

CARIBBEAN EXAMINATIONS COUNCIL

**REPORT ON CANDIDATES' WORK IN THE
SECONDARY EDUCATION CERTIFICATE EXAMINATIONS
MAY/JUNE 2008**

MATHEMATICS - (ROR SCRIPTS)

MATHEMATICS
GENERAL AND BASIC PROFICIENCY EXAMINATIONS
MAY/JUNE 2008

GENERAL COMMENTS

The General Proficiency Mathematics examination is offered in January and May/June each year, while the Basic Proficiency examination is offered in May/June only.

In May/June 2008 approximately 57 000 candidates registered for the General Proficiency examination. Candidate entry for the Basic Proficiency examination was approximately 4 000. At the General Proficiency level, approximately 37 per cent of the candidates achieved Grades I – III. At the Basic Proficiency level, approximately 32 per cent of the candidates achieved Grades I – III.

DETAILED COMMENTS

General Proficiency

One candidate scored the maximum mark on the overall examination. Twenty-eight per cent of the candidates scored at least half the available marks.

Paper 01 – Multiple Choice

Paper 01 consisted of 60 multiple choice items. This year, 53 candidates earned the maximum available mark. Approximately 54 per cent of the candidates scored at least half the total marks for this paper.

Paper 02 – Essay Choice

Paper 02 consisted of two sections. Section I comprised eight compulsory questions totaling 90 marks. Section II comprised six optional questions: two each in Relation, Functions and Graphs; Trigonometry and Geometry; Vectors and Matrices. Candidates were required to choose any two questions. Each question in this section was worth 15 marks.

This year, four candidates earned the maximum available mark on Paper 02. Approximately 18 per cent of the candidates earned at least half the maximum mark on this paper.

Compulsory Section

Question 1

This question was designed to test candidates' ability to:

- perform basic operations with decimals
- perform basic operations with fractions
- convert from one currency to another given the exchange rate

The question was attempted by 100 percent of the candidates, 33 per cent of whom scored the maximum available mark. The mean mark was 7.48 out of 10.

Responses were generally good with the majority of candidates obtaining correct solutions to all parts of the question.

In part (a), errors were made mainly by candidates who performed the computations without the use of calculators. They often failed to place the decimal point in the correct position when multiplying or when computing the square root. Candidates were more proficient in dividing fractions than in subtracting fractions.

In converting currencies using the given rate of exchange, some candidates used \$72.00 instead of \$72.50 and hence could not obtain the exact answer. They also ignored the cents and gave answers correct to the nearest dollar.

In part (b) (ii), a significant number of candidates correctly obtained the amount left (in \$JA) on the credit card by subtracting what was spent from \$30 000. However, they did not proceed to convert this amount to Canadian dollars.

Solutions

- | | | | | |
|-----|-----|-----------------------|------|---------------------|
| (a) | (i) | 1.873 | (ii) | $2\frac{4}{15}$ |
| (b) | (i) | JA \$18 125.00 | (ii) | CAN \$163.79 |

Recommendations

In order to avoid errors with respect to the position of the decimal point, students must be reminded to check for the reasonableness of their answers when performing operations on decimals. Unless a question specifies a particular degree of accuracy, students must leave their answers correct to the nearest cent when performing calculations with money.

Question 2

The question tested the candidates' ability to:

- perform operations involving directed numbers
- substitute numbers for algebraic symbols in simple algebraic expressions
- translate verbal phrases into algebraic symbols
- solve simple equations in one variable
- factorise simple algebraic expressions using common factors
- factorise a quadratic expression

The question was attempted by 99.6 per cent of the candidates, 2 per cent of whom scored the maximum available mark. The mean score was 5.3 out of 12.

Most candidates substituted the values correctly in the expressions but a significant number failed to simplify the answer. Weaknesses in operating with directed numbers were evident. For example $2(-1 + 3)$ was equated to $2(-4)$ or $2(-2)$. Candidates also made errors in simplifying $4(-1)^2$. This was often written as: $(-4 \times -4 \times -1 \times -1)$ or (-4^2) or $4(-1)$.

Too many candidates had poor responses to part (b) of this question. In part (i), four times the sum of x and 5 was stated as $4x + 5$, again ignoring the brackets. Far too many candidates wrote an inequality in response to part (ii) instead of an expression. A popular response was $16 > ab$.

In solving the equation in part (c), many candidates had problems in using the distributive law while others made errors in transposing terms. Hence, $2(3x + 1)$ was often seen as $6x + 1$ and $15 - 4x = 6x + 2$ was simplified to $-4x + 6x = 2 + 15$.

In using the method of common factors to factorise the expression, only a few candidates were able to get the correct HCF. Errors were frequently made in dividing algebraic terms. Weaker candidates had no idea what factorise meant and attempted to add the terms to give $18a^6b^4$.

Factorizing the quadratic expression also presented problems for candidates. Errors in signs were common. A significant number of candidates assumed it was an equation and attempted to use the quadratic formula or the method of completing the squares to solve for m .

