EXAMINATIONS COUNCIL OF ESWATINI

Eswatini General Certificate of Secondary Education

Physical Science (6888)

Examination Report for 2023

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EGCSE PHYSICAL SCIENCE

Paper 6888/01

Short Answers

General Comments

10 732 candidates were registered for this paper, however, 10482 candidates sat for this paper. This shows a slight increase from the previous year exam.

While there were many appropriate answers, candidates showed weakness with their knowledge of mixtures, semiconductors, magnetic field lines and preparation of carbon dioxide.

Candidates who performed well ensured they answered the question asked. If 'using the examples' appears in the question, then answers must related to the examples. For example, **Question 4** 'using the given examples' – answers had to include a reference to calcium and water. Comments regarding general definitions of an element and a compound did not answer the question.

Questions that were well answered by most candidates were **1, 5(a), 9(a)** and **13**. Questions that were more challenging to most candidates were Questions **3, 7, 9(b), 11, 14** and **15**. Question **3** proved to be the most demanding to most candidates as no candidate managed to get full marks.

Comments on Specific Questions

Question 1.

This question was well answered. Candidates were given a table showing a unit and symbol of a quantity and were required to complete the table by filling in the correct quantity. Most candidates were able to state the correct physical quantity. Some common incorrect responses were: triple beam balance, weight, 1, 1000, sugar, and rice.

Expected response: *mass*;

Question 2

This question proved to be challenging to most candidates. Candidates were required to complete a table showing the number of protons, neutrons and electrons in sodium-25 ion. Common incorrect responses included 11^{+}, 12 neutrons, and 11 electrons.

Expected response: *11 protons, 14 neutrons and 10 electrons*;

Question 3

This question was well answered by most candidates. Candidates were asked to explain how the Sun, as a source of solar energy, produces the solar energy. Some candidates were uncertain of how the Sun produces solar energy and they described energy changes in a solar panel/ described radiation/ referred to fusion of hydrogen atoms instead of hydrogen nuclei.

Expected response: *two light hydrogen nuclei fuse to form a heavier helium nucleus, the sum of the masses of the hydrogen nuclei is greater than the helium nucleus though. The mass difference is converted to huge amounts of energy*;

Question 4

This question was fairly answered. Candidates were given calcium as an example of an element and water as an example of a compound. They were required to describe the difference between an element and a compound using the given examples. Stronger responses referred to the given examples. A vast majority of the candidates defined an element and a compound without referring to the given examples.

Expected response: *calcium is made up of one kind of atom while water is made up of different types of atoms, hydrogen and oxygen chemically combined*;

Question 5

This question was well answered by some candidates. Candidates were given a diagram showing a parallel circuit with identical bulbs (**L_1**, **L_2** and **L_3**) and three ammeters (**A_1**, **A_2** and **A_3**).

(a) Candidates were asked to state the reading on ammeter **A_3**. There was uncertainty about the reading and common wrong responses were 0.5 A / 0.3 A / 0.1 A or a value without units. Candidates would benefit from being able to read an analogue scale.

Expected response*: 0.1 A*;

(b) Candidates were asked to state the effect on lamps **L_1** and **L_2** if lamp **L_3** breaks. The most frequent incorrect answers were **L_1** becomes dim / no effect and **L_2** will not work / shutdown / breaks.

Expected response*:* ***L_1*** *continues to light*;
L_2 *goes off*;

Question 6

This question was challenging to most candidates. Candidates were given the boiling point of bronze as 2300 °C. They were asked to explain why a sample of bronze was found to boil at 2350 °C. A vast majority of candidates' response was bronze is a metal / is mixed with other elements / is impure and could not be credited.

***Expected response**: sample is not pure*;

Question 7

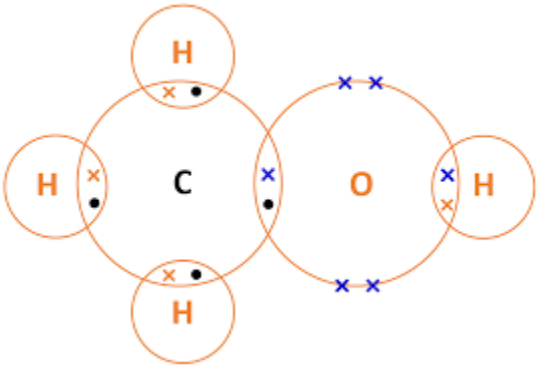
This question was demanding to many candidates. They were expected to describe what happens when the switch is closed. Most candidates' responses were current is induced in the coil, closed switch breaks the circuit, carbon brushes rotates, and coil rotates in anticlockwise direction and could not be credited. Some candidates were confusing the motor and a generator

***Expected response**: current flows through the coil, the coil experiences a torque causing the coil to rotate*;

Question 8

Candidates were required to complete a dot and cross diagram to show bonding ethanol, showing the outermost electrons only. Many candidates had an excellent understanding of bonding with a few having wrong labels such as CH_3 instead of C / labels missing/ double bonds/ lone pairs in oxygen atom missing.

***Expected response**: correct labels for all nine atoms, correct sharing of electrons and correct octet for all atoms*;



Question 9

(a) Candidates were required to mark with a cross on the graph the limit of proportionality of the spring.

There was some uncertainty where the '**x**' should be. Some candidates correctly identified the limit of proportionality and few incorrectly marked $\mathbf{x}$ on $(1.6,2.5)$. Most candidates lost marks for inaccuracy and failure to follow instructions. Some use a dot instead of the cross, others did not put the cross on the exact point.

Expected response: $\mathbf{x}$ *placed on* $(0.8,2)$;

(b) This question was challenging to most candidates. Candidates were asked to determine the length of the spring when the load is 1.5N. Most candidates were able to use the graph to find the extension, however, calculating the length of the spring was challenging. Common wrong responses were 0.6 cm, 2.4 cm.

Expected response: *3.6 cm*;

Question 10

This question was demanding to most candidates. Candidates were given a diagram showing the apparatus used to prepare carbon dioxide gas and calcium chloride in the school laboratory.

(a) A minority correctly identified the reactants. Candidates were asked to identify reactants **A** and **B**.
Many candidates incorrectly identified the reactants as residue, filtrate, solvent and solid.

Expected responses: ***A-*** *hydrochloric acid,* ***B-*** *calcium carbonate*

(b) The question was demanding for most candidates. Candidates were asked to complete the diagram by drawing the apparatus that can be used to collect the gas. A vast majority of candidates were drawing an apparatus for upward delivery method or condenser instead of a delivery tube. Some candidates drew a sealed collecting vessel or placed limewater in a collecting vessel.

Expected response: *upside down collecting vessel with mouth in water plus a delivery tube in the mouth of the collecting vessel / upright collecting vessel with a delivery tube in its mouth / syringe fitted to the delivery tube*;

Question 11

This question was challenging to many candidates. Candidates were given a diagram showing a p-n junction between two types of semi-conductors.

(a) There was some uncertainty in the example of a semi- conductor material and most candidates' responses were aluminium, plastic ruler, graphite which could not earn a credit.

***Expected response**:* *silicon/germanium/ tin/ arsenide*;

(b) The question was challenging to most candidates. Candidates were asked to describe the main feature of the p-side and the n-side in a p-n junction shown in the diagram. Common wrong responses were more positive ions / positive electrons / positive protons / positive charges / cathode on p-side, anode on n-side, and could not earn credit.

