C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

REPORT ON CANDIDATES' WORK IN THE SECONDARY EDUCATION CERTIFICATE EXAMINATION MAY/JUNE 2006

MATHEMATICS

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MAY/JUNE 2006

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 2006 approximately 86 479 candidates registered for the General Proficiency examination, a decrease of 2 080 over 2005. Candidate entry for the Basic Proficiency examination decreased from 5 803 in 2005 to in 2006.

At the General Proficiency level, approximately 35 per cent of the candidates achieved Grades I – III. This represents a 4 per cent decrease over 2005, however it is consistent with the performance in 2004. Forty per cent of the candidates at the Basic Proficiency level achieved Grades I – III compared with 17 per cent in 2005.

DETAILED COMMENTS

General Proficiency

In general, candidates continue to show lack of knowledge of basic mathematical concepts. The optional section of Paper 02 seemed to have posed the greatest challenge to candidates, particularly the areas of Relation. Function and Graphs; and Geometry and Trigonometry.

Six candidates scored the maximum mark on the overall examination compared with 11 candidates in 2005. Twenty-six per cent of the candidates scored at least half the available marks compared with 31 per cent in 2005.

Paper 01 - Multiple Choice

Paper 01 consisted of 60 multiple-choice items. This year, 84 candidates earned the maximum available mark compared with 167 in 2005. Approximately 47 per cent of the candidates scored at least half the total marks for this paper.

Paper 02 - Essay

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

This year, 17 candidates earned the maximum available mark on Paper 02 compared with 14 in 2005. Approximately 20 per cent of the candidates earned at least half the maximum mark on this paper in 2006 as well as 2005.

Compulsory Section

Question 1

This question tested candidates' ability to

– perform basic operations with decimals
– approximate a value to a given number of significant figures
– calculate the percentage of a quantity
– express one quantity as a percentage of another
– solve problems involving depreciation
– convert from one currency to another given a conversion rate.

The question was attempted by 93 per cent of the candidates, 5 per cent of whom scored the maximum available mark. The mean mark was 6.42 out of 12.

Many candidates demonstrated good use of the calculator in performing the operations. Those candidates who neglected to use electronic calculators frequently made conceptual errors in computation, for example 0.246 ÷ 3 was computed as either 0.0082 or 0.82, and $(12.3)^2$ was computed as 24.6.

Some candidates did not apply the principle of order of operations and chose to ignore the brackets completely thereby performing the operations from left to right.

Many candidates showed inaccurate understanding of significant figures. A large number confused significant figures with decimal places and standard form and clearly did not understand the role of zero in retaining the value of the number.

For example: 151. 208 was incorrectly rounded to 15, 150.000, and 151.21.

Even those candidates who obtained 11 marks, failed to earn the mark for approximation to significant figures.

In part (b), the majority of candidates understood how to find the value of the car after one year and computed 12 per cent of $40 000 correctly.

Calculating the rate of depreciation posed problems for several candidates who gave 85 per cent as the rate instead of 15 per cent.

Many candidates demonstrated a poor understanding of depreciation. A common error was the use of 24 per cent of $40 000 instead of using the principles of compound interest.

The currency conversion in part (c) was well done by the majority of candidates. However a significant number of candidates chose the same operation for both parts of the question.

Solutions:

(a)	**(i)**	**151.208**	**(ii)**	**150**
(b)	**(i)**	***p*= $4 800.**	**(ii)**	***q*= 15%**
(c)	**(i)**	**US$600.00**	**(ii)**	**EC$2 500.**

Recommendations

- Teachers need to emphasize the difference between decimal places, significant figures and standard form. With regards to significant figures, students need to appreciate that when a number has been rounded its value does not change significantly.
- In the calculating of depreciation, the value of the item reduces with each succeeding year. Hence, interest must be calculated on the reduced value rather than the initial value of the item.

Question 2

The question tested the candidates' ability to

- simplify algebraic fractions
- factorise quadratic expressions using the distributive law and the difference of two squares
- use and apply factorization in simplifying an algebraic fraction
- use simultaneous equations to solve a worded problem.

The question was attempted by 92 per cent of the candidates, 3 per cent of whom scored the maximum available mark. The mean mark was 4.54 out of 12.

