Continue

MATHEMATICS SYLLABUSES Secondary One to Four Express Course Normal (Academic) Course Implementation starting with 2020 Secondary One Cohort © 2019 Curriculum Planning and Development Division. This publication is not for sale. Permission is granted to reproduce this publication in its entirety for personal or non-commercial educational use only. All other rights reserved. Content SECTION 1: INTRODUCTION .... 1 Importance of Learning Mathematics .... 2 Secondary Mathematics Curriculum .... 2 Key Emphases .... 3 SECTION 2: MATHEMATICS CURRICULUM .... 4 Nature of Mathematics .... 5 Themes and Big Ideas .... 5 Mathematics Curriculum Framework .... 9 21st Century Competencies .... 11 SECTION 3: O-LEVEL MATHEMATICS SYLLABUS .... 12 Aims of Syllabus .... 13 Syllabus Organisation .... 13 Problems in Real-World Contexts .... 13 Content by Levels .... 15 SECTION 4: N(A)-LEVEL MATHEMATICS SYLLABUS........ 22 Aims of Syllabus .... 23 Syllabus Organisation .... 23 Problems in Real-World Contexts .... 23 Content by Levels .... 25 O-Level Maths Content for Secondary Five N(A) .... 32 SECTION 5: PEDAGOGY AND FORMATIVE ASSESSMENT .... 34 Teaching Processes .... 35 Phases of Learning .... 36 Formative Assessment .... 38 Use of Technology .... 39 SECTION 6: SUMMATIVE ASSESSMENT .... 40 Assessment Objectives........ 41 National Examinations 42
SECTION 1: INTRODUCTION Importance of Learning Mathematics Secondary Mathematics Curriculum Key Emphases Section 1: Introduction P a g e |1 1. INTRODUCTION Importance of Learning Mathematics Mathematics contributes to the developments and understanding in many disciplines and provides the foundation for many of today's innovations and tomorrow's solutions. It is used extensively to model and understand real-world phenomena (e.g. consumer preferences, population growth, and disease outbreak), create lifestyle and engineering products (e.g. animated films, mobile games, and autonomous vehicles), improve productivity, decision- making and security (e.g. business analytics, academic research and market survey, encryption, and recognition technologies). In Singapore, mathematics education plays an important role in equipping every citizen with the necessary knowledge and skills and the capacities to think logically, critically and analytically to participate and strive in the future economy and society. In particular, for future engineers and scientists who are pushing the frontier of technologies, a strong foundation in mathematics is necessary as many of the Smart Nation initiatives that will impact the quality of lives in the future will depend heavily on computational power and mathematical insights. Secondary Mathematics Curriculum Secondary education is a stage where students discover their strengths and interests. It is also the final stage of compulsory mathematics education. Students have different needs for and inclinations towards mathematics. For some students, mathematics is just a tool to be used to meet the needs of everyday life. For these students, formal mathematics education may end at the secondary levels. For others, they will continue to learn and need mathematics to support their future learning. For those who aspire to pursue STEM education and career, learning more advanced mathematics early will give them a head start. For these reasons, the goals of the secondary mathematics education are: to ensure that all students will achieve a level of mastery of mathematics that will enable them to function effectively in everyday life; and for those who have the interest and ability, to learn more mathematics so that they can pursue mathematics or mathematics-related courses of study in the next stage of education. There are 5 syllabuses in the secondary mathematics curriculum, catering to the different needs, interests and abilities of students: O-Level Mathematics N(A)-Level Mathematics N(T)-Level Mathematics O-Level Additional Mathematics N(A)-Level Additional Mathematics Section 1: Introduction P a g e |2 The O-, N(A)- and N(T)-Level Mathematics syllabuses provide students with the core mathematics knowledge and skills in the context of a broad-based education. At the upper secondary levels, students who are interested in mathematics may offer Additional Mathematics as an elective. This prepares them better for courses of study that require mathematics. Key Emphases The key emphases of the 2020 syllabuses are summarised as follows: 1. Continue to develop in students the critical mathematical processes such as, reasoning, communication and modelling, as they enhance the learning of mathematics and support the development of 21st century competencies; 2. Develop a greater awareness of the nature of mathematics and the big ideas that are central to the discipline and bring coherence and connections between different topics so as to develop in students a deeper and more robust understanding of mathematics and better appreciation of the discipline; and 3. Give attention to developing students' metacognition by promoting self-directed learning and reflection. Section 1: Introduction P a g e |3 SECTION 2: MATHEMATICS CURRICULUM Nature of Mathematics Themes and Big Ideas Mathematics Curriculum Framework 21st Century Competencies Section 2: Mathematics Curriculum P a g e |4 2. MATHEMATICS CURRICULUM Nature of Mathematics Mathematics can be described as a study of the properties, relationships, operations, algorithms, and applications of numbers and spaces at the very basic levels, and of abstract objects and concepts at the more advanced levels. Mathematical objects and concepts, and related knowledge and methods, are products of insight, logical reasoning and creative thinking, and are often inspired by problems that seek solutions. Abstractions are what make mathematics a powerful tool for solving problems. Mathematics provides within itself a language for representing and communicating the ideas and results of the discipline. Themes and Big Ideas From the above description of the nature of mathematics, four recurring themes in the study of mathematics are derived. What are the properties of How can the mathematical objects mathematical objects and how and concepts be represented and are they related? communicated? What meaningful actions can we How can the mathematical objects perform on the objects and how be further abstracted and where do we carry them out? can they be applied? 