EXAMINATIONS COUNCIL OF ESWATINI

EGCSE

EXAMINATION REPORT

FOR

PHYSICAL SCIENCE (6888)

YEAR

2021

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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 14518.

This reflected a significant increase 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. Twenty candidates scored zero even though they had attempted most of the questions.

Questions that were more challenging to most candidates were Questions **4, 5(a), 9(a), 11, 12, 15** and **17**. Question **9** and **11** proved to be most inaccessible questions because only a few candidates got full marks. Questions that were more accessible to most candidates were **1** and **14**.

Comments on Specific Questions

Question 1.

This question was one of the most accessible questions to candidates. Candidates were asked to state the SI base unit for current.

The expected response was: Ampere/amps/A.

Some common wrong responses; ampires, ampes, I, circuit symbol for ammeter, Ω, ohms.

Question 2

Candidates were given a diagram showing an underground tank that is fitted with blocks of element **A** to provide sacrificial protection against rusting.

(a) This question was accessible to most candidates. Candidates were required to state the name of the element suitable for use a block A, with a reason.

Expected correct answer was: Name: zinc

Common wrong response: cement, aluminium, copper

Reason : zinc is more reactive than iron / reacts with water (and oxygen) instead of iron.

Common wrong responses: zinc forms an oxide layer, zinc does not rust, zinc is high in the reactivity series.

(b) This part was accessible to most candidates. Candidates were required to name another method of rust prevention.

Expected correct response was: painting/ greasing/ oiling/ electroplating/ galvanizing.

Common wrong responses: coating, lubricating and wrong spelling such as gulvanising, gressing, greecing, grising.

Question 3

Candidates were given a figure showing different regions of the electromagnetic spectrum.

(a) This part was generally accessible to most candidates. Candidates were required to name the region labelled B in the figure.

The expected correct response was: infrared radiation.

Common wrong responses were: infrared light, infra radiation, TV waves and infa red.

(b) Candidates were required to state two features common to all members of the electromagnetic spectrum.

The expected response: travel through a vacuum or space/ are transverse waves/ transfer energy from one place to another/ all obey the wave equation ($v = f \lambda$)/ all travel at the same speed of (3 x 10^8 m/s) in a vacuum.

Common wrong responses: produce heat, use energy, travel at speed of light, require a medium, causes cancer, used in medicine. Others did not state that they travel through a vacuum.

Question 4

Candidates were given a graph showing the energy changes that occurred during a neutralization of hydrochloric acid, HCl by sodium hydroxide, NaOH.

(a) This question was inaccessible to most candidates. Candidates were required to explain why arrow 1 in the graph represents an endothermic process.

The expected correct response was: bond breaking requires energy absorption/ energy increase in diagram.

Common wrong responses: energy needed split elements instead of compounds, energy consumed, reaction change increases, heat breaks bonds in reactants to form products, reaction accelerates, temperature is at constant speed.

(b) Most candidates managed to get this question correct. Candidates were required to explain why the overall reaction is exothermic.

The expected response was: the energy of products is less than the energy of reactants/ net energy loss/ energy given off to the environment.

Common wrong responses were: temperature decreases, reaction decreases, water is formed.

Question 5

Candidates were told that passengers in a moving car move forward when brakes are suddenly applied.

(a) This part of the question was inaccessible to most candidates. Candidates were required to state the property of mass that is demonstrated by the forward movement of the passengers as the brakes are applied.

The expected correct response: inertia

Common wrong responses: mass, stability, centre of mass, force of friction

Common wrong spelling: inesia, inecia, initia, enertia.

(b) This part of the question was inaccessible to most candidates. Candidates were told that brakes are able to stop the car due to the presence of the force of friction. They were required to describe the force of friction.

The expected correct response: force that opposes relative motion between two surfaces sliding against each other.

Common wrong responses: pull or push or twist, force of gravity, force between two substances, force opposing direction, opposing motion.

Question 6

This question was inaccessible to most candidates.

Candidates were given a diagram showing the apparatus used to measure the energy released during combustion of a peanut. The table below shows the results.

Mass of water/g	Initial temperature/^{0}C	final temperature/^{0}C
5	24	42

They were asked to use the formula $q = mc \triangle T$, to calculate the amount of energy used to raise the temperature of the water from 24^{0}C to 42^{0}C. (specific heat capacity of water was given as 4.2 J/g/^{0}C.

The expected correct answer was: $\triangle T = 18\ ^0$C

$$q = 5 \times 4.2 \times 18$$

378 J

Common wrong responses were: 18 J, 90J, $4.2 \times 24 \times 5$, $4.2 \times 42 \times 5$.

Question 7

This question was accessible. Candidates were given a strontium nucleus, $^{90}_{38}Sr$, that decays by alpha emission. Candidates were requested to complete the following nuclear equation to show this decay.

$^{90}_{38}Sr$ ⟶ …… + ……

Expected correct response was: $^{86}_{36}Kr$ + $^{4}_{2}He$.

Common wrong responses were $^{86}_{36}Sr$, $^{90}_{36}Kr$, $^{84}_{36}Kr$, $^{4}_{2}H$, $^{4}_{2}a$.

Question 8

Candidates were given a diagram of an electrolytic cell used to extract aluminium from its ore.

(a) this part of the question was generally accessible to most candidates. They were required to suggest the name of waste gas C produced from the cell.

Expected correct response was: carbon dioxide/ oxygen

Common wrong responses: carbon monoxide, hydrogen, CO_2

(b) This part of the question was challenging to most candidates. They were required to explain why aluminium is used in the manufacture of food containers.

Expected response: less corrosion/ it does not react with the contents/ low density Common wrong responses: aluminium does not rust, good conductor of heat, does not react with water, light in weight.

Question 9

Candidates were given a diagram showing an a.c. motor.

(a) This part of the question was inaccessible to most candidates. Candidates were required to explain why the coil in the magnetic field experiences a turning effect when current flows through it.

Expected response: magnetic field due to magnets interacts with magnetic field due to the current on both sides of the coil producing forces which are equal but opposite/ current in the two parallel sides of the coil flows in different directions so the forces will be in opposite directions causing a turning effect.

Common wrong responses: electromagnetic induction, electric force, induced current, coil has an electric field, attraction of coils.

(b) This part of the question was accessible. Candidates were required to state one way by which the speed of rotation of the motor can be reduced.

The correct response was: decrease the amount of current in the coil/ reduce the number of turns in the coil/ use a weaker magnet.

Common wrong responses: use a weak magnet, reduce number of coils, reduce circuit, remove slip rings, reduce external circuit, reduce number of cells.

Question 10

This question was inaccessible to most candidates. Candidates were given two equations, one showing the reaction of zinc oxide with hydrochloric acid to form zinc chloride and water then the other showing the reaction of zinc oxide with sodium hydroxide to form sodium zincate. They were required to explain using the information given why zinc oxide is amphoteric.

Expected correct response was: zinc oxide neutralizes an acid showing a basic behavior and zinc oxide neutralizes sodium hydroxide showing acidic behavior.

Most candidates did not use the given information. Instead they were defining an amphoteric oxide without referring to behaviour of zinc oxide.

Common wrong responses: zinc neutralises both acids and bases, zinc oxide reacts with acidic oxide and basic oxide, zinc loses electrons.

Question 11

This question was the most challenging. Candidates were given a diagram showing water coming out of an irrigation sprinkler. They were required to explain why the water spreads out as it comes of the sprinkler.

Expected correct response: water particles receive same charge and like charges repel/ droplets leave sprinkler with a range of speeds and they follow different paths or trajectories.

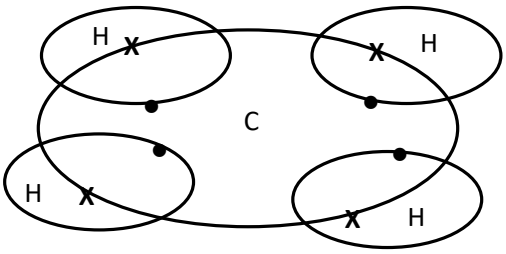
Common wrong responses: water has high pressure, sprinkler openings are small, sprinkler has smaller surface area.