Responses were generally unsatisfactory. Candidates generally demonstrated proficiency in computing L.C.M, factorizing using the difference of two squares and translating the worded problems into linear equations. In attempting to simplify the algebraic fraction, a significant number of candidates had difficulty with expanding $-3(x-2)$, they incorrectly obtained $-3x-6$ while other candidates did not retain the L.C.M in the expression. Some candidates could not factorise $x^2 - 5x$ and incorrectly treated it as a difference of two squares.

Part (b) (ii) was not attempted by many candidates. Only the very able candidates recognized that factorisation of both the numerator and denominator was necessary before the expression can be simplified.

In solving the simultaneous equations, those candidates who used the method of elimination did not always know whether to add or subtract to eliminate a variable while those who used substitution made errors in transposing.

Solutions:

(a) $\frac{2x-9}{15}$

(b) **(i)** **a)** $x(x-5)$

b) $(x-9)(x+9)$

(ii) $\frac{a}{a-1}$

(c) **$20.00**

Recommendations

- Teachers need to emphasize the meaning of terms such as solve, simplify and factorise. Students must also be able to distinguish between expressions and equations.

- Teachers must encourage students to determine the most efficient method to use in solving simultaneous equations.

Question 3

The question tested the candidates' ability to

– solve geometric problems using the properties of triangles, lines and angles.
– solve problems involving the use of Venn diagrams with not more than two sets.

The question was attempted by 92 per cent of the candidates, 3 per cent of whom scored the maximum available marks. The mean mark was 3.57 out of 11.

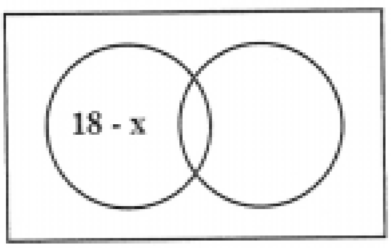
The overall performance on this item was unsatisfactory. In part (a), many candidates failed to use the properties of isosceles triangles and some were unable to identify the specific angles by their names. Reasons were either omitted or inaccurate and candidates had difficulty expressing their ideas using concise mathematical terminology.

In part (b) candidates generally knew how to label the complement of the two sets, however, they omitted to subtract x, the number of elements in the intersection from the number of elements in each set. Hence 18 and 15 were used instead of (18-x) and (15-x) on the Venn Diagram. Candidates were able to calculate x but omitted part (ii) which specifically asked for an expression in x.

Solutions:

(a) **(i)** **40°** **(ii)** **100°** **(iii)** **110°**

(b) **(i)**



(ii) **$2x + 33$** **(iii)** **3**

Recommendations

- Teachers need to focus on the properties of polygons especially quadrilaterals and triangles, describing the features of these polygons according to the lengths of the sides and the measure of the angles.

- Students need to use Venn diagrams to solve worded problems. Emphasis should be placed on the use of algebraic expressions and equations to determine unknown values.

Question 4

The question tested the candidates' ability to

- use instruments to construct a triangle and an angle of 60°
- draw line segments of a given length and measure the length of a line
- draw a line perpendicular to a given line
- use trigonometric ratios to determine the length of one side of a triangle
- calculate the perimeter of a triangle
- calculate the area of a triangle.

The question was attempted by 85 per cent of the candidates, 9 per cent of whom scored the maximum available mark. The mean mark was 5.9 out of 12.

Candidates generally succeeded in drawing the triangle with the prescribed dimensions and in measuring BC. They were also able to calculate the perimeter and area of triangle ABC.

Generally candidates experienced difficulty with the construction of a 60° angle, locating the point D and drawing the line through D, perpendicular to AB.

Some common errors were locating D outside of AB; drawing a perpendicular bisector of AB instead of a line through C, perpendicular to AB; using the ruler to measure lengths in that the initial point of measurement was taken as 1 instead of zero; using a protractor to measure 60° instead of constructing the angle; and using incorrect values in the formula for finding the area of a triangle.

Solutions:

(b) **7.0 to 0.1 cm**

(c) **20 cm**

(e) **4.33 cm**

(f) **17.3 cm^2**

Recommendations

- Teachers need to emphasize the difference between draw and construct and ensure that students can use instruments properly.

- Since a large number of candidates had problems interpreting directions, teachers must present opportunities for students to interpret instructions and pose their own instructions so that they gain competence in the proper use of the language of mathematics.

