3.6 GENERAL SCIENCE (237)

General science was tested for the first time in the year 2010. It is composed of two theory papers; Paper one and paper two .Each paper has three sections A, B and C. Section A has Biology questions with 34 marks, section B Chemistry questions with 33 marks and section C Physics questions with 33 marks. Each of the papers is marked out of 100.This subject is mostly done by private and non-formal centers that usually have no qualified science teachers.

CANDIDATES OVERALL PERFORMANCE

The overall performance of candidates in General Science between the years 2010 and 2013 is as shown in the table below.

Table 13: Candidates overall Performance in the Years 2010, 2011, 2012 and 2013

year	paper	candidature	Maximum score	Mean score	Standard Deviation
2010	**Paper 1**	1211	100	13.77	25.44
	Paper 2	1211	100	11.97	08.87
	overall	**1211**	**200**	**25.44**	**16.94**
2011	**Paper 1**	1242	100	12.84	10.12
	Paper 2	1237	100	9.68	7.91
	Overall	**1245**	**200**	**22.42**	**17.29**
2012	**Paper 1**	1285	100	13.93	10.61
	Paper 2	1285	100	9.46	8.92
	Overall	**1285**	**200**	**23.34**	**18.71**
2013	**Paper 1**	1100	100	12.33	10.99
	Paper 2	1100	100	7.22	6.64
	Overall	**1100**	**200**	**19.46**	**16.92**

From the table it can be observed that:

(i) Candidature for the subject reduced from 1285 in 2012 to 1100 in 2013 (0.14% decrease).

(ii) The mean for paper 2 in all the years has been lower than that of paper 1.This may be due to the fact that majority of candidates taking this subject are from private/non-formal centers who usually have no teacher. This makes it hard for them to cover and conceptualize concepts in forms 3 & 4 which are tested in paper 2.

(iii) There was a drop in the overall mean from 18.71 in 2012 to 16.92 in 2013.

The following is a discussion on some of the questions that were poorly performed.

3.6.1 General Science Paper 1 (237/1)

SECTION A: BIOLOGY

Questions that appeared to have given candidates a great challenge include numbers 2, 3, 8 and 10. These questions are briefly discussed below.

Question 2

(a) Give **one** function for each of the following parts of a light microscope: (2 marks)

(i) mirror;
(ii) rotating nose.

(b) Distinguish between a tissue and an organ system. (2 marks)

Candidates were required to give one function each for specified parts of a light microscope and differentiate between tissue and organ system.

Weaknesses
Most candidates were not able to state the right functions of the parts of a light microscope given. They didn't have a correct grasp of microscopy and majority appeared like they don't know the parts of a microscope. Candidates were also confusing the terms cell, tissue, organ and organ system.

Expected response
(a) (i) Directs/reflect light onto the specimen;
(ii) Places desired objective lens into position;

(b) Tissue - a group of similar cells performing a function;
Organ system - a group of (connected) organs functioning as a unit;

Question 3

(a) What is meant by active transport? (1 mark)

(b) Give **one** role of each of the following in plant roots: (2 marks)

(i) active transport;
(ii) osmosis.

Candidates were required to define active transport and give a role each of active transport and osmosis in plant roots.

Weaknesses
Candidates didn't bring out the complete definition of active transport. Some left out "a cross cell membrane" and "against concentration gradient". Majority didn't know the role of active transport and osmosis in plant roots.

Expected response

(a) Movement of substances against concentration gradient across cell membranes using energy;

(b) (i) Absorption of ions/mineral salts;
(ii) Absorption of water;

Question 8

(a) Name **two** products of anaerobic respiration in plants. (2 marks)

(b) Give **two** adaptations of blood capillaries to their function. (2 marks)

Candidates were required to name products of anaerobic respiration in plants and give adaptations of blood capillaries to their function.

Weaknesses
Some candidates gave products of aerobic respiration instead of anaerobic while others gave products of anaerobic respiration in animals .On adaptation of capillaries to function, some candidates were writing incomplete responses which denied them a mark. They just stated adaptation without relating it to function.