Expected response: *there are more holes on the p-side, there are more electrons on the n-side*;

Question 12

This question was easy to some candidates. Candidates were given that molten and aqueous copper (II) chloride can be decomposed by electrolysis. They were asked to identify ions present in molten copper (II) chloride and aqueous copper (II) chloride. Some candidates' responses such as chlorine ion, oxide ion, copper ion could not be credited. A few candidates lost marks for stating wrong symbols such as Cu^{+} and Cl_2^-

***Expected response**:* *molten copper (II) chloride - copper (II) and chloride ions*
aqueous copper (II) chloride- copper (II), hydrogen, chloride and hydroxide ions;

Question 13

This question was well answered by most candidates. Candidates were given a diagram showing a step-down transformer and were asked to calculate the voltage in the secondary (output) coil. Some candidates either used a wrong formula or mathematical presentation and could not earn credit. For example, candidates having equal signs on the numerator and denominator earned one mark for the correct answer.

***Expected response**:* $\frac{N_S}{N_P} = \frac{V_S}{V_P}$

$V_S = \frac{5 \times 20}{10}$;

$= 10\,V$;

Question 14

Candidates were told that steel is a solid alloy made by combining iron with other elements.

(a) This part of the question was well answered. Most candidates could correctly name the type of substance to which alloys such as steel belong. However, zinc was a common wrong response to some candidates

***Expected correct response**:* *mixture*;

(b) Many candidates had excellent understanding of alloys and hence were able to explain clearly why steel is stronger than iron. However, a minority confused ion for iron, and some could not clearly state the differences in terms of atomic size and layers. Some only described atomic size in steel without mentioning iron.

***Expected correct response**:* *layers of same sized atoms in iron easily slide over each other when force is applied while the layers of different sized atoms in steel do not easily slide over each other when force is applied*;

Question 15

This question proved to be challenging to a moderate number of candidates. They were asked to draw magnetic field lines caused by the arrangement of two bar magnets placed side by side with like poles facing each other. Common errors in candidates drawing was the lack evidence of repulsion, use of dotted lines instead of solid lines, lines touching or crossing each other and arrows in the south to north direction.

***Expected response**:* *pattern of field lines showing repulsion and a repulsion region shown opposite the like poles. At least two solid magnetic field lines not crossing, in north to south direction*;

Question 16

The question was fairly answered. Candidates were given a diagram showing metallic bonding in part of the structure of sodium metal and were required to identify particles **C** and **D**. Most candidates wrongly identified **C** as a proton/ positive charge/ positive electron and **D** as a neutron/ negative charge/ negative ion.

Expected response: ***C*** *- sodium ion,* ***D*** *– electron*;

EGCSE PHYSICAL SCIENCE

Paper 6888/02

Structured Questions

General Comments

10 732 candidates registered for this paper but the number of candidates who eventually sat for the component was 10 452. This showed an increase of more than 1 400 candidates compared to the previous year.

The paper was marked out of a total of 80 marks. The highest attained score was 61 and 10 marks lower than the highest score of the previous year. Most candidates scored between 05 – 15 marks.

Most candidates could not demonstrate sound knowledge and understanding of some areas of the syllabus. However, they displayed confidence with recall questions. A few candidates were able to develop excellent responses in novel contexts by making links with the underlying scientific principles that are rooted in the syllabus.

Candidates should ensure they read the questions carefully and should provide the exact answer required in the instructions. They should also ensure that they are familiar with the scientific terminology needed to answer questions precisely.

It was noted with great concern that the use of correct symbols in formulae and equations continued to be a challenge to most candidates. Candidates should be encouraged to write formulas in full. Most candidates presented expressions instead of equations and some were using wrong symbols in formulae and did not earn credit. Candidates should avoid rounding off unnecessarily. If the answer is not exact, rounding off should be done to 3 significant figures as stated in the syllabus.

Questions that proved particularly easy for most candidates were: **1(b), 1(c), 3(a), 5(a) and 7(b)** and questions that proved particularly difficult for most candidates were: **1(a), 3(b), 4(a), 5(c)(ii), 7(c), 8(b), 8(c), 9(b), 9(c), 9(d)(i), (ii) and (iii)**.

omments on Specific Questions

Question 1

(a) This question was challenging to a vast majority of candidates. Candidates were required to give the name for Group II elements. Only a minority was able to recall that Group II elements are called *alkaline earth metals*. Common wrong responses included: alkali earth metals and halogens.

(b) This question was well answered by most candidates. Candidates were required to suggest the number of electrons on the outer most shell of radium. Common wrong responses were 8 and 88.

***Expected response**: 2*.

(c) This question was fairly answered by most candidates. Some candidates were able to describe the required trend in physical property of the elements that were shown in Table 1.1. Common wrong responses included: they have a high melting point, boiling point increases as you go down the group, atomic number increases as you go down the group and reactivity increase as you go down the group.

***Expected response**: melting point decreases down the group, density generally increases down the group or density first decreases then increases down the group.*

(d) This question was fairly answered by most candidates. Candidates were required to use the kinetic particle theory to explain what happens when molten barium is heated further. Stronger responses showed an excellent reference to the kinetic particle theory and correct use of the terms: gain, weaker and further. Candidates are advised to carefully read each question before writing their answer. For example, some candidates did not realise that the question was about molten barium not solid barium. Some candidates were confusing the kinetic particle theory and collision theory. The use of comparative language was challenging many candidates, for instance, 'far' apart was common instead of 'further' apart. Common wrong responses included: reference to intermolecular forces / reference to vibration of particles / "barium gains kinetic energy" instead of "particles gain kinetic energy".

***Expected response**: liquid barium particles gain kinetic energy, forces of attraction between the particles become weaker or are overcome and the particles move further apart.*

Question 2

(a) **(i)** There was some uncertainty in the responses. Candidates were asked to describe the motion of the toy car which covered 50 cm every 2 seconds. Some candidates could not display good understanding of the speed-time graph and they wrote wrong responses including motion is constant, constant acceleration, accelerating at constant speed, and at rest.

***Expected response**: constant or uniform speed, constant or uniform velocity, zero acceleration.*

(ii) A fairly well done question and some candidates were able to calculate the average speed of the toy car. Candidates were asked to calculate the average speed of the toy car for the 150 cm journey shown in Fig. 2.1. Most candidates were omitting the subject in the formula for speed, failing to convert the 150 cm into metres before substituting into the formula, dividing by 2 seconds instead of 6 seconds, for rounding off the answer to 0.3 and as such lost marks. Candidates should be reminded that when writing in symbols $s = \frac{d}{t}$, *T* for *t* was not acceptable since T represents the period.

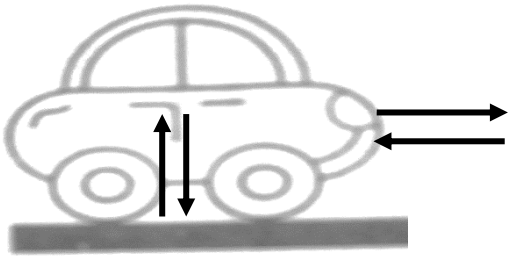
Expected response: $speed = \frac{distance}{time} = \frac{1.5\ m}{6\ s} = 0.25\ m/s$

(iii) This question was demanding to most candidates. Candidates were expected to calculate the kinetic energy of the toy car. Common errors included failure to convert 400 g mass of the toy car into 0.4 kg and not squaring the speed or velocity, using wrong symbols in the formula, omitting the unit, J, in the answer and rounding off the answer to 0.013. Acceptable symbols for kinetic energy were: k.e. and E_k.

Expected response: $k.e. = \frac{1}{2}\ m\ v^2$ = ½ x 0.4 x 0.25^2 = 0.0125 J.

(b) This question was challenging to most candidates, and many did not draw the vertical forces. Candidates were required to draw forces acting on a car moving at constant speed. The vertical forces were rare. A common error was using wrong labels for the forces yet the question did not demand that candidates label the forces.

Expected response: an opposite pair of horizontal forces on the car and an opposite pair of vertical forces on the car.



Note: The horizontal forces are the forward driving force and the air resistance or friction. The vertical forces are the weight and the normal force.