Question 5

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

- determine the elements of the domain that have a given range
- determine the roots of the function
- determine the minimum point of the function
- determine the intervals of the domain for which the elements on the range may be greater than or less than a given value
- estimate the value of the gradient of a curve at a given point given the tangent at the point.

This question was attempted by approximately 62 per cent of the candidates, less than 1 per cent of whom obtained the maximum available mark. The mean mark was 2.49 out of 11.

In general, the performance was very unsatisfactory. It was evident from the responses that candidates were not familiar with interpreting graphs and the majority of them attempted to use calculations to answer the questions posed.

In attempting to identify the values of a and b which define the domain $a \le \text{x}\ d \le$, candidates gave coordinates or vectors as answers rather than values.

The following incorrect answers were seen:

$\begin{pmatrix} -2 \\ 4 \end{pmatrix}$, (-2, 4), (-2,5) and (4, 5)

Part (b) required the candidate to state values of x for which $f(x) = 0$.

Many candidates used various algebraic methods such as solving by factorisation, completing the square, and using the quadratic formula.

Many candidates could identify the coordinates of the minimum point but some reversed the coordinates while others wrote them as column matrices.

Some candidates even used $\frac{4ac - b^2}{4a}$ to find the minimum value of y and $\frac{-b}{2a}$ to find the value of x when it occurs.

Although this question did not require candidates to draw a graph of $y = f(x)$, many of them redrew the graph and pointed out the minimum point.

In part (d) candidates were unable to list whole number values for which $f(x) < 1$. This part was omitted by a large number of the candidates. Others misinterpreted this question and listed all the whole numbers in the domain for the function.

Determining the gradient of the function at the point $x = 2$ posed great difficulty for candidates.

Many candidates demonstrated knowledge of the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ and attempted to use it but the points chosen were often not on the given tangent.

Careless errors in manipulating negative coordinates were also common. A significant number of candidates used the correct formula but interpreted the scales incorrectly.

Solutions:

(a) $\boldsymbol{a = -2 \quad b = 4}$

(b) $\boldsymbol{x = -1}$ **and** $\boldsymbol{x = 3}$

(c) **(1, – 4)**

(d) **0, 1 ,2, 3**

(e) **2**

Recommendations

- Teachers must caution students to pay attention to specific instructions given in a question.

- Since the majority of candidates opted to use calculations rather than read the graphs, it appears that skills in graphical interpretation are not well developed and more time must be devoted to such skills rather than merely drawing graphs.

Question 6

The question tested candidates' ability to

– use Pythagoras' Theorem to solve simple problems
– use trigonometric ratios in the solution of right-angled triangles
– solve problems involving bearings
– solve quadratic equations

The question was attempted by 77 per cent of the candidates, 4 per cent of whom scored the maximum available mark. The mean mark was 2.95 out of 11.

Most of the candidates were able to label the right-angled triangle correctly.

However, a significant number of them applied Pythagoras' Theorem incorrectly by using x as the hypotenuse. Some common errors were

$x = (x+7)^2 + 13^2$ and $x = (x+7)^2 - 13^2$

Squaring $(x+7)^2$ was also a major source of difficulty for many candidates who obtained the following incorrect results:

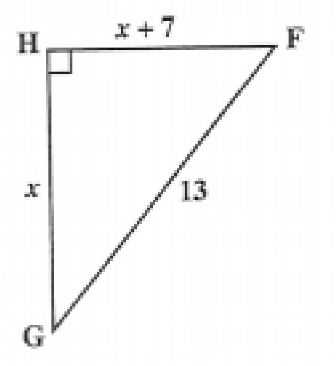
$x^2 + 49$; $14x + 49$ and $x^2 + 7^2$.

In solving the quadratic equation, those candidates who chose to use the quadratic formula or complete the square made several errors and were not as successful as those who used factorization.

Few candidates were successful at finding the bearing of F from G. However, the use of inefficient methods such as the sine or cosine rule instead of the trigonometric ratios could have resulted in loss of valuable time since these methods require lengthy calculations.

Solutions:

(a)



(b) $x^2 + (x + 7)^2$

(c) **5 km**

(d) **067.4°**

Recommendations

- Teachers need to encourage students to explore all possible methods in solving triangles and in choosing the most efficient method in a given situation.

Question 7

The question tested the candidates' ability to

– use the mid-point of the class interval to estimate the mean of data presented in grouped frequency tables

– complete a frequency polygon

– determine the probability of an event using data from a frequency table.

