PRINCIPAL EXAMINER'S REPORT

BOTSWANA EXAMINATIONS COUNCIL

BSSE SCIENTIFIC MATHEMATICS

2025

PAPER 1: WRITTEN PAPER

General Comments

The overall performance of candidates in the examination was mixed, with some topics being handled very well while others revealed significant conceptual weaknesses. Candidates generally performed well in routine procedures and straightforward applications of mathematical concepts, particularly in topics such as simultaneous equations using matrices, basic probability, simple function evaluation, geometrical constructions, and certain circle geometry concepts. However, performance was weaker in questions requiring deeper conceptual understanding, interpretation, algebraic manipulation, and application of mathematical principles in unfamiliar contexts.

Candidates demonstrated good understanding of recurring and procedural topics. Most of the candidates were able to correctly solve simultaneous equations using inverse matrices, evaluate functions through substitution, construct perpendicular bisectors and circumcircles accurately, and apply straightforward probability concepts. Questions involving basic logarithms, equation of a circle, and simple vector subtraction were also generally well done. In geometry, many candidates correctly applied circle theorems and provided valid geometrical reasons. These responses indicate that many candidates are comfortable with familiar procedures and direct substitution methods.

Despite these strengths, a number of weaknesses were consistently observed across the paper. One of the major challenges was poor conceptual understanding of fundamental algebraic concepts, particularly laws of indices, partial fractions, differentiation, variance, and vector ratios. Many candidates struggled with negative fractional indices, manipulation of surds, algebraic simplification, and correct interpretation of cumulative frequency graphs. Errors involving directed numbers, incorrect handling of signs, and poor manipulation of fractions were also common throughout the examination.

A significant number of candidates demonstrated difficulty in interpreting questions and applying the appropriate mathematical principles. In several items, candidates used incorrect formulae or confused related concepts. For example, in questions involving sectors, some candidates confused arc length with area, while in statistics many candidates failed to distinguish between squared values and squared deviations from the mean when calculating variance. In set notation, candidates struggled to determine intersections and interpret relationships between subsets correctly. Similar weaknesses were observed in appreciation questions, where candidates correctly calculated percentage increase but failed to add the appreciation to the original amount.

Candidates also showed weaknesses in mathematical communication and presentation. Some failed to provide required workings, while others substituted answers back into equations unnecessarily or used incomplete geometrical reasons. In some instances, candidates described diagrams instead of stating the relevant theorem or property. Poor algebraic presentation, especially in division and cancellation processes, also affected the clarity and validity of solutions.

Another concern was the number of candidates who left certain items unanswered, particularly questions involving vector ratios, algebraic manipulation, and differentiation. This suggests lack of confidence in more demanding topics and insufficient mastery of higher-order problem-solving skills.

Comments on Individual Items

1 The item was well done, as most of the candidates obtained the correct answer of $\frac{23}{99}$, although many did not show their working. Some candidates used incorrect combinations of powers of 10, for example combining 10 with 100, leading to the incorrect answer $\frac{21}{90}$.

***Answer*: $\frac{23}{99}$**

2 The item was well done. However, some candidates incorrectly used an equality sign instead of an inequality sign, resulting in $x = 7$ instead of the required solution.

***Answer*: $x \geq 7$**

3 The question was poorly done, as most of the candidates demonstrated weak understanding of the laws of indices. In particular, candidates failed to correctly interpret negative fractional indices. Many treated negative indices as positive or ignored the effect of fractional power, leading to incorrect simplification. Common errors included incorrect inversion of fractions, misuse of square roots, and confusion between indices and numerical evaluation. These responses indicate inadequate mastery of index laws and poor manipulation of fractions. A significant number of candidates misinterpreted the expression $\left(\frac{9}{4}\right)^{-\frac{1}{2}}$ *and instead treated it as* $\left(\frac{9}{4}\right)^{\frac{1}{2}}$.

Answer: $\frac{2}{3}$

4 The item was well done, with most of the candidates obtaining the correct answer. However, some candidates substituted the answer into the given equation instead of simply stating the value. Common wrong responses included $5^2 = 10, 2^5 = 32, \frac{2}{5} = 0.4, \frac{5}{2} = 2.5$ *and* $5\sqrt{25} = 5$,indicating misunderstanding of logarithmic evaluation and basic powers.

