# MINISTRY OF EDUCATION

**Republic of Ghana**

# NATIONAL SYLLABUS FOR MATHEMATICS
# (JUNIOR HIGH SCHOOL 1 - 3)

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# TEACHING SYLLABUS FOR MATHEMATICS
## (JUNIOR HIGH SCHOOL)

## RATIONALE

Mathematics is a logical, reliable and growing body of concepts, which makes use of specific language and skills to model, analyse and interpret the world. It provides a means of communication that is powerful, concise and precise. As a human activity, mathematics involves creativity in the discovery of patterns of shape and number, the recognition of relationships, the modelling of situations, the interpretation of data and the communication of emerging ideas and concepts.

Mathematics is one of the essential areas of learning. Everyone needs to develop mathematical concepts and skills to help them understand and play a responsible role in society. Mathematics education aims to provide students with those skills and understandings. The need for people to be numerate has always been identified as an important outcome. Mathematics education aims to contribute to the development of a broad range of numeracy skills. In an increasingly technological age the possession of problem solving and decision making skills is an essential requisite. Mathematics education provides the opportunity for students to develop these skills and encourages them to become flexible problem solvers.

Achieving this requires a sound mathematics curriculum, competent and knowledgeable teachers who can integrate instruction with assessment, classrooms with ready access to technology, and a commitment to both equity and excellence.

The mathematics curriculum has been designed to provide knowledge and mathematical skills to pupils from various backgrounds and levels of ability. Today's world demands that young people should be able to use numbers competently, read and interpret numeral data, reason logically, solve problems involving calculations and mathematical reasoning, as well as communicate effectively with other people using accurate mathematical data and interpretations. Acquisition of these skills will help them in their careers later in life and in the process benefit the society and the nation. That is, the curriculum emphasizes mathematical knowledge and skills that should help the young person to develop basic numeracy competence to be able to function effectively in society.

Several factors have been taken into account when designing the curriculum and these are: mathematical concepts and skills, terminology and vocabulary used, and the level of proficiency of English among teachers and pupils.

It is hoped that with the knowledge and skills acquired in mathematics, pupils will discover, adapt, modify and be innovative in facing changes and future challenges. The learning of mathematics at all levels involves more than just the basic acquisition of concepts and skills. It involves, more importantly, an understanding of the underlying mathematical thinking, general strategies of problem solving. The strong mathematical competencies developed at the J.H.S. level are necessary requirements for effective study in mathematics, science, commerce, industry and a variety of other professions and vocations for pupils terminating their education at the J.H.S level as well as for those continuing into tertiary education and beyond.

## GENERAL AIMS

Mathematics education aims to:

- help children appreciate the value of mathematics and its usefulness to them,

- develop in children the skills, concepts, understandings and attitudes which will enable them to cope confidently with the mathematics of everyday life;

- foster a sense of personal achievement and to encourage a continuing and creative interest in mathematics;

- help children develop a variety of problem solving strategies involving mathematics and develop the ability to think and reason logically;

- help children become mathematically literate in a world which is technologically and information oriented;

- provide a foundation for those children who may wish to further their studies in mathematics or other subjects where mathematical concepts are essential

**GENERAL OBJECTIVES**

The pupil will be able to:
- work co-operatively with other pupils and develop interest in Mathematics
- read and write numbers
- use appropriate strategies to perform number operations
- recognise and use patterns, relationships and sequences and make generalizations
- recognise and use functions, formulae, equations and inequalities
- identify and use arbitrary and standard units of measure
- make and use graphical representations of equations and inequalities
- use the appropriate unit to estimate and measure various quantities.
- relate solids and plane shapes and appreciate them in the environment
- collect, analyse and interpret data and find probability of events
- use the calculator to enhance understanding of numerical computation and solve real-life problems
- manipulate learning materials to enhance understanding of concepts and skills

**SPECIFIC MINIMUM OBJECTIVES**

In order to achieve the general aims of the mathematics curriculum, teachers must provide opportunities for children to realize the specific minimum objectives which are the National Minimum Standards (NMS) for JHS.

**NATIONAL MINIMUM STANDARDS (NMS) for JHS**

NMS for JHS 3 listed below, which are part of the main terminal objectives for basic school mathematics education, are intended to give the teacher an idea of some of the things all the pupils should be able to do by the end of Junior High School. Some targets may be more complicated than they seem and so the syllabus has been designed for the teacher to revisit some of these objectives more than once in the year. By the time the pupil completes JHS, he/she should be competent in these areas.

- Identify and use the appropriate operations (including combinations of operations) to solve word problems involving numbers and quantities, and explain methods and reasoning.
- Round off whole numbers up to four digit numbers to the nearest tens or hundreds and use it to find good estimate of sums involving two or three of such numbers.
- Write a decimal fraction (up to two decimal places) as a common fraction and convert it to its simplest form (and vice versa).
- Write common fractions which are multiples of halves, fourths, fifths, and tenths as percentages and convert it to its simplest form (and vice versa).
- Compare and order common rational numbers expressed as (common fractions, decimals and percentages).
- Add and subtract fractions where the denominator of one is a factor of the other (e.g. $\frac{3}{4} + \frac{7}{8}, \frac{2}{5} - \frac{3}{10}$ ).
- Use a fraction as an operator to find fractions of numbers or quantities (e.g. $\frac{3}{4}$ of 48, $\frac{7}{10}$ of 30, $\frac{15}{100}$ of 200 centimetres).
- Carry out column addition and subtraction of numbers involving decimals, up to 3 decimal places.
- Carry out short multiplication and division of numbers involving decimals.
- Carry out long multiplication of a three-digit by a two-digit integer.
- Solve simple problems involving ratio and proportion.
- Substitute the values of variables in algebraic expressions and simplify.

