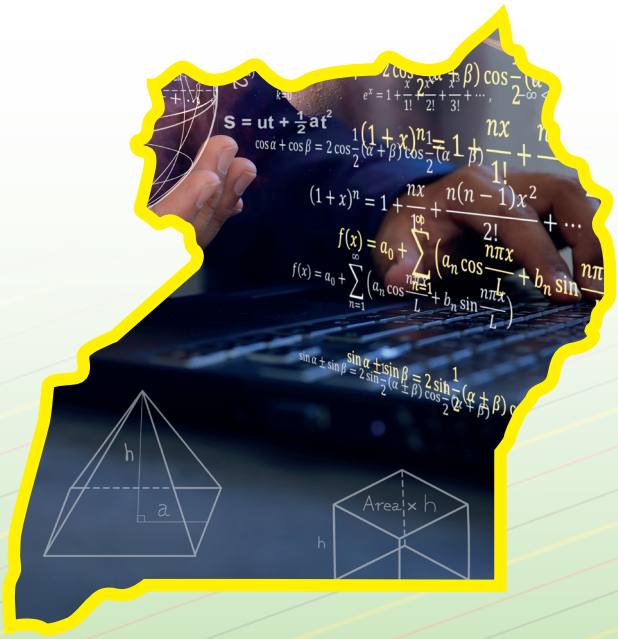
THE REPUBLIC OF UGANDA
Ministry of Education and Sports

ADVANCED SECONDARY CURRICULUM



PRINCIPLE MATHEMATICS ASSESSMENT GUIDELINES

NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE

2026

ADVANCED SECONDARY
CURRICULUM

PRINCIPLE MATHEMATICS
ASSESSMENT GUIDELINES

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DEVELOPMENT CENTRE

A product of the National Curriculum Development Centre for the Ministry of Education and Sports with support from the Government of Uganda

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ISBN: 978-9913- 06-116-2

Contents

Acknowledgements

The National Curriculum Development Centre (NCDC) is indebted to the Government of Uganda for financing the development of these Assessment Guidelines to support the implementation of the Advanced Secondary Curriculum.

Our gratitude goes to the Ministry of Education and Sports for overseeing the development process, the Curriculum Task Force of the Ministry of Education and Sports for the guidance and timely decisions whenever necessary, and members of the public who made helpful contributions towards shaping these Guidelines.

NCDC is also grateful to UNEB, Members of Parliament, schools, universities, and other tertiary institutions, the writing panels, critical reviewers, and professional bodies for their contribution towards the design and development of these Assessment Guidelines. To all those who worked behind the scenes to finalise the production of these Guidelines, your efforts are invaluable.
NCDC takes responsibility for any shortcomings that might be identified in this publication and welcomes suggestions for effectively addressing the inadequacies. Such comments and suggestions may be communicated to NCDC through P. O Box 7002, Kampala, or Email: admin@ncdc.go.ug or on the Website: www.ncdc.go.ug

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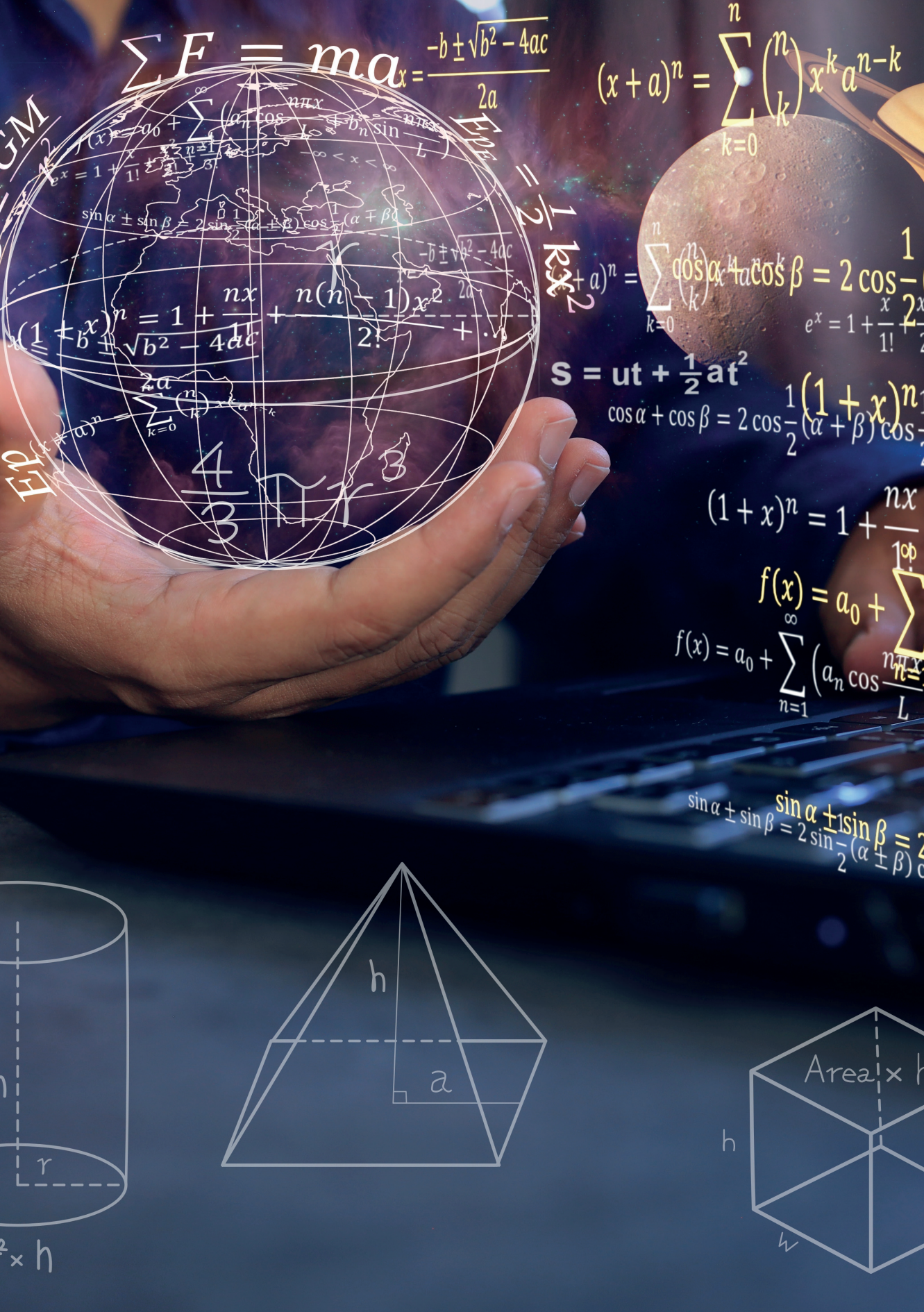
$\sum F = ma$
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
$(x+a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k}$
$S = ut + \frac{1}{2}at^2$
$\cos\alpha + \cos\beta = 2\cos\frac{1}{2}(\alpha+\beta)\cos$
$(1+x)^n = 1 + \frac{nx}{1!}$
$f(x) = a_0 +$
$\sin\alpha \pm \sin\beta = 2\sin\frac{1}{2}(\alpha \pm \beta)$
h
a
r
Area
h

1. Introduction

This assessment guidelines document has been developed as a companion to the Assessment Framework for Advanced Secondary Curriculum and should be read and applied in conjunction with it. The Framework provides the overarching principles, standards, and requirements for assessment across all subjects, while this guideline contextualises those provisions to the specific demands and practices of Principal Mathematics as a subject.

The assessment of Principal Mathematics will be guided by five assessment objectives, drawn from the five assessment constructs. The assessment items will be set at the level of the construct, allowing learners to integrate knowledge, skills and values, drawn from the topics within a construct in order to address a societal challenge or problem. The end of cycle assessment of Principal Mathematics will be administered by the Uganda National Examinations Board (UNEB).

1.1 Assessment Objectives

The end of cycle assessment for Principal Mathematics will be guided by five assessment objectives focusing on the learner's ability to:

AO1: manipulate a wide range of algebraic expressions and equations, evaluate logical proofs and apply these skills to strategically solve real-world problems.

AO2: perform transformations, reason logically, visualise spatial relationships in solving geometrical related challenges in real world.

AO3: apply analytical and numerical skills in mathematical modelling to solve real-life challenges involving rates of change, accumulation and optimisation for decision making.

AO4: predict future trends by analysing and interpreting statistical data using principles of statistics and probability to make reasonable conclusions.

AO5: Apply principles of statics and dynamics to analyse and solve real-world problems involving state of motion of bodies, and to predict their behaviours.

1.2 Linkage Between Assessment Objectives, Constructs and Syllabus

The table below shows a linkage between the assessment objectives, the constructs and the topics in the syllabus that contribute to the construct.

Table 1:

Table showing the relationship between assessment objectives, constructs, and the topics in the syllabus

Assessment Objective	Construct	Construct Description	Topics in the syllabus
AO1	Algebra	Applying algebraic principles to model and solve real-life problems and lead to informed decision making.	1) Numerical concepts 2) Equations and inequalities 12) Permutations and combinations 13) Series 25) Complex numbers
AO2	Geometry	Applying geometric concepts and spatial reasoning to interpret relationships in mathematical and real-life contexts for informed problem solving.	3) Coordinate geometry 1 5) Trigonometry 17) Vectors 24) Coordinate geometry 2
AO3	Calculus	Analysing and modelling of real-life situations involving rates of change, accumulation, and	4) Partial fractions 10) Differentiation 1 11) Integration 1 16) Error analysis

		optimisation of resources.	18) Differentiation 2 19) Integration 2 26) Differential equations 21) Trapezium rule 23) Iterative methods 27) Flow charts
AO4	Data analysis and probability	Analysing data and applying probability models to make informed decisions and predictions in personal, academic, and societal contexts	6) Descriptive statistics 7) Correlation and scatter diagrams 9) Probability theory 14) Random variables 15) Probability distributions 22) Sampling distribution
AO5	Mechanics	Analysing the effect of forces on bodies in motion or at rest, interpreting motion patterns and predict object behaviour and use it to solve real-world kinematic problems.	8) Dynamics 1 20) Dynamics 2

2. Table of Constructs

The table below details the constructs for Principal Mathematics, i.e., the competencies that make up the construct, the expected learner abilities and what the assessor should look out for in the learner's work as evidence of achievement of the intended learning outcomes (indicators of mastery).

