

JC Mathematics (309) and Additional Mathematics (519) Syllabuses  
November 2021 – 2023 Examinations

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## 1.0 INTRODUCTION






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The Junior Certificate (JC) syllabuses are designed as three-year courses for examination in Form 3. The syllabus assumes that learners have acquired knowledge, understanding and skills during their study of Mathematics at Primary Level (SPC). The curriculum content of the syllabus is arranged into topics covering four areas: Number; Shape, Position and Space; Algebra; and Data Handling, but it is treated throughout in a holistic way. It is intended to promote imaginative and innovative styles of teaching and learning so that the course is enjoyable for all learners, and is designed to assess what learners know, understand and can do. As such, it will enable learners to progress to higher-level courses of mathematical studies.

Learners will follow **Ordinary Mathematics (309)** Curriculum plus the **Additional Mathematics (519)** Curriculum. The **Ordinary Mathematics** curriculum is examined by two written papers. The **Additional Mathematics** curriculum is examined by a single paper. The papers are described in the Scheme of Assessment.

The syllabus will act as an instrument that will direct instruction and assessment in the classroom, as well as guide examinations. It is structured such that it dovetails with the Eswatini General Certificate of Secondary Education (EGCSE) and it conforms to international standards.

The main sections of the syllabus are:

-  Aims
-  Assessment Objectives
-  Scheme of Assessment
-  Curriculum Content
-  Grade Descriptions

Ordinary Mathematics - Syllabus Code: 309

**2.0 AIMS**

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The aims set out below describe the National Curriculum Educational Goals for a course in Mathematics for Junior Certificate and are the same for all learners. They are not written in order of priority.

The aims are to enable learners to:

1. develop their mathematical knowledge and oral, written and practical skills in away which encourages confidence and provides satisfaction and enjoyment;
2. read mathematics and write and talk about the subject in a variety of ways;
3. develop a feel for number, carry out calculations and understand the significance of the results obtained;
4. apply mathematics in everyday situations and develop an understanding of the part which mathematics plays in the world around them;
5. solve problems, present the solution clearly, check and interpret the results;
6. develop an understanding of mathematical principles;
7. recognise when and how a situation may be represented mathematically, identify and interpret relevant factors and, where necessary, select an appropriate mathematical method to solve the problem;
8. use mathematics as a means of communication with emphasis on the use of clear expression;
9. develop the ability to apply mathematics in other subjects, particularly science and technology;
10. develop the abilities to reason logically, to generalise and to prove;
11. appreciate patterns and relationships in mathematics;
12. produce and appreciate imaginative and creative work arising from mathematical ideas;
13. develop their mathematical abilities by considering problems and conducting individual and cooperative enquiry and experiment, including extended pieces of work of a practical and investigative kind;
14. appreciate the interdependence of different branches of mathematics;
15. acquire a foundation appropriate to their further study and of other disciplines.

### **3.0 ASSESSMENT OBJECTIVES**

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***There is a single Assessment Objective in Mathematics***

***TECHNIQUE WITH APPLICATION***

A description of the assessment objective follows.

Learners should be able to:

1. organise, interpret and present information accurately in written, tabular, graphical and diagrammatic forms;
2. perform calculations by suitable methods;
3. understand systems of measurement in everyday use and make use of them in the solution of problems;
4. estimate, approximate and work to degrees of accuracy appropriate to the context;
5. use mathematical and other instruments to measure and to draw to an acceptable degree of accuracy;
6. interpret, transform and make appropriate use of mathematical statements expressed in words or symbols;
7. recognise and use spatial relationships in two and three dimensions, particularly in solving problems;
8. recall, apply and interpret mathematical knowledge in the context of everyday situations;
9. make logical deductions from given mathematical data;
10. recognise patterns and structures in a variety of situations, and form generalisations;
11. respond to a problem relating to a relatively unstructured situation by translating it into an appropriately structured form;
12. analyse a problem, select a suitable strategy and apply an appropriate technique to obtain its solution;
13. apply combinations of mathematical skills and techniques in problem solving;
14. set out mathematical work, including the solution of problems, in a logical and clear form using appropriate symbols and terminology.

## 4.0 APPROACHES

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The curriculum content of the syllabus is arranged into topics covering four areas: Number; Shape, Position and Space; Algebra; and Data Handling, but it is treated throughout in a holistic way.

### Number

Number is the foundation of mathematics. Number enables us to interpret and represent the world in which we live. Mathematical intuition grows with a strong basic understanding of number and with that our ability to do mathematical problem solving.

Learners engage in problem solving within contextual situations by communicating, reasoning and connecting to:

- (i) represent and use numbers in a variety of equivalent situations by contextualised situations
- (ii) understand meanings of operations and how they relate to one another
- (iii) compute fluently and make reasonable estimates

### Algebra

Mathematics has been defined as the study of patterns. Learning to recognise, analyse, describe and represent patterns and number relationships connects math to the world and helps us to appreciate fully the value of such pleasures as art, science etc. Maths concepts formerly taught only in basic algebra courses are increasingly part of the culture and vocabulary of modern life.

Being able to see and use patterns has been identified as a fundamental skill needed for developing mathematical understanding. Algebra serves as a bridge between arithmetic and more broadly generalise mathematical situations. These generalisations can be expressed in words, tables and charts, the notation of formulas and graphs.

Algebra impacts the competency of workers, and algebraic thinking skills are crucial if workers are to compete in the global economy. Workplace skills requiring competencies in “information”, “systems” and “technology” stress the need for organising, interpreting and communicating information employing computers as a tool for those tasks as well as the ability to “discover a rule or principle underlying the relationship between two or more objects and apply it in solving a problem”. Identifying and expressing patterns, relations and functions are the algebraic skills imbedded within these competencies.

Learners engage in problem solving within contextual situations by communicating, reasoning and connecting to:

- (i) explore, identify analyse and extend patterns in mathematical and contextual situations
- (ii) articulate and represent number and data using words, tables, graphs, rules and equations
- (iii) recognise and use algebraic symbols to model mathematical and contextual situations
- (iv) analyse change in various contexts

## **Data Handling**

Numeracy and literacy learning is linked by Statistics and Probability. Numbers, logical reasoning and texts interweave to describe phenomena visually, numerically and verbally in what is termed data.