1. Properties and Relationships: What are the properties of mathematical objects and how are they related? Properties of mathematical objects (e.g. numbers, lines, function, etc.) are either inherent in their definitions or derived through logical argument and rigorous proof. Relationships exist between mathematical objects. They include the proportional relationship between two quantities, the equivalence of two expressions or statements, the similarity between two figures and the connections between two functions. Understanding properties and relationships enable us to gain deeper insights into the mathematical objects and use them to model and solve real-world problems. 2. Operations and Algorithms: What meaningful actions can we perform on the mathematical objects and how do we carry them out? Section 2: Mathematics Curriculum P a g e |5 Operations are meaningful actions performed on mathematical objects. They include arithmetic operations, algebraic manipulations, geometric transformations, operations on functions, and many more. Algorithms are generalised sequences of well-defined smaller steps to perform a mathematical operation or to solve a problem. Some examples are adding or multiplying two numbers and finding factors and prime numbers. Understanding the meaning of these operations and algorithms and how to carry them out enable us to solve problems mathematically. 3. Representations and Communications: How can the mathematical objects and concepts be represented and communicated within and beyond the discipline? Representations are integral to the language of mathematics. They include symbols, notations, and diagrams such as tables, graphs, charts and geometrical figures that are used to express mathematical concepts, properties and operations in a way that is precise and universally understood. Communication of mathematics is necessary for the understanding and dissemination of knowledge within the community of practitioners as well as general public. It includes clear presentation of proof in a technical writing as well as choosing appropriate representations (e.g. list, chart, drawing) to communicate mathematical ideas that can be understood by the masses. 4. Abstractions and Applications: How can the mathematical objects be further abstracted and where can they be applied? Abstraction is at the core of mathematical thinking. It involves the process of generalisation, extension and synthesis. Through algebra, we generalise arithmetic. Through complex numbers, we extend the number system. Through coordinate geometry, we synthesise the concepts across the algebra and geometry strands. The processes of abstraction make visible the structure and rich connections within mathematics and makes mathematics a powerful tool. Application of mathematics is made possible by abstractions. From simple counting to complex modelling, the abstract mathematical objects, properties, operations, relationships and representations can be used to model and study real-world phenomena. Big ideas express ideas that are central to mathematics. They appear in different topics and strands. There is a continuation of the ideas across levels. They bring coherence and show connections across different topics, strands and levels. The big ideas in mathematics could be about one or more themes, that is, it could be about properties and relationships of mathematical objects and concepts and the operations and algorithms involving these objects and concepts, or it could be about abstraction and applications alone. Understanding the big ideas brings one closer to appreciating the nature of mathematics. Eight clusters of big ideas are listed in this syllabus. These are not meant to be authoritative or comprehensive. They relate to the four themes that cut across and connect concepts from the different content strands, and some big ideas extend across and connect more concepts than others. Each cluster of big ideas is represented by a label e.g. big ideas about Equivalence, big ideas about Proportionality, etc. Section 2: Mathematics Curriculum P a g e |6 Big Ideas about Diagrams Main Themes: Representations and Communications Diagrams are succinct, visual representations of real-world or mathematical objects that serve to communicate properties of the objects and facilitate problem solving. For example, graphs in coordinate geometry are used to represent the relationships between two sets of values, geometrical diagrams are used to represent physical objects, and statistical diagrams are used to summarise and highlight important characteristics of a set of data. Understanding what different diagrams represent, their features and conventions, and how they are constructed helps to facilitate the study and communication of important mathematical results. Big Ideas about Equivalence Main Themes: Properties and Relationships, Operations and Algorithms Equivalence is a relationship that expresses the 'equality' of two mathematical objects that may be represented in two different forms. A number, algebraic expression or equation can be written in different but equivalent forms, and transformation or conversion from one form to another equivalent form is the basis of many manipulations for analysing and comparing them and algorithms for finding solutions. Big Ideas about Functions Main Themes: Properties and Relationships, Abstractions and Applications A function is a relationship between two sets of objects that expresses how each element from the first set (input) uniquely determines (relates to) an element from the second set (output) according to a rule or operation. It can be represented in multiple ways, e.g. as a table, algebraically, or graphically. Functional relationships undergird many of the applications of mathematics and are used for modelling real-world phenomena. Functions are pervasive in mathematics and undergird many of the applications of mathematics and modelling of real-world phenomena. Big Ideas about Invariance Main Theme: Properties and Relationships, Operations and Algorithms Invariance is a property of a mathematical object which remains unchanged when the object undergoes some form of transformation. In summing up or multiplying numbers, the sum or product is an invariant property that is not affected by the rearrangement of the numbers. In geometry, the area of a figure, the angles within it, and the ratio of the sides remain unchanged when the figure is translated, reflected or rotated. In