Expected response

(a) Carbon dioxide; alcohol; energy;

(b) Thin walled to reduce diffusion distance;
Numerous to increase surface area;
Moist to dissolve diffusing substances;

Question 10

(a) Describe how diabetes mellitus occurs. (2 marks)

(b) Explain the importance of sweating in regulating human body temperature. (2 marks)

Candidates were required to describe how diabetes mellitus occurs and explain the importance of sweating in regulating human body temperature.

Weaknesses
Some candidates were writing wrong biology when answering. Some wrote that bacteria enters the body, weakens the tissues making diabetes to spread. On sweating, some wrote that it enables the body to remove waste products like excess salts enabling blood to move faster which was not specific to the question that was asked.

Expected response

(a) Failure of the pancreas to secret enough insulin/Failure of the liver to convert glucose into glycogen; leading to excess sugar in the blood.

(b) When it is hot, sweat is produced on the skin;
The sweat uses heat from the body to evaporate thereby cooling the body;
(Latent heat of vaporisation)

SECTION B: CHEMISTRY

Candidates find this Chemistry section more friendly compared to Physics hence they tend to give it a lot of attention as shown by their performance. However, Chemistry still remains a challenge to this particular group of candidates.

Questions that were most challenging to the candidates are numbers 11, 15, 19 and 21which are briefly discussed below.

Question 11

A mixture contains ammonium chloride, sodium chloride and sand. Describe how one can separate and recover the substances in the mixture. (3 marks)

Candidates were required to describe how the mixture can be separated into its constituents.

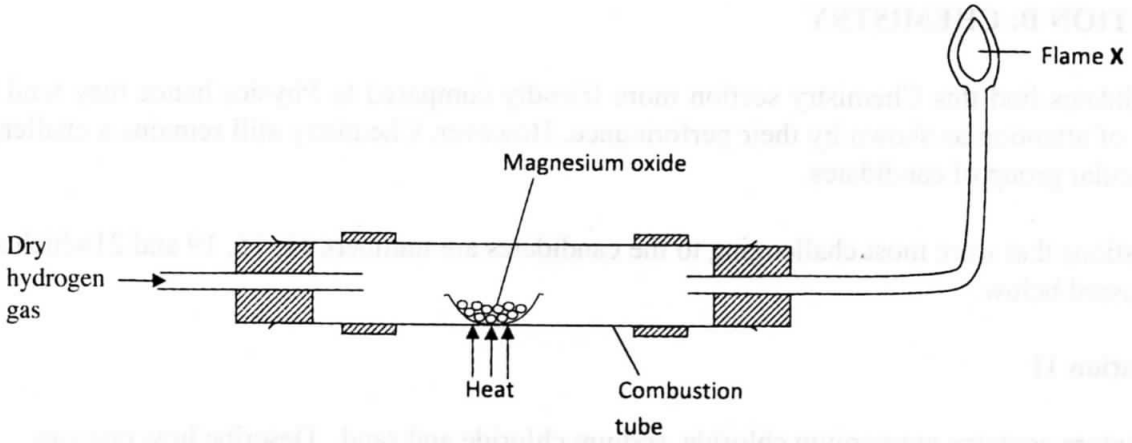
Weaknesses
Most of the candidates were unable to describe the process systematically to the end but gave uncoordinated bits.

Expected response

Heat the mixture $\surd(1/2)$ for ammonium chloride to sublime and collect the sublimate;$\surd(1/2)$.
Add water $\surd(1/2)$ to dissolve sodium chloride and decant / filter $\surd(1/2)$ to obtain sand as the residue and sodium chloride solution; Evaporate sodium chloride solution to dryness $\surd(1/2)$ to obtain sodium chloride crystals. $\surd(1/2)$

Question15

The diagram below illustrates an experiment where dry hydrogen gas is passed over heated magnesium oxide



(a) State the observation that is made in the combustion tube. (1 mark)

(b) Explain the observation made in (a) above. (1 mark)

(c) What substance burns at flame X? (1 mark)

Candidates were expected to state and explain the observation made when magnesium oxide is heated and to name the substance that burns at x.