Data, a wide-ranging topic touches on many areas of academic study and tells us much about our world. For instance, we learn about preference, group characteristics when we read and interpret data. We learn about the power of evidence as we develop the skills to make statements and evaluate arguments based on data. We learn the power of the question and the framer of the question when we collect and represent data, and we learn that sometimes true, sometimes false, pictures are created when we express data into statistics. Data is a powerful descriptive tool.

So powerful is data that agencies of authority often use it to generate, promote and sometimes, evaluate decisions.

Learners engage in problem solving within contextual situations by communicating, reasoning and connecting to:

- (i) collect, organise and represent data
- (ii) read and interpret data representations
- (iii) describe data using numerical descriptions, statistics and terminology
- (iv) make and evaluate arguments or statements by applying knowledge of data analysis, bias factors, graph descriptions and context
- (v) know and apply basic probability concepts

## **Shape, Position and Space**

Geometry and measurement help us represent in an orderly fashion what we see in our world. Whether we are shopping or designing, we continually bump up against these mathematical organisers.

Geometry and measures often spark a reward interest in mathematics. Investigative problems that involve geometry and measurement broaden all learners' mathematical understanding and engage them as they explore mathematical ideas.

Hands-on, interactive investigations, using non-standard and standard units, help learners develop an understanding of the many measurable attributes of physical objects. Measurement including length, time, temperature, capacity, weight, mass area, volume, and angle will benefit learners from this approach. This approach helps build an accessible measurement vocabulary and a meaningful comprehension of what it means to measure.

Learners engage in problem solving within contextual situations by communicating, reasoning and connecting to:

- (i) use and apply geometric properties and relationships to describe the physical world
- (ii) identify and analyse the characteristics of geometric figures
- (iii) relate geometric ideas to number and measurement ideas including the concepts of perimeter, area, volume, angle measure and capacity
- (iv) use transformations and symmetry to analyse mathematical situations
- (v) specify locations and describe special relationships using coordinate geometry and other representational systems

- (vi) understand measurable attributes of objects and the units, systems and processes of measurement
- (vii) apply appropriate techniques, tools and formulae to determine measurement

### 5.0 SPECIFICATION GRID

The grid below is for general guidance only and illustrates where particular objectives might receive more emphasis. Ticks are placed in the grid only where there is likely to be emphasis although the objective may also be met in other areas. There is no rigid emphasis between particular assessment objectives and individual examination components; the objectives may be assessed in any question. The components of the scheme will differ in emphasis placed on various objectives.

| <b>Objective Number</b> | <b>Short-answer questions</b> | <b>Structured/longer answer questions</b> | <b><i>Paper 1</i></b> | <b><i>Paper 2</i></b> |
|-------------------------|-------------------------------|---|-----------------------|-----------------------|
| 1 and 2                 | ✓                             | ✓   | ✓                     | ✓                     |
| 3 to 7                  | ✓                             | ✓   | ✓                     | ✓                     |
| 8                       | ✓                             | ✓   | ✓                     |                       |
| 9                       | ✓                             | ✓   | ✓                     | ✓                     |
| 10                      |                               | ✓   | ✓                     | ✓                     |
| 11                      |                               | ✓   |                       | ✓                     |
| 12                      |                               | ✓   |                       | ✓                     |
| 13                      | ✓                             | ✓   | ✓                     | ✓                     |
| 14                      |                               | ✓   |                       | ✓                     |

The short-answer questions fulfill a particularly important function in ensuring Paper 1 coverage and allowing the testing of knowledge, understanding and manipulative skills, while in Paper 2, greater emphasis is placed on applications to the processes of problem solving in the structured/longer answer questions.



## 6.0 SCHEME OF ASSESSMENT

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The purpose of assessment in Mathematics is two-fold:

- (i) it is to provide feedback to both the teacher and the learner as part of the teaching/learning process
- (ii) it is to evaluate the effectiveness of the Mathematics programme at the secondary school level.

### Scheme of Assessment

All candidates must enter for two papers. These will be Paper 1 and Paper 2.

|                          |
|--------------------------|
| <b>Paper 1</b> (2 hours) |
|--------------------------|

|  |
|--|
| Compulsory short-answer paper consisting of 100 marks. |
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|--|
| This paper will be weighted at 50% of the final total available marks. |
|--|

|   |
|---|
| <b>Paper 2</b> (2 hours and 30 minutes) |
|---|

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|--|
| Compulsory structured/longer answer paper consisting of 100 marks. |
|--|

|  |
|--|
| This paper will be weighted at 50% of the final total available marks. |
|--|

### Weighting of papers

| Paper | Weighting<br>Papers 1 and 2 only |
|-------|----------------------------------|
| 1     | 50%                              |
| 2     | 50%                              |

## 7.0 CURRICULUM CONTENT

Learners will follow the Ordinary Mathematics curriculum. The curriculum content is divided into topics covering four areas: Number; Shape, Position and Space; Algebra; and Data Handling. The table below shows the approximate weighting of these areas in each of the components of the examination.

| Paper | Number | Shape Position Space | Algebra | Data Handling |
|-------|--------|----------------------|---------|---------------|
| 1     | 30%    | 35%                  | 25%     | 10%           |
| 2     | 20%    | 35%                  | 30%     | 15%           |

Appropriate teaching time for the Mathematics syllabus should be equivalent to seven (7) periods of forty (40) minutes each over a period of ninety (90) weeks/cycles.

As well as demonstrating skills in the following techniques, candidates will be expected to apply them in the solution of problems.