Constructs	Topical Competencies The learner:	Abilities The learner should be able to:	Indicator of Mastery The learner:	Level of Complexity
ALGEBRA Applying algebraic principles to model and solve real-life problems and lead to informed decision making.	1) analyses contextual use of indices, logarithms and surds through mathematical computations for precision, developing analytical skills and making informed decisions to communicate effectively.	a) write an index notation. b) relate indices to logarithms. c) write logarithmic notation. d) applies laws of indices and logarithms to simplify expressions. e) apply laws of indices and logarithms to solve equations. f) solve exponentiation problems involving growth and decay.	i) writes index notation. ii) converts index notation into logarithmic notation and vice versa. iii) simplifies expressions involving indices and logarithms. iv) solves index and logarithmic equations. v) uses laws of indices and logarithms correctly in solving equations involving exponential growth and decay.	**HIGH**

		g) differentiate between rational and irrational numbers. h) simplify expressions involving surds. i) solve equations involving surds. j) rationalise surds. k) demonstrate applicability of surds in areas that require high precision and accuracy. l) explain solutions using mathematical notation and language in context of a real-life problem.	vi) simplifies expressions involving surds. vii) solves equations involving surds. viii) demonstrates applicability of surds in areas that require high precision and accuracy. ix) correctly interprets solutions in surd form.	
	2) investigates equations and inequalities to acquire mathematical, computational and analytical skills	a) solve quadratic equations using different methods e.g., graphical, factorisation,	i) solves quadratic equations using different methods. ii) determines sums and products of roots of quadratic equations.	

	applicable in the real world	completing squares, quadratic formula. b) relate sum and product of roots to coefficients of a quadratic equation. c) formulate quadratic equations given roots. d) express roots as sum and product. e) solve simultaneous equations where one is linear and the other quadratic. f) solve linear simultaneous equations in three variables using various methods. g) use graphical methods and algebraic techniques to solve quadratic inequalities.	iii) formulates quadratic equations given roots. iv) applies quadratic equations to model and solve real-life situations. v) formulates and solves linear simultaneous equations in three unknowns. vi) uses correct methods in solving linear simultaneous equations in three variables and evaluates their solutions. vii) draws graphs of quadratic inequalities. viii) obtains optimal solutions.	

		h) solve a real-world problem involving optimisation of resources. i) solve logarithmic equations that reduce to quadratic. j) solve exponential equations that reduce to quadratic. k) solve irrational equations that reduce to quadratic. l) determine minimum and maximum values by completing squares and graphical method. m) determine the nature of roots and discriminant. n) develop mathematical models for real-life situations.	ix) solves quadratic inequalities using algebraic techniques. x) expands and factorises polynomial expressions. xi) solves polynomials (with or without repeated roots). xii) computes the remainder when the divisor is linear or quadratic when the polynomial is known or unknown. xiii) uses Mathematics to justify and support decisions.	

		o) present optimised solutions with justification. p) solve polynomial problems, including linear, quadratic, and higher-degree equations. q) use division of polynomials to understand properties of polynomials like remainder and factor theorems. r) relate polynomial to other Math concepts, such as geometry, trigonometry, and calculus to model and solve real-word problems.		

		s) solve three-linear simultaneous equations using substitution, elimination and matrix /row reduction to echelon form methods. t) solve real-world problems that involve three linear simultaneous equations. u) solve linear inequalities. v) determine solutions of quadratic inequalities using graphical and algebraic techniques. w) formulate a polynomial. x) determine the degree of a polynomial.		

		y) use long division to determine the quotients and remainders. z) apply remainder theorem. i) use factor theorem to factorise a polynomial. ii) determine roots and factors of a polynomial equation. iii) determine a remainder of a polynomial with repeated roots.		
	12) applies the permutations and combinations concepts to solve mathematical problems and models	a) arrange objects in different ways. b) write a factorial notation. c) use factorial notation to determine the number of arrangements.	i) applies the concept of permutations to count and arrange objects in different orders.	

	solutions to real-world situations.	d) write the permutation formula. e) compute permutations for identical objects with or without repetitions, with restrictions, and circular arrangements. f) select items from a group. g) write the combination formula. h) differentiate between combinations and permutations i) evaluate combinations with restriction. j) apply combination and permutation in the real-world situations.	ii) calculates permutations, with and without repetition, with and without restrictions, using formulas and factorials. iii) applies permutations to solve real- world problems and identifies patterns and relationships. iv) accurately calculates combination values in a set of various scenarios. v) applies combination to solve problems involving selection, grouping, and counting in real-world contexts.	

	13) applies principles and techniques of series and binomial expansions to understand and solve mathematical and scientific problems in the real world.	a) identify a series. b) identify the relationship between a sequence and a series. c) identify common difference and common ratio. d) generate an arithmetic progression and geometrical progression. e) determine the nth term of arithmetic progression and geometrical progression. f) determine the sum of an arithmetic progression and geometrical progression.	i) defines, identifies and solves problems involving arithmetic progressions. ii) analyses and interprets arithmetic progressions in real-world contexts, such as finance and science. iii) accurately derives and applies formulas for geometrical progressions. iv) solves problems involving geometrical sequences and series. v) applies geometrical progressions to model and solve real-world problems.	

		g) Analyse the convergence of a g.p to determine the sum to infinity. h) model real-world situations using arithmetic progressions, such as calculating interest rates or population growth, radioactivity, and cell division. i) model real-world situations using geometrical progressions like compound interest, and exponential decay. j) prove mathematical statements and formulas using inductive reasoning.	vi) correctly proves mathematical statements and formulas using inductive reasoning. vii) accurately expands expressions using the binomial theorem. viii) correctly identifies and calculates specific terms or coefficients in a binomial expansion. ix) uses binomial theorem to compute roots of numerical values. x) determines the range of values within which binomial theorem is valid.	

		k) generate pascal's triangle to expand expressions of the form $(a + b)^n$ l) determine coefficients of terms in expansion $(a + b)^n$ m) deduce the binomial expansion. n) expand the terms of binomial theorem in ascending and descending order. o) use binomial theorem to: 1) compute a particular term and roots of numerical values. 2) state range of validity of binomial expansion.		

	25) applies concepts of complex numbers to solve modelling problems across different mathematical and real-world scenarios.	a) identify a complex number. b) determine the real and imaginary parts of a complex number. c) simplify expressions involving complex numbers. d) determine the square roots of a complex number. e) solve equations with complex roots. f) relate complex numbers to the Cartesian coordinate system. g) determine the argument and modulus of a complex number. h) write a complex number in polar form. i) describe the locus of a complex equation. j) represent the locus of a complex equation	i) performs operations on complex numbers. ii) solves equations with complex roots. iii) represents a complex number on an argand diagram. iv) expresses a complex number in modulus argument form. v) describes and represents locus of a complex equation or inequality on graph. vi) applies De Moivre's theorem in determining roots and powers of complex numbers, simplification of trigonometrical expressions and solving equations. vii) explores and investigates	

		and inequality on a complex plane. k) apply De Moivre's theorem in determining roots and powers of complex numbers, simplification of trigonometrical expressions and solving equations. l) explore and investigate applications of complex numbers in real-life situations.	applications of complex numbers in real-life situations.	
GEOMETRY Applying geometric concepts and spatial reasoning to interpret relationships in mathematical and real-life contexts for informed problem solving.	3) analyses linear relationships to solve geometric problems and interpret spatial relationships in real-life situations.	a) analyse geometry of a line to demonstrate understanding and visualisation of geometrical relationships. b) locate coordinates of any point on a line and sub divide a line.	i) analyses the geometry of a line to demonstrate understanding of geometrical relationships. ii) locates coordinates of any point on a line and sub divides a line.	HIGH

		c) determine the angle between a line and the x-axis. d) determine the angle between lines. e) relate gradients of parallel lines and perpendicular lines. f) determine shortest distance between a line and a point. g) solve real-life problems involving geometric concepts.	iii) interprets the relationship between the angle between lines and their gradients. iv) determines the shortest distance between a line and a point. v) uses ICT related aids to demonstrate geometrical concepts and their applications in real life.	
	5) trigonometric functions, identities, and equations to solve problems in Mathematics and real-life application in navigation, construction, aviation and other fields.	a) relate sides of a right-angled triangle to its angles. b) plot trigonometric graphs of sine, cosine and tangent functions.	i) relates sides of a right-angled triangle to its angles. ii) plots trigonometric graphs of sine, cosine and tangent functions.	

		c) determine angles of given functions in a given range. d) derive trigonometric ratios of 30^0, 45^0 and 60^0 *30^0, 45^0 and 60^0.* e) derive a variety of identities using trigonometric relationships. f) simplify expressions and proves trigonometric relationships. g) solve different trigonometric equations based on different identities. h) solve equations using inverse trigonometric functions.	iii) determines angles of given functions in a given range. iv) derives trigonometric ratios of 30^0, 45^0 and 60^0 *30^0, 45^0 and 60^0.* v) derives a variety of identities using trigonometric relationships. vi) simplifies expressions and proves trigonometric relationships. vii) solves different trigonometric equations based on different identities. viii) applies concepts of trigonometry to solve real-life challenges.	

		i) apply trigonometric concepts to solve real-life challenges.		
	17) applies vector concepts to model and solve mathematical and physical problems in 2D and 3D spaces.	a) Simplify expressions that involve vectors in 3D b) Determine the displacement between two points in 3D c) Identify whether vectors are parallel or perpendicular d) Analyse cartesian equation of a line e) Determine angle between two lines and point of intersection f) Determine the distance of a point from a line g) Analyse and interpret a geometric plane in 3D	i) Analyse the geometry of a line and a plane in 3D and their relationships. j) Analyses and determines the relationships between planes /planes and lines to solve real world problems.	

		h) develop geometrical models in real world Scenarios		
	24) applies algebraic and geometric techniques to analyse spatial relationships applicable in real-world contexts.	a) construct and interpret geometric shapes and patterns using loci. b) use geometric and differentiation concepts to interpret geometry of a circle, parabola and ellipse. c) solve real-world problems involving: o loci. o circles and their properties in designing circular structures, calculating distances and areas. o parabola. o elliptical shapes.	i) derives equations of loci for various geometric shapes and conditions. ii) Interprets geometry of a circle, parabola and ellipse. iii) includes tangents and solved geometrical problems.	

CALCULUS Analysing and modelling of real-life situations involving rates of change, accumulation, and optimisation of resources.	4) decomposes rational expressions into partial fractions useful in integral calculus and real-world context.	a) simplify the sum or difference of fractions as a single fraction. b) express an improper fraction into the sum of the quotient and proper fraction. c) decompose the denominator of proper fractions into a product: 1) linear factors. 2) repeated factors. 3) unfactorisable Quadratic factors. d) express a given fraction in partial form using various techniques. e) decompose rational fractions to solve real-world situations e.g., signal processing in communication.	i) explains clearly the different types of algebraic fractions. ii) breaks down fractions into proper and improper fractions into partial fractions. iii) decomposes rational fractions to solve real world situations e.g., signal processing in communication.	HIGH

	10) Applies differentiation techniques to solve problems in calculus and interprets their significance in real-world contexts.	a) differentiate functions using first principles and power rule. b) differentiate parametric, implicit and composite functions using the different differentiation techniques e.g., chain rule, product rule and quotient rule. c) sketch irrational curves. d) apply differentiation to determine velocity and acceleration given displacement. e) solve real-life situations that involve optimisation of resources.	i) differentiates functions using first principles and power rule. ii) differentiates parametric, implicit and composite functions using the different differentiation techniques e.g., chain rule, product rule and quotient rule. iii) sketches irrational curves. iv) applies differentiation to determine velocity and acceleration. v) solves real-life situations that involve optimisation of resources.	