- Add, subtract, and multiply simple algebraic expressions involving two terms up to two variables
- Draw and use Venn diagrams to solve simple two set problems.
- Use a protractor to measure acute and obtuse angles to the nearest degree.
- Bisect a given line segment and an angle and measure the result.
- Find the perimeter and area of simple shapes drawn in square grid or draw such shapes when given the perimeter and area.
- Calculate the perimeter and area of simple compound shapes that can be split into rectangles and calculate volume of prisms with such cross sections.
- Read and plot co-ordinates of point in the Cartesian plane.
- Describe a single transformation (i.e. translation, reflection or rotation) which maps a point onto an image in the coordinate plane.
- Solve a problem by extracting and interpreting information presented in tables, graphs and charts.
- Perform simple computation using the calculator as well as use it to check answers.

As stated in the primary syllabus, a few children with learning difficulties, including those in special schools, may not be able to achieve all the NMS by the end of Primary 6, and may need teachers' support in order to progress at junior high school. For this reason, it will be observed that several performance objectives which constitute the NMS for Primary 6 had been repeated in the JHS national minimum standards. Teachers are to identify these slow learners and support them to reach the NMS. In view of this, it is suggested that at least 70 percent (70%) of the NMS must be factored into the Basic Education Certificate Examination (BECE) to cater for all ability groups and also ensure that teachers pay more attention to the core mathematics required by all.

**SCOPE OF SYLLABUS**
This syllabus is based on the notion that an appropriate mathematics curriculum results from a series of critical decisions about three inseparable linked components: content, instruction and assessment. Consequently, the syllabus is designed to put great deal of emphases on the development and use of basic mathematical knowledge and skills. The major areas of content covered in all the Junior High classes are as follows:

1. Numbers and Numerals
2. Number operations & Algebra
3. Measures, Shape and Space
4. Collection and Handling Data (*Statistics & Probability*)
5. Problem Solving & Applications

*Numbers, and numerals* cover ways numbers are represented/recorded and the quantities for which they stand; the use of symbols, notation to represent and communicate quantities/numbers. The notations include writing numerals in using the decimal system, fractions, percentages as well as writing numbers in base two and base five; rounding numbers (to given significant figures and decimal places); and writing numerals in using standard form. Numbers, and numerals also cover identifying and using natural numbers, integers (positive, negative and zero), prime numbers, square numbers, common factors and common multiples, rational and irrational numbers (e.g. π , 2 ), real numbers; continue a given number sequence; recognise patterns in sequences, and relationships between different sequences, generalise to simple algebraic statements (including expressions for the nth term) relating to such sequences.

*Number Operations and Algebra* cover the basic operations (+, −, × & ÷) on whole numbers and fractions (including correct ordering of operations and use of brackets), and accuracy, efficiency as well as confidence in using them in calculations, mentally, and on paper. It also covers the elementary ideas and notation of ratio, direct and inverse proportion, and common measures of rate, dividing a quantity in a given ratio; use scales in practical situations; and calculate average speed. Number operations also provides opportunities for the development of pupils ability to estimate and to make approximations, and check the

reasonableness of results of calculations; use an electronic calculator efficiently; apply appropriate checks of accuracy while using the calculator. *Algebra* also provides opportunities for the development of pupils ability recognise patterns and relationships in mathematics and the real world; and develop the ability to use symbols, notation, graphs and diagrams to represent and communicate mathematical relationships and solve problem. Content of algebra includes algebraic expressions, relations, mappings and their graphs, linear equations and inequalities in one variable

*Measures* cover the use of current units of mass, length, area, volume and capacity in practical situations and express quantities in terms of larger or smaller units; calculating the perimeter and area of simple compound shapes and volume of prisms with such cross sections; time which include calculating times in terms of the 24-hour and 12-hour clock; read clocks, dials and timetables; and money which include using money and converting from one currency to another. *Shape and Space* provides opportunities for the development of pupils' ability to measure lines and angles; construct a triangle given the three sides using ruler and a pair of compasses only; construct other simple geometrical figures from given data using square grid paper, protractors and set squares as necessary; construct angle bisectors and perpendicular bisectors using straight edges and a pair of compasses only; read and make scale drawings. This content area also covers the use and interpretation of the geometrical terms: - point, line, parallel, bearing, right angle, acute, obtuse and reflex angles, perpendicular, similarity, congruence; use and interpret vocabulary of triangles, quadrilaterals, circles, polygons and simple solid figures including nets

*Statistics and probability* are important interrelated areas of mathematics. Collection and Handling Data involve the pupils in specifying a problem, planning and collecting data from various sources, organizing and representing data; interpreting and discussing results; and understanding the fundamental concepts of probability so that they can apply them in everyday life. The topics covered include - collecting, classifying and tabulating statistical data; reading, interpreting and drawing simple inferences from tables and statistical diagrams; constructing and using bar charts, pie charts, pictograms, simple frequency distributions, the stem and leaf plot and histograms.

Pupils come from various backgrounds and have different learning styles and abilities. It must be recognised that each pupil is an individual whose learning development and rate of progress is different from others. Different pupils will be ready for particular mathematical content and experiences at different times. It is therefore not expected that all children of the same age will be achieving at the same level at the same time, nor that an individual child will necessarily be achieving at the same level in all content areas of the mathematics curriculum. Notwithstanding, teachers must as much as possible ensure most children attain the terminal objectives or the NMS for JHS 3 by the end of basic education.