Question 12

Candidates were given the molecular formula of methane, CH_4, which is the main constituent of natural gas.

(a) This part of the question was accessible. Candidates were required to draw the dot and cross diagram for a methane molecule.

Expected correct response was:



Common wrong responses: drawing for ionic bonding, unstable shells, no labels, ethane structure

(b) This part of the question was accessible to most candidates. Candidates were required to draw a diagram showing arrangement of methane molecules at room temperature and pressure.

Expected correct response was: At least three congruent molecules, far apart and filling up the box.

Common wrong responses were wrong molecules for methane, crosses and dots, ionic bonding.

Question 13

Candidates were given a diagram showing a bar magnet, E, placed opposite an iron bar, F. They were told that the magnet attracts the iron bar.

(a) This part of the question was accessible to most candidates. Candidates were required to state the process that makes the iron bar to be attracted by the magnet, E.

Expected correct response was: magnetic induction

Common wrong responses were: electromagnetic induction, magnetization, oxygen, helium and hydrogen.

(b) This part was also accessible to most candidates though a reasonable number did not attempt the question. Candidates were asked to indicate on the figure the poles of the iron bar F.

Expected correct response was:

S	N

Common wrong responses were wrong pattern of magnetic field lines.

Question 14

Candidates were given a diagram showing fractional distillation apparatus.

(a) This part of the question was the most accessible to most candidates. They were required to identify the part of the diagram where a liquid and a gas exist together.

Expected correct response: J, the fractionating column

Common wrong responses: H which is the condenser, G which is the thermometer.

(b) This part of the question was easily accessible. Almost all candidates who attempted this question scored a mark. They were required to identify the part that contains a pure substance.

Expected correct response was H which is the condenser/ I which is the beaker

Common wrong response was J which is the fractionating column.

Question 15

This the question was inaccessible to most candidates. Candidates were given a diagram of a micrometer screw gauge. They were required to explain why the jaws of the micrometer screw gauge should be kept slightly apart when stored.

Expected correct response was: Gap allows for expansion of jaws.

Common wrong response were prevents expansion, rusting and corrosion.

Question 16

This question was inaccessible to most candidates. Candidates were required to state the chemical name of the white crust that is formed on the heating element of a kettle used to boil temporary hard water over a long period.

Expected correct response: Calcium carbonate/magnesium carbonate

Common wrong responses were scum, calcium hydrogen carbonate, limestone and $CaCO_3$.

Question 17

Candidates were given a diagram showing a wave motion on a slinky spring.

(a) This part of the question was inaccessible. Candidates were given to name the region labelled **K**.

Expected correct response was rarefactions.

Common wrong responses were rarefaction, wavelength, compression, depression, wavefront and amplitude.

(b) This part of the question was inaccessible. Candidates were required to explain why sound travels faster in solids than in gases.

Expected correct response: layers of molecules closer in solids than in gases and collisions between molecules faster in solids.

Common wrong response: gas particles loosely packed, scattered, far away, forces of attraction stronger in solids than in gases, solid particles touch.

In general candidates failed to compare the arrangement of particles in solids and gases. They also did not refer to collisions of particles.

EGCSE PHYSICAL SCIENCE

Paper 6888/02

Structured Questions

General Comments

Approximately 15559 candidates registered for this component but for some reasons the number of candidates that sat for the component was approximately 14773. This was an increase of slightly above 3100 candidates compared to the previous year. This increase may have been caused by normal progression in the academic year 2020.

The paper was marked out of a total of 80 marks. Generally, the paper was more difficult compared to the previous years. The highest score was 4 marks less than the previous year's. The scores ranged from 0 to 66. Most of the candidates scored between 05 and 20 marks with a noticeable number of single digit scores (0 – 10). There was a noticeable drop in the number of candidates who scored above 40.

Use of correct symbols in formulae and equations was still a challenge, for example, "M" instead of "m" for metres and "G" instead of "g" for gravitational filed strength. This resulted to loss of marks. Candidates also loss marks for use of wrong scientific terms such as "atoms" instead of "ions".

There was an increase in the number of candidates who left question or part questions unattempted. This might be an indication that candidates ran out of time.

Questions that proved particularly easy for most candidates were: **1(a), 1(c), 2(b), 5(a), 6(b), 7(a), 9(c), and 11(b)** as most candidates were able to score full marks from them.
Questions that proved particularly difficult for most candidates were: **3(b), 4(a), 4(c), 4(d), 5(c), 6(c), 7(c), 8(b), 9(b) (i), (ii) and the whole of Q10** as most candidates failed to obtain marks from these questions.

High order questions where candidates were required to explain or describe were challenging to most candidates.

Comments on Specific Questions

Question 1

(a) This question was well done as most of the candidates were able to score the mark.

Candidates were required to explain why particles **A** and **C** are atoms. The common wrong response was that they are atoms because they are made up of the smallest particle of matter.

The correct response of: *both have equal number of protons and electrons* was common.

(b) This question was fairly done as some candidates were able to score maximum marks while some candidates scored half the allocated marks.

Candidates were required to explain why particles **B** and **D** are oppositely charged ions.

Some common wrong responses included:

- **B** is a metal and **D** is a non-metal.
- **B** has lost an electron and **D** has gained electrons
- The number of protons is not the same.

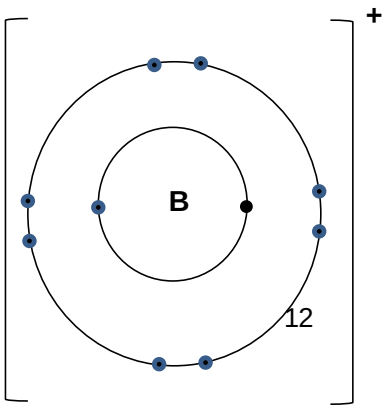
The expected response was: ***B*** *has more protons than electrons while* ***D*** *has more electrons than protons.*

(c) This part question was also well done. The majority of the candidates were able togive the expected response of: *both* ***A*** *and* ***D*** *have the same number of protons but have different number of neutrons.*

(d) This was a fairly well done question. Most candidates were able to score at least 1 mark out of the available 2.

Candidates were required to draw the electronic configuration of ion **B** from the table. Some candidates just wrote the configuration 2, 8 whereas the question had required them to draw and they lost marks. A common wrong response was that of drawing the electronic configuration of particle **B** and they ignored the word 'ion'.

The expected response was:



Question 2

This question was about measurement and calculations of volume and density.

(a) (i) This question was relatively easy but was poorly done as a majority of the candidates could not score the mark.

Candidates were required to state the name of an instrument that could be used to measure the length of the side of a cube of 10.31 mm.

Common wrong responses were: ruler, tape measure and measuring cylinder.

The correct responses was: *micrometer screw gauge or Vernier caliper* were not very common.

(ii) This was a fairly well done question. Candidates were required to calculate the volume of a cube of side 10.31 mm. The majority of the candidates were able to use the relation $v = s^3$ *to get the expected value of 1.1* cm^3. A few candidates who had no clue tried using the formula v = mass/density but got stuck and left it hanging.

Most candidates who lost marks were those that failed to convert 10.31 mm to 1.031 cm before substituting into the formula $v = s^3$. Only a minority of the candidates calculated the volume in mm^3 and then converted to cm^3 correctly.

(iii) This was another fairly well done question as the correct response of $33\ cm^3 - 1.1\ cm^3 = 31.9\ cm^3$ was common.

(b) This question proved to be easy to most candidates. The majority of the candidates were able to recall and use the formula $\rho = m/v$ *to get the correct mass of 1.32 g.* A common challenge was that of making mass, m, the subject of the formula.

Question 3

This question was about the preparation of ammonium nitrate.

(a) (i) This was a fairly well done question. The correct response of *Haber process* was common but there was a challenge of spelling. The most common wrong response was ammonification.

(ii) This was a challenging question to most candidates as they failed to identify fertilizer **F** from the flow diagram. Common wrong responses included: ammonia nitrate, ammonium nitrite and ammonium sulfate.

