EXAMINATIONS COUNCIL OF ESWATINI

Eswatini General Certificate of Secondary Education

Physical Science (6888)

Examination Report for 2023

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EGCSE PHYSICAL SCIENCE

Paper 6888/01

Short Answers

General Comments

11 070 candidates registered for this component but the number of candidates who sat for the component was 10 868. These numbers showed an increase of 386 candidates who sat for the component.

This short answer paper was marked out of a total of 40 marks. The highest attained score was 33 marks which is 3 marks higher than the highest score attained in the previous year. The majority of the candidates scored between 0 – 10 marks, with a significant increase in the number of candidates (~230) who scored zero. There was a decline in the number of candidates who obtained C or better, which reflects a poor performance compared to the previous year. There was an increase in the number of candidates with scores above 30 marks. It is also worth noting that fewer candidates obtained single digit scores than the previous year.

Questions that were more challenging to most candidates were Questions **5(b) ,6, 8, 9(a), 9(b), 13(b)** and **19(a)**. Question **9(b)** proved to be the most inaccessible because very few candidates managed to get full marks. Questions that were more accessible to most candidates were **1(a), 1(b) 12(a),** and **19(b).**

Comments on Specific Questions

Question 1

(a) This was one the most accessible questions to candidates. Candidates were asked to state the process used to separate ethanol from water. Common wrong responses: simple distillation, distillation, separating funnel. Common incorrect spelling: fractional destillation, frictional distillation, fractional distillation, and all these were no awarded credit.

Expected response: *fractional distillation*

(b) The question was accessible question to candidates. Candidates were asked to state the process used to separate a mixture of coloured food dyes. Common wrong responses were filtration, fractional distillation, separation by gravity, chromatogram. Common wrong spellings were cromatograph, chromotography, chroematography, chromatograph.

Expected response: *chromatography*

Question 2

The were mixed responses to this question. Candidates were given a diagram showing photographs of a racing car and a mini truck. Candidates were asked to state **two** reasons why the racing car is more stable than the mini truck. Strong responses showed understanding of the concept 'stability' such that they were able to make good comparisons. Common wrong responses were short, big

tyres, wider base area, large surface area, low base area, wider. Most candidates failed to compare and that resulted to loss of marks.

Expected response: *lower centre of mass, wider base*

Question 3

This question was moderately answered. Candidates were given a diagram showing a brown gas placed at the bottom of a gas jar covered with an upside down gas jar. After a few hours both gas jars were filled with the brown gas. Candidates were required to explain why the two gas jars were now filled by the brown gas. Common wrong responses were osmosis, Brownian motion, evaporation, particles move through a partially permeable membrane, gas moves from a high region of concentration. Common wrong spelling was defusion

Expected response: *gas particles have moved from their region of higher concentration to their region*

of lower concentration by diffusion

Question 4

This question was challenging to most candidates. Candidates were given a diagram showing the word 'AMBULANCE' and its image as seen in the rear-view mirror of a car. They were required to state the property of the image that is formed on the car's mirror. Most candidates' responses were general properties of an image, most of which are not related to the context. Common wrong responses were reflection, upside down, real, inverted, virtual, same size, literally inverted

Expected response: *lateral inversion*

Question 5

Candidates were given a diagram showing ions in a lattice of potassium chloride.

(a) This part of the question was challenging to most candidates. Candidates were required to name

the type of forces holding the ions together in the lattice of potassium chloride. Some candidates gave any type of force they know and did not earn credit. Common wrong forces were Van der Waals, ionic, covalent, frictional, and intermolecular.

Expected response: *electrostatic forces*

(b) This seemed to be the most challenging question. Candidates were required to explain why potassium chloride does not conduct electricity when solid but does when molten. Common wrong responses included ions do not move in solids, free electrons in molten potassium chloride, free particles in molten potassium chloride, and these were not awarded credit.

Expected response: *free moving ions in molten potassium chloride, while ions are in fixed positions in solid*

Question 6

This question was generally not well answered. Candidates were required to explain, using ideas about electromagnetic waves, why it is possible for a person in Mbabane to watch live news broadcast from London, which is thousands of kilometres away. Weaker responses did not quantify the speed and lacked reference to time. For example, electromagnetic waves travel at high speed/ long distance/ at the speed of sound. Some candidates lost marks as they did not state the unit for the speed of electromagnetic waves.

Expected response: *electromagnetic waves travel at a speed of 3 x 10^8 m/s, travelling a very long distance in a very short time*

Question 7

This question was accessible as most candidates proved to be familiar with the empirical formula. Candidates were required to determine the empirical formula of a hydrocarbon that is made up of 1.2 grams of carbon and 0.2 grams of hydrogen. Common wrong calculations were

$12+1=13$, $\frac{12}{1.2} : \frac{1}{0.2}$

Expected response*:* $C \ : \ H$

$$\frac{1.2}{12} : \frac{0.2}{1}$$

$$\frac{0.1}{0.1} : \frac{0.2}{0.2}$$

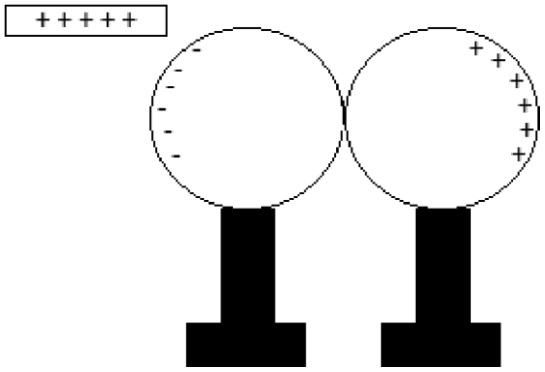
$$1 : 2$$

$$CH_2$$

Question 8

This question was inaccessible. Candidates were given a diagram showing two uncharged spheres touching each other. They were asked to draw the distribution of charges on the spheres when a positively charged polythene rod is brought near the spheres. Common wrong distribution of charges included both charges in the same sphere, ignoring the number of charges, charges separated incorrectly.

***Expected correct response**: 6 negative charges on left of left sphere, 6 positive charges on right of right sphere*



Question 9

The question tested the candidates understanding of electrolysis. Candidates were given a diagram showing the set-up of apparatus that can be used in the electrolysis of molten magnesium chloride.

(a) The question was challenging to most candidates. Candidates were required to explain why the size of the cathode has increased after a few minutes. Common wrong responses included cathode gains electrons, magnesium ions are deposited on the cathode, and cathode attracts magnesium ions which all did not earn credit.

***Expected response**: magnesium ions are reduced to magnesium atoms. The cathode is coated by the magnesium metal*

(b) This part of the question was inaccessible to most candidates. Candidates were asked to state how the composition of the electrolyte will differ if aqueous magnesium chloride is used. Common wrong responses were cathode gets smaller, anode increases in size. Most candidates did not compare the two electrolytes hence lost credit.

***Expected answer**: in addition, the electrolyte will have hydroxide and hydrogen ions*

Question 10

(a) This part question was challenging to most candidates. Candidates were required to state what is meant by the term electric current. There were several incorrect responses that were not awarded credit. These include flow of electricity, rate of flow of current, rate of flow of electricity, flow of charge, and rate of flow of charge per unit time.

***Expected answer**: rate of flow of charge*

(b) The question was fairly done. Some candidates were able to calculate the charge correctly. Candidates were asked to calculate the charge in the circuit when a current of 1.15 A flows through a circuit in 120s. Common wrong responses: Q =1.5×120 =180C, C = It, θ= It, Q = IT, V = It.

Expected correct response: $Q = It$

$=1.15 \times 120$

$=138C$

Question 11

This question was well done. Candidates were asked to state **one** negative impact of mining of minerals such as iron ore on plants. Most candidates did not refer to plants. Some candidates did not refer to large scale cutting down of trees which resulted to loss of marks. Common wrong responses included desertification, deforestation, soil erosion, loss of nutrients.

Expected response*: rate of photosynthesis reduced*
reduction in number of species

Question 12

Candidates were given a diagram showing an iron bar suspended near the North pole of a magnet.

