Mathematics Syllabus B 7361

This subject may be taken at both the May/June and January examinations.

Introduction

This syllabus was introduced to bring together the "modern" and "traditional" approaches to Ordinary level Mathematics.

The Examination

The examination will consist of two papers. Paper 1 will carry one-third and Paper 2 two-thirds of the maximum mark.

Both papers may contain questions from any part of the syllabus and the solution of any question may require knowledge of more than one section of the syllabus.

Questions will be set in SI units.

Paper 1. This will be of 1½ hours and will consist of about 30 questions with varying mark allocations per question which will be stated on the paper. All these questions may be attempted and answers will be written in the question booklet.

Paper 2. This will be of 2½ hours and will consist of about 12 questions with varying mark allocations per question which will be stated on the paper. All these questions may be attempted. Where a question on Paper 2 requires the use of one of the formulae below, that formula will be given at the end of the question.

Circumference of a circle	$2\pi r$
Area of triangle	$\frac{1}{2}bc\sin A$
Area of trapezium	$\frac{1}{2}(a+b)h$
Area of circle	πr^2
Curved surface area of right circular cylinder	$2\pi rh$
Curved surface area of right circular cone	πrl
Surface area of sphere	$4\pi r^2$
Volume of pyramid	$\frac{1}{3}\times$ base area $\times$ height
Volume of right circular cone	$\frac{1}{3}\pi r^2 h$
Volume of sphere	$\frac{4}{3}\pi r^3$
Sum of interior angles of polygon	$(2n-4)$ right angles
Solutions of $ax^2+bx+c=0$	$x=\frac{-b\pm\sqrt{(b^2-4ac)}}{2a}$
Determinant of matrix $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$	$ad-bc$
Inverse of matrix $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$	$\frac{1}{ad-bc}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$

Notation

The notation used will include the following:

{ }	the set of
n(A)	the number of elements in the set A
{x: }	the set of all x such that
$\in$	is an element of
$\notin$	is not an element of
$\varnothing$	the empty (null) set
$\mathcal{E}$	the universal set
$\cup$	union
$\cap$	intersection
$\subset$	is a subset of
A'	the complement of the set A
PQ	operation Q followed by operation P
f: A $\rightarrow B$	is a function under which each element of set A has an image in set B
f: $x \mapsto y$	f is a function under which x is mapped to y
f(x)	the image of x under the function f
f^{-1}	the inverse relation of the function f
fg	the function f of the function g
—○—○—	open interval on the number line
—●—●—	closed interval on the number line
a	the vector **a**
$\overrightarrow{AB}$	the vector represented in magnitude and direction by $\overrightarrow{AB}$

Candidates are expected to have available a calculator with at least the following keys:

$+, -, \times, \div, \pi, x^2, \sqrt{x}, \frac{1}{x}; x^y$

sine, cosine and tangent and their inverses in degrees and decimals of a degree.

SYLLABUS	NOTES
1. The ordinary processes of number manipulation.	The 'four rules' and combination of them by use of brackets.
Prime numbers, factors, multiples, indices.	To include finding HCF and LCM in simple cases where they can be found by inspection.
Natural numbers, integers, rational and irrational numbers.	Recognition of these sets; proofs of irrationality will not be required.
Weights, measures and money.	The nautical mile and the knot are excluded.
Fractions, decimals, ratio, proportion and percentage.	Candidates will be expected to interchange any of these methods of fractional representation and to select the most appropriate to given situations.
Expressing numbers to a given degree of accuracy.	Correction to a given number of decimal places or significant figures.
Numbers in standard form.	$a \times 10^n$, where n is an integer, and $1 \leq a < 10$. Questions may involve the application of any of the above processes to problems of everyday personal, domestic or community life.
2. Length, area, volume. Mensuration of the rectangle, parallelogram, triangle, circle, cylinder, cone and sphere.	Straightforward calculations, where appropriate, of areas and volumes of the shapes mentioned and also of plane shapes which can be divided into a collection of such shapes (eg trapezia, polygons).
Length of an arc, area of a sector of a circle.	Radian measure is excluded.
3. The idea of a set. Set language and notation.	Questions may be set involving these ideas in the abstract or derived from practical situations.
Union and intersection of sets. Number of elements in a set. Complementary sets. Subsets. Universal set, null set.	
Venn diagrams, and their use in simple logical problems. Use of symbols to represent sets.	Knowledge of truth tables and use of the symbols Δ and ∇ will not be expected.
Binary operations and tables; identity and inverse elements.	Questions on algebraic structures in general will not be set, but candidates should have an appreciation of identity and inverse elements.