The expected correct response was: *ammonium nitrate.*

(b) This was one of the most challenging questions to most candidates. The majority of the candidates failed to score a mark from this question.
Candidates were required to describe fractional distillation of liquid air to obtain nitrogen. The most common wrong response was that of describing fractional distillation of liquid mixtures and that of describing the preparation of ammonia instead of nitrogen.
The expected response was: *Put liquid air in fractionating column and warm or heat. Nitrogen boils first at about -196°C and is collected as a gas at the top.*

(c) This question was poorly done. Most candidates failed to give a correct balanced chemical equation for the formation of ammonia in the Haber process.
The most common wrong response was: $H_2 + N_2 \rightarrow HNO_3$
The expected response was: $3H_2 + N_2 \rightarrow 2HNO_3$

(d) This question was also poorly done as most candidates failed to name one use of nitrogen in plant life. A common wrong response was that it provides nutrients for plant growth.
The expected responses was: *synthesis of proteins or cytoplasm, synthesis of amino acids and formation of chlorophyll* were very rare.

Question 4

This question was about air resistance and terminal velocity. The whole of this question was very challenging to most candidates.

(a) This question was very challenging to most candidates and was poorly done. Candidates were given that skydiver 1 opens the parachute before reaching terminal velocity while skydiver 2 opens the parachute upon reaching terminal velocity. Candidates were then required to explain why air resistance is eventually greater in skydiver 2.
Most candidates could not make reference to the velocities of the skydivers. The most common wrong response was that it was because skydiver 2 opened the parachute later. Another common wrong response was that the skydiver opened the parachute and increased the surface area.
The correct response was: *velocity is higher in skydiver 2 so air resistance is also higher because air resistance increases as velocity increases* was very scarce.

(b) This question was also poorly done but was better attempted than **4 (a)**. Candidates were required to state the function of the upward resultant force when the parachute is opened.

Common wrong responses included statements like: to give balance to the skydiver, for safe landing and balancing of forces.

The expected response was: *to reduce the velocity of the diver to a safer value.*

(c) This was another poorly done question as very few candidates were able to score all the marks from it.

Candidates were required to describe how skydiver 2 reaches terminal velocity. Most candidates made reference to spreading of legs and arms to increase surface area. Some were defining terminal velocity in general instead of describing how this skydiver reaches terminal velocity.

The expected response was: as the skydiver falls, *air resistance increases and becomes equal to the weight of the skydiver and the resultant force becomes zero (0).*

(d) This question was also poorly done as the majority of the candidates failed to describe the motion of the skydivers if there is no air resistance. A common unacceptable response was: there will be no opposing force so they will land quicker.

The correct response was*: both would accelerate constantly / uniformly (at 10 m/s^2) until they reach the ground at the same time.*

Question 5

This question was about the decomposition of water by electrolysis.

(a) This was a well done question. The majority of the candidates were able to draw in the symbol of the cell in the diagram of the electrolysis.

The expected cell *was to be drawn with the positive terminal connected to the oxygen gas electrode.*

(b) The question was poorly done as most candidates failed to explain why the water was acidified during electrolysis. Common incorrect response was that it is acidified for ionization of water which was an incomplete answer.

The expected response was: *to increase the water ionisation or to improve the conductivity or to increase the concentration of hydrogen ions.*

(c) This was another challenging questions to most candidates as they failed to describe the reaction that occurs at the cathode. Most candidates lost a mark for not mentioning that it is the hydrogen ions that gain electrons not just hydrogen.

The expected response was: *each hydrogen ion gains an electron to form hydrogen molecules or hydrogen gas.* The half equation: $2H^+ + 2e \rightarrow H_2$ earned full marks but $H^+ + e \rightarrow H$ was not acceptable.

(d) This question was well done. Most candidates were able state that platinum electrodes are used because they are *unreactive or inert*. Candidates lost a mark for writing: platinum is less reactive.

Question 6

This question was on moments.

(a) This was a simple recall question but most candidates did not score the mark, hence, it was a poorly done question. Candidates were required to state the meaning of centre of mass. A common unaccepted response was that it where an object balances. Other common wrong responses included: position where all the mass is more concentrated, point where all the mass is centred, point where all the mass is balanced.
The expected response was: *a point on an object where its mass seems to be concentrated.*

(b) This question was well done as both marks were accessible to most candidates. Most candidates were able to recall and use the relation $W = mg$ and came up with the correct answer of *10 000 N.* A few candidates used 5000 kg instead of 1000 kg and they lost both marks since the formula plus correct substitution was worth 1 mark.

(c) This part question was poorly done as most candidates were only able to score the mark for units. Most candidates did not realise that they had to calculate the moment of the 5000 kg mass and the moment of the weight of the horizontal beam and find the sum of the moments, instead they added the 5000 kg and the 1000 kg and multiplied by 6 m. Some used the 5000 kg only.
The expected response was: *clockwise moment = (10 000 x 2) + (50 000 x 6)*
= 320 000 Nm

(d) This was another challenging question to the majority of the candidates as the correct response of: *mass **F** was at a shorter distance than both the centre of mass of the horizontal beam and the 5 000 kg mass, so to balance the moments mass **F** has to be larger.*

Question 7

(a) A very well done question. Correct characteristics of magnesium that show it is a metal were very common, especially physical properties.

The expected responses were: *ductile/ malleable/ good conductor of heat and electricity*.

The chemical property that magnesium *reacts with acids to form a salt and hydrogen* was also acceptable.

(b) **(i)** This question was fairly well done as the expected responses of *$FeSO_4$ and no reaction* was common. A common challenge was that of writing the correct formulae for iron (II) sulfate.

(ii) This question was fairly done. The correct response was common but there were numerous common wrong responses like chemical reaction, oxidation, reduction, endothermic reaction and exothermic reaction.

The expected response was: *displacement reaction*.

(c) **(i)** This was a challenging question to most candidates as they failed to explain reduction, in terms of electron transfer, using the given equation:

$Mg(s) + CuSO_4(aq) \rightarrow MgSO_4(aq) + Cu(s)$

Most candidates simply interpreted the given chemical equation in words. A common wrong response was that copper sulfate is reduced to copper metal.

The expected response was: *copper ions gain 2 electrons to form copper atoms.*

(ii) This was a fairly well done question. Most candidates were able to score maximum marks from this question. Candidates were required to calculate the number of moles in 16 g of copper (II) sulfate. A common wrong response was 112g for the molar mass of copper (II) sulfate. Candidates also lost a mark for omitting the unit, moles, or for writing a wrong unit. A common wrong unit was: g/mol.

The expected response was: *$n(CuSO_4) = 16/160 = 0.1$ moles.*

(iii) This part question was poorly done. It was one of the most challenging questions to most candidates. Candidates were required to use the chemical equation in **(c)(i)** to show that copper (II) sulfate is the limiting reagent. Only a few candidates had an idea of what a limiting reagent is.