(a) This question was accessible to some number of candidates, Candidates were asked to explain, in terms of magnetic induction, what happens to the iron bar when the magnet is moved closer. Most candidates were able to get a mark for stating 'attraction' and lost the second mark because they failed to explain. It was also common to get incorrect responses that were not credited, and these are attraction due to charges induced, move closer, attach and repel.

Expected response*: attraction, a South pole is induced in the iron bar end near the North pole*

(b) The question was challenging to most candidates. Candidates were required to state how they can determine if two iron bars are magnets. Common responses that were not awarded credit are use iron filings, bring them closer to a magnet.

Expected response: *repulsion*

Question 13

The question was testing candidates understanding of photochemical reactions with respect to photography.

(a) This question was fairly done. Candidates were asked to explain why photography is an endothermic process. Responses that were not awarded a mark are heat is absorbed, energy is not released, more energy released than absorbed, light is absorbed.

Expected response*: absorbs energy*

(b) This question was inaccessible to most candidates. Candidates were given the symbol equation for the overall reaction of silver bromide in the photographic film and asked to use the equation to describe photography in terms of electron transfer. Most candidates specified the wrong number of electrons and wrong charge of ions, for example Ag^{2+} which resulted in loss of marks. Some wrote half equations which were not balanced. Other common incorrect responses were silver bromide gains electrons. and bromide ions gain electrons

Expected response*: silver ions gain electrons to form silver atoms*

Question 14

This question was accessible most candidates. Candidates were asked to define a ferrous material such as steel. Most candidates were able to recall that it is *a material that contains iron.* Common wrong responses were magnetic material, strong material, does not rust, easily magnetized, and conduct electricity.

Question 15

Candidates were given a simple diagram of the Haber process.

(a) This question was fairly done. Candidates were asked to name the catalyst in the reactor. Common wrong answers were atm, platinum.

Expected response: *iron*

(b) This question was fairly answered. Candidates were asked to state the process that occurs at **X** to convert gaseous ammonia to liquid ammonia. Some candidates responses were more inclined to the nitrogen cycle. Common wrong responses were ammonification, nitrification, evaporation, compressing

Expected correct response: *condensation*

Question 16

This question was challenging to a majority of candidates. Candidates were asked to describe the colour changes observed when iron(II) nitrate is exposed to air and changes to iron(III) nitrate. Candidates are discouraged from writing colours as -ish colours, for example green***ish***, brown***ish*** as this is not awarded a mark. Most candidates just gave one colour not a change hence did not earn full marks. Common wrong colour changes not credited were white to purple, blue black, grey, silver, milky precipitate.

Expected response: *green to red brown*

Question 17

Candidates were given a diagram showing an electromagnet, and the questions were testing their knowledge of electromagnets.

(a) This part of the question was accessible to most candidates. Candidates were asked to state **one** way by which the strength of an electromagnet can be increased. Common answers that were not awarded credit are increase number of coils, increase turns, increase batteries, use a stronger magnet, increase power supply, increase cells, and close switch.

Expected response*: increase current/ increase number of turns*

(b) The question was accessible to a number of candidates. Candidates were required to explain why soft iron is used as a core in the electromagnet. Responses including easily magnetized, and good conductor of electricity were not credited. The spelling 'Temporal' for temporary was not given a mark.

Expected response*: forms a temporary magnet*

Question 18

This question was accessible to many candidates. Candidates were given a diagram showing a simple generator. Candidates were required to name the parts labelled **C** and **D**. Common wrong answers: C- slip ring commutator, split ring, copper ring, ring D-brush.

Expected response: C*- slip ring* ***D****- carbon brush*

Question 19

(a) This question was inaccessible to a number of candidates. Candidates were asked to state the nature of a beta particle. Common wrong answers were an electron, and a negative charge.

Expected response: a fast moving electron from the nucleus

(b) This question was accessible to a number of candidates. Candidates were required to name the type of radiation that is not deflected in a magnetic field. Common wrong answers that results to loss of a mark included beta, gamma particle, gamma radioactive decay. Common wrong spellings included gammar, and gammer.

Expected correct response*: gamma rays*

EGCSE PHYSICAL SCIENCE

Paper 6888/02

Structured Questions

General Comments

11 070 candidates registered for this component but the number of candidates who sat for the component was 10 868. These numbers showed an increase of 386 candidates who sat for the component.

The paper was marked out of a total of 80 marks. The highest attained score was 65 marks which is 4 marks higher than the highest score attained in the previous year. The majority of the candidates scored between 10 – 25 marks, which showed a better performance than the 05 – 15 marks which was scored by the majority of candidates in the previous year. There was an increase in the number of candidates with scores above 30 marks. It is also worth noting that fewer candidates obtained single digit scores than the previous year.

Most candidates had challenges with questions that required application, description and explanation. However, candidates continue to display confidence with recall questions and calculations. But calculations on stoichiometry is still a challenge for most candidates.

Candidates lost marks for failing to understand what the question required, for example, candidates stating a fact where they are required to explain the fact. Candidates should ensure they read the questions carefully and should provide the exact answer required in the instructions. Candidates should also ensure that they are familiar with the scientific terminology needed to answer questions precisely, for example, using the term speed where they are supposed to use velocity.

The use of correct symbols in formulae and equations continued to be a challenge for some candidates. Candidates should be encouraged to write formulae in full. Some candidates presented expressions instead of equations and some were using wrong symbols in formulae and did not earn marks. Candidates should avoid rounding off unnecessarily. If the answer is not exact, rounding off should be done to 3 significant figures as stated in the syllabus unless the accuracy is stated in the question.

Questions that proved particularly easy for most candidates were: **1, 2 (a), 3 (a) (i), 7 (a), 7 (b), 8 (b), 8 (c) (i), 10 (a) and 10 (b) (i).** Questions that proved particularly difficult for most candidates were: **2 (b), 3 (b), 4 (b) (i), 6 (a), 6 (d), 7 (c) (i), 9 (a), 9 (b), 10 (c), 10 (d), 10 (e) and 11 (b)**

Comments on Specific Questions Question 1

This question was generally well done by most candidates. most candidates were able to score 2 or more narks out of the available 6 marks. Candidates were given symbols for six elements and were required to identify which element corresponds to a given physical or chemical property. It was common for candidates to give names of the elements instead of the symbols given in the question. This led to wrong spellings and they ended up losing marks.

Expected responses:

(a) ***Na/ Mg/ Aℓ*** for a ductile element

(b) ***Mg*** for an element in the same group as calcium

(c) **Ar** for an unreactive element

(d) ***Na/ Mg*** for an element that reacts with water to form an alkali

(e) ***Cl*** for an element that displaces iodine from potassium iodide

(f) ***Si*** for an element in the same group as the element that forms the allotropes, graphite and graphene.

Question 2

(a) A fairly done question as most candidates were able to identify the instrument in Fig. 2.1 as the *micrometer screw gauge*. Common wrong responses were vernier caliper. Wrong spellings for micrometer were also common.

(b) This part of the question was poorly done as most candidates failed to read and add the readings of the sleeve and the spindle. Candidates were required to take readings from the micrometer screw gauge given in Fig. 2.1. There were so many wrong readings and additions with no specific common errors. However, most candidates missed the instruction that the reading should be in cm.

Expected response: *4.5 + 0.23*

4.73 mm

0.473 cm

(c) This question was fairly well done. Most candidates were able to score at least a mark from the available 3 marks. Most candidates were able to use the given formula for volume of a sphere to calculate the volume of the ball bearing. Candidates were able to score marks for substituting correctly, their value from **(b)**. Most candidates lost a mark for failing to round off their answer to 3 significant figures as required by the question.

Expected response: *0.473 ÷ 2 = 0.2365*

$V = \frac{4}{3} \pi (0.2365)^3$

= 0.0554

Question 3

(a) **(i)** This was a well-done question. Candidates were required to state the name given to two or more atoms of the same element that have the same proton number, but different nucleon numbers. The ***expected response*** of *isotope* was very common. A common wrong response was allotrope.

