



آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD

Secondary School Certificate
Examination Syllabus

Mathematics

Grades IX - X

(Based on New National Curriculum 2022-2023)

Student Learning Outcomes of AKU-EB SSC Mathematics Syllabus

Part I (Grade IX)

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level ¹		
		R	U	A and beyond
1. Real Numbers	Students should be able to:			
1.1 History of Numbers	1.1.1 explain, with examples, that civilisations throughout history have systematically study of living things e.g., the history of numbers from sumerians and its development to the present arabic system;		FA ²	
1.2 Real Numbers	1.2.1 describe terminating and non-terminating (recurring and non-recurring) decimal as rational and irrational numbers;		*	
	1.2.2 identify the set of real numbers as a union of sets of rational and irrational numbers;		*	
1.3 Properties of Real Numbers	1.3.1 identify the properties of real numbers (closure, commutative, associative, identities, inverse, distributive properties);		*	
1.4 Radicals and Radicands	1.4.1 identify radicals and radicands;		*	
	1.4.2 convert radical form to exponential form and vice versa;			A
1.5 Laws of Exponents/ Indices	1.5.1 apply the laws of exponents to simplify expressions with real base and exponents: $x^m \cdot x^n = x^{m+n}$, $(xy)^m = x^m y^m$, $(x^m)^n = x^{mn}$, $\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$, where $y \neq 0$, $y^0 = 1$, $\frac{x^m}{x^n} = x^{m-n}$, where $x \neq 0$.			A

¹R = Remember, U = Understand, A = Application and beyond [Apply (Ap), Analyse (An), Evaluate (E), Create (C)]

²FA= Formative Assessment, not to be assessed under examination conditions.

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			R	U	A and beyond
2. Logarithms	Students should be able to:				
2.1 Scientific Notation	2.1.1	convert a number in ordinary form (common form) to scientific notation and vice versa;			A
2.2 Logarithms	2.2.1	convert logarithmic form into exponential form and vice versa: (i.e., $a^x = y \leftrightarrow \log_a y = x$, $a > 0$, $y > 0$ and $a \neq 1$);			A
	2.2.2	solve problems related to SLO 2.2.1;			A
2.3 Laws of Logarithms	2.3.1	describe the following laws of logarithms: a. $\log_a (mn) = \log_a m + \log_a n$, b. $\log_a \left(\frac{m}{n}\right) = \log_a m - \log_a n$, c. $\log_a m^n = n \log_a m$, d. $\log_m n = \frac{\log_a n}{\log_a m}$, where $a > 0$, $a \neq 1$;		*	
2.4 Application of Logarithms	2.4.1	solve problems using the given laws of logarithm (without using log and antilog tables) in SLO 2.3.1.			A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
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3. Sets Theory	Students should be able to:			
3.1 Explore the Foundations of Mathematics	3.1.1 describe mathematics as the study of pattern, structure, and relationship;		FA	
3.2 Operations on Sets (Revision)	3.2.1 identify the sets denoted by N, Z, W, O, P, Q and by other symbols;		*	A
	3.2.2 solve problems using the following operations on sets: a. union, b. intersection, c. difference, d. symmetric difference, e. complement;			
3.3 Properties of Union and Intersection	3.3.1 describe the following fundamental properties of union and intersection of two or three sets: a. commutative property of union, b. commutative property of intersection, c. associative property of union, d. associative property of intersection, e. distributive property of union over intersection, f. distributive property of intersection over union, g. De Morgan's laws;		*	
3.4 Venn Diagram	3.4.1 draw Venn diagrams to represent: a. union and intersection of sets, b. difference of sets, c. complement of a set, d. symmetric difference of sets;			A
	3.4.2 apply properties/ laws of union and intersection to solve, problems using Venn diagram of: a. two distinct and overlapping sets, b. three overlapping sets;			A

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			R	U	A and beyond
3.5 Application of Sets Theory	3.5.1	apply concepts of set theory up to three overlapping sets to solve world problems;			A
3.6 Ordered Pairs and Cartesian Product	3.6.1	describe ordered pairs and Cartesian product;		*	A
	3.6.2	solve problems based on ordered pairs and Cartesian product;			
3.7 Binary Relation	3.7.1	describe a binary relation;		*	A
	3.7.2	find the domain and range of a binary relation.			