statistics, the standard deviation remains unchanged when a constant is added to all the data points. Many mathematical results express invariance, e.g. a property of a class of mathematical objects. Section 2: Mathematics Curriculum P a g e |7 Big Ideas about Measures Main Theme: Abstractions and Applications Numbers are used as measures to quantify a property of various real-world or mathematical objects, so that they can be analysed, compared, and ordered. There are many examples of measures such as length, area, volume, money, mass, time, temperature, speed, angles, probability, mean and standard deviation. Many measures have units, some measures have a finite range and special values which serve as useful references. In most cases, zero means the absence of the property while a negative measures the opposite property. Big Ideas about Models Main Themes: Abstractions and Applications, Representations and Communications Models are abstractions of real-world situations or phenomena using mathematical objects and representations. For example, a real-world phenomenon may be modelled by a function, a real-world object may be modelled by a geometrical object, and a random phenomenon may be modelled by the probability distribution for different outcomes. As approximations, simplifications or idealisations of real-world problems, models come with assumptions, have limitations, and the mathematical solutions derived from these models need to be verified. Big Ideas about Notations Main Themes: Representations and Communications Notations are symbols and conventions of writing used to represent mathematical objects, and their operations and relationships in a concise and precise manner. Examples include notations for mathematical constants like π and e, scientific notation to represent very big or very small numbers, set notations, etc. Understanding the meaning of mathematical notations and how they are used, including the rules and conventions, helps to facilitate the study and communication of important mathematical results, properties and relationships, reasoning and problem solving. Big Ideas about Proportionality Main Theme: Properties and Relationships Proportionality is a relationship between two quantities that allows one quantity to be computed from the other based on multiplicative reasoning. Fraction, ratio, rate and percentage are different but related mathematical concepts for describing the proportional relationships between two quantities that allow one quantity to be computed from the other related quantity. In geometry, proportional relationships undergird important concepts such as similarity and scales. In statistics, proportional relationships are the basis for constructing and interpreting many statistical diagrams such as pie charts and histograms. Underlying the concept of proportionality are two quantities that vary in such a way that the ratio between them remains a constant. Section 2: Mathematics Curriculum P a g e |8 Mathematics Curriculum Framework The central focus of the mathematics curriculum is the development of mathematical problem solving competency. Supporting this focus are five inter-related components – concepts, skills, processes, metacognition and attitudes. Mathematical Problem Solving Problems may come from everyday contexts or future work situations, in other areas of study, or within mathematics itself. They include straightforward and routine tasks that require selection and application of the appropriate concepts and skills, as well as complex and non- routine tasks that requires deeper insights, logical reasoning and creative thinking. General problem solving strategies e.g. Polya's 4 steps to problem solving and the use of heuristics, are important in helping one tackle non-routine tasks systematically and effectively. Mathematics Curriculum Framework Belief, appreciation, Awareness, monitoring and confidence, motivation, regulation of thought processes interest and perseverance Proficiency in carrying out Competencies in abstracting operations and algorithms, and reasoning, representing visualising space, handling and communicating, data and using applying and modelling mathematical tools Understanding of the properties and relationships, operations and algorithms Concepts The understanding of mathematical concepts, their properties and relationships and the related operations and algorithms, are essential for solving problems. Concepts are organised by strands, and these concepts are connected and inter-related. In the secondary mathematics curriculum, concepts in numbers, algebra, geometry, probability and statistics and calculus (in Additional Mathematics) are explored. Skills Being proficient in carrying out the mathematical operations and algorithms and in visualising space, handling data and using mathematical tools are essential for solving problems. In the secondary mathematics curriculum, operations and algorithms such as calculation, estimation, manipulation, and simplification are required in most problems. ICT tools such as spreadsheets, and dynamic geometry and graph sketching software may be used to support the learning. Section 2: Mathematics Curriculum P a g e |9 Processes Mathematical processes refer to the practices of mathematicians and users of mathematics that are important for one to solve problems and build new knowledge. These include abstracting, reasoning, representing and communicating, applying and modelling. Abstraction is what makes mathematics powerful and applicable. Justifying a result, deriving new results and generalising patterns involve reasoning. Expressing one's ideas, solutions and arguments to different audiences involves representing and communicating, and using the notations (symbols and conventions of writing) that are part of the mathematics language. Applying mathematics to real-world problems often involves modelling, where reasonable assumptions and simplifications are made so that problems can be formulated mathematically, and where mathematical solutions are interpreted and evaluated in the context of the real-world problem. The mathematical modelling process is shown in the diagram below. Mathematical Modelling Process Real World Mathematical World Formulating Understand the problem Make assumptions to simplify the problem Represent the problem mathematically Real-World Problem Mathematical Model Reflecting Solving Reflect on the real-world Select and use