PHYSICAL SCIENCE

Paper 0652/11
Multiple Choice

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

Chemistry

Question 1

The effect of impurities on the melting point of a substance was not understood by a large proportion of the candidates. There was evidence of widespread guesswork, particularly amongst the weaker candidates.

Question 2

This proved to be an easy question for the vast majority of the candidates.

Question 3

The fact that chlorine forms ionic compounds with metal was well known by the better candidates and the majority were able to identify W and Z as metallic elements.

Question 4

Many of the weaker candidates used the proton number for copper, sulfur and oxygen to calculate the mass of $CuSO_4$ rather than the relative atomic masses, and chose option **B**.

Question 5

The description of an exothermic reaction was well known by the vast majority of the candidates.

Question 6

Almost all of the candidates knew that the rate of reaction is increased by the temperature, but a number of the weaker candidates thought that the volume of carbon dioxide also increased, and chose option **D**.

Question 7

The majority of the candidates recognised that copper(II) oxide loses oxygen during the reaction and is therefore reduced.

Question 8

The majority of the more able candidates knew that the solid oxide was alkaline and therefore element X was a metal. However, there was evidence of guesswork amongst the weaker candidates.

Question 9

The majority of candidates recognised that acidified silver nitrate solution gives a white precipitate when it is added to aqueous copper(II) chloride, but only half of these candidates knew that the blue precipitate produced with ammonia dissolves in excess ammonia solution to give a blue solution.

Question 10

Many candidates knew that bromine displaces iodine from potassium iodide, but the formula of the bromine molecule was less well known.

Question 11

The better candidates were aware of the metallic properties of sodium. However, there was evidence of guesswork amongst the weaker candidates.

Question 12

The more able candidates understood the relationship between the relative reactivity of an element and the ease with which it can be extracted from its ore.

Question 13

The sources of the four metals were well known by the majority of candidates.

Question 14

The chemical test for water was well known by many, but there was evidence of guesswork amongst the weaker candidates.

Question 15

The vast majority of the candidates were aware of the role of water and oxygen in the rusting of iron.

Question 16

This was an easy question for the majority of candidates.

Question 17

A significant number of candidates thought that the thermal decomposition of calcium carbonate produced slaked lime rather than lime, and so chose option **C**.

Question 18

The relationship between the uses of petroleum fractions and the point in the fractionating column that they are collected was not well known by many of the candidates.

Question 19

This was an easy question particularly for the better candidates.

Question 20

The uses of ethanol were well known by the majority of candidates.

Physics

Question 25

Only a minority of candidates answered this correctly, with many confusing fission with regrouping of atoms.

Question 29

A significant number of candidates believed that the amplitude of a wave is the vertical distance measured 'peak to trough'.

Question 31

Although this question on the order of wave types in the electromagnetic spectrum has been commonly asked in different forms in the past, many candidates placed infra-red on the 'wrong' side of visible light.

Question 33

A very small majority of the candidates appreciated that the property of soft iron that make it so useful here is its poor retention of magnetism when the current is switched off.

Question 34

The majority of candidates answered this incorrectly, with the most common mistake being a belief that a conducting rod could be held in the hand and charged by rubbing with a cloth.

Question 38

There was widespread confusion over which deflection plates were connected to the a.c. supply to produce the waveform shown.

Question 39

Almost half of the candidates believed that beta-particles are emitted from an outer electron shell rather than from the nucleus.

Question 40

More able candidates had little difficulty with this question, but most of the less able appeared to be guessing.

PHYSICAL SCIENCE

Paper 0652/12
Multiple Choice

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

Chemistry

Question 1

The effect of impurities on the melting point of a substance was not understood by many of the candidates.

Question 2

This proved to be an easy question for the vast majority of the candidates.

Question 3

The fact that chlorine forms ionic compounds with metal was quite well known by the better candidates and the majority were able to identify W and Z as metallic elements.

Question 4

A number of the weaker candidates used the proton number for copper, sulfur and oxygen to calculate the mass of $CuSO_4$ rather than the relative atomic masses, and chose option **B**.

Question 5

The description of an exothermic reaction was well known by the vast majority of the candidates.

Question 6

Almost all of the candidates knew that the rate of reaction is increased by the temperature, but a significant number thought that the volume of carbon dioxide also increased, and chose option **D**.

Question 7

The majority of the candidates recognised that copper(II) oxide loses oxygen during the reaction and is therefore reduced.

Question 8

The majority of the more able candidates knew that the solid oxide is alkaline and therefore element X was a metal. However, a number of the weaker candidates thought that pH 13 represented an acidic solution, and chose option **D**.

Question 9

Many of the candidates recognised that acidified silver nitrate solution gives a white precipitate when it is added to aqueous copper(II) chloride, but fewer than half of these candidates knew that the blue precipitate produced with ammonia dissolves in excess ammonia solution to give a blue solution.

Question 10

The formula of bromine and its reaction with aqueous potassium iodide were not well known by the candidates as shown by evidence of widespread guesswork, even amongst the better candidates.

Question 11

The majority of candidates knew that sodium conducts electricity, but fewer than half of these, including the better candidates, were aware that sodium is malleable.