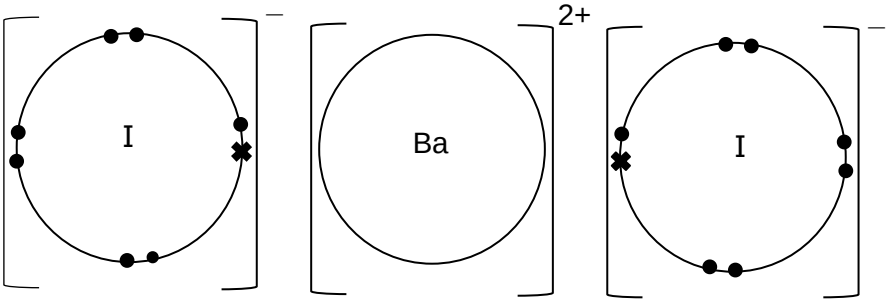
(ii) This part question was not well answered as expected. Most candidates were able to score at least 1 mark out of the three available marks. Candidates were required to work out the number of subatomic particles in an atom and ion of iodine. Most candidates had challenges with determining the number of electrons for the iodine ion.

Expected response:

subatomic particle	^{126}I	$^{129}I^-$
protons	*53*	*53*
neutrons	*73*	*76*
electrons	*53*	*54*

(b) This was one of the of the challenging questions for candidaes. A majority of the candidates were not able to draw the dot and cross diagram for barium iodide, BaI_2. A common wrong response was that of drawing covalent bonding.

Expected response:



Question 4

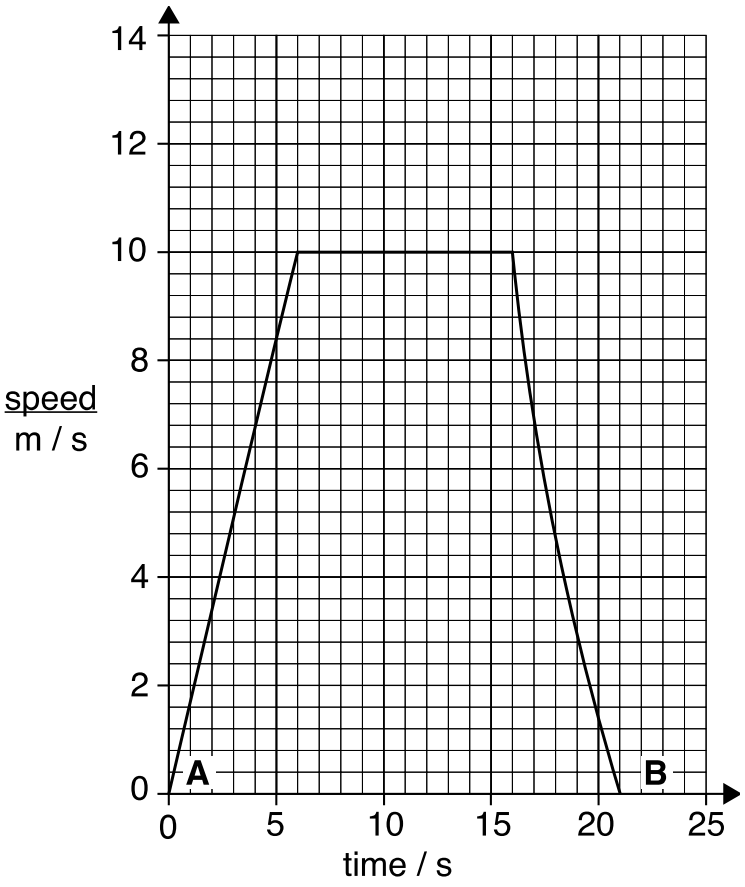
This question required candidates to use a speed time graph to answer the questions.

(a) This question was challenging for many candidates. Although this was a simple recall question but the majority of the candidates could not define acceleration. Candidates were required to define the term *acceleration.* Correct definition of acceleration was scarce. Common wrong responses included: rate of change of speed, rate of change of velocity per unit time and distance covered per unit time.

***Expected response**: rate of change of velocity or rate of change of speed in a specified direction*
or change of velocity per unit time.

(b) **(i)** The question proved to be challenging for most candidates as the correct drawing of a graph showing non-uniform speed was very rare. Candidates were required to complete a speed time graph to show a non-uniform deceleration for 5 seconds.

***Expected response:** the graph could either be curving to the right or curving to the left*



(ii) The question was well done as most candidates were able to calculate the acceleration of the minibus from the graph. Candidates were required to calculate the acceleration of the minibus during the first 6 seconds of the journey. Candidates were expected to use either the gradient or the formula $a = \frac{v-u}{t}$. Candidates lost marks for using incorrect symbols in the formula such as using upper case letter A for acceleration or upper-case letter T for time.

Expected response: $a = \frac{v-u}{t} = \frac{10-0}{6} = 1.67$

(iii) The question was fairly done. A noticeable number of candidates were able to recall that distance covered is equal to the area under the graph in a velocity/ speed-time graph. Candidates were required to calculate the distance covered by the minibus in the first 6 seconds of its journey. A common wrong response was d = speed x time = 10 x 6 = 60 m.

***Expected response*:** *distance = area under graph = ½ x b x h = ½ x 6 x 10 = 30 m*

(c) This was a well-done question. A majority of the candidates were able to recall the formula F = ma. Candidates were required to calculate the force needed to produce the acceleration calculated in **(b) (ii).** Common wrong formulae were F = mg and F = md. The question required the candidates to state the unit but still some candidates gave their answers without units. A common wrong unit was joule (J).

Expected response: *F = ma = 2800 x 1.67 = 4676 N*

Question 5

This question was testing candidates understanding of alloys.

(a) The question was fairly well done as most candidates were able to score the mark. Candidates were required to state what is meant by element. A common wrong response was that an element is a group of two or more atoms chemically combined.

Expected response: *a <u>substance</u> made up of one type/ kind of atoms.*

(b) This was a fairly done question. Some candidates lost this mark because they stated why solder conduct electricity instead of explaining why solder conduct electricity. A common incomplete response was that solder conducts electricity because it has free or delocalized electrons.

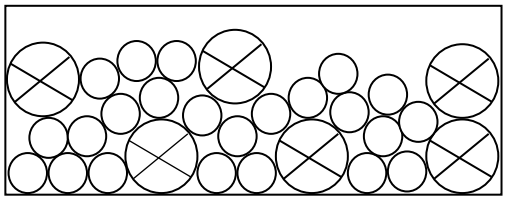
Expected response: *solder has free or delocalized electrons that can move and carry charge.*

(c) This question was fairly well done as a noticeable number of candidates were able to earn a mark from the question. Candidates were required to suggest **one** harmful effect on human health of using solder. A common wrong response was that it causes cancer without being specific which type of cancer.

Expected response: *nervous disorders/ learning disabilities in children/ kidney damage/ liver damage/ brain damage/ mental retardation/ infertility/ stillborn/ respiratory tract irritation/ respiratory tract diseases/ asthma/ eye irritation/ hearing problem/ lung cancer*

(d) This question was fairly well done as most candidates were able to score at least one mark out of the available 2 marks. Candidates were required to draw the arrangement of particles in bronze. Candidates lost marks for drawing particles that showed gaseous state or particles that were not starting from the base of the container/ box. Some candidates did not pay attention to the different sized particles and that led to loss of marks.

Expected response: *the diagram should show distorted regular layers and more copper atoms than tin atoms*



Question 6

This question was testing candidates' understanding of digital electronics.

(a) This question proved challenging as most candidates failed to score this mark. Candidates were required to explain what is meant by digital electronics. Most candidates had the idea of discrete data, highs and lows and 1s and 0s but failed to express themselves.

Expected response: *a signal that represents/ represents/ transmits data as discrete or discontinuous values.*

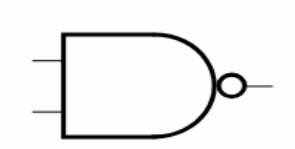
(b) This question was fairly well done as most candidates were able to score at least one mark out of the available 2 marks. Candidates were required to complete the truth table for the given combination of logic gates.

