

PRINCIPAL EXAMINER'S REPORT



BOTSWANA
EXAMINATIONS
COUNCIL

JCE GENERAL SCIENCE 2024

PAPER 1: MULTIPLE CHOICE

General Comments

The candidates performed poorly in the paper. The mean mark was 18.38 which is lower than the ideal mean mark of about 50% of the marks for the paper. There were six (6) items where at least 70% of the candidates got the item correct and twenty-two (22) items where less than 50% of the candidates got the item correct. The rest of the items, twelve (12), had between 50% and 69% of the candidates getting the item correct. Generally, the minimum proportion of candidates expected to get an item correct is 25% which is considered the guessing factor for a Multiple-Choice item. There were five (5) items where less than 25% of the candidates got the item correct.

The candidates did poorly in questions where they were expected to recall simple scientific concepts or to apply their knowledge of the concept. Candidates are encouraged to look for items that provide them with more opportunities to interact with application of the skills as outlined in the assessment guide. The item reports are given as tables that include key information as indicated:

N the number of candidates who selected each of the options

Key the option that was taken as the answer

Comments on Individual Questions

Item 1: Cells Structure

Option	N	Key	Comment
A	1001	A	Poorly done. The candidates were to identify a cell which is an animal cell. The strongest distractor was B, which is the basic plant cell. The other were the root hair cell and the stomata
B	724		
C	305		
D	244		

Item 2: Blood Groups

Option	N	Key	Comment
A	965	A	Poorly done. The item looked to be simple since there was blood group O but candidates still opted for group AB.
B	1069		
C	153		
D	87		

Item 3: Animal Nutrients

Option	N	Key	Comment
A	229	C	Fairly done. Generally, candidates were able to identify proteins as being key for growth of muscles.
B	302		
C	1262		
D	481		

Item 4: Digestion in Small Intestines

Option	N	Key	Comment
A	410	D	Poorly done. The item was on chemical digestion in the small intestines. Even though most of the candidates noted that it was protein digestion, a good number were spread across the distractors
B	461		
C	326		
D	1077		

Item 5: Digestive System and Enzymes

Option	N	Key	Comment
A	468	D	Poorly done. The distribution of the candidates shows that they were not aware of the answer and were just guessing. Pancreas produces amylase that is used for digestion of starch in the small intestines.
B	268		
C	700		
D	838		

Item 6: Circulatory System

Option	N	Key	Comment
A	315	B	Fairly done. The candidates noted that blood from the lungs, where it mixes with oxygen, through the heart, where it is pumped to other parts of the body, was rich in oxygen
B	1297		
C	515		
D	147		

Item 7: Excretory System

Option	N	Key	Comment
A	1583	B	Poorly done. The proportion of candidates who got the item correct was lower than 25%. Most candidates failed to note that P is required by body cells while Q is being removed from the cells. Carbon dioxide is not required by body cells but is a toxic product removed from the cells
B	410		
C	172		
D	109		

Item 8: Central Nervous System

Option	N	Key	Comment
A	338	C	Poorly done. The candidates should note that the main parts of the central nervous system are the brain and the spinal cord. The diagram shows the spinal cord and its neurone linkages to the skin and muscles
B	418		
C	665		
D	853		

Item 9: Personal Hygiene

Option	N	Key	Comment
A	331	D	Well done. Almost all the candidates identified the washing of hands as a good practice for personal hygiene
B	41		
C	26		
D	1876		



Item 10: Digestive System

Option	N	Key	Comment
A	311	C	Poorly done. The candidates should explore both physical and chemical digestions. The stomach is responsible for the chemical digestion of fats and proteins while starch is digested by amylase in the small intestine
B	1031		
C	789		
D	143		

Item 11: Transpiration

Option	N	Key	Comment
A	1062	A	Poorly done. The candidates were to study the diagram of the stem of a plant and identify the xylem from the diagram which was shaded
B	637		
C	329		
D	246		

Item 12: Respiration

Option	N	Key	Comment
A	148	B	Fairly done. The candidates were expected to use their knowledge on the products of respiration in animals and the reactants and products of photosynthesis in plants. Thus, the rat produces carbon dioxide while the plant uses carbon dioxide for photosynthesis
B	1240		
C	344		
D	542		