Weaknesses

Candidates were unable to state and explain the observation and even name the substance that burns at X.

Expected responses

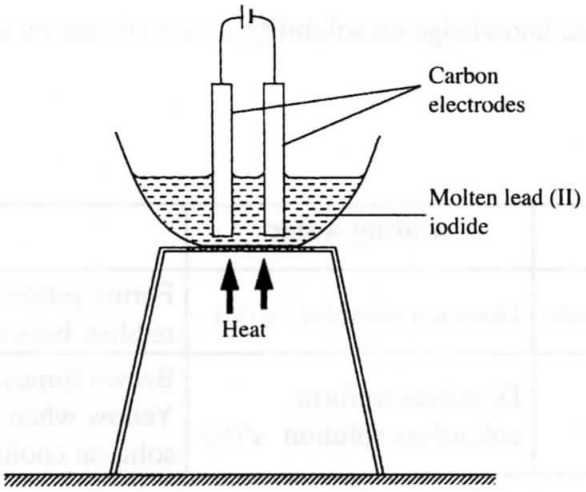
(a) White magnesium oxide remains white. √(1)

(b) Hydrogen is below magnesium in the reactivity series hence it can not reduce its oxide. √(1)
OR
Hydrogen is less reactive than magnesium, so it cannot reduce magnesium oxide.

(c) Hydrogen gas/H_2. √(1)

Question 19

The diagram below represents a set-up that was used to electrolyse molten lead (II) iodide. Use the diagram to answer the question that follows.



Why was molten lead (II) iodide used instead of solid lead (II) iodide. (2 marks)

Candidates were required to understand electrical conductivity of ionic compounds.

Weaknesses

Candidates could not explain why molten leads (II) iodide conducts electricity while solid lead (II) iodide does not conduct electricity.

Expected response

In the molten lead (II) iodide, the ions are mobile √(½) hence conducts electricity √(½)while in solid lead (II) iodide, the ions are at fixed √(½) positions hence does not conduct electricity.√(½)

Question 21

(a) A student put lead (II) carbonate and lead (II) nitrate in separate test tubes and performed the tests as shown in the table below. Complete the table by giving the expected observations.

Salt	Adding Water	Heating
Lead (II) carbonate		
Lead (II) nitrate		

(2 marks)

(b) State **one** use of calcium hydroxide. (1 mark)

Candidates were expected to have the knowledge of solubility and effect of heat on salts. They were also expected to know the uses of hydroxides.

Weaknesses
Most of the candidates lacked knowledge on solubility, action of heat on salts and uses of hrdroxides .

Expected responses

(a)

Salt	Adding water	Heating
Lead (II) carbonate	Does not dissolve √(½)	Forms yellow solid when hot turns reddish-brown solid on cooling √(½)
Lead (II) nitrate	Dissolves to form colourless solution √(½)	Brown fumes produced √(½) Yellow when hot, turns reddish-brown solid on cooling (any one observation)

(b)
- Making builder's mortar and plaster √(1)
- In agriculture to reduce/prevent too much acidity
- Making bleaching powder
- For detecting Carbon (IV) oxide gas in laboratory
- In softening hard water
- In scrubbing in contact process

SECTION C: PHYSICS

Like in the previous years, candidates find the Physics section very challenging. Many candidates don't attempt this section at all. They are advised to utilize the past reports to enhance their knowledge in Physics. The following are some of the questions that were found most challenging.

Question 24

Figure 2 shows a simple mercury barometer set up in a physics laboratory.