The question was attempted by 83 per cent of the candidates, 2 per cent of whom scored the maximum available mark. The mean mark was 3.93 out of 11.

The majority of candidates were competent in calculating the mid-interval values but only a small number of them displayed the ability to compute the mean.

Although they were able to correctly state the formula, they failed to use it successfully. Some common errors were failure to multiply mid-interval values by the corresponding frequencies; obtaining incorrect products and subsequent wrong summations; and dividing by the sum of the mid-interval values or by the number of class intervals instead of dividing by the sum of the frequencies

In attempting to complete the frequency polygon, many candidates had difficulties interpreting the given scale. As such, some opted to draw their own graph, and use a scale that they seemed comfortable to work with. In almost all the cases, candidates failed to complete the polygon by right-hand closure showing that they did not have the full concept of a polygon. In many instances, candidates failed to use a ruler. Many candidates chose to draw a histogram first and then construct the frequency polygon.

In the final part of the question, most candidates did not understand how to compute the probability and expressed their answers as whole numbers greater than one.

Solutions:

(a) **22, 27, 32**

(b) **(i) 17.85 kg**

(c) **32/100**

Recommendations

Teachers need to

- emphasize that a frequency polygon must be closed
- allow students to extract raw data from frequency tables and emphasize that for data in grouped frequency tables, some assumptions must be made
- vary the scales used in drawing graphics as much as possible the scales in graphs so that students will develop competence in interpreting scales
- use simple experiments to develop the concept of probability so that students appreciate the range of the probability scale.

Question 8

The question tested the candidates' ability to

– recognize patterns in shapes
– recognize number patterns and sequences
– predict subsequent steps in a pattern
– use algebraic reasoning to generalize a rule for a number pattern.

The question was attempted by 85 per cent of the candidates, 2 per cent of whom scored the maximum available marks. The mean mark was 6.13 out of 10.

The performance in this question was generally good. The candidates who performed well were generally able to draw the next square in the sequence and complete the table of values for $n = 4$ and $n = 7$.

Candidates were less successful in using algebraic thinking to generalise a rule for the series.

Solutions:

(ii) **a)** **40**

b) **112**

(b) **(i)** $\boldsymbol{n(n + 1) \times 2}$

(ii) **10; 10 x 11 x 2**

Recommendations

- Teachers should give students opportunities to create their own shape patterns and number patterns. These patterns should be analyzed so that a general rule emerges; such activities will enable them to develop their reasoning and analytical skills.

Question 9

The question tested the candidates' ability to

– solve simultaneous equations involving one linear and one quadratic equation
– translate verbal statements into algebraic symbols
– change the subject of an algebraic equation
– solve a problem involving a quadratic equation.

The question was attempted by 26 per cent of the candidates, 6.1 per cent of whom scored the maximum available marks. The mean mark was 2.83 out of 15.

In general, this question was poorly done. Many candidates were able to determine the strategy to be used in solving the simultaneous equations. While some experienced problems in eliminating one variable, the majority of candidates used substitution to find the second variable.

The rest of the question proved to be extremely challenging to the candidates. Candidates were unable to use the concepts of perimeter and area to write an algebraic expression for the length of the wire. They also had difficulty in solving the quadratic equation using the formula. Some rounded pre-maturely and obtained inaccurate answers.

Solutions:

(a) **2, – 1**

(b) **(i)** **2(3 + 6)**

(ii) $13 - 2x$

(iii) $x^2 - 6x + 39$

(iv) **3.5, 2.5**

Recommendations

Question 10

The question tested the candidates' ability to

- write inequalities from worded statements
- draw graphs of linear inequalities in one or two variables
- determine the solution of a set of inequalities
- use linear programming techniques to determine the maximum value of an expression.

The question was attempted by 30 per cent of the candidates, 3 per cent of whom scored the maximum available mark. Performance was generally fair with a mean mark of 5.37 out of 15.

Candidates were proficient in using the scale and drawing the straight line graphs although some of these graphs were derived from incorrect equations. In many cases the direction of the inequalities was reversed.

A significant number of candidates were able to identify the region satisfying their inequalities, however, some merely shaded a triangular region whether or not it was consistent with their inequalities.