### ORDINARY MATHEMATICS CONTENT

| TOPIC   | OBJECTIVES  |
|---|---|
| <b>1. Types of Numbers and their Sequences, Sets and Set Notation and Language</b><br><b>[Topic Area: Number]</b> | <p><b>All learners should be able to:</b></p> <p>1.1 identify sets of primes, multiples, factors, squares, cubes in natural numbers<br/> <i>Identify includes listing and describing</i></p> <p>1.2 express natural numbers as products of their prime factors</p> <p>1.3 identify common multiples and common factors (e.g. LCM and HCF)</p> <p>1.4 list directed numbers</p> <p>1.5 list sets and subsets of real numbers. (i.e. natural numbers, primes, factors, rational and irrational numbers) in a sequence</p> <p>1.6 find missing numbers in a sequence of<br/>           (i) composite numbers<br/>           (ii) triangle numbers<br/>           (iii) rectangle numbers<br/>           (iv) Pascal's triangle</p> <p>1.7 find rules for number patterns</p> |

| TOPIC  | OBJECTIVES   |
|--|--|
|  | <p>1.8 draw Venn diagrams for up to 3 sets and a universal set, and use the language and notation of sets (i.e. subsets, union, intersection complement and number of elements)</p> <p>1.9 describe and use set symbols:<br/> <math>\{ \}</math>- "... is a set of ..."<br/> <math>\in</math>- "... is an element of..."<br/> <math>\notin</math>- "...is not an element of..."<br/> <math>\emptyset</math>- the empty set<br/> <math>\cap</math>- intersection of<br/> <math>\cup</math>- union of<br/> <math>\subset</math>- proper subset of<br/> <math>\subseteq</math>- is a subset of<br/> <math>\not\subset</math>- is not a proper subset of<br/> <math>A'</math>- complement of set A<br/> <math>\xi</math> - universal set<br/> <math>n(A)</math>- number of elements in set A</p> |
| <p><b>2. Place Value, Estimation and Limits of Accuracy [Topic Area: Number]</b></p> | <p><b>All learners should be able to:</b></p> <p>2.1 determine place value of digits</p> <p>2.2 round off to specified level of accuracy</p> <p>2.3 estimate quantities (length, volume, capacity, area, population etc)</p> <p>2.4 approximate to a number of significant figures and decimal places and round off answers to reasonable accuracy in the context of a given problem</p> <p>2.5 approximate numbers to a given place value and/or decimal place</p> <p>2.6 find the upper and lower bounds for a given specified accuracy e.g. population, time, distance, speed, area, etc</p>  |
| <p><b>3. Operations [Topic Area: Number]</b></p>                                     | <p><b>All learners should be able to:</b></p> <p>3.1 use the four basic operations for calculations with whole numbers</p> <p>3.2 multiply and divide fractions by whole numbers and fractions</p> <p>3.3 convert fractions to<br/>           (i) their equivalent fractions and vice-versa<br/>           (ii) improper fractions, and vice-versa</p> <p>3.4 add and subtract decimals</p> <p>3.5 divide and multiply decimals by powers of 10</p>  |

| TOPIC   | OBJECTIVES  |
|---|---|
|   | <p>3.6 write fractions in order of size</p> <p>3.7 multiply and divide decimals by<br/>(i) a whole number,<br/>(ii) decimals and vice-versa</p> <p>3.8 multiply and divide fractions by<br/>(i) whole numbers<br/>(ii) fractions</p> <p>3.9 simplify numerical expressions involving mixed operations</p> <p>3.10 use correct order of operations and brackets</p> <p>3.11 convert fractions and decimals into percentages</p> <p>3.12 convert percentages into fractions and decimals</p> <p>3.13 find squares, cubes, square roots and cube roots of numbers</p> <p>3.14 use the four operations on directed numbers</p> <p>3.15 apply appropriate checks of accuracy</p> <p>3.16 order quantities and numbers by magnitude and demonstrate familiarity with the symbols =, ≠, &lt;, &gt;, ≤, ≥</p> |
| <p><b>4. Percentages [Topic Area: Number]</b></p> | <p><b>All learners should be able to:</b></p> <p>4.1 calculate a percentage of a given value or constant</p> <p>4.2 express one quantity as a percentage of another</p> <p>4.3 calculate:<br/>(i) the percentage change given the original and new values<br/>(ii) the new value given the original and percentage change</p> <p>4.4 calculate:<br/>(i) the percentage profit or loss given the buying and the selling price<br/>(ii) the selling price, given the buying price and the percentage loss or profit</p> <p>4.5 calculate the simple interest due to a customer after a certain period of time, given the percentage interest per annum and the amount deposited</p> <p>4.6 Calculate compound interest</p> <p>4.7 calculate the total cost given the percentage sales tax</p>           |

| TOPIC  | OBJECTIVES   |
|--|--|
| <p><b>5. Personal and Household Finance</b> [<i>Topic Area: Number</i>]</p>          | <p><b>All learners should be able to:</b></p> <p>5.1 use given data to solve problems on simple or compound interest</p> <p>5.2 extract and interpret information from tables and charts (rates and bills)</p> <p>5.3 calculate using money and convert from one currency to another including conversion graphs</p>   |
| <p><b>6. Ratio and Proportions</b> [<i>Topic Area: Number</i>]</p>                   | <p><b>All learners should be able to:</b></p> <p>6.1 demonstrate understanding of the elementary ideas of and notation of ratio, direct and inverse proportions (<i>variation</i>)</p> <p>6.2 divide quantities in a given ratio</p> <p>6.3 use scale in practical situations</p> <p>6.4 complete tables for simple direct proportion (<i>variation</i>)</p> |
| <p><b>7. Indices</b> [<i>Topic Areas: Number and Algebra</i>]</p>                    | <p><b>All learners should be able to:</b></p> <p>7.1 use and evaluate positive, negative and zero indices</p> <p>7.2 use the rules of indices</p> $a^0 = 1, a^{-n} = \frac{1}{a^n}$ $a^m \times a^n = a^{m+n},$ $a^m \div a^n = a^{m-n} \text{ and } (a^m)^n = a^{m \times n}$   |
| <p><b>8. Standard Form</b> [<i>Topic Area: Number</i>]</p>                           | <p><b>All learners should be able to:</b></p> <p>8.1 express numbers in standard form<br/><math>A \times 10^n</math> where <math>n</math> is a positive or negative integer and <math>1 \leq A &lt; 10</math></p> <p>8.2 use numbers in standard form</p>  |
| <p><b>9. Properties of Shapes</b> [<i>Topic Area: Shape, Position and Space</i>]</p> | <p><b>All learners should be able to:</b></p> <p>9.1 use and interpret vocabulary of n-sided<br/>(a) regular polygons<br/>(b) irregular polygons</p> <p>9.2 Calculate<br/>(a) interior angles of n-sided polygons<br/>(b) exterior angles of n-sided polygons</p> <p>9.3 identify and name prisms and pyramids (cones) using their</p>                       |

