

# PRINCIPAL EXAMINER'S REPORT



BOTSWANA  
EXAMINATIONS  
COUNCIL

**JCE SCIENCE**

**2023**



## **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.



## OVERALL PERFORMANCE BY CANDIDATES

### SECTION A

1 (a)	<p><b>Well done</b></p> <p>Almost all candidates managed to access the mark though some described what was happening at stage X instead of just stating its name. Examples: laying eggs, eggs hatching etc.</p> <p>Answer: <i>Egg(s)</i></p>
(b)	<p><b>Fairly done</b></p> <p>Most candidates wrote responses using brand names such as <i>using doom</i> instead of describing why a generic chemical was being used.</p> <p>Answer: <i>break cycle/ kill mosquito/ destroy breeding places/ cutting grasses/ removing stagnant water/ apply mosquito repellents</i></p>
(c)	<p><b>Poorly done</b></p> <p>Most candidates lacked the understanding of the concept asked. Candidates gave responses such as a pupa has a tail, or it is similar to a fish.</p> <p>Answer: <i>has trumpet/ respirator tubes/ air tubes/ spiracles/ it floats in water/ lighter/ less dense than water/ gills</i></p>
2 (a)	<p><b>Poorly done</b></p> <p>Majority of candidates failed to understand the task. Though the uses of a microscope were accepted, the task tested the candidates to demonstrate the benefit or usefulness of using a microscope. Most common wrong responses were to zoom, to view, or enlarge an object.</p> <p>Answer: <i>helpful in viewing surface details of a specimen/ magnifies images</i></p>
(b)	<p><b>Fairly done</b></p> <p>Most candidates managed to give only one function instead of the expected two. The most common response was that it contains cell sap. Common wrong responses were that it gave a cell its shape, it makes food etc.</p>



	<p><i>Answer: control cell volume/ turgidity; regulation of pH; storage of substances (amino acids/ sugars/ nutrients/ fluids/ carbon dioxide/ oxygen); removal of toxic/waste substances</i></p>
(c)	<p><b>Well done</b></p> <p>However, some candidates lacked the conventional way of labelling a diagram as they placed letter <b>X</b> over the part. Candidates are expected to use a line when labelling, more especially when they had been guided as two other parts had been labelled.</p> <p><i>Answer: X with a line from nucleus</i></p>

3 (a)	<p><b>Fairly done</b></p> <p>Some candidates knew the changes but could not state how a particular part changes. Common wrong responses were; it produces food, the ova becomes a fruit, flower dries and falls off etc.</p> <p><i>Answer: sepal; style; sigma; anthers; filament; petals lost/ dries and fall off/ ovules matured into/become seeds/ development of embryo; ovary ripened/ becomes fruit</i></p>
(b)	<p><b>Fairly done</b></p> <p>Some candidates gave responses which indicates lack of understanding that the petals are part of a flower. They gave responses such as; it protects the flower, beautify the flower, attracts pests etc.</p> <p><i>Answer: attract pollinators to the flower/ enclose structures / protection of internal parts</i></p>



<p>4 (a)</p>	<p>(i) <b>Well done</b></p> <p><i>Answer: X</i></p> <p>(ii) <b>Well done</b></p> <p><i>Answer: W</i></p> <p>(b) <b>Poorly done</b></p> <p>Majority of candidates gave a procedure for testing food for starch. For those who were closer to the correct response failed to describe the correct order of the emulsion test. Example; most indicated adding water first and not ethanol. Only a handful were aware of the translucent spot test.</p> <p><i>Answer: Dissolve the food substance in ethanol/ alcohol; add some drops of water; white emulsion forms/turns milky.</i></p> <p style="text-align: center;"><b>Alternative (Or)</b></p> <p><i>Rub the food substance / sample on a piece of (filter) paper; Leave it to dry/ stand; hold it (against light) to see a translucent/greasy spot</i></p>
<p>5(a)</p>	<p><b>Poorly done</b></p> <p>This was probably a guess work as candidates gave a variety of names, some not even of blood vessels. However, the two common wrong responses were artery and vein.</p> <p><i>Answer: Capillary</i></p> <p>(b) <b>Poorly done</b></p> <p>Candidates mostly gave descriptions of the vein or artery, especially that they failed part (a) of the question. Common wrong responses included it is thin, has no nucleus, has no valves etc.</p> <p><i>Answer: (wall) is one cell thick; allow for exchange of materials; less elastic; partially/ selectively permeable</i></p> <p>(c) <b>Poorly done</b></p>