appropriate solution mathematical methods Improve the model and tools (including ICT) Solve the problem and present the solution Real-World Solution Mathematical Solution Interpreting Interpret the mathematical solution in the context of the real-world problem Present the solution of the real-world problem Section 2: Mathematics Curriculum P a g e | 10 Metacognition Metacognition, or thinking about thinking, refers to the awareness of, and the ability to control one's thinking processes, in particular the selection and use of problem-solving strategies. It includes monitoring and regulation of one's own thinking and learning. It also includes the awareness of one's affective responses towards a problem. When one is engaged in solving a non-routine or open-ended problem, metacognition is required. Attitudes Having positive attitudes towards mathematics contributes to one's disposition and inclination towards using mathematics to solve problems. Attitudes include one's belief and appreciation of the value of mathematics, one's confidence and motivation in using mathematics, and one's interests and perseverance to solve problems using mathematics. 21st Century Competencies The learning of mathematics creates opportunities for students to develop key competencies that are important in the 21st century. When students pose questions, justify claims, write and critique mathematical explanations and arguments, they are engaged in reasoning, critical thinking and communication. When students devise different strategies to solve an open- ended problem or formulate different mathematical models to represent a real-world problem, they are engaged in inventive thinking. When students simplify an ill-defined real-world problem, they are learning how to manage ambiguity and complexity. As an overarching approach, the secondary mathematics curriculum supports the development of 21st century competencies (21CC) in the following ways: 1. The content are relevant to the needs of the 21 st century. They provide the foundation for learning many of the advanced applications of mathematics that are relevant to today's world. 2. The pedagogies create opportunities for students to think critically, reason logically and communicate effectively, working individually as well as in groups, using ICT tools where appropriate in learning and doing mathematics. 3. The problem contexts raise students' awareness of local and global issues around them. For example, problems set around population issues and health issues can help students understand the challenges faced by Singapore and those around the world. Section 2: Mathematics Curriculum P a g e | 11 SECTION 3: O-LEVEL MATHEMATICS SYLLABUS Aims of Syllabus Syllabus Organisation Problems in Real-World Contexts Content by Levels Section 3: O-Level Mathematics Syllabus P a g e | 12 3. O-LEVEL MATHEMATICS SYLLABUS Aims of Syllabus The O-Level Mathematics syllabus aims to enable all students to: acquire mathematical concepts and skills for continuous learning in mathematics and to support learning in other subjects; develop thinking, reasoning, communication, application and metacognitive skills through a mathematical approach to problem solving; connect ideas within mathematics and between mathematics and other subjects through applications of mathematics; and build confidence and foster interest in mathematics. Syllabus Organisation The concepts and skills covered in the syllabus are organised along 3 content strands. The development of processes, metacognition and attitudes are embedded in the learning experiences that are associated with the content. Concept and Skills Geometry and Number and Algebra Statistics and Probability Measurement Learning Experiences (Processes, Metacognition and Attitudes) Problems in Real-World Contexts Solving problems in real-world contexts should be part of the learning experiences of every student. These experiences give students the opportunities to apply the concepts and skills that they have learnt and to appreciate the value of and develop an interest in mathematics. Problems in real-world contexts can be included in every strand and level, and may require concepts and skills from more than one strand. Students are expected to be familiar with the following contexts and solve problems based on these contexts over the four years of their secondary education: In everyday life, including travel/excursion plans, transport schedules, sports and games, recipes, floor plans, navigation etc. In personal and household finance, including simple and compound interest, taxation, instalments, utilities bills, money exchange, etc. Section 3: O-Level Mathematics Syllabus P a g e | 13 In interpreting and analysing data from tables and graphs, including distance-time and speed-time graphs. The list above is by no means exhaustive or exclusive. Through the process of solving such problems, students will experience all or part of the mathematical modelling process. This includes: formulating the problem, including making suitable assumptions and simplifications; making sense of and discussing data, including real data presented as graphs and tables; selecting and applying the appropriate concepts and skills to solve the problem; and interpreting the mathematical solutions in the context of the problem. Section 3: O-Level Mathematics Syllabus P a g e | 14 Content by Levels Secondary One NUMBER AND ALGEBRA N1. Numbers and their operations 1.1. primes and prime factorisation 1.2. finding highest common factor (HCF) and lowest common multiple (LCM), squares, cubes, square roots and cube roots by prime factorisation 1.3. negative numbers, integers, rational numbers, real numbers and their four operations 1.4. calculations with calculator 1.5. representation and ordering of numbers on the number line 1.6. use of , ≤, ≥ 1.7. approximation and estimation (including rounding off numbers to a required number of decimal places or significant figures, and estimating the results of computation) N2. Ratio and proportion 2.1. ratios involving rational numbers 2.2. writing a ratio in its simplest form 2.3. problems involving ratio N3. Percentage 3.1. expressing one quantity as a percentage of another 3.2. comparing two quantities by percentage 3.3. percentages greater than 100% 3.4. increasing/decreasing a quantity by a given percentage (including concept of percentage point) 3.5. reverse percentages 3.6. problems involving percentages N4. Rate and Speed 4.1. concepts of average rate, speed, constant speed and average speed 4.2. conversion of units (e.g. km/h to m/s) 4.3. problems involving rate and speed N5. Algebraic expressions and formulae 5.1. using letters to represent numbers 5.2. interpreting notations: as × 1 as ÷ or × as × , 3 as × × , 2 as × × , . . . 