(c) Most candidates could not calculate the acceleration of the toy car. The candidates were asked to calculate the acceleration given the initial speed as 0.3 m / s and the final speed as 0.45 m / s. Common errors included use of distance instead of speed and dividing by 4 seconds instead of 2 seconds.

Expected response: $a = \frac{(v-u)}{t} = \frac{(0.45-0.3)}{2} = 0.075\ m/s^2$

(d) This was a fairly well answered question as most candidates were able to calculate the resultant force required to accelerate a 0.2 kg toy car by 1.5 m / s^2. Candidates should be discouraged to use small letter 'f' for force and this did not earn credit. Some candidates were confusing weight and force, hence used the formula, W = mg and this led to loss of marks.

Expected response: *F = ma = 0.2 x 1.5 = 0.3 N*

Question 3

(a) This question was well answered, and most candidates were able to draw the electron arrangement of an oxygen atom.

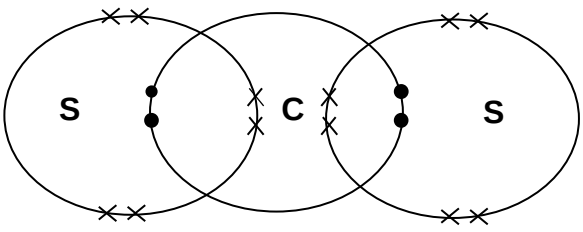
Expected response: 2 electrons in the first shell and 6 electrons in the second shell.

(b) A vast majority of candidates were not able to explain how lithium atoms and oxygen atoms form an ionic bond. Stronger responses specified the number of atoms gained or lost, the end product and referred to oppositely charged ions attracting. Weaker responses did not mention that the lithium loses electrons from the outer most shell, did not state that lithium ions and an oxide ion is formed, and stated that "opposite charges attract" instead of "oppositely charged ions attract".

Expected response: *two lithium atoms lose 1 outer shell electron each to form lithium ions. One oxygen atom gains two electrons to form an oxide ion. The oppositely charged lithium ions and oxide ion attract.*

(c) This was a fairly answered question and most candidates were able to draw a correct dot and cross diagram showing how electrons are arranged in a molecule of carbon disulfide, CS_2. However, a minority confused ionic bonding and covalent bonding, and these showed a transfer of electrons instead of sharing of electrons.

Expected response:



(d) This question proved to be challenging to most candidates. Candidates were expected to explain why molecules like carbon disulfide have low boiling points. Candidates who were unable to gain credit gave answers that lacked detail and specific chemistry terminology, such as describing that forces are weakened or overcome rather than forces are broken. Some

candidates omitted this question, suggesting a lack of knowledge of this syllabus learning outcome. A common wrong response was that molecules are non-metals.

Expected response: *they have weak intermolecular forces or weak van der Waals so less energy to be overcome*.

Question 4

(a) The question proved to be challenging to many candidates and most did not refer to the marble instead they used the general description of a longitudinal wave. Candidates were required to explain why the wave formed was a longitudinal wave.

Expected response*:* *direction of pulse or disturbance or vibration, is in the same direction as the direction of movement of the marble.*

(b) **(i)** Almost half the candidates answered this question correctly. Candidates were asked to state what happens to the amplitude and frequency of a wave if the vibrations are the same distance up and down but at a faster rate.

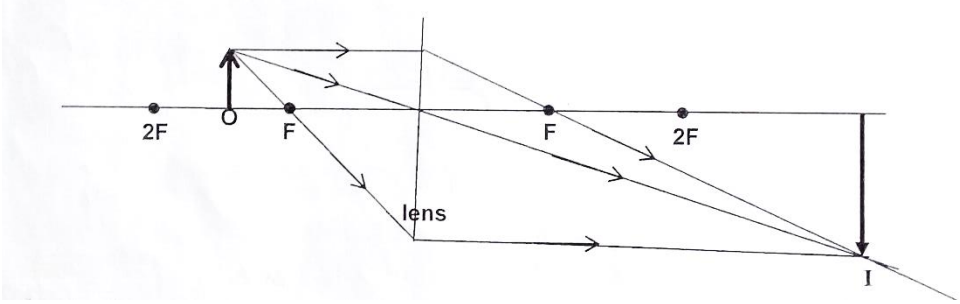
Expected response*:* *same amplitude*
higher frequency.

(ii) Most candidates were not able to calculate the frequency of a wave if one complete cycle is made in 0.6 seconds. A common wrong response was the use of v = f λ. Some candidates were using t instead of T for period and could not gain credit. Candidates should be encouraged to round off answers to 3 significant figures as stated in the syllabus.

Expected response*:* $f = \frac{1}{T} = : \frac{1}{0.6} = 1.67\ Hz$

(c) This question appeared to be challenging to most candidates. Some candidates displayed knowledge of correctly drew the lines but omitted the arrows that show direction and this was not credited. A majority of candidates were not able to correctly draw ray diagrams to show the image formed by a thin converging lens.

Expected response*:*



Question 5

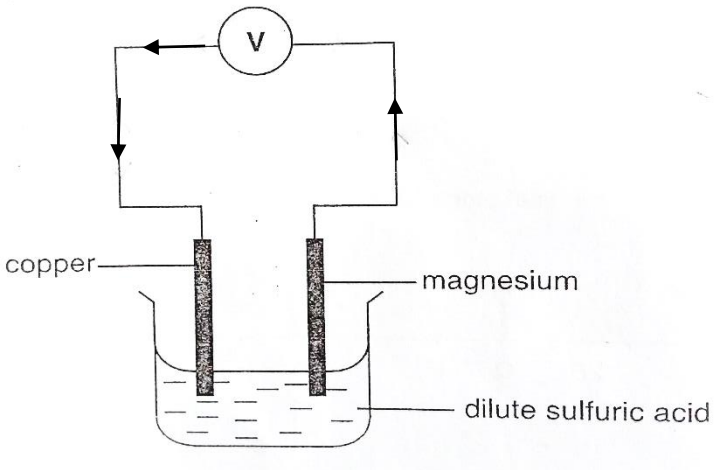
The question was assessing students' comprehension of simple cells. A set-up apparatus of a simple cell made from a strip of copper and a strip of magnesium dipped into an electrolyte of dilute sulfuric acid was given.

(a) A vast majority of candidates seemed to have an excellent understanding of the reactivity series. Candidates were required to place given metals in order of reactivity using the voltage produced in the simple cell. A common error was the listing of the voltages in order of size instead of the metals.

***Expected response**:* most reactive *magnesium*
chromium
tin
least reactive *copper*

(b) The question was challenging to most candidates. Some candidates omitted this question, suggesting a lack of knowledge of this syllabus learning outcome. Movement of electrons in the electrolyte instead of along the conducting wires was a common error.

***Expected response**:*



(c) **(i)** A few candidates were able to identify the gas released on the copper electrode as *hydrogen*.
Common wrong responses included oxygen, carbon dioxide and copper oxide.

(ii) A few candidates were able to describe what happens at the copper electrode. Some candidates were confusing a simple cell and an electrolytic cell. A common wrong response was that copper ions gain electrons.

***Expected response**:* hydrogen ions gain electrons or hydrogen ions are reduced producing hydrogen **OR** $2\ H^+ + 2e^- \rightarrow H_2$

(d) Almost half the candidates answered this question correctly. Candidates were required to state and explain the effect on the voltmeter reading, of replacing the copper electrode with a silver electrode. Some good explanations were seen that included increased difference in reactivity. Common errors included comparing the electrical conductivity of silver and copper.

***Expected response**: voltage increases because there is increased difference in reactivity.*

Question 6

The question was testing candidates understanding of thermometry.

(a) Candidates were asked to state two physical properties used in the measurement of temperature. Although these physical properties are stated in the syllabus, most candidates were not able to recall the physical properties. Common wrong responses were: sensitivity, linearity, and expansion.