| TOPIC  | OBJECTIVES  |
|--|---|
|  | <p>bases.</p> <p>9.4 Use and interpret vocabulary of solid figures<br/>(a) vertices<br/>(b) edges<br/>(c) faces<br/>(d) nets of solids</p> <p>9.5 identify and draw nets of different solids</p> <p>9.6 Use the following geometric properties<br/>(a) angles at a point<br/>(b) angles on a straight line and intersecting lines<br/>(c) angles formed with parallel lines<br/>(d) angle properties of triangles and quadrilaterals</p> <p>9.7 recognise rotational and line symmetry including order of rotational symmetry in 2 - Dimensions and properties of polygons and circles directly related to their symmetries</p>   |
| <p><b>10. Geometrical terms and Constructions</b><br/><i>[Topic Area: Shape, Position and Space]</i></p> | <p><b>All learners should be able to:</b></p> <p>10.1 understand and use the geometrical terms: point, line, parallel, bearing, right angle, acute, obtuse, reflex angles, perpendicular, similarity, and congruence</p> <p>10.2 understand and use vocabulary of triangles, quadrilaterals, circles, polygons and simple solid figures including nets</p> <p>10.3 measure length of lines and size of angles</p> <p>10.4 construct special angles using a ruler and compasses only: 30°, 45°, 60° and 90°</p> <p>10.5 construct a triangle using ruler, a protractor and compasses only</p> <p>10.6 bisect lines and angles using protractors and set squares as necessary</p> <p>10.7 construct angle bisectors and perpendicular bisectors using ruler and compasses only</p> <p>10.8 construct other simple geometrical figures from given data using protractors and set squares as necessary</p> <p>10.9 read and make scale drawings</p> |

| TOPIC   | OBJECTIVES   |
|---|--|
| <p><b>11. Loci</b> [<i>Topic Area: Shape, Position and Space</i>]</p>                                     | <p><b>All learners should be able to:</b></p> <p>11.1 construct and describe loci in 2-dimensions, of points equidistant from</p> <ul style="list-style-type: none"> <li>(a) a point</li> <li>(b) two points</li> <li>(c) a line</li> <li>(d) two parallel lines</li> <li>(e) two intersecting lines</li> </ul> <p>11.2 construct and describe simple intersecting loci</p>  |
| <p><b>12. Transformations</b> [<i>Topic Area: Shape, Position and Space</i>]</p>                          | <p><b>All learners should be able to:</b></p> <p>12.1 reflect simple plane figures in horizontal or vertical lines</p> <p>12.2 rotate simple plane figures about any point through multiples of <math>90^\circ</math> on a grid with given coordinates</p> <p>12.3 construct given translations and enlargements of simple plane figures on a grid</p> <p>12.4 recognise and give precise description of reflections, rotations, enlargements and translations on a grid</p>   |
| <p><b>13. Measurement, Time, Units and Mensuration</b> [<i>Topic Area: Shape, Position and Space</i>]</p> | <p><b>All learners should be able to:</b></p> <p>13.1 use current units of mass, length, area, volume and capacity in practical situations and express quantities in terms of larger or smaller units</p> <p>13.2 calculate times in terms of the 24-hour and 12-hour clock including the conversion between units of time e.g. 2 hours 24 minutes = 2.4 hours</p> <p>13.3 read clocks, dials and timetables</p> <p>13.4 calculate perimeter and area of</p> <ul style="list-style-type: none"> <li>(a) rectangles</li> <li>(b) triangles</li> <li>(c) circles</li> <li>(d) parallelograms</li> <li>(e) trapezium</li> <li>(f) other polygons</li> <li>(g) and composite shapes</li> </ul> <p>13.5 calculate the surface area and volume of:</p> <ul style="list-style-type: none"> <li>(i) cuboids</li> <li>(ii) cylinders</li> </ul> |

| TOPIC  | OBJECTIVES   |
|--|--|
|  | <p>(iii) other prisms</p> <p>13.6 solve problems involving the arc length and sector area as fractions of the circumference and area of circle</p> <p>13.7 solve problems involving time, distance and speed</p> <p>13.8 solve problems involving mass, volume and density</p>   |
| <p><b>14. Trigonometry</b><br/><i>[Topic Area: Shape, Position and Space]</i></p>                            | <p><b>All learners should be able to:</b></p> <p>14.1 apply Pythagoras Theorem</p> <p>14.2 find trigonometric ratios for angles of right-angled triangles</p> <p>14.3 use 3 figure tables to find the angle of a given ratio</p>   |
| <p><b>15. Bearings</b> <i>[Topic Area: Shape, Position and Space]</i></p>                                    | <p><b>All learners should be able to:</b></p> <p>15.1 draw and interpret bearings.</p> <p>15.2 interpret and use three-figure bearings measured clockwise from the north (i.e. <math>000^\circ</math> to <math>360^\circ</math>)</p> <p>15.3 apply bearings to solve simple problems involving not more than three north lines</p> <p>15.4 find distances and make simple scale drawings</p> |
| <p><b>16. Graphs in Practical situations</b> <i>[Topic Areas: Algebra and Shape, Position and Space]</i></p> | <p><b>All learners should be able to:</b></p> <p>16.1 draw and use simple graphs in practical situations, eg conversion, distance-time graphs, etc</p> <p>16.2 calculate speed from a distance-time graph</p>  |
| <p><b>17. Algebraic representation and formulae</b> <i>[Topic Area: Algebra]</i></p>                         | <p><b>All learners should be able to:</b></p> <p>17.1 use letters for numbers to express generalised numbers and expressions algebraically</p> <p>17.2 substitute numbers for words and letters in formulae</p> <p>17.3 construct simple algebraic expressions and set up simple equations</p> <p>17.4 state the number of terms in an expression</p>  |