The expected response:

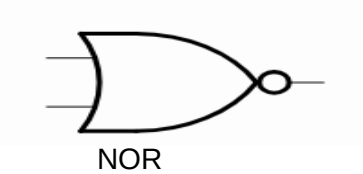
Inputs to AND gate		***Inputs to OR gate***		***Output E***
A	***B***	***C***	***D***	
		0		
			0	
				1
			0	

(c) This was another fairly well-done question as most candidates were able to draw correctly at least one of the required logic gates. Most candidates had challenges with drawing the symbol for a NOR gate. Candidates were required to draw the symbols of a NAND gate and a NOR gate. A common wrong response was that of drawing a symbol for a NOT gate for the NOR gate.

Expected response:



NAND



NOR

(d) This question was poorly done as the majority of the candidates could not score this mark. Candidates were required to state how the input of an AND gate differs from that of a NAND gate. A common wrong response was that of giving how a NAND gate and a NOR gate gives high outputs without stating the conditions for the other outputs. Candidates also lost marks for failing to express their answers fully.

Expected response: *the output of a NAND gate is opposite the output of an AND gate, for the same inputs.*

the output of an AND gate is high only if both inputs are high while the output of a NAND gate is high if at least one input is not high.

(e) This question was also challenging as most candidates failed to identify the given circuit symbol as *a light emitting diode*. Common wrong responses included diode, pause button, next button.

Question 7

The question was testing candidates understanding of the reactions of calcium compounds.

(a) This part of the question was generally well done. Most candidates were able to score both marks. A common wrong response for reagent **F** was hydrogen.

Expected response: ***(i)*** *quick lime*

(ii) *water*

(b) This was another well-done question. The majority of the candidates were able to explain why process **G** was a physical change. Common wrong responses were “calcium hydroxide can be reversed to form calcium oxide”.

Expected response: *the process is reversible/ no new substance is formed.*

(c) **(i)** This part of the question proved to be challenging for most candidates as they failed to explain why the bottle collapses. Candidates were required to explain why a plastic bottle with carbon dioxide, half-filled with distilled water and then shaken collapses. Most candidates confused collapsing with bursting or exploding, and also confused distilled water with lime water. Common wrong responses were: distilled water turns milky; bubbles are formed when shaking and the plastic bottles explodes or bursts.

Expected response: *carbon dioxide dissolves in water creating a vacuum hence decreasing the pressure inside the bottle.*

(ii) This question also proved to be very challenging for most candidates. Most candidates failed to describe the experiment to obtain crystals of calcium chloride from its solution. A common wrong response was “evaporate the mixture and calcium chloride crystals will be left behind”.

Expected response: *filter to remove excess calcium carbonate,*
heat to saturate or concentrate
and cool to form crystals.

(iii) **Step 1:** This was a fairly done question. Most candidates were able to recall the formula n = cv, however some candidates lost a mark for writing an expression instead of a formula. Some candidates lost a mark for failing to convert 100 cm^3 to 0.1 dm^3

Expected response: *n = cv = 0.4 x 0.1 = 0.04 moles*

OR

0.4 moles : 1 dm^3

n moles : 0.1 dm^3

$n = \frac{0.1 \times 0.4}{1} = 0.04$ *moles*

Step 2: This question was fairly done. A noticeable number of candidates were able to identify the ratio of HCℓ and CO_2 from the equation and then use it to determine the number of moles of carbon dioxide gas produced. There were no common wrong responses, however, there were a number of candidates who left the part question unattempted.

Expected response: *HCℓ : CO_2*

2 : 1

0.04 : x

x = 0.02 (moles CO_2)

Step 3: This was a fairly done question as the majority of candidates were able to recall the formula v = n x V_m and were able to use it with their value from step 2.

Expected response: *v = n x V_m = 0.02 x 24 = 0.48 dm^3*

Question 8

This question tested candidates' knowledge of forces and stretching.

(a) This was a fairly done question. Some candidates describe an elastic object instead of defining elasticity and they lost the mark.

Expected response: *the ability of an object to return to its original shape or size after being stretched or compressed.*

(b) This was one of the most well-done question in this component. Most of the candidates were able to determine the extension and length of the spring from the given information.

Expected response:

mass / g	*length of spring / cm*	*extension / cm*
0		
50		*4*
100		*8*
150	*22*	
200	*26*	

(c) (i) This question was well done. Most candidates were able to identify the limit of proportionality from a given load – extension graph. A common wrong response was putting the cross (x) at the end of the graph.

Expected response: *a cross at the beginning of curving of the graph.*

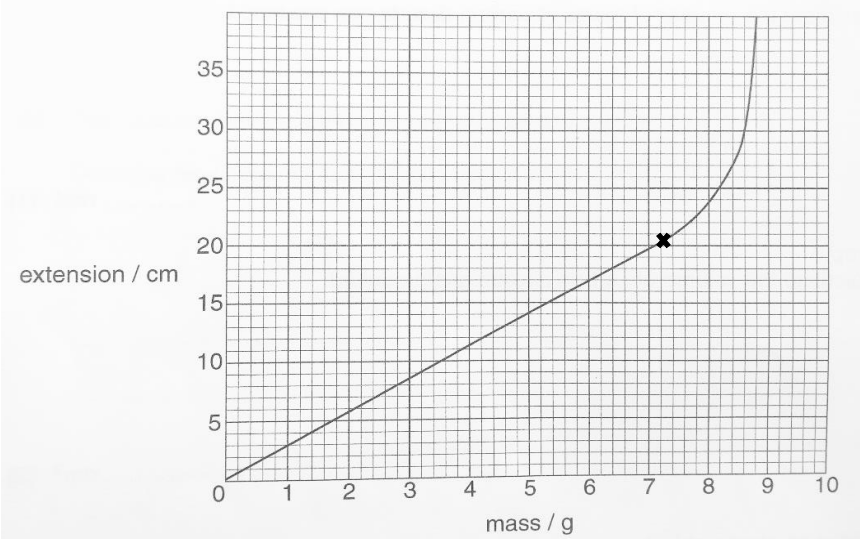


Fig. 8.1

(ii) This question was poorly answered as most candidates failed to explain what happens to the spring when the load of 9 g was removed. A common wrong response was that the spring will go back to its original length. Most candidates who scored a mark from this question were candidates who were able to state that the spring will not go back to its original length but they failed to explain why.

Expected response: *the spring does not return to its original length because it has exceeded its limit of proportionality.*

Question 9

This question assessed candidates' knowledge of energy and its related concepts.

(a) This part of the question proved challenging for the majority of the candidates as most candidates failed to score even 1 mark out of the available 2 marks. Candidates were required to describe what is meant by 1 J of work. Most candidates attempted to define work with no reference to 1 J of work.

Expected response: *1 J of work is the work done when a force of 1 N moves an object over a distance of 1 m in the direction of the force.*

(b) This was another challenging question for most candidates. Nuclear energy was very scarce in the candidates' responses. Even most of the high scoring candidates only managed to score 1 mark.

Candidates were required to state the main energy changes that take place in a power station that uses nuclear fission to release energy. A common wrong response was that of including light and heat at the end of the energy change.

Expected response: *nuclear energy → electrical energy*

(c) This question was fairly well done as most candidates were able to score the available 2 marks.

Candidates were required to explain why the energy changes in a car system are not 100% efficient. A few candidates omitted "some" and just wrote energy is lost" and lost the mark.

Expected response: *some of the energy is lost as heat (due to friction between all moving parts)*

Question 10

This question tested candidates understanding of organic chemistry.

(a) This part of the question was well done as the correct response of *alkanes* was very common. Common wrong responses were butane and alkenes.

(b) **(i)** This was another well-done question as the majority of the candidates were able to score the mark. Candidates were required to identify a structure, from a table of given structures, that is
an unsaturated organic compound. The ***expected response*** *of structure J* was common.

(ii) This was a fairly done question. Candidates were required to describe the test for an unsaturated organic compound. Some candidates who had an idea lost the mark for stating the test instead of describing it, for an example, candidates lost the mark for writing "bromine water" instead of "add bromine water". Common wrong responses were: clear, transparent, loses colour and colour disappears for the result.