Solutions

- | | | | | |
|-----|-----|---------------------------------------|------|-------------------------------------|
| (a) | (i) | 4 | (ii) | -2 |
| (b) | (i) | $4(x + 5)$ | (ii) | $16 + ab$ |
| (c) | (i) | $\frac{13}{10}$ | | |
| (d) | (i) | $6a^2b(b^2 + 2a^2)$ | (ii) | $(2m - 1)(m + 5)$ |

Recommendations

Teachers need to ensure that students are familiar with the necessary vocabulary associated with algebra. Terms such as expression, equation, factorize, simplify and solve must be explored fully. In the teaching of translation of worded statements to symbols, students need to reverse the process and translate symbols to words as well. When solving equations, students should verify their solutions. Careless mistakes in substitution can be avoided if students use brackets in making substitutions and then simplify each term separately before collecting them.

Question 3

The question tested the candidates' ability to:

- calculate the frequency of an item given the total frequency and a frequency distribution
- calculate the angles in sectors of a Pie Chart
- construct a Pie Chart

The question was attempted by 97 per cent of the candidates, 27 per cent of whom scored the maximum available mark. The mean score was 5.51 out of 12.

Almost all of the candidates who attempted this question were able to calculate the value of the unknown frequency, t .

Calculating the angles for the Pie Chart in (b) (i) posed the most difficult for candidates. Many failed to recognize that each frequency had to be expressed as a fraction of the total before multiplying by 360° . A

large number calculated percentages for each category and then multiplied these percentages by 360° in an attempt to convert them to angles.

In constructing the Pie Chart, far too many candidates did not use protractors to measure angles. Those who attempted to measure frequently made errors by reading the complement of the angle on the protractor, for example 80° was read as 100° . Incorrect angle calculations often resulted in Pie Charts in which angles did not add up to 360° . Hence it was quite common to see six instead of five sectors. There were also several instances where sectors were not labelled.

Solutions

(a) 105

(b) Lawyer: 80° ; Teacher: 63° ; Doctor 35° ; Artist: 72° ; Salesperson: 110°

Recommendations

Teachers must emphasize that a Pie Chart is a statistical graph in which the sectors of the circle represent fractions of the sample surveyed. Hence the calculation of fractional parts must precede calculation of angles. Students who used faulty algorithms to compute angles were unable to make this connection and could not detect their errors. The use of instruments in drawing accurate diagrams must also be emphasized. In particular, care must be taken in selecting the correct scale (inner or outer) when using a protractor.

Question 4

The question tested the candidates' ability to:

- list members of a set from a given description
- construct Venn Diagrams to show relationships between two sets within a Universal set
- list members of the union of two sets and the members of the complement of a set
- identify prime, odd and even numbers
- use instruments to construct angles and measure line segments
- use instruments to construct a parallelogram

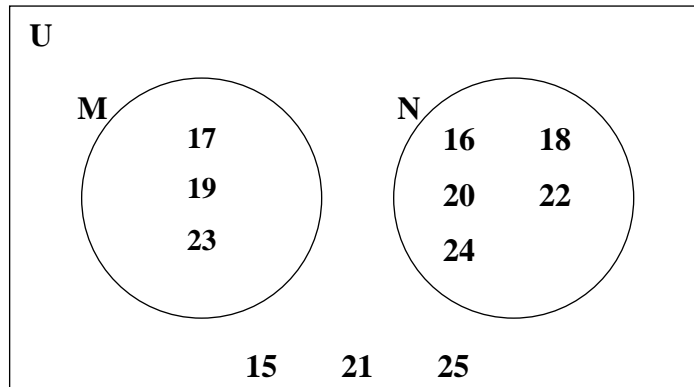
This question was attempted by approximately 98 per cent of the candidates 8 per cent of whom scored the maximum available mark. The mean mark was 6.80 out of 12.

Candidates had fairly good responses to part (a) in which concepts in sets was tested. They displayed strengths in identifying even numbers and prime numbers. Setting up the Venn Diagram also appeared to be an easy task for candidates although many did not recognize that the intersection was empty. Identifying members of the region $(M \cup N)'$ posed the most challenging for candidates who either omitted this part or gave members of the union instead.

In constructing the parallelogram, candidates generally were successful in constructing the 60° angle and measuring the lengths of sides AB and AC. Only a few candidates were able to use instruments to accurately construct the parallelogram. Errors in labelling the parallelogram were common and many located D incorrectly to produce a quadrilateral ACBD instead of ABCD.

Solutions

(a) (i)



(ii) $(M \cup N)' = \{15, 21, 25\}$

(b) $AC = 12.1 \pm 0.1$

Question 5

The question tested the candidates' ability to use graphs of a quadratic function to:

- calculate the perimeter of a compound shape
- calculate the area of a compound shape
- solve problems in measurement involving tiling

This question was attempted by approximately 88 per cent of the candidates 5 per cent of whom scored the maximum available mark. The mean mark was 4.38 out of 12.

Although candidates were familiar with the formulae for finding perimeter and area of rectangles they often applied them incorrectly, especially in finding the perimeter of the compound shape. There was a tendency to add the perimeter of rectangle A to the perimeter of rectangle B, thus including the length of a line which was not along the boundary of the shape.

Candidates were more successful in calculating the area of the compound shape, but correct answers to part (c) were hardly seen. Many candidates omitted this part completely and some who attempted used inconsistent units in their calculations. For example the area of one flooring board was often written as 1 m x 20 cm.