*Problem Solving and Application* this syllabus does not include Problem solving and Application as a distinct topic. Rather nearly all topics in this syllabus include solving word problems as activities. These activities relate to issues in real life situations, teachers are expected to derive problems and set out questions which will help students to think and apply scientific principles using mathematical theory. It is hope that teachers and textbook developers will incorporate appropriate problems that will require mathematical thinking rather than mere recall and use of standard algorithms. Other aspects of the syllabus should provide opportunities for the pupils to work co-operatively in small groups to carry out activities and projects which may require out-of-school time. The level of difficulty of the content of the syllabus is intended to be within the knowledge and ability range of Junior High School Pupils.


## APPROACHES TO TEACHING AND LEARNING MATHEMATICS

### Problem-solving Approach

A balanced mathematical programme incorporates concept learning and the development, maintenance and application of skills. These should be taught in such a way that children develop their ability to think mathematically.

Children learn mathematical thinking most effectively through the application of concepts and skills in interesting and realistic contexts that are personally meaningful to them. This implies that mathematics is best taught by helping children to solve problems drawn from their own experiences.

Real-life problems are not always closed, nor do they necessarily have only one solution. Determining the best approach for solving a problem where several approaches are possible is a skill frequently required in the workplace. Consequently, children need to be given various opportunities to work on open-ended

problems. The solution to problems, which are worth solving, rarely involves only one item of mathematical understanding or just one skill. Rather than remembering a single correct method, problem solving requires children to search for clues and make connections to the various pieces of mathematics and other knowledge and skills, which they have learned. Such problems encourage thinking rather than mere recall.

Closed problems, which follow a well-known pattern of solution, develop only a limited range of skills. They encourage memorisation of routine methods rather than experimentation and investigation. Without diminishing the importance of being fluent with basic techniques, routine methods only become useful tools when children can successfully apply them to non-routine and realistic problems. Good problem solving techniques are characterised by the systematic collection of data or evidence, experimentation (including trial and error followed by improvement), creativity, reflection on and critical evaluation of the process that has been followed. These characteristics may be developed by providing children with opportunities that encourage them to practise and learn simple strategies such as guessing and checking, drawing a diagram, making lists, looking for patterns, classifying, substituting, re-arranging, putting observations into words, making predictions and developing simple proofs.

Learning to communicate about mathematics and through mathematics is part of learning to become a mathematical problem solver and learning to think mathematically. Critical reflection may be developed by encouraging children to share ideas, to use their own words to explain their ideas and to record their thinking in a variety of ways, such as words, symbols, diagrams and models.

**The Medium of Instruction**

Teachers should ensure they use language that will facilitate the development and acquisition of mathematical concepts. Once this objective is achieved, however, it is essential that children be exposed to the mathematical ideas in English and listen to adults using the words correctly. Care must be taken to ensure that the English language used is simple and accessible; hence it should be presented in very short sentences in situations involving the appropriate mathematical language. The use of flash cards, pictures and real-life objects should be used to facilitate the pupils' understanding of the language, as do consistency and repetition. At the JHS level children should be encouraged to express and articulate their explanations, thinking and reasoning in English to strengthen their mathematical communication skills. However, on no account should the use of language (Ghanaian language or English) be to the detriment of children learning mathematics.

**Developing the Understanding of Mathematical Vocabulary**

Children's failure to understand mathematical vocabulary manifests itself when they fail to answer questions during lessons, when they fail to carry out a set task and when they do poorly in tests and examinations. Possible reasons for this failure could be that:
- they do not understand the spoken or written instructions; (e.g. draw a line . . .; put a circle around one of these numbers . . . )
- they are not familiar with the mathematical vocabulary; (e.g. difference, sum, product, one-third, estimate, . . .)
- they may be confused about mathematical terms which have different meanings in English; (e.g. table, volume, odd, . . .)
- they may be confused about other words; (e.g. sides and size; width and with; collect and correct, breadth and breath, . . . )

It is for these reasons that children need to acquire the appropriate mathematical vocabulary so that they can fully participate in set tasks and tests. An even more important reason is that mathematical language is crucial to the children's development of thinking. Unless they have the vocabulary to talk about division, perimeter, capacity, etc, they cannot make progress in understanding the various areas of mathematical knowledge.

Since children cannot learn the meaning of words in isolation, the use of questions is crucial in coming to grips with the mathematical ideas and mathematical terms correctly. It is important to ask questions in different ways so those children who do not understand the first time may subsequently pick up the meaning. One should not use only questions that require recall and application of facts but also questions, which require a higher level of thinking and promote good dialogue and interaction. Eventually children will begin to give more complex answers in which they explain their thinking.

All children need regular, planned opportunities to develop their mathematical vocabulary. They need to experience a cycle of oral work, reading and writing. They need oral work based on practical work so that they may have visual images and tactile experience of what mathematical words mean in a variety of contexts. Various forms of oral work include:

- listening to adults and children using words correctly;
- acquiring confidence and fluency in speaking, using complete sentences that include the new words and phrases, sometimes in chorus and sometimes individually;
- describing, defining and comparing mathematical properties, positions, methods, patterns, relationships, and rules;
- discussing ways of tackling a problem, collecting data and organising their work;
- hypothesising or making predictions about possible results;
- presenting, explaining and justifying their methods, results, solutions or reasoning, to the whole class or to a group or partner;
- generalising or describing examples that match a general statement.

They need to read aloud and silently, sometimes as a whole class and sometimes individually. For example, they should read:
- numbers, signs and symbols, expressions and equations;
- instructions and explanations in textbooks, workbooks, handouts, . . .;
- labels on diagrams, charts, graphs and tables.

