## 3.6 GENERAL SCIENCE (237)

The 2022 KCSE examinations for General Science consisted of two theory papers 237/1 and 237/2. There was no change in the format and weighting of the papers.

### 3.6.1 General candidates performance

The candidate's performance statistics since the year 2017 are as shown in the table below.

**Table 15: Performance of candidates for the last 6 years**

| Year | Paper | Candidature | Maximum score | Mean score | Standard deviation |
|---|---|---|---|---|---|
| 2017 | Paper 1 | 1473 | 100 | 11.34 | 11.17 |
| | Paper 2 | 1471 | 100 | 8.43 | 9.12 |
| | Overall | 1476 | 200 | 19.72 | 18.50 |
| 2018 | Paper 1 | 1158 | 100 | 12.32 | 11.82 |
| | Paper 2 | 1154 | 100 | 7.2 | 8.84 |
| | Overall | 1161 | 200 | 19.45 | 19.74 |
| 2019 | Paper 1 | 1120 | 100 | 13.00 | 10.971 |
| | Paper 2 | 1113 | 100 | 7.00 | 7.296 |
| | Overall | 1120 | 100 | 20.00 | 18.267 |
| 2020 | Paper 1 | 1031 | 100 | 9.58 | 11.42 |
| | Paper 2 | 1011 | 100 | 9.45 | 10.45 |
| | Overall | 1031 | 200 | 18.85 | 20.64 |
| 2021 | Paper 1 | 839 | 100 | 16.71 | 14.96 |
| | Paper 2 | 830 | 100 | 12.05 | 13.34 |
| | Overall | 841 | 200 | 28.56 | 26.34 |
| 2022 | Paper 1 | 840 | 100 | 16.14 | 15.35 |
| | Paper 2 | 840 | 100 | 13.54 | 14.08 |
| | Overall | 840 | 200 | 29.64 | 27.93 |

From the table, it can be observed that the mean score improved to **29.64 in 2022** from 28.56 in the year 2021. This is the highest mean score recorded in the subject for the last six years. However, it is worth noting that the candidature has continued to drop since 2017. The performance is still generally poor given that the majority of the students performed way below average.

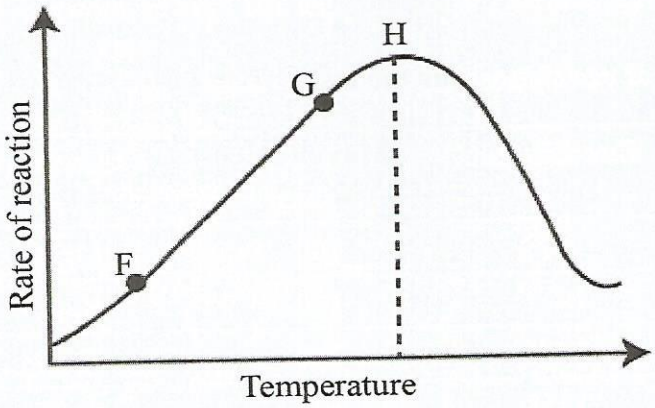
The following is a discussion on some of the questions that were poorly performed.

### 3.6.1 General Science Paper 1 (237)

## SECTION A: BIOLOGY

**Question 5:**

5. The graph below shows the effect of temperature on an enzyme catalysed reaction.




(a) Account for the shape of the curve between points **F** and **G** (2 mark)

(b) State what point H represents. (1 mark)

(c) Other than temperature, name three other factors that affect enzyme-controlled reaction (3 marks)

**Requirement**

Candidates were required to Interpret the graph based on the two variables.

**Weaknesses**

Most candidates were unable to interpret the graph as well as point out the highest point on the graph.

**Expected response**

| | | |
|---|---|---|
| 5(a) | As the temperature increases, the rate of reaction increases because the enzymes are activated. | **(2 marks)** |
| (b) | Maximum rate of reaction/ optimal. | **(1 mark)** |
| (c) | Optimum pH<br>– Substrate concentration<br>– Enzyme concentration<br>– Enzyme co-factors and co-enzymes<br>– Enzyme inhibitors | **(3 marks)** |

**Advice to Teachers**

Teachers to equip the learners with skills on graph based analysis and give assignments related to graph work to improve their interpret skills.