Solutions

(a) (i) **6 metres** (ii) **4 metres**

(b) **40 metres**

(c) **74 m²**

(d) **250 flooring boards**

Recommendations

Teachers need to emphasize the concept of perimeter using examples of irregular figures prior to using formulae to calculate the perimeter of a shape.

Practical work in measurement should be done using authentic situations such as tiling and carpeting.

Question 6

The question tested candidates' ability to:

- identify angles of elevation on a diagram
- use trigonometric ratios to solve a right-angled triangle
- describe a translation given the object and image
- draw the line $y = x$
- locate the image of an object under a reflection in the line $y = x$

This question was attempted by approximately 91 per cent of the candidates 1 per cent of whom scored the maximum available mark. The mean mark was 2.3 out of 12.

Inserting the angles of elevation in part (a) of this question was done correctly by less than half of the candidates. Common errors were interchanging the angles or inserting them between the vertical and the line of vision. Although many candidates recognized that they had to use the tangent ratio to calculate the unknown sides, they sometimes set up the ratio incorrectly or transposed incorrectly in solving for HK. A significant number did not attempt to find JK. Weaker candidates assumed triangle JKG was right-angled and used trigonometric ratios to find JK.

Part (b) was less popular than part (a) and few candidates had a completely correct response to this part of the question. Drawing the line $y = x$ posed great difficulty for candidates. Others could not successfully perform the reflection and only the very strong candidates described the translation correctly. There was a tendency to use informal language to describe the translation, and column matrices were rarely seen.

Solutions

(a) (ii) a) **19.2 metres** b) **4.4 metres**

(b) (i) A translation $\begin{pmatrix} 2 \\ -7 \end{pmatrix}$

(ii) **Coordinates of the image of P: (4, 4) (4, 6) (2, 4) and (2, 7)**

Recommendations

Trigonometry should be approached through out-door activities whereby students can actually measure the heights of buildings using three-dimensional models to represent situations. Teachers should emphasize that angles of elevation and depression are measured in relation to a horizontal line.

Transformations can be performed using manipulatives and moving them on a plane. Although informal verbal descriptions are necessary these should be followed with formal descriptions using the appropriate language so that students appreciate the need for precision and accuracy in representing mathematical ideas.

Question 7

The question tested the candidates' ability to:

- interpret the graph of a straight line by
 - stating the y-intercept
 - determining its gradient
 - determining the coordinates of the mid-point
- use the equation to calculate the value of one ordinate given the other
- determine the coordinates of the point of intersection of two lines given their equations.

The question was attempted by 91 per cent of the candidates, 2 per cent of whom scored the maximum available mark. The mean mark was 1.7 out of 12.

Very few candidates presented a completely correct solution to this question and many omitted it entirely. Only a small proportion used the graph to read off the values of c and m . Many attempted to calculate the gradient using points on the line but the coordinates were often read incorrectly. Errors were due to poor interpretation of the scale or poor choice of points on the line. A few who chose to use the x and y intercepts reversed the coordinates.

There were better attempts at finding the mid point of AB as many candidates chose the correct formulae. Errors were mainly due to substituting incorrect coordinates.

Those who attempted parts (b) and (c) failed to link these parts with the first part hence appropriate strategies were rarely seen. In part (c) some candidates completed a table of values for the line $y = x - 2$ but few proceeded to check if any of these coordinates were on the line AB. An extremely small number of candidates recognized that they had to solve the two equations simultaneously to find the coordinates of the point of intersection.

Solutions

(a) (i) 7 (ii) $\frac{-7}{2}$ (iii) (1, 3.5)

(b) $k = 14$

(c) (2, 0)

Recommendations

The poor response to this question suggests that students are unfamiliar with writing down the equation of a linear function from its graph. Determining the intercepts and gradient from observation should be explored using a variety of graphs so that students can become proficient in analysing a graph and relating it to its equation.

Question 8

The question tested the candidates' ability to:

- perform computations with money
- use different combinations of bills to make up an exact amount
- solve problems involving bills

The question was attempted by 63 per cent of the candidates, 3 per cent of whom scored the maximum available mark. The mean mark was 3.43 out of 10.

Nearly all the candidates who attempted this question were able to find the total cost of all the stamps. In solving the remaining parts candidates did not always work within the constraints and assumed that there were no limits as to the choice of stamps to make up the amount. Hence many candidates obtained a total of \$25.70 using stamps that exceeded what was in the collection.

Few candidates recognized that in order to obtain a total of \$25.70, there must be partial-sums ending in 50 cents and 20 cents.

Only the very able candidates recognized that in order to maximize the number of stamps, they must use as many of the stamps that are smaller in value, as possible.

Solutions

- (a) **\$52.20**
- (b) (i) **5 x \$4.00, 1 x \$2.50, 1 x \$1.20, 2 x \$1.00**
- (ii) **4 x \$4.00, 1 x \$2.50, 1 x \$1.20, 6 x \$1.00**
- (c) (i) **17 stamps**
- (ii) **5 x \$2.50, 6 x \$1.20, 6 x \$1.00**

Recommendations

This question called for high levels of quantitative reasoning in a quite familiar situation. Students' lack of familiarity with the reasoning processes required in solving this problem suggests that teachers need to pay closer attention to the development of thinking skills in their daily lessons. Teachers can make use of familiar situations in which decisions have to be made based on certain constraints and allow students to come up with a variety of options that satisfy all the constraints. Testing of solutions is also critical to this type of activity.