Item 13: Plants

Option	N	Key	Comment
A	443	C	Poorly done. The candidates were spread almost evenly across the options, a sign of guess work. Wetlands have higher transpiration rates hence more stomata while deserts have lower transpiration rates hence lower stomata
B	640		
C	652		
D	539		

Item 14: Nutrients

Option	N	Key	Comment
A	657	C	The candidates were to analyse the proportion of the nutrients in each meal and identify a meal that is effective in preventing constipation i.e. the one with a lot of roughage
B	548		
C	692		
D	377		

Item 15: Excretion

Option	N	Key	Comment
A	930	B	Poorly done. The item is a recall type with most candidates expected to know the answer. The strongest distractor was A which focuses only on the digestive system. Candidates should know that excretion is a broader term including all substances unwanted by the body
B	1080		
C	173		
D	91		



Item 16: Skeletal System

Option	N	Key	Comment
A	399	C	The item was fairly done as candidates were able to relate how the muscles work together to achieve movement of the arm. When one contracts the other relaxes
B	151		
C	1362		
D	362		

Item 17: Food Nutrients

Option	N	Key	Comment
A	301	C	Poorly done. The item was scored by the lowest proportion of candidates most likely through guess work. Most candidates selected mineral salts. Many failed to realise that proteins are responsible for urea content in the blood
B	1337		
C	242		
D	394		

Item 18: Reproductive System

Option	N	Key	Comment
A	231	B	Fairly done. The candidates were able to pick the portion of the graph where the woman was likely to fall pregnant, which is just after ovulation.
B	1129		
C	567		
D	347		

Item 19: Transpiration

Option	N	Key	Comment
A	48	B	Well done. Most candidates were able to interpret the information provided and translate it from one form to another. The loss of water is higher where the wind speed is greater
B	1789		
C	383		
D	54		

Item 20: Reproductive System - contraceptives

Option	N	Key	Comment
A	590	D	Fairly done. The candidates were able to identify the correct function of the contraceptive pill which being a chemical should stop ovulation
B	187		
C	178		
D	1319		

Item 21: Carbon Cycle

Option	N	Key	Comment
A	56	D	Fairly done. The item was guiding with carbon dioxide moving to plants for photosynthesis to make their own food
B	225		
C	827		
D	1166		



Item 22: Food Tests

Option	N	Key	Comment
A	230	B	Fairly done. Candidates generally noted that glucose turns brick red when heated gently mixed with Benedict's solution
B	1430		
C	518		
D	96		

Item 23: Vaccination

Option	N	Key	Comment
A	497	C	Fairly done. Candidates were to interpret the graphs on the levels of antibodies which they did fairly well
B	379		
C	1098		
D	300		

Item 24: Female Reproductive System

Option	N	Key	Comment
A	163	D	Poorly done. The strongest distractor was B with majority of the candidates being of the view that the fallopian tube produces egg cell
B	996		
C	480		
D	635		

Item 25: Measurement of Quantities - mass

Option	N	Key	Comment
A	2039	A	Excellent. Almost all the candidates were aware that the physical quantity being measured was mass
B	43		
C	113		
D	79		

Item 26: Measurement of Quantities - density

Option	N	Key	Comment
A	476	C	Poorly done. The distribution of the candidates shows guess work. The candidates had to convert the mass to grams so as to have a mass of 25 000 g. The density can then be obtained easily using $d = \frac{m}{lwh}$
B	569		
C	632		
D	597		

Item 27: Light

Option	N	Key	Comment
A	68	C	Fairly done. The candidates were able to note that light is reflected by the mirrors in the periscope for it to reach the eyes on the other side
B	209		
C	1145		
D	852		



Item 28: Sources of Energy

Option	N	Key	Comment
A	281	B	Well done. Candidates were able to identify petrol as chemical energy
B	1661		
C	240		
D	92		

Item 29: Eyes

Option	N	Key	Comment
A	470	B	Fairly done. Candidates should note that light from a distant object is represented by parallel rays of light and the rays converge at the retina, at the back of the eye, after refraction through the eye
B	1162		
C	225		
D	417		