| TOPIC   | OBJECTIVES   |
|---|--|
|   | <p>17.5 expand brackets e.g. <math>6(2x + 4)</math></p> <p>17.6 simplify algebraic expressions<br/>e.g. <math>5(x + 3) - 2(x - 5)</math></p> <p>17.7 factorise expressions with a common factor<br/>e.g. <math>3x + 6</math> , <math>12ax + 8ab + 4ac</math> , <math>2x^3 + 6x^5</math></p> <p>17.8 simplify simple algebraic fractions of the form<br/> <math display="block">\frac{ax}{k_1} \pm \frac{cx}{k_2} \quad \text{or} \quad \frac{x-a}{k_1} (\pm) \frac{x-b}{k_2} \quad (k_1, k_2 \neq 0)</math> <br/> e.g. <math>\frac{2x}{3} - \frac{x}{4} \quad \text{or} \quad \frac{2}{3m} + \frac{4}{5m}</math> <br/> <math>\frac{2}{3a} \times \frac{4}{5a} \quad \text{or} \quad \frac{2x}{3} \div \frac{x}{4}</math></p>   |
| <p><b>18. Coordinates, graphs, relations and function notation</b><br/><b>[Topic Area: Algebra]</b></p> | <p><b>All learners should be able to:</b></p> <p>18.1 calculate the gradient of a straight line</p> <p>18.2 find the equation of a straight line in the form <math>y = mx + c</math></p> <p>18.3 identify the gradient and the y-intercept when an equation of a line is given in the form <math>y = mx + c</math></p> <p>18.4 construct tables of values and draw and recognise graphs of the form <math>ax + b</math>, where <math>a</math> and <math>b</math> are integral constants</p> <p>18.5 find the output of a mapping given the input and vice-versa</p> <p>18.6 find the mapping given the output and input set</p> <p>18.7 relate the input as the x-coordinate and the output as the y-coordinate</p> <p>18.8 represent mappings using arrow diagrams</p> <p>18.9 plot and write coordinates</p> <p>18.10 evaluate and draw graphs of linear mappings</p> <p>18.11 represent inequalities on a number line and on a grid</p> <p>18.12 indicate the region containing the points whose coordinates satisfy at least one inequality of the form <math>ax + by &lt; c</math> , <math>ax + by &gt; c</math> , <math>ax + by \leq c</math> , <math>ax + by \geq c</math> , where <math>a</math>, <math>b</math> and <math>c</math> are integers</p> |

| TOPIC   | OBJECTIVES  |
|---|---|
|   | 18.13 interpret graphs of simple inequalities   |
| <b>19. Solution of equations and inequalities [Topic Area: Algebra]</b>                         | <p><b>All learners should be able to:</b></p> <p>19.1 solve simple linear equations<br/>e.g. <math>3x + 2 = 14</math> and <math>5(2x - 3) - 3(x + 4) = 2</math></p> <p>19.2 solve fractional equations with numerical denominators</p> <p>19.3 solve fractional equations with single term algebraic denominators</p> <p>19.4 solve simple linear inequalities including fractional inequalities with numerical denominators</p> <p>19.5 solve simultaneous linear equation in two unknowns by the graphical method</p> |
| <b>20. Matrices [Topic Areas: Algebra, Number, Data Handling and Shape, Position and Space]</b> | <p><b>All learners should be able to:</b></p> <p>20.1 write a matrix of any order</p> <p>20.2 state the order of a matrix</p> <p>20.3 multiply a matrix of any order by a scalar</p> <p>20.4 perform basic operations: addition, subtraction on matrices of any order (where appropriate)</p> <p>20.5 understand and use the zero matrix as an identity under addition</p>  |
| <b>21. Statistics [Topic Area: Data Handling]</b>   | <p><b>All learners should be able to:</b></p> <p>21.1 collect classify and tabulate data</p> <p>21.2 read, interpret and draw simple inferences from tables and diagrams</p> <p>21.3 construct and use bar charts for qualitative and numerical data (discrete and continuous data with equal intervals)</p> <p>21.4 construct and use pie charts</p> <p>21.5 calculate the mean, median and mode for discrete data and distinguish the purpose for which they are used</p>   |

| TOPIC  | OBJECTIVES  |
|--|---|
| <p><b>22. Probability [Topic Area: Data Handling]</b></p>                      | <p><b>All learners should be able to:</b></p> <p>22.1 explain the terms and phrases used in probability</p> <p>22.2 calculate the probability of a single event as either a fraction or a decimal (not a ratio)</p> <p>22.3 understand and use probability scale from zero to 1</p> <p>22.4 understand that:<br/>the probability of an event occurring = 1 minus (–) the probability of an event not occurring</p> <p>22.5 use the basic rules for combined events <i>a</i> and <i>b</i> or <i>a</i> or <i>b</i></p> <p>22.6 understand that relative frequency approximates to probability provided the number of trials is large enough</p> |
| <p><b>23. Vectors [Topic Areas: Algebra and Shape, Position and Space]</b></p> | <p><b>All learners should be able to:</b></p> <p>23.1 represent vectors by a directed line segment</p> <p>23.2 represent a vector by <math>\begin{pmatrix} x \\ y \end{pmatrix}</math><br/>or <math>\vec{AB}</math> or <math>\underline{a}</math></p> <p>23.3 add and subtract vectors</p> <p>23.4 multiply a vector by a scalar</p>  |

**Notes:**

Use of an Electronic Calculator and Mathematical Tables:

The use of electronic calculators is prohibited in Paper 1 and Paper 2.

1. The usual Mathematical Instruments may be used in all examinations.
2. Candidates are encouraged to use the value of pi ( $\pi$ ) as given in the question or on the cover page of the question paper.
3. Tracing paper may be used as an optional additional material for each of the written papers.

## **GRADE DESCRIPTIONS**

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The scheme of assessment is intended to encourage positive achievement by all candidates. Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The grade awarded will depend on the extent to which the candidate has met the assessment objectives overall.

Criteria for the standard of achievement likely to have been shown by candidates awarded Grades A, C and E are shown below.

