EXAMINATIONS COUNCIL OF ESWATINI

EGCSE

EXAMINATION REPORT

FOR

PHYSICAL SCIENCE (6888)

YEAR

2022

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EGCSE PHYSICAL SCIENCE

Paper 6888/01

Short Answers

General Comments

The total number of candidates who sat for this paper was about 9042.

This shows a significant decrease from the previous year exam. This year's performance was poor compared to last year. The marks ranged between zero and thirty- five. Most candidates scored in the range 1 - 10, very few got more than 30. Thirty-nine candidates scored zero even though they had attempted most of the questions.

Questions that were more challenging to most candidates were Questions **10(b), 11, 16, 17** and **18**. Question 18 proved to be the most inaccessible because no candidates managed to get full marks. Questions that were more accessible to most candidates were **1, 2, 4(a)** and **10(a).**

Comments on Specific Questions

Question 1.

This question was one of the most accessible questions to candidates. Candidates were asked to choose the statement that does **not** describe electromagnetic waves.

Expected response: C.

Some common wrong responses: **B** and **D**.

Question 2

Candidates were given a diagram showing distillation apparatus used to obtain water from aqueous copper (II) sulfate.

(a) This question was accessible to most candidates. Candidates were required to state the name of the substance found in **A** during the distillation process.

Expected response: *water/ water vapour*

Common wrong responses: *gas, condenser, distillate, smoke, water out, pure substance.*

(b) This part was accessible to most candidates. Candidates were required to name the two processes used to obtain the water from the aqueous copper (II) sulfate.

Expected response: *1. Condensation*

2. evaporation

Common wrong responses: *filtration, distillation, heating, cooling, wrong spelling such as evapouration, condesation, evaporasion.*

Question 3

This question was generally inaccessible to most candidates. Candidates were required tostate the energy changes that occur in a car engine that uses petrol as fuel.

Expected response: *chemical energy to kinetic/ sound/ heat energy*

Common wrong responses were: *chemical change, potential, electrical energy to electrical, sound, mechanical.*
Some candidates used dash instead of arrows to show energy change. Some got the sequence of energy changes wrong. This resulted to loss of marks.

Question 4

Candidates were given a table showing the electronic arrangement of four atoms **B**, **C**, **D** and **E**.

(a) This question was accessible to most candidates. Candidates were required to state the letter **B, C, D** or **E** of the atom of an unreactive element.

Expected response: ***C***.

Common wrong response: ***D***

(b) This part of the question was challenging to most candidates. Candidates were required to use the Periodic Table to give the name of an element that is in the same group as **D** but more reactive than **D**.

Expected response: fluorine/ F.

Common wrong responses: flourine, chlorine and bromine.

Question 5

This part of the question was accessible to a moderate number of candidates. Candidates were given a diagram showing a polythene rod suspended with a thin thread. The rod was rubbed with a dry-cloth.

Candidates were required to state and explain what happens when another polythene rod that has been rubbed with the same dry cloth is brought close to the suspended rod.

Expected response: *repel / moves away because they have the same charge.*

Common wrong responses: *polymerization, reaction, magnetization, like poles repel*

Common wrong spellings*:* *repal, repeal, repultion.*

Question 6

Candidates were given a diagram showing a substance changing from state **F** (solid) to state **G** (liquid).

(a) This part of the question was inaccessible to most candidates. Candidates were required describe the differences in the movement of particles in state **F** and in state **G.**

Expected response: in state **F** particles vibrate about fixed points while in G particles slide past each other.

Common wrong responses: particles in **F** do not move but vibrate in fixed points while in **G** particles are free to move past each other. Some candidates were referring to change of state e.g. state **F** is melting, particles in **F** vibrate when heated.

(b) This part of the question was accessible to most candidates. Candidates were required describe the differences in the forces of attraction between the particles of the substances in state **F** and in state **G.**

Expected response: *forces of attraction stronger in state **F** than in state **G**.*

Common wrong responses: *forces in **F** higher/ more than in **G**. Some candidates stated that state F rather than particles is held by strong forces.*

Question 7

Candidates found this question difficult. They were told that a body moving along a circular path had a constant speed, but its velocity was changing. They were required to explain why the velocity of the body changes.

Expected response: *change in direction.*

Common wrong responses: *velocity is a scalar/vector quantity, magnitude changes, acceleration changes. Others were giving the definition of velocity.*

Question 8

This question was accessible. Candidates were required to draw a dot and cross diagram to show bonding in a chlorine molecule, Cl_2, showing the outermost electrons only.

Expected response: two atoms correctly showing evidence of sharing and octet.

Common wrong responses: *wrong structure such as transfer of electrons, charges. Some candidates used wrong labelling such as Cl_2 on each atom.*

Question 9

This question was accessible. Candidates were given a diagram showing a uniform metre rule supported at its centre and balanced by two weights, 4N and 5N.

Candidates were required to calculate the length x, which is the distance between the pivot and the 5N weight.

Expected response: $5x = 4 \times 40$
$x = 32$

Common wrong responses: *use of ratios, 40 : 4*
x : 5
x = 50

Question 10

Candidates were given a diagram showing the apparatus used in the electrolysis of molten copper (II) chloride using carbon electrodes.

(a) This part of the question was accessible. Candidates were required to state the name of the electrode where copper metal is formed

Expected response: *cathode*

Common wrong responses: *carbon electrode, negative terminal, anode.*

Common wrong spelling: *carthode, cathod*

(b) This part of the question was inaccessible to most candidates. Candidates were required to describe how copper metal is formed on this electrode.

Expected response: *copper (II) ions are attracted/migrate to the negatively charged cathode, where each ion gains two electrons.*

Common wrong responses: *copper ions lose electrons.*

Question 11

This question was inaccessible. Candidates were told that a thermometer is sensitive to temperature changes.

They were required to name two features that can make a thermometer more sensitive.

Expected response: *narrower bore tube/ capillary tube and larger bulb/increase volume of liquid in the bulb.*

Common wrong responses: *thin capillary, thin bulb, wrong calibration. There was no comparison aspect.*

Question 12

This question was accessible to a moderate number of candidates. Candidates were told that ammonia is used in the manufacture of fertilizers.

They were required to describe the test for ammonia gas.

Expected response: test – damp red litmus paper
result – turns bue.

Common wrong responses: *test – red litmus paper, lighted splint, lime water*
result – bleached, pop sound, ammonia has a bad smell, turns milky

Question 13

This question was inaccessible to a most candidates. Candidates were required to explain why sound cannot travel through a vacuum.

Expected response: *sound requires a medium to travel.*

Common wrong responses*: a vacuum is an empty space, no air particles, sound is slow, sound travels in a straight line.*

Question 14

Candidates were told that carbon dioxide contributes to global warming.

(a) This part of the question was inaccessible to most candidates. They were required to state the main source of the carbon dioxide that contributes to global warming.

Expected response: *combustion of carbon containing/fossil fuels*

Common wrong responses: *incomplete combustion, factories, car exhaust, respiration, burning of fuels*

(b) This part of the question was accessible. They were required to state one adverse effect of global warming.

Expected response: *rise of environmental temperatures/ melting of Arctic glaciers (rise of sea levels)/loss of biodiversity/ loss of arable land/ extreme weather conditions (floods or drought)*

Common wrong response: *depletion of the ozone layer, greenhouse gases*

Question 15

This question was accessible to a moderate number of candidates. Candidates were given a diagram showing a ray of light striking a smooth surface. They were required to complete the diagram by constructing the path of the ray after striking the surface.

