CARIBBEAN EXAMINATIONS COUNCIL

Caribbean Secondary Education Certificate®

CSEC®

MATHEMATICS SYLLABUS

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Contents

This document CXC 05/G/SYLL 08 replaces the syllabus CXC 05/O/SYLL 01 issued in 2001.

Please note that the syllabus has been revised and amendments are indicated by italics and vertical lines.

First Published in 1977
Revised in 1981
Revised in 1985
Revised in 1992
Revised in 2001
Revised in 2008
Revised in 2015

Mathematics Syllabus

♦ RATIONALE

The Caribbean society is an integral part of an ever-changing world. The impact of globalization on most societies encourages this diverse Caribbean region to revisit the education and career opportunities of our current and future citizens. A common denominator of the Caribbean societies is to create among its citizens a plethora of quality leadership with the acumen required to make meaningful projections and innovations for further development. Further, learning appropriate problem-solving techniques, inherent to the study of mathematics, is vital for such leaders. Mathematics promotes intellectual development, is utilitarian and applicable to all disciplines. Additionally, its aesthetics and epistemological approaches provide solutions fit for any purpose. Therefore, Mathematics is the essential tool to empower people with the knowledge, competencies and attitudes which are precursors for this dynamic world.

The syllabus addresses the personal development and educational needs of Caribbean students by encapsulating a variety of skills integral to everyday life and prerequisites for entering environments of work and academia. These skills include critical and creative thinking, problem solving, logical reasoning, modelling ability, team work, decision making, research techniques, information communication and technological competencies for life-long learning. The syllabus also uniquely details a smooth progression of concepts that caters for students with primary or rudimentary knowledge of mathematics, and it can be easily subdivided to match the curricula of the different grades within the local high schools. Moreover, it is centrally positioned within the CXC sequence of examinations bridging the CPEA and CCSLC with the Additional and ***CAPE®*** *Mathematics syllabuses. Additionally, the competencies and certification acquired upon completion of this course of study is comparable with the mathematics curricula of high schools world-wide. In consideration of educational support, the syllabus provides teachers with useful approaches and techniques, and it points to resources which are suitable for every learning style.*

This syllabus will contribute to the development of the Ideal Caribbean Person as articulated by the CARICOM Heads of Government in the following areas: "demonstrate multiple literacies, independent and critical thinking and innovative application of science and technology to problem solving. Such a person should also demonstrate a positive work attitude and value and display creative imagination and entrepreneurship". In keeping with the UNESCO Pillars of Learning, on completion of this course the study, students will learn to do, learn to be and learn to transform themselves and society.

♦ AIMS

This syllabus aims to:

1. make Mathematics relevant to the *interests* and *experiences* of students *by* helping them to recognise Mathematics in the *local and global* environment;

2. help students appreciate the use of mathematics as a form of communication;

3. help students acquire a range of mathematical techniques and skills and to foster and maintain the awareness of the importance of accuracy;

4. help students develop positive attitudes, such as open-mindedness, *resourcefulness*, persistence and a spirit of enquiry;

5. prepare students for the use of Mathematics in further studies;

6. *help students foster a 'spirit of collaboration', not only with their peers but with others within the wider community*;

7. *help students apply the knowledge and skills acquired to solve problems in everyday situations; and,*

8. *integrate Information Communication and Technology (ICT) tools and skills in the teaching and learning processes.*

♦ ORGANISATION OF THE SYLLABUS

The syllabus is arranged as a set of topics as outlined below, and each topic is defined by its specific objectives *and content/explanatory notes*. It is expected that students would be able to master the specific objectives *and related content* after pursuing a course in Mathematics over five years of secondary schooling.

SECTION 1 – *NUMBER THEORY AND COMPUTATION*

SECTION 2 – CONSUMER ARITHMETIC

SECTION 3 – SETS

SECTION 4 – MEASUREMENT

SECTION 5 – STATISTICS

SECTION 6 – ALGEBRA

SECTION 7 – RELATIONS, FUNCTIONS AND GRAPHS

SECTION 8 – GEOMETRY AND TRIGONOMETRY

SECTION 9 – VECTORS AND MATRICES

♦ FORMAT OF THE EXAMINATIONS

The examination will consist of two papers: Paper 01, an objective type paper and Paper 02, an essay or problem solving type paper.

Paper 01
(1 hour 30 minutes)

The Paper will consist of 60 multiple-choice items, from all Sections of the syllabus as outlined below.

Sections	**No. of items**
Number Theory and Computation	6
Consumer Arithmetic	8
Sets	6
Measurement	8
Statistics	6
Algebra	6
Relations, Functions and Graphs	8
Geometry *and Trigonometry*	8
Vectors and Matrices	4
Total	**60**

Each item will be allocated one mark.

Paper 02
(2 hours and 40 minutes)

The Paper consists of ten compulsory structured type questions.

The marks allocated to the topics are:

Sections	**No. of marks**
Number Theory, Consumer Arithmetic and Computation	9
Measurement	9
Statistics	9
Algebra	10
Relations, Functions and Graphs	20
*Investigation	10
Geometry *and Trigonometry*	21
Vectors and Matrices	12
Total	**100**

* The investigation question may be set on any combination of objectives in the syllabus.

SCHOOL BASED ASSESSMENT: Paper 031 and Paper 032

Paper 031 (20 per cent of Total Assessment)

Paper 031 comprises a project.

The project requires candidates to demonstrate the practical application of Mathematics in everyday life. In essence it should allow candidates to probe, describe and explain a mathematical area of interest and communicate the findings using mathematical symbols, language and tools. The topic(s) chosen may be from any section or combination of different sections of the syllabus.

*See Guidelines for School Based Assessment on pages **43 – 47**.*

Paper 032 (Alternative to Paper 031)
(1 hour)

This paper is an alternative to Paper 031 and is intended for private candidates. This paper comprises two compulsory questions. The given topic(s) may be from any section or combination of different sections of the syllabus.

♦ CERTIFICATION AND PROFILE DIMENSIONS

The subject will be examined for certification at the General Proficiency.

In each paper, items and questions will be classified, according to the kind of cognitive demand made, as follows:

Knowledge — require the recall of rules, procedures, definitions and facts, that is, items characterised by rote memory as well as simple computations and constructions.

Comprehension — requires algorithmic thinking that involves translation from one mathematical mode to another. Use of algorithms and the application of these algorithms to familiar problem situations.

Reasoning — requires:

(i) translation of non-routine problems into mathematical symbols and then choosing suitable algorithms to solve the problems;

(ii) combination of two or more algorithms to solve problems;

(iii) use of an algorithm or part of an algorithm, in a reverse order, to solve a problem;

(iv) inferences and generalisations from given data;

(v) *justification of results or statement*; and,

(vi) analysis and synthesis.

Candidates' performance will be reported under Knowledge, Comprehension and Reasoning.

WEIGHTING OF PAPER AND PROFILES

The percentage weighting of the examination components and profiles is as follows:

PROFILES	**PAPER 01**	**PAPER 02**	**PAPER 03**	**TOTAL (%)**
Knowledge (K)	18	30	6 **(12)**	**60 (30%**
Comprehension (C)	24	40	8 **(16)**	**80 (40%)**
Reasoning (R)	18	30	6 **(12)**	**60 (30%)**
TOTAL	**60**	**100**	**20 (40)**	**200**
%	30%	50%	20%	100%

♦ REGULATIONS FOR RESIT CANDIDATES

Resit candidates must complete Papers 01 and 02 and Paper 03 of the examination for the year for which they re-register.

Resit candidates may opt to complete the School-Based Assessment (SBA) or may opt to re-use their previous SBA score which satisfies the condition below.

A candidate who rewrites the examination within two years may reuse the moderated SBA score earned in the previous sitting within the preceding two years. Candidates reusing SBA scores in this way must register as "Resit candidates" and provide their previous candidate number.

All resit candidates may register through schools, recognised educational institutions, or the Local Registrar's Office.

♦ REGULATIONS FOR PRIVATE CANDIDATES

Private candidates must be registered for the examination through the Local Registrar in their respective territories and will be required to sit Papers 01, 02 and 032,

Paper 032 is designed for candidates whose work cannot be monitored by tutors in recognised educational institutions. The Paper will be of 1 hour duration and will consist of two questions.

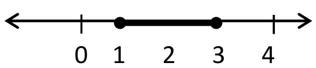
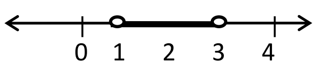
♦ SYMBOLS USED ON THE EXAMINATION PAPERS

The symbols shown below will be used on examination papers. Candidates, however, may make use of any symbol or nomenclature provided that such use is consistent and understandable in the given context. Measurement will be given in S I Units.

Sets

SYMBOL	MEANING
U	universal set
$\cup$	union of sets
$\cap$	intersection of sets
$\in$	element of
$\{\}$ or ϕ	the null (empty) set
$\subset$	subset of
A'	complement of set A
$\{x: \ldots\}$	the set of all x such that . . .

Relations, Functions and Graphs

SYMBOL	MEANING
$y \propto x^n$	y varies as x^n
$f(x)$	value of the function f at x
$f^{-1}(x)$	the inverse of the function $f(x)$
$gf(x)$, $g[f(x)]$	composite function of the functions f and g
$g2(x)$	$g[g(x)]$
	$\{x : 1 \leq x \leq 3\}$
	$\{x : 1 < x < 3\}$

Number Theory

$\mathbb{W}$	the set of whole numbers
$\mathbb{N}$	the set of natural (counting) numbers
$\mathbb{Z}$	the set of integers, where $\begin{cases} \mathbb{Z}^+ \text{ are positive integers} \\ \mathbb{Z}^- \text{ are negative integers} \end{cases}$
$\mathbb{Q}$	the set of rational numbers
$\mathbb{R}$	the set of real numbers
$5.\dot{4}3\dot{2}$	5.432 432 432 . . .
$9.87\dot{2}\dot{1}$	9.87212121 . . .

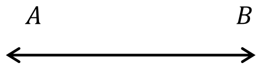
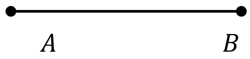
Measurement

05:00 h.	5:00 a.m.
13:15 h.	1:15 p.m.
7 mm ± 0.5 mm	7 mm to the nearest millimetre
10 m/s or 10 ms^{-1}	10 metres per second

Geometry

For transformations these symbols will be used.

M	reflection
R_θ	rotation through θ^o
T	translation
G	glide reflection
E	enlargement
MR_θ	rotation through θ followed by reflection
∡, ∠, ∧	angle
$\equiv$	is congruent to

	line AB
	ray AB
	line segment AB

<u>Vectors and Matrices</u>

$\underline{a}$ or **a**	vector **a**
$\overrightarrow{\text{AB}}$	vector AB
$\lvert\overrightarrow{AB}\rvert$	magnitude of vector AB
$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ or $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$	the matrix A
$\lvert A\rvert$ or det(A)	the determinant of A
Adj(A)	the adjoint of a matrix A.
A^{-1}	inverse of the matrix A
$I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	identity matrix under multiplication
$\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$	zero matrix or identity matrix under addition

<u>Other Symbols</u>

=	is equal to
$\geq$	is greater than or equal to
$\leq$	is less than or equal to
$\cong$	is approximately equal to
$\Rightarrow$	implies
$A \Rightarrow B$	if A, then B or A implies B
$A \Leftrightarrow B$	$\left.\begin{matrix} If\ A\ then\ B \\ and \\ If\ B\ then\ A \end{matrix}\right\}$ or A is equivalent to B

♦ FORMULAE AND TABLES PROVIDED IN THE EXAMINATION

LIST OF FORMULAE

Volume of a prism — $V = Ah$ where A is the area of a cross section and h is the perpendicular length.

Volume of cylinder — $V = \pi r^2 h$ where r is the radius of the base and h is the perpendicular height.

Volume of a right pyramid — $V = \frac{1}{3} Ah$ where A is the area of the base and h is the perpendicular height.

Circumference — $C = 2\pi r$ where r is the radius of the circle.

Arc length — $S = \frac{\theta}{360} \times 2\pi r$ where θ is the angle subtended by the arc, measured in degrees.

Area of a circle — $A = \pi r^2$ where r is the radius of the circle.

Area of a sector — $A = \frac{\theta}{360} \times \pi r^2$ where θ is the angle of the sector, measured in degrees.

Area of trapezium — $A = \frac{1}{2}(a + b)h$ where a and b are the lengths of the parallel sides and h is the perpendicular distance between the parallel sides.

Roots of quadratic equations — If $ax^2 + bx + c = 0$,

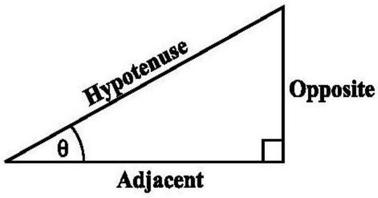
then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Trigonometric ratios

$\sin\theta = \dfrac{\text{opposite side}}{\text{hypotenuse}}$

$\cos\theta = \dfrac{\text{adjacent side}}{\text{hypotenuse}}$

$\tan\theta = \dfrac{\text{opposite side}}{\text{adjacent side}}$

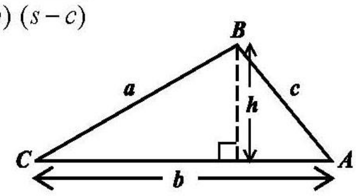


Area of triangle — Area of $\Delta = \frac{1}{2} bh$ where b is the length of the base and h is the perpendicular height.

Area of $\Delta ABC = \frac{1}{2} ab \sin C$

Area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$

where $s = \dfrac{a+b+c}{2}$



Sine rule — $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine rule — $a^2 = b^2 + c^2 - 2bc\cos A$

♦ USE OF ELECTRONIC CALCULATORS

Candidates are expected to *have* an electronic nonprogrammable calculator and are encouraged to use such a calculator in Paper 02.

Guidelines for the use of electronic calculators are listed below.

1. Silent, electronic handheld calculators may be used.

2. Calculators should be battery *or solar powered*.

3. Candidates are responsible for ensuring that calculators are in working condition.

4. Candidates are permitted to bring a set of spare batteries in the examination room.

5. **No** compensation will be given to candidates because of faulty calculators.

6. **No** help or advice is permitted on the use or repair of calculators during the examination.

7. Sharing calculators is **not** permitted in the examination room.

8. Instruction manuals and external storage media (for example, card, tape, disk, smartcard or plug-in modules) are **not** permitted in the examination room.

9. Calculators with graphical display, data bank, dictionary or language translation are **not** allowed.

10. Calculators that have the capability of communication with any agency in or outside of the examination room **are prohibited**.

♦ SECTION 1 – *NUMBER THEORY AND COMPUTATION*

GENERAL OBJECTIVES

On completion of this Section, students should:

1. demonstrate computational skills;
2. be aware of the importance of accuracy in computation;
3. appreciate the need for numeracy in everyday life;
4. demonstrate the ability to make estimates fit for purpose;
5. understand and appreciate the decimal numeration system;
6. appreciate the development of different numeration systems;
7. demonstrate the ability to use rational approximations of real numbers;
8. demonstrate the ability to use number properties to solve problems; and,
9. develop the ability to use patterns, trends and investigative skills.

SPECIFIC OBJECTIVES	CONTENT/ *EXPLANATORY NOTES*
Students should be able to:	
1. distinguish among sets of numbers;	*Sets of numbers:* *natural numbers* $\mathbb{N} = \{1, 2, 3, \ldots\}$*;* *whole numbers* $\mathbb{W} = \{0, 1, 2, 3, \ldots\}$*;* *integers* $\mathbb{Z} = \{\ldots -2, -1, 0, 1, 2, \ldots\}$*;* *rational numbers* $\mathbb{Q} = \{\frac{p}{q} :$ $p \text{ and } q \text{ are integers}, q \neq o\}$*;* *irrational numbers (numbers that cannot be expressed as terminating or recurring decimals, for example, numbers such as* π *and* $\sqrt{2}$*);* *real numbers* $\mathbb{R} =$ $\{\text{the union of rational and irrational numbers}\}$*;* *inclusion relations, for example,* $\mathbb{N} \subset \mathbb{W} \subset \mathbb{Z} \subset \mathbb{Q} \subset \mathbb{R}$*; and,* *sequences of numbers that have a recognisable pattern; factors and multiples; square numbers; even numbers; odd numbers; prime numbers; composite numbers.*

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
Students should be able to:	
2. *compute powers of real numbers of the form* x^a, where $a \in \mathbb{Q}$ *;*	*Including squares, square roots, cubes, cube roots.*
3. *evaluate numerical expressions* using any of the four basic operations *on* real numbers;	Addition, multiplication, subtraction and division of whole numbers, fractions and decimals; order of operations.
4. convert among fractions, per cents and decimals;	Conversion of fractions to decimals and percents, conversion of decimal to fractions and percents, conversion of percents to decimals and fractions.
5. list the set of factors and multiples of a given integer;	*Positive and negative factors of an integer.*
6. compute the H.C.F. or L.C.M. of two or more positive integers;	*Highest common factors and lowest common multiples.*
7. state the value of a digit of a numeral in a given base;	*Place value and face value of numbers in bases 2, 4, 8, and 10.*
8. convert from one set of units to another;	Conversion using conversion scales, converting within the metric scales, 12-hour and 24-hour clock.
9. express a value to a given number of: (a) significant figures; *and,* (b) decimal places.	1, 2 or 3 significant figures. 0, 1, 2 or 3 decimal places.
10. use properties of numbers and operations in computational tasks;	Properties of operations such as closure, associativity, additive and multiplicative identities and inverses, commutativity and distributivity.
11. write any rational number in *scientific notation*;	Scientific notation. *For example* $759000 = 7.59 \times 10^5$
12. calculate any fraction or percentage of a given quantity;	Fractions and percentages of a whole. The whole given a fraction or percentage.

SPECIFIC OBJECTIVES		**CONTENT/ *EXPLANATORY NOTES***
Students should be able to:		
13.	express one quantity as a fraction or percentage of another;	Comparing two quantities using fractions and percentages.
14.	compare quantities;	Ratio, proportion *and rates*.
15.	order a set of real numbers;	*Rearranging a set of real numbers in ascending or descending order. For example* $1.1, \frac{7}{2}, \sqrt{2}, 1.45, \pi$ *in ascending order is* $1.1, \sqrt{2}, 1.45, \pi, \frac{7}{2}$.
16.	*compute* terms of a sequence given a rule;	
17.	derive an appropriate rule given the terms of a sequence;	
18.	divide a quantity in a given ratio; *and,*	Ratio, proportion of no more than three parts.
19.	solve problems involving concepts in number theory.	*Including ratio, rates and proportion.*

<u>Suggested Teaching and Learning Activities</u>

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities listed below.

1. Encourage the use of:

(a) calculators;

(b) games and quizzes; (for example, to investigate whether a given number is rational or irrational)

(c) appropriate software;

(d) examples of computation drawn from current affairs;

(e) the use recipes in teaching ratio and proportion; *and,*

(f) online demonstrative videos.

2. *Explore the link between mathematics and other disciplines, for example:*

   (a) *Music: the octave;*

   (b) *Sciences and Nature: periodic tables, counting petals, leaves and other random natural events;*

   (c) *Art and Geography: enlargement of photos as compared with ratio and proportion;*

   (d) *Architecture: number patterns and lighting patterns, ratio of width to length to height of a building or building part;*

   (e) *Health and Family Life: nutrition facts of food products; and,*

   (f) *Business Studies: using approximations in transactions, finding percentages of investments and capital.*

3. *Engage the students in the history of numbers.*

4. *Teachers can engage students in the process of "mental computation". The use of divisibility tests and other ready reckoners and properties such as associativity.*

5. *In the development of mental computation in the classroom, teachers can provide oral or written questions and encourage students to explain how they arrived at their answers and to compare their problem-solving strategies with those of their classmates. Below are two examples.*

   (a) *A flight departs on a journey at 0800 hours. After 30 minutes of flying time the journey is $\frac{1}{3}$ complete. Estimate the arrival time of the flight assuming the flight was at constant speed throughout the journey.*

   (b) *In a cricket game, at the end of the fifth over the run rate of a team is 4.6 runs per over. If the team continues to score at the same rate, determine the projected score at the end of the twentieth over.*

♦ SECTION *2* – CONSUMER ARITHMETIC

GENERAL OBJECTIVES

On completion of this Section, students should*:*

1. develop the ability to perform the calculations required in normal business transactions, and in computing their own budgets;

2. appreciate the need for both accuracy and speed in calculations;

3. appreciate the advantages and disadvantages of different ways of investing money;

4. appreciate that business arithmetic is indispensable in everyday life; *and,*

5. demonstrate the ability to use concepts in consumer arithmetic to describe, model and solve real-world problems.