***Answer*: 25**

5 The item was generally well done, with the majority of candidates demonstrating adequate understanding of the equation of a circle. Most of them were able to correctly identify the centre and radius and apply the standard formula. Candidates who performed well showed correct substitution of values and appropriate handling of signs, resulting in accurate equations such as $(x-5)^2 + (y+6)^2 = 169$. However, some candidates displayed weaknesses in the application of the formula. Common errors included incorrect identification of the centre, wrong signs when substituting the coordinates, incorrect squaring of the radius, and writing expressions instead of a complete equation. These errors led to loss of marks. In general, candidates showed reasonable knowledge of the topic, but the errors observed indicate the need for more practice in interpreting given information and accurately applying the standard form of the equation of a circle.

***Answer*: $(x-5)^2 + (y+6)^2 = 169$**

6 The item was fairly well attempted, with the majority of candidates correctly recognising the need to rationalise the denominator by multiplying both the numerator and the denominator by $\sqrt{5}$ or $2\sqrt{5}$.These candidates demonstrated an appropriate understanding of simplifying expressions involving surds. A few candidates, however, produced incorrect responses due to misunderstandings in the simplification process. The most frequent incorrect answers included, $\frac{6\sqrt{5}}{10}$, $\frac{6\sqrt{5}}{4+5}$ and $6\sqrt{5}$.

Answer: $\frac{3\sqrt{5}}{10}$

7 **(a)** The item was well done, as most of the candidates correctly calculated the length of the arc by applying the appropriate fraction of the circumference using the arc length formula. However, some candidates lost marks due to incorrect application of the formula. Common errors included treating the radius as the arc length, using incorrect angle fractions, and confusing arc length with area. Typical incorrect responses included $\frac{\pi}{3} \times 15^2 = 75\pi$ and $\frac{\pi}{3} \times 15 \times 2 = 75\pi$, indicating poor understanding of the arc length formula.

(b) The item was poorly done, as most candidates demonstrated limited understanding of the formula for the area of a sector. Weaknesses were observed in stating and applying the correct formula. Common errors included use of the area of a circle, cone, cylinder and triangle formulae.

Answers: (a) 5π **(b)** 37.5π

8 **(a)** The item was well done, with many candidates providing the correct answer together with an appropriate geometrical reason. Most of the candidates demonstrated a sound understanding of the required geometric relationship. A notable incorrect answer was 17, which candidates obtained by incorrectly dividing 34 by 2. This reflects a misconception in applying the relevant geometric property and suggests that some candidates relied on numerical manipulation instead of reasoning based on the diagram. Some candidates described the diagram rather than stating the specific geometrical reason required.

(b) The item was well attempted, with a reasonable number of candidates arriving at the correct answer and reason. However, a significant proportion demonstrated misunderstandings in angle properties within circles. Frequently observed incorrect answers included:

- **112°**, typically obtained from the incorrect calculation 180° − 68°
- **136°**, obtained by doubling 68°

These errors indicate uncertainty regarding the correct application of circle theorems. Errors in the reasons often involved the omission of key words such as *opposite* and *cyclic*, which rendered the explanations incomplete or incorrect.

***Answers*:** **(a)** 68°, angle at the Centre is twice the angle at the circumference

(b) 146°, opposite angles in a cyclic quadrilateral (are supplementary) or angle at the Centre is twice the angle at the circumference or angles in opposite segments (are supplementary/add up to 180).

9 The performance of candidates on this item was very poor; candidates did not understand the concept of appreciation at all whereas they did extremely good on finding the percentage of the quantity. They were able to calculate the value of shares before appreciation, which was 150 × 40= 6000 and the increase $\frac{2}{100}$ × 6000= 120 correctly but failed to add them together. Some other candidates continued to subtract 120 from 6000 instead of adding it which showed lack of knowledge about the concept of appreciation.

***Answer*: 6120**

10 Overall, performance on the item testing the evaluation of the function $\boldsymbol{g(x) = x^3 + 3x}$ was very good. Almost all candidates were able to score full marks, demonstrating sound understanding of substitution into a linear function. Candidates showed confidence in carrying out the basic steps required to compute g (−2).

However, a small number of candidates failed to obtain the correct final answer due to errors in the evaluation of directed numbers. Centres are advised to continue emphasising the correct handling of negative integers, as this remains a common source of error.

