PRINCIPAL EXAMINER'S REPORT

BOTSWANA
EXAMINATIONS
COUNCIL

JCE MATHEMATICS

2021

PAPER 2

General Comments

The 2021 performance of candidates in Mathematics Paper 2 was below expectation. The most concerning issues about the candidates still remains, being the use of wrong methods for some questions and leaving the questions unattended indicating lack of exposure to some mathematical concepts. Most of the marks in Section **A** were scored by an overwhelming number of candidates, while it was on the contrary for Section **B** and Section **C**. Centres need to address candidates on questions that involve graphs as they seem to be having a challenge. Centres should discourage candidates from using freehand to draw triangles, and straight edge rule to draw cumulative frequency graphs. Calculations involving the use of π should be done in accordance with the instructions given in the paper otherwise the use of 3.14 and $\frac{22}{7}$ as π instead of 3.142 or π in the calculator should be avoided. Candidates should follow the rubrics as given in the question paper.

Comments on specific questions

Section A

The questions in this section were satisfactorily done but some of the candidates clearly demonstrated that they lacked basic computational skills in dealing with numbers and operations.

1	Most candidates performed poorly in this question; they could not multiply corresponding elements or entries from a 2 by 2 matrix to a 2 by 1 matrix. Some candidates were adding the elements together while others did not appreciate that elements in the row for the first matrix were to be multiplied by the corresponding columns in the second matrix, hence their work was haphazard. Most common wrong workings were as follows: $\begin{pmatrix} 2\times1+5\times1 \\ 1\times-3+-2\times-3 \end{pmatrix} = \begin{pmatrix} 2+5 \\ -3+6 \end{pmatrix} = \begin{pmatrix} 7 \\ 3 \end{pmatrix}, \begin{pmatrix} 2+1 & 5+1 \\ 1+3 & -2+3 \end{pmatrix} = \begin{pmatrix} 3 & 6 \\ 4 & 1 \end{pmatrix}, \begin{pmatrix} 2\times1 & 5\times1 \\ 1\times3 & -2\times-3 \end{pmatrix} = \begin{pmatrix} 2 & 5 \\ 1 & 6 \end{pmatrix}.$ **Answer**: $\begin{pmatrix} -13 \\ 7 \end{pmatrix}$

2	The question was fairly done; most candidates were able to convert 135 kilometers to meters but could not convert hours to second even though they knew that they had to divide distance in meters by time in seconds to get the desired result. Some could not even put the decimal point at the correct place. Most common wrong workings and answers were; $\dfrac{135 \times 1000}{200} = 675$ m/s, $\dfrac{135}{60}$, 135×10 and $\dfrac{135000}{3600} = 375$. **Answer:** *37.5 m/s*
3	Most candidates did well in this question. They were able to subtract 3 both sides and divide by 2 both sides to get the correct answer. Some candidates could not apply proper steps for solving linear equations while in some cases candidates used trial and error method to get the correct answer. The most common wrong workings and answers were; $5m = 7$, $5m + 7 = 12$, $2m = 10$ and $\dfrac{2m}{4} = 0.5$. **Answer:** *m = 2*
4	It was fairly done; Most candidates were able to calculate the time difference of the given countries but could not express time in either 12-hour clock or 24-hour clock. Most common wrong answers were 9am, 9 O'clock, 09:00am and 9.00. **Answer:** 0900 hours
5	Most candidates performed poorly in this question; they were able to at least find the correct denominator, *xy*, which is the lowest common expression for the given algebraic denominators, but could not apply the concept of equivalent fractions with LCM being variables. The most common mistakes and wrong answers were as follows; $\dfrac{4}{y} + \dfrac{3}{x} = \dfrac{7}{yx}$, $\dfrac{4}{y} + \dfrac{3}{x} = \dfrac{7}{y+x}$, $\dfrac{4}{y} + \dfrac{3}{x} = \dfrac{4x + 3y}{y + x}$, and $\dfrac{4}{y} + \dfrac{3}{x} = \dfrac{4y + 3x}{yx}$.

