



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)

Part II (Grade X)

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level ³		
			R	U	A and beyond
15. Quadratic Equations	Students should be able to:				
15.1 Quadratic Equations (in one variable)	15.1.1	distinguish between quadratic equations and other equations;		*	A
	15.1.2	convert a given quadratic equation in standard form;			
15.2 Solution of Quadratic Equations	15.2.1	solve a quadratic equation in one variable by: a. factorisation method, b. completing square method, c. using quadratic formula;			A
	15.2.2	solve problems of “changing the subject”;			A

³R = Remember, U = Understand, A = Application and beyond [Apply (Ap), Analyse (An), Evaluate (E), Create (C)]

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level					
		R	U	A and beyond			
15.3 Solution of Equation Reducible to Quadratic Equation in one Variable	15.3.1	solve equations reducible to quadratic equation in one variable of the following forms: a. $px^{2n} + qx^n + r = 0, p \neq 0,$ b. $(x+p)(x+q)(x+r)(x+s) = k$, where $p+q = r+s,$ c. radical equations (e.g., $l(ax^2 + bx) + m\sqrt{ax^2 + bx + c} = 0$);					FA ⁴
	15.3.2	solve equations reducible to quadratic equation in one variable of the following forms: a. exponential equations (e.g., $p^{2x} - q.p^{x+2} + k = 0$), b. reciprocal equations (e.g., $px^4 + qx^3 + rx^2 + sx + t = 0,$ $\frac{1}{(x+p)} + (x+p) = r$), c. radical equations (e.g., $\sqrt{x+p} + \sqrt{x+q} = \sqrt{x+r}$); (check extraneous roots if any by substitution) (where p, q, r and s are real numbers);					A

⁴FA= Formative Assessment, not to be assessed under examination conditions.

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			R	U	A and beyond
15.4 Nature of the Roots of a Quadratic Equation	15.4.1	define discriminant ($b^2 - 4ac$) of the quadratic equation $ax^2 + bx + c = 0$; $a \neq 0$;	*		
	15.4.2	determine the nature of roots of a given quadratic equation by using discriminant;			A
15.5 Simultaneous Equations	15.5.1	solve system of two simultaneous equations in two variables when: <ul style="list-style-type: none"> a. one equation is linear and the other is quadratic (i.e., $a_1x + b_1y = c_1$, $a_2x^2 + b_2y^2 = c_2$), b. both the equations are quadratic (i.e., $a_1x^2 + b_1y^2 = c_1$, $a_2x^2 + b_2y^2 = c_2$); 			A
15.6 Applications of Quadratic Equations	15.6.1	solve word problems related to quadratic equations.			A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
16. Plotting and Interpreting the Graphs	Students should be able to:			
16.1 Plotting and Interpreting the Graphs	16.1.1 describe graphs of the Linear and Nonlinear functions such as Quadratic, Cubic, Reciprocal, and Exponential;		*	
	16.1.2 interpret graphs of the Linear and Nonlinear functions such as Quadratic, Cubic, Reciprocal, and Exponential;			An
	16.1.3 solve a system of equations (one linear and one quadratic equation) graphically;			A
	16.1.4 interpret exponential growth/ decay of a practical phenomenon through its graph;			An
16.2 Graphs Sketching	16.2.1 sketch graphs of the Linear functions and Nonlinear functions such as Quadratic, Cubic, Reciprocal, and Exponential;			A
	16.2.2 sketch graph of the function where n is a positive integer, negative integer, rational number for $y = x^n$;			FA
16.3 Application of Graphs	16.3.1 apply concepts of sketching and interpreting graph to solve real life problems (such as in tax payment, income and salary problems and cost and profit analysis).			FA