Answers: –14

11 The probability question was generally well attempted. Most of the candidates scored full marks, indicating good understanding of basic probability concepts. However, a few candidates lost marks due to weaknesses in fraction operations, particularly addition and multiplication of fractions.

***Answer*: $\frac{2k}{5k}$**

12 **(a)** This question was fairly done. Most of the candidates were able to recognise that vector AB is found by subtracting OA from OB, but a number of candidates still lost marks through sign errors. A common incorrect response was r + s showing misunderstanding of how to form a vector between two points. A few candidates did not attempt the question at all. Candidates who answered correctly showed sound understanding of vector subtraction.

(b) This item was poorly done. Many candidates incorrectly carried forward their answer from part (a) in an inappropriate way, giving answers such as $\frac{3}{5}$ (their answer from (a)), $-r + s + \frac{5}{8}$. These responses indicate limited understanding of vector ratios and how to express a point dividing a line segment in a given ratio. Some candidates did not attempt the part question.

***Answer*: (a) $\boldsymbol{-r + s}$ (b) $\frac{3}{8}(-r + s)$**

13 Most of the candidates performed very well on the question assessing the solving of simultaneous equations using matrices. Almost all candidates obtained full marks and demonstrated a good understanding of the use of the inverse matrix method.

However, a small number of candidates failed to score full marks due to incorrect calculation of the determinant, inappropriate use of elimination and substitution methods, and errors in forming or multiplying matrices. Centres are advised to strengthen learners' foundational understanding of matrix operations, particularly determinants and inverses.

***Answer*: $x = 3, y = -2$**

14 **(a)** This part of the question was well done, as most of the candidates were able to construct the perpendicular bisector of side RQ.

(b) Majority of the candidates performed very well on the construction question. Almost all candidates scored all the available marks, showing good understanding of basic geometrical constructions. Most of the candidates were able to use the required instruments correctly and demonstrate competence in drawing perpendicular bi-sectors and circumcircles. However, a few candidates failed to score full marks due to inaccuracies in constructing the circumcircle of a triangle.

***Answers*:** (a) Correct bisector drawn (b) Correct circumcircle drawn

15 **(a)** The performance on this item was fair. Many candidates were able to apply substitution correctly, but some lost marks through avoidable errors, particularly when substituting negative values such as writing (-2^2) instead of $(-2)^2$. This reflects a lack of clarity in handling directed numbers and indices.

Another recurring problem was poor presentation of division. Some candidates cancelled values incorrectly or drew long division lines that extended across both sides of the equation, making working unclear and mathematically invalid. Candidates who showed clear steps and correct substitution were able to arrive at the correct simplified expression.

(b) This part question was poorly done. A notable number of candidates did not attempt the question at all. Among those who attempted it, many made errors by attempting to convert their answers into decimals, which introduced rounding mistakes or unnecessary complexity. The method required careful algebraic manipulation, and the few who followed correct procedures obtained the correct solutions.

***Answers*: $q = \frac{10}{3}$, $r = \frac{8}{3}$**

16 The item was poorly done, as most of the candidates showed limited understanding of how to calculate elements of a set. Weaknesses were observed in determining the intersection and finding the number of candidates with laptops only and cell phones only from the given information. Common errors included substituting numbers directly from the question without applying set principles and using the sum of laptops and cell phones as the intersection.

***Answers*:** 20, 5, 11

17 The performance on this item was fairly done. A number of candidates were able to obtain the correct answer by applying the correct variance formula. However, many candidates lost marks due to the use

of incorrect formulae or confusion between summing squared values and summing squared deviations from the mean. A few candidates did not attempt the question at all.

***Answer*: 2.5**

18 The question required candidates to express $\frac{3}{(x-1)(2x-1)}$ as a sum of partial fractions. Majority of the candidates failed to score all the marks, mainly due to incorrect determination of the constants A and B. Those who performed well demonstrated a clear understanding of equating numerators and solving for unknown constants. Poor responses reflected confusion in substitution, sign errors, or incorrect algebraic manipulation. Some candidates wrote forms that did not correspond to the original expression or did not satisfy the identity for all values of x.

***Answer*: $\frac{3}{x-1} - \frac{6}{2x-1}$.**

19 The question required Candidates to estimate the number of athletes who took 35 minutes or more. The total number of athletes was 80, and the cumulative frequency at 35 minutes was 59. The correct approach was: Number of athletes taking 35 minutes or more $= 80 - 59 = 21$.

