

The **2021 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.

### General Candidates Performance

The candidate's performance statistics since the year 2016 are as shown in the table below.

**Table 12: Performance of candidates for the last 6 years**

Year	Paper	Candidature	Maximum score	Mean Score	Standard Deviation
2016	Paper 1	1,449	100	9.20	8.71
	Paper 2	1,438	100	5.65	6.5
	<b>Overall</b>	<b>1,455</b>	<b>200</b>	<b>14.74</b>	<b>14.30</b>
2017	Paper 1	1,473	100	11.34	11.17
	Paper 2	1,471	100	8.43	9.12
	<b>Overall</b>	<b>1,476</b>	<b>200</b>	<b>19.72</b>	<b>18.50</b>
2018	Paper 1	1,158	100	12.32	11.82
	Paper 2	1,154	100	7.2	8.84
	<b>Overall</b>	<b>1,161</b>	<b>200</b>	<b>19.45</b>	<b>19.74</b>
2019	Paper 1	1120	100	13.00	10.971
	Paper 2	1113	100	7.00	7.296
	<b>Overall</b>	<b>1120</b>	<b>100</b>	<b>20.00</b>	<b>18.267</b>
2020	Paper 1	1031	100	9.58	11.42
	Paper 2	1011	100	9.45	10.45
	<b>Overall</b>	<b>1031</b>	<b>200</b>	<b>18.85</b>	<b>20.64</b>
2021	Paper 1	839	100	16.71	14.96
	Paper 2	830	100	12.05	13.34
	<b>Overall</b>	<b>841</b>	<b>200</b>	<b>28.56</b>	<b>26.34</b>

From table 1, it can be observed that the mean score improved to **28.56** in the year 2021 from **18.85** of the year 2020. This is the highest mean recorded in the subject since 2016. However, it is worth noting that the candidature has dropped further to 841 in 2021 from **1031** in the year 2017, which is about 22.59 % decline.

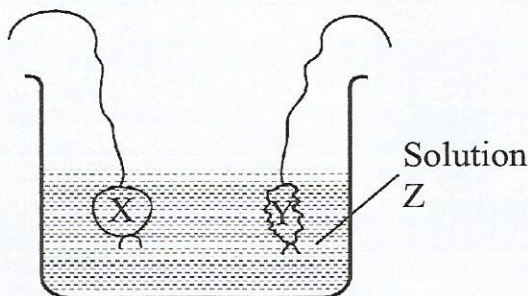
The following is a discussion on some questions that posed a challenge to the candidates.



**SECTION A: BIOLOGY**

**Question 3**

The diagram below illustrates an experiment used to demonstrate water relations in plant cells. X and Y are solutions in bags whose walls are semi-permeable.



- (a) Identify the solution which is hypertonic to the liquid in the beaker. (1 mark)
- (b) Account for the observations made in the bag containing solution X. (2 mark)

**Weakness**

Most candidates were unable to explain the concept of water relations in plants based on the observations of the illustration provided.

**Expected response**

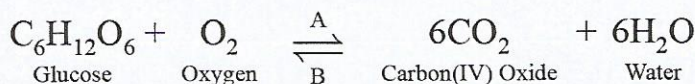
- (a) Solution Y; (1 mark)
- (b) Solution X is hypertonic; it therefore draws in water from the surrounding solution Z by osmosis; (1 mark for hypertonic 1 mark for explanation)

**Advice to teachers**

Teachers should expose learners to practical approaches so as to internalize the concept of water relations in plants.

**Question 8**

Study the equation below and answer the questions that follow. (3 marks)



- (a) Identify process A and B. (2 mark)  
 A.....  
 B.....
- (b) In which cell organelle does process B take place? (1 mark)



Candidates were unable to relate the forward and back reactions to the process of photosynthesis and respiration of the provided equation.

Candidates were unable to tell the site/organelle where process B (photosynthesis) takes place.

### Expected response

- (a) A – respiration (Aerobic) Total 1 mark  
 B- photosynthesis; Total 1 mark
- (b) Chloroplast; 1 mark

### Advice to teachers

- (i) Teachers to expose learners to both word and chemical equations of the process of photosynthesis and respiration.
- (ii) Teachers to employ the use of illustrations/diagrams to emphasize on the sites of both light and dark reactions.

## SECTION B: CHEMISTRY

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

### Question 15:

Burning sodium metal was lowered into a gas jar containing a green gas E. A white solid F was formed.

- (a) Identify:
- (i) Gas E (1 mark)
- (ii) Solid F (1 mark)
- (b) Name the product formed if sodium metal was replaced with zinc metal. (1 mark)
- (c) Write a chemical equation for the reaction taking place between zinc and gas E. (1 mark)

Candidates were expected to know the reaction of halogens with metals

### Weaknesses

Most candidates were unable to identify gas E and thus product formed correctly.