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
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4. Functions and Graphs	Students should be able to:			
4.1 Functions	4.1.1 define function; 4.1.2 describe: a. into function, b. into and one-one function (injective function), c. onto function (surjective function), d. one-one and onto function (bijective function); 4.1.3 identify: a. into function, b. into and one-one function (injective function), c. onto function (surjective function), d. one-one and onto function (bijective function); 4.1.4 describe the concept and notation of a function, its domain, codomain and range; 4.1.5 determine the value of a function for given values of dependent and independent variables; 4.1.6 apply concepts from functions to real world problems; 4.1.7 interpret the functions mentioned in SLO 4.1.2;	*	*	A An
4.2 Inverse Functions	4.2.1 describe the inverse of a function and its notation; 4.2.2 find the inverse of a function and its domain and range;		*	A
4.3 Composition of Functions	4.3.1 describe the composition of functions and its notation; 4.3.2 write composite functions as defined by $g(f(x)) = f(g(x))$;		*	A
4.4 Graphical Representations	4.4.1 plot graphs of a constant function, identity function, linear function and absolute valued functions; 4.4.2 determine the domain and range of a function through the graph; 4.4.3 apply concepts of absolute valued functions to real-world problems.			A A FA

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level			
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5. Factorisation	Students should be able to:				
5.1 Algebraic Identities (Revision)	5.1.1	apply the following algebraic identities to solve problems: a. $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$, b. $(a + b)^2 - (a - b)^2 = 4ab$, c. $(a + b)(a - b) = a^2 - b^2$, d. $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$, e. $(a + b)^3 = a^3 + 3ab(a + b) + b^3$, f. $(a - b)^3 = a^3 - 3ab(a - b) - b^3$, g. $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$, h. $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$;			A
5.2 Factorisation	5.2.1	factorise the expression of the following types: a. $ka + kb + kc$, b. $ac + ad + bc + bd$, c. $a^2 \pm 2ab + b^2$, d. $a^2 - b^2$, e. $a^2 \pm 2ab + b^2 - c^2$, f. $a^4 \pm a^2b^2 + b^4$ or $a^4 + b^4$, g. $ax^2 + bx + c$, h. $(a^3 \pm 3a^2b + 3ab^2 \pm b^3)$, i. $a^3 \pm b^3$;			A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
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5.3 Remainder Theorem	5.3.1 define zeros of a polynomial; 5.3.2 solve the expression to find the remainder using remainder theorem; (Note: when a polynomial of degree up to 4 is divided by polynomial of degree up to 2)	*		A
5.4 Factorisation of a Cubic Polynomial	5.4.1 apply factor theorem to: a. factorise a cubic polynomial, b. find zeros of a polynomial;			A
	5.4.2 apply concepts of remainder and factor theorem to solve problems.			A

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
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6. Algebraic Manipulation	Students should be able to:				
6.1 Highest Common Factor and Least Common Multiple	6.1.1	determine the highest common factor (H.C.F.) and the least common multiple (L.C.M.) of algebraic expressions using factorisation;			A
	6.1.2	apply H.C.F., L.C.M. and their relationship in solving problems;			A
6.2 Algebraic Fraction	6.2.1	describe rational expressions;		*	A
	6.2.2	simplify algebraic fractional expressions or rational expressions involving basic operations of +, -, ×, ÷ ;			
6.3 Square Root of Algebraic Expressions	6.3.1	calculate square root of algebraic expressions by: a. factorisation, b. division;			A
6.4 Partial Fractions	6.4.1	distinguish between proper and improper rational fractions;		*	A
	6.4.2	convert an algebraic fraction into partial fractions when its denominator consists of : a. non-repeated linear factors, b. repeated linear factors;			
	6.4.3	represent an algebraic fraction into partial fractions when its denominator consists of: a. non-repeated quadratic factors, b. repeated quadratic factors.			A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
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7. Linear Equations and Inequalities	Students should be able to:			
7.1 Linear Equations and Radical Equations	7.1.1 define linear equation in one variable; 7.1.2 solve linear equation with real coefficients; 7.1.3 solve problems based on linear equations; 7.1.4 solve radical equations reducible to linear form; 7.1.5 verify the solution (discarding extraneous roots);	*		A A A E
7.2 Equations involving Absolute Value	7.2.1 define absolute valued functions in one variable; 7.2.2 solve equations involving absolute valued functions in one variable;	*		A
7.3 Linear Inequalities	7.3.1 define inequalities: a. less than ($<$), b. greater than ($>$), c. less than or equal (\leq), d. greater than or equal (\geq); 7.3.2 solve linear inequalities with real coefficient, in one and two variables and represent the solution on the number line; 7.3.3 solve absolute valued inequalities in one variable and represent the solution on the number line; 7.3.4 plot linear inequality with two variables on graph; 7.3.5 solve two linear inequalities with two variables graphically; 7.3.6 interpret the regions in the plane that are bounded by two linear inequalities involving two variables.	*		A A A A An