	11) applies integration techniques to solve problems involving areas under curves, accumulation of quantities, and other real-world applications.	a) compute definite and indefinite integrals to determine area under the curve(s) and volume of solids of revolution. b) apply integration concepts to solve real –world problems in various fields like motion.	a) computes definite and indefinite integrals to determine area under the curve(s) and volume of solids of revolution. b) applies integration concepts to solve real –world problems in various fields like motion.	
	18) applies differentiation techniques to non-algebraic functions, Maclaurin's series and irrational curves to analyse real-world phenomena in various fields.	a) use various techniques to differentiate: i) trigonometric functions. ii) inverse trigonometric functions. iii) exponential and logarithmic functions. iv) algebraic functions. b) relate exponential functions to natural	i) differentiates various functions using various techniques. ii) applies Maclaurin's theorem to approximate values. iii) correctly sketches curves.	

		logarithms and deduce their derivatives. c) generate and applies Maclaurin's theorem to approximate functions and truncate series to a desired degree. d) analyse the behaviour of rational curves and sketches them. e) apply differentiation techniques in various fields to address real-world problems.		
	19) applies appropriate methods of integration to solve real-world problems.	a) integrate functions using different integration techniques. b) use appropriate integral techniques in solving real-life scenarios.	i) integrates functions using different integration techniques. ii) uses appropriate integral techniques in solving real-life scenarios.	

	26) models and solves problems involving rates of change to interpret the solutions for prediction in context for acquisition of analytical skills.	a) model and solve first order differential equations using various techniques. b) create and present solutions to differential problems using various media, such as written reports, graphs or tables. c) solve real-world scenarios involving prediction of population growth/decline, forensic analysis (time of death estimation), drug absorption, and rainfall formation.	i) solves first order differential equations using various methods. ii) models real-world scenarios using differential equations displaying an understanding of mathematical concepts.	

	16) analyses errors in mathematical operations and functions to understand the role of precision and accuracy in problem-solving.	a) compute absolute error, relative error and percentage errors. b) determine the limits of accuracy. c) derive and compute errors in the sum, difference, product and quotient of expressions. d) derive the formulae for error propagation in functions. e) apply errors in real-world phenomena e.g., in business. f) identify the sources and effects of errors in calculations and functions.	i) correctly applies formulas and mathematical principles related to error analysis. ii) explains the significance of errors in their results and conclusions. iii) examines the sources of errors in real-world problems. iv) documents error analysis process and results. v) uses mathematical tools and techniques to minimise errors in various contexts.	

	21) applies the trapezium rule to estimate definite integrals and areas under a curve to solve problems involving numerical integration.	a) determine the approximate area under the curve. b) compare the approximate area with the exact area.	i) compares exact and approximate area and draws conclusions on how the error can be reduced.	
	23) applies iterative numerical methods to approximate solutions to problems while critically analysing accuracy and limitations of methods used in real-life situations.	a) predict the non-tabular points or values that are within and outside the table of values. b) estimate the roots of the transcendental functions using linear interpolation and Newton Raphson methods. c) analyse accuracy and limitations of using linear interpolation and Newton Raphson methods in real-life scenarios.	i) predicts the non-tabular points or values that are within and outside the table of values. ii) estimates the roots of the transcendental functions using linear interpolation and Newton Raphson methods.	

	27) develops flowcharts to organise and represent mathematical processes and problem-solving strategies by breaking down complex tasks into simpler, more manageable steps, and applies these skills to tackle emerging challenges.	a) design an algorithm to solve a problem. b) create a visual representation of mathematical processes to solve a problem. c) analyse the flowchart to ensure it effectively solves the given mathematical problem.	i) creates a visual representation of mathematical processes to solve a problem. ii) analyses the flowchart to ensure it effectively solves the given mathematical problems.	
DATA ANALYSIS AND PROBABILITY Analysing data and applying probability models to make informed decisions and predictions in personal, academic, and societal contexts.	6) analyses data through collection, presentation, and evaluation of population parameters and sample statistics in order to predict and plan for self and community development.	a) organise data and represents it graphically (histogram and Ogive) and use it to estimate mode and measures of relative position. b) compute measures of central tendency, measures of spread and relative positions.	i) organises and represents data on graph to estimate mode and measures of relative position. ii) interprets solutions to predict and make informed decisions. iii) uses ICT tools to analyse data for	HIGH

		c) interpret solutions, predicts and make informed decisions. d) use ICT tools to analyse data for prediction of real-world situations.	prediction of real-world situations.	
	7) investigates the relationship between two quantitative variables through graphical representation and evaluation of correlation coefficients for decision making and prediction.	i) draw scatter plot and predict the line of best fit. ii) compute the rank correlation coefficients of a set of data. iii) comment on correlation coefficients and scatter graphs using different approaches. iv) analyse the given data to draw a relationship between two variables.	i) draws scatter plots and predicts the line of best fit. ii) computes the rank correlation coefficients of a set of data. iii) comments on correlation coefficients and scatter graphs using different approaches. iv) analyses the given data to draw a relationship between two variables.	

		v) use ICT tools to draw scatter plots between two variables and predicts relationships.	v) uses ICT tools to draw scatter plots between two variables and predicts relationships.	
	9) evaluates probabilities through applying the probability laws and theorems to predict the occurrence of events in real life.	a) determine the chance of occurrences of different events in different situations. b) apply probability theory in real life to solve problems.	i) analyses a situation, and chooses an appropriate approach to determine the probabilities of different events in different situations.	
	14) models and analyses the outcomes of random phenomena through determining probabilities and expected values for prediction of uncertainties in real life.	a) differentiate between a discrete and a continuous random variable. b) formulate a probability distribution of a discrete random variable. c) determine probabilities,	ii) analyses different random variable situations, calculates key statistical measures and makes predictions. iii) identifies, models, and interprets real-life situations using discrete and	

		measures of central tendency, measures of dispersion and relative positions of discrete and continuous random variable. d) determine the cumulative distribution function of a discrete and continuous random variable and sketches the P.d.f and c.d.f respectively. e) use a c.d.f to obtain unknowns, probabilities, and measures relative positions. f) investigate the application of discrete and continuous random variables.	continuous random variables. iv) justifies choice of distribution, and evaluates implications of probabilistic outcomes.	

	15) demonstrates the ability to analyse and apply binomial, rectangular, and normal distributions to solve real-world problems.	a) determine probabilities using a binomial formula and mathematical tables. b) determine mean, mode and variance of a binomial distribution. c) determine the probabilities, mean, mode and variance in a rectangular distribution. d) determine probabilities of the normal distribution. e) de standardise the normal variables to determine parameters. f) describe conditions for binomial to be approximated by normal distribution.	i) interprets a scenario and uses an appropriate probability. distribution to compute statistical measures. ii) models a statistical situation and uses ICT tools to analyse a statistical measure, predicts and makes informed decisions.	

		g) determine probabilities, expectation and variance under normal approximation to binomial distribution. h) model a statistical situation and uses ICT tools to analyse a statistical measure, predict and make informed decisions.		
	22) estimates population parameters by using sample distributions to predict and eliminate variability in research and collection of statistical data.	a) standardise the sample mean and use the standardised variable to determine the probabilities. b) determine point estimates and interval estimates of population parameters.	i) standardises the sample mean and uses the standardised variable to determine the probabilities. ii) determines point estimates and interval estimates of population parameters.	

		c) compute the confidence interval for population mean when the population variance is known or unknown for large sample (n≥30*n≥30).* d) interpret the results of confidence intervals and point estimates in the context of real-world problems.	iii) computes the confidence interval for population mean when the population variance is known or unknown for large sample (n≥30*n≥30*). iv) interprets the results of confidence intervals and point estimates in the context of real-world problems.	
MECHANICS Analysing the effect of forces on bodies in motion or at rest, interpreting motion patterns and predicting object behaviour and using it to solve real-world kinematic problems	8) determines the resultant force and analyses the effect of forces on bodies by applying Newton's laws to solve problems in real-world phenomena.	a) determines resultant force and direction of the resultant of any number of forces and in polygons. b) analyse forces in moving and static bodies.	i) analyses forces in moving and static bodies. ii) develops mathematical models to describe the behaviour of bodies under the influence of friction on various surfaces.	HIGH

		c) develop mathematical models to describe the behaviour of bodies under the influence of friction on various surfaces.		
	20) analyses motion patterns of objects as observed from different reference points to predict their behaviour and solving kinematic issues.	a) determine the resultant, relative and true velocity of moving bodies and their displacement at any time. b) evaluate the distance time and course for closest approach and collision to simplify motion related problems. c) apply equations of motion to solve problems projectiles in the vertical, horizontal, and at an angle in relation to real-world scenarios.	i) determines the resultant, relative and true velocity of moving bodies and their displacement at any time. ii) evaluates the distance time and course for closest approach and collision to simplify motion related problems. iii) applies equations of motion to solve problems projectiles in the vertical, horizontal, and at an angle in relation to real-world scenarios.	

3. Structure of the Assessment Papers

There will be two assessment papers for Principal Mathematics at Advanced Secondary Curriculum (ASC).

Paper 1:

This Paper assesses mathematical concepts in the constructs of Algebra, Geometry and Calculus. The paper will assess the learner's ability to apply mathematical principles in practical problem-solving and real-world applications.

The items in the paper will be scenario-based. The paper will have five equally weighted items. One item in Section A will be on Geometry, two items in Section B will be on Algebra, and two items in Section C will be on Calculus. The learner will be required to attempt one item from each section.

The Paper will last $2\frac{1}{3}$ hours. (Each item will take 40 minutes and 20 minutes for the learner to read through and make a choice out of the optional items).

Paper 2:

This Paper assesses mathematical concepts in the constructs of Data Analysis and Probability, and Mechanics. The Paper will assess the learner's ability to apply mathematical principles in practical problem-solving and real-world applications.

The items in the Paper will be scenario-based. The Paper will have 4 equally weighted items from two sections. Two items in Section A will be on Data Analysis and Probability, and the other two items in section B will be on Mechanics. The learner will be required to attempt two items from section A and one item from section B. The Paper will last $2\frac{1}{4}$ hours. (Each item will take 40 minutes and 15 minutes for the learner to read through and make a choice out of the optional items).