SPECIFIC OBJECTIVES | **CONTENT/ *EXPLANATORY NOTES***

Students should be able to:

1. calculate:

   (a) discount;

   (b) sales tax;

   (c) profit; *and,*

   (d) loss;

2. calculate

   (a) percentage profit; *and,*

   (b) percentage loss;

3. express a profit, loss, discount, markup and purchase tax, as a percentage of some value;

4. solve problems involving marked price, selling price, cost price, profit, loss or discount;

5. solve problems involving payments by instalments as in the case of hire purchase and mortgages;

SPECIFIC OBJECTIVES	CONTENT/ *EXPLANATORY NOTES*
Students should be able to:	
6. solve problems involving simple interest;	Principal, time, rate, amount.
7. solve problems involving compound interest;	*Formulae may be used in computing compound interest. The use of calculators is encouraged.*
8. solve problems involving appreciation and depreciation;	
9. solve problems involving measures and money; *and,*	Currency conversion.
10. solve problems involving:	
(a) rates and taxes;	
(b) utilities;	
(c) invoices and shopping bills;	
(d) salaries and wages; *and,*	
(e) insurance and investments.	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Encourage the use of:*

   (a) *calculators;*

   (b) *games and quizzes;*

   (c) *appropriate software (for example, create an excel document to calculate utility bills and net salary);*

   (d) *examples of consumer arithmetic drawn from current affairs;*

   (e) *online videos;*

CONSUMER ARITHMETIC (cont'd)

(f) *advertisement clippings for comparing prices; comparing prices and determining best buy; calculating hire purchase; and,*

(g) *bills and financial forms, for example, calculating utility cost and completing tax forms.*

2. Solve problems using the straight line and reducing balance method.

3. Conduct surveys or solve problems based on comparative shopping; finding total price for an item purchased online.

4. Encourage in-class role play of market situations and Cambio.

5. Examine and verifying premiums and interest using amortization tables.

♦ *SECTION 3* – SETS

GENERAL OBJECTIVES

On completion of this Section, students should:

1. demonstrate the ability to communicate using set language and concepts;
2. demonstrate the ability to reason logically; and,
3. appreciate the importance and utility of sets in analysing and solving real-world problems.

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
Students should be able to:	
1. explain concepts relating to sets;	Examples and non-examples of sets, description of sets using words, membership of a set, cardinality of a set, finite and infinite sets, universal set, empty set, complement of a set, subsets.
2. represent a set in various forms;	*Representation of a set. For example*, (a) Description: the set A comprising the first three natural numbers. (b) Set builder notation: $A = \{x: 0 < x < 4, x \in \mathbb{N}\}$; (c) Listing: $A = \{1,2,3\}$
3. list subsets of a given set;	*Identifying the subsets as well as determining the* number of subsets of a set with n elements.
4. determine elements in intersections, unions and complements of sets;	Intersection and union of not more than three sets. Apply the result $n(A \cup B) = n(A) + n(B) - n(A \cap B)$.
5. describe relationships among sets using set notation and symbols;	Universal, complement, subsets, equal and equivalent sets, intersection, disjoint sets and union of sets.
6. *draw* Venn diagrams to represent relationships among sets;	Not more than 4 sets including the universal set.
7. *use Venn diagrams to represent the relationships among sets;* and,	

8. solve problems in Number Theory, Algebra and Geometry using concepts in Set Theory.

<u>Suggested Teaching and Learning Activities</u>

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Encourage the use of:*

    (a) *calculators;*

    (b) *games and quizzes;*

    (c) *appropriate software (for example, whiteboard apps for drawing and labelling Venn diagrams);*

    (d) *examples of sets drawn from current affairs;*

    (e) *the use of recipes in teaching sets; and,*

    (f) *online demonstrative videos.*

2. *Explore the link between sets and other disciplines, for example:*

    (a) *Music: types of instruments, classification of songs;*

    (b) *Sciences: periodic tables; find the number of elements in a naturally occurring set based on characteristics of other sets;*

    (c) *Art and Geography: classifying regions according to soil type or altitude;*

    (d) *Architecture: classifying buildings according to the style of roof, shape of building, number of floors, historical design;*

    (e) *Health and family life: use medical records to categorize patients by disease, identify intersections for example hypertension and diabetes; and,*

    (f) *Business studies: types of businesses, types of products and services.*

3. *Engage in activities which assign students to groups based on their interests (sets) noting those in more than one group (intersection) and those not in a group (complement).*

4. *Use graphic organisers for comparing and/or classifying sets of items: the set of real numbers, plane figures, solids.*

♦ SECTION *4* – MEASUREMENT

GENERAL OBJECTIVES

On completion of this Section, students should:

1. understand that the attributes of geometrical objects can be quantified using measurement;

2. appreciate that all measurements are approximate and that the relative accuracy of a measurement is dependent on the measuring instrument and the measurement process; *and,*

3. demonstrate the ability to use concepts in measurement to model and solve real-world problems.

SPECIFIC OBJECTIVES	**CONTENT/ *EXPLANATORY NOTES***
Students should be able to:	
1. convert units of length**,** mass, area, volume, capacity;	*Refer to Sec 1, SO8.*
2. use the appropriate SI unit of measure for area, volume, capacity, mass, temperature and time (24-hour clock) and other derived quantities;	*Refer to Sec 1, SO8.*
3. *determine* the perimeter of a *plane shape*;	*Estimating and measuring the perimeter of compound and irregular shapes.* *Calculating the perimeter of polygons and circles.*
4. calculate the length of an arc of a circle;	*Perimeter of sector of a circle*
5. estimate the area of plane *shapes*;	*Finding the area of plane shapes without using formulae.*
6. calculate the area of polygons and circles;	
7. calculate the area of a sector of a circle;	
8. calculate the area of a triangle given two sides and the angle they form;	Use of formulae. Including given two sides and included angle.
9. calculate the area of a segment of a circle;	

MEASUREMENT (cont'd)

SPECIFIC OBJECTIVES		CONTENT/*EXPLANATORY NOTES*
Students should be able to:		
10.	calculate the surface area of solids;	Prisms including cubes and cylinders; right pyramids including cones; spheres. Surface area of sphere, $A = 4\pi r^2$.
11.	calculate the volume of solids;	Prism including cube and cuboid, cylinder, right pyramid, cone and sphere. Volume of sphere, $V = \frac{4}{3}\pi r^3$
12.	solve problems involving the relations among time, distance and speed;	*Average speed.*
13.	estimate the margin of error for a given measurement;	Sources of error. Maximum and minimum measurements.
14.	use *scales* and scale drawings to determine distances and areas; *and,*	*(Link to Geography)*
15.	solve problems involving measurement.	*Perimeter, area and volume of compound shapes and solids.*

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Encourage the use of:*

(a) *calculators;*

(b) *games and quizzes;*

(c) *appropriate software (for example, use of white board software for sketching diagrams; Mobile apps: Math Ref with list of formulae); and,*

(d) *online demonstrative videos.*

MEASUREMENT (cont'd)

2. *Explore the link between measurement and other disciplines, for example:*

   (a) *Music: creating music with bottles of water where the height/volume of water results in a particular tone;*

   (b) *Sciences and nature: area of naturally occurring surfaces; length of the beach or water edge; experiments in calculating speed, distance or time; plot a graph to show the cooling rate of boiling water as time elapse; use various measurement instruments from a science laboratory;*

   (c) *Art and Geography: use of rain gauge, map reading, measuring distances on map including irregular paths;*

   (d) *Architecture: finding the perimeter, area or volume of structures: roof, wall, floor, room, column, eaves;*

   (e) *Health and family life: experiment to calculate BMI; and,*

   (f) *Business studies: determining amounts to buy given various units of lengths, area and volume.*

3. *Teacher-made resources: grid for finding area of irregular shapes, rubric for peer to peer assessment by students.*

4. *Engage students in investigating the value of pi and the area of the circle.*

♦ SECTION *5* – STATISTICS

GENERAL OBJECTIVES

On completion of this Section, students should:

1. appreciate the advantages and disadvantages of the various ways of presenting and representing data;

2. appreciate the necessity for taking precautions in collecting, analysing and interpreting statistical data, and making inferences;

3. demonstrate the ability to use concepts in statistics and probability to describe, model and solve real-world problems; and,

4. *understand the four levels/scales of measurement that inform the collection of data.*

SPECIFIC OBJECTIVES	CONTENT/*EXPLANATORY NOTES*
Students should be able to:	
1. *differentiate between sample and population attributes;*	*Sample statistics and population parameters.*
2. construct a frequency table for a given set of data;	*Discrete and continuous variables.* *Ungrouped and grouped data*.
3. determine class features for a given set of data;	Class interval, class boundaries, class limits, class midpoint, class width.
4. construct statistical diagrams;	Pie charts, bar charts, line graphs, histograms with bars of equal width and frequency polygons.
5. determine measures of central tendency for raw, ungrouped and grouped data;	*Ungrouped data*: mean, median and mode *Grouped data*: modal *class, median class and the estimate of the mean.*
6. determine when it is most appropriate to use the mean, median and mode as the average for a set of data;	*Levels of measurement (measurement scales): nominal, ordinal, interval and ratio.* *Sets with extreme values or recurring values.*
7. determine the measures of dispersion (spread) for raw, ungrouped and grouped data;	Range, interquartile range and semi-interquartile range; *estimating these measures for grouped data.*
8. *use standard deviation to compare sets of data;*	*No calculation of the standard deviation will be required.*

STATISTICS (cont'd)

SPECIFIC OBJECTIVES		CONTENT/*EXPLANATORY NOTES*
Students should be able to:		
9.	draw cumulative frequency curve (Ogive);	Appropriate scales for axes. Class boundaries as domain.
10.	analyse statistical diagrams;	*Finding the mean, mode, median,* range, quartiles*, interquartile range, semi-interquartile range; trends and patterns.*
11.	determine the proportion or percentage of the sample above or below a given value from raw data, frequency table or cumulative frequency curve;	
12.	identify the sample space for simple experiment;	*Including the use of coins, dice and playing cards.* *The use of contingency tables.*
13.	determine experimental and theoretical probabilities of simple events; and,	*The use of contingency tables.* *Addition for exclusive events; multiplication for independent events.*
14.	make inference(s) from statistics.	Raw data, tables, diagrams, summary statistics.

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Encourage the use of:*

   (a) *calculators;*

   (b) *games and quizzes;*

   (c) *appropriate software (for example, use of applications to generate and solve statistical problems including charts and calculating measures of central tendencies);*

   (d) *examples of statistics drawn from newspapers, magazines and other sources of current affairs; and,*

   (e) *online demonstrative videos.*

2. *Explore the link between statistics and other disciplines, for example:*

   (a) *Music: comparing record sales of various artistes, number of weeks artistes are in the top ten chart;*

   (b) *Sciences: statistics (birth and death rates) on various types of populations: people, plants and animals;*

   (c) *Geography: track rain fall, population count and density;*

   (d) *Art and Architecture: average floor size of rooms in a buildings, house lots;*

   (e) *Health and family life: monitoring weight and height, average amounts of calories, nutritional facts; and,*

   (f) *Business studies: Gross Domestic Product, predicting sales, purchasing decision.*

3. Discuss when it is most appropriate to use Nominal, Ordinal, Interval or Ratio scales.

4. Use the class of students as the population and extract samples to investigate concepts such as bias and sampling, measures of central tendencies and spread.

♦ SECTION *6* – ALGEBRA

GENERAL OBJECTIVES

On completion of this Section, students should:

1. *appreciate the use of algebra as a language and a form of communication;*

2. *appreciate the role of symbols and algebraic techniques in solving problems in mathematics and related fields;*

3. *demonstrate the ability to reason* with abstract entities.

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
Students should be able to:	
1. use symbols to represent numbers, operations, variables and relations;	Symbolic representation.
2. *translate between algebraic symbols and worded expressions;*	
3. *evaluate* arithmetic operations involving directed numbers;	
4. *simplify algebraic expressions using* the four basic operations;	
5. substitute numbers for *variables* in algebraic expressions;	
6. *evaluate expressions involving* binary operations (other than the four basic operations);	*Commutative, associative and distributive properties.*
7. apply the distributive law to factorise or expand algebraic expressions;	*For example,* $x(a + b) = ax + bx$ *and* $(a + b)(x + y) = ax + bx + ay + by.$

ALGEBRA (cont'd)

SPECIFIC OBJECTIVES	CONTENT/ *EXPLANATORY NOTES*
Students should be able to:	
8. simplify algebraic fractions;	*The four basic operation on algebraic fractions.*
9. use the laws of indices to manipulate expressions with integral indices;	For $m \in \mathbb{Z}$, $n \in \mathbb{Z}$. *(i)* $x^m \times x^n = x^{m+n}$ *(ii)* $\frac{x^m}{x^n} = x^{m-n}$ *(iii)* $(x^m)^n = x^{m \times n}$ *(iv)* $x^{-m} = \frac{1}{x^m}$
10. solve linear equations in one unknown;	
11. solve simultaneous linear equations, in two unknowns, algebraically;	
12. solve a simple linear inequality in one unknown;	
13. change the subject of formulae;	*Including equations* involving roots and powers.
14. factorise algebraic expressions;	*Expressions of the type:* $a^2 - b^2$; $a^2 \pm 2ab + b^2$ $ax + bx + ay + by$ $ax^2 + bx + c$ where a, b, and c are integers and $a \neq 0$
15. *rewrite a quadratic expression in the form* $a(x+h)^2 + k$	*Completing the square of a quadratic expression.*
16. *solve quadratic equations algebraically;*	*Formula and by methods of factorisation and completing the square.*

ALGEBRA (cont'd)

17.	solve word problems;	Linear equation, Linear inequalities, two simultaneous linear equations, quadratic equations. *Applications to other subjects for example demand and supply functions of business studies.*
18.	solve a pair of equations in two variables when one equation is quadratic or non-linear and the other linear;	
19.	prove two algebraic expressions to be identical;	*Equations vs. identities.*
20.	represent direct and *inverse* variation symbolically;	y varies directly as x: $y \propto x, y = kx$ y varies inversely as x: $y \propto \frac{1}{x}, y = \frac{k}{x}$
21.	solve *problems* involving direct variation and inverse *variation.*	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Encourage the use of:*

    (a) *calculators;*

    (b) *games and quizzes;*

    (c) *appropriate software (for example, equation solving apps);*

    (d) *examples of algebraic problems drawn from real-life situations; and,*

    (e) *online demonstrative videos.*

2. *Explore the link between algebra and other disciplines, for example:*

    (a) *Music: the use of music symbols;*

    (b) *Sciences and nature: rearranging scientific formulae;*

    (c) *Architecture: determine the size or amounts of tiles/windows/doors of a floor or wall; and,*

    (d) *Business studies: solving equations to determine profit/loss, demand and supply.*

3. *Introduce students to symbolic representation using examples drawn from everyday life such as safety symbols, road signs and other familiar informational and warning signs.*

4. *Promote appropriate use of variables. For example, differentiate between* $5\,m$ *as an abbreviation for 5 metres and* $5m$*, where* m *represent the number of mangoes bought.*

5. *Explore the concept of equality through the use of:*

   (a) *Pan Balance activities with numbers* $(8 + 4 = x - 2)$ *and shapes; and,*

   (b) *Hands-on Algebra.*

6. *Use manipulatives such as integer chips, algebra tiles and other appropriate materials to develop the understanding of:*

   (a) *Operations with integers.*

   (b) *Simplifying algebraic expressions (adding/subtracting like terms).*

   (c) *Multiplying binomials of power 1.*

   (d) *Solving linear equations with one unknown.*

   (e) *Rearranging an equation/formula.*

7. *Conduct labs to assist students in the efficient use of calculators. For example: to explore the order of operations, to evaluate expressions with exponents and roots.*

♦ SECTION 7 – RELATIONS, FUNCTIONS AND GRAPHS

GENERAL OBJECTIVES

On completion of this Section, students should:

1. appreciate the importance of relations in Mathematics;

2. appreciate that many mathematical relations may be represented in symbolic form, tabular or pictorial form; and,

3. appreciate the usefulness of concepts in relations, functions and graphs to solve real-world problems.

SPECIFIC OBJECTIVES	CONTENT/ *EXPLANATORY NOTES*
Students should be able to:	
1. explain basic concepts associated with relations;	Concept of a relation, types of relations, examples and non-examples of relations, domain, range, image, co-domain.
2. represent a relation in various ways;	Set of ordered pairs, arrow diagrams, graphically, algebraically.
3. state the characteristics that define a function;	Concept of a function, examples and non-examples of functions.
4. use functional notation;	For example, $f : x \to x^2$; or $f(x) = x^2$ as well as $y = f(x)$ for given domains. *The inverse function* $f^{-1}(x)$. *Composite functions* $fg = f[g(x)]$
5. distinguish between a relation and a function;	Ordered pairs, arrow diagram, graphically (vertical line test).
6. draw graphs of linear functions;	Concept of linear function, types of linear function ($y = c$; $x = k$; $y = mx + c$; where m, c and k are real numbers).
7. determine the intercepts of the graph of linear functions;	x-intercepts and y-intercepts, graphically and algebraically.
8. determine the gradient of a straight line;	Definition of gradient/*slope*.

