PRINCIPAL EXAMINER'S REPORT

BOTSWANA
EXAMINATIONS
COUNCIL

JCE SCIENCE

2022

Advancing learning, certifying your future

GENERAL COMMENTS

PAPER STRUCTURE

The paper consists of structured questions totaling eighty (80) marks. The paper assessed materials taught and learned during the three-year JC science syllabus. In terms of the final grade assigned to candidates, it accounts for seventy percent (70%) while the other paper, 14/1, accounts for 30% of the candidates' work.

The items assessed candidates' ability to demonstrate the following skills:

1. Knowledge and understanding of science concepts
2. Application and problem-solving
3. Experimental and investigative

The science assessment syllabus contains vital information on the three broad skill areas of assessment, including the assessment grid, grade descriptors, and data presentation.

Section A. This section is worth sixty (60) marks in compulsory items. It consists of short-answer questions designed to assess students' ability to respond to knowledge and understanding of science concepts, their application to everyday life situations, and demonstrations to solve problems given.

Section B: This section is allocated 20 marks and is therefore compulsory. This section evaluates the candidates' abilities to transform data from one form to another and demonstrate experimental and investigative skills.

CONSIDERATIONS BY CENTRES

1. The candidates' overall performance fell short of expectations. Centres are advised to study the assessment syllabus to acquaint themselves with skills that learners

should master before sitting for the final examinations. There are standards that also need to be followed, and the assessment syllabus provides guidance on such.

2. Centers are highly encouraged to help candidates improve the following skills in order to enhance their overall performance in science examinations:

a) Experimental and investigative skills

The majority of candidates failed to adequately demonstrate the skill. They lacked knowledge of the use of apparatus and materials in an experimental setup. They also demonstrated poor skills in interpreting and evaluating data, as well as making observations and drawing conclusions. Centres are therefore advised to avail more time and opportunities for candidates to practice experimental activities. Previous reports have made a similar plea and there is no significant change to that effect.

b) Computation skills

Every year, candidates are given tasks to demonstrate achievement of the skill, especially on physics items. In 2022, only a few students demonstrated that they could work with tasks involving numbers with ease. Centres are advised to help candidates in making it a habit of writing a formula before completing any problem involving calculations. They must also present their work in the appropriate space. It is recommended that centres consider increasing the time spent on computation skills.

c) Plotting a graph

Though candidates did relatively well in the plotting of points from a table of results to a graph they disappoint when joining the plotted points. Candidates are expected to demonstrate appropriate skill in joining points using a line of best fit. The vast majority of candidates lacked this ability. Centres are once more encouraged to give learners more time to practice the skill.

OVERALL PERFORMANCE BY CANDIDATES

SECTION A

1 (a)	**Fairly done** Candidates at least associated the diagram to the two common life processes of photosynthesis and respiration. The main problem was placing these two processes incorrectly. Other common incorrect responses included transpiration and evaporation. *Answer:* ***L****: Respiration* ***M****: Photosynthesis*
(b)	**Well done** Most candidates managed to state one of the correct responses. However, there were those that did not restrict themselves to naming carbon compounds found only in plants. The most common incorrect response was *carbon dioxide in the air*. *Answer: Carbohydrates/Starch/Simple sugars/Protein/Fats/Amino acids*
(c)	**Fairly done** Candidates did not adequately show knowledge on how specific human activities contribute to increasing of carbon dioxide in the atmosphere. Common incorrect responses included *use of fossil fuels, greenhouse gases, combustion and eating.* *Answer:* ***Burning*** *of fuels/ Deforestation/ Mining*

2 (a)	**Fairly done** There was no adequate understanding of the set up of the production of gas by the process of photosynthesis. Majority of those giving an incorrect response named the gas as carbon dioxide. *Answer: Oxygen*
(b)	**Poorly done** The majority of candidates failed to relate the task to the setup given as they just gave a general response. They stated different ways by which oxygen can be produced in a lab. The most common incorrect responses were *manganese (iv) oxide* and *hydrogen peroxide.* Some went to the extent of stating the named parts of the experimental set-up.