Most candidates lacked an understanding on how the different types of white blood cells protects the body against infections. Though some had an idea of engulfing, they wrongly named the white blood cells in action. It will be advisable for candidates to be general and not being specific about the name. Some even indicated that the bacteria is being pushed out of the blood vessel.

*Answer: Engulfed/surrounded by white blood cells; to protect the organism/ fight infections/ digest / destroy*

6 (a) **(i) Fairly done**

Most common wrong responses were conduction and convection which are other two methods of heat transfer. It showed guess work and not good comprehension of the concept. There were some that totally had no idea of heat transfer methods as they wrote reflection, getting hot and heat energy.

*Answer: radiation*

**(ii) Poorly done**

Most common answer given by candidates was black surface attract heat, black is a good conductor of heat. They used contract, conduct, attract and absorb interchangeably.

*Answer: increase absorption (of heat radiation)/ good absorber of heat*

**(iii) Fairly done**

Candidates threw any colour that possibly came to their minds. The most common wrong responses were shiny, bright colours like orange and red.

*Answer: silver/white*

**(iv) Poorly done**

Most candidates failed to capture the idea of preventing heat loss. Most concentrated on avoiding water from evaporating or being lost from the pot. Common inadequate responses include prevent steam from escaping, prevent eater from spilling during boiling and to trap air inside.



(b)	<p><i>Answer: reduces heat loss; through/by convection/ through reduction of evaporation of water.</i></p> <p><b>Poorly done</b></p> <p>Candidates failed to understand that the task was not general about the use of firewood. The task was on using solar energy to heat the water and not its general value. Most common response were: <i>firewood is cheap and burns fast, firewood is renewable whole solar is not, to prevent deforestation, solar saves time as firewood has to be collected from the bush.</i></p> <p><i>Answer: solar energy is cheaper (over a long period of time)/ no or less pollution/ environmentally friendly</i></p>
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7 (a)	<p><b>(i) Poorly</b></p> <p>This particular item showed most candidates lacked application skills. Though they have knowledge on refraction, they failed dismally to show the correct straight-line movement of light from the object to the eye. Some candidates even drew lines outside the water container.</p> <p><i>Answer: dashed (dotted) lines correctly from the refracted rays at the water surface Image (I) shown from dashed lines originating above the pool floor</i></p> <p><b>(ii) Well done</b></p> <p>However, some students gave an incorrect property of light such as reflection and dispersion.</p> <p><i>Answer: Refraction</i></p> <p>(b) <b>(i) Well done</b></p> <p>However, there were responses such as concave mirror, convex, converging lens and diverging lens. Candidates are advised not to describe a lens when asked to name it. Stating that the lens is a diverging lens is not stating its name but rather describing its effect on light.</p> <p><i>Answer: (bi)concave</i></p>
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**(ii) Poorly done**

Most candidates drew converging lines while some used dotted lines to show light rays after passing the lens. It should be noted that rays should always be represented by a solid line.

*Answer: rays drawn as solid line (after the lens) and diverging*

**(iii) Fairly done**

There is evidence shown that candidates confuse eye defects to eye diseases. The most common incorrect responses were trachoma and pink eye. Other candidates gave any name of an eye defect that came to their mind such as astigmatism, presbyopia, and long sight.

*Answer: short sight/ myopia*

8 (a) **Poorly done**

Majority of candidates failed to capture the idea of an object being at equilibrium when the two opposing moments are equal. Candidates are advised to always state a principle as is and avoid paraphrasing as it may distort it. Some candidates described the principle as the balancing of forces and not moments.

*Answer: at equilibrium, the (total sum of the) anti clockwise moment is equal to (the total sum of) the clockwise moment*

(b) **(i) Fairly done**

Candidates are advised to always precede any mathematical working with a formula. This helps spinning off or mixing up what is supposed to be done. Applying the correct units was also a challenge for many, some even left the value worked without any unit. One of the common incorrect units indicated was N/m.