Expected response:

test: *add bromine water or add iodine solution or add acidified potassium manganate (VII) solution*

result: *becomes decolourised or becomes colourless*

(c) This part of the question seemed challenging as most candidates were not able to state the conditions needed to convert structure **L** into structure **J**. Some candidates who had an idea of the correct response lost the mark for failing to state that the catalyst sulfuric acid or phosphoric acid must be concentrated. Common wrong responses for temperature were: 450°C and very high temperature. Pressure of 60 - 70 atm was another common wrong response.

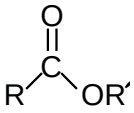
Expected response: catalyst: *concentrated sulfuric acid or concentrated phosphoric acid or aluminium oxide*

temperature: *150°C - 170°C*

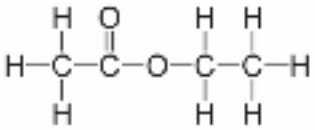
(d) This question was poorly done as only a minority of the candidates were able to score both marks.

Candidates were required to draw the structure formed when **K** reacts with **L**. A few candidates were able to score a mark for the functional group only. Common wrong responses included structures with the carboxylic group COOH and structures with the alcohol group OH.

Expected response: ester functional group;

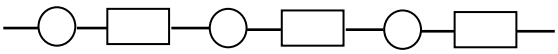


correct structure;



(e) This was another challenging question as the correct part structure of starch was very rare amongst candidates' responses. Candidates were required to draw a part structure of starch using a given model of a glucose molecule. A large number of candidates left this question unattempted. There were no common wrong responses as candidates gave varying wrong responses.

Expected response:



Question 11

This question assessed candidates understanding of transformers.

(a) This was a fairly done question. Correct comparison of a step-down and step-up transformer significant but not very common. Candidates lost marks for failing to base their comparison on the primary and secondary coils. Common wrong responses included incomplete comparison statements and number of coils instead of number of turns.

Expected responses: *step-down transformer reduces voltage in the secondary coil while a step-up transformer increases voltage in the secondary coil.*
a step-down transformer has less number of turns in the secondary coils than in the primary coil while a step-up transformer has more number of turns in the secondary coil than in the primary coil.

(b) This part question was also poorly performed as most candidates failed to score even a single mark from the available 2 marks. A few candidates were able to score 1 mark. Candidates were required to explain why high voltage is used in the transmission of electricity. A common wrong response was that the electricity needs to travel very distances.

Expected response: *low current in the cables reduces energy loss as heat in the cables.*

(c) This question was fairly done as there were noticeable number of candidates who scored the mark. Candidates were required to explain why power cables are hung slack between the poles. Common wrong responses included: they are hung slack so that they do not come to contact with each other when they expand and to allow for thermal expansion.

Expected response: *to allow for <u>contraction</u>.*

EGCSE PHYSICAL SCIENCE

Paper 6888/03

Practical Test

General Comments

This Practical Test paper assesses the experimental skills and investigative skills of candidates, which is Assessment objective C of the syllabus. The paper consists of two questions, one Chemistry and one Physics, each totaling 20 marks. The time allocated the paper seemed to be adequate as candidates attempted all questions. Candidates should be encouraged to carry out the experiments more than once if there is still time to spare as this assist candidates to make the correct observations and increases the reliability of results.

The performance of candidates was generally poor when compared to the previous year. Generally, the candidates' performance in questions involving substitution into formula and writing their answers to 3 significant figures was not satisfactory. Some candidates lacked calculator skills as proven by their failure to get a correct value regardless of substituting correctly. Most candidates displayed poor graphical skills especially choosing a reasonable scale suitable for their results, plotting points clearly and drawing a curve or line of best fit was not common. Candidates are also encouraged to use the results they obtained in subsequent questions and not use made-up values as this results in the loss of marks.

Candidates performed poorly in questions involving the command words 'suggest', 'explain' and 'justify your choice". Quite a number of candidates also performed poorly in questions where their responses involved comparisons.

The time allocated the paper seemed adequate as there was no evidence of mass failure to finish by the candidates.

Comments on specific questions

Question 1

The question required candidates to investigate the reaction of zinc metal and aqueous copper(II) sulfate. Candidates were provided with zinc granules, a thermometer and a polystyrene cup containing 50 cm^3 copper(II) sulfate.

(a) This part of the question was generally well done as most candidates could read thermometer scales correctly. Candidates inserted a thermometer into the polystyrene cup and measured the initial temperature of the copper(II) sulfate. Candidates who lost the mark on offer are those who had challenges reading the scale hence gave very low or very high temperatures beyond the scale of a laboratory thermometer. Common wrong responses included: $-2.3, 4.8, 2300$.

***Expected response**: room temperature/ supervisor's value* ± 1

(b) Candidates then placed the zinc granules into the polystyrene cup containing copper(II) sulfate and started the stopwatch. Candidates gently stirred the contents of the polystyrene cup with the thermometer.

(i) This part of the question was well done by candidates. Candidates measured and recorded the temperature at 60 seconds intervals for 480 seconds. Candidates who lost the mark on offer are those who had fluctuating temperature values.

***Expected response**: general increase in temperature from 60s to 480s*

(ii) This part of the question was well done. Candidates were asked to calculate temperature changes using the formula $\Delta T = T - T_0$. A few candidates calculated the difference between successive temperatures instead of subtracting the initial temperature, T_0, from each temperature value. Some candidates subtracted the temperature from the time interval given in the table, and they lost the two marks.

***Expected response**: correct differences calculated from candidates recorded values*

(iii) Candidates were asked to explain using the collision theory why they continuously stirred the contents of the polystyrene cup. This part of the question was fairly well done. Most candidates could not get all the marks on offer since they gave incomplete responses. They either referred to gain in kinetic energy by particles and not say anything about more successful collisions or vice versa. Common wrong responses: stirring increases temperature of contents/ causes collisions between particles/ makes particles move.

***Expected response**: causes an increase in kinetic energy of particles and results in more /increase in successful collisions*

(c) **(i)** This part of the question was fairly well done, although some candidates only earned one mark instead of two as their justification contradicted their choice. Some candidates did not give any justification as a result they only earned one mark. Candidates were asked to state whether the reaction was endothermic or exothermic and give a reason for their choice.

Common wrong responses included: exothermic reaction because the temperature decreases/ endothermic because there is a rise in temperature/ exothermic because temperature is absorbed from the surroundings/ endothermic because temperature is given out to the environment

***Expected response**: exothermic because there is a temperature increase/ energy is released to the environment*

(ii) This part of the question was poorly done. Candidates were asked to explain why it was better to use a polystyrene cup than a beaker to carry out the experiment. Most candidates made reference to the precaution, "*stir gently to avoid breaking the bulb of the thermometer"* given in the question in their responses which resulted in the loss of the two marks on offer. Some candidates who understood the question lost the marks as they only referred to either the beaker or polystyrene cup and showed no comparison between the two in their responses. Common wrong responses were the beaker is hard it would break the bulb of the thermometer/ polystyrene cup is soft and makes it easy to stir without breaking the thermometer/ a beaker is a good conductor of heat/ a beaker will lose heat energy to the environment.

***Expected response**: polystyrene cup poor conductor/ better insulator than beaker hence retains more heat/ less heat lost through walls*

(iii) This part of the question was poorly done. Candidates were asked to suggest a modification to the polystyrene cup that could improve the accuracy of the results. Most common wrong responses included increase surface area of cup/ calibrate cup/ use transparent cup/ cover cup with metal.

***Expected response**: cover top with lid/ stopper/ lag cup (with a named insulating material)*

(d) Candidates were asked to carryout filtration on the contents of the cup. The filtration apparatus were set up by the supervisor.

(i) The question was well done although quite a number of candidates earned one mark instead of two as they could not name the residue. Candidates were asked to describe the residue and suggest the name of the new substance formed. Common wrong responses were zinc granules have changed colour from silver to brown/ colour remains blue/ copper(II) sulfate / reddish residue/ dark substance/ zinc granules.