	Answer: Water and Carbon dioxide
(c)	**Poorly done** As stated in b) above, lack of understanding the experiment meant the candidates were bound to fail the task. Most of the candidates were off the task as they could not apply the required knowledge to complete it. The common incorrect responses were *increasing the number of pond weeds, adding a catalyst and warming the plant.* *Answer: Increasing light intensity/moving the lamp closer*

3 (a)	**(i)&(ii) Poorly done** Though upper candidates got the item correctly, the majority of the average and below-average candidates failed the task. It appears they could not associate with the diagram of a cell given and the organ in which it was found. The most common incorrect response was *plant cell*. *Answer: Leaf/ stem*
(b)	**Poorly done** It seems the majority of the candidates are not exposed to the different cell organelles. In some centers, even the top candidates failed the item. The most common and incorrect responses were on the *functions of a nucleus* or *cytoplasm*. There were also off the mark responses such as *fighting infection, a powerhouse of a cell* and *absorbing water*. *Answer: Energy production/stem cell regulation/calcium storage/programmed cell death/site for reactions/cell multiplication*

4 (a)	**Fairly done** Candidates demonstrated an understanding of how a food chain is constructed though there was a challenge with the direction of the arrows. In some centres, the majority of candidates included the sun as part of the food chain (*Sun → Grass...)* Centres are further employed to encourage candidates to always refer to diagrams given when attempting questions. Some candidates constructed food chains without using the organisms shown on the diagram. *Answer: Food chain with the following:* *Green plants eaten by tadpoles, eaten by fish, eaten by stork*
(b)	**Fairly Done** The most common and incorrect response was *three* trophic levels. This could possibly be that candidates equate the number of arrows to trophic levels. Candidates need to be made aware that there is trophic levels represent where there is feeding. *Answer: Four (4)*

5(a)	**Fairly done** Candidates did relatively well by identifying the blood vessel though the task was to **name** the blood vessel. The common response was the *artery*. *Answer: Pulmonary vein*
(b)	**Poorly done** The majority of the candidates were off task as they were differentiating between the blood vessels (pulmonary vein and aorta) instead of the blood moving through those vessels. The most common and incorrect response was *blood in **Z** carries deoxygenated blood and in the aorta carries oxygenated blood.* This did not make any sense. *Answer: blood in **W** oxygenated/blood in **Z** flows at higher pressure*
(c)	**Fairly done** It appears most candidates never paid attention to the word “structure” as they just gave any difference between blood flowing through the vena cava and blood vessels. *Answer: vena cava has valves or no valves in **Y**/ vena cava has thinner walls or **Y** has thicker walls/ vena cava has a large lumen or **Y** has small lumen/ Vena cava has fibrous wall and **Y** has elastic wall*

6 (a)	**Poorly done** Candidates failed to demonstrate their investigative skills. The majority of candidates failed to construct a simple statement as the aim of the investigation. They could not connect between the balance and water loss. The most common and incorrect responses were *to find the weight of the water* and *to measure the density of water and plant.* *Answer: To investigate (the rate of) water loss from plant leaves/transpiration*
(b)	**Poorly done** Some candidates gave responses based on the factors affecting the rate of water loss (transpiration) such as an *increase in temperature*. Other common incorrect responses included an *increase in weight* and *weight remaining the same.* *Answer: decreases/goes down*
(c)	**Fairly** Candidates did well to show an understanding that oil is impermeable to water, hence completing the task as expected. However, some did not relate this knowledge to the experimental set up shown. The most common and incorrect response was *to stop evaporation.* This was an incomplete response as there was also water evaporating through the leaves. *Answer: prevents evaporation* ***(from t****he flask)*

7 (a)	**Fairly done** Most candidates were able to show that excretion has to do with the removal of certain substances from the body. Some could not score the mark as they could not indicate that the substances removed were ***products*** of chemical processes in the body. The most common and inadequate response was *Excretion is the removal of materials from the body.* This definition could also be applied to defecation, hence not attracting a mark available. *Answer: Process by which an organism get rid of (excess or toxic) waste products/ removal of metabolic waste from the body.*
(b)	**Fairly done** Candidates are aware of products excreted by human skin. However, some candidates gave any excretory product without realizing the item restricted them only to the skin. The most common and incorrect response was *carbon dioxide*. *Answer: urine/sweat/salts/water/mineral ions*
(c)	**Well done** Most candidates were able to name other organs in the human excretory system. *Answer: kidneys/lungs/urinary bladder/gall bladder/urethra/liver/ureter*

8 (a)	**Fairly done** However, candidates are advised to stick to the instructions of the task. Instead of using letters to classify each substance, they wrote the information given about each substance. *Answer: Element – **T*** *Compound – **S*** *Mixture – **R***
(b)	**Well done** Many candidates defined the term as expected. Most of those that failed to access the mark did not show or imply in their responses that there are chemical bonds or just bonding between the atoms. *Answer: A group of two or more atoms that are chemically bonded together/ two or more atoms joined together*

9 (a) **i) Well done**

Element	*Atomic Number*	*Number of Neutrons*	*Mass Number*
G	*7*	***9***	*14*
H	*9*	*10*	***19***

ii) Fairly Done
Candidates are however encouraged to draw neatly and follow the guide stated in the science assessment syllabus. In some centres, candidates included the number of electrons as part of the nucleus, hence losing the mark.

