2c. Content of FSMQ: Additional Maths (01)

Content	Learners should be able to	Notes
Algebra (AL)		
Algebraic Manipulation	AL1 Know and use algebraic vocabulary and notation.	i.e. constant, coefficient, expression, equation, identity, index, variable, unknown, f(x) .
	AL2 Simplify expressions involving algebraic fractions and square roots.	e.g. Simplify $\frac{2}{x-1}-\frac{1}{x+1}$.
		e.g. Simplify $\sqrt{125}$, $\sqrt{12}+\sqrt{27}$, $\frac{1}{2+\sqrt{3}}$.
	AL3 Perform operations with polynomials, including addition, subtraction, multiplication and division.	e.g. $\frac{x^3-3x^2-x-3}{x-1}$.
	AL4 Find linear factors of a polynomial.	Includes the use of the factor theorem.
	AL5 Complete the square of a quadratic polynomial.	$ax^2+bx+c \equiv a(x+p)^2+q$
Applications of equations	AL6 Set up and solve problems leading to linear, quadratic and cubic equations in one unknown, and to simultaneous equations in two unknowns.	Problems could be set in mathematical or non-mathematical contexts.
Inequalities	AL7 Manipulate inequalities.	e.g. $24x+28y \leqslant 400$
	AL8 Set up and solve linear and quadratic inequalities algebraically and graphically.	e.g. solve $-3 < 2x-1 < 5$
	AL9 Illustrate linear inequalities in two variables.	i.e. the use of appropriate shading.
Recurrence relationships	AL10 Understand and use notation of recurrence relationships to describe and determine sequences.	e.g. $x_{n+1}=x_n+a$ e.g. $x_{n+1}=ax_n$ e.g. $x_{n+2}=x_n+x_{n+1}$
	AL11 Use recurrence relationships in modelling.	e.g. modelling compound interest.

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Enumeration (EN)		
Binomial expansion	EN1 Understand and be able to apply the binomial expansion of $(a+b)^n$ where n is a positive integer.	e.g. Expand $(2+3x)^5$ in ascending powers of x .
Representation	EN2 Construct and use tree diagrams, two way tables, Venn Diagrams or the binomial distribution to enumerate outcomes.	
Product Rule	EN3 Use the product rule for counting numbers of outcomes of combined events.	e.g. Number of outcomes rolling n dice is 6^n e.g. Number of arrangements of n distinct objects is $n!$.
Permutations	EN4 Enumerate the number of ways of obtaining an ordered linear subset (permutation) of r elements from a set of n distinct objects.	e.g. How many ways of awarding two prizes in a group of ten people. Includes the use of the notation ${}_nP_r$ (${}^nP_r$).
Combinations	EN5 Enumerate an unordered subset (combination) of r elements from a set of n distinct objects.	e.g. How many ways are there of choosing two people out of a group of ten to sit on a committee? Includes the use of the notation ${}_nC_r$ (${}^nC_r$).
Applications	EN6 Solve problems about outcomes, including problems in the context of probability.	e.g. Find the probability of obtaining at least two sixes when five dice are rolled.

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Coordinate Geometry (two dimensions only) (CG)		
The straight line	CG1 Calculate the distance between two points. CG2 Find the mid-point of a line segment.	e.g. $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$. e.g. $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$.
The coordinate geometry of circles	CG3 Know and use the equation of a circle $(x-a)^2+(y-b)^2=r^2$, where (a,b) is the centre and r is the radius of the circle.	e.g. A(1, 1) and B(5, 7) are the ends of a diameter of the circle. Show that the equation of the circle is $(x-3)^2+(y-4)^2=13$.
Graphs	CG4 Sketch and plot linear, polynomial, trigonometric and exponential functions. CG5 Know, understand and use gradient, intercept, tangent and normal in problems involving points that can be defined by equations and inequalities.	
Applications in linear programming	CG6 Express real situations in terms of linear inequalities. CG7 Use graphs of linear inequalities to solve 2-dimensional maximisation and minimisation problems. CG8 Know the definition of objective function and be able to find it in 2-dimensional cases.	e.g. Given $4x+7y<56$, $6x+3y<54$, $x>0$, $y>0$ find the maximum value of $x+y$.