Question 12

The relationship between the relative reactivity of an element and the ease with which it can be extracted from its ore was well understood by the better candidates.

Question 13

The sources of the four metals were well known by many of the candidates.

Question 14

The chemical test for water was not well known by many of the candidates and there was evidence of guesswork even amongst the better candidates.

Question 15

The vast majority of candidates were aware of the role of water and oxygen in the rusting of iron. However, many did not recognise the significance of the effect of pure oxygen and chose option **B** instead of option **D**.

Question 16

This was an easy question for the majority of candidates.

Question 17

A significant number of candidates thought that the thermal decomposition of calcium carbonate produced slaked lime rather than lime, and so chose option **C**.

Question 18

The relationship between the uses of petroleum fractions and the point in the fractionating column that they are collected was well known by many of the candidates.

Question 19.

This was an easy question particularly for the better candidates.

Question 20

The uses of ethanol were well known by the majority of candidates.

Physics

Question 25

Only a small proportion of responses were correct, with many candidates confusing fission with regrouping of atoms.

Question 27

Many candidates opted for **B**, failing to notice that the boiling point in this option was above the stated temperature of 25 °C.

Question 31

Although this question on the order of wave types in the electromagnetic spectrum has been commonly asked in different forms in the past, fewer than half of the candidates placed infra-red correctly.

Question 33

Only a small minority of the candidates appreciated that the property of soft iron that makes it so useful here is its poor retention of magnetism when the current is switched off.

Question 34

This question was very poorly answered, with the most common mistake being a belief that a conducting rod could be held in the hand and charged by rubbing with a cloth.

Question 36

Many candidates simply added the three resistor values together, paying no regard to their connection.

Question 38

Although the vast majority realised that the time-base was switched on, equal numbers believed that the a.c. supply was connected to either set of deflection plates to produce the waveform shown.

Question 39

The most common error here was a belief that beta-particles are emitted from an outer electron shell rather than from the nucleus.

PHYSICAL SCIENCE

Paper 0652/21
Core Theory

Key Messages

A sound knowledge of the basic facts is a prerequisite for success in any examination.

General Comments

There were some scripts where the candidates had a good knowledge of most of the basic facts and showed some understanding of even the most difficult of the concepts.

Comments on Specific Questions

Question 1

(a) Common mistakes were to work backwards from the graph and to try to calculate the extension by subtracting the length of the spring with a load of 2 N fromm the length with a load of 1 N, rather than from the unloaded length.

extension = 2.8 cm

(b) (i) Plotting the the point on the graph was done quite well, the most common error being a failure to recognise that each division on the *y*-axis corresponded to 2 mm.

(ii) Candidates need to avoid vague statements such as, 'the extension increases as the load increases'. Any straight line graph through the origin shows that the variables are proportional to one another.

(c) (i) The majority of candidates correctly calculated the volume.

volume = 45 cm^3

(ii) Although there were many correct calculations, there were relatively few candidates who gave the correct unit.

density = 1.4 g / cm^3

Question 2

(a) The experimental techniques for the identification for copper ions were not well known.

(b) Candidates needed to describe the crystallisation technique in detail. For example, only a few candidates mentioned that the residue from filtering needed to be dried.

(c) Common errors were to describe the crystals as copper oxide, copper sulphide or copper, although a good number of candidates did recognise them as copper sulphate.

Question 3

(a) The majority of candidates recognised the described reaction as being exothermic. A small number gave *oxidation* rather than the generic term for reactions in which there is an energy output.

(b) Candidates continue to have difficulty balancing equations. Many need to understand that hydrogen and oxgygen gases do not consist of single atoms but of molecules constituted from two hydrogen atoms or two oxygen atoms.

(c) (i) **C**andidates needed to recognise that both oxygen – oxygen and hydrogen – hydrogen bonds are broken. Many recognised the formation of hydrogen – oxygen bonds. Additionally, those candidates who recognise that the bond in a hydrogen molecule is broken need to take care to describe that bond as a hydrogen – hydrogen bond, not simply a hydrogen bond.

(ii) Candidates need to be aware that the breaking of a bond absorbs energy and that the creation of a bond releases energy.

Question 4

(a) Many candidates recognised the meaning of the term alloy. The most common error was to describe an alloy as a 'mixture of substances or elements'; the term 'metal' needs to be used.

(b) A minority of candidates linked this to the idea of expansion, the majority stated that the bending is something to do with softening before melting or the conductivity of the metals.

(c) Those that understood the action of the bimetal strip were usually able to give a good explanation of its use in a thermostat.

Question 5

(a) There were some good diagrams showing how the volume of the carbon dioxode gas produced could be measured. The most common error was to try and collect the gas directly into a sealed container.

(b) Many candidates scored well here, correctly calculating the RMM of calcium carbonate and relating that to the RAM of carbon. Candidates are reminded of the need to set their working out logically or produce some explanation of the working as they do the calculation.

Question 6

(a) When indicating distances, care must be taken. Some candidates lost a mark through carelessness.

(b) (i) Candidates needed to ensure that the reflected wavefronts showed an angle of reflection equal to the angle of incidence. Some candidates drew the waves as refracted, not reflected

(ii) Some candidates assumed that the experiment demonstrated refraction, not reflection.