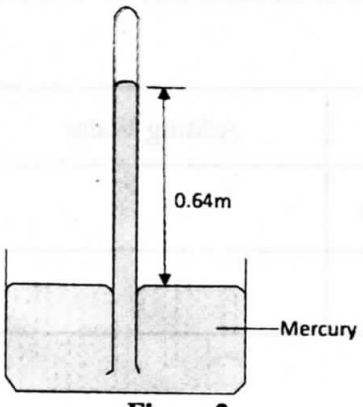


Figure 2

The height of the mercury column is 0.64 m. Given that the density of mercury is 13600 kgm^{-3}

and acceleration due to gravity, g is 10 ms^{-2}, determine the atmospheric pressure in Nm^{-2}.

(3 marks)

Candidates were expected to determine atmospheric pressure in Nm^{-2}.

Weaknesses

Most candidates were unable to determine the pressure; they lacked the appropriate formula for determining the atmospheric pressure.

Expected response

Pressure = $h\rho g$ √

= $\frac{640 \times 1.36 \times 10^4 \times 10}{1000}$ √

= 87040 Nm^{-2} √

Question 26

Figure 3 shows a glass container being used to heat a liquid. The wire gauze is placed between the container and the flame.

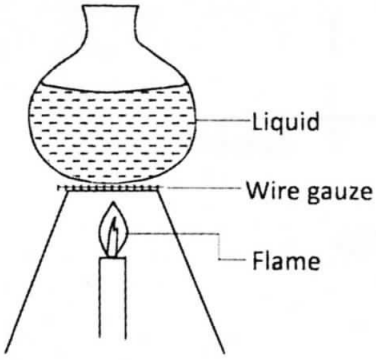


Figure 3

Explain how the wire gauze prevents the glass container from cracking.

(3 marks)

Candidates were expected to explain how a wire gauze on a tripod stand prevents the glass from cracking.

Weaknesses

Other than mentioning the fact that the wire gauze is a good conductor of heat, they did not explain how the conduction prevents the container from cracking.

Expected response

(a) The wire gauze prevents the glass from being heated at one point, √

(b) Since the wire gauze is a good conductor √ it conducts the heat evenly √ to a large area of the glass container.

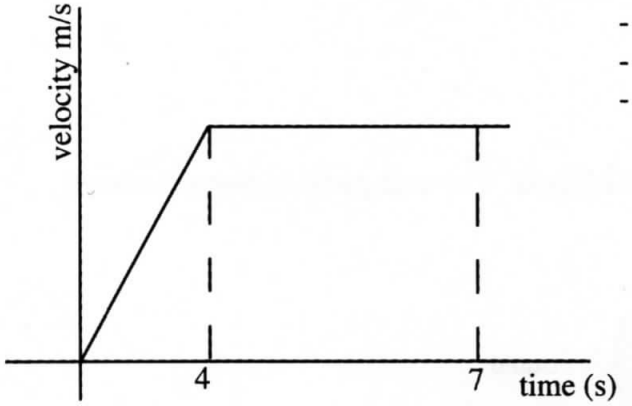
Question 31

A car starts from rest and accelerates uniformly for 4 seconds. It attains a velocity of 15 ms^{-1} and maintains it for 3 seconds. Sketch a velocity time graph for the motion of the car within the 7 seconds. (3 marks)

Candidates were required to sketch a graph of motion for a car that accelerates uniformly from rest and attains a certain velocity for 3 seconds.

Weaknesses
Most candidates did not interpret the motion graphically, some failed to label the axis.

Expected response



- labelled axis √
- accelerating for first 4 seconds √
- uniform velocity between 4 seconds and 7 seconds √

3.6.2 General Science Paper 2 (237/2)

SECTION A: BIOLOGY

Questions that were most challenging to the candidates are numbers 2, 4, 7 and 10 which are briefly discussed below.

Question 2

(a) State the functions of each of the following structures in human beings: (3 marks)

(i) ovary; .....

(ii) uterus; .....

(iii) Cowper's gland. .....

(b) What is implantation? (1 mark)

Candidates were required to state functions of given structures in human beings and define implantation.