Question 9

The question tested the candidates' ability to:

- use the laws of indices to simplify algebraic expressions with integral and fractional indices
- interpret and make use of the functional notation $f(x)$, $f^l(x)$ and $fg(x)$
- interpret a given scale

- draw the graph of a non-linear function given a table of values
- use a graph to
 - (i) estimate values
 - (ii) determine the gradient at a point

The question was attempted by 67 per cent of the candidates, less than 1 per cent of whom scored the maximum available marks. The mean mark was 5.3 out of 15.

This question was the most popular optional question and candidates demonstrated strengths in simplifying algebraic expressions involving integral indices, evaluating $f(2)$, interpreting the given scale, plotting points, drawing the temperature/time graph, and using the graph to estimate a value of one variable.

Candidates were generally unable to substitute the square root with a fractional index and this part of the question was poorly done.

Although the majority of candidates used the correct procedure for finding $f^{-1}(x)$, some made errors in transposing while others did not substitute $x = 0$, to find $f^{-1}(0)$. Candidates who solved for x from the equation $2x - 3 = 0$ had more success than those who attempted to find the inverse.

Candidates failed to recognize that $f^{-1} f(2) = 2$. They also did not link all parts of the question and proceeded to re-evaluate $f(2)$, and then apply the inverse. Some of the weaker candidates interpreted the inverse as the reciprocal of the function while others interpreted the composite $f^{-1} f(2)$ as a product of two functions.

Calculating the rate of cooling at $t = 30$ minutes was omitted by almost all the candidates. The few who attempted it merely read the graph instead of drawing a tangent at the point.

Solutions

- (a) (i) x (ii) a^2b^4
- (b) (i) 1 (ii) $\frac{3}{2}$ (iii) 2
- (c) (ii) a) $49^\circ \pm 1^\circ$ b) 0.66° per minute

Recommendations

Teachers need to emphasize the meaning of functional notation, and give students opportunities to verbalise expressions and equations using this notation. They should understand that $f^{-1}(x)$ is not the same as the reciprocal of $f^{-1}(x)$.

The importance of acquiring proficiency in basic algebraic skills as a necessary pre-requisite for attempting this option must be emphasized.

Question 10

The question tested the candidates' ability to:

- solve a pair of equations in two variables when one is linear and one is non-linear

- determine whether a set of points satisfy all conditions described by a set of inequalities
- write a set of inequalities to define a given region
- use linear programming techniques to solve problems in two variables

The question was attempted by 24 per cent of the candidates, less than 1 per cent of whom scored the maximum available marks. The mean mark was 2.3 out of 15.

Almost all candidates attempted to eliminate one of the variables in solving the pair of equations but many could not do so successfully and ended up with an incorrect quadratic equation. Errors were more predominant when a fractional expression was used at the substitution stage. The majority used the formula to solve the quadratic and substituted their values to obtain the value of the second variable.

In part (b), when correct conclusions were made these were not supported by reasons. In describing the region defined by the set of inequalities, errors were made in stating the direction of the inequalities and in interpreting the scale so that the inequality $y \geq 2$ was written as $y \geq 4$.

Candidates generally had no problems in writing the profit equation, but in calculating the minimum profit they sometimes used non-integer values.

Solutions

(a) $x = (5, 7)$ and $(2, 19)$

(b) (i) a) $(10, 5)$ is not in the region b) $(6, 6)$ is in the region

(ii) $y \leq \frac{4}{5}x + 12$, $y \leq 2x$, $y \geq 2$

(iii) a) $3x + 5y$ b) $\$13.00$

Recommendations

Teachers need to encourage students to devise methods for determining the most efficient strategy in solving simultaneous equations in a given situation.

Students need to be encouraged to test points to verify their solutions when identifying regions common to a system of inequations.

Question 11

The question tested the candidates' ability to:

- use the properties of parallel lines and theorems in circle geometry to calculate the measure of angles
- use trigonometric ratios to determine the size of an angle in a sector of a circle
- calculate the area of a triangle given two sides and the included angle
- calculate the area of a sector and a segment of a circle

- calculate the length of an arc of a circle

The question was attempted by 15 per cent of the candidates, 1 per cent of whom scored the maximum available mark. The mean mark was 2.0 out of 15.

Responses to part (a) was extremely poor. Candidates could not explicitly give reasons for their answers. Although some candidates were familiar with circle theorems, they could not use them to justify their answers.

In part (b), attempts to use trigonometrical ratios to solve for the angle in the sector were unsuccessful because candidates failed to divide the triangle into two right-angled triangles and solve for one half of angle AOB. Those who used the cosine rule also experienced difficulties by substituting incorrect values into the formula.

