CARIBBEAN EXAMINATIONS COUNCIL

Caribbean Secondary Education Certificate®

SYLLABUS

MATHEMATICS

CXC 05/G/SYLL 16

Effective for examinations from May–June 2027

CSEC®

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NOTE TO TEACHERS AND LEARNERS

This document CXC 05/G/SYLL 16 replaces the syllabus CXC 05/O/SYLL 08 issued in 2008.

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

First Published in 1977
Revised in 1981
Revised in 1985
Revised in 1992
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For access to short courses, training opportunities and teacher orientation webinars and workshops go to our Learning Institute at https://pli.cxc.org/

PLEASE NOTE

This icon is used throughout the syllabus to represent key features which teachers and learners may find useful.

Mathematics Syllabus

♦ RATIONALE

The Caribbean society is an integral part of an ever-changing world. The impact of globalisation 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 and career paths. 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 twenty-first century skills include critical and creative thinking, problem solving, logical reasoning, modelling ability, teamwork, 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, this modularised syllabus provides teachers with useful teaching, learning and assessment approaches and techniques to support all learners. The syllabus also suggests 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 of 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.*

♦ *SUGGESTED TIMETABLE ALLOCATION*

It is recommended that a minimum of five 40-minute periods per week (over a two-year period) or the equivalent should be allocated to the syllabus. Additionally, a minimum of 65 hours per module should be allocated

♦ ORGANISATION OF THE SYLLABUS

The syllabus is *organised into three modules, each containing a series of general objectives along with recommended teaching and learning activities. The modules progress seamlessly from concrete to abstract concepts with Module 1 being a crucial pre-requisite to Modules 2 and 3. Each module covers a distinct set* of topics *as outlined below with* each topic *clearly* defined by its specific objectives and content/*explanatory notes*. *Successful completion of a module is equivalent to one credit weighting.*

MODULE 1*: *FUNDAMENTALS OF SECONDARY LEVEL MATHEMATICS	***MODULE 2*: *INTERMEDIATE SECONDARY LEVEL MATHEMATICS***	***MODULE 3*: *HIGHER CONCEPTS IN SECONDARY LEVEL MATHEMATICS***
1. *Number Theory and Computation* 2. *Consumer Arithmetic* 3. *Sets* 4. *Measurement* 5. *Algebra 1* 6. *Introduction to Graphs*	1. *Statistics 1* 2. *Algebra 2* 3. *Relations, Functions and Graphs 1* 4. *Geometry and Trigonometry 1* 5. *Vectors and Matrices 1*	1. *Statistics 2* 2. *Relations, Functions and Graphs 2* 3. *Geometry and Trigonometry 2* 4. *Vectors and Matrices 2*

♦ APPROACHES TO TEACHING THE SYLLABUS

The specific objectives delineate the scope of the content and the activities that should be covered. It is recommended that the modules be taught in sequential order to provide opportunities for students to gain foundational knowledge before progressing to more complex content. While each module of the syllabus is distinct, efforts should be made to integrate concepts and apply skills in various contexts. Teachers are encouraged to employ a collaborative, and highly practical approach to facilitate students' learning and assessment.

The **CSEC®** Mathematics Syllabus is designed to be completed over a two-year period. It is expected that students would be able to master the specific objectives and related content after pursuing this course *of study. However, successful completion will also depend significantly on the acquisition of critical knowledge and skills gained* over five years of secondary schooling.

♦ QUALIFICATION OVERVIEW

Credentialing is defined as the issuing of formal certification for successful achievement of a defined set of outcomes targeting specific knowledge, skills, and competencies. It includes the granting of an award or digital unit of measurement for learning. ***CXC®*** *offers three categories of credentials across all levels of qualifications:*

1. *A micro-credential is awarded after successful completion of a module. The Caribbean Targeted Education Certificate®* ***(CTEC®)*** *is a stackable micro-credential that allows individuals to achieve an intermediate or macro qualification;*

2. *An intermediate credential is awarded after successful completion of a set of defined modules that together, make up a* ***CSEC®*** *subject; and,*

3. *A macro-credential is awarded after successful completion of a combination of intermediate (subjects) and micro-credentials (modules) that culminate in the award of credits for a certificate, diploma or associate degree.*

A total of three micro-credentials may be obtained from pursuing the discrete modules captured in ***CSEC®*** *Mathematics. Candidates who pursue the requirements of individual modules of the syllabus may qualify for micro-credentials while those who pursue all the modules in one sitting (the regular examination) may qualify for micro-credentials (if they earn Grades A-C) and the intermediate credential.* ***It is strongly recommended that candidates pursuing the modularised approach be required to get an acceptable grade in Module 1 as a pre-requisite to move on to Modules 2 and 3. Once an acceptable grade is obtained students have the option of sitting Module 2 then Module 3 or Modules 2 and 3 together****.*

Module	Duration	Credit Weighting
Module 1: Fundamentals of Secondary Level Mathematics	*65 hours*	*1*
Module 2: Intermediate Secondary Level Mathematics	*65 hours*	*1*
Module 3: Higher Concepts in Secondary Level Mathematics	*65 hours*	*1*

**The SBA is a requirement for the completion of the first micro-credential undertaken.*

♦ CERTIFICATION

The syllabus is offered for General Proficiency certification. A candidate's performance will be indicated on the certificate by an overall numerical grade on a six-point scale for the intermediate qualification as well as a letter grade for each Module.

♦ *SKILLS AND ABILITIES TO BE ASSESSED*

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

Conceptual* Knowledge *(CK)

The knowing of facts, procedures and concepts.

Candidates should be able to:

1. *accurately recall and retrieve rules, procedures, terminologies, definitions and facts;*

2. *understand systems of measurement in everyday use;*

3. *recognise the appropriate mathematical procedures for a routine situation; and,*

4. *measure, classify/order and compute in simple situations with and without a calculator.*

Algorithmic Knowledge (AK)

Applying mathematical knowledge, techniques and conceptual understanding to solve problems.

Candidates should be able to:

1. *represent, model and translate problems into a series of mathematical processes;*

2. *apply/implement an appropriate technique to obtain a solution to a problem; and,*

3. *solve routine mathematical problems.*

Reasoning (R)

Reason, interpret and communicate mathematically.

Candidates should be able to:

1. translate non-routine problems into mathematical symbols and then choose appropriate algorithms to solve the problems;

2. combine two or more algorithms to solve problems and/use an algorithm or part of an algorithm, in a reverse order, to solve a problem;

3. make deductions, generalisations, inferences and draw conclusions from mathematical information;

4. construct chains of reasoning to achieve a given result;

5. analyse, interpret and communicate information accurately;

6. assess the validity of an argument and critically evaluate a given way of presenting information; *and,*

7. synthesise/integrate information and create appropriate justifications of the results or statement.

Candidates' performance will be reported under *Conceptual Knowledge, Algorithmic Knowledge* and Reasoning.

♦ FORMAT OF THE EXAMINATIONS

The examination will consist of *three* papers: Paper 01, an objective type paper, Paper 02, structured type paper *and Paper 03, the SBA (031) or its alternative (032).* **CXC®** *will offer candidates the following three options for sitting the Paper 01 and Paper 02.*

Option A – Regular Sitting

For the regular sitting, candidates will be required to complete Paper 01, comprising of 60 multiple-choice questions from across all THREE modules with 20 questions on each module. Paper 02 consists of nine compulsory structured type questions, three from each module (the investigative question is included in Module 1).

Option B – Modular Sitting (One Module)

Candidates attempting one module will be required to complete a modular Paper 01 and a modular Paper 02. Papers 01 comprises of 20 multiple-choice questions from the selected module and Paper 02 comprises of three compulsory structured type questions from the selected module.

Option C – Modular Sitting (Two Modules)

Candidates attempting two modules will be required to complete a modular Paper 01 and a modular Paper 02. Papers 01 comprises of 40 multiple-choice questions from the selected module and Paper 02 comprises of six compulsory structured type questions, three from each of the modules selected.
All candidates will be required to attempt the SBA or its alternative (private candidates only) at the first sitting regardless of the approach chosen.

Paper	Topics		
Paper 01	***Module 1***	**No. of items**	
Regular	*Number Theory and Computation*	*4*	
(1 hour 30 minutes)	*Consumer Arithmetic*	*4*	
	Sets	*3*	
Modular	*Measurement*	*4*	
One Module	*Introduction to Graphs*	*2*	
(30 minutes)	Algebra 1	3	
			20
	Module 2		
Two Modules			
(1 hour)	Relations, Functions and Graphs 1	4	
	Geometry and Trigonometry 1	4	
	Statistics 1	4	
	Algebra 2	4	
	Vectors and Matrices 1	4	
			20
	Module 3		
	Relations, Functions and Graphs 2	6	
	Geometry and Trigonometry 2	6	
	Statistics 2	4	
	Vectors and Matrices 2	4	
			20
	Total		**60**
	Each item will be allocated one mark		
	The marks allocated to the topics in each module are as follows:		
Paper 02	***Module 1***	***No. of marks***	
Regular	*Consumer Arithmetic, Number Theory and Computation*	*9*	
(2 hours and 30 minutes)	*Graphs, Sets, Measurement and Algebra 1*	*12*	
	**Investigation*	*9*	
Modular			***30***
One Module	***Module 2***		
(50 minutes)			
Two Modules	*Algebra 2, and Relations, Functions and Graphs 1*	*12*	
(1 hour 40 minutes)	*Geometry and Trigonometry 1*	*9*	
	Statistics 1	*6*	
	Vectors and Matrices 1	*3*	
			30

Paper	Topics	
	Module 3	***No. of marks***
	Vectors and Matrices 2	*9*
	Relations, Functions and Graphs 2	*6*
	Geometry and Trigonometry 2	*9*
	Statistics 2	*6*
		30
	Total	***90***
	** The investigation question may be set on any combination of objectives in Module 1 of the syllabus.*	
	N.B. *Questions may be set from a combination of topics within a module to constitute the marks shown in the table above.*	

SCHOOL-BASED ASSESSMENT: Paper 031 and Paper 032

Paper 031 (30 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. Students are encouraged to work in groups of no more than six candidates.

See Guidelines for School-Based Assessment on pages 56-62.

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 THREE optional questions, one from each module. Candidates will be required to complete any one question. The topic(s) chosen for each question may be from a particular objective or combination of objectives within a module of the syllabus for Paper 032. Each question is worth 20 marks.

♦ ASSESSMENT GRID

The Assessment Grid shows the marks assigned to *Modules,* Papers and to the Skills and Abilities to be Assessed, and percentage contributions of each paper and *module* to the total scores. *Assessment Grid A shows the overall marks assigned when the regular sitting is chosen and Assessment Grid B shows the marks assigned to each module.*

Assessment Grid A – Overall Marks Assigned (Regular Sitting)

Papers	Module 1	Module 2	Module 3	Total Weighted marks	Total %
Paper 01	*30*	*30*	*30*	90	30
Paper 02	*50*	*50*	*50*	150	50
Paper 031 OR Paper 032	20	20	20	60	20
Total (Weighted)	***100***	***100***	**100**	**300**	**100**

Assessment Grid B – Marks Assigned for EACH Module

Papers	*Conceptual Knowledge (CK)*	*Algorithmic Knowledge (AK)*	*Reasoning (R)*	*Total Weighted marks*	*Total %*
Paper 01	*9 (6 raw)*	*12 (8 raw)*	*9 (6 raw)*	*30*	*30*
Paper 02	*15 (9 raw)*	*20 (12 raw)*	*15 (9 raw)*	*50*	*50*
Paper 031 OR Paper 032	*6 (9 raw)*	*8 (12 raw)*	*6 (9 raw)*	*20*	*20*
Total (Weighted)	***30***	***40***	***30***	***100***	***100***

♦ 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 THREE optional questions, one from each Module. Candidates will attempt ONE question. Each question will be 20 marks.

♦ REGULATIONS FOR RESIT CANDIDATES

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

Candidates may reuse any moderated SBA score within a four-year period. In order to assist candidates in making decisions about whether or not to reuse a moderated SBA score, the Council will continue to indicate on the preliminary results if a candidate's moderated SBA score is less than 50% in a particular subject.

Candidates reusing SBA scores should register as "Resit candidates" and must provide the previous candidate number when registering.

All resit candidates may register through schools, recognised educational institutions, or the Local Registrar's Office. A candidate who sat the regular examinations may opt to resist only the Module/s in which they were unsuccessful. That is, candidates may reuse their modular performance if they earned Grades A-C for any Module/s when they register to resist.

♦ *GUIDELINES FOR MODULAR CANDIDATES*

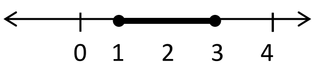
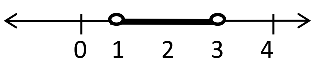
Candidates opting to sit the modular examinations must complete a Modular Paper 01, a Modular Paper 02 and EITHER Paper 031 OR Paper 032 (Private Candidates only) at their first sitting. Candidates who are using a modular approach must successfully complete all modules within a four-year period to be awarded the full ***CSEC®*** *award.*

Candidates using a modular approach may reuse their moderated SBA score or Paper 032 score from their first sitting within a four-year period when attempting the other modules. A candidate who was not registered as a private candidate at their first sitting but wishes to register as private after their first sitting may reuse their SBA score or register for the Paper 032. In order to assist candidates in making decisions about whether or not to reuse a moderated SBA score, the Council will continue to indicate on the preliminary results if a candidate's moderated SBA score is less than 50 per cent in the particular subject.

Modular candidates may enter through schools or recognised educational institutions, or as private candidates through the Local Registrar's Office.

♦ 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.

SYMBOL	MEANING
Sets	
U	universal set
$\cup$	*union of sets*
$\cap$	*intersection of sets*
$\in$	*element of*
$\{\ \}$ *or* ϕ	the null (empty) set
$\subset$	subset of
$A \subset B$	*A is a subset of B*
A'	complement of set A
$\{x: \ldots\}$	the set of all x such that . . .
Relations, Functions and Graphs	
$y \ \alpha \ x^n$	y varies *directly with* 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
$g^2(x)$	$g[g(x)]$
	$\{x : 1 \leq x \leq 3\}$
	$\{x : 1 < x < 3\}$

Number Theory

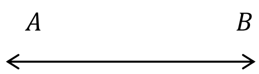
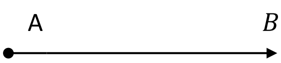
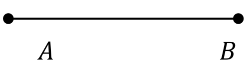
$\mathbb{W}$	the set of whole numbers
$\mathbb{N}$	the set of natural (counting) numbers
$\mathbb{Z}$	the set of integers, where $\begin{cases} \mathbb{Z}^+ \text{ are positive integers} \\ \mathbb{Z}^- \text{ are negative integers} \end{cases}$
$\mathbb{Q}$	the set of rational numbers
$\mathbb{R}$	the 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_q	rotation through q
T	translation
G	glide reflection
E	enlargement
MR_q	rotation through q followed by reflection
∡, ∠, ∧	angle
	line AB
	ray AB
	line segment AB

Vectors and Matrices

$\underline{a}$ or **a**	vector **a**
$\overrightarrow{AB}$	vector A to B
$\lvert\overrightarrow{AB}\rvert$	magnitude of vector $\overrightarrow{AB}$
$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ or $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$	*the matrix A*
$\lvert A\rvert$ or $\det(A)$	*the determinant of a matrix A*
Adj(A)	*the adjoint of a matrix A.*
A^{-1}	inverse of *a* 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*

Other Symbols

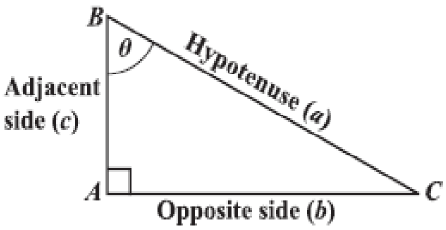
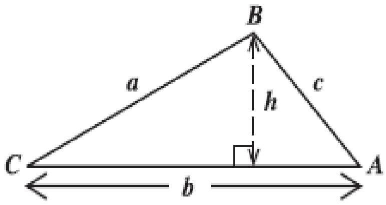
=	is equal to
≥	is greater than or equal to
≤	is less than or equal to
≅	is approximately equal to
⟹	implies
$A \Rightarrow B$	if A, then B or, A implies B
$A \Leftrightarrow B$	$\left.\begin{matrix} If\ A\ then\ B \\ and \\ If\ B\ then\ A \end{matrix}\right\}$ or A is equivalent to B

♦ FORMULAE AND TABLES PROVIDED IN THE EXAMINATION

LIST OF FORMULAE

Volume of a prism $V = Ah$	A – area of a cross-section h – the perpendicular length
Volume of a cylinder $V = \pi r^2 h$	r – radius of the base h – the perpendicular height
Volume of a right circular cone/right pyramid $V = \frac{1}{3} Ah$	A – area of the base h – the perpendicular height
Curved surface area of a cone $CSA = \pi rl$	r – radius of the base l – the slant height of the cone
Surface area of a sphere $SA = 4\pi r^2$	r – radius of the sphere
Volume of a sphere $V = \frac{4}{3} \pi r^3$	r – radius of the sphere
Circumference of a circle $C = 2\pi r$ $C = \pi d$	r – radius of the circle d – diameter of the circle
Arc length $S = \frac{\theta}{360} \times 2\pi r$	θ – the angle subtended by the arc, measured in degrees
Area of a circle $A = \pi r^2$	r – radius of the circle
Area of a sector $A = \frac{\theta}{360} \times \pi r^2$	θ – the angle of the sector, measured in degrees
Area of a trapezium $A = \frac{1}{2}(a + b)\,h$	a and b – the lengths of the parallel sides h – the perpendicular distance between the parallel sides
Simple interest $SI = \frac{P \times R \times T}{100}$	P – principal (initial amount) R – annual rate of interest T – time (in years)
Compound interest $A = P\left(1 + \frac{r}{100}\right)^n$	A – total amount after n years P – principal (initial amount) r – annual rate of interest n – number of years money is invested.
Depreciation $A = P\left(1 - \frac{r}{100}\right)^n$	A – value of item after depreciation P – initial value of the item r – annual rate of depreciation n – number of years

LIST OF FORMULAE (continued)

Roots of quadratic equations If $ax^2 + bx + c = 0$, $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	a – the coefficient of x^2 b – the coefficient of x c – the constant term
Trigonometric ratios $\sin\theta = \dfrac{b}{a}$ $\cos\theta = \dfrac{c}{a}$ $\tan\theta = \dfrac{b}{c}$	 a – length of the hypotenuse b – length of the opposite side c – length of the adjacent side
Pythagoras' theorem $a^2 = b^2 + c^2$	
Area of a triangle Area of $\Delta = \dfrac{1}{2}bh$	 b – length of the base of the Δ h – the perpendicular height of the Δ
Area of a $\Delta\, ABC = \dfrac{1}{2}ab\sin C$	a and b – the lengths of the adjacent sides of the Δ C – the included angle
Area of a $\Delta\, ABC =$ $\sqrt{s(s-a)(s-b)(s-c)}$	$s = \dfrac{a+b+c}{2}$ – the semi-perimeter of the Δ a, b and c – the sides of the Δ
Sine rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$	a, b and c – the sides of the Δ A, B and C – the angles opposite the corresponding sides of the Δ
Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$	a, b and c – the sides of the Δ A – the angle opposite Side a
Union of sets $n(A \cup B) =$ $n(A) + n(B) - n(A \cap B)$	A and B – two finite intersecting sets

♦ 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**.

♦ MODULE 1: *FUNDAMENTALS OF SECONDARY LEVEL MATHEMATICS*

Skills and Abilities: Conceptual Knowledge, Algorithmic Knowledge and Reasoning
Duration: Minimum of 65 hours
Credit Weighting: 1

GENERAL OBJECTIVES

On completion of this Module, students should:

Number Theory and Computation

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;
9. develop the ability to use patterns, trends and investigative skills;

Consumer Arithmetic

10. develop the ability to perform the calculations required in normal business transactions, and in computing their own budgets;
11. appreciate the need for both accuracy and speed in calculations;
12. appreciate the advantages and disadvantages of different ways of investing money;
13. appreciate that business arithmetic is indispensable in everyday life;
14. demonstrate the ability to use concepts in consumer arithmetic to describe, model and solve real-world problems;

Sets

15. demonstrate the ability to communicate using set language and concepts;
16. demonstrate the ability to reason logically;
17. appreciate the importance and utility of sets in analysing and solving real-world problems;

Measurement

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

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

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

Algebra 1

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

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

23. *demonstrate the ability to reason* with abstract entities*;*

Introduction to Graphs

24. *understand the usefulness of the Cartesian Plane; and,*

25. *appreciate the usefulness of linear graphs to solve real-world problems.*

SPECIFIC OBJECTIVES	CONTENT/*EXPLANATORY NOTES*
1. *NUMBER THEORY AND COMPUTATION*	
Students should be able to:	
1.1 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* $\mathbb{Q} = \left\{\frac{p}{q} : p \text{ and } q \text{ are integers}, q \neq o\right\}$*;* *irrational numbers (numbers that cannot be expressed as terminating or recurring decimals, for example, numbers such as p 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,*

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
NUMBER THEORY AND COMPUTATION (cont'd)	
Students should be able to:	
	sequences of numbers that have a recognisable pattern; factors and multiples; square numbers; even numbers; odd numbers; prime numbers; composite numbers.
1.2 compute *powers of real numbers of the form* x^a, where $a \in \mathbb{Q}$ *;*	*Including squares, square roots, cubes, cube roots.*
1.3 *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.
1.4 convert among fractions, percents and decimals;	Conversion of fractions to decimals and *percentages*, conversion of decimal to fractions and percent*ages*, conversion of percent*ages* to decimals and fractions.
1.5 list the set of factors and multiples of a given integer;	*Positive and negative factors of integers.*
1.6 compute the H.C.F. or L.C.M. of two or more positive integers;	*Highest common fcators and lowest common multiples.*
1.7 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.*
1.8 convert from one set of units to another;	Conversion using conversion scales, converting within the metric scales, 12-hour and 24-hour clock.
1.9 express a value to a given number of:	1, 2 or 3 significant figures.
(a) significant figures; and,	0, 1, 2 or 3 decimal places.
(b) decimal places.	
1.10 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.

SPECIFIC OBJECTIVES	CONTENT/*EXPLANATORY NOTES*
NUMBER THEORY AND COMPUTATION (cont'd)	
Students should be able to:	
1.11 calculate any fraction or percentage of a given quantity;	Fractions and percentages of a whole. The whole given a fraction or percentage.
1.12 write any rational number in *scientific notation;*	Scientific notation. *For example,* (a) $759000=7.59\times10^5$ (b) $0.00759 = 7.59 \times 10^{-3}$
1.13 express one quantity as a fraction or percentage of another;	Comparing two quantities using fractions and percentages.
1.14 compare quantities;	Ratio, proportion *and rates*.
1.15 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* $1.1, \sqrt{2}, 1.45, \pi, \frac{7}{2}$.
1.16 compute terms of a sequence given a rule;	
1.17 derive an appropriate rule given the terms of a sequence;	
1.18 divide a quantity in a given ratio; *and,*	Ratio, proportion of no more than three parts.
1.19 solve problems involving concepts in number theory and computation.	*Including ratio, rates and proportion.*

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
2. *CONSUMER ARITHMETIC*	
Students should be able to:	
2.1 calculate: (a) discount; (b) sales tax; (c) profit; *and,* (d) loss.	
2.2 calculate: (a) percentage profit; *and,* (b) percentage loss.	
2.3 express a profit, loss, discount, markup and purchase tax, as a percentage of some value;	
2.4 solve problems involving marked price, selling price, cost price, profit, loss or discount;	
2.5 solve problems involving payments by instalments as in the case of hire purchase and mortgages;	
2.6 solve problems involving simple interest;	Principal, time, rate, amount.
2.7 solve problems involving compound interest;	*Formulae may be used in computing compound interest. The use of calculators is encouraged.*
2.8 solve problems involving appreciation and depreciation;	
2.9 solve problems involving measures and money; *and,*	Currency conversion.

SPECIFIC OBJECTIVES	**CONTENT/ *EXPLANATORY NOTES***
CONSUMER ARITHMETIC (cont'd)	
Students should be able to:	
2.10 solve problems involving: (a) rates and taxes; (b) utilities; (c) invoices and shopping bills; (d) salaries and wages; *and,* (e) insurance and investments.	
3. ***SETS***	
3.1 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.
3.2 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: $A = \{1,2,3\}$
3.3 list subsets of a given set;	*Identifying the subsets as well as determining the* number of subsets of a set with n elements.
3.4 determine elements in intersections, unions and complements of sets;	Intersection and union of not more than three sets. Apply the result $n(A \cup B) = n(A) + n(B) - n(A \cap B)$.
3.5 describe relationships among sets using set notation and symbols;	Universal, complement, subsets, equal and equivalent sets, intersection, disjoint sets and union of sets.

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
SETS (cont'd)	
Students should be able to:	
3.6 draw Venn diagrams to represent relationships among sets;	Not more than 4 sets including the universal set.
3.7 *use Venn diagrams to represent the relationships among sets;* and,	
3.8 solve problems in Number Theory, Algebra and Geometry using concepts in set theory.	
4. *MEASUREMENT*	
4.1 convert units of length**,** mass, area, volume, capacity;	*Refer to Module 1, SO 1.8.*
4.2 use the appropriate SI unit of measure for area, volume, capacity, mass, temperature and time (24-hour clock) and other derived quantities;	*Refer to Module 1, SO 1.8.*
4.3 *determine* the perimeter of a *plane shape*;	*Estimating and measuring the perimeter of compound and irregular shapes.* *Calculating the perimeter of polygons and circles.*
4.4 calculate the length of an arc of a circle;	*Perimeter of sector of a circle.*
4.5 estimate the area of plane *shapes*;	*Finding the area of plane shapes without using formulae.*
4.6 calculate the area of polygons and circles;	
4.7 calculate the area of a sector of a circle;	
4.8 calculate the surface area of solids;	Prism including cubes and cylinders; right pyramids including cones; spheres. Surface area of sphere, $A = 4\pi r^2$

SPECIFIC OBJECTIVES		CONTENT/*EXPLANATORY NOTES*
MEASUREMENTS (cont'd)		
Students should be able to:		
4.9	calculate the volume of solids;	Prism including cube and cuboid, cylinder, right pyramid, cone and sphere. Volume of sphere, $V = \frac{4}{3}\pi r^3$
4.10	solve the problems involving the relations among time, distance and speed;	*Average speed.*
4.11	estimate the margin of error for a given measurement;	Sources of error. Maximum and minimum measurements.
4.12	use scales and scale drawings to determine distances and areas; and,	*(Link to Geography, associate with map drawing and map reading).*
4.13	solve problems involving measurement.	*Perimeter, area and volume of compound shapes and solids.*
5.	***ALGEBRA 1***	
5.1	use symbols to represent numbers, operations, variables and relations;	Symbolic representation.
5.2	*translate between algebraic symbols and worded expressions;*	
5.3	*evaluate* arithmetic operations involving directed numbers;	
5.4	*simplify algebraic expressions using* the four basic operations;	
5.5	evaluate *expressions involving* binary operations (other than the four basic operations);	*Commutative, associative and distributive properties.*
5.6	substitute numbers for *variables* in algebraic expressions;	

SPECIFIC OBJECTIVES		CONTENT/*EXPLANATORY NOTES*
ALGEBRA 1 (cont'd)		
Students should be able to:		
5.7	apply the distributive law to factorise or expand algebraic expressions;	*For example,* $x(a+b) = ax+bx$ $(a+b)(x+y) = ax+bx+ay+by.$
5.8	simplify algebraic fractions;	*The four basic operations on algebraic fractions.*
5.9	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) $x^{-m} = \frac{1}{x^m}$
5.10	solve linear equations in one unknown;	
5.11	Solve a simple linear inequality in one unknown;	*Represent solutions using set builder notation.*
5.12	change the subject of formulae;	*Equations of the type to include:* $y = mx + c$ $C = 2\pi r$ $P = \frac{c}{2x}$
5.13	factorise *simple* algebraic expressions;	*Expressions of the type to include:* $ax + bx$ $ax^2 + b$

SPECIFIC OBJECTIVES	CONTENT/ *EXPLANATORY NOTES*
ALGEBRA 1 (cont'd)	
Students should be able to:	
5.14 solve worded problems; *and,*	Linear equations *and* Linear inequalities.
5.15 prove two algebraic expressions to be identical.	*Equations versus identities.*
6. *INTRODUCTION TO GRAPHS*	
6.1 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). *For example,* $y = 0\ (x - axis);\ x = 0\ (y - axis)$
6.2 determine the intercepts of the graph of linear functions; *and,*	x-intercepts and y-intercepts, graphically and algebraically.
6.3 *solve problems involving graphs of linear functions.*	

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.