2 3 as + + or 3 × 3(+) as 3 × (+) 3+ 1 5 as (3 +) ÷ 5 or 5 × (3 +) 5.3. evaluation of algebraic expressions and formulae 5.4. translation of simple real-world situations into algebraic expressions 5.5. recognising and representing patterns/relationships by finding an algebraic expression for the nth term 5.6. addition and subtraction of linear expressions 5.7. simplification of linear expressions such as −2(3 − 5) + 4 ; 2 3(−5) − 3 2 5.8. use brackets and extract common factors Section 3: O-Level Mathematics Syllabus P a g e | 15 N6. Functions and graphs 6.1. Cartesian coordinates in two dimensions 6.2. graph of a set of ordered pairs as a representation of a relationship between two variables 6.3. linear functions = + 6.4. graphs of linear functions 6.5. the gradient of a linear graph as the ratio of the vertical change to the horizontal change (positive and negative gradients) N7. Equations and inequalities 7.1. concept of equation 7.2. solving linear equations in one variable 7.3. solving simple fractional equations that can be reduced to linear equations such as x x2 3; 3 4 3 6 x2 7.4. formulating a linear equation in one variable to solve problems GEOMETRY AND MEASUREMENT G1. Angles, triangles and polygons 1.1. right, acute, obtuse and reflex angles 1.2. vertically opposite angles, angles on a straight line, angles at a point 1.3. angles formed by two parallel lines and a transversal: corresponding angles, alternate angles, interior angles 1.4. properties of triangles, special quadrilaterals and regular polygons (pentagon, hexagon, octagon and decagon), including symmetry properties 1.5. classifying special quadrilaterals on the basis of their properties 1.6. angle sum of interior and exterior angles of any convex polygon 1.7. construction of simple geometrical figures from given data using compasses, ruler, set squares and protractors, where appropriate G5. Mensuration 5.1. area of parallelogram and trapezium 5.2. problems involving perimeter and area of composite plane figures 5.3. volume and surface area of prism and cylinder 5.4. conversion between cm2 and m2 , and between cm3 and m3 5.5. problems involving volume and surface area of composite solids STATISTICS AND PROBABILITY S1. Data handling and analysis 1.1. simple concepts in collecting, classifying and tabulating data 1.2. analysis and interpretation of: tables bar graphs pictograms line graphs pie charts 1.3. purposes and uses, advantages and disadvantages of the different forms of statistical representations 1.4. explaining why a given statistical diagram leads to misinterpretation of data Section 3: O-Level Mathematics Syllabus P a g e | 16 Secondary Two NUMBER AND ALGEBRA N2. Ratio and proportion 2.4. map scales (distance and area) 2.5. direct and inverse proportion N5. Algebraic expressions and formulae 5.9. expansion of the product of algebraic expressions 5.10. changing the subject of a formula 5.11. finding the value of an unknown quantity in a given formula 5.12. use of: (+)2 = 2 + 2 + 2 (−)2 = 2 − 2 + 2 2 − 2 = (+)(−) 5.13. factorisation of linear expressions of the form + + + 5.14. factorisation of quadratic expressions 2 + + 5.15. multiplication and division of simple algebraic fractions such as 3 5 (2) ( ) 3 2 3 9 ÷ 4 10 5.16. addition and subtraction of algebraic fractions with linear or quadratic denominator such as 1 2 + −2 −3 1 2 + 2 − 9 − 3 1 2 + − 3 (− 3)2 N6. Functions and graphs 6.6. quadratic functions y ax 2 bx c 6.7. graphs of quadratic functions and their properties: positive or negative coefficient of 2 maximum and minimum points symmetry N7. Equations and inequalities 7.5. concept of equation and inequality 7.6. solving simple inequalities in the form ax b c and ax b c and representing the solutions on the number line 7.7. graphs of linear equations in two variables (+ =) 7.8. solving simultaneous linear equations in two variables by: substitution and elimination methods graphical method 7.9. solving quadratic equations in one variable by factorisation 7.10. formulating a pair of linear equations in two variables to solve problems GEOMETRY AND MEASUREMENT G2. Congruence and similarity Section 3: O-Level Mathematics Syllabus P a g e | 17 2.1. congruent figures 2.2. similar figures 2.3. properties of similar triangles and polygons: corresponding angles are equal corresponding sides are proportional 2.4. enlargement and reduction of a plane figure 2.5. solving simple problems involving congruence and similarity G4. Pythagoras' theorem and trigonometry 4.1. use of Pythagoras' theorem 4.2. determining whether a triangle is right-angled given the lengths of three sides 4.3. use of trigonometric ratios (sine, cosine and tangent) of acute angles to calculate unknown sides and angles in right-angled triangles G5. Mensuration 5.6. volume and surface area of pyramid, cone and sphere STATISTICS AND PROBABILITY S1. Data handling and analysis 1.5. analysis and interpretation of: dot diagrams histograms stem-and-leaf diagrams 1.6. purposes and uses, advantages and disadvantages of the different forms of statistical representations 1.7. explaining why a given statistical diagram leads to misinterpretation of data 1.8. mean, mode and median as measures of central tendency for a set of data 1.9. purposes and use of mean, mode and median 1.10. calculation of the mean for grouped data S2. Probability 2.1. probability as a measure of chance 2.2. probability of single events (including listing all the possible outcomes in a simple chance situation to calculate the probability) Section 3: O-Level Mathematics Syllabus P a g e | 18 Secondary Three/Four NUMBER AND ALGEBRA N1. Numbers and their operations 1.8. use of standard form A10n , where n is an integer, and 1 A 10 1.9. positive, negative, zero and fractional indices 1.10. laws of indices N6. Functions and graphs 6.8. sketching the graphs of quadratic functions given in the form: = (−)2 + = −(−)2 + = (−)(−) = −(−)(−) 6.9. graphs of power functions = , where n = 2, 1, 0, 1, 2, 3, and simple sums of not more than three of these 6.10. graphs of exponential functions = , where is a positive integer 6.11. estimation