Question 7

(a) Some candidates recognised that that carbon dioxide was formed in the combustion of candle wax, but few went on to add that carbon dioxide is soluble in water.

(b) Very few candidates recognised that the gas remaining in the bell jar is nitrogen.

(c) A significant number of candidates thought that a limited supply of air would lead to an explosion. Those who recognised that carbon monoxide would be produced also needed to explain that carbon monoxide is toxic.

Question 8

(a) The majority of candidates recognised that effervescence takes place but needed to add further specific detail, such as 'the sodium darts about the surface of the water'. General non-specific comments such as 'a violent reaction occurs' were not given credit.

(b) This was done well with many candidates scoring both marks.

(c) As in the previous section this was done well, showing that candidates have a good understanding of the term *Period*.

(d) Candidates found this very challenging, with few scoring any marks. Many drew sodium chloride as a covalent substance. Others tried to draw a single atom, with the number of electrons on this single atom being the sum of the electrons on the chlorine and the sodium atoms.

Question 9

(a) (i) Few candidates spotted that the cells in in the third example opposed each other and therefore the current would be zero and the lamps would not light.

(ii) Some candidates recognised that the cells in examples 2 and 4 would run out most quickly, but fewer were able to explain that this was because the currents in those circuits were higher.

(b) (i) **C**andidates generally recognised that the instrument used to measure current is the ammeter, although some confused this with a voltmeter. Another common error was to think that the meter is an amplifier.

(ii) Many candidates scored all three marks in this section, correctly giving the correct circuit diagram symbol for an ammeter and showing it connected correctly. Common errors were to try to connect the meter in parallel with the bulbs or to represent the ammeter with a sketch of the meter used in class.

Question 10

(a) (i) **A** good proportion of candidates recognised that the iron bar would be magnetised; some described it as being 'charged'.

(ii) Candidates needed to realise that not all metals are magnetic materials. Many candidates thought that the metallic pieces were not picked up because they had the same charge as the iron rod.

(b) **C**andidates needed to recognise that the pins become induced magnets with similar poles at the pinheads leading to a mutual repulsion.

Question 11

(a) Candidates need to understand the meaning of proton and nucleon numbers and to recognise the difference between them.

(b) (i) There were a fair number of good diagrams showing the structures of both ethane and ethene correctly.

(ii) A good number of candidates know the test to distinguish between alkanes and alkenes.

(iii) There were some good answers to this although some candidates lost marks by not fully answering the question. A simple statement such as 'Alcohol' was insufficient; Ethene is not an alcohol, although it is used to make an alcohol (ethanol).

Question 12

(a) (i) This section was done well with most candidates recognising that the curved path of the cathode rays was the clue and its attraction to the positive plates (or repulsion from the negative plates) was the evidence which established that the cathode rays are negative.

(ii) Fewer candidates got the mark here. A common error was state that the particles are beta-particles, which is technically incorrect – cathode rays are electrons which are thermionically emitted from a hot cathode, whereas beta-particles are electrons which come from the nucleus of an unstable atom.

Question 13

(a) (i) Candidates needed to realise that the scatter is due to the random nature of radioactive decay.

(b) Many candidates gave an answer which indicated that they misunderstood the half life to be half the time the decay curve covers.

(c) Many candidates described the properties of alpha-particles rather than the nature of an alpha-particle. Candidates need to read the question carefully and answer the question that is set.

PHYSICAL SCIENCE

Paper 0652/22
Core Theory

Key Messages

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General Comments

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Comments on Specific Questions

Question 1

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extension = 2.8 cm

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volume = 45 cm^3

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density = 1.4 g / cm^3

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(b) A minority of candidates linked this to the idea of expansion, the majority stated that the bending is something to do with softening before melting or the conductivity of the metals.

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(b) (i) Candidates needed to ensure that the reflected wavefronts showed an angle of reflection equal to the angle of incidence. Some candidates drew the waves as refracted, not reflected

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(b) Very few candidates recognised that the gas remaining in the bell jar is nitrogen.

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(b) This was done well with many candidates scoring both marks.

(c) As in the previous section this was done well, showing that candidates have a good understanding of the term *Period*.

(d) Candidates found this very challenging, with few scoring any marks. Many drew sodium chloride as a covalent substance. Others tried to draw a single atom, with the number of electrons on this single atom being the sum of the electrons on the chlorine and the sodium atoms.

Question 9

(a) (i) Few candidates spotted that the cells in in the third example opposed each other and therefore the current would be zero and the lamps would not light.

(ii) Some candidates recognised that the cells in examples 2 and 4 would run out most quickly, but fewer were able to explain that this was because the currents in those circuits were higher.

(b) (i) **C**andidates generally recognised that the instrument used to measure current is the ammeter, although some confused this with a voltmeter. Another common error was to think that the meter is an amplifier.

(ii) Many candidates scored all three marks in this section, correctly giving the correct circuit diagram symbol for an ammeter and showing it connected correctly. Common errors were to try to connect the meter in parallel with the bulbs or to represent the ammeter with a sketch of the meter used in class.

Question 10

(a) (i) **A** good proportion of candidates recognised that the iron bar would be magnetised; some described it as being 'charged'.