Expected response: *correct construction showing the normal, reflected ray with arrow and the two angles of incidence and reflection being equal* ($i = r$).

Common wrong answers: *Reflected ray without an arrow, arrow showing wrong direction, wrong labelling. Some candidates constructed a refracted ray.*

Question 16

This question was inaccessible to most candidates. Candidates were told that iron is extracted from iron ore. They were required to describe the role of carbon in the extraction of iron.

Expected response: *carbon reacts with oxygen to form carbon dioxide which then reacts with the carbon to form carbon monoxide. The carbon monoxide removes oxygen from the iron (III) oxide/ carbon reduces iron (III) oxide.*

Common wrong answers: *carbon reacts with coke, carbon acts as a fuel, carbon reacts with hot air, carbon mixes with oxygen, carbon serves as a catalyst. Some candidates failed to give the correct chemical name of iron ore, i.e. were writing iron oxide instead of iron (III) oxide.*

Question 17

Candidates were given an extension – load graph for a suspended spring.

(a) This part of the question was inaccessible. Candidates were required to state term used for the point labelled **P**.

Expected response: *elastic limit*

Common wrong response: *limit of proportionality, acceleration, extension limit, elastic point, terminal velocity.*

(b) This part of the question was inaccessible. Candidates were required to describe the extension-load relationship between the points **O** and **N.**

Expected response: *extension directly proportional to the load/extension force.*

Common wrong response: *Increasing the load increases the extension, Points **N** and **P** are directly proportional, extension is proportional to load, accelerating uniformly.*

(c) This part of the question was inaccessible. Candidates were required to describe the effect of the load on the spring beyond point **P**.

Expected response: *Spring does not return to its original length when the load is removed/ Spring loses its permanent set.*

Common wrong answers: *spring breaks/does not return to original state or position.*

Question 18

This question was inaccessible to most candidates. Candidates were required to describe how fluorescent lamps produce light.

Expected response: *current ionises/excites mercury vapour producing Ultra-Violet light causing coating (phosphor) to glow.*

Common wrong answers: *Lamp has tungsten filament with argon gas, paraffin lamp, lamp filled with fluorine.*

EGCSE PHYSICAL SCIENCE

Paper 6888/02

Structured Questions

General Comments

9275 candidates registered for this component but for some reasons the number of candidates that actually sat for the component was 9003. This is a decrease of approximately 5700 candidates compared to the previous year.

The paper was marked out of a total of 80 marks. Judging from the scores, generally, the paper was easier compared to the previous year's. The highest score was 5 marks higher than the previous year. There was a drop in the single digit scores (0 – 10). The scores ranged from 0 to 71 with the majority of the candidates scoring between 10 and 30 marks.

Use of correct symbols in formulae and equations was still a challenge.

There was a noticeable number of candidates that left some questions or part questions not attempted. However, this might not indicate that candidates ran out of time.

Questions that proved particularly easy for most candidates were: **1(a) (i), (ii), (c), 2 (a) (ii), 3(a), 4(a), 8 (a) (i) and 9 (a) (ii)** as the majority of the candidates were able to score full marks from them.
Questions that proved difficult for most candidates were: **2 (a) (i), 4 (d), 5, 6, 7, 9 (c) (i), (ii), and 10 (b), (d) as** the majority of the candidates failed to obtain marks from these questions.
However, there was an improvement in responses to higher order questions where candidates were required to explain or describe. Most candidates who attempted those questions made an effort to respond to the command words "explain or describe".

Comments on Specific Questions

Question 1

(a) (i) This was a well done question as the majority of the candidates were able to score both marks.
Candidates were required to identify, from the table, a Group I metal and give a reason for the answer.
Expected response: ***A*** *or* ***D*** *because they have a low melting point* or *because they are soft* was very common.

(ii) This was another well done question. Most candidates were able to identify a transition metal from the given table.

Expected response: ***B*** *because it has a high density or it has a high melting point or it is hard or it forms coloured salts* was common.

A common wrong response was ***B*** *because it is blue instead of "B because it forms coloured salts or it forms a blue salt".*

(b) This question was fairly done as most candidates were able to score at least 1 mark out of the available 2. Candidates were required to **explain**, in terms of metallic bonding, why all the metals in the given table were good conductors of electricity.

Expected response: *they have delocalised electrons which flow or move to produce current.*

Most candidates scored the first mark of delocalized electrons but missed the part that the delocalised electrons flow or move to produce current.

(c) This was a well done part question as both marks were accessible to most candidates. The majority of the candidates were able to state other physical properties of metals not shown in the given table as: *malleable, ductile, lustrous, good heat conductors and sonorous.*

Common wrong responses were malleability and ductility.

Question 2

This question was about waves and light.

(a) **(i)** This was a challenging question as most candidates were not able to score a mark from it.

Candidates were required to explain the difference between transverse and longitudinal waves. The candidates' responses showed that the topic was done but they failed to express themselves to earn marks.

A common wrong response included:

- transverse waves can travel in vacuum while longitudinal waves cannot.
- transverse wave move perpendicular to its motion while a longitudinal wave move parallel to its motion.

Expected response:

in transverse, vibrations are perpendicular to direction of wave motion while in longitudinal, vibrations are parallel to direction of wave motion.

(ii) This was a well done question. The correct response of *sound (waves)* as an example of a longitudinal wave was common**.**

Common wrong responses were: radio waves, water waves and spring waves.

(b) **(i)** This question was challenging to most candidates. Candidates were required to calculate the wavelength of a water wave given that its frequency is 5 Hz and its speed is 15 m/s. Candidates loss marks for use of wrong symbols in formula such as use of **F** for frequency, ***f*** and **W** for **λ**. Candidates also lost a mark for not writing the unit of wavelength, m.

Expected response: $\lambda = \frac{v}{f} = \frac{15}{5} = 3\ m$

(ii) This question was fairly done. Most candidates were able to score at least 1 mark from the available 3 marks.

Candidates were required to calculate the angle of refraction for a light ray given that the angle of incidence is 30° and water has a refractive index of 1.33. Most candidates were able to recall the formula: $n = \frac{\sin i}{\sin r}$, but some had challenges making ***r*** the subject. A common error was that of substituting sin i for 30°. Candidates also lost a mark for wrong symbols in the formula. A common wrong symbol was **R** for refractive index, ***n***.

Expected response: $n = \frac{\sin i}{\sin r}$

$$1.33 = \frac{\sin 30°}{\sin r}$$

$$\sin r = \frac{\sin 30°}{1.33}$$

$$r = 22.1°$$

Question 3

This question was about separation techniques, specifically chromatography.

(a) This question was well done with the majority of the candidates scoring the mark. Candidates were required to suggest a suitable solvent that could be used to obtain a chromatogram for the components of ink. A common wrong response was: locating agent.

Expected responses: *water, ethanol, alcohol* were common. *Acetone and propanone* were also correct but were very rare.

(b) This was a fairly done question as some candidates were able to score the mark. Candidates were required to explain, using the chromatogram, why student N is the one that wrote the letter.

Expected response: *ink of student **N** has the same components as the ink in the letter.*

A common challenge that lead to loss of marks was the mixing up of the terms or words: ink, dyes and components. For example, candidates would write: the ink in **N** was the same as the ink in the letter.