SPECIFIC OBJECTIVES	**CONTENT/ *EXPLANATORY NOTES***
Students should be able to:	
9. determine the equation of a straight line;	Using: (a) the graph of the line; (b) the co-ordinates of two points on the line; (c) the gradient and one point on the line; (d) one point on the line or its gradient, and its relationship to another line.
10. solve problems involving the gradient of parallel and perpendicular lines;	
11. determine from co-ordinates on a line segment: (a) the length; and, (b) the co-ordinates of the midpoint;	The concept of magnitude or length, concept of midpoint.
12. *solve a pair of simultaneous linear equations in two unknowns graphically;*	*Intersection of graphs.*
13. represent the solution of linear inequalities in one variable using: (a) set notation; (b) the number line; and, (c) graph.	
14. draw a graph to represent a linear inequality in two variables;	

SPECIFIC OBJECTIVES	CONTENT/*EXPLANATORY NOTES*
Students should be able to:	
15. use linear programming techniques to graphically *solve* problems involving two variables;	
16. derive the composition of functions;	Composite function of no more than two functions, for example, fg, f^2 given f and g. Non-commutativity of composite functions ($fg \neq gf$) *in general*.
17. state the relationship between a function and its inverse;	The concept of the inverse of a function; *The composition of inverse functions* $f(x)$ and $f^{-1}(x)$ *is commutative and results in* x.
18. derive the inverse of a function;	$f^{-1}, (fg)^{-1}$
19. evaluate a function $f(x)$ at a given value of x	$f(a), f^{-1}(a), fg(a)$, where $a \in \mathbb{R}$.
20. *draw and use the graph of a quadratic function to identify its features:*	*Roots of the equation.*
(a) an element of the domain that has a given image;	
(b) the image of a given element in the domain;	
(c) the maximum or minimum value of the function; and,	
(d) the equation of the axis of symmetry;	

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
Students should be able to:	
21. *interpret the graph of a quadratic function to determine*:	*Concepts of gradient of a curve at a point, tangent, turning point. Roots of the function*.
(a) the interval of the domain for which the elements of the range may be greater than or less than a given point;	
(b) an estimate of the value of the gradient at a given point;	
(c) intercepts of the function;	
22. determine the *equation of the* axis of symmetry and the maximum or minimum value of a quadratic function expressed in the form $a(x + h)2 + k$;	
23. sketch the graph of a quadratic function expressed in the form $y = a(x + h)2 + k$ and determine the number of roots;	
24. draw graphs of non-linear functions;	$y = ax^n$ where $n = -1, -2$ and $+3$ *and a is a constant*. Including distance-time and speed-time.
25. *interpret graphs of functions;* and,	Including distance-time graphs and speed-time graphs.
26. *solve problems involving graphs of linear and non-linear functions.*	

RELATIONS, FUNCTIONS AND GRAPHS (cont'd)

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Encourage the use of:*

   (a) *calculators;*

   (b) *games and quizzes;*

   (c) *appropriate software (for example, the use of graphing apps in demonstrating properties of graphs);*

   (d) *examples of functions and graphs obtained from magazines and newspapers;* and,

   (e) *online demonstrative videos.*

2. *Explore the link between relations, functions and graphs and other disciplines, for example:*

   (a) *Music: create a mapping of the number of beats to the music notes;*

   (b) *Sciences: plot graphs of sound waves, path of a projectile such as a shot putt, 2-dimensional graph of a terrain;*

   (c) *Art and Geography: identifying locations on a map using coordinate systems, the use of GPS technology;*

   (d) *Architecture: gradient of a roof, ramp;*

   (e) *Health and family life: plotting a graph of weight against time and finding the rate using the gradient of a function;* and,

   (f) *Business studies: finding marginal cost using the concept of gradient, break even analysis.*

3. *Students can be provided with samples of ordered pairs and be required to determine the domain, the range and whether the relation is or is not a function.*

4. *Encourage students to describe a function based on its properties and not the independent variable.*

5. *Use functions machines to show input and output.*

6. *Demonstrate relationships between a function and its inverse: for example doubling will undo halving, geometric interpretation as a reflection in the line $y = x$.*

7. *Relate reverse processes of real life situations to functions and their inverses, for example, the route from home to school.*

8. *Use real life examples of items that fit related categories to identify common characteristics as an analogy to linear programing.*

♦ SECTION *8* – GEOMETRY AND TRIGONOMETRY

GENERAL OBJECTIVES

On completion of this Section, students should:

1. appreciate the notion of space as a set of points with subsets of that set (space) having properties related to other mathematical systems;

2. understand the properties and relationship among geometrical objects;

3. understand the properties of transformations;

4. demonstrate the ability to use geometrical concepts to model and solve real world problems;

5. appreciate the power of trigonometrical methods in solving authentic problems.

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
Students should be able to:	
1. explain concepts relating to geometry;	Points, lines, parallel lines, intersecting lines and perpendicular lines, line segments, rays, curves, planes; types of angles; number of faces, edges and vertices.
2. draw and measure angles and line segments accurately using appropriate instruments;	
3. construct lines**,** angles, and polygons using appropriate instruments;	Parallel and perpendicular lines. *Bisecting line segments and angles.* *Constructing a line perpendicular to another line, L, from a point that is not on the line, L.* Triangles, quadrilaterals, regular and irregular polygons. Angles include $30^o, 45^o, 60^o, 90^o, 120^o$ *and their combinations.*
4. identify the type(s) of symmetry possessed by a given plane figure;	Line(s) of symmetry, rotational symmetry, order of rotational symmetry.

SPECIFIC OBJECTIVES	CONTENT/*EXPLANATORY NOTES*
Students should be able to:	
5. solve geometric problems using properties of:	*Determining and justifying the measure of angles: adjacent angles, angles at a point, supplementary angles, complementary angles, vertically opposite angles.*
(a) lines, angles, and polygons;	*Parallel lines and transversals, alternate angles, corresponding angles, co-interior angles.* *Triangles: Equilateral, Isosceles, scalene, obtuse, right, acute.* *Quadrilaterals: Square, rectangle, rhombus, kite, parallelogram, trapezium.* *Other polygons.*
(b) congruent triangles;	*Cases of congruency*.
(c) similar figures;	*Properties of similar triangles*
(d) faces, edges and vertices of solids; and,	
(e) classes of solids;	Prisms, pyramids, cylinders, cones, sphere.
6. *solve geometric problems using properties of circles and circle theorems;*	*Radius, diameter, chord, circumference, arc, tangent, segment, sector, semicircle, pi.* *Determining and justifying angles using the circle theorems:* *The angle which an arc of a circle subtends at the centre of a circle is twice the angle it subtends at any point on the remaining part of the circumference.* *Angles at the circumference in the same segment of a circle and subtended by the same arc/chord are equal.* *The angle at the circumference subtended by the diameter is a right angle.* *The opposite angles of a cyclic quadrilateral are supplementary.*

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
Students should be able to:	*The exterior angle of a cyclic quadrilateral is equal to the interior opposite angle.* *The angle between a tangent to a circle and a chord through the point of contact is equal to the angle in the alternate segment.* *A tangent of a circle is perpendicular to the radius/diameter of that circle at the point of contact.* *The lengths of two tangents from an external point to the points of contact on the circle are equal.* *The line joining the centre of a circle to the midpoint of a chord is perpendicular to the chord.*
7. represent translations in a plane using vectors;	Column matrix notation $\begin{pmatrix} x \\ y \end{pmatrix}$.
8. determine and represent the location of : (a) the image of an object under a transformation; (b) an object given the image under a transformation;	Translation in the plane. Reflection in a line in that plane. Rotation about a point (the centre of rotation) in that plane. Enlargement in the plane.
9. state the relationship between an object and its image in the plane under geometric transformations;	*Orientation*, similarity, congruency.
10. describe a transformation given an object and its image;	*Translation: vector notation.* *Reflection: mirror line/ axis of symmetry.* *Rotation: centre of rotation, angle of rotation, direction of rotation.* *Enlargement: centre, scale factor k such that* $\lvert k\rvert > 1$ or $0 < \lvert k\rvert < 1$.
11. locate the image of *an object* under a combination of transformations;	*Combination of any two of :* (a) *enlargement;* (b) *translation;* (c) *rotation; and,* (d) *reflection.*

SPECIFIC OBJECTIVES	CONTENT/*EXPLANATORY NOTES*
Students should be able to:	
12. use Pythagoras' theorem to solve problems;	
13. define the trigonometric ratios of acute angles in a right triangle;	Sine, Cosine, Tangent.
14. relate objects in the physical world to geometric objects;	Angle of elevation, angle of depression, bearing.
15. *apply the trigonometric ratios to solve problems;*	*Spatial* geometry and scale drawing, angles of elevation and depression.
16. *use* the sine and cosine rules *to solve* problems involving triangles; and,	
17. solve problems involving bearings.	*Relative position of two points given the bearing of one point with respect to the other; bearing of one point relative to another point given the position of the points. Bearing written in 3-digit format for example* 060^o.

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Encourage the use of:*

   (a) *calculators;*

   (b) *games and quizzes;*

   (c) *appropriate software (for example, 3-D sketching software, 2-D apps such as Geogebra);*

   (d) *Concrete models of geometric figures in common places; and,*

   (e) *online demonstrative videos.*

2. *Explore the link between geometry and trigonometry and other disciplines, for example:*

    (a) *Music: Exploring geometric properties of musical instruments;*

    (b) *Sciences: orbital locus of planets, galaxies; geometry in nature: leaves, shells, waves, spherical objects;*

    (c) *Geography: the use of bearings;*

    (d) *Art and Architecture: geometry of structures, triangles, circles; using geometric figures to create art such as paintings, tessellations; symmetry, similarity and congruency in structures such as the roof; and,*

    (e) *Health and family life: the geometry of postures in exercise and athletics.*

3. *Explore concepts of elevation, depression, bearings in real life situations.*

4. *Estimate distances and area using geometry, pictures with a known distance.*

5. *Engage students in activities of detecting which of two objects is taller.*

6. *Construction of shapes for art work such as collages.*

7. *Use instruments and strings to locate points of a defined locus.*

♦ SECTION *9* – VECTORS AND MATRICES

GENERAL OBJECTIVES

On completion of this Section, students should:

1. demonstrate the ability to use vector notation and concepts to model and solve real-world problems;

2. develop awareness of the existence of certain mathematical objects, such as matrices, that do not satisfy the same rules of operation as the real number system; and,

3. appreciate the use of vectors and matrices in representing certain types of linear transformations in the plane.

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
Students should be able to:	
1. *explain* concepts associated with vectors;	Concept of a vector, magnitude, *unit vector*, direction,, scalar. *Scalar multiples: parallel vectors, equal vectors, inverse vectors.*
2. *simplify expressions involving vectors*;	*Vector algebra: addition, subtraction, scalar multiplication.* *Vector geometry: triangle law, parallelogram law.*
3. *write the position vector of a point* $P(a, b)$ *as* $\overrightarrow{OP} = \begin{pmatrix} a \\ b \end{pmatrix}$ where O is the origin $(0,0)$;	Displacement and position vectors; *including the use of* co-ordinates in the x-y plane to identify and determine displacement and position vectors.
4. *determine* the magnitude of a vector;	*Including unit vectors.*
5. *determine the direction of a vector;*	
6. use vectors to solve problems in geometry;	*Points in a straight line, Parallel lines; displacement, velocity, weight.*
7. *explain basic* concepts associated with matrices;	Concept of a matrix, row, column, square, identity rectangular, order.
8. *solve problems involving matrix operations*;	*Addition and subtraction of matrices of the same order. Scalar multiples.* *Multiplication of conformable matrices.* *Equality, non-commutativity of matrix multiplication.*

SPECIFIC OBJECTIVES	CONTENT/ *EXPLANATORY NOTES*
Students should be able to:	
9. *evaluate* the determinant of a ‘2 x 2’ matrix;	
10. *define the multiplicative inverse of a non-singular square matrix;*	*Identity for the square matrices.*
11. obtain the inverse of a non-singular ‘2 x 2’ matrix;	Determinant and adjoint of a matrix.
12. *determine a* ‘2 x 2’ *matrix* associated with a specified transformation; and,	*Transformation which is equivalent to the composition of two linear transformations in a plane (where the origin remains fixed).* (a) *Reflection in: the x-axis, y-axis,* the lines $y = x$ and $y = -x$. (b) *Rotation in a clockwise and anticlockwise direction about the origin; the general rotation matrix.* (c) *Enlargement with centre at the origin;*
13. *use* matrices to solve simple problems in *Arithmetic, Algebra and Geometry .*	*Data matrices, equality*. Use of matrices to solve linear simultaneous equations *with two unknowns.* *Problems involving determinants are restricted to 2x2 matrices. Matrices of order greater than ‘mxn’ will not be set, where m ≤ 4, n ≤ 4.*

<u>Suggested Teaching and Learning Activities</u>

To facilitate students’ attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Encourage the use of:*

   (a) *calculators;*

   (b) *games and quizzes;*

   (c) *appropriate software (for example, the use of matrix solver apps);*

(d) *data matrix that are extracted from sources such as grades spread sheet; and,*

(e) *online demonstrative videos.*

2. *Explore the link between vectors and matrices and other disciplines, for example:*

(a) *Sciences & Nature: the effects of a river current as a vector quantity;*

(b) *Art & Geography: dividing an image/photo into a matrix of smaller images for enlargement; and,*

(c) *Architecture: representing items in the class room such as a tile on the floor using vector notation.*

3. *Tabulate data into matrix form.*

4. *Finding hidden treasures using clues given as vectors.*

5. *The use of matrices as operators in transformation.*

♦ *GUIDELINES FOR THE SCHOOL-BASED ASSESSMENT*

RATIONALE

School-Based Assessment (SBA) is an integral part of student assessment in the course covered by this syllabus. It is intended to assist students in acquiring certain knowledge, skills and attitudes that are critical to the subject. The activities for the School-Based Assessment are linked to the "Suggested Practical Activities" and should form part of the learning activities to enable the student to achieve the objectives of the syllabus.

During the course of study of the subject, students obtain marks for the competencies they develop and demonstrate in undertaking their SBA assignments. These marks contribute to the final marks and grades that are awarded to students for their performance in the examination.

The guidelines provided in this syllabus for selecting appropriate tasks are intended to assist teachers and students in selecting assignments that are valid for the purpose of the SBA. These guidelines are also intended to assist teachers in awarding marks according to the degree of achievement in the SBA component of the course. In order to ensure that the scores awarded by teachers are not out of line with the CXC standards, the Council undertakes the moderation of a sample of SBA assignments marked by each teacher.

School-Based Assessment provides an opportunity to individualise a part of the curriculum to meet the needs of students. It facilitates feedback to the students at various stages of the experience. This helps to build the self-confidence of the students as they proceed with their studies. School-Based Assessment further facilitates the development of critical skills and that allows the students to function more effectively in their chosen vocation. School-Based Assessment' therefore, makes a significant and unique contribution to the development of relevant skills by the students. It also provides an instrument for testing them and rewarding them for their achievements.

The Caribbean Examinations Council seeks to ensure that the School Based Assessment scores are valid and reliable estimates of accomplishment. The guidelines provided in this syllabus are intended to assist in doing so.

THE PROJECT

The project may require candidates to collect data or demonstrate the application of Mathematics in everyday situations.

The activities related to the Project should be integrated into the classroom instruction so as to enable the candidates to learn and practice the skills needed to complete the project.

Some time in class should be allocated for general discussion of project work; allowing for discussion between teacher and student, and student and student.

<u>Role of the Teacher</u>

The role of the teacher is to:

1. *Guide students in identifying suitable topics for the project for the School Based Assessment.*

2. *Provide guidance throughout the project and guide the candidate through the SBA by helping to resolve any issues that may arise.*

3. *Ensure that the project is developed as a continuous exercise that occurs during scheduled class hours as well as outside class times.*

4. *Assess the project and record the marks. Hardcopies of the completed documents should be kept by both the teacher and the student. The teacher should use the mark scheme provided by CXC and include comments pertinent to the conduct of the assessment.*

<u>Assignment</u>

The School Based Assessment consists of ONE project to be marked by the teacher in accordance with CXC guidelines.

ASSESSMENT CRITERIA

The project will be presented in the form of a report and will have the following parts.

1. Project Title
2. Introduction
3. Method of Data Collection
4. Presentation of Data
5. Analysis of Data
6. Discussion of Findings
7. Conclusion

It will be marked out of a total of 20 marks and the marks will be allocated to each task and profile as outlined below.

Project Descriptors	Mark			
	K	C	R	Total
Project Title				**1**
• Title is clear and concise and relates to a real-world problem	1			
Introduction				**4**
• Objectives are clearly stated	1			
• Comprehensive description of the project		2		
• Limited description of the project		(1)		
• Detailed contents page with page numbers	1			
Method of Data Collection				**2**
• Data collection method is clearly described, appropriate and without flaws		2		
• Data collection method is stated		(1)		
Presentation of Data				**5**
• Data is accurate and well organised		2		
• Data is presented but is not well organised		(1)		
• Tables/graphs included, correctly labelled and used appropriately		2		
• Tables/graphs included		(1)		
• Accurate use of mathematical concepts	1			
Analysis of Data				**2**
• Detailed analysis done which is coherent			2	
• Limited analysis of findings			(1)	
Discussion of findings				**2**
• Statement of findings clearly stated			1	
• Statement of findings follows from data collected			1	
Conclusion				**2**
• Conclusion was based on findings and related to the purpose of the project			2	
• Conclusion related to the purpose of the project			(1)	
Overall Presentation				**2**
• Information was communicated logically using correct grammar	2			
• Information was poorly organised or difficult to understand at times	(1)			
Maximum for each profile	**6**	**8**	**6**	**20**

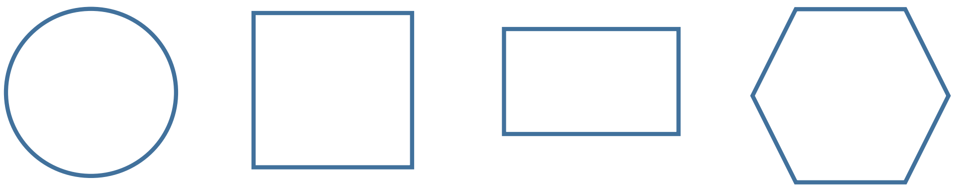
EXEMPLAR

Project Title: Designing a Basketball Hoop - Why Use a Circle?

Introduction: The purpose of this project was to determine the most suitable shape for a basketball hoop. The number of goals scored using the traditional hoop was compared to the number scored using square, rectangular and hexagonal hoops.

Data Collection: The area enclosed by the circular hoop was calculated and hoops were made using frames to enclose an area. The dimensions of the frames were calculated to ensure that a standard basketball could pass through each frame.

The area enclosed by a standard basketball hoop is 1641 cm^2. Efforts were made to use dimensions which would give this approximate area. The hoops in the different shapes were made with the enclosed areas shown.



Circle	Square	Rectangle	Hexagon
1641 cm^2	1640 cm^2	1640 cm^2	1644 cm^2

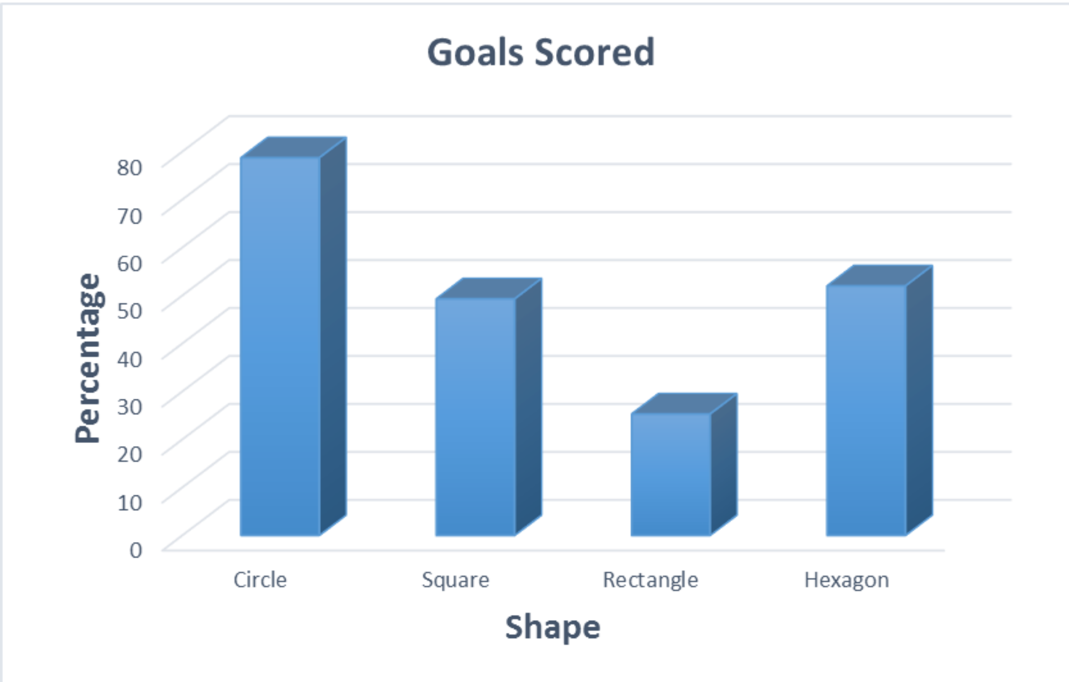
Data Collection Sheet

Name of Student: ____________________	
Shape	**No. of goals**
Circle	
Square	
Rectangle	
Hexagon	

Presentation Data: The table below shows the number of goals scored by each student, using of each of the hoops. Each student made 25 goal attempts for each shape. Hence, there were a total of 300 goal attempts made.