Candidates were also able to write down the coordinates of their vertices correctly but the majority tested only one point and as such had no basis for comparison even if they had recognized the maximum point.

Solutions:

(i) $x + y \leq 60$

(ii) $y \geqq 10$

(iii) $y \leq 2x$

(v) $6x + 5y$

(vi) **(5, 10) (20, 40) (50, 10)**

(vii) **The maximum fees was $350.**

Recommendations

Students need to be able to differentiate the graph of an inequation in one variable from an inequation in two variables. Students seem to be having a lot of difficulty in drawing lines through the origin, horizontal and vertical lines.

The interpretation of phrases such as no more than, and at most, and at least need to receive particular attention and must be treated as necessary prerequisites for this topic.

Students must show working to justify conclusions, for example, testing a sufficient number of points to determine which point gives the maximum.

Question 11

The question tested the candidates' ability to

– solve practical problems involving heights and distances in three-dimensional situations
– use trigonometric ratios to solve problems involving angles of elevation
– use theorems in circle geometry to calculate the measure of angles.

The question was attempted by 37 per cent of the candidates, 3 per cent of whom scored the maximum available mark. The mean mark was 4.49 out of 15.

Part (a) was generally well done. Candidates showed a reasonable level of proficiency in trigonometry. Most of the candidates labelled the diagram correctly although a significant number had the angles of elevation aligned with the vertical instead of the horizontal.

In calculating the length of TW, some candidates chose the incorrect trigonometric ratios. Those who used the cosine rule chose a longer route and exposed themselves to more computational errors.

Part (b) which tested circle geometry was not as popular as part (a). However, some candidates demonstrated sound knowledge of circle theorems while others used properties of triangles and quadrilaterals to arrive at their answers. A few candidates experienced difficulty in giving reasons to support their answers.

Solutions:

(a) (ii) 15 m

(b) (i) 90°

(ii) 70°

(iii) 140°

(iv) 40°

Recommendations

- Teachers should ensure that candidates use diagrams to represent two and three dimensional situations, highlighting important lines and angles, as well as lines of latitude and longitude.

- Candidates also need to be exposed to different orientations of the right angled triangle so that trigonometric ratios can be easily determined for any triangle.

Question 12

The question tested the candidates' ability to

– use the cosine rule to solve problem involving triangles
– determine the area of a triangle given two sides and an included angle
– show, on a diagram of the earth, the equator, meridian of greenwich and two points on the same latitude but with different longitudes
– calculate the circumference of a circle of latitude and the distance between two points on the surface of the earth along their common circle of latitude.

The question was attempted by 13 per cent of the candidates with only one per cent scoring the maximum available mark. The mean mark was 2.88 out of 15.

In general, this question was poorly done. In part (a), many candidates did not recognize the triangle to be non-right angled and hence incorrectly used Pythagoras' Theorem instead of the cosine rule to calculate HF. Some of the candidates who correctly substituted into the cosine rule made computational errors in simplifying their terms. Weaker candidates used 4.2 cm, the length of one side of the parallelogram as the perpendicular height of the parallelogram, hence displaying poor understanding of the concept of height.

Although the majority of candidates could label the diagram, far too many candidates could not perform the calculations which followed. Even though many candidates knew the correct formula to use for circumference of a circle, they could not substitute the correct value for the radius, neither could they substitute the correct value for the angular distance.

Solutions:

(a) (i) 6.03 cm (ii) 23.68 cm^2

(b) (ii) a) 30 191 km b) 6 541 km

Recommendations

The use of practical models is recommended in the teaching of circle geometry so that students can visualize the angles and distances before applying the formulae.

Question 13

The question tested the candidates' ability to

- write vectors using column matrix notation
- add vectors using column matrix notation
- use a vector method to prove three points are collinear
- use vectors to represent and solve problems in geometry.

The question was attempted by 23 per cent of the candidates, less than 1 per cent of whom scored the maximum available mark. The mean mark was 3.58 out of 15.

Performance was generally poor. Candidates were able to copy the given diagram, and in some cases complete the parallelogram. However, very few candidates labelled the vector, ***u***, correctly on their diagram; they also neglected to insert the arrow to show the direction of the vector.

Candidates successfully wrote down the column vectors for OA and OC but many had difficulty in determining AC.

Although G was correctly located, some candidates wrote the coordinates in column matrix form.