	Answer: $\dfrac{4x+3y}{xy}$
6	It was fairly done. Some of the candidates gave common responses such as 155°, 205°, 130° which were incorrect. Some incorrectly applied the concept of alternate angles and corresponding angles, hence concluding that the r was 155°, which was wrong. **Answer:** 25°
7	It was poorly done; Most candidates did not know what to do with the terms in the given algebraic expression, as such they simplified the expression by adding the like terms instead of factorizing the expression. Most common wrong answers were $2x^2 + 11x + 12$ and $2x^2 + 5x + 12$. **Answer:** $(x-4)(2x-3)$
8	This question was poorly done. Most candidates could not apply the concept of factorizing using the difference of two squares to get algebraic expression factors which consists of sum and difference of the square roots for the terms in the initial algebraic expression. Some candidates had wrong answers such as $q(16q-18)$, $4q(4q-81)16q-18$ and $(16q-9)(16q+9)$. **Answer:** $(4q-9)(4q+9)$
9	It was poorly done; Some candidates were able to substitute correctly the values of m and t but could not write the square root sign correctly to cover both the numerator and denominator. Most common wrong workings and answers were: $\dfrac{\sqrt{7^2}}{15+1} = \dfrac{\sqrt{49}}{16} = 0.4375$, $\dfrac{\sqrt{7^2}}{15+1} = \dfrac{\sqrt{14}}{16} = 0.935$ and $\sqrt{\dfrac{49}{15}} + 1 = 2.81$. In some few instances, some candidates gave

	their answers as improper fraction, $\frac{7}{4}$, which did not attract any score or mark as there is an expectation that the answers should not be left as such but rather mixed fractions or decimals. **Answer:** $p = 1.75$ or $1\frac{3}{4}$
10	The question was fairly done. Most candidates did not know that perimeter is a closed path that encompasses or surrounds a given figure which was evident as they added all the measurements given on the figure. Some candidates could not figure out the missing sides *BC*, *CD*, *DE* and *EF* which led to inaccurate conclusions or calculations. The most common wrong working and answer was; 8+8+8+10+10+8+8+8 = 68. **Answer:** 52
11	Most candidates performed poorly in this question. A considerable number of candidates used a formula for the circumference of a circle instead of a formula for the area of a sector. Some of the candidates who used the correct formula could not make *r* the subject of the formula. Some common wrong workings and wrong answers were; $r = \frac{60}{360} \times 3.142 \times 42.5 = 22.2$ and $r = \frac{60}{360} \times 3.14$. There are still candidates who used 3.14 despite the fact that they were told to use π as 3.142 in the question. **Answer:** *9.01*
12	Most candidates did well in this question. Most candidates were able to identify the prism which was represented by the given net, though the spelling of 'triangular' was a challenge to some candidates. The most common wrong names were triangle prism, trigular and triglur prism. **Answer:** Triangular Prism

13	It was poorly done; Most candidates could not make t the subject of the formula as they either left the question with no attempt or were not able to apply the cube root on both sides of the equation. Some confused a square root for a cube root, which indicated that candidates knew something had to be done to the power of t. Some common wrong answers were as follows: $\dfrac{6-F}{2} = \dfrac{2t^3}{2}$ and $t = \sqrt{\dfrac{F-6}{2}}$. **Answer:** $t = \sqrt[3]{\dfrac{F-6}{2}}$
14	This question was poorly done. Most candidates randomly put any number as the value of x which in most cases were wrong. Some candidates could not interpret the scale in the x-axis properly, hence their responses were outside the given range. **Answer:** $x = 2.4$ to $x = 2.5$ or $x = -2.4$ to $x = -2.5$
15	It was poorly done. Some candidates calculated the coordinates of the mid-point instead of the distance between two points. Some candidates were unable to find a value of $\sqrt{164}$ and gave their wrong answer as 164. Some candidates were able to substitute correct values into the formula for distance between two points but struggled with manipulation of numbers and operations. **Answer:** 12.8
	Section B

16	(a) (i) This question was fairly done. Some candidates were not able to calculate the value of the 45% of P145 000 while others used the installment amount of P4 800 instead of P145 000, which was incorrect. A handful added P4 800 to the expected outcome of P65 250 showing a misinterpretation of what equal monthly installments meant or lack of understanding thereof. Most common mistakes were as follows; $\frac{45}{100} \times \frac{145000}{1} = P6525.00$, 45% of 4800 = 2160 x 24 = P51 840.00, and $\frac{45}{100} \times \frac{145000}{1} = P6525.00 + 4800 = $ P70 050.
	Answer: P65 250
	(a) (ii) This question was poorly done. Most candidates could not calculate correct amount of money paid by the farmer due to an inaccurate deposit calculated or the number of installments used not being equivalent to 24 months of payment. Most common mistakes shown were; P62 250 + P4 800 = P 67 050.00, and 45 + P4800 x 24 = P115 245.00.
	Answer: P180 450
	(b) It was poorly done; most candidates could not calculate the money that could have been saved due to inaccurate calculations which candidates made prior, for the total amount of money paid by the farmer when buying the tractor on hire purchase. At least they knew that the cash price amount was to be subtracted from the hire purchase price amount to obtain the amount which could be saved, even though the hire purchase amount was wrong. Some candidates had a common wrong working and wrong answer of P145 000 – P115 200 = P29 800.
	Answer: P35 450
17	(a) It was well done; most candidates were able to interpret the table correctly and obtained the cost appropriate for registering a 5.4 tonnes truck.