Item 30: Transfer of Thermal Energy

Option	N	Key	Comment
A	446	A	Poorly done. The key was selected by the lowest proportion of the candidates. Conduction happens mainly in solids because of the close arrangement of particles which is the handle
B	732		
C	515		
D	581		

Item 31: Transfer of Thermal Energy

Option	N	Key	Comment
A	436	C	Poorly done. Convection currents have warm air rising or moving upward and being replaced by cold air from the top. The majority of the candidates thought the air moves in a horizontal circular movement
B	941		
C	489		
D	408		

Item 32: Light - Reflection

Option	N	Key	Comment
A	856	D	Poorly done. Candidates should be aware that angles are measured between the <u>normal</u> and the respective ray. Thus, the angle of reflection is between the normal and the reflected ray. The angle of incidence and the angle of reflection are always equal
B	919		
C	209		
D	289		

Item 33: Light - Refraction

Option	N	Key	Comment
A	268	D	Fairly done. The candidates were able to identify the definition of refraction which happens when light moves from one medium to another
B	155		
C	683		
D	1167		



Item 34: Measurement - time

Option	N	Key	Comment
A	74	C	Well done. Almost all the candidates remembered the units for time as minutes
B	19		
C	2131		
D	49		

Item 35: Acids and Bases

Option	N	Key	Comment
A	332	C	Poorly done. Candidates failed to notice that the gas produced is deduced from the salt used. A carbonate salt which has carbonate ions (CO_3^{2-}), which is the one that produces carbon dioxide, CO_2
B	155		
C	630		
D	1156		

Item 36: Test for Oxygen

Option	N	Key	Comment
A	385	C	Fairly done. Oxygen makes a glowing splint to relight, and it is the simple test that can be used
B	464		
C	1154		
D	269		

Item 37: Soap Making

Option	N	Key	Comment
A	716	D	Most candidates were of the view that fats should be boiled with water. Generally, the distribution of the candidates indicate that they were not aware the process
B	515		
C	429		
D	612		

Item 38: Change of State

Option	N	Key	Comment
A	179	D	Well done. Most candidates were able to deduce from the diagrams that the process was melting as the space between the particles was increased
B	219		
C	198		
D	1676		

Item 39: Hardness of Water

Option	N	Key	Comment
A	565	B	Poorly done. Candidates were almost evenly distributed across the options. Calcium hydroxide (lime water) is added to the water to make it softer
B	767		
C	614		
D	323		



Item 40: Reactions of Acids and Bases

Option	N	Key	Comment
A	725	A	Poorly done. A gas that turns lime water milky is carbon dioxide. Carbon dioxide is obtained from the reaction between a carbonate and an acid. A sulphate may produce sulphur dioxide. Candidates should use the names of the salts as a clue to the gas that can be produced
B	168		
C	485		
D	846		

PAPER 2: WRITTEN THEORY

General Comments

The performance of the 2024 cohort was about the same as that of the 2023 cohort. Candidates were able to recall, relate scientific concepts and apply basic scientific knowledge to given situations better. Nonetheless, candidates continue to show deficiencies in questions that require science processing skills, inferring relations of variables from experimental results and drawing conclusions based on information presented on graphs and tables. Centres are encouraged to expose learners to hands on activities and items which will engage their high order thinking skills and apply themselves rather than just engage in simple recall of information.

Candidates continue to ignore mark allocation and hence continue to lose marks by leaving out certain points to get a full mark for the question. The mark allocation should be used as a clue to the response that should be given. Centres should encourage candidates not to repeat the questions as this takes a lot of space for the answer.