Proving the three point to be collinear was indeed a challenge for the majority of candidates. Of those who attempted to find AC, GC and AG, few were unable to follow through the proof to completion. An extremely small number of candidates used the fact that there is a common point.

Solutions:

(b) (i) $\begin{pmatrix} 6 \\ 2 \end{pmatrix}$

(ii) $\begin{pmatrix} 0 \\ 4 \end{pmatrix}$

(iii) $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$

(c) (i) (3, 3)

Recommendations

Emphasis should be placed on

- recognition of the properties of quadrilaterals prior to teaching this topic
- differentiating between a column vector and the coordinates of a point
- the technique of using a vector method in formulating a proof.

Question 14

The question tested the candidates' ability to

– evaluate the determinant of a 2 x 2 matrix
– obtain the inverse of a non-singular 2 x 2 matrix
– use matrices to solve simple problems in geometry
– perform multiplication of matrices
– determine the elements of a 2 x 2 matrix which transform two points into two given images.

The question was attempted by 26 per cent of the candidates, 2 per cent of whom scored the maximum available mark. The mean mark was 5.07 out of 15.

Responses to this question were fair. Most of the candidates knew how to obtain the determinant of a matrix but poor algebraic skills hindered their attempts to calculate the value of *x*.

Showing that $MM^{-1} = l$ also proved to be challenging for many candidates due to errors in handling negative numbers and failure to use their determinant in computing the inverse.

Obtaining the equation to represent the transformation posed the most difficulty for the majority of candidates. A large number of them omitted this part of the question and went on to write down the values of *p, q, r*, and *s*, thus demonstrating proficiency in recognizing the matrix for the reflection in the *X*-axis.

Solutions:

(a) (i) $x = 3$ **(ii)** $\frac{1}{9}\begin{pmatrix} 3 & -3 \\ 1 & 2 \end{pmatrix}$ **(iii)** $MM^{-1} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

(b) (i) a) $\begin{pmatrix} 2 & 5 \\ 4 & 3 \end{pmatrix}$ **b)** $\begin{pmatrix} 2 & 5 \\ -4 & -3 \end{pmatrix}$

(ii) $\begin{pmatrix} p & q \\ r & s \end{pmatrix}\begin{pmatrix} 2 & 5 \\ 4 & 3 \end{pmatrix} = \begin{pmatrix} 2 & 5 \\ -4 & -3 \end{pmatrix}$

(iii) $p = 1, \; q = 0, \; r = 0, \; s = -1$

Recommendations

- Teachers need to emphasize that matrix multiplication is order specific and once matrices are set up for multiplication students should be encouraged to verify that multiplication is possible before proceeding to multiply.

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 that tested at the General Proficiency level.

This year candidates demonstrated a fairly good understanding of the concepts tested.

Approximately 42 per cent of the candidates achieved Grades I - III. This represents a significant increase of 26 per cent over 2005.

Paper 01 – Multiple Choice

Paper 01 consisted of 60 multiple-choice items. The maximum mark was not attained by any of the candidates. However, two candidates earned 58 out of 60 possible marks. Approxi-mately 35 per cent of the candidates scored at least half the maximum mark on this paper. This was achieved by 45 per cent of the candidates in 2005.

Paper 02 – Essay

Paper 02 consisted of 10 compulsory questions. Each question was worth 10 marks. The highest score earned was 98 out of 100. This was earned by one candidate. Twenty-five per cent of the candidates earned at least half the total marks on this paper.

Question 1

The question tested the candidates' ability to

- perform the basic operations with rational numbers
- convert from one currency to another
- express one quantity as a fraction of another.

The question was attempted by 97 per cent of the candidates, 1 per cent of whom scored the maximum available mark The mean mark was 4.6 out of 10.

The candidates were generally able to express one decimal as a fraction of the other, although some candidates did not know which fraction should be in the numerator/denominator. They were also able to add the fractional quantities but in dividing, inverted the incorrect fraction. Most candidates were able to convert from US dollars to Barbados dollars but were unable to reconvert the remaining Barbados dollars to US dollars.

Solutions:

(a) $\frac{2}{25}$

(b) $\frac{5}{2}$

(c) **(i)** **BDS $170**

(ii) **US $38**

Recommendations

- Students need to be exposed to mathematical terms and the language used in mathematics.

- There should also be a greater focus on the basic computational skills that will be needed for further work in mathematics.