Answer: P1 750

(b) It was fairly done; most of the candidates were able to identify the corresponding registration fees for the two trucks in question, one weighing 3.9 tonnes and the other 9.2 tonnes, being P1500 and P2500 respectively but could not present the answer as expected by adding them together to get P4000, rather they presented the fees in isolation which was wrong.

Answer: P4 000

(c) This question was poorly done. Some candidates gave P4 500 only without considering the penalty fee for registration as their answer, which was wrong while some correctly calculated 15% of P4 500 which resulted in a penalty of P675 but did not add it to P4 500 to obtain the total amount paid by Ntapa for registration and penalty.

Answer: P5 175

18	(a) The question was poorly done; Most of the candidates were able to identify the correct transformation as Enlargement but could not determine the centre of enlargement and the scale factor of the enlargement. Some candidates were getting the centre of enlargement but could not present it appropriately as evidenced by their use of a vector, $\begin{pmatrix} -5 \\ -5 \end{pmatrix}$ instead of coordinates, (- 5, - 5). A small number of candidates gave wrong responses for method such as translation and rotation. **Answer:** Enlargement, Scale factor = 3 and Centre of enlargement (- 5, - 5). (b) The question was poorly done; most candidates could not correctly translate triangle *LMN* by the vector $\begin{pmatrix} 5 \\ 3 \end{pmatrix}$ given in the question as they confused the movement along the y-axis with that of the x-axis and vice versa. In some instance, some candidates did not know the implication on the movement of an object when the values in the vector were positive or negative.

	Answer: Triangle PQR with coordinates P (3, 10), Q (3, 1) and R (9, 1).
19	(a) Most candidates did well in this question as they were capable of naming the cross-section of the prism which was the shaded part of the prism. The handful who did not get it correct, gave their wrong answers as rhombus, parallelogram and, surprisingly, even rectangle. **Answer:** Trapezium (b) It was poorly done; most candidates could not calculate the area of the trapezium as some candidates used wrong formulae such as the volume of a prism whereas some ignored the use of brackets in the formula for the area of a trapezium even though they had used the right measurements in the correct places. Most common wrong workings and wrong answers were as follows: $\frac{1}{2} \times 23 + 17 \times 5 = 142.5\,\text{cm}^2$, 23 x 5 = 115 cm², 23 x 49 = 1127cm² and 22 x 5 x 17 = 1955 cm². **Answer:** 100 cm² (c) This question was poorly done. Most candidates were unable to identify the length of the given prism. Most of them multiplied the cross-sectional area by any given measurement in the prism. **Answer:** 4 900 cm³
20	(a) It was well done. Most candidates were able to substitute 6 in the equation $y = 3 - \frac{2}{3}x$ correctly to get the value of *K*. Nonetheless, some candidates could not correctly resolve the sum in spite of their correct substitution. **Answer:** **K** = - 1

	(b) It was fairly done as most candidates were able to plot the points correctly on the x-y plane using the given scales, but used free hand to draw the line which was unacceptable. **Answer:** Correctly drawn line. (c) It was poorly done; most candidates disregarded the equation given in the part question and drew lines of the form of $x = 2$, $x = -2$ and $y = 2$. **Answer:** Correctly drawn line $y = x - 2$. (d) It was poorly done. Most candidates could not draw the two lines $y = x - 2$ and $y = 3 - \dfrac{2}{3}x$ correctly, hence giving a wrong intersection. Some were able to interpret the solution from the graph even though the line drawn were incorrect. **Answer:** $x = 3$ or $y = 1$
21	(a) The question was well done. Most candidates were able to write the correct expression required as they realized that the missing sides were equivalent to the given sides and further that all sides were to be added together to get the perimeter. **Answer:** $2x + 3 + 2x + 3 + x + x$ (b) (i) It was well done as most candidates were able recognize that they were required to equate the perimeter expression to the value of the perimeter of the land, which is 36. **Answer:** $2x + 3 + 2x + 3 + x + x = 36$ (ii) It was poorly done. Most candidates could not collect like terms in the equation and, hence failed to find the value of x. At least most of the candidates realized

that there were supposed to solve the equation which they had obtained earlier on.