Similar problems were encountered in the other parts of the problem, where candidates chose the correct formula for calculating the area of the triangle, area of the segment and the length of the arc but made incorrect substitutions into these formulae. For example in using $\frac{1}{2} ab \sin C$ many candidates substituted $\frac{1}{2} \times 8.5 \times 14.5 \sin AOB$ instead of $\frac{1}{2} \times 8.5 \times 8.5 \sin AOB$. A few calculated the length of the minor arc instead of the major arc.

Solutions

(a) (i) 64° (ii) 38°

(b) (i) 117° (ii) 32.2 cm^2 (iii) 41.5 cm^2 (iv) 36 cm

Recommendations

The use of deductive reasoning in solving problems in geometry continues to be a challenge for students. Teachers need to address this need by exposing students to techniques using discourse and arguments before introducing them to formal proofs.

The application of formulae in solving problems in trigonometry also needs to be addressed through systematic approaches focusing on what information is given so as to avoid candidates merely plugging in values in formulae without analysing the particular situation.

Question 12

The question tested the candidates' ability to:

- represent the relative position of points on a diagram given bearings
- solve non-right angled triangles using the sine rule
- solve right-angled triangles using trigonometric ratios
- determine the bearing of one point relative to another

The question was attempted by 25 per cent of the candidates 2 per cent of whom scored the maximum available mark. The mean mark was 4.02 out of 15.

There were marked improvements this year in drawing of diagrams and many candidates got only this part of the problem correct. A few still had problems in representing the bearings while others labelled the points incorrectly. Some candidates did not realise that the journey started at R, and positioned R at the end of the

first line segment drawn. Once a correct diagram was obtained, locating the position of X was usually correct.

Calculating angle RST proved to be difficult for the majority of candidates. Therefore correct answers to the rest of the question were hardly seen since this incorrect value was substituted in their further calculations. The use of the sine rule was recognised but not always applied correctly. The bearing of R from T proved to be very challenging for candidates who either omitted this part or measured the bearing starting clockwise instead of anti-clockwise from the north direction.

Only a few candidates managed to get to the final part of the question but once again these had difficulties with calculating the angle required to solve the problem.

Those students who used scale drawings produced excellent diagrams but when asked to calculate they resorted to the use of measurements instead.

Solutions

(b) (i) 101° (ii) 47.1° (iii) 260.1°

(c) $TX = 73.88 \text{ km}$

Recommendations

Teachers need to strengthen student skills in representing three-dimensional drawings on a plane through the use of models. Calculating angles can be made easier if students draw all the North/South lines at each vertex of the triangle. This would enable them to see which angles are equal and so facilitate their calculations.

Question 13

The question tested the candidates' ability to:

- show the relative position of points on a diagram
- add vectors using the triangle law
- use a vector method to prove collinearity
- calculate the length of a vector
- use vectors to represent and solve problems in geometry

The question was attempted by 13 per cent of the candidates less than 1 per cent of whom scored the maximum available mark. The mean mark was 2.15 out of 15.

In completing the diagram most candidates were able to locate the position of M, the midpoint of a line and the approximate position of P. However, the point N was hardly seen.

Writing an expression for the vector, AB did not pose problems for the majority of candidates. However, incorrect responses were common for those vectors in which routes had to be expressed in fractional parts of a line segment.

Proving collinearity continues to be a challenge for even the more able candidates. While some selected the correct line segments they had difficulties proving the vectors were parallel mainly because of algebraic and

arithmetical errors in simplifying terms. Making a concluding remark as to why the vectors were parallel was rarely seen.

The few candidates who attempted part (d) knew how to find the length of a vector but incorrect routes or values substituted often resulted in incorrect responses.

Solutions

$$(b) \quad (ii) \quad \overline{AB} = -a + b \quad \overline{PA} = \frac{1}{3} a \quad \overline{PM} = -\frac{1}{6} a + \frac{1}{2} b$$

$$(d) \quad \sqrt{20} \text{ or } 4.47$$

Recommendations

Prior to the study of vectors, teachers need to present situations to students whereby they can describe the relative position of one point relative to another along a straight line. Comparing the lengths of line segments using fractions are necessary pre-requisites for the teaching of this topic. Concepts of parallelism and collinearity also need to be strengthened.

Question 14

The question tested the candidates' ability to:

- evaluate the determinant of a 2 x 2 matrix
- perform addition, subtraction and multiplication of matrices
- compute the square of a 2 x 2 matrix
- obtain the inverse of a non-singular matrix
- determine the matrices associated with enlargement and rotation
- determine the 2 x 2 matrix for a single transformation which is equivalent to the combination of two successive transformations
- use matrices to solve simple problems in geometry.

The question was attempted by 27 per cent of the candidates, less than 1 per cent of whom scored the maximum available mark. The mean mark was 2.88 out of 15.

Responses to this question were barely satisfactory with candidates demonstrating lack of knowledge of basic concepts and principles in relation to matrices. For example, almost all of the candidates could not evaluate the square of a matrix. They merely squared each element. Those who set up the matrices correctly for squaring made errors in multiplication. Addition of matrices appeared to be the only skill well understood.

In part (b), even the stronger candidates were stumped and did not recognise that an inverse was required.

In determining the value of k, the scale factor of the enlargement, candidates failed to recognise that a ratio was required and some subtracted the coordinates instead.