The expected response was: *1 mole $CuSO_4$: 1 mole Mg, therefore 0.2 moles Mg should react with 0.2 moles $CuSO_4$. There is 0.1moles $CuSO_4$ and copper sulfate gets used up first thereby limiting the reaction.*

(d) This question was well done. Both marks were accessible to most candidates. Candidates were required to calculate the percentage composition of copper in copper (II) sulfate, $CuSO_4$. A common wrong calculation was $\frac{16}{160}\ x\ 100\%$ = 10%

The expected response was: $\frac{64}{160}\ x\ 100\%$ = *40%*

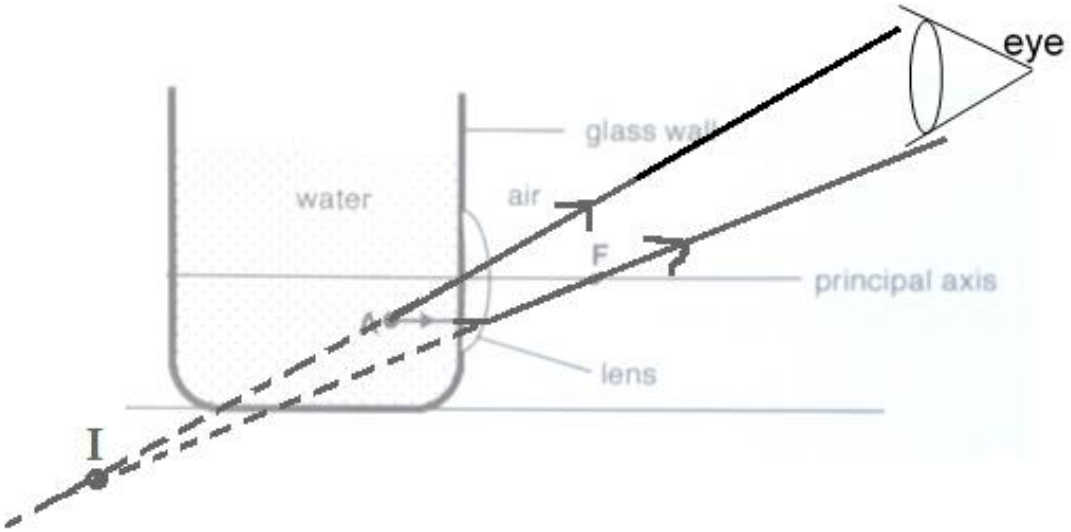
Question 8

This was another very challenging question to most candidates. A noticeable number of the candidates did not attempt this question.

(a) This part question was fairly done. Although the correct response was not common but a noticeable number of candidates was able to score 2 or more marks from the available 3. Probably candidates were confused by the 3 different mediums; water, lens and air. Some candidates did not complete the given ray instead they drew their own ray.
The expected response was: *ray goes straight without bending inside the lens, then it refracts/bends away from the normal at the edge of the lens and pass through **F**.*

(b) This part question was poorly done as most candidates got it wrong and some did not even attempt it. Again, some candidates just drew a line from nowhere instead of drawing it from the point **A**.
The expected response was: *a ray drawn from **A** passing through the centre of the lens. Then both rays extended to meet. The point of intersection is the image point, I.*

(c) This was another very challenging question to most candidates especially because **(a)** and **(b)** should be correct for candidates to be able to draw a correct position of the eye which will enable the student to see the image constructed in **(b).**
The expected response was: that *the eye should be in the air on the right of the lens above the principal axis with rays entering the eye.*



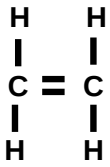
Question 9

This question was about the formation of polymers from monomers by the process of polymerization.

(a) This question was poorly done. Most candidates were not able to score the maximum marks of 2 from this question. A noticeable number of the candidates did not attempt it. There is no clear evidence whether this was due to lack of time or because it was not covered in class.

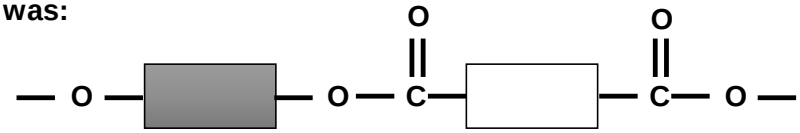
Candidates were required to draw a structural formula of a monomer from a given polymer.

The expected response was:



(b) **(i)** This was another poorly done question as the majority of the candidates did not show understanding of what was expected of them. Candidates were required to draw a part-structure of a terylene molecule. Most of the minority of the candidates that attempted the question only got a mark for the correct functional group but could not complete the whole structure. Again, a noticeable number of candidates left the question unattempted.

The correct response was:



(ii) This question was fairly done as the correct response of: *water molecules are formed when the monomers combine* was common but some candidates simply described the condensation process and they lost the mark.

(iii) This question was poorly done as most candidates failed to score the mark. Candidates were required to name a natural polymer that has the same ester linkage as terylene. The most common wrong responses were: proteins, oil and plastic.
The expected response was: *fats*

(c) This part question was fairly well done. Most candidates were able to state the effect of polymers on the environment as *pollution*.

Question 10

The whole of this question was very challenging to most candidates. The question was on thermometry.

(a) (i) This part question was poorly done. The majority of the candidates did not score full marks on this question. The question required candidates to describe the range of a thermometer with reference to a diagram of a clinical thermometer. Some candidates even used the wrong figure (Fig. 10.1) for reference when the question clearly stated that they should use Fig. 10.2.
The expected response: *the difference between maximum and minimum temperature that the thermometer can measure, which is 43°C - 35°C = 8°C*, was rare.

(ii) This was another very challenging question. Some candidates were able to score 1 mark but most candidates could not score even a single mark out of the available 2 marks. Candidates were required to explain why a clinical thermometer (Fig. 20.2) is more sensitive than a laboratory thermometer (Fig. 10.1). Most responses lacked comparison which lead to lost marks.
The expected response was: *the thermometer in Fig. 10.2 has a thinner capillary tube than the thermometer in Fig. 10.1 therefore there would be more increase or decrease in mercury column length per 1°C rise or drop in temperature.*

(b) (i) This was a challenging question to most candidates. The mark was not common even with high scoring candidates. Most candidates failed to state the physical property that varies with temperature that a thermocouple thermometer uses. Common wrong responses included volts, voltmeter and temperature difference.
The expected response was: *thermo e.m.f. or current or potential difference.*

(ii) This was also a poorly done question as most candidates were not able to sore full marks from it. A few candidates were able state the advantage of a thermocouple thermometer over a liquid-in-glass thermometer but could not explain the advantage. A common wrong response was that it is more sensitive and no explanation was given.

The expected responses were: *it measures higher temperatures because the materials used have high melting points,*

-it can measure rapidly changing temperatures because there is no contraction or expansion or because the wires used are good conductors of heat and electricity,

-it measures a wider range of temperature because the wires used have high melting points.

Question 11

(a) This question was fairly well done as most candidates were able to identify the type of circuit as *a parallel circuit*. There were very few common wrong responses such as: series circuit, electric circuit and transformer.

(b) This question was also well done. Most candidates were able to indicate the live wire on *the side containing a fuse*. Very few candidates left it not attempted or indicated the wrong side.

(c) this question was fairly well done as most candidates were able to score maximum marks from it. The relation P = V I was common. A common challenge was that of making I the subject. Common wrong responses were I = V/R and C = W/V. another challenge with some candidates was rounding off correctly.

The expected response was: $\mathbf{I = \frac{P}{V} = \frac{1000}{240} = 4.17\ A}$

EGCSE PHYSICAL SCIENCE

Paper 6888/03

Practical Test

General Comments

This component is designed to test science practical skills and a demonstration of scientific literacy was demanded by some questions in the paper. A range of science skills were assessed such as presenting scientific data, communicating scientific information, manipulation of data, suggesting improvements to scientific procedure and rationalising scientific procedures.

The time allocated the paper proved to be adequate as there was no evidence of candidates who failed to finish the paper. A number of candidates showed a weakness in communicating scientific observations.

Question 1(c) proved quite challenging to some candidates. This part of the question was investigating the physical properties of carbon dioxide. **Question 2(h)** was also poorly done. A number of candidates lacked mathematical skills which are required by the syllabus.

Comments on Specific Questions

Question 1

The candidates were provided with substances **A** and **B**.

Substance **A** was aloe juice and **B** was copper(ll) carbonate.

Candidates had to determine the relative acidity and alkalinity of **A** and **B**.

(a) (i) Candidates were asked to add 6 cm3 of A into a test tube.

Candidates also added 6 cm^3 of distilled water and a quarter spatula of substance **B** into another test-tube and stirred.

Then added a few drops of Universal indicator into each substance and recorded their observations.

This part of the question was well done by candidates. A few number of candidates lost the two marks on offer as they gave responses such as ‘orange to red’,’ blue to purple’ instead of stating the colour they observed.

The expected response was; ***A*** *– orange/ red and* ***B*** *– green/blue*.

(ii) Candidates had to determine the pH value of each substance in **(a)(i)** using a pH chart.

This part of the question was fairly well done.

Some candidates gave pH values that did not correspond to the indicator colour changes they recorded, as a result they lost the marks. Some candidates gave a pH range for each substance and this too resulted in the loss of marks.