Number Theory and Computation

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 *of* 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.*

Consumer Arithmetic

6. *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;*

(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.*

7. *Solve problems using the straight line and reducing balance method.*

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

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

10. *Examine and verifying premiums and interest using amortization tables.*

Sets

11. *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.*

12. *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.*

13. *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).*

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

Measurement

15. *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.*

16. *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.*

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

18. *Utilise teacher-made resources to complete activities. For example, grid for finding area of irregular shapes, rubric for peer-to-peer assessment.*

Algebra 1

19. *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.*

20. *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.*

21. *Introduce students to the use of symbolic representation in everyday life and in algebra. For example,* $y = 2x$*, safety symbols, road signs and other familiar informational and warning signs.*

22. *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.*

23. *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.*

24. *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; and,*

(e) *Rearranging an equation/formula.*

25. *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.*

Introduction to Graphs

26. *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.*

27. *Explore the use of graphs in other disciplines, for example: Music, Science, Art, Geography, Architecture, Health and Family and Business Studies.*

♦ MODULE 2: *INTERMEDIATE SECONDARY LEVEL MATHEMATICS*

Skills and Abilities: Conceptual Knowledge, Algorithmic Knowledge and Reasoning
Duration: Minimum Of 65 Hours
Credit Weighting: 1

GENERAL OBJECTIVES

On completion of this Module, students should*:*

Statistics 1

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;

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

Algebra 2

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

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

7. *demonstrate the ability to reason* with abstract entities*;*

Relations, Functions and Graphs 1

8. appreciate the importance of relations in Mathematics;

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

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

Geometry and Trigonometry 1

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

12. understand the properties and relationship among geometrical objects;

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

14. appreciate the power of trigonometrical methods in solving authentic problems*;*

Vectors and Matrices 1

15. demonstrate the ability to use vector *and matrix* notations and concepts to model and solve real-world problems; *and,*

16. *understand* that vectors *and matrices* do not satisfy the same rules of operation as the real number system.

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
1. *STATISTICS 1*	
Students should be able to:	
1.1 *differentiate between sample and population attributes;*	*Sample statistics and population parameters.*
1.2 construct a frequency table for a given set of data;	*Discrete variables.* *Ungrouped data*.
1.3 construct statistical diagrams;	Pie charts *and* bar charts.
1.4 determine measures of central tendency for raw ungrouped data;	*Ungrouped data*: mean, median and mode.
1.5 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.*
1.6 determine the measures of dispersion (spread) for raw, ungrouped data;	Range, interquartile range and semi-interquartile range;
1.7 analyse statistical diagrams;	*Finding the mean, mode, median,* range, quartiles, *interquartile range, semi-interquartile range; trends and patterns.*
1.8 use standard deviation to compare sets of ungrouped data;	*No calculation of the standard deviation will be required.*
1.9 determine the proportion or percentage of the sample above or below a given value from raw ungrouped data or frequency table;	
1.10 identify the sample space for simple experiment; and,	*Including the use of coins, dice and playing cards. Simple probabilities.*
1.11 make inference(s) from statistics.	Raw data, tables, diagrams, summary statistics.

SPECIFIC OBJECTIVES	CONTENT/*EXPLANATORY NOTES*
2. *ALGEBRA 2*	
Students should be able to:	
2.1 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 $a \neq 0$
2.2 change the subject of formulae;	*Equations of the type to include:* $V = \frac{4}{3}\pi r^3$ $T = 2\pi\sqrt{\frac{l}{g}}$ $M = \sqrt{P + 2M}$
2.3 solve simultaneous linear equations, in two unknowns, algebraically;	
2.4 rewrite *a quadratic expression in the form* $a(x+h)^2 + k$;	*Completing the square of a quadratic expression.*
2.5 solve *quadratic equations algebraically;*	*Formula and by methods of factorisation and completing the square.*
2.6 solve worded problems;	Two simultaneous linear equations, quadratic equations. *Applications to other subjects for example demand and supply functions of business studies.*
2.7 solve a pair of equations in two variables when one equation is quadratic or non-linear and the other linear;	

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
ALGEBRA 2 (cont'd)	
Students should be able to:	
2.8 represent direct and *inverse* variation symbolically; and,	y varies directly as x: $y \propto x, y = kx$ y varies inversely as x: $y \propto \frac{1}{x}, y = \frac{k}{x}$
2.9 solve *problems* involving direct variation and inverse *variation.*	
3. ***RELATIONS, FUNCTIONS AND GRAPHS 1***	
3.1 explain basic concepts associated with relations;	Concept of a relation, types of relations, examples and non-examples of relations, domain, range, image, co-domain.
3.2 represent a relation in various ways;	Set of ordered pairs, arrow diagrams, graphically, algebraically.
3.3 state the characteristics that define a function;	Concept of a function, examples and non-examples of functions.
3.4 use functional notation;	For example, $f :$ x à x^2; or $f(x) = x^2$ as well as $y = f(x)$ for given domains. *The inverse function* $f^{-1}(x)$. *Composite functions* $fg = f[g(x)]$.
3.5 distinguish between a relation and a function;	Ordered pairs, arrow diagram, graphically (vertical line test).
3.6 determine the gradient of a straight line;	Definition of gradient/*slope*.
3.7 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; and, one point on the line or its gradient, and its relationship to another line.

SPECIFIC OBJECTIVES	**CONTENT/ *EXPLANATORY NOTES***
RELATIONS, FUNCTIONS AND GRAPHS 1 (cont'd)	
Students should be able to:	
3.8 solve problems involving the gradient of parallel and perpendicular lines;	
3.9 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.
3.10 *solve a pair of simultaneous linear equations in two unknowns graphically;*	*Intersection of graphs.*
3.11 derive the composition of functions;	Composit*ion* 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*.
3.12 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.
3.13 derive the inverse of a function;	$f^{-1}, (fg)^{-1}$
3.14 evaluate a function $f(x)$ at a given value of x;	$f(a), f^{-1}(a), fg(a)$, where $a \in \mathbb{R}$.
3.15 *draw the graph of a quadratic function;*	
3.16 *use the graph of a quadratic function to identify its features;*	(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;

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

RELATIONS, FUNCTIONS AND GRAPHS 1 (cont'd)

Students should be able to:

(d) the equation of the axis of symmetry; *and,*

(e) Roots of the equation.

3.17 *interpret the graph of a quadratic function;*

(a) Concepts *of gradient of a curve at a point, tangent, turning point.*

(b) *Roots of the function*.

(c) *Interpreting the graph to determine:*

(i) the interval of the domain for which the elements of the range may be greater than or less than a given *number*;

(ii) an estimate of the value of the gradient at a given point; and,

(iii) intercepts of the function.

3.18 determine the *equation of the* axis of symmetry and the maximum or minimum value of a quadratic function expressed in the form

$a(x+h)^2 + k$;

3.19 sketch the graph of a quadratic function expressed in the form

$y = a(x+h)^2 + k$

and determine the number of roots; *and,*

3.20 *solve problems involving graphs of linear and non-linear functions.*

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
4. GEOMETRY AND TRIGONOMETRY 1	
Students should be able to:	
4.1 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.
4.2 draw angles and line segments accurately using appropriate instruments;	
4.3 measure angles and line segments accurately using appropriate instruments;	
4.4 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.*
4.5 identify the type(s) of symmetry possessed by a given plane figure;	Line(s) of symmetry, rotational symmetry, order of rotational symmetry.
4.6 solve geometric problems using properties of: (a) lines, angles, and polygons; (b) congruent triangles; (c) similar figures; (d) faces, edges and vertices of solids; and, (e) classes of solids.	*Determining and justifying the measure of angles:* *adjacent angles, angles at a point, supplementary angles, complementary angles, vertically opposite angles.* *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.*

SPECIFIC OBJECTIVES		**CONTENT/*EXPLANATORY NOTES***
GEOMETRY AND TRIGONOMETRY 1 (cont'd)		
Students should be able to:		
		Cases of congruency.
		Properties of similar triangles.
		Prisms, pyramids, cylinders, cones, sphere.
4.7	use Pythagoras' theorem to solve problems;	
4.8	define the trigonometric ratios of acute angles in a right triangle;	Sine, Cosine, Tangent.
4.9	relate objects in the physical world to geometric objects; *and,*	Angle of elevation, angle of depression, bearing.
4.10	*apply the trigonometric ratios to solve problems.*	*Spatial* geometry and scale drawing, angles of elevation and depression.
5.	***VECTORS AND MATRICES 1***	
5.1	*explain* concepts associated with vectors;	Concept of a vector, magnitude, *unit vector*, direction, scalar.
		Scalar multiples: parallel vectors, equal vectors, inverse vectors.
5.2	*simplify expressions involving vectors*;	*Vector algebra: addition, subtraction, scalar multiplication.*
		Vector geometry: triangle law, parallelogram law.
5.3	*explain basic concepts associated with matrices;*	Concept of a matrix, row, column, square, identity rectangular, order.
5.4	*solve problems involving matrix operations*;	*Addition and subtraction of matrices.*
		Scalar multiplication.
		Multiplication of conformable matrices.
		Equality, non-commutativity of matrix multiplication.
5.5	*use* matrices to solve simple problems in *Arithmetic and Algebra.*	*Data matrices, equality*.

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.

Statistics 1

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 population 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.

Algebra 2

5. *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.*

6. *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.*

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.*

Relations, Functions and Graphs 1

8. *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.*

9. *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.*

10. *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.*

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

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

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

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

Geometry and Trigonometry 1

15. *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.*

16. *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.*

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

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

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

20. *Construction of shapes for artwork such as collages.*

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

Vectors and Matrices 1

22. *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.*

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

(a) *Science and Nature: representing data sets as matrices; the effects of a river current as a vector quantity;*

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

(c) *Architecture: representing items in the classroom such as a tile on the floor using vector and/or matrix notations.*

24. *Tabulate data into matrix form.*

25. *Use vectors and/or matrices to give clues in finding hidden treasures.*

♦ MODULE 3: *HIGHER CONCEPTS IN SECONDARY LEVEL MATHEMATICS*

Skills and Abilities: Conceptual Knowledge, Algorithmic Knowledge and Reasoning
Duration: Minimum of 65 hours
Credit Weighting: 1

GENERAL OBJECTIVES

On completion of this Module, students should:

Statistics 2

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;

Relations, Functions and Graphs 2

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

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

Geometry and Trigonometry 2

6. understand the properties and relationship among geometrical objects;

7. understand the properties of transformations;

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

9. appreciate the power of trigonometrical methods in solving authentic problems*;*

Vectors and Matrices 2

10. demonstrate the ability to use *vector and matrix* notations and concepts to model and solve real-world problems;

11. develop awareness that *vectors and* matrices do not satisfy the same rules of operation as the real number system; *and,*

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

SPECIFIC OBJECTIVES		**CONTENT/*EXPLANATORY NOTES***
1.	***STATISTICS 2***	
Students should be able to:		
1.1	construct a frequency table for a given set of data;	*Discrete and continuous variables. Grouped data*.
1.2	determine class features for a given set of data;	Class interval, class boundaries, class limits, class midpoint, class width.
1.3	construct statistical diagrams;	Line graphs, histograms with bars of equal width and frequency polygons.
1.4	determine measures of central tendency for raw grouped data;	*Grouped data: modal class, median class and the estimate of the mean.*
1.5	determine the measures of dispersion (spread) for grouped data;	Estimating range, interquartile range and semi-interquartile range.
1.6	use standard deviation to compare sets of data;	*No calculation of the standard deviation will be required.*
1.7	draw cumulative frequency curve (Ogive);	Appropriate scales for axes. Class boundaries as domain.
1.8	analyse statistical diagrams;	*Finding the mean, mode, median,* range, quartiles, *interquartile range, semi-interquartile range; trends and patterns.*
1.9	determine the proportion or percentage of the sample above or below a given value from raw grouped data, frequency table or cumulative frequency curve;	
1.10	determine experimental and theoretical probabilities of simple events; and,	*The use of contingency tables. Addition for exclusive events; multiplication for independent events.*
1.11	make inference(s) from statistics.	Raw data, tables, diagrams, summary statistics.

SPECIFIC OBJECTIVES	CONTENT/*EXPLANATORY NOTES*
2. *RELATIONS, FUNCTIONS AND GRAPHS 2*	
Students should be able to:	
2.1 draw a graph to represent a linear inequality in two variables;	
2.2 represent the solution of linear inequalities in one variable;	Using: (a) Number line; and, (b) Graphs.
2.3 use linear programming techniques to graphically solve problems involving two variables;	
2.4 draw graphs of non-linear functions;	$y = ax^n$ where $n = -1, -2$ and $+3$ *and* a *is a constant*. Distance-time and speed-time.
2.5 interpret graphs of functions; and,	Including distance-time graphs and speed-time graphs.
2.6 solve problems involving graphs of linear and non-linear functions.	*Including a combination of linear and non-linear functions.*
3. *GEOMETRY AND TRIGONOMETRY 2*	
3.1 *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.*

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
GEOMETRY AND TRIGONOMETRY 2 (cont'd)	
Students should be able to:	
	The opposite angles of a cyclic quadrilateral are supplementary. *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.*
3.2 represent translations in a plane using vectors;	Column matrix notation $\begin{pmatrix} x \\ y \end{pmatrix}$.
3.3 determine and represent the location of: (a) the image of an object under a transformation; and, (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.
3.4 state the relationship between an object and its image in the plane under geometric transformations;	*Orientation*, similarity, congruency.
3.5 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 $0 < \lvert k \rvert < 1$.

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
GEOMETRY AND TRIGONOMETRY 2 (cont'd)	
Students should be able to:	
3.6 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.*
3.7 *use* the sine and cosine rules *to solve* problems involving triangles;	
3.8 calculate the area of a triangle given two sides and the angle they form;	Use of formulae. Including given two sides and included angle.
3.9 calculate the area of a segment of a circle; and,	
3.10 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.
4. *VECTORS AND MATRICES 2*	
4.1 *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.
4.2 *determine the magnitude of a vector;*	*Including unit vectors.*

SPECIFIC OBJECTIVES	**CONTENT/*EXPLANATORY NOTES***
VECTORS AND MATRICES 2 (cont'd)	
Students should be able to:	
4.3 *determine the direction of a vector;*	
4.4 *use vectors to solve problems in geometry;*	*Points in a straight line, Parallel lines; displacement, velocity, weight.*
4.5 *evaluate* the determinant of a '2 x 2' matrix;	
4.6 *define the multiplicative inverse of a non-singular square matrix;*	*Identity for the square matrices.*
4.7 obtain the inverse of a non-singular '2 x 2' matrix;	Determinant and adjoint of a matrix.
4.8 *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.*
4.9 *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.*

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.

Statistics 2

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 population 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. 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.

Relations, Functions and Graphs 2

4. *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.*

5. *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.*

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

Geometry and Trigonometry 2

7. *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.*

8. *Explore the link between geometry and trigonometry and other disciplines, for example: Music, Science, Geography, Art, Architecture, Health and Family Life.*

Vectors and Matrices 2

9. *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.*

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

    (a) *Science and Nature: representing data sets as matrices; the effects of a river current as a vector quantity;*

    (b) *Art and Geography: representing a city plan as a matrix; viewing the seating arrangement in a classroom as a matrix; and,*

    (c) *Sports: use matrices to represent a scorecard and to conduct matrix multiplication in order to give an outcome.*

11. *Tabulate data into matrix form.*

12. *Use vectors and/or matrices to give clues in finding hidden treasures.*

13. *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 length of the report should be maximum 1000 words, not including appropriate quotations, sources, charts, graphs, tables, pictures, references and appendices. Students are encouraged to work in groups of no more than six.

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.

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

Role of the Teacher

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. Only the final score is to be indicated on the record sheets which are submitted to **CXC®** electronically via the SBA data capture module on the Online Registration System (ORS) on the Council's website.*

Assignment

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

Why a project?

The study of mathematics is essential to everyday life. It pervades almost every aspect of our daily activities: planning a picnic, baking a cake, comparing performances in a 100 metre race, shopping for groceries, all require applying mathematical concepts and principles to investigate, describe, explain or predict some real-world phenomena.

However, to those engaged in learning mathematics in secondary schools, the links between mathematics and the real world are often not recognized or at least not identified and practised. The purpose of a project is to encourage students to apply mathematical concepts, skills and procedures to investigate, describe and explain real world phenomena, to practise problem-solving, and to evaluate results. And these experiences are to be realized by encouraging all students to:

1. *Define problems in personal ways, especially by how the problems were motivated;*

2. *Discuss the problems with (a) their teachers, (b) their classmates and (c) their parents and knowledgeable adults;*

3. *Develop ways of solving the problems of interest and of curiosity;*

4. *Record their problems and the ways they would attempt to find solutions using:*

words	*charts*	*models*
symbols	*tables*	*algorithms*
diagrams	*figures*	

5. *Develop positive attitudes towards the methods of mathematics, use of mathematics and the enjoyment associated with knowing mathematics and solving mathematical problems; and,*

6. *Extend mathematical processes and products to exploring and understanding other subjects on the school curriculum.*

Sample Areas of Research May Include:

Hire Purchase or Cash?

1. *An explanation of the advantages and disadvantages of hire purchase, using data collected from at least two stores.*

Sports Utility Vehicles versus Cars

2. *Comparative analyses of the costs of different types of vehicles, considering fuel economy, maintenance and features.*

What features should be included in your project?

1. *Explaining the mathematical ideas contained in your project.*

2. *Carrying our practical tasks, using one or more of the following:*

   (a) *Ruler, compasses, protractor.*

   (b) *Drawing, constructing, measuring.*

   (c) *Counting, looking for patterns, weighing.*

   (d) *Calculators, computers, other technological devices.*

3. *Performing calculations*

   (a) *Mentally.*

   (b) *With paper and pencil.*

   (c) *Using calculators.*

4. *Responding orally to mathematics questions asked by the teacher, peers or other interested persons.*

5. *Identifying sections of project which:*

   (a) *are to be done inside normal class time and scheduled by teacher; and,*

   (b) *may be done outside normal class time at student's convenience.*

Guidelines for students (and their teachers)

Main Activities for the Project:

1. *Stating the task(s) you wish to undertake – its nature, scope and focus.*

2. *Planning:*
   (a) *What you will do.*

   (b) *How you will do it.*

   (c) *Materials you will need.*

   (d) *Procedures you will use.*

3. *Carrying out the plan, procedures or activities.*

4. *Recording what you did, how you did it, and why you did what you did, using words (including mathematical words and phrases); diagrams, tables, figures or charts.*

5. *Conclusion:*

   (a) *Your findings.*

   (b) *Comments on your findings.*

   (c) *How to improve your findings.*

   (d) *Making your findings more useful.*

Seven strategies that students use when they are searching for solutions to problems in mathematics.

1. *Using simple numbers:*

   - *Replace the original numbers with very simple numbers and try to find a solution. After the solution has been found, try the solution with the original numbers.*

2. *Sketch a simple diagram:*

   - *Attempt to understand the problem using your insight from geometry and the physical arrangements of the spaces around you.*

3. *Make a table of the results:*

   - *Try to discover any pattern within the table. You may reduce the size of the table, rotate the table and view its content from a second perspective.*

4. *Guess and check.*

5. *Look for patterns:*

   - *Try to create patterns by combining numbers in novel ways.*

6. *Use algebraic symbols to express ideas.*

7. *Make full use of calculators:*

   (a) *Explore number ideas, number patterns and number sense.*

   (b) *Highlight estimation skills associated with arithmetic operations (such as ×, ÷, √,).*

   (c) *Check calculations associated with a wide range of applications (from real life).*

   (d) *Focus on the processes associated with problem-solving.*

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. *Conclusion*

The project will be marked out of a total of 30 marks, and the marks will be allocated to each task and profile as outlined below. Marks for the project will be allocated across Modules in the ratio 1:1:1. The marks earned by a student are assigned to each Module. For example, if a student earns 25 out of 30 for his School-Based Assessment, 25 marks will be assigned to Module 1, 25 marks to Module 2 and 25 marks to Module 3. The total score will be 25+25+25= 75 out of 90.

Project Descriptors	Mark Awarded			
	CK	**AK**	**R**	**Total**
Project Title				
Title is clear and concise and relates to a real-world problem ○ *Title may be in the form of a statement or a question.*	2			
	2	**0**	**0**	**2**
Introduction				
Objective(s) is/are clearly stated and relate(s) to the title	2			
Description of the project ○ Background describes the context of the problem. ○ The purpose of the project is relevant to the background. ○ Method of analysis is stated and is relevant to the purpose of the project.	1	1 2		
	3	**3**	**0**	**6**

Project Descriptors	Mark Awarded			
	CK	**AK**	**R**	**Total**
Method of Data Collection				
- *Data collection method is stated.* - *Data collection method is appropriate, and the process clearly described.*		1 2		
	0	**3**	**0**	**3**
Presentation of Data				
Data is genuinely obtained, accurate and well organised	2			
Tables - *At least one table used which is clearly presented (unambiguous and systematic).* - *Appropriate title and headers (columns and/or rows) are given.* *Graphs/charts/diagrams* - *At least one graph/chart/diagram used with appropriate title given.* - *Correct labels (axes/sectors); scales/keys given (where appropriate).* ***N.B. If Raw data is NOT presented, award at most 2 marks.***		1 2 1 2		
	2	**6**	**0**	**8**
Analysis of Data				
Accurate use of mathematical concepts o *Data analysis attempted.* o *Accurate formulas/equations used.* o *Accurate utilization of the data presented (analysis relates to the objectives/purpose of the project).* o *ALL steps of the analysis are shown and are accurate.* ***Candidates who do not show working will NOT be awarded full marks for this section.***			1 1 2 2	
	0	**0**	**6**	**6**
Conclusion				
Conclusion is based on analysis of data. *Conclusion is related to the objectives/ purpose of project.*			1 2	
	0	**0**	**3**	**3**
Overall Presentation				
Information is communicated logically using correct grammar most of the time ***N.B.*** *If the information is poorly organised or difficult to understand at times. –* ***Award 1 mark***	2			**2**
Total Marks	**9**	**12**	**9**	**30**
Maximum for each profile (Total weighted to)	**6**	**8**	**6**	**20**

Procedures for Reporting and Submitting the School-Based Assessment

*School-Based Assessment Record Sheets are available on the **CXC®** website (www.cxc.org).*

*All School-Based Assessment Record of marks must be submitted online using the SBA data capture modules of the Online Registration System (ORS) by stipulated deadlines. ALL SBAs must be electronically submitted to **CXC®** for moderation purposes. Each candidate's assignment should be a single word processing document (preferably PDF) with all supporting images embedded.*

*These assignments will be reassessed by **CXC®** Examiners who moderate the School-Based Assessment. Teachers' marks may be adjusted as a result of moderation. The Examiners' comments will be sent to schools.*

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

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 remarked by **CXC®**.*

PAPER 032

(a) *This paper consists of THREE optional questions, one from each module of the syllabus. The duration of the paper is **1 hour**.*

(b) *The questions chosen will require an extended response.*

(c) *The topic(s) chosen for each question may be from a particular module or combination of objectives within that module.*

(d) *The paper carries a maximum of **20** marks, which will then be weighted to **60** marks. Marks will be awarded for Conceptual Knowledge, Algorithmic knowledge and Reasoning as follows:*

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

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

  (iii) *Reasoning: translation of non-routine problems into mathematical symbols; making inferences and generalisations from given data; analysing 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 Thrones Limited, 2001.
Layne, Ali, Bostock, Chandler, Shepherd and Ali.	*STP Caribbean Mathematics for CXC Book 4*. United Kingdom: Nelson Thrones 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.

Websites

http://mathworld.wolfram.com/

http://plus.maths.org/

http://mathforum.org/

♦ 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.
Relate	show connections between; explain how one set of facts or data depend on others or are determined by them	

WORD	DEFINITION	NOTES
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 $\|x\|$, is defined by $\|x\| = x$ if $x > 0$ and $\|x\| = -x$ if $x < 0$. For example, $\|-4\| = 4$.
Acceleration	The rate of change of velocity with respect to time.
Acute Angle	An angle whose measure is greater than 0 degrees *but* 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 type 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.

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 $4d+5t^2+3s$, 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 $f(g(x))$ 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 Ø.

WORD	MEANING
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 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.

WORD	MEANING
Frustum	The frustum is a portion of a cone or pyramid bounded by two faces parallel to the base.
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 is 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.

WORD	MEANING
Irrational Number	A number that cannot be represented as an exact ratio of two integers. For example, π or the square root of 2.
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 q^{th} 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 $\frac{1}{a}$ 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 = $7x10^3$ or 0.0000019 = $1.9x10^{-6}$).
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.

Western Zone Office
17 October 2025

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TEST CODE **01234010**

SPECIMEN 2025

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 01 – General Proficiency

1 hour 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This test consists of 60 items. You will have 1 hour and 30 minutes to answer them.

2. In addition to this test booklet, you should have an answer sheet.

3. **A list of formulae is provided on pages 2 and 3 of this booklet**.

4. 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.

5. On your answer sheet, find the number which corresponds to your item and shade the space having the same letter as the answer you have chosen. Look at the sample item below.

   Sample Item

   The expression $2p + 3(p - q)$ written in its simplest form is

   (A) $5p - q$
   (B) $5p - 3q$
   (C) $5p + 3q$
   (D) $5p(1 - q)$

   Sample Answer

   (A) ● (C) (D)

   The best answer to this item is "$5p - 3q$", so (B) has been shaded.

6. If you want to change your answer, erase it completely before you fill in your new choice.

7. When you are told to begin, turn the page and work as quickly and as carefully as you can. If you cannot answer an item, go on to the next one. You may return to that item later.