of the gradient of a curve by drawing a tangent N7. Equations and inequalities 7.11. solving quadratic equations in one variable by: use of formula completing the square for y x 2 px q graphical method 7.12. solving fractional equations that can be reduced to quadratic equations such as 6 1 2 x3; 5 x4 x2 x3 7.13. solving linear inequalities in one variable (including simultaneous inequalities) and representing the solution on the number line 7.14. formulating a quadratic equation in one variable to solve problems N8. Set language and notation 8.1. use of set language and the following notation: Union of A and B ∪ Intersection of A and B ∩ Number of elements in set A ( ) "… is an element of …" ∈ "… is not an element of …" ∉ Complement of set A ′ The empty set ∅ Universal set A is a subset of B ⊆ A is a not a subset of B ⊈ A is a (proper) subset of B ⊂ A is a not a (proper) subset of B ⊄ 8.2. union and intersection of two sets 8.3. Venn diagrams N9. Matrices 9.1. display of information in the form of a matrix of any order 9.2. interpreting the data in a given matrix 9.3. product of a scalar quantity and a matrix 9.4. problems involving addition, subtraction and multiplication of matrices Section 3: O-Level Mathematics Syllabus P a g e | 19 GEOMETRY AND MEASUREMENT G2. Congruence and similarity 2.6. scale drawings 2.7. properties and construction of perpendicular bisectors of line segments and angle bisectors 2.8. determining whether two triangles are: congruent similar 2.9. ratio of areas of similar plane figures 2.10. ratio of volumes of similar solids G3. Properties of circles 3.1. symmetry properties of circles: equal chords are equidistant from the centre the perpendicular bisector of a chord passes through the centre tangents from an external point are equal in length the line joining an external point to the centre of the circle bisects the angle between the tangents 3.2. angle properties of circles: angle in a semicircle is a right angle angle between tangent and radius of a circle is a right angle angle at the centre is twice the angle at the circumference angles in the same segment are equal angles in opposite segments are supplementary G4. Pythagoras' theorem and trigonometry 4.4. extending sine and cosine to obtuse angles 1 4.5. use of the formula ab sin C for the area of a triangle 2 4.6. use of sine rule and cosine rule for any triangle 4.7. problems in two and three dimensions including those involving angles of elevation and depression and bearings G5. Mensuration 5.7. arc length, sector area and area of a segment of a circle 5.8. use of radian measure of angle (including conversion between radians and degrees) G6. Coordinate geometry 6.1. finding the gradient of a straight line given the coordinates of two points on it 6.2. finding the length of a line segment given the coordinates of its end points 6.3. interpreting and finding the equation of a straight line graph in the form y mx c 6.4. geometric problems involving the use of coordinates G7. Vectors in two dimensions x |, and | | 7.1. use of notations: y , , , | 7.2. representing a vector as a directed line segment 7.3. translation by a vector 7.4. position vectors x 7.5. magnitude of a vector y as x2 y2 7.6. use of sum and difference of two vectors to express given vectors in terms of two coplanar vectors 7.7. multiplication of a vector by a scalar Section 3: O-Level Mathematics Syllabus P a g e | 20 7.8. geometric problems involving the use of vectors STATISTICS AND PROBABILITY S1. Data handling and analysis 1.11. quartiles and percentiles 1.12. range, interquartile range and standard deviation as measures of spread for a set of data 1.13. analysis and interpretation of: cumulative frequency diagrams box-and-whisker plots 1.14. purposes and uses, advantages and disadvantages of the different forms of statistical representations 1.15. calculation of the standard deviation for a set of data (grouped and ungrouped) 1.16. using the mean and standard deviation to compare two sets of data S2. Probability 2.3. probability of simple combined events (including using possibility diagrams and tree diagrams, where appropriate) 2.4. addition and multiplication of probabilities (mutually exclusive events and independent events) Section 3: O-Level Mathematics Syllabus P a g e | 21 SECTION 4: N(A)-LEVEL MATHEMATICS SYLLABUS Aims of Syllabus Syllabus Organisation Problems in Real-World Contexts Content by Levels Section 4: N(A)-Level Mathematics Syllabus P a g e | 22 4. 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Students are expected to be familiar with the following contexts and solve problems based on these contexts over the four years of their secondary education: In everyday life, including travel/excursion plans, transport schedules, sports and games, recipes, floor plans, navigation etc. In personal and household finance, including simple and compound interest, taxation, instalments, utilities bills, money exchange, etc. Section 4: N(A)-Level Mathematics Syllabus P a g e | 23 In interpreting and analysing data from tables and graphs, including distance-time and speed-time graphs. The list above is by no means exhaustive or exclusive. Through the process of solving such problems, students will experience all or part of the mathematical modelling process. This includes: formulating the problem, including making suitable assumptions and simplifications; making sense of and discussing data, including real data presented as graphs and tables; selecting and applying the appropriate concepts and skills to solve the problem; and interpreting the mathematical solutions in the context of the problem. Section 4: N(A)-Level Mathematics Syllabus P a g e | 24 Content by Levels Secondary One NUMBER AND ALGEBRA N1. Numbers and their operations 1.1. primes and prime factorisation 1.2. finding highest common factor (HCF) and lowest common multiple (LCM), squares, cubes, square roots and cube roots by prime factorisation 1.3. negative numbers, integers, rational numbers, real numbers and their four operations 1.4. calculations with calculator 1.5. representation and ordering of numbers on the number line 1.6. use of , ≤, ≥ 1.7. approximation and estimation (including rounding off numbers to a required number of decimal places or significant figures, and estimating the results of computation) N2. Ratio and proportion 2.1. comparison between two or more quantities by ratio 2.2. relationship between