Principal Mathematics

Paper 1

November 2025

Time: $2\frac{1}{3}$ hours

UGANDA ADVANCED CERTIFICATE OF EDUCATION

SAMPLE EXAMINATION PAPER

PRINCIPAL MATHEMATICS

Paper 1

Time: 2 hours and 20 minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of **three** *sections;* **A, B** and **C.** *It has five assessment items.*
Section **A** has **one compulsory** item.
*Section **B** has* **two** *items. Answer **one** item **only**.*
*Section **C** has* **two** *items. Answer **one** item **only**.*
*Answer a total of **three** items.*
Any additional item(s) answered will **not** *be scored.*
All *answers* **must** *be written in the answer booklets/sheets provided.*
Graph paper is provided.
Silent non-programmable scientific calculators and mathematical tables with a list of formulae may be used.

FOR OFFICIAL USE ONLY		
SECTION A	ITEM 1	
SECTION B	ITEM 2	
	ITEM 3	
SECTION C	ITEM 4	
	ITEM 5	
	TOTAL	

SECTION A

ITEM 1

A community is experiencing weak network signal. A telecom company plans to put up a mast to serve three towns, A, B and C whose map coordinates (in hectometres) are (1,1) and (7,1) and (1,9) respectively. The mast must be positioned equidistant from all the three towns. A dish will be mounted on a mast at a height, h (in hectometres) so that the signal to any of the town makes an angle of 60^0 with the horizontal.

The signals transmitted by the dish are modelled by $s(\theta) = 12cos\theta + 5sin\theta$, where θ is the angle of the dish's inclination and $s(\theta)$ is signal strength in the direction θ.

The company wishes to determine the mast location, suitable height, the maximum signal strength and the angle at which it occurs for proper planning.

The community well-wisher also plans to construct a community school along a path that connects all the three towns and keeps a constant distance from the mast to ensure steady network coverage.

Task:

a) Help the company to plan accordingly.

b) Analyse the path that connects the three towns and advise the community well- wisher where to construct the school. Justify your reasoning.

SECTION B

ITEM 2

Mr. Katende, a local farmer, is planning to expand his operations by investing in a new sustainable farming project. He is evaluating two financial options over a five- year planning period; to either invest first and use the proceeds later or borrow from a microfinance institution to expand immediately.

Option A: He can delay expansion and earn interest first by investing 20 million in a fixed deposit account that offers an annual interest rate of 8%, compounded semi-annually. He plans to withdraw the accumulated amount after 5 years to fund the farm expansion.

Option B: He could combine his own 20 million with a loan of UGX 15,000,000 taken from a microfinance institution to expand immediately. The microfinance uses a digital loan system that applies interest at continuous compounding rate. For agricultural loans, there is one -year grace period—during which no interest accrues, before loan repayment begins. He has been informed that a loan of similar amount with no grace period grew to UGX.17,624,000 in two years. Mr. Katende wishes to know how much he would owe if he gets the loan of UGX. 15,000,000 for five years.

To optimise production, he aims to ensure his production methods remain profitable while conserving soil fertility and minimising financial risk. The agricultural consultant provides the following information: the crop yield Y (in kg) responds to fertiliser, x in kg per acre according to the function $Y(x) = 500 + 40x - 2x^2$; the crops sell at UGX. 3500 per kg, the cost of the fertilisers is UGX. 1500 per kg, other costs are UGX. 200,000 per acre. The initial expansion will cover the newly acquired three acres of land. Mr. Katende assumes that if he proceeds with option B, the total annual net profit from these three acres calculated using the optimal fertiliser rate, will be applied directly towards repaying the loan.

To diversify, he plans to select 3 varieties from 10 unique types of drought-resistant seeds for an initial trial and plant one variety per acre on his recently acquired three acres land to test their performance and suitability under local conditions.

Tasks:

a) Compare the two financial options to help Mr. Katende make an informed decision.

b) Based on your findings, prepare a short report advising Mr. Katende on better financial option for his five-year plan, whether the annual profit is sufficient to pay off the total loan obligation and how seed selection might influence his financial decision, assuming each new variety has a different yield potential.

ITEM 3

Faced with persistent dry seasons that disrupt water access, a secondary school faces water shortage during the dry season and wants to install rainwater harvesting cuboid tank. The engineer explains that the possible side lengths (in meters) of the tank satisfy:

$$f(x) = x^3 - 10x^2 + 31x - 30 = 0.$$

Records from the past rainy season show that the school collected: $1200, 1800, 2700, \ldots litres$ each month, increasing by 50% from month to month. The rainy season lasts for four months. The school has 800 learners, each needing 40 litres of water per day for drinking, cooking and cleaning.

To build the tank, exactly two lead technicians must be selected from **n** available technicians while the remaining offer supportive roles during the construction. The engineer mentions that there are 66 different possible 2-person teams that could accomplish the work and that this number is equal to the coefficient of y^2 in the expansion of $(1 + y)^n$.

The headteacher must arrange payment for the construction period. The two lead technicians are paid UGX 60,000 per day, and the remaining supportive technicians are each paid UGX 30,000 per day. The construction is expected to take 10 days.

Tasks:

a) Based on your results and the school's water needs, write a brief advisory note recommending whether the engineer should keep the current tank dimensions or propose new ones.

b) Advise the headteacher on the total number of available technicians and explain how this information could affect payment decisions during the construction period.

SECTION C

ITEM 4

A new parish irrigation scheme draws water from a central reservoir to feed crop field sprinklers. If the flow rate to the field is too low, the irrigation is ineffective; if it is too high, the field becomes waterlogged. Agricultural engineers have determined that irrigation is ineffective below 100 m^3/h and waterlogging occur above 600 m^3/h.

At 6:00 p.m. (t = 0), the reservoir holds 200 m^3 of water. The reservoir interacts with two water movements: Inflow, I(t), from a nearby river, which varies naturally due to temperature and rainfall, and outflow, Q(t), to the irrigation sprinklers, controlled by a pumping system.

The inflow rate is modelled $by\ I(Q) = 150 + 80\sin(30t)$ and the controlled outflow rate is modelled by $Q(t) = 3t^2 - 36t + 60$ where I(Q) and Q(t) are in m^3/h, t is measured in hours for $0 \leq t \leq 24$.

The irrigation management wants to keep irrigation within the safe flow range, prevent the reservoir from running dry or overflowing and use mathematical modelling to plan effective pumping times.

Tasks:

Help the management to:

a) Conduct a comprehensive analysis of the pumping schedule and provide a justification.

b) If a farm attendant notices that the water from the sprinklers is 95m^3/h at 8:00A.M., what would be your advice?

ITEM 5

A remote community depends on a small wind turbine for electricity, but recently the community has been experiencing frequent power shortages. Engineers traced the issue to poor turbine blade design. Akello, the lead engineer, has been assigned to redesign a high-efficiency turbine blade that will improve power reliability for the community. She is a visual engineer; she insists that the computational steps be organised clearly in a step – by – step sequence and prefers to see processes diagrammatically alongside calculations.

Simulation studies show that the stress experienced by the blade depends on its thickness x (mm) and is modelled by:

$$\sigma(x) = \frac{1200}{x} + 0.8x \text{ ;(Stress in MPa)}$$

To satisfy safety requirements, the stress must equal exactly 62 MPa. Starting with an initial guess value of x of 30.0 mm, Akello and her assistant keep changing the value of x until the difference between two successive guesses is less than 0.0005 mm.

Wind tunnel testing shows that the blade width (chord length) varies along its span as follows:

k (m)	0	3	6	9	12	15
c(k) (m)	6.2	5.4	4.9	3.1	1.8	0.6

The blade area (top view) bounded by c(k) is from k=0 to k = 15. Since no explicit function exists, Akello must estimate the area A. To work efficiently, the blade must satisfy the requirement that $A \geq 60\ m^2$.

Tasks:

a) Perform a numerical iteration that satisfies safety requirements and provide visual representation of the processes.
b) Determine whether the blade design satisfies the requirement needed. Suggest what design factor could be adjusted if the area is not sufficient.

END

Principal Mathematics

Paper 2

November 2025

Time: $2\frac{1}{4}$ hours

UGANDA ADVANCED CERTIFICATE OF EDUCATION

SAMPLE EXAMINATION PAPER

PRINCIPAL MATHEMATICS

Paper 2

Time: 2 hours 15 Minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of **two** *sections;* **A** and **B.** *It has four assessment items.*
Section ***A*** *has two items and is* ***compulsory.***
Section ***B*** *has two items. Answer one item only.*
Answer a total of **three** *items.*
Any additional item(s) answered will **not** *be scored.*
All *answers* **must** *be written in the answer booklets/sheets provided.*
Graph paper is provided.
Silent non-programmable scientific calculators and mathematical tables with a list of formulae may be used.

FOR OFFICIAL USE ONLY		
SECTION A	**ITEM 1**	
	ITEM 2	
SECTION B	**ITEM 3**	
	ITEM 4	
	TOTAL	

SECTION A

ITEM 1

A non-governmental organisation (NGO), has been running a farmer support program in Masaka district aimed at improving coffee yields. They assume that increased fertiliser application leads to higher coffee production. To evaluate this, a random sample of 20 household farmers who participated in this program were interviewed, each having used a different amount of fertiliser. For each farmer, they recorded the total fertiliser applied (in kg/acre) and their average coffee yield in bags per acre for the most recent harvest.

The NGO has set the following criteria for future action:

1) **Support Plan**: If the assumption is true, the NGO will support the farmers with more fertilisers.
2) **Expansion Condition**: The NGO plans to expand its program to a new group only if the chance of finding at least 4 selected farmers achieving a yield of 30 bags or more per acre is greater than 54%.
3) **Program Success Criterion**: The overall program is considered a success if the range of the middle 60% of the coffee yield data is less than 25 bags.

Farmer ID	Fertiliser Application (kg/acre)	Coffee yield (bags per acre)
1	10	15
2	25	30
3	15	18
4	30	35
5	20	25
6	5	12
7	35	40

Farmer ID	Fertiliser Application (kg/acre)	Coffee yield (bags per acre)
8	12	16
9	28	32
10	18	20
11	40	45
12	8	14
13	22	28
14	32	38
15	17	22
16	29	34
17	11	17
18	38	42
19	6	13
20	55	48

You have been selected to take part in the analysis of the data, help the NGO to:

a) Ascertain whether it will support farmers with more fertilisers.

b) i) Propose a framework for deciding whether to expand the programme.

ii) Based on this framework, what would your recommendation be?

c) Determine whether the programme is a success and propose strategic recommendations for program enhancement.

ITEM 2

The Ugandan Ministry of Health (MoH) is simultaneously managing two urgent public health issues that strain the national budget and healthcare resources: a community malaria outbreak and a high rate of Road Traffic Injuries (RTIs) on the major roads.

During a malaria outbreak, the MoH needs to treat children. Due to a financial constraint, the Ministry can only afford to purchase one of the two World Health Organisation (WHO) recommended treatments.

The recommended drugs are Coartem (C) and Doxycycline (D), however Coartem represents a lower-cost treatment option.