*The acceptable pH values for **A** was in the range 3 – 5 and for B 7 – 9, corresponding with the colour change recorded in **(a)(i)**.*

(iii) Candidates had to make a conclusions for each substance based on their observations.

This part of the question was generally well done.

A few number of candidates lost the marks on offer as they gave conclusions that were opposite to their observations. They would state pH 9 is acidic or pH 4 is alkaline.

The expected response was: A – acidic and **B** – neutral/alkaline/basic.

(iv) Candidates had to describe how they determined the pH values of the solutions when using the Universal indicator solution.

This part of the question was poorly done.

Quite a large number of candidates could not describe what they did to get to the answer instead they gave responses such as use pH chart.

Other common wrong responses were ‘pH chart’, ‘compare colour to chat’, ‘compare colour to Universal indicator’.

The expected response was: *compare colour formed on Universal indicator to the pH chart.*

(b) Substance **B** was placed in a test-tube fitted with a delivery tube. The delivery tube was immersed in limewater contained in another test-tube. Candidates had to heat substance **B** using a strong Bunsen burner flame for about three minutes.

Candidates had to observe what happens to the limewater.

(i) Candidates had to explain why the gas produced was carbon dioxide.
This part of the question was fairly well done.
A few number of candidates lost the mark on offer as they gave response such as 'it turns milk', 'it's white'.
The expected response was: *carbon dioxide turns limewater milky/a white precipitate is formed.*

(ii) Candidates were asked to name the type of reaction that takes place when substance **B** is heated.

This part of the question proved challenging to candidates. Some candidates did not give a response. Some of the common wrong responses were 'chemical change', 'composition', 'black substance formed'.

The expected response was: *thermal decomposition*.

(iii) Candidates were asked to explain using the observations they made when carrying out the experiment why a chemical change had occurred.

This part of the question was poorly done.

Quite a large number of candidates gave the response 'a new substance is formed and it is irreversible'. This resulted in the loss of the two marks on offer as no reference to observation was made.

The expected response *was:* *substance **B** changed from green to black showing a permanent colour change and a gas carbon dioxide was formed which is a new substance.*

(c) Candidates were provided with two samples of carbon dioxide gas, one sample in a plastic bottle and another in a test-tube.

(i) Candidates were asked to determine the smell of carbon dioxide gas in the test-tube.

This part of the question was well done as the expected response of o*dourless/no smell* was very common.

(ii) Candidates were asked to describe the correct method of determining the smell of a gas.

Quite a number of candidates gave the wrong responses such as 'place test-tube close to nose and inhale the gas', 'blow the gas to the nose'.

The expected response was: *use hand to waft the gas towards the nose*.

(iii) Candidates were asked to explain why the gas will escape slowly when the test-tube is in the upright position.

This question was poorly done. The most common wrong response was that carbon dioxide is less dense than air.

The expected response was: *carbon dioxide is denser than air*.

(iv) Candidates were asked to measure 100 cm^3 of distilled water and quickly add t the water to the bottle containing carbon dioxide and close it tightly.

Then shake the bottle for about a minute. Candidates were asked to state and explain their observations.

This question was poorly done. Some candidates left this part of the question unanswered.

Some of those who attempted the question gave vague responses, they had no idea what was happening. Some common wrong responses included 'carbon dioxide does not react with water', 'carbon dioxide does not dissolve in water', 'carbon dioxide is denser than water', 'carbon dioxide has reacted with oxygen in the bottle', 'distilled water turns milky or cloudy' and 'carbon dioxide has escaped'.

The expected response was: observation; *bottle collapses/shrinks* explanation; *carbon dioxide dissolves in ater leaving empty space/ carbon dioxide dissolves in water resulting in less pressure inside than outside.*

(d) Candidates were asked to describe an experiment that can be used to test for the presence of iron (III) ions in substance **A**.

This question proved challenging to candidates. Some candidates who used the give chemistry notes, lost a mark as they did not give the state of the sodium hydroxide. Others stated that the precipitate is insoluble when in excess, instead of the precipitate is insoluble in excess aqueous sodium hydroxide.

The expected response was: *add a few drops of sodium hydroxide solution/ ammonium hydroxide to aloe juice/ substance **A** in a test-tube. A red-brown precipitate will be formed which is insoluble in excess sodium hydroxide solution/ammonium hydroxide*.

Question 2

In this question candidates had to investigate the effect of height in driving a steel nail into a bar of soap by dropping a 1 kg mass.

Fig.2.1 shows the set-up the candidates used.

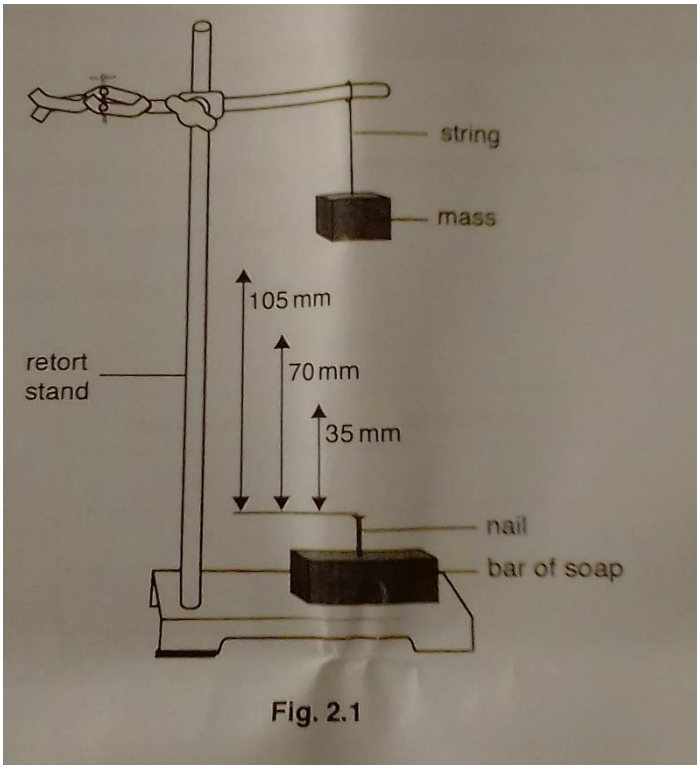


Fig. 2.1

Candidates pushed the nail into the bar of soap to a marked position of 1 cm from the tip of the nail. The mass was raised to the height of 35 mm from the top of the nail and released hitting the nail directly on the head. The nail was marked at the position it protruded just above the bar of soap and this position was marked **X**. The nail was gently removed from the bar of soap.

(a) Candidates measured the length from the 1 cm mark to **X** was and recorded.

This part of the question was fairly well done.

A few number of candidates gave unrealistic results such as 23 cm or larger. They lost the mark because the length of the nail was much shorter.

The expected respond was: supervisors result $\pm 5\ mm$.

(b) Candidates pushed a second nail into the bar of soap at a new position up to the 1 cm mark and raised the mass such that its base is at a 70 mm height from the top of the nail.

The procedure done with the first nail was repeated with the second nail.

This part of the question was well done.

A few number of candidates lost the mark by giving unrealistic values and by giving values smaller than their value of **(a)**.

The expected response was: supervisor result $\pm 5\ mm$.

(c) The candidates push a third nail into the bar of soap at a new position up to the 1 cm mark.

Then raise the mass to the 105 mm mark and repeated the procedure done with the first and second nails.

This part of the question was fairly well done.

(d) A few candidates lost the mark as their value of length was smaller than both their **(a)** and values instead of being the greatest.

The expected response was: the supervisor result $\pm 5\ mm$.

(e) Candidates were asked to state the kind of energy the **mass** has as it hits the nail.

This question was fairly well done.

Some of the common wrong responses were gravitational kinetic energy, potential energy and sound energy.

The expected response was: *kinetic energy*.

(f) Candidates were told that when the mass hits the nail, the nail was forced into the bar of soap. The energy of the mass was transformed into other forms of energy.

Candidates were asked to state the forms of energy they observed.