***Expected response**: volume, potential difference and electrical resistance.*

(b) **(i)** This was a fairly answered question and most candidates were able to identify the suitable materials for wires. Candidates were asked to suggest suitable materials for wires used in a thermocouple thermometer. Common wrong responses were: earth, live, neutral, any of Group 1 and group 2 elements and wrong spelling of constantan.
Note: conductors **C** and **E** must be the same and **D** a different conductor.

***Expected response**:* **C** – *copper / iron / aluminium*

D – *constantan / nichrome*

E – *copper / iron / aluminium*

(ii) The question appeared to be challenging and most candidates could not give the correct voltmeter reading. Candidates were asked to state the voltmeter reading if both junctions of a thermocouple thermometer are placed in a beaker of water of the same temperature, 80°C. Common wrong responses included 0 °C, no reading and same reading.

***Expected response**: 0 mV.*

(iii) A vast majority of candidates displayed an understanding of this learning outcome. Candidates were given that when junction **A** is placed in a beaker of iced water (0 °C) and junction be is placed in a beaker of boiling water (100 °C) the voltmeter reads 25 mV. When junction **B** is placed in a beaker of water of unknown temperature, the voltmeter reads 12 mV.

They were asked to determine the unknown temperature. Some candidates did not show any working and this resulted to a loss of marks.

Expected response: *25 mV : 100 °C*

12 mV : x

$$x = \frac{12 \times 100}{25}$$

x = 48 °C.

(iv) The question proved to be challenging to most candidates. Candidates were asked to state **one** advantage of a thermocouple thermometer over a liquid-in-glass thermometer. Stronger responses showed excellent comparison of the two types of thermometers.

Expected response: *a thermocouple can measure higher temperatures than a liquid-in-glass thermometer, a thermocouple can measure rapidly changing temperatures while a liquid-in-glass cannot, a thermocouple measures a wider range of temperature than a liquid-in-glass thermometer.*

(c) This was a fairly answered question and a moderate number of candidates appeared to have good understanding of the differences. Candidates were expected to state **one** difference between boiling and evaporation. Common wrong responses included the use of the word '"point' instead of 'temperature' and 'evaporation happens after boiling'.

Expected response: *boiling occurs at a fixed temperature while boiling occurs at any temperature* **or** *boiling occurs through-out the liquid while evaporation occurs on the surface of the liquid.*

Question 7

The question was assessing candidates understanding of stoichiometric calculations. The question was based on the reaction of calcium carbonate with hydrochloric acid, according to the equation:

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

(a) (i) Only a minority was able to correctly calculate the number of moles carbon dioxide. Candidates were asked to calculate the number of moles carbon dioxide formed by reacting 12.5 g of calcium carbonate with an excess of hydrochloric acid. A common wrong response was 12.5 ÷ 44 = 0.28 moles.

Expected response: $\frac{12.5}{100} = 0.125\ moles\ CaCO_3$.

from the equation, $CaCO_3$: CO_2 = 1 : 1, therefore 0.125 moles CO_2.

(ii) This question was fairly answered by most candidates were able to calculate the mass of carbon dioxide. Candidates were asked to calculate the mass of carbon dioxide formed by reacting 12.5 g of calcium carbonate with an excess of hydrochloric acid. A common error was that of multiplying by M_r = 100 instead of 44.

***Expected response**: $m = nM_r = 0.125 \times 44 = 5.5$ g.*

(b) A large majority of candidates were able to correctly do the calculation. Candidates were asked to calculate the number of molecules in 2 moles of hydrochloric acid. Some candidates showed lack of the skill to multiply in standard form.

***Expected response**: number of molecules = $nL = 2 \times 6.02 \times 10^{23}$*

$= 1.204 \times 10^{24}$.

(c) A minority of candidates had excellent understanding of limiting reactants. Candidates were required to explain, showing their working, which one is a limiting reactant if 12.5 g of $CaCO_3$ reacts with 7.3 g HC*l*. Some candidates who appeared to have limited knowledge, calculated the number of moles and lost the mark for not stating the reactant which the calculated number of moles are for. Some candidates could not carry out any calculation, instead they drew their conclusion based on the observed differences in the mass stated in the stem of the question i.e. stating that HC*l* is the limiting reactant because it has a smaller mass of 7.3 g than $CaCO_3$ which was 12.5 g.

***Expected response**: $CaCO_3$: HCl*

$$\frac{12.5}{100} : \frac{17.3}{36.5}$$

0.125 moles $CaCO_3$: 0.2 moles HCl

according to the equation, $CaCO_3$: HCl = 1 : 2

0.125 : x

x = 0.125 x 2 /1

x = 0.25 moles HCl

HCl is the limiting reactant because 0.2 moles are available instead of the required 0.25 moles.

Question 8

This question was assessing candidates understanding of electricity.

(a) **(i)** The question was challenging to a vast majority of candidates. Candidates were required to calculate the total resistance of two resistors, **Y** and **Z**, in parallel. Common wrong responses included $R_T = R_Y + R_Z = 2 + 2 = 4\ \Omega$ and $R_T = ½ + ½ = 1\ \Omega$. Some candidates omitted the subject of the formula and were not awarded credit.

***Expected response**:* $R_T = \frac{Ry \times Rz}{Ry + Rz} = \frac{2 \times 2}{2 + 2} = 1\Omega$

(ii) This was a fairly answered question. Candidates were required to calculate the combine resistance of two resistors in parallel plus one resistor in series with the parallel connection. A few candidates were able to read the question carefully and calculate the combined resistance correctly. Many candidates used the formulas $R_T = R_1 + R_2 + R_3$, $R_T = \frac{R1 \times R2 \times R3}{R1 + R2 + R3}$ and $\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$ which all yielded wrong responses.

***Expected response**:* $R_T = \frac{2 \times 2}{2 + 2} + 1 = 1 + 1 = 2\ \Omega$

(iii) This part question was challenging to a majority of the candidates. Candidates were asked to calculate the current flowing through resistor **X**, which is the resistor connected in series with the resistors in parallel. Some candidates who recalled the formula I = V/R could not determine the potential difference from the circuit diagram. The circuit had 2 cells, therefore 2 x 1.5 V = 3 V as the potential difference to be used. Common wrong responses were 0 A and 3/1 A.

***Expected response**:* *I = V/R = 3/2 = 1.5 A*

(b) This was a very challenging question to most candidates as they failed to describe the property of a semiconductor. Common wrong responses were: they are good conductors of heat and electricity and that they partially conduct electricity. Candidates also lost a mark for failing to refer to electrical conductivity not just conductivity.

Expected response: material with electrical conductivity between that of a conductor and that of an insulator.

(c) This part question was also very challenging to most candidates. The majority of the candidates was not able to describe how LEDs produce light. Candidates were required to describe how LEDs produce light. Most candidates were confusing LEDs and solar flood lights.

***Expected response**:* *when current is supplied to the diode, electrons move in one direction and the holes move in the opposite direction. When the electron combines with a hole, the electron loses energy in the form of light or photon.*

Question 9

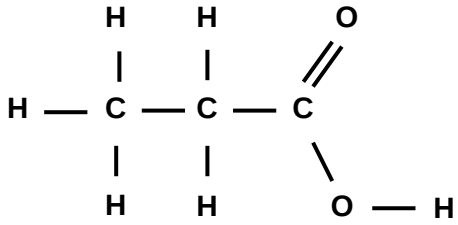
This was the most challenging question to most candidates. The question was testing candidates conceptual understanding of organic chemistry.

(a) **(i)** Most candidates were able to recall that all members in a homologous series have the same functional group. Candidates were required to describe a homologous series.
It was a common error for candidates to write that "compounds with same properties" instead of "similar properties."

***Expected response**:* *<u>compounds</u> with similar properties because of the presence of the same functional group* was not very common.