Question 2

The question tested the candidates' ability to

- use symbols to represent binary operations
- use the laws of indices to manipulate expressions with integral indices
- solve simultaneous linear equations in two unknowns algebraically.

The question was attempted by 92 per cent of the candidates, 2 per cent of whom scored the maximum available mark. The mean score was 2.81 out of 10.

Candidates were generally able to manipulate the indices to obtain the correct solution. They were also able to determine the value of the binary expression but could not show that the operation was commutative. Most of the candidates attempted to eliminate a variable, they were able to correctly substitute the first value to determine the second unknown. However, errors were made in manipulating the equations.

Solutions:

(a) x^6

(b) **(i)** **9**

(c) $x = 5; y = 1$

Recommendations

- Emphasis should be placed on the laws of indices and directed numbers with practical application of both.

Question 3

The question tested the candidates' ability to

- solve problems involving payments by installments in the case of hire purchase
- calculate depreciation
- solve problems involving simple interest, compound interest and depreciation.

The question was attempted by 96 per cent of the candidates, 9 per cent of whom scored the maximum available mark. The mean score was 4.89 out of 10.

The candidates were generally able to calculate the percentage of a given amount but did not understand the concept of depreciation. The majority of the candidates calculated the time taken to save the given sum of money and correctly computed the total installments. However, the deposit was omitted in calculating the total hire purchase price. The reasons for using hire purchase were not well written.

Solutions:

(a) $32 400

(b) (i) 13 weeks

(ii) $86.50

(iii) Hire purchase requires less money to be paid each week; Cash payment costs less overall.

Recommendations

- More time should be spent on the distinction between simple and compound interest as well as between compound interest and depreciation.

- Students should also be encouraged to reflect on mathematical processes and to express their ideas both orally and in written form.

Question 4

The question tested the candidates' ability to

- calculate the area of a region enclosed by a square
- calculate the volume of a simple right prism
- convert units of capacity within the SI system
- solve problems involving measurements.

The question was attempted by 87 percent of the candidates, 1 percent of whom scored the maximum available mark. The mean score was 2.53 out of 10.

Most candidates were able to calculate the length of the side of the square. Candidates experienced difficulty calculating the volume of the tank and converting between units. Candidates were however able to express the volume of water as a percentage of the volume of the tank.

Solutions:

(a) **(i)** **5.2 cm**

(ii) **$27.04\ \text{cm}^2$**

(b) **(i)** **$90\ 000\ \text{cm}^3$**

(ii) **60%**

Recommendations

- Students need exposure to practical work in measurement.
- The properties of two and three dimensional shapes and solids should also be emphasized.

Question 5

The question tested the candidates' ability to

- perform operations involving directed numbers
- translate verbal phrases into algebraic symbols and vice versa
- simplify algebraic fractions
- use a linear equation to solve a word problem.

The question was attempted by 91 per cent of the candidates, 3 per cent of whom scored the maximum available mark. The mean score was 3.22 out of 10.

The candidates were generally able to substitute numbers into the given expression but experienced difficulty computing the directed numbers. Generally, candidates were not able to simplify the algebraic expression without errors including attempts to cross multiply and incorrectly applying the distributive law. Candidates experienced difficulty in determining the algebraic expressions for Pam's age and the sum of the ages.

Solutions:

(a) **4**

(b) $\frac{x+3}{6}$

(c) **(i)** $x + 12$

(ii) $2x + 12$

Recommendations

- Teachers need to find innovative ways of introducing algebra, making reference to real life applications, where possible.

Question 6

The question tested candidates' ability to solve problems involving rates.

The question was attempted by 89 per cent of the candidates, 14 per cent of whom scored the maximum available mark. The mean score was 4.03 out of 10.

The candidates were generally able to calculate the cost of typing 10 and 15 pages but had difficulty calculating the cost of typing 23 pages, where the calculation required the use of two different rates. Some candidates were able to determine the number of pages in the document in part (b) although a trial and error method was used by some candidates. A common error in this section was using one rate instead of two to determine the solution.

Solutions:

(a) **(i)** **$4.00**

(ii) **$6.00**

(iii) **$8.40**

(b) **55 pages**

Recommendations

- Teachers need to use everyday examples such as actual bills, when teaching consumer arithmetic.
- Students should also be encouraged to simulate buying and selling activities in the classroom.