Weaknesses

Some candidates described the ovary like it is the one that is fertilized to form a zygote. Majority were not able to give the correct functions of the structures .On implantation, some wrote that it is the process whereby a zygote is attached to the walls of the uterus. They dint understand at what stage an ovum turns into a zygote after fertilization and seems that they didn't know about a blastocyst.

Expected response

(a) (i) Ovary - produces eggs / ova ; and female hormones;

(ii) Uterus - where the embryo develops;
Contraction of the walls aids in the expulsion of the developed foetus during birth / parturition;

(iii) Cowper's gland - secrets an alkaline fluid that neutralizes the acidity along the urethra;

(b) Attachment of the blastocyst to the walls of the uterus; by the villi.

Question 4

(a) What is fertilisation? (2 marks)

(b) With an example, describe discontinuous growth. (2 marks)

Candidates were required to define fertilization and describe continuous growth.

Weaknesses

Most candidates were not able to give a correct biological definition of fertilization. Some definitions were incomplete with some missing nucli fusion to form a zygote. Most candidates were also unable to give correct description of discontinuous growth with examples.

Expected response

(a) The fusion of nucleus of male gamete / sperm with the nucleus of female gamete / ovum; to form a zygote;

(b) In a discontinuous growth, the organism shows a number of periods of rapid growth followed by long periods when no growth occurs; e.g. Growth shown by arthropods; (an example of an arthropod like locust, crab etc).

Question 7

(a) Explain the following terms: (2 marks)

(i) niche; .....

(ii) carrying capacity. .....

(b) Describe the origin of life by special creation. (2 marks)

Candidates were expected to explain the ecological terms and describe the origin of life by special creation.

Weaknesses

Candidates were not very clear especially when explaining carrying capacity. Some wrote that it is the size of communities that a certain ecosystem can support without depletion of its resources. The statement appears to be correct but it didn't bring out the idea that it is the size fo a particular species of organisms. A good number of candidates tried to bring out the idea that organisms were created by God/supernatural being. This may be due to the fact that this concept is not only talked about in biology but also in other gatherings including church. Still some candidates didn't get it right.

Expected response

(a) (i) Niche - the position that an organism occupies in a habitat / a functional description of a species role in a community / an expression of the range of all the factors that influence whether a species has all the resources it needs and whether it can carry out all the activities necessary for survival and reproducing;

(ii) Carrying capacity - the maximum population / number of organisms of a particular speies that can be sustained by a given supply of resources; in an environment.

(b) Special creation - life was brought into existence / created by a supreme being / God; life was created in perfect forms and have remained unchanged over time;

Question 10

State the importance of support and movement in plants. (3 marks)

(i) .....
(ii) .....
(iii) .....

Candidates were expected to state the importance of support and movement in plants.

Weaknesses

The question appeared simple but most candidates gave responses that were biologically incorrect. One candidate wrote that support and movement provides anchorage; promote growth in plants and reproduction and continuity. These are not directly associated with reproduction.

Expected response

Importance of support and movement in plants.

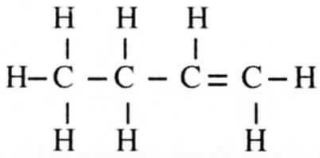
- At cellular level, like growth of pollen tube to bring about fertilization;
- At organ level such as tropic movements for survival value;
- Enable plants to get resources from the environment such as light / water nutrients;
- For escape to avoid harmful stimuli such as temperature;
- Bearing of leaves, fruits

SECTION B: CHEMISTRY

Questions that were most challenging to the candidates were numbers 11, 12, 14, 16 and 19.

Question 11

(a) Name the compound whose structure is given below. (1 mark)



(b) Name **two** reagents that can be used to distinguish between alkanes and alkenes. (1 mark)

(c) State **two** uses of alkenes. (2 mark

Candidates were required to:

a) name an alkene;
b) name the reagents used to distinguish alkanes and alkenes;
c) state uses of alkenes.

Weaknesses

Candidates were unable to name the alkene, name the reagents used to distinguish alkanes and alkenes and state the uses of alkenes.

