most candidates followed the instructions given and used the graph they had drawn correctly to determine a sensible value for the weight of the stone they had been provided with.

(f) (i) All candidates recorded the length of the spring when the stone attached to it was immersed in water. All results recorded showed the expected decrease in length compared to when the attached stone was in air.

(ii) The majority of candidates substituted correctly into the given equation and arrived at values for the density of the stone that were within the tolerances set.

PHYSICAL SCIENCE

Paper 0652/61
Alternative to Practical

Key messages

The candidates performed well when asked to draw apparatus and read scales. Answers supplied were generally to the degree of accuracy requested or demonstrated elsewhere in the data presented in the question.

It is important that candidates have practical experience of laboratory work in preparation for this paper.

Candidates should be reminded to read all questions carefully to ensure that they answer as the question has been set.

General Comments

Candidates would benefit from more exposure, either by video or teacher demonstration, to the experimental aspects of radioactivity and the processing and analysis of results.

Candidates' knowledge of qualitative analysis tests was not secure and this would benefit from more focus.

Graphical representation of data must include a sensible choice of linear scales to cover over half the paper, and there must be indication on the graph as to how a gradient was evaluated.

Comments on specific questions

Question 1

(a) (i) Most candidates drew good diagrams to include a v-shaped filter paper without a hole, within a funnel which included a stem, and labelled at least a couple of items.

(ii) A few candidates referred vaguely to mixing rather than dissolving, and some incorrectly mentioned mixture **H** dissolving despite it containing the insoluble element **J**.

(b) Qualitative analysis tests, observations and results were a challenge for most candidates. However, candidates did use key words such as "effervescence" and "precipitate".

(c) (i) Nearly all candidates identified hydrogen from its positive test, but few supplied the type of element present, namely a metal.

(ii) Only the strongest candidates answered this question correctly. Incorrect answers referred to flame tests or litmus paper.

Question 2

(a) Most candidates read both scales correctly, but 0.125 A was a relatively common error.

(b) To stop the current flowing or to obtain accurate readings were common insufficient response here. To avoid the circuit overheating or to avoid the cell running down were the expected answers.

(c) Numbers were nearly always substituted correctly into the given formulae.

(d) Candidates were expected to add the values contained in the tables and most did, but some candidates used their own formula.

(e) Some reference to experimental error was expected but only stronger candidates gave this. Candidates should note that stated values without comparison, or simply stating that the values do not match, are usually not sufficient for credit.

(f) (i) Many candidates used the values in the table to explain the series bulbs being less bright successfully.

(ii) Weaker candidates tried to either rearrange the series circuit into a parallel circuit which did not address the question as it had been set, or tried simply to move the ammeter However, stronger candidates answered this correctly.

Question 3

(a) A number of weaker candidates were unable to transfer a direct mass reading into the table.

(b) Some candidates labelled axes appropriately, including units, plotted points carefully, and followed the instruction concerning the line of best fit, but the majority of graphs were too small due to inappropriate choice of y axis scale.

(c) (i) The gradient was often either entirely omitted, or working was not shown on the graph.

(ii) Few candidates drew a line showing a faster rate of reaction.

(d) (i) Almost all candidates incorrectly stated that the cotton wool was to keep the gas in.

(ii) Stronger candidates realised that a bung would prevent gas escaping, leading to an unchanged mass, and some correctly referred to the danger of a build-up of pressure within the flask.

Question 4

(a) and (b) Candidates were highly proficient in the accurate measurement of lines that they had drawn, and most gained full credit. In a few cases the normal was incorrectly drawn.

(c) Most candidates answered this correctly.

(d) Almost all candidates gave a correct answer and quoted to three significant figures.

(e) Here the simple statement that the answers were close or distant was credited as long as it matched their answers, as consideration of experimental error was considered elsewhere.

(f) Few candidates recognised that reading from the top of the pin would be incorrect if the pin was not placed vertically. Vague references to improved accuracy or precision were not credited.

Question 5

(a) Most candidates read the thermometer correctly, but a correct subtraction was often not entered in the table to one decimal place in order to match the other values.

(b) (i) Safety precautions must always be specified with regard to the particular experimental procedure under consideration. Lab coats and safety spectacles were not considered specific enough for credit here. The main danger to be avoided here was the flammability of alcohols, as well as hair and clothes.

(ii) Same volume of alcohols/water, as well as same temperature rise, were common incorrect answers, as was a vague reference to temperature – the starting temperature is irrelevant when measuring a temperature change, but a constant lab temperature during the course of the experiment was accepted.

(iii) Very nearly all candidates identified a measuring cylinder as a suitable piece of apparatus for measuring volume, as well as pipettes and burettes, but a handful of candidates incorrectly chose a beaker.

(c) (i) Most candidates selected the correct piece of data and inserted it into the equation provided, but many did not follow the instruction to give the answer to three significant figures.