The two drugs can be used independently. Preliminary data on a child's survival indicates that the chances of survival are: 1 child survives in every 6 treated with both Coartem and Doxycycline, and 2 children survive in every 3 treated with either drug.

The MoH in partnership with the traffic police, is studying the high rate of Road Traffic Injuries (RTIs) on the major roads in the country. These injuries place a major burden on the national health system. The MoH assumes that controlling excessive speed is the most effective preventative measure.

Data collected on a random a sample of 50 major roads indicate that the speeds of motorists are normally distributed with a mean of 80 km/h and a standard deviation of 15 km/h.

The (MoH) and traffic police need statistical insights to finalise their enforcement and safety policies.

a) Identify Reckless Speed by only the top 5% of drivers exceed. This speed will define the most reckless group causing severe accidents.
b) Determine Safe Speed Interval required to contain at least 85% of all motorists, which will establish the bounds for safe driving speeds.
c) Estimate True Mean Speed interval for all roads basing on 99.5% confidence to better inform future highway design and safety standards.

As a mathematician, ~~a~~dvise:

a) the Ministry of health to choose the single drug to be used, and justify the choice of the drug.
b) the Ministry of health and the police address the three policy challenges under Road Traffic Injuries (RTIs) and make justifications.

SECTION B

ITEM 3

A local art gallery is preparing for a new exhibition and needs to move a marble sculpture on to a display platform. The sculpture is too heavy to lift manually, so the gallery staff has decided to use a pulley system with a counter weight. The sculpture is of mass 450kg and is attached to one end of a strong cable that passes over a smooth fixed pulley mounted on the ceiling beam. One end of the cable is tied to a crate filled with construction materials that acts as a counterweight. The crate rests on a rough plane inclined at an angle of 60^0 to horizontal
concrete floor.
The gallery crew would like know the crates weight sufficient to overcome the friction between the crate and the incline.
given:

i) Coefficient of friction between crate and incline: 0.2
ii) Acceleration due to gravity: 9.8 m/s^2
iii) Air resistance is negligible.

(a) Analyse the lifting system to determine if the minimum crate mass required to initiate the sculpture's movement is also sufficient to sustain its motion at a constant speed. In your response, provide the calculated minimum mass and a reasoned explanation based on the relevant mechanics principles.

(b) As a safety measure, the crate's acceleration must be limited to a maximum of 0.874 m/s^2. Propose a suitable mass for the crate that adheres to this safety constraint. In your response, justify how this specific mass value ensures a controlled acceleration and discuss one potential risk that is mitigated by imposing this acceleration limit.

ITEM 4

The Israel Ministry of Defence (IMOD) is using a radar to track a cargo aircraft that is involved in a sensitive operation. The aircraft flying horizontally at a constant velocity of $100ms^{-1}$ and at a constant altitude of 200 meters above the horizontal ground, releases a package of emergency supplies. At this exact instant IMOD radar spots the aircraft and communicates to their drone in space positioned 150 km away from the aircraft's current position on a bearing 150^0 relative to the cargo aircraft's position. The drone remains stationary at the altitude of the aircraft. The cargo aircraft maintains its velocity but changes the course to $N30^0E$ after the supplies are released. A missile is immediately fired from the drone at a maximum constant speed of $190ms^{-1}$ to intercept the aircraft in the shortest time and range possible, thereby minimising the extent of damage.

The IMOD is struggling to determine the emergency supplies' landing point, a critical data point for the operation and the course the missile should take.

Task

Analyse the motion patterns in the context above and provide justified solutions to the challenge the IMOD is facing.

4. Scoring Rubrics

SCORING RUBRIC for Paper I

SCORING RUBRIC ITEM 1: Telecom Mast Planning

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
1) **Interpretation of the scenario and task**	Demonstrates full and precise interpretation of the scenario; correctly identifies: i) Town Coordinates, ii) Triangle (for location) iii) Equidistant Position (Circumcentre) iv) Angle (60^0) for signal v) Trigonometry (for height) vi) Signal Function $S(\theta)$, and Constant Distance Path (circle)	i) Shows strong interpretation; identifies 6-7 ideas; equidistance and height requirement but with minor omissions (e.g., partial explanation of locus or incomplete link to tan 60°). ii) Correctly recognises the need for	i) Shows basic understanding of some (3-5) key elements (e.g., equidistance of mast or angle requirement) but misses one major component such as path locus or signal maximisation. ii) Interpretation is partially correct but not complete	i) Shows limited understanding (1 -2) correct concepts; identifies ideas (e.g., mast must be central) but misinterprets others (e.g., wrong angle relation, incorrect locus concept). ii) Key pieces of the scenario remain unclear

	vii) R-Formula (for max signal), and viii) Distance Formula (for the path)	maximising signal strength but may not fully articulate dependence on angle.		
2) **Generating And Presenting ideas** a) **Generate Ideas that address the task**	i) Demonstrates comprehensive understanding by stating all the five relevant mathematical approaches: ii) The mast must be placed at the circumcentre of triangle ABC iii) Height must satisfy tan 60° = h/slant-distance iv) The signal model requires finding its maximum value and angle of occurrence	• Demonstrates good understanding by stating most of the relevant approaches (4 of above)	• Demonstrates basic understanding by stating 2 -3 mathematical approaches needed	• Demonstrates limited understanding by stating less than 2 relevant approaches

	v) The school path must be a locus of points equidistant from mast (circular arc or Apollonian structure) vi) Shows complete understanding of towns' coordinates and geometric configuration.			
b) **Makes connections within and between ideas and context**	Performs all required computations accurately, including: i) Finding circumcentre using perpendicular bisectors or coordinate formulas	i) Performs most processes correctly but may make minor computational or algebraic errors OR omit one sub-step ii) Still obtains mostly valid results for mast location, height, and signal analysis	i) Applies methods with partial correctness: correct approach to circumcentre but incorrect height OR correct signal reasoning but wron maximum. ii) Work is partially correct	i) Shows weak application: attempts some methods (e.g., tries perpendicular bisectors or uses ta 60 wrongly). ii) Large errors and conceptual gaps remain

	ii) Correctly stating mast centre (4, 5), calculating radius r=5 iii) Computes correct mast height from tan 60° using slant distance iv) Analyses S (θ) to determine maximum signal strength, Smax = 13 and the exact angle θ=22.62° where it occurs v) Describes or computes the equation of the locus of points at constant distance from the mast.			

c) **Presents ideas coherently**	i) Presents clear, coherent, sequential working. ii) Correct and efficient use of geometry, trigonometry, coordinate methods, and analysis of the signal function.	• Mostly coherent presentation with logical structure of calculation clear	• Generally understandable but lacks completeness or consistency.	• Work is fragmented and inconsistent; analysis appears disjointed.
3) **Making informed judgement**	Provides fully justified, mathematically sound recommendations, including: i) Clear statement of the best mast position (circumcentre). ii) Valid assessment of mast height and coverage adequacy.	i) Provides well-reasoned recommendations with minor gaps ii) Conclusions are mostly correct and based on computations, though justification may be brief or not fully integrated.	i) Provides adequate but partly supported recommendations. ii) Some conclusions follow from partial results. iii) Explanation may be shallow or incomplete.	i) Provides weak or poorly justified recommendations ii) Conclusions may be vague, partly incorrect, or not clearly linked to the earlier mathematical work.

	iii) Correct identification of maximum signal strength and angle. iv) Insightful guidance for locating the community school along the constant-distance path, with clear justification based on locus geometry. v) Demonstrates deep reasoning and strong connection to mathematical results.			

ITEM 2: Farmer Financial Planning

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
1) **Interpretation of the scenario and task**	• Demonstrates comprehensive understanding by identifying all the eight important variables/ concepts: i) Option A: Compound interest with semi-annual compounding ii) Option B: Continuous compounding with grace period	i) Demonstrates good understanding by Identifying 5-7 important variables/ concepts	i) Demonstrates basic understanding by Identifying 3-4 important variables/concepts	i) Demonstrates limited understanding by Identifying less than 3 important variables/ concepts or irrelevant variables

	iii) Loan growth comparison for rate determination iv) Profit function optimisation for fertiliser application v) Revenue and cost functions derivation vi) Seed selection combinatorics vii) Risk assessment and diversification benefits viii) Five-year financial planning horizon.			

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
2) **Generating and Presenting ideas** a) Generate ideas that address the task	i) Demonstrates comprehensive understanding. ii) States all five relevant mathematical approaches: a) Compound interest: $A = P\,(1 + \frac{r}{n})^{nt})$ b) Continuous compounding : $A = {}_{P}e^{rt}$ c) Profit optimisation using derivatives	i) Demonstrates good understanding by stating most (4) relevant approaches.	i) Demonstrates basic understanding by stating basic (2 - 3) mathematical approaches needed.	i) Demonstrates limited under-standing by stating one (1) relevant approach or irrelevant approaches.

	d) Combinatorics for seed selection e) Cost-benefit analysis framework			
b) Makes connections within and between ideas and context	i) Strong logical connections demonstrated by correctly performing 14-16 of these manipulations: ii) Calculate Option A future value: $20M \times (1.04)^{10}$ iii) Compute $(1.04)^{10} = 1.48024428$ iv) Final Option A: 29, 604, 886 UGX	i) Logical connections among most variables and computations (10-13 manipulations)	i) Some connections among variables (5-9 manipulations)	i) Few connections among variables (1-4 manipulations)

	v) Determine continuous rate from given loan: $17.624M =$ $15M \times e^{2r}$ vi) Solve for $r = 0.0806$ vii) Calculate Option B obligation: $15M \times e^{0.0806 \times 4}$ viii) Compute $e^{0.3224} = 1.3804$ ix) Final Option B: 20,706,000 UGX x) Develop revenue function: $R(x) = 3500 \times (500 + 40x - 2x^2)$			

	xi) Develop cost function: $C(x) = 1500x + 200,000$ xii) Form profit function: $P(x) = R(x) - C(x)$ *xiii)* Differentiate profit: $P'(x) = 138,500 - 14,000x$ xiv) Solve for optimal $x = 9.89$ kg/acre xv) Calculate max profit per acre: 2, 235, 110 UGX xvi) Total profit for 3 acres: 6, 705, 330 UGX xvii) Seed combinations: $\binom{10}{3} = 120$			

c) **Presents Ideas *coherently***	Clear, logical, fluent presentation with: i) Smooth transitions between financial options analysis ii) Well-organised advisory report structure iii) Complete recommendations for both parts iv) 14-16 manipulations presented clearly	Mostly coherent presentation with: i) Logical sequencing of financial analysis. ii) Clear transitions between decision criteria. iii) Minor lapses which do not hinder understanding. iv) 10-13 manipulations presented clearly.	i) Generally understandable but lacks smooth flow between financial methods (5-9 manipulations)	i) Lacks clear organisation; financial analyses appear disjointed (1-4 manipulations)