(c) This was a challenging question to most candidates as the correct full response was very scarce.
Candidates were required to explain why the line of origin was slightly above the solvent line. Most candidates were able to state that it was to prevent the sample from dissolving into the solvent but they did not state the effect of that on the chromatogram.
Expected response: *to prevent the sample from dissolving into the solvent because if that happens the components will not separate or there will be no clear chromatogram formed.*

(d) This was a fairly well done question. Most candidates were able to score 1 mark out of 2.
Candidates were required to describe how invisible components of ink from student Q can be made visible.
A common wrong response was the use of the locating agent ninhydrin. Ninhydrin is used for amino acids not for inks or dyes.

Expected response: *expose chromatogram to UV light.*
UV light makes the ink fluoresce and emits visible light.

Question 4

This question was about electromagnets.

(a) This question was well done. The majority of the candidates were able to name *copper* as the suitable material for the coil of the electromagnet. Common wrong responses included iron and wire.

(b) This question was also well done as most candidates were able to score both marks.
Candidates were required to state two ways of increasing the strength of the electromagnet.
Common wrong responses included: use of a stronger magnet, increase number of coils and increase number of bulbs.
Expected response: - *increase number of turns on coil*
- increase current or voltage or number of cells.

(c) This was a challenging question to most candidates as the majority failed to score the mark. Candidates were required to explain why soft iron was used as a core in the electromagnet. **A common wrong response was** *iron is a good conductor of electricity*.

Expected response: *iron is easily magnetised and easily demagnetised or it forms a temporal magnet.* Candidates lost the mark for giving incomplete answers such as: iron is easily magnetised

(d) This was another challenging question to most candidates as most candidates were not able to access the 3 marks. Candidates were required to explain why the plotting compass needle deflects when the switch is closed. A noticeable number of candidates' responses showed that they did not understand what is to deflect. Some even thought that when the switch is closed no current flows.

Expected response:

- current flows in the circuit or coil

- the soft iron core becomes a magnet.

- attraction or repulsion between the magnetised soft iron core and the plotting compass needle causes a deflection on the compass needle.

OR

- a current carrying wire has a magnetic field around it.

- the interaction between the magnetic field of the plotting compass and the magnetic field around the current carrying wire cause the compass needle to deflect.

(e) This was a fairly done question. For some unknown reason a number of candidates did not attempt this question. A good number of those who attempted it were able to score the mark. Candidates were required to draw, on the given figure, the poles of the soft iron core when the switch is closed. A common wrong response was that of writing + and – at the ends of the soft iron core.

The correct response was:

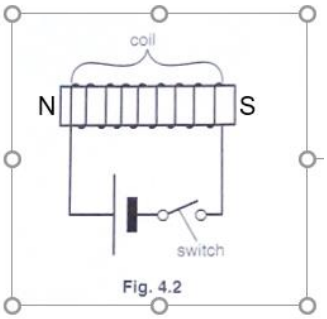


Fig. 4.2

Question 5

This question was about allotropes of carbon.

(a) **(i)** This was a challenging question to most candidates as the mark was not accessible to the majority of the candidates. Candidates were required to state one similarity in the structure of graphite and graphene. Common wrong responses were: they both conduct electricity and they are both bonded to three carbon atoms.

Expected responses:

- they both have a hexagonal structure

- they both have free or delocalised electrons

- in both structures, each carbon atom is covalently bonded to three other carbon atoms.

(ii) This part question was challenging to most candidates. Candidates were required to state one difference in the structure of graphite and graphene. The majority of the candidates failed to score this mark. A common wrong response was that graphite has layers while graphene has no layers. Some candidates mentioned strong forces between layers in graphite and weak forces between atoms in graphene.

Expected response:

-single layer in graphene while multilayers in graphite

-layer of graphene thinner than layer of graphite.

(b) This was another challenging question to most candidates as the two marks wre very scarce. Candidates were required to state one use of graphite and relate it to its property. Common wrong responses included uses like jewellery and making drill bits because graphite is strong. Another common wrong response was that it is used to make pencils instead of pencil lead.

Expected responses:

- used for making pencil lead because it is flaky or has a layered structure or it is slippery

- used as a lubricant because it is soft and slippery

- used in the manufacture of electrodes because it conducts electricity.

Question 6

This question was on radioactivity. The whole of this question was challenging to most candidates.

(a) This was one of the most challenging questions. Even some of the high scoring candidates failed to score these two marks. Candidates were required to describe radioactive emission. There were no common wrong responses.

Expected response*:* *emission of particles/ energy/ radiation from an unstable nucleus.*

(b) This question was not well done. Candidates lost marks because they failed to express themselves and in the process ended up writing wrong science. Candidates were required to describe the behaviour of alpha particles and gamma radiation in an electric field. Candidates lost marks for stating that "the alpha particle bends" instead of 'the path of the alpha particle bends".

Expected response: *alpha particles are deflected towards the negative plate and the gamma radiation is not deflected.*

(c) This part question was one of the most challenging question to most candidates. Candidates were required to describe how radioactive isotopes are used to detect leaks from water pipes. Most candidates showed little understanding of the concept of applications of radioisotopes.

Expected response:

- the radioisotope is added to water in the pipes.

- where there is a leak the water will escape from the pipe

- and will be detected by a radioactive detector (GM tube).

Question 7

This question was about hydrocarbons.

(a) **(i)** This was a very challenging question to candidates as very few candidates were able to score marks from it. Candidates were required to calculate the empirical formula for a hydrocarbon that is made up of 85.7% carbon and 14.3% hydrogen by mass. Most candidates had no idea of what was required of them.

Expected response:

carbon: hydrogen

$$\frac{85.7}{12} : \frac{14.3}{1}$$

$$\frac{7.1}{127.1} : \frac{14.3}{7.1}$$

1: 2

CH_2

(ii) This was another very challenging question to most candidates. Most candidates had no idea of what a molecular formula is. Candidates were required to determine a molecular formula for the hydrocarbon in **(i)** if it had a molecular mass of 70. A common wrong response was Ga, probably taken direct from the periodic table for an element with a relative atomic mass of 70.

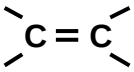
Expected response: $\frac{Mr\ Unknown}{Mr\ CH2} = \frac{70}{14} = 5$, molecular formula: C_5H_{10}

(b) **(i)** This question was also challenging to most candidate as the majority of the candidates failed to score the mark. Candidates were required to name apparatus **F** from fig. 7.1. Common wrong responses included: beaker, water bath and basin.

Expected response: *trough.*

(ii) This part question also proved challenging to most candidates. Candidates were were required to draw the functional group of hydrocarbons in the same homologous series as ethene. Candidates showed familiarity with the content asked but failed to answer the question. Instead they gave the structural formula of ethane and ethene.

Expected response:



(iii) This was another challenging question to most candidates. Most candidates failed to give the expected answer of *octane* as the other product of the cracking process. Carbon dioxide and water were the most common wrong responses.

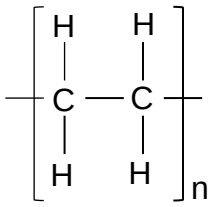
(c) **(i)** This was another challenging question to most candidates as they failed to describe addition polymerization. Most candidates wrote about adding monomers together with no reference to breaking double bonds.

Expected response:

- *the breaking of a double bond*
- *to join monomer units to form a polymer or to form a giant structure.*

(ii) This was another poorly done part question as the correct structure of poly (ethene) was scarce among candidates' responses. Candidates were required to draw the structure of poly(ethene). Some candidates who attempted this question lost the mark for not writing *n* for number of times and for leaving out the linkages at the ends.