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Pythagoras' Theorem and Trigonometry (PT)		
Ratios of any angles	PT1 Use the definitions of $\sin\theta$, $\cos\theta$ and $\tan\theta$ for any angle and their graphs. PT2 Know the sine and cosine rules and be able to apply them, including the ambiguous case for sine.	Measured in degrees only. e.g. In a triangle ABC, AB = 10 m, AC = 8 m and angle B = 40°. Find the two possible values of angle C.
Trigonometric identities	PT3 Know and use the identity $\tan\theta \equiv \frac{\sin\theta}{\cos\theta}$. PT4 Know and use the identity $\sin^2\theta + \cos^2\theta \equiv 1$.	
Trigonometric equations	PT5 Solve simple trigonometric equations in given intervals.	e.g. Solve $\tan 2x = 0.5$ for $0° \leqslant x \leqslant 360°$.
Applications in modelling	PT6 Apply Pythagoras' Theorem and trigonometry to 2- and 3-dimensional problems.	e.g. Find the angle of greatest slope.

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Calculus (CA)		
Differentiation	CA1 Differentiate kx^n where n is a positive integer or 0, and the sum of such functions. CA2 Know that the gradient function gives the gradient of the curve and measures the rate of change of y with x . CA3 Know that the gradient of the function is the gradient of the tangent at that point. CA4 Find the equation of a tangent and normal at any point on a curve. CA5 Use differentiation to find stationary points on a curve. CA6 Determine the nature of a stationary point. CA7 Sketch a curve with known stationary points.	i.e. use of notation $\frac{dy}{dx}$, $f'(x)$, $\dot{x}$. e.g. Find the equations of normal to the curve $y = x^3 - 2x + 3$ at the point (1, 2).
Integration	CA8 Integrate kx^n where n is a positive integer or 0, and the sum of such functions. CA9 Be aware that integration is the reverse of differentiation. CA10 Know what is meant by an indefinite and a definite integral. CA11 Evaluate definite integrals. CA12 Find the area between a curve, two ordinates and the x-axis. CA13 Find the area between two curves.	$\int y\,dx$ e.g. be able to find the equation of a curve, given its gradient function and one point. Understand the constant of integration. $\int_a^b y\,dx$ $\int_a^b f(x)\,dx - \int_a^b g(x)\,dx$
Application to kinematics	CA14 Use differentiation and integration with respect to time to solve simple problems involving variable acceleration. CA15 Recognise the special case where the use of constant acceleration formulae is appropriate.	

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Numerical Methods (NM)		
Solving equations	NM1 Solve equations approximately by considering the change of sign. NM2 Use a simple iterative method to solve equations approximately. NM3 Recognise when these numerical methods may fail.	
Gradients of tangents	NM4 Use a chord to estimate gradient of a tangent to a curve at a point. NM5 Recognise how to improve an estimate for the gradient of a curve at a point.	
Area under a curve	NM6 Use rectangular strips to estimate the area between a curve and the *x*-axis. NM7 Use trapezium rule to estimate the area between a curve and the *x*-axis. NM8 Recognise whether an estimate would be an over or under estimate, and understand how to calculate an improved estimate.	Formula will be provided.
Applications of Numerical methods	NM9 Apply numerical methods in context where appropriate.	e.g. determine the velocity from displacement-time curve.

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Exponentials and logarithms (EL)		
Properties of the exponential function	EL1 Know and use the function ka^x and its graph, where a is positive.	
Properties of the logarithmic function	EL2 Know and use the definition of $\log_a x$ as the inverse of a^x. EL3 Understand and use the laws of logarithms.	i.e. • $\log x + \log y = \log(xy)$ • $\log x - \log y = \log\left(\frac{x}{y}\right)$ • $\log x^n = n \log x$.
Reduction to linear form	EL4 Convert equations of the form $y = ka^x$ and $y = kx^n$ to a linear form using logarithms. EL5 Estimate values of k and a or k and n from graphs.	
Equations involving exponentials	EL6 Solve equations of the form $a^x = b$ for $a > 0$. EL7 Use exponentials and logarithms in problems involving exponential growth and decay.	