SCORING RUBRIC ITEM 3: Water Harvesting Tank Project

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
1) **Interpretation of the scenario and task**	Demonstrates comprehensive understanding Identifies **all seven** important variables/concepts: i) Cubic equation for tank dimensions: $x^3 - 10x^2 + 31x - 31 = 0$ ii) Geometric sequence for water collection: 1200, 1800, 2700, …	Demonstrates good understanding; i) Identifies 5-6 important variables/concept	Demonstrates basic understanding; i) Identifies 3-4 important variables/ concept	Demonstrates limited understanding; i) Identifies less than 3 important variables/concept

	iii) School water requirements: 800 learners x 40 litres/day. iv) Combinatorics for technician teams: $nC2 = 66$ v) Payment structure: lead vs support technicians vi) Capacity vs requirement analysis vii) Construction cost budgeting			

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
2) **Generating and presenting ideas** a) Generates ideas that address the task	Demonstrates comprehensive understanding; 1) States all four relevant mathematical approaches: i) Polynomial root finding for tank dimensions ii) Geometric series sum for water collection iii) Combinatorial equation solving iv) Cost calculation and budgeting	Demonstrates good understanding; i) States most relevant approaches (3 of above)	Demonstrates basic understanding; i) States basic mathematical approaches needed	Demonstrates limited understanding; i) States few relevant approaches

b) Makes connections with and between ideas and context	Strong logical connections demonstrated by correctly performing 12-14 of these manipulations: i) Solve cubic equation: f (2) = 0 identified ii) Polynomial division: $\frac{(x^3 - 10x^2 + 31x - 30}{x - 2} = x^2 - 8x + 15$ iii) Factor quadratic: (x – 3) (x – 5) = 0 iv) Determine dimensions: 2m, 3m, 5m v) Calculate volume: 2 × 3 × 5 = 30 m = 30,000 litres.	i) Logical connections among most variables and computations (8-11 manipulations)	i) Some connections among variables (4-7 manipulations)	i) Few connections among variables (1-3 manipulations)

	vi) Identify GP parameters: a = 1200, r = 1.5 vii) Calculate total collection: $S = 1200 \times \frac{1.5^4 - 1}{0.5}$ viii) Compute $1.5^4 = 5.0625$ ix) Final collection: 9, 750 litres x) Calculate daily requirement: 800 × 40 = 32, 000 litres xi) Calculate dry sea- son requirement: 32, 000 × 90 = 2, 880, 000 litres. xii) Solve combinatorial equation: $\frac{n(n-1)}{2} = 66$.			

	xiii) Find n = 12 technicians. xiv) Calculate labour cost: 2 × 60, 000 + 10 × 30, 000 = 420, 000/day. xv) Total cost: 420, 000 × 10 = 4, 200, 000 UGX.			
c) Presents ideas coherently	Clear, logical, fluent presentation with: i) Smooth transitions between engineering analyses ii) Well-structured advisory notes for both parts	Mostly coherent presentation with: i) Logical sequencing of calculations ii) Clear transitions between technical and financial aspects	i) Generally understandable but may lack smooth flow between methods (4-7 manipulations)	i) Lacks clear organisation; analyses appear disjointed (1-3 manipulations)

	iii) Complete dimensional and financial recommendations iv) 12-14 manipulations presented clearly	iii) 8-11 manipulations presented clearly		
3) **Making informed judgement**	Forms highly informed, insightful judgement by: i) Providing critical tank adequacy assessment with quantitative evidence ii) Offering compelling recommendation for new dimensions with justification iii) Giving comprehensive payment advice with budget planning	Forms clear, logical judgement by: i) Connecting calculations to engineering decisions ii) Making specific dimensional and financial recommendations iii) Supporting conclusions with quantitative analysis	Forms generally relevant judgement by: i) Applying Mathematics to engineering context ii) Providing basic design recommendations iii) Beginning to link analysis to practical implementation	Forms limited judgement by: i) Recognising engineering context ii) Attempting basic design suggestions iii) Showing under-standing of water requirements

	iv) Integrating all technical analyses into practical implementation plan v) Considering school's actual water needs versus current capacity	iv) Addressing both technical and budgetary aspects		

SCORING RUBRIC ITEM 4: Irrigation System Management

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
1) Interpretation of the scenario and task	Demonstrates **comprehensive** understanding Identifies all seven important variables/concepts: i) Inflow function: $I(t) = 150 + 80\sin(30t)$ ii) Outflow function: $Q(t) = 3t^2 - 36t + 60$ iii) Safe flow range: 100-600 m^3 /h iv) Reservoir initial volume: 200 m	Demonstrates good understanding; i) Identifies 5-6 important variables/concept	Demonstrates basic understanding; i) Identifies 3-4 important variables/concepts	Demonstrates limited understanding; i) Identifies Less than 3 important variables/concept

	v) Time conversion: t=0 at 6:00 PM vi) Net rate analysis: $dV/dt = I(t) - Q(t)$ vii) System troubleshooting for observed discrepancies			
a) Generates ideas that address the task	Demonstrates comprehensive understanding; i) States all four relevant mathematical approaches: a) Quadratic equation solving for safe flow	Demonstrates good understanding; i) States most relevant approaches (3).	Demonstrates basic understanding; i) States basic mathematical approaches needed (2)	Demonstrates limited understanding; i) States 1 relevant approach or irrelevant approaches

	boundaries b) Trigonometric function analysis c) Time conversion and scheduling d) System performance verification			
b) Makes connections within and between ideas and context	Strong logical connections demonstrated by correctly performing 11-13 of these manipulations: i) Solve $Q(t) = 100$: $3t^2 - 36t + 60 = 100$	i) Logical connections among most variables and computations (8-10 manipulations)	i) Some connections among variable (4 - 7 manipulations)	i) Few connections among variables (1-3 manipulations)

	ii) Solve quadratic: $t = 13.02$ hours iii) Solve $Q(t) = 600$: $3t^2 - 36t + 60 = 600$ iv) Solve quadratic: $t = 20.70$ hours v) Convert to clock time: 13.02h = 7:01 AM vi) Convert to clock time: 20.70h = 2:42 PM vii) Determine safe pumping window: 7:01 AM to 2:42PM			

	viii) Calculate net rate: $dV/dt = I(t) - Q(t)$ ix) Compute $Q(14)$ For 8:00AM: $3(14)^2 - 36(14) + 60 = 144\ m^3/h$ x) Compare observed vs calculated flow: 95 vs 144 m^3/h xi) Identify system issues from discrepancy xii) Develop troubleshooting recommendations xiii) Formulate emergency response plan			

c) Presents ideas coherently	Clear, logical, fluent presentation with: i) Smooth transitions between scheduling and troubleshooting ii) Well-organised management advisory structure iii) Complete pumping schedule and emergency response plan iv) 11-13 manipulations presented clearly	Mostly coherent presentation with: i) Logical sequencing of time analyses ii) Clear transitions between mathematical and practical aspects iii) Minor lapses that do not hinder understanding iv) 8-10 manipulations presented clearly.	Generally understandable but may lack smooth flow between analysis types (4-7 manipulations)	Lacks clear organisation; irrigation concepts appear disjointed (1-3 manipulations)

1) **Making informed judgement**	Forms highly informed, insightful judgement by: i) Providing precise pumping schedule with time conversion ii) Offering comprehensive system diagnosis for observed discrepancy iii) Giving immediate emergency response plan with specific actions iv) Integrating all mathematical analyses into	Forms clear, logical judgement by: i) Connecting calculation to operational decision ii) Making specific scheduling and troubleshooting recommendations iii) Supporting management choices with quantitative analysis iv) Addressing both normal operations and emergency situations	Forms generally relevant judgement by: i) Applying Mathematics to irrigation context ii) Providing basic scheduling recommendations iii) Beginning to link analysis to practical implementation	Forms limited judgement by: i) Recognising irrigation management context ii) Attempting basic scheduling suggestions iii) Showing understanding of flow requirements

	operational management v) Considering real-world irrigation constraints and crop requirements.			

SCORING RUBRIC ITEM 5: Wind Turbine Blade Redesign

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
1) **Interpretation of the scenario and task**	Demonstrates comprehensive understanding by identifying all the five important variables/concepts: i) Stress Function σ(x) ii) Target Stress (62 MPa) iii) Initial Guess (x_0=30.0mm) iv) Stopping Criterion ($\Delta x < 0.0005\ mm$), and v) Area Table/Requirement: A ≥ 60 m	Demonstrates good understanding by identifying 4 important variables/ concepts	Demonstrates basic understanding by identifying 2-3 important variables/ concepts	Demonstrates limited understanding by identifying 1 important variables/ concepts

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
2) Generating and Presenting ideas a) Generate Ideas that address the task	Demonstrates comprehensive understanding by stating all the five relevant mathematical approaches: i) numerical Iteration Setup σ (x); Use of Newton Raphson method. ii) differentiation of σ(x) iii) Flow diagram iv) Area Estimation using Trapezoidal Rule v) Requirement Analysis: Required: A ≥ 60 m	i) Demonstrates good understanding by stating 3-4 relevant approaches	i) Demonstrates basic understanding by stating 2 mathematical approaches needed	i) Demonstrates limited understanding by stating 1 relevant approach

b) Makes connections within and between ideas and context	Strong logical connections demonstrated by correctly performing 8-9 of these manipulations: i) Correct iteration method (Newton–Raphson recommended) ii) Defining f(x) and f'(x); show derivative σ'(x) iii) Show iterations starting x_o=30.0 iv) performing accurate iterations to converge to the solution. v) full iteration table until tolerance met. vi) setting up the Trapezoidal Rule.	i) Good method and mostly correct numeric. ii) Logical connections among most variables and computations (5-7) manipulations). iii) Learner uses Newton correctly and reaches a value close to the model answer but may have one or two minor rounding arithmetic slips; area computed correctly	i) Some connections among variables (3-4) manipulations)	i) Partial correctness. ii) Few/weak connections among variables (1-2) manipulations). iii) Learner shows the method and some iterations but stops too early or has arithmetic mistakes; area computed using trapezoid but arithmetic error reduces accuracy

	vii) calculating the estimated area. viii) a correct numerical integration for area. ix) comparing A to the 60 mm^2 requirement			
c) Presents ideas coherently	Clear, logical, fluent presentation with a smooth transition between numerical iteration and numerical integration. 8 -9 manipulations presented clearly, including a visual table/diagram of the iteration process	Mostly coherent presentation with logical sequencing of analyses; 5-7 manipulations presented clearly	Generally understandable but may lack smooth flow; 3-4 manipulations	Lacks clear organisation; analyses appear disjointed; 1 - 2 manipulations