(ii) This part question was challenging to most candidates and a vast majority of the candidates' response was C_2H_5OH. Candidates were required to state the molecular formula for ethanoic acid. Most candidates were confusing ethanol and ethanoic acid.
***Expected response**:* *$C_2H_4O_2$.*

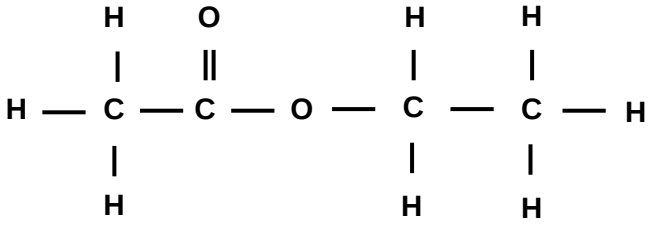
(iii) This was a challenging question to most candidates and many were not able to identify name of the carboxylic acid. Candidates were required to name the carboxylic acid shown.



Common wrong responses were: alcohol, pentanol and ethanoic acid.

***Expected response**:* *propanoic acid.*

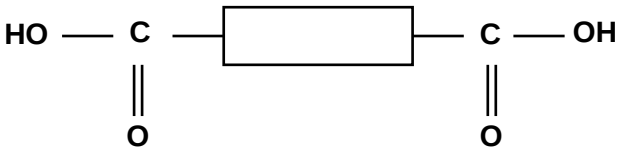
(b) A few candidates were able to draw the structure of ethyl ethanoate. Candidates were expected to draw the structure of ethyl ethanoate.
***Expected response**:*



(c) A vast majority of the candidates appeared to lack knowledge of terylene. Candidates were asked to identify and draw the two monomers that make up the polymer terylene. Candidates who wrote OH instead of HO in the bonds were not given credit as that meant H was directly bonded to O.

***Expected response**:*

dioic acid structure:



diol structure:

(d) **(i)** This question was challenging, and a majority of the candidates were not able to name the expected reactant used in the preparation of ethanoic acid as *potassium dichromate (VI) or potassium permanganate (potassium manganate (VII)).*
Common wrong responses were: oxygen, steam and water.

(ii) Only a few candidates were able to recall that *oxidation* is the type of reaction that occurs when ethanol is converted to ethanoic acid. Common wrong responses included: redox, exothermic, combustion and bacterial oxidation.

(iii) The question was challenging to most candidates and the expected observation was very rare. Candidates were required to describe what is observed during the preparation of ethanoic acid by heating ethanol with potassium dichromate (VI). Common wrong responses were: bubbles are observed, there is colour change, sour taste and bad smell.

***Expected response**:* *colour change from orange to green* (if potassium dichromate (VI) is used) *purple colour becomes colorless* (if potassium permanganate is used).

EGCSE PHYSICAL SCIENCE

Paper 6888/03

Practical Test

General Comments

This Practical Test paper assesses the experimental skills of candidates. The paper consists of two questions, one Chemistry and one Physics questions. The paper is marked out of 40 marks. The time allocated the paper seemed to be adequate as candidates attempted all questions.

The performance of candidates was better when compared to the previous year. There were fewer candidates who obtained marks below 25%.

Generally, the candidates' performance in questions involving substitution into formulae and writing of answers to 3 significant figures was not satisfactory. Some candidates lacked skills of manipulating a calculator and this evident from their failure to get a correct value regardless of substituting correctly.

Comments on specific questions

Question 1

(a) (i) The question was challenging to a vast majority of candidates. Candidates were asked to suggest another instrument, more accurate than a measuring cylinder that could be used to measure the 8 cm^3 of water. Common wrong responses included eureka can, rain gauge, beaker and measuring cylinder. Some candidates wrote incorrect spellings such as " biurete, berete, bierate" and this did not earn credit.

***Expected response**: burette/ graduated pipette.*

(ii) Candidates were expected to use a thermometer to measure and record the temperature of the water. Some candidates gave ridiculously low temperature values such as – 2.3 °C to 5 °C. Some candidates gave temperatures values of above 100 º C.

***Expected response**:* ± of the supervisor's value.

(b) (i) This part of the question was well answered, and a majority of candidates were able to record a reasonable temperature of the water after about 4 minutes. Common wrong responses included temperature values of above 110 °C and temperatures values below the temperature value given in **(a)(i)** by the candidate.

Expected response**:* a *temperature value above that given in **(a)(i).

(ii) The question was fairly answered. Candidates were expected to calculate the temperature change (Δ*T*) of the water. Some candidates subtracted their temperature values in **(b)(i)** from **(a)(i)** which resulted in negative change in temperature and lost the mark. Other candidates worked out the sum of the two temperature values which also resulted in the loss of the mark.

Expected response*: correctly subtract their temperature value in* ***(a)(i)*** *from their value of temperature in* **(b)(i)***.*

(iii) Candidates were expected to use the formula q = mc Δ*T* to calculate the amount of energy released by the peanut. This part of the question was well answered and quite a number of candidates *substituted correctly into the given formula and obtained correct value*. Common wrong responses included substituting 1 g for the mass of water instead of 8 g and using the value of temperature in **(b)(i)** instead of the difference calculated in **(b)(ii)**, substituting into the formula and not work out the value of energy produced.

(iv) This part of the question was challenging to most candidates. Candidates were expected to use their observation in **(b)** and identify a chemical change that has happened. A large number of candidates wrote the general characteristics of a chemical change such as 'there was a change in colour, a new substance is formed, it is irreversible' and these did not earn credit.

Expected response*: peanut change colour from brown to black / flame produced giving off heat energy / ash a new substance formed/ ash irreversible.*

(v) This question was fairly answered by almost half the candidates. Candidates were expected to use their results and explain why the reaction is an exothermic reaction.The most common wrong responses included 'temperature of water increases' and 'burning of peanut'. Some candidates attempted to explain exothermic reaction in terms of the difference between the activation energy and energy given off to the surroundings but due to language barrier failed to express themselves clearly.

Expected response*: energy increase in water/ flame produced indicates energy released.*

(c) (i) Candidates were asked to describe how the mass of 10 g of liquid ethanol was measured. This was challenging to most candidates. Some candidates could not recall the name of the balance for measuring mass and others failed to explain how the mass of the ethanol is obtained from the mass of the empty beaker and the mass of the beaker with ethanol.

***Expected response**: measure the mass of the empty beaker using an electronic / triple beam balance. Then measure the mass of the beaker with ethanol and the difference between the masses is the mass of the ethanol.*

(ii) Some candidates were able to plot the results in Table 1.1 on the grid and draw the line of best fit. Common errors that led to loss of marks included non-linear scales / scales that did not cover more than half the grid (unreasonable scales), failure to draw the line of best fit and not using a ruler to draw the line of best fit.

NB: The line of best fit is a line that pass through the point (0,24) and has almost equal number of points above and below it or passes through most of the points.

***Expected response**: a reasonable scale, all points correctly plotted and a line of best fit drawn.*

(iii) The question proved to be challenging to most candidates and they were not able to calculate the change in temperature. Candidates were expected to use the formula **q = mc Δ*T*** to calculate the energy released by ethanol. Some candidates used the mass of ethanol which was given as 10 g instead of the mass of water which was 8 g, which also resulted to the loss of the marks.

***Expected response**:* $q = 8 \times 4.2 \times 12 = 403.2$ J

(iv) This part of the question proved challenging to candidates, even those candidates who attempted the question gave incomplete responses such as 'peanut is the more efficient fuel'. Candidates were expected to use their results in **(a)**, **(b)** and **(c)** to explain whether ethanol or a peanut is the more efficient fuel.

***Expected response**: peanut produces more energy per gram / peanut produces more energy per unit mass or ethanol produces less energy per unit mass / ethanol produces less energy per gram.*

(v) This question was well answered. Candidates were asked to suggest **one** improvement that could be made in the experiments to make it a fair comparison of the energy released per unit gram of fuel.