(ii) Candidates needed to realise that not all metals are magnetic materials. Many candidates thought that the metallic pieces were not picked up because they had the same charge as the iron rod.

(b) **C**andidates needed to recognise that the pins become induced magnets with similar poles at the pinheads leading to a mutual repulsion.

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(a) Candidates need to understand the meaning of proton and nucleon numbers and to recognise the difference between them.

(b) (i) There were a fair number of good diagrams showing the structures of both ethane and ethene correctly.

(ii) A good number of candidates know the test to distinguish between alkanes and alkenes.

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Question 12

(a) (i) This section was done well with most candidates recognising that the curved path of the cathode rays was the clue and its attraction to the positive plates (or repulsion from the negative plates) was the evidence which established that the cathode rays are negative.

(ii) Fewer candidates got the mark here. A common error was state that the particles are beta-particles, which is technically incorrect – cathode rays are electrons which are thermionically emitted from a hot cathode, whereas beta-particles are electrons which come from the nucleus of an unstable atom.

Question 13

(a) (i) Candidates needed to realise that the scatter is due to the random nature of radioactive decay.

(b) Many candidates gave an answer which indicated that they misunderstood the half life to be half the time the decay curve covers.

(c) Many candidates described the properties of alpha-particles rather than the nature of an alpha-particle. Candidates need to read the question carefully and answer the question that is set.

PHYSICAL SCIENCE

Paper 0652/31
Extended Theory

Key Messages

A sound knowledge of the basic facts is a prerequisite for success in any examination.

General Comments

There were some excellent scripts where the candidates not only showed a good knowledge of basic facts but also showed a really good understanding of the science involved.

Comments on Specific Questions

Question 1

(a) (i) The vast majority new the name for a chemical reaction that releases energy; amongst the few who did, not the most common errors were to state that it was combustion or oxidation.

(ii) Many candidates stated that energy was released on the breaking of bonds. Amongst those who did show understanding of bond breaking and bond making, few went on to compare the amount of energy absorbed and released in the two processes.

(b) (i) Many candidates gave answers such as, 'coal' or 'petrol'

(ii) The most common error was to state that methane was very reactive, explosive or simply, a gas.

Question 2

(a) (i) Whilst the majority of candidates scored this mark a significant number gave 5.5, 5.2 or 5 N.

(ii) Candidates found this challenging, both in matching the calculation to grams or kilograms and with whether the weight should be multiplied or divided by *g*.

(b) Most candidates were aware of the method of displacement but few made details such as fully submerging the object in the water clear. Others lost marks for attempting to measure the displaced water with a beaker or unidentified container, rather than with a measuring cylinder.

(c) This was done well, although the failure to convert the mass in kilograms to grams cost some candidates credit.

Question 3

(a) Candidates needed to answer this question precisely to gain full credit. The question required candidates to state either that the demand for fractions such as gases and petroleum was much greater than supply or that production of fractions such as gas oil and fuel oil were in excess of demand, naming the fractions in question.

(b) (i) Most candidates have a good understanding of cracking, a few confusing the breaking down of the hydrocarbon chains with polymers and monomers. Only a few candidates described the conditions required for the process to occur.

(ii) Many candidates needed to be more precise in their answers. Candidates needed to specify that the large chains which are in excess can be cracked to make smaller chains of those in demand.

(c) (i) There were some good answers to this with candidates showing a pleasing understanding of the importance that the functional group is the same throughout each homologous series.

(ii) Most candidates recognised that it is the double bond in ethene which makes it an alkene.

Question 4

(a) Most candidates understand the general meaning of the term *frequency*; only a few gave the formal definition that frequency is the number of wavefronts passing a point (or complete oscillations) per unit time.

(b) (i) Candidates need to take more care with their diagrams. The answer required semi-circular wavefronts centred on the gap with the distance between each wavefront the same as those approaching the gap. Those candidates who used compasses for their diagrams were more succesful.

(ii) Many recognised this as diffraction, although few spelt the term correctly.

(c) While many candidates recognised a correct similarity, few recognised that the wave passing through the larger gap would have a flatter section with the edges being curved. A common error was to state that there would be less diffraction. This is not actually true – there is the same amount of diffraction; it is simply a smaller percentage of the total wavefront.

Question 5

(a) (i) The vast majority of candidates got this correct.

(ii) This was well answered.

(b) This was also done well, the most common error being not to describe a trend, but to make general comments such as 'they all have high boiling points'.

(c) (i) Candidates found this difficult. Although many recognised that there is a 'sea of electrons', few correctly described the lattice of positive ions. Some incorrectly described the positive ions as 'positive protons'.

(ii) In this section candidates recognised that the free or delocalised electrons played the significant role in conducting electricity in metals. Few, however, went on to explain that these electrons carried the charge through the lattice.

(iii) This was done well, with more than 9 out of 10 candidates identifying boron as the non-metal and the majority of those recognising that the clue was that it was a poor conductor.

Question 6

(a) Most candidates recognised that the resistance increased with current.

(b) (i) A significant minority ignored the instruction to use the graph to find the answer and attempted to calculate the answer.

(ii) Some candidates assumed that the current was the same throughout the circuit, perhaps confusing the parallel circuit with a series circuit.