This part of the question was fairly well done.

Quiet a large number of candidates obtained one marked out of the two marks on offer. Most of the candidates were able to correctly state that one form of energy observed was sound.

The most common wrong answer was potential energy.

The forms of energy observed should have been *sound and kinetic energy* (of the nail penetrating deeper into the bar of soap).

(g) Candidates were asked to state and explain the height that causes the nail to be forced the greatest distance into the bar of soap.

This question was fairly well done.

Quite a number of candidates were able to give the expected response for the first part of the question but not the second, hence earning one mark out of two. A number of these candidates referred to the force of gravity in their explanation instead of the potential energy gained by the mass or increase in kinetic energy.

The expected response was; height- *105 mm*

explanation- *it has the most potential energy / largest kinetic energy/ greatest speed before impact.*

(g) Candidates were asked to write a conclusion on the relationship between the height from which the mass is released and the distance moved by the nail into the soap.

This part of the question was poorly done.

The most common wrong respond was the distance moved by the nail into the bar of soap depended on the mass. Other wrong responses were the mass is proportional to the distance moved, the height is inversely proportional to the distance moved by the nail.

The expected response was*: the height of the mass is proportional to the depth moved by the nail/ the increase in height results in an increase in depth (distance moved by the nail into the bar of soap)*.

(h) When the mass is released, it accelerates at 10 m/s^2.

(i) Candidates were asked to calculate, using the formula $E_p = mgh$, the potential energy gained by the mass when it was raised to a height of 70 mm.

This question was poorly done. A majority of candidates could not convert from mm to m, hence lost all the marks on offer.

The expected response was: Ep = mgh

$$= 1 \times 10 \times 0.07 = 0.7$$

(ii) Candidates were asked to calculate, using the formula $v = \sqrt{2gh}$, the maximum speed at which the mass hits the nail when released from the 70mm height.

This question was poorly done. Some candidates had difficulty evaluating the formula because of the square root. Others substituted incorrect values which resulted in the loss of marks.

The expected response was $v = \sqrt{2 \times 10 \times 0.07} = 1.18$ m/s

(i) In raising the mass to 70 mm, more energy was used than calculated in (h)(i).
Candidates were asked to explain why more energy was used.

This question was poorly done. Quite a number of candidates lost all the two marks on offer as they referred to loss in kinetic energy and not stating the force that was opposing the motion of the mass.
The expected response was *the extra energy was needed to overcome friction and some energy was lost as heat.*

(j) Candidates were asked to suggest **two** changes in the design, without changing the height that could make the nail be driven further into the bar of soap.

This part of the question was poorly done. The most common wrong responses were change the mass, change the nail and sharpness of nail without stating how. Another common wrong response was use a softer bar of soap.

The expected response was *use a greater mass and use a thinner/sharper nail*.

(k) In another experiment, the bar of soap was replaced with a wooden block.

Candidates were asked to draw a diagram based on the principle of moments, to show how one could easily pull out the nail from the wooden block.

This part of the question was fairly well done. Some candidates showed a lack of understanding of the principle of moments, others showed a good grasp of the concept but lost one mark out of the two as they failed to show where the force is applied.
The expected response was *a drawing showing the fulcrum between the nail (load) and effort (first class lever) and the fulcrum closer to nail than effort (effort indicated with an arrow).*

EGCSE PHYSICAL SCIENCE

Paper 6888/04

Alternative to Practical Test

General Comments

The Alternative to Practical paper assesses candidates on the level of acquisition and achievement of the experimental and investigative skills stated in Assessment Objective C of the syllabus, which specifies the quality criteria for excellence in this component. The paper assumes that experiments are conducted during teaching and learning time; and the development of the experimental and investigative skills is done in tandem with the rest of the knowledge in the syllabus. The paper provides a form of differentiated assessment as it affords learners a slightly different mode of responding to the inherent challenge in the syllabus content. This is evidenced by questions that allow learners to respond using drawings so as to display their creativity and probably circumvent the language challenge characteristic of explanations and descriptions.

The paper accounts for a 20% weighting to the overall final mark of the candidates as per the syllabus directive. 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 the previous years at around 11500. 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, seemed to have complied with the principles of assessment in being fair to candidates, valid, transparent and inclusive. The use of drawings in responding to questions is an example of an inclusivity measure as it accommodates learners with challenges in expressing themselves using English which could be their second or third language. An effort was made to ensure that the assessment tool developed from the instrument would also not disadvantage candidates.

The performance of the candidates was generally poor compared to previous years. The main indicator for this was having no student obtaining marks in excess of 80%. The highest mark obtained was 78%, showing a 10% variance with the 88% obtained as the highest mark in the previous year. There were indeed a few candidates that obtained marks above 70% relative to other years. Another indicator for the poor performance was that the average mark

was probably around 40% which is rather low relative to the other years, with a significantly high number of learners earning zeros or percentages in proximity with same.

There was a general concern by the Examiners that candidates fail to differentiate between 'state', 'describe' and 'explain'. It is worth noting that after a description, one could be able to carry out what has been described by the candidate, e.g., in testing for ions. However, in an explanation, candidates should note that there is invariably an inherent 'because' in the response. There was also a challenge noted with respect to responses to observations, analysis of results and conclusions. Some learners would give observations or analysis when expected to give conclusions which led to loss of marks. It is indeed still a general concern that candidates have challenges when they have to explain concepts using English even though an effort is made not to disadvantage them for this as per the guidelines of marking. It is worth mentioning that at times it becomes a bit of a challenge for Examiners to glean the science from the expression of some candidates.

Responses to specific questions

Question 1

(a) (i) Candidates were expected to complete the table by stating the colour of the Universal Indicator in each substance.

This was generally well answered by the candidates.

Most candidates were able to give the correct colour in substance A. However, a large number of candidates failed to give the correct colour of the Universal indicator in solution B. Red was the common wrong answer. Other common wrong responses were the colours: light blue, purple, indigo, dark –blue, sky blue, blue-black for solution A. Colourless and white were common errors for solution B. The expected response was that substance A was blue while substance B was green.

(ii) Candidates were expected to write a conclusion based on the results in **(i).**

This was also well attempted by the candidates. Most of them were able to correctly state that substance A was a base/alkali while substance B was neutral.
The most common source of error was candidates writing conclusions based on their wrong observations in the second column and ignore the result in the third column which could have ensured the possibility of getting the conclusion even if the

observation was incorrect. Some elected to answer using the alkalinity in the question and were duly punished. A number of candidates had challenges with the spellings for alkali and neutral giving responses such as alkale, alkali, alkane, nutral, newtral, netril and neutral.

(iii) This question expected candidates to describe how they would determine the exact pH values of the substances. It is worth noting that the yardstick for the description is that one can take the description of the candidate and conduct the experiment.

This question proved inaccessible to most candidates as they failed to state that one had

to compare the colour formed with the colour on the Universal Indicator chart. Most of the descriptions of the candidates could not meet the description threshold alluded to above. They would write phrases like: use pH chart, use pH scale, without any clear description. A few decided to write about litmus papers and lost the mark.

Reference to a pH scale instead of a pH chart did not incur any penalties. Those who responded using the pH meter had to describe that it had to be inserted in the substance to be tested and the pH read from the meter.

(b) (i) Candidates had to give an observation that shows that carbon dioxide had been produced.

Most candidates were able to correctly state the observation that limewater turns milky or make reference to the formation of a white precipitate. Those who could not score the mark gave responses like: white colour, white emulsion, white solution or black substance. A few mentioned the formation of bubbles which was unacceptable since the bubbles could have been produced by any gas. Candidates who responded by saying the limewater turned chalky were not penalised since calcium hydroxide turns into calcium carbonate when carbon dioxide is bubbled through limewater. The calcium carbonate formed is white and incidentally calcium carbonate is also known as chalk. Hence chalky was considered to be a legitimate response. Coloured chalks are due to dyes being added, otherwise chalk is white.

(ii) Candidates were expected to name the type of reaction that had taken place in test-tube C.