(ii) Candidates were asked for an equation, not an expression, and only the strongest candidates realised that energy needed to be divided by mass.

(iii) Butanol was selected by most candidates who attempted this question, but often without explanation.

(d) Most candidates did not attempt this question. From those answers seen, “heat loss” without qualification was insufficient for credit.

Very few candidates referred to incomplete combustion.

Question 6

Several candidates either omitted this question completely, or only attempted the first two parts.

(a) 20.25 was given as an answer fairly often. Candidates needed to read the question more carefully regarding the level of approximation which was expected.

(b) Nearly all candidates realised that the count rate from source was calculated by subtracting the background radiation which they had previously calculated, from the measured count rate, but a few candidates added it on.

(c) Generally this graph was plotted well, and a smooth curve enabled the values in **d(i)** to be read off correctly.

(d) (ii) Very few candidates realised that the half-life was obtained by subtracting their value of time at 300s from their value at 600s obtained in **d(i)**.

(e) (i) Surrounding the source was the most common incorrect answer here, and a few candidates started discussing expected results due to relative penetrating power instead of addressing the emphasis on apparatus in the question.

(ii) Very few candidates addressed the results, i.e. the counts obtained after inserting paper and aluminium between the source and the detector. A few candidates knew that beta particles would penetrate paper but not aluminium.

PHYSICAL SCIENCE

Paper 0652/62
Alternative to Practical

Key messages

The candidates performed well when asked to draw apparatus and read scales. Answers supplied were generally to the degree of accuracy requested or demonstrated elsewhere in the data presented in the question.

It is important that candidates have practical experience of laboratory work in preparation for this paper.

Candidates should be reminded to read all questions carefully to ensure that they answer as the question has been set.

General Comments

Graph plotting must include axes labelled with units and should show a sensible choice of linear scale so that the candidate plot covers over half the paper.

Answers should be given to the stipulated number of significant figures. If not stipulated, then to the degree of approximation used already in a table.

Comments on specific questions

Section A

Question 1

This question required interpretation of test-tube observations through knowledge of inorganic qualitative analysis. Several candidates realised that sulfate and zinc ions react to form a white precipitate which redissolves in excess, and that exothermic reactions cause warming of the test-tube.

In **a (iii)** sulfate and K were rarely identified.

The apparatus was well drawn by stronger candidates. Many candidates showed just one container for gas evolution and testing.

Answers to **b(ii)** were rarely correct, indicating that candidates had difficulty in applying their knowledge to an unfamiliar situation.

Question 2

The spring was measured carefully and accurately, but graph drawing was not strong. Very few candidates realised that their graph needed to be extended to find the y-axis intercept, and there was little reference to experimental error.

Density was calculated correctly by nearly all candidates.

Question 3

Nearly all candidates identified NaOH and chloride, but a few referred to particle size decrease in order to speed the reaction when there was no solid there.

A few candidates inverted the reactivity series, but most realised that it was moderately reactive. Stronger candidates referred to reaction with water or acid to justify their claim.

Filtration apparatus was well drawn and labelled by a few candidates.

Most candidates predicted a green precipitate, but very few attributed the brown colouration to the formation/displacement of copper, and instead referred to the oxidation to Fe(III).

The final solution was often brown.

Question 4

The circuit diagram was only completed by the stronger candidates.

Table values were usually correct, and latitude was allowed over the degree of approximation of the power. The answer was expected to be given to two significant figures as that matched the rest of the entire table, but two decimal places was also acceptable as it matched the final column entries.

Most candidates thought brightness dropped, but candidates often failed to relate their answer in **(e)** to the salient variables. A number of candidates did not attempt **(f)**.

Question 5

There were many vague answers relating to the safety procedures. Responses needed to relate to the actual experiment, not the general approaches of using safety spectacles and lab coats.

Some candidates knew that mass would change on cooling and the calculation was nearly always correct. However, very few attributed the white powder to the formation of MgO.

Several candidates gave hydrogen, but oxygen and even ammonia were also given, and the reaction was often classified as exothermic rather than redox.

Most candidates recognised that sodium was too reactive and either chose a figure or mentioned that the pH must be greater than 7. However, in **c (ii)** few candidates recognised the idea of neutralisation followed by the formation of a soluble salt.

Question 6

Many candidates were unfamiliar with this experiment, but careful thought could have prompted the correct responses even from those candidates who had carried out little practical work.

Repeating the measurement was suggested by several candidates, but requesting the help of others was rare.

The scale was correctly read by most candidates, but there were a few answers of 4.4 caused by inverting the scale. Only the strongest candidates made a sensible prediction in **(c)**.

Very few candidates of those who attempted these last three parts realised that the magnet was closer to the iron, that values of F would be larger, or that a wider scale would lead to smaller pointer movement and hence less accurate readings.