(iii) Candidates who had struggled at the first two parts also found this difficult. Candidates need to be aware of the Physics of parallel circuits.

(iv) The simple way to answer this was to take the current from **(iii)** and apply the formula $R = V/I$. A more difficult way is to calculate the resistance of each lamp and then to apply the formula $1/R_{total} = 1/R_1 + 1/R_2$. Those candidates that used the former method generally got the answer but those candidates who used the latter method often made mistakes in calculation.

(v) Although a good number of candidates recognised that the charge passing is equal to current times time, many did not convert the time into seconds.

Question 7

(a) (i) The majority of candidates drew an uncharged sulfur atom, not the the sulfur ion as asked in the question. It is important that candidates take time reading the question to ensure that they understand what is being asked for.

(ii) There were some difficulties here, with common errors being NaS, $NaSO_4$, and NaS_2.

(b) There were some excellent answers to what was a challenging task. A common error was to omit the 2 lone pairs of electrons on the sulphur atom.

Question 8

(a) The majority of candidates were able to answer this; there were a significant number who were challenged to interpret the nuclide symbol.

(b) (i) This was less well done. Candidates needed to apply their knowledge of the nature of an alpha particle to deduce the missing superscripts and subscripts.

(ii) Those who had an swered the previous question correctly were usually able to identify the element.

(c) (i) Candidates need to be able to explain what is meant by the term *half-life.*

(ii) A few candidates knew how to approach this question. Others needed to recognise that when the count falls to one eighth of the original, 3 half lives (½ x ½ x ½) will have passed.

Question 9

(a) Candidates made a good attempt at this. The majority gained the tenorite mark, fewer the malachite mark and a minority the cuprite mark.

(b) There were some outstanding efforts here with a pleasing number of candidates scoring all three marks. Common errors were to miscalculate the RFM of copper carbonate (188) and to fail to recognise that the number of moles of copper produced would be equal to the number of moles of copper carbonate used.

(c) Many candidates scored full marks here.

(d) Most candidates were able to give a use for copper and relate it to a suitable property. Some candidates gave answers that were too vauge, for example, giving the use as ‘wires’, as opposed to ‘electrical connecting wires’.

Question 10

(a) The specific type of potential energy, elastic (or strain) potential was required to score the mark.

(b) (i) The most common error here was the failure to square the velocity (0.76 m/s), even when the formula had been written out correctly. Another error was to forget to convert the mass into kilograms.

(ii) It was disappointing that the understanding that some of the energy is converted to heating energy as work is done against friction is not well understood. Nevertheless most candidates did score some marks for a partially correct answer.

Question 11

This was a challenging question, asking candidates to interpret experimental findings that they are unlikely to have met before. Only a few candidates recognised that the magnitude of the two charges would be the same; however a good number did recognise that the different tracks were caused by the interaction of the charge in the magnetic field and consequently the charges were of opposite sign. Some erroneously thought that the charges were the same sign and the paths were caused by electrostatic repulsion. If this were the case ,then the paths would be quite different with the curve decreasing as the charges moved further apart.

PHYSICAL SCIENCE

Paper 0652/32
Extended Theory

Key Messages

A sound knowledge of the basic facts is a prerequisite for success in any examination.

General Comments

There were some excellent scripts where the candidates not only showed a good knowledge of basic facts but also showed a really good understanding of the science involved.

Comments on Specific Questions

Question 1

(a) (i) The vast majority new the name for a chemical reaction that releases energy; amongst the few who did, not the most common errors were to state that it was combustion or oxidation.

(ii) Many candidates stated that energy was released on the breaking of bonds. Amongst those who did show understanding of bond breaking and bond making, few went on to compare the amount of energy absorbed and released in the two processes.

(b) (i) Many candidates gave answers such as, 'coal' or 'petrol'

(ii) The most common error was to state that methane was very reactive, explosive or simply, a gas.

Question 2

(a) (i) Whilst the majority of candidates scored this mark a significant number gave 5.5, 5.2 or 5 N.

(ii) Candidates found this challenging, both in matching the calculation to grams or kilograms and with whether the weight should be multiplied or divided by *g*.

(b) Most candidates were aware of the method of displacement but few made details such as fully submerging the object in the water clear. Others lost marks for attempting to measure the displaced water with a beaker or unidentified container, rather than with a measuring cylinder.

(c) This was done well, although the failure to convert the mass in kilograms to grams cost some candidates credit.

Question 3

(a) Candidates needed to answer this question precisely to gain full credit. The question required candidates to state either that the demand for fractions such as gases and petroleum was much greater than supply or that production of fractions such as gas oil and fuel oil were in excess of demand, naming the fractions in question.

(b) (i) Most candidates have a good understanding of cracking, a few confusing the breaking down of the hydrocarbon chains with polymers and monomers. Only a few candidates described the conditions required for the process to occur.

(ii) Many candidates needed to be more precise in their answers. Candidates needed to specify that the large chains which are in excess can be cracked to make smaller chains of those in demand.

(c) (i) There were some good answers to this with candidates showing a pleasing understanding of the importance that the functional group is the same throughout each homologous series.

(ii) Most candidates recognised that it is the double bond in ethene which makes it an alkene.