Expected response:



(iii) This part question was fairly done since the majority of the candidates were able to score at least 1 mark out of the available 2 marks. Candidates were required to explain why poly(ethene) causes serious pollution problems.

Expected response: - *poly(ethene) is non-biodegradable,*
- *when burnt it produces poisonous gases or causes air pollution.*

Common wrong responses were: - poly(ethene) is not degradable
- poly(ethene) contains gases which cause global warming.

Question 8

This question was about resistance and the transformer.

(a) (i) This question was generally well done as most candidates were able to score all the marks. Candidates were required to calculate resistance of an electric bell given that it has a rating of 240 V, 0.7 A. Candidates lost marks for failure to round off correctly and for use of wrong symbols in the formula.

Expected response: $R = \frac{V}{I} = \frac{240}{0.7} = 349.9\ \Omega$

(ii) This question was well done. Candidates were required to calculate the charge moving in the circuit if the bell is switched on for 2 minutes. Most candidates were able to recall the formula: Q = It. Some candidates used C instead of Q for charge and they lost a mark. Candidates also lost a mark for leaving out the unit in their answer. A common error was that of not converting the 2 minutes into 120 seconds before calculating the final answer.

Expected response: *Q = It = 0.7 2 x 60 = 84 C*

(b) (i) This question was fairly well done as most candidates were able to score at least one mark from the available two marks. The question required candidates to calculate the combined resistance of two appliances with resistances of 6 Ω and 3 Ω connected in parallel. Candidates loss a mark for not writing the subject of the formula.

Expected response: $R_t = \frac{R1\ x\ R2}{R1+R2} = \frac{6\ x\ 3}{6+3} = 2\ \Omega$

(ii) This question was fairly well done as most candidates were able to recall and use the formula $V_p/V_s = N_pN_s$. Candidates were required to calculate the number of turns in the secondary coil of a transformer which transforms 240 V to 12 V if the primary coil has 1000 turns. Candidates lost marks for wrong substitution. A common error was: using 240 V for V_s and 12 V for V_p and using 100 turns instead of 1000 turns.

Expected response: *Vp/Vs = Np/Ns*

$$N_s = \frac{12\ x\ 1000}{240}$$

$$N_s = 50\ turns$$

Question 9

This question was about the thermal decomposition of copper (II) carbonate to form copper (II) oxide.

(a) (i) This question was well done as most candidates were able to name *carbon dioxide* as the other product of the thermal decomposition. Common wrong responses were carbon and carbon monoxide. It should be noted that CO_2 was not accepted because the command word was "name" the other product.

(ii) This was another well done question. Most candidates were able to score this mark. Candidates were required to explain why the thermal decomposition of copper (II) carbonate is a chemical change.
Expected response: *colour change, gas evolved and new substance formed.*

(b) This was a fairly done question. Most candidates were able to score at least one mark out of the available two marks. The question required the candidates to describe one similarity and one difference in the thermal decomposition of copper (II) carbonate and calcium carbonate. Most candidates were able to describe the similarity but failed to describe the difference. A common wrong response was that copper (II) carbonate decomposes to form copper (II) oxide while calcium carbonate decomposes to form calcium oxide.

Expected response:

similarity:
- *both release carbon dioxide*
- *both produce an oxide*
- *both produce an oxide and a gas.*

difference:
- *copper (II) carbonate decomposes faster than calcium carbonate*
- *there is colour change in the decomposition of copper (II) carbonate while there is no colour change in the decomposition of calcium carbonate.*
- *copper (II) carbonate decomposes at a lower temperature than calcium carbonate.*

(c) (i) This was one of the worst poorly done question as the majority of the candidates did not show understanding of the procedure of preparing pure crystals.
Candidates were required to describe how pure crystals of copper (II) chloride can be prepared.

Expected response:

- filter to remove excess copper (II) oxide

- heat to concentrate or heat to saturate

- cool to crystalise

(ii) This question was also challenging to most candidates. Candidates were required to state two other factors, besides using powder form, that can increase the rate of the reaction. Candidates lost marks for stating general factors that affect the rate of a reaction without making reference to increasing the rate of the reaction. Common wrong responses were: temperature, catalyst and add more hydrochloric acid.

Expected response:

- heating or increasing the temperature

- increase concentration of the acid

- stirring

Question 10

This question was on electromagnetic induction.

(a) This part question was well done as most candidates were able score this mark. Candidates were required to state one way in which the e.m.f. can be increased. A few candidates confused electromagnetic induction with an electromagnet.

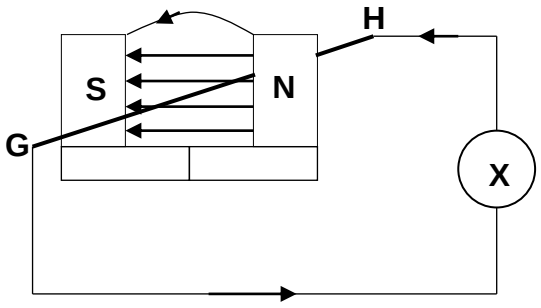
Expected response: *moving the wire faster or using a stronger magnet.*

(b) This was another challenging question to most candidates as the correct answer was not common. Candidates were required to name the instrument that could be used to measure the charge generated during electromagnetic induction.

Expected response: *galvanometer because it is sensitive to small currents flowing in the circuit.*

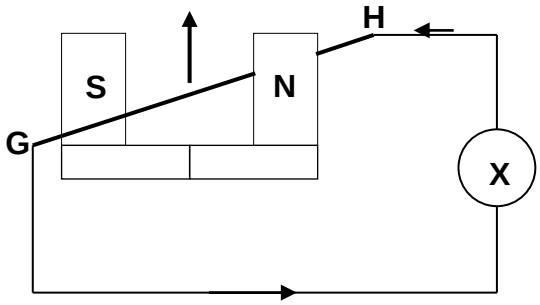
(c) This was a well done question as most candidates were able to draw the magnetic field lines between the poles of the magnet.

Expected response:



(d) This was another challenging question to most candidates. Only a few of the high scoring candidates were able to score this mark. Candidates were required to indicate, using an arrow, the direction of movement of the wire **GH** in order for the current to be induced in the direction shown.

Expected response: *an arrow vertically upwards.*



EGCSE PHYSICAL SCIENCE

Paper 6888/03

Practical Test

General Comments

The Practical paper is intended to assess the ability of candidates in experimental skills. The paper assessed a range of scientific skills including the correct use of equipment, accuracy in the use of equipment, following procedure, making observation, drawing and interpreting conclusions. The paper is marked out of 40 marks and consist of one Chemistry and one Physics question. The time allocated the paper seemed adequate.

Generally, it was observed that candidates lacked observation skills as shown by their responses to **Question 1(a), (c) and (d)**. It was also observed that the concept of extension was not familiar to quite a number of candidates as they ended up with negative extensions. Taking measurement using a metre rule was poorly done. Describing an experimental procedure proved challenging to quite a number of candidates.

The paper proved challenging to candidates as they lacked quite a number of practical skills. Some of the candidates who were able to accurately record their observations, had challenges interpreting their observations. There was a concern about the mathematical abilities of candidates as they had challenges in **Question 2,** where they had to substitute values in a given formula. Some left these parts of the question unanswered while others rearranged the variables in the formula.