Question 7

The question tested the candidates' ability to

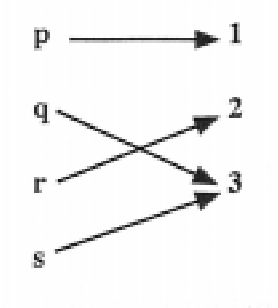
- use arrow diagrams to show relations
- define a function as a many-to-one or one-to-one relation
- interpret data presented in a graphical form.

The question was attempted by 94 per cent of the candidates, 3 per cent of whom scored the maximum available mark. The mean score was 5.02 out of 10.

The majority of the candidates completed the arrow graph correctly although some repeated the element "3" in the range. As a result, these candidates stated that the relation was one-to-one. The candidates were generally able to read the points from the line graph and identify the steepest slope. There was difficulty however, in determining the rate of decrease and stating the period of time.

Solutions:

(a) **(i)**



(ii) **many to one since both q and s map to 3.**

(b) **(i)** **25°C**

(ii) **15°C**

(iii) **7.5°C/hr**

(iv) **4:00 to 5:00**

Recommendations

- Greater emphasis need to be placed on the types of mapping diagrams and the description of a function.

- Teachers need to engage students in discussions, including interpretation and analysis, on graphs and diagrams.

Question 8

The question tested the candidates' ability to

- use instruments to draw and measure angles and line segments
- use instruments to construct a triangle
- state the relationship between an object and its image in a plane when it undergoes a translation in that plane
- identify and describe a transformation given the object and its image.

The question was attempted by 72 per cent of the candidates, less than 1 per cent scored the maximum available mark. The mean score was 3.32 out of 10.

The majority of the candidates were able to draw the line segments PQ and PR accurately, but a number of them did not complete the triangle or state the length of the side QR. In many cases there was no evidence that a compass was used to construct the angles. The candidates generally had difficulty completing part (b). While some could identify the angle centre of the rotation, they were unable to state the direction using terms such as right, left, north and east. Further, many of the candidates did not recognise that the dimensions of an object did not change after a translation.

Solutions:

(a) QR **= 7.2 cm**

(b) **(i)** ABC **is mapped onto** $A'B'C'$ **by a rotation of 90 degrees about the Origin in a clockwise direction.**

(ii) **a)** $A''B'' = 6$ **cm**

b) $\angle C''A''B''$ **is 90 degrees**

Recommendations

- Students need more practice in drawing polygons using geometrical tools with special emphasis on constructing angles with the compasses.

- Transformation geometry should be taught both on graph paper and on plain paper so that students become familiar with different orientations without depending on graph lines.

Question 9

The question tested the candidates' ability to

- draw and use bar charts
- determine the mean for a set of data
- determine experimental and theoretical probabilities of simple events.

The question was attempted by 95 per cent of the candidates, 4 per cent of whom scored the maximum available mark. The mean score was 6.08 out of 10.13 per cent of the candidates scored at least half the marks on this question.

The candidates were generally able to calculate how many more chocolates were sold, the total number sold for the week and the mean number sold for the week, although a few candidates calculated the median instead of the mean. There was some difficulty computing the probability.

Solutions:

(a) **15**

(b) **220**

(c) **44**

(e) $\frac{3}{5}$

Recommendations

- Teachers should expose students to more experimental probability conducting simple experiments in the classroom.

- The measures of central tendency (mean, median, mode) also need to be clearly defined and sufficient examples and exercises provided so that students can differentiate among them.

Question 10

The question tested the candidates' ability to

- use the properties of perpendicular and parallel lines to solve problems
- use Pythagoras' Theorem to solve problems
- use the sine, cosine and tangent ratios in the solution of right-angled triangles
- solve problems involving bearings.

The question was attempted by 67 per cent of the candidates, less than 1 per cent of them scored the maximum available mark. The mean mark was 2.09 out of 10.

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The candidates were generally able to determine the values of the unknown angles. However, they were unable to use Pythagoras' theorem correctly, use trigonometric ratios to determine the unknown angle or determine the bearing.

Solutions:

(a) $x = 110^\circ$; $y = 110^\circ$

(b) **(i)** **15 m**

(ii) 58°

(iii) 32°

Recommendations

- Students need more practice in the real life application of Pythagoras' Theorem, trigonometric ratios and bearings to complement the work done in the classroom.