Question 4

(a) Most candidates understand the general meaning of the term *frequency*; only a few gave the formal definition that frequency is the number of wavefronts passing a point (or complete oscillations) per unit time.

(b) (i) Candidates need to take more care with their diagrams. The answer required semi-circular wavefronts centred on the gap with the distance between each wavefront the same as those approaching the gap. Those candidates who used compasses for their diagrams were more succesful.

(ii) Many recognised this as diffraction, although few spelt the term correctly.

(c) While many candidates recognised a correct similarity, few recognised that the wave passing through the larger gap would have a flatter section with the edges being curved. A common error was to state that there would be less diffraction. This is not actually true – there is the same amount of diffraction; it is simply a smaller percentage of the total wavefront.

Question 5

(a) (i) The vast majority of candidates got this correct.

(ii) This was well answered.

(b) This was also done well, the most common error being not to describe a trend, but to make general comments such as 'they all have high boiling points'.

(c) (i) Candidates found this difficult. Although many recognised that there is a 'sea of electrons', few correctly described the lattice of positive ions. Some incorrectly described the positive ions as 'positive protons'.

(ii) In this section candidates recognised that the free or delocalised electrons played the significant role in conducting electricity in metals. Few, however, went on to explain that these electrons carried the charge through the lattice.

(iii) This was done well, with more than 9 out of 10 candidates identifying boron as the non-metal and the majority of those recognising that the clue was that it was a poor conductor.

Question 6

(a) Most candidates recognised that the resistance increased with current.

(b) (i) A significant minority ignored the instruction to use the graph to find the answer and attempted to calculate the answer.

(ii) Some candidates assumed that the current was the same throughout the circuit, perhaps confusing the parallel circuit with a series circuit.

(iii) Candidates who had struggled at the first two parts also found this difficult. Candidates need to be aware of the Physics of parallel circuits.

(iv) The simple way to answer this was to take the current from **(iii)** and apply the formula $R = V/I$. A more difficult way is to calculate the resistance of each lamp and then to apply the formula $1/R_{total} = 1/R_1 + 1/R_2$. Those candidates that used the former method generally got the answer but those candidates who used the latter method often made mistakes in calculation.

(v) Although a good number of candidates recognised that the charge passing is equal to current times time, many did not convert the time into seconds.

Question 7

(a) (i) The majority of candidates drew an uncharged sulfur atom, not the the sulfur ion as asked in the question. It is important that candidates take time reading the question to ensure that they understand what is being asked for.

(ii) There were some difficulties here, with common errors being NaS, $NaSO_4$, and NaS_2.

(b) There were some excellent answers to what was a challenging task. A common error was to omit the 2 lone pairs of electrons on the sulphur atom.

Question 8

(a) The majority of candidates were able to answer this; there were a significant number who were challenged to interpret the nuclide symbol.

(b) (i) This was less well done. Candidates needed to apply their knowledge of the nature of an alpha particle to deduce the missing superscripts and subscripts.

(ii) Those who had an swered the previous question correctly were usually able to identify the element.

(c) (i) Candidates need to be able to explain what is meant by the term *half-life.*

(ii) A few candidates knew how to approach this question. Others needed to recognise that when the count falls to one eighth of the original, 3 half lives (½ x ½ x ½) will have passed.

Question 9

(a) Candidates made a good attempt at this. The majority gained the tenorite mark, fewer the malachite mark and a minority the cuprite mark.

(b) There were some outstanding efforts here with a pleasing number of candidates scoring all three marks. Common errors were to miscalculate the RFM of copper carbonate (188) and to fail to recognise that the number of moles of copper produced would be equal to the number of moles of copper carbonate used.

(c) Many candidates scored full marks here.

(d) Most candidates were able to give a use for copper and relate it to a suitable property. Some candidates gave answers that were too vauge, for example, giving the use as ‘wires’, as opposed to ‘electrical connecting wires’.

Question 10

(a) The specific type of potential energy, elastic (or strain) potential was required to score the mark.

(b) (i) The most common error here was the failure to square the velocity (0.76 m/s), even when the formula had been written out correctly. Another error was to forget to convert the mass into kilograms.

(ii) It was disappointing that the understanding that some of the energy is converted to heating energy as work is done against friction is not well understood. Nevertheless most candidates did score some marks for a partially correct answer.

Question 11

This was a challenging question, asking candidates to interpret experimental findings that they are unlikely to have met before. Only a few candidates recognised that the magnitude of the two charges would be the same; however a good number did recognise that the different tracks were caused by the interaction of the charge in the magnetic field and consequently the charges were of opposite sign. Some erroneously thought that the charges were the same sign and the paths were caused by electrostatic repulsion. If this were the case ,then the paths would be quite different with the curve decreasing as the charges moved further apart.

PHYSICAL SCIENCE

Paper 0652/51

Practical Test

Key message

The ability to recognise a graphical relationship as proportional or inversely proportional is essential in this paper and is part of the Mathematical Requirements in the syllabus.

General comments

Both exercises worked well and all candidates were able to complete this paper in the time allocated. There was some confusion between the terms *filtrate* and *residue*.