ratio and fraction 2.3. dividing a quantity in a given ratio 2.4. ratios involving rational numbers 2.5. equivalent ratios 2.6. writing a ratio in its simplest form 2.7. problems involving ratio N3. Percentage 3.1. expressing percentage as a fraction or decimal 3.2. expressing one quantity as a percentage of another 3.3. comparing two quantities by percentage 3.4. percentages greater than 100% 3.5. increasing/decreasing a quantity by a given percentage (including concept of percentage point) 3.6. finding percentage increase/decrease 3.7. reverse percentages 3.8. problems involving percentages N4. Rate and Speed 4.1. relationships between distance, time and speed 4.2. writing speed in different units (e.g. km/h, m/min, m/s and cm/s) 4.3. concepts of average rate, speed, constant speed and average speed 4.4. conversion of units (e.g. km/h to m/s) 4.5. calculation of speed, distance or time given the other two quantities 4.6. problems involving rate and speed N5. Algebraic expressions and formulae 5.1. using letters to represent numbers 5.2. interpreting notations: as × 1 as ÷ or × 2 as × , 3 as × × , 2 as × × , . . . 3 as + + or 3 × 3(+) as 3 × (+) 3 y 1 as(3 +) ÷ 5 or × (3 +) 5 5 Section 4: N(A)-Level Mathematics Syllabus P a g e | 25 5.3. evaluation of algebraic expressions and formulae 5.4. translation of simple real-world situations into algebraic expressions 5.5. recognising and representing patterns/relationships by finding an algebraic expression for the nth term 5.6. addition and subtraction of linear expressions 5.7. simplification of linear expressions with integral coefficients such as 2(x 3 y) 4 x 2(3x 5) 3(x y) (2 y x) y N7. Equations and inequalities 7.1. concepts of equation 7.2. solving linear equations with integral coefficients in one variable 7.3. formulating a linear equation in one variable to solve problems GEOMETRY AND MEASUREMENT G1. Angles, triangles and polygons 1.1. right, acute, obtuse and reflex angles 1.2. vertically opposite angles, angles on a straight line, angles at a point 1.3. angles formed by two parallel lines and a transversal: corresponding angles, alternate angles, interior angles 1.4. properties of triangles G5. Mensuration 5.1. area of parallelogram and trapezium 5.2. problems involving perimeter and area of composite plane figures 5.3. volume and surface area of prism and cylinder 5.4. conversion between cm2 and m2 , and between cm3 and m3 5.5. problems involving volume and surface area of composite solids STATISTICS AND PROBABILITY S1. Data handling and analysis 1.1. simple concepts in collecting, classifying and tabulating data 1.2. analysis and interpretation of: tables bar graphs pictograms line graphs pie charts 1.3. purposes and uses, advantages and disadvantages of the different forms of statistical representations 1.4. explaining why a given statistical diagram leads to misinterpretation of data Section 4: N(A)-Level Mathematics Syllabus P a g e | 26 Secondary Two NUMBER AND ALGEBRA N2. Ratio and proportion 2.8. map scales (distance and area) 2.9. direct and inverse proportion N5. Algebraic expressions and formulae 5.8. simplification of linear expressions with fractional coefficients such as 2 x 3(x 5) 3 2 5.9. expansion of the product of two linear expressions 5.10. use brackets and extract common factors 5.11. use of: (a b) 2 a 2 2ab b 2 (a b) 2 a 2 2ab b 2 a 2 b 2 (a b)(a b) 5.12. factorisation of quadratic expressions ax2 bx c 5.13. multiplication and division of simple algebraic fractions such as 3a 5ab 2 4b 3 3a 9a 2 4 10 N6. Functions and graphs 6.1. Cartesian coordinates in two dimensions 6.2. graph of a set of ordered pairs as a representation of a relationship between two variables 6.3. linear functions y ax b 6.4. graphs of linear functions 6.5. the gradient of a linear graph as the ratio of the vertical change to the horizontal change (positive and negative gradients) N7. Equations and inequalities 7.4. solving linear equations in one variable (including fractional coefficients) 7.5. concept and properties of inequality 7.6. solving simple inequalities in the form ≤ , ≥ , < and > , where a and b are integers. 7.7. solving simple fractional equations that can be reduced to linear equations such as x x2 3 3; 6 3 4 x2 7.8. graphs of linear equations in two variables(+ =) 7.9. solving simultaneous linear equations in two variables by: substitution and elimination methods graphical method 7.10. formulating a linear equation in one variable or a pair of linear equations in two variables to solve problems Section 4: N(A)-Level Mathematics Syllabus P a g e | 27 GEOMETRY AND MEASUREMENT G1. Angles, triangles and polygons 1.5. properties of special quadrilaterals and regular polygons (pentagon, hexagon, octagon and decagon) including symmetry properties 1.6. classifying special quadrilaterals on the basis of their properties 1.7. angle sum of interior and exterior angles of any convex polygon 1.8. construction of simple geometrical figures from given data using compasses, ruler, set squares and protractors, where appropriate G2. Congruence and similarity 2.1. congruent figures 2.2. similar figures 2.3. properties of similar triangles and polygons: corresponding angles are equal corresponding sides are proportional G4. Pythagoras' theorem and trigonometry 4.1. use of Pythagoras' theorem 4.2. determining whether a triangle is right-angled given the lengths of three sides. G5. Mensuration 5.6. volume and surface area of pyramid, cone and sphere STATISTICS AND PROBABILITY S1. Data handling and analysis 1.5. analysis and interpretation of: dot diagrams histograms stem-and-leaf diagrams 1.6. purposes and uses, advantages and disadvantages of the different forms of statistical representations 1.7. explaining why a given statistical diagram leads to misinterpretation of data 1.8. mean, mode and median as measures of central tendency for a set of data 1.9. purposes and uses of mean, mode and median 1.10. calculation of the mean for grouped data S2. Probability 2.1. probability as a measure of chance 2.2. probability of single events (including listing all the possible outcomes in a simple chance situation to calculate the probability) Section 4: N(A)-Level Mathematics Syllabus P a g e | 28 Secondary Three/Four NUMBER AND ALGEBRA N1. Numbers and their operations 1.8. use of standard form A10n , where n is an integer, and 1 A 10 1.9. positive, negative, zero and fractional indices 1.10. laws of indices N5. Algebraic expressions and formulae 5.14. factorisation of linear expressions of the form ax + bx + kay + kby 5.15. expansion of the product of algebraic expressions 5.16. changing the subject of a formula 5.17. finding the value of an unknown quantity in a given formula 5.18. addition and subtraction of algebraic fractions with linear or quadratic denominator such as 1 2 x 2 x 3 1 2 x2 9 x 3 1 2 x 3 (x 3) 2 N6. Functions and graphs 6.6. quadratic functions y ax 2 bx c 6.7. graphs of quadratic functions and their properties: 2 positive or negative coefficient of x maximum and minimum points symmetry 6.8. graphs of power functions y ax n , where n = 2, 1, 0, 1, 2, 3, and simple sums of not more than three of these graphs of exponential functions y ka , where a is a positive integer x 6.9. 