3) **Making informed judgement**	Insightful, quantitative recommendations. Must state: i) Stress requirement: using model, final thickness required to obtain σ=62MPa; check if this thickness is acceptable for manufacturing and strength specifications. ii) Providing the converged blade thickness, including a visual representation of the process. iii) Area requirement computed and practical design recommendations (how to meet area and/or stress requirements), cost/feasibility comment and monitoring suggestions.	Good recommendations with correct identification of both problems (stress and area) and at least one practical adjustment but less detailed discussion	Adequate judgement. Recognises area shortfall and provides e.g., increase chord or reduce thickness slightly, but lacks follow-up plan	Limited judgement. Notes shortfall but suggests vague or unrealistic fixes without numbers

SCORING RUBRICS FOR PAPER II

SCORING RUBRIC ITEM 1: NGO Farmer Support Program

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
1) **Interpretation of the scenario and task**	Demonstrates comprehensive understanding by identifying all the eight important variables/ concepts: i) Fertiliser application and coffee yield data pairs. ii) Spearman's rank correlation requirement. iii) Support plan criterion for fertiliser distribution.	Demonstrates good understanding by identifying 5-**7** of the important variables/ concepts	Demonstrates basic understanding by identifying 3-4 of the important variables/ concepts	Demonstrates limited understanding by identifying 1-2 of the important variables/ concepts

	iv) Expansion condition using binomial probability. v) Program success criterion (middle 60% range). vi) Data ranking methodology. vii) Probability calculation for high-yield farmers. viii) Percentile analysis for range calculation.			
2) **Generating and Presenting ideas** a) Generates Ideas that address the task	Demonstrates comprehensive understanding by stating all relevant statistical methods for all three parts.	Demonstrates good understanding by stating most relevant statistical methods	Demonstrates basic understanding by stating any 2 statistical approaches needed	Demonstrates limited understanding by stating any 1 statistical approach needed

	Spearman's rank correlation: $r_s = 1 - \frac{6\sum d^2}{n(n^2-1)}$ i) Data ranking and difference calculation ii) Correlation interpretation criteria iii) Decision framework for fertiliser support	(3 of the above)		
b) Makes connections within and between ideas and context	Strong and logical connections demonstrated by correctly performing 14-16 of these manipulations: i) Rank fertiliser application data correctly ii) Rank coffee yield data correctly	Logical connections among most variables and computations (8-13 manipulations)	Some connections among variables (4-7 manipulations)	Few connections among variables (1-3 manipulations)

	iii) Calculate rank differences $d = R_x - R_y$ iv) Square the differences d^2 v) Sum of squared differences $\sum d^2 = 4$ vi) Apply Spearman's formula: $r_s = 1 - \frac{6 \times 4}{20 \times 399}$ vii) Calculate $r_s = 0.997$ viii) Interpret correlation strength ix) Count farmers with yield ≥ 30: 9 out of 20 x) Calculate probability $p = 9/20 = 0.45$			

	xi) Set up binomial: $X \sim$ Binomial (20, 0.45) xii) Calculate $P(X = 0), P(X = 1), P(X = 2), P(X = 3)$ xiii) Compute $P(X \leq 3) = 0.083017$ xiv) Calculate $P(X \geq 4) = 0.916983$ xv) Sort yield data for percentile analysis xvi) Calculate middle 60% range = 22 bags			
c) Presents ideas coherently	Clear, logical, fluent presentation with: i) Smooth transitions between correlation, probability, and range analysis	Mostly coherent presentation with: i) Logical sequencing of statistical analyses	Generally understandable but may lack smooth flow between statistical methods (4 - 7 manipulations)	Lacks clear organisation; statistical analyses appear disjointed (1-3 manipulations)

	ii) Well-organised statistical report structure iii) Complete recommendations for all three parts 14-16 manipulations presented clearly	ii) Clear transitions between decision criteria iii) Minor lapses don't hinder understanding iv) 8-13 manipulations presented clearly		
3.**Making informed judgement**	Forms highly informed, insightful judgement by: i) Providing clear fertiliser support recommendation based on strong correlation. ii) Offering comprehensive expansion framework with probability justification.	Forms clear, logical judgement by: i) Connecting statistical results to NGO criteria ii) Making data-driven recommendations for each part iii) Supporting conclusions with calculations	Forms generally relevant judgement by: i) Applying statistics to decision context ii) Providing basic recommendations iii) Beginning to link analyses to program decisions	Forms limited judgement by: i) Recognising agricultural context ii) Attempting basic program assessment iii) Showing understanding of decision needs

	iii) Determining program success with proper range analysis. iv) Giving specific strategic recommendations for program enhancement. v) Integrating all three analyses into cohesive decision framework.	iv) Addressing all three task components		

SCORING RUBRIC ITEM 2: Ministry of Health Policy Analysis

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
1) **Interpretation of the scenario and task**	Demonstrates comprehensive understanding by identifying 8-9 important variables/concepts: i) Drug survival probabilities: $p(c \cap d) = 1/6$ $p(c \cup d) = 2/3$ ii) Independence assumption for drugs. iii) Cost comparison between treatments. iv) Normal distribution for speeds: $x \sim n(80, 152)$. v) Reckless speed threshold (top 5%).	i) Demonstrates good understanding by identifying **6-7** of the important variables/ concepts	i) Demonstrates basic understanding by identifying **3-5** of the important variables/ concepts	i) Demonstrates Limited understanding by identifying **1-2** of the important variables/concepts

	vi) Safe speed interval (85% containment). vii) True mean speed interval (99.5% confidence). viii) Sample size n = 50 for speed data. ix) Policy implications for health and safety.			
2) **Generating and Presenting ideas** a) Generate ideas that address the task	Demonstrates comprehensive understanding by stating all four relevant mathematical approaches: i) Probability addition rule: P (C ∪ D) = P (C)+P (D)−P (C ∩ D) ii) Independence: P(C∩D) =P (C)×P (D)	ii) Demonstrates Good understanding by stating most relevant mathematical approaches (3 of the above)	ii) Demonstrates basic understanding by stating basic mathematical approaches needed (2)	ii) Demonstrates limited understanding by stating few relevant mathematical approaches (1)

	iii) Quadratic equation solution for individual probabilities iv) Cost-effectiveness analysis framework			
3) **Generating and Presenting ideas** a) Generate ideas that address the task	Demonstrates comprehensive understanding by stating all four relevant mathematical approaches: i) Probability addition rule: P (C ∪ D) = P (C)+P (D)−P (C ∩ D) ii) Independence: P(C∩D) =P (C)×P (D) iii) Quadratic equation solution for individual probabilities iv) Cost-effectiveness analysis framework	i) Demonstrates good understanding by stating most relevant mathematical approaches (3 of the above)	i) Demonstrates basic understanding by stating basic mathematical approaches needed (2)	i) Demonstrates limited understanding by stating few relevant mathematical approaches (1)

b) Makes connections within and between ideas and context	Making strong logical connections demonstrated by correctly performing 12-14 of these manipulations: i) Set up probability equations: $pq = \frac{1}{6}$, $p + q - \frac{1}{6} = \frac{2}{3}$ ii) Solve for $p + q = \frac{5}{6}$ iii) Form quadratic equation: $x^2 - \frac{5}{6}x + \frac{1}{6} = 0$ iv) Solve quadratic: $x = \frac{5 \pm 1}{12}$ v) Determine probabilities:	i) Making logical connections among most variables and computations (8-11 manipulations)	i) Making some connections among variables (4-7 manipulations)	i) Making few connections among variables (1-3 manipulations)

	$P(C) = \frac{1}{2}, P(D) = \frac{1}{3}$ vi) Compare cost-effectiveness vii) Find z-value for top 5%: $z = 1.6449$ viii) Calculate reckless speed: $80 + 1.6449 \times 15 = 104.67$ km/h ix) Find z-value for 85% interval: $z = 1.4395$ x) Calculate safe speed bounds: $80 \pm 1.4395 \times 15$ xi) Determine 99.5% confidence z-value: $z = 2.807$ xii) Calculate standard error: $\frac{15}{\sqrt{50}} = 2.121$ xiii) Compute margin of error: $2.807 \times$			

	$2.121 = \underline{5.95}$ xiv) Determine confidence interval: 80 ± 5.95			
c) Presents ideas coherently	Presenting work in a clear, logical, fluent presentation with: i) Smooth transitions between drug analysis and speed policy. ii) Well-organised policy recommendation structure. iii) Complete justifications for all recommendations. iv) 12-14 manipulations presented clearly.	Presenting work in mostly coherent presentation with: i) Logical sequencing of analyses ii) Clear transitions between health and safety components iii) Minor lapses don't hinder understanding iv) 8-11 manipulations presented clearly	i) Presenting work in generally understandable way but may lack smooth flow between analysis types (4-7 manipulation)	i) Presenting work that lacks clear organisation; analysis appear disjointed (1-3 manipulations)

4) **Making informed judgement**	Forms highly informed, insightful judgement by: i) Providing evidence-based drug selection with cost- benefit analysis. ii) Offering comprehensive speed policy framework with three specific thresholds. iii) Giving practical enforcement recommendations for traffic police. iv) Integrating health and safety considerations into cohesive policy. v) Considering real-world implementation factors.	Forms clear, logical judgement by: i) Connecting calculations to policy decisions ii) Making specific recommendations for both parts iii) Supporting policy choices with quantitative analysis iv) Addressing all policy challenges	Forms generally relevant judgement by: i) Applying Mathematics to policy context ii) Providing basic recommendation iii) Beginning to link analysis to real-world impact	Forms limited judgement by: i) Recognising public health context ii) Attempting basic policy suggestions iii) Showing understanding of decision criteria

SCORING RUBRIC ITEM 3: Art Gallery Pulley System

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
1) **Interpretation of the scenario and task**	Demonstrates comprehensive understanding by identifying **7-8** important variables/concepts: i) Sculpture mass: $m_s = 450$ kg *ii)* Incline angle: $\vartheta = 60^\circ$ iii) Coefficient of friction: $\mu = 0.2$ iv) Gravity: $g = 9.8$ m/s^2 v) Maximum acceleration constraint: $a_{max} = 0.874$ m/s^2 vi) Force resolution on inclined plane vii) Newton's second law application viii) Safety risk mitigation requirements	Demonstrates good understanding by identifying **5-6** of the important variables/ concepts	Demonstrates basic under-standing by identifying **3-4** of the important variables/ concepts	Demonstrates limited understanding by identifying **1-2** of the important variables/ concepts

2) **Generating and Presenting ideas**	i) Stating all relevant Physics principles and equations ii) Making strong logical connections between static and dynamic analysis iii) Presenting work in clear, logical, fluent manner with 13- 15 correct manipulations	Demonstrates good understanding by: i) Stating most relevant Physics equations ii) Making logical connections between most concepts iii)Presenting work with **8-12** correct manipulations in clear manner	Demonstrates basic understanding by: i) Stating basic Physics principles ii) Making some connections between concepts Presenting work with **4 -7** correct manipulations	Demonstrates limited understanding by: i) Stating few relevant equations ii) Making weak connections between concepts iii) Presenting work with **1-3** correct manipulations