### **A Grade A candidate should be able to:**

- 1 Use and evaluate positive, negative and zero indices in both numerical and algebraic work.
- 2 Express any number to 1, 2, or 3 significant figures.
- 3 Find missing numbers in a sequence of composite, triangle, rectangle and Pascal's triangle numbers
- 4 For three (3) sets and a universal set, draw Venn diagrams and use the language of sets
- 5 Describe and use set symbols
- 6 Relate a percentage change to a multiplying factor and vice versa, e.g., multiplication by 1.03 results in a 3% increase.
- 7 Calculate the percentage change given original and new values
- 8 Calculate new value given the original and percentage change
- 9 Calculate the percentage profit and loss
- 10 Calculate simple interest
- 11 Calculate total cost percentage sales tax
- 12 Use given data to solve problems on simple interest
- 13 Obtain appropriate upper and lower bounds for given data to a specified accuracy.
- 14 Solve problems involving solids including nets of solids.
- 15 Calculate the surface area and volumes of simple prisms including cuboids and cylinders
- 16 Solve problems involving the arc length and sector area.
- 17 Draw and interpret bearings
- 18 Interpret and use three-figure bearings
- 19 Apply bearings to solve simple problems involving not more than three North lines
- 20 Multiply and divide decimals by decimals
- 21 Add, subtract, multiply and divide algebraic fractions.
- 22 Manipulate algebraic equations – linear, simultaneous.
- 23 Write down algebraic formulae, expressions and equations from a description of a situation.
- 24 Solve equations with numerical denominators
- 25 Solve simultaneous linear equations in two unknowns
- 26 Calculate the gradient of a straight line
- 27 Find square roots and cube roots of numbers.
- 28 Construct and describe loci in two dimensions
- 29 Calculate the probability of simple combined events
- 30 Recognise, describe and generalise in algebraic format patterns
- 31 Extract and interpret information from tables and charts
- 32 Calculate the mean, median and mode for discrete data and distinguish the purpose for which they are used

- 33 Use the basic rules for combined events ( a and b, a or b)
- 34 Process data, discriminating between necessary and redundant information.
- 35 Make quantitative and qualitative deductions from distance/time and speed/time graphs
- 36 Give clear mathematical justifications for the conjectures made in problem solving.
- 37 Solve ratio and proportion problems
- 38 Calculate using money and convert from one currency to another including conversion graphs

**A Grade C candidate should be able to:**

- 1 Apply the four rules of number to positive and negative integers, and vulgar and decimal fractions.
- 2 Apply Pythagoras Theorem
- 3 Identify sets of primes and cubes in natural numbers
- 4 Calculate percentage change.
- 5 Perform calculations involving several operations.
- 6 Multiply and divide decimals by a whole number
- 7 Find squares and square roots of numbers
- 8 Use the four operations on directed numbers
- 9 Estimate quantities
- 10 Give a reasonable approximation to a calculation involving the four rules.
- 11 Approximate number of significant figures and decimal places and round off answers to a reasonable level of accuracy in the context of a given problem
- 12 Round off to a specified level of accuracy
- 13 Order quantities by magnitude and demonstrate familiarity with symbols =, ≠, <, >, ≤, ≥ .
- 14 Use the rules of indices
- 15 Use and understand the standard form of a number.
- 16 Use current units of mass, length, area, volume and capacity in practical situations
- 17 Express quantities in terms of larger or smaller units
- 18 Solve problems involving perimeters and areas of compound shapes bounded by line segments and/or circular arcs.
- 19 Solve practical problems involving mass, volume and density.
- 20 Draw distance-time graphs.
- 21 Make quantitative and qualitative conclusion from distance-time graphs.
- 22 Manipulate algebraic fractions with denominators containing a single term (numerical or algebraic).
- 23 Form simple algebraic expressions
- 24 Simplify algebraic expressions e.g.  $5(x + 3) - 2(x - 5)$
- 25 Solve simple linear equations
- 26 Form and solve linear equations in practical situations.
- 27 Find the ratio of an angle in a right-angled triangle
- 28 Use 3- figure tables to find the angle of a given ratio.
- 29 Calculate angles in geometrical figures.
- 30 Recognise, and in simple cases formulate, rules for generating a pattern or sequence.
- 31 Solve simple simultaneous linear equations in two unknowns.
- 32 Identify and describe rotational and line symmetry in two dimensions
- 33 Draw and or state loci of points in two dimensions.
- 34 Draw, recognise and describe transformations of shapes (translation, rotation, reflection and enlargement).

- 35 Rotate simple plane figures about any point through multiples of  $90^\circ$
- 36 Make, use and interpret scale drawings.
- 37 Use and interpret vocabulary of  $n$ - sided regular and irregular polygons
- 38 Identify and draw nets of different solids
- 39 Use the following geometric properties: angles at a point, angles on a straight line, parallel lines and intersecting lines
- 40 Understand and use angle properties of triangles and quadrilaterals
- 41 Understand and use vocabulary of triangles, quadrilaterals, circles, polygons and simple solid figures
- 42 Calculate times in terms of the 24- hour clock including the conversion between units
- 43 Perform addition and subtraction on matrices
- 44 Calculate the probability of single events.
- 45 Make and justify estimates of probability.
- 46 Understand that relative frequency approximates to probability.
- 47 Analyse a given situation, generate data, generalise the data and describe the situation using mathematical symbols, words or diagrams.
- 48 Read, interpret and draw simple inferences from tables and diagrams
- 49 Transform simple formulae.
- 50 Use brackets and extract common factors from algebraic expressions.
- 51 Construct a pie-chart from simple data.
- 52 Plot and interpret graphs, including travel graphs and graphs of linear equations.(include practical situations)
- 53 Represent, add and subtract vectors.