This question was poorly attempted by the candidates. The candidates failed to realise that heat was breaking the carbonate into separate products, hence decomposing it. The most common responses that failed to earn marks included endothermic, chemical displacement, sublimation and exothermic. Some noticed that heat was involved and thought this was a combustion reaction which was unacceptable since there is no addition of oxygen in the products.

The expected response was: thermal decomposition. The mark was earned even if the candidate omitted thermal.

(iii) Candidates had to give an explanation of why a chemical change had occurred using the observations in **(b)**.

This question was quite challenging to the candidates and it was only a handful that earned all the marks. The learners had to state the observation or result and then explain why it was a chemical change to obtain one mark. Most candidates would state the observation without an explanation or the explanation without an observation and lose both marks.

Some candidates noticed that the colour changed to black without mentioning 'permanent' colour change and lost the mark. Some gave the products that were formed, such as carbon dioxide or copper (II) oxide, without mentioning that the reaction was irreversible and also got penalised. There were those who gave observations without explanations and thus lost both marks. Others were stating that copper(II) carbonate was irreversible which did not score any marks.

There were those candidates who seemed to assume that limewater was the product of the decomposition of copper(II) carbonate, hence referring to the irreversibility of limewater which made them to lose the marks. They seemed not to realise that the question was referring to test-tube C, so they gave observations for test-tube D which was deemed incorrect.

Most candidates failed to obtain both marks since they explained only one observation. Some gave general responses such as that a new substance was formed or that the reaction was irreversible without demonstrating reference to the question and could not earn any marks.

The expected response was: that candidates had to state that copper(II) carbonate showed a permanent colour change as it turned black or that a black substance was formed, which was a new substance or that the black substance formed was irreversible.

They could respond in terms of the carbon dioxide observed by mentioning that the gas (carbon dioxide) was formed which was a new substance/irreversible. Both marks could be earned even if the response was in terms of copper(II) oxide.

(c) (i) Candidates were required to name the part E in the experimental set-up.

This was a poorly done question.

Candidates seemed not to be familiar with the apparatus. Common wrong answers were: thistle funnel, burette, funnel, separating funnel, fallopian tube, dropper and pipette. The correct response was a dropping funnel/tap funnel.

(ii) This question required candidates to state the smell of carbon dioxide gas.

This was fairly well attempted by the candidates. However, a significant number of candidates wrongly surmised that carbon dioxide had a bad smell, chocking smell or a pungent smell. Some described the smell as neutral, pure or gave wrong responses such as audioless instead of stating that the smell was odourless or carbon dioxide had no smell.

(iii) Candidates had to describe the correct method of determining the smell of carbon dioxide.

This was poorly attempted by the candidates with the description threshold alluded earlier not met in most cases. A lot of them failed to give the expected description which was that the hand could be used to waft the gas towards the nose.

A number of candidates had the vague idea but found themselves using descriptors that were unacceptable. Some would correctly describe how the gas had to be moved but then neglected the ultimate destination of the gas which was the nose and thereby lost the mark. The common wrong responses included: wave the gas with your hand, smell with your noise, blow the air towards you, use a mask, use a respirator, use the nose to smell the gas, to name but a few.

(iv) Candidates were expected to explain why the plastic bottle, full of carbon dioxide and half-filled with distilled water, collapsed when shaken.

This question was quite inaccessible to most candidates. They failed to realise that carbon dioxide is soluble and hence it will dissolve in the water and create space leading to the collapse of the bottle.

Some candidates thought that after shaking the bottle, the water and carbon dioxide molecules gained kinetic energy and created a high pressure inside the bottle leading to the collapse which led to loss of marks. Some candidates thought carbon dioxide and water molecules expanded leading to the escape of the gas causing the bottle to collapse which was also unacceptable. Some correctly mentioned that carbonic acid was formed as the carbon dioxide dissolved in the distilled but then thought the acid corroded the walls of the container leading to the collapse of the bottle which made them lose the second mark.

A few wrote relatively wild responses such as that when you shake the bottle, it became warm or that the distilled water was acidic which could not be accepted.

The expected response was that carbon dioxide dissolves in water, creating a vacuum.

The marks could also be earned by explaining that carbon dioxide was used up as it dissolved forming carbonic acid creating space inside the bottle. This then caused the collapse.

Correct reference to pressure variance in and outside the bottle also earned both marks.

(v) Candidates had to explain why carbon dioxide escaped slowly when the test-tube was in an upright position.

The question was fairly well attempted by candidates as most candidates were able to state that carbon dioxide was denser than air. The main source of error was that candidates seemed to think carbon dioxide **does not** escape when in an upright position, so the 'escape slowly' seemed to confuse them.

Some of the common wrong responses included that carbon dioxide was less dense than air; carbon dioxide is dense, without comparing it to the air which was not accepted. Some were comparing the density of carbon dioxide to that of water which was also punished. Others were stating that carbon dioxide is more dense than the other gases which was not specific enough.

(vi) The question required candidates to describe the modification of the experimental design

to:

- Increase the speed of the reaction.

This was fairly well attempted by the candidates as most of the candidates correctly stated that the temperature could be increased or that the acid concentration could be increased. Some of those who failed to earn the mark referred to the increase in the concentration of the reactants without specifying the acid which was rather too general. Some suggested that more calcium carbonate or acid could be added which was also punished. There were those who wrote Bunsen burner without explaining what to do with the burner. A few included the use of a catalyst which was not accepted since the reaction is fast enough while shaking, stirring or any form of agitation of the reactants were all not appropriate for this experiment.

- Measure the volume of the carbon dioxide gas produced.

This was also fairly well attempted by the candidates. Most of those who failed to get the mark referred to a marked or numbered test-tube without making reference to gradation or calibration of the test-tube. Some suggested that bubbles could be counted per unit time which was also a bit unrealistic. Some referred to collecting the gas using a beaker which was also not acceptable owing to the lack of accuracy of a beaker in this context. There

were those who suggested that a measuring cylinder could be inserted in the plastic bottle which was also penalised.

The expected response was that candidates had to describe the replacing of the plastic bottle or test-tube using a syringe or any named calibrated collecting vessel.

(d) The candidates had to describe an experiment that could be used to test for the presence of iron(III) ions in substance A.

This was poorly attempted as most candidates failed to attain the description threshold expected of any description. A significant number of candidates suggested the use of a magnet to determine the presence of the iron(III) ions in the solution, stating that these ions would be attracted by the magnet. Others were not sure of which solution to use, so they used words like, acidify with dilute nitric acid and add aqueous silver nitrate. A number of those who knew the reagents failed to specify that the sodium hydroxide had to be in solution or that a few drops had to be added first before adding excess of the test reagent. In the result, a few candidates were writing brown precipitate, reddish brown precipitate while others were writing red-brown colour without including the word 'precipitate' which led to them losing marks.

Expected response:

Test: add a few drops of aqueous sodium hydroxide/aqueous ammonia.

Result: red-brown precipitate was formed. To earn the third mark, candidates had to state that the precipitate was insoluble in excess sodium hydroxide/ammonia.

Question 2

(a) **(i)** Candidates were expected to read and record the depth of the nail into the soap bar.

The question was generally well done with most candidates correctly reading the depth as 10 mm. There were some candidates that did not convert the 1 cm to mm as required by the table. These did not incur penalties if they clearly indicated that they were using centimetres.

A number of candidates failed to note that the nail was already pushed 1 cm into the soap and hence gave their answer as 20 mm or 2 mm which made them lose the mark. Other common wrong responses included 1 mm, 2 mm, 11 mm, 20 mm, 1 cm and 2 cm.

(ii) Candidates had to state one precaution to be taken when reading from the ruler.
This was poorly done as most candidates failed to describe the error of parallax. They would describe it as 'look at the ruler straight or direct' instead of 'the eye should be perpendicular to the reading **not** ruler OR eye should be directly above the reading **not** ruler.'

Some mentioned precautions that are taken when reading the volume of a liquid such as that the reading should be taken at the bottom of the meniscus OR that the ruler should be placed on a flat surface.