Comments on Specific Questions

Question 1

Candidates were provided with three liquids labelled **A**, **B** and **C**. Liquid **A** was distilled water, liquid **B** was aqueous calcium chloride and liquid **C** was aqueous calcium hydrogen carbonate.

Candidates had to investigate the properties of the three liquids.

(a) Candidates placed a spatula-full of anhydrous copper(II) sulfate powder in each of three petri dishes labelled **1**, **2** and **3**.

(i) Candidates added two drops of liquid **A**, using a dropper, on the copper(II) sulfate powder in petri-dish **1** and recorded their results.
This part of the question was fairly well done as most candidates were able to give the expected response of “turns blue’.

(ii) Candidates added two or three drops of liquid **B**, using a dropper, on the copper(II) sulfate powder in petri-dish **2** and recorded their results.

This part of the question was fairly well done. Most learners were able to get this mark.

Expected response: *copper(II) sulfate powder turns blue.*

(iii) Candidates added two or three drops of liquid **C** on the copper(II) sulfate powder in petri-dish **3** and recorded their results.

This part of the question was fairly well done.

Expected response: *copper(II) sulfate powder turns blue.*

Some of the common wrong responses in **(i)**, **(ii)** and **(iii)** included a blue precipitate is formed/ no change/ copper(II) sulfate powder remains white.

(iv) Candidates were asked to state their conclusion about the presence or absence of water in each of the three liquids **A**, **B** and **C**.

Some candidates left the question unanswered. Others were not using the observations they made in **(a) (i)-(iii)**, their responses alternated between water is present and water is absent as a result lost the mark.

Expected response: *water present in all*.

(b) Candidates were asked to describe an experiment that could be carried out to test if liquid **A** was a pure substance.

This question proved challenging to candidates as a large number of them could not earn all the 3 marks on offer. Most of the candidates omitted the name of the apparatus containing the liquid, the name of the heating source and the instrument for measuring temperature.

Some of the candidates who drew the heating or cooling curve, did not label the axis and the melting/ freezing point.

The most common wrong response was describing chromatography as the experiment that could be carried out to test the purity of liquid **A**.

Expected response: *was heat the liquid in a test-tube/boiling tube using a Bunsen burner until it boils. Then measure the boiling point of the liquid using a thermometer. If liquid **A** is pure, the temperature will be constant at the boiling point/ if impure the temperature will not be constant.*

(c) Candidates poured 50 cm^3 of liquid **A** into a beaker and labelled it **A**. The candidates also poured 50 cm^3 of liquids **B** and **C** labelling the beakers **B** and **C** respectively.

(i) Candidates were asked to add a spatula-full of washing powder into each of the three beakers and stir each for about a minute and record their observations.

Quite a number of the candidates could not spell ‘lather’. They wrote words such as ‘luther, leather, lether’. Some could not spell scum instead they wrote ‘scam’.

Expected response were.

A – *lather forms readily*

B – *lather forms after some time*

C – *no lather/ scum forms*

(ii) The volume of the liquids was the same in all the beakers.

Candidates were asked to suggest another variable that must be kept constant as the investigation proceeded.

This part of the question was fairly well done as most candidates gave the expected responses of same temperature/ same mass of washing powder.

Some wrong responses included 'same type of beaker and same time for stirring'.

(d) Candidates poured 50 cm^3 of liquids **A**, **B** and **C** into separate clean beakers.

(i) Candidates heated **A** with a strong flame for about 2 minutes, ensuring that the liquid starts to boil. Thereafter cooled the beaker in a cold water bath for about 2 minutes. Then added a spatula-full of washing powder and stirred.

(ii) Beaker **B** and beaker **C** were each heated for about 4 minutes, cooled in a cold water bath and a spatula-full of washing powder added into each beaker. Each beaker was stirred for about 3 minutes and observations recorded.

Expected response:

A – *lather forms*

B – *lather forms*

C – *no lather/ scum observed*

Quite a number of candidates lost the 2 marks on offer as they gave responses such as 'powder does not dissolve, powder remains blue or blue precipitate formed'.

(e) Candidates poured 50 cm^3 of liquids **A**, **B** and **C** into separate clean beakers.

(i) Candidates added a spatula-full of washing soda to liquid **A**. Then stirred the mixture for about a minute and added a spatula- full of washing powder and stirred.

(ii) Candidates added a spatula-full of washing soda to liquid **B** and stirred the mixture for about a minute. Then decanted the clear liquid into a clean beaker and added a spatula-full of washing powder and stirred. The same procedure was repeated for liquid **C**.

The candidates recorded their observations for **(i)** and **(ii).**
Some common wrong responses included a leather formed/ blue precipitate formed/white mixture.

Expected response:

A – *lather forms*

B – *lather forms*

C – *lather forms*

(f) Candidates were asked to suggest the name of the anion responsible for the observations made in liquid **B**.

This part of the question was poorly done as the majority of candidates left it unanswered or gave wrong responses. Some of the wrong responses were magnesium ion/ calcium ion/ zinc.

The most common wrong response was 'carbonate ion'.

Expected response: *hydrogen carbonate ion.*

(g) In this part of the question candidates were asked to suggest the name of the cation that causes the changes that were observed in liquid **C**.

Some candidates gave the formula of the cations but the charges were incorrect Ca^{+} / Mg^{+}, as a result lost the mark.

Expected response: *calcium/ magnesium ions.*

(h) In this part of the question candidates were asked to suggest a reason for using different stirring rods in the three beakers.

Some candidates lost the mark as they gave incomplete responses such as 'to avoid mixing' and 'prevent solutions from reacting'. This resulted in the loss of the mark on offer.

Expected response: *was to avoid contamination of the liquids/ avoid mixing of solutions in order to get correct/ accurate results.*

(i) Candidates had to determine the pH of the washing powder using the Universal Indicator solution. The candidates had to give the colour of indicator after adding it to the washing powder, pH value and draw a conclusion from their observation.

Quite a number of candidates gave responses such as green to blue/blue to purple which was not accepted. Others gave a range of pH values which also resulted in the loss of the mark. Candidates are expected to give one colour change and one pH value. The pH value must be a whole number.

Expected response:

Colour: blue to dark blue

pH value: 8 to 10

conclusion: alkaline/ basic

Question 2

In this question candidates were investigating the density of glass using a glass block.
A spring was hang on a retort stand by the supervisor.

(a) (i) Candidates had to read and record the position of the bottom of the spring, X_0, on the metre rule.

Some responses were unrealistic such as 450 metres, as a result the two marks on offer were lost.

This question was fairly well done as quite a number of candidates gave values within the range of the reading given by the supervisor and the expected units were centimetres/ correct conversion to mm or m.

(ii) Candidates hung the glass block vertically on the spring using a string and recorded the new position of the bottom of the spring, X_1.

Quite a number of candidates read from the wrong scale of the metre rule and obtained values of X_1 smaller than X_0.

Expected response: *a value of X_1 greater than X_0.*

(iii) In this part of the question candidates were asked to calculate the extension, e_1, on the spring using the equation, $e_1 = X_1 – X_0$.
Some candidates lost the two marks on offer as they subtracted X_1 from X_0.

Other candidates earned 1 mark out of the 2 marks on offer as their e_1 was negative.

Expected response: *a correct substitution of X_1 and X_0 and a correct value (correct difference from candidates values).*

(b) Candidates gently raised a beaker containing 200 cm^3 water under the glass block, until the glass block was totally submerged.