Expected response

(a) But-l-ene. √(1)/butene

(b) Bormine water. √(½)
Acidified potassium manganate (VII). √(½) /$KMnO_4$

(c) Ripening of fruits.
Manufacture of plastics.
Manufacture of detergents
Manufacture of ethan-1, 2-diol
Manufacture of ethanol through hydrolysis

Question 12

(a) Name **two** common ores of iron. (1 mark)

(b) Describe the reduction process in extraction of iron metal from its chief ore. (3 marks)

(c) State any **one** use of wrought iron. (1 mark)

Candidates were expected to know the ores of iron, have sufficient knowledge of extraction of iron by reduction process and to know the uses the different types of iron.

Weaknesses

Candidates were unable to name iron ores, describe reduction process of iron (III) oxide by carbon or coke and state uses of wrought iron.

Expected responses

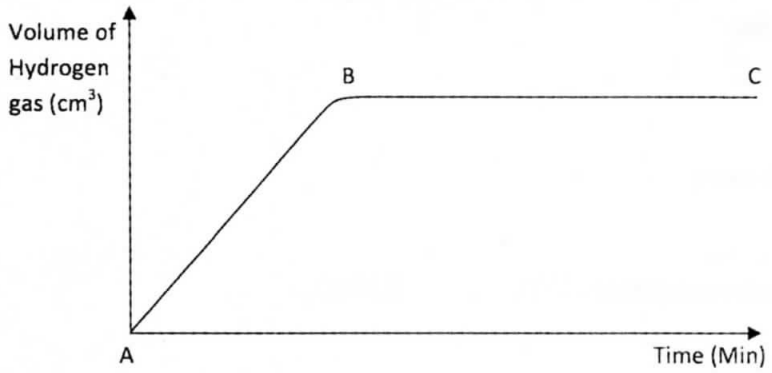
(a) haematite √(½)
magnetite √(½)

(b) Coke in the furnace burns in the hot air to form carbon (IV) oxide √(1).
Carbon (IV) oxide √(1) rises to the middle of the furnance and reacts with more coke to form carbon (II) oxide √(1). Carbon (II) oxide/ coke reduces the Iron (III) oxide to the Iron metal and carbon (IV) oxide. √(1)

(c) Making Agricultural implements, nails, sheets, ornaments and horse-shoes.

Question 14

The graph below shows the rate of production of hydrogen gas when zinc granules are reacted with excess 2 M hydrochloric acid. The hydrogen gas produced was collected in a syringe.



(a) Explain why part BC of the graph is horizontal. (2 marks)

(b) On the same axes, sketch the curve expected if zinc powder of the same amount as the zinc granules was used. (1 mark)

(c) What will be the effect of using excess 1 M hydrochloric acid instead of excess 2 M hydrochloric acid. (1 mark)

Candidates were expected to interpret a graph on reaction rates and to recall the factors affecting rate of reactions.

Weaknesses

Candidates were unable to interpret the graph as required.