Although candidates were familiar with the 2×2 matrices for rotation and enlargement, they often reversed the order in obtaining the matrix for the combined transformation.

Solutions

(a) $\begin{pmatrix} 8 & -1 \\ -2 & 8 \end{pmatrix}$

(b) $\begin{pmatrix} 3 & -2 \\ -1 & 1 \end{pmatrix}$

(c) (i) a) $k = 1.5$ b) $E' = (3, 10.5)$ $F' = (12, 6)$

(ii) a) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

b) $D'' = (18, -7.5)$ $E'' = (10.5, -3)$ $F'' = (6, -12)$

c) $\begin{pmatrix} 0 & \frac{3}{2} \\ -\frac{3}{2} & 0 \end{pmatrix}$

Recommendations

In the treatment of matrices, teachers need to emphasize that such objects cannot always be treated in the same way as other systems. The meaning of concepts in Number Theory such as inverse and identity element should be reviewed prior to the introduction of similar concepts in matrices to enable students to make the necessary connections.

Similar practices should be adopted in the treatment of matrix transformations whereby links between geometric and matrix transformations should be established.

DETAILED COMMENTS

Basic Proficiency

The Basic Proficiency examination is designed to provide the average citizen with a working knowledge of the subject area. The range of topics tested at the Basic level is narrower than at the General Proficiency level.

This year approximately 32 per cent of the candidates achieved Grades I to III.

Paper 01 – Multiple Choice

Paper 01 consisted of 60 multiple choice items. This year, 53 candidates earned the maximum available mark. Approximately 43 per cent of the candidates scored at least half the total marks for this paper.

Paper 02 – Essay Choice

Paper 02 consisted of 10 compulsory questions. Each question was worth 10 marks. The highest score earned was 96 out of 100. This was earned by one candidate. Thirteen per cent of the candidates earned at least half the total marks on this paper.

Question 1

This question tested candidates' ability to:

- perform basic operations with rational numbers, namely whole numbers and fractions
- compare two quantities in a given ratio
- express one quality as a percentage of another

The question was attempted by 97 per cent of the candidates, 9 per cent of whom scored the maximum available mark. The mean score was 3.93 out of 10.

Many candidates exhibited very good knowledge of the order of operations (BODMAS). In part (b) they knew that all quantities had to be added in order to get the total. Percentage was fairly done in part (b) (iii).

Candidates subtracted numerators and denominations in order to solve Part (a). For example:

$$\left(\frac{5}{8} \div 1 \frac{1}{4} \right) = \frac{5 - 1}{8 - 4} = \frac{4}{4} = 1.$$

Many candidates found difficulty in converting mixed numbers to improper fractions and inverting in order to divide by a fraction. For example:

$$1 \frac{1}{3} - \left(\frac{5}{8} \div 1 \frac{1}{4} \right) \text{ was done as } 1 \frac{1}{3} - \frac{5}{8} \times \frac{4}{4} \text{ or } \frac{4}{3} - \frac{5}{8} \times \frac{5}{4} \text{ with LCM of 32.}$$

They also found difficulty with: $\frac{4}{3} - \frac{1}{2} = \frac{8-3}{6}$. They did $\frac{4}{3} - \frac{1}{2} = 1 \frac{2-3}{6} = 1 \frac{5}{6}$ or $1 \frac{1}{6}$.

They had difficulty calculating ratio. The majority could have calculated the quantity for one proportional part – that is, $6 \frac{5}{13} = 5$ in part (b) (i) but did not multiply by 2 to get the correct answer.

Solutions

(a) $\frac{5}{6}$

(b) (i) **10** (ii) **200** (ii) **88%**

Recommendations

Teachers should ensure that students practice the conversion of fractions, worded problems and complex ratios.

Question 2

The question tested the candidates' ability to:

- substitute numbers for algebraic symbols in simple algebraic expressions
- perform operations involving integers
- perform basic operations with algebraic expressions
- solve a simple linear inequality in one unknown

The question was attempted by 97 per cent of the candidates, 4 per cent of whom scored the maximum available mark. The mean score was 4.37 out of 10.

Generally, candidates performed satisfactorily. However, some candidates experienced difficulty in some parts of the question.

In part (a) (i), some candidates were unable to substitute a number for an algebraic symbol in expression $2b + c$. For example, they incorrectly substituted $b = 5$ and $c = -2$ by writing $25 + (-2) = 23$ instead of $2 \times 5 + (-2) = 10 - 2 = 8$.

In part (a) (ii), many candidates were unable to compute $2(-2)^2$. Instead they wrote:

$$\frac{-2^2}{4} = \frac{-4}{4} = 1.$$

In part (b), candidates multiplied the entire expression by 3 instead of the terms in the brackets. Thus $3(4y + 1) - 5y$ was equated to $12y + 3 - 15y$. They experienced difficulty collecting the like terms and simplifying.

In part (c), candidates were unable to transpose correctly thus not obtaining the correct solution. Many candidates did not change the inequality sign when dividing by a negative.

Solutions

(a) (i) **8** (ii) **1**

(b) **$7y + 3$**

(c) **$x \leq 3$ or $3 \geq x$**

Recommendations

More emphasis should be placed on operations with directed numbers and substituting numerals in algebraic expressions.