They need to write and record in a variety of ways, progressing from words, phrases and short sentences to paragraphs and longer pieces of writing. Different forms of writing include:
- writing prose in order to describe, compare, predict, interpret, explain, justify;
- writing formulae, first using words, then symbols;
- sketching and labelling diagrams to clarify their meaning;
- drawing and labelling graphs, charts or tables, and interpreting and making predictions.


**Mental Exercises**

The first five to ten minutes of each period must be devoted to mental work. The aim should be to develop speed and accuracy in applying the four rules, to ensure a mastery of the requisite tables and to prepare the class for the day's main lesson in mathematics. At least one half of the mental exercises given must relate to work that is to follow in the main lesson.

In order that the limited time available may not be wasted, the teacher must get the mental exercises prepared beforehand. A notebook to be seen by the Headteacher along with the lesson notes, should be kept, in which the teacher should set down the mental exercises for each day. Pupils will write the numbers 1 to 10 (up to 20) in two columns, leaving adequate space against the numbers for the answers. The teacher will then dictate the mental exercises from his note-book at a reasonably brisk pace and without repetition.

A variation from dictated mental work is to give out prepared individual cards with graded exercises on them which the class should do as speed work, or when time permits, to write on the blackboard/whiteboard before the period begins, the exercises to be done as speed work. The drawback of the last two variations is that they make it easy for some pupils to scribble down hidden calculations instead of doing the work mentally.

When mental work is being prepared it should be remembered that the same process can be tested by using a variety of expressions. The examples that follow are intended as no more than patterns to help the teacher to make up his own exercises in the light of the main lesson planned for the day or of any weaknesses that previous mental work may have revealed.

*Addition*

1. 27 plus 9.
2. Add 18 and 5.
3. What is the sum of 36 and 7?
4. Increase 43 by 5.
5. Find the total of 71 and 9.

*Multiplication*

1. 12 times 9.
2. Multiply 13 by 7.
3. What is the product of 6 and 8?
4. Find the square of 12.
5. What must be divided by 11 to give 33?

*Subtraction*

1. Subtract 8 from 22.
2. From 41 take 5.
3. 25 minus 9.
4. What is the difference between 40 and 16?
5. What must be added to 18 to make 33?

*Division*

1. Divide 96 by 8.
2. 11 into 110.
3. Share 42 pins amongst 6 girls.
4. How many times is 5 contained in 35?
5. What must be multiplied by 11 to give 132?

*Short Methods and Sundry Tables*

1. Find the cost of three 5 kg bags of rice at 2 Ghana cedis per kg.
2. What is the cost of 1 dozen of eggs at 25 pesewas each?
3. 8 x 99.
4. 28 x 25.
5. How many 21cm pieces can I cut off a string one metre long?
6. What fraction of a litre is 250ml?
7. The area of a square board is 81 cm$^2$. What is its perimeter?
8. Two angles of a triangle add up to 98$^o$. What is the size of the third angle?
9. How many minutes from 10.15 a.m. to noon?
10. 84 pesewas as a decimal of ¢2.40?

Since the aim of mental drills is to give practice and increase children's confidence in recalling their basic number facts, exercises set should be easy enough for every child to obtain at least half of the total score. Teachers should use variety of teaching strategies including games, music and physical activities as well as rewards to motivate children to practice and increase their confidence in recalling their basic number facts.

**Catering for Individual Needs (Differentiation)**

According to the national constitution, all children should be given the opportunity to achieve the maximum of their potential. Children of lower ability need to have the opportunity to experience a range of mathematics, which is appropriate to their level of development, interests and capabilities. Equally children with exceptional ability in mathematics must be extended (i.e. challenged) and not simply be expected to carry out different repetitions of work they have already mastered.

As new experiences cause children to refine their existing knowledge and ideas, so they construct new knowledge. The extent to which teachers are able to facilitate this process significantly affects how well children learn. It is important that they are given opportunities to relate their new learning to knowledge and skills, which they have developed in the past (i.e. making connections).

Some children fail to reach their potential because they do not see the applicability of mathematics to their daily lives and because they are not encouraged to connect new mathematical concepts and skills to experiences, knowledge and skills they already have. As a result these children develop a negative attitude towards mathematics. The development of more positive attitudes to mathematics and a greater appreciation of its usefulness are the key to improving child participation.

Teachers should note that punishing pupils who get their sums wrong is against children's rights and professionally not allowed; any teacher found doing so could face the full rigors of the law.

**Use of Teaching Learning Materials (TLMs)**

*Concrete Materials or Manipulatives*

The importance of the use of TLMs to help children form mathematical concepts is well known. Using TLMs provides a foundation of practical experience on which children can build abstract ideas. It encourages them to be inventive, helps to develop their confidence and encourages independence.

Teachers need to make use of an appropriate range of apparatus to focus the children's thinking on the concept to be developed, modifying the TLMs as the learner's understanding grows. The use of manipulative also facilitates the children's thinking during the problem solving process.

*Textbooks*

Textbooks contain materials that provide children with practice and enrichment. They contain ideas for problem solving situations, which develop mathematical skills and understanding. There should be regular, planned opportunities for children to read mathematics textbooks both in class and at home. However teachers must realise that a textbook is just one tool to help with the implementation of the syllabus.

*Information and Communication Technology (ICT)*

Computers and calculators are learning tools which children can use to discover and reinforce new ideas. ICT can provide children with opportunities to:
– learn from feedback;
– observe patterns;
– see connections;
– work with dynamic images;
– explore data;
– "teach" the computer by giving it simple instructions.