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
17. Complex Numbers	Students should be able to:			
17.1 Introduction to Complex Numbers	17.1.1 describe complex number z represented by an expression of the form $z = a + ib$, where a and b are real numbers and $i = \sqrt{-1}$; 17.1.2 identify a as real part and b as imaginary part of $z = a + ib$; 17.1.3 state $\bar{z} = a - ib$, the complex conjugate of $z = a + ib$; 17.1.4 describe the condition for equality of complex numbers; 17.1.5 apply the condition for equality of complex numbers; 17.1.6 solve problems based on the conjugate of a complex number; where $i^n, n = 2$; 17.1.7 calculate $ z = \sqrt{a^2 + b^2}$, the absolute value or modulus of a complex number $z = a + ib$;	*	*	A A A
17.2 Basic Operations on Complex Numbers	17.2.1 apply basic operations (i.e. addition, subtraction, multiplication, and division) on complex numbers;			A
17.3 Properties of Complex Numbers	17.3.1 describe the properties of complex numbers (commutative, associative and distributive with respect to addition and multiplication); 17.3.2 describe the following properties of complex numbers: a. $ z = -z = \bar{z} = -\bar{z} $, b. $\overline{\bar{z}} = z, z\bar{z} = z ^2, \overline{z_1 \pm z_2} = \bar{z}_1 \pm \bar{z}_2$, c. $\overline{z_1 z_2} = \bar{z}_1 \bar{z}_2, \overline{\left(\frac{z_1}{z_2}\right)} = \frac{\bar{z}_1}{\bar{z}_2}, z_2 \neq 0$; 17.3.3 determine the additive inverse and multiplicative inverse of a complex number;		*	A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
	17.3.4 solve problems based on the properties of complex numbers mentioned in SLO 17.3.2;			A
	17.3.5 determine the real and imaginary parts of the following types of complex numbers: a. $(x+iy)^n$, b. $\left(\frac{x_1+iy_1}{x_2+iy_2}\right)^n$; $x_2+iy_2 \neq 0$, a. where $n = \pm 1$ and $n = \pm 2$;			A
17.4 Application of Complex Numbers	17.4.1 apply mathematical models and equations to predict outcomes, evaluate hypotheses, and analyse complex systems in various scientific contexts.			FA

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			R	U	A and beyond
18. Matrices and Determinants	Students should be able to:				
18.1 Introduction to Matrices	18.1.1 18.1.2	define matrix; describe: a. order of a matrix, b. equality of matrices;	*	*	
18.2 Types of Matrices (up to order 3)	18.2.1 18.2.2	describe row matrix, column matrix, rectangular matrix, square matrix, zero/ null matrix, diagonal matrix, scalar matrix, unit matrix and symmetric matrix; explain the transpose of a matrix;		*	
18.3 Addition and Subtraction of Matrices (up to order 3)	18.3.1 18.3.2 18.3.3 18.3.4 18.3.5 18.3.6 18.3.7	explain the given matrices are conformable for addition/ subtraction; determine the sum and difference of two matrices; explain commutative and associative laws under addition; define the additive identity of a matrix; determine the additive identity of a matrix; define the additive inverse of a matrix; determine the additive inverse of a matrix;	*	*	A A A
18.4 Multiplication of Matrices (up to order 2)	18.4.1 18.4.2 18.4.3 18.4.4 18.4.5	determine the multiplication of a matrix by a real number; explain the given matrices are conformable for multiplication; determine the multiplication of two (or three) matrices; describe associative law under multiplication; describe distributive laws of multiplication over addition and subtraction;		*	A A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
	18.4.6 explain that the commutative law under multiplication does not hold in general (i.e. $AB \neq BA$); 18.4.7 verify the result $(AB)^t = B^t A^t$ with the help of examples;		*	E
18.5 Multiplicative Inverse of a Matrix (up to order 2)	18.5.1 describe the determinant of a square matrix; 18.5.2 calculate the determinant of a matrix; 18.5.3 define singular and non-singular matrix; 18.5.4 solve problems related to singular and non-singular matrix; 18.5.5 determine the adjoint of a matrix and related problems; 18.5.6 define the multiplicative identity of a matrix; 18.5.7 determine the multiplicative inverse of a non-singular matrix A ; 18.5.8 verify that $AA^{-1} = I = A^{-1}A$, where I is the multiplicative identity matrix; 18.5.9 verify the result $(AB)^{-1} = B^{-1}A^{-1}$ with the help of examples;	*	*	A A A A E E
18.6 Solution of Matrix Equations and Simultaneous Linear Equations	18.6.1 solve matrix equations (e.g. Find A , if $A + \begin{bmatrix} 2 & 1 \\ 0 & 3 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix} = 5 \begin{bmatrix} 3 \\ 2 \end{bmatrix}$); 18.6.2 solve a system of two simultaneous linear equations in two unknowns using: a. matrix inverse method, b. Cramer's rule;			A A
18.7 Application of Matrices	18.7.1 convert a real life word problem in the form of a matrix equation; 18.7.2 analyse the key role played by mathematics in the development of new scientific theories and technologies.			A FA