Candidates performed poorly in this question, most of them failed to apply this correctly. Instead of subtracting the cumulative frequency at 35 minutes from the total number of athletes, many candidates simply stated 59 as the answer. Others incorrectly subtracted 35 from 80, which shows a misunderstanding of the concept. These responses indicate limited understanding of the interpretation of cumulative frequency curves, particularly the distinction between values less than and greater than a given value.

***Answer*: 21**

20 The question required candidates to calculate the gradient of the curve $2x^2 - 3x + 5$ at $x = 2$ using differentiation. Majority of the candidates failed to score all the marks because they were unable to differentiate correctly.

Candidates who performed well showed a clear understanding of the differentiation of simple polynomial functions. Poor responses indicated confusion between differentiating and substituting into the original function, and some candidates added arbitrary constants unnecessarily.

***Answer*: 5**

PAPER 2: WRITTEN PAPER

General Comments

There was a lot of premature approximation in the working stages of compounded interest, money and variance, leading to answers out of range. The expectation is that candidates should only approximate the final answer.

Many candidates were lacking arithmetic skills and algebraic manipulations involving directed numbers such as expanding by a negative sign and negative numbers. They were also challenged in the efficient use of the calculator, especially in calculating compounded interest and angles. The algebra and calculus module was especially challenging for them They were not able to multiply out indices collect like terms, substitute correctly into given formulae and form equations. The diagrams were often hand-drawn. Some candidates had the computational skills, but their work was often punctuated by numerical errors, although the component is a calculator paper. The candidates used rulers in their diagrams and they were neat. Some candidates were neat in their presentation and had neat diagrams.

Comments on Individual Items

1 Candidate did well in this question, many of them were able to calculate dividends. Unsuccessful candidates had P3187.5. The expectation is that numerical answers involving money should be approximated to two decimal places. A few candidates had $\frac{850}{3.75} = 266.67$, while other candidates had $850 + 3.75 = 853.75$.

Answer: P3187.50

2 Again candidates did well in this question, many of them were able to calculate the required terms. Unsuccessful candidates had 31 obtained by evaluating $2^5 - 1$ and 30 obtained by evaluating $2^5 - 2$.

Answer: 16, 8

3 Most of the candidates failed to expand the brackets. The multiplying out of the brackets was often punctuated by numerical errors and misapplication of the rules of indices. Some candidates were not successful in multiplying out the powers of the variables and had $2x \times 4x^2 = 8x^2$, $\boldsymbol{8x^3 - 18x + 45}$ from $8x^3 + 12x^2 + 18 - 12x^2 - 18x + 27$ and $\boldsymbol{8x^3 + 12x^2 - 12x - 27}$ from $8x^3 + 12x^2 + 18x - 12x - 18x - 27$.

Answer: $8x^3 - 27$

4 Candidates performed poorly in this question; they were not able to draw image of the shape after shear. Most of the candidates had an image after a x –shear with a shear factor $\frac{2}{3}$ followed by a translation $\binom{2}{0}$. Other candidates had a stretch of factor 2 parallel to the x–axis with vertices (0, 0), (4,0), (4, 3) and (0, 3).

***Answer*:** Parallelogram with vertices (0, 0), (2, 0), (6, 3) and (8, 3)

5 The performance of candidates in this question was fair. Most of them were able to multiply fractional indices with a further power of 2 and had $\frac{x^{-3}}{y^{-1}}$ and went no further, while other candidates changed the negative indices to the positive indices and had $\left(\frac{y^{\frac{1}{2}}}{x^{\frac{3}{2}}}\right)^2$ and went no further. A few candidates had $\frac{x^{-\frac{3}{2}\times-\frac{3}{2}}}{y^{-\frac{1}{2}\times-\frac{1}{2}}} = \frac{x^{\frac{9}{4}}}{y^{\frac{1}{4}}}$.