**Mathematics Across the Curriculum**

Teachers need to help children appreciate the importance of mathematics in their lives. They may achieve this by using the Thematic Approach or by asking colleagues teaching other subjects to provide examples and contexts that may be used in mathematics lessons. Setting students projects that cut across subjects is one way of teaching mathematics across the curriculum.

Here are some opportunities that link Mathematics to other subjects:

*English*

In mathematics general accuracy in using language can be promoted through:
– interpreting questions orally and in writing;
– clarifying the precise meaning of words or mathematical terms;
– discussing the essential ideas identified in the questions and interpreting them to identify the mathematical content;
– creating an awareness of patterns of language by asking children to explain, argue and present their conclusions to others;
– drawing their attention to the statements involved in mathematical reasoning and proof, such as if … then, because, therefore, …

*Science*

Almost every scientific investigation or experiment is likely to require one or more of the mathematical skills of classifying, counting, measuring, calculating, estimating, recording in tables and graphs. Children will, for example, order numbers, including decimals, calculate means and percentages, decide whether it is more appropriate to use a line graph or bar chart and plot, interpret, and predict from graphs.

*Creative Arts*

Measurements are often needed in Art and Craft. Many patterns and constructions in our own and other cultures are based on properties of shapes, including symmetry and spatial ideas. Designs may need enlarging or reducing, introducing ideas of multiplication or ratio.

*Social Studies*

Discussing evidence in history or geography may involve measurement, estimation and approximation skills, and making inferences. Children will make statistical enquiries, for example, in analysing population data to explore and compare lifestyles. The study of maps includes the ideas of angle, direction, position and scale.

*Physical Education, Music, Drama*

Athletic activities use measurement of height, distance and time. Ideas of counting, time, symmetry, pattern (beats and rhythm), movement, position and direction are used extensively in music, dance and competitive games. Role Play provides children with opportunities to relate mathematics to real-life experiences.

**Assessment in Mathematics**

Evaluation of children's achievement is an essential part of mathematics education. This is necessary for various purposes:

- to give teachers feedback on the success of their methods and approaches and to assist planning for new learning (formative);
- to assess the children's readiness for new learning and to find out what they have learnt (summative).

Diagnostic assessment procedures enable teachers to discover difficulties that individual children may be having. Appropriate diagnostic assessment may reveal that the reason for a particular student's lack of progress is lack of understanding achieved at an earlier time and the difficulty may be relatively easily addressed. Diagnosis may also reveal that the child is very talented and is simply bored by lack of stimulation. Diagnostic assessments enable teachers to plan further learning activities specifically designed to meet the learning needs of individual children. Worthwhile diagnosis may be carried out by employing closed and open-type questions. School Based Assessment (SBA) should focus both on what children know and can do, and on how they think about mathematics. It should involve a broad range of tasks and problems and require the application of a number of mathematical ideas. Skills assessed should include the ability to communicate findings, to present an argument and to exploit an intuitive approach to a problem.

Assessment should be an integral part of the normal teaching and learning programme. It should involve multiple techniques, including written, oral and demonstration formats. Group and team activities should also be assessed. In SBA, teachers should avoid carrying out only tests which focus on a narrow range of skills (or profile dimensions) such as the correct application of standard algorithms (procedures). While such skills are important, a consequence of a narrow assessment procedure, which isolates skills or knowledge, is that children tend to learn in that way. Mathematics becomes for them a set of separate skills and concepts with little obvious connection to other aspects of learning or to their world.

SBA should also be undertaken to provide children and their parents with an indication of the child's progress. When marking children's work and giving feedback (oral or written) teachers should indicate what the children have done well and what they need to do to improve and to act on feedback given to them. In summarising the results of evaluations of children's achievement, teachers should report what the children have achieved and how well they achieved it. A grade or mark alone is insufficient.

As stated above under the NMS, a few children with learning difficulties may not be able to achieve all the NMS by the end of Primary 6. It is important teachers identify such slow learners and support them to reach the NMS. The 2011 reviewers of the JHS syllabus strongly suggest that at least 70 percent (70%) of the NMS must be factored into the Basic Education Certificate Examination (BECE) to cater for all ability groups and to ensure teachers pay more attention to the core mathematics required by all.

Currently, the national examination which certifies that a pupil has completed basic education, ( i.e. the BECE), is one that focuses on selection of the few above average pupils who qualify to offer general/academic programmes at the Senior High School (SHS) level. The so called "PASS" in BECE, defined as gaining an aggregate range of 6-30 in the best six subjects with a grade 5 or better in the core subjects (i.e. Mathematics, English, Integrated Science and Social Studies),

has clouded the purpose of the examination making people to inadvertently use it to label the majority of children who complete JHS as failures, even though they have not failed by the standards guiding the examination. This is because usually about half of JHS leavers qualify and obtain places in SHS, but the majority of the remaining students who qualify to offer non-academic or technical/vocational programmes at the SHS level are labelled failures, even though their certificates indicate that they have passed the BECE.

Since for ALL children, 'basic education' aims to provide opportunities for achieving "the minimum knowledge and skills required at the end of JHS" (i.e. NMS), and for some "the additional (or supplementary) content that are necessary at the end of JHS for continuing at the SHS level, it is recommended that the BECE should be designed to achieve these two important goals. Therefore to ensure the BECE can certify that a child who has completed basic education has really attained the NMS in numeracy, a substantial proportion of the Paper 1 (i.e. about 70% of the test) should be devoted to assessing the NMS and the Paper 2 devoted to assessing the supplementary content required to cope with SHS work. Only the former should be used in certifying whether or not a child has attained the NMS in numeracy. And to ensure teachers focus on teaching this core (i.e. the NMS), selection to SHS should be based on a score of at least 80% in the Paper 1 as well as performance in the Paper 2.