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			R	U	A and beyond
19. Application of Trigonometry	Students should be able to:				
19.1 Laws of Sine and Cosine	19.1.1	define law of Sine and Cosine;	*		
19.2 Area of Triangles	19.2.1	explain the formulae for the area of a triangle when length of:		*	
		a. two sides and their included angle are given,			
		b. one side and two angles are given,			
	19.2.2	apply the above formulae to determine the area of a triangle;			A
	19.2.3	solve trigonometric problems in two dimensions;			A
19.3 Bearing	19.3.1	describe bearing;		*	
	19.3.2	solve problems involving bearing;			A
19.4 Application of Trigonometry	19.4.1	apply concepts of trigonometry to real life world problems.			A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
20. Circles	Students should be able to:			
20.1 Chords of a Circle	20.1.1 apply the following theorems to solve related problems: a. one and only one circle can pass through three non-collinear points, b. a straight line drawn from the centre of a circle to bisect a chord which is not a diameter is perpendicular to the chord and vice versa, c. if two chords of a circle are congruent then they will be equidistant from the centre and vice versa;			A
20.2 Tangent to a Circle	20.2.1 apply the following theorems to solve related problems: a. if a line is drawn perpendicular to a radial segment of a circle at its outer end point, it is tangent to the circle at that point and vice versa, b. the two tangents drawn to a circle from a point outside it is equal in length, c. if two circles touch externally or internally the distance between their centres is respectively equal to the sum or difference of their radii;			A
20.3 Chords and Arcs	20.3.1 apply the following theorems to solve related problems: a. if two chords of circle (or of congruent circles) are equal, then their corresponding arcs (minor, major or semi-circular) are congruent and vice versa, b. equal chords of a circle (or of congruent circles) subtend equal angles at the centre (at the corresponding centres) and vice versa;			A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
20.4 Angle in a Segment of a Circle	20.4.1 apply the following theorems to solve related problems: <ol style="list-style-type: none"> the measure of a central angle of a minor arc of a circle, is double that of the angle subtended by the corresponding major arc, any two angles in the same segment of a circle are equal, the inscribed angle in a semi-circle is a right angle, the angle in a segment greater than a semi-circle is less than a right angle, the angle in a segment less than a semi-circle is greater than right angle, the opposite angles of any quadrilateral inscribed in a circle are supplementary. 			A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
21. Practical Geometry	Students should be able to:			
21.1 Construction of triangle	21.1.1 construct a triangle when: a. two sides and one of the angles is given, b. one side and two of the angles are given;			A
	21.1.2 construct the following using compass for a given triangle: a. angle bisectors, b. perpendicular bisectors, c. medians, d. altitudes;			A
	21.1.3 verify, for a given triangle, the concurrency of: a. angle bisectors, b. altitudes, c. perpendicular bisectors, d. medians;			E
21.2 Construction of Circle	21.2.1 find the centre of a given circle;			A
	21.2.2 draw a circle passing through three given non-collinear points;			A
	21.2.3 complete the circle: a. by finding the centre, b. without finding the centre, c. when a part of its circumference is given;			A
21.3 Tangents to the Circle	21.3.1 draw a tangent to a given arc, without using the centre, through a given point P when P is: a. the middle point of the arc, b. at the end of the arc, c. outside the arc;			A
	21.3.2 draw a tangent to a given circle from a point P when P lies: a. on the circumference of the circle, b. outside the circle;			A
	21.3.3 draw two tangents to a circle meeting each other at a given angle.			A