(i) Candidates read and recorded the new position of the bottom of the spring, X_2.

This part of the question was generally well done by candidates as they were able to get a value of X_2 less than that of their X_1.

Some candidates lost the mark as they gave the value of X_2 as 200 cm^3 which was the volume of water in the beaker.

(ii) Candidates had to calculate the extension, e_2, on the spring using the equation;
$e_2 = X_2 – X_0$

This part of the question was generally well done except for some candidates who subtracted X_1 instead of X_0 from X_2.

Some candidates earned only 1 mark out of 2 as the value of their extension was negative.

One mark was for correct substitution and the second mark for correct value.

(c) In this part of the question candidates were asked to calculate density, ρ, of the material that makes up the glass block using the formula $\rho = \frac{e1\rho w}{(e1-e2)}$

Quite a number of candidates earned 2 marks out of 3 marks on offer. They lost the mark for not writing their answer to 3 significant figures.

A few candidates lacked calculator skills and did not insert brackets in their denominator hence had a wrong value of density. Others left the question unanswered.

(d) **(i)** Candidates were asked to describe how they avoided parallax error when taking the reading from the metre rule.

Some of the common wrong responses included ’place metre rule on flat surface’,’ metre rule must be straight’. Other candidates tried to describe how they used a 30 cm rule to take the correct measurement but they came short due to the language barrier.

Expected response: *view or take reading perpendicular or straight in front of metre rule.*

(ii) Candidates were asked to state any other precautions they took before taking the readings.

Some candidates were not familiar with the name of the retort stand and wrote phrases such as place iron stick on flat surface.

This part of the question was not well done as most candidates described the error of parallax. Some of the expected response included apparatus should be placed on a flat surface/ glass block must not touch bottom of beaker/ metre rule in vertical position.

(e) The glass block was replaced with another glass block of the same material and mass but thinner and longer.

This block was not completely submerged in the water.

Candidates were asked to state and explain whether;

(i) the value calculated for e_2 would be greater, smaller or equal to that obtained in **(b)(ii)**.

This part of the question was poorly done as quite a number of candidates did not attempt the question. Those who did attempt it, answered only the first part and did not give any explanation.

Expected response:

value of e_2 greater
explanation – less force exerted by the water on the block/ less upward force/ less upthrust force.

(ii) the value calculated for density, ρ, would be greater, smaller or equal to that calculated in **(c).**

This part of the question was poorly done as most candidates could not explain why the density would be greater. Most candidates seemed to be guessing.

Expected response:
value of density would be greater
explanation – the value of denominator/divisor is smaller.

(f) Candidates were asked to replace beaker **A** with beaker **B** containing 200 cm^3 of cooking oil in the set-up.

(i) Candidates gently raised beaker **B** under the glass block until the block was totally submerged.
Candidates had to read and record the reading on the metre rule.
Some candidates gave unrealistic values, that is, values that could not be measured by the metre rule as they were greater than the range of a metre rule.
Expected response: *was a value less than X_2.*

(ii) Candidates were asked to explain why the value in **(f)(ii)** is different from that in **(b)(i)**.

Some of the wrong responses included oil is denser than water/liquid **B** is lighter.

The expected response was that liquid **B** is less dense because less force pushing block upwards/ smaller upthrust force.

EGCSE PHYSICAL SCIENCE

Paper 6888/04

Alternative to Practical Test

General Comments

The Alternative to Practical Paper assesses the attainment of investigative skills by the candidates. It is marked out of 40 marks and consists of one Chemistry and one Physics question. The paper is premised on the assumption that experiments are conducted during teaching and learning to develop the investigative skills of the candidates.

The paper accounts for a 20% weighting to the overall mark of the candidates as per the syllabus stipulation. The number of entries was quite low relative to the previous year at about 7000. The time allocated for the paper seemed to be adequate as there was no evidence of big numbers of candidates failing to finish the paper.

The performance of the candidates was generally better relative to the previous year. Even though there was no candidate who obtained 80% in the component, most candidates were able to earn marks around the 50% mark which was an improvement to the mean mark of the previous year. There were significantly fewer candidates who obtained marks below 25% relative to the other years and markedly fewer zero marks were recorded this year.

The candidates generally performed well in the Physics question. They had challenges with the Chemistry question with only a few centres doing well in that question. The perennial challenge of candidates having challenges with expressing their responses in English was quite evident even in this session. However, an effort was made to accommodate such candidates in congruence with the advice from the Cambridge instructions which categorize these candidates as ‘second or third English language speakers.’

Responses to specific questions

Question 1

(a) (i) This was a simple recall kind of question requiring candidates to state the colour of anhydrous cobalt(II) chloride powder. Most candidates were able to get the correct answer of blue. Some lost the mark for giving shades of blue such as pale blue or dark blue. There were those who came up with Universal Indicator colours like yellow, red or purple. The most common wrong response was ‘white’ which is the colour for anhydrous copper(II) sulfate. Some candidates gave ‘pink’ as the response and lost the mark since that is the colour for the positive test for water using cobalt(II) chloride.

(ii) This part was most accessible to most candidates. Candidates were required to state conclusions based on the colour obtained in the three test-tubes **A**, **B** and **C**. They were expected to use the words: presence or absence of water. Most candidates were able to note that the changing of anhydrous cobalt(II) chloride to pink meant water was present in all the three liquids **A**, **B** and **C**. However, some candidates seemed not to understand the question and gave responses about the water being pure and its effect on litmus paper. Others wrote alkaline for liquid **A**, neutral for liquid **B** and acidic for liquid **C**. Other candidates wrote colour change for all three test-tubes without concluding what the colour change meant.

(b) This question was quite challenging to most candidates. Only a few candidates managed to score all the three marks allocated for this question. Candidates were required to describe an experiment they could carry out to test if liquid **A** was a pure substance. They had more than one option on this item. For the first mark candidates were to mention heating of liquid in a named container using a named heat source. Most candidates failed to name the container and heat source thus losing the mark. The second mark was earned through showing that they would measure the temperature of the liquid which most candidates showed and the last mark was for specifying that a pure substance would have a constant or fixed boiling point and an impure substance would have a range of boiling points or just compare the boiling point to known boiling points. Description using a heating curve was acceptable.

Another option was measuring the mass of the liquid using a named balance and volume using a named instrument for the first mark. They could then calculate density of the substance to earn the second mark and the last mark was for comparing the density to known densities. It was indeed a few candidates that used this option.

Most candidates opted to use chromatography to test for purity.

On this option, candidates were required to mention placing of spot of liquid **A** on an adsorbent medium above a named solvent. Use of suitable solvent and adsorbing medium earned the candidates the first mark. Most candidates lost this mark because they only mentioned one or two of the above mentioned items. Since the liquids in the question were not coloured, candidates were expected to mention the use of a locating agent to earn the second mark. Only a few candidates were able to score the second mark. Lastly candidates were to mention that a pure substance would produce one spot on the adsorbing medium and an impure substance would separate to more than one spot. Most candidates were giving the general test for the purity of water yet the question required a test for determining the purity of any substance. A number of candidates seemed to show the common misconception that neutrality and purity was the same thing as observed by candidates answering in terms of pH tests. They seemed to think that if a substance is neutral, then it is pure.