***Expected response**: there must be equal quantities of ethanol and peanut / the heating time should be the same / the initial temperature should be the same.*

(d) **(i)** A vast majority of the candidates were unable to match the colour they obtained with the corresponding pH value. Candidates were expected to use the Universal Indicator paper provided to determine the pH value of the solution formed.

***Expected response**: colour: green- blue*
pH value: 8 – 10

(ii) The question was challenging to some candidates. Candidates were asked to use their results in **(d)(i)** and suggest the class of substances formed when a peanut is burned. Candidates were expected to state whether the substance formed is an acidic oxide, base oxide or neutral based on the pH obtained. Some of the common wrong responses included 'ash, oxide, new product, reversible'.

***Expected response**: bases / basic oxide.*

Question 2

This question required candidates to determine the density of a wooden block.

(a) The question required candidates to calculate the volume of provided wooden block.

(i) This question was well answered. Candidates were expected to measure the length, height and width of the wooden block provided using a ruler. Some candidates mixed up the sizes of the dimensions, for example, writing 6 cm for the height and 4 cm for the length and this led to a wrong answer.

***Expected response**:* length 6 cm / ±0.1 supervisor
width 4 cm / ± 0.1 supervisor
height 2 cm / ± 0.1 supervisor

(ii) This question was well answered by some candidates. Candidates were expected to calculate the volume of the wooden block using the equation:

$$volume = length \times width \times height$$

Some candidates did not show their working, others only substituted into the formula and did not compute the answer and no credit was awarded.

Expected response: *correct substitution of dimensions into formula and correct value.*

(b) Candidates are expected to determine the mass of the wooden block.

(i) Some candidates answered this question very well. Candidates were asked to record the distance, **x**, from the position of the load, **L**, to the pivot, **C**. Candidates were expected to subtract 30 cm from 50 cm since the pivot was at the 50 cm mark. The common wrong response was 30 cm.

***Expected response**:* 20 cm.

(ii) The question was well answered by most candidates. Candidates were asked to record the distance**, y**, from the pivot, **C**, to the position of the wooden block. Some candidates recoreded values of **y** above 50 cm and this did not earn credit.

***Expected response**:* ± 0.1 supervisor's value.

(iii) This part of the question was fairly well answered by most candidates. Candidates were expected to calculate the moment of the 10 g mass about the pivot using the formula:

Moment = force x distance

Common wrong responses included missing up the distances **x** and **y**, taking **y** as the distance of the load from the pivot and this was not credited.

Expected response: $moment = 0.1 \times 0.2 = 0.02$ *Nm*

(c) Most of the candidates appeared to lack substitution skills and others could not work out the answer after correctly substituting, which could be associated with not being familiar with calculators. Candidates were expected to calculate the mass, **m**, of the wooden block using the equation: $m = \frac{10x}{y}$

Candidates need to be encouraged to have and use calculators correctly as it is one of the requirements of the paper. Some candidates did not give the value to 3 significant figures, could not round up or round down correctly and this was not credited.

***Expected response**: correct substitution into formula and correct value.*

(d) **(i)** Candidates were expected to move the load, **L,** to the 20 cm mark and then move the wooden block until the rule balances. Candidates were then asked to calculate and record the values of **x, y** and m. Common wrong responses included the value of **x** being 20 cm and the value of **y** being smaller than that obtained in **(b)(ii).** The expected value of **x** was 30 cm (50 – 20) from the pivot.

***Expected response**: ±1 of the Supervisor's value*.

(ii) Candidates were expected to move the load, **L**, to the 15 cm mark and then move the wooden block until the rule balances. Candidates were then asked to calculate the values of **x**, **y** and m. Common wrong responses included **x** = 15 cm, **y** values either greater than 50 cm or less than the value obtained in **(d)(i)**. The expected value of **x** was 35 cm and the value of **y** greater than that obtained in **(d)(i)**.

***Expected response**: ±1 of the supervisor's value.*

(e) **(i)** Candidates were expected to calculate the average value of the mass for the wooden block, **m**, using the three values of the mass in **(c), (d)(i)** and **(d)(ii)**. The most common wrong response was finding the sum of the masses or the product of the masses instead of the average. Some of the candidates who knew what was required of them did not work out the correct value and it was assumed that these candidates had no calculators.

***Expected response**:* $average = sum\ of\ values\ of\ m \div 3 = correct\ value$

(ii) This question proved to be challenging and some candidates left this part of the question unanswered. Candidates were expected to state why it is necessary to calculate the average value of mass, *m*. Common wrong responses included 'to find a same value', 'to see the mass of the wooden block', and 'to find how heavy the block is'.

***Expected response**: to improve accuracy / reduce experimental errors.*

(f) **(i)** This question proved to be challenging and some candidates did not attempt the question. Candidates were expected to use the values obtained in **(a)(ii)** and **(e)(i)** to calculate the density of the wooden block using the equation, $density = \frac{mass}{volume}$ and state the units.

Some candidates failed to transpose the formula correctly and lost all the marks. Common errors were wrong units e,g m^3/g, kg/ cm^3 and writing answers that are not rounded to 3 significant figures.

***Expected response**: correct substitution into formula;*
correct value; g / cm^3.

(ii) This question was challenging to most candidates. Candidates were expected to predict whether the wooden block will sink or float in water. Some candidates who did not calculate the density of the wooden block in **(f)(i)** did not attempt the question.

***Expected response**: sink / float (depending on candidates' value of density) sink if value of density higher than the density of water which is 1 g / cm^3 or float if density less than 1 g / cm^3.*

(g) Most candidates appeared to be familiar with the concept, but poor scientific literacy severely limited the quality of responses. Candidates were expected to state **one** precaution taken to ensure an accurate reading is obtained from the metre rule. Some candidates tried to describe the position of the rule before taking measurement but due to limited prowess of scientific language they described it as straight instead of horizontal. Some candidates tried to describe how to avoid the error of parallax and failed due to language barrier. Instead they wrote responses such as 'place your eyes on the mark' and 'your eyes must be straight to the rule'. The most common wrong response was "place the metre rule on a flat surface."

***Expected response**: avoid the error of parallax / ensure rule is horizontal before taking measurement.*

(h) Candidates were expected to explain whether the value of **y** will be greater than or less than the value of **y** in **(b)(ii).** Most candidates were not able to explain, instead they either wrote less than or greater than only, as a result they lost the mark.

***Expected response**: less than because the bigger the mass the shorter the distance from the pivot.*

EGCSE PHYSICAL SCIENCE

Paper 6888/04

Alternative to Practical Test

General Comments

The Alternative to Practical paper is an assessment instrument used to adjudicate the level of attainment of investigative and experimental skills in Assessment Objective C of the syllabus by the candidates, aimed at inculcating and engendering scientific dexterity in the candidates. It is premised on the assumption that experimental work is the primary pedagogical mode used to develop and nurture holistic scientific skills and knowledge in the candidates during teaching and learning.

The Alternative to Practical paper accounts for a 20% weighting to the overall final mark of the candidates as per the syllabus provisions. It is marked out of 40 and consists of one Chemistry and one Physics question. The number of entries was much higher this year relative to last year at around 8400, an increase of about 1400. The time allocated for the paper seemed adequate as there was no evidence of mass failure to finish by the candidates.

The paper, as an assessment instrument, assessed a range of scientific skills such as measurement, making observations, analysing results, the amelioration of accuracy in experimental procedure, precautions to be taken when conducting experiments as well as the correct use of technical scientific language especially when making inferences and explanations. It also assessed scientific values and attitudes such as concern for precision and accuracy when explaining the importance of averages to scientific enquiry as well as adherence to accuracy in the table and the standard significant figures when handling data.

The performance of the candidates was generally poor relative to previous years. The main indicator was the relatively low marks obtained by most candidates with the mean mark estimated at below 25%. There were a significantly high number of zeros obtained with only a few centres having no zeros. The highest grade obtained was about 80%, however, it was quite a few candidates that obtained marks more than 50%.