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
22. Basic Statistics	Students should be able to:			
22.1 Frequency Distribution and Graphs	22.1.1 construct a grouped frequency table (using direct and tally marks method);			A
	22.1.2 draw histograms with equal and unequal class intervals;			A
	22.1.3 draw a frequency curve and a frequency polygon;			A
	22.1.4 interpret the histogram frequency curve and frequency polygon;			An
22.2 Cumulative Frequency Distribution	22.2.1 construct a cumulative frequency table;			A
	22.2.2 draw a cumulative frequency curve and cumulative frequency polygon;			A
	22.2.3 draw box and whisker plot;			A
	22.2.4 interpret the cumulative frequency curve, cumulative frequency polygon, box and whisker plot;			An
22.3 Measures of Central Tendency	22.3.1 calculate the arithmetic mean by direct method (only), weighted mean, median and mode for ungrouped data;			A
	22.3.2 calculate the arithmetic mean by direct method (only), median and mode for grouped data;			A
	22.3.3 solve real life situations involving mean, weighted mean, median, and mode for given data;			A
	22.3.4 find the approximate value of median and mode graphically;			An
	22.3.5 define quantiles (quartiles, deciles and percentiles);	*		
	22.3.6 calculate quartiles, deciles and percentiles for ungrouped and grouped data;			A
	22.3.7 interpret the median, quartiles, deciles, percentiles, and inter quartile range from cumulative frequency curve;			An

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
22.4 Measures of Dispersion	22.4.1	calculate the range, variance and standard deviation for grouped and ungrouped data;		A
	22.4.2	calculate the coefficient of variation for grouped and ungrouped data;		A
	22.4.3	solve problems related to variance, standard deviation and coefficient of variation;		A
22.5 Correlation	22.5.1	draw scatter diagrams and a line of best fit;		FA
	22.5.2	interpret the correlation between the variables from scatter diagram.		FA

Topics and Sub-topics	Student Learning Outcomes	Cognitive Level		
		R	U	A and beyond
23. Probability	Students should be able to:			
23.1 Probability	23.1.1 define the following terms: a. statistical experiment, b. sample space and event, c. mutually exclusive and mutually inclusive events, d. equally likely events, e. dependent and independent events, f. simple and compound events;	*		
	23.1.2 apply the given formula to find the probability of an event E , i.e., $P(E) = \frac{n(E)}{n(S)}, 0 \leq P(E) \leq 1$;			A
	23.1.3 solve word problems involving probability;			A
23.2 Probability of Combined Event	23.2.1 describe combine events, tree diagram and venn diagrams;		*	
	23.2.2 calculate the probability of combined events using tree diagrams and Venn diagrams;			A
	23.2.3 explain the given laws of probability: a. law of compliment, b. law of addition, c. law of multiplication;		*	
	23.2.4 solve problems related to laws of probability mentioned in SLO 23.2.3;			A
23.3 Relative and expected frequencies	23.3.1 define relative frequency and expected frequency;	*		
	23.3.2 calculate relative frequency and expected frequency as an estimate of probability;			A
	23.3.3 solve real life problems involving relative and expected frequencies.			A

Table 2:Exam Specifications

Topic No.	Topics	Marks Distribution		Total Marks
		MCQs	CRQs	
15.	Quadratic Equation	7	Total 3 Marks (1 CRQ)	10
16.	Plotting and Interpreting the Graphs	2	Total 4 Marks (1 CRQ)	6
17.	Complex Number	7	Total 3 Marks (1 CRQ)	10
18.	Matrices and Determinants	7	Total 4 Marks Choose any ONE from TWO	11
19.	Application of Trigonometry	7	Total 3 Marks Choose any ONE from TWO	10
20.	Circles	3	Total 3 Marks (1 CRQ)	6
21.	Practical Geometry	1	Total 3 Marks (1 CRQ)	4
22.	Basic Statistics	6	Total 4 Marks Choose Any ONE from TWO	10
23.	Probability	5	Total 3 Marks (1 CRQ)	8
Total		45	30	75