Teachers need to revisit the simplification of algebraic expressions at the first form and second form level.

Question 3

The question tested the candidates' ability to:

- solve simple problems involving payments by instalments as in the case of hire purchase
- use the simple interest formula to calculate simple interest for a specific time period
- determine the amount after simple interest has been added in a $\frac{1}{2}$ yearly arrangement
- solve problems involving fractions, decimals and percentages

The question was attempted by 97 per cent of the candidates, 4 per cent of whom scored the maximum available mark. The mean score was out of 10.

In part (a) (i), most candidates demonstrated an understanding of the monthly payments of the hire purchase. However, they experienced difficulty adding \$100 to get the total hire purchase cost.

In part (a) (ii), most candidates understood the concept of EXTRA amount paid although the difference involved incorrect numbers or showed a reverse, e.g. \$510 – \$540 instead of \$640 – \$510 or \$540 – \$510 instead of \$640 – \$510. In part (b) (i), most candidates were able to obtain the total amount deposited for six months. In part (b) (ii), most candidates experienced problems with the use of the formula as it related to calculating $\frac{1}{2}$ yearly simple interest. Most wrote $\frac{4 \times 240 \times 6}{100}$ rather than $\frac{4 \times 240 \times 0.5}{100}$.

However, for the last part, most candidates were able to sum the interest obtained to the principal in order to find the amount.

Solutions

(a) (i) **\$640** (ii) **\$30**

(b) (i) **\$240** (ii) **\$244.80**

Recommendations

- (i) Greater emphasis should be placed on calculating half yearly simple interest.
- (ii) Students should be exposed to more consumer arithmetic problems involving percentages, decimals and fractions.

Question 4

The question tested the candidates' ability to:

- solve simultaneous linear equations in two unknown algebraically
- use symbols to represent numbers, operations, variables and relations
- translate several phrases into algebraic symbols

The question was attempted by 93 per cent of the candidates, 2 per cent of whom scored the maximum available mark. The mean score was 1.97 out of 10.

In part (a), candidates were able to arrive at a method for solving the equations simultaneously (most used the elimination method). However they were unable to use the method correctly.

In part (b), most candidates were able to

- a) express Sue's age ($p + 3$); and
- b) arrive at the sum of the ages of Dwight, Sue and Joan

In part (a), candidates were unable to do the operation to arrive at the correct answers. In part (b) they were not able to see Joan's age as $2(p + 3)$, or twice Sue's age and hence were not successful in getting the sum of the ages correctly.

Solutions

(a) $x = 4; y = 3$

(b) (i) $p + 3$

(ii) $2(p + 3)$

(iii) $p + (p + 3) + 2(p + 3)$

(iv) $p = 7$ years

Recommendations

- (i) More practice using different types of examples.
- (ii) Teachers should use real life situations to teach algebra.

Question 5

The question tested candidates' ability to:

- solve problems involving salaries and wages

- solve problems involving measures and money including exchange rates

The question was attempted by 95 per cent of the candidates, 19 per cent of whom scored the maximum available mark. The mean score was 5.54 out of 10.

Many candidates were able to calculate the overtime wage yet unable to determine the overtime rate of pay. They were able to find the quantity of US currency and to convert to EC currency. However, some wrongly converted to BDS currency. The 2 per cent bank charge on the EC currency proved difficult to calculate with some candidates subtracting 0.02 from the total amount of EC dollars. In converting the US \$ to EC \$ students did the calculation on the four individual quantities rather than on their sum. A similar procedure was repeated in finding the 2 per cent charge.

Solutions

- | | | | | |
|-----|-----|----------------|------|-------------------|
| (a) | (i) | \$37.50 | (ii) | \$7.50 |
| (b) | (i) | \$610 | (ii) | \$1 614.06 |

Recommendations

- Newspaper clippings on percentages and other practical examples should be used to arouse candidates' interest in this topic.
- More practice is needed in problems involving salaries and wages.

Question 6

The question tested candidates' ability to:

- use instruments to draw and measure angles and line segments and to construct triangles
- use Pythagoras' theorem to solve problems
- use simple trigonometrical ratios to solve right-angled triangles and problems based on measures in the physical world.

The question was attempted by 83 per cent of the candidates, 1 per cent of whom scored the maximum available mark. The mean score was 2.86 out of 10.

Candidates showed greater proficiency at measuring line segments rather than constructing line segments. Too many candidates did not attempt to construct the 90° angle. While candidates recognised the need to use trigonometry to solve for an angle, they found difficulty determining which ratio to use and how to get the required angle using the inverse trigonometric function. Incorrect application of Pythagoras' theorem was often seen. Some candidates found the area of the triangle, instead of the height. Few students attempted to present their answer to 2 significant figures.

Solutions

- | | | | | |
|-----|------|---------------|------|------------|
| (a) | (ii) | 8.6 cm | | |
| (b) | (i) | 2.7 m | (ii) | 42° |

Recommendations

- More practice in constructing lines, angles and triangles.
- The concept of significant figures should be reinforced.
- More problems on practical applications of trigonometry.