8. You may do any rough work in this booklet.

9. Calculators and mathematical tables are NOT allowed for this paper.

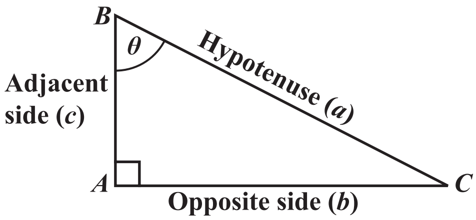
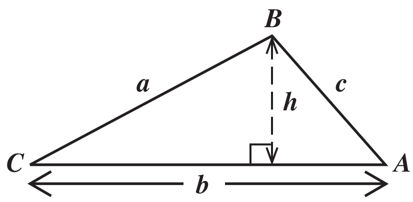
10. **Diagrams in this booklet are NOT drawn to scale, unless otherwise stated.**

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

LIST OF FORMULAE

Volume of a prism $V = Ah$	A – area of a cross-section h – the perpendicular length
Volume of a cylinder $V = \pi r^2 h$	r – radius of the base h – the perpendicular height
Volume of a right circular cone/right pyramid $V = \frac{1}{3} Ah$	A – area of the base h – the perpendicular height
Curved surface area of a cone $CSA = \pi rl$	r – radius of the base l – the slant height of the cone
Surface area of a sphere $SA = 4\pi r^2$	r – radius of the sphere.
Volume of a sphere $V = \frac{4}{3}\pi r^3$	r – radius of the sphere
Circumference of a circle $C = 2\pi r$ $C = \pi d$	r – radius of the circle d – diameter of the circle
Arc length $S = \frac{\theta}{360} \times 2\pi r$	θ – the angle subtended by the arc, measured in degrees
Area of a circle $A = \pi r^2$	r – radius of the circle
Area of a sector $A = \frac{\theta}{360} \times \pi r^2$	θ – the angle of the sector, measured in degrees
Area of a trapezium $A = \frac{1}{2}(a + b)\, h$	a and b – the lengths of the parallel sides h – the perpendicular distance between the parallel sides
Simple interest $SI = \frac{P \times R \times T}{100}$	P – principal (initial amount) R – annual rate of interest T – time (in years)
Compound interest $A = P\left(1 + \frac{r}{100}\right)^n$	A – total amount after n years P – principal (initial amount) r – annual rate of interest n – number of years money is invested
Depreciation $A = P\left(1 - \frac{r}{100}\right)^n$	A – value of item after depreciation P – initial value of the item r – annual rate of depreciation n – number of years item depreciates

LIST OF FORMULAE (continued)

Roots of quadratic equations If $ax^2 + bx + c = 0$, $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	a – the coefficient of x^2 b – the coefficient of x c – the constant term
Trigonometric ratios $\sin \theta = \dfrac{b}{a}$ $\cos \theta = \dfrac{c}{a}$ $\tan \theta = \dfrac{b}{c}$	 a – length of the hypotenuse b – length of the opposite side c – length of the adjacent side
Pythagoras' theorem $a^2 = b^2 + c^2$	
Area of a triangle Area of $\Delta = \dfrac{1}{2}\, bh$	 b – length of the base of the Δ h – the perpendicular height of the Δ
Area of $\Delta\, ABC = \dfrac{1}{2}\, ab \sin C$	a and b – the lengths of the adjacent sides of the Δ C – the included angle.
Area of $\Delta\, ABC =$ $\sqrt{s\,(s-a)\,(s-b)\,(s-c)}$	$s = \dfrac{a+b+c}{2}$ – the semi-perimeter of the Δ a, b and c – the sides of the Δ
Sine rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$	a, b and c – the sides of the Δ A, B and C – the angles opposite the corresponding sides of the Δ
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$	a, b and c – the sides of the Δ A – the angle opposite Side a
Counting formula: union of 2 sets $n\,(A \cup B) =$ $n\,(A) + n\,(B) - n\,(A \cap B)$	A and B – two finite intersecting sets

1. The number 3 857 written to 3 significant figures is

(A) 386
(B) 3 850
(C) 3 860
(D) 4 000

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. There are 50 children in a youth club. Girls make up 60% of the club. Of the boys in the club, 25% of them play chess. How many boys play chess?

(A) 5
(B) 10
(C) 15
(D) 24

5. Tom bought a pen for \$60. He sold it to gain 20% on the cost price. The profit he gained was

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

6. How much simple interest is due on a loan of \$1 200 for two years, if the annual rate of interest is 5%?

(A) \$120
(B) \$132
(C) \$264
(D) \$330

Item 7 refers to the following chart which shows rates on fixed deposits for 2023 and 2024.

Rates on Fixed Deposits	
2023	7.8%
2024	7.5%

7. How much MORE interest did a fixed deposit of \$10 000 earn in 2023 than in 2024?

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

8. The Water Authority charges \$10 per month for the rental of the meter, \$25 for the first 100 litres and \$1 for each additional 10 litres of water used.

Jonathan's bill for December was \$50. What is the LEAST amount of water he most likely used?

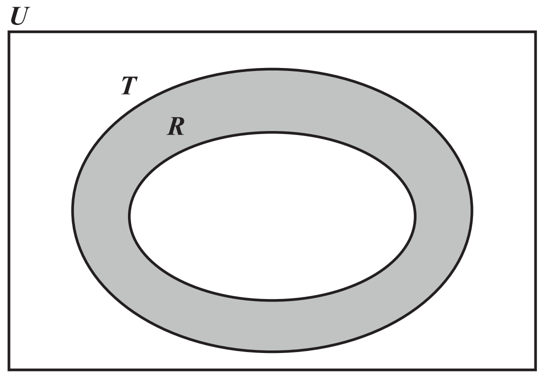
(A) 250 litres
(B) 260 litres
(C) 300 litres
(D) 350 litres

9. Which of the following sets has an infinite number of elements?

(A) {Factors of 20}
(B) {Multiples of 20}
(C) {Prime numbers less than 20}
(D) {Odd numbers between 10 and 20}

Items **10 and 11** refer to the following Venn diagram which represents the relationship between T and R for students in Form 5B, as defined below.

U = students in Form 5B
T = students who like thriller movies
R = students who like romance movies



10. The shaded area in the Venn diagram above represents students who like

(A) romance movies
(B) thriller but not romance movies
(C) romance but not thriller movies
(D) both romance and thriller movies

11. Of the 36 students in Form 5B, $n(T') = 7$. If the number of students in the shaded area in the Venn diagram is the same as $n(T')$, then the number of students in $T \cap R$ is

(A) 7
(B) 14
(C) 22
(D) 29

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

(A) $5\frac{1}{4}$ hours

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

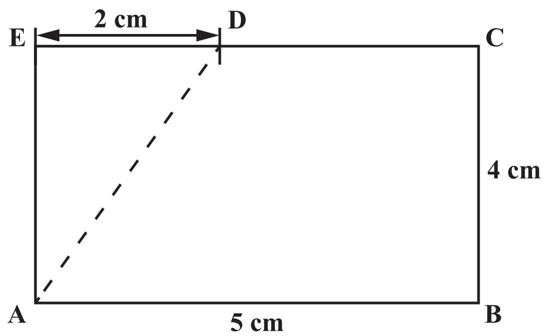
(C) 6 hours

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

13. How many litres of water would a container whose capacity is 36 cm^3 hold when filled?

(A) 0.036
(B) 0.36
(C) 36
(D) 3 600

Item **14** refers to the following diagram of a rectangle, *ABCE*, which consists of a trapezium, *ABCD,* and a triangle, *ADE.*

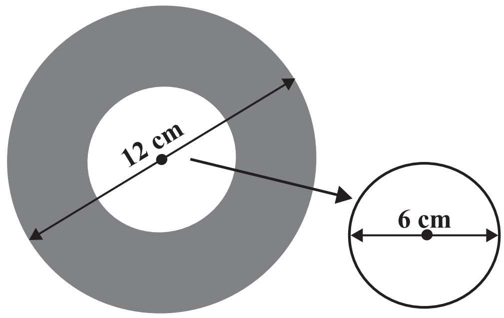


14. In the diagram above, the angles at *B, C* and *E* are right angles.

The area of the trapezium, *ABCD,* is

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

15. A circular hole with a diameter of 6 cm is cut from a circular piece of card that has a diameter of 12 cm, as shown in the diagram below.



The area of the remaining card, in cm^2, is

(A) 6π
(B) 27π
(C) 36π
(D) 108π

16. Seven times a number *p* plus the number *q* may be written as

(A) $7pq$
(B) $49\,pq$
(C) $7p + q$
(D) $7(p + q)$

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

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

18. The result of $\frac{3x + 1}{2} - \frac{x}{4}$ is

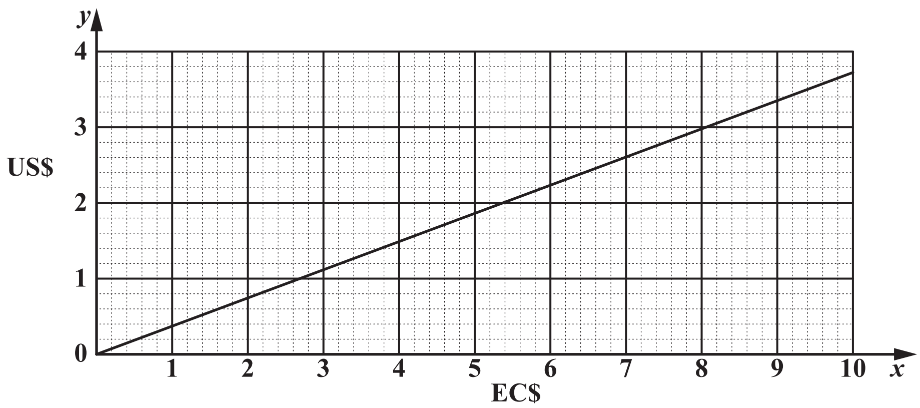
(A) $\frac{2x + 1}{4}$

(B) $\frac{2x + 2}{4}$

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

(D) $\frac{5x + 2}{4}$

<u>Items **19** and **20**</u> refer to the following graph which shows the conversion rate with respect to United States dollars (US$) and Eastern Caribbean dollars (EC$).



19. Based on the graph, the coordinates of the x-intercept are

(A) (0, 0)
(B) (0, 1)
(C) (1, 0)
(D) (1, 1)

20. Using the graph, EC$7 is equivalent to US$

(A) 2.00
(B) 2.60
(C) 3.00
(D) 4.00

Items **21–23** refer to the following table which shows the distribution of scores for 25 students who took a spelling test that was marked out of 10.

Score	4	5	6	8	9	10
Number of Students	5	3	5	3	4	5

21. The number of students who scored AT MOST 8 marks on the test is

(A) 3
(B) 9
(C) 12
(D) 16

22. The median score of the distribution of scores for the 25 students is

(A) 5
(B) 6
(C) 7
(D) 8

23. What is the probability that a student chosen at random scores AT LEAST 5 marks on the test?

(A) $\frac{1}{5}$

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

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

(D) $\frac{4}{5}$

24. The mean of 10 numbers is 58. If one of the numbers is 40, what is the mean of the other 9?

(A) 18
(B) 60
(C) 68
(D) 540

25. The factorisation of $x^2 + 6x + 9$ is

(A) $(x - 3)^2$
(B) $(x + 3)^2$
(C) $(x - 3)(x + 3)$
(D) $(2x + 3)(x + 3)$

26. If $xy = yz - x$, then $x =$

(A) $\frac{yz}{y + 1}$

(B) $\frac{yz}{y - 1}$

(C) $\frac{-yz}{y + 1}$

(D) $\frac{y}{z(y + 1)}$

Item **27** refers to the following information.

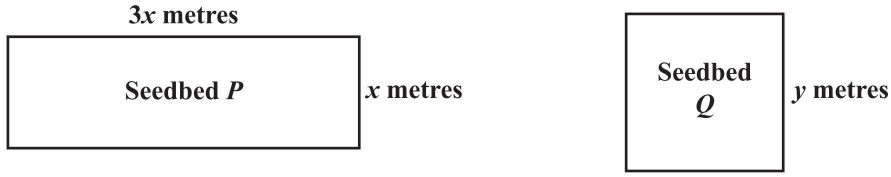
The force, F, applied to an object is directly proportional to the extension, e, produced by that object. The incomplete table below shows the corresponding values of F and e.

F	8	25	60
e	0.2	x	1.5

27. According to the table, the value of x is

(A) 0.375
(B) 0.625
(C) 1.225
(D) 1.875

Item **28** refers to the following diagram which shows 2 seedbeds, *P* and *Q*. Seedbed *P* is a rectangle and Seedbed *Q* is a square with dimensions as shown in the diagram.



28. If 60 m of mesh was used to enclose the 2 seedbeds, then a simplified expression for y in terms of x is

(A) $y = 15 - 2x$
(B) $y = 2x + 15$
(C) $y = 8x - 60$
(D) $y = 3x + 60$

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29. 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) $y = \frac{1}{3}x$

(C) $y = 3x + 2$

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

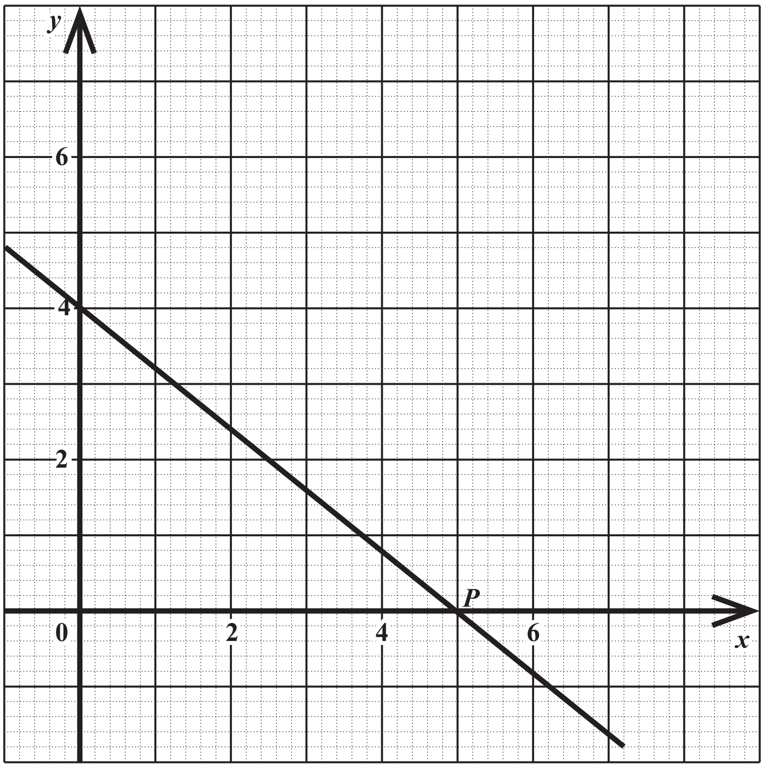
30. If g is a function such that $g(x) = 2x + 1$, which of the following coordinates satisfy this function?

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

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

(A) –13
(B) –7
(C) 5
(D) 20

Item **32** refers to the following diagram which shows a graph of a straight line intersecting the x and y axes.



32. The equation of the perpendicular line that passes through P is

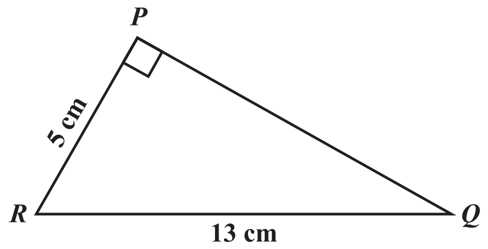
(A) $y = -\frac{4}{5}x + 4$

(B) $y = \frac{5}{4}x - \frac{25}{4}$

(C) $y = \frac{5}{4}x + \frac{25}{4}$

(D) $y = -\frac{4}{5}x - \frac{25}{4}$

<u>Items **33** and **34**</u> refer to the following diagram which shows Triangle PQR in which angle $RPQ = 90°$, $RP = 5$ cm and $RQ = 13$ cm.



33. The length of PQ, in cm, is

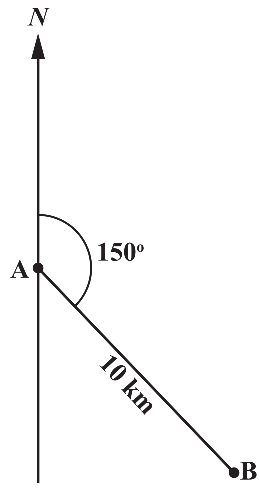
(A) 7
(B) 11
(C) 12
(D) 17

34. Which of the following trigonometric ratios is/are equivalent to $\frac{5}{13}$?

I. cos R
II. sin Q
III. tan R

(A) III only
(B) I and II only
(C) I and III only
(D) II and III only

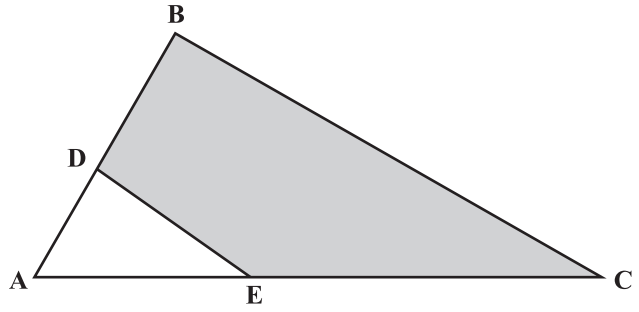
<u>Item **35**</u> refers to the following diagram which shows the path of a plane that travels from Point A on a bearing of 150° to Point B which is 10 km from A.



35. The distance of B due east of A is given by

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

Item **36** refers to the following diagram which shows that Triangle *ABC* is an enlargement of Triangle *ADE* such that $\frac{AD}{DB} = \frac{AE}{EC} = \frac{1}{2}$.



36. If the area of ABC = 36 cm^2, then the area of the shaded region, *DECB*, in cm^2, is

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

<u>Items **37** and **38**</u> refer to the following matrix labelled R.

$$R = \begin{pmatrix} 2 & 5 & 9 \\ 0 & 1 & -1 \\ 6 & 3 & -3 \\ -4 & 2 & 8 \end{pmatrix}$$

37. The order of Matrix R is

(A) 3 × 3
(B) 3 × 4
(C) 4 × 3
(D) 4 × 4

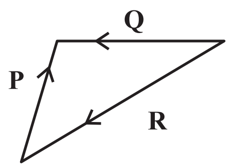
38. Matrix R is **pre-multiplied** by another matrix, B. If the order of the matrix product of the 2 matrices B and R is 3 × 3, then the order of Matrix B is

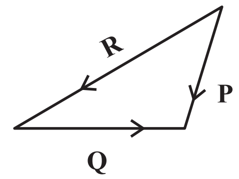
(A) 3 × 3
(B) 3 × 4
(C) 4 × 3
(D) 4 × 4

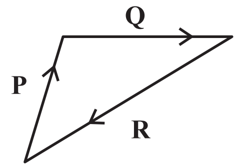
39. Which of the following groups of quantities represents a set of scalar quantities?

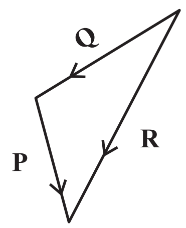
(A) Mass, time, volume
(B) Force, frequency, acceleration
(C) Displacement, speed, acceleration
(D) Displacement, force, temperature

40. Which of the following diagrams represents the vector sum **R** = **P** + **Q**?

(A)


(B)


(C)


(D)


Items **41 and 42** refer to the following frequency distribution which shows the marks received by a group of young adults on a driving test.

Marks	11–20	21–30	31–40	41–50	51–60
Frequency	9	7	4	3	7

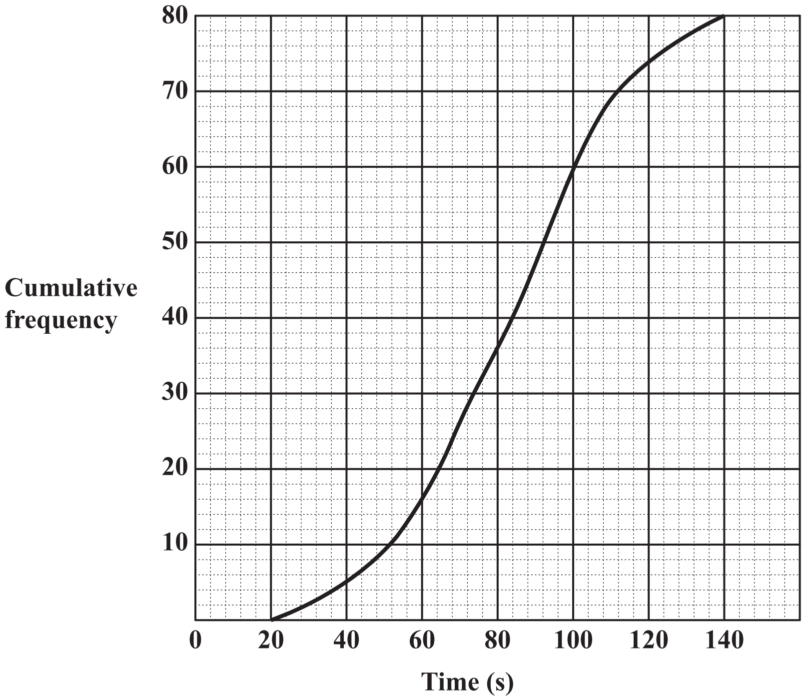
41. How many young adults scored GREATER THAN 40 marks on the test?

(A) 7
(B) 10
(C) 14
(D) 20

42. The lower limit of the median class is

(A) 11
(B) 21
(C) 31
(D) 41

Item **43** refers to the following cumulative frequency curve for the time *t*, in seconds, taken by 80 students to complete a mathematical task.



43. According to the graph, the semi-interquartile range is

(A) 18 s
(B) 36 s
(C) 50 s
(D) 64 s

<u>Item **44**</u> refers to the following contingency table which shows the results of a survey of 10 families who were asked whether they have a cat or a dog or neither.

	A Dog	**No Dog**	**Total**
A Cat	1	2	3
No Cat	3	4	7
Total	4	6	10

44. A family was chosen at random from the 10 families surveyed and was found to have a dog. What is the probability that this family also owns a cat?

(A) $\frac{1}{10}$

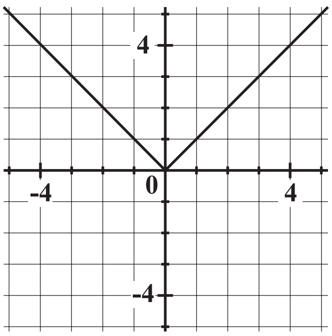
(B) $\frac{1}{4}$

(C) $\frac{3}{10}$

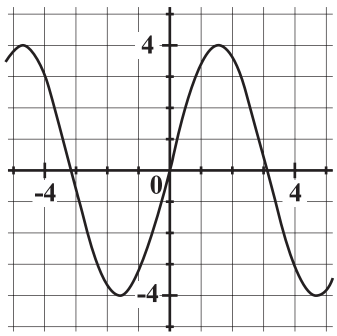
(D) $\frac{4}{10}$

45. In which of the following diagrams does the graph represent a linear function?

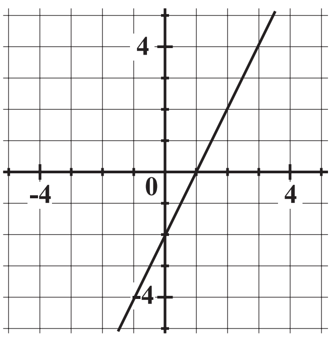
(A)



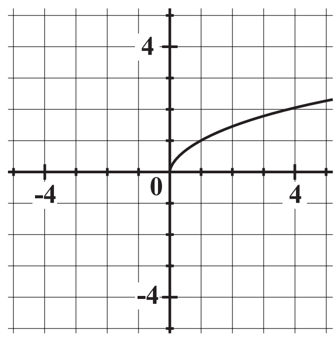
(B)



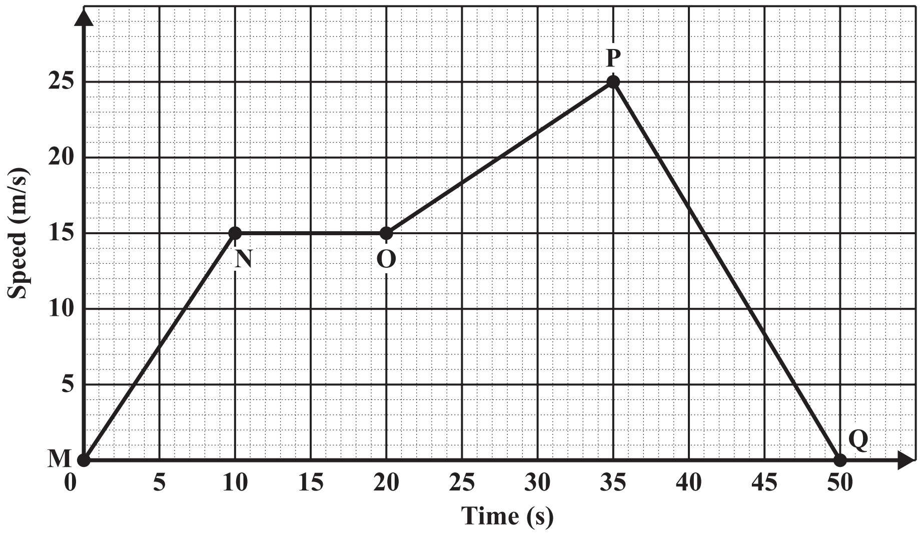
(C)



(D)



<u>Items **46 and 47**</u> refer to the following diagram which shows a speed–time graph for the motion of an object along a straight line.



46. During which phase of its journey is the object travelling at constant speed?

(A) *NO*
(B) *OP*
(C) *PQ*
(D) *MN*

47. According to the graph, the acceleration of the object in the first 10 seconds is

(A) $0.67\ \text{ms}^{-2}$
(B) $1.5\ \text{ms}^{-2}$
(C) $15.0\ \text{ms}^{-2}$
(D) $25.0\ \text{ms}^{-2}$

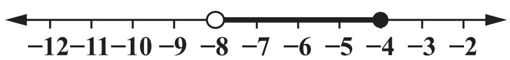
48. Which of the following line graphs represents the solution set for the inequality $x < 2x - 4 < 12$?

(A)

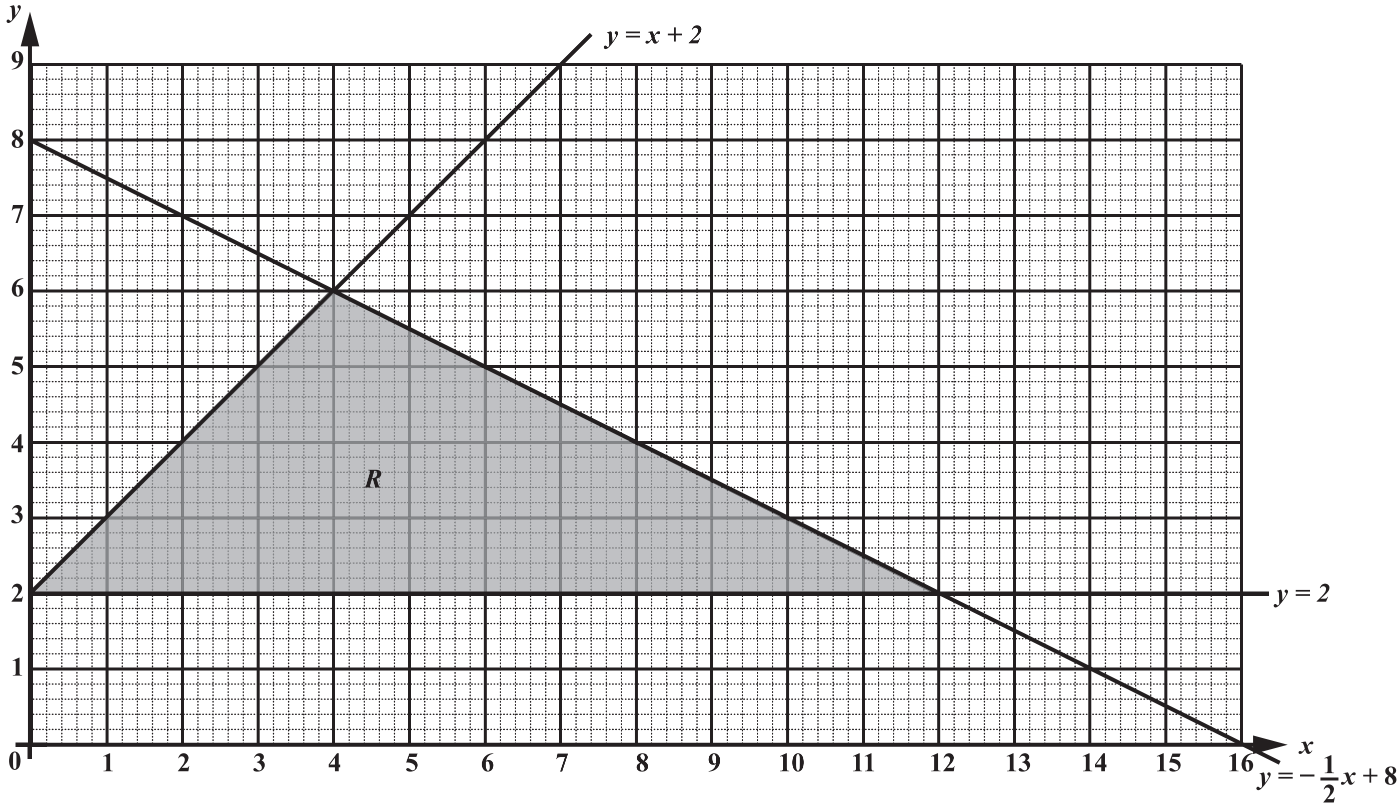
(B)

(C)

(D)



Items **49** and **50** refer to the following diagram which shows the graph of 3 lines and a shaded region, R, which represents the common region for 3 inequalities associated with the lines that define R.