Comments on specific questions

Question 1

The accepted observations in part **(a)** were adjusted according to Supervisor's comments. Common errors seen were the use of the word transparent instead of colourless, and the confusion of the terms residue and filtrate. In part **(b)** many candidates recorded the final colourless solution and correctly concluded the presence of the zinc ion but fewer noted the white precipitate in each case. Some incorrectly described the precipitate as cloudiness.

A colour of the solution was always recorded for the first part of **(c)**; fewer candidates recorded the presence of bubbles or effervescence. Simply saying that a gas is evolved is not an acceptable observation. The colours of the following filtrate and residue were accurately recorded.

The copper ion was the usual conclusion in part **(d)** when a dark blue solution was observed but this was not always accompanied by the observation of a blue precipitate. Once again cloudiness was incorrectly used as a substitute for precipitate.

The required reagent in part **(e)** was well known but many omitted the observation or simply gave the colour without the word precipitate or its abbreviation, ppt.

Question 2

There were many excellent sets of readings seen for part **(a)**. A common error was the recording of current values in the voltage column and vice versa. Less common errors were recording values with no decimal places, not using the length values given in the question and recording resistance values to an inconsistent number of significant figures. Exact values, e.g. 1.00/0.20 = 5, were accepted.

A significant number of candidates either omitted the units in the table or did not know the unit of resistance. Many answers for part **(a)(v)** referred to the danger of electrical shocks which was not creditworthy.

Most candidates chose a scale for the graph which allowed ease of plotting and made good use of the grid. Plotting was done well and many good straight lines were seen. A few candidates chose non-linear scales and were therefore unable to be awarded full credit.

Very few candidates described the relationship as proportional although this is a skill required in the Mathematical Requirements section of the syllabus. Those that recognised proportionality correctly related this to the straight line they had drawn.

PHYSICAL SCIENCE

Paper 0652/61
Alternative to Practical

Key Messages

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

General Comments

Most candidates completed the examination in the time allowed. There is an improvement in the reading of values of temperature, masses, and volumes, as well as dials. Candidates must take more care to enter values to the same degree of accuracy as any already entered in tables, and to round values correctly.

Comments on Specific Questions

Question 1

Most candidates identified evaporation correctly, but condensation was less well known. Some candidates identified condensation as cooling. Part **(b)** was well answered. Rust was identified by about half the candidates as the common name for iron oxide in part **(c)**.

Many candidates completed the table in **(c)(ii)** very well; candidates were not penalised for the use of incorrect volume readings if the subtractions were correct. Most candidates were able to compare correctly the oxygen content, but part **(d)(ii)** showed that candidates need to take care not to round inappropriately. A few simply quoted 21%, disregarding their calculated volumes entirely.

Question 2

There were many good diagrams which scored full marks in **(a)**; but some candidates did not show the filter paper clearly, and/or lacked one of the two labels expected. In **(b)** a white precipitate was often identified correctly, but fewer candidates noted that the precipitate redissolves in excess ammonia. The limewater test for carbon dioxide in **(c)** was well known; a minority referred to splint tests. There was some confusion over shades of blue with reference to the precipitate and its re-dissolving. Many candidates need to be more specific in their answers to part **(d),** where a reference to a red-brown colour with no mention of precipitate or solution could not be awarded credit.

Question 3

Almost all candidates read the voltages correctly and then calculated the correct resistances, and most entered all values to 1dp. The graph was generally well drawn, but candidates must guard against non-linear and/or inverted axes, odd points plotted wrongly, or a lack of continuation through the origin. In **(c)(ii),** many linked the increasing resistance to increasing length; a minority stated that relationship is proportional. A few candidates realised that the wire in part **(d)** would heat up unless the circuit is switched off; some candidates suggested that, if not switched off, readings would be cumulative; others that the resistances will hold a residual charge which would make future readings incorrect. Most candidates knew that the thicker wire of part **(e)** would have a lower resistance.

Question 4

Most candidates read the masses and times correctly thereby gaining full marks for **(a)** and **(b)**. Candidates found part **(c)(i)** challenging; several gave no response, while those who did answer often misread the scale of the graph and plotted 13.5 and 16.5 wrongly, did not draw lines, or did not take sufficient care to read off values accurately. A number of candidates knew that burning the fuel would decrease the mass of the lantern, but burning of oxygen or loss of heated molecules from the lantern were also frequently suggested as reasons for the loss in mass. For part **(d)**, the majority of candidates knew that molecules gained energy when heated, but fewer linked increased energy to weakening of intermolecular forces or molecules moving apart. Some of the answers to part **(e)** stated that nylon is biodegradable.

Question 5

Many candidates referred to bubbling or water for part **(a)(i)**, rather than the expected answer of a constant temperature reading or liquid dripping into the beaker. Very few gained credit for part **(a)(ii)** indicating that the distinction between boiling and evaporation is poorly understood; many candidates stated that thermal energy had reached its peak, or was being lost through the condenser or the walls of the flask. The thermometer was nearly always read carefully and accurately, and in **(a)(iv)** the process of condensation was explained correctly by many. Many candidates correctly reported that a solid would be seen on freezing, but some failed to score by referring to ice or to the process of freezing. The temperature was well read by the majority of candidates, but answers of 16 or 17 were unacceptable having been instructed to read it to the nearest 0.5. Most found part **(b)(iii)** very challenging, full marks being achieved by the very strong candidates.