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
a) Generate ideas that address the task	Demonstrates comprehensive understanding by stating all five relevant Physics approaches: i) Force resolution: $mg\sin\vartheta$, $mg\cos\vartheta$ ii) Friction force: $f = \mu N = \mu mg\cos\vartheta$ iii) Equilibrium equations for impending motion iv) Newton's second law for dynamic case v) Tension relationship in pulley system	States most relevant Physics approaches (4 of the above)	States basic Physics approaches needed (**2-3**)	States few relevant Physics approaches (any 1)
b) Makes connections within and between ideas and context	Making strong logical connections demonstrated by correctly performing 13-15 of these manipulations: i) Resolve weight into components: $mg\sin\vartheta$, $mg\cos\vartheta$	Making logical connections among most variables and computations (8-12 manipulations)	Making some connections among variables (4-7 manipulations)	Making few connections among variables (1 -3 manipulations)

	ii) Calculate normal force: $N = m_c g \cos\vartheta$ iii) Calculate maximum friction: $f_{max} = \mu m_c g \cos\vartheta$ iv) Set up equilibrium equations for im- pending motion *v)* Solve for minimum crate mass: $m_c = \frac{m_s}{\sin\theta - \mu\cos\theta}$ vi) Compute $\sin 60° = 0.8660$, $\cos 60° = 0.5$ vii) Calculate: $\sin\vartheta - \mu\cos\vartheta = 0.7660$ viii) Compute $m_c = 450/0.7660 = 587.47$ kg ix) Analyse static vs kinetic friction implications x) Set up dynamic equations with acceleration xi) Apply Newton's second			

	law to both masses xii) Derive tension: $T = m_s(g + a)$ xiii) Substitute into crate equation xiv) Solve for safe mass: $m_c = \frac{m_s(g+a)}{g(\sin\theta - \mu\cos\theta) - a}$ xv) Compute safe mass: $m_c = 724.18$kg			
c) Presents ideas coherently	Clear, logical, fluent presentation with: i) Smooth transitions between static and dynamic analysis ii) Well-organised safety assessment structure iii) Complete risk mitigation discussion iv) 13-15 manipulations presented clearly	Mostly coheren presentation with: i) Logical sequencing of Physics analysis ii) Clear transitions between calculation stages iii) Minor lapses don't hinder understanding iv) 8-12 manipulations presented clearly	Generally understandable but may lack smooth flow between analysis types (4-7 manipulations)	Lacks clear organisation; Physics concepts appear dis-jointed (1-3 manipulations)

3) **Making informed judgement**	Forms highly informed, insightful judgement by: i) Providing precise mass calculations for both scenarios ii) Offering comprehensive safety analysis with risk mitigation iii) Explaining static vs kinetic friction implications iv) Giving specific v) Safety recommendations with justification vi) Considering practical implementation factors	Forms clear, logical judgement by: i) Connecting Physics calculations to safety requirements ii) Making specific mass recommendations iii) Supporting safety choices with quantitative analysis iv) Addressing both parts completely	Forms generally relevant judgement by: i) Applying Physics to engineering context ii) Providing basic safety recommendations iii) Beginning to link calculations to risk assessment	Forms limited judgement by: i) Recognising safety context ii) Attempting basic mass calculations iii) Showing understanding of acceleration concerns

SCORING RUBRIC ITEM 4: Israel Ministry of Defence Interception

Basis of Assessment	SCORE 4	SCORE 3	SCORE 2	SCORE 1
1) **Interpretation of the scenario and task**	Demonstrates comprehensive understanding by identifying all nine important variables/concepts: i) Aircraft velocity: 100 m/s horizontal ii) Altitude: 200 m iii) Package projectile motion analysis iv) Drone position: 150 km at bearing 150◦	• Demonstrates good understanding by identifying **6-8** of the important variables/ concepts	• Demonstrates basic understanding by identifying **3-5** of the important variables/concepts	• Demonstrates limited understanding by identifying **1-2** of the important variables/ concepts

	v) Coordinate system setup vi) Aircraft course change to N30◦E vii) Missile speed: 190 m/s viii) Relative motion principles ix) Interception time x) Minimisation			
2) **Generating and presenting ideas** a) Generate ideas that	Demonstrates comprehensive understanding by stating all the four relevant mathematical approaches:	Demonstrates good understanding by stating most relevant mathematical approaches (3 of the above)	Demonstrates basic understanding by stating basic mathematical approaches needed (2)	Demonstrates limited understanding by stating 1 relevant mathematical approach

address the task	i) Projectile motion equations: $y = y_0 - \frac{1}{2}gt^2$ ii) 2 iii) Coordinate transformation for bearings iv) Relative velocity vectors v) Interception time optimisation			

b) Makes connections within and between ideas and context	Strong logical connections demonstrated by correctly performing 12-14 of these manipulations: i) Calculate package fall time: $200 = \frac{1}{2} \times 9.8 \times t^2$ 2 ii) Solve for $t = 6.388$ s iii) Calculate landing distance: $100 \times 6.388 = 638.8$ m iv) Convert drone position from polar to Cartesian coordinates v) Calculate $x_d = 150 \times \sin 150^\circ = 75$ km vi) Calculate $y_d = 150 \times \cos 150^\circ = -129.9$ km	Logical connections among most variables and computations (8-11 manipulations)	Some connections among variables (4-7 manipulations)	Few connections among variables (1-3 manipulations)

	vii) Convert km to meters viii) Resolve aircraft velocity after turn ix) Calculate $v_{ax} = 100 \times \sin 30^\circ = 50$ m/s x) Calculate $v_{ay} = 100 \times \cos 30^\circ = 86.60$ m/s xi) Set up interception equations xii) Express missile velocity components in terms of time xiii) Apply missile speed constraint: $v_{mx}^2 + v_{my}^2 = 190^2$ xiv) Solve numerically for optimal interception time.			

c) Presents ideas coherently	Clear, logical, fluent presentation with: i) Smooth transitions between projectile and interception analysis ii) Well-organised military operation structure iii) Complete mission recommendations iv) 12-14 manipulations presented clearly	Mostly coherent presentation with: i) Logical sequencing of kinematic analyses ii) Clear transitions between calculation stages iii) Minor lapses don't hinder understanding iv) 8-11 manipulations presented clearly	Generally understandable but may lack smooth flow between analysis types (4-7 manipulations)	Lacks clear organisation; kinematics concepts appear disjointed (1-3 manipulations)

3) **Making informed judgement**	Forms highly informed, insightful judgement by: i) Providing precise landing point calculation for emergency supplies ii) Offering optimal interception strategy with time minimisation iii) Giving comprehensive mission recommendations iv) Considering real- time operational factors v) Integrating all motion analysis into cohesive plan	Forms clear,logical judgement by: i) Connecting kinematics calculations to mission objectives ii) Making specific interception recommendations iii) Supporting operational choices with quantitative analysis iv) Addressing both landing and interception challenges	Forms generally relevant judgement by: i) Applying Mathematics to military context ii) Providing basic operational recommendation iii) Beginning to link analysis to mission success	Forms limited judgement by: **i)** Recognising military operation context **ii)** Attempting basic trajectory calculations **iii)** Showing understanding of interception concept

5. Performance Level Descriptors

MATHEMATICS PAPER 1

Construct	Performance level	Descriptor
ALGEBRA Applying algebraic principles to model and solve real-life problems and lead to informed decision making	**Exceptional**	The learner models real-life situations using correct algebraic expressions and methods; identifies all variables and justifies conclusions independently.
	Outstanding	The learner uses correct algebraic methods with minor errors; identifies most variables and justifies conclusions reasonably.
	Satisfactory	The learner uses basic algebraic procedures with partial accuracy; shows limited justification and requires guidance.
	Basic	The learner shows fragmented or incorrect algebraic reasoning; struggles to apply methods or justify results.
	Elementary	The learner shows no evidence of meaningful algebraic reasoning.
GEOMETRY	**Exceptional**	The learner applies geometric reasoning accurately, uses correct diagrams/representations, and justifies solutions.

Applying geometric concepts and spatial reasoning to interpret relationships in mathematical and real-life contexts for informed problem solving.	**Outstanding**	The learner shows correct use of geometric methods with minor lapses; diagrams mostly accurate.
	Satisfactory	The learner shows partial application of geometric concepts; limited connections and weak justification.
	Basic	The learner misinterprets geometric ideas; diagrams inaccurate; justification missing.
	Elementary	The learner is unable to apply geometric concepts or represent the situation.
CALCULUS Analysing and modelling of real-life situations involving rates of change, accumulation, and optimisation of resources.	**Exceptional**	The learner uses calculus to model change and solve contextual problems; justifies decisions with correct interpretation.
	Outstanding	The learner uses correct differentiation/integration with minor interpretation errors.
	Satisfactory	The learner performs basic procedures correctly but struggles to interpret meaning.
	Basic	The learner applies calculus mechanically without understanding; inaccurate results.
	Elementary	The learner shows no evidence of calculus understanding or application.

MATHEMATICS PAPER 2

Construct	Performance level	Description of the grade
DATA ANALYSIS AND PROBABILITY Analysing data and applying probability models to make informed decisions and predictions in personal, academic, and societal contexts	**Exceptional**	Flawlessly selects optimal models, executes complex analysis, and translates results into precise, well-justified decisions with profound contextual awareness.
	Outstanding	Accurately selects and executes appropriate tools. Provides clear, data-supported decisions, effectively linking evidence to outcomes with high reliability.
	Satisfactory	Generally, selects appropriate tools and correctly executes basic analysis. Decisions are plausible and partially supported but may lack depth in justification or complexity.
	Basic	Struggles to select correct approaches, relies on simple methods, and frequently makes calculation errors. Decisions are vague or weakly supported.
	Elementary	Minimal or no conceptual understanding. Fails to select appropriate models, and analysis is fundamentally flawed. Unable to make informed decisions.
MECHANICS Analysing the effect of forces on bodies in	**Exceptional**	Flawless analysis of complex forces and motion, accurate prediction, and construction of original, highly effective solutions. Perfectly logical and clearly communicated.

motion or at rest, interpreting motion patterns and predict object behaviour and use it to solve real world kinematic problems	**Outstanding**	Accurate analysis of intricate forces and patterns, reliable prediction, and successful application to challenging problems with minimal errors. Well-communicated.
	Satisfactory	Mostly accurate analysis of standard forces/patterns, generally successful prediction and solving of standard problems. Solutions are understandable but may lack detail.
	Basic	Struggles with analysis, misinterprets fundamental concepts, and makes significant errors when attempting to predict and solve problems. Solutions are confusing or incomplete.
	Elementary	Minimal or no understanding. Fails to analyse basic forces or motion. Unable to set up or solve even simple problems. Work is disorganised and fundamentally flawed.

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ISBN 978-9913-06-116-2
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