**A Grade E candidate should be able to:**

- 1 Perform the four basic operations on positive integers and decimal fractions (one operation only)
- 2 List sets and subsets of real numbers in a sequence
- 3 Identify sets of multiples, factors and squares in natural numbers
- 4 Identify common multiples and common factors
- 5 List directed numbers
- 6 Determine the place value of a digit
- 7 Convert fractions to their equivalent fractions
- 8 Convert a fraction to a decimal.
- 9 Calculate a simple percentage.
- 10 Divide quantities in a given ratio
- 11 Use metric units of length, mass and capacity.
- 12 Understand the relationship between mm, cm, m, km, g, and kg.
- 13 Continue a straightforward number sequence.
- 14 Find rules for number patterns
- 15 Use letters for numbers
- 16 Find the perimeter and area of a rectangle and other rectilinear shapes.
- 17 Construct a triangle.
- 18 Construct simple geometric figures from given data using protractors and set squares
- 19 Bisect lines and angles
- 20 Measure lines and angles
- 21 Substitute numbers in a simple formula and evaluate the remaining terms.
- 22 Solve simple linear equations in one unknown.
- 23 Extract information from simple timetables.
- 24 Collect, classify and tabulate data to find the frequency of given scores.
- 25 Tabulate numerical data

- 26 Construct and use bar charts ( discrete data with equal intervals)
- 27 Plot given points.
- 28 Identify the gradient and y- intercept when an equation is given in the form  $y = mx + c$
- 29 Read travel graph.
- 30 Calculate the mean of a set of numbers.
- 31 Manipulate simple algebraic expressions e.g.  $6(2x + 4)$ .
- 32 Recognise and name plane shapes and solids (prisms and pyramids using their bases).
- 33 Recognise, describe and reflect plane shapes on a coordinate grid in lines parallel to the axes.
- 34 Translate plane shapes on a plane grid.
- 35 Identify and use reflective symmetry in two dimensional shapes.
- 36 Read tables, graphs (including travel graphs) and diagrams.
- 37 Display information in the form of a matrix of any order
- 38 Represent vectors by a directed line segment and a column matrix  $\begin{pmatrix} x \\ y \end{pmatrix}$
- 39 Multiply a matrix ( including a column vector) by a scalar
- 40 Read clocks, dials and time tables

## **ADDITIONAL MATHEMATICS - Syllabus Code: 519**

All learners should take this course as it forms the basis for EGCSE.

### **1.0 Aims**

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The course should enable learners to:

1. extend their elementary mathematical skills and use these in the context of more advanced techniques;
2. develop an ability to apply mathematics in other subjects, particularly science and technology;
3. develop mathematical awareness and the confidence to apply their mathematical skills in appropriate situations;
4. extend their interest in mathematics and appreciate its power as a basis for specific applications.

### **2.0 ASSESSMENT OBJECTIVES**

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In addition to the assessment objective outlined for Ordinary Mathematics, learners should be able to:

1. recall and use manipulative techniques;
2. interpret and use mathematical data, symbols and terminology;
3. comprehend numerical, algebraic and special concepts and relationships;
4. recognise the appropriate mathematical procedure for a given situation;
5. formulate problems into mathematical terms; select and apply appropriate techniques of solution.



### 3.0 SCHEME OF ASSESSMENT

The purpose of assessment in Mathematics is two-fold:

- (i) to provide feedback to both the teacher and the learner as part of the teaching/learning process
- (ii) to evaluate the effectiveness of the Mathematics programme at the secondary school level.

All candidates must enter for the Additional Mathematics Paper.

|                                      |   |
|--------------------------------------|---|
| To be taken by <b>all</b> candidates | <p><b>Additional Mathematics</b> (2 hours and 30 minutes)<br/> <b>Compulsory</b> structured/longer answer paper consisting of 100 marks. The questions will contain material from the Additional as well as Ordinary curriculum.</p> <p>This paper will be weighted at 100% of the final total available marks.</p> |
|--------------------------------------|---|

#### Weighting of papers

|                        |                                      |      |
|------------------------|--------------------------------------|------|
| Additional Mathematics | To be taken by <b>all</b> candidates | 100% |
|------------------------|--------------------------------------|------|

#### Notes:

1. Use of an Electronic Calculator and Mathematical Tables:
  - (i) All candidates should be able to use an electronic calculator efficiently and apply it appropriately to the required degree of accuracy.
  - (ii) The syllabus assumes that candidates will be in possession of an electronic calculator for the Additional Mathematics paper. Three significant figures will be required in answers except where otherwise stated.
2. Use of Mathematical Instruments:  
The usual mathematical instruments may be used in this examination.
3. Candidates are encouraged to use the value of pi ( $\pi$ ) from their calculators if their calculator provides this. Otherwise, they should use the value of  $\pi$  as given in the question or on the front page of the question paper.
4. Tracing paper may be used as an optional additional material for each of the written papers.

#### **4.0 CURRICULUM CONTENT**

Learners will follow the Additional Mathematics curriculum. The curriculum content that follows is divided into topics covering four areas: Number; Shape, Position and Space; Algebra; and Data Handling. The table below shows the approximate weighting of these areas in each of the components of the examination.

| Paper     | Number | Algebra | Shape, Position and Space | Data Handling |
|-----------|--------|---------|---------------------------|---------------|
| One paper | 10 %   | 50 %    | 20 %                      | 20 %          |

Appropriate teaching time for the Additional Mathematics syllabus should be equivalent to *three (3)* periods of forty (40) minutes each over a period of *thirty (30)* weeks/cycles.

As well as demonstrating skill in the following techniques, candidates will be expected to apply them in the solution of problems.

#### **CONTENT**

| TOPIC  | OBJECTIVES   |
|--|--|
| <b>1. Trigonometry [Topic Area: Shape, Position and Space]</b>         | <p><b>All learners should be able to:</b></p> <p>1.1 apply Pythagoras Theorem</p> <p>1.2 calculate sides and angles of a right-angled triangle using sine, cosine and tangent ratios</p> <p>1.3 solve simple problems involving angles of depression and elevation (from right angled-triangles)</p>   |
| <b>2. Vectors [Topic Areas: Algebra and Shape, Position and Space]</b> | <p><b>All learners should be able to:</b></p> <p>2.1 calculate the magnitude/ length of a vector and use the notation <math> \underline{a} </math> to represent vector magnitude or length of vector</p> <p>2.2 use the sum and difference of two vectors to express given vectors in terms of two coplanar vectors</p> <p>2.3 identify parallel vectors as those that are scalar multiples of each other</p> <p>2.4 simplify vector expressions</p> |