Expected response: observation: brown/ red-brown solid

name of residue: copper metal

(ii) This part of the question was fairly well done. Candidates were asked to identify the type of reaction that has occurred between copper(II) sulfate and zinc granules. Common wrong responses included chemical reaction/ endothermic reaction/ exothermic reaction/ substitution reaction

***Expected response**: displacement reaction of metals/ reduction*

(e) This part of the question was challenging to a majority of candidates. Candidates were asked to suggest and explain an additional observation they could have made if the zinc granules were left in the solution for 30 minutes. Most of the candidates seem not to understand the question hence their responses referred to the filtrate that it will remain blue. A few number of candidates were able to give the expected observation of blue colour fades but could not explain why it fades. Common wrong responses included solution becomes darker/ zinc granules change colour/ more copper ions in solution/ copper oxidised

Expected response: observation: blue colour fades/ solution becomes colourless
explanation: copper(II) ions decreases/ copper(II) ions used up/ copper(II) ions reduced to copper metal

(f) Candidates were asked to place 5 cm^3 of the filtrate into a test-tube and add a few drops of nitric acid and a few drops of barium nitrate solution.

(i) This part of the question was fairly well done. Candidates were asked to state and explain their observation. Quite a number of candidates were able to state the expected observation but could not explain it as a result they earned one mark out of two. Common wrong responses included blue precipitate formed showing the presence of copper ions/ dark brown ppt showing that copper is formed/ milky suspension on top of solution

Expected response: a white precipitate formed showing the presence of sulfate ions

(ii) This question was poorly done as most candidates displayed a poor understanding of the reactivity. Candidates were asked to explain why there was no change when an aluminium rod were placed in the filtrate and left for 30 minutes. Most common wrong response: zinc displaces aluminium, its more reactive/ aluminium cannot displace zinc from its compounds as aluminium is less reactive/ aluminium is unreactive

***Expected response**: aluminium rod is covered with an oxide layer which prevents the aluminium from displacing zinc from its compounds*

Question 2

In this experiment candidates determined the upward force exerted by water on a test-tube. Candidates were provided with a test-tube marked with 5 equal divisions fitted with a stopper with a pin and string tied to the pin.

(a) Candidates determined the weight of the test-tube + stopper by hanging these on a spring balance and recorded the weight as $\mathbf{W_1}$.

(i) This part of the question was fairly well done. Common wrong response included values that were larger than the scale of the spring values such as 25 N.

***Expected response**: supervisor's value* ± 1

(ii) This part of the question was well done. Candidates poured water into the test-tube up to the second mark and then measured the weight of the test-tube with the water + stopper, $\mathbf{W_2}$, using the spring balance. A few candidates lost the mark by having this value less than the value of the test-tube + stopper without water ($\mathbf{W_1}$).

***Expected response**: W_2 greater than W_1*

(iii) This part of the question was well done. Candidates were asked to calculate the weight, **W**, of the water in the test-tube using the results they obtained in **(i)** and **(ii)**. Some candidates who lost the two marks subtracted $\mathbf{W_2}$ from $\mathbf{W_1}$ and got a negative value for weight. Common wrong response: negative value of weight/ subtract made-up values not recorded anywhere.

***Expected response**:* $W_2 - W_1$ */ correct substitution and correct value*

(iv) Generally well done although a majority of candidates earned one mark instead of two as they changed their answer when recording in the table. Candidates were asked to calculate the mass, **m**, of water in the test-tube using the formula $\mathrm{w} = \mathrm{mg}$ and recorded in the given table. A majority of candidates correctly substituted into the formula but failed to transpose the formula making mass the subject. These candidates earned one mark for correct substitution. Common wrong response: candidates will get the correct value the divide it by 10. eg $m = 0.2 \div 10 = 0.02$ then divide the answer by 10 again resulting in the loss of the second mark. Some candidates attempted to converted the mass into grams and lost a mark since the column in the table had kilograms as unit.

***Expected response**: correct substitution into* $w = mg$ *and correct value of mass calculated.*

(v) Generally, well done as candidates were able to get increasing values of mass. Candidates then determined the mass of water for the other three divisions **1**, **3** and **4** by carrying out three more experiments. Candidates repeated steps **(ii**), **(iii)** and **(iv)** for each division and recorded the values of mass for each division.
Common wrong responses: values of mass that were unrealistic that is very large like 500 kg/ values of mass that were fluctuating.

***Expected response**: mass of water for division1 less than mass of water for division 2 and general increase in mass down the column*

(b) Candidates then carried out experiments to determine the weight of the test-tube containing water up to the division 2 as it is lowered into the water. Candidates suspended the test-tube on the spring balance then lower the test-tube into a measuring cylinder containing three quarters of water.

(i) This question was generally well done. Some candidates lost a mark for writing unrealistic values.

***Expected response**: weight less than weight W_2*

(ii) This part of the question was challenging to many candidates. Candidates repeated **(b)** by lowering the test-tube using the other markings 2, 3 and 4 with the same amount of water at up to division 2. Candidates recorded the values of weight at each marking.
Most common wrong response: increasing values of weight.

***Expected response**: decreasing values of weight down the column*

(iii) This part of the question was challenging and quite a number of candidates left it unanswered because they had value of weight for the fourth division. Candidates were asked to suggest why there was no reading after the fourth division. Common wrong response: has reached its limit of proportionality/ spring has been damaged
***Expected response**: test-tube is floating or upward force is equal to weight of test-tube*

(c) This part of the question was challenging. Quite a number of candidates did not use the values they already had in the table hence lost the two marks on offer. Candidates were asked to calculate the upward force of water on the test-tube at the different markings by using the formula $\text{upward force} = \mathbf{W_2} - \mathbf{W_3}$. Some candidates did not use their value of $\mathbf{W_2}$ instead they subtracted 10 from all the values whilst others divided their $\mathbf{W_3}$ values by 10. They also lost the two marks.

***Expected response**: correct values of differences using their values*

(d) This part of the question was fairly done. Candidates were asked to state what happens to the weight of the test-tube as it is lowered into the water in the measuring cylinder. Quite a number of candidates were able to use their results and interpret them correctly even though their results were wrong hence earned the mark on offer.

***Expected response**: weight decreases or weight becomes smaller*

(e) This part of the question was fairly well done. Candidates were asked to plot a graph of upward force of water against the division mark on the test-tube using their results. The axes were labelled for the candidates. Some candidates showed poor graphical skills, they could not come up with a reasonable and linear scale instead use the results of upward force as they are. This resulted in the loss of three marks –for scale, plotting and graph. Some candidates changed the axes and lost a mark.

***Expected response**: correct scale covering more than half the grid, all points correctly plotted, graph drawn according to points or line of best fit and pass through the origin.*

(f) This part of the question was challenging to a majority of candidates. Candidates were asked to calculate the gradient of the graph they drew in **(e)**. In **(e)** some candidates drew curve not a line of best fit and therefore had to calculate a gradient of a tangent at a point of the curve. Most candidates did not possess such skills hence lost all two marks. Other candidates could not remember the formula for calculating the gradient.

***Expected response**: working shown ($m = \frac{\Delta y}{\Delta x}$) and correct value*

EGCSE PHYSICAL SCIENCE

Paper 6888/04

Alternative to Practical Test

General Comments

The Alternative to Practical Paper assesses the experimental skills of candidates. It consists of two questions: one Chemistry and one Physics question. The paper is marked out of 40 marks. It accounts for a 20% weighting to the overall mark of the candidates in accordance with the provisions of the syllabus. The number of entries was much higher this year relative to the previous year at about 8600, an increase of about 300 from the previous year. The time allocated for the paper seemed to be adequate as most of the candidates attempted all the questions.

The Alternative to Practical Paper is premised on the assumption that candidates conducted experiments during the instructional phase of learning. That is why this paper assessed a range of skills including making observations; accurately reading instruments; analysing results; the use of the correct scientific technical language when making inferences, descriptions and or explanations; graphical skills; the correct presentation of significant figures when handling numerical data; to name but a few.