Answer: $\frac{y}{x^3}$

6 Most of the candidates performed poorly in this question. Some candidates calculated simple interest and had $15785\left(1+\frac{4}{100}\right)^3 = P17755.98$. Some candidates had $15785\left(1+\frac{4}{12}\right)^3 = 37416.30$. .A few candidates had P25428.95 obtained from $15785(1+\frac{0.04}{3})^{36}$

Answer: P17793.99

7 **(a)** This part of the question was poorly answered. Most of the candidates were able to substitute correctly $f(x)$ into $g(x)$ but then had $-3\left(\frac{5x}{2}+4\right)$ obtained from $2-5\left(\frac{5x}{2}+4\right)$. Other candidates were not able to multiply out with the negative sign and had $2-\frac{5x}{2}+20$. A few candidates had $2-5(x+2)$, while others had $2-\frac{5x}{10}+4$.

(b) A fair proportion of the candidates were successful in making x the subject of the formula in $y = 2-5x$. The tendency was to omit the negative sign and have $y-2=5x$. Some candidates had $\frac{x+2}{5}$, while other candidates had $\frac{x+2}{-5}$.

Answer: (a). $-\frac{5x}{2}-18$ (b). $\frac{2-x}{5}$

8 Candidate performed very well in this question. A large proportion of the candidates were able to calculate the discriminant and make the appropriate conclusion on the nature of the roots. Some of the candidates who were successful in calculating the discriminant omitted the word “real” which is key in defining the nature of the roots.

Answer: Real distinct roots

9 Candidates performed fairly in this question. Strong candidates were successful in manipulating a correct equation and using the key angle to find angles in the appropriate quadrants. Some average candidates were successful in manipulating the equation and calculation of the key or primary angle, but calculated angles in the wrong quadrants. The most common wrong quadrant was the second

because candidates were not able to interpret the sign of the value of $sin\,\theta$. A few candidates had a negative primary angle and went no further.

Answer: θ = 222°, θ = 318°

10 A large proportion of the candidates were unsuccessful in attempting the question. They had the points (3, 1) and $(-3, -1)$ for the vertex. They calculated the distance between the vertex and the focus, then added it to the wrong coordinate and had answers such as (6, 1), (1, 6) and rarely (3, 4).

Answer: Vertex (1, 3), Focus (4, 3)

11 **(a)** A fair proportion of the candidates were able to describe the correlation. Unsuccessful candidates had answers such as fluctuating, scatter, no correlation and zero correlation.

(b) A fair proportion of the candidates were able to plot the given semi-average points and join them with a ruler. Some candidates plotted the semi-average points but used a free hand to join them. Other candidates drew the line of best fit by inspection, and it tended to pivot around the point (20, 10).

(c) Candidates performed fairly in this question. Strong candidates were successful in determining the equation of line of best fit. Average candidates calculated the gradient, substituted it and went no further. Other average candidates. The most common wrong equations were $2x$ + 14.5 = y and $y = 2x - 9$, obtained from exchanging the coordinates of the semi-averages in calculating the gradient.

Answers: (a). Positive (b). Correct line of best fit passing through (29, 19) and (45, 27) (c). M = 0.5v + 4.5.

12 **(a)** Candidates performed very well in this question, they were able to write the upper bound of the distance AC. Unsuccessful candidates had 13 and 13.05.

(b) A large proportion of the candidates were unsuccessful in determining the upper bound of the angle, likely due to an incorrect interpretation of the accuracy to one decimal place. They had either 31.5 or 31.6.

(c) A large proportion of the candidates were unsuccessful in calculating the upper bound of the area of the field. They used the values given in the diagrams even when their answers from part (a) were correct. Some candidates had $\frac{1}{2} \times 9.5 \times 17.5\, Sin\, 31.55$, obtained from using BC instead of AC. Other candidates had $\frac{1}{2} \times 13 \times 17\, Sin\, 31.5 + 0.05 = 57.75$.

Answers: **(a)** 13.5 **(b)** 31.55 **(c)** 61.8

13 Candidates performed poorly in this question. Although the method was specified in the question, a fair proportion of the candidates used grouping. The candidates who used the factor theorem were able to determine the first factor and then determine the quadratic expression using long division, which was often punctuated by numerical errors and incorrect signs. The most common binomial products were

$(x-1)(x^2+5x+3)$ and $(x+1)(2x^2+x-3)$, but then candidates were unsuccessful in factorising them.