6.10. estimation of the gradient of a curve by drawing a tangent N7. Equations and inequalities 7.11. solving quadratic equations in one variable by: factorisation use of formula completing the square for y x 2 px q graphical method 7.12. solving fractional equations that can be reduced to quadratic equations such as 6 x3 x4 1 2 5 x2 x3 7.13. formulating a quadratic equation in one variable to solve problems Section 4: N(A)-Level Mathematics Syllabus P a g e | 29 GEOMETRY AND MEASUREMENT G2. Congruence and similarity 2.4. enlargement and reduction of a plane figure 2.5. scale drawings 2.6. properties and construction of perpendicular bisectors of line segments and angle bisectors 2.7. solving simple problems involving congruence and similarity G3. Properties of circles 3.1. symmetry properties of circles: equal chords are equidistant from the centre the perpendicular bisector of a chord passes through the centre tangents from an external point are equal in length the line joining an external point to the centre of the circle bisects the angle between the tangents 3.2. angle properties of circles: angle in a semicircle is a right angle angle between tangent and radius of a circle is a right angle angle at the centre is twice the angle at the circumference angles in the same segment are equal angles in opposite segments are supplementary G4. Pythagoras' theorem and trigonometry 4.3. use of trigonometric ratios (sine, cosine and tangent) of acute angles to calculate unknown sides and angles in right-angled triangles 4.4. extending sine and cosine to obtuse angles 1 4.5. use of the formula ab sin C for the area of a triangle 2 4.6. use of sine rule and cosine rule for any triangle 4.7. problems in two and three dimensions including those involving angles of elevation and depression and bearings G5. Mensuration 5.7. arc length as fraction of the circumference and sector area as fraction of the area of a circle 5.8. area of a segment 5.9. use of radian measure of angle (including conversion between radians and degrees) 5.10. problems involving the arc length, sector area of a circle and area of a segment G6. Coordinate geometry 6.1. finding the gradient of a straight line given the coordinates of two points on it 6.2. finding the length of a line segment given the coordinates of its end points 6.3. interpreting and finding the equation of a straight line in the form y mx c 6.4. geometric problems involving the use of coordinates STATISTICS AND PROBABILITY S1. Data handling and analysis 1.11. quartiles and percentiles 1.12. range, interquartile range and standard deviation as measures of spread for a set of data 1.13. analysis and interpretation of: cumulative frequency diagrams box-and-whisker plots 1.14. purposes and uses, advantages and disadvantages of the different forms of statistical representations 1.15. calculation of the standard deviation for a set of data (grouped and ungrouped) Section 4: N(A)-Level Mathematics Syllabus P a g e | 30 1.16. using the mean and standard deviation to compare two sets of data S2. Probability 2.3. probability of simple combined events (including using possibility diagrams and tree diagrams, where appropriate) 2.4. addition and multiplication of probabilities (mutually exclusive events and independent events) Section 4: N(A)-Level Mathematics Syllabus P a g e | 31 O-Level Maths Content for Secondary Five N(A) [First Year of Exam: 2024] This document listing the content for Sec 5 N(A) is to be read in conjunction with the N(A) syllabus document. Secondary Five NUMBER AND ALGEBRA N6. Functions and graphs 6.11. sketching the graphs of quadratic functions given in the form: y (x p)2 q y (x p) 2 q y (x a)(x b) y (x a)(x b) N7. Equations and inequalities 7.14. solving linear inequalities in one variable (including simultaneous inequalities) and representing the solution on the number line N8. Set language and notation 8.1. use of set language and the following notation: Union of A and B ∪ Intersection of A and B ∩ Number of elements in set A ( ) "… is an element of …" ∈ "… is not an element of …" ∉ Complement of set A ′ The empty set ∅ Universal set A is a subset of B ⊆ A is a not a subset of B ⊈ A is a (proper) subset of B ⊂ A is a not a (proper) subset of B ⊄ 8.2. union and intersection of two sets 8.3. Venn diagrams N9. Matrices 9.1. display of information in the form of a matrix of any order 9.2. interpreting the data in a given matrix 9.3. product of a scalar quantity and a matrix 9.4. problems involving addition, subtraction and multiplication of matrices GEOMETRY AND MEASUREMENT G2. Congruence and similarity Section 4: N(A)-Level Mathematics Syllabus P a g e | 32 2.8. determining whether two triangles are: congruent similar 2.9. ratio of areas of similar plane figures 2.10. ratio of volumes of similar solids G7. Vectors in two dimensions x | and | | 7.1. use of notations: y , , , | 7.2. representing a vector as a directed line segment 7.3. translation by a vector 7.4. position vectors x 7.5. magnitude of a vector y as x2 y2 7.6. use of sum and difference of two vectors to express given vectors in terms of two coplanar vectors 7.7. multiplication of a vector by a scalar 7.8. geometric problems involving the use of vectors Section 4: N(A)-Level Mathematics Syllabus P a g e | 33 SECTION 5: PEDAGOGY AND FORMATIVE ASSESSMENT Teaching Processes Phases of Learning Formative Assessment Use of Technology Section 5: Pedagogy and Formative Assessment P a g e | 34 This site uses cookies from Google to deliver its services and to analyze traffic. Information about your use of this site is shared with Google. By using this site, you agree to its use of cookies.