**FORM OF ASSESSMENT**

From September 2012, the form of assessment in schools will follow the requirements of the School Based Assessment (SBA) system. Schools will assess pupils/students at the end of the first four weeks, at the end of the eighth week and at the end of the eleventh week. Each test is called "Class Assessment Task (CAT)". CAT1 will be administered at the end of the first four weeks of the term; CAT2 will be administered at the end of eight weeks of the term, and CAT3 will be administered at the end of the eleventh week, while the End-of-Term test will come possibly at the end of the twelfth week.

Apart from the three CATs and the end-of-term test, pupils/students will be required to carry out a project for each term. The project for the term will constitute CAT4 in the first term. Projects are intended to encourage pupils to apply knowledge and skills acquired in the term to write an analytic or investigative paper, use science and mathematics to solve a problem or produce a physical three-dimensional product as may be required in Creative Arts and in Natural Science.

Assessment in the school system will hence follow the guideline below:

Term 1

CAT1 – End of week 4 of Term 1
CAT2 – End of week 8 of Term 1
CAT3 - End of week 11 of Term 1
CAT4 – Project work to be submitted at the end of the 11th week
End-of-term examination administered at the end of the twelfth week

Term 2

CAT5 – End of week 4 of term 2
CAT6 – End of week 8 of term 2
CAT7 – End of week 11 of term 2
CAT8 – Project work to be submitted at the end of the 11th week
End-of-term examination administered at the end of the twelfth week

Term 3

CAT9  – End of week 4 of term 3
CAT10 – End of week 8 of term 3
CAT11 – End of week 11 of term 3
CAT12 – Project work to be submitted at the end of the 11th week
End-of-term examination administered at the end of the twelfth week

The information detailed above is further provided in the diagramme below:

**MODE OF ADMINISTRATION OF TASKS**

| TASK | TERM | TIME OF ADMINISTRATION | DESCRIPTION OF TASK | NOTES/REMARKS | SCORES |
|---|---|---|---|---|---|
| 1 | 1 | End of 4th week | Individual Test | | 10 |
| 5 | 2 | | | | 10 |
| 9 | 3 | | | | 10 |
| | | | | | |
| 2 | 1 | End of 8th week | Group Exercise | Two or three instructional objectives the teacher considers very important and challenging to teach and learn should be used | 10 |
| 6 | 2 | | | | 10 |
| 10 | 3 | | | | 10 |
| | | | | | |
| 3 | 1 | 11th 0r 12th week | Individual Test | | 10 |
| 7 | 2 | | | | 10 |
| 11 | 3 | | | | 10 |
| | | | | | |
| 4 | 1 | The whole term | Project Work/Group Project work | Nine project topics divided into 3 topics for each term. Each pupil should be guided to select one project work in each term. For a group project work the pupils should do it in teams. | 20 |
| 8 | 2 | | | | 20 |
| 12 | 3 | | | | 20 |
| | | | | | **The total for each term is 50%** |

CAT1, CAT5 and CAT9 will generally consist of an objective test, with possibly structured questions or story problems depending upon the subject.

CAT2, CAT6 and CAT10 will be based on 1, 2 or 3 topics that the teacher identifies as important but difficult for pupils/students to learn in the first and second month of the term. CAT2, CAT6 and CAT10 will be organized as Group Exercise where groups of pupils/students will discuss and learn by the

co-operative learning approach and each group's work awarded marks by the teacher. The group exercise could also be based on so me practical work such as in ICT and BDT.

CAT3, CAT7 and CAT11 will be administered tasks consisting of objective items, structured questions and possibly practical exercises.

It is expected that the administration of all the CATs will be completed by the end of the eleventh week of the term to allow schools enough time to prepare for the administration of the end-of-term examination.

Because of increasing numbers in classrooms, project work will be carried out as group projects where each project will be pl anned and carried out by a group of pupils/students. Schools will be supplied with at least six project topics for each class for the year. Groups of pupils/students will be expected to select a project topic of their interest in each term in the first two weeks of the term, carry out the project over the next two months and submit their completed project by the end of the eleventh week.

**End-of-term Examination**

The end-of-term examination should be developed to consist of Section A and Section B. Section A will be the objective items section; Section B will be the structured questions section. Depending upon the requirements of the subject, there could be a Section C, the practical test component.

**Home Work and Class Exercises**

Home work and class exercises are very important aspects of formative evaluation in the teaching and learning process but will not be included in the SBA. Teachers are however, expected to give homework and class exercises as part of the regular teaching and learning process.

**SBA at JHS3**

SBA will terminate at the end of the first term of JHS3 after completing CATs 1- 4. This is to allow JHS3 students the time to prepare for the BECE coming at the end of April of the next year.

**Purposes of SBA**

The SBA system will consist of 12 assessments a year instead of the 33 assessments in the previous continuous assessment system. This will mean a reduction by 64% of the work load compared to the previous continuous assessment system.