The paper seemed to be fair to the candidates as it was accessible to most candidates while adequately discriminating, evidenced by the range of marks obtained by the candidates. The main indicator of this was a relatively few candidates obtaining zeros while limiting the numbers earning marks in excess of 80%. The paper was also valid in terms of content and construct validity as all the questions were sourced from the syllabus and candidates were assessed on a range of construct skills such as writing descriptions, making explanations, suggesting modifications and so on. There were no ambiguous questions or sub questions noted during the marking, which was another indicator that the paper was valid.

The general performance of the candidates was good relative to the previous year. The mean mark was also higher than the previous year as well as the highest mark which was 85%. It was noteworthy that there was a significant number of candidates who obtained marks more than 75%, a clear indicator that the paper was more accessible than the one in the previous year.

Comments to specific questions

Question 1

(a) This question was based on the reaction between zinc metal and copper(II) sulfate, where candidates were to demonstrate their ability to read scales. This question was well done because most candidates were able to give the correct value of 24°C. A few candidates seemed to confuse the intervals and came up with 20.4°C as their value and lost the mark. Other common errors were 23, 25 and 37°C.

***Expected response**: 24°C*

(b) **(i)** Candidates were supposed to record the temperature for the time interval, 360 seconds. This question was well done with most candidates correctly obtaining 28.5 °C. A few candidates seemed not to pay attention to accuracy by maybe not using rulers to ensure accuracy, and ended up obtaining values below 28.5°C and values above 29°C. Some candidates failed to note that the thermometer was zoomed and assumed the lines were pointing to the mark 28 or 29°C, even though this did not incur any penalties.

***Expected response:** 28.5°C. However, a range of values from 28°C to 29°C was quite acceptable.*

(ii) Candidates were required to calculate temperature changes for the given time intervals from the initial temperature using the formula: $\Delta T = T - T_0$. The question was competently attempted by most candidates. A significant number of candidates that failed to earn marks assumed that the 'T' in the formula was for time and subtracted the temperature from the time. Some would add the temperature and the time. That is why common errors included values such as 31.5 °C, 94 °C, 34 °C, 88.5 °C, and other big values calculated by adding or subtracting the temperature from time. Others lost the marks by subtracting the temperature from the previous value instead of the initial temperature.

***Expected responses**: 1.5°C, 2.0°C, 3.0°C, 3.5°C, 4.0°C, 4.5°C, 5.0°C, and 5.5°C*

(iii) Candidates were expected to explain, using the collision theory, why the contents in the polystyrene cup were continuously stirred. This question gave a number of candidates some challenges. The main misconception was that candidates assumed that stirring increased the temperature of the reactants which may not necessarily be correct. This subsequently made them to give their explanation in terms of temperature and lost some or all of the marks. Some gave their explanations at a macro level while the explanation had to be at a micro level, that is, in terms of particles. Candidates that elected to name the particles had to name them correctly, otherwise, they would lose at least one of the

marks. The common wrong responses were: to mix the reactants; to dissolve the reactants; to get accurate results; to make particles slide past each other; to increase the temperature, concentration and surface area and to increase the rate of reaction without explaining in terms of the collision theory.

***Expected response**: that stirring increased the kinetic energy of the particles, resulting in increased successful collisions*

(c) (i) Candidates were required to state whether the reaction occurring in the polystyrene cup was endothermic or exothermic and justify their choice with reference to Table 1.1. Most candidates were able to access the first mark but failed to justify their choice. A number of candidates lost the second mark by assuming that an increase in the temperature was caused by absorbing energy. Some candidates used theory to justify their choice instead of the results in Table 1.1. by making reference to the energy of the reactants being more than the energy of the products and lost the second mark. The most common wrong response was referring to the reaction as an endothermic reaction and then mentioning that the increase in temperature was caused by absorbing energy from the surroundings.

***Expected response**: the reaction was exothermic because there was an increase in temperature*

(ii) Candidates were supposed to explain why it is better to use a polystyrene cup than a beaker to carry out the experiment. This question was quite discriminating. Most candidates failed to realise that the beaker and the polystyrene cup were both poor conductors of heat and they had to compare this conductivity. Some candidates thought that the polystyrene cup was a metal and hence a good conductor of heat and thereby lost the mark. Other candidates were making reference to emitters and absorbers of heat which was not acceptable since it was not the painting that was affecting the conductivity but rather the nature of the material. Others mentioned that the polystyrene cup was stronger than a beaker so it would not be broken by the thermometer or more heat. This also led to loss of the mark since some beakers can withstand high temperatures and the temperatures involved were relatively low.

***Expected response**: polystyrene is a poorer conductor of heat than the beaker/ polystyrene is a better insulator so it retains more heat than the beaker/ less heat is lost through the walls*

(iii) Candidates were required to suggest a modification to the polystyrene cup that could improve the accuracy of the results. This question was also challenging to the candidates. A number of candidates decided to change the polystyrene cup instead of suggesting modifications to it. Some suggested covering the cup with metallic lids and were punished since there would be more heat loss by conduction. One of the most common wrong responses was to use a graduated polystyrene cup which earned no marks since there was no measurement of any product or reactant in the experiment. Others mentioned repeating the experiment more than once which was incorrect since the modification suggested had to be on the polystrene cup. Other wrong responses included placing the cup on a flat surface; painting the cup; covering the cup with aluminium foil; increasing the thickness of the cup with no reference to lagging the cup which all could not earn any credit.

***Expected response**: to cover the top with a lid to reduce heat loss or to lag the cup with any named poor conductor such as cotton wool*

(d) (i) Candidates were told that the reaction between zinc and copper(II) sulfate was left undisturbed for 30 minutes and then later filtered. The question required them to state the colour of the residue and suggest its name. Most candidates were failing to attain the first mark, but were able to identify the residue as copper. Some seemed to assume that the copper was still in an ionic state and wrote blue as the observed colour which was unacceptable. Others added suffixes to the observed colours, writing colours such as brownish and were penalised. There were those who lost the second mark by adding an oxidation state to the copper. Common wrong responses were that the colour of copper metal was blue and that the copper was brownish. Other candidates wrote a white precipitate or any other guessed colour. For the residue, common wrong responses included copper(II),
zinc or copper(II) sulfate.

***Expected response**: colour: brown*
name of residue: copper metal

(ii) Candidates were to name the type of reaction that occurred between copper(II) sulfate and zinc metal. Most candidates seemed to have a philia with the type of reactions cited in the question in **(c)(i)**, that is, exothermic or endothermic and lost the mark since there are negligible energy changes when this reaction occurs. Some were general and referred to this as a chemical reaction which did not earn marks since it is rather too broad. A few assumed this was ionic precipitation and also lost the mark. The common wrong

responses were: exothermic; endothermic; chemical reaction; oxidation; neutralisation and physical reaction.

***Expected response**: displacement of metals. Reduction and redox were acceptable responses*

(e) (i) Candidates were given the name of the filtrate as zinc sulfate and were required to suggest the colour of the filtrate and give an explanation for their given colour. This question was poorly done. Most candidates failed to realise that there were no longer any copper ions in the solution. There were zinc ions and zinc salts are white and form colourless solutions.

Some realised that zinc salts are white and then answered in terms of the solid salt, not the solution as per the demand of the question and lost the mark. Those that correctly explained the gradual fading of copper(II) ions in the solution were not penalised. Some wrote that a clear solution was formed and were penalised since even coloured solutions can be clear.

Common wrong responses included: white precipitate, clear solution, blue, brown for the colour of the solution. For the explanation candidates would state that zinc was a transition metal so it forms coloured compounds. They would also mention that zinc salts were white which is true but a relatively neutral response.

***Expected response**: colourless and the explanation was that copper(II) ions were used up/copper(II) ions were reduced to copper metal*

(ii) Candidates were informed that few drops of nitric acid were added and few drops of barium nitrate solution. They were to state and explain their observation. Most of the candidates failed to earn both marks were able to state the observation but seemed not to be aware that they then had to explain the observation. They would therefore get the first mark but not the second one. Some of those that gave an explanation stated that barium sulfate was formed without then indicating that the formation of barium sulfate showed that there were sulfate ions in the solution. Some candidates assumed ammonia would be formed due to the addition of nitric acid and lost the marks. Common wrong responses were: white precipitate due to zinc ions, blue-black colour or a brown colour. There were some candidates that stated that bubbles would be formed and lost the first mark. Most explained the white colour by mentioning the formation of barium sulfate which was an incomplete response.