49. The system of inequalities that satisfies the region R is

(A) $y \le x + 2$, $y \le -\frac{1}{2}x + 8$, $y \ge 2$

(B) $y \ge x + 2$, $y \ge -\frac{1}{2}x + 8$, $y \ge 2$

(C) $y \le x + 2$, $y \le -\frac{1}{2}x + 8$, $y \le 2$

(D) $y \ge x + 2$, $y \ge -\frac{1}{2}x + 8$, $y \le 2$

50. In the diagram, the shaded region, R, represents the only possible number of toy phones (x) and toy trucks (y) that a manufacturer can make.

According to the graph, the number of phones and the number of trucks which will give the MAXIMUM profit is MOST likely

	x	y
(A)	0	2
(B)	8	3
(C)	4	7
(D)	12	2

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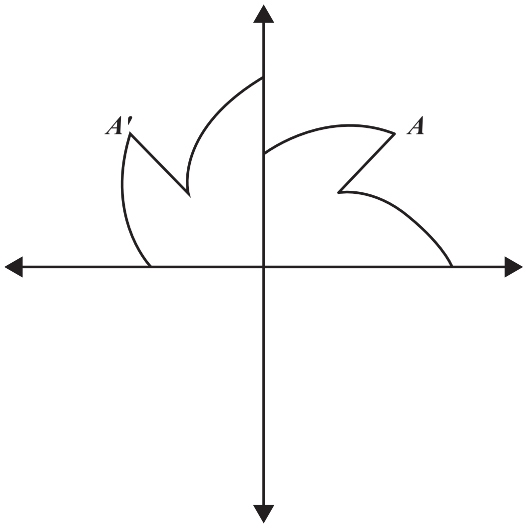
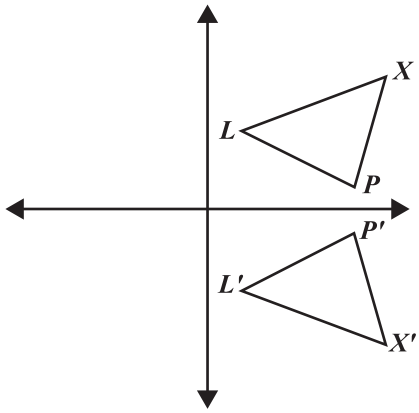
51. Which of the following diagrams represents a reflection in a line?

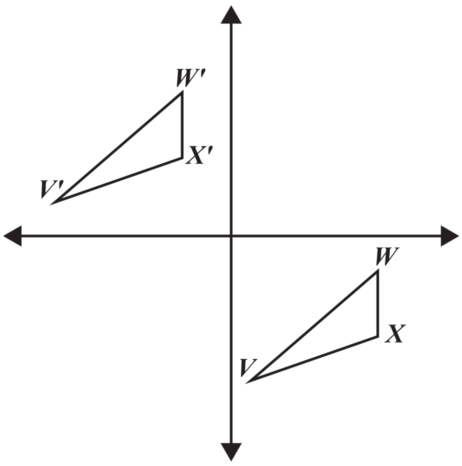
(A)



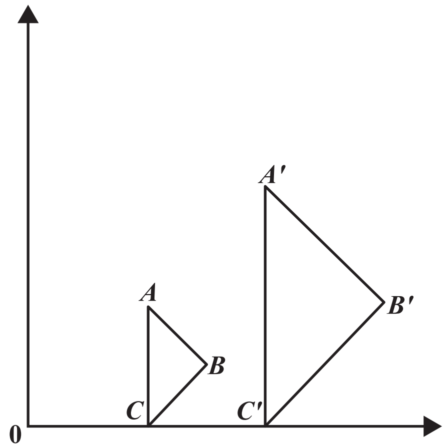
(B)



(C)



(D)

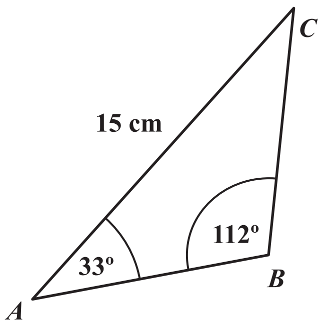


52. The point $P(2, -3)$ is rotated about the origin through an angle of 90° in an anti-clockwise direction.

What are the coordinates of the image of P?

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

<u>Item **53**</u> refers to the following diagram which shows Triangle ABC where the length of AC is 15 cm, Angle ABC = 112° and Angle BAC = 33°.



53. The length of BC is given by

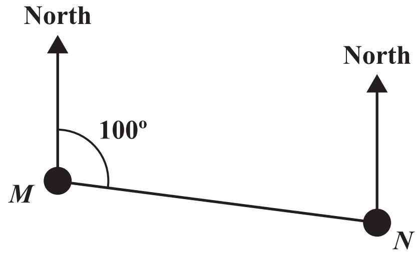
(A) $\dfrac{15 \sin 33°}{\sin 112°}$

(B) $\dfrac{15 \sin 112°}{\sin 33°}$

(C) $\sqrt{225 - 495 \cos 33°}$

(D) $\sqrt{495 - 225 \cos 112°}$

<u>Item **54**</u> refers to the following diagram which shows the location of 2 points, M and N, on level ground.

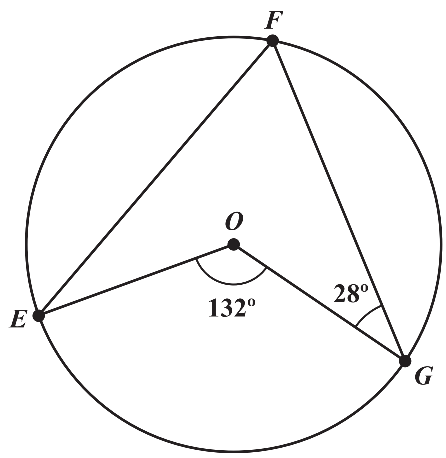


54. On the diagram, the bearing of N from M is 100°. What is the bearing of M from N?

(A) 80°
(B) 120°
(C) 260°
(D) 280°

<u>Item **55**</u> refers to the following diagram which shows a circle with centre O and the points E, F and G on its circumference.

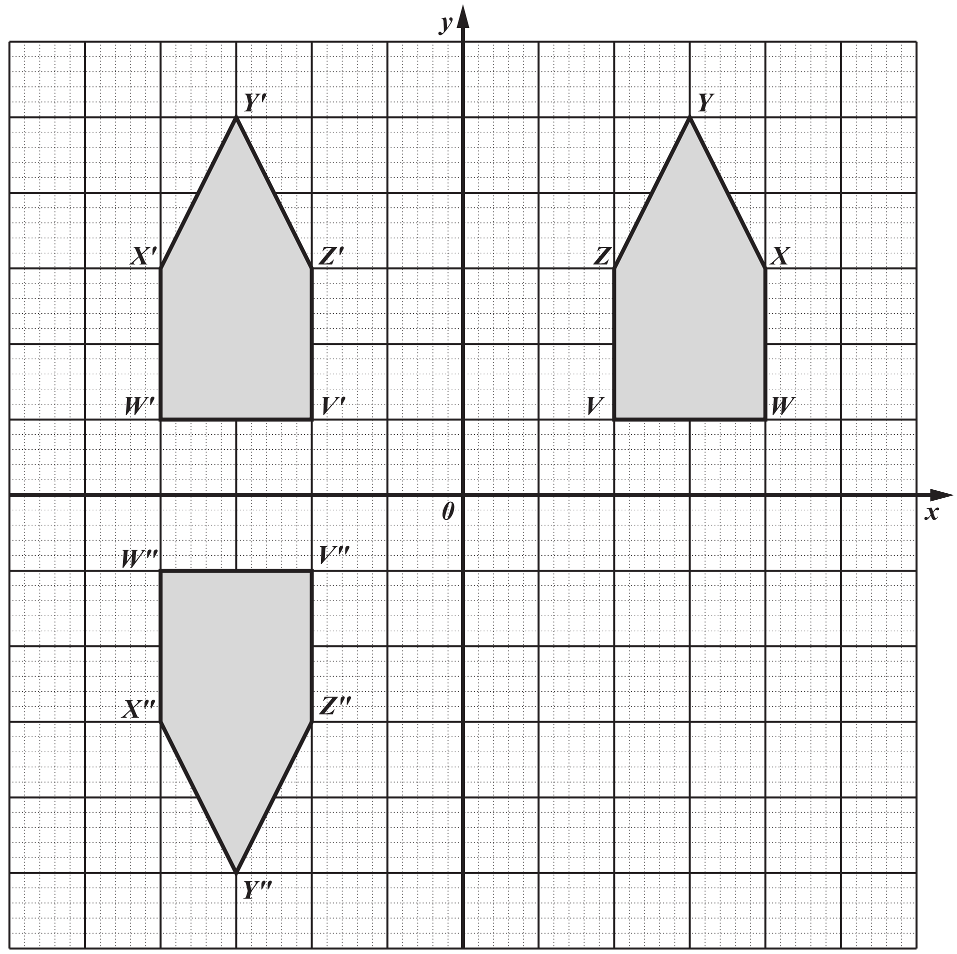
Angle EOG = 132°.
Angle FGO = 28°.



55. The value of Angle FEO is

(A) 20°
(B) 28°
(C) 38°
(D) 84°

<u>Item **56**</u> refers to the following diagram which shows a pentagon, *VWXYZ,* and its image *V'W'X'Y'Z'* and *V"W"X"Y"Z"*, after it undergoes a composite/double transformation.



56. The single transformation that maps Pentagon *VWXYZ* onto its image *V"W"X"Y"Z"* is a

(A) reflection in the line $y = -x$

(B) reflection in the y-axis

(C) translation with vector $\begin{pmatrix} -4 \\ -2 \end{pmatrix}$

(D) rotation of 180° about the origin

57. 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 with scale factor 2

58. If $|A| = 0$, then Matrix A is

(A) an inverse matrix
(B) a singular matrix
(C) an identity matrix
(D) a non-singular matrix

59. Given that P and Q are points with coordinates $P(1, 3)$ and $Q(-1, 4)$, then the position vector PQ is

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

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

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

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

60. The 2×2 matrix $L = \begin{pmatrix} 2 & a \\ b & -2 \end{pmatrix}$, where a and b are constants, maps the point $E(2, 5)$ onto the point $F(-1, 2)$.

The value of a and the value of b are

	a	***b***
(A)	–1	6
(B)	–1	–6
(C)	1	–6
(D)	1	6

END OF TEST

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

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CANDIDATE'S RECEIPT

INSTRUCTIONS TO CANDIDATE

1. Fill in all the information requested clearly in capital letters.

TEST CODE | 0 | 1 | 2 | 3 | 4 | 0 | 1 | 0 |

SUBJECT MATHEMATICS – Paper 01

PROFICIENCY GENERAL

REGISTRATION NUMBER | | | | | | | | | | |

FULL NAME ______________________________

(BLOCK LETTERS)

SIGNATURE ______________________________

DATE ______________________________

2. Ensure that this slip is detached by the Supervisor or Invigilator and given to you when you hand in this booklet.

3. Keep it in a safe place until you have received your results.

INSTRUCTION TO SUPERVISOR/INVIGILATOR

Sign the declaration below, detach this slip and hand it to the candidate as his/her receipt for this booklet collected by you.

I hereby acknowledge receipt of the candidate's booklet for the examination stated above.

Signature ______________________________

Supervisor/Invigilator

Date ______________________________

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CARIBBEAN SECONDARY EDUCATION CERTIFICATE
MATHEMATICS
SPECIMEN PAPER 01
KEYS

Item Number	Topic	Specific Objective	Cognitive Level	Key
1	Number Theory and Computation – Significant Figures	1.1.9	CK	C
2	Number Theory and Computation – Scientific notation	1.1.12	AK	C
3	Number Theory and Computation – Evaluating numerical expressions	1.1.3	AK	D
4	Number Theory and Computation – Problem Solving	1.1.11/19	R	A
5	Consumer Arithmetic – Profit & Loss	1.2.1	CK	A
6	Consumer Arithmetic – Simple Interest	1.2.6	AK	A
7	Consumer Arithmetic – Rates	1.2.10	AK	C
8	Consumer Arithmetic – Utilities	1.2.10	R	A
9	Sets – Types of Sets	1.3.1	CK	B
10	Sets – Venn Diagrams	1.3.7	AK	B
11	Sets – Number of Elements in Two Intersecting Sets	1.3.4	R	C
12	Measurement – Problem Solving Involving Time	1.4.10	CK	B
13	Measurement – Converting Units, Capacity	1.4.1	AK	A
14	Measurement – Area	1.4.13	AK	B
15	Measurement – Area of Circles	1.4.6	R	B
16	Algebra 1 – Translating Verbal Statements to Symbolic Expressions	1.5.2	CK	C
17	Algebra 1 – Linear Equations	1.5.10	AK	A
18	Algebra 1 – Simplifying Algebraic Fractions	1.5.8	R	D
19	Introduction to Graphs	1.6.2	CK	A
20	Introduction to Graphs	1.6.3	R	B
21	Statistics 1 – Problem Solving	2.1.9/11	CK	D
22	Statistics 1 – Measures of Central Tendency	2.1.4	AK	B
23	Statistics 1 – Simple Probability	2.1.10	AK	D
24	Statistics 1 – Problem Solving, Measures of Central Tendency	2.1.4	R	B
25	Algebra 2 – Factorization	2.2.1	CK	B
26	Algebra 2 – Changing the Subject of Formulas	2.2.2	AK	A
27	Algebra 2 – Direct Variation	2.2.9	R	B
28	Algebra 2 – Problem Solving	2.2.6	R	A
29	Relations, Functions & Graphs – Equation of a straight line	2.3.7	CK	D
30	Relations, Functions & Graphs – Representing Functions	2.3.2	AK	C
31	Relations, Functions & Graphs – Evaluating Composite Functions	2.3.14	AK	A
32	Relations, Functions & Graphs – Equation of Perpendicular Lines	2.3.7/8	R	B
33	Geometry & Trigonometry 1 – Pythagoras' Theorem	2.4.7	CK	C
34	Geometry & Trigonometry 1 – Trigonometric Ra-tios	2.4.8	AK	B

35	Geometry & Trigonometry 1 – Bearing, Problem Solving	2.4.9	AK	D
36	Geometry & Trigonometry 1 – Similar Triangles	2.4.6	R	C
37	Vectors & Matrices 1 – Order of a Matrix	2.5.3	CK	C
38	Vectors & Matrices 1 – Matrix Operation	2.5.4	CK	B
39	Vectors & Matrices 1 – Scalar Quantities	2.5.1	AK	A
40	Vectors & Matrices 1 – Vector Algebra, Triangle Law	2.5.2	R	D
41	Statistics 2 – Problem Solving	3.1.9	CK	B
42	Statistics 2 – Median/Other Features from Grouped Data	3.1.2/8	AK	B
43	Statistics 2 – Semi-Interquartile Range	3.1.8	AK	A
44	Statistics 2 – The Use of Contingency Tables	3.1.10	R	B
45	Relations, Functions & Graphs – Graphs of Linear & Non-Linear Functions	3.2.6	CK	C
46	Relations, Functions & Graphs 2 – Speed-time Graphs	3.2.5	CK	A
47	Relations, Functions & Graphs 2 – Speed-time Graphs	3.2.5	AK	B
48	Relations, Functions & Graphs 2 – Linear Inequalities	3.2.2	AK	B
49	Relations, Functions & Graphs 2 – Linear Programming	3.2.3	R	A
50	Relations, Functions & Graphs 2 – Linear Programming	3.2.3	R	D
51	Geometry & Trigonometry 2 – Reflection	3.3.3	CK	B
52	Geometry & Trigonometry 2 – Rotation	3.3.3	AK	A
53	Geometry & Trigonometry 2 – Sine & Cosine Rule	3.3.7	AK	A
54	Geometry & Trigonometry 2 – Bearings	3.3.10	AK	D
55	Geometry & Trigonometry 2 – Circle Theorems	3.3.1	R	C
56	Geometry & Trigonometry 2 – Combination of Transformations	3.3.6	R	D
57	Vectors & Matrices 1 – Transformation Matrices	3.4.8	CK	D
58	Vectors & Matrices 1 – Determinant of a 2×2 Matrix	3.4.5	CK	B
59	Vectors & Matrices 1 – Position Vectors	3.4.1	AK	D
60	Vectors & Matrices 1 – Problem Solving	3.4.9	R	A

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EXAMINATION

FILL IN ALL THE INFORMATION REQUESTED CLEARLY IN CAPITAL LETTERS.

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SUBJECT MATHEMATICS – Paper 02

PROFICIENCY GENERAL

REGISTRATION NUMBER

SCHOOL/CENTRE NUMBER					

NAME OF SCHOOL/CENTRE

CANDIDATE'S FULL NAME (FIRST, MIDDLE, LAST)

DATE OF BIRTH

D	D	M	M	Y	Y	Y	Y

SIGNATURE ____________________________________

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Current Bar Code

"*"Barcode Area"*"
Sequential Bar Code

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SPECIMEN 2025

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 02 – General Proficiency

2 hours 40 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE sections: I, II and III.
2. Section I has THREE questions; Section II has THREE questions and Section III has THREE questions.
3. Answer ALL questions, writing your answers in the spaces provided in this booklet.
4. Numerical answers that are non-exact should be given correct to 3 significant figures or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
5. Do NOT write in the margins.
6. All working MUST be clearly shown.
7. **A table of formulae is provided on pages 4 and 5 of this booklet.**
8. 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**.
9. **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.**
10. **Diagrams in this booklet are NOT drawn to scale, unless otherwise stated.**

Required Examination Materials

Electronic calculator
Geometry set

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

LIST OF FORMULAE

Volume of a prism $V = Ah$	A – area of a cross-section h – the perpendicular length
Volume of a cylinder $V = \pi r^2 h$	r – radius of the base h – the perpendicular height
Volume of a right circular cone/right pyramid $V = \frac{1}{3} Ah$	A – area of the base h – the perpendicular height
Curved surface area of a cone $CSA = \pi rl$	r – radius of the base l – the slant height of the cone
Surface area of a sphere $SA = 4\pi r^2$	r – radius of the sphere
Volume of a sphere $V = \frac{4}{3}\pi r^3$	r – radius of the sphere
Circumference of a circle $C = 2\pi r$ $C = \pi d$	r – radius of the circle d – diameter of the circle
Arc length $S = \frac{\theta}{360} \times 2\pi r$	θ – the angle subtended by the arc, measured in degrees
Area of a circle $A = \pi r^2$	r – radius of the circle
Area of a sector $A = \frac{\theta}{360} \times \pi r^2$	θ – the angle of the sector, measured in degrees
Area of a trapezium $A = \frac{1}{2}(a + b)h$	a and b – the lengths of the parallel sides h – the perpendicular distance between the parallel sides
Simple interest $SI = \frac{P \times R \times T}{100}$	P – principal (initial amount) R – annual rate of interest T – time (in years)
Compound interest $A = P\left(1 + \frac{r}{100}\right)^n$	A – total amount after n years P – principal (initial amount) r – annual rate of interest n – number of years money is invested
Depreciation $A = P\left(1 - \frac{r}{100}\right)^n$	A – value of item after depreciation P – initial value of the item r – annual rate of depreciation n – number of years item depreciates

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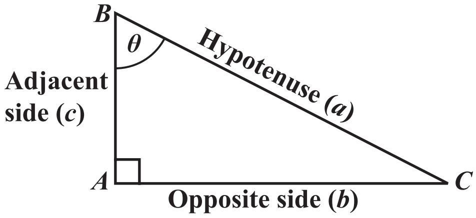
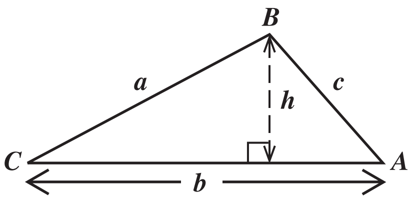
LIST OF FORMULAE (continued)

Roots of quadratic equations If $ax^2 + bx + c = 0$, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	a – the coefficient of x^2 b – the coefficient of x c – the constant term
Trigonometric ratios $\sin \theta = \frac{b}{a}$ $\cos \theta = \frac{c}{a}$ $\tan \theta = \frac{b}{c}$	 a – length of the hypotenuse b – length of the opposite side c – length of the adjacent side
Pythagoras' theorem $a^2 = b^2 + c^2$	
Area of a triangle Area of $\Delta = \frac{1}{2}\, bh$	 b – length of the base of the Δ h – the perpendicular height of the Δ
Area of $\Delta\, ABC = \frac{1}{2}\, ab \sin C$	a and b – the lengths of the adjacent sides of the Δ C – the included angle.
Area of $\Delta\, ABC =$ $\sqrt{s\,(s-a)\,(s-b)\,(s-c)}$	$s = \frac{a+b+c}{2}$ – the semi-perimeter of the Δ a, b and c – the sides of the Δ
Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$	a, b and c – the sides of the Δ A, B and C – the angles opposite the corresponding sides of the Δ
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$	a, b and c – the sides of the Δ A – the angle opposite Side a
Counting formula: union of 2 sets $n(A \cup B) =$ $n(A) + n(B) - n(A \cap B)$	A and B – two finite intersecting sets

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Module 1 – Fundamentals of Secondary-Level Mathematics

Answer ALL questions.

All working MUST be clearly shown.

1. (a) Determine the value of the following, giving your answer in standard form.

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

....

(2 marks)

(b) The diagram below shows rates of exchange at a cambio.

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

(i) Using the table, calculate the BBD equivalent of US$1.00.

....

(2 marks)

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(ii) Gail exchanged BBD$1 806.00 for US dollars. Calculate the amount she received in US dollars.

....

(1 mark)

(c) John's electricity bill is based on the number of kWh of electricity that he consumes for the month. He is charged $5.10 per kWh of electricity consumed. The two meter readings for the month of March 2016 are displayed in the diagram below.

01 March	**0 3 0 1 1**	**kWh**
31 March	**0 3 3 0 7**	**kWh**

(i) Calculate the TOTAL amount that John paid for his electricity consumption for the month of March 2016.

....

(2 marks)

(ii) For the next month, April 2016, John paid $2 351.10 for his electricity consumption. Determine his meter reading at the end of April 2016.

....

(2 marks)

Total 9 marks

GO ON TO THE NEXT PAGE

2. Desron forms a sequence using natural numbers, the cubes of these numbers and operations on these numbers and their cubes.

(a) Firstly, Desron cubed the natural numbers (1, 2, 3, 4, 5, ...) and calculated the sum of the cubes of the first 2, then the first 3, the first 4 and so on. He then put these sums **together** with the cube of the number 1 to form a sequence. The first 5 terms of the sequence are shown in the table below.

n	**Series**	**Sum**
1	1^3	$\left[\frac{1}{2}(1+1)\right]^2 = 1$
2	$1^3 + 2^3$	$\left[\frac{2}{2}(1+2)\right]^2 = 9$
3	$1^3 + 2^3 + 3^3$	$\left[\frac{3}{2}(1+3)\right]^2 = 36$
4	$1^3 + 2^3 + 3^3 + 4^3$	$\left[\frac{4}{2}(1+4)\right]^2 = 100$
5	$1^3 + 2^3 + 3^3 + 4^3 + 5^3$	$\left[\frac{5}{2}(1+5)\right]^2 = 225$
....	....	$\left[\frac{8}{2}(1+8)\right]^2 =$ ....
⋮	⋮	⋮
n		$\left[\frac{......}{2}(1+......)\right]^2 =$ ....

Study the pattern of numbers in each row of the table above. Each row relates to one of the terms (cubed numbers) in the sequence of numbers. Some rows have not been included in the table.

Complete the table by filling in the missing information.

(6 marks)

GO ON TO THE NEXT PAGE

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(b) Desron added the first 2 natural numbers, then the first 3, the first 4 and so on. He noted that

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

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

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

Using the information in the table **on page 8** and the pattern derived from the 3 statements, determine

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

....

(2 marks)

(ii) a formula in terms of $\boldsymbol{n}$ for the series $1 + 2 + 3 + 4 + ... + n$.

....

(1 mark)

Total 9 marks

3. (a) (i) Factorize completely

$$p^3q^2 + pq^5m.$$

....

(1 mark)

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

a) $3 * 4$

....

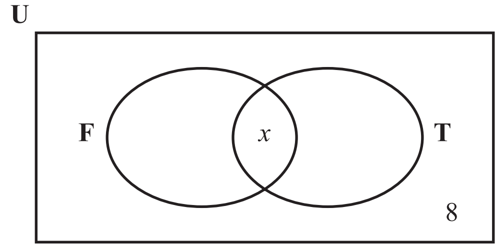
(1 mark)

b) $(3 * 4) *1$.

....

(1 mark)

(b) The incomplete Venn diagram below shows the number of students in a class of 28 who play football and tennis.



U = {all students in the class}
F = {students who play football}
T = {students who play tennis}

Additional information about the class is that

12 students play tennis
15 students play football
8 students play neither football nor tennis
x students play BOTH football and tennis.

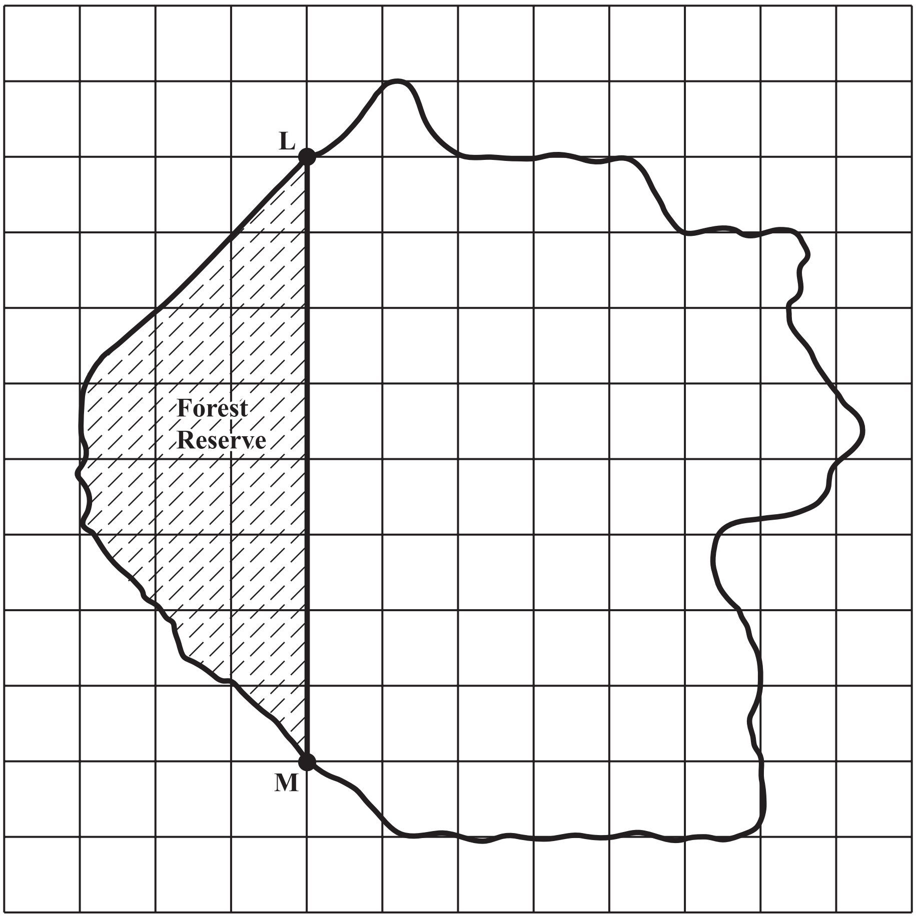
(i) Complete the Venn diagram above to represent the information, showing the number of students in EACH subset. **(2 marks)**

(ii) Calculate the value of x.