SYLLABUS	NOTES
4. The basic processes of algebra. The symbolic expression of general results.	
The construction, interpretation and use of formulae: their manipulation in simple cases.	To include change of subject of a formula (either by rearrangement or the 'reverse flow diagram' technique).
The factorisation of simple algebraic expressions.	To include the use of the factor theorem for integer values of the variable.
The manipulation of simple algebraic fractions, the denominators being numerical or linear.	Simple cases involving sum, difference, product and quotient of algebraic fractions.
Solution of equations of 1^{st} and 2^{nd} degree containing one unknown quantity.	Solution of quadratics to include solution by factorisation, by graph, by completing the square or by formula. Problems which result in the solution of such equations may also be set.
Solution of linear simultaneous equations in two unknowns.	No questions will be set on linear programming, but simple questions may be set requiring the graphical solution of simultaneous linear inequalities.
Solution of linear inequalities, and the representations of solutions on the number line and in two-dimensional space.	
The idea of a sequence.	

SYLLABUS	NOTES
5. The idea of a function of a variable. Function as a mapping or as a correspondence between the elements of two sets.	To include the representation of functions as a 1 – 1 mapping on parallel number lines in addition to the rectangular cartesian representation.
Domain and range of a function.	Questions will not be set on continuity, but candidates will be expected to recognise when parts of the domain need to be excluded (eg x = 0 must be excluded from the domain of the function f where f(x) = 1/x).
Composite functions,	"fg" will mean "do g first then f".
Inverse functions. Variation.	To include the following cases: $y \propto x$; $y \propto \frac{1}{x}$; $y \propto x^2$; $y \propto \frac{1}{x^2}$; $y \propto x^3$.
Rectangular cartesian coordinates. Graphs and graphical treatment of the equation: $y = Ax^3 + Bx^2 + Cx + D + \frac{E}{x} + \frac{F}{x^2}$ in which the constants are numerical and at least three of them are zero.	
The gradients of these graphs by drawing.	Candidates will be expected to draw a reasonable tangent to the graph at a named point, and to construct an appropriate right angled triangle from which to calculate the gradient.
Differentiation of *integer* powers of x. Determination of gradients, rates of change, maxima and minima.	Candidates will be expected to be able to relate their calculations to their graphs and vice-versa.
Applications to linear kinematics and to other simple practical problems.	This includes the drawing and interpretation of distance/time and speed/time graphs and other graphs of a similar nature.

SYLLABUS	NOTES
6. Representation of data by a matrix.	
Addition and multiplication of matrices	An understanding of ideas of compatibility of matrices for these operations will be expected.
Multiplication of a matrix by a scalar.	
Unit (identity) matrix and zero (null) matrix.	Of order not more than 3×3.
Determinants; singular matrices.	2×2 only.
Inverses of non-singular 2×2 matrices.	
Transformations of the plane associated with 2×2 matrices. Combination of transformations.	If an invariant of a transformation is required algebraically, a lead will be given.
7. Scalar and vector quantities.	Vectors will be in 2 dimensions only.
Representation of a vector by a directed line segment.	
Sum and line difference of two vectors.	
Modulus of a vector.	
Multiplication of a vector by a scalar.	To include areas of similarity and enlargement.
Multiplication of a vector by a matrix.	To include the finding of a matrix for a given transformation of the plane, using the unit base vectors. These transformations will be those for which the origin is unchanged.

SYLLABUS	NOTES
8. Geometrical properties of Euclidean space, as listed below.	In solving any problem or rider, candidates may use any knowledge they possess. Solutions may be by traditional methods (eg, congruent triangles etc.), vectors, the use of transformations of translation, reflection, rotation and enlargement, or a mixture of these. Formal proofs of theorems will not be required.
Angle properties of parallel lines, triangles and polygons.	Angles measured anticlockwise will be taken as positive; clockwise as negative.
Properties of the parallelogram, rectangle, square, rhombus, trapezium and kite.	
Symmetry about a point, line or plane.	
Use of Pythagoras' theorem.	Including its use in any acute angled triangle where an altitude is given or constructed. The angle bisector theorems are excluded.
Similarity: areas and volumes of similar figures.	
Chord, angle and tangent properties of circles.	To include knowledge of the intersecting chord properties (both internal and external) and the alternate segment property.
Loci in 2 dimensions. Construction of bisector of an angle and of perpendicular bisector (mediator) of a straight line.	Any accurate method using normal geometrical instruments will be acceptable. "Tracing paper" methods will not be acceptable. Ruler and compass constructions only will not be required.
9. Use of sine, cosine and tangent of angles up to 180°.	Angles will be measured in degrees and decimals of a degree.
Solution of problems in 2 and 3 dimensions by calculation and by drawing.	Questions requiring the use of sine and cosine rules will not be set, although their use will not be precluded. Questions on latitude and longitude will not be set. Calculations of the angle between two planes or of the angle between a straight line and a plane will not be set.
Angles of elevation and depression. Bearings.	Angles will be given in degrees and decimals of a degree; the normal convention of bearings being measured clockwise will be adopted.

SYLLABUS	NOTES
10. Graphical representation of numerical data.	To include bar diagrams, circular diagrams (pie charts) and histograms. Cumulative frequency graphs are excluded.
Determination of the mean and median of a small number of quantities.	
Determination of the mean of a larger number of quantities given in grouped frequencies.	Questions involving weighted or moving means will not be set.
Simple probability.	The use of tree diagrams will be expected.
Sum and product rules of probability and their application to simple problems.	

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