Some candidates stated that the liquid could be evaporated by heating; they seemed to think that a pure liquid could be completely evaporated, leaving nothing behind, otherwise it was impure. A few candidates got the question wrong as they stated the use of anhydrous copper(II) sulfate which would change to a blue colour when added to a pure liquid.

(c) **(i)** In this question, candidates had to state the test the student was carrying out in Experiment 1. Most candidates were able to state that the test being carried out in Experiment 1 was a test for the hardness of water and were hence able to earn the mark. Others however, lost this mark because they stated that the test was for the hardness of a liquid which did not earn them the mark. Others lost the mark because they thought the test was for temporary or permanent hardness of water. A number of candidates failed to realise that it was a test for water hardness and then had challenges even in the subsequent questions.

(ii) Candidates were required to suggest a reason for using different stirring rods in the three test-tubes in Experiment 1. The expected response was avoiding cross contamination of the liquids, which a number of candidates were able to state correctly. A lot of candidates lost this mark for simply stating that the reason was to avoid mixing the liquids. They lost the mark as they failed to qualify the mixing by stating its effect or consequence thereby rendering their response incomplete. Others lost the mark for stating that the reason was for obtaining reliable or accurate results which was not acceptable.

(iii) Candidates were expected to suggest another variable that must be kept constant as the reaction proceeded. The expected response was temperature. However, an allowance was made for the amount of washing powder. A number of candidates were able to score the mark. Some candidates lost the mark for wrongly stating the variable as concentration or volume of washing powder. Others stated the variable as the size of the test-tubes used, time taken or mass of the liquid, for which they were penalised.

(d) **(i)** Candidates were required to give an observation that would be made in liquid **A** in Experiment 2. The expected response was that lather formed readily. Candidates were able to score this mark with a number of candidates losing the mark for stating the observation as scum forms, lather forms after sometime.

(ii) This question was one of the most challenging to candidates. Candidates were required to explain the change in lather formation observed in test-tube **B** in Experiment 2. The expected response needed candidates to understand that test-tube

B contained a liquid with temporary hardness and that boiling removed the hardness, hence making the liquid soft. Most candidates lost marks by not mentioning that the liquid was temporarily hard but instead just mentioned the removal of hardness by boiling thereby losing one pf the marks. Other candidates lost even the second mark because they failed to state that the hardness of the liquid was removed but instead referred to hardness being reduced which was quite unacceptable. Others gave the idea that boiling increased lather formation due to heat increasing the rate of reaction or the kinetic energy of particles causing the washing powder to dissolve faster. Some were of the idea that heating removed germs or impurities allowing the lather to form faster. There were others that said that the heat provided optimum temperature for enzymes to work and lost the mark.

(iii) This question was quite accessible to the candidates as most were able to state the formation of bubbles as an observation made when heating test-tube as required by the question. Other expected responses were white precipitate, white layer or suspension as an observation. The mark was awarded only when candidates demonstrated an understanding that the colour of whatever substance formed was white. Wrong responses included the formation of scum or lather after some time, boiling increased temperature, decrease in volume as liquid evaporates, the colour of the changes to white, production of a gas, lime scale being formed, kettle scale formed, to name but a few.

(e) **(i)** This was question was fairly well attempted by the candidates. Candidates were expected to complete a table which had other options in the table. Candidates were able to easily pick up any response from the table and correctly suggested that lather formed readily because addition of washing soda removed hardness. Some candidates lost this mark by giving responses such as lather forms after some time, scum forms and lather forms slowly.

(ii) This question was quite challenging to most of the candidates as they seemed not to understand what was expected of them. Candidates were expected to state the procedure responsible for the observation in test-tube **C** in experiment 3. The expected responses were ion exchange/displacement of ions (calcium or magnesium ions) and ionic precipitation. Common wrong responses included addition of sodium carbonate and removal of hardness from water. Ionic precipitation was also accepted as a correct response.

(iii) This question also seemed to be quite challenging to almost all the candidates. They were expected to suggest a name of the anion that caused the observations in liquid **B** in Experiment 3. The correct response was hydrogen carbonate (HCO_3^-). Most candidates lost this mark by referring to the ion as carbonate ion $(CO_3)^{2-}$. A majority of the candidates seemed not to understand what is meant by the term anion as they gave cations whilst others stated the name as sodium carbonate. That is why even if they correctly worked out the presence of the hydrogen carbonate anion, they would spoil their response by adding a cation thereby giving a complete compound instead of the anion only. Other common wrong responses included anode, chloride, sulfate, calcium hydrogen carbonate and the carbon ion, to name but a few.

(iv) Candidates also had quite some difficulty attempting this question. They were expected to state the name of a cation that caused the observations in liquid **C** in Experiment 3 as given in the table. Even in this question, the candidates seemed to fail to distinguish between an anion and a cation which was critical in competently attempting the question. There were a few candidates that correctly named the cation that caused the changes observed as the calcium or magnesium ion. Formulae of the ions were accepted even though some candidates correctly wrote the ions using words and then wrote wrong formulae which made them lose the mark. A lot of candidates stated the cation as sodium or sodium carbonate and lost the mark. Another common wrong response was the cathode.

(f) **(i)** Candidates were required to describe how they would test the pH of the washing powder. The expected response was that they would add a few drops of Universal Indicator to earn the first mark. They then had to explain that the colour formed had to be matched against the pH chart to get the pH value of the solution to earn the second mark. Candidates were also expected to appreciate that the washing powder had to be dissolved first even though failure to state same did not incur any penalties.

Most candidates lost the first mark by their failure to adhere to the basic demand of the command word 'describe'. They had to clearly show that it was a few drops of indicator that were added or a relatively small volume, not just that Universal Indicator was used. Failure to quantify the amount of Universal Indicator used resulted in loss of the first mark. Some candidates lost the second mark for stating a chart, indicator chart, colour chart, colour table instead of the pH chart or pH scale. A significant number of candidates answered using litmus paper and lost both marks.

(ii) Candidates were given the observation that the indicator turned blue when added to the washing powder. They had to suggest the pH value and state whether the solution was acidic, neutral or alkaline which was a conclusion of the results observed. The expected pH value of the washing powder was between 8 and 10 with the pH being alkaline. A lot of candidates were able to get full marks by stating the pH value as 8. A number of candidates however, lost all the marks after mixing up the pH value and the pH. Others lost all marks by suggesting that the pH was neutral with a pH value of 7. A number of candidates would write pH values less than 7 but then give the pH as alkaline thereby earning only the second mark.

Question 2

(a) **(i)** Candidates were supposed to read and record the reading X_o, shown on the metre ruler in this question. It was generally well done with most candidates reading X_o as 50.4 cm to earn the two marks on offer with the second mark for units. Some candidates, however, lost the second mark either by omitting the units or using wrong units, mainly the metre and millimetres. The correct units in the context of the question were centimetres. Those who wrote millimetres and metres had to clearly demonstrate that they had read and converted their values to the unit in order to earn the mark otherwise these units were not acceptable. Other candidates somehow decided to subtract the length of the spring from 50.4 cm and lost the mark. There were those who could not appreciate that the metre rule was cut roughly between 50-57 cm but instead thought it was 5.0 cm, hence got common wrong answers such as 5.04 cm, 5.04 m and 5.4 m.