....

(2 mark)

(c) The diagram below shows a map of an island drawn on a grid where each small square measures 1 cm by 1 cm. The map is drawn to a scale of 1:50 000.



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

....

(1 mark)

(ii) The actual distance between two towns on the island is 475 000 cm. What is this actual distance in km?

....

(1 mark)

(iii) Calculate the ACTUAL area, in km^2, of the forest reserve given that

$$1 \times 10^{10}\ cm^2 = 1\ km^2.$$

....

(3 marks)

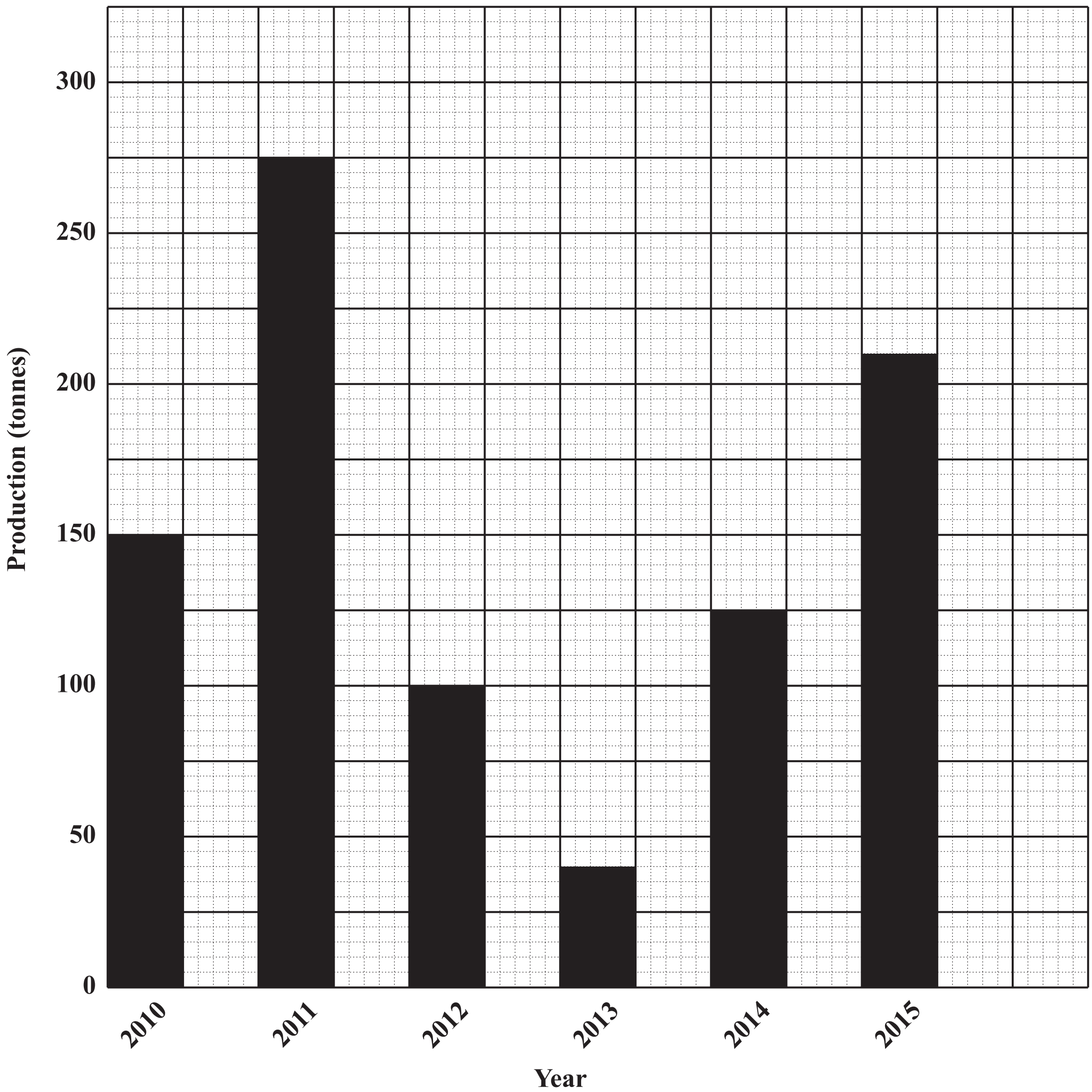
Total 9 marks

Module 2 – Intermediate Secondary-Level Mathematics

Answer ALL questions.

All working MUST be clearly shown.

4. (a) The bar graph below shows the quantity of bananas (to the nearest tonne) produced annually on a farm over a period of 6 years.



(i) Determine the range of the number of tonnes of bananas produced from 2010 to 2015.

....

(1 mark)

(ii) During which year was there the GREATEST production of bananas?

....

(1 mark)

(iii) Calculate the mean number of tonnes of bananas produced over the six-year period.

....

(2 marks)

(b) In a football tournament, points are awarded as follows: 3 points for a win, 1 point for a draw and 0 points for a loss.

(i) Write a 3×1 matrix, P, to represent this information.

....

(1 mark)

(ii) During the tournament, Team Alpha recorded 5 wins, 1 draw and 3 losses, while Team Beta recorded 3 wins, 4 draws and 2 losses.

Write a 2×3 matrix, R, to represent this information.

....

(1 mark)

(iii) Calculate the matrix product RP.

....

(2 marks)

(iv) What does the matrix product *RP* represent?

....

....

....

....

(1 mark)

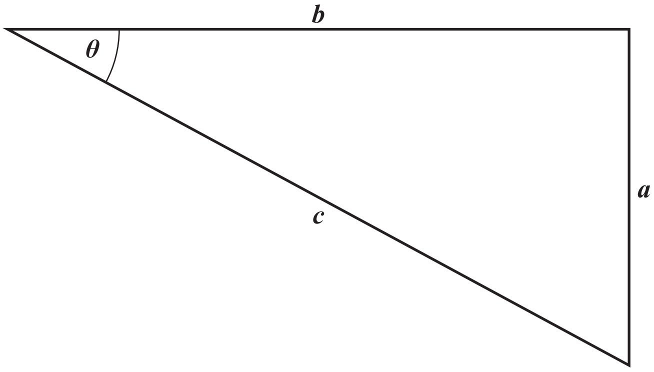
Total 9 marks

5. (a) Using a ruler, a pencil and a pair of compasses, construct the right-angled triangle *ABC*, such that *AB* = 5 cm, <*ABC* = 90° and <*BAC* = 60°.

....

(4 marks)

(b) The diagram below shows a right-angled triangle with sides a units, b units and c units.



Using the diagram,

(i) express c in terms of a and b.

....

(1 mark)

(ii) write, in terms of a, b and c, an expression for $\sin\theta + \cos\theta$.

....

(2 marks)

(iii) Using the results from (b) (i) and (ii), show that $(\sin\theta)^2 + (\cos\theta)^2 = 1$.

....

(2 marks)

Total 9 marks

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

(i) The equation of the line *BC* is of the form $y = mx + c$. Determine the value of *c*.

....

(2 marks)

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

....

(2 marks)

GO ON TO THE NEXT PAGE

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(b) The functions f and g are defined as

$$f(x) = 4x - 5 \text{ and } g(x) = \frac{2x - 1}{x + 3}, x \neq -3.$$

(i) Determine $gf(3)$.

....

(2 marks)

(ii) Derive a simplified expression for $g^{-1}(x)$.

....

(3 marks)

GO ON TO THE NEXT PAGE

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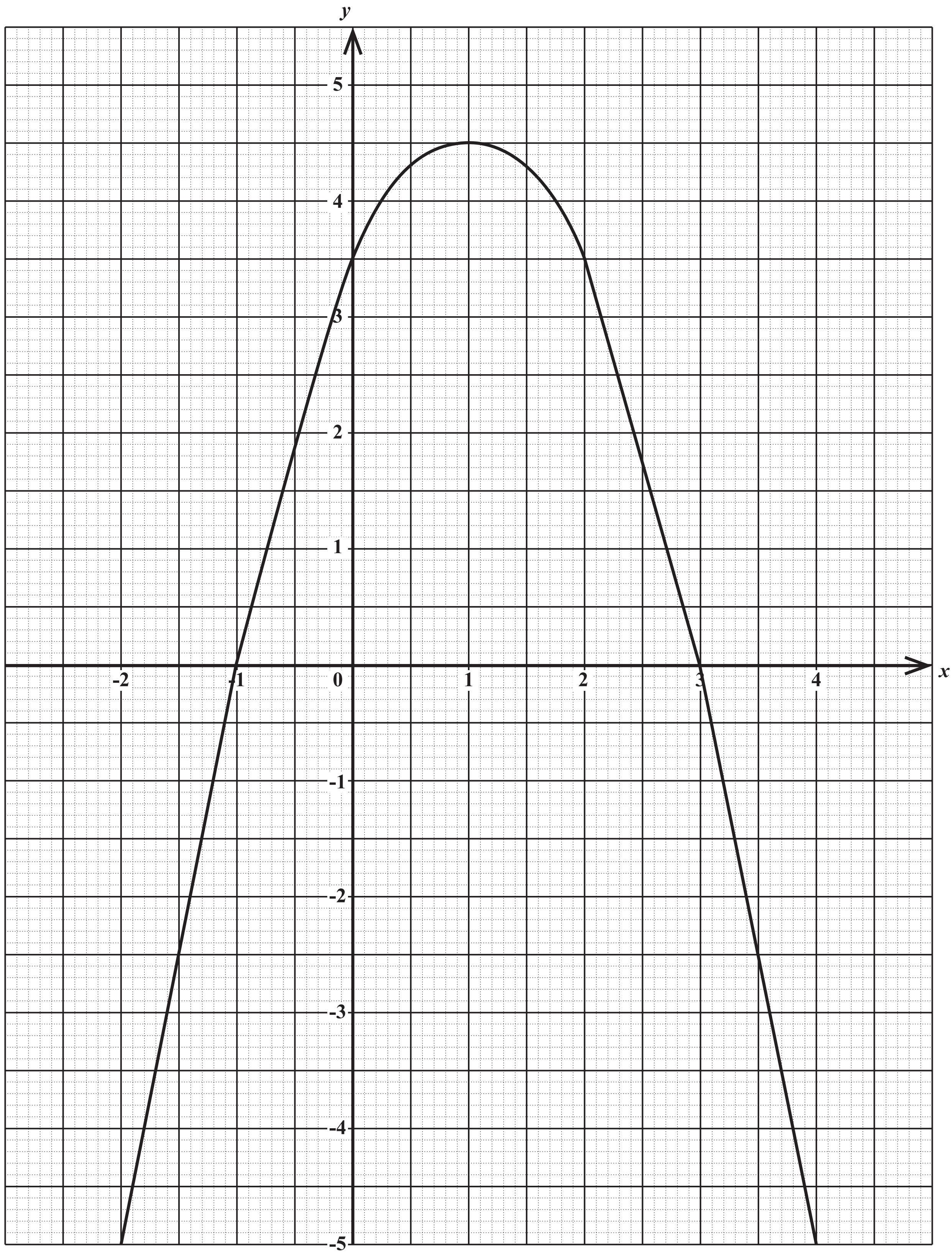
Sequential Bar Code

(c) The diagram below shows the graph of the quadratic function $y = ax^2 + bx + c$.



GO ON TO THE NEXT PAGE

Using the graph,

(i) state the coordinates of the turning point of the quadratic function

....

(1 mark)

(ii) determine the value of c

....

(1 mark)

(iii) write down one of the solutions of the equation $ax^2 + bx + c = 0$.

....

(1 mark)

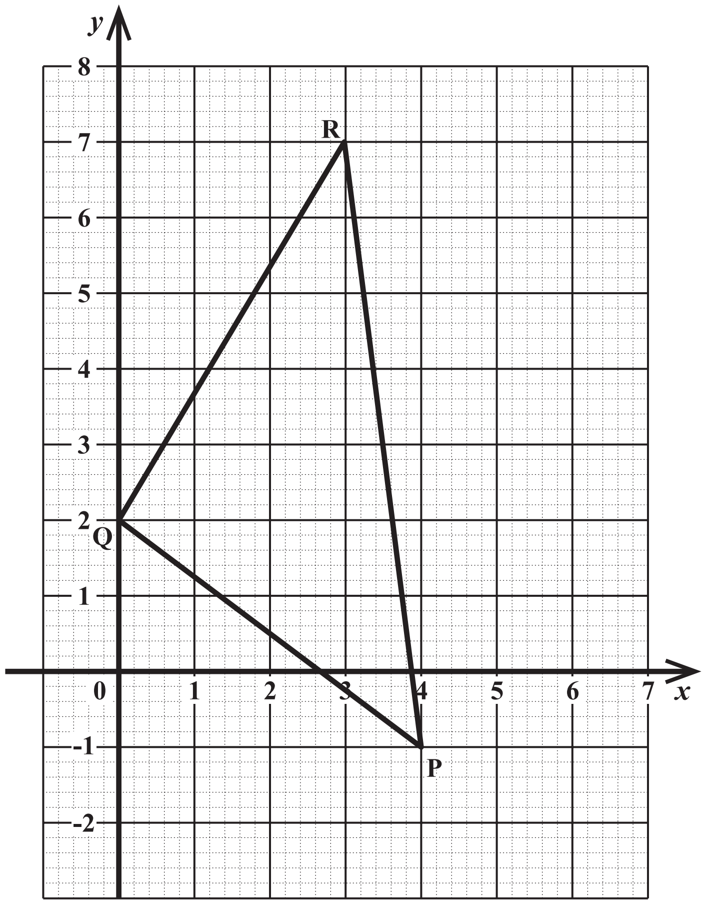
Total 12 marks

Module 3 – Higher Concepts in Secondary-Level Mathematics

Answer ALL questions.

All working MUST be clearly shown.

7. (a) The graph below shows 3 points, *P, Q* and *R*, relative to the origin, *O*.



(i) Write as a column vector in the form $\begin{pmatrix} x \\ y \end{pmatrix}$

a) $\overrightarrow{OP}$

....

(1 mark)

b) $\overrightarrow{QR}$.

....

(1 mark)

(ii) Determine the magnitude of $\overrightarrow{QR}$.

....

(2 marks)

(b) Matrices P and Q are such that

$$P = \begin{pmatrix} 3 & 2 \\ 5 & 4 \end{pmatrix} \text{ and } Q = \begin{pmatrix} 4 & 0 \\ 3 & -1 \end{pmatrix}.$$

(i) Find P^{-1}, the inverse of P.

....

(2 marks)

(ii) Write the following pair of simultaneous equations as a matrix equation.

$$3x + 2y = 1$$
$$5x + 4y = 5$$

....

(1 mark)

(iii) Using a matrix method, solve for x and y.

....

(2 marks)

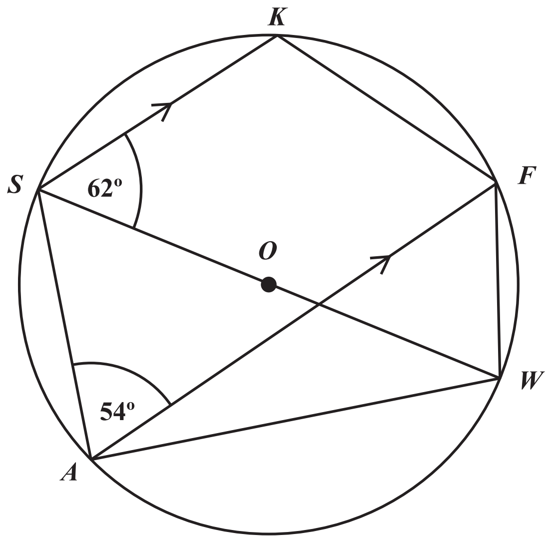
Total 9 marks

GO ON TO THE NEXT PAGE

NOTHING HAS BEEN OMITTED.

8. (a) In the diagram below, *O* is the centre of the circle and the points *A, S, K, F* and *W* lie on the circumference of the circle.

The line segments *SK* and *AF* are parallel with <*KSW* = 62° and <*SAF* = 54°.



Calculate, giving reasons for your answer, the measure of

(i) <*FAW*

....

....

....

....

(2 marks)

(ii) <*SKF*.

....

....

....

....

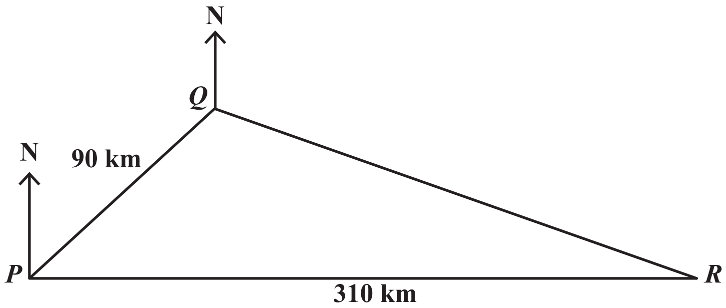
(2 marks)

GO ON TO THE NEXT PAGE

"*"Barcode Area"*"
Sequential Bar Code

DO NOT WRITE IN THIS AREA *DO NOT WRITE IN THIS AREA* *DO NOT WRITE IN THIS AREA*

(b) A ship travels from Penville (P), on a bearing of 030°, to Quintel (Q), 90 km away. It then travels to Rostown (R) which is 310 km due east of Penville (P), as shown in the diagram below.



(i) Indicate on the diagram the bearing 030°. **(1 mark)**

(ii) Determine the bearing of P from Q.

....

(1 mark)

(iii) Calculate, to the nearest km, the distance between Q and R.

....

(3 marks)

Total 9 marks

9. (a) The table below shows the amount of time 25 students spent at the school canteen waiting to be served.

Time Spent at the Canteen (minutes)	**Frequency**	**Cumulative Frequency**
6–10	2	2
11–15	5	7
16–20	6	13
21–25	8	21
26–30	3	24
31–35	1	25

(i) On the grid on **page 31**, draw a cumulative frequency curve to show the amount of time the students spent at the canteen. Use a scale of **2 cm to represent 5 minutes** on the horizontal axis and **2 cm to represent 5 students** on the vertical axis.

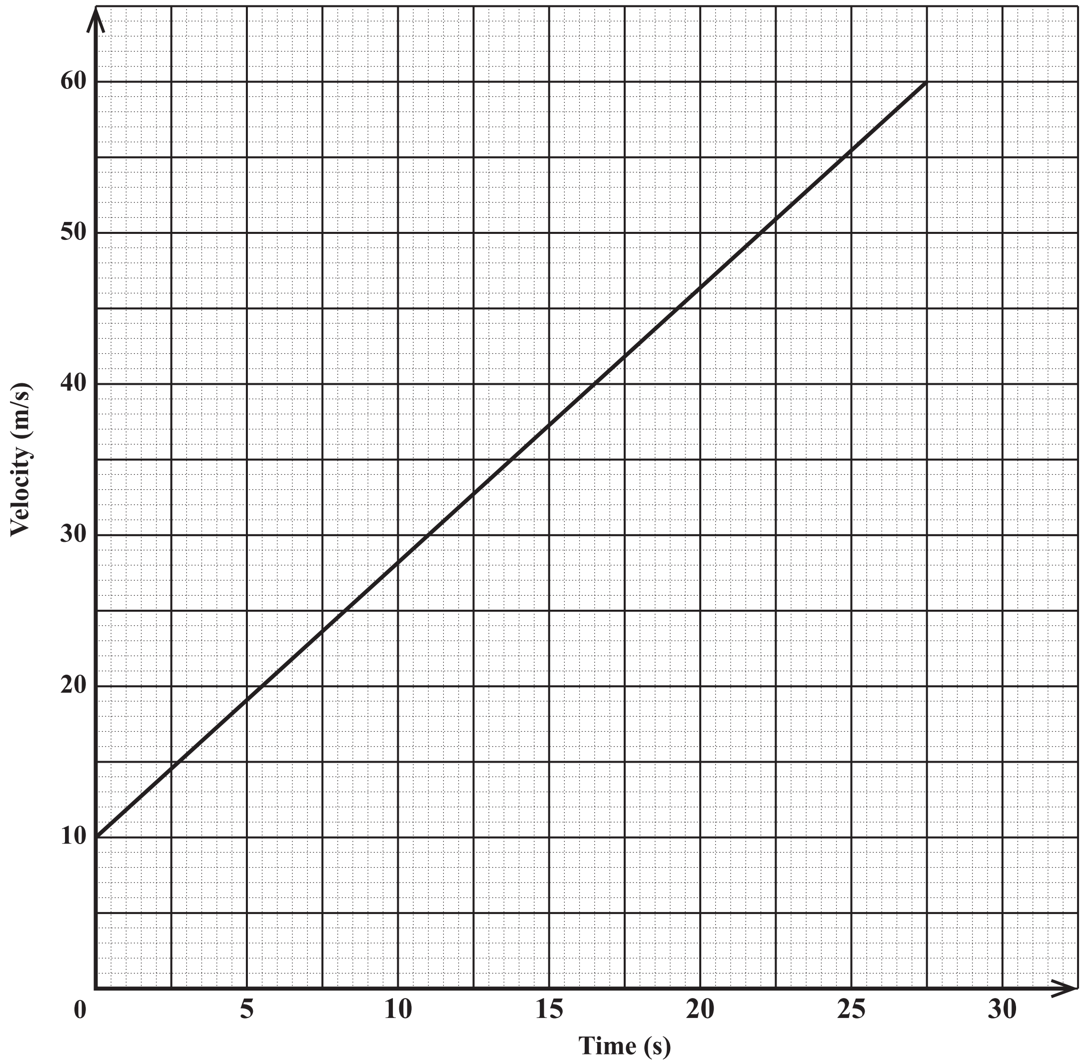
(5 marks)

(ii) A student is randomly chosen from the group of students who visited the canteen. Determine the probability that he/she waited more than 20 minutes to be served.

....

(2 marks)

(b) The diagram below represents the velocity of an object over a period of 25 seconds.



(i) Given that the linear motion of the object can be expressed in the form $v = at + u$, where a and u are constants, use the graph to determine the values of a and u.

....

(3 marks)

(ii) Calculate the TOTAL distance travelled by the object.

....

(2 marks)

Total 12 marks

END OF TEST

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

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No.

DO NOT
WRITE ON
THIS PAGE

CANDIDATE'S RECEIPT

INSTRUCTIONS TO CANDIDATE

1. **Fill in all the information requested clearly in capital letters.**

TEST CODE | 0 | 1 | 2 | 3 | 4 | 0 | 2 | 0 |

SUBJECT MATHEMATICS – Paper 02

PROFICIENCY GENERAL

REGISTRATION NUMBER | | | | | | | | | | |

FULL NAME ____
(BLOCK LETTERS)

SIGNATURE ____

DATE ____

2. **Ensure that this slip is detached by the Supervisor or Invigilator and given to you when you hand in this booklet.**

3. **Keep it in a safe place until you have received your results.**

INSTRUCTION TO SUPERVISOR/INVIGILATOR

Sign the declaration below, detach this slip and hand it to the candidate as his/her receipt for this booklet collected by you.

I hereby acknowledge receipt of the candidate's booklet for the examination stated above.