| TOPIC  | OBJECTIVES   |
|--|--|
| <p><b>3. Algebraic representation and formulae</b> [<i>Topic Area: Algebra</i>]</p>                | <p><b>All learners should be able to:</b></p> <p>3.1 Change the subject of simple formulae</p> <p>3.2 Simplify algebraic fractions of the form <math>\frac{k_1}{x \pm a} \pm \frac{k_2}{x \pm b}</math> where <math>k_1, k_2, a</math> and <math>b</math> are integers</p> <p>3.3 Expand algebraic expressions of the form <math>(x + a)(x + b)</math></p> <p>3.4 Factorise quadratic expressions of the form <math>ax^2 + bx + c</math> where <math>a = 1</math></p>  |
| <p><b>4. Coordinates, graphs, relations and function notation</b> [<i>Topic Area: Algebra</i>]</p> | <p><b>All learners should be able to:</b></p> <p>4.1 Use the words domain and range interchangeably with input and output respectively</p> <p>4.2 Use basic function language for linear functions<br/>e.g. <math>f(x) = x + 3</math> and <math>f: x \rightarrow x + 3</math></p> <p>4.3 Evaluate a linear function by substituting for a given value of the domain</p> <p>4.4 Relate the equivalences of <math>f(x)</math> and <math>y = \dots</math>. And hence use them interchangeably</p> <p>4.5 Construct tables of value and draw and recognise graphs for Functions of the form <math>ax + b</math> and <math>ax^2 + bx + c</math></p> <p>4.6 Relate a quadratic mapping to a function using <math>y =</math> and <math>f(x) = \dots</math> notation</p> <p>4.7 Solve equations approximately by graphical methods</p> |
| <p><b>5. Solution of equations and inequalities</b> [<i>Topic Area: Algebra</i>]</p>               | <p><b>All learners should be able to:</b></p> <p>5.1 solve fractional equations with numerical denominators</p> <p>5.2 solve fractional equations with two term denominators</p> <p>5.3 solve simple linear inequalities including fractional inequalities with numerical denominators</p> <p>5.4 solve simultaneous linear equations in two unknowns by<br/>(i) the method of substitution,<br/>(ii) the method of elimination,<br/>(iv) graphical method</p> <p>5.5 solve quadratic equations of the form <math>x^2 + bx + c = k</math> by the graphical method</p>  |

| TOPIC  | OBJECTIVES   |
|--|--|
|  | 5.6 solve quadratic equations of the form $x^2 + bx + c = 0$ by factorisation  |
| <b>6. Matrices [Topic Areas: Algebra, Number, Data Handling and Shape, Position and Space]</b> | <p><b>All learners should be able to:</b></p> <p>6.1 perform multiplication on matrices of any order (where appropriate)</p> <p>6.2 use equality of matrices in simple matrix equations.</p> <p>6.3 use the algebra of 2 x 2 matrices including the zero and identity matrices</p>   |
| <b>7. Statistics [Topic Area: Data Handling]</b>   | <p><b>All learners should be able to:</b></p> <p>7.1 construct and interpret a cumulative frequency table for ungrouped data</p> <p>7.2 draw cumulative frequency diagrams</p> <p>7.3 find the median from a cumulative frequency curve</p> <p>7.4 use and interpret the cumulative frequency diagram</p>  |
| <b>8. Probability [Topic Area: Data Handling]</b>  | <p><b>All learners should be able to:</b></p> <p>8.1 explain the terms and phrases used in probability</p> <p>8.2 calculate the probability of a single event as either a fraction or a decimal (not a ratio)</p> <p>8.3 understand and use probability scale from 0 to 1</p> <p>8.4 understand that the probability of an event occurring is <b>1 – (minus) the probability of an event not occurring</b></p> <p>8.5 find probabilities of two combined events using</p> <ul style="list-style-type: none"> <li>(i) a possibility space diagram; outcomes represented by points on a grid</li> <li>(ii) a tree diagram</li> </ul> |

The scheme of assessment is intended to encourage positive achievement by all candidates. Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The grade awarded will depend on the extent to which the candidate has met the assessment objectives overall.

Criteria for the standard of achievement likely to have been shown by candidates awarded Grades A and C is shown below.

**A Grade A candidate should be able to:**

- 1 Solve simple problems involving angles of elevation and depression
- 2 Simplify vector expressions
- 3 Change the subject of formulae
- 4 Construct tables, draw and recognize graphs of functions of the form  $ax + b, ax^2 + bx + c$  where  $a, b$  and  $c$  are integers
- 5 Solve equations by graphical methods
- 6 Perform matrix multiplication where possible
- 7 Use the algebra of  $2 \times 2$  matrices including the zero and identity matrices
- 8 Draw cumulative frequency diagrams
- 9 Show an understanding that the probability of an event occurring = 1 minus the probability of an event not occurring
- 10 Find probabilities of two combined events using possibility space diagrams and tree diagrams
- 11 Solve fractional equations with a two- term denominator

**A Grade C candidate should be able to:**

- 1 Apply Pythagoras Theorem
- 2 Calculate the magnitude / length of a vector
- 3 Use the sum and difference of two vectors to express a vector in terms of two coplanar vectors
- 4 Solve simultaneous linear equations using a suitable method
- 5 Identify parallel vectors
- 6 Use basic function language for linear functions
- 7 Evaluate a linear function for a specified domain
- 8 Find the equation of a straight line and identify the gradient and y- intercept of the line in the form  $y = mx + c$
- 9 Relate a quadratic mapping to a function using  $y = \dots$  and  $f(x) = \dots$  notation
- 10 Solve fractional equations and inequalities with numerical denominators
- 11 Use equality of matrices in simple matrix equations
- 12 Construct a cumulative frequency table for ungrouped data
- 13 Find median from a cumulative frequency curve
- 14 Calculate the probabilities of a single event
- 15 Show understanding that probability ranges from 0 to 1
- 16 Calculate sides and angles of a right triangle using sine, cosine and tangent ratios
- 17 Use the words domain and range interchangeably with input and output respectively
- 18 Solve simple linear equations
- 19 Explain the terms used in probability