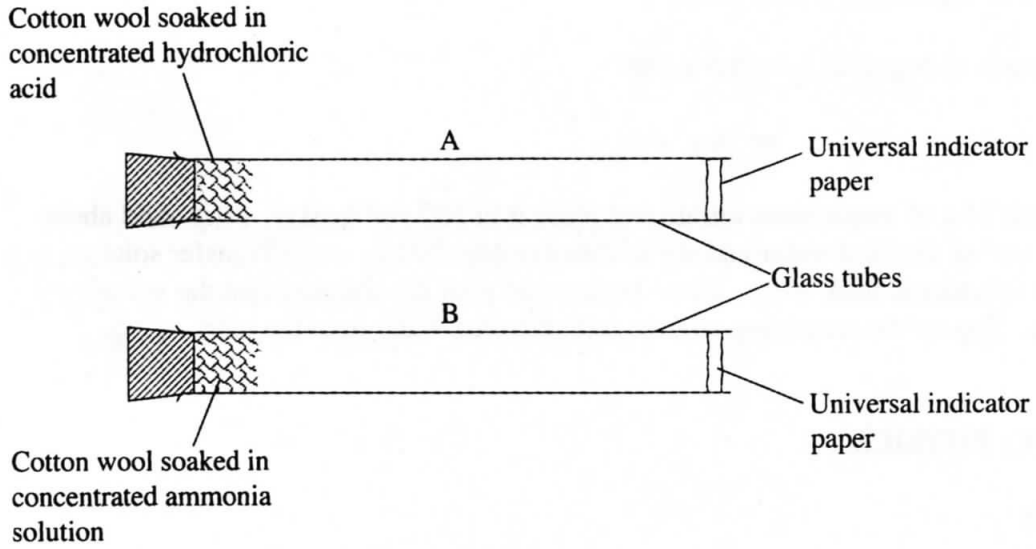
Expected response

(a) The reaction is over √(1) since all the zinc √(1)granules have been used up.

(b) On the graph √(1)

Question 16

The set-up below was used to investigate the rates of diffusion of ammonia and hydrogen chloride gases. Pieces of cotton wool were soaked in concentrated solutions of hydrochloric acid and ammonia respectively, and inserted into the glass tubes A and B of the same size at the same time.
(H = 1.0; Cl = 35.5; N = 14.0).



(a) In which tube did the universal indicator paper change first? Explain (2 marks)

(b) State the observations made in tubes A and B after some time. (1 mark)

Candidates were expected to know the effects of acids and bases on the universal indicator.

Weaknesses
Candidates were unable to state the colour of the universal indicator in an acid and a base.

Expected responses

(a) B / NH_3 √(1)

Ammonia gas (RMM 17) is less dense √(½)than hydrogen chloride gas/hydrochloric acid gas (RMM = 36.5) and hence diffused faster. √(½)

(b) In glass tube A, the universal indicator turned Red, √(½) while in glass tube B, the universal indicator turned green. √(½)

Question 19

Describe how one can prepare one litre of 0.5 M magnesium nitrate solution.
(Mg = 24.0; N = 14.0; O = 16.0). (3 marks)

Candidates were expected to describe the preparation of a molar solution of a given salt.

Weaknesses
Majority of the candidates could not calculate the mass needed to prepare a molar solution. They were unable to describe the correct procedure of preparing a molar solution.

Expected response

RFM of $Mg(NO_3)_2 = 148$ √(½)

0.5 mole of $Mg(NO_3)_2 = 0.5 \times 148$

$= 74$ g √(½)

Weigh 74 g of magnesium nitrate and place it in 500 cm^3 beaker. √(½) Add about 400 cm^3 of distilled water and stir to dissolve $Mg(NO_3)_2$. √(½) Transfer solution to a litre volumetric flask √(½). Rinse beaker and pour the solution into the volumetric flask. Top up the remaining volume with distilled water upto the mark. √(½)

SECTION C: PHYSICS

Question 20

Figure 1 shows two rays of light from a point O at the bottom of a beaker full of water. The rays are refracted into the air at the surface of the water.