### Expected response

15. (a)	i. Chlorine gas ii. Sodium chloride
(b)	Zinc chloride
(c)	$Zn(s) + Cl_2(g) \rightarrow ZnCl_2(s)$ $Zn(s) + Cl_2(g) \rightarrow ZnCl_2(s)$

### Advice to Teachers

Teachers to emphasize on different products formed when halogens reacts with metals. Teachers should also inform candidates about colours of different gases.



21. **Table 3** shows the volume of soap used with equal volumes of water from different sources to form lather.

**Table 3**

Water source	Volume of soap used
H	12 cm <sup>3</sup>
Z	2 cm <sup>3</sup>

- (a) Identify which water source is hard. (1 mark)  
 (b) Describe how sodium carbonate can be used to soften hard water. (2 marks)

Candidates were expected to describe how water hardness is removed. They were also expected to know how hardness of water affects volume of soap used.

### Weaknesses

Most candidates were unable to describe how sodium carbonate can be used to soften hard water.

### Expected response

- (a) Water Source H  
 (b) Add Sodium Carbonate solution to water source to precipitate Calcium and Magnesium ions responsible for water hardness.

### Advice to Teachers

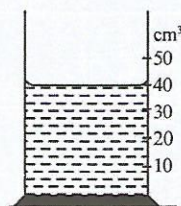
Teachers to provide practical approach and carry out several practices with candidates on softening of hard water using different methods.

## SECTION C: PHYSICS

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

### Question 23

**Figure 5** shows a measuring cylinder containing a liquid of mass 40 g.



**Figure 5**

Determine:

- (a) the volume of the liquid.  
 (b) the density of the liquid.



**Weaknesses**

Most of the candidates, did not attempt this question and even those who attempted it, did not get it right. This shows that this group of candidates lack mathematical competencies. Reading the scale became the major challenge.

**Expected response**

a)  $40 \text{ cm}^3$

$$\begin{aligned} \text{b) Density} &= \frac{\text{Mass}}{\text{Volume}} \\ &= \frac{40}{40} = 1 \text{ gcm}^{-3} \end{aligned}$$

**Question 26**

Smoke particles enclosed in a transparent glass bottle are seen to be moving randomly when viewed through a microscope. Explain this observation.

**Weaknesses**

Majority of the candidates could not visualize that it is the air particles knocking the smoke particles.

**Expected response**

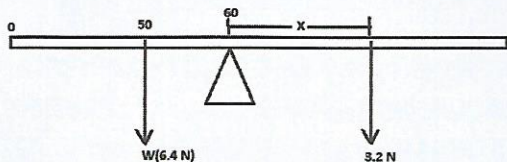
They are being knocked by invisible air particles in constant random motion hence appears to be in constant random motion

**Question 29**

A uniform metre rule weighing 6.4 N is pivoted at the 60 cm mark. Determine the point on the metre rule where a weight of 3.2 N should be suspended for the rule to be at equilibrium.

**Weaknesses**

Almost all the candidates did not attempt this question, those who attempted it did not get it right. This shows lack of mathematical competencies. Coming up with the correct equation on the law of principal of moment the candidates were not able to do the correct substitution.

**Expected response**

Sum of clockwise moment = Sum of anticlockwise moment

$$6.4 \times 10 = 3.2 \times X$$

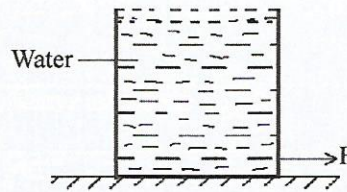
$$X = 20 \text{ cm}$$

3.2 N should be at **80 cm** mark.



**Question 53**

**Figure 11** shows a bucket filled with water to the brim resting on a horizontal surface.



**Figure 11**

It is observed that, when the bucket is suddenly moved forward by a force  $F$ , some water spills out in the backwards. State the reason why water spills.

**Weaknesses**

Majority of the candidates were not able to relate the pouring out of water in the opposite direction with the inertia of Newton's first law of motion.

**Expected response**

Because of inertia hence some water tends to remain behind as the bucket is pulled forward.

**3.6.2 General Science Paper 2 (237)****SECTION A: BIOLOGY****Question 6**

Explain how sex is determined in humans.

(4 marks)

**Weakness**

Candidates could not describe sex determination in humans based on the X and Y chromosomes.

**Expected response**

- Females have two sets of X chromosomes;
- Males have X and Y set of chromosomes; Each ovum and sperm carry one set of chromosome with the ovum carrying only X chromosome while the sperm may carry X or Y chromosome;
- Fusion between an ovum and an X chromosome carrying sperm results in a girl/female.
- Fusion between an ovum and a sperm carrying Y chromosome results in a boy/male.
- Acc genetic cross or punet square

(4 marks)

**Advice to teachers**

Teachers to explain the origin of both X and Y chromosomes/ gametes and their role in sex determination.