Question 6

In **(a)(i)** a full digital display was penalised, as entries into tables must correspond to data already recorded. Some candidates did not appreciate the continuity of the experiment in answering part **(a)(ii).** The calculation in **(b)(i)** was well attempted with just a few candidates failing to square or using the wrong value of t. In **(b)(ii)** there were few references to errors but several to improving accuracy rather than reliability. For part **(c),** candidates were expected to address the time taken for sound to travel and the consequent effect on the actions of both candidates; several gained one mark by comparing the time taken to hear the instruction in both experiments without reference to the consequences.

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.

General Comments

Candidates from many Centres demonstrated good understanding of practical knowledge and techniques. The reading of the instruments was of an excellent standard but candidates need to take care when rounding calculated values. The standard of graph drawing was high.

Comments on Specific Questions

Question 1

This experiment investigated the speeds of cars.

(a) (i) Most candidates read the dials correctly but many didn't follow the data already in the table and so gave 22 rather than 22.0.

(ii) Speeds of the cars were calculated correctly by most candidates; some candidates needed to take care with rounding.

(iii) Most candidates converted to km/h correctly; again, some candidates needed to take care with rounding.

(iv) More able candidates appreciated that the car could be changing speed during the journey and so average times would be used.

(v) A few candidates appreciated the effect of reaction time on the recorded times.

(b) (i) Most candidates added the speeds; fewer then divided by three to attain the average.

(ii) Candidates were directed to refer to the results in the table in the question; many candidates instead referred to the business of the roads.

Question 2

This experiment involved the energy changes on dissolving.

(a) Candidates gained credit for realising that the salt was powdered to increase the rate of dissolving. Many candidates gave an explanation in terms of increased surface area increasing the rate of reaction.

(b) (i) The majority of candidates read both thermometers correctly.

(ii) The majority of candidates correctly calculated the temperature changes but some candidates either omitted or reversed the signs.

(c) More able candidates scored both marks, with some reversing the terms. Many candidates named an energy type, usually heat, chemical or kinetic.

(d) This question required candidates to look at the diagram and suggest changes to improve the accuracy of the experiment. Improvements such as putting the thermometer into the body of the solution, use a thermometer or use a stirring rod were not creditworthy as they were already given in the diagram.

(e) The vast majority of candidates found this question challenging.

Question 3

This experiment involved Hooke's Law and an application of it.

(a) (i) The majority of candidates read both rulers correctly.

(ii) Many candidates appreciated the proportional relationship between the load and extension.

(b) The majority of candidates read both rulers correctly.

(c) (i) The majority of candidates correctly calculated the density; a significant number of candidates made rounding errors.

(ii) The majority of candidates gave mass.

(iii) The majority of candidates gave volume; a few answered velocity.

(d) The possible causes of inaccuracy were not well answered with few candidates gaining full credit.

Question 4

This was an investigation of the reaction of magnesium with hydrochloric acid.

(a) (i) The majority of candidates measured both lengths correctly. Candidates need to note the number of decimal places and significant figures of any data already given in a table, and present their answers with the same precision as any similar data.

(ii) The majority of candidates read both measuring cylinders correctly

(b) (i) Most candidates plotted the points correctly and drew a line of best fit.

(ii) Most able candidates calculated the gradient correctly and most of these marked the graph to show their working. Some candidates inverted the division, some marked the midpoint as the gradient and a number omitted this part.

(c) Few candidates gave a modification that could increase accuracy.

(d) More able candidates warmed the mixture to increase the rate.

Question 5

In this experiment metals are identified by a series of reactions and tests.

(a) (i) Hydrogen was well known.

(a) (ii) The test and result for hydrogen gas was well known; a significant number specified a glowing splint and were unable to be awarded credit.

(b) (i) Many candidates realised that the white precipitate was calcium carbonate. Incorrect answers of calcium, calcium oxide or calcium hydroxide were frequently seen.

(ii) Calcium hydroxide was known only by the most able candidates. Calcium, calcium oxide or carbon dioxide were common incorrect responses.

(c) The majority of candidates named metal **A** as magnesium.

(d) (i) The majority of candidates knew that a white precipitate was formed. Only the most able knew that the white precipitate re-dissolves in excess.

(ii) Very few candidates appreciated that the green precipitate was $Fe(OH)_2$.

(e) Very few candidates knew that a white (silver chloride) precipitate would be formed. A significant number simply wrote ‘silver’ or ‘no reaction ‘ and were unable to be awarded credit.

Question 6

This was an investigation of The Law of Reflection.

(a) (i) More able candidates measured the two angles correctly. 30 and 30 was a common incorrect response.

(ii) Many candidates stated that the normal needed to be perpendicular to the mirror. A significant number used imprecise terminology such as ‘the normal was not straight’ and were unable to be awarded credit.

(iii) Many candidates gave creditworthy responses by stating that the law was not obeyed and explaining why.

(b) (i) The rays were generally drawn well.

(ii) More able candidates measured the two angles correctly. ‘55 and 65’ was a common incorrect response.

(iii) Many candidates found this part on identifying the mistakes challenging.

(c) Only the most able candidates knew that these particles were electrons.