*Answer:  $M = F \times d / 300N \times 8m$   
 $2400; Nm$  (anti clockwise)*

**(ii) Fairly done**

Most of the average and above average candidates managed to easily work out the problem. The challenge was mainly experienced by weaker candidates. Candidates





	<p>are advised from indicating a unit when it has already been provided for them. Example: writing N once more when it is already there could mean NN or N<sup>2</sup>.</p> <p>Answer: <math>\frac{f \times 6}{6} = \frac{2400 N}{6} / f_1 \times d_1 = f_2 \times d_2 / f_2 = \frac{f_1 \times d_1}{d_2}</math> <math>F = 400</math></p>
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9 (a)	<p><b>Fairly done</b></p> <p>Though most of the candidates were able to correctly name the indicated layer, few gave responses such as crest, underground and outer layer while the remaining were just off task.</p> <p>Answer: (earth) crust</p>
(b)	<p><b>Fairly done</b></p> <p>Candidates did well in showing understanding about the three states of matter though some failed to identify the applicable one to the layer indicated.</p> <p>Answer: liquid / molten</p>

10(a)	<p><b>Poorly done</b></p> <p>Majority of candidates failed to state the key words of the definition mainly <i>unstable nucleus</i>. They just indicated it as being the release of energy from an atom.</p> <p>Answer: <i>spontaneous disintegration of unstable nuclei (to give out particles and/ or energy)</i></p> <p>Note: the words shown in brackets were optional, that is, it was not necessary for the candidates to have stated them in their response.</p>
(b)	<p><b>Fairly done</b></p> <p>The most common wrong response was death. Candidates need to be advised that death is usually a result of something having gone in the body. Most of those getting the answer correct, indicated <i>burning</i> more than any other correct response.</p>



	<p><i>Answer: genetic mutation/ deformed offspring; causes cancer; radiation poisoning/ burns; acute radiation syndrome/sterility; blindness</i></p>
(c)	<p><b>Well done</b></p> <p>However, there was a common response about using protective wear instead of being specific as some of such wear is not relevant when handling radioactive sources.</p> <p><i>Answer: using long rods/ distancing oneself; tongs/ forceps used; having lead/ concrete shield between source and people; pointing source away from people; use small amount; reduce the time of exposure; not eating in radioactive lab; labelling containers with radioactive hazard warning sign</i></p>
(d)	<p><b>Poorly done</b></p> <p>It appears most candidates were not aware that radioactive substances can be used to generate electricity, hence responses that made no sense. Example: it does not need power station. Some indicated that it does not pollute the environment.</p> <p><i>Answer: higher yield/ more energy from unit mass; no emission of greenhouse gases</i></p>