Answer: $x = 5$

(c) It was poorly done. Most candidates realized that there supposed to solve their equations obtained from the previous subparts of the question even though they were initially wrong as such could not find the correct length of the fence as they used the wrong values of x. Some candidates could not apply the rule of pythagorus theorem for this part of the question, deviating from expectation.

Answer: 13.9

22	(a) It was well done. Most candidates were able to identify the correct month with the highest amount of rainfall. **Answer:** October (b) It was poorly done as most candidates were able to add all the rainfall amounts for the different months but could not divide by the number of months to calculate the average rainfall required. Most common wrong working and wrong answer was 30 + 50 + 90 + 70 + 80 = 320. **Answer:** 64 (c) It was fairly done. Some candidates were able to draw the correct graph while other candidates were able to plot the correct coordinates but used a free hand to draw the graph, which was wrong. There are few cases where some candidates started the graph from zero. However, few candidates drew bar graphs instead of a line graph. **Answer:** Correct line drawn

	(d) It was poorly done. Most candidates identified October and December as their responses which was incorrect. Other candidates could not interpret the graph correctly. **Answer:** November and December
23	(a) It was well done. Most candidates were able to subtract 0900hrs from 1200hrs to find the difference in time between Gaborone and Palapye. However, a few candidates wrote 1200 as their wrong answer. **Answer:** 3 hours (b) It was fairly done. Some candidates were able to calculate the correct value of the speed whereas some other candidates, though few, divided 300km by 1200hrs without any consideration of the correct interpretation of the time taken. **Answer:** 100 km/h (c) The question was fairly done. Some candidates were able to draw the second stage of the journey but failed to draw the third stage of the journey correctly. There were isolated cases of some candidates using a freehand to complete the graph. **Answer:** Correctly drawn graph (d) It was well done. Most candidates were able to identify the correct time which was corresponding to the arrival time of the bus in Sefhophe even though some graphs may not have had straight edge lines. **Answer:** 1400 hrs
24	(a) The question was well done. Most candidates were able to identify the correct entries which was an indication of the candidates' awareness of the possibility space

diagram.

Answer: 7, 9

(b) It was fairly done. Some candidates were able to give the correct total possible outcomes as a result of correct interpretation of the possibility space diagram.

Answer: 12

(c) (i) It was poorly done. Most candidates could not identify the expected entries due to lack of association of sameness of numbers required in the question with different pairs of numbers in the outcomes of the possibility space diagram. Other candidates did not present a probability as their response but just gave the number of possibilities, hence most common wrong answers were whole numbers.

Answer: $\dfrac{1}{4}$ or 0.25

(ii) The question was poorly done. Most candidates could not identify the correct total number of the expected outcomes due to possibly being unable to identify a combination of prime numbers and even numbers as per the requirement of the question.

Answer: $\dfrac{5}{12}$

Section C

25.	This question was poorly done. Majority of candidates added 4 rounds to 5 rounds to get 9 as their wrong answer.

	Answer:	13
26.	It was poorly done. Most candidates randomly gave any number for bulls, female cows and calves which did not add up to 10. Other candidates were concerned about 30ml only and disregarded the requirement of all the cattle being a total of 10. **Answer:** **2** Bulls, **3** Female cows and **5** Calves.	
27.	The question was fairly done. Some candidates could not use the number once as per requirement by the question. Other candidates just filled in numbers without applying the rules which were given in the question; ensuring that a number appears in every row and diagonal. **Answer:**	

1	2	3	4
4	3	2	1
2	1	4	3
3	4	1	2

28.	It was poorly done. Most candidates were not able to find the number of pencils and the number of jars. Other candidates were drawing diagrams of jars and pencils inside them but could not make conclusions from their approach or working though they were in the right track. **Answer:** **Number** of **pencils** is 16 and number of **jars** is 5.	
29.	It was poorly done. Most candidates could not calculate the correct number of coins per each denomination as they randomly added 25 thebe and 50 thebe until they got P7.00, without considering the relationship between the numbers of the denominations as specified in the question. **Answer:** **Number** of **50 thebe coins** is 8 and number of **25 thebe coins** is 12.	

30.	This question was poorly done. Most candidates could not recognize that the question was using the concept of place values and calculating the difference between numbers with the same number of digits as such many responses were haphazard and wrong. Candidates could not make a connection between the result of the subtraction of number **ab8** from 600 and that of subtraction of 500 from number **c4a**.
	Answer: **a** = 2, **b** = 5 and **c** = 8