	Number of Goals Scored				
Student	**Circle**	**Square**	**Rectangle**	**Hexagon**	**Total**
Alan	22	14	09	15	**60**
Briana	20	12	06	10	**48**
Chris	17	11	04	14	**46**
Total	**59**	**37**	**19**	**39**	**154**
% success by shape	**78.7**	**49.3**	**25.3**	**52.0**	
% of scored goals (out of 154)	**38.3**	**24.0**	**12.3**	**25.3**	

The graph below shows the percentage of goals scored for each of the shapes.



Analysis of Data: The data collected from the experiment revealed that of the three students, Alan scored the most goals and Chris the least. Although some students were more successful in scoring, for each student, the most goals were scored with the standard basketball hoop which was in the shape of a circle where the success rate was 79 percent. Overall, out of the 154 goals scored 38.3 percent were using the circle, 25.3 percent with the hexagon, 37 percent with the square and 24 percent with the rectangle.

Discussion of Findings/ Conclusion:	While it is possible to construct a basketball hoop using many different shapes, all shapes will not give the same results. A rectangular shaped hoop is the least suitable shape and the circular hoop, the most preferred. Hence, in constructing a basketball hoop, the most appropriate shape to ensure success in scoring goals is a circle.

Procedures for Reporting and Submitting the School Based Assessment

Teachers are required to record the mark awarded to each candidate under the appropriate profile dimension on the mark sheet provided by CXC. The completed mark sheets should be submitted to CXC no later than April 30 of the year of the examination.

Note: The school is advised to keep a copy of the project of each candidate as well as copies of the mark sheets.

Teachers will be required to submit to CXC copies of the projects of a sample of candidates as indicated by CXC. The sample will be re-marked by CXC for moderation purposes.

Moderation of School Based Assessment

The candidate's performance on the project will be moderated. The standard and range of marks awarded by the teacher will be adjusted where appropriate. However, the rank order assigned by the teacher will be adjusted only in special circumstances and then only after consideration of the data provided by the sample of marked projects submitted by the teacher and re-marked by CXC.

PAPER 032

(a) *This paper consists of two questions based on topics from any section or combination of different sections of the syllabus. The duration of the paper is **1 hour**.*

(b) *All questions are compulsory and will require an extended response.*

(c) *The paper carries a maximum of **20** marks. Marks will be awarded for Knowledge, Comprehension and Reasoning as follows:*

*Knowledge: the recall of rules, procedures, definitions and facts; simple computations. (**6** marks)*

*Comprehension: algorithmic thinking, use of algorithms and the application of algorithms to problem situations. (**8** marks)*

*Reasoning: translation of non-routine problems into mathematical symbols; making inferences and generalisations from given data; analyzing and synthesising. (**6** marks)*

♦ *RECOMMENDED TEXTS*

Buckwell, G., Solomon, R., and Chung Harris, T.	*CXC Mathematics for Today 1*, Oxford: Macmillan Education, 2005.
Chandler, S., Smith, E., Ali, F., Layne, C. and Mothersill, A.	*Mathematics for CSEC,* United Kingdom: Nelson Thorne Limited, 2008.
Golberg, N.	*Mathematics for the Caribbean 4,* Oxford: Oxford University Press, 2006.
Greer and Layne	*Certificate Mathematics*, *A Revision Course for the Caribbean*, United Kingdom: Nelson Thorness Limited, 2001.
Layne, Ali, Bostock, Chandler, Shepherd and Ali.	*STP Caribbean Mathematics for CXC Book 4*, United Kingdom: Nelson Thorness Limited, 2005.
Toolsie, R.	*Mathematics, A Complete Course Volume 1,* Caribbean Educational Publisher Limited, 2006.
Toolsie, R.	*Mathematics, A Complete Course Volume 2,* Caribbean Educational Publisher Limited, 2006.

<u>Websites</u>

http://mathworld.wolfram.com/
http://plus.maths.org/
http://nrich.maths.org/public/
http://mathforum.org/
http://www.ies.co.jp/math/java/

♦ GLOSSARY OF EXAMINATION TERMS

KEY TO ABBREVIATIONS

K - Knowledge
C - Comprehension
R - Reasoning

WORD	DEFINITION	NOTES
Analyse	examine in detail	
Annotate	add a brief note to a label	Simple phrase or a few words only.
Apply	use knowledge/principles to solve problems	Make inferences/conclusions.
Assess	present reasons for the importance of particular structures, relationships or processes	Compare the advantages and disadvantages or the merits and demerits of a particular structure, relationship or process.
Calculate	arrive at the solution to a numerical problem	Steps should be shown; units must be included.
Classify	divide into groups according to observable characteristics	
Comment	state opinion or view with supporting reasons	
Compare	state similarities and differences	An explanation of the significance of each similarity and difference stated may be required for comparisons which are other than structural.
Construct	use a specific format to make and/or draw a graph, histogram, pie chart or other representation using data or material provided or drawn from practical investigations, build (for example, a model), draw scale diagram	Such representations should normally bear a title, appropriate headings and legend.
Deduce	make a logical connection between two or more pieces of information; use data to arrive at a conclusion	

WORD	DEFINITION	NOTES
Define	state concisely the meaning of a word or term	This should include the defining equation/formula where relevant.
Demonstrate	show; direct attention to...	
Derive	to deduce, determine or extract from data by a set of logical steps some relationship, formula or result	This relationship may be general or specific.
Describe	provide detailed factual information of the appearance or arrangement of a specific structure or a sequence of a specific process	Description may be in words, drawings or diagrams or any appropriate combination. Drawings or diagrams should be annotated to show appropriate detail where necessary.
Determine	find the value of a physical quantity	
Design	plan and present with appropriate practical detail	Where hypotheses are stated or when tests are to be conducted, possible outcomes should be clearly stated and/or the way in which data will be analysed and presented.
Develop	expand or elaborate an idea or argument with supporting reasons	
Diagram	simplified representation showing the relationship between components	
Differentiate/ Distinguish (between/ among)	state or explain briefly those differences between or among items which can be used to define the items or place them into separate categories	
Discuss	present reasoned argument; consider points both for and against; explain the relative merits of a case	
Draw	make a line representation from specimens or apparatus which shows an accurate relation between the parts	In the case of drawings from specimens, the magnification must always be stated.
Estimate	make an approximate quantitative judgement	
Evaluate	weigh evidence and make judgements based on given criteria	The use of logical supporting reasons for a particular point of view is more important than the view held; usually both sides of an argument should be considered.
Explain	give reasons based on recall; account for	

WORD	DEFINITION	NOTES
Find	locate a feature or obtain as from a graph	
Formulate	devise a hypothesis	
Identify	name or point out specific components or features	
Illustrate	show clearly by using appropriate examples or diagrams, sketches	
Interpret	explain the meaning of	
Investigate	use simple systematic procedures to observe, record data and draw logical conclusions	
Justify	explain the correctness of	
Label	add names to identify structures or parts indicated by pointers	
List	itemize without detail	
Measure	take accurate quantitative readings using appropriate instruments	
Name	give only the name of	No additional information is required.
Note	write down observations	
Observe	pay attention to details which characterize a specimen, reaction or change taking place; to examine and note scientifically	Observations may involve all the senses and/or extensions of them but would normally exclude the sense of taste.
Outline	give basic steps only	
Plan	prepare to conduct an investigation	
Predict	use information provided to arrive at a likely conclusion or suggest a possible outcome	
Record	write an accurate description of the full range of observations made during a given procedure	This includes the values for any variable being investigated; where appropriate, recorded data may be depicted in graphs, histograms or tables.

WORD	DEFINITION	NOTES
Relate	show connections between; explain how one set of facts or data depend on others or are determined by them	
Sketch	make a simple freehand diagram showing relevant proportions and any important details	
State	provide factual information in concise terms outlining explanations	
Suggest	offer an explanation deduced from information provided or previous knowledge. (... a hypothesis; provide a generalization which offers a likely explanation for a set of data or observations.)	No correct or incorrect solution is presumed but suggestions must be acceptable within the limits of scientific knowledge.
Use	apply knowledge/principles to solve problems	Make inferences/conclusions.

♦ GLOSSARY OF MATHEMATICAL TERMS

WORD	MEANING
Abscissa	The x-coordinate in a Cartesian coordinate system.
Absolute value	The absolute value of a real number x, denoted by $\lvert x\rvert$, is defined by $\lvert x\rvert = x$ if $x > 0$ and $\lvert x\rvert = -x$ if $x < 0$. For example, $\lvert -4\rvert = 4$.
Acceleration	The rate of change of velocity with respect to time.
Acute Angle	An angle whose measure is greater than 0 degrees and less than 90 degrees. **Acute triangle** is a triangle with all three of its angles being acute.
Adjacent	Being next to or adjoining **Adjacent angles** are two angles that have the same vertex and share a common arm. In a right triangle the **adjacent side**, with respect to an acute angle, is the shorter side which, together with the hypotenuse, forms the given acute angle.
Adjoint Matrix	The adjoint of a 2×2 matrix A, denoted $Adj(A)$, satisfies the following: If $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, then $Adj(A) = \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$.
Algebraic Expression	A combination of numbers, variables and algebraic operations. For example $\frac{3x^4}{17} + 5(y - \sqrt{16z})$ is an algebraic expression.
Algebraic Term	An algebraic expression that is strictly a multiplication of constants and variables. For example the algebraic expression $6x^3 - 3x^2 + 5x$ contains three algebraic terms: $(6x^3)$, $(-3x^2)$ and $(5x)$.
Algorithm	A process consisting of a specific sequence of operations to solve a certain types of problems. See **Heuristic**.
Alternate Interior Angles	Angles located inside a set of parallel lines and on opposite sides of the transversal. Also known as 'Z-angles'.
Altitude	The altitude of a triangle is the perpendicular distance of a vertex to the line of the side opposite. A triangle has three altitudes.
Appreciation	An increase in value of an asset that is not due to altering its state.
Approximate	To find the value of a quantity within a specified degree of accuracy.
Arc	A portion of a circle; also a portion of any curve. **See circle.**
Area	The area of a plane figure is a measure of how much of that plane is enclosed by the figure.

WORD	MEANING
Arithmetic Mean	The average of a set of values found by dividing the sum of the values by the amount of values.
Arithmetic Sequence	A sequence of elements, a_1, a_2, a_3,….., such that the difference of successive terms is a constant d. For example, the sequence $\{2, 5, 8, 11, 14, \ldots\}$ has common difference 3.
Associative Property	A binary operation $\circ$ on a set S is associative if, for all a, b and c in S, $(a \circ b) \circ c = a \circ (b \circ c)$.
Asymptotes	A straight line is said to be an asymptote of a curve if the curve has the property of becoming and staying arbitrarily close to the line as the distance from the origin increases to infinity.
Average	The average of a set of values is the number which represents the usual or typical value in that set. Average is synonymous with measures of central tendency. These include the mean, mode and median.
Axis of symmetry	A line that passes through a figure such that the portion of the figure on one side of the line is the mirror image of the portion on the other side of the line.
Bar Graph	A diagram showing a system of connections or interrelations between two or more things by using bars.
Base	1. The base of a polygon is one of its sides; for example, a side of a triangle. 2. The base of a solid is one of its faces; for example, the flat face of a cylinder. 3. The base of a number system is the number of digits it contains; for example, the base of the binary system is two.
Bimodal	Having two modes, which are equally the most frequently occurring numbers in a list.
Binary Numbers	Numbers written in the base two number system. The digits used are 0 and 1. For example, 11011_2.
Binomial	An algebraic expression consisting of the sum or difference of two terms.
Bisector	To cut something in half. For example, an angle bisector is a line that divides one angle into two angles of equal size.
Capacity	The maximum amount that something can contain.
Cardinality	The cardinality of a set is the number of elements it contains.

WORD	MEANING
Cartesian Plane	A plane with a point selected as an origin, some length selected as a unit of distance, and two perpendicular lines that intersect at the origin, with positive and negative directions selected on each line. Traditionally, the lines are called x (drawn from left to right, with positive direction to the right of the origin) and y (drawn from bottom to top, with positive direction upward of the origin). Coordinates of a point are determined by the distance of this point from the lines, and the signs of the coordinates are determined by whether the point is in the positive or in the negative direction from the origin.
Chord	A line segment that connects two points on a curve. **The Diameter** of a circle is a special chord that passes through the centre of the circle.
Circle	The set of points in a plane that are all a fixed distance from a given point which is called the centre. **The Circumference** of a circle is the distance along the circle; it's a special name for the perimeter of the circle.
Class Interval	Non-overlapping intervals, which together contain every piece of data in a survey.
Coefficients	The constant multiplicative factor of a mathematical object. For example, in the expression 4d+5 t^2 +3s, the 4, 5, and 3 are coefficients for the variables d, t^2, and s respectively.
Collinear	A set of points are said to be collinear if they all lie on the same straight line.
Commutative Property	Reversing the order in which two objects are being added or multiplied will yield the same result. For all real numbers a and b, a+b=b+a and ab=ba.
Complement	The complement of a set A is another set of all the elements outside of set A but within the universal set.
Complementary Angles	Two angles that have a sum of 90 degrees.
Composite Function	A function consisting of two or more functions such that the output of one function is the input of the other function. For example, in the composite function $f\big(g(x)\big)$ the input of f is g.
Composite Numbers	Numbers that have more than two factors. For example, 6 and 20 are composite numbers while 7 and 41 are not.
Compound Interest	A system of calculating interest on the sum of the initial amount invested together with the interest previously awarded; if A is the initial sum invested in an account and r is the rate of interest per period invested, then the total after n periods is $A(1+r)^n$.

WORD	MEANING
Congruent	Two shapes in the plane or in space are congruent if they are identical. That is, if one shape is placed on the other they match exactly.
Coordinates	A unique order of numbers that identifies a point on the coordinate plane. On the Cartesian two dimensional plane the first number in the ordered pair identifies the position with regard to the horizontal (x-axis) while the second number identifies the position relative to the vertical (y-axis).
Coplanar	A set of points is coplanar if the points all lie in the same plane.
Corresponding Angles	Two angles in the same relative position on two parallel lines when those lines are cut by a transversal.
Decimal Number	A number written in base ten.
Degrees	A degree is a unit of measure of angles where one degree is $\frac{1}{360}$ of a complete revolution.
Depreciation	The rate which the value of an asset diminishes due only to wear and tear.
Diagonal	The diagonal of a polygon is a straight line joining two of its nonadjacent vertices.
Discontinuous Graph	A line in a graph that is interrupted, or has breaks in it.
Discrete	A set of values are said to be discrete if they are all distinct and separated from each other. For example the set of shoe sizes where the elements of this set can only take on a limited and distinct set of values.
Disjoint	Two sets are disjoint if they have no common elements; their intersection is empty.
Distributive Property	Summing two numbers and then multiplying by a third number yields the same value as multiplying both numbers by the third number and then adding. In algebraic terms, for all real numbers a, b, and c, $a(b + c) = ab + ac$.
Domain of the function f	The set of objects x for which f(x) is defined.
Element of a set	A member of or an object in a set.
Empty Set	The empty set is the set that has no elements; it is denoted with the symbol $\emptyset$.
Equally Likely	In probability, when there are the same chances for more than one event to happen, the events are equally likely to occur. For example, if

WORD	MEANING
	someone flips a fair coin, the chances of getting heads or tails are the same. There are equally likely chances of getting heads or tails.
Equation	A statement that says that two mathematical expressions have the same value.
Equilateral Triangle	A triangle with three equal sides. Equilateral triangles have three equal angles of measure 60 degrees.
Estimate	The best guess for an unknown quantity arrived at after considering all the information given in a problem.
Event	In probability, an event is a set of outcomes of an experiment. For example, the even A may be defined as obtaining two heads from tossing a coin twice.
Expected Value	The average amount that is predicted if an experiment is repeated many times.
Experimental Probability	The chances of something happening, based on repeated testing and observing results. It is the ratio of the number of times an event occurred to the number of times tested. For example, to find the experimental probability of winning a game, one must play the game many times, then divide by the number of games won by the total number of games played.
Exponent	The power to which a number of variables is raised.
Exponential Function	A function that has the form $y=a^x$, where a is any real number and is called the base.
Exterior Angle	The exterior angle of a polygon is an angle formed by a side and a line which is the extension of an adjacent side.
Factors	1. The factors of a whole number are those numbers by which it can be divided without leaving a remainder. 2. The factors of an algebraic expression A are those expressions which, when multiplied together, results in A. For example x and $(3-y)$ are the factors of $3x-xy$.
Factorise	The process of rewriting an algebraic expression as a product of its factors. For example, $4x^2-4y^2$ when factorised may be written as $(2x-2y)(2x+2y)$. To **factorise completely** is to rewrite an expression as a product of prime factors. For example, $4x^2-4y^2$ when factorised completely is $4(x-y)(x+y)$.
Frequency	The number of items occurring in a given category.
Frustum	The frustum is a portion of a cone or pyramid bounded by two faces parallel to the base.

WORD	MEANING
Function	A correspondence in which each member of one set is mapped unto a member of another set.
Graph	A visual representation of data that displays the relationship among variables, usually cast along x and y axes.
Histogram	A bar graph with no spaces between the bars where the area of the bars are proportional to the corresponding frequencies. If the bars have the same width then the heights are proportional to the frequencies.
Hypotenuse	The side of the Right triangle that is opposite the right angle. It is the longest of the three sides.
Identity	1. An equation that is true for every possible value of the variables. For example, $x^2 - 1 = (x-1)(x+1)$ is an identity while $x^2 - 1 = 3$ is not, as it is only true for the values ± 2. 2. The **identity element** of an operation is a number such that when operated on with any other number results in the other number. For example, the identity element under addition of real numbers is zero; the identity element under multiplication of 2 x 2 matrices is $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$.
Inequality	A relationship between two quantities indicating that one is strictly less than or less than or equal to the other.
Infinity	The symbol ∞ indicating a limitless quantity. For example, the result of a nonzero number divided by zero is infinity.
Integers	The set consisting of the positive and negative whole numbers and zero, for example, {… -2, -1, 0, 1, 2,…}.
Intercept	The **x-intercept** of a graph is the value of x where the curve crosses the x-axis. The **y-intercept** of a graph is the y value where the curve crosses the y-axis.
Intersection	The intersection of two sets is the set of elements which are common in both sets.
Inverse	The inverse of an element under an operation is another element which when operated on with the first element results in the identity. For example, the inverse of a real number under addition is the negative of that number.
Irrational Number	A number that cannot be represented as an exact ratio of two integers. For example, π or the square root of 2.

WORD	MEANING
Isosceles Triangle	A triangle that has two equal sides.
Like Terms	Two terms are like terms if all parts of both, except for the numerical coefficient, are the same.
Limit	The target value that terms in a sequence of numbers are getting closer to. This limit is not necessarily ever reached; the numbers in the sequence eventually get arbitrarily close to the limit.
Line Graph	A diagram showing a system of connections or interrelations between two or more things by using lines.
Line symmetry	If a figure is divided by a line and both divisions are mirrors of each other, the figure has line symmetry. The line that divides the figure is the line of symmetry.
Linear Equation	An equation containing linear expressions.
Linear Expression	An expression of the form $ax + b$ where x is a variable of power one and a and b are constants, or in more variables, an expression of the form $ax + by + c$, $ax + by + cz + d$ where a, b, c and d are constants.
Magnitude	The length of a vector.
Matrix	A rectangular arrangement of numbers in rows and columns.
Mean	In statistics, the average obtained by dividing the sum of two or more quantities by the number of these quantities.
Median	In statistics, the quantity designating the middle value in a set of numbers which have been arranged in ascending or descending order.
Mode	In statistics, the value that occurs most frequently in a given set of numbers.
Multimodal distribution	A distribution with more than one mode. For example, the set {2, 4, 3, 5, 3, 6, 5, 2, 5, 3} has modal values 3 and 5.
Multiples	The product of multiplying a number by a whole number. For example, multiples of 5 are 10, 15, 20 or any number that can be evenly divided by 5.
Natural Numbers	The set of the counting numbers, that is, N = {1, 2, 3, 4…}
Negative Numbers	Numbers less than zero. In graphing, numbers to the left of zero. Negative numbers are represented by placing a minus sign (-) in front of the number. For example, $-3, -0.5, -\frac{14}{9}$ are negative numbers.