**Question 6**

(a) State the meaning of each of the following:

(i) Blood transfusion (1 mark)

(ii) Agglutination (1 mark)

(b) Complete the blanks to show blood donors and blood recipients in the table below. (4 marks)

| Blood group | Can donate blood to | Can receive blood from |
|---|---|---|
| A | (i) _____ | A, O |
| B | AB and B | (ii) _____ |
| AB | (iii) _____ | (iv) _____ |
| O | A, B, AB, O | O |

**Requirement**

Candidates were required to apply knowledge on compatibility of blood based on the available antigens on the red blood cell surfaces and antibodies in the blood plasma.

**Weaknesses**

Most candidates did not understand antigen antibody interactions and therefore could not get the correct combinations of blood groups.

**Expected response**

| | | |
|---|---|---|
| 6.(a) | (i) Transfer of blood from the donor to (the circulatory system of) the recipient.<br><br>(ii) Clumping together of the red blood cells. | **(1 mark)**<br><br>**(1 mark)** |
| (b) | (i) A, AB<br>(ii) B, O<br>(iii) AB<br>(iv) A, B, AB, O | **4 marks)** |

**Advice to Teachers**

Teachers to use practical approaches and animations to explain antigen antibody interactions in blood with relevant examples.

## SECTION B: CHEMISTRY

The following questions were a challenge to most of the candidates.

**Question 16**

(a) Using dot (•) and cross (X) diagram show the bonding in magnesium oxide. (2 marks)
(O = 8 , Mg = 12)

(b) Diamond is a non-conductor of electricity. Give a reason. (1 mark)

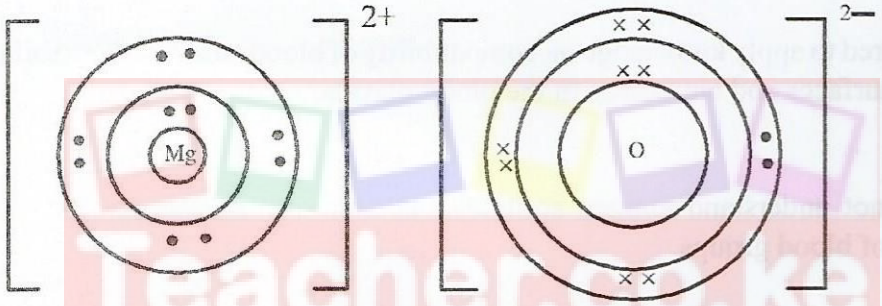
**Requirement**

Candidates were expected to know properties and types of chemical structures and bonding.

**Weaknesses**

Most candidates were unable to identify the ionic bond in magnesium oxide and drew the covalent bond which takes place between atoms sharing electrons.

**Expected response**

| | | |
|---|---|---|
| 16. (a) |  | (2 marks) |
| (b) | It has no delocalized electrons. | (1 mark) |

**Advice to Teachers**

Teachers to emphasize on different types of chemical bonding, formation of the bonds and to inculcate regular practice by the students for mastery of the concept in structure and bonding.

**Question 21:**

The electron arrangement of elements represented by letters S, T, U and J are as follows:
S = 2.8, T = 2.8.8.2, U = 2.8.8.1 and J = 2.7

(a) Select a letter representing an element which forms:
(i) an anion (1 mark)
(ii) a soluble carbonate (1 mark)

(b) Identify a letter representing an element with the smallest atomic radius. (1 mark)

**Requirement**

Candidates were expected to display the knowledge of periodic table, electron arrangements and physical properties of elements.

**Weaknesses**

Most candidates were unable to identify the elements from the electron arrangement.

**Expected response**

| | | |
|---|---|---|
| 21.(a)(i) | J | (1 mark) |
| (ii) | U | (1 mark) |
| (b) | S | (1 mark) |

**Advice to Teachers**

Teachers to provide various ways of identifying elements and their properties using electron arrangement.

## SECTION C: PHYSICS

Even though there is an improvement in the mean score, these candidates have consistently showed lack of basic ability to comprehend correctly simple tasks given. This has always been attributed to the lack of preparedness before sitting the exam.