Signature ______________________________
Supervisor/Invigilator

Date ______________________________

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 02 – GENERAL PROFICIENCY

KEY AND MARK SCHEME

MATHEMATICS

PAPER 02 – GENERAL PROFICIENCY

KEY AND MARK SCHEME

SECTION I

Module 1 – Fundamentals of Secondary-Level Mathematics

Question 1			Profiles			Total
			CK	AK	R	
(a)		**Determination of the value of** $\frac{(32.9)^2 - 5.5}{\sqrt{1.5 \times 0.06}}$ $= 3589.7$ **CK_1 – CAO** $= 3.5897 \times 10^3$ **R_1 – in standard form**	1		1	
(b)	(i)	**Barbados equivalent of US$1** $BBD\$1.00 = TT\$3.00$ $\therefore TT\$1.00 = \frac{BBD\$1}{3}$ **R_1 – finding BBD equivalent of TT$1** $US\$1.00 = TT\$6.45$ $\therefore$ Barbados equivalent of TT$6.45 $= \left(\frac{1.00}{3.00}\right) \times 6.45$ **AK_1 – multiplying BBD equivalent of TT$1 by 6.45** $= \$2.15$ $\therefore US\$1.00 = BBD\$2.15$		1	1	
	(ii)	**Gail will receive** $BBD\$1806.00 = US\$\left(\frac{1806}{2.15}\right)$ $= \$840.00$ **AK_1 – dividing by "her" BBD equivalent of US$1**		1		
			1	2	2	5

Question 1 cont'd

(c) (i) **Total electricity bill for March 2016**

= (03307 - 03011)´ $5.10 **$AK_1$ – process/method**

= 296´ $5.10

= $1509.60 **$CK_1$ – CAO**

(ii) **Meter reading at the end of April**

$= 03307 + \left(\frac{\$2351.10}{\$5.10}\right)$ **R_1 – method/process**

$= 03307 + 461$

$= 03768$

CK_1 – CAO

Profiles			Total
CK	AK	R	
	1		
1			
		1	
1			
2	1	1	4
3	3	3	9

Specific Objectives: 1.1.3., 1.1.9., 1.1.12., 1.2.9., 1.2.10

Question 2

(a) **Completion of table**

n	Series	Sum
1	1^3	$\left[\frac{1}{2}(1+1)\right]^2 =$ **1**
2	$1^3 + 2^3$	$\left[\frac{2}{2}(1+2)\right]^2 =$ **9**
3	$1^3 + 2^3 + 3^3$	$\left[\frac{3}{2}(1+3)\right]^2 =$ **36**
4	$1^3 + 2^3 + 3^3 + 4^3$	$\left[\frac{4}{2}(1+4)\right]^2 =$ **100**
5	$1^3 + 2^3 + 3^3 + 4^3 + 5^3$	$\left[\frac{5}{2}(1+5)\right]^2 =$ **225**
CK1 **8**	AK1 $\mathbf{1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3}$	R1 $\left[\frac{8}{2}(1+8)\right]^2 =$ **1296**
⋮	⋮	⋮ AK1R1
n	CK1 $\mathbf{1^3 + 2^3 + 3^3 + 4^3 + 5^3 + \ldots + n^3}$	$\left[\frac{n}{2}(1+n)\right]^2 = \frac{n^2}{4}(1+n)^2$

Profiles			Total
CK	AK	R	
	1	1	
2	2	2	6

Question 2 cont'd

(b) (i) **Value of x**

$1+2+3+4+5+6=\sqrt{x}$ **AK_1 – method/process**

Þ $x=(1+2+3+4+5+6)^2$

$x=21^2$

$x=441$ **CK_1 – CAO**

(ii) **Formula for nth term**

$1+2+3+4+5+\ldots+n=\sqrt{\frac{n^2}{4}(1+n)^2}$

$=\sqrt{\left(\frac{n}{2}\right)^2(1+n)^2}=\sqrt{\left[\frac{n}{2}(1+n)\right]^2}$

$=\frac{n}{2}(1+n)$ **R_1 – correct formula**

Profiles			Total
CK	AK	R	
	1		
1			
		1	
1	1	1	3
3	3	3	9

Specific Objectives: 1.1.1., 1.1.2., 1.1.16., 1.2.17

Question 3

(a) (i) **Simplifying**

$p^3q^2 + pq^5m$

$= pq^2\left(p^2 + q^3m\right)$ **AK$_1$ – CAO**

(ii) **a) Finding the value of**

$a*b = 2a - 5b$

$3*4 = 2(3) - 5(4)$ **AK$_1$ – method/process**

$3*4 = -14$

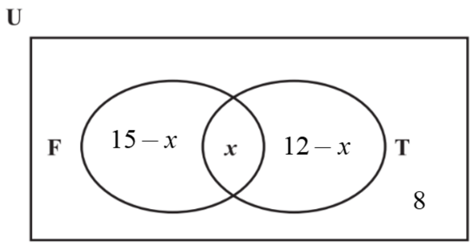
b) Finding the value of

$(3*4)*1 = 2(-14) - 5(1)$

$(3*4)*1 = -28 - 5$ **R$_1$ – both operations correct**

$(3*4)*1 = -33$

(b) (i) **Completed Venn diagram**



AK$_1$ – 15 – x seen
AK$_1$ – 12 - x seen

(ii) **Value of x**

$15 - x + x + 12 - x + 8 = 28$ **R$_1$ –correct equation**

$35 - x = 28$

$x = 35 - 28$

$x = 7$ **CK$_1$ – CAO**

	CK	AK	R	Total
(a)(i)		1		
(a)(ii) a)		1		
(a)(ii) b)			1	
(a) subtotal	0	2	1	3
(b)(i)		2		
(b)(ii)	1		1	
(b) subtotal	1	2	1	4
Total	1	4	2	7

Question 3 cont'd

(c) (i) **Distance LM on map**

$LM = 8$ cm **CK_1 – CAO**

(ii) **Actual distance between the 2 towns on the island**

$= \dfrac{475\ 000}{100\ 000}$ km

$= 4.75$ km **AK_1 – CAO**

(iii) **Actual area, in km^2, of the forest reserve**

Area of forest reserve on map $\approx 15\ cm^2$

CK_1 – determining the area correctly

Actual area in km^2

$= \dfrac{15 \times (50\ 000)^2}{1 \times 10^{10}}$ km^2 **R_1 – method/process**

$= 3.75$ km^2 **AK_1 – CAO**

	Profiles			Total
	CK	AK	R	
(c)(i)	1			
(c)(ii)		1		
(c)(iii)	1		1	
		1		
	2	2	1	5
	3	6	3	12

Specific Objectives: 1.5.5., 1.5.7., 1.3.6., 1.4.12

	CK	AK	R	Total
TOTAL SECTION I	9	12	9	30

SECTION 2

Module 2 – Intermediate Secondary-Level Mathematics

Question 4

	CK	AK	R	Total
(a) (i) **The range of the number of tonnes of bananas produced between 2010 and 2015** Range = largest to smallest Range = 275 - 40 = 235 **CK_1 – CAO**	1			
(ii) **Year in which the production of bananas was the greatest** - 2011 **AK_1 – computation/method/process**		1		
(iii) **Mean** $\text{Mean} = \frac{150 + 278 + 100 + 40 + 125 + 210}{6}$ **AK_1 – computation/method/process**		1		
$\text{Mean} = \frac{900}{6}$ Mean = 150 tonnes **CK_1 – CAO**	1			
	2	**2**	**0**	**4**

Profiles: CK, AK, R

Question 4 cont'd	**Profiles**			**Total**
	CK	**AK**	**R**	
(b) (i) **Matrix P**				
$P = \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$ **CK_1 – CAO**	1			
(ii) **Matrix R**				
$R = \begin{pmatrix} 5 & 1 & 3 \\ 3 & 4 & 2 \end{pmatrix}$ **AK_1 – correct rows and columns**		1		
(iii) **Matrix product, RP**				
$RP = \begin{pmatrix} 5 & 1 & 3 \\ 3 & 4 & 2 \end{pmatrix}\begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$ **AK_1 – computation/method/process**		1		
$RP = \begin{pmatrix} 16 \\ 13 \end{pmatrix}$ **CK_1 – CAO**	1			
(iv) **Representation of Matrix product, RP**				
- RP represents the total points for teams Alpha (16) and Beta (13) **R_1 – description**			1	
	2	2	1	5
	4	4	1	9

Specific Objectives: 2.1.7., 2.5.4., 2.5.5

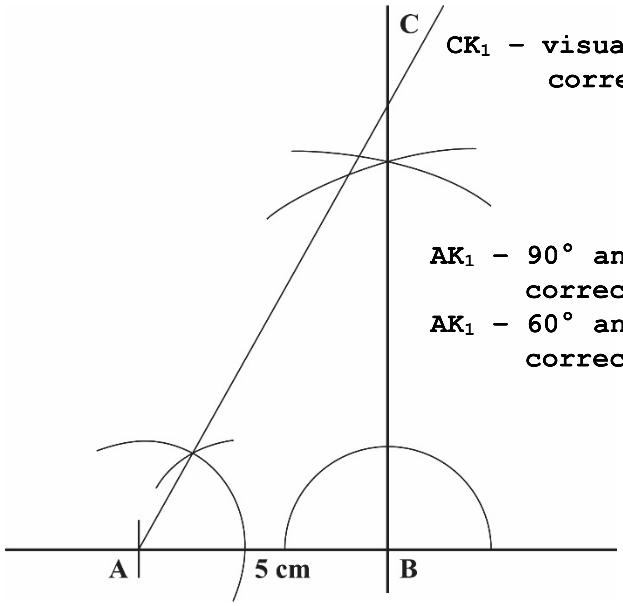
MATHEMATICS

PAPER 02 – GENERAL PROFICIENCY

KEY AND MARK SCHEME

Question 5

(a) **Construction of right-angled triangle, *ABC***



	Profiles			Total
	CK	AK	R	
CK_1 – visually correct	1			
AK_1 – 90° angle correct **AK_1 – 60° angle correct**		2		
R_1 – correct location of C			1	

Question 5	**Profiles**			**Total**
	CK	**AK**	**R**	
(b) (i) **Expression of *c* in terms of *a* and *b***				
- From Pythagoras' theorem $c^2 = a^2 + b^2$ **R_1 – applying Pythagoras' theorem** $\backslash \quad c = \sqrt{a^2 + b^2}$			1	
(ii) **Expression for sin *θ* + cos *θ***				
$\sin q + \cos q = \frac{a}{c} + \frac{b}{c}$ **R_1 – substitution of ratios**			1	
$\sin q + \cos q = \frac{a + b}{c}$				
but $c = \sqrt{a^2 + b^2}$ **AK_1 – method/process, sub. c**		1		
$\backslash \ \sin q + \cos q = \frac{a + b}{\sqrt{a^2 + b^2}}$				
(iii) **Proof** $(\sin q)^2 + (\cos q)^2 = 1$				
$(sin\,\theta)^2 + (cos\,\theta)^2 = \left(\frac{a}{c}\right)^2 + \left(\frac{b}{c}\right)^2$ **R_1 – substituting ratios**			1	
$(sin\,\theta)^2 + (cos\,\theta)^2 = \frac{a^2 + b^2}{c^2}$				
but $c^2 = a^2 + b^2$ **AK_1 – method/process, sub. c^2**		1		
$\therefore (sin\,\theta)^2 + (cos\,\theta)^2 = \frac{c^2}{c^2} = 1$				
	0	2	3	5
	1	4	4	9

Specific Objectives: 2.4.4., 2.4.8.,2.4.10

Question 6	**Profiles**			**Total**
	CK	**AK**	**R**	
(a) (i) **Equation of BC**				
Given $A(-5, 3)$ and $m = \frac{2}{5}$				
$y = mx + c$				
$3 = \frac{2}{5}(-5) + c$				
$c = 3 + 2 = 5$ **AK$_1$ – finding c**		1		
$\therefore y = \frac{2}{5}x + 5$ **CK$_1$ – correct equation**	1			
OR				
$y - 3 = \frac{2}{5}(x - (-5))$				
$y - 3 = \frac{2}{5}x + 2$ **AK$_1$ – computation/method/process**				
$\therefore y = \frac{2}{5}x + 5$ **CK$_1$**				
(ii) **Equation of line which passes through the origin and is perpendicular to** ***BC***				
Using $(0, 0)$ *and* $m = -\frac{5}{2}$ **AK$_1$ – correct gradient**				
$y = -\frac{5}{2}x$ **CK$_1$ – correct equation**	1	1		
	2	**2**	**0**	**4**

Question 6 cont'd

(b) (i) **Evaluating composite function gf**

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

$f(3) = 4(3) - 5 = 7$

$gf(3) = g(7)$ **AK_1 – method/process**

$gf(7) = \dfrac{2(7)-1}{7+3} = 1.3$ **CK_1 – CAO**

(ii) **Inverse function $g^{-1}(x)$**

$g(x) = \dfrac{2x-1}{x+3}, x \neq -3$

Let $y = g(x)$

$\therefore\ y = \dfrac{2x-1}{x+3}$

Interchanging y with x yields

$x = \dfrac{2y-1}{y+3}$

$x(y+3) = 2y - 1$ **AK_1 – method/process**

$xy + 3x = 2y - 1$

$2y - xy = 1 + 3x$

$y(2-x) = 1 + 3x$ **CK_1 – collecting like terms**

$y = \dfrac{1+3x}{2-x}$

$\therefore\ g^{-1}(x) = \dfrac{1+3x}{2-x}$ **R_1 – correct inverse**

	Profiles			Total
	CK	AK	R	
(b)(i)	1	1		
(b)(ii)	1	1	1	
	2	2	1	5

	CK	AK	R	Total
Question 6 cont'd				
(c) (i) **Coordinates of turning point**				
– **(1, 4) R_1 – correct coordinates given**			1	
(ii) **Value of c**				
According to the graph,				
c = 3 R_1 – correct value			1	
(iii) **Solutions of** $ax^2 + bx + c = 0$				
– **x = -1 or x = 3**				
R_1 – either of the solutions correct			1	
	0	0	3	3
	4	4	4	12

(Column headers CK, AK, R are grouped under **Profiles**.)

Specific Objectives: 2.3.7., 2.3.8.,2.3.11., 2.3.13., 2.3.16., 2.3.17

	CK	AK	R	Total
TOTAL SECTION II	9	12	9	30

MATHEMATICS

PAPER 02 – GENERAL PROFICIENCY

KEY AND MARK SCHEME

SECTION 3

Module 3 – Higher Concepts in Secondary-Level Mathematics

Question 7

(a) (i)

a) Vector $\overrightarrow{OP}$

$\overrightarrow{OP} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$ **CK_1 – CAO**

b) Vector $\overrightarrow{QR}$

$\overrightarrow{QR} = \begin{pmatrix} 3 \\ 5 \end{pmatrix}$ **AK_1 – CAO**

(ii) **Magnitude of** $\overrightarrow{QR}$

$Q(0,2), R(3,7)$

$|\overrightarrow{QR}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$|\overrightarrow{QR}| = \sqrt{(3-0)^2 + (7-2)^2}$

$|\overrightarrow{QR}| = \sqrt{9+25} = \sqrt{34}$ **AK_1 – computation/method /process**

$|\overrightarrow{QR}| = 5.83$ sq.units

OR

$|\overrightarrow{QR}| = \sqrt{x^2 + y^2}$ **CK_1 – CAO**

$|\overrightarrow{QR}| = \sqrt{3^2 + 5^2}$

$|\overrightarrow{QR}| = \sqrt{9+25} = \sqrt{34}$

$|\overrightarrow{QR}| = 5.83$ sq.units

Profiles			Total
CK	AK	R	
1			
	1		
	1		
1			
2	2	0	4

<u>Question 7 cont'd</u>

(b) (i) **Inverse of Matrix P**

$P = \begin{pmatrix} 3 & 2 \\ 5 & 4 \end{pmatrix}$

$$P^{-1} = \frac{1}{|P|} \times P \text{ Adjoint}$$

$$P^{-1} = \frac{1}{(3 \times 4) - (5 \times 2)} \times \begin{pmatrix} 4 & -2 \\ -5 & 3 \end{pmatrix}$$

$$P^{-1} = \frac{1}{2} \times \begin{pmatrix} 4 & -2 \\ -5 & 3 \end{pmatrix}$$

AK_1 – computation /method /process

$$P^{-1} = \begin{pmatrix} 2 & -1 \\ -\frac{5}{2} & \frac{3}{2} \end{pmatrix}$$

CK_1 – CAO

(ii) **Matrix equation**

$\begin{pmatrix} 3 & 2 \\ 5 & 4 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 \\ 5 \end{pmatrix}$ **R_1 – matrices in correct order**

(iii) **Solution using matrix equation**

$\begin{pmatrix} 3 & 2 \\ 5 & 4 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 \\ 5 \end{pmatrix}$

Pre-multiplying by P^{-1}

$$\frac{1}{2}\begin{pmatrix} 4 & -2 \\ -5 & 3 \end{pmatrix}\begin{pmatrix} 3 & 2 \\ 5 & 4 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{2}\begin{pmatrix} 4 & -2 \\ -5 & 3 \end{pmatrix}\begin{pmatrix} 1 \\ 5 \end{pmatrix}$$

AK_1 – pre-multiplying

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{2}\begin{pmatrix} -6 \\ 10 \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$$

$\therefore x = -3, y = 5$

R_1 – equating corresponding elements

	Profiles			Total
	CK	AK	R	
(b)(i) AK_1		1		
(b)(i) CK_1	1			
(b)(ii) R_1			1	
(b)(iii) AK_1		1		
(b)(iii) R_1			1	
	1	2	2	5
	3	4	2	9

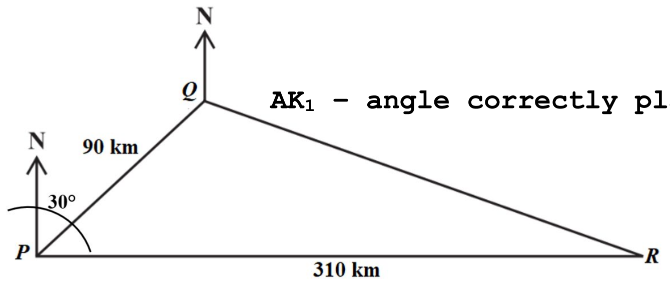
Specific Objectives:3.4.1., 3.4.2., 3.4.7.,3.4.9.

Question 8.

Working	CK	AK	R	Total
(a) (i) **Angle FAW**				
$\angle FAW = 90° - 54°$ **AK_1 – subtracting from 90°**		1		
$\angle FAW = 36°$ SW is a diameter of the circle hence, $\angle SAW$ is right-angled. **R_1 – Reason**			1	
(ii) **Angle SKF**				
$\angle SKF = 180° - 54°$ $\angle SKF = 126°$ **AK_1 – computation/method/process**		1		
ASKF is a cyclic quadrilateral, $\therefore \angle SKF$ and $\angle SAF$ are supplementary. **R_1 – Reason**			1	
	0	2	2	4

Question 8

(b) (i) **Completion of diagram**



AK_1 – angle correctly placed

(ii) **Bearing of P from Q**

$= 360° - [180° - 30°]$

$= 360° - 150°$

$= 210°$

R_1 – subtracting from both 180° and 360°

(iii) **Distance between *Q* and *R***

Applying the cosine rule

R_1 – applying in the cosine rule

$QR^2 = q^2 + r^2 - 2qr\cos p$

$QR^2 = 310^2 + 90^2 - 2(310 \times 90)\cos 60°$

$QR^2 = 96100 + 8100 - 27900$

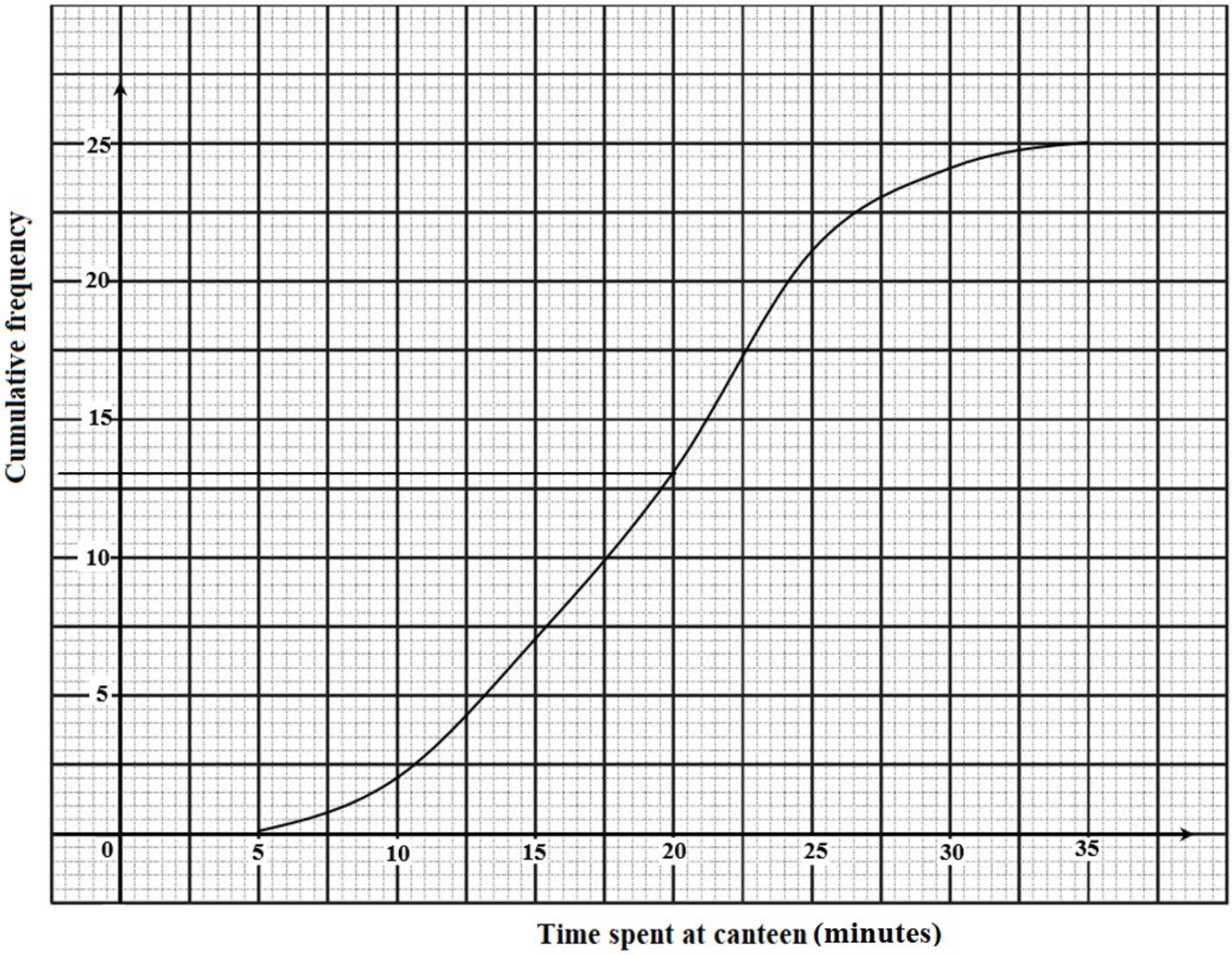
$QR = \sqrt{76300}$ **AK_1 – method/computation**

$QR = 276.22$ km **CK_1 – CAO**

Part	Profiles CK	Profiles AK	Profiles R	Total
(b)(i)		1		
(b)(ii)			1	
(b)(iii)	1	1	1	
	1	2	2	5
	1	4	4	9

Specific Objectives:3.3.1.,3.3.7.,3.3.10

Question 9(a)(i)



Question 9 cont'd

(a) (i) **Cumulative frequency curve**

Labels – both labels correct, 1 mark CK_1

Plotted points – every 3 points plotted correctly, 1 mark AK_2

Scale – correct scales used, 1 mark R_1

Smooth curve – 1 mark CK_1

(ii) **Probability:** AK_1 **– computation/method/process**

R_1 **– correct numerator**

$P(> 20 \text{ minutes}) = \frac{25 - 13}{25}$

$P(> 20 \text{ minutes}) = \frac{12}{25}$ CK_1 **– CAO**

$P(> 20 \text{ minutes}) = 0.68$

CK	AK	R	Total
2	2	1	
		1	
1			
3	2	2	7

Question 9 cont'd	**Profiles**			**Total**
	CK	**AK**	**R**	
(b) (i) **Values of *a* and *u***				
a = *gradient*				
From the graph, using the points (25, 60) and (0, 10),				
$a = \frac{60 - 10}{25 - 0}$ **R_1 – relating a to the gradient**	1	1	1	
$a = \frac{50}{25}$				
$a = 2$ **AK_1 – correct gradient**				
u = the y-intercept				
$\therefore u = 10$ **CK_1 – correct y-intercept**				
(ii) **Total distance travelled**				
Total distance travelled = Area under graph				
$\therefore d = \frac{1}{2} \times base \times height$				
$d = \frac{1 \times 25 \times 50}{2}$ **AK_1 – correct substitution /method**		1		
d = 625 sq. metres **CK_1 – CAO**	1			
	2	2	1	5
	5	4	3	12
Specific Objectives:3.1.7.,3.1.9.,3.2.5				
TOTAL SECTION III	9	12	9	30

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

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EXAMINATION

FILL IN ALL THE INFORMATION REQUESTED CLEARLY IN CAPITAL LETTERS.

TEST CODE

0	1	2	3	4	0	3	2

SUBJECT MATHEMATICS – Paper 032

PROFICIENCY GENERAL

REGISTRATION NUMBER

SCHOOL/CENTRE NUMBER					

NAME OF SCHOOL/CENTRE

CANDIDATE'S FULL NAME (FIRST, MIDDLE, LAST)

DATE OF BIRTH

D	D	M	M	Y	Y	Y	Y

SIGNATURE ____________________

"*"Barcode Area"*"
Current Bar Code

"*"Barcode Area"*"
Sequential Bar Code

DO NOT
WRITE ON
THIS PAGE

TEST CODE **01234032**

SPECIMEN 2025

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

1 hour

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE optional questions. You MUST answer only ONE question.
2. Write your answers in the spaces provided in this booklet.
3. Numerical answers that are non-exact should be given correct to 3 significant figures or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
4. Do NOT write in the margins.
5. All working MUST be clearly shown.
6. **A table of formulae is provided on pages 4 and 5 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.**
9. **Diagrams in this booklet are NOT drawn to scale, unless otherwise stated.**

Required Examination Materials

Electronic calculator
Geometry set

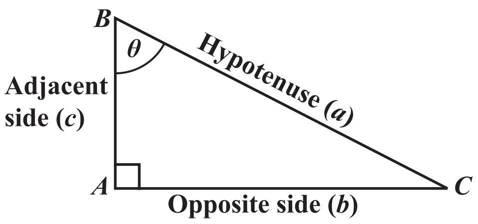
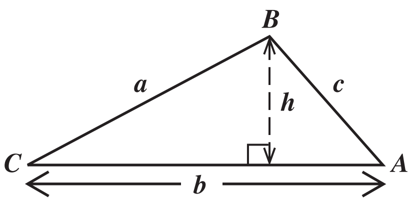
DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

LIST OF FORMULAE

Volume of a prism $V = Ah$	A – area of a cross-section h – the perpendicular length
Volume of a cylinder $V = \pi r^2 h$	r – radius of the base h – the perpendicular height
Volume of a right circular cone/right pyramid $V = \frac{1}{3} Ah$	A – area of the base h – the perpendicular height
Curved surface area of a cone $CSA = \pi rl$	r – radius of the base l – the slant height of the cone
Surface area of a sphere $SA = 4\pi r^2$	r – radius of the sphere
Volume of a sphere $V = \frac{4}{3} \pi r^3$	r – radius of the sphere
Circumference of a circle $C = 2\pi r$ $C = \pi d$	r – radius of the circle d – diameter of the circle
Arc length $S = \frac{\theta}{360} \times 2\pi r$	θ – the angle subtended by the arc, measured in degrees
Area of a circle $A = \pi r^2$	r – radius of the circle
Area of a sector $A = \frac{\theta}{360} \times \pi r^2$	θ – the angle of the sector, measured in degrees
Area of a trapezium $A = \frac{1}{2}(a + b)h$	a and b – the lengths of the parallel sides h – the perpendicular distance between the parallel sides
Simple interest $SI = \frac{P \times R \times T}{100}$	P – principal (initial amount) R – annual rate of interest T – time (in years)
Compound interest $A = P\left(1 + \frac{r}{100}\right)^n$	A – total amount after n years P – principal (initial amount) r – annual rate of interest n – number of years money is invested
Depreciation $A = P\left(1 - \frac{r}{100}\right)^n$	A – value of item after depreciation P – initial value of the item r – annual rate of depreciation n – number of years item depreciates

GO ON TO THE NEXT PAGE

LIST OF FORMULAE (continued)

Roots of quadratic equations If $ax^2 + bx + c = 0$, $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	a – the coefficient of x^2 b – the coefficient of x c – the constant term
Trigonometric ratios $\sin\theta = \dfrac{b}{a}$ $\cos\theta = \dfrac{c}{a}$ $\tan\theta = \dfrac{b}{c}$	 a – length of the hypotenuse b – length of the opposite side c – length of the adjacent side
Pythagoras' theorem $a^2 = b^2 + c^2$	
Area of a triangle Area of $\Delta = \dfrac{1}{2}\ bh$	 b – length of the base of the Δ h – the perpendicular height of the Δ
Area of Δ ABC = = $\dfrac{1}{2}$ $ab \sin C$	a and b – the lengths of the adjacent sides of the Δ C – the included angle
Area of Δ ABC = $\sqrt{s(s-a)(s-b)(s-c)}$	$s = \dfrac{a+b+c}{2}$ – the semi-perimeter of the Δ a, b and c – the sides of the Δ
Sine rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$	a, b and c – the sides of the Δ A, B and C – the angles opposite the corresponding sides of the Δ
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$	a, b and c – the sides of the Δ A – the angle opposite Side a
Counting formula: union of 2 sets $n(A \cup B) =$ $n(A) + n(B) - n(A \cap B)$	A and B – two finite intersecting sets

GO ON TO THE NEXT PAGE

"*"Barcode Area"*"
Sequential Bar Code

You must answer ONE question.

All working must be clearly shown.

1. The cash price of a 75-inch television set is $5 000. Maharati wants to buy the television, on credit, for his new home. He can purchase the television on hire purchase or pay by cash. You are required to conduct an investigation to help Maharati determine the best option to use to make his purchase.

The details of the 2 hire purchase plans, HP1 and HP2, are shown in the table below.

	HP1	**HP2**
Initial deposit	$475	$0
Duration	5 years	6 years
Monthly installment	$180	$170

To help Maharati determine the better hire purchase deal, you are required to provide responses to the following questions.

(a) (i) Write a suitable title for the investigation. The title should be clear and may be in the form of a statement or a question.

....

....

....

....

(2 marks)

(ii) Briefly outline ONE approach that Maharati could have used to obtain the information given in the table.

....

....

....

....

(1 mark)

(b) What percentage of the cash price is the initial deposit for HP1?

....

(2 marks)

(c) (i) Calculate the TOTAL monthly instalments for HP1 and HP2.

....