Question 7

The question tested the candidates' ability to:

- determine the distance on a map, given the scale
- convert units of length within the SI system
- calculate the area of two triangles within a quadrilateral
- determine the length of one side of a quadrilateral given the perimeter of the quadrilateral and the length of three sides.

The question was attempted by 79 per cent of the candidates, less than 1 per cent of whom scored the maximum available mark. The mean score was 1.9 out of 10.

In part (a), performance was generally poor. Very few candidates were able to convert 20 km to centimetres and then obtain the distance on the map. Instead, candidates multiplied 500 000 by 20 km. In part (b) (i) most candidates were able to identify the right-angled triangle within the quadrilateral and so they used the formula $\frac{1}{2} \text{ base} \times \text{height}$ to determine the area of ΔKJM . However, in part (b) (ii), most candidates could not obtain the area of ΔKLM . Some candidates used Pythagoras' theorem while others used different trigonometric ratios instead of just subtracting the area of ΔKLM from the area of the quadrilateral. In part (b) (iii), most candidates were able to obtain the length of the three sides and then subtracted the results from the perimeter of the quadrilateral.

Solutions

(a) 4 cms

(b) (i) 13.5 cm² (ii) 12.76 cms (iii) 7.5 cms

Recommendations

- (i) More emphasis should be placed on map work.
- (ii) Candidates should be exposed to more practical work on finding the area and perimeter of complex or composite shapes.

Question 8

The question tested candidates' ability to:

- define translation in plane as vectors, written as column matrices and recognise them when specified
- state the relationship between an object and its image when it undergoes translation in a plane

- state the relationship between an object and its image in a plane under a given enlargement in that plane

The question was attempted by 75 per cent of the candidates. No candidate scored the maximum available mark. The mean score was 1.1 out of 10.

Candidates were able to correctly apply the formula for area of triangle. In part (a), some candidates wrote the coordinates by stating the y before the x .

They could not have identify the type of transformation in (a) (ii). Instead, they drew a replica of ΔPQR in different quadrants. Most candidates were unable to identify the centre of enlargement. Even when the centre of the enlargement was identified, it was not correctly used to do the required enlargement.

Solutions

(a) (i) **P (6, - 4) Q (10, - 4) R (6, -2)**

(ii) **Translation = $\left(\begin{array}{c} -4 \\ 8 \end{array}\right)$ or 4 left and 8 up**

(b) (i) **C = (0, 2) (ii) P'' (4, 6) Q'' (12, 6) R'' (4, 10)**

(c) **4 cm² \Rightarrow triangle PQR 16 cm² \Rightarrow triangle P''Q''R''**

Recommendations

- More practice involving plotting points and reading coordinates.
- Practice drawing objects and images using various types of transformations.

Question 9

The question tested candidates' ability to:

- recognise the gradient of a line as the ratio of the vertical rise to the horizontal shift
- find by calculation the gradient of graphs of linear functions
- determine the equation of a line given the graph of the line
- use the functional notation $f(x)$ for given domains
- draw, read and interpret graphs of
 - (a) $f(x) = a + bx + cx^2$
 - (b) simple non-linear functions given a table of values.

The question was attempted by 67 per cent of the candidates, less than 1 per cent of whom scored the maximum available mark. The mean score was 2.10 out of 10.

Generally candidates performed unsatisfactorily. They experienced difficulty in all parts of the question. In part (a) (i), many candidates were unable to calculate or estimate the gradient of the line ℓ . They did not use the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$.

In part (a) (ii), most candidates were unable to state the equation of the line correctly, while in part (b) (i), most candidates were unable to calculate the correct values in the table and hence did not draw the desired quadratic curve.

In part (b) (ii), most candidates only plotted the three points which were given in the table. Many candidates did not draw a smooth curve, instead they connected the points with straight lines. In part (b) (iii), most candidates were unable to state the points of intersection (1, 2) and (-3, -6). They did not extend the line ℓ to meet the curve $f(x)$.

Solutions

(a) (i) 2 (ii) $y = 2x$

(b) (i)

x	-3	-2	-1	0	1	2
fx	-6	-1	2	3	2	-1

(c) (1, 2) and (-3, -6)

Recommendations

- Students need more practice in curve sketching and how to differentiate between graphs of linear and non-linear functions.
- Teachers should do more problems in estimating and calculating gradients from given linear functions.

Question 10

The question tested the candidates' ability to:

- solve problems involving averages
- draw and use pie charts
- determine experimental and theoretical probabilities of simple events

The question was attempted by 83 per cent of the candidates, 3 per cent of whom scored the maximum available mark. The mean score was 2.29 out of 10.

In part (a), candidates were able to accurately compute the total runs scored. In part (b), most candidates were able to arrive at the correct solution to (i) and (ii).

However, candidates were unable to arrive at the correct solution for runs scored in the fourth match and had difficulty expressing probability as a proper fraction. In addition, candidates did not subtract from 120 the sum of children who swam and who played soccer and did not express the answer as a proper fraction.

Solutions

(a) (i) 165 (ii) 79

(b) (i) 50 (ii) 138° (iii) $\frac{24}{120}$ or $\frac{1}{5}$ or 0.2

Recommendations

- (i) Students need to be exposed to more real life applications in order to reinforce the concept of average.
- (ii) Teachers need to reinforce the probability (1).