*Answer: Nucleus shown with 7 protons and 7 electrons **only***
2 electrons shown in the first shell
5 electrons shown in the second outer most shell

(b) **i) Fairly done**
The majority of candidates managed to use the periodic table given to access the information required. However, some either used upper case or lower case to indicate the symbol for Beryllium instead of the first letter being the upper case and the second letter a lower case. The most common and incorrect response given was magnesium.

Answer: chemical symbol of beryllium
Correct atomic and mass number written orderly

ii) Well done
Most candidates were able to classify the element appropriately as a metal.

Answer: Metal

iii) Fairly done
Some candidates failed to justify their correct choice given at ii), they were expected to interpret the information about the substance given in the table. Incorrect responses included: *it is metal because it has a melting point of 1278 ^{O}C, has a boiling point of 1278 ^{O}C, it is in group II and period 2.* Such information was just being copied from the table without making any analysis of it.

Answer: high melting point/ high boiling point/ all elements in group 2 are metals/ all metals are on the left of the table

10(a)	**i) Poorly done** Most candidates described the water cycle and failed to relate the less density to become warmer. In some instances, candidates repeated the descriptions indicated by the diagram. *Answer: air got heated; it expanded; it is less dense; gained more kinetic energy; air above land got warmer* **ii) Fairly done** Though the other two methods of heat transfer were stated, the majority of the candidates were able to associate the flow of breeze from sea to land with the correct method. Some candidates gave their response as convectional which is not a method but rather an adjective pertaining to, or employing convection or convective. This could mean rainfall or discharge of electricity and not necessarily heat transfer. *Answer: Convection*
(b)	**i) Poorly done** Candidates failed to relate the function of the ear in regulating heat in the body of an organism. Most candidates related the bigger ears to flapping by foxes so that they can cool themselves down. Some were off the task as they indicated that the bigger ears would help foxes to capture more sound energy for better hearing. *Answer: bigger ears have larger surface area; for **more** heat loss* **ii) Poorly done** Most candidates gave responses that shows poor skills in the understanding of scientific concepts and occurrences. They gave off the mark responses such as *the fur acts as a blanket to block the cold* and *fur absorbs the heat that keeps the fox warm.* *Answer: fur is an insulator of heat/ poor conductor/ traps air that stops heat loss*
(c)	**Fairly done** The most common wrong responses were bright colours or shiny colours. Some gave adjectives such as whitish and yellowish. These are not colours and are not stand-alone words. *Answer: White/Silver*

11(a)	**i) Poorly done** Candidates failed to interpret the information provided on the diagram of the bulb. The most common incorrect responses were *scalar quantity, energy consumption, wattage,* and *electricity*. *Answer: Power* **ii) Fairly done** Some candidates failed to relate the 10W and 30W to lower power consumption. Candidates gave general responses not related to the task. Common responses were *filament bulbs are expensive, fluorescent bulbs are cheaper, and they use less voltage or last longer.* *Answer: consume less power/energy/electricity/releases less heat*
(b)	**Fairly done** Candidates did not fully comprehend the task as it only required energy changes within a lit filament bulb only. Most started with chemical energy, making the first part of their response incorrect. *Answer: electrical to heat energy OR electrical energy to light energy*

12(a)	**i) Fairly done** Some candidates failed to name the process but instead gave descriptions of what was happening such as *bending, refracting or refracted.* Candidates need to be advised on how to state a scientific name, concept or a term. *Answer: Refraction* **ii) Poorly done** There were instances where candidates failed to attempt the task. However, for those that managed to attempt the task, they showed the ray ending upwards or reflecting internally. Some used dotted lines to represent the ray after leaving the glass prism. Centres are further advised to encourage candidates to use rulers when making rays. *Answer: A continuous ray bending downwards outside the glass prism*
(b)	**i) Poorly done**

	As indicated before, candidates have a challenge of stating names and they continue using descriptive words. Common incorrect responses were *splitting, colours of spectrum, rainbow* and *ROYGBIV.* **ii) Well done** Most candidates were able to associate the natural phenomenon of white light ray separating by refraction. *Answer: Rainbow*