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
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8. Vectors	Students should be able to:			
8.1 Introduction of Vector	8.1.1 describe rectangular coordinate system in plane; 8.1.2 describe magnitude of a vector, equal vectors, negative of a vector, unit vector, zero/ null vector, position vector, parallel vectors; 8.1.3 determine magnitude of a vector; 8.1.4 represent translation by a vector; 8.1.5 represent vectors as directed line segment;		*	A A A
8.2 Vectors in a Plane	8.2.1 explain addition and subtraction of vectors; 8.2.2 explain multiplication of a vector by a scalar; 8.2.3 apply the concepts given in SLOs 8.2.1 and 8.2.2 of two vectors geometrically; 8.2.4 represent a vector in a Cartesian plane by describing the fundamental unit vectors i and j ; 8.2.5 apply concepts from geometrical problems involving the use of vectors (such as parallel and perpendicular lines in geometrical shapes).		*	A A A

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
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9. Introduction to Coordinate Geometry	Students should be able to:				
9.1 Distance Formula	9.1.1	describe coordinate geometry;		*	
	9.1.2	explain distance formula by locating the position of two points in coordinate plane;		*	
	9.1.3	determine the distance between two given points;			A
9.2 Midpoint Formula	9.2.1	calculate the midpoint of a line segment;			A
	9.2.2	solve word problems related to midpoint formula;			A
9.3 Gradient of a Straight Line	9.3.1	explain inclination and gradient of a line;		*	
	9.3.2	determine the gradient of a straight line: a. when coordinates of two points are given, b. when inclination is given;			A
	9.3.3	determine the gradient of: a. parallel lines, b. perpendicular lines;			A
9.4 Standard Form of Equation of a Straight Line	9.4.1	describe equation of a straight line in: a. slope-intercept form, b. point-slope form;		*	
	9.4.2	convert the general form of the equation of a straight line into the form mentioned in SLO 9.4.1(a);			A
	9.4.3	determine the x and y intercepts from the given linear equation;			A
9.5 Application of Coordinate Geometry	9.5.1	apply the concepts of coordinate geometry to real world problems.			A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
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10. Loci	Students should be able to:			
10.1 Locus	10.1.1 define locus; 10.1.2 describe simple loci of points in two dimensions; 10.1.3 explain the locus of points under the given conditions: a. at a given distance from a given point, b. at a given distance from a given straight line, c. equidistant from two given points, d. equidistant from two given intersecting straight lines;	*	*	
10.2 Application of Loci	10.2.1 solve problems using the method of intersecting loci for sets of points in two dimensions which are mentioned in SLO 10.1.3.			A

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Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
11. Logic	Students should be able to:			
11.1 Logic	11.1.1 differentiate between a mathematical statement and its proof; 11.1.2 differentiate between an axiom, conjecture and theorem; 11.1.3 formulate simple deductive proofs [algebraic proofs that require showing the LHS to be equal to the RHS].		FA FA	FA

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Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
12. Similar Figures	Students should be able to:			
12.1 Similar Figures	12.1.1 describe the conditions for following polygons and solids to be similar: a. triangle, b. square and rectangle, c. cube and cuboid, d. semi-circle and circle;		*	
	12.1.2 solve problems by applying the relationship between area and volume of similar figures as mentioned in SLO 12.1.1;			A
	12.1.3 analyse whether the two figures are similar as mentioned in SLO 12.1.1.			An