**Question 23**

**Figure 5** shows a stop watch clock used during a race.

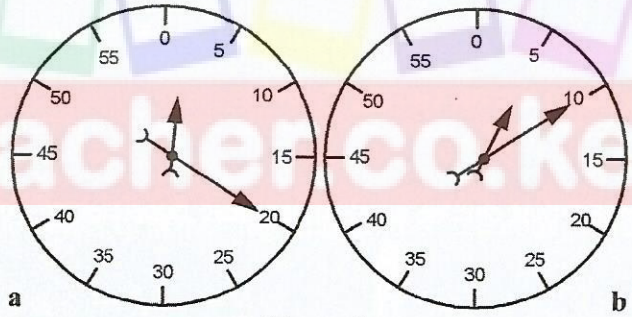



**Figure 5**

**Figure 5 (a)** shows the reading on the clock at the beginning of the race while **Figure 5 (b)** shows the reading at the end of the race. Determine the duration the race took. (2 marks)

**Weaknesses**

None of the candidates who attempted the question got it right. Relating the two scales and their interpretation became a challenge.This shows that these candidates lack basic knowledge on scale reading.

**Expected response**

$(60 \times 5 + 10) - 20$ (√)

$= 290$ seconds (√) or 4 minutes 50 seconds

**Question 25**

**Figure 6** shows a measuring cylinder inverted in a beaker containing some water.

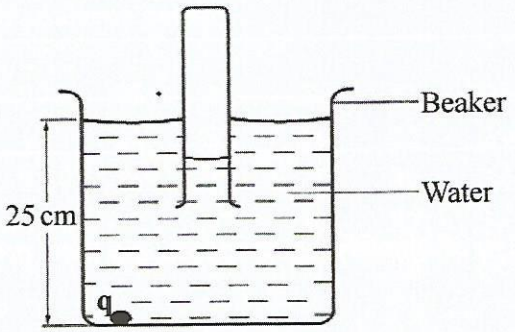



**Figure 6**

(a) State the reason why the level of the water in the measuring cylinder is lower than that in the beaker.

(b) Determine the pressure exerted by the water at point **q**.

**Weaknesses**

Majority of the candidates could not conceptualize why the level of water in the tube was lower than that in the beaker. Majority of them were describing the whole scenario using none physics language.

**Expected response**

Due to pressure exerted by air in the measuring cylinder.

**Question 35**

**Figure 11** shows a hydrometer that can be used to measure densities of liquids.

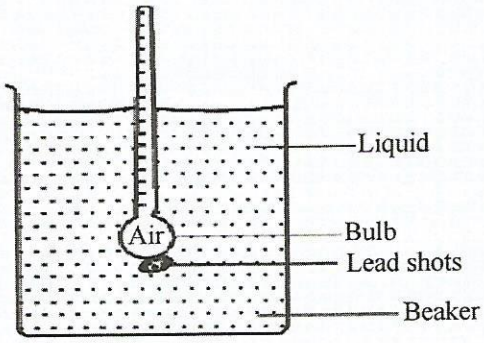



**Figure 11**

Explain what would be observed when the size of the bulb is reduced without changing the mass.

(3 marks)

**Weaknesses**

None of the candidates who attempted this question got it right. This shows lack of competencies in understanding the law of flotation and its applications in real life.

**Expected response**

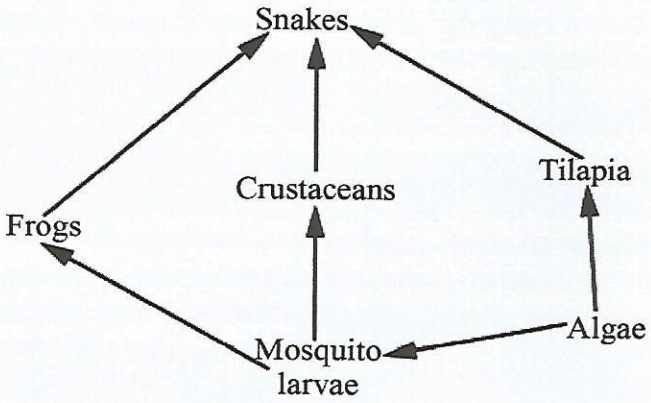
The hydrometer sinks more (√). To displace **same volume** of the liquid keeping the up thrust constant. (√)

### 3.6.2 General Science Paper 2 (237)

## SECTION A: BIOLOGY

**Question 2**

The diagram below represents a food web.