***Expected response**: a white precipitate would be formed due to the presence of sulfate Ions*

(iii) The candidates were told that an aluminium rod was placed in the remaining zinc sulfate filtrate and left for 30minutes. They were informed that after 30 minutes there was no change observed, and they were to explain why no change was observed. This question was poorly done. The candidates basically failed to realise that the question was on the apparent unreactivity of aluminium. They wrongly assumed, from the observation, that zinc was more reactive than aluminium. Some made reference to the protective layer without mentioning that it was an oxide layer, which was an insufficient response which however did not incur any penalties. A few mentioned that aluminium was inert and lost the second mark. Common wrong responses were: aluminium forms a protective layer that prevents it from being in contact with other substances, the reaction was complete, aluminium is less reactive than zinc, aluminium is unreactive, and aluminium is more reactive than zinc, so zinc cannot displace aluminium.

***Expected response**: aluminium is covered by an oxide layer and the oxide layer prevents aluminium from displacing zinc from its compound even though it is more reactive than it*

Question 2

(a) (i) The candidates were expected to record the weight of the empty test-tube + stopper as 'W_1'. This was an accessible question to most candidates as they were able to read correctly the scale as 0.3 N for W_1. However, some candidates had challenges with correctly reading the scale. The main source of error for such candidates was failure to realise that each subdivision was 0.2 but instead they thought it was 0.1. That is why common wrong responses included 0.15, 0.25, 0.2 etc.

***Expected response**: 0.3 N*

(ii) The candidates were expected to record the weight of the test-tube with water + stopper as 'W_2'. This again was an accessible question as the majority of the candidates were able to correctly read the value as 0.5 N for W_2. The same problem observed in **(a)(i)** of candidates assuming each subdivision is 0.1 instead of 0.2 was observed even here. This made candidates to give wrong responses such as 0.25 or 0.45. Some candidates failed to note that the value was a fraction of a Newton and ended up giving values such as 2.5 N or 5 N which made them lose the mark. That is why the common wrong responses included 0.25 N, 0.45 N, 2.5 N and 5 N.

***Expected response**: 0.5 N*

(iii) In this question, the candidates had to calculate the weight, W, of the water in the test-tube using the results obtained in **(i)** and **(ii)**. Most candidates seemed to understand that they could calculate the weight by taking the difference between their values in **(i)** and **(ii)** and were able to earn the marks on offer. There were those who elected to add the values while some decided to multiply the values. That is why the most common wrong responses included 0.7 N, 0.45 N, 0.25 N, 0.1 N and 0.03 N.

***Expected response**: the difference between 0.5 N and 0.3 N, giving 0.2 N*

(iv) Candidates were expected to calculate the mass, m, of water in the test-tube using the formula W = mg. They were given that g= 10 N / kg. A large number of candidates were able to correctly use their mathematical skills to substitute into the given formula to get correct mass of the water in the test-tube. The candidates then had challenges transferring the mass into Table 2.1 as they would record in the slot for division 1 which made them lose some marks. Some candidates struggled with changing the subject of the formula and ended up multiplying the value obtained in **(iii)** by 10 N instead of dividing it by the same by 10. This made them lose both marks. The most common wrong responses were 2 kg, 20 kg, 0.2 kg and 4.5 kg.

***Expected response**: 0.02 kg*

(v) This question required the candidates to calculate the mass of water in the test-tubes for divisions 1, 3 and 4 using Fig. 2.4. They were expected to record their results in Table 2.1. Candidates had serious challenges with this question as most of them failed to realise that they had to use the method in **(iv)** to calculate the mass for the rest of the divisions. Some correctly calculated the values but then could not write them in the correct rows in Table 2.1.

There were those that lost the marks by taking the readings shown by the spring balances and divide them by 10 N without first subtracting W_2 from the values. These would come up with values such as 0.04 kg, 0.06 kg and 0.07 kg which were common wrong responses since these were the masses of the test-tube + stopper + the water. Those candidates who had a challenge with reading the scale in **(i)** and **(ii)** would give common wrong responses such as 0.02 kg, 0.03 kg and 0.035 kg which did not earn any mark.

***Expected responses**: 0.01 kg, 0.03 kg and 0.04 kg*

(b) Candidates were expected to record the weight of the test-tube when it was lowered up to the first mark as shown in Fig. 2.5. They had to record the weight in Table 2.1 as 'W_3'. This was well

attempted by the candidates were able to correctly read W_3 for the weight of test-tube with water. Even candidates who had challenges with reading scales in the previous sub questions seemed to be able to competently read this value correctly. Those who had challenges with the subdivisions read the values as 0.2 N making this one of the most common errors noted in the question. 0.5 N was another common wrong response as some candidates neglected to ensure accuracy when reading the values.

***Expected response**: 0.4 N*

(c) This question required candidates to calculate the upward force of water in the test-tube at the different markings using the formula:

upward force of water = W_2-W_3

This question was not accessible to most candidates. The main source of error was their failure to identify W_2 and or W_3. They could not pick the correct values to subtract. The candidates seemed to randomly pick values from Table 2.1 and obtained values such as 0.01. 0.02, 0.03 and 0.04 which were common wrong responses. A few candidates would take the difference between their responses in columns 2 and 3 which made them lose all the marks.

***Expected response**: 0.1 N for division 1, 0.2 N for division 2, 0.3 N for division 3 and 0.4 N for division 4. These values were obtained by subtracting the values in the third column of Table 2.1 (W_3) from 0.5 N (W_2)*

(d) The question expected the candidates to use the results in Table 2.1 to state what happened to the weight of the test-tube as it was lowered into the water in the measuring cylinder. A few candidates failed to realise that they had to use the data from column 3 of Table 2.1 to draw this inference and ended up assuming that the weight would increase if they used values from either column 2 or 4. That is why the most common wrong response was that the weight would increase. Some candidates answered in terms of density and made reference to the test-tube being lighter which incurred some penalties.

***Expected response**: weight of the test-tube would decrease or become smaller*

(e) This part of the question expected candidates to suggest why there would be no reading after the fourth division. This question proved to be one of the most challenging to the candidates. Candidates should have deduced from the values in the table that the weight was constantly decreasing and noted that as the weight decreased, the upward force from the water would eventually overcome the weight of the test-tube. This would result in the test-tube floating and giving no reading. A significant number of candidates failed to realise that they had to give an inherently implied explanation of the observed phenomenon in the question and lost the mark.

Some candidates stated that the test-tube had no weight which was unacceptable and some assumed that the spring balance was permanently deformed resulting in the loss of the marks.

***Expected response**: that the test-tube would float in the water or that the upward force of the water would be equal or higher than the weight of the test-tube. Giving the response in terms of the upthrust force earned full marks*

(f) The candidates were expected to plot a graph of upward force of water against the division mark on the test-tube in the given grid. Most candidates managed to score at least one mark from this question as they were able to plot the points using data from the first and last column of Table 2.1.

The main source of error for those that lost most of the marks in the question was failure to come up with the correct scale on both axes. Some used linear scales using their points in the Table 2.1 and lost most of the marks. A few candidates would plot points that were not in Tale 2.1 and lost most or all of the marks. Those that had negative values in their data struggled to make their graphs to pass through the origin and were duly penalised.

***Expected response**:*

- *correct scale covering more than half the grid in both axes;*
- *all points correctly plotted*
- *line of best fit plotted*
- *plotted line extrapolated to pass through the origin*

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(g) The candidates were expected to calculate the gradient of the graph in Fig. 2.5. This was generally well done as most candidates were able to calculate gradients from their graphs. Candidates that drew curves instead of straight lines had slight challenges with calculating gradients of tangents in the curves. Some candidates attempted to calculate the gradients using the formula: $y = mx + c$ and failed to obtain any marks as this method was not applicable in this case. Some lost marks by using values that were not on their graph to calculate the gradients. A few candidates would divide the change in the horizontal values with the vertical change which made them to also lose the marks.

***Expected response**: a gradient of 0.2*