Other common wrong responses included that the measurement had to be taken from the 0 cm mark or that the reading had to be converted to mm.

(b) **(i)** Candidates were required to explain why the depth of the nail into the bar was not proportional to the height through which the nail had been raised.

This question proved to be extremely inaccessible to most candidates as it was poorly done. Most of the candidates failed to understand that the question was on the non-uniformity of depths at the different heights i.e. the intervals decreased from 10 mm to 8 mm to 7 mm as height increased uniformly by 35 mm from 35 mm to 70 mm to 105 mm. This was due to the fact that friction between the soap and the nail increased with depth OR air resistance on the mass increased with height. Most of the candidates made reference to the general relationship between height and **total** depth/length being directly proportional which was a wrong response for this question. Some repeated the question whilst others stated that the depth intervals were decreasing without stating the reason, which was the expected task for the candidates. Such responses were incomplete since the reason is always a threshold for the command word 'Explain' as alluded to earlier.

(ii) Candidates were expected to state the kind of energy the mass had as it hit the nail.

This was well attempted as most candidates were able to correctly state the energy type as kinetic energy. However, some candidates would state wrong energy types such as gravitational potential energy, heat energy or sound energy.

(c) Candidates had to state the forms of energy observed when the nail was forced into the bar.

This was fairly well done as some candidates were able to correctly state the energy forms as kinetic energy (of the nail) and sound energy. However, some candidates listed heat energy which was unacceptable as it was not easily observable in this activity. A significant number of candidates provided energy conversions flow diagrams that start when the mass was released at height 35 mm which was wrong e.g.

gravitational potential ⟶ kinetic ⟶ sound ⟶ heat energy

Some seemed to get an opportunity to list all the energy forms they knew and were duly punished.

(d) Candidates were expected to state and explain the height that forced the nail to be forced the greatest distance into the bar of soap.

This was fairly well done as a majority of the candidates were able to correctly get the height as 105 mm but failed to get the correct explanation: "that the mass at this height had the largest gravitational potential energy OR at this height the mass gained the largest kinetic energy before hitting the nail." Most of them would try to explain using forces e.g. that the mass had more gravitational force at this height, instead of greatest energy types the mass gains at this height hence lost the mark. A few candidates could not specify the energy type and only referred to more energy gained and were also not able to obtain the mark.

(e) The question required candidates to write a conclusion on the relationship between the height from which the mass was released and the distance moved by the nail into the bar of soap.

This was generally well attempted by the candidates. Most of the candidates who lost the mark failed to notice that they were concluding the relationship between two variables: height and distance. Some would compare the size of the mass with the distance moved by the nail while some would refer to length and penetration. Some thought the variables were directly proportional which was wrong, instead of just proportional. Others thought the variables were indirectly proportional which was also not acceptable. The expected response was that an increase in height results in an increase in length (or the distance moved by the nail into the soap.)

(f) **(i)** Candidates had to calculate the potential energy gained by the mass when raised to a 70 mm height using the formula: $E_p = mgh$.

This was fairly well done by the candidates. A number of those who could not score the mark failed to correctly convert the 70 mm to metres getting values like 0.007m or 70 cm instead of converting it to 0.07m. There were those who substituted the 70 mm directly without converting it to metres while some unnecessarily converted the 1 kg to 1000 g and all incurred a range of penalties. A few candidates elected to substitute 18 mm for length from Table 2.1 instead of the height 70 mm specified in the question and virtually lost all the marks.

The candidates were expected to convert 70 mm to 0.07 and then substitute into the formula to get 0.7J to score both marks:

$$E_p = mgh$$

$$= 1kg\ x\ 10N/kg\ x\ 0.07m$$

$$= 0.7J$$

(ii) The question expected candidates to calculate the maximum speed at which the mas hit the nail when released from a height of 70 mm using the formula**:** $v = \sqrt{2gh}$**.**

The question was fairly well attempted by the candidates. However, some candidates substituted the wrongly converted value of 70 mm in **(i)** for the height and got wrong values. Some elected not to use the square root when substituting and were penalized. A significant number of candidates failed to correctly use a calculator to compute and got a common wrong response, e.g.

$$v = \sqrt{2x10x70} \text{ or } \sqrt{2x10x0.07}$$
$$= 989.95 \text{ or } 0.9899 \text{ m/s}$$

proving that the candidates did not put the brackets when substituting on the calculator. A few decided to use the 18 mm length from Table 2.1 for 'g' that gave a wrong answer, whereas, g = 10m/s^2, was given in the question. There were those who lost the mark for units by giving wrong responses such as m/s^2, mm^3, mm/s or km/h.

Those who earned all the marks correctly calculated the velocity using the given formula like this:

$$v = \sqrt{2gh}$$
$$= \sqrt{2x10x0.07}$$
$$= 1.18 \text{ m/s}$$

(g) Candidates had to explain why more energy was used in raising the mass to 70 mm relative to the one calculated in **(f)(i)**.

This was poorly done as the majority of the candidates failed to notice that the extra energy caters for overcoming friction or air resistance/drag while some energy was lost as heat when raising the mass to the 70 mm mark. Those who seemed to have an idea messed up their responses by assuming that the extra energy to the 0.7J calculated in **(f)(i)** was to overcome the force of gravity (weight of the mass) yet this was balanced by the upward force from the muscles before the mass started moving up. They failed to appreciate that even during lifting of the mass, the two forces were balanced. Since the mass was moving up, work was done (F x d = mgh) against gravity which became gravitational potential energy gained by the mass. But the extra energy had to be provided to overcome air resistance or friction and also cater for the energy lost as heat due to the friction.

Expected response was: extra energy was used to overcome friction or air resistance for the first mark and they had to state that some energy was lost as heat due to the friction.

(h) Candidates were expected to suggest two changes in the design of the experiment that could make the nail to be driven further into the bar of soap.

This was fairly well attempted by the candidates as most of them were able to obtain at least one of the marks on offer. A significant number of candidates failed to score the second mark because they did not compare. They would mention that a thin or sharp nail could be used which did not earn marks since it showed no comparison with the initial nail. Some thought the surface area of the nail's head had to be increased which was incorrect as this change would have no effect on the distance of penetration by the nail into the bar of soap. Some thought that the use of a shorter or longer string could increase the penetration of the nail which was also not acceptable. There were those who suggested that the height from which the nail was released could be increased which was marked incorrect since the question clearly stated that the height had to be maintained constant. Some suggested an increase in the speed of the nail which was not a design really and failed to earn any marks. There were those who suggested changes on the bar of soap like the use of a softer or moist soap to increase the penetration. This response did not earn marks since close analysis of the question suggest that the bar should not be changed i.e. not an ideal variable. The expected responses from the candidates were that a greater mass could be used and that a sharper or thinner nail could be used.

(i) Candidates had to draw a diagram to show how the student could easily pull out

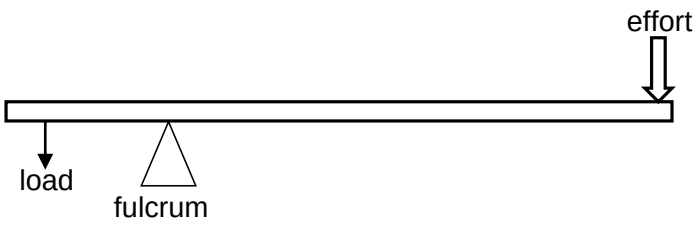
the nail from a wooden block using the principle of moments in this question.

This was fairly well done as a significant number of candidates were able to apply the principle of 1^{st} class levers with the fulcrum closer to the load.

The candidates earned the marks if:

1. the nail, as a load, and effort were on opposite sides of the fulcrum.
2. the fulcrum was closer to the load.

The expected standard diagram was:



The equipment that were first class levers drawn by the candidates included but was not limited to crowbars, pliers, claw hammer, and so on. This earned all the marks if correctly attached to the nail on the wooden block with the fulcrum clearly closer to the nail (load).

Most candidates who lost the mark seemed to depict a pulley system instead of the principle of moments and got penalized. Some drew duplicates of Fig. 2.1 while a significant number left a blank space.