WORD	MEANING
Obtuse Angle	An angle whose measure is greater than 90 degrees but less than 180 degrees.
Obtuse Triangle	A triangle containing one obtuse angle.
Ordered Pair	A set of numbers where the order in which the numbers are written has an agreed-upon meaning. For example, points on the Cartesian plane are represented by ordered pairs such as P(4,7) where 4 is the x-value and 7 the y-value.
Origin	In the Cartesian coordinate plane, the origin is the point at which the horizontal and vertical axes intersect, at zero (0,0).
Parallel	Given distinct lines in the plane that are infinite in both directions, the lines are parallel if they never meet. Two distinct lines in the coordinate plane are parallel if and only if they have the same slope.
Parallelogram	A quadrilateral that contains two pairs of parallel sides.
Pattern	Characteristic(s) observed in one item that may be repeated in similar or identical manners in other items.
Percent	A ratio that compares a number to one hundred. The symbol for percent is %.
Perpendicular	Two lines are said to be perpendicular to each other if they form a 90 degrees angle.
Pi	The designated name for the ratio of the circumference of a circle to its diameter.
Pie Chart	A chart made by plotting the numeric values of a set of quantities as a set of adjacent circular wedges where the arc lengths are proportional to the total amount. All wedges taken together comprise an entire disk.
Pie Graph	A diagram showing a system of connections or interrelations between two or more things by using a circle divided into segments that look like pieces of pie.
Polygon	A closed plane figure formed by three or more line segments.
Polyhedra	Any solid figure with an outer surface composed of polygon faces.
Polynominal	An algebraic expression involving a sum of algebraic terms with nonnegative integer powers. For example, $2x^3 + 3x^2 - x + 6$ is a polynomial in one variable.
Population	In statistics population is the set of all items under consideration.
Prime	A natural number p greater than 1 is prime if and only if the only positive integer factors of p are 1 and p. The first seven primes are 2, 3, 5, 7, 11, 13, 17.

WORD	MEANING
Probability	The measure of how likely it is for an event to occur. The probability of an event is always a number between zero and 1.
Proportion	1. A relationship between two ratios in which the first ratio is always equal to the second. Usually of the form $\frac{a}{b} = \frac{c}{d}$. 2. The fraction of a part and the whole. If two parts of a whole are in the ratio 2:7, then the corresponding proportions are $\frac{2}{9}$ and $\frac{7}{9}$ respectively.
Protractor	An instrument used for drawing and measuring angles.
Pythagorean Theorem	The Pythagorean Theorem states that the square of the hypotenuse is equal to the sum of the squares of the two sides, or $a^2 + b^2 = c^2$, where c is the hypotenuse.
Quadrant	The four parts of the coordinate plane divided by the x and y axes. Each of these quadrants has a number designation. First quadrant contains all the points with positive x and positive y coordinates. Second quadrant contains all the points with negative x and positive y coordinates. The third quadrant contains all the points with both coordinates negative. Fourth quadrant contains all the points with positive x and negative y coordinates.
Quadratic Function	A function given by a polynomial of degree 2.
Quadrilateral	A polygon that has four sides.
Quartiles	Consider a set of numbers arranged in ascending or descending order. The quartiles are the three numbers which divide the set into four parts of equal amount of numbers. The first quartile in a list of numbers is the number such that a quarter of the numbers is below it. The second quartile is the median. The third quartile is the number such that three quarters of the numbers are below it.
Quotient	The result of division.
Radical	The radical symbol (√) is used to indicate the taking of a root of a number. $\sqrt[q]{x}$ means the qth root of x; if q=2 then it is usually written as $\sqrt{x}$. For example $\sqrt[5]{243} = 3$, $\sqrt[4]{16} = 2$. The radical always means to take the positive value. For example, both 5 and -5 satisfy the equation $x^2 = 25$, but $\sqrt{25} = 5$.
Range	The range of a set of numbers is the difference between the largest value in the set and the smallest value in the set. Note that the range is a single number, not many numbers.
Range of Function f	The set of all the numbers f(x) for x in the domain of f.

WORD	MEANING
Ratio	A comparison expressed as a fraction. For example, the ratio of three boys to two girls in a class is written as $\frac{3}{2}$ or 3:2.
Rational Numbers	Numbers that can be expressed as the quotient of two integers, for example, $\frac{7}{3}$, $\frac{5}{11}$, $\frac{-5}{13}$, 7 = $\frac{7}{1}$.
Ray	A straight line that begins at a point and continues outward in one direction.
Real Numbers	The union of the set of rational numbers and the set of irrational numbers.
Reciprocal	The reciprocal of a number **a** is equal to $\frac{1}{\boldsymbol{a}}$ where $a \neq 0$.
Regular Polygon	A polygon whose side lengths are all the same and whose interior angle measures are all the same.
Rhombus	A parallelogram with four congruent sides.
Right Angle	An angle of 90 degrees.
Right Triangle	A triangle containing an angle of 90 degrees.
Rotate	The turning of an object (or co-ordinate system) by an angle about a fixed point.
Root	1. The root of an equation is the same as the solution of that equation. For example, if y=f(x), then the roots are the values of x for which y=0. Graphically, the roots are the x-intercepts of the graph. 2. The n^{th} root of a real number x is a number which, when multiplied by itself n times, gives x. If n is odd then there is one root for every value of x; if n is even there are two roots (one positive and one negative) for positive values of x and no real roots for negative values of x. The positive root is called the **Principal root** and is represented by the radical sign (√). For example, the principal square root of 9 is written as $\sqrt{9} = 3$ but the square roots of 9 are $\pm\sqrt{9} = \pm 3$.
Sample	A group of items chosen from a population.
Sample Space	The set of outcomes of a probability experiment. Also called probability space.
Scalar	A quantity which has size but no direction.
Scalene Triangle	A triangle with no two sides equal. A scalene triangle has no two angles equal.

WORD	MEANING
Scientific Notation	A shorthand way of writing very large or very small numbers. A number expressed in scientific notation is expressed as a decimal number between 1 and 10 multiplied by a power of 10 (for example, 7000 = $7\text{x}10^3$ or 0.0000019 = $1.9\text{x}10^{-6}$).
Sector	The sector of a circle is a closed figure formed by an arc and two radii of the circle.
Segment	1. A line segment is a piece of a line with two end points. 2. A segment of a circle is a closed figure formed by an arc and a chord.
Sequence	A set of numbers with a prescribed order.
Set	A set is a well-defined collection of things, without regard to their order.
Significant Digits	The amount of digits required for calculations or measurements to be close enough to the actual value. Some rules in determining the number of digits considered significant in a number: - The leftmost non-zero digit is the first significant digit. - Zeros between two non-zero digits are significant. Trailing zeros to the right of the decimal point are considered significant.
Similar	Two figures are said to be similar when all corresponding angles are equal. If two shapes are similar then the corresponding sides are in the same ratio.
Simple Event	A non-decomposable outcome of a probability experiment.
Simple Interest	An interest of a fixed amount calculated on the initial investment.
Simultaneous Equations	A system (set) of equations that must all be true at the same time.
Solid	A three dimensional geometric figure that completely encloses a volume of space.
Square Matrix	A matrix with equal number of rows and columns.
Square Root	The square root of a positive real number n is the number m such that $m^2 = n$. For example, the square roots of 16 are 4 and -4.
Subset	A subset of a given set is a collection of things that belong to the original set. For example, the subsets of $A = \{a, b\}$ are: $\{a\}, \{b\}, \{a, b\}$, and the null set.

WORD	MEANING
Surface Area	The sum of the areas of the surfaces of a solid.
Statistical Inference	The process of estimating unobservable characteristics of a population using information obtained from a sample.
Symmetry	Two points A and B are symmetric with respect to a line if the line is a perpendicular bisector of the segment AB.
Tangent	A line is a tangent to a curve at a point A if it just touches the curve at A in such a way that it remains on one side of the curve at A. A tangent to a circle intersects the circle only once.
Translate	In a tessellation, to translate an object means repeating it by sliding it over a certain distance in a certain direction.
Translation	A rigid motion of the plane or space of the form X goes to X + V for a fixed vector V.
Transversal	In geometry, given two or more lines in the plane a transversal is a line distinct from the original lines and intersects each of the given lines in a single point.
Theoretical Probability	The chances of events happening as determined by calculating results that would occur under ideal circumstances. For example, the theoretical probability of rolling a 4 on a fair four-sided die is ¼ or 25%, because there is one chance in four to roll a 4, and under ideal circumstances one out of every four rolls would be a 4.
Trapezoid	A quadrilateral with exactly one pair of parallel sides.
Trigonometry	The study of triangles. Three trigonometric functions defined for either acute angles in the right triangle are: Sine of the angle x is the ratio of the side opposite the angle and the hypotenuse. In short, $\sin x = \frac{O}{H}$; Cosine of the angle x is the ratio of the short side adjacent to the angle and the hypotenuse. In short, $\cos x = \frac{A}{H}$; Tangent of the angle x is the ratio of the side opposite the angle and the short side adjacent to the angle. In short $\tan x = \frac{O}{A}$
Union of Sets	The union of two or more sets is the set of all the elements contained in all the sets. The symbol for union is U.
Unit Vector	A vector of length 1.

WORD	MEANING
Variable	A placeholder in an algebraic expression, for example, in $3x + y = 23$, x and y are variables.
Vector	Quantity that has magnitude (length) and direction. It may be represented as a directed line segment.
Velocity	The rate of change of position overtime in a given direction is velocity, calculated by dividing directed distance by time.
Venn Diagram	A diagram where sets are represented as simple geometric figures, with overlapping and similarity of sets represented by intersections and unions of the figures.
Vertex	The vertex of an angle is the point where the two sides of the angle meet.
Volume	A measure of the number of cubic units of space an object occupies.

<u>Western Zone Office</u>
19 September 2014

CARIBBEAN EXAMINATIONS COUNCIL

Caribbean Secondary Education Certificate®
CSEC®

MATHEMATICS

Specimen Papers and Mark Schemes/Keys

Specimen Papers:

Paper 01
Paper 02
Paper 032

Mark Schemes and Key:

Paper 01
Paper 02
Paper 032

The Specimen Papers

Paper 01

1. The Paper 01 consists of 60 items. However, there are 30 items in this specimen paper. The Specimen represents the syllabus topics and the profiles in the same ratio as they will occur on the Paper 01 for the revised syllabus.

2. Vectors and Matrices will be tested on Paper 01.

Paper 02

1. The Paper 02 will be marked electronically. The structure of the actual paper has been modified to allow candidates to write in the spaces following each part of a question. However, in an effort to limit the number of pages in the specimen paper, the spaces for the working were omitted.

2. The topic Sets will no longer be tested on Paper 02.

Paper 032

1. This is a new paper and is designed for candidates whose work cannot be monitored by tutors in recognised educational institutions. The Paper will be of one hour duration and will consist of two questions.

2. The Paper 032 will be marked electronically and the structure, as presented in the specimen, will allow candidates to write in the spaces following each part of a question.

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

CARIBBEAN SECONDARY EDUCATION CERTIFICATE®
EXAMINATION

SPECIMEN
MULTIPLE CHOICE QUESTIONS
FOR

MATHEMATICS

READ THE FOLLOWING DIRECTIONS CAREFULLY

Each item in this test has four suggested answers lettered (A), (B), (C), (D). Read each item you are about to answer and decide which choice is best.

Sample Item

2a + 6a =

(A) 8a
(B) $8a^2$
(C) 12a
(D) $12a^2$

Sample Answer

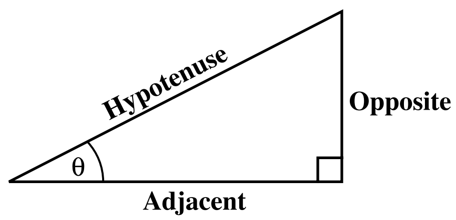
● (B) (C) (D)

The best answer to this item is "8a", so answer space (A) has been shaded.

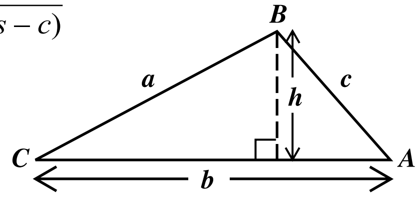
There are 30 items in this specimen paper. However, the Paper 01 test consists of 60 items.

LIST OF FORMULAE

Volume of a prism	$V = Ah$ where A is the area of a cross-section and h is the perpendicular length.
Volume of cylinder	$V = \pi r^2 h$ where r is the radius of the base and h is the perpendicular height.
Volume of a right pyramid	$V = \frac{1}{3} Ah$ where A is the area of the base and h is the perpendicular height.
Circumference	$C = 2\pi r$ where r is the radius of the circle.
Arc length	$S = \frac{\theta}{360} \times 2\pi r$ where θ is the angle subtended by the arc, measured in degrees.
Area of a circle	$A = \pi r^2$ where r is the radius of the circle.
Area of a sector	$A = \frac{\theta}{360} \times \pi r^2$ where θ is the angle of the sector, measured in degrees.
Area of trapezium	$A = \frac{1}{2}(a + b)\, h$ where a and b are the lengths of the parallel sides and h is the perpendicular distance between the parallel sides.
Roots of quadratic equations	If $ax^2 + bx + c = 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Trigonometric ratios	$\sin\theta = \frac{\text{opposite side}}{\text{hypotenuse}}$ $\cos\theta = \frac{\text{adjacent side}}{\text{hypotenuse}}$ $\tan\theta = \frac{\text{opposite side}}{\text{adjacent side}}$



Area of triangle	Area of $\Delta = \frac{1}{2} bh$ where b is the length of the base and h is the perpendicular height. Area of $\Delta\, ABC = \frac{1}{2} ab \sin C$ Area of $\Delta\, ABC = \sqrt{s\,(s-a)\,(s-b)\,(s-c)}$ where $s = \frac{a+b+c}{2}$
Sine rule	$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
Cosine rule	$a^2 = b^2 + c^2 - 2bc\cos A$



GO ON TO THE NEXT PAGE

1. The number 2 747 written to 3 significant figures is

(A) 2 740
(B) 2 750
(C) 274
(D) 275

2. Expressed in scientific notation 0.045×10^{-3} is

(A) 4.5×10^{-1}
(B) 4.5×10^{-4}
(C) 4.5×10^{-5}
(D) 4.5×10^{-6}

3. The value of $\frac{(5+2)^3}{5^2 - 2^2}$ in its simplest form is

(A) $\frac{8}{21}$

(B) $\frac{7}{3}$

(C) $\frac{7}{2}$

(D) $\frac{49}{3}$

4. How much simple interest is due on a loan of $1 200 for two years if the annual rate of interest is $5\frac{1}{2}$ per cent?

(A) $120.00
(B) $132.00
(C) $264.00
(D) $330.00

Item **5** refers to the chart shown below.

Rate on Fixed Deposits	
2014	7.8%
2015	7.5%

5. How much more interest did a fixed deposit of $10 000 earn in 2015 than in 2014?

(A) $ 0.30
(B) $ 3.00
(C) $30.00
(D) $33.00

6. Tom bought a pen for $60. He sold it to gain 20% on his cost. How much money did he gain?

(A) $12
(B) $40
(C) $72
(D) $80

7. The Water Authority charges $10.00 per month for the meter rent, $25.00 for the first 100 litres and $1.00 for each additional 10 litres.

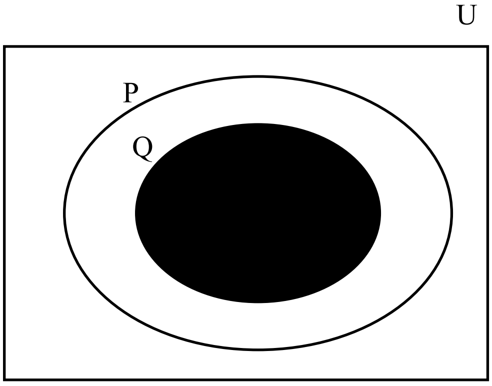
What is the total bill for 250 litres used in one month?

(A) $25.00
(B) $35.00
(C) $40.00
(D) $50.00

8. Which of the following sets has an infinite number of members?

(A) {factors of 20}
(B) {multiples of 20}
(C) {prime numbers less than 20}
(D) {odd numbers between 10 and 20}

Item **9** refers to the Venn diagram below.



9. The shaded area in the Venn diagram above represents

(A) P'
(B) Q'
(C) $P \cup Q$
(D) $P \cap Q$

10. P and Q are two finite sets such that $n(P) = 7$, $n(Q) = 5$ and $n(P \cap Q) = 3$. What is $n(P \cup Q)$?

(A) 6
(B) 9
(C) 15
(D) 18

11. How many litres of water would a container whose volume is 36 cm^3 hold?

(A) 0.036
(B) 0.36
(C) 36
(D) 3600

12. A man leaves home at 22:15 hrs and reaches his destination at 04:00 hrs. On the following day, in the same time zone. How long did the journey take?

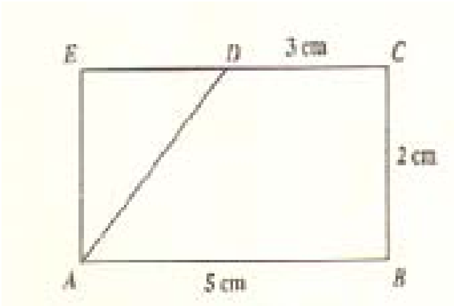
(A) 5 hrs

(B) $5\frac{3}{4}$ hrs

(C) 6 hrs

(D) $6\frac{1}{4}$ hrs

Item **13** refers to the trapezium below, **not drawn to scale**.



13. *ABCD* is a trapezium and *ADE* is a triangle. Angles *B*, *C* and *E* are right angles.

The area of the trapezium *ABCD* is

(A) 8 cm^2
(B) 16 cm^2
(C) 30 cm^2
(D) 32 cm^2

14. A circular hole with diameter 6 cm is cut from a circular piece of card with a diameter of 12 cm. The area of the remaining card, in cm^2, is

(A) 6π
(B) 27π
(C) 36π
(D) 108π

15. The mean of ten numbers is 58. If one of the numbers is 40, what is the mean of the other nine?

(A) 18
(B) 60
(C) 162
(D) 540

<u>Items **16–17**</u> refer to the table below which shows the distribution of the ages of 25 children in a choir.