The purposes of the new SBA are as follows:

- To provide a reduced but more effective system of internal school assessment replacing the former Continuous Assessment syste m which was rather tedious for both teachers and pupils/students
- To standardize the practice of internal school assessment throughout the country
- To provide teachers with guidelines for constructing assessment items/questions
- To provide teachers with advice on how to conduct remedial instruction to improve pupil/student school performance
- To provide guidance in marking and grading test items and questions and carry out general appraisal of pupil/student performa nce

**SBA Handbook**

Details of the SBA system are contained in the "Teachers' Handbook on School Based Assessment". The details include issues on the following:

- Characteristics of the SBA
- Structure of the SBA and mark allocation for the SBA
- Directions for developing and administering the SBA and the end-of-term examination
- Using SBA for improving learning; including marking and grading systems
- Guidelines for project development and project assessment

The handbook contains sample items and questions for all subjects from Primary 1 to JHS3. Teachers are expected to use the sample items and questions provided in the handbook as guides for developing their own items and questions for the CATs and end-of-term examinations.

Accompanying the SBA Handbook are the following records:

- Primary School/JHS SBA Register
- Pupil's/Student's Report Card
- Pupil's/Student's Progress Record (i.e. Cumulative record)

Teachers are encouraged to obtain copies of the SBA Handbook to guide them in carrying out the SBA process.

**DEFINITION OF PROFILE DIMENSIONS**

The concept of profile dimensions was made central to the syllabuses developed from 1998 onwards. A 'dimension' is a psychological unit for describing a particular learning behaviour. More than one dimension constitutes a profile of dimensions. A specific objective may be stated with an action verb as follows: The pupil will be able to describe….. etc. Being able to "describe" something after the instruction has been completed means that the pupil has acquired "knowledge". Being able to explain, summarize, give examples, etc. means that the pupil has understood the lesson taught.

Similarly, being able to develop, plan, solve problems, construct, etc. means that the pupil can "apply" the knowledge acquired in some new context. Each of the specific objectives in this syllabus contains an "action verb" that describes the behaviour the pupil will be able to demonstrate after the instruction. "Knowledge", "Application", etc. are dimensions that should be the prime focus of teaching and learning in schools. It has been realized unfortunately that schools still teach the low ability thinking skills of knowledge and understanding and ignore the higher ability thinking skills. Instruction in most cases has tended to stress knowledge acquisition to the detriment of the higher ability behaviours such as application, analysis, etc. The persistence of this situation in the school system means that students will only do well on recall items and questions and perform poorly on questions that require higher ability thinking skills. For there to be any change in the quality of people who go through the school system, students should be encouraged to apply their knowledge, develop analytical thinking skills, develop plans, generate new and creative ideas and solutions, and use their knowledge in a variety of ways to produce good quality work. Each action verb indicates the underlying profile dimension of each particular specific objective. Read each objective carefully to know the profile dimension toward which you have to teach.

The explanation and key words involved in each of the profile dimensions are as follows:

**Knowledge and Understanding (KU)**

Knowledge          The ability to:
remember, recall, identify, define, describe, list, name, match, state principles, facts and concepts.
Knowledge is simply the ability to remember or recall material already learned and constitutes the lowest level of learning.

Understanding      The ability to:
explain, summarise, translate, rewrite, paraphrase, give examples, generalize, estimate or predict consequences based upon a trend.
Understanding is generally the ability to grasp the meaning of some material that may be verbal, pictorial, or symbolic.

**Use of Knowledge (UK)**

This dimension is also referred to as "Application of knowledge". Ability to use knowledge or apply knowledge, as implied in this syllabus, has a number of behaviour levels. These levels include application, analysis, synthesis, and evaluation. These may be considered and taught separately, paying attention to reflect each of them equally in teaching. The dimension "Use of Knowledge" is a summary dimension for all four learning levels. Details of each of the four levels are as follows:

Application        The ability to:
apply rules, methods, principles, theories, etc. to concrete situations that are new and unfamiliar. It also involves the ability to produce, solve, operate, plan, demonstrate, discover etc.

Analysis           The ability to:
break down material into its component parts; to differentiate, compare, distinguish, outline, separate, identify significant points, recognize unstated assumptions and logical fallacies, recognize inferences from facts, etc.

Synthesis         The ability to:
put parts together to form a new whole. It involves the ability to combine, compile, compose, devise, plan, revise, design, organize, create, generate, write an essay, write a letter, write a report etc.

Evaluation        The ability to:
appraise, compare features of different things and make comments or judgement, contrast, criticize, justify, support, discuss, conclude, make recommendations etc. Evaluation refers to the ability to judge the worth or value of some material based on some criteria.

**STRUCTURE OF THE SYLLABUS**

The syllabus is structured in five columns: Units, Specific Objectives, Content, Teaching and Learning Activities and Evaluation. A description of the contents of each column is as follows:

**Column 1 - Units** The units in column 1 are the major topics of the year. You are expected to follow the unit topics according to the linear order in which they have been presented. However, if you find at some point that teaching and learning in your class will be more effective if you branched to another unit before coming back to the unit in the sequence, you are encouraged to do so.

**Column 2 - Specific Objectives**:    Column 2 shows the Specific Objectives for each unit.  The specific objectives have a special numbering system such as 1.2.5 or 3.4.1.  These numbers are referred to as "Syllabus Reference Numbers".  The first digit in the syllabus reference number refers to the year/class; the second digit refers to the unit, while the third refers to the rank order of the specific objective.  For instance 1.2.5 means Year 1 or JHS 1, Unit 2 and Specific Objective 5.  In other words 1.2.5 refers to Specific Objective 5 of Unit 2 of JHS 1.  Similarly, the syllabus reference number 3.4.1 simply means Specific Objective number 1 of Unit 4 of JHS 3.  Using syllabus reference numbers provide an easy way for communication among teachers and educators.  It further provides an easy way for selecting objectives for test construction.  For instance, if Unit 4 of JHS 3 has seven specific objectives 3.4.1 - 3.4.7, a teacher may want to base his/her test items/questions on objectives 3.4.4 to 3.4.7 and not use the other first three objectives.  In this way, a teacher would sample the objectives within units to be able to develop a test that accurately reflects the importance of the various specific objectives and skills taught in class.