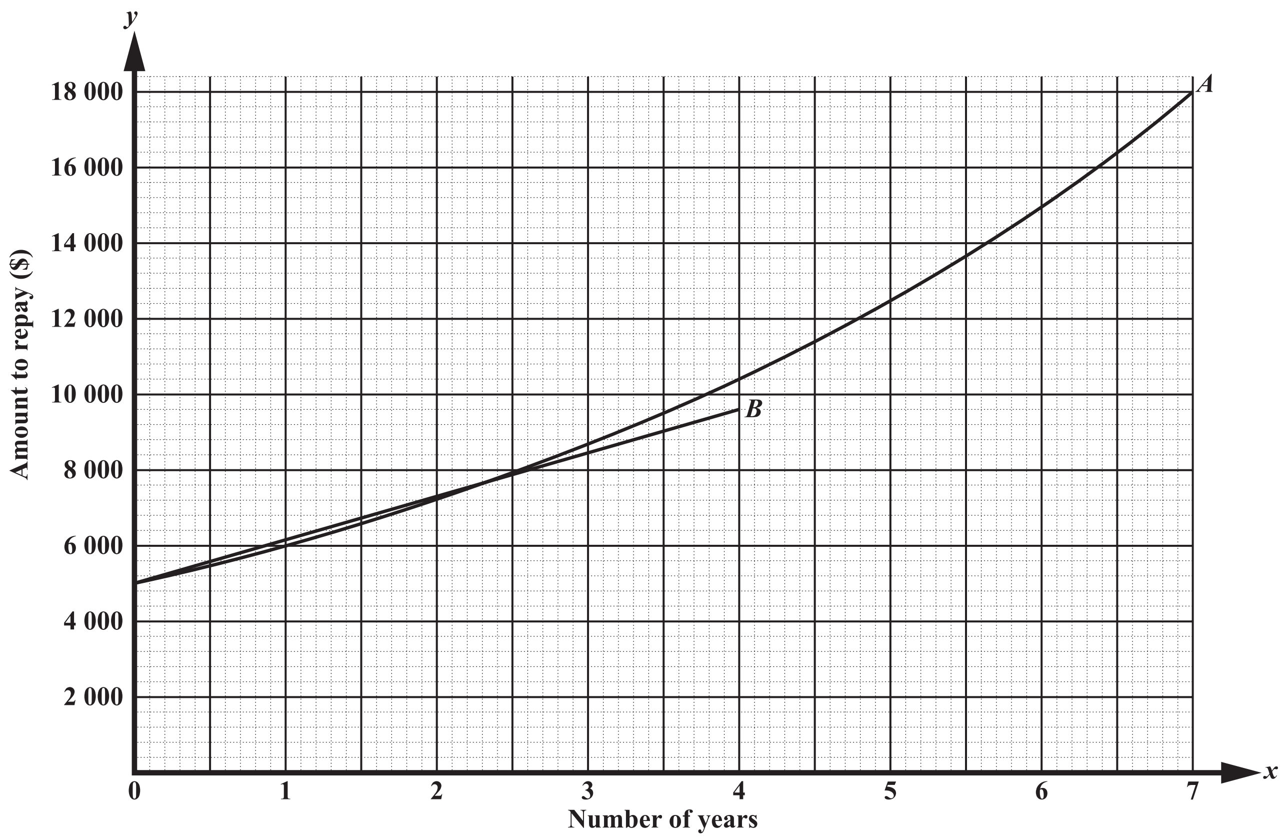
(2 marks)

(ii) Determine the TOTAL hire purchase price for HP1.

....

(1 mark)

(d) To obtain the cash to purchase the television set, Maharati can take a small loan from a bank . Two promotions, *A* and *B*, are available to him. Some details of *A* and *B* are shown on the graph below.



(i) State the value of the *y*-intercept for Graph *A* and briefly explain its meaning.

Value ....

Meaning ....

....

(2 marks)

(ii) Based on the graph, state ONE **main** difference between the two promotions, *A* and *B*.

....

....

....

(1 mark)

GO ON TO THE NEXT PAGE

“*”Barcode Area”*”
Sequential Bar Code

(iii) Assuming that Maharati opted for Promotion A for 4 years, using the graph **on page 8**, estimate the amount he paid for the television set.

....

(1 mark)

(iv) Promotion A is a loan with a compound interest of 20% for at least 2 years. Show, by calculation, that your estimate in (d) (iii) is correct (to the nearest hundred dollar).

....

(2 marks)

(v) Promotion B is a loan for up to n years at x % simple interest per annum. Suppose Maharati chooses this offer for the maximum number of years. Determine the value of x, the rate of interest on the loan.

....

(3 marks)

(e) Complete the table below to show the findings of the investigation. Based on these findings, what is the BEST recommendation you would give to Maharati? Justify your response.

	HP1	**HP2**	***A***	***B***
Deposit				
Amount repayable				
Monthly instalment				

....

....

....

....

....

....

....

....

(3 marks)

Total 20 marks

2. Shawna is a meteorology student who was asked to collect and analyse data regarding the daily minimum temperatures recorded (in °C) in her country over a two-month period. To accomplish this task, she collected data for the month of September and then compared her results with that for the month of January of the same year.

The data below shows the daily minimum temperatures recorded by Shawna for the 30 days in September.

21	22	22	22	24	21	23	21	23	24
21	26	23	21	23	23	24	25	24	23
26	24	21	22	22	24	22	24	22	24

You are required to write a description of how the investigation would have been conducted by using the headings provided and answering the questions that follow.

(a) (i) Write a suitable title for your investigation/research project. The title should be clear and may be in the form of a statement or a question.

....

....

....

....

(2 marks)

(ii) Explain how Shawna obtained the minimum temperature for a given day.

....

....

....

....

(1 mark)

GO ON TO THE NEXT PAGE

(b) (i) Determine the range of the daily minimum temperature readings recorded in the table.

....

(1 mark)

(ii) Complete the tally and frequency columns in the table below.

Temperature (ºC)	**Tally**	**Frequency *(f)***
21	~~IIII~~ I	6
22		
23	~~IIII~~ I	6
24		
25	I	1
26	II	2

(2 marks)

(iii) Using the data **on page 11**, determine the

a) mean daily minimum temperature for the 30-day period

....

(2 marks)

b) median daily minimum temperature for the 30-day period

....

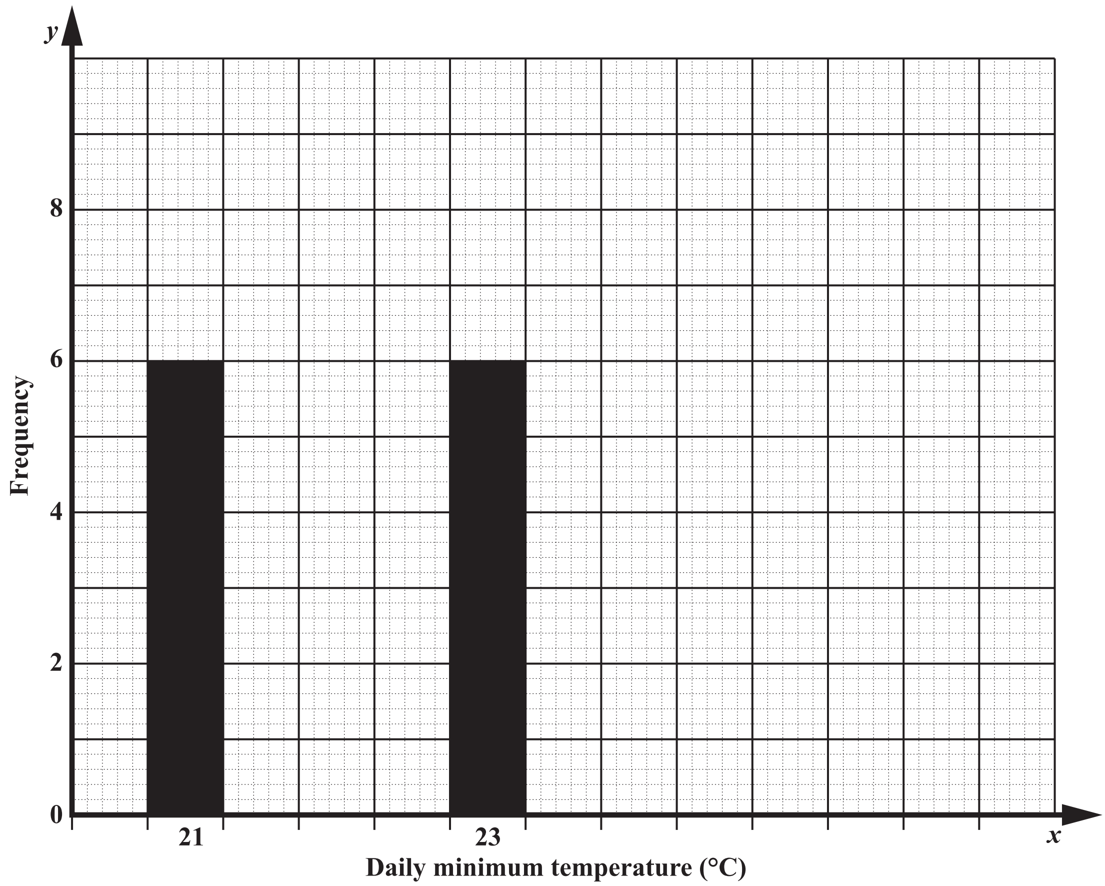
(1 mark)

c) modal daily minimum temperature for the 30-day period.

....

(1 mark)

(c) Using your finalized table **on page 12**, complete the bar chart below to show the daily minimum temperatures recorded in September.



(3 marks)

(d) The table below shows the statistics for the 2 months under consideration. Most of the statistics for September are missing.

Statistics	January	September
Minimum (°C)	21	
Maximum (°C)	23	
Mean (°C)	21.8	
Median (°C)	22	
Mode (°C)	21	
Standard deviation	1.02	1.42

Using the data in the table above and the results of your calculations, complete the analysis and interpretation of data section below.

Analysis and Interpretation of Data

- Of the two months under consideration, the lower average daily minimum temperature was recorded in the month of ....
  The lowest daily minimum temperature recorded for both months was ....

- In January, the daily minimum temperatures ranged from .... to ...., with half the values located below .... and the most frequently occurring measurement being .... In September, the daily minimum temperatures ranged from .... to ...., with half the values below .... and the most frequently occurring measurement being ....

- The spread/variation among the measurements was lower in January. This is BEST indicated by the lower .... recorded for that month and means that most of the daily minimum temperature readings for the month were ....

(7 marks)

Total 20 marks

NOTHING HAS BEEN OMITTED.

3. The Cornerstone Farmers' Cooperative Society grows 2 crops, *P* and *Q*, on 72 hectares of land. The Society must allocate the land to the 2 crops in a manner that will allow the farmers to earn a huge surplus while ensuring the protection of the environment.

You are asked to set up and solve a related linear programming problem to advise the farmers.

The constraints to be considered are listed in the table below.

Let *x* and *y* represent the number of hectares of land to be allocated to Crop *P* and Crop *Q* respectively.

Situation/Constraints	**Inequality (in its simplest form)**
The Society has 72 hectares of land to grow the 2 crops, *P* and *Q*.	....
Herbicide is applied to the crops as follows: 20 litres per hectare for *P* and 10 litres per hectare for *Q*. **No more than** 1 000 litres of herbicide can be used.	....
At least a **quarter** of the number of hectares of land must be planted with *P*.	$x \geq 18$
At **most two-thirds** the number of hectares of land must be planted with *Q*.	....

GO ON TO THE NEXT PAGE

You are required to write a description of how the investigation would have been conducted by using the headings provided and answering the questions that follow.

(a) (i) Write a suitable title for your investigation/research project. The title should be clear and may be in the form of a statement or a question.

....

....

....

....

(2 marks)

(ii) State the method that would have been MOST appropriate to use to obtain the data in this investigation.

....

....

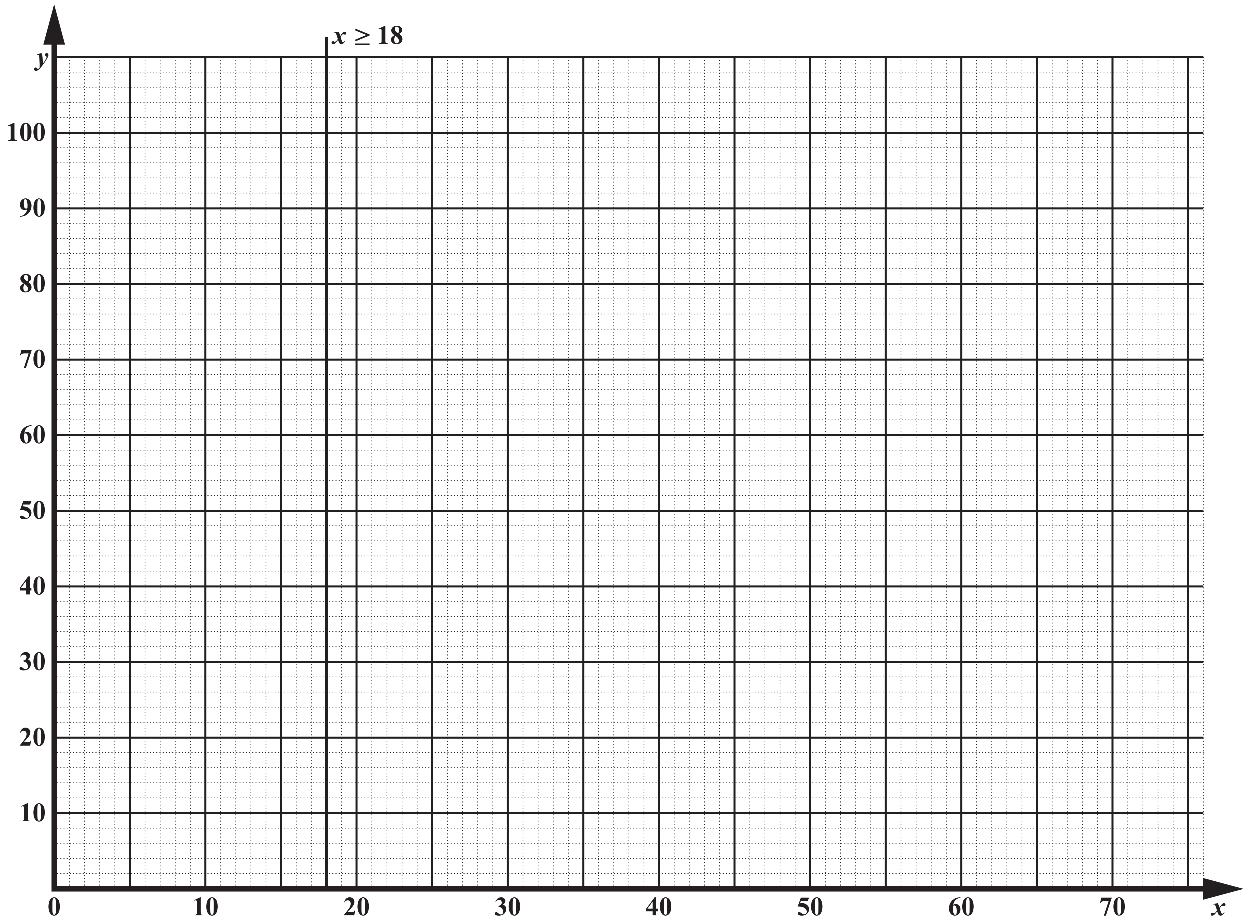
....

....

(1 mark)

(b) In the table **on page 18**, complete Column 2 by inserting the appropriate inequalities that are associated with the given constraints. **(3 marks)**

(c) On the diagram below, draw the lines associated with the THREE inequalities you have given in (b) and complete the diagram to derive the solution of the problem. On the diagram, shade and label the feasibility region as ***R***.



(5 marks)

(d) The surplus from crops P and Q, per hectare, are estimated to be \$1 520 and \$1 210 respectively. Using the information presented above and your graph,

(i) write down an equation that can be used to calculate the maximum expected surplus, S.

....

(1 mark)

(ii) Complete the statement below.

To gain the maximum expected surplus of \$95 800, the farmers must plant

.... hectares of land with Crop P and ....

hectares of land with Crop Q.

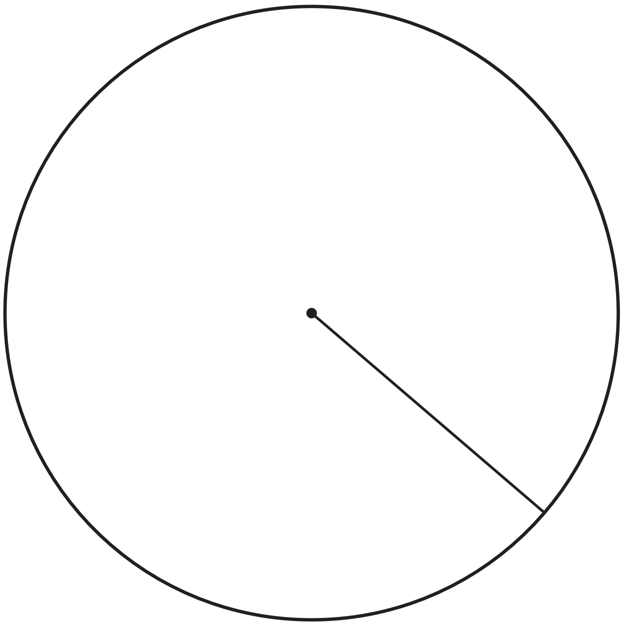
(1 mark)

(e) The Cornerstone Farmers' Cooperative Society must report on its distribution of surplus after each crop. Details on the proposed distribution of the surplus and for constructing a pie chart are shown in the table below.

Item	Percentage (%)	Amount of Surplus ($)	Sector Angle on Pie Chart (in degrees)
Additional investment	....	....	90°
Charity	2.5%	2 395	9°
Savings	10%	....	....
Education trust fund	2.5%	2 395	9°
Members' diviends	....	57 480	....

(i) Complete the table above. **(3 marks)**

(ii) Use the information in your completed table **on page 22** to construct the pie chart to show the distribution of surplus for the Cornerstone Farmers' Cooperative Society.



(4 marks)

Total 20 marks

END OF TEST

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

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No.

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No.

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No.

DO NOT

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CANDIDATE'S RECEIPT

INSTRUCTIONS TO CANDIDATE

1. **Fill in all the information requested clearly in capital letters.**

TEST CODE | 0 | 1 | 2 | 3 | 4 | 0 | 3 | 2 |

SUBJECT MATHEMATICS – Paper 032

PROFICIENCY GENERAL

REGISTRATION NUMBER | | | | | | | | | | |

FULL NAME ____
(BLOCK LETTERS)

SIGNATURE ____

DATE ____

2. **Ensure that this slip is detached by the Supervisor or Invigilator and given to you when you hand in this booklet.**

3. **Keep it in a safe place until you have received your results.**

INSTRUCTION TO SUPERVISOR/INVIGILATOR

Sign the declaration below, detach this slip and hand it to the candidate as his/her receipt for this booklet collected by you.

I hereby acknowledge receipt of the candidate's booklet for the examination stated above.

Signature ______________________________
Supervisor/Invigilator

Date ______________________________

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

KEY AND MARK SCHEME

MATHEMATICS

PAPER 032 – GENERAL PROFICIENCY

KEY AND MARK SCHEME

Question 1			**Profiles**			**Total**
			CK	**AK**	**R**	
(a)	(i)	**Title of project** 1. Determining the most affordable/cost-effective way (plan) to purchase a television set 2. Buying on credit. Determining which form of credit buying is most affordable/cost-effective. 3. Would purchasing a television set on hire purchase be more affordable/cost-effective than taking a loan? 4. Any other logical suggestion **CK_2 – suitable/logical/clear title given** **CK_1 – title given somewhat clear and suitable**	**2**			
	(ii)	**Approach used to collect data** - Interviewing/visiting the stores and getting/collecting the information. - Collecting documents/brochures online or from the stores themselves or from any other media. - Survey: distribute a questionnaire to collect the information. **AK_1 – appropriate data collection method stated**		**1**		
			2	**1**	**0**	**3**
(b)		**Initial deposit as a percentage of cash price** $= \frac{\text{deposit}}{\text{cash price}} \times 100\%$ $= \frac{475}{5000} \times 100\%$ **AK_1 – multiplying fraction by 100%** $= 9.5\%$ **CK_1 – CAO**	**1**	**1**		
			3	**2**	**0**	**5**

Question 1 continued			Profiles			Total
			CK	AK	R	
(c)	(i)	**Total instalments** **HP1** Total instalments = $180 ´ 60 = $10 800 **$AK_1$ – multiplying by 36** **HP2** Total instalments = $170 ´ 6 ´ 12 = $12 240 **$CK_1$ – CAO**	1	1		
	(ii)	**Hire purchase price for HP1** HP = deposit + TI HP = $475 + 10 800 HP = $11 275 **$AK_1$ – adding 2 correct components**		1		
			1	2	0	3
(d)	(i)	**y-intercept of graph** - $5 000 **$AK_1$ – correct read-off of y-intercept** - The y-intercept is the value of the loan. **R_1 – correct meaning given**		1	1	
	(ii)	**Main difference between the two promotions** - *A* is offered for an unlimited number of years while *B* is offered for at most 4 years. **R_1 – difference outlined clearly**			1	
	(iii)	**Estimated cost of the television using *A* for 4 years** - $10 400 **$CK_1$ – CAO**	1			
	(iv)	**Cost of the television using *A* for 4 years** P = $5 000, R = 20%, T = 4 yrs $A = P\left(1+\frac{r}{100}\right)^n$ $A = \$5\,000\left(1+\frac{20}{100}\right)^4$ **AK_1 – correct substitution** $A = \$5\,000(1.2)^4$ $A = \$5\,000 \times 2.0736$ $A = \$10\,368$ **R_1 – correct computation/CAO** $A = \$10\,400$ (to the nearest hundred)		1	1	
			2	4	3	9

<table>
<tr><td colspan="3"><u>Question 1 continued</u></td><td colspan="3">Profiles</td><td rowspan="2">Total</td></tr>
<tr><td></td><td></td><td></td><td>CK</td><td>AK</td><td>R</td></tr>
<tr><td></td><td>(v)</td><td>Interest rate using Promotion B

P = $5 000, R = x%, T = 4 years
A = $9 600 $\therefore$ I = 9 600 - 5 000 = $4 600
R_1 – finding SI correctly
$R = \frac{100I}{PT}$ AK_1 – transposing formula and substituting correctly
$R = \frac{100 \times 4\ 600}{5\ 000 \times 4}$
R = 23% CK_1 – CAO

N.B. Calculations can also be done at T = 1, 2 or 3 years.</td><td>1</td><td>1</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td>2</td><td>3</td><td>4</td><td>9</td></tr>
<tr><td>(e)</td><td></td><td>Recommendation

<table>
<tr><th></th><th>HP1
($)</th><th>HP2
($)</th><th>A
($)</th><th>B
($)</th></tr>
<tr><td>Deposit</td><td>475</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Amount repayable</td><td>10 800</td><td>12 240</td><td>10 400</td><td>9 600</td></tr>
<tr><td>Monthly instalment</td><td>180</td><td>202</td><td>216.67</td><td>200</td></tr>
</table>
AK_1 – completion of table
– Overall, <u>taking the loan for 4 years with simple interest (Promotion S) will be the best deal.</u> Maharati should buy the television by taking the loan under Promotion S to facilitate the cash purchase.
– Even though the monthly payment for HP1 is <u>$180 (which may better suit Maharati’s financial situation), in the long-run, he will eventually pay more for the television set.</u>

Reasonable recommendation made including the points outlined above – 2 marks</td><td></td><td>1</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>6</td><td>8</td><td>6</td><td>20</td></tr>
</table>

Specific Objectives: 1.2.5., 1.2.6, 1.2.7.,1.6.2, 1.6.3

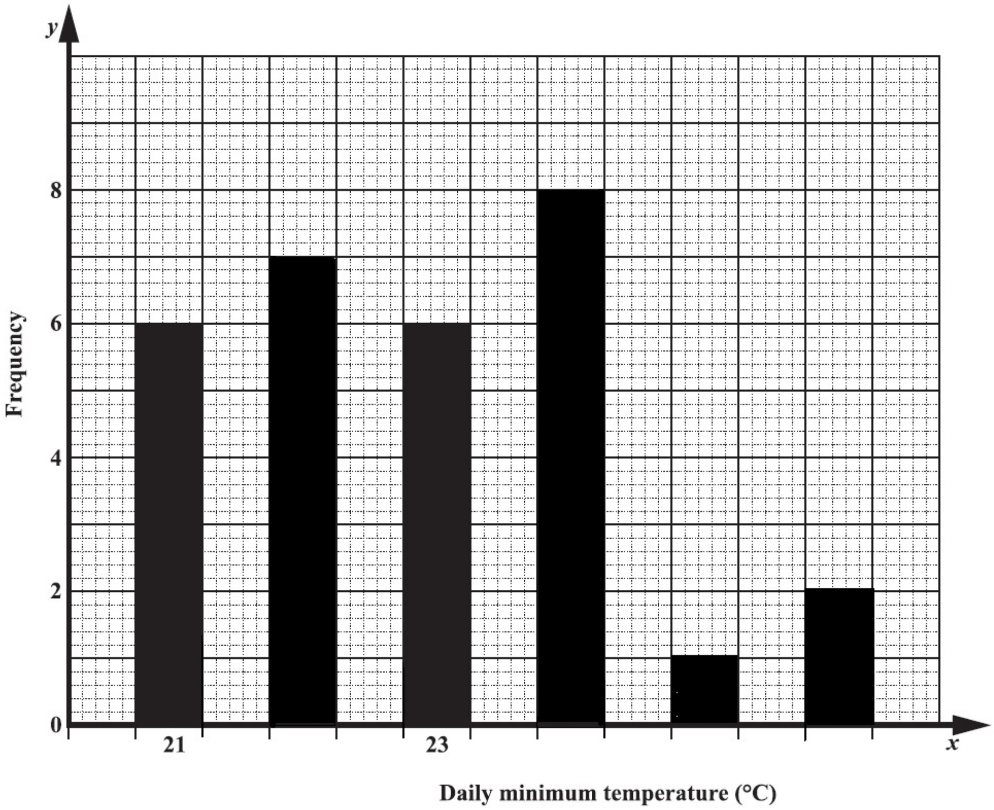
MATHEMATICS

PAPER 032 – GENERAL PROFICIENCY

KEY AND MARK SCHEME

Question 2			**Profiles**			**Total**
			CK	**AK**	**R**	
(a)	(i)	**Title of project** 1. Comparing the daily minimum temperature. readings in Country A over a three-month period 2. An analysis of the daily minimum temperature readings in Country A over a three-month period. 3. How would the average daily minimum temperature reading for September compare with those for January and June in the same year? 4. Any other logical suggestion. **CK_2 – suitable/logical/clear title given** **CK_1 – title given somewhat clear and suitable**	**2**			
	(ii)	**Procedure used to collect data** By recording at least three temperature readings at various segments throughout that day and then selecting the minimum temperature. **AK_1 – appropriate data collection method described**		**1**		
			2	**1**	**0**	**3**
(b)	(i)	**Range of the measurements:** Range = highest to lowest Range = 26 - 21 **AK_1 – subtracting correct values** Range = 5		**1**		

Question 2 continued			**Profiles**			**Total**
			CK	**AK**	**R**	
(b)	(ii)	**Completion of table** Temperature (°C) | Tally | Frequency (f) | $f \times x$ 21 | 𝍸 | | 6 | 126 22 | 𝍸 || | 7 | 154 23 | 𝍸 | | 6 | 138 24 | 𝍸 ||| | 8 | 192 25 | | | 1 | 25 26 | || | 2 | 52 Total | | 30 | 687 **AK_1 – both tallies correct** **CK_1 – both frequencies correct**	1	1		
	(iii)	**a) Mean daily minimum temperature** $\text{Mean} = \frac{\sum fx}{\sum f}$ $\text{Mean} = \frac{687}{30}$ $\text{Mean} = 22.9\ ^\circ C$ **AK_1 – correct values obtained** **b) Median daily minimum temperature** = 23 °C **AK_1 – CAO** **CK_1 – CAO** **c) Modal daily minimum temperature** = 24 °C **CK_1 – correct value obtained**	1 1	1 1		
			3	4	0	7