11(a)	<p><b>(i) Fairly done</b></p> <p>Though most candidates knew the correct names of the pins found in a three-pin plug, they seem to have a challenge of their position in the plug. This is because some swapped the names of pins X and Y.</p> <p><i>Answer: X- neutral Y- earth</i></p> <p><b>(ii) Poorly done</b></p> <p>Most candidates failed to describe what happens when current flow exceeds 13A. They just stated that the fuse only allows current of less than 13A to flow which does not really cover the essence of the protective function of a fuse.</p> <p><i>Answer: the fuse melts (and) / breaks the circuit when the current exceeds 13 A</i></p>
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<p>(b)</p> <p>(c)</p>	<p><b>(i) Fairly done</b> Candidates are familiar with the colours of insulation materials of the wires in a three-pin plug. But the challenge is not being competent in knowing which wire is covered by which colour of the insulating material. For lower performing candidates, the common response was orange.</p> <p><i>Answer: Blue/ Black</i></p> <p><b>(ii) Poorly done</b> Majority of candidates failed to demonstrate that the live wire supplies and depends on the fuse to allow current to flow before passing it to an appliance. Few candidates only stated the second part of the answer only, being the protective function.</p> <p><i>Answer: because live wire is a supply cable/ to cut the supply (when the current is too high); to protect the electrical appliance/ before it reaches electrical appliances</i></p> <p><b>Well done</b> The item was general and did not refer to the diagram given. However, some candidates did not name the missing pin but rather stated that it was wire Q. But such did not disadvantage them as the response was credited.</p> <p><i>Answer: earth wire</i></p>
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<p>12(a)</p> <p>(b)</p>	<p><b>Poorly done</b> Most candidates failed to demonstrate an understanding that the property of a gas determines method of collecting a gas used. Common responses were; <i>the gas is less dense than water, it will rise up, it dissolves in water</i>. The item also showed that candidates failed to identify the gas produced from the reaction of metal and water.</p> <p><i>Answer: gas produced is less dense than air; rises and floats above air/ displaces air from the test tube</i></p> <p><b>Fairly done</b> Majority of candidates indicated production of bubbles and failed to describe the second observation. Some candidates indicated that heat is produced, but it should be noted that it is not an observation but rather an inference. Candidates were to state that <i>the flask got warmer/hot</i>. Most of the below average candidates stated</p>
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	<p>observations not specific to the reaction shown, such as <i>smoke given off</i> and <i>change of colour</i>.</p> <p><i>Answer: metal/lithium dissolves/ lithium reduces in size; bubbles produced/ effervescence; flask becomes warm; (hissing) sound produced; metal floating</i></p>
(c)	<p><b>Poorly done</b></p> <p>Candidates threw in any gas test that came to their minds. However, it was expected for them to perform poorly as most could not pick that a reaction of lithium and water produces hydrogen gas. Common wrong responses included lime water turning milky and glowing splint relights.</p> <p><i>Answer: <b>Test:</b> insert/introduce a burning splint (into a gas)</i> <i><b>Results:</b> pop/ squicky sound produced</i></p>
(d)	<p><b>Fairly done</b></p> <p>It appears most candidates were not familiar with lithium metal but just applied general properties of metals to describe it.</p> <p><i>Answer: high melting point/ low melting point than other metal; solid at room temperature; shiny when (freshly) cut; soft; ductile; malleable; high specific heat capacity</i></p>

## SECTION B

13(a)	<p><b>Fairly done</b></p> <p>There were candidates who indicated that the component <b>P</b> blows when too much current flow instead of stating its role in a circuit.</p> <p><i>Answer: regulate amount of current in the circuit</i></p>
(b)	<p><b>Fairly done</b></p> <p>Most candidates used the correct symbol of a voltmeter. However, some connected in series or along the circuit.</p> <p><i>Answer: A voltmeter symbol connected parallel to S</i></p>



<p>(c)</p> <p>(d)</p>	<p><b>Poorly done</b> Most candidates failed to show an understanding of how the same number of components can be re-arranged to increase larger current flow. Common responses were: <i>increasing the number of cells, make parallel circuit and remove the resistor.</i></p> <p><i>Answer: Resistor connected in parallel to the bulb</i></p> <p><b>Fairly done</b> The only challenge by candidates getting a wrong answer was failure to apply the correct formula or not managing to make current the subject of the formula using the ohm's law.</p> <p><i>Answer: <math>I = \frac{V}{R} = \frac{6}{15}</math> <math>= 0.4 A</math></i></p>
<p>14(a)</p> <p>(b)</p> <p>(c)</p>	<p><b>Fairly done</b> Most of candidates managed to plot the points correctly but failed to use freehand to make a smooth curve. Majority used a ruler to connect the plotted points, hence losing the mark for joining them to obtain a curve.</p> <p><i>Answer: All 8 plotted points correct – 3 marks 6 – 7 plotted points correct – 2 marks 3 – 5 plotted points correct – 1 mark</i></p> <p><i>Smooth curve (dependent on at least 3 points correctly plotted) – 1 mark</i></p> <p><b>Poorly done</b> Most candidates failed to use their graph to deduce number of bubbles released per minute by a light intensity of 20 watts. Some managed to get the correct value but failed to demonstrate how they obtained it. Candidates are advised to always show their extrapolation on the graph.</p> <p><i>Answer: A line drawn to estimate the value; 37 bubbles per minute (+/- 1)</i></p> <p><b>Well done</b> Only few candidates gave carbon dioxide as their response. This at least shows candidates are familiar with gases involved in photosynthesis.</p>