Comments on Individual Questions

- 1 (a) Poorly done. Most candidates stated the functions of blood, or they described blood as a group of different cells. The candidates failed to explain that blood is a group of similar cells working together to perform a function which are the features of a tissue. Some candidates also failed to explain important points such as a group of similar cells working together hence lost a mark.
- (b) Fairly done. Most of the candidates got a mark only as they were able to mention only one of the two substances, mainly water. Very few candidates gave responses such as proteins, enzymes, salts, ions, hormones, sugars, antibodies and fibrinogen. Common wrong responses were white blood cells, red blood cells, phagocytes, oxygen, carbon dioxide.
- 2 (a) Poorly done. Candidates failed to name the slide or cover slip. Candidates were not familiar with the laboratory equipment. Centres are encouraged to do hands-on activities, prepare slides of animal and plant cells and use a microscope to view them. This will enable the candidates to learn the names of the laboratory equipment. The most common wrong responses were white tile, petri dish, filter paper, microscope.
- (b) (i) Well done. Most of the candidates were able to label the stage with the letter X and accessed the mark.
- (ii) Poorly done. Most candidates failed to name the eye piece and lost the mark. Centres are encouraged to expose candidates to the use of a microscope and label its parts. The common wrong response was lens.
- (iii) Poorly done. Majority of the candidates failed to state the function of the mirror, which is to reflect and focus the light, in the microscope. This shows lack of exposure to laboratory equipment and hands-on activities. Common wrong responses were to reflect the image and to magnify the image.

- (c) Fairly done. Majority of the candidates noted that the microscope should be placed on a flat surface when it is used. There were very few who noted that the microscope should be handled with two hands and the lens adjusted gently. Centres are advised to give candidates exposure to laboratory equipment so that they can learn better from observations.
- 3 (a) Well done. Majority of the candidates were able to deduce what was happening in the diagram and suggested two ways from sewage, farming and domestic on how the river is being polluted. Some of the candidates suggested two ways under domestic and hence lost a mark as the other point was already given. For candidates to access all the marks they were to suggest one way under domestic, sewage or one way under industry and farming. The most common wrong responses were types of pollution such as air pollution and land pollution.
- (b) Well done. Many of the candidates remembered that the water should be boiled to be made safe for drinking. They were very few who suggested other methods like chlorination and sterilisation. Some candidates gave processes like distillation, filtration and desalination which cannot kill the germs in the water. Some gave answers such as chlorophyll.
- (c) Well done. Candidates mainly suggested Bilharzia and Cholera as their answers to a water borne disease and accessed the mark. The other diseases not mentioned by the candidates were typhoid fever, Hepatitis A and Dysentery. The most common wrong responses were diarrhoea, syphilis, malaria, gonorrhoea, flu and tuberculosis.
- 4 (a) Fairly done. Most candidates defined pollination as the transfer of pollen grains from anther to stigma. Some of the candidates defined pollination as the transfer of pollen grains to the stigma without stating from the anther hence lost a mark. Centres are advised to give candidates adequate practice on definition of terms.
- (b) Fairly done. Most of the candidates named the structure Y as style. Some candidates labelled Y using the female parts and the male parts of the flower stigma, filament and lost the mark.
- (c) Fairly done. Most candidates failed to state that the pollen tube carries male sex cells to the ovary. Common wrong responses were a passage or path for pollen grain, transports nutrients, supports the pollen grains.
- (d) (i) Well done. Most candidates were able to name the process that occurs at Z as fertilisation. Common wrong responses were ovulation and pollination. Candidates mixed up processes taking place in humans and flowers.
- (ii) Poorly done. Candidates failed to explain how fertilisation occurs in flowers. They missed to explain the part where the pollen tube enters the ovule. Some candidates were able to score a mark when stating that the male sex cell fuses with the female sex cell. The common wrong responses were male sex cell meets with the ovum, ovules develop into seeds, ovary develops into a fruit.