(a) Name the ecosystem from which the food web was constructed. (1 mark)

(b) Identify the producer in the above food web. (1 mark)

(c) Write the food chain in which the snake is a secondary consumer. (1 mark)

(d) State the immediate effect of removing tilapia from the ecosystem. (1 mark)

**Requirement**

Candidates were expected to identify the correct ecosystem using the provided organisms in the food web.

**Weaknesses**

Candidates could not relate the organisms with the correct ecosystem.

**Expected response**

| | | |
|---|---|---|
| 2. | (a) Aquatic/water;<br>(b) Algae;<br>(c) Algae → Tilapia → Snakes;<br>(d) Algae would increase.<br>1 x 4 | (4 marks) |

**Advice to Teachers**

Teachers should expose learners to field excursions to explore various ecosystem for reinforcing concepts in ecology.

**Question 5**

(a) Define each of the following terms:

(i) Hybrid vigour (1 mark)

(ii) Mutagen (1 mark)

(b) The gene for chlorophyll formation in maize causes the plant to be colourless when in homozygous recessive condition. Such plants die after their seed food reserves are used up. In the heterozygous state the plant survives.

(i) Why does the homozygous recessive plant die? (1 mark)

(ii) Let the gene for normal chlorophyll be **R** and that of the mutant recessive gene be **r**. Two pale green heterozygous plants were crossed. What were the genotypes of the offsprings? Show your working. (3 marks)

**Requirement**

Candidates were required to interpret the diagram and explain the observations.

**Weaknesses**

Candidates were unable to interpret the diagram correctly thus ended up with incorrect responses.

**Expected response**

(a) (i) A state where an offspring shows beneficial characteristics not shown by either of the parents;

1 x 1

(ii) Factors in the environment which induce mutations;

1 x 1

**(b) (i) It does not photosynthesize due to lack of chlorophyll;**

**1 x 1**

(ii) Parental phenotype: Pale green plant x Pale green plant

Parental genotypes: Rr x Rr ;

Gametes : R r R r ;

Fusion:

Offspring : RR Rr Rr rr;

**OR**

Parental phenotype: Pale green plant x Pale green plant

Parental genotypes: Rr x Rr ;

| Gametes; | R | r |
|---|---|---|
| R | RR | Rr |
| r | Rr | rr |

;

Award if:

Gametes are in complete circles or separate
Fusion lines must touch the gamete circle
The punnet square must be complete square

**Advice to Teachers**
Teachers to take learners through genetic concepts and terminologies. Learners to understand gene dominance and control of traits in both homozygous and heterozygous.

**SECTION B: CHEMISTRY**

The following questions challenged the candidates:

**Question 12:**

Iron is extracted from its ore using the blast furnace.

(a) Name the main ore of iron. (1 mark)
(b) Give the role of calcium carbonate in the extraction of iron. (1 mark)
(c) State a major pollutant in the extraction of iron. (1 mark)
(d) State **one** use of steel. (1 mark)

**Requirement**
Candidates were expected to know the extraction of iron metal, role of various chemicals during the extraction process and PCIs of metals extraction.

**Weaknesses**

Most candidates were confusing the lead metal and Iron metal extraction process.

**Expected response**

| | | |
|---|---|---|
| 12. | (a) Haematite 1✓<br><br>(b) - Calcium carbonate decomposes to form carbon (iv) oxide ✓<br>- Removal of impurities<br>(any 1 x 1 mark)<br><br>(c) Carbon (iv) oxide. ✓<br>(d) making nails<br>railway lines<br>ship bodies<br>rods<br>making stainless steel utencils<br>(any 1 x 1 mark) | (4 marks) |

**Advice to Teachers**

Teachers to use comparability approaches and several questions/answer methods for candidates to get the differences in metal extraction processes.

**Question 20**

(a) State Le Chatelier's Principle. (1 mark)

(b) Study the equilibrium equation shown and answer the questions that follow.

$$2G_{2(g)} + X_{2(g)} \rightleftharpoons 2G_2X_{(g)} \quad \triangle H = -104\,kJ/mol$$

State the effect on the position of equilibrium if:

(i) pressure is decreased (1 mark)

(ii) temperature is increased (1 mark)

**Requirement**

Candidates were expected to demonstrate clear understanding of the factors affecting the position of equilibrium for a reaction.