The following questions challenged the candidates:

**Question 13:**

13. (a) What is meant by the term exothermic reaction? (1 mark)  
(b) Carbon burns in oxygen to form carbon (IV) oxide producing  $394 \text{ kJmol}^{-1}$  of heat.  
Represent this information on an energy level diagram. (2 marks)

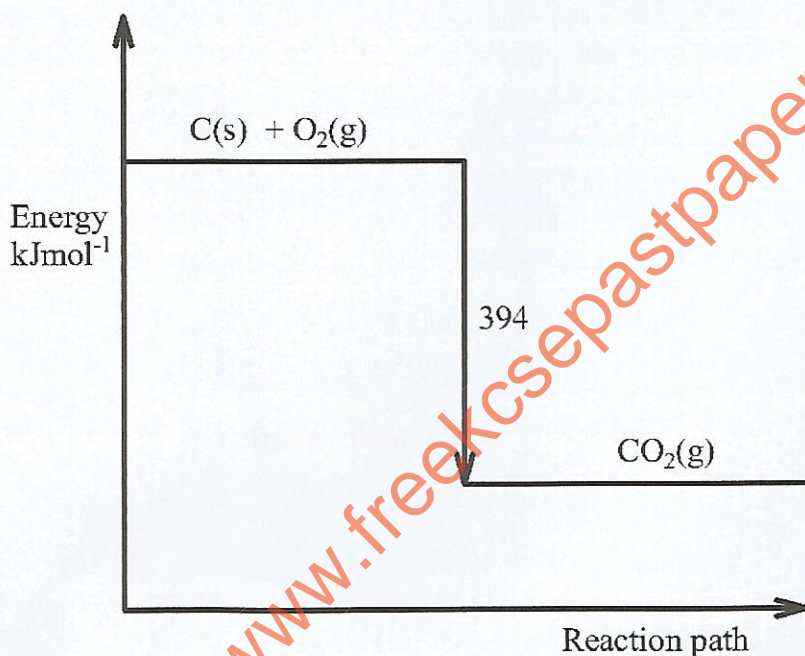
Candidates were expected to know the definition of exothermic and how to represent such a reaction on an energy level diagram.

**Weaknesses**

Most candidates were confusing the endothermic reactions with exothermic reactions.

**Expected response**

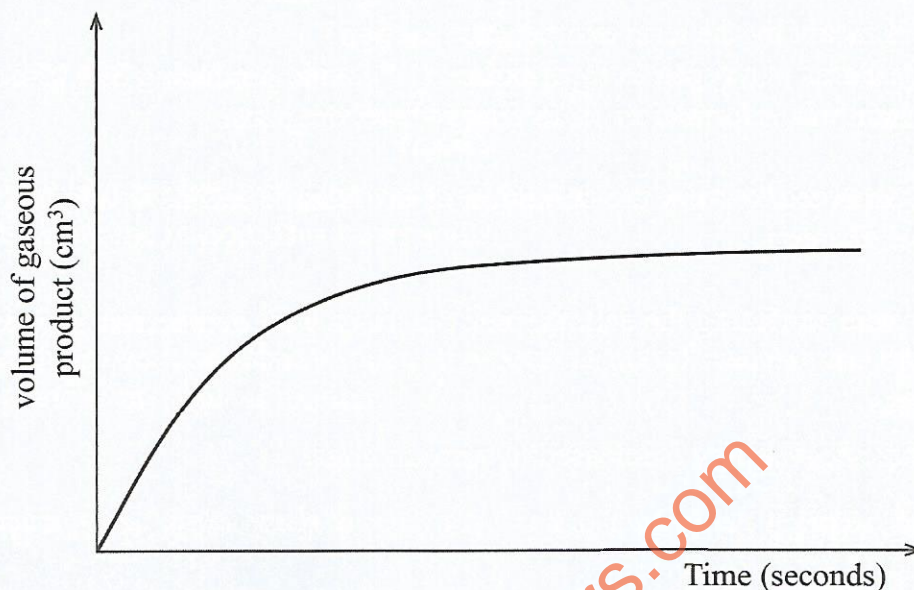
- (a) Reactions where heat energy is released to surroundings.  
(b)

**Advice to Teachers**

Teachers to use practical approaches and several questions/answer methods for candidates to get the difference between exothermic and endothermic reactions.