	<p><i>Answer: Oxygen</i></p>
(d)	<p><b>Fairly done</b> Candidates lacked reasoning skills, hence failed the second part of the question. Most of them were able to indicate that the graph had flattened but could not provide a reason behind their observation. Only a few candidates related flattening with constant production but still failed to give a reason as to why.</p> <p><i>Answer: no change in bubbles produced / graph is flat or flattened / amount of gas released is constant; rate of photosynthesis has reached its maximum</i></p>
(e)	<p><b>Poorly done</b> Most candidates interpreted the results as shown on the table instead of the graph. They wrote more light used, produced more number of gas bubbles. Centers are advised to give candidates more practice on sharpening their skill on writing a conclusion.</p> <p><i>Answer: as the light intensity increases, the rate of photosynthesis also increases (until it reaches its maximum)</i></p>

15(a)	<p><b>Fairly done</b> The most common wrong response was simple distillation. As much as the response attracted a cross, it was plausible and showed that candidates were at least familiar with distillation as a separation technique.</p> <p><i>Answer: (fractional) distillation</i></p>
(b)	<p><b>Poorly done</b> Though most candidates were aware that the set up represented a form of distillation, they failed to identify the important part of the technique. Common answers were: <i>water cooler, distillatory tube, delivery tube</i> etc.</p> <p><i>Answer: (lieberg) condenser</i></p>
(c)	<p><b>Well done</b> Almost all candidates managed to state a property of water.</p>



<p>(d)</p>	<p><i>Answer: boils at 100 °C at sea level/ melts at 0 °C/ density of 1 g/cm<sup>3</sup>/ tasteless/ odourless/ colourless/ liquid at room temperature/ universal solvent/ high heat capacity/ high surface tension/ it is amphoteric / less dense when solid than when liquid/ exist as liquid at room temperature.</i></p> <p><b>Poorly done</b></p> <p>Though there are two chemical tests for water, most candidates had no idea. The most common test by those who had an idea was the use of cobalt (II) chloride paper even though they just wrote it as cobalt-chloride. Centres are advised to correct the misconception that cobalt (II) chloride is just the same as cobalt chloride.</p> <p><i>Answers: <b>Test:</b> add the liquid/substance to anhydrous copper (II) sulphate <b>Result:</b> colour changes from white to blue</i></p> <p style="text-align: center;"><b>OR</b></p> <p><i><b>Test:</b> place cobalt (II) chloride paper into a liquid/substance <b>Result:</b> colour changes from blue to pink</i></p>
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### ISSUES OF ATTENTION

Overall, the candidates' performance did not live up to expectations. It is recommended that centres familiarise themselves with the skills that students need to grasp in order to sit for the final examinations by studying the assessment syllabus. The assessment syllabus offers guidelines on standards that must also be adhered to.

In order to help candidates perform better in the science exam, centres are strongly encouraged to assist candidates in sharpening their skills in the following areas:

#### a) Experiments and scientific investigations

It is recommended that centres give candidates more time and opportunities to participate in experimental activities because the majority of applicants did not demonstrate the ability sufficiently. They demonstrated insufficient knowledge of how



to use tools and supplies in experimental setups, as well as insufficient abilities in making observations, drawing conclusions, and analysing and interpreting data. This request has been made in previous reports, and nothing notable has changed in that regard.

**b) Plotting a graph**

While candidates performed reasonably well when it came to plotting points from a results table to a graph, they fall short when it comes to connecting the plotted points. It is required of candidates to exhibit the necessary proficiency in joining points. Most of the candidates did not possess this skill. Again, centres are urged to allow students additional time to practice the skill.

**c) Computation / mathematical solutions**

Each year, candidates are given tasks that test their comprehension of the subject matter, which is primarily focused on physics items. Few students showed that they could finish tasks involving numbers with ease. Centres are advised to assist candidates in developing the habit of writing down formulas prior to attempting to solve any calculation-based problems. Additionally, they must present their work in a suitable setting. It is recommended that centres think about setting aside more time for teaching computational skills.