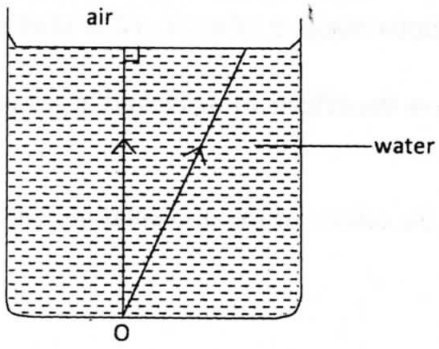


Figure 1

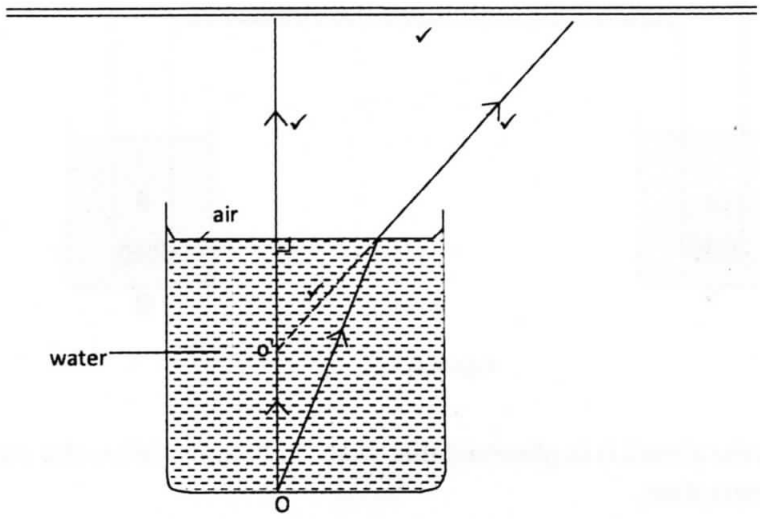
On the diagram, complete the path of the rays in air to show the position of the image O' of the point. (3 marks)

Candidates were expected complete a ray diagram to show the position of an object observed in water due to refraction.

Weaknesses

Candidates failed to realize that the ray is refracted away from the normal and not towards the normal.

Expected response



Question 23

A student is given a magnet with its ends marked N and S. She is also given a metal bar with its ends marked A and B. Explain how the student can prove that the metal bar is a magnet. (1 mark)

Candidates were expected to explain how they can prove that a piece of metal bar is a magnet.

Weaknesses

Most candidates lacked knowledge of the fact that repulsion is the surest way of confirming magnetism.

Expected response

The bar is a magnet if any of √ it ends is repelled by the magnet North or South poles. √

Question 27

Figure 4, shows a circuit consisting of two different coils A and B connected in series with a battery and a switch. The coils are immersed in equal amounts of water in beakers P and Q.

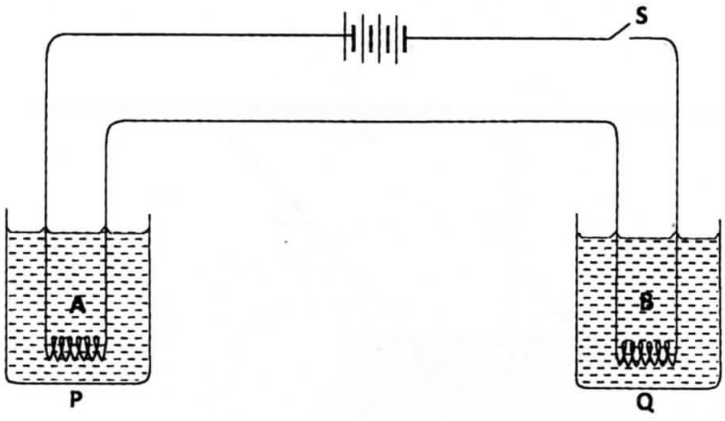


Figure 4

After switching on the circuit it is observed that water in Q boils before the water in P. State a reason for the observation. (1 mark)

Candidates were expected to observe an experimental set up and use it to explain why one of the containers facilitates faster boiling than the other. The greater the resistance the greater the heat generated hence the faster the water boils.

Weaknesses

Candidates failed to recognize that the coils were different and hence offered different resistance hence causing a difference in the heat generated.

Expected response

Coil B has higher resistance than A

Advice to Teachers

Emphasis should be made on

- Application of knowledge in different situations.
- Proper mastery of content by giving practice.
- Though this is general science, teachers should strive to let students do experiments and if this is not possible, carry out demonstrations with them.
- Teachers should strive to ensure that the students grasp the concepts being taught by using creative approaches in presentation of content in class.
- Expose candidates to more problem - solving on electrolytes.
- Expose the learners to graphical presentation of data on reaction rates.

NB: This subject is mostly done by private candidates and non-formal centers that in most cases have no access to qualified science teachers continuously. This poses a challenge in preparing these candidates for national examinations.