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level			
		R	U	A and beyond	
13. Geometrical Properties of Regular Polygons	Students should be able to:				
13.1 Parallelograms and Triangles	13.1.1	apply the following properties to solve related problems: a. if two opposite sides of a quadrilateral are congruent and parallel, it is a parallelogram, b. in a parallelogram: i. the opposite sides are congruent, ii. the opposite angles are congruent, iii. the diagonals bisect each other; c. the line segment, joining the midpoints of two sides of a triangle, is parallel to the third side and is equal to one half of its length;			A
13.2 Application of Regular Polygon	13.2.1	solve real world problems that involve the properties mentioned in SLO 13.1.1 of the following polygons: a. triangle, b. rectangle, c. square.			A

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			R	U	A and beyond
14. Introduction to Trigonometry	Students should be able to:				
14.1 Measurement of an Angle	14.1.1	describe the sexagesimal system (degree, minute and second);		*	A
	14.1.2	convert an angle from $D^{\circ}M'S''$ to decimal form or vice versa;	*		A
	14.1.3	define radian;			
	14.1.4	convert an angle from degree to radian and vice versa;			A
14.2 Trigonometric Ratios	14.2.1	identify quadrants and quadrantal angles ($0, \pm 90^{\circ}, \pm 180^{\circ}, \pm 270^{\circ}, \pm 360^{\circ}$);		*	
	14.2.2	identify the signs of trigonometric ratios in different quadrants;		*	
	14.2.3	calculate the values of trigonometric ratios and their reciprocals for $30^{\circ}, 45^{\circ}$ and 60° ;			A
14.3 Application of Pythagoras' Theorem and Trigonometric Ratios	14.3.1	determine the unknown sides or angles in a right-angled triangle by applying Pythagoras' theorem and the sine, cosine and tangent ratios for acute angles ($30^{\circ}, 45^{\circ}$, and 60°);			A
14.4 Trigonometric Identities	14.4.1	explain the fundamental trigonometric identities i.e., $\sin^2 \theta + \cos^2 \theta = 1, 1 + \tan^2 \theta = \sec^2 \theta, 1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$;		*	
	14.4.2	prove different trigonometric relations using the trigonometric identities mentioned in SLO 14.4.1;			E
14.5 Angle of Elevation and Depression	14.5.1	describe the angle of elevation and depression;		*	
	14.5.2	solve word problems involving angle of elevation and depression in a right-angled triangle.			A

Scheme of Assessment

Grade IX

Table 1: Exam Specifications

Topic No.	Topics	Marks Distribution		Total Marks
		MCQs	CRQs	
1.	Real Numbers	-	Total 3 Marks (1 CRQ)	3
2.	Logarithms	-	Total 3 Marks (1 CRQ)	3
3.	Sets Theory	3	Total 3 Marks (1 CRQ)	6
4.	Functions and Graphs	3	Total 3 Marks Choose any ONE from TWO	6
5.	Factorisation	7	Total 3 Marks Choose any ONE from TWO	10
6.	Algebraic Manipulation	4	Total 3 Marks (1 CRQ)	7
7.	Linear Equations and Inequalities	7	Total 3 Marks Choose any ONE from TWO	10
8.	Vectors	3	-	3
9.	Introduction To Coordinate Geometry	5	Total 3 Marks (1 CRQ)	8
10.	Loci	3	-	3
11.	Logic	-	FA	
12.	Similar Figures	3	-	3
13.	Geometric Properties of Regular Polygon	3	-	3
14	Introduction To Trigonometry	4	Total 6 Marks Choose any TWO from THREE	10
Total		45	30	75

Examination Structure for Grades IX and X

- Multiple Choice Question (MCQ) requires candidates to choose one best/ correct answer from four options for each question. Each MCQ carries ONE mark.
- Constructed Response Question (CRQ) requires students to respond with a short text (few phrases/ sentences), calculations or diagrams.
- Table 1 and 2 contains the mark distribution for each topic.
- There will be two examinations, one at the end of grade IX and one at the end of grade X.
- In each grade, the theory paper will be of 3 hours and will consist of two parts: paper I and paper II.
- Paper I theory will consist of 45 compulsory, multiple choice items. These questions will involve four responses options. The answer sheet for paper I will be provided separately.
- Paper II theory will carry 30 marks and consist of Constructed Response Questions (CRQs).
- The booklet for paper II will serve as an answer script.

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