- 5 (a) Fairly done. Most candidates failed to capture the interaction between biotic and abiotic factors. Some candidates defined a habitat and lost the marks. The expected response was relations or interaction of biotic and abiotic factors in a habitat.
- (b) Fairly done. A food chain should start with a producer which some candidates failed to note. Candidates also had a challenge in processing information from the pond ecosystem hence they drew food webs and food pyramids. Candidates could not differentiate between the three feeding relationships. Candidates lost marks for starting the food chain with the Sun as the first trophic level. Some of the responses were:
- Green plants → Small fish → Big fish
- Algae → Tad pole → Big fish
- (c) Poorly done. Candidates failed to determine the factors namely, water type, temperature, type of nutrients, availability of sunlight and availability of dissolved oxygen, that determine types of plants in a pond. Common wrong responses were water, type of soil, Sun, long root system.
- 6 (a) Fairly done. Candidates were able to explain the trend in sales of cigarettes from 1965 to 1985. Some candidates lost some marks for not breaking down their description according to time frames where different changes were observable i.e. 1965 to 1980 there was an increase while 1980 to 1985 there was a decrease. Other candidates used words such high, low, acceleration and deceleration to explain the trend in cigarette sales which denied them marks.
- (b) Poorly done. Candidates failed to label X between the section from 1980 to 1985. Most candidates labelled X at the peak and the lower part of the line. Candidates should be advised to always make a mark on the line when required to place a letter on the graph.
- (c) Fairly done. Most candidates recalled that smoking may cause lung cancer. Very few candidates gave responses related to damaging air sac and causing bronchitis. However, some candidates lost a mark for giving lung cancer and respiratory disease as their answers. Lung cancer is a respiratory disease; hence the point was already given. Common wrong responses were burn the lungs, change the colour of the lungs , damage the lungs.
- 7 (a) (i) Fairly done. Most candidates were able to identify X as carbon dioxide. Common wrong responses were oxygen and red blood cells.
- (ii) Well done. Candidates identified structure labelled Z as red blood cells.
- (b) Well done. Most candidates recalled that the alveolus is found in the lungs.
- (c) Fairly done. Candidates failed to recognise that the pulmonary vein, which transports oxygen-rich blood, receives blood leaving the capillaries. Common wrong responses were vein without pulmonary and pulmonary artery.

- 8** Poorly done. Candidates failed to match the enzymes with the type of food it digests. Candidates swapped responses and lost marks. The salivary amylase digests starch in the mouth. Pepsin digests proteins in the stomach. The end products are glucose and amino acids.
- 9 (a) (i)** Poorly done. Candidates failed dismally to respond to the question. Most of the responses were based on neutralisation only without a mention of what was being neutralised which is the acid in the teeth. The pH given on the question was 8.5 (weak alkali) which was missed by most of the candidates. Common wrong responses were to neutralise the pH in the mouth, to neutralise the mouth or teeth.
- (ii)** Fairly done. Candidates accessed a mark on how brushing with toothpaste would help to prevent tooth decay using anti- bacterial agent as it kills or destroys bacteria or prevents bacterial growth. Common wrong response was to reduce bacteria.
- (b)** Fairly done. Candidates were able to access the mark for stating some of the common ways of maintaining healthy teeth that includes regular visits to the dentist, avoiding smoking and reducing sugar intake. Common wrong responses were brushing teeth regularly, eating a healthy diet and using a toothpick.
- (c)** Well done. Candidates were able to state some of the signs of gum diseases mainly bleeding of gums and swollen gums.
- 10 (a)** Poorly done. Most candidates could not link the process of photosynthesis with the diagram given and therefore could not name glucose as the product formed when carbon dioxide and light enter the leaf. The most common wrong responses were oxygen and chlorophyll.
- (b)** Fairly done. Some candidates were not able to identify substance V which is water and could not state the vessel responsible for transporting substance V. Candidates confused the function of the phloem vessel to that of the xylem vessel.
- (c)** Poorly done. Most candidates were not able to identify substance V which is water, and they failed to realise that water was moving from the ground into the roots by osmosis. Common wrong responses were transpiration, diffusion, respiration and active transport.
- 11 (a)** Fairly done. Some candidates misinterpreted the question as they stated instruments used for measuring mass and volume mainly triple beam balance and measuring cylinder rather than the combination of the masses that could balance 65 g. Some candidates did not write the units or wrote incorrect units such as kg, yet the units were given which led to them losing a mark.
- (b) (i)** Poorly done. Most candidates failed to note that the sinker was required to submerge the piece of wood in water. Most candidates did not know what a sinker was. Centres are urged to do perform experiments on finding the volume of irregularly shaped objects to familiarise the candidates with the apparatus used. Common wrong response was to compare densities of wood and sinker, density of sinker is more than that of water.