Answer: $(x-1)(2x+3)(x+1)$

14 Candidates performed fairly in this question. Some candidates were successful in applying the laws of logarithms, removing the logs to form the required equation and solving it. Other candidates were successful in applying the laws of logarithms to both sides of the log equation but were unsuccessful in removing the logs. Some candidates were only successful in applying the laws of logarithms in subtraction but were unsuccessful in expressing 1 as a logarithm of base 5. Others had $\log_5\left(\frac{3x+7}{2x}\right)=-7$, omitted log to base 5 and had the equation $\frac{3x+7}{2x}=-7$. Other weak candidates omitted the log of base 5 in the original equation and had $(3x+7)-2x=1$ leading to the solution $x=-6$.

Answer: $x=1$

15 A large proportion of the candidates were unsuccessful in differentiating the power. A few were successful in differentiating the base and had $7\times 10x\times(5x^2-1)$, thereby omitting the index 6. Some candidates successfully differentiated the power and had either $7(5x^2-1)^6\times 10$ or $7(5x^2-1)^6$ and went no further. A few candidates had $(35x^2-1)^6$.

Answer: $70x(5x^2-1)^6$

16 Candidates performed poorly in this question. Some candidates were able to form the equation for the sum of the first 30 terms and the equation for the sum of the next 20 terms, others formed an equation for the sum of the first 50 terms. The equations were solved simultaneously, often punctuated by numerical errors. Some candidates were successful in forming the equation for the sum of the first 30 terms. They were challenged in forming the equation for the sum of the next 20 terms or for the sum of the first 50 terms. They instead formed an equation for the sum of the first 20 terms and had $2a+19d=-221$. There were attempts to solve the equations simultaneously, also punctuated by numerical errors. Still other candidates were not able to form any equations.

Answer: -3

17 A large proportion of the candidates were successful in calculating the y –values and plotting all the required points. Strong candidates were successful in drawing the graph of the tangent function, showing the asymptotes. However, the graphs tended to stop in the range $-1\leq y\leq 1$. Very few candidates had graphs in the given range. Average candidates also calculated the y –values, plotted the points except (0, 0). The plotted points were joined in a continuous smooth curve, resulting in the graph of the sine function. Some candidates drew the graph of the cosine function.

Answer: Correct graph asymptotic at 90° and 270°.

18 Save for the strong candidates, a large proportion of the candidates were unsuccessful in estimating the 7th decile. Most of the candidates were unsuccessful in determining the position of the 7th decile.

Answer: 729

19 Candidates performed poorly in this question,. Most of the candidates evaluated the function at the given points. Some subtracted the values and had 24, some multiplied the values and had 217, while others expressed the values as a point. A few of those who expressed the values as a point went further to calculate the magnitude from the origin and had 31.8. Some candidates did not attempt this question at all.

Answer: 34

20 Candidates performed fairly in this question. Some candidates were able to express $tan\theta$ as $\frac{sin\theta}{cos\theta}$, multiplying each term on both sides with $\cos\theta$ to remove the denominator and used the identity $cos^2\theta + sin^2\theta = 1$ to form the required equation. Angles in the correct quadrants were calculated. A few candidates calculated the angle in the first quadrant and stopped there. some candidates were able to express $tan\theta$ as $\frac{sin\theta}{cos\theta}$, but were not successful in removing the denominator. They had $cos\theta + \frac{sin^2\theta}{cos\theta} = 3$ followed by $cos\theta + \frac{1-cos^2\theta}{cos\theta} = 3$ and stopped there. Some candidates had $\frac{1}{sin\theta} + sin\theta \times \frac{sin\theta}{cos\theta} = 3,$ while others had $cos\theta + sin\theta \times \frac{cos\theta}{sin\theta} = 3$ and also $(1 - sin\theta) + sin\theta\frac{sin\theta}{cos\theta} = 3.$ other candidates had $cos\theta + (1 - cos\theta)tan\theta = 3$

Answer: $\theta = 70.5°$, $\theta = 289.5°$

21 **(a)** Some candidates were successful in calculating the variance, even with their calculated mean. Average candidates were successful in calculating the midpoints of the given classes, the total frequency, but did not use the frequencies of the classes in their calculations and had 5016.6. The midpoint of the class, $25 \leq m < 40$, had the most errors, often 32. There was a lot of premature approximation in the calculation that used the formula $\frac{\sum f(x-\bar{x})^2}{\sum f}$.

(b) All the candidates who had some value for the variance were successful in calculating the standard deviation.

Answer: **(a)**. 78.3, 106.89, 77.9 **(b)** 8.85, 10.3, 8.82