Age	11	12	13	14	15	16
No. of children	6	3	5	4	4	3

16. What is the probability that a child chosen at random is AT LEAST 13 years old?

(A) $\frac{4}{25}$

(B) $\frac{9}{25}$

(C) $\frac{14}{25}$

(D) $\frac{16}{25}$

17. What is the mode of this distribution?

(A) 4
(B) 6
(C) 11
(D) 16

18. Seven times the product of two numbers, a and b, may be written as

(A) $7ab$
(B) $7a + b$
(C) $7a + 7b$
(D) $49\,ab$

19. If $2(x - 1) - 3x = 6$, then $x =$

(A) -8
(B) -4
(C) 4
(D) 8

20. $\frac{3x + 1}{2} - \frac{x + 1}{4} =$

(A) $\frac{7x + 3}{4}$

(B) $\frac{7x + 1}{4}$

(C) $\frac{5x + 1}{4}$

(D) $\frac{5x + 3}{4}$

21. The equation of the line which passes through the point $(0, 2)$ and has a gradient of $\frac{1}{3}$ is

(A) $y = 3x$

(B) $y = 3x + 2$

(C) $y = \frac{1}{3}x$

(D) $y = \frac{1}{3}x + 2$

22. If g is a function such that $g(x) = 2x + 1$, which of the following coordinates satisfies the function?

(A) (–3, –5)
(B) (–6, 11)
(C) (5, 2)
(D) (13, 6)

23. What is the gradient of a line which passes through the points (–4, 3) and (–2, 5)?

(A) –4

(B) $\frac{-1}{3}$

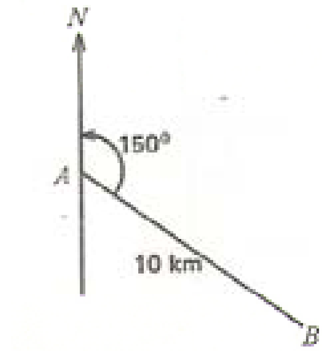
(C) $\frac{1}{3}$

(D) 1

24. If $f(x) = 2x - 3$ and $g(x) = 3x + 1$, then $fg(-2)$ is

(A) –13
(B) –7
(C) 5
(D) 20

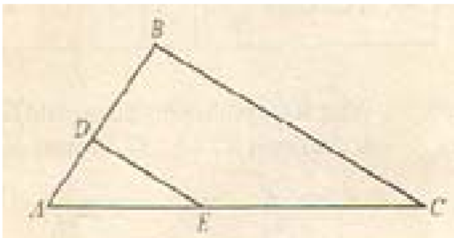
Item **25** refers to the diagram below, **not drawn to scale**.



25. A plane travels from point A on a bearing 150^0 to point B which is 10 km from A. How far east of A is B?

(A) 10 tan 30^0
(B) 10 cos 30^0
(C) 10 cos 60^0
(D) 10 sin 60^0

Item **26** refers to the diagram below, **not drawn to scale**.



26. Triangle ABC is an enlargement of triangle ADE such that

$$\frac{AD}{DB} = \frac{AE}{EC} = \frac{1}{2}$$

If the area $ABC = 36$ cm^2, then the area of $DECB$, in cm^2, is

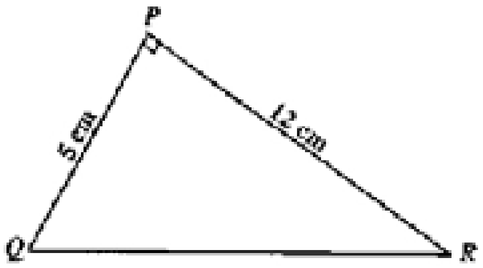
(A) 18
(B) 24
(C) 27
(D) 32

27. The point $P(2, -3)$ is rotated about the origin through an angle of 90° in an anti-clockwise direction.

What are the coordinates of the image P?

(A) (3, 2)
(B) (2, 3)
(C) (−3, 2)
(D) (3, −2)

Item **28** refers to the triangle PQR below, **not drawn to scale**.



28. If angle $QPR = 90°$, $PR = 12$ cm and $PQ = 5$ cm then the length of QR, in cm, is

(A) 7
(B) 11
(C) 13
(D) 17

29. Given that P and Q are points with coordinates $P(1, 3)$ and $Q(-1, 4)$, the position vector $\overrightarrow{PQ}$ is

(A) $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$

(B) $\begin{pmatrix} 0 \\ 7 \end{pmatrix}$

(C) $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$

(D) $\begin{pmatrix} 2 \\ -1 \end{pmatrix}$

30. The transformation matrix $Q = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$ represents

(A) a 180° rotation about (0, 2)
(B) a reflection in the line $x = 2$
(C) a reflection in the line $y = 2$
(D) an enlargement by scale factor 2

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE

MATHEMATICS

SPECIMEN PAPER 01

Item Number	Specific Objective	Key
1	Number Theory and Computation 9(a)	B
2	Number Theory and Computation 11	C
3	Number Theory and Computation 2	D
4	Consumer Arithmetic 6	B
5	Consumer Arithmetic 10 (e)	C
6	Consumer Arithmetic 4	A
7	Consumer Arithmetic 10 (b)	D
8	Sets 1	B
9	Sets 7	D
10	Sets 4	B
11	Measurement 1	A
12	Measurement 12	B
13	Measurement 6	A
14	Measurement 6	B
15	Statistics 5	B
16	Statistics 13	D
17	Statistics 5	C
18	Algebra 2	A
19	Algebra 10	A
20	Algebra 8	C
21	Relations, Functions & Graphs 9	D
22	Relations, Functions & Graphs 4	A
23	Relations, Functions & Graphs 8	D
24	Relations, Functions & Graphs 19	A
25	Geometry & Trigonometry 13	C
26	Geometry & Trigonometry 5 (c)	D
27	Geometry & Trigonometry 11 (c)	A
28	Geometry & Trigonometry 12	C
29	Vectors & Matrices 3	C
30	Vectors & Matrices 12	D

TEST CODE **01234020/SPEC**

FORM TP 01234020/SPEC

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

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

MATHEMATICS

SPECIMEN PAPER

Paper 02 – General Proficiency

2 hours 40 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of TWO sections: I and II.
2. Section I has SEVEN questions and Section II has THREE questions.
3. Answer ALL questions from the TWO sections.
4. Write your answers in the booklet provided.
5. Do NOT write in the margins.
6. All working must be clearly shown.
7. Unless otherwise stated in the question, any numerical answer that is not exact MUST be written to THREE significant figures.
8. A list of formulae is provided on page 4 of this booklet.
9. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra page(s) provided at the back of this booklet. **Remember to draw a line through your original answer**.
10. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

Examination Materials Permitted

Silent, non-programmable electronic calculator
Mathematical instruments

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

LIST OF FORMULAE

Volume of a prism — $V = Ah$ where A is the area of a cross-section and h is the perpendicular length.

Volume of cylinder — $V = \pi r^2 h$ where r is the radius of the base and h is the perpendicular height.

Volume of a right pyramid — $V = \frac{1}{3}Ah$ where A is the area of the base and h is the perpendicular height.

Circumference — $C = 2\pi r$ where r is the radius of the circle.

Arc length — $S = \frac{\theta}{360} \times 2\pi r$ where θ is the angle subtended by the arc, measured in degrees.

Area of a circle — $A = \pi r^2$ where r is the radius of the circle.

Area of a sector — $A = \frac{\theta}{360} \times \pi r^2$ where θ is the angle of the sector, measured in degrees.

Area of trapezium — $A = \frac{1}{2}(a + b)\,h$ where a and b are the lengths of the parallel sides and h is the perpendicular distance between the parallel sides.

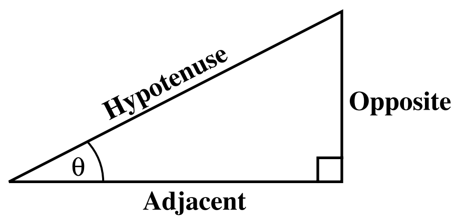
Roots of quadratic equations — If $ax^2 + bx + c = 0$,

then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2\text{a}}$

Trigonometric ratios — $\sin\theta = \dfrac{\text{opposite side}}{\text{hypotenuse}}$

$\cos\theta = \dfrac{\text{adjacent side}}{\text{hypotenuse}}$

$\tan\theta = \dfrac{\text{opposite side}}{\text{adjacent side}}$

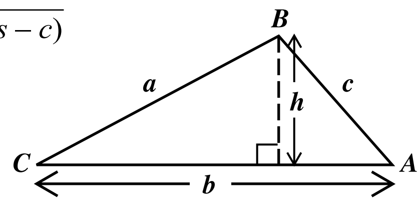


Area of triangle — Area of $\Delta = \frac{1}{2}bh$ where b is the length of the base and h is the perpendicular height.

Area of $\Delta\, ABC = \frac{1}{2}ab\sin C$

Area of $\Delta\, ABC = \sqrt{s\,(s-a)\,(s-b)\,(s-c)}$

where $s = \dfrac{a+b+c}{2}$



Sine rule — $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine rule — $a^2 = b^2 + c^2 - 2bc\cos A$

GO ON TO THE NEXT PAGE

SECTION I

Answer ALL questions in this section.

All working must be clearly shown.

1. (a) Using a calculator, determine the value of

$$\frac{(3.29)^2 - 5.5}{\sqrt{1.5 \times 0.06}}$$

giving your answer to 1 decimal place. **(3 marks)**

(b) The table below shows rates of exchange.

US\$1.00 = TT\$6.45
BBD\$1.00 = TT\$3.00

(i) Using the table, calculate the amount in BBD dollars equivalent to US\$1.00. **(2 marks)**

(ii) Gail exchanged BBD\$1806.00 for US dollars. Calculate the amount she received in US dollars. **(1 mark)**

(c) The cash price of a laptop is \$4799.00. It can be bought on hire purchase by making a deposit of \$540.00 and 12 monthly instalments of \$374.98 EACH.

(iii) Calculate the TOTAL hire purchase price of the laptop. **(2 marks)**

(iv) Calculate the amount saved by purchasing the laptop at the cash price. **(1 mark)**

Total 9 marks

2. (a) Simplify: $p^3q^2 \times pq^5$ **(1 mark)**

(b) If $a * b = 2a - 5b$, calculate the value of

(i) $3 * 4$ **(1 mark)**

(ii) $(3 * 4) * 1$ **(1 mark)**

(c) Factorize completely: $3x + 6y - x^2 - 2xy$ **(2 marks)**

(d) A string of length 14 cm is cut into two pieces. The length of the first piece is x cm. The second piece is 5 cm **longer** than half the length of the first piece.

(i) State in terms of x, the length of the second piece of string. **(1 mark)**

(ii) Write an expression, in terms of x, to represent the TOTAL length of the two pieces of string. **(1 mark)**

(iii) Hence, calculate the length of the first piece of string. **(2 marks)**

Total 9 marks

3. (a) Using a ruler, a pencil and a pair of compasses, construct a rhombus, PQRS, in which PR = 6 cm and RPQ = 60°. **(4 marks)**

(b) **Use the graph on page 5 to answer this question.**

The diagram shows triangle JKL and its image J´K´L´ after an enlargement.

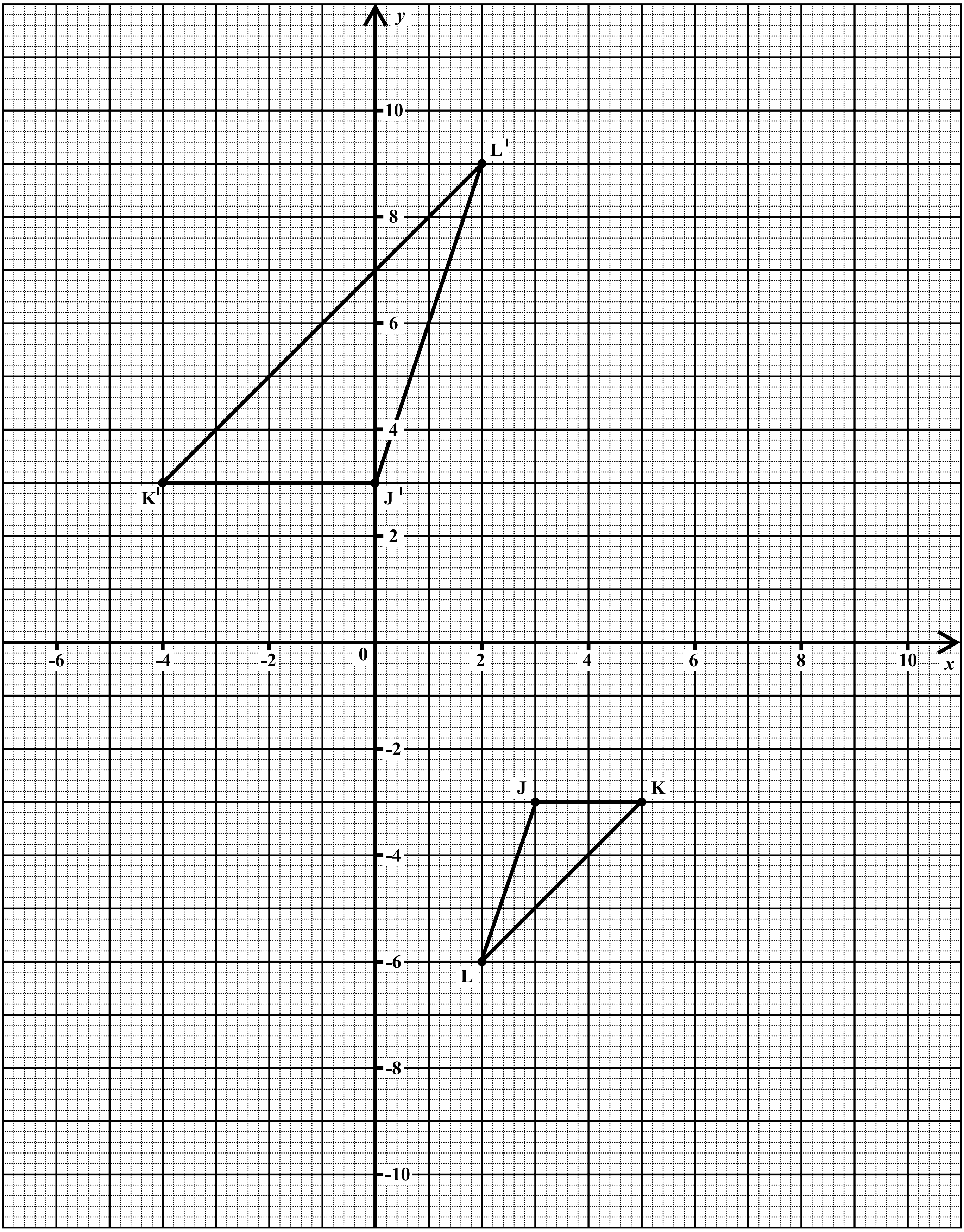
(i) Draw lines on your diagram to locate the point G, the centre of the enlargement. **(1 mark)**

(ii) State the coordinates of the point G. **(1 mark)**

(iii) State the scale factor of the enlargement. **(1 mark)**

(iv) On your diagram, show the point J´´, the image of the point J´, after a reflection in the line $x = 4$. **(2 marks)**

Total 9 marks


y
10
8
6
4
2
-2
-4
-6
-8
-10
-6
-4
-2
0
2
4
6
8
10
x
L'
K'
J'
J
K
L

4. (a) The line BC passes through the point A(−5, 3) and has a gradient of $\frac{2}{5}$.

(i) Write the equation of the line BC in the form $y = mx + c$. **(2 marks)**

(ii) Determine the equation of the line which passes through the origin and is perpendicular to the line BC. **(2 marks)**

(b) The functions f and g are defined as:

$$f(x) = \frac{2x-1}{x+3} \qquad g(x) = 4x - 5$$

(i) Determine f g(3). **(2 marks)**

(ii) Derive an expression for $f^{-1}(x)$. **(3 marks)**

Total 9 marks

5. **A graph sheet is provided for this question.** The table below shows the time spent, to the nearest minute, by 25 students at the school canteen.

	Time spent at the bookstore (minutes)	Frequency	Cumulative Frequency
	6–10	2	2
	11–15	4	6
	16–30	5	11
(i)	21–25	_____	20
(ii)	26–30	4	_____
	31–35	1	25

(a) Complete the rows numbered (i) and (ii). **(2 marks)**

(b) On your graph on page 7, draw a cumulative frequency curve of the time spent at the canteen, using a scale of **2 cm to represent 5 minutes** on the horizontal axis and **2 cm to represent 5 students** on the vertical axis. **(4 marks)**

(c) **Use the graph drawn at (b)** to estimate

(i) the median time spent at the canteen **(1 mark)**

(ii) the probability that a student selected at random spent LESS than 24 minutes at the canteen. **(2 marks)**

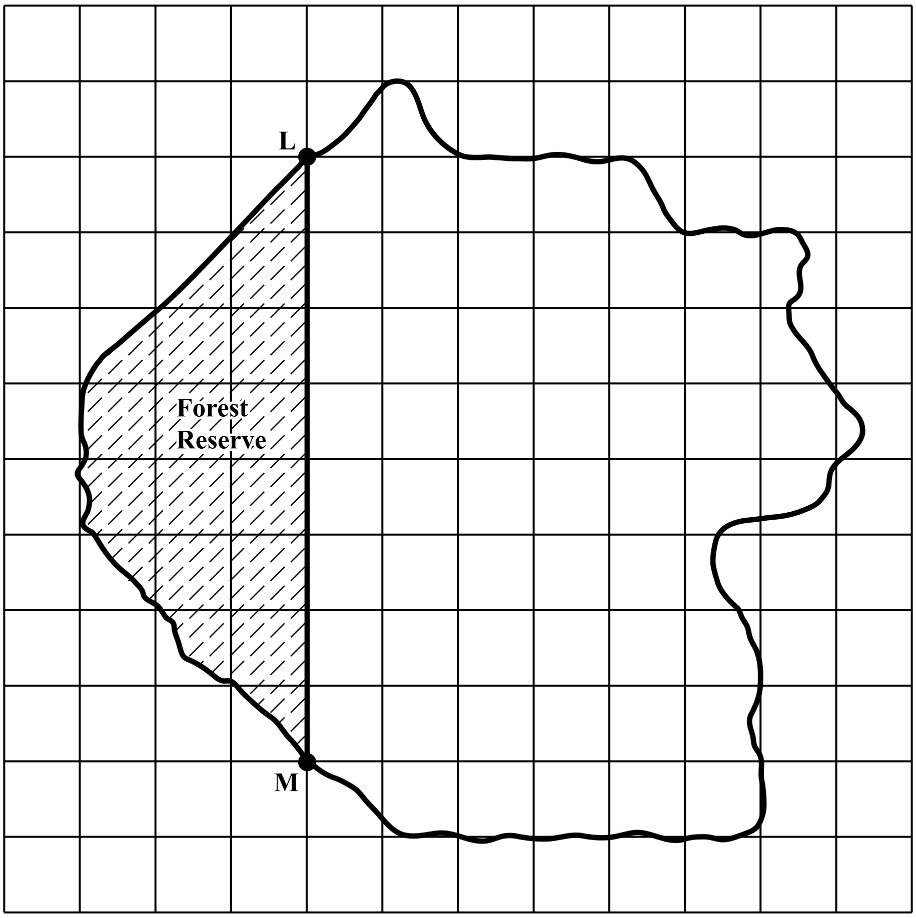
Total 9 marks

6. (a) In this question, use $\pi = \frac{22}{7}$.

(i) A piece of wire is bent to form a square of area 121 cm^2. Calculate the perimeter of the square. **(2 marks)**

(ii) The same piece of wire is bent to form a circle. Calculate the radius of the circle. **(2 marks)**

(b) The diagram below shows a map of an island drawn on a grid of 1 cm squares. The map is drawn to a scale of 1:50 000.



(i) L and M are two tracking stations. State, in centimetres, the distance LM on the map. **(1 mark)**

(ii) Calculate the ACTUAL distance, in kilometres, from L to M on the island. **(2 marks)**

(iii) Calcuate the ACTUAL area, in km^2, of the forest reserve, given that $1 \times 10^{10}\ cm^2 = 1\ km^2$. **(2 marks)**

Total 9 marks

7. The table below represents the calculation of the sum of the cubes of the first **n** natural numbers. Information is missing from some rows of the table.

(a) Study the pattern in the table and complete the rows marked (i), (ii) and (iii).

	n	Series	Sum	Formula
	1	1^3	1	$\frac{1^2}{4}(1+1)^2$
	2	$1^3 + 2^3$	9	$\frac{2^2}{4}(1+2)^2$
	3	$1^3 + 2^3 + 3^3$	36	$\frac{3^2}{4}(1+3)^2$
	4	$1^3 + 2^3 + 3^3 + 4^3$	100	$\frac{4^2}{4}(1+4)^2$
(i)	5	....	....	....
	6	$1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3$	441	$\frac{6^2}{4}(1+6)^2$
(ii)	....		....	$\frac{8^2}{4}(1+8)^2$
(iii)	**n**			....