- Question 19:**
- (a) Explain how an increase in concentration of substances affects the rate of a reaction. (2 marks)
- (b) Using the following graph given in **Figure 2**, sketch a curve which will represent an increase in temperature on a reaction. (2 marks)



**Figure 2**

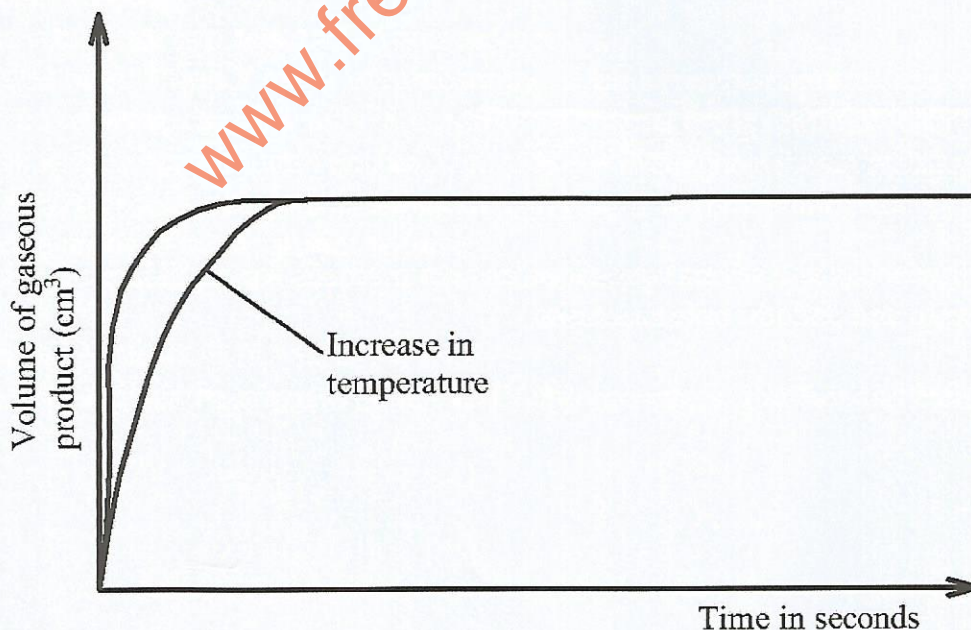
Candidates were expected to demonstrate clear understanding of the factors affecting rate of reactions.

### Weaknesses

Most candidates were unable to display the understanding of how concentration and temperature affects the rate of a chemical reaction.

### Expected response

- (a) Increase in concentration increases the collision between the reacting particles thus the higher the rate of a reaction.
- (b)



### Advice to Teachers

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



**Question 26**

State the difference between progressive waves and stationary waves in terms of energy transmission.

**Weaknesses**

Majority of the candidates were only able to state the difference using other parameters but not the energy transmission.

**Expected response**

In progressive waves energy is transferred from one point to another while in a stationary wave, the energy is localized

**Question 27**

Explain why sound travels faster in wood than in air.

**Weaknesses**

Most of the candidates were unable to comprehend how sound can travel faster in wood than air. Therefore, they instead explained why sound travels faster in air than in wood and not as was demanded by the task.

**Expected response**

Wood particles are closer than air hence transfer sound faster

**Question 29**

Figure 7 shows a ray of white light **R**, entering a rain drop and emerges as ray **P** and **Q**.

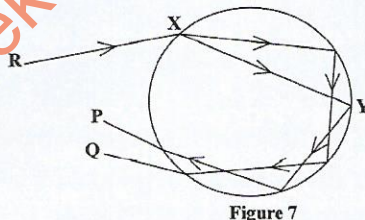


Figure 7

- State the property of light demonstrated at points **X** and **Y**.
- Identify the colour ray **Q**.

**Weaknesses**

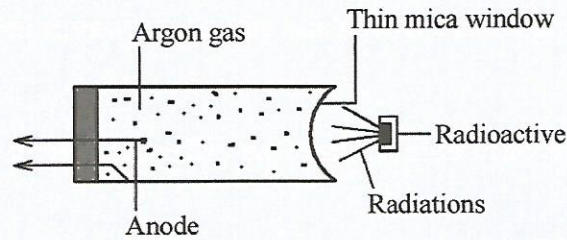
Most of the candidates were not able to identify correctly the properties of waves that was demonstrate. There was a lot of mix-up in identification.

**Expected response**

- X** – Refraction  
**Y** – Total internal reflection
- Q** - Violet



**Question 34**  
**Figure 10** shows part of a GM-tube and a radioactive source placed in front of it.



**Figure 10**

Describe what happens in the tube when radiations enter the tube through the mica window.

### Weaknesses

Coming up with the correct activities that take place in the tube was a big challenge for those who attempted it. The candidates who attempted the question were just mentioning that current will be produced.

### Expected response

When radiations enter the tube, the argon gas is ionized producing both negative and positive ions. The negative ions are attracted to the anode while the positive ions are attracted to the cathode.