**Weaknesses**

Most candidates were unable to display the understanding of how pressure and temperature affects the position of equilibrium.

**Expected response**

| | | |
|---|---|---|
| 20. | (a) Le Chatelier's principle states that when a change in conditions is applied to a system in equilibrium, the system moves to oppose that change. ✓1<br><br>(b) (i) The equilibrium position will shift to the right. ✓1<br>(ii) The equilibrium position will shift to the left ✓1 | (3 marks) |

**Advice to Teachers**

Teachers to do thorough revision on the factors affecting the rate of reactions and equilibrium position shifts with candidates for better understanding of the concept.

## SECTION C: PHYSICS

**Question 28**

**Figure 7** shows an incomplete circuit diagram which is to be used to investigate the relationship between the current through a wire and the potential difference across it.

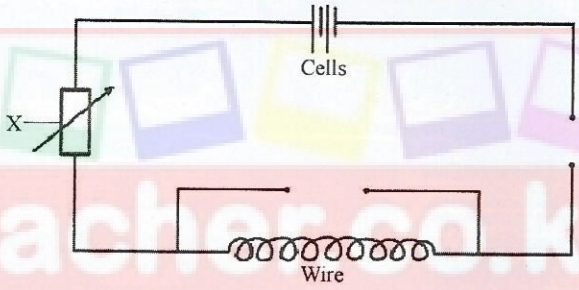



**Figure 7**

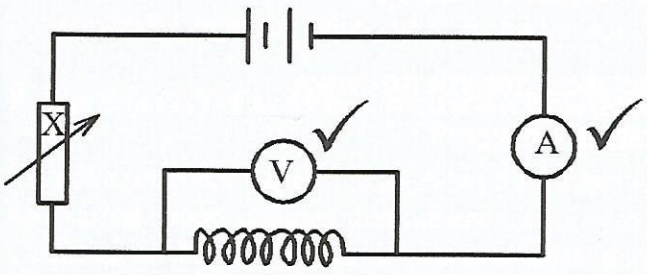
(a) Complete the diagram by inserting the missing components. (2 marks)

(b) State the name of the circuit component X. (1 mark)

**Weaknesses**

Majority of the candidates were not able to put the right measuring instrument in the right place. This shows that candidates are not conversant with the use of a voltmeter and an ammeter. Some candidates also drew the circuit symbol of a voltmeter and an ammeter outside the circuit instead of inserting them in the spaces that were provided.

**Expected response**



**Question 30**

A trader uses 2 kW water heater for 4 hours per day. Determine the number of units of energy consumed per day by the trader. (3 marks)

**Weaknesses**

Majority of the candidates were unable to determine the energy consumed. This was due to the fact that they were not able to recall the correct formula.

**Expected response**

$E = pt$ ✓

$= 2 \times 4$ ✓

$= 8\ kwh$ ✓

**Question 29**

**Figure 10** shows an x-ray tube.

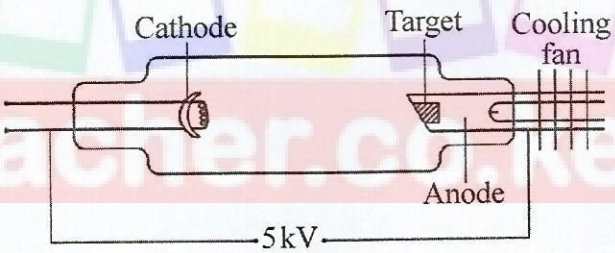



**Figure 10**

(a) State the reason why the cathode should be concave shaped. (1 mark)

(b) The potential difference between the anode and cathode was increased from 5kV to 32kV during operation. State the effect on the nature of the x-rays produced. (1 mark)

**Weaknesses**

None of the candidates got the correct responses. They were not able to relate the concave shaped cathode to focusing of cathode rays to the target. It was also noted that the candidates could not relate increase in voltage to the speed of the x-ray hence the nature of the x-ray produced in the tube.

**Expected response**

(a) To concentrate the electrons ✓ produced and direct them towards the target.

(b) Hard x-rays are produced /x-rays of high penetrating power. ✓