(6 marks)

(b) It was further noted that:

$1 + 2 = 3 = \sqrt{9}$

$1 + 2 + 3 = 6 = \sqrt{36}$

$1 + 2 + 3 + 4 = 10 = \sqrt{100}$

Using information from the table above and the pattern in the three statements above, determine

(i) the value of x for which $1 + 2 + 3 + 4 + 5 + 6 = \sqrt{x}$ **(2 marks)**

(ii) a formula in terms of **n** for the series: $1 + 2 + 3 + 4 + ... + n$ **(2 marks)**

Total 10 marks

GO ON TO THE NEXT PAGE

SECTION II

Answer ALL questions in this section.

All working must be clearly shown.

8. (a) Solve the pair of simultaneous equations:

$x^2 = 4 - y$

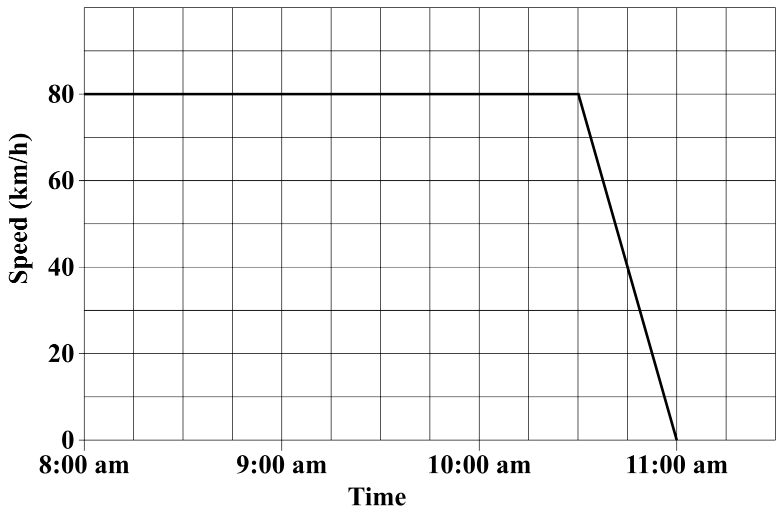
$x = y + 2$ **(4 marks)**

(b) (i) Express $3x^2 + 2x + 1$ in the form $a(x + p)^2 + q$ where a, p and q are real numbers. **(2 marks)**

(ii) Hence, determine for $f(x) = 3x^2 + 2x + 1$

- the minimum value for $f(x)$
- the equation of the axis of symmetry. **(2 marks)**

(c) The speed–time graph below shows the journey of a car from 8:00 a.m. to 11:00 a.m.



Using the graph, determine

(i) the time at which the speed of the car was 40 km/h **(1 mark)**

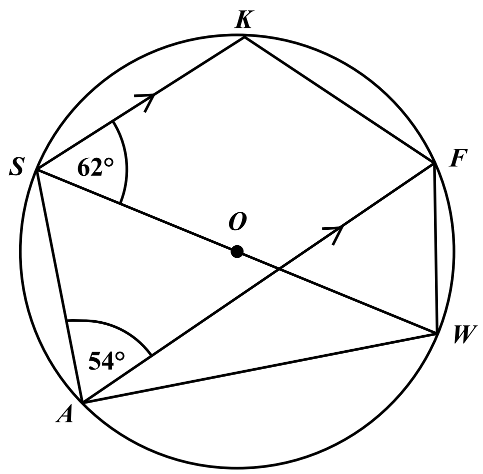
(ii) the TOTAL distance the car travelled for the entire journey **(2 marks)**

(iii) the average speed of the car for the entire journey. **(1 mark)**

Total 12 marks

9. (a) In the diagram below, **not drawn to scale**, O is the centre of the circle. The lines SK and AF are parallel.

$\angle KSW = 62°$ $\angle SAF = 54°$



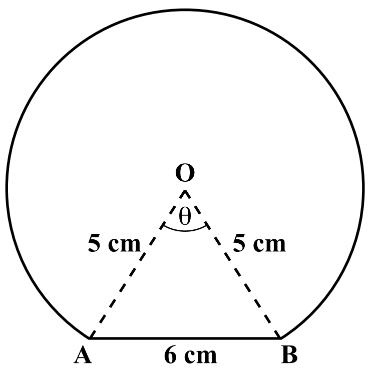
Calculate, **giving reasons for your answer**, the measure of:

(i) $\angle FAW$ **(2 marks)**

(ii) $\angle SKF$ **(2 marks)**

(iii) $\angle ASW$ **(2 marks)**

(b) A machine produces circular discs of diameter 10 cm. The machine malfunctions and cuts a disc to produce the shape in the figure below, **not drawn to scale**, with centre, O.



Use $\pi = 3.14$

Determine

(i) the measure of angle θ **(2 marks)**

(ii) the area of triangle AOB **(2 marks)**

(iii) the area of the disc that was cut off. **(2 marks)**

Total 12 marks

10. (a) The vertices of a quadrilateral, OPQR are (0,0), (4,2), (6,10) and (2,8) respectively.

(i) **Using a vector method**, express in the form $\begin{pmatrix} x \\ y \end{pmatrix}$ the vectors

- $\overrightarrow{OP}$
- $\overrightarrow{RQ}$ **(2 marks)**

(ii) Calculate $|\overrightarrow{OP}|$, the magnitude of $\overrightarrow{OP}$. **(2 marks)**

(iii) State ONE geometrical relationship between the line segments OP and RQ. **(2 marks)**

(b) The matrix, K, maps the point S (1,4) onto S′ (−4,−1) and the point T (3,5) onto T′ (–5,–3).

Given that K = $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$,

(i) express as a matrix equation, the relationship between K, S, S′, T and T′. **(2 marks)**

(ii) hence, determine the values of a, b, c and d. **(3 marks)**

(iii) describe COMPLETELY the geometric transformation which is represented by the matrix K. **(2 marks)**

Total 12 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

CARIBBEAN EXAMINATIONS COUNCIL
SECONDARY EDUCATION CERTIFICATE EXAMINATION
MATHEMATICS

Specimen Paper

Table of Specifications

Ques.	Specific Objectives	P1	P2	P3	Total
1	Number Theory and Computation: 2, 3, 9 (b) Consumer Arithmetic: 5, 9	4	3	2	**9**
2	Algebra: 2, 6, 9, 10	3	4	2	**9**
3	Geometry and Trigonometry: 2, 3, 8 (a), 10	3	3	3	**9**
4	Relations, Functions & Graphs: 9 (c), 10, 18, 19	3	3	3	**9**
5	Statistics: 2, 5, 7, 9, 11	3	3	3	**9**
6	Measurement: 2, 3, 14, 15	2	4	3	**9**
7	Investigation	3	2	5	**10**
8	Algebra: 15, 18 Relations, Functions & Graphs: 22, 25, 26	3	6	3	**12**
9	Geometry and Trigonometry: 6, 15, 16,	3	6	3	**12**
10	Vectors & Matrices: 3, 4, 11, 12, 13	3	6	3	**12**
	TOTAL	**30**	**40**	**30**	**100**

01234020/SPECIMEN PAPER/MS/2015

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CARIBBEAN SECONDARY EDUCATION CERTIFICATE®

EXAMINATION

MATHEMATICS

PAPER 02 – GENERAL PROFICIENCY

MARK SCHEME

SPECIMEN PAPER 2015

MATHEMATICS

PAPER 02 – GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

QUESTION: 1

	PROFILES K	PROFILES C	PROFILES R	Total
(a) $\frac{(3.29)^2 - 5.5}{\sqrt{1.5 \times 0.06}}$				
$= \frac{10.8241 - 5.5}{0.3}$	1			
$= 17.747$	1			
$= 17.7$ to 1 decimal place	1			
	3	**–**	**–**	**3**
(b) (i) US \$ 1.00 = BD \$ $\left(\frac{1.00}{3.00}\right) \times 6.45$			1	
= BD \$ 2.15	1			
(ii) Amount Gail received = US \$ $\left(\frac{1806.00}{2.15}\right)$		1		
= US \$ 840.00				
	1	**1**	**1**	**3**
(c) (i) Cash price on laptop = \$4799.00				
Deposit = \$540.00				
Total Instalments = \$374.98 × 12				
= \$4499.76		1		
The total hire purchase price of the laptop = \$ 540.00 + \$ 4499.76			1	
= \$5039.76				
(ii) The amount saved by buying the laptop at the cash price = \$5039.76 – \$4799.00		1		
= \$ 240.76	**–**	**2**	**1**	**3**
TOTAL	**4**	**3**	**2**	**9**

MATHEMATICS

PAPER 02 – GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

QUESTION: 2

	PROFILES			Total
	K	C	R	
(a) $p^3q^2 \times pq^5 = p^4q^7$	1			
	1	**–**	**–**	**1**
(b) $a * b = 2a - 5b$				
(i) $3 * 4 = 2\ (3) - 5\ (4)$ $= 6 - 20$ $= -14$		1		
(ii) $(3 * 4) * 1 = (-14) * 1$ $= 2\ (-14) - 5\ (1)$ $= -28 - 5$			1	
$= -33$	**–**	**1**	**1**	**2**
(c) $3x + 6y - x^2 - 2xy$				
$= 3\ (x + 2y) - x\ (x + 2y)$		1		
$= (3 - x)(x + 2y)$	1			
	1	**1**	**–**	**2**
(d) (i) Length of 2nd piece $= \frac{1}{2}x + 5$		**1**		
(ii) Sum of two lengths $= x + \frac{1}{2}x + 5$ $= \frac{3}{2}x + 5$	**1**			
(iii) $= \frac{3}{2}x + 5 = 14$ $= \frac{3}{2}x = 9$ $x = 6$			**1**	
Length of 1st piece is 6 cm		**1**		
	1	**2**	**1**	**4**
TOTAL	**3**	**4**	**2**	**9**

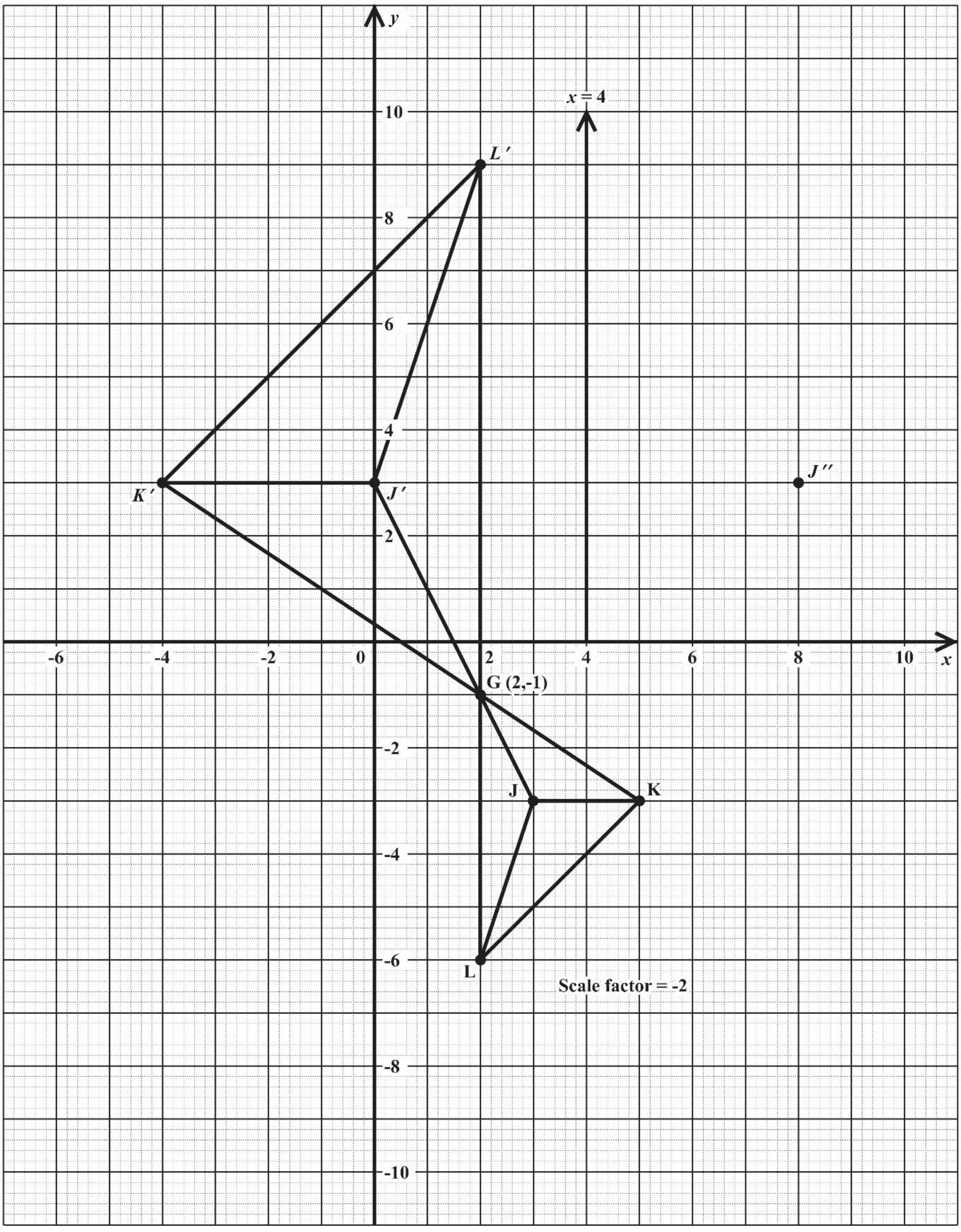
MATHEMATICS

PAPER 02 – GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

QUESTION: 3



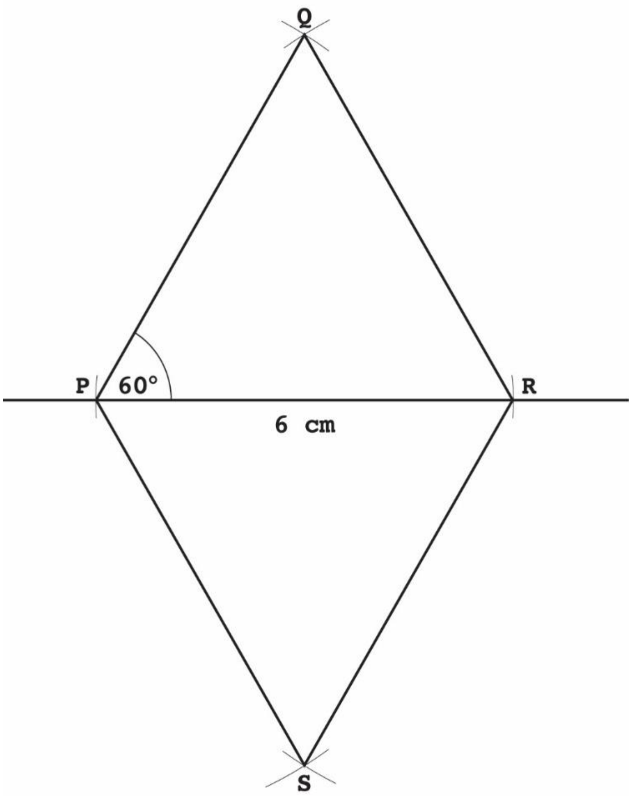
MATHEMATICS

PAPER 02 – GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

QUESTION: 3

	PROFILES			Total
	K	C	R	
(a)				
PR = 6cm			1	
∠ RPQ = 60°		1		
Locating Q		1		
Locating S	1			
 [Not drawn to scale]				
	1	2	1	4

MATHEMATICS

PAPER 02 - GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

		PROFILES K	PROFILES C	PROFILES R	Total
(b) (i) Any 2 of KK, JJ and LL	R1			1	
(ii) G (2, −1)	K1	1			
(iii) Scale factor = −2	R1			1	
(iv) a) x = 4 drawn (soi)	K1	1			
b) J” at (8, 3)	C1		1		
		2	**1**	**2**	**5**
TOTAL		**3**	**3**	**3**	**9**

MATHEMATICS

PAPER 02 - GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

QUESTION: 4

	K	C	R	Total
(a) A(−5, 3); m = $\frac{2}{5}$				
(i) Equation of line BC is $y - 3 = \frac{2}{5}(x + 5)$		1		
i.e. $y = \frac{2}{5}x + 5$		1		
(ii) Gradient of line perpendicular to BC is $-\frac{5}{2}$	1			
Equation of line through (0, 0) is $y = -\frac{5}{2}x$			1	
	1	**2**	**1**	**4**
(b) $f(x) = \frac{2x-1}{x+3}$; $g(x) = 4x - 5$				
(i) $g(3) = 12 - 5 = 7$	1			
$\therefore\ fg(3) = \frac{14 - 1}{7 + 3} = \frac{13}{10}$			1	
(ii) $\frac{2(f^{-1})-1}{(f^{-1})+3} = x$			1	
$2(f^{-1}) - 1 = xf^{-1} + 3x$		1		
$f^{-1}(2 - x) = 3x + 1$				
$f^{-1} = \frac{3x + 1}{2 - x}$	1			
	2	**1**	**2**	**5**
TOTAL	**3**	**3**	**3**	**9**

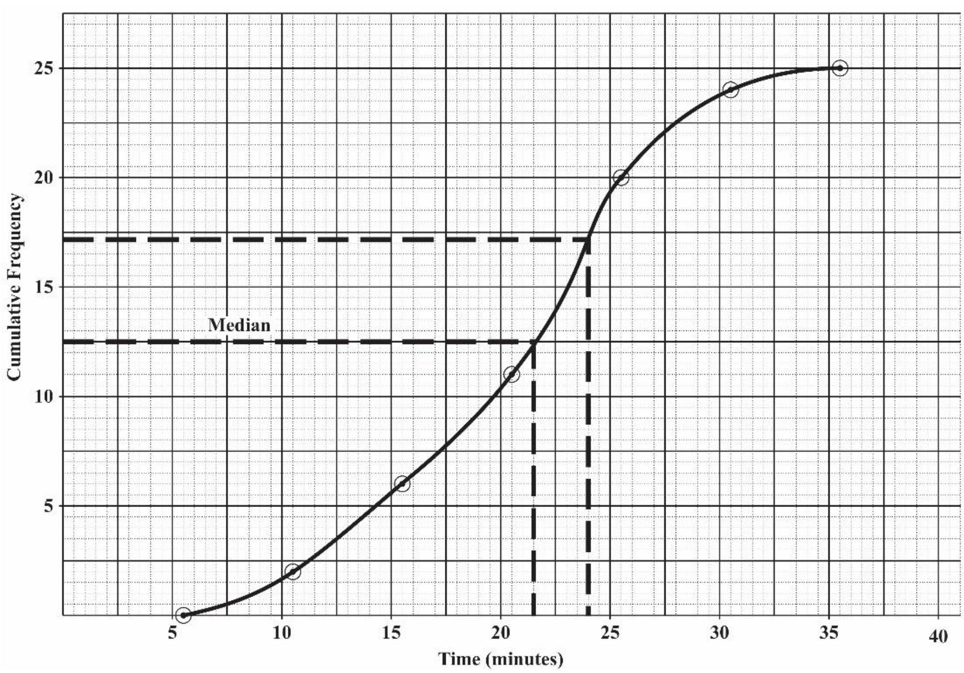
MATHEMATICS

PAPER 02 - GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

QUESTION: 5

	PROFILES K	PROFILES C	PROFILES R	Total
(a) Missing frequency = 9 Missing cumulative frequency = 24	1 1			
	2			2
(b)  Correct scale on both axes 3 or more points plotted correctly Plotting at class boundary Smooth ogive	1	 1 1	 1	
	1	2	1	4

MATHEMATICS

PAPER 02 - GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

	PROFILES K	PROFILES C	PROFILES R	Total
(c) (i) Median time spent = 21.5 minutes			**1**	
(d) (ii) P (time spent < 24) = $\frac{17}{25}$		**1**	**1**	
		1	**2**	**3**
TOTAL	**3**	**3**	**3**	**9**