You will notice that specific objectives have been stated in terms of the pupil's ability i.e. what the pupil will be able to do during and after instruction and learning in the unit.  Each specific objective hence starts with the following "The pupil will be able to….."  This in effect, means that you have to address the learning problems of each individual pupil. It means individualizing your instruction as much as possible such that the majority of pupils will be able to master the objectives of each unit of the syllabus.

**Column 3 - Content:**  The "content" in the third column of the syllabus presents a selected body of information that you will need in teaching the particular unit.  In some cases, the content presented is quite exhaustive.  In some other cases, you could add some more information based upon your own training and based also on current knowledge and information.

**Column 4 - Teaching/Learning Activities (T/LA):**    T/LA that will ensure maximum pupil participation in the lessons is presented in Column 4.  The General Aims of the subject can only be most effectively achieved when teachers create learning situations and provide guided opportunities for pupils to acquire as much knowledge and understanding of mathematics as possible through their own activities.  Pupils' questions are as important as teacher's questions.  There are times when the teacher must show, demonstrate, and explain.  But the major part of a pupil's learning experience should consist of opportunities to explore various mathematical situations in their environment to enable them make their own observations and discoveries and record them.  Teachers should help pupils to learn to compare, classify, analyze, look for patterns, spot relationships and come to their own conclusions/deductions. Avoid rote learning and drill-oriented methods and rather emphasize participatory teaching and learning in your lessons.  You are encouraged to re-order the suggested teaching/learning activities and also add to them where necessary in order to achieve optimum pupil learning.

A suggestion that will help your pupils acquire the capacity for analytical thinking and the capacity for applying their knowledge to problems and issues is to begin each lesson with a practical problem.  Select a practical problem for each lesson.  The selection must be made such that pupils can use knowledge gained in the previous lesson and other types of information not specifically taught in class.  The learning of any skill considered important must start early.  From age six, engage your pupils in analytical thinking and practical problem solving techniques.

**Column 5 - Evaluation:**      Suggestions and exercises for evaluating the lessons of each unit are indicated in Column 5.  Evaluation exercises can be in the form of oral/written quizzes, class assignments, essays, project work, etc.  Try to ask questions and set tasks and assignments, etc. that will challenge pupils to apply their knowledge to issues and problems as has already been said, and that will engage them in developing solutions, and in developing observational and investigative skills as a result of having undergone instruction in this subject.  The suggested evaluation tasks are not exhaustive.  You are encouraged to develop other creative evaluation tasks to ensure that pupils have mastered the instruction and behaviours implied in the specific objectives of each unit.

Lastly, bear in mind that the syllabus cannot be taken as a substitute for lesson plans.  It is necessary that you develop a scheme of work and lesson plans for teaching the units of this syllabus.

## ORGANIZATION OF THE SYLLABUS

### General Objectives

Specific minimum objectives (National Minimum Standards) for this syllabus have been listed on page (iv) of the syllabus. The specific minimum objectives flow from the general aims of mathematics teaching, listed on page (iv) of this syllabus. The Specific minimum objectives form the basis for the selection and organization of the units and their topics. Read the general objectives very carefully before you start teaching.  After teaching all the units, go back and read the general aims and general objectives again to be sure you have covered both of them adequately in the course of your teaching.

### Time Allocation

Mathematics is allocated ten periods a week, each period consisting of thirty (30) minutes.  The ten periods should be divided into five double periods, of one-hour duration for each day of the week.

### Years and Units

The syllabus has been planned on the basis of Years and Units. Each year's work is covered in a number of units sequentially arranged and in a meaningful manner such that each unit's work will provide the necessary and enabling skills for the next unit.

JHS 1 has 14 units; JHS 2 has 14 units, while JHS 3 has 7 units of work.  The unit topics for each year have been arranged in the sequence in which teachers are expected to teach them.  No attempt has been made to break each year's work into terms. This would have been desirable but it is quite difficult to predict, with any degree of certainty, the rate of progress of pupils during those early stages. Moreover, the syllabus developers wish to discourage teachers from forcing the instructional pace but would rather advise teachers to ensure that pupils progressively acquire a good understanding and application of the material specified for each year's class work. It is hoped that no topics will be glossed over for lack of time because it is not desirable to create gaps in pupils' knowledge.  The unit topics for the three years' course are indicated on the next page.

**Unit topics for the three year Junior High School Mathematics**

| Unit | JHS 1 | JHS 2 | JHS 3 |
|---|---|---|---|
| 1 | Numbers and Numerals | Statistics | Application of Sets |
| 2 | Sets | Rational Numbers | Rigid Motion |
| 3 | Fractions | Mapping | Enlargements and Similarities |
| 4 | Shape and Space | Linear Equations and Inequalities | Handling Data and Probability |
| 5 | Length and Area | Angles | Money and Taxes |
| 6 | Powers of Natural Numbers | Shape and Space | Algebraic Expressions |
| 7 | Introduction to Calculators | Geometric Constructions | Properties of Polygons |
| 8 | Relations | Number Plane | |
| 9 | Algebraic Expressions | Vectors | |
| 10 | Capacity, Mass , Time and Money | Properties of Quadrilaterals | |
| 11 | Integers | Ratio and Proportion | |
| 12 | Decimal Fractions | Rates | |
| 13 | Percentages | Area and Volume | |
| 14 | Collecting and Handling Data(Discrete) | Probability | |