There was a general concern by the Examiners at the apparent dearth of basic skills in the candidates. A significant number of candidates had serious challenges with reading of a simple scale, a skill which is supposed to be basic as well as the determination of averages. The examiners were of the view that paying attention to such basic skills would go a long way in improving the performance of the candidates in such papers.

Comments to specific questions

Question 1

The students were given mixture **B** which contained copper(II) oxide, a black solid insoluble in water, and a solid which was white and soluble in water.

(a) Candidates were asked to describe the appearance of mixture **B**. A majority of candidates were giving colours that do not relate with the black and white colours. There seemed to be a fundamental failure by candidates to appreciate that a mixture should have properties of both the white and black substance, hence an intermediate appearance between black and white was expected. Common wrong responses were: blue-black, brown, milky or cream white, blue. Some candidates assumed that water was already added to the mixture, and they would give responses like white solution with a black precipitate which was not acceptable. Some candidates still described colours using the suffix –ish which made them to lose marks.

Expected response: *black and white / charcoal / grey or any other correctly described mixture within the black and white continuum*.

(b) **(ii)** Candidates were required to describe how to smell the gas formed. A few candidates were able to correctly describe that one had to *waft the gas into the nose using the hand*. One major challenge for candidates was expressing the description of the smelling of the gas even if they had the correct idea. Common wrong responses given by the candidates included the assumption that one had to wear a mask, removing the gas away from the nose, use a respirator, wipe the gas, blow the air instead of gas. Some candidates lost one of the marks for not mentioning the nose as a sense organ for smell as they would state that waft the gas towards the face instead of the nose. A common misconception noted was that the gas had to be smelt after diffusion had taken place, which is why they would say one must leave the gas in a room for some time with closed windows.

(c) **(i)** Candidates were given that a substance was released when adding aqueous sodium hydroxide to the filtrate of mixture **B**. They were informed that the substance turned a damp red litmus paper blue. They were required to suggest the pH of the substance and identify the substance that caused the change of the damp red litmus paper. The most common wrong responses were candidates giving values below 7, just writing above 7 as a response, 8-14, giving out of range values like 20 and giving values above 11 indicating that the substance was a strong base. Some candidates were writing wrong units such as °C, alkaline or base instead of pH values. For the identity of the substance formed, most candidates gave sodium hydroxide as the most common wrong response. Some of those

who had the correct idea referred to the gas as ammonium gas and this was not credited. Some candidates would give pH values below 7 and on the identity they would write alkaline or base which showed a lack of understanding of the pH scale. A few candidates wrote ammonium gas and lost the mark.

***Expected response**:* a pH *value within the range 8-11*
identity of the substance was ammonia.

(ii) Candidates were expected to identify the cation in solid **A**. Most candidates seemed not to understand what was meant by the term cation as they would write the names of compounds instead of cations. The most common error in a number of candidates who had the correct idea was writing ammonia instead of the *ammonium ion*, which was the correct response.

This was manifest of a basic lack of understanding of the concept being assessed. Other common wrong responses included the aluminium ion, copper or writing a wrong formula next to the correct name of the cation.

(v) Candidates were required to identify solid **A** in this question. A majority of the candidates could not realise that the silver nitrate was used to test for the presence of chloride ions in solid **A** and therefore incorrectly surmised that solid **A** was a silver salt. Other common wrong responses were that the salt was a magnesium salt, chlorine, a calcium salt such as calcium carbonate or calcium chloride. Some candidates who had the correct idea still confused ammonia and the ammonium salt.

***Expected response**: ammonium salt.*

(d) (i) Candidates were expected to state the cation responsible for the blue colour in the filtrate. Most candidates failed to note that the residue was copper(II) oxide, hence copper(II) oxide was reacting with sulfuric acid. It was also in this question that most candidates seemed not to understand the meaning of the term cation and thereby gave compounds instead of the cations. Some candidates who were able to identify the cation were not sensitive to the oxidation state of the cation and did not earn credit. The most common wrong response was writing copper without the oxidation state or copper compounds such as copper(II) oxide.

***Expected response**:* copper(II) ion or Cu^{2+}.

(ii) Candidates were required to state and explain the observation made at the cathode and anode during electrolysis. A large number of candidates did not attempt this question. Some candidates who attempted to respond to the question demonstrated a basic lack of understanding of the concept of electrolysis. For the cathode reaction, candidates could not realise that the positively charged hydrogen and copper ions would be attracted to the cathode and copper would be discharged instead of hydrogen. Some of the common wrong responses included general reference to positive ions being attracted to the cathode / bubbles would be observed with an explanation that hydrogen was discharged instead of the copper ions. A few candidates would give conclusions instead of the required observations.

Some candidates would not differentiate between the copper ion and the copper metal.

In the anode reaction, most candidates were able to correctly state that bubbles would be observed, but then could not state that the bubbles showed that a gas was formed. However, most candidates erroneously thought the oxide ion instead of the hydroxide ion was attracted to the anode. Common wrong responses included chlorine, hydrogen, and sulfur gas.

***Expected response**:* cathode: observation- *brown solid*
explanation- *copper(II) ions gained two electrons to form copper metal.*
anode: observation- *bubbles*
explanation - *oxygen gas is formed*.

(iii) Candidates were asked to state and explain what would be observed when magnesium ribbon was added to the filtrate. A few candidates correctly noted that a brown solid would be formed or that the blue colour of the solution would start fading. Most candidates were not able to realise that this was a displacement reaction, instead they were assuming it was a reaction of an acid with a metal. Common wrong responses for the observation included fizzing, the formation of bubbles and a salt was formed. For the explanation, common wrong responses were that magnesium was quite reactive, without comparing with the reactivity of copper or that magnesium was more reactive than water. Some candidates explained the displacement reaction between copper(II) oxide and magnesium instead of copper(II) sulfate with magnesium.

***Expected response**: magnesium more reactive than copper or the blue colour was fading as the copper ions were used up.*

(iv) The question was well answered by many candidates and most were able to correctly name the salt that would be formed as magnesium sulfate. Candidates were asked to name the substance formed as a result of the displacement reaction. A few candidates who had assumed it was a metal-acid reaction were not able to realise that copper metal was the main product of this reaction. Common wrong responses included magnesium oxide, magnesium hydroxide, magnesium sulphide to name but a few.

***Expected response**:* magnesium sulfate / copper (metal).

(**e)** **(i)** The question was challenging to most candidates. Candidates were required to state their observation and suggest the type of substance formed when the filtrate was heated gently with a Bunsen burner flame in an evaporating dish. Most of them could not realise that the question was on separation techniques, especially the evaporation of a soluble salt. Some of those who had noted that it was evaporation could not give the colour of the salt that remains in the evaporating dish which made them lose the mark. The key to the question was the gentle heating which formed a hydrated salt instead of a non-hydrous salt which could have been formed by heating the evaporating dish strongly. Common wrong responses included white crystals, salt crystals, blue precipitate and evaporation. For the type of substance, some candidates would state that water evaporates leaving crystals without mentioning the type of crystals.

***Expected response**:* observation- *blue crystals or a blue solid or powder*
type of substance formed- *salt*.

(ii) Candidates were required to suggest the laboratory use of the substance that is formed when the student continued to heat the substance in the evaporating dish. Some candidates were able to identify that the salt produced could be used to test for the presence of water.

Common wrong responses included identifying ions, making salts, purifying water, carrying out experiments, cleaning, making detergents or that the substance was used to form salts. A few candidates assumed that the substance could be used to test for water purity and this
was also not awarded credit.