- (ii) Fairly done. Some of the candidates failed to read the scale of the measuring cylinder taking the middle marks to be 5 cm^3 instead of 10 cm^3 . A mark was awarded when both responses were correct.
- (iii) Fairly done. The candidates were to subtract V_1 from V_2 to get the volume of the piece of wood. Some candidates added the values or multiplied the values. The most common wrong responses were 260 cm^3 and 15300 cm^3 .

- (c) Fairly done. Most candidates were able to recall the formula for density and used it correctly. However, the candidates were challenged with presentation of answer as they gave their answer to one significant figure, 0.8 g/cm^3 , which made them to lose a mark. There were some candidates who failed to state the correct formula and/or substitute correctly in the formula.

Answers: (a) 50 g, 10 g, 5 g (b) (ii) 90 cm^3 , 170 cm^3 (b) (iii) 80 cm^3 (c) 0.8125 g/cm^3

- 12 (a) (i) Fairly done. Most candidates were able to note that light will be detected before sound.
- (ii) Poorly done. Most candidates failed to explain why light was detected first, since they did not relate the detection to the speed of light when compared to sound. The responses given were incomplete and there were in some instances no comparison with responses such as light travels faster.
- (b) (i) Fairly done. Most candidates noted that the soldier on the ground (soldier 2) will hear the explosion first. There were a few who suggested soldier 1.
- (ii) Poorly done. Majority of the candidates failed to explain why the soldier on the ground heard the explosion first. They failed to relate the hearing of the explosion to the speed of sound in different mediums, soil and air. Common wrong responses were explosion happens on the ground so soldier 2 is also on the ground, the distance of soldier 2 from the explosion is closer than soldier 1.
- 13 (a) Poorly done. Most candidates could not name the suspensory ligament – R and the cornea – S. The common wrong responses were R – ciliary muscle and S – cochlea.
- (b) Well done. Most candidates were able to identify the lens as being responsible for focusing images on the retina.
- (c) (i) Poorly done. The candidates failed to note that the size or shape of the lens is not affected by the amount of light but rather changes when the position of the object is changed. Some candidates had an impression that it will become bigger or answered in relation to the pupil rather than the lens.
- (ii) Poorly done. Candidates failed to give a reason why the lens remains unchanged. The thickness of the lens is affected by the distance of the object and not light intensity.

- 14 (a) (i)** Fairly done. Candidates remembered that the experiment produces oxygen. Common wrong responses were carbon dioxide and hydrogen.
- (ii)** Poorly done. Most candidates confused the test for hydrogen and the test for carbon dioxide with the test for oxygen. The candidates gave tests like use of lime water, use of a burning splint. Oxygen reignites a glowing splint.
- (b)** Poorly done. Most candidates did not know the method used to collect the gas (downward displacement of water) and could not explain why the method was used. The candidates were expected to state the reasons as oxygen being insoluble in water and less dense than water. Most of the candidates who got the question wrong opined that oxygen was less dense than air or it was easy to collect the gas using the method.
- 15 (a)** Fairly done. Most candidates managed to plot the points correctly. They however failed to use free hand to draw a smooth curve. Majority joined each point to the next using a ruler and joined the anomalous point hence failing to come up with a smooth curve. Majority of the candidates lost a mark for a smooth curve.
- (b)** Fairly done. Majority of candidates were able to name the gas as carbon dioxide which was the expected response.
- (c)** Fairly done. The candidates were expected to draw a vertical line from 2.5 minutes up until it meets the graph and determine the volume where it meets the graph. Majority of the candidates were able to capture the correct response between 28 cm^3 and 31 cm^3 .
- (d)** Poorly done. Majority of the candidates failed to interpret either the table or the graph to pick a time after which the volume remained constant or unchanged. Most candidates related the stopping of the reaction, 6 minutes, when no more gas is produced to the time taken to do the experiment, 8 minutes. They failed to note from the table and the graph that the experiment ends when the gas produced remains constant.
- (e)** Poorly done. Most candidates failed to state the time interval when the reaction was fastest. The candidates gave a single time, 1 minute rather than an interval, 0 to 1 minute.
- (f)** Fairly done. Majority of candidates were able to draw a circle around the point (4,34) which seemed to be an error.