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MARK SCHEME

QUESTION: 6

	K	C	R	Total
(a) (i) Area of square = 121 cm^2 a) ∴ length of side = $\sqrt{121}$ cm = 11 cm		1		
b) Perimeter of square = 4 × 11 cm = 44 cm	1			
(ii) Perimeter of circle = 44 cm i.e. $2\pi R$ = 44 cm $R = \frac{44}{2\pi}$ cm = 7 cm		1	1	
	1	2	1	4
(b) (i) *LM* = 8 cm on map	1			
(ii) Actual distance in km $= \frac{8 \times 50\,000}{100\,000}$ km = 4 km		1	1	
(iii) Area of forest reserve on map ≈ 15 cm^2 Actual area in km^2 $= \frac{15 \times (50\,000)^2}{1 \times 10^{10}}$ km^2 = 3.75 km^2		1	1	
	1	2	2	5
TOTAL	2	4	3	9

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SPECIMEN

MARK SCHEME

QUESTION: 7

(a)

	n	Series	Sum	Formula
(i)	5	$1^3+2^3+3^3+4^3+5^3$	225	$\frac{5^2}{4}(1+5)^2$
(ii)	8		1296	$\frac{8^2}{4}(1+8)^2$
(iii)	n			$\frac{n^2}{4}(1+n)^2$

Part	K	C	R	Total
(a)(i)	1	1	1	
(a)(ii)	1	1		
(a)(iii)			1	
(a)	2	2	2	6

(b) (i) $1 + 2 + 3 + 4 + 5 + 6 = \sqrt{x}$

$\Rightarrow x = (1 + 2 + 3 + 4 + 5 + 6) = 21$

$= 21^2$

$= 441$

(ii) $1 + 2 + 3 + 4 + \ldots + n = \sqrt{\frac{n^2}{4} + (1+n)^2}$

$= \frac{n}{2}(1 + n)$

Part	K	C	R	Total
(b)(i)	1			
(b)(i)			1	
(b)(ii)			1	
(b)(ii)			1	
(b)	1		3	4
TOTAL	**3**	**2**	**5**	**10**

MATHEMATICS

PAPER 02 - GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

QUESTION: 8

	K	C	R	Total
(a) $x^2 = 4 - y \ldots (1)$ $\quad x = y + 2 \ldots (2)$			1	
From (2): $y = x - 2$				
$\therefore x^2 = 4 - (x - 2)$				
$x^2 = 4 - x + 2$		1		
$\Rightarrow x^2 + x - 6 = 0$				
$(x + 3)(x - 2) = 0$		1		
$\Rightarrow x = -3, 2$				
when $x = -3$, $y = -5$				
when $x = 2$, $y = 0$	1			
	1	2	1	4
(b) (i) $3x^2 + 2x + 1 = 3\left(x^2 + \frac{2}{3}x\right) + 1$				
$= 3\left[\left(x + \frac{1}{3}\right)^2 - \frac{1}{9}\right] + 1$		1		
$= 3\left(x + \frac{1}{3}\right)^2 - \frac{1}{3} + 1$				
$= 3\left(x + \frac{1}{3}\right)^2 + \frac{2}{3}$	1			
(ii) For $f(x) = 3x^2 + 2x + 1$		1		
(a) $f(x)_{min} = \frac{2}{3}$			1	
(b) Axis of symmetry is $x = -\frac{1}{3}$				
	1	2	1	4
(c) (i) Speed was 40 km/h at 10:45 am		1		
(ii) Distance travelled $= \frac{1}{2}(3 + 2.5)(80)$ km				
$= 220$ km	1		1	
(iii) Average speed $= \frac{220}{3}$ km/h				
$= 73\frac{1}{3}$ km/h		1		
	1	2	1	4
TOTAL	**3**	**6**	**3**	**12**

MATHEMATICS

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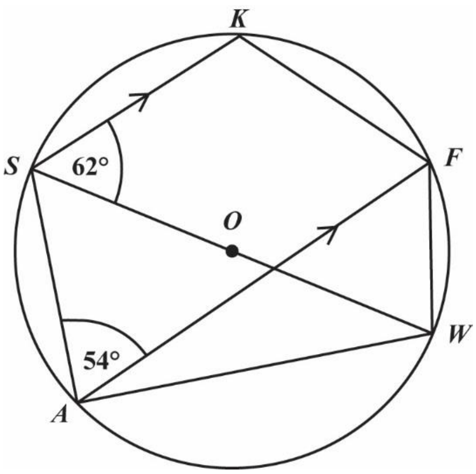
SPECIMEN

MARK SCHEME

QUESTION: 9

	PROFILES K	PROFILES C	PROFILES R	Total
(a) (i) 				
$F\hat{A}W = 90° - 54° = 36°$ Use of 90° (angle in a semicircle)	1		1	
(ii) $S\hat{K}F = 180° - 54° = 126°$ Use of 180° (opposite angles of cyclic quad)		1 1		
(iii) $A\hat{S}W = 180° - (62° + 54°) = 64°$ (co-interior angles)		1	1	
	1	3	2	6

MATHEMATICS

PAPER 02 - GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

	PROFILES K	PROFILES C	PROFILES R	Total
(b) (i) $6^2 = 5^2 + 5^2 - 2 \times 5 \times 5 \cos \theta$		1		
$\cos Q = \frac{14}{50}$ $\therefore \quad Q = 73.7°$	1			
(ii) Area of $\Delta AOB = \frac{1}{2}(5 \times 5) \sin 73.7°$ $= 12 \text{ cm}^2$	1	1		
(iii) Area of sector $AOB = \frac{73.7}{360} \pi (5^2)$ $= 16.1 \text{ cm}^2$			1	
$\therefore$ Area of segment removed $= 16.1 \text{ cm}^2 - 12 \text{ cm}^2 = 4.1 \text{ cm}^2$		1		
	2	3	1	6
TOTAL	3	6	3	12

MATHEMATICS

PAPER 02 – GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

QUESTION: 10

	PROFILES			Total
	K	C	R	
(a) (i) OP = $\begin{pmatrix}4\\2\end{pmatrix}$	1			
RQ = $\begin{pmatrix}6\\10\end{pmatrix} - \begin{pmatrix}2\\8\end{pmatrix} = \begin{pmatrix}4\\2\end{pmatrix}$		1		
(ii) $\mid OP \mid = \sqrt{4^2 + 2^2} = \sqrt{20}$	1	1		
(iii) *OP* and *RQ*				
either – have the same length				
or – are parallel			1	
	2	**2**	**1**	**5**
(b) (i) $\begin{pmatrix}a & b\\c & d\end{pmatrix}\begin{pmatrix}1 & 3\\4 & 5\end{pmatrix} = \begin{pmatrix}-4 & -5\\-1 & -3\end{pmatrix}$	1		1	
(ii) det of $\begin{pmatrix}1 & 3\\4 & 5\end{pmatrix}$ = 5 – 12 = -7		1		
Inverse of $\begin{pmatrix}1 & 3\\4 & 5\end{pmatrix} = \frac{1}{7}\begin{pmatrix}5 & -3\\-4 & 1\end{pmatrix}$				
$\therefore \begin{pmatrix}a & b\\c & d\end{pmatrix} = -\frac{1}{7}\begin{pmatrix}-4 & -5\\-1 & -3\end{pmatrix}\begin{pmatrix}5 & -3\\-4 & 1\end{pmatrix}$				
$= -\frac{1}{7}\begin{pmatrix}0 & 7\\7 & 0\end{pmatrix}$		1		
$= \begin{pmatrix}0 & -1\\-1 & 0\end{pmatrix}$			1	
[Complete matrix C2 R1 *b* or *c* only C1 each]				
(iii) The matrix $K = \begin{pmatrix}0 & -1\\-1 & 0\end{pmatrix}$				
Representing a reflection in the line		1		
$y = -x$		1		
	1	**4**	**2**	**7**
TOTAL	**3**	**6**	**3**	**12**

TEST CODE **01234032/SPEC**

FORM TP 01234032/SPEC

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

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

MATHEMATICS

SPECIMEN PAPER

Paper 032 – General Proficiency

2 hours 40 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of TWO questions.
2. Answer ALL questions.
3. Write your answers in the booklet provided.
4. Do NOT write in the margins.
5. All working MUST be clearly shown.
6. **A list of formulae is provided on page 2 of this booklet.**
7. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra page(s) provided at the back of this booklet. **Remember to draw a line through your original answer**.
8. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

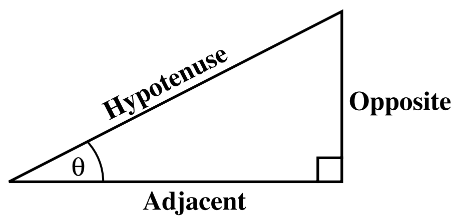
Examination Materials Permitted

Silent, non-programmable electronic calculator
Mathematical instruments

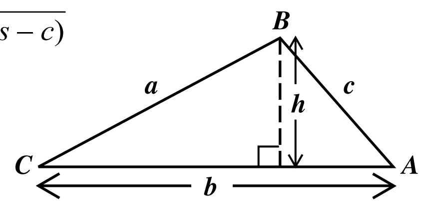
DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

LIST OF FORMULAE

Volume of a prism	$V = Ah$ where A is the area of a cross-section and h is the perpendicular length.
Volume of cylinder	$V = \pi r^2 h$ where r is the radius of the base and h is the perpendicular height.
Volume of a right pyramid	$V = \frac{1}{3} Ah$ where A is the area of the base and h is the perpendicular height.
Circumference	$C = 2\pi r$ where r is the radius of the circle.
Arc length	$S = \frac{\theta}{360} \times 2\pi r$ where θ is the angle subtended by the arc, measured in degrees.
Area of a circle	$A = \pi r^2$ where r is the radius of the circle.
Area of a sector	$A = \frac{\theta}{360} \times \pi r^2$ where θ is the angle of the sector, measured in degrees.
Area of trapezium	$A = \frac{1}{2}(a + b)\, h$ where a and b are the lengths of the parallel sides and h is the perpendicular distance between the parallel sides.
Roots of quadratic equations	If $ax^2 + bx + c = 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Trigonometric ratios	$\sin\theta = \frac{\text{opposite side}}{\text{hypotenuse}}$ $\cos\theta = \frac{\text{adjacent side}}{\text{hypotenuse}}$ $\tan\theta = \frac{\text{opposite side}}{\text{adjacent side}}$



Area of triangle	Area of $\Delta = \frac{1}{2} bh$ where b is the length of the base and h is the perpendicular height. Area of $\Delta\, ABC = \frac{1}{2} ab \sin C$ Area of $\Delta\, ABC = \sqrt{s(s-a)(s-b)(s-c)}$ where $s = \frac{a+b+c}{2}$
Sine rule	$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
Cosine rule	$a^2 = b^2 + c^2 - 2bc \cos A$



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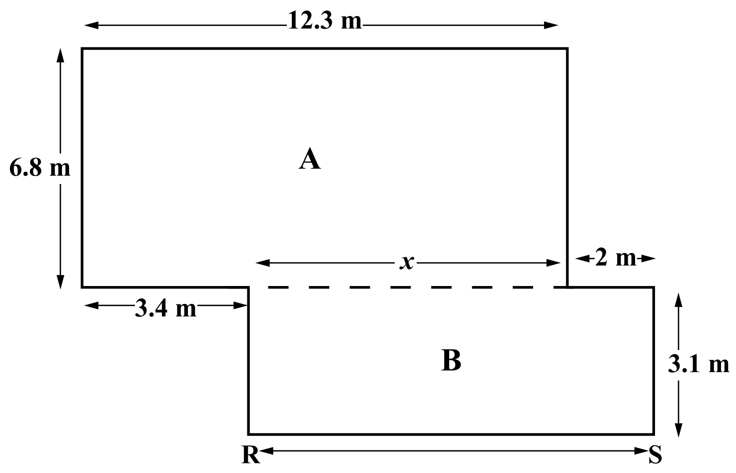
1. The diagram below, **not drawn to scale**, represents the plan of a floor. The broken line *RS* divides the floor into two rectangles, **A** and **B**.



(a) (i) Calculate the value of x.

(1 mark)

(ii) Hence, determine the length of RS.

(1 mark)

(b) Calculate the area of the entire floor.

(4 marks)

(c) Section A of the floor is to be covered with flooring boards measuring 1 metre by 30 centimetres.

What is the MINIMUM number of flooring boards that would be needed to completely cover Section A?

(4 marks)

Total 10 marks

2. A graph sheet is provided for this question.

A company manufactures gold and silver stars to be used as party decorations. The stars are placed in packets so that each packet contains x gold stars and y silver stars.

The table below shows some of the conditions for packaging the stars.

	Condition	**Inequality**
(1)	Each packet must have at least 20 gold stars	$x \geq 20$
(2)	Each packet must have at least 15 silver stars	
(3)	The total number of stars in each packet must be no more than 60	
(4)		$x < 2y$

(a) Complete the table above by

(i) writing the inequalities to represent conditions (2) and (3) **(2 marks)**

(ii) describing in words, the condition represented by the inequality $x < 2y$.
(2 marks)

(b) Complete the graph on page 5, to show the common region represented by ALL FOUR inequalities in the table above. **(3 marks)**

(c) Three packets of stars (A, B, and C) were selected for inspection. Their contents are shown in the table below.

Packet	**No. of gold stars (x)**	**No. of silver stars (y)**
A	25	20
B	35	15
C	30	25

(i) Plot the points representing A, B and C on the graph drawn at (b). **(1 mark)**

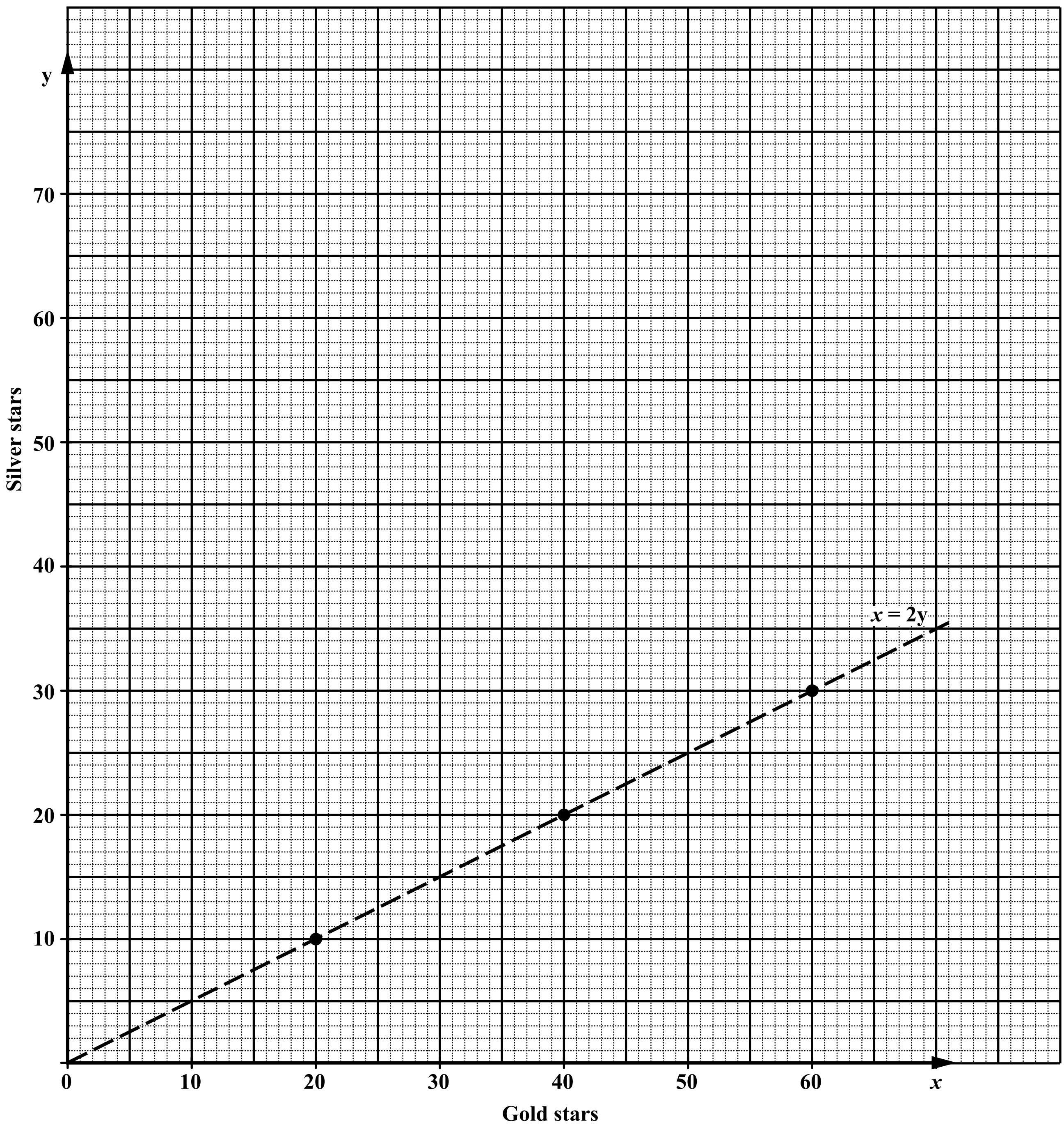
(ii) Hence, state which of the three packets satisfy ALL the conditions for packaging. Justify your response.

....

....

(2 marks)

GO ON TO THE NEXT PAGE



Total 10 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

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

CARIBBEAN SECONDARY EDUCATION CERTIFICATE®

EXAMINATION

MATHEMATICS

PAPER 032 – GENERAL PROFICIENCY

MARK SCHEME

SPECIMEN PAPER 2015

MATHEMATICS

PAPER 032 – GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

QUESTION: 1

	PROFILES K	PROFILES C	PROFILES R	Total
(a) (i) $x = (12.3 - 3.4)\text{m} = 8.9\text{ m}$		1		
(ii) RS = $(8.9 + 2.0)\text{m} = 10.9\text{ m}$			1	
	-	**1**	**1**	**2**
(b) Area of **A**: $12.3\text{ m} \times 6.8\text{ m} = 83.64\text{ m}^2$	1	1		
Area of **B**: $10.9\text{ m} \times 3.1\text{ m} = 33.79\text{ m}^2$				
TOTAL area = 117.43 m^2	1		1	
Correct method for finding area: C1 Either Area of A or Area of B correct: K1 Adding to find the total area: R1 Correct total: K1				
	2	**1**	**1**	**4**
(c) Area of board 0.3 m^2 (seen or implied)		1		
Number of boards = $\frac{83.64}{0.3}$ (Division:C1)	1	1		
= 278.8 (Correct answer K1)				
Number of boards needed is 279			1	
	1	**2**	**1**	**4**
TOTAL	**3**	**4**	**3**	**10**

MATHEMATICS

PAPER 032 – GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME

QUESTION: 2

	PROFILES			Total
	K	C	R	
(a) (i) [2] $y \geq 15$	1			
[3] $x + y \leq 60$		1		
(ii) The number of gold stars must be LESS than TWICE the number of silver stars. - Less than (C1); Twice the number of silver(R1)		1	1	
	1	**2**	**1**	**4**
(b) **See graph on next page**				
Line $x = 20$ **OR** line $y = 15$	1			
Line $x + y = 60$	1			
Correct region seen or implied		1		
	2	**1**	**-**	**3**
(c) (i) Plotting any two points correctly		1		
(ii) Packets A and C satisfy the conditions but Packet B does not satisfy condition [4] - Response must be supported by points seen on the graph			1 1	
	-	**1**	**2**	**3**
TOTAL	**3**	**4**	**3**	**10**

MATHEMATICS

PAPER 032 – GENERAL PROFICIENCY

SPECIMEN

MARK SCHEME