SECTION B

13(a)	**i) Fairly done** The common and incorrect responses given were stating a dry cell as a battery and a bulb as a switch. *Answer: bulb* *(dry) cell* **ii) Fairly done** A series circuit was very common though it was incorrect. Some candidates included circuit components that were not given in the table such *as an ammeter, fuse* and *switch.* There were drawings where there was a route with connecting wires only, hence making a short circuit and not a parallel circuit. *Answer: parallel circuit drawn with a variable resistor, bulb and dry cell only.*
(b)	**i) Well done** However, some candidates divided the sum obtained further by 12V. Some candidates used the formula for finding the total resistance of resistors in parallel. *Answer: Total Resistance = 4Ω + 2Ω* *= 6Ω* **ii) Fairly done** The only challenge was remembering and applying the ohm's law formula to complete the task. *Answer:* $I = \frac{12V}{6}$ *= 2A*

14(a)	**i) Poorly done** Most students did not state any plausible observation. They stated their general knowledge and understanding about digestion of starch. The most common response was that *the starch will disappear in set up 2.* *Answer: Set-up 2: reduced size of the visking tubing/solution becoming clearer* *Set-up 1: size of the visking tubing appear bigger than in 2* **ii) Poorly done** Since most candidates failed to state the expected observation, they automatically got this part of the item wrong. *Answer: Set-up 2: breakdown of starch/diffusion of glucose into the water/* *Set-up 1: water moving into the visking tubing*
(b)	**i) Fairly done** Candidates demonstrated an understanding about the digestion of starch by amylase. However, some candidates indicated that *maltose* will be found in set up 2. Though plausible, the time frame of one hour rules out any possibility of its presence. *Answer: Glucose* **ii) Fairly done** The most common and incorrect response was *iodine solution.* Candidates that gave this response were probably not aware that amylase will eventually digest starch into glucose. *Answer: Benedict's solution*
(c)	**Poorly done** The responses given showed that candidates did not comprehend the introductory statement of the task. Some candidates stated organs that are not part of the digestive system. *Answer: Small intestines/ ileum*

15(a)	**i) Well done** Most candidates were able to name the appropriate instrument which was likely to have been used to measure time for the experiment. *Answer: stopwatch/clock/timer* **ii) Fairly done** Though candidates read the volume of water level shown, some did not follow the task by recording it in the table given. They stated their readings next to the question. The most common and incorrect response was 32 mm^3, probably due to failure to observe the meniscus. *Answer: 31*
(b)	**i) Fairly done** Most candidates managed to plot the points on the grid very well. The main issue was connecting the points to make a line graph which was unexpected. Majority used freehand to join each point to the next one instead of using the line of best fit to make a straight line. Centres are encouraged to strengthen this skill in candidates. *Answer: All 9 plotted points correct (3 marks)* *OR* *6 – 8 plotted points correct (2 marks)* *OR* *3 – 5 plotted points correct (1 mark)* *Line of best fit (1 mark)* **ii) Poorly done** The majority of candidates failed to determine the rate at which the water level rises as they did not have a straight line in their graph. Candidates needed to have a straight line in order to calculate the gradient. Some candidates used data in the table of results to determine the gradient instead of picking the points along the line drawn. *Answer: substituting correctly in the gradient formula/* $m = \frac{Y_2 - Y_1}{Y_2 - Y_1}$ *(1mark)* *= correct answer (1mark)* *with correct units (1mark)*

(c)	**Poorly done** Candidates gave random responses that were not relevant to the set up given. They instead recalled general precautions taught in class. Candidates needed to study the set up given carefully and apply their knowledge on possible sources of errors when making reading from measuring instruments. The most common and incorrect responses were *placing the instrument on a flat surface, damaged the instrument* and *holding the instrument*. All these responses were not relevant to the setup shown. *Answer: parallax error/ eye not being perpendicular to the reading/level of colored water*

16(a)	**Well done** The majority of the candidates were able to define what pH is. *Answer: pH is a measure of how acidic or alkaline a solution is/ measure of acidity or alkalinity of a solution/concentration of hydrogen ions in a solution.*
(b)	**i) Poorly done** Most candidates wrongly selected *sodium hydroxide pellets* as the most suitable. This shows that candidates are either not aware that sodium hydroxide is a strong alkali or that calcium carbonate ions could eventually make a slightly acidic water neutral or weak alkaline. Only a few candidates selected *vinegar*. *Answer: Calcium carbonate* **ii) Poorly done** As a follow-up item to the above, the choice made in (b)(i) determined whether the response given will be considered for awarding of a mark or not. Since most failed to make the right choice, then it follows that their explanation will also be considered wrong. *Answer: Calcium carbonate raises the pH of the water to alkaline/ neutralizes the acidity of the water* **iii) Well done** Candidates are aware of the different acid-alkali indicators that could be used to confirm whether the pH is suitable or appropriate for a particular condition. *Answer: Use universal indicator/litmus paper/ methyl orange/phenolphthalein*