(ii) Candidates were expected to read and record the new position of the bottom of the spring X_1 in this question. This question was also accessible to most candidates as most of them were able to correctly record the value as 55.9 cm. The problem observed in the previous question of subtracting from 55.9 cm obtained even in this question. The most common wrong response was 5.59 cm. A few candidates just counted the divisions from 51 cm up to the position of X_1 and came up with 4.9 cm which did not earn any mark. Other wrong responses included 5.49 cm, 4.5 cm or 4.9 cm.

(iii) This question required candidates to calculate the extension, e_1 on the spring using the equation $e_1=X_1-X_o$. This question was also quite accessible to the candidates as most of them were able to obtain the correct value of 5.5 cm and earn both marks.
Some candidates obtained negative extensions from their values and lost the second mark since extension cannot be negative. Some substituted wrongly and obtained

incorrect values which made them lose some or all the marks. There were those who decided to calculate without using a calculator and thereby enhancing their chances of making errors and possible loss of marks.

(b) **(i)** The candidates performed quite well in this question wherein they were expected to read and record the new position of the bottom of the spring, X_2. Most candidates were able to correctly record the position as 54.9 cm. There were a few candidates who did not realise that the ruler was continuous and counted from the values that are shown. This made them to obtain 5.49 cm which was unacceptable. Other common wrong responses included 5.9 cm, 4.9 cm and 0.49 cm.

(ii) Candidates were required to suggest an improvement in the experiment to increase the accuracy of the value of X_2. They had to state that one had to repeat the experiment and then calculate the average. This question was very challenging to the candidates as most of them were aware that they had to repeat the experiment but then neglected to make reference to the average, hence providing an incomplete response. A number of candidates assumed that the question was on precautions instead of accuracy and gave irrelevant responses. Some common wrong responses included but were not limited to: put the apparatus on a flat surface, avoid error of parallax, use different liquids, increase the volume of the water, and take reading at eye level.

(iii) Candidates were expected to calculate the extension, e_2, on the spring using the equation $e_2=X_2-X_o$. This question was quite accessible to the candidates as most of them were able to write the correct value as 4.5 cm. Most of them were able to earn all the marks by correctly substituting their values of X_2 and X_o and calculating the extension using their values for **2(a)(i)** and **2(b)(i)**. There were some candidates who elected to subtract X_2 from X_o instead of the other way round and thus lost the both marks. There were those who obtained negative extensions even here and lost one or both marks.

(c) Candidates were expected to calculate the density of the glass block Q using the equation $p = \frac{e_1 p_w}{e_1 - e_2}$. They were given the density of water. They were e4xpected to substitute into the equation like this: $p = \frac{5.5 \, x \, 1.0}{5,5-4.5}$ and this was expected to give them 5.5g/cm^3 as the correct response.

This question was generally well done with most candidates scoring full marks. Some candidates lost the second mark by omitting to put brackets on the denominator when using a calculator. They ended up getting -3.5 g/cm^3 as their density which was unacceptable. Some candidates would substitute with values X_1(55.9) and X_2(54.9) instead of e_1 and e_2 and lost both marks. Others would substitute correctly with the wrong values they obtained in **(a)(iii)** and **(b)(iii)** and then come up with negative density and lost one of the marks. Others would use p_w as10 g/cm^3 instead of 1.0 g/cm^3 given in the question, resulting in a wrong answer which made them lose both marks.

(d) **(i)** This question required candidates to describe how the error of parallax would be avoided when taking the reading from the ruler. This question proved to be quite challenging to the candidates as it was not just general but specific to an instrument. Most candidates failed to correctly state that the error is avoided by taking the reading perpendicular or directly straight in front of the reading. A number of candidates seemed to lack the concept of error of parallax confusing it with other precautions when taking the reading. Common wrong responses were: put the ruler on a flat surface, place apparatus on a flat surface, take reading parallel to the ruler, block must not be moving, be horizontal to the reading, standing near the experiment, standing in front of the experiment, look straight to the ruler, eyes should be directly above the ruler. Other candidates were mentioning precautions that are taken when reading the volume of a liquid from a measuring cylinder such as reading at the bottom of the meniscus. Others mentioned that the reading must be taken from the zero mark of the ruler which was also incorrect,

(ii) The candidates fairly well attempted this question which expected them to state any other precaution the student took before taking the reading. A number of responses earned them marks such as: the apparatus had to be placed on a flat surface, the block was not supposed to touch the bottom of the beaker, the metre rule had to be in a vertical position, and the spring had to be stationary. Most candidates seemed to mix up **2(d)(i)** and **2(d)(ii)**. Some referred to the beaker or ruler being placed on a flat surface instead of the whole apparatus. Some candidates decided to make reference to the error of parallax which had been assessed in the previous sub-question and lost the mark. Others made reference to a string instead of the spring shown and also got punished. Some common wrong responses were: repeat the experiment, read below the meniscus, there must be no movement, to name but a few.

(e) **(i)** Candidates were expected to state and explain whether, the value expected for e_2 would be greater, smaller or equal to that obtained in **(b)(iii)** in this question. The expected response was that e_2 was greater which earned the first mark. To earn the second mark, candidates had to explain that the downward force was more than the upward force. This question was a bit challenging to most candidates. A number of them were able to earn the first mark but could not give a plausible explanation for the statement. A significant number of candidates were not able to attempt the explanation while some had some slight challenges of explaining using English. The explanation part was either blank or candidates just repeated the question. There were those candidates who thought the value of e_2 would be greater because the block was not fully submerged which was incorrect. Most candidates seemed not to realise that their explanation had to be based on the concept of forces which did not predispose them to answering the question competently. Common wrong answers were that the centre of mass was higher, the glass block was longer, and the mass of the block was the same hence e_2 was equal.

(ii) Candidates were required to state and explain whether the value calculated for density, p, would be greater, smaller or equal to that calculated in **(c)**. Candidates were supposed to use their mathematical skills to note that if e_2 in **2(e)(i)** was greater, the difference between e_1 and e_2 would be smaller, thus dividing by a smaller number which would give a greater value of the density. This question also proved to be challenging to the candidates and those who were able to score one mark seemed to have guessed that the density would be greater. Other candidates had misconceptions that when inserting the blocks, an equal amount of water would be displaced, hence resulting in equal volumes of the two blocks. This would imply that the density was equal which was incorrect. Even here, candidates seemed to have challenges with giving an explanation as it brought the language challenges to the fore.

(f) **(i)** This question required candidates to read and record the position of the bottom of the spring, X_3. The expected response was X_3= 55.2 cm. This question was generally well done. A few candidates did not realise even here that a full metre rule was shown and counted only the visible length. There were those who subtracted the initial value that appeared on the rule from the position and also lost the mark. Some common wrong answers were 5.52 and 56.8 cm.

(ii) Candidates were required to explain why the reading in **(f)(i)** was different from the reading in **(b)(i)**. This question was divided into two parts. The candidates had to understand that oil was less dense than water and also that if a liquid was less dense it

would have a smaller opposing force. This question was challenging to most candidates, especially the second part. For the first part most candidates were able to state that oil was less dense than water even though some candidates were stating that the liquids have different densities without specifying which one was denser.

Other common errors with respect to the first mark were that water was less dense than oil, oil was less dense than the glass block, cooking oil was thicker than water or that cooking oil was heavier than water. For the second mark, most candidates failed to earn this mark since they thought that oil acted as a lubricant thereby making the block to slide easily. Some candidates gave their response in terms of weight which made them to lose this mark since the masses of the blocks were the same. Most candidates attempted the question poorly because of failure to realise that their explanation had to be in terms of forces.