***Expected response**:* *to test for the presence of water*.

Question 2

(a) (i) The question was challenging to most candidates, and many were not able to recognise that each subdivision on the scale was 0.2 seconds Candidates were expected to read and record the time, **t**, taken by the pendulum from an analogue scale that was given. A minority was able to read the scale correctly. Common wrong responses included 15.35, 15.4, 15.6, 15.05, 15.06 and values in the range of 18.2 to 18.6.

***Expected response**: 15.7*.

(ii) Candidates were asked to read the given analogue stopwatch face scales. The same challenge as in **(a) (i)** was observed in this question. A vast majority of candidates were not able to read 15.7 and 15.8 correctly. Common wrong responses included 15.35 and 15.4, 15.65 and 15.7, 18.5 and 19.

***Expected response**: t_1 - 15.7 s*
t_2 - 15.8 s.

(iii) The question was challenging to some candidates. Candidates were required to calculate the average of the three values they had read in **(a)(i)**, **(ii)** and **(iii)**. Some candidates seemed to lack basic mathematical skills as they would simply add the three numbers and then give the obtained value as an answer. Some candidates did not carefully read the question and they added the two last responses to **(a)(ii)** and divide with 2. A few candidates did not write their answer correctly to three significant figures as specified in the question and this did not earn credit. A few candidates seemed to fail to correctly use a calculator to compute the expected value of 15.7 from (15.7 + 15.7 + 15.8) ÷ 3. They would instead punch 15.7 + 15.7 + 15.7 ÷ 3 = 36.7 which was a wrong answer. Some candidates lost some of the marks because they elected to divide the sum of the values by ten instead of three.

***Expected response**: 15.7 s*.

(iv) Candidates were expected to determine the period, **T**, using the average from **(a)(iii)**. Stronger responses calculated the period as $\frac{\text{time for all the swings}}{\text{number of swings}} = \frac{answer\ to\ (a)(iii)}{10}$ or $\frac{1}{f}$

Some of these candidates did not first first calculate the frequency before using the equation, leading to a wrong response, T = $\frac{1}{15.7}$ = 0.0637 Some candidates calculated the period using a wrong formula, T = $\frac{10}{15.7}$ = 0.637 and this was the frequency of the oscillation that had to be substituted into the formula T = $\frac{1}{f}$ to get 15.7 to three significant figures.

***Expected response**: 15.7 s*.

(v) Candidates were expected to state the importance of taking readings more than once and then finding an average. Most candidates who seemed to have difficulty to explain that this improves accuracy, only mentioning that it was for accuracy. Common wrong responses included "improves reliability or validity, to get accurate results or avoid mistakes.

***Expected response**: improves or increase the accuracy*
reduces experimental errors.

(vi) The question was fairly answered by candidates. Candidates were expected to state the type of energy possessed by the bob before being released. Most candidates were not able state that the potential energy possessed by the bob was gravitational potential energy and were not awarded credit. The most common wrong responses included kinetic energy, kinetic potential energy, gravitational energy and potential gravitational energy.

***Expected response**: gravitational potential energy*.

(b) (i) The question required candidates to calculate an average from data given in a table. The same skill that was assessed in **(a)(iii)** was tested in this question. The adherence to the demand that the response be written to three significant figures proved to be a challenge to most candidates. The common wrong response was 13.04. Some candidates would give the sum of the three values, 39.11 and a minority decided to divide the sum by the number of swings to obtain 3.91 and these did not earn credit.

Expected response: *13.0 s*.

(ii) The question proved to be challenging to most candidates. Candidates were asked to determine the period, T_2, of the pendulum of length 40 cm. Stronger candidates divided the answer to **(b)(i)**, 13.0 by the total number of swings. Weaker responses resulted from dividing the total by 10 in **(b)(i)** and ended up dividing their wrong answer e.g. 3.91 by the length of cm of the pendulum to get a range of wrong answers such as 0.0978. Some candidates who were able to correctly calculate **(b)(i)** and decided to use the formula $T = \frac{1}{f}$ made the same mistake as in **(a)(iv)**, giving the frequency, $f = \frac{1}{13.0} = 0.0769$.

***Expected response**: 1.30 s*.

(c) Most candidates were not able to **relate** the length of the pendulum to the time taken and failed to relate the time taken to the period. Candidates were expected to state the effect of length on the period of a pendulum. Most candidates did not refer to **(a)(iv)**, **(b)(ii)** answers as they would state that the longer the length of the pendulum the longer the time taken, which was evident that they were comparing the averages for ten swings in **(a)(iii)** and **(b)(i)** and this was the most common wrong response. Some candidates related the length of the pendulum to the speed of swing instead of the period of the pendulum, e.g. the longer the length of the pendulum the higher the speed and this did not earn credit. A few candidates appeared to lack an understanding of the question completely as they would state that the longer the length of the pendulum the shorter the period or vice versa. Some candidates gave vague responses that referred to direct proportionality.

***Expected response**: increasing the length of the pendulum increased the period*.

(d) **(i)** The question proved to be challenging to many candidates and a majority calculated the averages and assumed that this was the correct response. Candidates were expected to use given data to calculate the periods for two different masses and then calculate average periods for the masses. Candidates with an excellent understanding of the question, further divided the averages by ten to obtain the Period. Some candidates failed to concentrate on what was required by the question and just added the time for the ten swings for the 100 g or 150 g mass and divide the sum by 100 g or 150 g, respectively. Some would divide their values by the combined mass of 250 g and also lost all the marks. Common wrong responses included 13.33,1.333, 0.267 and 0.177.

***Expected response**:* $\frac{13.33}{10}$ *= 1.33.*

(ii) The question was challenging to some candidates. Candidates were expected to state the effect of mass on the period of a pendulum based on their results. Candidates who had correctly calculated the periods in **(d)(i)** were able to correctly state that there was *no effect of changing the mass on the period of a pendulum*. Some candidates stated that an increase in mass had no effect on the period of the pendulum and this response was not awarded a credit.

(e) **(i)** There was some uncertainty in the responses. Candidates were expected to calculate the period, **T**, of a pendulum of length 60 cm using the formula $T = 2\pi\sqrt{l/g}$. Some candidates did not convert the length to metres and a mark was not credited. Common wrong responses included 15.4 s, 154 s or 4.87 s and 0.487 s.

Expected response: $\frac{60}{10} = 0.6\ m$

$$T = 2\pi\sqrt{\frac{0.6}{g}}$$

$$= 1.54.$$

(ii) Candidates were expected to compare the periods of length 60 cm when calculated using the method in **(a)(iv)** and **(e)(ii)**. The value in **(a)(iv)** was an experimental value while the other one was from calculations. Candidates were supposed to note that the experimental value was more or less equal to the calculated value as there were experimental errors within an acceptable limit. The slight differences were within the acceptable experimental limits hence candidates were expected to state that the values were the same. Indeed, this skill needs to be emphasized to science learners. Some candidates who got **(a)(iv) and (e)(i)** correctly wrongly assumed that the slight difference of 0.04 meant the values were different.

Expected response: *values are the same*.

(f) The question was challenging to many candidates, and most were plagued with an apparent lack of understanding that the presence of air resistance will have the dampening effect. This means that the movement of the pendulum will slow down due to air resistance making the period to increase as kinetic energy is lost due to air resistance mainly as heat energy to the surroundings. Candidates were required to state and explain the effect of air resistance on the period of a pendulum. Some candidates seemed to be confusing air resistance with wind such that they would mention that the air resistance would speed up the movement of the pendulum while decreasing its period which was scientifically wrong and as such did not score any mark. Some candidates used the terms motion and acceleration to try to explain the effect of air resistance on the period of the pendulum. They would state that the motion would be slowed down and the acceleration would increase which was contradictory. Some would state that the acceleration would decrease without explicitly stating the effect on the pendulum which was a vague response that did not earn any mark. Some candidates correctly describe terminal velocity with respect to freely falling objects in air which did not apply in this question and earned no marks.

Expected response: *period increased*

pendulum lost some energy or speed due to air resistance.