Question 2 continued			**Profiles**			**Total**
			CK	**AK**	**R**	
(c)	**Completion of graph**  **AK_2 – first 2 bars correct** **CK_1 – either of the last 2 bars correct**		**1**	**2**		
			6	**7**	**0**	**13**

Question 2 continued			**Profiles**			**Total**
			CK	**AK**	**R**	
(d)		**Analysis and interpretation of data** **1.** Of the two months under consideration, the lower average daily minimum temperature was recorded in the month of **January**. The lowest daily minimum temperature recorded for both months was **21°C**. **AK_1R_1 - both underlined parts correct** **AK_1 – either one correct** **2.** In January, the daily minimum temperatures ranged from **21°C to 23°C**, with half the number of values located below **22°C** and the most frequently occurring measurement being **21°C**. In September, the daily minimum temperatures ranged from **21°C to 26°C**, with half the number of values below **23°C** and the most frequently occurring measurement being **24°C**. **Recognizing the range in both cases, R_1, the median, R_1 and the mode, R_1.** **3.** The spread/variation among the measurements was lower in January. This is BEST indicated by the lower **standard deviation** recorded for that month and means that most of the daily minimum temperature readings for that month were **close to the mean/bunched up about the mean.** **Recognizing and comparing the standard deviations – R_1** **Interpretation of the standard deviation – R_1**		1	1 3 2	
			6	8	6	20

Specific Objectives: 2.1.3., 2.1.5., 2.1.6., 2.1.8

MATHEMATICS

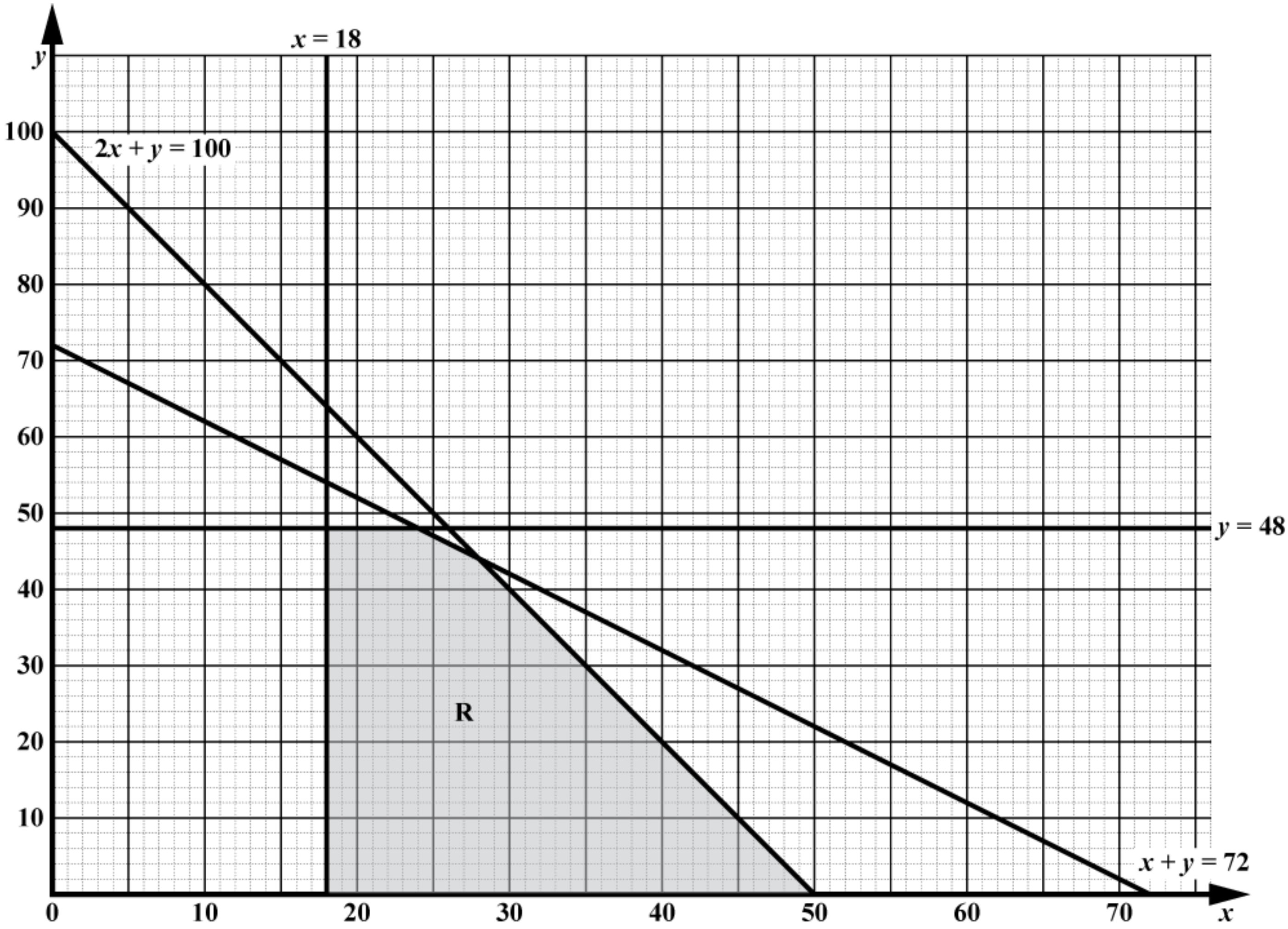
PAPER 032 – GENERAL PROFICIENCY

KEY AND MARK SCHEME

<u>Question 3</u>			**Profiles**			**Total**
			CK	**AK**	**R**	
(a)	(i)	**Title of project** 1. Determining the number of hectares of land to be planted with Crop P and Crop Q to yield maximum surplus and ensure protection of the environment. 2. What number of hectares of available land must be allocated to Crop P and Crop Q to yield maximum surplus and ensure protection of the environment? 3. Any other logical suggestion. **CK_2 – suitable/logical/clear title given** **CK_1 – title given somewhat clear and suitable**	**2**			
	(ii)	**Methods used to collect data** - Interviewing the farmers to collect. information on the constraints. - Collecting documents/researching online to find out information leading to the constraints/solution to the problem. - Survey: distribute a questionnaire to collect the information. **AK_1 – appropriate data collection method stated**		**1**		
			2	**1**	**0**	**3**
(b)		**Inequalities** 1. $x + y$ £ 72 **AK_1 – CAO** 2. $20x + 10y$ £ 1000 $2x + y$ £ 100 **R_1 – either inequality given** 4. y £ 48 **CK_1 – CAO**	**1**	**1**	**1**	
			3	**2**	**1**	**6**

Question 3 continued

(c)



		Profiles			Total
		CK	AK	R	
	Graph **Correct line, y = 48 – CK_1** **Correct line, x + y = 72 – AK_1** **Correct line, 2x + y = 100 – AK_1R_1** **Correct location of the common region – R_1**	**1**	**2**	**2**	**5**

Question 3 continued			Profiles CK	Profiles AK	Profiles R	Total
(d)	(i)	**Maximum expected surplus** $S = 1520x + 1210y$ **R_1 – CAO**			1	
	(ii)	**Completion of statement** x / y / S: 18 / 48 / \$85 440 24 / 48 / \$94 560 **28 / 44 / \$95 800** 50 / 0 / \$76 000 18 / 0 / \$27 360 To gain the maximum expected surplus of \$95 800, the farmers must plant **28** hectares of land with Crop P and **44** hectares of land with Crop Q. **AK_1 – having both values correct**		1		
			0	1	1	2
(e)	**Completion of table** (see table below) **Having the "additional investment" row correct – R_1** **Having the "savings" row correct – AK_1** **Having the "members' dividends" row correct – CK_1** **Pie chart visually correct - R_1** **Additional investment sector - CK_1** **Members' dividends sector - AK_1** **Charity and education sectors same but different than savings - AK_1**		2	3	2	
			6	8	6	20

Table for (d)(ii):

x	y	S
18	48	\$85 440
24	48	\$94 560
28	**44**	**\$95 800**
50	0	\$76 000
18	0	\$27 360

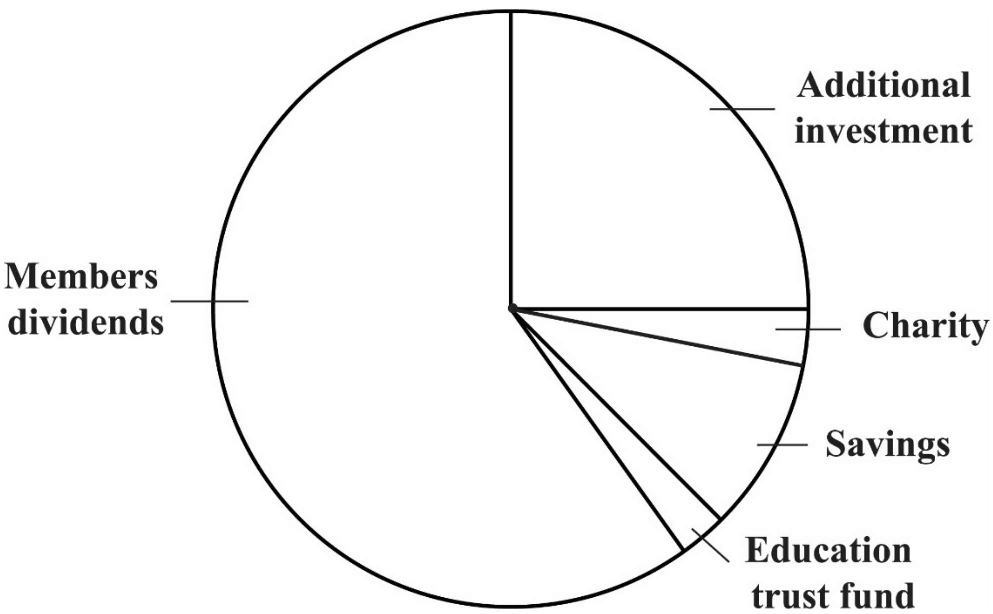
Table for (e):

Item	Percentage (%)	Amount of Surplus \$	Sector Angle on Pie Chart (in degrees)
Additional investment	**25**	**23 950**	90°
Charity	2.5	2 395	9°
Savings	10%	**9 580**	**36°**
Education trust fund	2.5	2 395	9°
Members' dividends	**60%**	57 480	**216°**

Specific Objectives:3.2.3., 3.1.3

Question 3(e) continued

Pie chart showing the distribution of surplus



Comparing the Heights of Male and Female Students in Form 5 at Jay's Community School

Candidates:

Candidate 1
Candidate 2
Candidate 3
Candidate 4

Table of Contents

Title

Comparing the heights of male and female students in Form 5 at Jay’s Community School.

Introduction

Jay’s Community School is a co-educational institution that has been assisting students with viewing study in a more positive light so that they can excel academically and enjoy other aspects of life. There are four Form 5 classes: 5A, 5B, 5C and 5D. The Form 5 student body has 120 students, comprising 65 females and 55 males.

Generally, males are taller than females. However, we have some extremely tall female students in our year group. This was mentioned in a discussion among a few of us, which raised an interesting question about which gender is taller, on average, in our form. As a result of this curiosity, we decided to investigate which of the two genders is taller. To do this, we measured the heights of some students from the Form 5 population, using appropriate measuring tools: measuring tape, spirit level, pens and paper. We then collated and analysed this data by comparing statistical measures in order to deduce the taller gender.

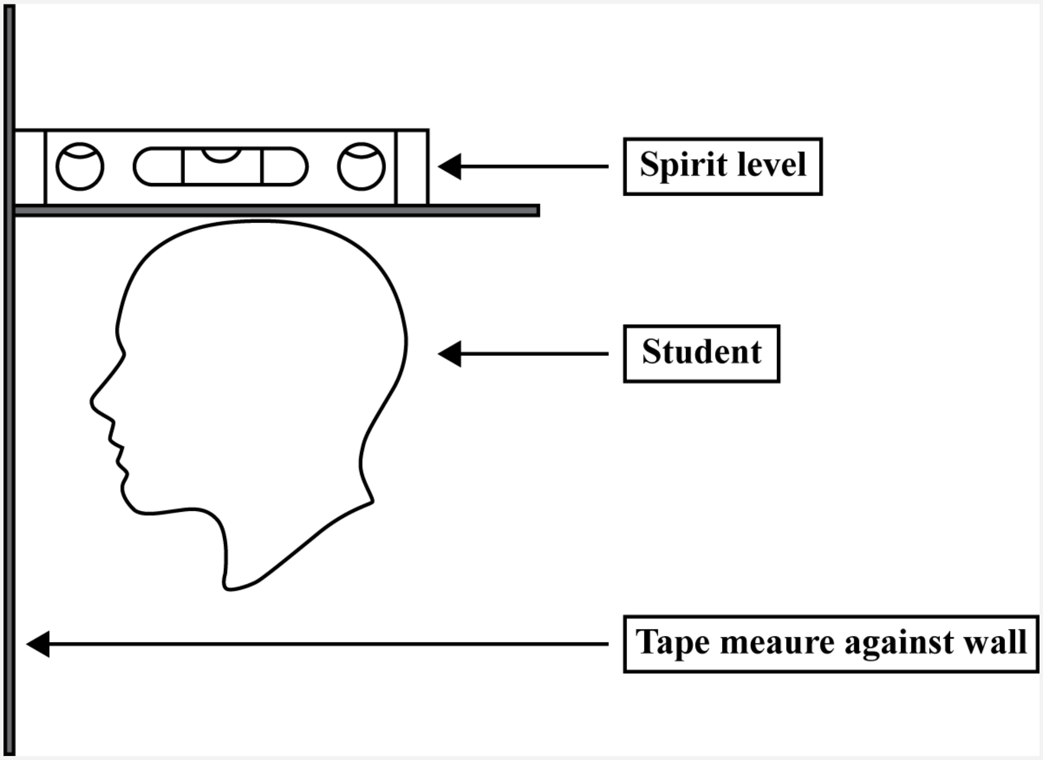
Method of Data Collection

For our investigation, we took height measurements from 64 students, 32 males and 32 females. Eight male students and eight female students were randomly chosen from each of the four Form 5 classes. To facilitate this process, we sought and obtained permission to measure the heights of the selected students. During our Mathematics periods on the 22nd and 24th of February, our team, accompanied by our Mathematics teacher, measured the heights of these 64 randomly selected students.

Our research team ensured that the measuring tape was flush against the wall, completely vertical and touching the ground. To obtain their heights, the students were asked to stand, facing forward, next to the measuring tape. The spirit level was placed on the students' heads ensuring that it was horizontal. The measurements were then recorded (see Figure 1).

We thanked the students for participating in this exercise and the teachers for allowing us to conduct the measurements during class time.

Figure 1: Spirit level



Presentation of Data

Table 1: Data Collected for Boys

Height (cm)	Frequency
160	1
161	2
163	1
164	1
165	1
167	1
169	2
170	1
171	2
172	2
174	3
175	4
176	1
178	3
179	0
181	2
182	1
184	1
185	1
186	1
187	1

Table 2: Data Collected for Girls

Height (cm)	Frequency
141	1
148	1
152	2
155	3
156	2
159	2
161	2
162	4
163	2
164	4
165	3
166	3
167	1
168	1
171	1

Table 3: Cumulative Frequency for all Students

Height (cm)	Frequency	Cumulative Frequency
< 150	2	2
150 – 154	5	7
155 – 159	5	12
160 – 164	20	32
165 – 169	9	41
170 – 174	12	53
175 – 179	4	57
180 – 184	5	62
185 – 189	2	64

Table 4: Cumulative Frequency for Boys

Height (cm)	Frequency	Cumulative Frequency
< 150	0	0
150 – 154	0	0
155 – 159	1	1
160 – 164	5	6
165 – 169	4	10
170 – 174	11	21
175 – 179	4	25
180 – 184	5	30
185 – 189	2	32

Table 5: Cumulative Frequency for Girls

Height (cm)	Frequency	Cumulative Frequency
< 150	2	2
150 – 154	5	7
155 – 159	4	11
160 – 164	15	26
165 – 169	5	31
170 – 174	1	32
175 – 179	0	32
180 – 184	0	32
185 – 189	0	32

Figure 2

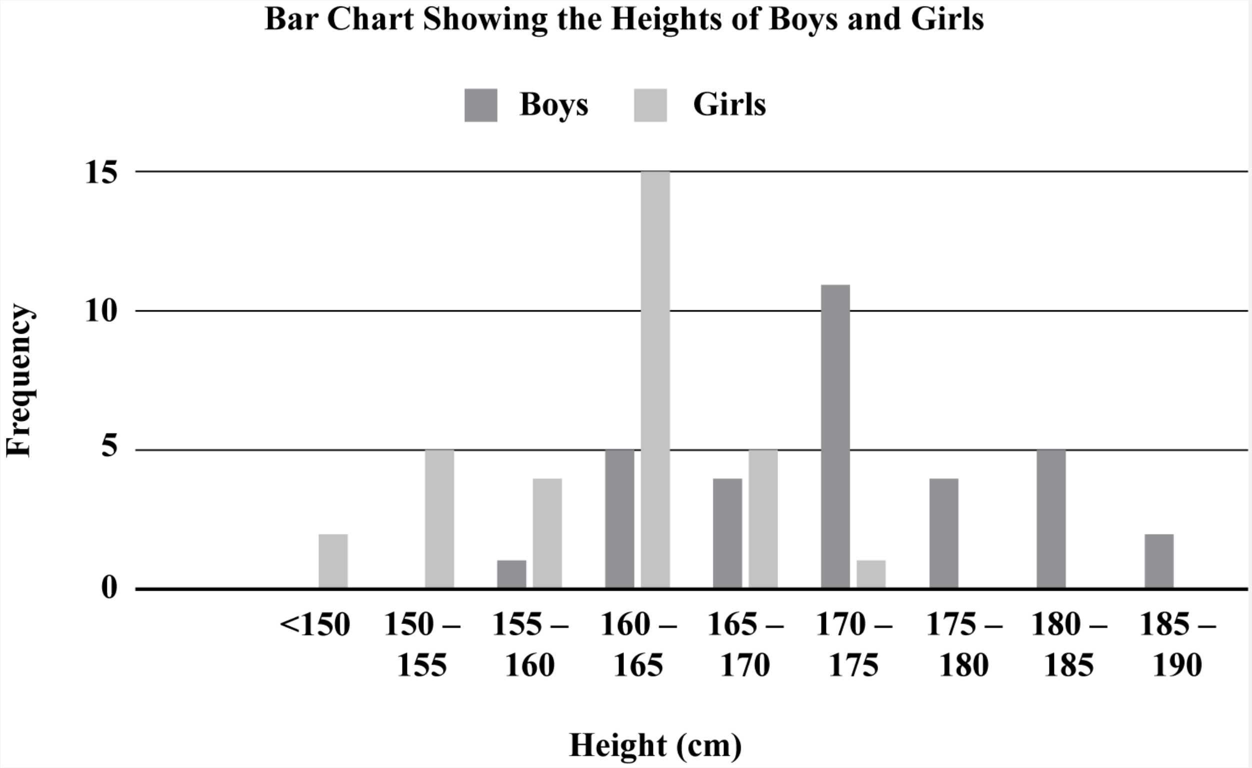


Figure 3

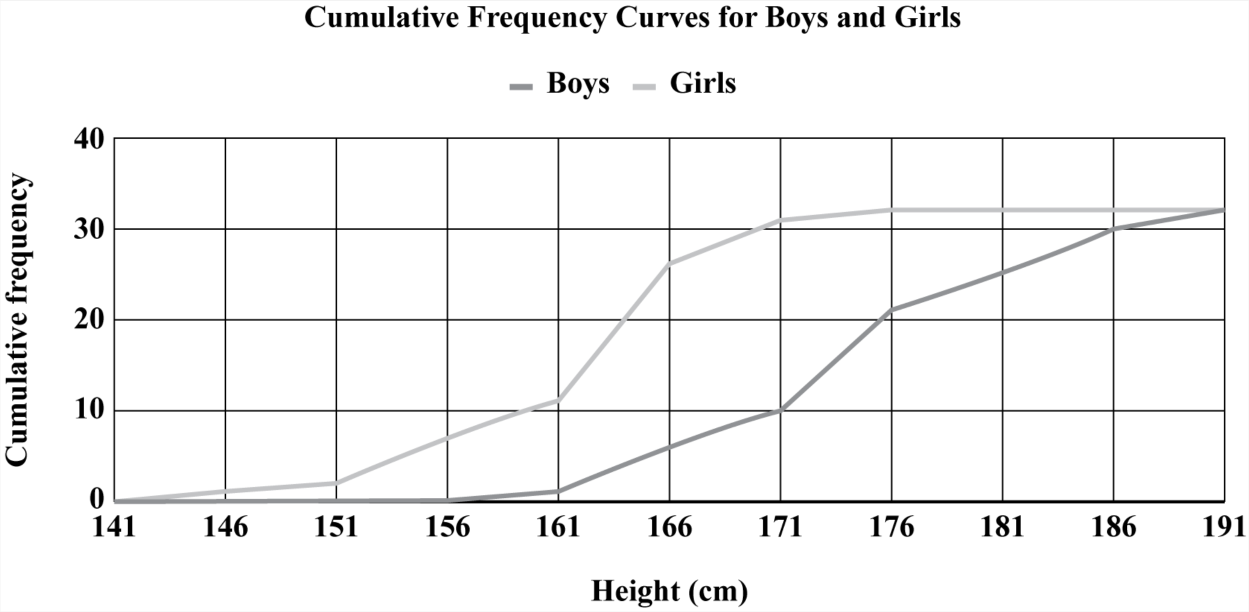
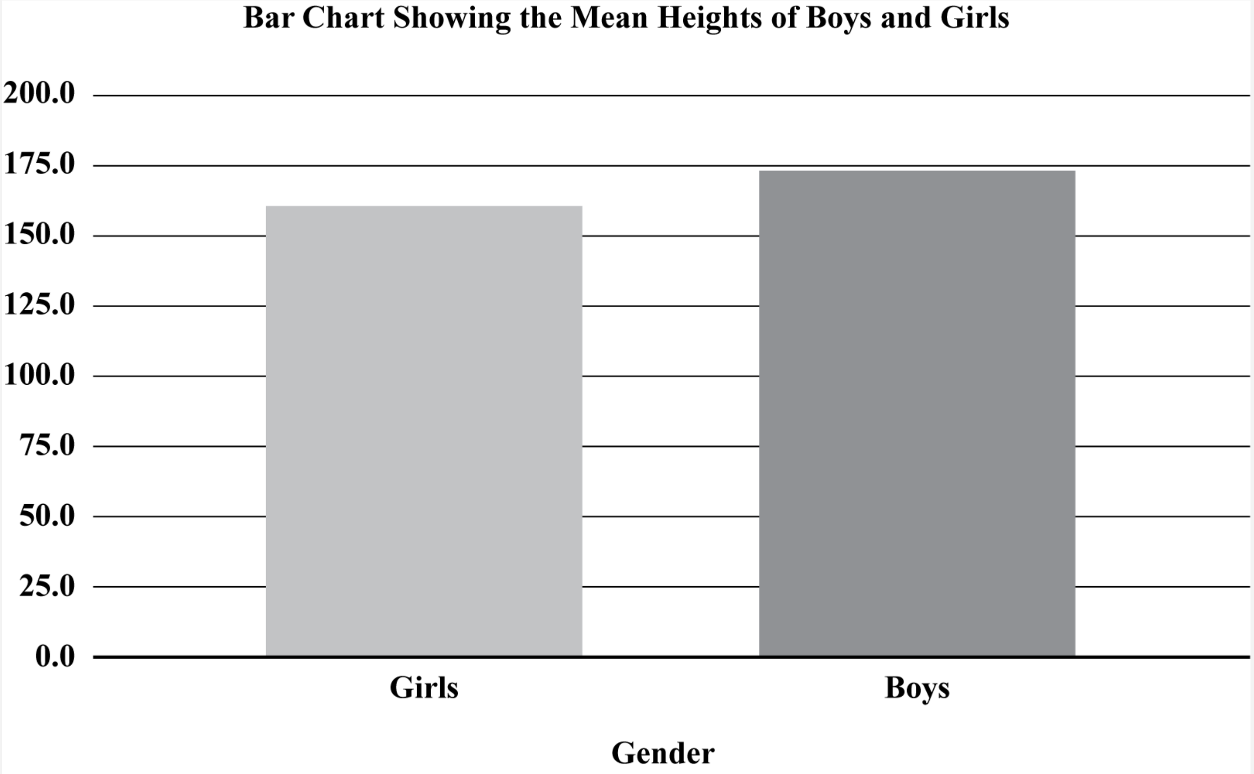


Figure 4



Analysis of Data

Mean

The mean height was calculated for boys, girls and all students using the formula $\underline{x} = \frac{\Sigma x}{N}$.

Where: $\underline{x}$ is the mean

Σx is the sum of the students' heights and

N is the number of students

Boys:

Σx = 5553 cm N = 32

Thus $\underline{x} = \frac{5553}{32}$ = 173.5 cm

Girls:

Σx = 5139 cm N = 32

Thus $\underline{x} = \frac{5139}{32}$ = 160.6 cm

All students:

Σx = 10692 cm N = 64

Thus $\underline{x} = \frac{10692}{64}$ = 167.1 cm

Median

The median height was then found. The median position is the $\frac{1}{2}(N+1)^{th}$ height, where N is the number of students.

Boys:

position = $\frac{1}{2}(32+1)$ = 16.5

Q_2 = 174 cm

Girls: position = $\frac{1}{2}(32+1)$ = 16.5

Q_2 = 162 cm

All students: = $\frac{1}{2}(64+1)$ = 32.5

$Q_2 = \ 165\ cm$

Range

The range was also found using the formula:

range = maximum – minimum

Boys:

max = 187 min = 160

= 187 - 160 = 27

Girls: max = 171 min = 141

range = 171 - 141 = 30

All students:

max = 187 min = 141

range = 187 - 141 = 46

Interquartile Range

The interquartile range of the dataset was then found using the formula:

Interquartile range, I.Q.R = $Q_3 - Q_1$

where:

the upper quartile, $Q_1 = \frac{1}{4}(n+1)^{th}$ height and

the lower quartile, $Q_3 = \frac{3}{4}(n+1)^{th}$ height

Boys:

Q_1 position = $\frac{1}{4}(32+1)$ = 8.25

$Q_1 = 169\ cm$

Q_3 position = $\frac{3}{4}(32+1)$ = 24.75

$Q_3 = 178.75\ cm$

I.Q.R = 9.75 cm

Girls:

Q_1 position = $\frac{1}{4}(32+1)$ = 8.25

$Q_1 = 156\ cm$

Q_3 position = $\frac{3}{4}(32+1)$ = 24.75

$Q_3 = 165\ cm$

I.Q.R = 9

All students:

Q_1 position = $\frac{1}{4}(64+1)$ = 16.25

$Q_1 = 161.25\ cm$

Q_3 position = $\frac{3}{4}(64+1)$ = 48.75

Q_3 = 174 cm

I.Q.R = 12.75

Conclusion

This study aimed at comparing the heights of male and female students in Form 5 from at Jay's Community School. The results showed that the mean height of male students was 173.5 cm, which was greater than the mean height of female students, 160.6 cm. Similarly, the median height of male students, 174 cm, exceeded that of female students, 162 cm. These findings indicate that, on average, male students in Form 5 at Jay's Community School tend to be taller than their female counterparts.

The interquartile range (IQR), which measures the spread of the central 50% of the data, was 9.75 cm for males and 9 cm for females. This suggests that the variability in heights within the middle range is relatively similar for both groups. However, the overall range of heights was greater for females, 30 cm, than for males, 27 cm. This indicates that the overall spread of heights among female Form 5 students was wider than that of their male classmates, suggesting greater height variability among female students.

--- End of SBA ---

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